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D 1.1 – Current supply of space/geospatial education and training

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Work package / Task:

WP1 - Preparing the Space/Geospatial Sector Skills Strategy

T1.1 - Identifying the supply of GI and EO education and training at academic and vocational levels

Short Description:

This report covers the following topics:

- It summarizes the analysis of existing studies in the space/geospatial sector
- It analyses the results of a survey on supply of space/geospatial education & training among project partners and key stakeholders across Europe
- It assesses a collection of EO/GIS training resources available on the WWW.

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Acronyms

Acronym	Description
BoK	Body of Knowledge
EC	European Commission
EACEA	Education, Audio-visual, Culture Executive Agency
EARSC	European Association of Remote Sensing Companies
EARSeL	European Association of Remote Sensing Laboratories
ECTS	European Credit Transfer and Accumulation System
ECVET	European Credit System for Vocational Education and Training
EO	Earth Observation
EO/GI	EO and GI sectors
EQF	European Qualifications Framework
EU	European Union
ESA	European Space Agency
ESERO	European Space Education Resource Office
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
GDPR	General Data Protection Regulation
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GI	Geographic Information
GISIG	Geographic Information System International Group
GIS&T BoK	Geographic Information Science & Technology Body of Knowledge
GNSS	Global Navigation Satellite System
ISPRS	International Society for Photogrammetry and Remote Sensing
MOOC	Massive Open Online Course
NEREUS	Network of European Regions Using Space Technologies
OECD	Organisation for Economic Co-operation and Development
OER	Open Educational Resources
RS	Remote sensing
RUS	Research and User Support (for Sentinel Core products)
SAR	Synthetic Aperture Radar
SME	Small and Medium Enterprises

SNAP	Sentinel Application Platform
VET	Vocational Education and Training

Glossary

- **Body of Knowledge (BoK)** is the complete set of concepts, terms, activities and relations between them, that make up a professional domain, (in this case EO/GI BOK) as defined by the relevant learned society or a professional association.
- **European Credit Transfer and Accumulation System (ECTS)** is a credit system designed to make it easier for students to move between different countries.
- **Education, Audiovisual and Culture Executive Agency (EACEA)** manages funding for education, culture, audiovisual, sport, citizenship and volunteering.
- **European Centre for the Development of Vocational Training (CEDEFOP)** is one of the EU's decentralised agencies. Founded in 1975 and based in Greece since 1995, it supports development of European vocational education and training (VET) policies and contributes to their implementation.
- **European Credit System for Vocational Education and Training (ECVET)** have common instruments helping individuals in transfer, recognition and accumulation of their assessed learning outcomes, to achieve a qualification or to take part in lifelong learning.
- **European Qualifications Framework (EQF)** is a common European reference framework whose purpose is to make qualifications more readable and understandable across different countries and systems.
- **Geographic Information (GI)** is the data of a geographic location spatial data, their combination with non-spatial information (e.g. statistical data) and their representation as a map.
- **Geographic information: Need to Know (GI-N2K)** is a project under the Lifelong Learning Programme Erasmus of the EU that aimed to improve the way in which future GI professionals are prepared for the labour market so that the GI sector in general can evolve in a dynamic and innovative way.
- **Geographic Information System (GIS)** is a computerized tool designed for storing, analysing and consulting data where geographic location is an important characteristic or critical to the analysis.
- **Sector Skills Alliance** (SSAs) are designed to tackle skills, aligning vocational education and training (VET) systems with labour market needs. This is done by: (i) modernising VET by adapting to skills needs and integrating work-based learning, (ii) strengthening the exchange of knowledge

and best practices, (iii) improving labour market mobility, (iv) increasing the recognition of qualifications. More info.

- **Skill** means the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualifications Framework, skills are described as cognitive or practical skills.
- **Vocational Education and Training (VET)** is a key element of lifelong learning systems equipping people with knowledge, know-how, skills and/or competences required in particular occupations or more broadly on the labour market.

1. Introduction

EO4GEO is an **Erasmus+ Sector Skills Alliance** gathering **26 partners from 13 EU countries,** most of which are part of the **Copernicus Academy Network.** Be they from academia, public or private sector, they are all active in the education and training fields of the space / geospatial sectors. The project is also supported by a strong group of Associated Partners mostly consisting of associations or networks active in space/geospatial ecosystem. The project started on January 1st, 2018, upon approval by the EU Education, Audiovisual and Culture Executive Agency (EACEA) and runs over four years.

EO4GEO **aims to help bridging the skills gap in the space/geospatial sector** by creating a strong alliance of players from the sector/community reinforcing the existing ecosystem and **fostering the uptake and integration of space/geospatial data and services**. EO4GEO will work in a **multi- and interdisciplinary** way and apply innovative solutions for its education and training actions including: case-based and collaborative learning scenarios; learning-while-doing in a living lab environment; on-the-job training; co-creation of knowledge, skills and competencies; etc.

EO4GEO will define a long-term and sustainable strategy to fill the gap between supply of and demand for space/geospatial education and training taking into account the current and expected technological and non-technological developments in the space/geospatial and related sectors (e.g. ICT). The strategy will be implemented by: creating and maintaining an ontology-based Body of Knowledge for the space/geospatial sector based on previous efforts; developing and integrating a dynamic collaborative platform with associated tools; designing and developing a series of curricula and a rich portfolio of training modules directly usable in the context of Copernicus and other relevant programmes and conducting a series of training actions for a selected set of scenario's in three sub-sectors - integrated applications, smart cities and climate change to test and validate the approach. Finally a long-term Action Plan will be developed and endorsed to roll-out and sustain the proposed solutions

For more information on the project please visit http://www.eo4geo.eu/about-eo4geo/.

1.1. Objectives of the supply analysis

This document reports the results of the work carried out in the first six months of the project regarding the Task 1.1 - Identifying the supply of GI and EO education and training at the academic and vocational levels. The EO4GEO Work Package 1 (Preparing the Space/Geospatial Sector Skills Strategy) groups the preparatory activities for the definition of a Sector Skills Strategy for space/geospatial sector. The output of this preparatory work package will pave the way for implementation and test stage that will include, as main results, the development of a renewed and

extended Body of Knowledge for the space/geospatial sector (BoK for GI & EO), the design of VET curricula and the development of new training material.

Task 1.1 focuses on the analysis of the supply of academic and vocational education and training in Europe in the space/geospatial sector, with the following main objectives:

- reviewing previous studies on learning material related to the EO/GI sector: this review is important in order to analyse the approaches followed in previous studies and surveys carried out with the aim to support the activities of task 1.1.
- identifying space/geospatial training resources: the main focus is to discover through a survey, to describe and catalogue the material currently available in the space/geospatial sector, produced in Europe and possibly open for reuse.
- establishing a database of the training modules identified and of the training providers: it is essential to make available to project partners a structured catalogue of the training resources that have been identified, so that they can be further analysed and exploited in the following phases of the project.
- identifying the most relevant topics included in the existing EO/GI training materials by conducting an in- depth analysis of the catalogued training offer.
- investigating the availability of online of training resources: An in-depth web investigation allowing to complement the survey with structured training resources accessible on line provided by institutions operating in the EO/GI sector or resulting from previous initiatives.

1.2. Structure of the document

Being the main outcome of Task 1.1, this report is structured around the main objectives identified above. The document pays special attention to the analysis of the results of an extensive data collection campaign and therefore much of the text (including the annexes) is devoted to this task.

In order to provide a comprehensive evaluation of the main results and findings, the report starts with a necessary introduction to the methods and tools used (Chapter 2). The choice of these methods and tools was considered and discussed at the preparatory stages of the task.

Chapter 3 is dedicated to the analysis of former studies and documentation in our field of interest. This section starts with a list of the most relevant studies, taking into consideration the scope of our task and examining what they tell about the supply of education and training in the space/geospatial sector at the time they were conducted.

Chapter 4 and 5 focus on the methodology followed and the results obtained through a survey organized and promoted by the project. This survey was carried out through an online questionnaire, the "*EO4GEO Survey on supply of EO and GI education and training*". In particular,

Chapter 4 gives a description of the organizational, technical, legal and methodological aspects, while Chapter 5 focuses on the detailed analysis of the information collected during the survey.

Chapter 6 provides the results of an additional information collection campaign by screening the web for training resources. This chapter is structured according to the nature of the different providers.

Chapter 7 aims at providing a summary of the main results of the work specified in the previous chapters. It draws overall conclusions on the state of supply regarding the existing offerings in the space/geospatial education and training fields.

Finally, the document contains also a series of annexes offering in-depth information on the aspects presented in the previous chapters, such as the online questionnaire and the complete list of training resources collected.

2. Overall Methodology

The definition of the methodological and organizational aspects is of great importance, since this is a task dedicated entirely to the collection and analysis of information,

- Which kind of information do we need to know and therefore collect?
- Which instruments and approaches will we use to access the information that is of interest to us?
- How far we want to go? What scale does our research should have and which quantitative parameters do we establish as an objective?
- How deep the analysis of the results of our research must be?
- What impact our work will have on the progression of tasks of our project?

In order to be able to answer each of the questions above, every sub-task was conceived and designed beforehand during online meetings and email discussions between the partners involved.

It should be noted that Task 1.1 was developed in parallel with the Task 1.2 (Identifying the current demand for GI and EO skills and occupational profiles). While Task 1.1 is focused on the study of the training offer, Task 1.2 pays attention to demand side. But, since T1.2 is also aimed at the collection and analysis of information, many of the methodological aspects were jointly discussed and approved. This was done for the sake of adopting a similar approach regarding project results and with the intention of benefiting from a collaborative working environment within the Consortium.

As a result, both tasks coincide with the following aspects:

- Joint effort on the collection and analysis of previous studies in the EO/GI sector.
- Use of the same approach for information collection, with an on-line survey. The choice of the same technical platform for the creation and management of the online surveys.
- The creation of a unique campaign of dissemination and promotion for the online surveys.

As an essential preparatory activity of the EO4GEO project, the main objective of the study of the training offer is to provide an image, at the present time, of the quantity, quality and nature of the training offer regarding the space/geospatial sector.

Obviously, this premise looks quite ambitious. As in any state of the art study to be performed, the intention is to offer as a result an assessment and evaluation as complete and realistic as possible. However, a good result depends not only on the time and the effort dedicated to its achievement,

but also on the choice of appropriate information gathering methods, especially when the involvement of the academic, professional and scientific community is necessary.

In this sense, communication is essential. For this purpose, project website[1] and various communication channels (newsletter[2] and Twitter[3]) have been used intensively in the promotion of the campaign, especially to promote the online survey. The involvement of the EO4GEO Associated Partners[4] and the use of the project partner's large contact networks is also worth noting, especially in order to show the community that our study is of great importance in the context of the current EO/GI market. Hence we can consider this communication effort the first step in establishing a real and effective collaboration network to promote the EO4GEO long term sector skills strategy.

More details on the specific parts of the results of task 1.1 elements will be available in each of the sections of this report: You will find here below a summary of the main methodological aspects applied in the various sub-tasks.

Identification of relevant studies

The identification of previous studies (see Chapter 3) to be analysed for the training offer and demand was performed with an online search and by inviting the EO4GEO partners to fill-in a shared document available in project the collaborative workspace (based on the Slack cloud-based platform[5]). It should be noted that Task leaders were already aware of a significant number of these studies thanks to the involvement of different members of EO4GEO in them. After a first screening, the subset of the document relevant for the training offer study were then analysed.

Choosing the survey method

Focusing just on online/offline questionnaires or in face-to-face or telephone interviews may provide different results and data. The approach chosen in the study was mixed. In order to guarantee the most complete and efficient assessment of the subject of our investigation, different data collection methods were used:

- Online survey
- Screening of the WWW
- Personal contacts
- Project partners consultation

[1] http://www.eo4geo.eu/
[2] http://www.eo4geo.eu/publications/
[3] https://twitter.com/EO4GEOtalks
[4] http://www.eo4geo.eu/partnership/#associated
[5] https://slack.com/

Online surveys are one of the most widely used survey methods in scientific research. It is obviously a faster way of collecting data from the respondents as compared to other survey methods such as “paper-and-pencil” or personal interviews. Another advantage of an online survey is the deploying minimal cost (especially when using open-source platforms) and in particular the data-handling aspect. The responses are automatically stored in a survey database, providing wide possibilities for analysing the data collected and a smaller probability of data errors. Anyway, sometimes the absence of an interviewer makes it difficult to assess responses, especially as regards open-ended questions, so feedback not always really contributes to study objectives

The online survey is the main data collection tool used in Task 1.1 (more information on this method can be found in Chapter 4), but to complement and enrich the results obtained by the questionnaire other techniques were used as well. These methods were more suitable to specific requirements that could hardly be covered by an online survey.

The aim of Task 1.1 is to give a comprehensive overview of the situation regarding supply of education and training in our field. But since it is impossible to cover and get information on the entire available training offer by using only the online survey as a source, we performed an extensive web search to identify and describe as many courses or training materials as possible. More information and the results of this sub-task can be found in Chapter 6 of this report.

Finally, the collaboration of our project partners has proved crucial when collecting information relevant for the training offer study. It should be remembered that the EO4GEO Consortium includes those key players from academia, private and public sector who were very active in the education/training and space/geospatial sector. The EO4GEO Partners were able to participate on the data collection process thanks to a number of shared documents available on the project’s online collaborative space. Among the tasks carried out by our Consortium we can highlight:

- The promotion and distribution of the online questionnaire in their communication networks (such as Nereus and EARSC networks) and contacts (especially in their own countries).
- The participation in the identification of relevant studies in the field of space/geospatial training.
- The participation in the identification and description of courses, modules, seminars, and other training materials available online.

In-depth interviews are a good way to assess questions to the target audience. However, in our case, interviews are planned at a later stage, to be performed after the analysis of the online survey and targeted to a selection of respondents identified both in the survey and during the examination of the training resources available on the WWW. The selection criterion of the interviewees responds to the need to have more information in relation to the training material potentially reusable, in view of the future EO4GEO training ecosystem to be developed. It is worth mentioning that the result of these interviews is not the subject of this document.

3. Previous relevant studies

The first activity in Task 1.1 was to search, identify and analyse previous studies in the field. At a first stage, the studies were collected using a shared document open to all partners of the Consortium (especially those involved in Work Package 1) since the resulting list was also needed for Task 1.2 (demand of skills). Afterwards, a desktop study was conducted (or desk analysis, meaning the one of already existing information) basically based on thorough reading of these materials and the compilation of a working document in which the findings relevant to the Task 1.1 subject area were specified.

Initially 25 documents (most of all open online resources such as PDF files) were considered. This first selection was based on past involvement in similar projects (e.g. GI-N2K), studies released by (international) organisations with an expertise in the field of education and/or supply/demand analysis and well known market studies related to the Copernicus programme socio-economic impact.

This report focus on the experiences these studies can provide about the supply of education and training in the space/geospatial sectors. Therefore, it is important to highlight that, after an accurate reading, some of the studies do not offer enough relevant elements for the analysis from the perspective and for the scope of this deliverable, although their conclusions are interesting from other points of view. The studies that have been examined and taken into consideration from the perspective of supply of space/geospatial training are listed in Table 1. All of them offer (to a greater or lesser extent) some interesting findings that will be analysed in detail in the following pages.

No.	Title	Year	Source	Link
1	A Taxonomy for the EO Services Market: enhancing the perception and performance of the EO service industry	2015	EARSC	Link
2	Analysis of the supply of geospatial education and training Results of the GI-N2K Supply Survey	2014	GIN2K	Link
3	Integrated analysis of the demand for and supply of geospatial education and training	2015	GI-N2K	Link
4	Study to examine the socio-economic impact of Copernicus in the EU	2016	European Commission	Link
5	The Geospatial Industry Magazine	2018	Geospatial World	Link

No.	Title	Year	Source	Link
6	More than counting pixels – perspectives on the importance of remote sensing training in ecology and conservation	2016	German Research Foundation (DFG) / University of Bayreuth	Link
7	EU survey on Earth observation in a global context survey.	2014	GEO	Link
8	Skills for a Digital World	2016	OECD	Link

Table 1 - Reference studies in the EO/GI sector about supply of EO/GI training

The aim of the EARSC study "***A Taxonomy for the EO Services Market: enhancing the perception and performance of the EO service industry***" (Study #1) is addressing the common products and services from two perspectives: a market segmentation to classify and understand the markets for EO services as well as to define the types of customer [client view]; a thematic segmentation to describe and classify the products that are offered by the service providers [supplier view]. From the EO4GEO perspective this study gives input to define some of the terms used in the questions of the survey for identifying the application field or thematic focus of a given training resource.

The study that has given more insights regarding the state of the current supply of education and training in the space/geospatial sector is the public report from the GI-N2K project "***Supply survey results***" (See study #2 in Table 1).

The study is based on a survey aimed at evaluating the appropriateness of the original GIS&T Body of Knowledge (DiBiase, 2006) to describe offered teaching about Geographic Information Science and Technology.

One of the main objectives of this survey was to collect information about which GI-subjects in courses and programmes were available at that time (2014) and to discover which parts of the GI-domain were present in teaching programs without however being covered by the Body of Knowledge (BoK). The survey was successfully completed by organizations involved in GI teaching in Europe from 28 different countries. As a result of the survey, 570 courses on GIS&T in Europe were identified. Considering the possible interest, reference to those courses are included in chapter 6.2.5.

From the EO4GEO perspective, the most relevant part of this study is the analysis of the teaching content and therefore the topics and "knowledge areas" of the offered courses. In this sense, 'Analytical Methods', 'Geospatial Data' and 'Cartography and Visualization' were most often indicated as the subject of existing GIS courses.

Despite the absence of knowledge areas directly related to Earth Observation in the reference GIS&T BoK (strongly focused on Geoinformatics), a big number of courses identified during the

GIN2K survey (70) were directly related to the "Geospatial Data" knowledge area. In the 2006 BoK, the satellite and remote sensing topics constitute an important "Core unit" of this "Geospatial Data" area. It is therefore quite significant that, the highest number of current and foreseen courses in that specific area were related to the "Satellite and shipboard Remote Sensing", including subjects such as "Nature of multispectral image data", "Platforms and sensors", "Algorithms and processing", "Ground verification and accuracy assessment" and "Applications and settings".

In any case, the study confirms the fact that, in general, topics related to Earth Observation were not well covered or not covered at all by the "old" GIS&T BoK. This conclusion of the GI-N2K survey (even if not surprising) is directly related to the EO4GEO objectives, since it demonstrates that many EO/GI topics present in existing teaching should be covered in a modern and extended BoK and in the curricula designed from it. On the other hand, the study shows that many topics covered are useful for the Copernicus uptake side, e.g. when it comes to applications development making use of geospatial API's.

Finally, it should be noted that this study and the final report for the GI-N2K project - "***Integrated analysis of the demand for and supply of geospatial education and training***" (Study #3) -, in which several EO4GEO partners participated, have been very useful in terms of previous experience from a methodological point of view for organizing the distribution of the EO4GEO questionnaires as well as for analysing the results.

A good number of studies collected and analysed during Task 1.1 assess the economic implications of Copernicus and the EO Services Market in the EU. For instance, the "***Study to examine the socio-economic impact of Copernicus in the EU***" (Study #4), concludes that one of the main threats of Copernicus user uptake is the lack of appropriate skills. The study does not evaluate in detail the state of the training and education offer, but identifies the need of expensive and time-consuming trainings on complex topics which are not obvious for non EO-experts as a threat: *Copernicus data is currently mainly used by the scientific community. Potential users are reluctant to use space solutions, as it requires expensive and time-consuming trainings for non EO-experts.* (Study #4, page 28). In this sense it is worth remembering that the relation between the training offer and demand will be studied during Task 1.4.

In fact, one of the main concerns expressed by Copernicus end users is the lack of capacity building initiatives. Based on the results of a stakeholders' consultation and survey, this study highlights the fact that most users think that the EC, beyond the university training offer, should propose: "*…more basic EO training based on MOOCs (Massive Open Online Courses) or a FAQ (Frequently Asked Questions) with a user-friendly interface where questions could be asked.*" (Study #4, page 30).

In short, training and education is definitely an important driver of Copernicus market uptake. Access to specific and dedicated training or materials related to the use of Copernicus data and products are a must, and the number of Copernicus toolkits and handbooks should be definitely increased.

A recent report by the **Geospatial Industry Magazine** (Study #5) focuses on the understanding of the EO services and products market, the technology challenges and the industry needs. The study, based on a survey involving 125 industry leaders from across the world, states that developing a trained workforce is the biggest challenge faced by the sector. In fact, 21% of the respondents list this as their main challenge. Needless to say, acquiring new talents skilled in emerging technologies depends very much on the quantity and quality of the specialised training programs offered.

"***More than counting pixels****"* (Study #6) is an interesting reading published in 2017 in the "Remote Sensing in Ecology and Conservation" journal. The article highlights the need for an effective and successful training of professionals working in the field of remote sensing (RS) and GIS, and analyses the impact and benefits of the courses offered on these topics in university curricula.

This article includes the results of an online survey collecting experiences of students and professionals in different fields. As a result, it highlights the need for more training at University level, specially "*practical and hands-on training*", and the need to provide "*remote sensing education based on state of the art methods and using an interdisciplinary approach*". Actually, one of the main conclusions of the article is the fact that besides a good knowledge in theory, hands-on work has proven to be most helpful to complement Remote Sensing training and education. It is also important to highlight learning context differences and the importance given to the attendance to university hands-on seminars in comparison with normal and theoretical university lectures or even online courses.

The "***EU survey on Earth observation in a global context survey***" (Study #7) presents the results of a consultation which aimed to estimate the general awareness on Earth Observations (EO), the Group on Earth Observation (GEO), the Global Earth Observation System of Systems (GEOSS).

The "***Skills for a Digital World***" (Study #8) provides new evidences of the effects of digital technologies on the demand for skills and discusses key policies to foster skills development for the digital economy. OECD Skills Strategy helps countries assessing strengths and weaknesses of their systems in developing relevant skills, activating skills and putting skills to effective use. Massive Online Open Courses (MOOCs) and Open Educational Resources (OER) modify learning methods and allow a larger number of people to access quality resources thanks to more flexible timetables. The use of digital technologies in formal education and vocational training has the potential to improve learning.

As a conclusion, it is worth to highlight the heterogeneity of the studies collected and analysed. Some of them are relevant to our analysis, since they are somehow related to GI training and education, other ones, having a more general character, include considerations of interest from our perspective although they do not offer a detailed analysis of the situation in terms of training offer.

In fact, most of the studies refer to the state of the geospatial sector and Copernicus program from the point of view of the socio-economic impact and none of them is specifically related to the study of the current training offer in the EO/GI field, in terms of number of courses, topics covered etc.

The analysis of the above studies has allowed to verify the state of the art in the matter of education and training in the geospatial sector with some important inputs for addressing the context and the methodology of the survey and the analysis of the training offer.

Besides, it should be noted that, however, there is a common consideration in all the studies analysed: a strong need to support and increase the training offer, especially in areas with high demanding technical capabilities. We can also conclude that this fact is much more accentuated in relation to potential EO data and service end users. Obviously, better digital competences can contribute to more qualified workers in the EO industry. Copernicus is a powerful instrument to trigger business in SMEs, but any lack of knowledge should be covered with high quality training.

In some cases, data sources are available, and the "science" community (mostly in universities) has found ways to deal with this. But for a myriad of potential users outside of this group (especially in the private sector), technical capabilities are very different. In most of the cases users need further individual training support to process and interpret these EO resources for their own specific purpose. In this sense, more training materials are needed, and technical documentation should be clearer and easier. The role of the Copernicus Academy is a key in this regard. One of the main goals of this network is to "*develop lectures, training sessions, traineeships as well as educational and training material*", and it is obvious that this objective must have the maximum priority and be concretized in training material production.

In other words, a real Copernicus user uptake process is directly related to the need for help and guidance on how to use and access EO data.

Desk research is particularly useful in the preliminary phase of any project. But it is possible that there is no information already collected by others, or that the information found is poor, outdated, incomplete or not very explanatory for our purpose. In such case the only way to collect data is field research, which consists in creating new information through interviews, surveys, web search, etc.: the next chapters of our report will focus on this kind of research.

4. EO4GEO Survey on Supply of Education

One of the most important features regarding the field research conducted in Task 1.1 has been the creation of an online survey on the supply of EO and GI education and training. This survey was launched in parallel with the survey on demand for EO and GI skills and occupational profiles in the context of Task 1.2.

The core objective of the questionnaire designed for this survey was collecting information on existing and planned education and training offer in the sector and on the organisations (both from the academy and private sector), which can contribute to the improvement of the skills needed for the user uptake of Copernicus data and services.

Several steps were followed prior to the submission of the questionnaire to the EO4GEO target audiences. First of all, questions were discussed and designed to extract as much useful information as possible from the respondents. The idea was to create a light but complete questionnaire: in order to be effective and to receive the maximum possible feedback, the questionnaire should not require too much time or effort to respond to, but, at the same time, it should allow to examine in depth the key aspects of the training offer specified.

A key aspect for a good understanding of the questionnaire from the potential respondents was the definition of a clear and common terminology.

In this sense, the "*Taxonomy for the EO Services Market*" from EARSC (EO4GEO project partner) was used to define some of the terms used in the questions of the survey. The thematic terminology from this reference document is used intensively by Copernicus stakeholders and by private companies active in the sector and was especially useful in the survey for identifying the application field or thematic focus of a given training resource. An online document containing more information regarding the taxonomy used, was included as a link in the questionnaire to support our respondents in case of doubt when selecting the right application field covered by the training material.

Based on the experience of other projects, a common terminology was agreed upon for referring to training resources, such as courses, modules and lectures. Since these definitions are often open to various interpretations and used differently in an academic and other contexts, the terms were defined in the questionnaire for a better understanding by the respondent and to allow a uniform categorization of the type of training resources. A number of questionnaire draft versions were discussed in teleconferences between the WP1 tasks leaders, in order to share ideas, weak points, improvements and to make the survey more effective. After having completed the analysis of all the comments received, the final version was finalised and ready for being published online.

The "Training Supply" questionnaire is structured in four sections:

- Section 1 - Information about the respondent organisation. This section is important in order to know and categorize the type of organization (such as academia, company or public administration) that offers training resources.
- Section 2 - Currently (or available in the next two years) EO/GI education and training offer. This is the most relevant section for EO4GEO. Here the respondent is able to describe in detail up to 4 different training resources (such as courses, training modules or single lectures) offered by the organisation they work for. For a clear identification of the type of training resource, a definition of each of them is provided in the survey. From the point of view of the analysis, the most important questions in this section refer to the application field and the accessibility/re-usability of these resources.
- Section 3 - Interest in EO4GEO project and its results. This section is aimed at establishing further contact and interaction with the organisation providing the training material.
- Section 4 - Personal contact of the respondent (optional). The respondent can fill in the contact fields (in compliance to the EO4GEO data policy which is conformant to the GDPR) or leave the survey reply anonymous. Obviously, the respondents were encouraged to submit their personal info in order to allow EO4GEO to inform them about the progress of EO4GEO and potential collaboration.

Annex I of this report provides the full questionnaire.

Once the survey structure, questions and their format were approved, the next task was the choice of the tool to be used. This exercise was performed together with Task 1.2, since the adoption of a common tool for both questionnaires (supply and demand) was the most consistent and efficient option, taking into account that the information collection campaign to be launched had to be unique/common.

Several online survey tools were analysed and tested: Survey Monkey, LimeSurvey and EUSurvey. The initial requirements were:

- using as much as possible an Open Source platform;
- being cloud-based to avoid the setup of a web server-based software;
- being an easy-to-use platform and having an interface to develop and publish, collect responses, create statistics, and export the resulting data;
- being suitable with the nature and format of our questions;

Finally, based on the testing and on previous experiences, EUSurvey[6] was chosen as the most suitable platform for our purpose. EUSurvey is the European Commission's official survey management tool and is supported by the European Commission's ISA programme. The

[6] https://ec.europa.eu/eusurvey

application, hosted at the European Commission's Department for digital services (DG DIGIT), is available free of charge to all EU citizens, is fully open-source and is published under the EUPL licence.

In the EO4GEO survey(s), privacy policy issues have been seriously considered, by referring to potential sensitive information and the protection of personal data, which treatment has to comply with the Regulation (EU) 2016/679 (General Data Protection Regulation - GDPR)[7].

To cope with the above Regulation, a disclaimer was added at the bottom of the surveys dedicated web page in the project website http://www.eo4geo.eu/surveys/ . Also, in the supply survey itself, at the beginning of the questionnaire, reference is made to the project's own Privacy Policy. Finally, in "Section 4: CONTACT" of the questionnaire (that is shown only if the respondent decides to select the option "keep me informed" on the project and leave personal data), a consent checkbox conformant with the recent GDPR (together with a link to the downloadable general EO4GEO privacy policy document) is showed.

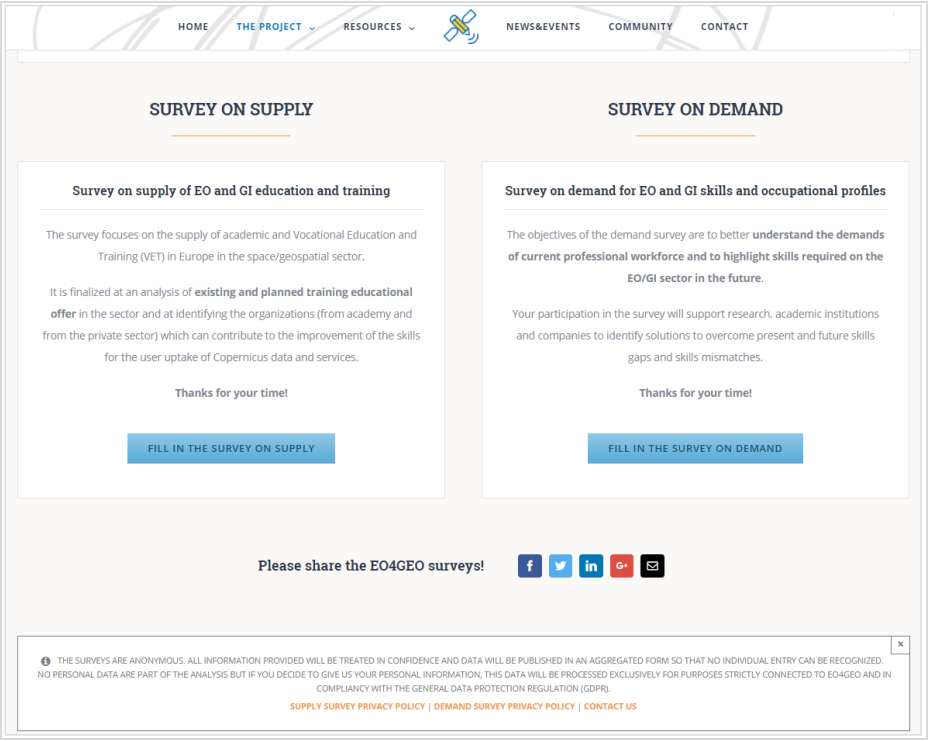


Figure 1: Dedicated surveys page on the project website

[7] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32016R0679&from=EN

Regarding the awareness and distribution of the supply survey the main objective was not only to achieve the maximum possible number of results, but also to ensure that these answers were well distributed, both from the geographical point of view and from the one of the type of organizations involved.

The "EO4GEO survey on supply of EO and GI education and training" is available at the following URL:
https://ec.europa.eu/eusurvey/runner/EO4GEO_survey_supply

To guarantee an as extensive as possible campaign, all the project partners were obviously invited to answer the survey. But, which is even more important, in order to reach as many organizations as possible, EO4GEO partners were also asked to disseminate the survey announcement among their contacts/networks, specially addressing those organizations active in the provision of training, thus exploiting the "network of networks" nature of the EO4GEO partnership. For this purpose, a message for disseminating both surveys (supply and demand) was carefully prepared and sent to the partners and to the Associated Partners, also with the purpose of multiplying its dissemination.

The survey promotion was carried out in various email campaigns from April to July 2018. After the first Progress Meeting in Castellon (30th May – 1st June) a new effort was done to promote the survey among the workshop participants and new Associated Partners.

