



## D4.4 – Training Material

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### Work package / Task:

WP4 – Designing GI and EO curricula in support of Copernicus

T4.3 – Improving existing and developing new training material

### Short Description:

Accompanying document to the delivery of the training material online.

### Keywords:

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CO	Confidential, only for members of the consortium (including EACEA and Commission services and project reviewers)	

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V0.0	27.10.2020	Barbara Hofer, Eva Missoni-Steinbacher	First draft	Drafting the content of the sections
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V2.0	13.01.2021	Barbara Hofer	Final version	Inclusion of comments received by quality evaluation process



## Executive Summary

This document is a supplement to the online training materials provided as results of Task T4.3 – The improvement of existing and development of new training material. The online resources are available on GitHub: <https://github.com/eo4geocourses> and in the training material catalogue: <http://www.eo4geo.eu/training-material-catalogue/>.

This document addresses the objectives of this task and how these objectives were realized. The main points covered are:

- Development of training material for concepts/skills as identified in the business process analysis. The training material partly makes use of existing sources and improves them according to the state-of-the-art EO\*GI technology; this refers, among others, to the use of Copernicus data, Jupyter Notebooks and the Terrascope Platform. The training material comprises conceptual parts to be integrated in case-based learning material in *WP5 – Testing and validating the strategy based on case-based learning scenrio's in 3 sub-sectors*. It covers a variety of educational levels and can be used in vocational education and training as well as in academic courses.
- Innovative and consistent design of training material: in times of distance learning and virtual trainings, a web-based approach for the development of training materials has been pushed using a library for creating web-based slides (*reveal.js*).
- Collaborative development and provision of training material on an extensible platform: the technical infrastructure put in place on GitHub allows the provision and maintenance of training materials. The number of repositories providing training materials can be scaled to the materials required within the project and beyond.
- Findability of training material in a dedicated catalogue: retrieving specific material requires the annotation of resources with metadata. Consistent metadata elements for all training materials have been specified in a format used in web development. The metadata include reference to concepts from the EO\*GI Body of Knowledge.
- Integration of training material with the EO4GEO toolset: the standardized metadata can be included, e.g. in the BoK Matching Tool, to use the training material in comparisons between various resources.



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## Acronyms

Acronym	Description
AI	Artificial Intelligence
API	Application Programming Interface
BoK	Body of Knowledge
CC	Creative Commons
DC	Dublin Core
DIAS	Data and Information Access Services
DoW / DoU	Description of Work / Document of Understanding
EO	Earth Observation (inc. Meteorology)
EO*GI	EO and GI Sector
EQF	European Qualifications Framework
FP7	7 <sup>th</sup> Framework Programme for Research and Technological Development
GI	Geographic Information
GIS	Geographic Information System
GIS&T	Geographic Information Science & Technology
GIS&T BoK	Geographic Information Science & Technology Body of Knowledge
HTML	Hypertext Markup Language
RDFa	Resource Description Framework in Attributes
RS	Remote Sensing
VET	Vocational Education and Training
WP	Work Package



## Glossary

**Blended learning** a type of education in which students learn via electronic and online media as well as traditional face-to-face teaching.

**Bloom's Taxonomy** is a classification of thinking or cognitive skills, which is often used in the design of educational, training and learning processes, and especially in the definition of learning outcomes. Bloom's Taxonomy consist of six levels of thinking skills, ranged from lower order thinking skills to higher order thinking skills.

**Body of Knowledge (BoK)** is the complete set of concepts and relations between them, that make up a professional domain, (in this case EO/GI BoK) and the related learning outcomes as defined by the relevant learned society or a professional association.

A **Course** is a unit of teaching, a set of lectures or a plan of study on a particular subject, usually leading to an exam or qualification. This unit can be used for teaching theoretical as well as practical content; depending on the specific subject of the course and its theoretical or practical nature the assessment of learners is done with an exam or through the assessment of assignments.