It must be emphasized that, beyond project partners' effort to disseminate the survey in their own networks, special efforts were made in the context of WP7 "Capacity Building and Dissemination" by spreading the survey in various media and awareness campaigns. In this sense, it is worth noting the wide dissemination through the Twitter channel of the project https://twitter.com/EO4GEOtalks, and the section dedicated to the survey in the first issue of the project newsletter http://bit.ly/EO4GEO_Newsletter-1.

With regard to some important aspects of this survey, some limitations must be highlighted:

- Even if all questions had been designed to be as clear as possible, we cannot ensure that each individual has the same understanding, so sometimes results can be subjective.
- Multiple choice questions can be graphed, but open-ended questions are more difficult to handle. Open-ended questions allow for individualized answers which cannot be quantified and must be reviewed one-by-one.
- The survey has been largely disseminated and distributed, but obviously the survey results do not cover in any way all the courses available in our field of interest. At any rate, our

sample allows us without a doubt to offer reliable measurements for a valid and representative analysis.

5. Survey results

The Supply questionnaire has been open from April the 3rd 2018. The responses analysed in the context of this report were those received between April 3rd and September 7th. Overall, the number of **231** "training resources" have been described and considered within this report, from more than **120** organisations (from **26** countries) and one international organization. In some cases, different departments of the same organization contributed to the surveys. The survey got a total of **157** responses, with the possibility for the organisations to include in the questionnaire up to four courses/modules/lectures for each reply. Should more than four training resources be described, more than one survey had to be filled in.

Annex II of this document contains the complete list of training resources collected in the survey. The list is structured by "Organisation", "Country", "Title" (name of the training resource), "Type of training" (course, module, webinar, etc.) and "Accessibility" (description of the way to access the training resource).

The following sections will explore the results from both quantitative and qualitative perspectives.. In the survey, questions based on the single/multiple choices format are able to be quantified by way of generating numerical data or data that can be transformed into usable statistics. On the other hand, open text questions in our questionnaire are obviously very much subject to interpretation. In that case, we proceed to a qualitative analysis, trying to detect trends in the responses and make hypotheses about them.

5.1. Quantitative analysis

The quantitative analysis, a technique seeking to understand behaviour by using mathematical and statistical modelling, aims at representing the "closed text" answers of the survey.

For each of these answers, a graphic with short description is given in the next paragraphs.

5.1.1. Organisations and respondents

The first section of the survey was devoted to the origin of the respondent and the profile of the responding organisation.

The EO4GEO project consortium includes 26 members from 13 countries and all of them contributed, to a greater or lesser extent, to spread and promote the survey, especially in their own countries. Being Italy the country with more project partners, it had to be expected that the biggest number of answers would come precisely from that country.

During the survey the origin of the responses was continuously monitored in order to receive, at least, feedback from all partner's countries.

A small number of responses was received from organisations outside Europe.

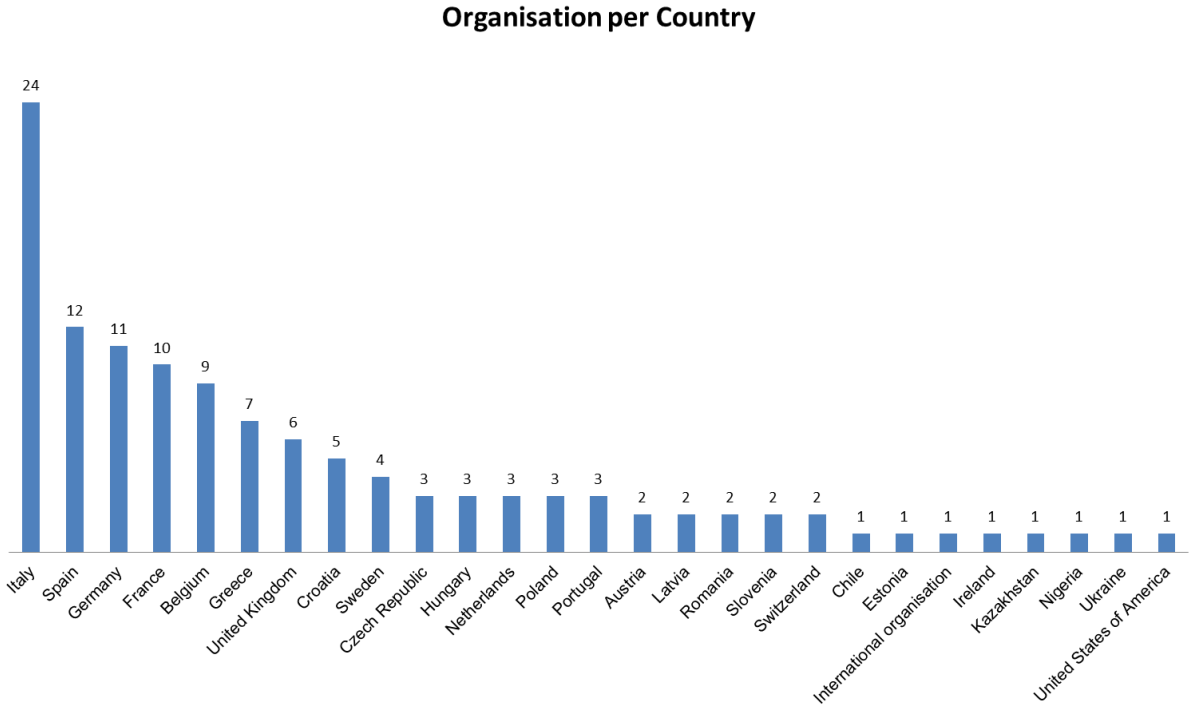


Figure 2: Total number of organisations responding per Country

Regarding the organisations type, more than half of the training providers participating in the survey (70%) work in the education and research sector and it should be noted that most of these organizations are educational institutes (mainly universities). The feedback received from private sector (17%) is not negligible and undoubtedly shows an obvious interest in the provision of training related to the EO/GI sector.

Type of organisation	**Percentage**
Education&Research (Education -all levels-, Academy Research)	70%
Small Medium Enterprise (SME)	15%
Administration/Public Body (at all levels)	8%
Other	3%

Industry/Company (Large Enterprise)	2%
VET Providers	1%
TOT.	100%

Table 2 – Responding organisations by type

Regarding the profile of the respondents, it should be added that, in the last section of the questionnaire, we asked our respondents about their interest in being kept informed about the results of the survey and the project in accordance with the GDPR new regulation: 87% of the participants showed interest in EO4GEO and its results and therefore, as a first action, they were automatically subscribed to the EO4GEO newsletter.

5.1.2. Type of training

This section analyses the format of the training resources provided in the survey. The survey asked to describe a maximum of 4 existing training resources in each reply. In questionnaire design phase a definition of the different types of training resources was agreed based on the common terminology mostly accepted in the academic community:

- A "course" is defined as a university course or a training course not related to an academic path, made up of one or more training modules, individual lectures or practical lessons.
- A "training module" is intended as a set of learning materials/lectures with specific objectives and learning outcomes, which is self-consistent and can be followed independently from other modules in a course or combined with them.
- A “lecture” is a very small unit of teaching, which is part of a course or a module.
- A “Training Package” is defined as a group of training courses/modules.

Regarding the “Type of training”, most of the resources (44%) were defined as “courses”. The remaining types are divided in almost an equal way between Training Module (16%), Training Package (15%) and Lecture (16%); with the same lower incidence we have Summer School and Webinar (4%). Finally Book or e-book are indicated by a very small number of respondents.

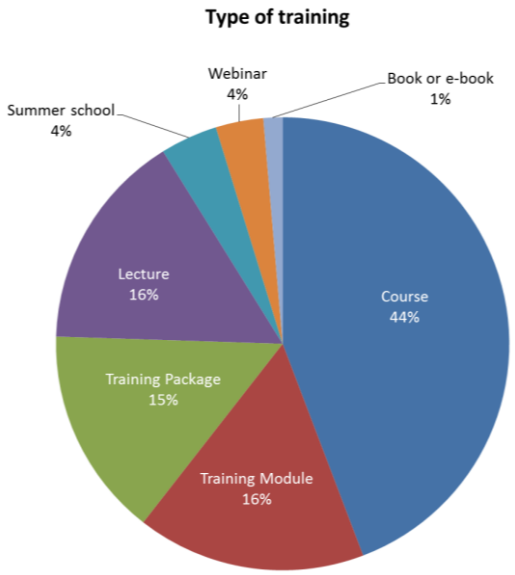


Figure 3: Type of training

More analysis is performed in chapter 5.1.6 where the types of training are analysed in relation of the EQF levels indicated.

5.1.3. Application fields

This section analyses the application fields covered by the training material content. Application fields were defined carefully after a discussion on the correct thematic taxonomy to be used. Reference taxonomy[8] (based on the EARSC EO taxonomy[9]) was provided to respondents directly in the survey for their convenience.

[8] https://docs.google.com/document/d/1YtU7xxGx2EsnBKcWSXmBEt9Nwb6BEjQ34ODaMII8y7g/edit
[9] https://earsc-portal.eu/pages/viewpage.action?pageId=15794378

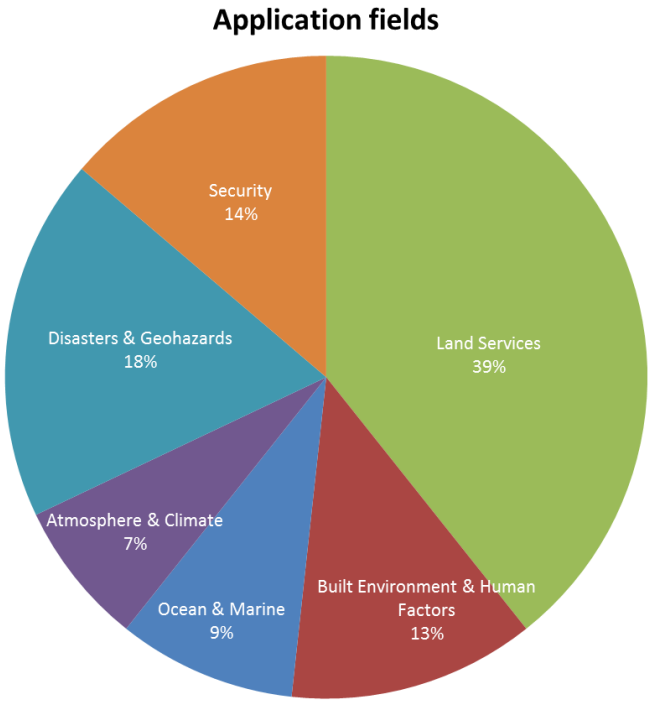
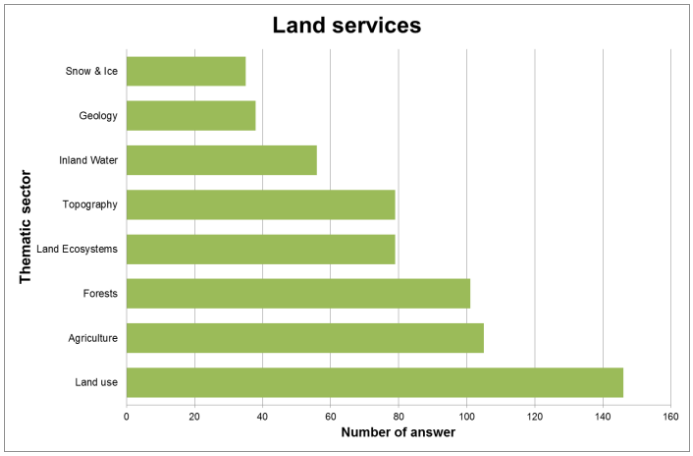
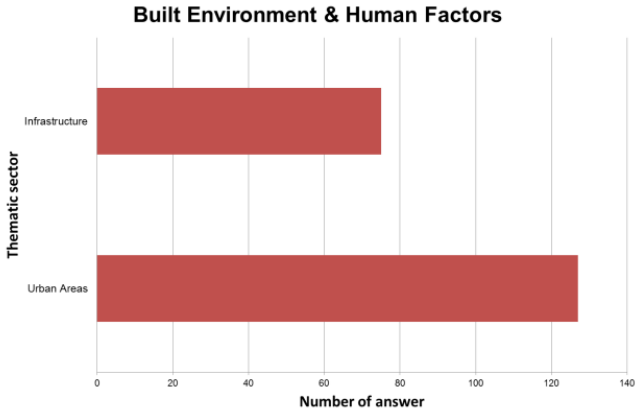


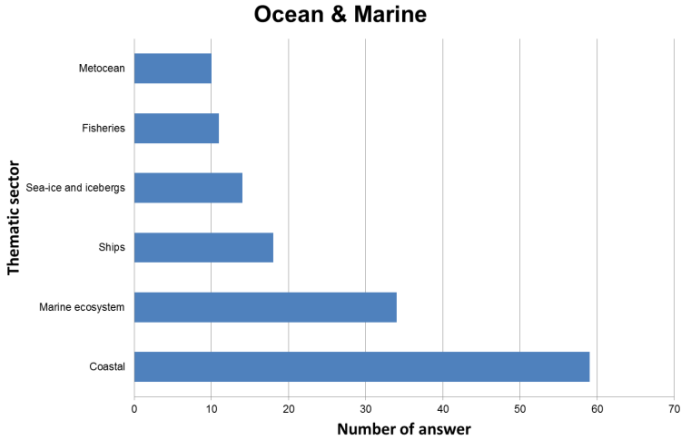
Figure 4: Application field covered by the content

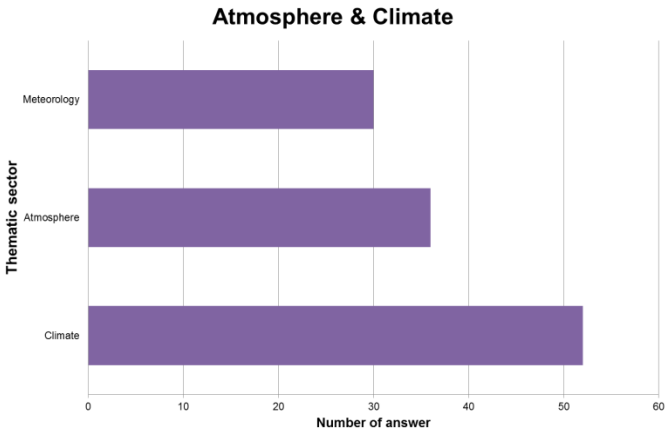
Each application field has been characterized by a second level of information about the thematic sector; multiple choices were possible and the respondent was able to find more information in the document linked to the survey.

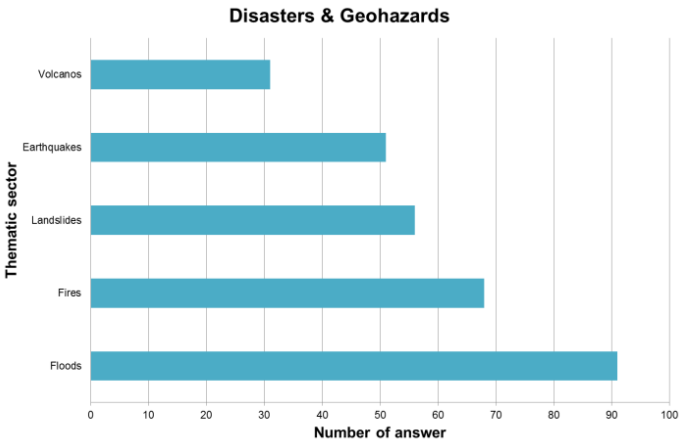
In figure 5 we can find the frequency of the thematic sectors for each of the application fields.


Land services
Thematic sector
Snow & Ice
Geology
Inland Water
Topography
Land Ecosystems
Forests
Agriculture
Land use
0
20
40
60
80
100
120
140
160
Number of answer


Built Environment & Human Factors
Thematic sector
Infrastructure
Urban Areas
0
20
40
60
80
100
120
140
Number of answer


Ocean & Marine
Thematic sector
Metocean
Fisheries
Sea-ice and icebergs
Ships
Marine ecosystem
Coastal
0
10
20
30
40
50
60
70
Number of answer


Atmosphere & Climate
Thematic sector
Meteorology
Atmosphere
Climate
0
10
20
30
40
50
60
Number of answer


Disasters & Geohazards
Thematic sector
Volcanos
Earthquakes
Landslides
Fires
Floods
0
10
20
30
40
50
60
70
80
90
100
Number of answer

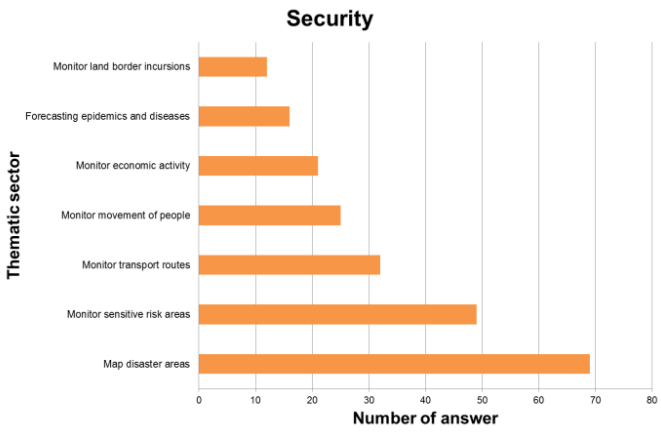

Security
Thematic sector
Monitor land border incursions
Forecasting epidemics and diseases
Monitor economic activity
Monitor movement of people
Monitor transport routes
Monitor sensitive risk areas
Map disaster areas
0
10
20
30
40
50
60
70
80
Number of answer

Figure 5: Frequency of the thematic sectors for each of the application fields

In figure 6, a first cloud has been generated from all thematic sector words.

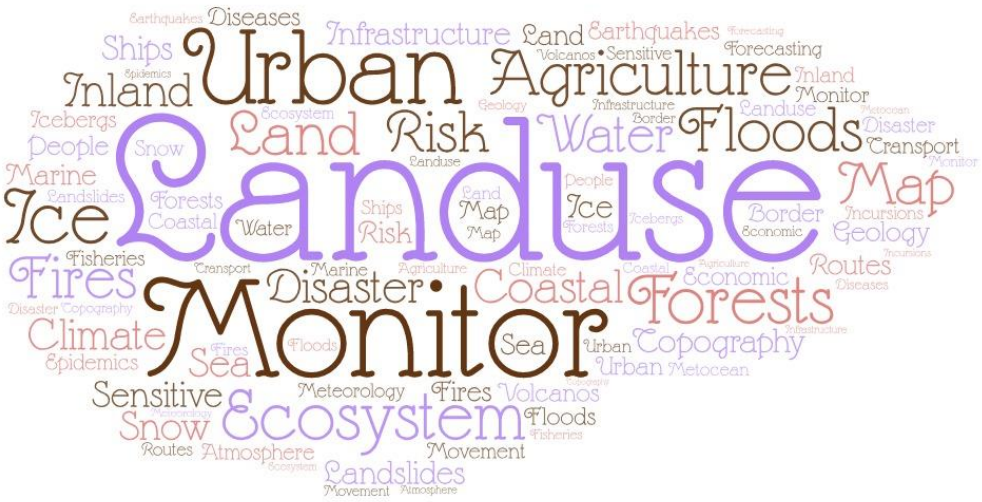


Figure 6: Word cloud based on all the application fields topics

5.1.4. Copernicus Services and related data

Figure 7 shows an analysis of the usage that the training material makes of the Copernicus services. We find that the strongest interest by far lies in Land Services.

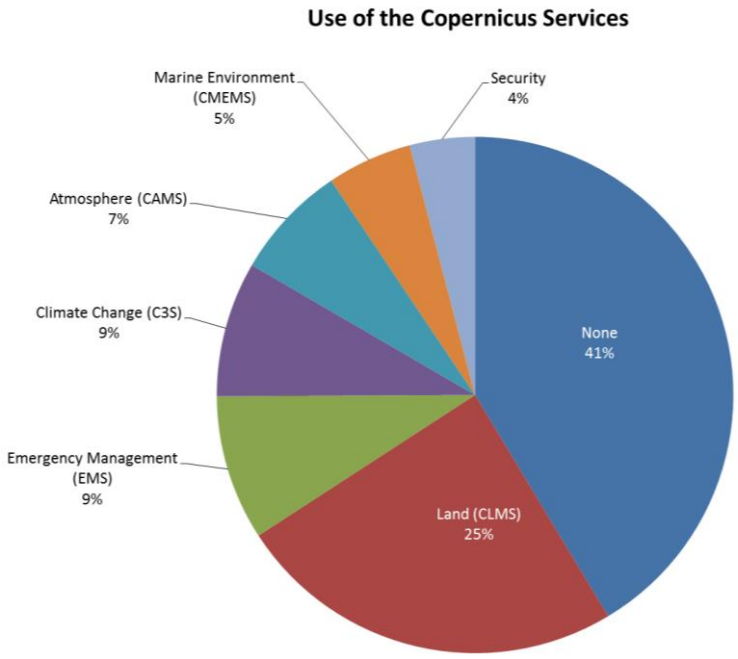


Figure 7: Use of the Copernicus Services in the teaching provided

5.1.5. Language, duration and registration period

The language in which teaching is offered plays a role in teaching accessibility for students with another mother tongue or coming from abroad. Regarding training resource language it should be noted that just over half of them are in English.

In fact, English is the most widespread language used in master's and postgraduate degrees across Europe for the education and training offer described by the respondents.

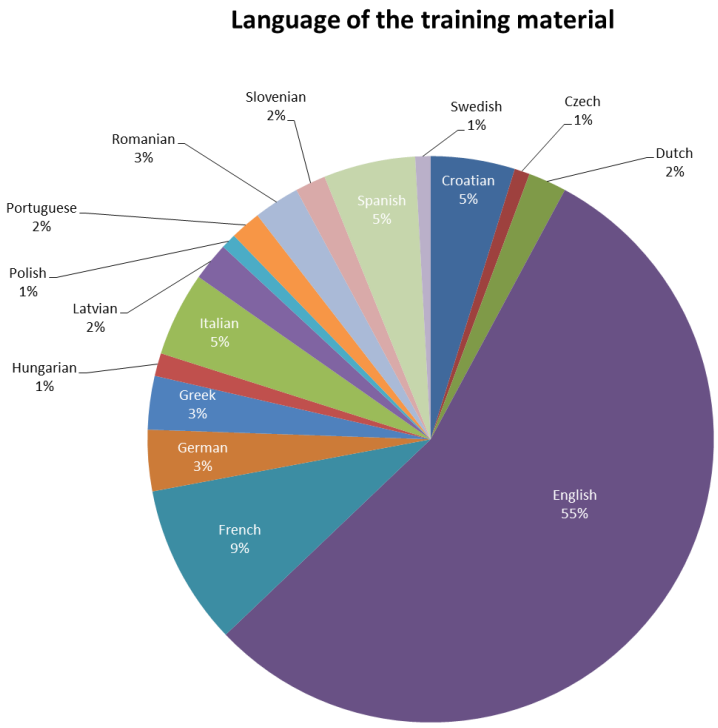


Figure 8: Language of the training material

As far as registration period is concerned, that is the period in which the “material” indicated in each response is available: the majority answered that it is currently available.

It is worth noting that even if the answer is “available in the next two years”, only very few (4) indicated that the material is planned, but not existing yet.

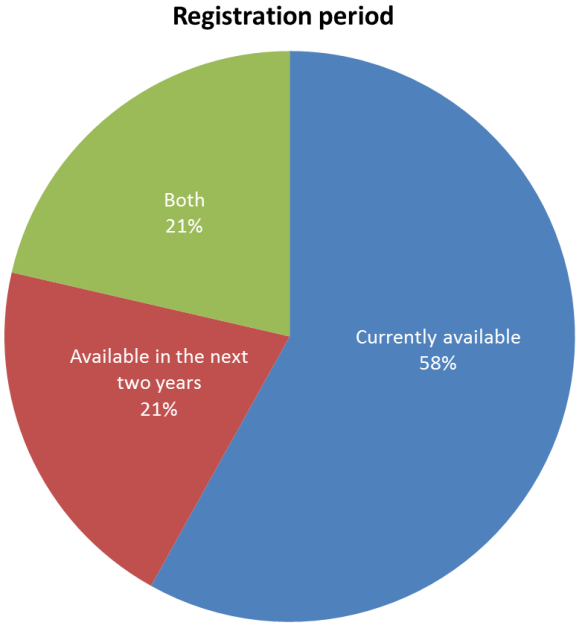


Figure 9: Registration period

5.1.6. Credits and qualification

This section analyses training resource qualification in connection with European Qualifications Framework (EQF) and the size in ECTS (European Credit Transfer System) credits.

EQF Analysis

The European Qualification Level (EQF) indicates if students will develop vocational, professional or academic competences.

EQF level has not been indicated in 66 of the training resources. Moreover, for 26 responses more than one EQF level has been indicated.

Only 137 resources have one unique EQF level, split according to figure 10:

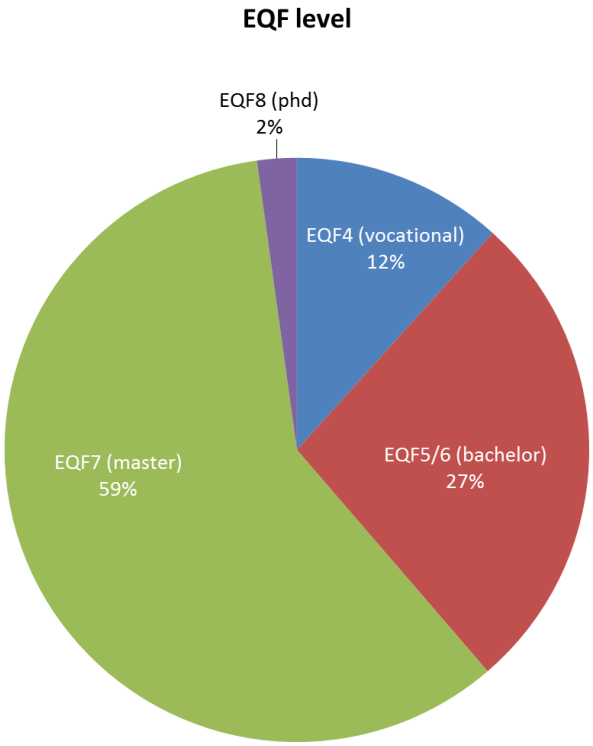


Figure 10: Training resources per EQF level

It is worth pointing out that training resources at highly specialised training programs (level 7 and 8), mainly within master's and postgraduate degrees, are almost entirely provided by Universities.

Type of providers	EQF8	EQF7	EQF5/6	EQF4
Education&Research	3	79	37	9
Industry/Company	/	/	/	1
Small Medium Enterprise	/	/	/	3
Administration/Public Body	/	2	/	1
VET Providers	/	/	/	/
Other	/	/	/	2

Table 3: EQFs vs providers in the 137 resources analysed

Since the questionnaire provided the possibility of indicating more than one type of training, in Table 4 all the answers have been added and put in relation to the EQF levels.

Type of training	EQF8	EQF7	EQF5/6	EQF4
Course	2	56	26	11
Training Module	/	11	7	2
Training Package	/	16	3	6
Lecture	1	8	10	2
Summer school	1	3	/	/
Webinar	/	1	/	2
Book or e-book	/	1	1	1

Table 4 EQFs vs type of training in the 137 resources analysed

Among the 66 training resources with no EQF level indicated, most organisations are from Education&Research (40), followed by Small Medium Enterprise (14), and the main training type is Course, followed by Lecture and Training Package.

Among the 26 training resources with more than one EQF, most organisations are from Education&Research (13), followed by Small Medium Enterprise (6) and the main training type is Course, followed by and almost equally distributed Training Module, Training Package and Lecture.

ECTS Analysis

The ECTS, the European Credit Transfer and Accumulation System (European Community 2009), is a standard means for comparing the "volume of learning based on the defined learning outcomes and their associated workload" for higher education across the European Union and other collaborating European countries. On average 1 ECTS corresponds to 25-30 clock hours of study load; one academic year corresponds to 60 ECTS credits that are normally equivalent to 1500–1800 hours of total workload.

ECTS credits have not been indicated in 92 of the training resources.

For the 137 resources with this field compiled the results are shown on figure 12:

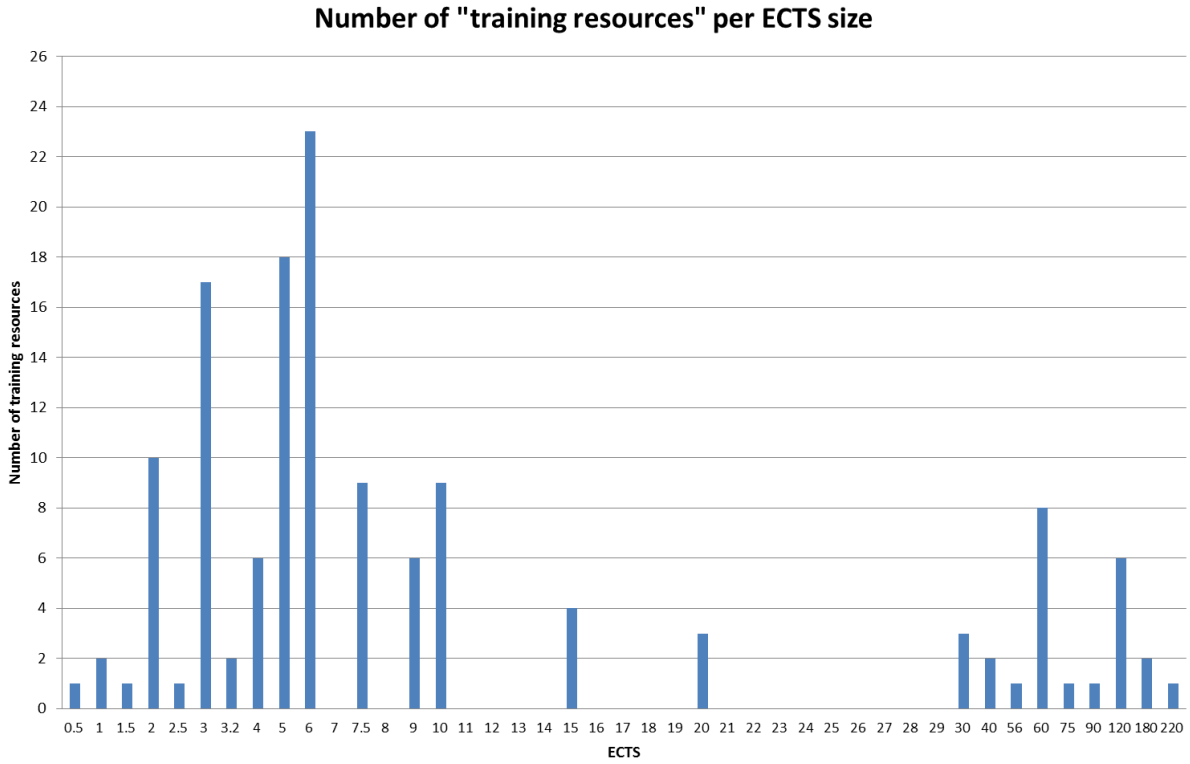


Figure 11: Number of training resources per ECTS size class

In 8 training resources EQF level is missing and in 15 of them EQF level is not uniquely indicated; so these resources have been excluded from the analysis summarised in the matrix below.

ECTS	0.5	1	1.5	2	2.5	3	3.2	4	5	6	7.5	9	10	15	20	40	56	60	75	90	120	220
EQF8		1	1										1									
EQF7	1			4	1	7		1	5	16	3	6	8	4	1	1	1	6	1	1	6	
EQF5/6				5		4		2	11	4	2				2							
EQF4						2	2	1								1		1				1

Table 5: Number of training resources per ECTS size class and EQF level

The majority of training resources at EQF7 level has a study load of 6 ECTS, whereas at EQF5/6 level a size of 5 ECTS occurs the most; EQF8 and EQF4 are equally distributed, with no peak.

5.1.7. Accessibility and reuse

Here the means of accessing learning materials and the possibility of re-using them in other contexts are analysed.

While 30% of the training resources has been indicated as not being accessible, the remaining 70% is freely accessible or has a restricted access, sometimes with the possibility of "specific agreement", considering that most of the respondents have declared their interest for further contacts.

In this case, the total percentages are:

- Accessible only for registered students (or under other restrictions) 28%
- Not accessible 30%
- Accessible by everybody 42%

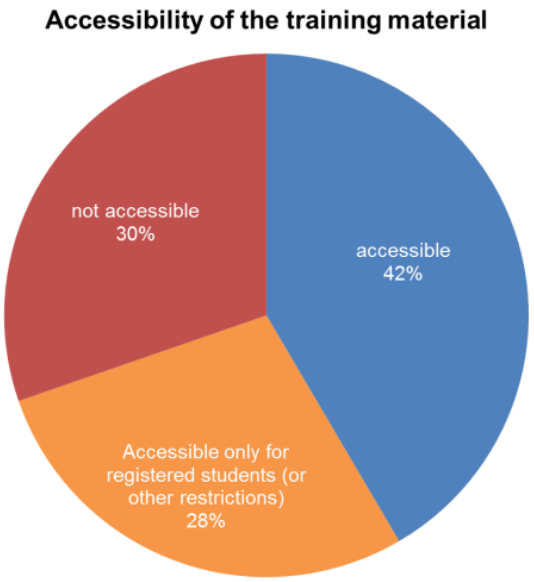


Figure 12: Accessibility of the training material

Regarding the accessible materials, 66% have indicated the web link.

Two different approaches have been used for reporting reusability analysis: At first general reusability has been considered (i.e. whether the materials are reusable or not, regardless of their accessibility) - see Figure 13. In Figure 14 we can see a combination of two criteria: Accessibility and reusability. The chart indicates the percentage of training material for each possible combination:

- Accessible and reusable: 37%
- Accessible, but non-reusable: 4%
- Not accessible, but reusable: 26%
- Not accessible and non-reusable: 33%

For the second approach (figure 14), the material has been considered “not accessible” even when it has been indicated as “accessible only for registered students”.

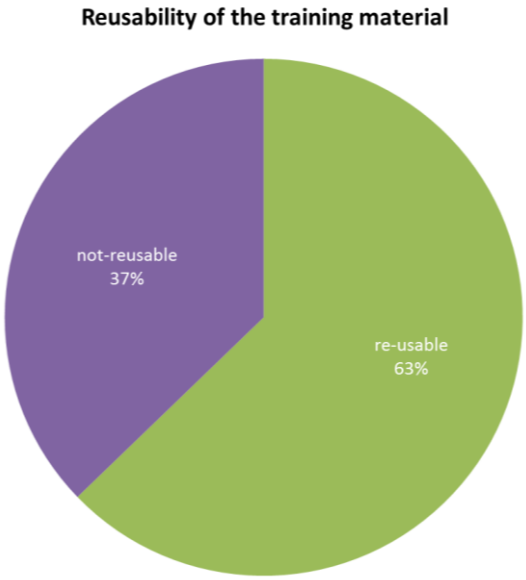


Figure 13: Reusability of the training material

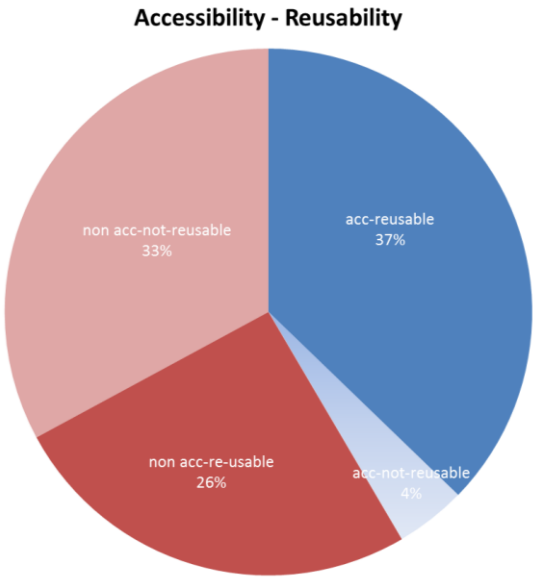


Figure 14: Mixed analysis

5.2. Qualitative analysis

This section focuses on learning material content analysis and the expected acquired skills at the end of the learning process. It should be noted that, in the survey, the questions aimed at describing training content and learning outcomes were open and text based.

Even if the survey was meant for collecting information in an extensive and quite heterogeneous academic field, its main goal was to put the focus on receiving responses related to Earth Observation and, more precisely, regarding those materials directly or potentially contributing to the user uptake strategy of Copernicus data and services.

Nevertheless, the survey addresses the space/geospatial sector in its wide sense and a considerable number of answers refers to GI rather than Remote Sensing or Earth Observation.

In a preliminary analysis, two main blocks of responses were identified: GIS and Geomatics courses (including knowledge in Remote Sensing), and training materials entirely focused on RS.

Besides, from the analysis of the descriptions of the training materials, we can highlight a clear distinction between two educational resource knowledge levels: “basic” and “advanced”. We found also another big group of training material that we can call “domain specific” (focused on the application of Remote Sensing in a particular scientific field).

This chapter will be therefore divided into tree subsections based on the aforementioned groups: Basic knowledge, advanced knowledge and domain specific.

5.2.1. Basic knowledge

Basic knowledge training materials in Remote Sensing (RS) are aimed at establishing the theoretical basis of remote sensing, its methods and technology. These courses build a solid foundation for further study and application in a variety of fields.

Although we obviously found basic training in RS in Bachelor’s programs (EQF Level 6), the majority of responses regarding RS courses belongs to the formative context of University Master programs (EQF Level 7). These Masters are, for the most part, advanced post-graduate training programs in GIS/Geomatics and include one or more modules dedicated to Remote Sensing. Needless to say, the degree of deepening in the subject is slightly different for each Master, but we can find a number of similarities among them.

The curricula of these masters often include an “Introduction to remote sensing” module. The topics covered by these “introductory” modules provide the basic theoretical, methodological and technological principles of RS. These courses within Master programs also include the study of different applications and some practical experience on the basic image processing chain. Students are guided through the most important spatial analysis techniques by analysing and solving problems of increasing complexity.

In any case, very often the approach is elementary, rather wide and not much domain-centred. Also, most of the RS basic courses focus on the generic area of environmental Remote Sensing

and usually make use, in their theoretical and practical examples, of vegetation and land cover-related information (which are very frequent areas of study).

The main topics covered in the basic and introductory RS courses refer to the physical principles, platforms, types of sensors, data acquisition techniques, pre-processing, visual interpretation, basic image transformations and basic image classifications.

These fundamental methodological and technological topics are extended in the following list, which includes the most common training material subjects:

- Study of the principal sensors (optical and radar) and their characteristics
- Air-borne and space-borne platforms
- Physics foundation of electromagnetic energy
- Basic knowledge on signal theory (mainly in the radar context).
- Remote sensing orbits
- Processing of the remotely sensed images:
    - Application of image transformations
    - Classification of satellite data
    - Methods of image segmentation
    - Radiometric and geometric operations
- Change detection methods
- Basic experience in RS imagery practical use
- Introduction to LiDAR
- Introduction to positioning systems
- Identifying and searching databases of satellite images

You will find below a few considerations concerning these subjects:

Regarding the practical work performed in basic RS courses, it seems that the work is mainly based on vegetation analysis and the application of change detection methods (mainly land use changes). Also, as far as air-borne and space-borne platforms are concerned, the main emphasis is on satellite imagery.

Even if the identification of available databases of satellite images (in order to select the appropriate data for each application) is present in a number of master programs, it seems to be a secondary aspect and not to have the importance it deserves.

Moreover, for a real Copernicus user uptake in the training and education process, it is a key aspect to put more focus on the development of new applications by the students. However, based

on the information received in the questionnaire, just a few master courses make explicit reference to the creation of real “applications” during the courses.

Regarding the technology aspects of the basic knowledge courses, we can highlight a few findings:

Both optical RS and radar RS are introduced in most courses without apparently giving much more importance to one or the other technology. Some basic courses focus on the passive optical satellite techniques to perform basic satellite data analysis for environmental applications. In other cases, there is much more focus on radar remote sensing (SAR) in comparison with other imaging remote sensing methods.

Besides, LIDAR and satellite navigation systems are normally introduced in basic knowledge courses even if there is no special attention to deepen this in such “parallel” fields.

5.2.2. Advanced knowledge

When looking at the responses in the questionnaires, the main difference lies in the degree of deepening in RS subjects. Advanced knowledge training in RS includes highly specialised training resources, especially when dealing with a particular RS method or technology.

A small part of the Master programs described in the answers is dedicated entirely to Earth Observation and Remote Sensing. On the other hand, it is very common to find vocational training (mostly based on eLearning courses or summer schools) dedicated entirely to RS subjects, targeted to highly specialised professionals and focused on operational applications.

The following list summarizes the most common topics we found as regards “advanced” training resources. These subjects are commonly excluded or not very present in “basic” GIS/Geomatics Masters:

- Advanced remote sensing’s physical basis
- Advanced radar remote sensing techniques (mostly SAR image processing)
- Advanced pre-processing and pre-classification techniques
- Advanced image analysis and calculation
    - Resolution
    - Calibration and correction
    - Data fusion
    - Segmentation
    - Advanced classification methods
    - Image processing algorithms
- Programming and scripting
- Quality control and data quality issues including validation
- Advanced LIDAR
- Advanced navigation systems
- Deep study of real-world application scenarios.

Generally speaking, advanced RS training resources focus on specific technological aspects. This means that these courses are targeted to an audience already familiarized with the fundamentals and aimed at developing solid skills on a given method or technique. These resources are often single courses, of limited duration and focused on a single topic.

The following is a list of topics found in the questionnaires regarding courses dedicated to very specific RS technological aspects:

- Geo-scripting
- Object-based Image Analysis (OBIA)
- Earth Observation from Micro-Satellites
- Data Fusion of Optical & SAR Data
- Spatio-temporal Earth datacubes
- Interferometric SAR (InSAR) techniques
- Polarimetric SAR (PolSAR) techniques
- Deformation Monitoring with SAR Interferometry
- Urban object extraction
- DSM mapping from SAR data
- Artificial Intelligence for Earth Observation
- Radiative transfer and remote sensing
- Remote sensing in the Microwave and millimetre-wave spectral range
- Generation of 3D point clouds based on photogrammetry
- Algorithms for remote sensing data processing (LiDAR and Radar)
- Sentinel Application Platform (SNAP)

Below, a few considerations regarding these “advanced” and “technology focused” RS training resources are outlined:

Different types of satellite data have different uses and each RS technique has its advantages and drawbacks. From the analysis of the advanced courses described, we can conclude that there is a clear trend for courses based on radar RS over optical RS, and more specifically courses based on SAR. Synthetic Aperture Radar (SAR) is an emerging technology in remote sensing (in fact, Copernicus Sentinel-1 is equipped with this type of sensor). The biggest advantage of radar data over optical data is that it is not affected by weather conditions.

LIDAR is a remote sensing technique used to examine the surface of the Earth. We can consider this technology mainly as a “surveying method” used to make high-resolution and three-dimensional maps. From the responses received, we found that, to a greater or lesser degree, LIDAR is a matter of study in RS courses (especially in the advanced ones), but, on the other hand, we can conclude that LIDAR training resources are typically standalone courses, and therefore in-depth knowledge of various LiDAR systems is gained in training resources dedicated entirely to this matter.

The same happens when dealing with navigation and global satellite positioning systems (especially GPS). In most cases, this field of study is introduced in RS basic Master programs but deepened only in dedicated courses (especially as regards GNSS data acquisition for terrain modelling).

Geoscripting is a topic that has lately acquired a lot of importance due to the scarce programming base of many Geo-Information professionals. Scripting languages that are applied to RS and earth observation are mainly based on R, Python platforms and Google Earth Engine.

It is also worth mentioning some findings in connection with software tools. While in basic courses there is there is little mention of the instruments used in practical exercises, normally advanced and specialised courses are heavily based on the use of a particular toolbox with very specific features and aimed at solving particular problems by performing very concrete operations. A number of tools and platforms are mentioned, but based on the answers received it is not possible to establish a clear trend or specific preference. In any case, we can perceive a slight preference for Open Source resources and platforms for highly specialised radar image processing.

In some cases, Open-source data (Sentinel) and software are explicitly promoted for practical work. Among the Open software tools and platforms mentioned there are the following:

- Copernicus EMS
- Copernicus SNAP
- UN IWG-SEM portal
- Orfeo ToolBox (OTB)
- ESA SAR toolboxes and platforms
- ILWIS
- QGIS
- GRASS

However, from the answers received, it is important to observe also the use of commercial platforms such as:

- ERDAS Imagine
- ArcGIS
- Google Earth Engine
- ENVI image analysis software

Moreover, we received responses regarding a good number of “Copernicus oriented” courses. In this regard we must mention RUS (Research and User Support for Sentinel Core products) courses. These resources are specialised courses for MSC students, PostDoc and professionals, and are fully oriented to promote Sentinel data uptake.

Finally, we can highlight the presence in the questionnaires of one course entirely dedicated to the processing of sentinel data based on the Sentinel Application Platform (SNAP) devoted to creating Earth Observation applications using Copernicus data.

5.2.3. Domain specific

Outside geography, land surveying and environmental science (basically land and marine management and monitoring), remote sensing is used in numerous fields and in most Earth Science disciplines: biology, civil engineering, geology, urban and regional planning, atmospheric sciences, physics of the Earth, agronomics, oceanography and computer science among others.

It is noteworthy that the majority of the “domain-specific” training resources analysed are in general targeted to professionals or experts. Some of these resources are part of specialised master programs, but a large number of them are courses outside the academic context.

Most of this RS training is aimed at giving introductory knowledge on RS in terms of presenting the potentiality of the use of satellite- or aircraft-based sensor technologies in a specific scientific field.

In these domain-specific courses, training focuses mainly on practical applications and on how to use and apply RS data to support decision making. Normally, practical experience in using/analysing Earth Imagery has more relevance than theoretical aspects.

In our questionnaire we collected a good number of training resources belonging to very different fields of study. The following list of subjects relates to training on RS included in master programs or single highly-specialised courses in the context of other disciplines than environmental GIS/Geomatics:

- Landscape Architecture
- Precision farming
- Defence applications
- Risks management
- Spatial planning
- Sustainable urban development
- Monitoring of active, inactive, and abandoned mines
- Convective and volcanic clouds detection
- Horticulture engineering
- Coastal and marine management and monitoring
- Geological and geomorphological analysis
- Urban area mapping
- Atmospheric processes
- Legal and regulatory issues for the Remote Sensing industry
- Disaster monitoring and mapping
- Fisheries and aquaculture
- Oceanographic applications

    - Oil spill detection
    - Sea ice concentration
- Permafrost mapping
- Glaciers and snow cover

6. Training supply WWW investigation

In addition to the survey about geospatial training and education supply as described in Chapter 5, an investigation has been carried out about existing courses (several of them also available on line) or other training initiatives, mainly provided by:

1. Copernicus and related organisations
2. European and International Networks
3. Summer Schools organized by Universities and research institutions
4. Comprehensive training packages offered by companies

6.1. Copernicus and related organisations

Official “Copernicus Organisations” or initiatives, such as the European Space Agency (ESA), the Copernicus Research and User Support (RUS)[10] and the European Organisation for the Exploitation of Meteorological Satellites (EUMESTAT), offer a wide range of training in Earth Observation, as described in the following sections.

6.1.1. Copernicus training videos and InfoSessions

A total of 129 training videos related to Copernicus programme are available on the official Copernicus YouTube channel.

Copernicus YouTube channel:
https://www.youtube.com/channel/UCpuwnbuwGG20enAdE50g6TA/videos

Among them 76 (See Annex III for the complete list) are devoted to foster user uptake concerning the use of Copernicus data (with information on how to access and process Copernicus data and how to use the Copernicus Services for specific applications/case studies) and the promotion of the Copernicus Accelerator, the Copernicus Start-up Programme devoted to the involvement of start-ups and entrepreneurs.

In detail:

[10] The RUS Service has been developed and is operated on behalf of EC and ESA by a consortium led by CS SI (Fr) and involving Along-Track (Fr), Noveltis (Fr), Serco SpA (It) and CS Romania (Ro).

- General - 5 videos
- Copernicus Atmosphere Monitoring Service - 6 videos
- Copernicus Marine Environment Monitoring Service - 6 videos
- Land Monitoring Service - 8 videos
- Climate Change Adaptation and Mitigation - 5 videos
- Copernicus Emergency Management Service - 8 videos
- Copernicus for Renewable Energy - 4 videos
- Copernicus for GI - 5 videos
- Access to Copernicus Data - 6 videos
- Copernicus for Entrepreneurs and Developers - 5 videos
- Coastal Zone Management - 6 videos
- Copernicus for Local and Regional Authorities - 5 videos
- Copernicus Accelerator - 7 videos

Moreover, Copernicus InfoSessions aim to promote awareness as regards the many uses of Copernicus data and information, and these events are organised in the different Member States. The InfoSessions are open and free to registered participants and 16 such sessions have been organised until September 2018**.** They target both Copernicus "intermediate" end users (technical) and end user communities (non-technical).

Copernicus InfoSessions: http://copernicus.eu/main/infosessions

6.1.2. ESA

The European Space Agency (ESA) undertakes a wide range of education, training and capacity building activities in the field of Earth Observation. The scope of these activities ranges from high level training in state-of-the-art processing to more general outreach activities and Earth Observation education for schools.

As one of the most important training initiatives, ESA has established a training and educational portal (https://earth.esa.int/web/guest/eo-education-and-training) to provide information about their education activities, and enabled access to all the resources produced.

On this portal various links to different training resources are provided:

- **ESA MOOCs** (Massive Open Online Courses), 3 courses: https://earth.esa.int/web/guest/eo-education-and-training/moocs.
- **LearnEO!** (Learn Earth Observation with ESA): http://www.learn-eo.org/index.php. (LearnEO! has developed 10 lessons for the UNESCO Bilko software, showing how data from ESA satellites (EnviSat, SMOS, CryoSat, GOCE) can be used to monitor the

environment. Also available are the 3 winning lessons from the LearnEO! lessons writing competition in 2013/14, as well as 10 lessons developed by the Global Lakes Sentinel Services (GLASS), developed for the BEAM/SNAP software).

- **EO Education for Schools**: https://earth.esa.int/web/guest/eo-education-and-trainingweb/eo-edu/education-for-schools, with links to:
    - Eduspace: http://www.esa.int/SPECIALS/Eduspace_EN/ (a website for secondary schools, This website contains a wealth of knowledge about remote sensing, image processing, satellites, instruments and applications of Earth Observation, and many exercises and case studies, designed to be used with software and data, that can be downloaded freely from the site), 6 lessons + 14 case studies.
    - EO Educational Tools: ESA develops educational tools in the form of books, information packs. More information is found at 'ESA School Atlas' page: https://earth.esa.int/web/guest/eo-education-and-trainingweb/eo-edu/esa-school-atlas (The Atlas is built on satellite imagery and is packed with the most current and visually stunning results of Earth Observation. It displays all the fundamental processes affecting the Earth system and demonstrates the techniques of the future for monitoring and understanding our planet).
- **EO Summer Schools**: https://earth.esa.int/web/eo-summer-school/home/, see chapter 6.3 - Summer School for details.
- **Dragon Training**: http://dragon4.esa.int/page_training.php (Dragon is a co-operation between ESA and the Ministry of Science and Technology (MOST) of the P.R. China).
- **Tiger Training**: http://www.tiger.esa.int/page_training.php (in 2002 ESA launched the TIGER initiative to promote the use of Earth Observation (EO) for improved Integrated Water Resources Management (IWRM) in Africa).
- **Advanced EO Training:** https://earth.esa.int/web/guest/eo-education-and-trainingweb/eo-edu/pis-advanced-training, for Principal Investigators, 20 training courses. These trainings are held yearly and hosted in European Universities and Research institutions. They are targeted to the European, ESA member state and Canadian research and development community, in particular post-doc researchers as well as masters and PhD students.
- **Other EO Training**: https://earth.esa.int/web/guest/eo-education-and-training/university-undergraduate-level (ESA organises EO training events on an ad-hoc basis, and produces EO training material at various levels), 20 Training Package, most of them on Radar Remote Sensing.

The above training material is detailed in the Annex IV.

Other ESA useful resources are:

- **ESA EO beginners handbook:** The handbook ´New comers Earth Observation Guide´ is an excellent reference to start learning about EO before diving into Copernicus https://business.esa.int/newcomers-earth-observation-guide
- **STEP platform:** The Science Toolbox Exploitation Platform (STEP) from ESA http://step.esa.int/ is a rich source of documentation toolboxes (mostly tutorials) and training materials for scientists using the Sentinel Application Platform (SNAP) software.

Moreover, ESA produced several courses, that are available on not-ESA Platforms, as the Future Learn Platform (https://www.futurelearn.com/) and other platforms - see Annex IV, Miscellaneous section, for a list of relevant training materials available.

6.1.3. RUS-Training

ESA provides an on-line platform, called RUS (Research and User Support for Sentinel), to host EO application development and processing in the scope of promoting the uptake of the Sentinel data by potential users.

An important part of the RUS service is the Training programme, that includes a full and varied range of training courses, from basic demo sessions - where the learner is guided step by step and can learn how to download, process, analyse and visualise Sentinel data - to longer events, where both theory and hands-on sessions are included.

Training material is divided into two categories:

- Training Sessions: https://rus-training.eu/training
- E-Learning Courses: https://rus-training.eu/course

Moreover, a YouTube channel "RUS Copernicus Training" is dedicated to RUS Copernicus Training programme.

See Annex V for a complete list of the training material available, updated to July 2018.

6.1.4. ESERO

The European Space Education Resource Office (ESERO) project (https://www.esa.int/Education/Teachers_Corner/European_Space_Education_Resource_Office) is the ESA's main way for supporting primary and secondary education community in Europe.

ESERO offers an annual series of national or regional training sessions for both primary and secondary school teachers, as part of continual professional development qualifications.

These training sessions are offered in collaboration with national partners who are already active in STEM (Science, Technology, Engineering and Mathematics) education. Real space data and the

application of real-life scientific methodology, accompanied by the role model support of real space experts such as scientists and even astronauts, are used as much as possible.

The ESERO project also helps stimulate young people's awareness of Europe's space programme and of its importance for modern society and economy.

ESERO has national offices in different European countries: Austria, Belgium, Czech Republic, Denmark, Germany, Ireland, Luxembourg, Netherlands, Nordic countries (Sweden, Finland and Norway), Poland, Portugal, Romania, Spain, UK.

6.1.5. EUMETSAT

EUMETSAT is a global operational satellite agency, whose purpose is to gather accurate and reliable satellite data on weather, climate and the environment, and to deliver them to Member States, international partners and users world-wide.

EUMETSAT is responsible for operating Sentinel-3 satellites, with ESA support, and delivering the marine data and will also operate and deliver products from Sentinel-4, Sentinel-5 instruments and Sentinel-6 satellites.

EUMETSAT provides data, products and support services to the Copernicus information services and user communities, with a focus on marine, atmosphere and climate.

In addition, upon request of the EC, EUMETSAT is also responsible for delivering data and products from Sentinel missions to third parties around the world.

EUMETSAT makes free available on its website training materials for anyone wishing to understand how to use and interpret satellite data:

- the online Training Library:

  https://www.eumetsat.int/website/home/Data/Training/TrainingLibrary/index.html

  with modules regarding the following topics
  - Atmosphere (131)
  - Data dissemination (3)
  - Land (37)
  - Marine (37)
- the Image Library:

  https://www.eumetsat.int/website/home/Images/ImageLibrary/index.html
  hosting more than 1300 EUMETSAT imagery and case studies of weather phenomena and environmental events observed by EUMETSAT's fleet of weather satellites; 24 of them are directly referred to the use of Sentinel's data.
- courses in the Training Zone:

  https://training.eumetsat.int/
  hosting all EUMETSAT's courses (should you click on "Find all training", you'll be redirect to http://trainingevents.eumetsat.int/ , where you can find Workshops, Conferences, Classroom, Online courses, Events

In addition, on the FutureLearn platform the following MOOCs (Massively Open Online Courses) are also available:

- Monitoring the Oceans from Space (https://www.futurelearn.com/courses/oceans-from-space). This course isn't running right now, but will be probably available soon again.
- Monitoring Atmospheric Composition (https://www.futurelearn.com/courses/atmospheric-composition), starting on 5 November 2018.

These MOOCs are funded by the EU's Copernicus Programme and developed by EUMETSAT and the Copernicus Atmosphere Monitoring Service/ECMWF.

Finally, it is worth noting the resources present in the EUMETSAT YouTube channel (https://www.youtube.com/channel/UCiN59j5b1fAGnXVzIYFpaMw), in particular a series of videos that provide training on how to access, download and manipulate Sentinel-3 marine data from its Copernicus Online Data Access (CODA) platform.

See Annex VI for some sample training resources.

6.2. European and International Networks

European and International Networks are catalysts of interests and knowledge of their respective members, promoting training initiatives as well as to support transfer of knowledge and open training opportunities to the respective Communities.

In the following sections the description of the training initiatives from some of these networks operating in the geospatial field are provided.

6.2.1. NEREUS

NEREUS, the Network of European Regions Using Space Technologies, offers a dynamic platform to all European regions wishing to use space technologies to improve their public policies for the benefit of their citizens. Moreover, it ensures a significant representation of a rapidly growing group of industry players, SMEs, universities and research centres operating in the space downstream sector.

Amongst its initiatives to raise the awareness and understanding of the benefits of using space technologies, NEREUS developed an online tool called the **NEREUS e-catalogue** (http://www.nereus-space-training.eu/), developed as an activity of the Communication, Education and Training Working Group (co-chaired by Prof. Michel Bousquet and Ms. Martina Hilger).

The e-catalogue, updated on a yearly basis until 2017, provides an open and up-to-date inventory of training courses performed in the space domain in the NEREUS network regions. It covers all types of training such as initial university training as well as vocational training or apprenticeship

training. Only courses coming from NEREUS members (full and associate members) are included in it. It is structured by topics and several search mechanisms are available. For each topic, a list of organizations offering training in that subject is listed. Then, for each organization, the training program (usually a Master, bachelor program, or other university training degree) is listed. Finally, for each training program a description of the offer is available in the form of a metadata sheet offering the course details, update date and access mode.

Since each university program covers a number of different topics, you can find the same course in different places in the catalogue.

In conclusion, this resource is a training catalogue representing an useful resource for the educational and scientific communities (especially students) as regards space sector.

The first edition of this e-catalogue dates back to 2011. In the 2017-18 edition, the catalogue gives information on **368 training courses** and constitutes a rather good view on the state of the European university training offer. It is noteworthy that the topics are quite broad (from engineering to applications). As far as earth observation and geo-informatics are concerned (the topic most related to EO4GEO), the catalogue gives information on 97 training courses (most of them university programs) from 56 European academic institutions (mainly technical or engineering school/universities).

6.2.2. EARSeL

EARSeL (EO4GEO Associated Partner) is a scientific network of European remote sensing institutes, coming from both academia and commercial/industrial sector.

In September 2018 EARSeL organised a Summer School (http://earsel.org/summer-school/), Sentinel for Applications in Agriculture (more info in chapter 6.3 - Summer School).

Every year, EARSeL publishes new documents reporting on its activities, from which useful information can be obtained:

- Books series: http://earsel.org/publications/books-series/, mainly on remote sensing
- peer-reviewed EARSeL eProceedings: http://earsel.org/eproceedings/, mainly on LIDAR, remote sensing and its applications
- Workshop proceedings: http://earsel.org/publications/workshop-proceedings/

  The most relevant are:

  - 2nd Workshop on Education and Training http://www.earsel.org/SIG/ET/2nd-workshop/WS_Education-Training-2009-publications.htm

- 4th Workshop on Education and Training: http://www.earsel.org/SIG/ET/4th-workshop/proceedings.php, with teaching materials, encyclopaedia, easy-to-use image processing - the FIS Learning Portal on remote sensing http://www.fis.uni-bonn.de/en

See ANNEX VII for the list of the most relevant resources.

6.2.3. ISPRS

The ISPRS (International Society for Photogrammetry and Remote Sensing) is a non-governmental organization devoted to the development of international cooperation for the advancement of photogrammetry and remote sensing, and their applications.

The ISPRS Foundation, Inc. (TIF) is an independently registered entity that has been established to provide financial assistance and in-kind support solely for benevolent purposes that are pursued by the International Society for Photogrammetry and Remote Sensing (ISPRS).

In 2017 ISPRS has introduced the Education and Capacity Building Initiatives to support projects of interest to the ISPRS community.

On their website there is a page with a list of Educational Sites, Master Courses and Online Courses: http://www.isprs.org/education/education.aspx (19 resources indicated).

Moreover, the Executive Committee of The ISPRS Foundation (TIF) announced a further offer of 16 Brilliant Remote Sensing Labs (https://remote-sensing-portal.com/courses/).

See ANNEX VIII for details.

6.2.4. GISIG

GISIG (EO4GEO Coordinator) offers a dynamic Training Platform with several Training Packages, developed by and with many academic, public and private sector partners within different projects, each of them designed to make available existing knowledge and to transfer developed skills to users' target groups.

Each package can be reached from the following links:

- LINKVIT Training Framework
- eENVplus Training Framework
- LIFE+IMAGINE Training Framework
- GeoSmartCity Training Framework

It should be noted that those packages offer training on GI and not on EO/RS in the strict sense. However, some of the materials might prove usable for some of the EO4GEO scenario's and training actions that will be organised around them.

A Metadata template is used to describe all the Training Packages (see Annex IX for details), which can be useful in the development of new training materials within EO4GEO (WP4 Designing GI and EO curricula in support of Copernicus).

6.2.5. GI-N2K

The project GI-N2K (completed in 2016) analysed the GI market demands with regard to the knowledge and skills, and compared them with the training offer in the GI S&T sector.

The project conducted two surveys aimed at evaluating the appropriateness of the original Geographic Information Science and Technology Body of Knowledge (DiBiase 2006) in terms of describing both the workforce demand and offered teaching (supply).

Survey target group were professionals and institutions actively working in the GIS&T domain in Europe. The “supply” survey was successfully completed by 234 organizations involved in GI teaching in Europe. Responses came from 28 different countries.

The survey collected and analysed educational offers by programmes and curricula in the GI domain. 570 courses on GIS&T in Europe were identified, of which 427 were currently on offer at the time of survey results analysis (end of 2014).

Most of the identified courses had a study load between 0 and 11 ECTS, i.e. a duration of 4 days to about 7 weeks. With regard to the teaching level, most of the existing 5 ECTS courses, i.e. courses with a workload of 140 hours, were given on the levels of EQF5_6 and EQF7.

The results of this survey and the complete list of courses identified is publicly available here: http://www.gi-n2k.eu/?wpdmdl=456

6.2.6. HatariLabs

HatariLabs (https://www.hatarilabs.com/ih-en) is an initiative focused on bringing the newest information related to the use of different software. They have a variety of research areas, from water resources applications to Python programming.

HatariLabs produced a group of videos called "Working with Sentinel 2 Imagery on QGIS" showing the complete procedure to download, represent and process Sentinel 2 images in QGIS.

See Annex X for the complete list.

6.2.7. EO College

Starting in 2011 with the compilation and provision of educational material for the field of Radar remote sensing, the SAR-EDU initiative, developed by the Friedrich-Schiller University in Jena,

Germany, can be seen as a classical example for an OER (Open Educational Resources) movement initiative.

EO College is the logic evolution of the Remote Sensing Education Initiative SAR-EDU. EO College is an attempt to establish an EO education hub, in order to give learners a place they can go to and find courses and resources, as well as to get informed about other EO-related topics and learning opportunities. EO College is completely free to use and is designed to be a collaborative platform for as many creators of educational EO and EO-related content as possible.

EO College provides learning materials (mostly presentations) and online courses (MOOCs) on EO-related topics. By now, the focus is on radar remote sensing, but an extension to other EO fields is planned.

Among the others, EO College is hosting the MOOC: *'Echoes in Space' - Introduction to Radar remote sensing*, which has been followed by 5.700 users in first live run.

EO College is available at www.eo-college.org and is of free access after registration.

6.2.8. GEO University

The Slovenian online learning platform GEO University offers a wealth of free or low cost training courses. Also, with a yearly subscription users can access the entire content available.

Training on Earth Observation, multispectral applications using Sentinel data, image analysis and processing, hyperspectral remote sensing, applications such as oil spill mapping, are some of the topics covered.

The entire list of courses is available at the following link:
https://www.geo.university/collections?category=courses

6.3. Summer Schools

An Important offer on training in the geospatial sector is also constituted by the organization of Summer Schools, in particular as regards EO.

Even if the Summer Schools are training initiatives designed for the specific edition of an event, they can be considered best practice examples of organized training initiatives whose structure and related training material could be considered for new initiatives.

Meaningful examples in this connection are:

- **Sentinel for Applications in Agriculture** (http://earsel.org/summer-school).

The Italian Association of Remote Sensing (AIT), jointly with the Institute for Electromagnetic Sensing of the Environment (IREA) of the National Research Council of Italy (CNR), in cooperation with European Space Agency (ESA) and European Association of Remote Sensing Laboratories (EARSeL) organizes a Remote Sensing Summer School focused on Agricultural applications of SENTINEL data.

This Summer School is open to early career scientists or employers, such as Ph.D. students, young postdoctoral scientists, technicians specialized in Earth Science disciplines, wishing to expand and improve their knowledge and skills on EO in Agriculture.

The School includes lectures covering overviews of recent ESA Sentinel missions, Earth System Modelling, Data Assimilation, as well as hands-on data processing practical exercises.

- **UNIGIS EO4Alps Summer School** (https://obia.zgis.at/eo4alps/)

  "Earth observation and geospatial information: supporting a sustainable use of alpine ecosystems and water resources"

  The EO4Alps Summer School 2018 has been jointly organized by University of Salzburg, Department of Geoinformatics (Z_GIS, www.zgis.at) and the Group on Earth Observations (GEO, www.earthobservations.org) in Salzburg, Austria, June 24 – July 6, 2018.

  Alpine areas show high spatial variability due to complex terrains, steep vertical gradients in climate elements, and inhomogeneity induced by transitions between vegetation zones and to the cryosphere. The resulting patterns of climate and climate change are often highly complex and very demanding in terms of monitoring, modelling, and analysis. The Summer School explores the potential of satellite derived information (such as from the European Earth Observation Programme Copernicus) for monitoring and analysing Alpine ecosystems and water resources.

- **Climate-KIC InnoSpace Journey summer school** (https://journey.climate-kic.org/)

  The "InnoSpace" Journey summer school (June 24 to July 28, 2018) provided climate change knowledge combined with entrepreneurship skills by using Copernicus Earth Observation and Geographic Information Science (GIS) data, allowing the participants to get the skills and tools to translate ideas into end-user applications together with people from a wide range of backgrounds – a business model which will help our environment.

  The Journey brings together students and professionals from all over the world.

- **9th EO Summer School** (http://eoscience4society.esa.int/EOSS18/)

  European Space Agency (ESA) organises a series of summer schools on monitoring the Earth System to promote the exploitation of Earth Observation (EO) data across disciplines, with a specific focus on their assimilation into Earth System models.

The two-week course, held in ESA/ESRIN (near Rome, Italy) from July 30 to August 10, 2018, aims at providing students with an integrated end-to-end perspective going from measurement techniques to end-user applications. Courses include lectures covering issues related to Remote Sensing, Earth System Modelling and Data Assimilation, as well as hands-on computing exercises on the processing of EO data. Keynote lectures on global change issues are also given to discuss the current state of the science of global change and its relationship to society, in order to help students appreciate how their specific field fits into a broader scientific and political context.

The school is open to Early Career Scientists (i.e. Ph.D. students, young post-doctoral scientists) who are specialised in a variety of Earth Science disciplines and wish to expand and improve their knowledge and skills.

6.4. Training packages offered by GI vendor companies

Survey results (see chapter 3) show that also many technology vendors stimulated the geospatial market by supporting GI knowledge and (their) tools.

The training offer is wide and very often parcelled on the specific software products offered by the vendors. Some vendors offer well-structured training packages not only for their products in order to support their customers, but also as comprehensive GI Educational programmes.

We provide here examples of a selection of training offers by two key players of the GI Industry - ESRI and HEXAGON.

As far as ESRI is concerned, it is worth mentioning the direct contact established with the Global Education Manager at ESRI, who collaborated with the project in providing information on company training offer.

Obviously, in the market there are other companies linked to the production of software products for the RS/EO sector. Each of these companies also offers training resources related to their products. Some examples of companies are the following: SARMAP[11], CS[12], TERRASIGNA[13] and PLANETEK[14].

6.4.1. ESRI

Different resources (indicated in the survey) are available, with EO-related interesting material:

[11] http://www.sarmap.ch/wp/index.php/capacity-building-2/
[12] https://uk.c-s.fr/GeoInformation-Image-Processing_a529.html
[13] http://www.terrasigna.com/eo-solutions.html
[14] https://www.planetek.it/soluzioni/applicazioni/space_software

- a Book, “Imagery and GIS: Best Practices for Extracting Information from Imagery” (TOC and Chapter 1 available on the Esri Press page: https://esripress.esri.com/display/index.cfm)
- an eBook, “The ArcGIS Imagery Book” to explore how imagery and remote sensing power modern GIS (freely available online https://learn.arcgis.com/en/arcgis-imagery-book/ or as pdf http://downloads.esri.com/LearnArcGIS/pdf/The-ArcGIS-Imagery-Book.pdf)
- some free online courses (part of the training catalogue):
  - “Earth Imagery at Work” (https://www.esri.com/training/catalog/57aba196cbc441087e0d2395/earth-imagery-at-work/)
  - “Get Started with Imagery” (https://www.esri.com/training/catalog/57660ca7bb54adb30c945424/get-started-with-imagery/)

Moreover, the ESRI catalogue includes many freely available e-learning resources and many more that are available to individuals and organizations having a current maintenance subscription for an ESRI Qualifying Product.

The Training catalogue houses hundreds of professionally curated resources created by ESRI education specialists and subject matter experts. Resources are available in a variety of e-Learning and instructor-led formats.

The Training catalogue (https://www.esri.com/training/catalog/search/), enriched with 586 entries (193 of them are free-access ones), is organised, for covering both GIS Capabilities and Products (supporting the ESRI offer)

The catalogue offers as well the option to select the modules on training material types:

- Instructor-Led Training (ESRI instructors specialize in delivering engaging class experiences that prepare students to immediately apply what they have learned.)
- E-Learning (Web Courses, Training Seminars, MOOCs, Videos, Tutorials, Story Maps)
- Teacher Resources (GeoInquiries, SpatiaLABS, Mapping Our World, Thinking Spatially Using GIS)
- Documents.

Another important resource is http://learn.arcgis.com/en/, presenting guided lessons based on real-world problems, that can improve one’s knowledge of ESRI software and enable to learn making maps with the ArcGIS applications (ArcGIS Online, ArcGIS Pro and ArcMap).

Also, many of the ESRI regional and national offices offer training courses as part of the University Site License annual renewal.

6.4.2. HEXAGON Geospatial

Hexagon is a global technology group that markets its products and services under more than 35 different brands worldwide. Among these brands, Hexagon offers geospatial solutions such as

GEOMEDIA, Intergraph popular desktop-based GIS, and ERDAS, a system supplying advanced tools for Remote Sensing and Photogrammetry needs.

The training catalogue of the HEXAGON Geospatial products offer an extensive knowledge base, similar to the one featured by ESRI. Obviously, in both cases it is understood that there has been a big effort and dedicated resources have been used in order to create quality training assets as a strategy to provide better support to its customers.

The Hexagon Geospatial education program (https://www.hexagongeospatial.com/industries/education) is the main gateway to a big number of free and on-demand training resources. These resources are classified according to different education programs, basically referring to the type of software (desktop or server-based). Training is not only dedicated to professionals, but also designed for university educators, and among the training material offered we can find high-quality, step-by-step tutorials, webcasts, videos, presentations and example data.

One of these resources, the Smart M.Apps for EDU Education Program, invites students, professors and research scientists to build cloud-based applications.

As far as software products specially related to earth observation are concerned, a dedicated training portal gives access to a big number of resources such as eTraining (mainly video-tutorials), written tutorials, product documentation and user support. The ERDAS IMAGINE, training catalogue (http://community.hexagongeospatial.com/t5/ERDAS-IMAGINE/tkb-p/eTErdasImagine/page/3) features online courses of different levels, from introductory materials to the most advanced technical training. Users can find both good quality self-paced video training on the use of the tool and very comprehensive video materials on the principles of Remote Sensing.

7. Conclusions

The community of the space/geospatial sector is a wide community dealing with Geographical Information and related technologies, Earth Observation and Remote Sensing, etc. As a consequence, training in the space/geospatial field is highly flexible, offering different types of training resources and initiatives from different perspectives, targeting the academic context, companies, public organisations, professional and operators in the field.

The studies that have been taken into consideration from the perspective of supply of space/geospatial training (Chapter 3) give a common consideration that there is a strong need of supporting and increasing training offer, especially in areas with high demanding technical capabilities.

Then, the scope of the survey as regards the supply of EO and GI education and training has been the identification of a large number of training resources currently available.

To that purpose two different complementary approaches has been adopted.

The first approach is based on the organisation and the promotion of an online survey, with the aim of discovering, characterizing and cataloguing “bottom-up” training supply. In any case we were aware that this survey would not result in a comprehensive collection of the whole training supply in the field. Actually, the main limitation of its approach is depending on “voluntary” feedback and implying very heterogeneous answers from different training providers of different countries.

The main result of the survey has been the identification of **231** “training resources” among more than **120** organisations from **26** Countries.

The survey and the subsequent analysis (see chapters 4 and 5) allowed to get a picture of training wide offer, in particular in relation to the Copernicus user uptake, also in different fields of applications.

The second one dealt with a systematic web investigation concerning organized and structured training resources available on-line and provided by well-known organisations in the space/geospatial sector. Such an investigation allowed to discover a large number of training resources with an increasing level of detail as the analysis of the training resources available (often throughout training portals) lead to the discovery of a great number of training packages. In this case, again, the aim was not being exhaustive. Nevertheless, this work allowed to discover and catalogue (see Chapter 6 and related annexes) more than 1,000 valuable training resources.

The results of the in-deep analysis of the topics addressed in the training offer described through the online our questionnaire are shown in Chapter 5.

Questionnaire closed questions, parameterized through graphics, allowed a quantitative analysis of the answers, thus giving an overview of the puzzle of the bottom-up training offer (see chapter 5.1).

On the other hand, questionnaire open questions allowed a content and qualitative analysis (see section 5.2), even though there is an obvious variety of possible interpretations. Based on such an analysis we can highlight the following main findings:

- While bachelor's degree courses on Geomatics (EQF5/6) provide very basic knowledge on remote sensing, “advanced” theoretical and practical knowledge of Remote Sensing are mainly part of Master Programs (EQF7). Vocational training resources (EQF4) described in the questionnaires are a small part of survey responses; they are often part of “internal training” (especially in agencies and public administration bodies) and aimed at integrating EO services in existing activities and workflows. These courses are frequently offered by private companies (mostly SME’s) dedicated to consultancy and based on the use of specific (often commercial) software packages.

- While most of the basic courses are in the academic context and aimed at university students, the majority of the “advanced” and “domain specific” ones are devoted to professionals, PHD students and experts, since they are aimed at solving specific problems in a work or study field. In this case most of the lectures are followed by a lab and practical training has a greater relevance.

- Even if different remote sensing methods are a common matter of study in GIS/Geomatics Master programs, we can conclude that, when it comes to advanced and highly specialised RS training, radar remote sensing (especially SAR) is much more popular than optical remote sensing.

- In general, training materials devoted to learn how to develop RS applications are mostly out of the academic context and more present in highly specialised courses (such as eLearning courses and summer schools), courses promoted by agencies or public administration bodies and in private vocational training.

- The majority of Remote Sensing training described in our responses is related to the general environmental domain (environment monitoring and analysis). In any case we also received responses regarding training resources dealing with RS applied to very specific domains demonstrating the great wide-ranging capability and added value of this discipline and the enormous degree of specialization that can be achieved.

- Another finding is that we perceive that basic RS training pays insufficient attention to the latest technologies and new policies, while advanced and dedicated training is much more sensitive to the latest developments in the sector.

- Specialised and advanced training resources (not much linked to university master programs) pay more attention to the study of particular case studies, practical and hands-on work, and also to the latest developments on the field. This includes more attention to the Copernicus program development. Therefore, based on the answers received, we can

confirm, that the penetration degree of the Copernicus program in “generic” GIS/Geomatics master programs is still scarce and that the use of its data and platforms do not have much prominence yet.

- In the description of the Remote Sensing modules within GIS/Geomatics master programs we can see that the study of the sources of remote sensing & GIS information has little importance. Just in a few cases this aspect seems to be relevant in course contents. In more advanced and specialised training, learning about data sources and how to obtain free and proprietary data is mentioned a few times as a learning outcome. In any case, we can state that the process of searching and downloading data from open repositories does not have, in general, the relevance that we think it should have.

- We can conclude that is vital for a true Copernicus user and market uptake strategy that the existing training programs (especially University Master’s programs) pay more attention to Copernicus awareness and to the access/use of Copernicus data in practical training.

The effort made in chapter 6 “Training supply investigation” is noteworthy. We believed from the very beginning that an analysis of the educational offer made through a public questionnaire would not allow to obtain a complete list of available training resources. For this purpose, to complement the survey and to guarantee the most complete and efficient assessment of the subject, we performed an accurate web search to list and characterise as many courses or training materials as possible.

In this sense, it is necessary to underline the results of the investigation about the availability of training material carried out in various directions, towards:

- **Copernicus and related organisations:**
  Training coming from these organisations is strongly focused on the awareness, use and benefits of the Copernicus program. These materials are specifically targeted to end users at different knowledge levels, from newcomers to experts. As expected, these organisations offer specific training to foster user uptake in connection with the use of Copernicus Data and Copernicus Services, also by means of exercises and case studies designed to be used with specific software and for specific applications.

- **European and International Networks:**
  Around the Copernicus program there is a rich ecosystem of organizations and networks which plays an important role in the promotion and use of EO data and services. Some of them, such as NEREUS and EARSEL, are especially active in making available training materials, disseminating courses and organizing thematic training events.

- **Summer Schools:**
  Summer schools on remote Sensing and Earth Observation are mainly hosted by Universities and very often jointly organized with the collaboration of key players in the

sector, such as research institutes and Space Agencies. Summer schools are mainly focused on practical training and are related to very specific scientific fields.

- **Training packages offered by companies:**
  These training resources have in common a material high quality and a format large variety. They are often part of user support platforms including comprehensive tutorials, demonstrations and sample data. Software companies put a lot of efforts on these resources as a key factor on their business strategy and to attract customers. Even if we can find a good number of such materials free online, these companies mainly put their focus on paid and customized training.

The results of this task T1.1 are especially relevant for the development of Task 1.4. This task will further analyse the supply of training resources, with a focus on assessing the gaps and mismatches between current training offer and the demand of skills and occupational profiles (Task 1.2 results). In this sense, in addition to current document, a structured database in different formats including all on-line survey answers is available to the project partners for further analysis.

The results shown in this document will also have an important impact on the work that will be carried out in WP4 (Designing GI and EO curricula in support of Copernicus). WP4 aims at designing a series of VET curricula and revising existing academic courses. For this purpose, one of the main tasks of WP4 will be the analysis of the education and training offer described in Task 1.1, with a special emphasis on the resources that have been identified as reusable.

ANNEX I – The online survey questionnaire

Fields marked with * are mandatory.

Section 1: YOUR ORGANISATION

*** Name of the organisation**

Organisation website

*** Country of the organisation**
Please specify "International" or European" in case of Intergovernmental organisation

- International organisation
- European organisation
- Afghanistan
- …
- …

*** How can your organization be best characterized?**

- Education&Research (Education -all levels-, Academy Research, …)
- Industry/Company (Large Enterprise)
- Small Medium Enterprise (SME)
- Administration/Public Body (at all levels)
- VET Providers
- Other (see below)

Other type of organisation
In case your organization does not respond to any of the types listed above, please specify it in this box.

*** Main Business sector**

Section 2: EO/GI EDUCATION AND TRAINING OFFER

The training/educational offer in your organization can be a single course (or even a single module or a single lecture), or a number of courses, organised in a programme.
Please specify the most relevant courses/modules/lectures that best reflect the focus, or the core, of Spatial /Geospatial teaching in your organization.

Please answer to the following block of questions for each of your course/module/lecture.

Course/Module/Lecture #1

***Title (English name)**

*** Type of training**

A "**course**" could be a university course or a training course not related to an academic path, composed by one or more training modules. A "**training module**" is intended as a set of learning material/lectures with specific objectives and learning outcomes, which is self-consistent and can be followed independently with others or combined with other modules in a course.

- Course
- Training Module
- Training Package (a package of training courses/modules)
- Lecture
- Summer school
- Webinar
- Book or e-book

Other type of training

In case your training offer does not respond to any of the types listed above, please specify it in this box.

In case your training is part of a larger teaching programme, please mention the name and a short description of the programme

i.e. a University program/curriculum, or an organized training package, which consists of a set of courses/modules.
In the Academic context , for example, it could leads to a university degree (e.g. a Master of Science or MSc).

*** Please provide a short description of the content**

*** Please indicate the learning outcomes**

Learning outcomes are statements of what a learner knows, understands and is able (Knowledge Skills Competences) to do on completion of a learning process.
Typical statements could be "upon completion of this course the student will be able to identify and search databases to gather reliable information about …" or " …the student will be able to summarize current theories on…" (avoid vague and not measurable verbs like "become familiar with, understand, know about,…"

Which is the application field covered by the content?

Multiple choice possible. Find more information on the thematic used below **HERE taxonomy**

Land Services

- Agriculture
- Inland Water
- Land Ecosystems
- Topography
- Forests
- Snow & Ice
- Land use
- Geology

Built Environment & Human Factors

- Urban Areas
- Infrastructure

Ocean & Marine

- Marine ecosystem
- Metocean
- Ships
- Coastal
- Fisheries
- Sea-ice and icebergs

Atmosphere & Climate

- Atmosphere
- Climate
- Meteorology

Disasters & Geohazards

- Floods
- Earthquakes
- Volcanos
- Fires
- Landslides

Security

- Monitor sensitive risk areas
- Monitor land border incursions
- Monitor economic activity
- Forecasting epidemics and diseases
- Map disaster areas
- Monitor movement of people
- Monitor transport routes

Other application field (please specify)

*** Does it use any of the following Copernicus Services (and related data)?**

Find **HERE** more information regarding the **Copernicus Services**

- Atmosphere (CAMS)
- Marine Environment (CMEMS)
- Land (CLMS)
- Climate Change (C3S)
- Emergency Management (EMS)
- Security
- None

*** Language of the learning material**

*** Duration (total number of hours)**

*** Registration period**

- Currently available
- Available in the next two years

*** Is the learning material accessible? If accessible, please specify how, the copyrights and URL (if online)**

*** Is the learning material open for possible re-use in other educational and training contexts?**

Possibility to re-use the learning material in other contexts, i.e. in other universities, in other training courses, in professional settings
outside academic courses (training/updating professionals) or even in courses related to other connected disciplines. It is meant here a concept of reuse in a wide sense , either under open license or upon payment of fees (please, in case specify

Size in ECTS credits (if applicable)
ECTS: European Credit Transfer and Accumulation System. On average 1 credit equals 28 hours of study load, 60 credits = 1 year.

European Qualification Framework (EQF) Level
Find **HERE** more information regarding the **European Qualifications Framework** (EQF)

- EQF4 (vocational)
- EQF5/6 (bachelor)
- EQF7 (master)
- EQF8 (phd)

*** Please add another Course/Module/Lecture**

- Yes, I want to add add another Course/Module/Lecture block
- No, go to the final section of the questionnaire

Section 3: INTERESTED IN EO4GEO?

*** Would you be interested in sharing your learning material within the EO4GEO and Copernicus Networks?**

- Yes
- No

Any comments or suggestions for other stakeholders to which we could send this questionnaire?

*** Do you want to be informed about the follow up of this survey and about EO4GEO in general?**

- Yes, keep me informed (we will ask your contact information)
- No, thanks

Section 4: CONTACT

If you want to be updated on the progress of EO4GEO and further collaborate with us please indicate:

*** Name /Surname**

Position in the organisation

*** Email address**

I hereby authorize the processing of my personal data in conformity with the REGULATION (EU) 2016 /679 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

EO4GEO Survey Privacy Policy

☐ ***** I accept your Terms

ANNEX II – List of the Courses (from the online survey)

No.	Organisation	Country	Title	Type of training	Accessibility
1	Department of Geoinformatics - Z_GIS, University of Salzburg	Austria	Advanced Remote Sensing	Course	The course is offered for students of the master programme Applied Geoinformatics of the University of Salzburg.
2	University of Salzburg, Department of Geoinformatics Z_GIS	Austria	Object-based Image Analysis (OBIA)	Course; Lecture	The course is fully online, including self-paced learning elements, assignments, exercises, and an exam. It is available on the learning platform and accessible for registered students from all over the world.
3	University of Salzburg, Department of Geoinformatics Z_GIS	Austria	EO4Alps - Earth observation and geospatial information: supporting a sustainable use of alpine ecosystems and water resources	Summer school	Only accessible to participants.
4	WU Vienna University of Economics and Business	Austria	GIS-T GIS for Transport and Logistics, Location Analytics and Geospatial Data, SCM IT-Seminar	Course; Training Package; Lecture	Accessible to registered students via lear@wu
5	WU Vienna University of Economics and Business	Austria	IT Competence Field "Spatial Business Intelligence"	Course; Training Package; Lecture	Only for registered students

6	Analyses Géospatiales (ANAGEO), Institut de Gestion de l'Environnement du Territoire (IGEAT), Université Libre de Bruxelles	Belgium	remote sensing	Course	The learning material is accessible for the registered student on an online web platform based on Moodle.
7	Analyses Géospatiales (ANAGEO), Institut de Gestion de l'Environnement du Territoire (IGEAT), Université Libre de Bruxelles	Belgium	Geographical Information systems and projections	Course	The learning materials are accessible for registered students on an online web platform based on Moodle.
8	Analyses Géospatiales (ANAGEO), Institut de Gestion de l'Environnement du Territoire (IGEAT), Université Libre de Bruxelles	Belgium	eLearning course to make thematic maps with QGIS	Training Module	Yes, it is available through internet (http://cafesig.ulb.ac.be/) in the section "Matériel didactique sur les SIG libres" / "Introduction sur la géomatique et eLearning" / "Parcours eLearning"
9	Analyses Géospatiales (ANAGEO), Institut de Gestion de l'Environnement du Territoire (IGEAT), Université Libre de Bruxelles	Belgium	6 months training in GIS using FOSS	Training Package	Yes (http://cafesig.ulb.ac.be/)
10	Centre Spatial de Liège	Belgium	Technologies for Earth Observation from Micro-Satellites	Training Package	Accessible to registered participants
11	GIM n.v.	Belgium	1). ArcMap basic level; 2). ArcGIS automatization; 3). Feature Manipulation Engine (FME) desktop;4). FME server;	Training Module; Training Package	No

			5). QGIS basics; 6). WEB OGC Services' introduction; 7). Start to GIS; 8). Introduction to PostGIS and GeoServer; 9). GeoServer Advanced; 10). Compliance of data according to INSPIRE specifications; 11). Inspire directive - how to pragmatically start; 12). Introduction to GML; 13). GeoNetwork;		
12	Hogeschool Gent	Belgium	Postgraduate GEO-ICT	Training Package; Lecture	Through the digital learning environment maintained by Hogeschool Gent
13	Informatie Vlaanderen	Belgium	many different detailed product trainings	Course; Lecture	depending on the topic
14	KU Leuven - Faculty of BioScience Engineering	Belgium	Remote Sensing of Vegetative Systems	Course	TBD
15	KU Leuven - Faculty of BioScience Engineering	Belgium	Earth Observation	Course	TBD
16	KU Leuven, Campus Sint Lucas Gent	Belgium	Quantitative spatial analysis	Course	Only available for registered students of KULeuven Master in Spatial Planning and Urbanism on the learning platform of the university (Toledo)
17	KULeuven	Belgium	Kwantitaieve ruimtelijke analyse en GIS	Course	Available in Toledo (blackboard) for registered students in the programme
18	SIGGIS	Belgium	We offer all instructor-led courses from the ESRI curriculum (https://www.esri.com/training/assets/downloads/esri-course-catalog.pdf) as well as all instructor-led courses from Latitude Geographics:	Course	No

			https://www.geocortex.com/support-services/training/		
19	University of Leuven (KU Leuven)	Belgium	'GIS and Spatial Modelling'	Training Package	General information is available via https://onderwijsaanbod.kuleuven.be/2017/opleidingen/e/SC_50916350.htm# The learning materials are available via a Blackboard platform but to registered users only
20	University of Leuven (KU Leuven)	Belgium	'Geo-information'	Training Package	General information is available via https://onderwijsaanbod.kuleuven.be/2017/opleidingen/e/CQ_52701663.htm#activetab=diploma_omschrijving The learning materials are available via a Blackboard platform but to registered users only In course I0U99A 'Spatial Data Infrastructures' used is made of open learning materials: www.linkvit.eu
21	UNIVERSIDAD DE VALPARAÍSO	Chile	the use of data to reduce disaster risk	Course; Summer school	A la base de Copernicus, se obtiene algunos de ellos, otros, la mayoría son locales, de instituciones públicas, o de la autoría del profesor suscrito.
22	Faculty of Geodesy	Croatia	Bachelor study of Geodesy and Geoinformatics	Course	http://e-ucenje.geof.unizg.hr/ (each course is usually accessible separately)
23	Faculty of Geodesy University of Zagreb	Croatia	Bachelor study courses: Photogrammetry / Remote Sensing / Satellite positioning	Course	In principle yes, however it depends on specific professor.

			Master study courses: Space geodesy / Application of remote sensing / Advanced remote sensing / Programming engineering in geomatics		
24	Faculty of Geodesy University of Zagreb	Croatia	Remote Sensing in Landscape Architecture	Course	books: Oštir, K., Mulahusić, A.: Daljinska istraživanja, Ljubljana i Sarajevo 2014 Davis, B.E.: GIS a Visual Approach, 2nd edition, Onword press, 2001 Lo, C.P.: Applied remote sensing. Longman Scientific & Technical, New York 1986 PPT slides
25	Faculty of Geodesy University of Zagreb	Croatia	Integrated systems in geomatics	Course	Yes, for students attending the course via Faculty Moodle platform.
26	Faculty of Geodesy, University of Zagreb	Croatia	Spatial databases	Course	online, but in e-learning application
27	Faculty of Geodesy, University of Zagreb	Croatia	Remote Sensing	Lecture	The learning material is accessible by internet (university net).
28	Faculty of Geodesy, University of Zagreb	Croatia	Advanced Remote Sensing	Lecture	The learning material is accessible by internet (university net).
29	GDi	Croatia	Image Analysis with ArcGIS	Course	The attendees receive a hardcopy workbook and a DVD with exercise data. Digital materials are copyright of Esri.
30	University of Osijek Faculty of Civil Engineering Osijek	Croatia	Geodesy	Course	No

31	University of Osijek Faculty of Civil Engineering Osijek	Croatia	GIS in Hydrotechnics	Course	No
32	University of Osijek Faculty of Civil Engineering Osijek	Croatia	GIS and Engineering Geodesy in Transport Infrastructure	Course	No
33	University of Split	Croatia	Introduction to GIS with practical applications	Summer school	via web page, for the participants only: https://split-summerschool.com/courses/introduction-to-gis-with-practical-applications/
34	University of split Croatia	Croatia	Remote Sensing	Course; Lecture; Book or e-book	Yes
35	University of Zagreb, Faculty of Geodesy	Croatia	Geoinformation Infrastructure	Course	No
36	Dept. of Geoinformatics, Palacky University Olomouc	Czech Republic	Geoinformatics and Geography - bachelor Geoinformatics - master Geoinformatics and Cartography - PhD	Course	Only for registered
37	GISAT	Czech Republic	Earth Observation for Sustainable Urban Development - Selected Use Cases	Webinar	Coming soon...
38	World from Space,s.r.o.	Czech Republic	How to use Copernicus in municipalities	Course; Lecture	No
39	GEO University	Estonia	Multispectral Earth Observation Applications using ESA Sentinel Application Platform	Course	https://www.geo.university/courses/multispectral-earth-observation-applications-using-esa-sentinel-application-platform

40	GEO University	Estonia	ESA Sentinel Application Platform Tutorial	Course	https://www.geo.university/courses/tutorial-to-esa-snap-software
41	GEO University	Estonia	Glacier Mapping using Earth Observation Satellites	Course	https://www.geo.university/courses/glacier-mapping-using-earth-observation-satellites
42	GEO University	Estonia	Overview of LiDAR; system variations, data interpretation & applications	Course	https://www.geo.university/courses/overview-of-lidar-system-variations-data-interpretation-applications
43	AgroParisTech - Paris Institute of technology for life, food and environmental sciences (Institut des Sciences et Industries du Vivant et de l'Environnement)	France	MsC in Geomatics	Course	The learning material is only available to registered students
44	AgroParisTech - Paris Institute of technology for life, food and environmental sciences (Institut des Sciences et Industries du Vivant et de l'Environnement)	France	Master of Advanced Studies SILAT	Course	Some of them, with prior agreement of the authors
45	AgroParisTech - Paris Institute of technology for life, food and environmental sciences (Institut des Sciences et Industries du Vivant et de l'Environnement)	France	Initiation to remote sensing (E-learning)	Training Package	Yes, some of them : https://lms.agreenium.fr/course/view.php?id=36

46	Cerema	France	using space data for risks and spatial planning.	Course; Training Module	Restricted
47	École Nationale des Sciences Géographiques	France	Captor and acquisitions / Image Processing basic and advanced (First Year)	Training Package; Webinar	Work in progress
48	École Nationale des Sciences Géographiques	France	Introduction to remote sensing and OTB tools	Summer school	No
49	École Nationale des Sciences Géographiques	France	Introduction to remote sensing	Training Package	No
50	École Nationale des Sciences Géographiques	France	introduction to radar remote sensing	Training Package	most of videos are available on the following URL : http://cours-fad-public.ensg.eu/
51	Faculty of Geography and Planning / Strasbourg University of Strasbourg (Faculté de géographie et d'aménagement / Université de Strasbourg)	France	Earth Observation and Geomatics Course	Course	The learning material is only available to registered students, through the Moodle exchange platform
52	GIS BreTel (Brittany Remote Sensing Group)	France	Summer School: Ocean Remote Sensing Synergy (GIS BreTel, IMT Atlantique)	Lecture; Summer school	No
53	GIS BreTel (Brittany Remote Sensing Group)	France	Coastal geomatics - GIS remote sensing (University of Western Brittany, University of Southern Brittany)	Course	No
54	GIS BreTel (Brittany Remote Sensing Group)	France	Remote sensing applied to land management and environment	Training Module	No
55	GIS BreTel (Brittany	France	Master in Electronics, Electrical Energy,	Course	No

	Remote Sensing Group)		Automatics (Rennes 1 University) - Embedded systems Course (SE) - Signal, image, systems, automatic Course (SISEA), cohability with IMT Atlantic and Central Supelec - Communication Systems Course (SC)		
56	GIS BreTel (Brittany Remote Sensing Group)	France	Digital Campus Environnement, Land planning (ENVAM) Remote sensing, introduction	Training Package	https://www.envam.org/formations/teledetection-une-introduction
57	GIS BreTel (Brittany Remote Sensing Group)	France	Digital Campus Environnement, Land planning (ENVAM) Image processing - Remote Sensing	Training Package	https://www.envam.org/formations/traitement-dimages-appliquees-la-teledetection
58	IDGEO	France	GEOMATICIAN	Training Package	Not yet. The pedagogical material (practicals) will be built in priority from Copernicus data sets / services...
59	Rennes 2 University	France	Master TELENVI : Remote sensing and the environment (Rennes 2 University)	Course	No
60	Rennes 2 University	France	Satellite images of the territories (Rennes 2 University)	Training Module	No
61	SERTIT	France	Introduction to operational emergency mapping	Training Package	No
62	TOPOSAT	France	GPS for topography	Training Module	The learning material is only available to trainees

63	VisioTerra	France	Getting / processing / sharing / exporting Sentinel data, Copernicus products and many other data	Course; Training Module; Training Package; Lecture	Training material of Serge RIAZANOFF is freely available at http://www-igm.univ-mlv.fr/~riazano/ VisioTerra edits regularly newsletters giving access to training material like www.visioterra.fr/telechargement/P185_FONDATION_TOTAL_PACE/VT-P185-SLD-002-F-01-00_Training_NARA_Colombo_Sri_Lanka_02-06_October_2017.pdf. VisioTerra believes that the techniques evolve so fast that it is illusory to maintain copyrights on a material which must permanently be adapted to the new requirements.
64	Albert-Ludwigs University Chair for remote sensing and landscape information systems	Germany	Geomatic 1	Lecture	PowerPoint slides + book references
65	Albert-Ludwigs University Chair for remote sensing and landscape information systems	Germany	Geomatic 2	Lecture	PowerPoint slides + book references + ESRI online training
66	BHO Legal	Germany	We have already conducted a number of lectures (Leiden University LLM on Air and Space Law), conferences (with BavAIRia e.V. and DLR), conference sessions (e.g. at Geospatial World	Course; Training Module; Training Package; Lecture;	Learning material would be made available to all training participants

			Forum), conference presentations and in-house trainings on legal and regulatory issues for the Geospatial and/or Remote Sensing industry, including aspects such as international legal framework, European legal framework, licensing, procurement, data policies, data protection, cloud computing contracts, Service Level Agreements etc.	Summer school; Webinar	
67	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	SAR-EDU Summer School	Summer school	The materials are available online at: https://saredu.dlr.de/unit
68	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Remote Sensing I (available in English and German Language)	Training Module; Lecture	Only via intranet
69	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Cartography II (available in English and German Language)	Training Module; Lecture	Not yet
70	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Land surface parameters (available in English and German Language)	Training Module	Available via intranet
71	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for	Germany	Data exploitation in EO (available in English and German Language)	Course; Training Module	Via intranet

	Earth Observation				
72	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Digital Image Processing	Training Module	Yes, under: https://eo-college.org/resources/digital-image-processing/
73	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Classification of remote sensing data (Methods and Algorithms)	Lecture	Yes, under: https://eo-college.org/resources/classification/
74	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Change Detection (Introduction to Principles and Methods)	Lecture	Yes, under: https://eo-college.org/resources/change/
75	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Data Fusion of Optical & SAR Data (Basics, Concepts & Techniques)	Lecture	Yes, under: https://eo-college.org/resources/fusion/
76	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Urban Areas (An Introduction)	Lecture	The lecture is available at: https://eo-college.org/resources/urban_intro/
77	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Urban Footprints	Lecture	The lecture is available at: https://eo-college.org/resources/urban_footprints/
78	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for	Germany	Urban land cover / land cover change classification	Lecture	This lecture is available at: https://eo-college.org/resources/urban_lc/

	Earth Observation				
79	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Extraction of Urban Objects	Lecture	This lecture is available at: https://eo-college.org/resources/extraction_objects/
80	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Urban Digital Surface Model	Lecture	Available at: https://eo-college.org/resources/urban_dsm/
81	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Urban – Synergy of Optical and SAR	Lecture	Available at: https://eo-college.org/resources/urban_synergy/
82	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	InSAR Basics	Training Module	The materials are available at: https://eo-college.org/resources/insar_basics/
83	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	SAR Interferometry Error Sources	Lecture	Available at: https://eo-college.org/resources/insar_errors/
84	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Deformation Monitoring with SAR Interferometry	Lecture	Available at: https://eo-college.org/resources/anthrophsphere/
85	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for	Germany	Subsidence monitoring (NEST) Tutorial – SAR Interferometry	Training Module	Available at: https://eo-college.org/resources/insar_deformation/

	Earth Observation				
86	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Hydrosphere	Training Module	Yes, at: https://eo-college.org/resources/hydrosphere_introduction/ https://eo-college.org/resources/soil_moisture/ https://eo-college.org/resources/hydrosphere_applications/ https://eo-college.org/resources/hydrosphere_sensors_missions_data/
87	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Oceanography	Training Module	Available at: https://eo-college.org/resources/oceanography/ https://eo-college.org/resources/surface_wind/ https://eo-college.org/resources/surface_waves/ https://eo-college.org/resources/surface_currents/ https://eo-college.org/resources/oil_detection/
88	Friedrich-Schiller-Universität Jena, Institute of Geography, Department for Earth Observation	Germany	Cryosphere	Training Module	Available at: https://eo-college.org/resources/cryosphere_basics/ https://eo-college.org/resources/snow_cover/

					https://eo-college.org/resources/glaciers/ https://eo-college.org/resources/sea_ice/ https://eo-college.org/resources/permafrost/
89	Geomatics Research Group, Ruhr-University Bochum	Germany	Interactive STEM classes based on satellite and ISS earth observation	Training Module	http://www.fis.uni-bonn.de/en
90	Jacobs University	Germany	Introduction to Datacube Standards	Course; Training Package; Webinar	http://earthserver.eu/webinars, CC-BY
91	Julius-Maximilians-University Wuerzburg	Germany	Applications in Remote Sensing	Lecture	Material is accessible for registered students
92	Karlsruhe Institute of Technology Institute of Geography and Geoecology	Germany	Remote sensing-based environmental monitoring	Course	Not yet, but could be made accessible.
93	Rasdaman GmbH	Germany	Big Data(cubes): Concepts, Standards, Implementation	Course; Training Module; Training Package; Lecture	Yes, partially. See http://myogc.org/go/coveragesDWG
94	Research Group for Earth Observation, Department of Geography, Heidelberg University of Education	Germany	Geospektiv / Space2Place	Training Module; Training Package; Webinar	The learning material is for everyone free accessible and available. Since today courses are mostly in German (one is currently in English offered "Spae2Place"), but more courses will be translated in English in coming months.
95	Technische Universität Berlin	Germany	Remote Sensing of Environment	Course; Training Module;	The learning material is available via a university internal platform (not externally

	Geoinformation for Environmental Planning Lab			Lecture	applicable): https://isis.tu-berlin.de/
96	University Jena - EO College	Germany	EO College	Course; Training Module; Training Package	eo-college.org (free access after registration)
97	Demokritus University of Thrace	Greece	remote sensing	Course	No
98	Department of Geology University of Patras	Greece	Exploration and Mining Geology	Course; Lecture	Yes
99	EPSILON INT.	Greece	Forest Fire Management	Training Module	Will be accessible through the giCASES platform (http://www.gicases.eu/partners/www.epsilon.gr)
100	Epsilon International SA	Greece	GIS Basic Training	Training Package	We want to create such a course thus the training material is not available yet. If available it will be strictly available to the trainees.
101	HAROKOPIO UNIVERSITY/ DEP. OF GEOGRAPHY	Greece	GEOINFORMATICS which is a direction of our master course	Course; Training Module	Partially is accessible for some lecturers. Normally, we use e-class which is open for the students using their personal password
102	Laboratory of Atmospheric Physics, University of Patras	Greece	Radiative transfer in the atmosphere	Training Package	the learning material is accessible only to registered students
103	Laboratory of Atmospheric Physics, University of	Greece	Energy Meteorology	Training Package	the learning material is accessible only to registered students

	Patras				
104	Laboratory of Atmospheric Physics, University of Patras	Greece	Atmospheric Physics II	Course	The learning material is accessible only to registered students
105	Laboratory of Atmospheric Physics, University of Patras	Greece	Atmospheric Pollution	Course	The learning material is accessible only to registered students
106	National and Kapodistrian University of Athens	Greece	Satellite Meteorology	Training Module; Book or e-book	No
107	University of Patras - Department of Architecture	Greece	courses on Spatial Planning, Cartography and GIS (four courses)	Course; Training Module; Training Package	Via e-class of university of Patras
108	Óbuda University Alba Regia Technical Faculty	Hungary	Precision Farming	Course	The learning material is accessible for students attending the course. The code is required.
109	Szent István University	Hungary	Geoinformatics & Remote Sensing	Course	It is accessible for enrolled students only.
110	University of Debrecen	Hungary	Environmental modelling and Impact Assessment	Training Module	No
111	Esri Inc.	International organisation	Imagery and GIS: Best Practices for Extracting Information from Imagery	Lecture	TOC (http://esripress.esri.com/storage/esripress/images/341/imageryandgistoc.pdf) and Chapter 1 (http://esripress.esri.com/storage/esripress/images/341/imageryandgischapone.pdf) are freely available online
112	Esri Inc.	International organisation	The ArcGIS Imagery Book	Lecture	http://downloads.esri.com/LearnArcGIS/pdf/The-ArcGIS-Imagery-Book.pdf

					plus Instructional Guide: https://learn.arcgis.com/en/arcgis-imagery-book/instructional-guide or as printed book: http://esripress.esri.com/display/index.cfm?fuseaction=display&websiteID=308&moduleID=0
113	Esri Inc.	International organisation	Earth Imagery at Work	Course; Webinar	https://www.esri.com/training/catalog/57aba196cbc441087e0d2395/earth-imagery-at-work/
114	Esri Inc.	International organisation	Get Started with Imagery	Webinar	https://www.esri.com/training/catalog/57660ca7bb54adb30c945424/get-started-with-imagery/
115	University College Cork	Ireland	EO for fisheries and Aquaculture	Lecture	No, given to students only
116	University College Cork	Ireland	Introduction to Remote Sensing	Course	Only to registered students
117	University College Cork	Ireland	Environmental Remote Sensing	Course	Only to registered students
118	University College Cork	Ireland	Introduction to Geoinformatics	Course	Only to registered students
119	ARPA- Friuli Venezia Giulia	Italy	GIS Open Source/Geodatabase/Earth Observation	Course	Official QGis/Postgresql-Postgis learning material/Tutorials
120	ARPA Lombardia - Agenzia Regionale per la Protezione dell'Ambiente	Italy	Earth Observation technologies for Public Administration	Course	Not at this early stage (ok into perspective)
121	ASITA Federazione delle	Italy	Training course concerning Drones,	Training Module	Yes, in the website www.asita.it

	Associazioni Scientifiche per le Informazioni Territoriali e Ambientali		rules and applications		
122	Comune di Schio	Italy	Doct.	Training Module	No
123	Consiglio Nazionale delle Ricerche - Istituto di Metodologie per l'Analisi Ambientale Università della Basilicata - Dipartimento di Scienze	Italy	Remote Sensing for the Environment	Course	No
124	Epsilon Italia srl	Italy	GIS for professionals	Course	No
125	Epsilon Italia srl	Italy	INSPIRE data and metadata harmonisation in the energy saving domain	Training Module	It will be soon available in the giCASES training platform
126	ER srls	Italy	Convective and Volcanic Clouds detection, monitoring and modelling	Summer school	No
127	ER srls	Italy	Geoscience Communication School	Summer school	No
128	GISIG Geographical Information Systems International Group	Italy	Geospatial Knowledge Base (GKB) Training Platform	Training Package	To access the training material, users have to follow these simple steps: 1. Visit the JRC website 2. Access the GKB Training Package page https://inspire.ec.europa.eu/portfolio/training-library

					3. Enter the courses they are interested in 4. Subscribe to the training modules of their interest Training Modules are freely accessible upon registration and licensed under a CC BY-SA license
129	GISIG Geographical Information Systems International Group	Italy	GeoSmartCity Training Framework	Training Package	To access the training material, users have to follow these simple steps: 1. Visit the GeoSmartCity website 2. Access the Training page http://www.geosmartcity.eu/training/ 3. Enter the courses they are interested in 4. Subscribe to the training modules of their interest Training Modules are freely accessible upon registration and licensed under a CC BY-SA license
130	GISIG Geographical Information Systems International Group	Italy	eENVplus Training Framework	Training Package	To access the training material, users have to follow these simple steps: 1. Visit the eENVplus website

					2. Access the Training page http://www.eenvplus.eu/project/eenvplus-training/ 3. Enter the courses they are interested in 4. Subscribe to the training modules of their interest Training Modules are freely accessible upon registration and licensed under a CC BY-SA license
131	GISIG Geographical Information Systems International Group	Italy	LIFE+IMAGINE Training Package (Integrated Coastal Area Management Application Implementing GMES /Copernicus, INSPIRE and SEIS Data Policies)	Training Package	Yes. The material is accessible by the www.life-imagine.eu web site/Training. Subscription to each module is needed. Access is free of charge.
132	Institute for Applied Mathematics and Information Technologies National Research Council (CNR-IMATI)	Italy	The eENVplus Thesaurus Framework	Training Module	Yes, at http://www.gisig.eu/platform/course/view.php?id=88 The material is provided under Creative Commons Attribution Share-Alike License (http://creativecommons.org/licenses/by-sa/3.0/)
133	Italian Society of Remote Sensing	Italy	Sentinel for applications in agriculture	Summer school	https://www.springer.com/cn/book/9781402090134
134	National Research Council of Italy - Institute for the Electromagnetic Sensing of	Italy	Sentinel for Water Resources	Summer school	https://aitonline.org/2017/04/08/ait-summer-school-sentinel-for-water-

	the Environment				resources/
135	Physics Department of Bari	Italy	High Energy Astrophysics	Course	No
136	Planetek Italia	Italy	“Using SAR data for Defence applications”	Course	No, learning material is confidential
137	Politecnico di Bari	Italy	Telerilevamento (i.e. Remote Sensing) in Civil Engineering master degrees;	Course	Don't know
138	Politecnico di Milano	Italy	Master of Science in Geoinformatics Engineering	Training Package	It depends on individual professors
139	Politecnico di Milano	Italy	Positioning and Location based services	Course	Accessible to students, by Politecnico Beep pages (https://beep.metid.polimi.it/)
140	Sapienza Università di Roma	Italy	Remote Sensing systems	Course	http://elearning.psm.uniroma1.it/. Registration is needed
141	Serco Italia	Italy	Face to Face thematic data hands on training events to promote Sentinel data uptake.	Course	Note: duration in hours refer to one typical 2 days event... Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License. https://rus-training.eu/training https://www.youtube.com/channel/UCB01WjameYMvL7-XfI8vRIA https://rus-copernicus.eu/portal/the-rus-library/learn-by-yourself/ =>RUS Lectures
142	Serco Italia	Italy	Monthly thematic Webinars to promote	Webinar	The duration indicated above refers to the typical duration of 1 Webinar (1 hour)

			Sentinel data uptake		See description already provided for the Face to face events
143	Serco Italia	Italy	E-learning portal to promote Sentinel data uptake.	Lecture	Typical duration of one module (course) is 45 minutes. the course is freely accessible (only user registration requested). https://rus-training.eu/course
144	University of "Tor Vergata"	Italy	Remote Sensing and Cartography	Course	Accessible only for registered students
145	University of Basilicata	Italy	Remote Sensing of Environment	Course	Accessible for students attending the course on the Unibas e-learning platform
146	University of Basilicata, School of Engineering	Italy	Methods and Techniques for Earth Observations	Course	The material is accessible upon enrolment
147	University of Bologna - Department of Civil, Chemical, Environmental and Materials Engineering (DICAM)	Italy	Remote Sensing and GIS	Course	for the students only
148	University of Bologna - Department of Civil, Chemical, Environmental and Materials Engineering (DICAM)	Italy	Applied Geomatics	Course	for the students only
149	University of Bologna - Department of Civil, Chemical, Environmental and Materials Engineering (DICAM)	Italy	Geomatic Engineering for Cultural Heritage	Course	for the students only
150	University of bologna, Department of Physics and	Italy	Radiative transfer and remote sensing	Training Package	It is accessible to the students enrolled in the MSc course. It could be made

	Astronomy				available to other people in case it is requested.
151	University of Parma	Italy	Geographical Information Systems course within the second cycle degree in Sciences and Technologies for Environment and Resources (http://cdlm-star.unipr.it/)	Course	Only available to University of Parma students enrolled in my GIS course http://cdlm-star.unipr.it/degreecourse/details/149661
152	University of Rome "Tor Vergata"	Italy	Artificial Intelligence for Earth Observation	Course	Only for registered students
153	University of Torino - Earth Sciences Department	Italy	Geomatics and GIS Laboratory	Course	Only for Students by online campusnet platform
154	ENU by L.N.GUMILEV	Kazakhstan	GIS	Course	www.enu.kz
155	ENU by L.N.GUMILEV	Kazakhstan	GIS	Course	www.enu.kz
156	ENU by L.N.GUMILEV	Kazakhstan	GIS	Course	www.enu.kz
157	ENU by L.N.GUMILEV	Kazakhstan	GIS and RS	Course	www.enu.kz
158	Riga Technical University	Latvia	Basics of Geomatics	Course; Training Module; Lecture	Standard textbooks in English and Latvian
159	University of Latvia	Latvia	Principles of Paleoecology	Course; Lecture	Will be available through the online Moodle system.
160	University of Latvia	Latvia	Geospatial models and simulations in GIS environment and Remote sensing for geospatial analysis (lectures in the study course Forest landscapes and management	Course	Learning material is accessible online in the e-module upon the registration to the course
161	University of Latvia	Latvia	Evolution of the Earth	Course	Accessible for registered students; part of

					material is in English
162	University of Latvia	Latvia	Dynamic systems of Earth	Course	Material accessible for registered students; both in Latvian and English languages
163	University of Latvia	Latvia	Groundwater resources, dynamics and monitoring	Course	Accessible for registered students
164	University of Latvia	Latvia	Contemporary geological processes	Course	Material accessible for registered students; also in English
165	ITC - University of Twente	Netherlands	Spatial Engineering at the University of Twente	Course	No
166	ITC-Faculty of Geo-Information Science and Earth Observation, University of Twente	Netherlands	Earth Observation	Course; Lecture; Book or e-book	The material is not accessible outside the organization because of Intellectual Property Rights issues
167	University of Utrecht	Netherlands	GIS and fieldwork	Training Module	Yes
168	Wageningen University	Netherlands	geoscripting	Course	https://geoscripting-wur.github.io/
169	Wageningen University	Netherlands	Geo-scripting	Course	https://geoscripting-wur.github.io/
170	Maat Technology Convergence and Allied	Nigeria	Geoinformatics	Course; Training Module; Training Package; Lecture; Book or e-book	No
171	Institute of Geodesy and Cartography	Poland	Spatial Information Infrastructure Fundamentals and Practice	Course	No

172	UNEP/GRID-Warsaw Centre	Poland	Use of geospatial information/tools and SDI in land/environmental management.	Course; Training Package; Lecture	Learning material is not broadly accessible only for registered students
173	University of Warsaw, Faculty of Geography and Regional Studies, Department of Geoinformatics, Cartography and Remote Sensing	Poland	Geoinformatics, Cartography and Remote Sensing	Training Package	No
174	Department of Geography	Portugal	Cartography and Geographic Information Systems	Training Module	No, just for students use and apply in practical lessons
175	NOVA FCSH	Portugal	Geographic Information Systems	Training Module	Only for enrolled students
176	NOVA FCSH	Portugal	Geographic Information Systems and Spatial Modelling	Training Module	Only for enrolled students
177	NOVA FCSH	Portugal	GIS and Spatial Analysis	Training Module	Only for enrolled students
178	Nova Information Management School	Portugal	Remote Sensing	Course	Only for registered students
179	Technical University for Civil Engineering	Romania	Visualisation of Geospatial Data	Lecture	Learning material is distributed to students, in Romanian language
180	Technical University of Civil Engineering	Romania	Remote Sensing	Course; Lecture	The learning material is not accessible online
181	University of Agronomic Sciences and Veterinary Medicine of Bucharest	Romania	Radar Remote Sensing	Course	The learning material is provided to the students during the semester. All the learning material (manual and step-by-step exercises) will be published soon

					(hopefully this year). It is not available online.
182	University of Agronomic Sciences and Veterinary Medicine of Bucharest	Romania	Remote Sensing	Course	The learning material is provided to the students during the semester. It is not available online.
183	University of Agronomic Sciences and Veterinary Medicine of Bucharest	Romania	Earth Observation Programmes and Applications	Course	The learning material is provided to the students during the semester. It is not available online.
184	University of Agronomic Sciences and Veterinary Medicine of Bucharest	Romania	Remote Sensing for Agriculture and Environment	Course	The learning material is provided to the students during the semester. It is not available online.
185	University of Ljubljana, Faculty of Civil and Geodetic Engineering	Slovenia	Remote Sensing	Course	internally
186	University of Maribor, Faculty of Electrical Engineering and Computer Science	Slovenia	Principles of Geographic Information Systems	Course	Accessible after contacting the lecturer (prof. Domen Mongus, , domen.mongus@um.si)
187	University of Maribor, Faculty of Electrical Engineering and Computer Science	Slovenia	Algorithms for remote sensing data processing	Course	Accessible after contacting the lecturer (prof. Domen Mongus, , domen.mongus@um.si)
188	University of Maribor, Faculty of Electrical Engineering and Computer Science	Slovenia	Principles of Modern GIS	Course	Accessible after contacting the lecturer (prof. Domen Mongus, , domen.mongus@um.si)
189	Autonomous university of Madrid. Department of	Spain	Photointerpretation and Remote	Course	No

	Geography		Sensing		
190	Centro Nacional de Información Geográfica	Spain	http://cursos.ign.es/	Training Package	material accessible by subscription to training course
191	Escuela Técnica Superior de Ingeniería Geodésica, Cartográfica y Topográfica - Universitat Politècnica de València	Spain	Remote sensing	Course	No
192	Escuela Técnica Superior de Ingeniería Geodésica, Cartográfica y Topográfica - Universitat Politècnica de València	Spain	Remote Sensing And Cartographic Updating	Course	No
193	ESERO Spain	Spain	Earth Observation	Training Package	Www.esero.es
194	IHCantabria	Spain	Master´s Course in Water Systems Integral Management	Course; Training Module	No
195	Institute Cartographic and Geological of Catalonia	Spain	Master on Geoinformation (with the University Autonomous of Barcelona-UAB as coordinator)	Course	Only for applicants and UAB and ICGC teaching
196	Instituto Geográfico Nacional	Spain	Remote sensing, photogrammetry, LiDAR and Land Cover	Training Package	Material is not accessible. Students are required to register and to pay a fee.
197	SHS Consultores	Spain	GIS Development Expert	Training Package	No
198	SIGTE - University of Girona-	Spain	GIS & Remote Sensing	Training Module	The learning material of the module is not accessible outside our platform.
199	Universidad de Málaga - European Topic Centre	Spain	Remote sensing application for wetland monitoring	Course	Harmonised learning material will be available on the swos-service.eu website

200	Universidad de Málaga - European Topic Centre	Spain	Prevention and protection of groundwater to contamination: Groundwater vulnerability and risk assessment for protection of water for human consumption	Training Package	It is restricted to students
201	University Jaume I	Spain	Introduction to GIS	Course	No, it is restricted. Available to students only.
202	University Jaume I	Spain	GIS Servers	Course	Only available for students
203	University Jaume I	Spain	Remote Sensing Applications	Course	Available upon request
204	University Jaume I	Spain	Remote sensing applications	Course; Summer school	No but we can provide on request
205	University of Valencia	Spain	Master's Degree in Remote Sensing	Training Package	It is accessible online to enrolled students (https://aulavirtual.uv.es/)
206	Lund University	Sweden	NGEN08 Satellite remote sensing	Course	No
207	Stockholm University	Sweden	Advanced Remote Sensing	Course	No
208	Stockholm University, Department of Human Geography	Sweden	GIS & Cartography 7.5 HEC's	Course	Only to registered students
209	Stockholm University, Department of Human Geography	Sweden	Geographical Information and Analysis I	Course	Only to registered students
210	Stockholm University, Department of Human Geography	Sweden	Geographic Information and Analysis II	Course	No only to registered student
211	Swedish University of Agricultural Sciences	Sweden	Geographic Information Technology II (GIT II)	Course	https://www.slu.se/en/education/programmes-

					courses/courses/?sprak=en&anmkod=40099.1718
212	Swedish University of Agricultural Sciences	Sweden	Remote Sensing and Forest Inventory	Course	https://www.slu.se/en/education/programmes-courses/courses/?sprak=en&anmkod=30165.1718
213	Swedish University of Agricultural Sciences	Sweden	Laser scanning and digital photogrammetry in the forestry	Course	https://www.slu.se/en/education/programmes-courses/courses/?sprak=en&anmkod=10121.1718
214	Swedish University of Agricultural Sciences, Division of Forest Remote Sensing	Sweden	Forest remote sensing	Course; Training Module	No
215	Swedish University of Agricultural Sciences, Division of Forest Remote Sensing	Sweden	3D remote sensing of forests	Course	No
216	Uppsala University, Department of Earth Sciences	Sweden	1GE100, 10ETCS, Geographical Information system and Remote Sensing (bachelor level) 1GE039, 5 ETCS, Applied Geoinformatics for Earth Sciences, (Master level) 1TV444, 5 ECTS, Geographical Information systems for environmental engineers (engineering)	Course; Training Package	Registration on courses. No Fee for EU students.

			1ME410, 5 ECTS, Remote sensing with Meteorological applications (bachelor level) 1GE045, 5 ECTS. Introduction to geographical information systems (basic level)		
217	Federal office of topography Swisstopo	Switzerland	Geodata from Swisstopo in 3D	Lecture	http://www.ikg.ethz.ch/en/education/cas-ris1.html
218	sarmap	Switzerland	Synthetic Aperture Radar	Course; Training Module; Training Package; Lecture; Webinar	No
219	World Data Centre for Geoinformatics and Sustainable Development Igor Sikorsky KPI	Ukraine	Introduction to GIS	Course	No in open access
220	World Data Centre for Geoinformatics and Sustainable Development Igor Sikorsky KPI	Ukraine	Database Management Systems for SDI	Course	No in open access
221	World Data Centre for Geoinformatics and Sustainable Development Igor Sikorsky KPI	Ukraine	Spatial Cadastral Information Systems for SDI	Course	No
222	World Data Centre for Geoinformatics and	Ukraine	GIS Project Management for SDI	Course	No

	Sustainable Development Igor Sikorsky KPI				
223	Bournemouth University	United Kingdom	Geographical Information Systems	Training Module	Only available to BU students
224	Bournemouth University	United Kingdom	Environmental Remote Sensing	Training Module	Only available to BU students
225	King's College London	United Kingdom	Environmental Remote Sensing	Course	No
226	Plymouth Marine Laboratory (PML) and PML Applications Ltd	United Kingdom	Contracted to EUMETSAT to provide Marine Training for Copernicus data.	Training Package	Events and material are shared through the EUMETSAT training Moodle: http://training.eumetsat.int YouTube tutorials: https://www.youtube.com/watch?v=z9GGmvJzDx0&list=PLOQg9n6Apif1ODObv39j43j8IAvJDOAVY MOOC: https://www.futurelearn.com/courses/oceans-from-space
227	Specto Natura	United Kingdom	Bespoke training in Earth Observation	Training Module; Training Package; Lecture; Webinar	No
228	University College London	United Kingdom	Various modules in remote sensing, modelling and geospatial computing	Course; Training Module; Lecture	Some, via institutional web pages, free to use.
229	University College London	United	Principles of remote sensing	Course	Mostly, via my website:

		Kingdom			http://www2.geog.ucl.ac.uk/~mdisney/teaching/GEOGG141/GEOGG141.html
230	University of Leicester	United Kingdom	Radar Remote Sensing	Training Module	Yes, on request to hb91@le.ac.uk. (C) University of Leicester
231	U.S. Department of the Interior Office of Surface Mining Reclamation and Enforcement	United States of America	Using Remote Sensing to Monitor Active, Inactive, and Abandoned Mines	Training Module	Accessible thru TIPS/SCORM.

ANNEX III – Copernicus Training videos

Title	Short description
What is the Copernicus Programme? (also in DE, FR, ES, IT, PL)	*Copernicus is the European Union's revolutionary Earth Observation and Monitoring programme, looking at our planet and its environment for the ultimate benefit of all European citizens. Thanks to a variety of technologies, from satellites in space to measurement systems on the ground, in the sea and in the air, Copernicus delivers operational data and information services openly and freely in a wide range of application areas.*
EN - COPERNICUS Programme - Unique opportunities for developers (also in DE, FR, ES, IT, PL)	*Copernicus is the European Union's revolutionary Earth Observation and Monitoring programme, looking at our planet and its environment for the ultimate benefit of all European citizens. Thanks to a variety of technologies, from satellites in space to measurement systems on the ground, in the sea and in the air, Copernicus delivers operational data and information services openly and freely in a wide range of application areas.*
What is the Copernicus Academy?	
What are the Copernicus Relays?	
Copernicus Atmosphere Monitoring Service: Greenhouse Gases	*Today, some of the most important environmental concerns are related to the composition of atmosphere. Increasing concentrations of greenhouse gases and cooling effect of aerosols are prominent drivers if these changes. Copernicus Atmosphere Monitoring Service (CAMS) monitors these gases and in this video you will learn how to access, retrieve and visualise greenhouse gas data*
Copernicus Atmosphere Monitoring Service: Regional Air Quality	*Learn about Copernicus Atmosphere Monitoring Service CAMS regional Air Quality products*
Copernicus Atmosphere Monitoring Service:	*Learn how to access, retrieve, and visualise CAMS data to assess solar resources, to identify suitable*

Assessment of Solar Resources	*sites for solar plants*
Copernicus Atmosphere Monitoring Service: Success Stories - Applications for Air Quality	*Air quality is affects all of our lives, especially of those living in urban areas. See some examples of how CAMS data was used to develop applications that inform about air quality*
Copernicus Atmosphere Monitoring Service: Defining UV related Risk Zones	*Learn how to access, retrieve and visualise geo-localised UV radiation data from CAMS. It can be related to define UV-risk zones*
Copernicus Atmosphere Monitoring Service: Global Forecasts and Reanalysis	*Learn how to access Copernicus Atmosphere Monitoring Service (CAMS) Global Forecasts and Reanalysis datasets that are used to monitor dust, natural and anthropogenic emissions, and aerosols*
Copernicus Marine Service: Examples of Tools for Sea Situational Awareness Using CMEMS Data	*Learn about tools for sea situational awareness using Copernicus Marine Environment Monitoring Service*
Copernicus Marine Service: Monitoring Ocean Colour Python Procedure for Download	*Learn how Copernicus Marine Service can provide ocean colour information to derive indicators of algae bloom*
Copernicus Marine Environment Monitoring Service: Statistics Derived from Targeted Products	*This video shows specific cases where Copernicus Marine Service was used to deliver users information about climate change, algae bloom, and sea ice extent trends*
Copernicus Marine Environment Monitoring Service: Product Portfolio and Data Access	*This video will show you how to browse Copernicus Marine Service product catalogue, how to access and download data through the portal and how to visualise the downloaded products*
Copernicus Marine Environment Monitoring Service: Products Visualisation with Open Source GIS Tool	*Learn how to visualise Copernicus Marine Environment Monitoring Service products and display them in QGIS tool*
Copernicus Marine Environment Monitoring Service: Ocean Current Forecast for Routing Activities	*Learn how Copernicus Marine Environment Monitoring Service products like real-time ocean current forecast can help routing activities in the sea*
Land Monitoring Service - Submodule A: Product portfolio and data access	*Learn how to access Copernicus Land Monitoring data.*
Land Monitoring Service - Submodule B: Combined	*Learn about properties and characteristics of high-resolution layers, digital elevation products and*

value of hi-res layers and 3D visualisation	*visualisation techniques, such as 3D visualisation.*
Land Monitoring Service - Submodule C: Forest damage detection through high resolution forest layer	*Introduction to high resolution forest layer and how to use it for forest damage detection.*
Land Monitoring Service - Submodule D: Monitoring stability of protected areas and related pressures	*Learn about monitoring the stability of Natura2000 protected sites*
Land Monitoring Service - Submodule E: Soil erosion modelling in Spain using Global Land Products	*A use case study of soil erosion monitoring in Spain using Copernicus Global Land Products*
Land Monitoring Service - Submodule F: Grassland harvest estimation	*This module deals with a very practical application of the high resolution forest layer product which is a component of the continental Land Monitoring Product and deals with assessing and estimating grassland harvest in Bavaria, Germany*
Land Monitoring Service - Submodule G: HRL imperviousness for environmental applications	*This presentation will show a case of High Resolution Layer (HRL) imperviousness for environmental applications.*
Land Monitoring Service - Submodule H: Agriculture – global component	*Learn about Copernicus Global component products and services for agriculture*
Climate Change Adaptation and Mitigation: Climate Change and the Agricultural Sector	*Farmers across Europe are already experiencing the effects of climate change like climate induced stresses, pests and diseases. Learn how Copernicus Climate Change service can support the agricultural sector.*
Climate Change Adaptation and Mitigation: What is Copernicus Climate Change Service?	*In this video, learn what is Copernicus Climate Change service and what data, information and support it provides to the users*
Climate Change Adaptation and Mitigation: the use of ERA Interim Data	*Learn how to use ERA Interim Data in the operational oceanography framework*
Climate Change Adaptation and Mitigation: Climate	*European cities are already experience the effects of climate change. In this video, you will learn how*

Change in Europe's Cities	*Copernicus Climate Change Service (C3S) is helping these cities to adapt to climate change*
Climate Change Adaptation and Mitigation: Climate Change & the Water Sector	*Climate and water cycle are closely linked. Climate change is already affecting water management. In this video, you will learn how Copernicus Climate Change Service (C3S) is helping the water sector*
Copernicus Emergency Management Service: Risk Planning and Recovery	*In this video, you will learn more about the Risk & Recovery module of the Copernicus Emergency Management Service. This service addresses prevention, preparedness, disaster risk reduction or recovery phases (product delivery in weeks/months*
Copernicus Emergency Management Service: the use of Copernicus products in a situation room	*Copernicus EMS can provide maps and brief analysis of a situation within hours or days after a crisis event. In this video learn how crisis managers can use the Copernicus EMS products in a situation room*
Copernicus Emergency Management Service: what can users expect from the EMS mapping service?	*Learn how Copernicus EMS mapping can support emergency managers during the crisis events*
Copernicus Emergency Management Service: Forecasting Floods	*In this video, you will learn more about EFAS - the European Flood Awareness System*
Copernicus Emergency Management Service: In Support of Crisis Preparedness and Response Operations	*Learn about the Copernicus Emergency Management Service background, evolution and the current state. Overview of rapid mapping, risk & recovery mapping, EFFIS and EFAS*
Copernicus Emergency Management Service: Access to EMS mapping	*Learn how to access the Copernicus Emergency Management Service mapping component. This video explains who can trigger the service and how, who is going to approve the request, and how to fill the Service Request Form - the standard tool for providing information about the request*
Copernicus Emergency Management Service: Forecasting forest fires with EFFIS	*This video is an introduction to Copernicus EMS Early Warning System EFFIS - European Forest Fire Information System*
Copernicus EMS for floods and storms - emergency alerts and crisis operations	*In this video, you will learn how Copernicus EMS rapid mapping component can be used to support emergency alerts and crisis operations in cases of floods and storms*

Copernicus for Renewable Energy: Define Zone of Visual Influence of Wind Turbines	*Renewable energy sector is one of the best places to apply new opportunities brought by Copernicus and its full, free and open data policy. In this video, learn how to delineate the visual influence of wind turbines in a landscape using Copernicus Land Monitoring Service*
Copernicus for Renewable Energy: Impact of Dust on Solar Farm Productivity	*Dust can be a serious problem for solar farm productivity and finding a suitable place for solar farm is crucial. In this video, learn how to access, download and visualise dust forecast from the Copernicus*
Copernicus for Renewable Energy: Estimation of Annual Forest Biomass Production	*In this video, learn how to estimate annual forest biomass production with Sentinel imagery and derived products provided by the Copernicus Land Monitoring Service*
Copernicus for Renewable Energy: Environmental Monitoring of Marine Renewable Energy Farms	*This video will show the Copernicus Marine Environment Monitoring Service data and information use cases for Marine Environmental Impact Assessment Studies (EIAS) and Marine Environmental Monitoring as well as for offshore projects for renewable energy and also dredging, oil & gas, etc.*
Copernicus for GI: Fertilizer Application Governed by Sentinel-2	*The Geographic Information community can benefit greatly from the full, free and open Copernicus data. This video focuses on a case study about using Sentinel-2 data for fertilizer and fungicide application in farming fields*
Copernicus for GI: Land Cover Detection Using Sentinel-2	*The Geographic Information community can benefit greatly from the full, free and open Copernicus data. This video focuses on a case study about land cover mapping using Sentinel-2 data*
Copernicus for GI: Mapping Urban Housing Density in Accra, Ghana	*The Geographic Information community can benefit greatly from the full, free and open Copernicus data. This video focuses on identifying urban housing density mapping in Accra city in Ghana*
Copernicus for GI: Using Sentinel-2 to Identify and Map Wildfire Events	*The Geographic Information community can benefit greatly from the full, free and open Copernicus data. This video shows a case study of how Sentinel-2 data was used for mapping wildfire events in Greece*
Copernicus for GI: Copernicus for High-Resolution Mapping of Water Quality	*The Geographic Information community can benefit greatly from the full, free and open Copernicus data. This video focuses on a case study about using Copernicus data for high-resolution mapping of water quality*

Access to Copernicus Data: Overview and Introduction	*Copernicus data is full, free and open. In this video, you can learn how to access this data*
Access to Copernicus Data: Downloading a Subset of Data	*In this module, you will learn how to access ocean colour procedures and download a subset of data. The use case in this video shows the monitoring of ocean colour in the North Atlantic Ocean to evaluate the presence of algae blooms, suspended matter in sea water.*
Access to Copernicus Data: Navigation in Time Series Viewer	*This module will show how to view charts and maps in a time series viewer of Copernicus Land Cover Data and how to navigate the viewer and get the relevant information*
Access to Copernicus Data: Registration For Copernicus Services	*This module provides a guide how to register for different Copernicus Services*
Access to Copernicus Data: Using the ESA SciHub Navigators	*In this module, you will learn how to access Copernicus Sentinel 2 and 3 data via the European Space Agency's Scientific Hub*
Access to Copernicus Data: Using ESA/EUMETSAT Data Access and User Support	*In this module learn how to access Copernicus data via Sentinel Data Hub, Coordinated Data Access System (CSC-DA), EUMETCast, Copernicus Online Data Access (CODA), Data Centre Long-Term Archive and EUMETView*
Copernicus for Entrepreneurs and Developers: Using Satellite Imagery in the Sales Process	*In this video, we present a case study of "Building Radar", an award-winning company that used Sentinel satellite imagery to give their customers information that they can use to increase their sales*
Copernicus for Entrepreneurs and Developers: Ship Traffic and Oil Spill Monitoring with Sentinel-1	*In this video, we will look at how ship traffic and oil spills are monitored with Copernicus*
Copernicus for Entrepreneurs and Developers: Developing a Mobile Application with Copernicus	*In this module you will learn about mobile applications for citizens and how you can create your own app using Copernicus data*
Copernicus for Entrepreneurs and Developers: Getting Access to Copernicus Data, Tools and Financing	*Learn where to find the Copernicus data, which tools you can use and where you can find help to turn your ideas into products or applications*
Copernicus for Entrepreneurs and Developers:	*In this video, you will learn how Copernicus uses the cloud and how entrepreneurs and start-ups can*

Copernicus in the Cloud	*access Copernicus data. We also present a case study of Sinergise and their product Sentinel Hub*
Coastal Zone Management: Spatial Statistics for EU directives Reporting on Coastal Areas	*The European Union issues various directives that impact coastal zone directly or indirectly. Learn how to use spatial statistics for EU directives reporting*
Coastal Zone Management: Food Provision & Aquaculture Assessment	*Learn how Copernicus data can help to tackle issues that you may face in maritime and coastal economy management, including food provision and aquaculture assessment*
Coastal Zone Management: Anthropogenic Pressure on Coastal Zones	*Learn how to use Copernicus data to analyse anthropogenic pressure on coastal areas for management purposes*
Coastal Zone Management: Coastal Dynamics	*Learn how coastal oceanography supports technical experts, coastal engineers, policy makers, and everyone involved in activities in coastal zones*
Coastal Zone Management: Coastal Pollution	*There are many sources of coastal pollution. This presentation will touch on two of them - litter and oil spill, and will show you how Copernicus data can help detect and manage coastal pollution*
Coastal Zone Management: Coastal Vulnerability Assessment	*Because of climate change, coastal areas are becoming more vulnerable and impact the lives of people living nearby and the environment. In this module, learn how you can use Copernicus data to assess coastal vulnerability*
Copernicus for Local and Regional Authorities: Introduction	*This video will introduce you to how Copernicus can support local and regional authorities in Europe*
Copernicus for LRAs: Green Areas - an Easy Way to Map Vegetation	*This video will show how satellite data can be used to support public policymaking in cities, in this case for policies related to the urban green areas*
Copernicus for LRAs: Mitigating Heat Wave and Urban Heat Island Effect Using Copernicus Data	*Learn how Copernicus data can be used to mitigate heat wave and urban heat island effects in small to large cities*
Copernicus for LRAs: Space Technologies for public administration bodies	*Learn how satellite data can support public administration bodies when they have to perform checks related to the eligibility of farmers to receive EU aid in agriculture.*

Copernicus for LRAs: Copernicus Supporting the Marine Strategy Framework Directive	*This video will illustrate how Copernicus supports local and regional authorities for monitoring and reporting for the European Marine Strategy Framework Directive*
SME Instrument Webinar	*With its free, full, and open data policy, the Copernicus programme enables to boost innovation and economic growth in Europe, and beyond. The commercial sector in general and SMEs and start-ups in particular play a key role in maximising the benefits of Copernicus and are a prime target of the EU entrepreneurship policies and funding instruments*
Copernicus Accelerator: Testing your product	*Building a start-up? Learn how to test your product in this video from the Copernicus Accelerator*
Copernicus Accelerator: Lean Start-up Methodology	*Building lean is the key to your start-up success. Learn how to do it like a pro in this webinar from the Copernicus Accelerator*
Copernicus Accelerator: Minimal Viable Product	*To start lean, you need to build a Minimum Viable Product (MVP) - learn how to do it and grow your start-up with this Copernicus Accelerator webinar*
Copernicus Accelerator: Pitch anything	*Perfecting your pitch is essential if you want your start-up to succeed. Learn how to make a perfect pitch with this Copernicus Accelerator webinar*
Copernicus Accelerator: Motivation & Productivity	*"Being an entrepreneur is like eating glass and staring into the abyss" Elon Musk once said and it is true that starting your own start-up journey can be a scary endeavour. You will need to keep yourself and your team motivated and productive doing the right stuff. Learn more about motivation & productivity in this Copernicus Accelerator webinar*
Copernicus Accelerator: Marketing your Start-up with zero budget	
Copernicus Accelerator programme: take your idea to the next level	

ANNEX IV – ESA TRAINING

MOOCs: https://earth.esa.int/web/guest/eo-education-and-training/moocs

Title	Link	Description
Echoes in space	https://eo-college.org/courses/echoes-in-space/	a journey through the exciting world of Radar Remote Sensing. Learn the basics that will help you to understand where this technology is coming from, how the images are acquired and which manifold applications already use Radar Remote Sensing to help protect our planet.
Earth Observation from Space: the Optical View	https://www.futurelearn.com/courses/optical-earth-observation	Discover how optical Earth observation data is gathered and used in this free online course from the European Space Agency (ESA). You'll find out how satellite data is acquired and used, the range of data types available, and the terminology and techniques involved. The course will also provide detailed case studies of how this data is used in diverse fields, from climate science to humanitarian relief, monitoring of urban change to agriculture, and many other areas.
Monitoring Climate from Space	https://www.futurelearn.com/courses/climate-from-space	Explore our planet from space and learn how Earth observation is used to monitor climate change, with this free online course. In this free online course, you will join leading experts and scientists from ESA and key European research centres, to explore the science that underpins Earth observation. We will look at recent and current satellite missions that are providing an archive of essential data; and find out how this data is used in local and international policy and planning.

LearnEO!: http://www.learn-eo.org/index.php

Ten lessons from LearnEO!

Title	Description	Level
Lesson 1: The Amazon river plume	Measurement of sea surface salinity (SSS) from space began with the launch of the ESA Soil Moisture and Ocean Salinity (SMOS) satellite in November 2009. One of the most obvious features when looking at SMOS data is the input of freshwater from the Amazon River. The Amazon also delivers a vast quantity of nutrients into the Atlantic, which encourages the growth of phytoplankton. This lesson uses these two features of the impact of the Amazon to compare the spatial scales over which changes in salinity and ocean colour can be viewed using EO data.	Intermediate. Suitable for students with some background in oceanography
Lesson 2: Monitoring oil pollution at sea	SAR (synthetic aperture radar) is a well-established tool for detecting oil on the sea surface. More recently optical sensors such as MERIS and MODIS are also used, particularly in the subtropics, where cloud is less of a problem than at higher latitudes or along the equator. This lesson uses ASAR and full resolution MERIS data to show how SAR and optical data may be used to monitor illegal discharge of oil at sea, or to provide information for oil spill clean-up and environmental assessments after accidents.	Intermediate. Requires some knowledge of ocean remote sensing
Lesson 3: El Niño and the Southern Oscillation (ENSO)	El Niño is one of the most famous phenomena in the ocean-atmosphere system. In the ocean it affects sea surface height and ocean temperature. In the atmosphere it affects the winds and transport of moisture. It therefore	Beginner

	influences seasonal weather patterns in many regions of the world, and understanding how it develops can help us estimate the likelihood of floods or droughts in these areas. This lessons looks at the progression of El Niño across the Pacific Ocean and its turn back to La Niña, using the power of the global view made possible by satellite observations.	
Lesson 4. Monitoring Atlantic storms	Significant wave height is a by-product of measuring sea surface height from satellites. Even if the orbit repeat times of altimetry satellites means we cannot measure wave heights for all storms, many impressive examples are available. These show that storms in the Atlantic can create waves comparable with those whipped up by hurricanes. Using historical examples from the altimetry record, supported by meteorological observations and wave height data from other sources, this lessons explains how wave height is read from the altimetry wave form and teaches the interpretation of along-track (non-imagery) satellite data and its use in oceanography.	Intermediate. Suitable for students with some background in oceanography
Lesson 5. Observing Earth gravity: the geoid and its use to compute ocean dynamic topography	Gravimetric satellites, including GOCE, have improved our knowledge of the geoid. As a result we are now able to calculate the mean ocean currents from altimetric measurements of sea surface height - something that was not possible before the advent of gravimetric satellites. This lesson introduces the geoid as computed from GOCE measurements. It highlights some of the geoid features that match either deep inhomogeneities, or reliefs in the Earth's crust, and explains how these influence sea surface height.	Advanced
Lesson 6. Monitoring Arctic sea ice	The Arctic is one of the areas where the impacts of global climate change are strongest. It is also an area which is	Intermediate

	quite difficult to measure in situ and thus one where satellite observations show their full strength. Several different sensors are used to monitor sea ice in the Arctic. Some allow us to see the global picture; others give a closer, more detailed view. This lesson introduces examples of both types. Monthly radiometer data is supplemented with a zoom in on one area with SAR data. The lesson also mentions freeboard measurements from CryoSat altimetry, which will become available as an ESA product towards the end of 2013.	
Lesson 7. Forest monitoring	Optical satellite data have been used successfully to map fire scars and post-fire recovery, but are limited by cloud cover. C-band space-borne radar can 'see' through cloud, and has the potential for assessing the extent and severity of wild fire impacts, provided the effects of soil moisture and low vegetation is taken into account. This lesson shows how a time series of SAR images can be used to monitor both deforestation and vegetation recovery after forest fires. The synergy with optical data is demonstrated through the use of Landsat imagery. The importance of satellites for global fire monitoring is also shown, using example data from A/ATSR.	Intermediate. Requires some understanding of SAR remote sensing theory
Lesson 8. Monitoring urban growth	Satellite observations are a valuable tool for updating urban maps and analysing settlement dynamics - both important for planning sustainable development. The ERS-Envisat SAR archive provides a unique source of data that can be used to track and understanding the dramatic changes in land cover around many large cities over the past 15 years. Using the city of Rome as an example, this lesson demonstrates the use of SAR data to monitor short term and long-term changes. It also	

	explains how interferometric coherence can add valuable information, and shows how optical data may be used to validate results.	
Lesson 9. Land cover mapping	Land cover data is required for conservation, land resource planning, and studies of biodiversity and environmental change. The only feasible way of obtaining such information for large areas over several years is with satellites. However, obtaining data of sufficient accuracy is not always straightforward. Results may vary depending on sensor characteristics and classification methods. This lesson shows how to obtain land cover information form multi and hyperspectral data at different spatial resolution, and teaches the basics of land-cover data validation. It also looks at the possibility of obtaining extra information by using sensors that look at a location from several viewing angles.	
Lesson 10. Monitoring soil moisture	Soil moisture is a key variable for understanding global water and energy budgets. It controls the redistribution of rainfall into infiltration, surface runoff and evaporation at the earth surface, and also has a strong effect on surface energy exchange. Information on soil moisture is also important for flood and drought monitoring, weather forecasting, water management and agricultural planning. The SMOS mission was designed to provide such information. However, measuring soil moisture from satellites is not trivial because of the effects that surface roughness and vegetation cover have on the signal recorded by the satellite. This lesson explains the physical principles of soil moisture retrieval from SMOS, and demonstrates some of the processing steps necessary to produce soil moisture maps from SMOS	

	measurements.	

Winning lessons from the LearnEO! lesson writing competition

Title	Description	Level
1st Prize. Monitoring phytoplankton seasonality: phenology indices and their importance for coral reef biology Authors: Marie-Fanny Racault and Dionysios E. Raitsos	Being the base of the marine food-web, phytoplankton provides a source of food for the larvae of many coral reef species, including fish, crustaceans and molluscs. The bloom timing (phenology) and intensity is determinant for the larvae survival. The lesson introduces phenology metrics to monitor the seasonality of phytoplankton using remote sensing ocean colour data from the European Space Agency (ESA) Climate Change Initiative project (OC-CCI). It investigates the phytoplankton dynamics in major coral reefs of the Red Sea, which is one of the most saline and warm seas in the world.	Suitable for university students or continued professional development training (intermediate level).
2nd Prize. Detection of harmful algal blooms in coastal waters: examples from the Benguela upwelling system. Authors: Hayley Evers-King and Marie Smith	Phytoplankton blooms fuel vast coastal fishery and aquaculture resources. However these blooms can often be harmful, as a result of anoxia or presence of toxins. Thanks to its high temporal and spatial resolution, ocean colour data allows scientists and managers to understand these phenomena and manage risks to resources. This lesson covers how we can use both in situ and satellite derived ocean colour data to detect high biomass blooms and how we can address the challenges of using this data in the dynamic coastal environment.	Suitable for university students or continued professional development training (intermediate to advanced level).
3rd Prize. Observing the Eyjafjallajökull volcanic plume	Phytoplankton blooms fuel vast coastal fishery and aquaculture resources. However these blooms can	Suitable for university students or continued professional development training (intermediate

Author: Mirko Lamantea	often be harmful, as a result of anoxia or presence of toxins. Thanks to its high temporal and spatial resolution, ocean colour data allows scientists and managers to understand these phenomena and manage risks to resources. This lesson covers how we can use both in situ and satellite derived ocean colour data to detect high biomass blooms and how we can address the challenges of using this data in the dynamic coastal environment.	level).

The GLaSS (Global Lakes Sentinel Service) Project

Title	Description	Level
Lesson 1: EO data handling	The Sentinel 2 and 3 data handling session introduces the spatial, temporal, spectral and format specifications of the European multispectral high resolution sensors Sentinel 2 and 3 of the Copernicus programme as well as for Landsat operated by USGS. The lesson provides information about access mechanisms and image importing software solutions, all demonstrated with exercises on selected test data sets in order to learn how to select and handle satellite data for water quality monitoring purposes.	Suitable for university students or continued professional development training (beginner level).
Lesson 2: Tools for GLaSS data analysis	Lesson designed to familiarize EO data users with the tools developed for the GLaSS project that are available in BEAM/SNAP. These tools are focused on image classification and statistical analysis of data. The training material is prepared for the understanding of the optical water tool (GLaSS Deliverable 3.3, 2014), and the image classification method (Magic Wand and Prediction tool,	Suitable for university students or continued professional development training (beginner level).

	(GLaSS Deliverable 3.6, 2014) included currently in BEAM 5, and that will be transfer into SNAP in the short term.	
Lesson 3: Eutrophic lakes	There is a world-wide need to monitor eutrophication and algal blooms. Earth observation give good coverage both in spatial and temporal scale for evaluation of in-water constituents in the water bodies. The lessons shows how to analyse the spatial variability in algal concentrations in Lake Peipsi, Estonia, using MERIS satellite data. This includes some basic handling of the image, atmospheric correction, application of a concentration-retrieval algorithm and finally validation of the results with in situ measurements.	Suitable for university students or continued professional development training (beginner level).
Lesson 4. Assessing trophic status tendency from 10-years observation from MERIS	Deep clear lakes are less vulnerable to eutrophication than small shallow lakes, but a continuous input of nutrients can lead to increasing eutrophication. This lesson shows how we can use satellite data to assess the trend of trophic level in Lake Tanganyika, the third largest lake in the world by volume, and one of the richest freshwater ecosystems supplying fish to one million people living around the lake.	Suitable for university students or continued professional development training (beginner level).
Lesson 5. Phytoplankton phenology in deep clear lakes	Phytoplankton are at the base of aquatic food webs, so their biomass is coupled to all upper trophic levels. However, phytoplankton biomass is sensitive to environmental change, with shifts in the seasonality of blooms (phenology). This lesson covers how satellite data allow phytoplankton phenology investigations for Lake Constance.";	Suitable for university students or continued professional development training (intermediate level).
Lesson 6. Shallow turbid lakes	In shallow lakes waves can easily mix this bottom material up into the water column. High turbidity can make these lakes less attractive for recreation, and for	Suitable for university students or continued professional development training (beginner level).

	fish and birds that need to see their prey. The turbidity reduces underwater light intensity and therefore the amount of submerged vegetation. This lesson shows how to use satellite data to monitor the effect of waves and other disturbances (such as dredging).	
Lesson 7. Assessing colour of lakes influenced by glacier dynamics in the Mount Everest Region	Glacial lakes are strongly influenced by glacier dynamics that are sensitive to climate change. Increasing melting rates can increase both the number and size of glacial lakes. Melt-water increases lake volume and can make lake waters grey and very turbid. This lesson covers how we can use satellite data to classify lakes in the Sagarmatha National Park (SNP) using lake colour and turbidity derived from reflectance brightness in order to find potentially dangerous lakes with risk of outburst flood.	Suitable for university students or continued professional development training (intermediate level).
Lesson 8. Lakes with a high concentration of humic substances	High concentrations of humic substances leads to strong absorption of light in the blue and green parts of the spectrum, so that the remaining colour is yellow/red/brownish and dark. This leads to a low signal-to-noise ratio, so that small errors, for example in the atmospheric correction might lead to relatively large errors in the retrieval of water quality parameters. This lesson gives an overview of issues that limit remote sensing of water, with a focus on the effects of high absorption.	Suitable for university students or continued professional development training (beginner level).
Lesson 9. Mine tailing ponds	Worldwide there are hundreds of thousands of mine tailing ponds, some well maintained, others abandoned and not well documented. The first step in monitoring the risk from such ponds is to locate them all. This lesson shows how to select suitable satellite data, apply masks and designing the first step towards a tool to automatically locate mine tailing ponds in large remote areas based on	Suitable for university students or continued professional development training (intermediate level).

	Earth Observation data.	
Lesson 10. Assessing ecological status according to the WFD	Lakes are valuable resources whose protection in the European Union is regulated by the Water Framework Directive (WFD). This forces Member States to systematically monitor all natural and artificial lakes with surface area larger than 0.5 km^2 based on multiple components and parameters. Some of these can be determined by remote sensing, and this lesson shows how we can use satellite data to assess the ecological status oflakes in southern Sweden.	Suitable for university students or continued professional development training (intermediate level).

Eduspace: http://www.esa.int/SPECIALS/Eduspace_EN/

Remote Sensing Principles:

- What is remote sensing?
- Remote sensing in depth
- History of Earth observation
- Mapping and satellite data
- Satellite orbits
- Earth observation satellites

Case studies:

- Glacier analysis using radar imagery
- The Andean Volcanic Belt
- The shrinking of Lake Chad
- Flash floods in Thessaloniki

- The Gulf Stream
- Climate change and glaciers
- Glacier Ice Flow
- Lost in the Andes
- Urban sprawl in Córdoba
- Rondonia
- Vegetation in South America
- Hurricane Katrina
- Meteosat images
- Himalayan climate

EO Educational Tools

'ESA School Atlas' page. https://earth.esa.int/web/guest/eo-education-and-trainingweb/eo-edu/esa-school-atlas

The Atlas is accompanied by a Teacher's Handbook and a digital version on two DVDs. It is available in both English and German.

The Atlas contains the following content:

1. Introduction to ESA (10 pages) - this section contains a colourful introduction to the European Space Agency, describing its role and its many programmes and resources.
2. Earth Observation (8 pages) - this section explains - with the help of many images and diagrams - the fundamentals of Earth Observation. It includes an introduction to satellite systems, remote sensing, image processing and GIS.
3. Global Overview (20 pages) - this contains information about different global processes and phenomena. It includes sections on topography and plate tectonics, ocean currents, cloud cover, natural hazards, etc. There are also sections on human aspects observed at the global scale, such as population distribution, and atmospheric pollution.

4. Continental Overview (82 pages) - this focuses on each continent, and examines phenomena observable from space that is relevant to a particular continent, such as seasonal variations, particular landscapes and their dynamics and the variation of the sea and shelf ice extent in the Polar Regions.
5. The Natural Sphere (60 pages) - this contains information about natural phenomena, focusing on key areas. There are sections on hydrology, geology, geomorphology, rifts, volcanism, etc.
6. The Cultural Sphere (78 pages) - this contains information about human phenomena, such as land use, agricultural patterns, urban development, mining, energy, industry, and tourism, but also a number of natural and cultural World Heritage Sites are displayed and analysed.
7. Index (18 pages) - At the end of the Atlas there is an index of place names, and glossaries of remote sensing and geographical terms.

The Teachers' Handbook accompanying the ESA School Atlas provides an introduction to Earth Observation and a general description of each double page of the Atlas. For every image or thematic map, technical information on the data, as well as descriptions and interpretation aids are provided.

EO Summer School: https://earth.esa.int/web/eo-summer-school/home/

1. EO Summer School 1 – 2003: https://earth.esa.int/web/eo-summer-school/programme/eo-school-1
2. EO Summer School 2 – 2004: https://earth.esa.int/web/eo-summer-school/programme/eo-school-2
3. EO Summer School 3 – 2006: https://earth.esa.int/web/eo-summer-school/programme/eo-school-3
4. EO Summer School 4 – 2008: https://earth.esa.int/web/eo-summer-school/programme/eo-school-4
5. EO Summer School 5 – 2010: https://earth.esa.int/web/eo-summer-school/programme/eo-school-5
6. EO Summer School 6 – 2012: https://earth.esa.int/web/eo-summer-school/programme/eo-school-6
7. EO Summer School 7 – 2014: https://earth.esa.int/web/eo-summer-school/programme/eo-school-7
8. EO Summer School 8 – 2016: https://earth.esa.int/web/eo-summer-school/programme/eo-school-8
9. Earth Observation Summer School: http://eoscience4society.esa.int/EOSS18/

EO training activities

Dragon 4 Cooperation: http://dragon4.esa.int/page_training.php (Dragon is a cooperation between ESA and the Ministry of Science and Technology (MOST) of the P.R. China).

The 4 cooperation phases are:

- Dragon 1 (2004 to 2008)
    - Four Advanced training courses were held in China from 2004 to 2007 with the objective of training young scientists in theory and retrievals for land, ocean and atmospheric remote sensing using ERS and Envisat EO data.
- Dragon 2 (2008 to 2012)
    - Four Advanced training courses were held in China from 2008 to 2011 with the objective of training young scientists in theory and retrievals for land, ocean and atmospheric remote sensing using ESA, ESA TPM and Chinese EO data.
- Dragon 3 (2012 to 2016)
    - 2016 Atmospheric Training Course
- Dragon 4 (2016 to 2020)

Tiger initiative: http://www.tiger.esa.int/page_training.php (in 2002 ESA launched the TIGER initiative to promote the use of Earth Observation (EO) for improved Integrated Water Resources Management (IWRM) in Africa).

Training and capacity building activities within TIGER are organized by the **TIGER Capacity Building Facility (TCBF),** led by the International Institute for Geo-Information Science and Earth Observation, ITC. Some **19 training sessions** have been organised focused on both the needs of the different research projects and the requirements of the water authorities and end users involved in TIGER projects.

- Basic EO education, provided via distance learning.
- Training courses focussed on selected earth observation techniques.
- Short courses, tailored to the research interest and technical background of the participants
- Scientific research supervision
- TIGER workshop organization
- Maintenance and updating of the TIGER training kit

The **TIGER training kit** is addressed to trainers and intends to provide African partners with the latest knowledge and understanding of the use of EO technology in support to water-related issues. A particular focus was given to include the latest observation capabilities provided by the Copernicus Sentinels satellites.

The following 6 topics are packaged in separate kits:

- Earth Observation Data Acquisition
- Land Cover Mapping
- Crop Monitoring and Irrigation
- Open Water and Flood Mapping – Optical and SAR-based
- Water Quality Monitoring – Inland Waters
- Vegetation Monitoring and Evapotranspiration

Five topics, excluding Data Acquisition, are organized as material for a five-day course.

Advanced EO Training for PIs (Principal Investigators): https://earth.esa.int/web/guest/eo-education-and-trainingweb/eo-edu/pis-advanced-training

TITLE	LINK	DESCRIPTION
Advanced Atmospheric Training Courses		
2nd ESA Advanced Training Course on Atmospheric Remote Sensing 2014	https://earth.esa.int/web/guest/content-events/-/article/2nd-esa-advanced-training-course-on-atmospheric-remote-sensing	As part of the Scientific Exploitation of Operational Missions (SEOM) programme element, the European Space Agency (ESA) is organising an advanced Atmospheric Training Course, co-sponsored by Forschungszentrum Jülich - Institute of Energy and Climate Research, which will take place in Jülich, Germany, from 27 to 30 October 2014. The aim of the course is to train the next generation of European and Canadian Principal Investigators (PIs), and explain the principles and applications of atmospheric remote sensing. Tools, methods and data products will be discussed as well as the applications of ESA EO (including the future Sentinel-5P) and Third Party Missions for atmospheric remote sensing.
Advanced Atmospheric Training Course 2008	https://earth.esa.int/web/guest/content-events/-/article/advanced-atmospheric-training-course-5489	The specific objectives of the course are to stimulate and support the exploitation of ESA EO and Third Party Mission (TPM) remote sensing data for atmospheric applications; introduce available tools and methods for the exploitation of ERS, Envisat

		and TPM satellite data; train the next generation of European and Canadian Principal Investigators (PIs). The deadline for registration is 30 May 2008.
Advanced Ocean Training Courses		
Ocean Training Course 2017	https://earth.esa.int/web/guest/content-events/-/article/ocean-training-course-20-1	The European Space Agency (ESA) is organising an advanced Ocean Remote Sensing Training Course devoted to train the next generation of Earth Observation (EO) scientists to exploit data from ESA and operational EO Missions (e.g. Copernicus Sentinels) for science and application development. The training course is being organised by ESA in cooperation with the University of Porto and will be held in Porto, Portugal from 11 to 15 September 2017. This course includes a series of lectures and laboratory classes, group-work and discussion, and the aim of the course is to develop new skills in the application of complementary satellite ocean remote sensing data sets and their application in synergy for science and applications serving society.
4th ESA Advanced Training on Ocean Remote Sensing 2015	https://earth.esa.int/web/guest/content-events/-/article/4th-esa-advanced-training-on-ocean-remote-sensing	As part of the Scientific Exploitation of Operational Missions (SEOM) programme element, the European Space Agency (ESA) is organising an advanced Ocean Remote Sensing Training Course,

		devoted to train the next generation of Earth Observation (EO) scientists to exploit data from ESA and operational EO Missions for science and applications development. The course will take place at the French Research Institute for Exploitation of the Sea (IFREMER) in Brest, France, from 07 to 11 September 2015. The aims of the course are to: Explain theoretical principles of Ocean Colour Radiometry, SST retrievals, SAR and Radar Altimetry principles and applications; Introduce tools and methods for the exploitation of EO satellite data; Stimulate and support the exploitation of the ESA Earth Explorer missions and the Sentinels for ocean remote sensing science and applications.
3rd ESA Advanced Training on Ocean Remote Sensing 2013	https://earth.esa.int/web/guest/content-events/-/article/3rd-esa-advanced-training-on-ocean-remote-sensing	The 3rd ESA Advanced Training on Ocean Remote Sensing course will be held in Cork, Ireland, at the National Maritime College of Ireland from 23 to 27 September 2013. As part of the Scientific Exploitation of Operational Missions (SEOM) programme element, the European Space Agency (ESA) is organising a series of advanced thematic training courses devoted to train the next generation of Earth Observation (EO) scientists to use data from ESA

		and operational EO Missions for science and applications development.
2nd Advanced Training on Ocean Remote Sensing 2009	https://earth.esa.int/web/guest/content-events/-/article/2nd-advanced-training-on-ocean-remote-sensing-6161	ESA is organising a series of regular advanced thematic training courses - held yearly and hosted in European Universities and Research institutions - devoted to the exploitation of Earth Observation data from ESA and Third Party Mission instruments.
Advanced Training Course in Ocean Remote Sensing 2006	https://earth.esa.int/web/guest/content-events/-/article/advanced-training-course-in-ocean-remote-sensing-4078	The 2006 Advanced Training Course in Ocean Remote Sensing will be held at the Institute of Oceanography of the University of Hamburg from 25 to 29 September 2006. The objective of the course is to provide first-hand information on a broad range of ocean research topics including key principles of SAR, Radar Altimetry, Ocean Colour and Sea Surface Temperature measurements, processing algorithms, data products and their use in oceanographic applications. The training course is open to young researchers (Ph.D. students, young post-doc) from Europe wishing to expand and improve their knowledge and skills in ocean research.
Advanced Cryosphere Training Courses		
ESA advanced training course on remote sensing of the Cryosphere 2018	https://earth.esa.int/web/guest/content-events/-/article/esa-advanced-training-course-on-remote-sensing-of-the-cryosphere	As part of the Earth Observation (EO) Science for Society – Scientific Exploitation element of EOEP-5 program, the European Space Agency (ESA) is

		organising an advanced training course on remote sensing of the Cryosphere, devoted to train the next generation of scientists and specialists to exploit EO data for science and applications. Postgraduate-level, PhD students, post-doctoral research scientists and users from Europe and Canada interested in applications of remote sensing of the Cryosphere are welcome to apply to the 6-day course, held at University Centre in Svalbard (UNIS) in Longyearbyen, Svalbard, from 11 to 16 June 2018.
1st ESA Advanced Training Course on Remote Sensing of the Cryosphere	https://earth.esa.int/web/guest/content-events/-/article/1st-esa-advanced-training-course-on-remote-sensing-of-the-cryosphere	As part of the Scientific Exploitation of Operational Missions (SEOM) programme element, the European Space Agency (ESA) is organising a new advanced Cryosphere Training Course devoted to train the next generation of Earth Observation (EO) scientists to exploit data from ESA and operational EO Missions (e.g. the Sentinels) for science and applications development.
Advanced Other Training Courses		
4th Advanced Course on Radar Polarimetry 2017	https://earth.esa.int/web/guest/content-events/-/article/4th-advanced-course-on-radar-polarimetry	The European Space Agency (ESA) is organising the 4th Advanced Course on Radar Polarimetry devoted to train the next generation of Earth Observation (EO) scientists to exploit dual and fully polarimetric data for science and applications

		development. The event will be hosted at ESA ESRIN, Frascati (Rome), Italy The main objectives of the course are to: • Train the next generation of European and Canadian Principal Investigators (PIs); • Explain theoretical principles, processing algorithms, data products and their use in applications; • Introduce available tools and methods for the exploitation of dual polarization and fully polarimetric data; • Provide first-hand and up-to-date information on the state of the art in Radar Polarimetry and Polarimetric SAR Interferometry.
3rd ESA Advanced Course on Radar Polarimetry 2015	https://earth.esa.int/web/guest/content-events/-/article/3rd-esa-advanced-course-on-radar-polarimetry	As part of the Scientific Exploitation of Operational Missions (SEOM) programme element, the European Space Agency (ESA) is organising the 3rd Advanced Course on Radar Polarimetry devoted to train the next generation of Earth Observation (EO) scientists to exploit dual and fully polarimetric data

		for science and applications development. The course will be held at ESA ESRIN in Frascati, Italy, from 19 to 23 January 2015. Post graduate, PhD students, post-doctoral research scientists and users from European countries and Canada interested in Radar Polarimetry and its applications are invited to apply to the 5 day course on the subject.
2nd Advanced Course on Radar Polarimetry 2013	https://earth.esa.int/web/guest/content-events/-/article/2nd-advanced-course-on-radar-polarimetry-1	The 2nd Advanced Course on Radar Polarimetry will be held in ESA/ESRIN, Frascati, Italy. The course will provide a substantial and balanced introduction to the basics and advanced concepts of theory, scattering concepts, systems and applications typical of radar polarimetric remote sensing, as well as hands-on computing exercises on PolSAR and Pol-InSAR data processing for remote sensing applications
Advanced course on RADAR Polarimetry 2011	https://earth.esa.int/web/guest/content-events/-/article/advanced-course-on-radar-polarimetry-7151	ESA is organising the 1st Advanced Course on Radar Polarimetry, a devoted course on SAR Polarimetry, Polarimetric Interferometry and its applications. The course will be hosted in ESRIN, Frascati, Italy on 17-21 January 2011. PhD students from European countries and Canada, interested in Radar polarimetry, are invited to attend.

		Subject to availability, Principal Investigators and students from all other countries are also welcome to apply.
Advanced Land Training Courses		
7th Advanced Training Course on Land Remote Sensing 2017	https://earth.esa.int/web/guest/content-events/-/article/7th-advanced-training-course-on-land-remote-sensing	As part of the Scientific Exploitation of Operational Missions (SEOM) programme element, the European Space Agency (ESA) has organised an Advanced Land Training Course devoted to train the next generation of Earth Observation (EO) scientists to exploit data from ESA and operational EO missions (e.g. the Sentinels) for science and applications development. Post graduate-level, PhD students, post-doctoral research scientists and users from Europe and Canada interested in land remote sensing and its applications are welcome to apply to the 6-day course which shall be held at Szent István University (SZIU), in Gödöllő, Hungary from 04 to 09 September 2017.
6th ESA Advanced Training Course on Land Remote Sensing 2015	https://earth.esa.int/web/guest/content-events/-/article/6th-esa-advanced-training-course-on-land-remote-sensing	As part of the Scientific Exploitation of Operational Missions (SEOM) programme element, the European Space Agency (ESA) organises each year an advanced Land Training Course devoted to train the next generation of Earth Observation (EO) scientists to exploit data from ESA and operational

		EO Missions (e.g. Sentinels) for science and applications development. Post graduate, PhD students, post-doctoral research scientists and users from European countries and Canada interested in Land Remote Sensing and its applications are invited to apply to the 5 day course on the subject, which will be held at the University of Agronomic Science and Veterinary Medicine, in Bucharest, Romania from 14 to 18 September 2015.
5th ESA Advanced Training Course on Land Remote Sensing 2014	https://earth.esa.int/web/guest/content-events/-/article/5th-advanced-training-course-on-land-remote-sensing	As part of the Scientific Exploitation of Operational Missions (SEOM) programme element, the European Space Agency (ESA) organises each year an advanced Land Training Course devoted to train the next generation of Earth Observation (EO) scientists to exploit data from ESA and operational EO Missions for science and applications development.
4th Advanced Training Course in Land Remote Sensing 2013	https://earth.esa.int/web/guest/content-events/-/article/4th-advanced-training-course-in-land-remote-sensing-1	The European Space Agency (ESA) is organising a series of advanced thematic training courses devoted to train the next generation of Earth Observation (EO) scientists to exploit data from ESA and Third Party EO Missions for science and applications development. Post graduate, PhD students, post-doctoral research scientists and users from European countries and

		Canada interested in land remote sensing and its applications are invited to attend a 5 day course which will be held in Harokopio University, Athens, Greece from 1 to 5 July 2013. Research scientists and students from all other countries are also welcome to apply and participate to the course, subject to space availability.
Advanced Training Course on Land Remote Sensing 2011	https://earth.esa.int/web/guest/content-events/-/article/advanced-training-course-in-land-remote-sensing-7501	The European Space Agency is organising a series of advanced thematic training courses devoted to train the next generation of EO PIs to exploit data from ESA and Third Party EO Missions for science and applications development.
Advanced Training Course on Land Remote Sensing 2009	https://earth.esa.int/web/guest/content-events/-/article/advanced-training-course-on-land-remote-sensing-5672	ESA is organising a series of advanced thematic training courses devoted to train the next generation of Earth Observation Principal Investigators to exploit data from ESA and Third Party EO Missions for science and applications development. PhD students, post-doctoral and research scientists from European countries and Canada interested in Land remote sensing applications are invited to attend this 6 day advanced training course on the subject, organised by the Czech Space Office and ESA.
Advanced Training Course on Land Remote Sensing 2007	https://earth.esa.int/web/guest/content-events/-/article/advanced-training-course-on-land-remote-sensing-4798	The training course will be devoted to the exploitation of Earth Observation data from ESA and Third Party Mission instruments for land applications,

		with a focus on applications over Europe. It is hosted by the Instituto Superior de Estatística e Gestao de Informaçao, Universidade Nova de Lisboa (ISEGI-UNL), with coordination support from the Remote Sensing Unit of the Portuguese Geographic Institute (Instituto Geográfico Portugues, IGP).

Other EO Training: https://earth.esa.int/web/guest/eo-education-and-training/university-undergraduate-level

TITLE	LINK	DESCRIPTION
10th ESA Training on Earth Observation (17 - 21 September 2018)	https://earth.esa.int/web/guest/training-packages/-/article/10th-esa-training-on-earth-observation-17-21-september-2018	Training on Earth Observation from optical and radar sensors, with emphasis on combining Sentinel-1 and Sentinel-2 for environmental applications. The course will be held in Bratislava, Slovakia.
Multi-sensor Approaches in Studying Land Cover/Land Use Change (07 - 11 June 2018)	http://web.natur.cuni.cz/gis/tat/?page_id=24	Training for early-career scientists on remote sensing of land-cover changes and ecosystem dynamics. The purpose of the Trans-Atlantic Training (TAT) courses are to share and discuss advanced research methods and technologies from space during a series of meetings for scientists and students from both Europe and the USA.
9th ESA Training on Radar and Optical Remote Sensing (3 - 7 July 2017)	https://earth.esa.int/web/guest/training-packages/-/article/9th-esa-training-on-radar-and-optical-remote-sensing-3-7-july-2017-	Course aimed at the promotion and dissemination of Earth Observation (EO) technology in a variety of science and industry fields for postgraduate

		students, mainly from ESA European Cooperating States (ECS). The course was held in Vilnius, Lithuania.
Multi-sensor Approaches in Studying Land Use/Land Cover Change (16 - 20 June 2017)	http://web.natur.cuni.cz/gis/tat/	Training course on the evaluation of impacts of land use/land cover change on ecosystems (e.g. forest disturbances, agricultural land changes) through multisensor analysis. The training is the fifth in the series of Trans-Atlantic Training (TAT) courses.
8th ESA Training Course on Radar and Optical Remote Sensing (5 - 9 Sep 2016)	https://earth.esa.int/web/guest/training-packages/-/article/8th-esa-training-course-on-radar-and-optical-remote-sensing	Theory and practical training course on optical and radar remote sensing. Practical exercises focus on the processing of Sentinel data with the Sentinels Application Platform (SNAP) software. The course is held in Cesis, Latvia.
7th ESA Training Course on Radar Remote Sensing (30 May - 4 Jun 2016)	https://rrs16.esa.uacg.bg/	Training course on the theory and applications of space-borne Synthetic Aperture Radar (SAR). The course is held in Sofia, Bulgaria.
3rd ESA-EARSeL course on remote sensing for archaeology (9-11 November 2015)	http://earth.esa.int/heritage/2015-events/15m38/training.html	Training on remote sensing for archaeological applications. Held at ESA/ESRIN on the occasion of the 5th EARSeL workshop "Advances in Remote Sensing for Cultural Heritage: from site detection, to documentation and monitoring".
6th ESA Training Course on Radar Remote Sensing (7 - 11 Sep 2015)	https://earth.esa.int/web/guest/training-packages/-/article/6th-esa-training-course-on-radar-remote-sensing-7-11-september-2015	Training course on the theory and applications of space-borne Synthetic Aperture Radar (SAR). The course is held in Maribor, Slovenia.
ESA Synthetic Aperture Radar Course, Malta (10 - 14 Nov 2014)	https://earth.esa.int/web/guest/training-packages/-/article/esa-synthetic-aperture-radar-course-malta-10-14-nov-2014	A modular course on space-borne Synthetic Aperture Radar (SAR), at beginner level, for different thematic application areas (forest, agriculture, marine applications, GIS/GPS integration, archaeology).
Radar Remote Sensing Course 2013 (16 - 20	https://earth.esa.int/web/guest/training-packages/-	The training course will provide participants with

Sep 2013)	/article/radar-remote-sensing-course-2013	an introduction to radar remote sensing technology as well as examples of end-user applications of this technique relevant to Cyprus. The course takes place in Nicosia, Cyprus.
Radar Remote Sensing Technology and Environmental Applications (16 - 20 Apr 2012)	https://earth.esa.int/web/guest/training-packages/-/article/radar-remote-sensing-technology-and-environmental-applications	Training course providing an introduction to Radar Remote Sensing Technology and Environmental Applications. Tartu, Estonia.
SAR Capacity Building Course (05 - 09 Sep 2011)	https://earth.esa.int/web/guest/training-packages/-/article/sar-capacity-building-course	Training in SAR applications to glacier monitoring exploiting ESA SAR/ASAR data. The course was held in Bariloche, Argentina.
ESA / University of Szeged / DLR - Radar Remote Sensing Course (13 - 17 Jun 2011)	https://earth.esa.int/web/guest/training-packages/-/article/radar-remote-sensing-course	Training course on theory and applications of SAR (Synthetic Aperture Radar). Applications covered include: forestry, agriculture, biomass and disaster monitoring.
Coast Guards' Training Course in Remote Sensing for Marine Applications (10 Feb 2011)	https://earth.esa.int/web/guest/training-packages/-/article/coast-guards-training-course-in-remote-sensing-for-marine-applications	Theory on remote sensing for marine applications with a focus on SAR. Practical exercise on processing SAR data for marine applications using NEST.
AndesSAT 2010 Practical Sessions (25 - 29 Oct 2010)	https://earth.esa.int/web/guest/training-packages/-/article/andessat-2010-practical-sessions	Exercises in processing with ESA EO software toolboxes for applications related to mountain regions.
ESA / Polish Academy of Science / DLR - Radar Remote Sensing Course - Warsaw (06 - 10 Sep 2010)	https://earth.esa.int/web/guest/training-packages/-/article/esa-polish-academy-of-science-dlr-radar-remote-sensing-course-warsaw	Theory and practical exercises on the applications of SAR (Synthetic Aperture Radar) applied to forestry, agriculture, biomass and disaster monitoring.
ROSA / ESA / DLR - Radar Remote Sensing Course (26 - 30 Oct 2009)	https://earth.esa.int/web/guest/training-packages/-/article/radar-remote-sensing-course-1	Training in radar remote sensing theory and applications with a focus on TerraSAR-X data (but including also ASAR).
EO training during XIV SBSR (26 Apr 2009)	https://earth.esa.int/web/guest/training-packages/-/article/eo-training-during-xiv-sbsr	Exercises in use of ESA and UNESCO EO toolboxes. Applications include disaster mapping and environmental degradation monitoring. SAR

		and optical data used.
CEOS Case Studies of EO in Risk Management (2009)	https://earth.esa.int/web/guest/training-packages/-/article/ceos-case-studies-of-eo-in-risk-management	Exercises including flood mapping, burnt area mapping and oil slick monitoring using optical and radar data and a variety of software.
SAR Land Applications Tutorial (2009)	https://earth.esa.int/web/guest/training-packages/-/article/sar-land-applications-tutorial	Presentation on SAR processing and applications. Exercise using ENVISAT ASAR data and Bilko software.

Miscellaneous

Title	Description	Online or face2face	Date and Place	link
The Frozen Frontier: Monitoring the Greenland Ice Sheet from Space	This online course highlights how the Greenland ice sheet is monitored from space and the ground. You'll look at the measurements made possible by Earth Observation (EO) satellites like Cryosat, the technologies and techniques involved, the data generated, and its uses and challenges.	online	Duration 3 weeks 4 hours per week Date to be announced	https://www.futurelearn.com/courses/greenland-ice-sheet
Earth Observation from Space: the Optical View	This free online course will provide an introduction to optical Earth observation - monitoring our planet from satellites, using photography, imaging in various wavelengths, lidar and other optical sensing technologies. You'll find out how satellite data is	online	Free Access to this course for 7 weeks Includes any articles, videos, peer reviews and quizzes Duration 5 weeks	https://www.futurelearn.com/courses/optical-earth-observation https://view.vzaar.com/10971480/download/hd

	acquired and used, the range of data types available, and the terminology and techniques involved. The course will also provide detailed case studies of how this data is used in diverse fields, from climate science to humanitarian relief, monitoring of urban change to agriculture, and many other areas.		4 hours per week	
Monitoring Climate from Space	In this free online course, you will join leading experts and scientists from ESA and key European research centres, to explore the science that underpins Earth observation. We will look at recent and current satellite missions that are providing an archive of essential data; and find out how this data is used in local and international policy and planning.	online	The 'live run' of the course, allowing you to interact with experts and other learners, will continue until 28th August 2016, and you can register any time up to that date Duration 5 weeks 3 hours per week	https://www.futurelearn.com/courses/climate-from-space
ESA Cryosphere Remote Sensing Training Course 2018	Advanced training course on remote sensing of the Cryosphere, devoted to train the next generation of scientists and specialists to exploit EO data for science and applications.	Face2face	University Centre in Svalbard (UNIS) in Longyearbyen, Svalbard, from 11 to 16 June 2018.	http://eoscience4society.esa.int/CTC18/
8th Advanced Training Course on Land Remote	Advanced Training Course on Land Remote Sensing dedicated to training the next generation of Earth Observation (EO) scientists to exploit data from EO missions (e.g. the Copernicus Sentinels) for science and applications	Face2face	University of Leicester in the United Kingdom during 10–14 September 2018.	http://eoscience.esa.int/landtraining2018/

	development. The course is part of ESA's EO Science for Society – Scientific Exploitation element of EOEP-5 (the fifth cycle of ESA's Earth Observation Envelope Programme).			
7th International EarthCARE Science Workshop in conjunction with First ESA EarthCARE Validation Workshop	The workshop will provide the forum for the discussion of the preparation of the mission exploitation and its product validation. It combines the Seventh International EarthCARE Science Workshop – following the sixth workshop held in 2014 in Tokyo – and the First ESA EarthCARE Validation Workshop, following ESA's Announcement of Opportunity for submitting proposals for the calibration and validation of EarthCARE, to organize the activities of the Principal.	Face2face	11 – 15 June 2018, Bonn, Germany	https://atpi.eventsair.com/QuickEventWebsitePortal/earthcare/home
ESA ECS Training Course on Earth Observation	The main aim of this Training on Earth Observation course is to promote and disseminate Earth Observation (EO) technologies in various scientific and industrial fields providing theoretical information followed by practical computer exercises on ESA EO data and available Sentinel data. The focus on the Earth Observation (EO) technologies varies from optical and radar sensors, with emphasis on combining Sentinel-1	Face2face	17th – 21th September 2018 Slovak Centre of Scientific and Technical Information (SCSTI) in Bratislava.	http://slovak.space/ESA-ECS-Training-Slovakia-2018.html

	and Sentinel-2 for environmental applications. The practical will demonstrate the use of the Sentinels Application Platform (SNAP) software and the Copernicus Research and User Support (RUS) Service.			
Echoes in Space: Introduction to Radar remote sensing	Echoes from space will take you on a journey through the exciting world of Radar Remote Sensing. Learn the basics that will help you to understand where this technology is coming from, how the images are acquired and which manifold applications already use Radar Remote Sensing to help protect our planet. Funded by ESA Developed by JENA	MOOC	Echoes in space is closed for now	https://eo-college.org/landingpage https://eo-college.org/courses/echoes-in-space/

ANNEX V – RUS-TRAINING

RUS Training session

Title	Description	Online or face-to-face	Date	Place	Link
SENTINEL data use for urban mapping and monitoring *RUS environment demo*	This two day hands-on training course is organized by RUS Copernicus as a part of EARsel 5th Joint Workshop "Urban Remote	Face2face	Wednesday 26th September 2018 - Thursday 27th September 2018	Ruhr-Universität Bochum Universitätsstraße 150, 44801 Bochum, Germany	https://rus-training.eu/training/sentinel-data-use-for-urban-mapping-and-monitoring

	Sensing – Challenges & Solutions" taking place in Bochum, Germany. The main goal of this training session is to create theoretical and practical competences on the use of Sentinel data for urban mapping and monitoring. We will be looking at topics such as urban extent, urban sprawl based on multi-temporal and multi-sensor analysis and urban land subsidence using SAR Interferometry (InSAR). The course includes lectures on the theory of satellite image processing and classification as well as hands-on exercises				
SAR and optical data fusion *Hands-on session using the ESA Toolbox SNAP*	This session will be divided in: A theoretical lecture where the Sentinel missions will be introduced aiming to provide an overall background on image fusion methods and applications, A hands-on session with data processing exercises about Sentinel-1 and Sentinel-2 data fusion methods and applications. The hands-on session will be based on Open tools developed within the ESA SEOM Programme (with focus on the ESA SNAP	Face2face	Sunday 22nd of July 2018	The participation to the course is open to the people registered to the International Geoscience and Remote Sensing Symposium (IGARSS 2018). Feria Valencia Avinguda de les Fires, s/n, 46035 València, Valencia, Spain	https://rus-training.eu/training/sar-and-optical-data-fusion

	Toolbox, STEP platform) in the RUS environment.				
Mapping Arctic lakes from space - *A tutorial on Copernicus data access and processing*	This training session will demonstrate the usage of the Open Tools (ESA SNAP, Orfeo Toolbox, QGIS, etc.) available within the RUS environment for mapping water bodies using satellite data, focusing specifically on Arctic landscapes. The training will be provided as part of the 5th European Conference on Permafrost programme (EUCOP5 2018).	Face2face	Wednesday 27th of June 2018 Duration 4.5 hours	241 Allée du Majestic, 74400 Chamonix-Mont-Blanc, France	https://rus-training.eu/training/mapping-arctic-lakes-from-space
Exploiting Copernicus satellite data for GIS and cartographic applications *RUS environment demo: Exploiting Copernicus satellite data within a cloud computing environment for GIS and cartographic applications during 7 ICC&GIS*	During this demonstration, which will be held as part of the 7th International Conference on Cartography and GIS, you will get familiar with the RUS environment and will be informed on how to request a RUS Virtual Machine for Earth Observation projects and activities exploiting the Copernicus Sentinel data. During the showcase, you will learn about the Sentinel missions and how to download and process Sentinel data for applications such as DEM generation. Examples on how to integrate Earth Observation data in a GIS environment will be shown	Face2face	Thursday 21st of June 2018 Duration 4 hours	The participation to the course is open to the people registered to the 7th International Conference on Cartography and GIS (7 ICC&GIS). https://iccgis2018.cartography-gis.com/	https://rus-training.eu/training/exploiting-copernicus-satellite-data-for-gis-and-cartographic-applications

	as well.				
Land Subsidence mapping with Sentinel-1 *RUS environment demo*	In this webinar, you will learn how to use SAR interferometry (InSAR) to identify and map land subsidence using the ESA SNAP Sentinel-1 Toolbox. We will show you how to access the RUS Service and how to download, process, analyse and visualize the free data acquired by the Copernicus satellites.	Webinar	Thursday 14th of June 2018 1 hour + 20 minutes for Q&A		https://rus-training.eu/training/land-subsidence-mapping-with-sentinel-1 https://youtu.be/w6ilV74r2RQ
Sentinel data use for Forestry and Crop Mapping - *RUS Hands-on exercises on the use of Sentinel data over forested areas and for crop mapping during TAT 2018*	Two hands-on sessions on the use of Sentinel data over forested areas and for crop mapping are provided by RUS within the Trans-Atlantic Training event. The topic of TAT 2018 (TAT-6) is Integration of Radar and Optical Remote Sensing in Studying Land Cover/Land Use Change. Lectures and training activities will be focused on the evaluation of ecosystems (e.g. forest disturbances, agricultural land changes and abandonment) by using different types of sensors.	Face2face	Thursday 7th of June 2018 - Monday 11th of June 2018	University of Zagreb, Trg Republike Hrvatske 14, 10000, Zagreb, Croatia	https://rus-training.eu/training/sentinel-data-use-for-forestry-and-crop-mapping
Oil spill mapping with Sentinel-1 *RUS environment demo: Oil spill mapping with Sentinel-1*	In this webinar, you will learn the basics of image processing for oil spill mapping. We will show you how to access the RUS Service and how to download, process, analyse and visualize the free data acquired by the Copernicus	Webinar	Tuesday 15th of May 2018 Duration 1 hour + 20 minutes for Q&A		https://rus-training.eu/training/oil-spill-mapping-with-sentinel-1

	satellites. We will employ the ESA SNAP Sentinel-1 Toolbox to demonstrate the methodology to map an area affected by this type of pollution.				
Sentinel-1 InSAR for Subsidence monitoring - *Introduction to RUS environment: Sentinel-1 InSAR for Subsidence monitoring*	This Short Course, demonstrating the usage of the Open Tools available within the RUS environment in a practical case and focusing on the exploitation of Sentinel-1 (SAR) interferometric data, will be provided as part of the EGU General Assembly 2018 event.	Face2face	Tuesday 10th of April 2018	Austria Center Vienna, Bruno-Kreisky-Platz 1, 1220 Wien, Austria	https://rus-training.eu/training/sentinel-1-insar-for-subsidence-monitoring
Mapping waterbodies from space - *RUS environment demo: Mapping waterbodies from space*	This is a special edition of our monthly webinar as it is part of the 2nd International Electronic Conference on Remote Sensing, a free-of-charge, online-only event. You will learn about the basic methods of mapping waterbodies from space using Sentinel-1 SAR and Sentinel-2 Optical data. We will show you how to access the RUS Service and how to download, process, analyse and visualise the free data acquired by the Copernicus satellites using ESA SNAP Toolboxes	Webinar	Tuesday 3rd of April 2018		https://rus-training.eu/training/mapping-waterbodies-from-space
Land monitoring with Sentinel-3 - *RUS environment demo:*	In this webinar, you will learn the basics of image processing for land dynamics monitoring. We will	Webinar	Tuesday 13th of March 2018		https://rus-training.eu/training/land-monitoring-with-sentinel-3

Land monitoring with Sentinel-3	show you how to access the RUS Service and how to download, process, analyse and visualise the free data acquired by the Copernicus satellites. We will employ the ESA SNAP Sentinel-3 Toolbox to demonstrate the methodology for monitoring land surface dynamics.				
Ocean colour monitoring with Sentinel-3 - *RUS environment demo: Ocean colour monitoring with Sentinel-3 data using ESA SNAP S-3 Toolbox*	In this webinar, you will learn the basics of image processing for ocean colour monitoring: we will show you how to access the RUS Service and how to download, process, analyse and visualise the free data acquired by the Copernicus satellites. We will employ the ESA SNAP Sentinel-3 Toolbox to demonstrate the methodology for the detection and mapping of phytoplankton blooms.	Webinar	Wednesday 21st of February 2018		https://rus-training.eu/training/ocean-colour-monitoring-with-sentinel-3
Sentinel data use for Land Cover and Forest Fires monitoring - *Using Sentinel data for Land Cover Land Use (LCLU) monitoring and Forest Fires applications - face-to-face theory and practice in Lisbon (Portugal)*	The main goal of this training session is to create theoretical and practical competences on the use of Sentinel data for Land Cover Land Use (LCLU) monitoring (i.e. mapping and change detection) and for forest fires related applications (e.g. fire risk and burned area mapping). This training course is the outcome of the Copernicus Training and	Face2face	Thursday 8th of February 2018 - Friday 9th of February	NOVA IMS Information Management School, Campus de Campolide, 1070-312 Lisboa, Portugal	https://rus-training.eu/training/land-cover-and-forest-fires-monitoring

	Information session which took place in Lisbon on 7 June 2017, where the requirements for hands-on sessions were defined and participants' interest collected.				
Crop mapping with Sentinel-2 - *RUS environment demo: Crop mapping in Spain with Sentinel-2 data using ESA SNAP S-2 Toolbox*	In this webinar, you will learn the basics of image processing for crop mapping: we will show you how to access the RUS Service and how to download, process, analyse and visualise the free data acquired by the Copernicus satellites. We will employ the ESA SNAP Sentinel-2 Toolbox to demonstrate the crop mapping methodology over the agricultural area of the Guadalquivir Marshes near Seville, Spain.	Webinar	Tuesday 16th of January 2018		https://rus-training.eu/training/crop-mapping-with-sentinel-2
Burned area mapping with Sentinel-2 - *RUS environment demo: burned area mapping in Portugal with Sentinel-2 data using ESA SNAP S-2 Toolbox*	In this webinar, you will learn the basics of image processing for burned area mapping: we will show you how to access the RUS service and how to download, process, analyse and visualise the free data acquired by the Copernicus satellites constellation. We will employ the ESA SNAP Sentinel-2 Toolbox to demonstrate the burned area mapping methodology on the disastrous wildfires that occurred in central Portugal in June 2017.	Webinar	Tuesday 5th of December 2017		https://rus-training.eu/training/burned-area-mapping
Flood Mapping with	In this webinar, you will learn the	Webinar	Tuesday 7th of		https://rus-

Sentinel-1 - *RUS environment demo: flood mapping in Malawi with Sentinel-1 data using ESA SNAP S-1 Toolbox*	basics of image processing for flood mapping: we will show you how to access the RUS service and how to download, process, analyse and visualise the free data acquired by the Copernicus satellites constellation. We will employ the ESA SNAP Sentinel-1 Toolbox to demonstrate the flood mapping methodology on the disastrous event that occurred in January 2015 in Malawi.		November 2017		training.eu/training/flood-mapping-webinar
Ship Detection with Sentinel-1 - *RUS environment demo: ship detection with Sentinel-1 data using ESA SNAP S-1 Toolbox*	In this webinar you will learn the basics of image processing for ship detection: we will show you how to access the RUS service and how to download, process, analyse and visualise the free data acquired by the Copernicus satellites constellation. We will employ the ESA SNAP Sentinel-1 Toolbox to demonstrate an example of marine surveillance in the Gulf of Trieste, Italy using Sentinel-1 satellite-borne Synthetic Aperture Radar (SAR).	Webinar	Thursday 5th of October 2017		https://rus-training.eu/training/ship-detection-webinar
Flood monitoring with Sentinel-1 data - *RUS environment demo*	After a general introduction on RUS, this hands-on session focused on an example of flood mapping in Malawi using Sentinel-1 data. All participants were provided with access to the RUS Virtual Machines, as well as with step by	Face2face	Wednesday 5th of July 2017	Università degli Studi di Trieste, Piazzale Europa, 1, 34127 Trieste TS, Italia	https://rus-training.eu/training/flood-monitoring-sentinel-1

	step instructions on downloading, visualising and processing SAR data.				
Ship detection with Sentinel-1 data - *RUS environment demo*	After a general introduction on RUS, this hands-on session focused on ship detection in the Gulf of Trieste using Sentinel-1 data. All participants were provided with access to the RUS Virtual Machines, as well as with step by step instructions on downloading, visualising and processing SAR data	Face2face	Wednesday 5th of July 2017	Università degli Studi di Trieste, Piazzale Europa, 1, 34127 Trieste TS, Italia	https://rus-training.eu/training/ship-detection-sentinel-1
InSAR application to Earthquakes	A demo on the use of Sentinel-1 data for monitoring the Amatrice earthquake (2016) presented during Fringe 2017.	Face2face	Thursday 8th of June 2017	Helsinki, Finland	https://rus-training.eu/training/insar-earthquakes

RUS e-Learning

Title	Description	Duration	Published on	Author	Link
SAR 05 - Loi de Rayleigh, notions sur le filtrage	Origin of the speckle, successively in the case of a pixel containing 1 target, then 2 targets, then a large number of targets. Variability of the amplitude response for a homogeneous zone, presentation of the Rayleigh law, coefficient of variation (standard deviation on average) on a neighbouring pixel. Simple averaging filter or matched filter. Effect of filtering on the coefficient of variation. Number of views. *Materials derived from a SAR Basic Theory Course organised by ESA and given by prof. J-P. Rudant.*	28m 47s	19 April 2018	Jean-paul Rudant Professeur chez Université Paris-Est Marne-la-Vallée	https://rus-training.eu/course/sar-05-loi-de-rayleigh-notions-sur-le-filtrage Chapters list: 01 Principe Speckle / Speckle principle (10:17)

					02 Loi de Rayleigh / Rayleigh law (05:28) 03 Filtres / Filters (13:02)
SAR 04 - Lecture et visualisation d'images	Coding of amplitude images and complex images, visualisation of real and imaginary parts, phase, amplitude and intensity. 16 bit per pixel encoding compression to 8 bit per pixel for visualisation. *Materials derived from a SAR Basic Theory Course organised by ESA and given by prof. J-P. Rudant.*	15m39s	9 March 2018	Jean-paul Rudant Professeur chez Université Paris-Est Marne-la-Vallée	https://rus-training.eu/course/sar-04-lecture-et-visualisation-d-images Chapters list: 01 Images IW Sentinel-1/ Sentinel-1 IW images (02:29) 02 Visualisation d'images / Image visualization (05:52) 03 Extraction d'une sous image / Sub-setting an image (07:18)
SAR 03 - Premières illustrations d'images	Discussion of the factors influencing the RADARresponse, ground pixel surface, local incidence, hemispheric reflectivity, directional coefficient, wavelength, polarization. Comparison of the effects of relief on an optical image and on a RADAR image, comparison of different polarizations, highlighting effects of roughness. *Materials derived from a SAR Basic Theory Course organised by ESA and given by prof. J-P. Rudant.*	18m 54s	5 March 2018	Jean-paul Rudant Professeur chez Université Paris-Est Marne-la-Vallée	https://rus-training.eu/course/sar-03-premieres-illustrations-d-images Chapters list: 01 Analyse d'une image ERS / The analysis of an ERS image (07:08) 02 Analyse des images RADAR / The analysis of RADAR

					images (07:09) 03 Comparaison des images optiques vs RADAR / Optical images vs RADAR images (04:37)
SAR 02 - Équation RADAR revisitée (et simplifiée) pour la télédétection	Spatial variability of responses over a homogeneous area, calculation of average values, energy received by a ground pixel, reflected energy, backscattering, RADAR vs optical remote sensing. *Materials derived from a SAR Basic Theory Course organised by ESA and given by prof. J-P. Rudant.*	17m 8s	19 January 2018	Jean-paul Rudant Professeur chez Université Paris-Est Marne-la-Vallée	https://rus-training.eu/course/sar-02-equation-radar-pour-la-teledetection Chapters list: 01 L'équation RADAR (a) / The RADAR equation (a) (06:49) 02 L'équation RADAR (b) / The RADAR equation (b) (07:41) 03 Télédétection RADAR vs optique / RADAR vs optical remote sensing (02:38)

SAR 01 - Introduction des images RADAR	General introduction to RADAR images, microwaves domain, pixel measurement for a RADAR image (amplitude and phase), concepts of polarization, RADAR geometry and range and azimuth resolution. *Materials derived from a SAR Basic Theory Course organised by ESA and given by prof. J-P. Rudant.*	22m 56s	3 January 2018	Jean-paul Rudant Professeur chez Université Paris-Est Marne-la-Vallée	https://rus-training.eu/course/sar-01-introduction-des-images-radar Chapters list: 01 Les images RADAR / The RADAR images (05:30) 02 Les mesures RADAR / The RADAR measurements (02:59) 03 La structure de l'image / The image structure (04:59) 04 La géométrie RADAR (a) / The RADAR geometry (a) (06:03) 05 La géométrie RADAR (b) / The RADAR geometry (b) (03:25)

ANNEX VI – EUMETSAT TRAINING

From https://www.eumetsat.int/website/home/Images/ImageLibrary/index.html

Title	Description
DENSE DUST OUTBREAK ACROSS THE ARABIAN PENINSULA	Summer Shamal pushed dense dust across the Arabian peninsula to its south coast and out over the Arabian Sea in late July/early August 2018.
FIRST IMAGES FROM SENTINEL-3B	In early May the first images from the new Sentinel-3B were released. This case takes a quick tour though some of the elements visible in the imagery.
TRANSPORT OF AFRICAN-ARABIAN DUST TO PAKISTAN AND NORTH INDIA	In May 2018 dust clouds from Africa and the Arabian peninsula travelled as far as India.
SEA-ICE MELT RESULTED IN COLD WATER SPILL OVER THE LABRADOR CURRENT	Ice melt along the Labrador coast resulted in freshwater water spill over the Labrador Current, showing some very steep gradients in temperature and chlorophyll concentration fields while meeting the warm Gulf current around Newfoundland.
USING SENTINEL-3 TO MONITOR CHLOROPHYLL CONCENTRATIONS IN THE BLACK SEA	Using Sentinel-3 ocean colour data to investigate the question 'Does a light breeze influence the distribution of chlorophyll concentrations in the Black Sea?'.
ANOTHER PHASE OF ERUPTIONS FROM VOLCANO AOBA (VANUATU)	Since September 2017 volcano Aoba, in the archipelago of Vanuatu, had been showing intermittent activity. Between 5 and 14 April 2018 there was further increased activity.
LONG-RANGE DUST OUTBREAK OVER AFRICA AND GREECE	In late March 2018 a cold outbreak drove Saharan dust from the Atlas mountains down to the south-west coast of Africa and on to Greece.
HERRING SPAWN SEEN FROM SPACE	Optical sensors on two of the Sentinel satellites spotted a herring spawning event near Vancouver Island in March 2018.
SENTINEL-3 'SEES' BLACK SMOKE FROM SHIP FIRE	In early March 2018 Sentinel-3 'saw' black smoke from a container ship fire, thanks to sunglint from the ocean surface.
SULPHUR PLUMES OFF NAMIBIA 'SEEN' BY SENTINEL-3	Using Sentinel-3 satellite data to explain bright waters and unusual smells during a cruise to monitor carbon.
VIOLENT BLAST FROM SINABUNG VOLCANO	Ash plumes from the eruption of the Indonesian volcano Sinabung could be seen in satellite imagery on 19 February 2018.

SOUTH AFRICAN ALGAL BLOOMS	Detection of harmful algal blooms in the southern Benguela, as seen by OLCI aboard Sentinel-3.
IMAGE LIBRARY TOP TEN FOR 2017	A look at our most popular case studies from 2017.
ERUPTION OF VOLCANO AOBA (AMBAE) IN VANUATU ARCHIPELAGO	Located on the small island Aoba, or Ambae, in the South Pacific nation of Vanuatu, the volcano of the same name erupted in the days from 22 September 2017 onward.
SEVERE FLOODING IN CORNWALL	The small village of Coverack in West Cornwall was badly damaged by flooding after a storm brought torrential rain to the area on 18 July 2017.
DEVASTATING WILDFIRES IN PORTUGAL	Hot spots and smoke from a deadly, widespread forest fire in central Portugal could be seen by Meteosat, Sentinel-3 and Suomi-NPP on 18, 19 & 20 June 2017
FLOODS IN SOUTH AMERICA	Due to reinforcing of El Niño along the western coast of South America, large areas of Colombia, Ecuador and Peru were severely affected by weeks of almost continuous rain in March and April 2017.
CLEAR SKIES FOR START OF BRITISH SUMMER TIME	The first day of official British Summer Time brought blue skies and above average, warm temperatures to Britain and the UK on 26 March 2017.
CLEAR SKIES OVER THE MEDITERRANEAN	Satellite images of the Mediterranean sea are informative even on clear days, as is shown in this case from March 2017.
OIL SPILL OVER ARABIAN GULF	On 8 March 2017 an oil spill occurred in the Arabian Gulf off the west coast of UAE and reached the Al-Fujairah coast.
DUST OVER THE SEA OF OMAN	A large area of dust was seen by both Meteosat and Sentinel-3A as it travelled across parts of the Middle East in November 2016.
RARE RING-OF-FIRE ECLIPSE OVER AFRICA	On 1 September a rare 'ring-of-fire' double eclipse occurred over Africa. Meteosat-10 captured the shadow as the satellite passed over the continent.
BLOOMS IN THE BALTIC SEA	An image of algal blooms and ocean eddies were captured by Sentinel-3A in July 2016.
EXAMPLE OF USING SENTINEL-3 DATA FOR METEOROLOGY	An early look at data from the Ocean and Land Colour Instrument on Sentinel-3.

From http://trainingevents.eumetsat.int/ .

6 events on Europe in English:

Title	When	Where	Description	Type
EUMETSAT	17-21	Tallinn,	EUMETSAT has organised a meteorological satellite conference every year for over	Conference

Meteorological Satellite Conference 2018	September, 2018	ESTONIA	thirty years. During that time, the conference has become a key annual event for the meteorological and scientific communities where participants from around the world can meet to share their experience and knowledge during plenary, poster and workshop sessions. The 2018 conference will discuss such topics as preparing for MTG and EPS-SG, atmospheric chemistry monitoring and applications, and climate and ocean monitoring. The conference location also lends itself to discussions on the topics of observations for the Baltic Basin, as well as Arctic monitoring and applications.	
EUMeTrain Weather Briefing	21 September, 2018 12:00 UTC	ONLINE	Online weather discussion about the phenomena that occurred in the last month, after the last weather briefing. Satellite imagery is used to discuss interesting situations and features. Every month another country, another presenter presents the weather events. The Weather Briefing is hosted by EUMeTrain. Any additional questions can be asked via the provided email.	Online Weather discussion
CALMet Online Design Workshop	27 September, 2018 14:00 UTC	ONLINE	A series of online collaboration sessions for trainers in the field of meteorology. Participants submit current training projects that they would like to discuss with other trainers; much of the workshop focuses on generating ideas for actively engaging our learners. We record and share the ideas, examples, and discussion with everyone who participated in each one-hour long session.	Online workshop
Synoptic and Mesoscale Analysis of Satellite Images 2018	1 October - 1 December, 2018		The course will be offered in a blended format, consisting of an online phase followed by a classroom phase. The location of the classroom phase as well as additional information about the course content and application process will be available soon. Please note that the event dates are provisional.	Blended course
The use of Satellite Products for Agriculture	22-25 October, 2018	Darmstadt, Germany	Expand the use of Land-SAF and Hydrology SAF products and other agencies related products among the European agrometeorologists and water managers to enhance the benefits derived and to collect and exchange experience from that use; Development of capacity building at the NMHS and Ministries of Agriculture in Central and Eastern Europe in relation with vegetation status monitoring, soil moisture, rainfall estimations, sand and dust warnings, radiative balance and land use; Institutional cooperation reinforcement between EUMETSAT, WMO, FAO and the	Classroom course English Europe

			National Institutions of the region in terms of satellite product utilization and reception stations optimization for drought management and agriculture production; Development of the cooperation between the Drought Management Centre for South Eastern Europe and other WMO and FAO partners at the Region and benefit from their experience and methods in drought monitoring and institutional agreements.	
CALMet XIII Conference	17-20 September, 2019	Darmstadt, Germany	CALMET - Inspire, Share and Collaborate Is a forum that brings together educators and trainers from universities, research institutions and National Meteorological and Hydrological Services. During the forum participants share experiences, expectations, and new ideas for applying emerging technologies and strategies in meteorology and hydrology education and training. CALMET provides an opportunity to collaborate and network with international training entities involved with workforce development in support of [national meteorological and hydrological services / the global weather, water and climate enterprise].	Conference

ANNEX VII – EARSel Training resources

Books

Title	Editor	References
Remote Sensing and Digital Image Processing	Anna Jarocinska (EARSeL Series Editor)	ISSN: 1567-3200
Multitemporal Remote Sensing:Methods and Applications	Yifang Ban (Eds.)	ISBN: 978-3-319-47035-1 (Print), 978-3-319-47037-5 (Online)
Remote Sensing Time Series:Revealing Land Surface Dynamics	Claudia Kuenzer & Stefan Dech & Wolfgang Wagner (Eds.)	ISBN: 978-3-319-15966-9 (Print), 978-3-319-15967-6 (Online)
GNSS Remote Sensing:Theory, Methods and Applications	Jin Shuanggen & Estel Cardellach & Feiqin Xie	ISBN: 978-94-007-7481-0 (Print), 978-94-007-7482-7 (Online)
Land Use and Land Cover Mapping in Europe:Practices & Trends	Ioannis Manakos & Matthias Braun (Eds.)	ISBN: 978-94-007-7968-6 (Print), 978-94-007-7969-3 (Online)

Thermal Infrared Remote Sensing:Sensors, Methods, Applications	Claudia Kuenzer & Stefan Dech (Eds.)	ISBN: 978-94-007-6638-9 (Print), 978-94-007-6639-6 (Online)
Satellite Remote Sensing:A New Tool in Archaeology	Rosa Lasaponara & Nicola Masini (Eds.)	ISBN: 978-90-481-8800-0 (Print), 978-90-481-8801-7 (Online)
Land Remote Sensing and Global Environmental ChangeNASA's Earth Observing System and the Science of ASTER and MODIS	Bhaskar Ramachandran, Christopher O. Justice & Michael J. Abrams (Eds.)	ISBN: 978-1-4419-6748-0 (Print), 978-1-4419-6749-7 (Online)
Remote Sensing of Urban and Suburban Areas	Tarek Rashed & Carsten Jürgens (Eds.)	ISBN: 978-1-4020-4371-0 (Print), 978-1-4020-4385-7 (Online)
Radar Remote Sensing of Urban Areas	Uwe Soergel (Ed.)	ISBN: 978-90-481-3750-3 (Print), 978-90-481-3751-0 (Online)
Satellite Radar Interferometry Subsidence Monitoring Techniques	V. B. H. Ketelaar	
Radar Interferometry Persistent Scatterer Technique	Bert Kampes	ISBN: 978-1-4020-9427-9 ISBN: 978-1-4020-4576-9 (Print), 978-1-4723-7 (Online)

EARSeL eProceedings (some of the most relevant)

Title	Author	References
Integration of remote sensing data into forest inventory in close-to-nature forests: An initial case study in Smolnícka Osada, Slovakia	Ivan Sačkov, Maroš Sedliak, Ladislav Kulla, Tomáš Bucha	DOI: 10.12760/01-2017-1-07
ALS for terrain mapping in forest environments: an analysis of lidar filtering algorithms	Mihnea Cățeanu, Ciubotaru Arcadie	DOI: 10.12760/01-2017-1-02
Monitoring post-fire forest recovery using multi-temporal Digital Surface Models generated from different platforms	Irene Aicardi, Matteo Garbarino, Andrea Lingua, Emanuele Lingua, Raffaella Marzano, Marco Piras	DOI: 10.12760/01-2016-1-01
Unsupervised classification of satellite images using K-Harmonic Means Algorithm and Cluster Validity Index	Habib Mahi, Nezha Farhi, Kaouther Labed	DOI: 10.12760/01-2016-1-02
A compact Doppler wind lidar for controlling the operation of wind turbines	Paul Gerke Hofmeister, Christoph Bollig, Sarah Fayed, Martin Kunze, Rainer Reuter	DOI: 10.12760/01-2015-1-01
Deriving a DTM from a DSM by uniform regions and context	Charles Beumier, Mahamadou Idrissa	DOI: 10.12760/01-

		2015-1-02
Monitoring municipal solid waste small magnitude landfill settlement with DInSAR	Pietro Milillo, Eric J. Fielding, Salvatore Masi, Paul Lundgren, Carmine Serio	DOI: 10.12760/01-2015-1-03
Monitoring cultural heritage environments in Svalbard: Smeerenburg, a whaling station on Amsterdam island	Alma Elizabeth Thuestad, Hans Tømmervik, Stian Andre Solbø, Stine Barlindhaug, Anne Cathrine Flyen, Elin Rose Myrvoll, Bernt Johansen	DOI: 10.12760/01-2015-1-04
The applicability of remote sensing and geodetic methods for studying water bodies on the western White Sea coast	Natalia Frolova, Elena Krasnova, Mikhail Fatkhi, Timofey Samsonov, Alexey Sazonov, Anna Telegina, Ekaterina Telegina	DOI: 10.12760/02-2015-1-10
SYSIPHE System: A state of the art airborne hyperspectral imaging system. Initial results from the first airborne campaign	Laurent Rousset-Rouviere, Christophe Coudrain, Sophie Fabre, Yann Ferrec, Laurent Poutier, Trond Løke, Andrei Fridman, Søren Blaaberg, Ivar Baarstard, Torbjorn Skauli, Isabelle Sisakoun	DOI: 10.12760/02-2015-2-02
Feature-based tree species classification using hyperspectral and Lidar data in the Bavarian Forest National Park	Carolin Sommer, Stefanie Holzwarth, Uta Heiden, Marco Heurich, Jörg Müller, Wolfram Mauser	DOI: 10.12760/02-2015-2-05
Satellite remote sensing applied to off-shore wind energy	Sara Venafra, Marco Morelli, Andrea Masini	DOI: 10.12760/01-2014-1-01
Extreme Learning Machine for classification of high resolution remote sensing images and its comparison with traditional Artificial Neural Networks (ANN)	Shailesh Shrestha, Zbigniew Bochenek, Claire Smith	DOI: 10.12760/01-2014-2-02
Multi-sensor ocean colour atmospheric correction for time-series data: Application to LANDSAT ETM+ and OLI data	Samantha Lavender	DOI: 10.12760/01-2014-2-03
Shape-texture features for the VHSR satellite images classification using the MLP neural net	Habib Mahi, Mounia Kaouadji	DOI: 10.12760/01-2014-2-04
Building detection with multi-view colour infrared imagery	Charles Beumier, Mahamadou Idrissa	DOI: 10.12760/01-2014-2-05
Characterization of riparian zones in Wallonia (Belgium) from local to regional scale using aerial Lidar data and photogrammetric DSM	Adrien Michez, Hervé Piégay, Philippe Lejeune, Hugues Claessens	DOI: 10.12760/01-2014-2-06
Potential applications of the Sentinel-2 multispectral sensor and the Enmap hyperspectral sensor in mineral exploration	Christian Mielke, Nina Kristine Bösche, Christian Rogass, Karl Segl, Christoph Gauert, Hermann Kaufmann	DOI: 10.12760/01-2014-2-07
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measurements in Magura National Park (SE Poland)	Ejdys, Łukasz Sławik, Marcin Borowski, Krzysztof Będkowski, Jaroslaw Chormanski	2014-2-08
Data processing of Russian forest fire remote monitoring systems	Vitold Komorovski	DOI: 10.12760/02-2014-1-03
A new method for artefact-free estimation of surface slope from bathymetric Lidar data	Teemu Kumpumäki, Tarmo Lipping	DOI: 10.12760/02-2014-1-01
Use of a Lidar high resolution Digital Elevation Model for risk stability analysis	Nathalie Stephenne, Christophe Frippiat, Mathieu Veschkens, Marc Salmon, Daniel Pacyna	DOI: 10.12760/02-2014-1-05
Wetland Leaf Area Index modelling with field and satellite hyperspectral data	Tomasz Berezowski, Jaroslaw Chormański	DOI: 10.12760/02-2014-1-06
Extraction of urban building heights from LiDAR data: An integrated remote sensing and GIS approach	Muhammad Tauhidur Rahman	DOI: 10.12760/02-2014-1-11
Forest damage assessment using SAR and optical data: Evaluating the potential for rapid mapping in mountains	Ruben Remelgado, Claudia Notarnicola, Ruth Sonnenschein	DOI: 10.12760/02-2014-1-14
A GIS-based flash flood runoff model using high resolution DEM and meteorological data	Evangelia Gioti, Chrisoula Riga, Kleomenis Kalogeropoulos, Christos Chalkias	DOI: 10.12760/01-2013-1-04
Teaching materials, encyclopaedia, easy-to-use image processing – the FIS Learning Portal on remote sensing	Roland Goetzke, Henryk Hodam, Andreas Rienow, Kerstin Voß	DOI: 10.12760/01-2013-2-08
Experimental study on graph-based image segmentation methods in the classification of satellite images	Balázs Dezsö, Roberto Giachetta, István László, István Fekete	DOI: 10.12760/01-2012-1-02
Reconstruction of cloud-free time series satellite observations of land surface temperature	Hamid Reza Ghafarian, Massimo Menenti, Li Jia, Hendrik den Ouden	
Agricultural crop change detection by means of hybrid classification and high resolution images	Eva Savina Malinverni, Michele Rinaldi, Sergio Ruggieri	
Comparative analysis of crop maps for chosen test areas on the territory of Bulgaria and Romania using simulated Proba-V and Spot vegetation data	Eugenia Roumenina, Lachezar Filchev, Vassil Vassilev, Petar Dimitrov, Georgi Jelev, Gheorghe Stancalie, Elena Savin, Denis Mihailescu	
Comparison of methods for land-use classification incorporating remote sensing and GIS inputs	Offer Rozenstein, Arnon Karnieli	
ESA DUE Permafrost: An Earth observation (EO) permafrost monitoring system	Birgit Heim, Annett Bartsch, Kirsten Elger, Hugues Lantuit, Julia Boike, Sina Muster, Moritz Langer, Claude Duguay, Sonia Hachem, Aiman Soliman,	

	Christoph Paulik, Tazzio Strozzi, Frank-Martin Seifert	
Monitoring the reopening of roads in the Democratic Republic of Congo with Earth Observation data	Nathalie Stephenne, Ides Bauwens, Mathieu Rahm, Nicolas Dosselaere	
GlobGlacier: A new ESA project to map the World's glaciers and ice caps from space	Frank Paul, Andreas Kääb, Helmut Rott, Andrew Shepherd, Tazio Strozzi, Espen Volden	
Risk and vulnerability assessment to tsunami hazard using very high resolution satellite data: The case study of Padang, Indonesia	Hannes Taubenböck, Joachim Post, Ralph Kiefl, Achim Roth, Febrin A. Ismail, Günter Strunz, Stefan Dech	
Integration of differential SAR interferometry and ancillary GIS data for the study of superficial deformations	Angela Losurdo, Savina Pacifico, Valentina Sarli, Antonio Colangelo, Maurizio Leggeri	
Use of remote sensing data and GIS technology for assessment of landslide hazards in Susa Valley, Italy	Nora Tassetti, Annamaria Bernardini, Eva Savina Malinverni	
Glacier monitoring by remote sensing and GIS techniques in open source environment	Eva Savina Malinverni, Claudia Croci, Fabrizio Sgroi	
A supervised classification of multi-channel high-resolution SAR data	Dirk Borghys, Christiaan Perneel	
A combined classification scheme to characterise river ice from SAR data	Yves Gauthier, Frank Weber, Stéphane Savary, Martin Jasek, Lisa-Marie Paquet, Monique Bernier	
Snow extent mapping in alpine areas using polarimetric SAR data	Audrey Martini, Jean-Pierre Dedieu, Laurent Ferro-Famil, Monique Bernier, Eric Pottier	
Snow depth mapping in the Alps: Merging of in situ and remotely-sensed data	Nando Foppa, Andreas Stoffel, Roland Meister	

ANNEX VIII – ISPRS list of Educational Sites, Master Courses and Online Courses

Master Courses

Title	Responsible
International M.Sc. in Airborne Photogrammetry	Institut of Geomatics, Barcelona
International M.Sc. in Geodesy and Geoinformatics	KTH - Royal Institute of Technology in Stockholm
International M.Sc. in Geodesy and Geoinformation Science	TU Berlin, Germany
International M.Sc. in Geomatics Engineering	University of Stuttgart
International M.Sc. in Earth Oriented Space Science and Technology	Technische Universität München
International M.Sc. in Photogrammetry and Geoinformatics	University of Applied Sciences in Stuttgart
International M.Sc. in Geo-information Science and Earth Observation	ITC, University of Twente, The Netherlands
International M.Sc. in GeoSpatial Engineering	Spatial Information Sciences Group at the Dublin Institute of Technology (DIT), Ireland
International M.Sc. in Geo-Information Science	Wageningen University, the Netherlands
International M.Sc. Geomatics for the Built Environment	Delft University of Technology, the Netherlands
International M.Sc. in Geodetic Engineering	University of Bonn, Germany
Master on Geoinformation Applications and Management	coorganized by the Departament de Geografia de la Universitat Autònoma de Barcelona, in cooperation with LIGIT (Laboratori d'Informació Geogràfica i Teledetecció) of the UAB, and the Institut Cartogràfic i Geològic de Catalunya (the regional mapping agency from the Catalan Governement), Barcelona, Spain
Master's Programme in Geoinformatics	Aalto University, Finland

French M.Sc. in Photogrammetry, Positioning and Deformation Measurements (PPMD)	ENSG, National School of Geographic Sciences (www.ensg.eu), in Marne la Vallée (close to Paris), France

Online Courses

Title	Responsible	Description
Sensing Planet Earth – From Core to Outer Space	Free online courses from Chalmers University	Deepen your understanding of global change by learning about the techniques and tools used to study the Earth
Sensing Planet Earth – Water and Ice	Free online courses from Chalmers University	Learn how to measure and monitor the Earth's water and ice masses to deepen your understanding of global change

Short Courses

Courses Of Remote Sensing Specialist Certificate.

1 Space Science and Satellites Overview for General Managers & Supervisors
2 Remote Sensing Fundamentals
3 Introduction to Practical Remote Sensing Using ERDAS Imagine
4 Satellite Images Geometric Correction and Map Projection
5 Satellite Images Visual Interpretation
6 Satellite Images Digitizing and Annotation
7 Satellite Images Classification Essential
8 Satellite Images Classification (Advanced) + Image Differencing
9 Map Production From Satellite Images

Courses Of Remote Sensing Proffesional Certificate

10 Satellite Images Subseting and Mosaicking
11 Satellite Images Enhancement
12 Satellite Images Terrain Analysis

13 3D viewing & Simulation For Satellite Images Using Virtual GIS

Courses Of Remote Sensing Solution Developer Certificate

14 Solution Developer Level 1
15 Solution Developer Level 2
16 Solution Developer Level 3

ANNEX IX – Standard metadata for VET courses/modules

Training Module name:
Short Abstract
A summary of the module to be included in the list of the modules of the Training Framework. *This item is not part of the module metadata.* *(max. 10 lines)*
Source
It refers to the context in which the module has been created (most of the module are developed within a specific context or project).
Ownership
Name of author(s), copyright and other restrictions on the usage and license (for instance Creative Commons Attribution Share-Alike License (http://creativecommons.org/licenses/by-sa/3.0/).
Abstract
A written summary (abstract) of the module. *What are the major topics of the module?* *In this section the major subject areas shall be specified. They should be overarching subject areas covered by the trainers to meet the overall aim of the module. Also ensure that the list is an indicative one rather than a precise list of lecture titles, to give the module coordinator the flexibility to keep them updated every year. It is expected that these indicative module contents will be update on a regular basis to keep the module at the cutting edge of the subject area.* *Please also indicate the major formats of the module and if the module is a self-learning module or if an instructor will provide feedback?* *(max. 20 lines)*
Structure
Please indicate the structure of the module in terms of training components, chapters or building blocks, as more appropriate. The structure is an ordered list of learning units.
Learning outcomes
Please indicate what a learner is expected to know, understand and able to do after completing the modules, with reference to the Bloom's taxonomy (action verbs). *Other verbs may be "distinguish between", "choose", "assemble", "adjust", "identify", "solve" "apply" and "list". The learning outcomes should be written from a learners perspective.* *Setting learning outcomes assists in the process of defining the expectations of module developer,*

and provides an effective way of communicating to participants what a module encompasses. Clarity in the expression and description of outcomes will help to improve communication with participants and help them to understand what it is they are trying to achieve. *(max. 15 lines)*
Intended Audience
Please describe the expected audience to which this module interested.
Pre-requisites
Please refer to previous knowledge that is required for the module.
Language
Language(s) of the training material.
Format
Different type of resources (i.e. PPT presentation, presentation with voice, video (<duration>),, screencast, exercises, self-learning questions, teacher feedback etc.).
Expected workload
Expected workload for a learner to achieve the learning outcomes

ANNEX X – HatariLabs TRAINING

Who	Title	Description	Online or face-to-face	Date and Place	link
Blog Hatari Labs HatariLabs is an initiative focused on bringing the newest information related to the use of different software.	Working with Sentinel 2 Imagery on QGIS	This is a group of videos called "Working with Sentinel 2 Imagery on QGIS" that shows the complete procedure to download, represent and process Sentinel 2 images in QGIS.	online		https://www.hatarilabs.com/ih-en/working-with-sentinel-2-imagery-on-qgis **Video List** How to Download ESA Sentinel 2 Satellite Images This tutorial show the procedure to download images of ESA Sentinel 2 from the website: https://scihub.copernicus.eu/ https://www.hatarilabs.com/ih-en/how-to-download-esa-sentinel-2-satellite-images How to Download Specific Granules from ESA Sentinel 2 Images This tutorial show the procedure to download specific granules from a ESA Sentinel 2 Image using the website: https://scihub.copernicus.eu/ https://www.hatarilabs.com/ih-en/how-to-download-specific-granules-from-esa-sentinel-2-images

					How many Spectral Bands have the Sentinel 2 Images? This is a video with a deeper explanation on the band distribution https://www.hatarilabs.com/ih-en/how-many-spectral-bands-have-the-sentinel-2-images How to represent Sentinel 2 Bands in a True Colour Image with QGIS This tutorial show the procedure represent the bands of a Sentinel 2 Granule (Image) in QGIS. The representation of the image is True Colour (Red, Green and Blue) https://www.hatarilabs.com/ih-en/how-to-represent-sentinel-2-bands-in-a-true-color-image-with-qgis How to represent Sentinel 2 Bands in a False Colour Image with QGIS False colour images are used to enhance certain cover types as vegetation on the image representation. This tutorial show the procedure represent the bands of a False Colour image from Sentinel 2 bands in QGIS. https://www.hatarilabs.com/ih-en/how-to-represent-sentinel-2-bands-in-a-false-color-image-with-qgis How to calculate the NDVI Index from a Sentinel 2 Image This tutorial show the procedure to calculate the NDVI from Sentinel 2 bands on QGIS. https://www.hatarilabs.com/ih-en/how-to-calculate-the-ndvi-

					index-from-a-sentinel-2-image How to cut a Raster File on QGIS - Example on a NDVI Layer This tutorial show the procedure to cut a NDVI Raster File calculated from a Sentinel 2 Granule on QGIS. https://www.hatarilabs.com/ih-en/how-to-cut-a-raster-file-on-qgis-example-on-a-ndvi-layer How to create contours from a Raster File - Example on a NDVI Layer This tutorial show the procedure to create contours from a raster file considering interval definition. The example is made from a NDVI raster file. https://www.hatarilabs.com/ih-en/how-to-create-contours-from-a-raster-file-example-on-a-ndvi-layer