**European Credit Transfer and Accumulation System (ECTS)** is a credit system designed to make it easier for students to move between different countries.

The term **Earth Observation (EO) related services** is taken to mean any geo-spatial information service activity which in some way involves data coming from EO satellites (including meteorological satellites) i.e. any satellite with one or more sensors that measure parameters coming from the earth's surface or atmosphere. The involvement may be direct i.e. processing or distributing imagery or indirect i.e. consultancy based around knowledge of the imagery or its use. It starts from the point where imagery is transmitted to the ground, so it does include reception, processing, and interpretation / analysis of imagery but does not include construction of ground stations or the satellites delivering the data. Note that it includes all geo-spatial information services activities where satellite EO data has been used as a critical source and so extends to downstream information processing of geospatial information where data being used has been derived from EO imagery possibly in combination with other data types.

**European Qualifications Framework (EQF)** descriptor is defined by 8 levels of descriptors that indicates at that level the learning outcomes relevant to qualifications in any system of qualifications.

**Geographic Information (GI)** is the data of a geographic location and information derived thereof combined with non-spatial information (e.g. statistical data) and their representation as a map.

**Knowledge** means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices related to a field of work or study. In the context of the European Qualifications Framework, knowledge is described as theoretical and/or factual.

**Learning** is the process by which an individual assimilates information, ideas and values and thus acquires knowledge, know-how, skills and/or competences. (Source: Cedefop, 2008) Learning occurs through **teaching** (from a perspective of teacher, facilitator) / **learning** (from perspective of learner, trainee) activities such as reading, reflecting, practising, networking, discussing, problem solving etc. It may take place in formal (in an organised and structured environment), non-formal (embedded in planned activities not explicitly designated as learning) or informal (resulting from daily activities) settings (adapted from Cedefop, 2008).



**Learning outcome:** Learning outcomes are statements of what a learner knows, understands and is able to do on completion of a learning process. In EO4GEO they are described in terms of Knowledge and Skills.

A **Lecture** is a formal talk or practical exercise on a serious subject intended to display information or teach people about a particular subject (also known as lessons or classes).

**Soft Skills** are a combination of people skills, social skills, communication skills, character or personality traits, attitudes, career attributes, social intelligence and emotional intelligence quotients, among others, that enable people to navigate their environment, work well with others, perform well, and achieve their goals with complementing hard skills (<https://beta.skillsmatch.eu>).

**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.

**Skills deficit** refers to a job market in equilibrium with supply equalling demand, yet both supply and demand are below what they could be.

**Skills gap** refers to a situation where the demand for skills exceeds supply internally within a firm or organization. The term is also used to refer to a gap in the current education and training system, which is not able to provide people with the necessary skills.

A **Study program** is a curriculum of two or more courses (grouped or not in Modules) that is intended to lead to a degree, diploma, or certificate. (Source: CDT)

**Training** is the organized activity aimed at transmitting and receiving information and/or instructions to improve the recipient's (learner, trainee) knowledge and/or skill. Methods of imparting training are, for example, **on-the-job training** (development through performance), **case-based methods** (analysis of an actual situation), **knowledge-based methods** (lectures, seminars, workshops) (adapted from Talloo, 2007 and BusinessDictionary).

**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

### 1.1. *EO4GEO project*

EO4GEO is an **Erasmus+ Sector Skills Alliance** gathering **25 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 sector. The project is also supported by a strong group of Associated Partners mostly consisting of associations or networks active in space/geospatial domain. 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 works in a **multi- and interdisciplinary** way and applies 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 defines 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 is 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/>.

### 1.2. *Objectives of the work package*

Work package 4 consists of four tasks: Task 4.1 has the aim to identify business processes and link them with relevant occupational profiles. Task T4.2 will then analyse these business processes, specify required skills and group them into curricula with specified learning outcomes. Task 4.3 will improve existing and develop new training material. Task 4.4 will develop a mobility programme to promote internships and project work by students and young professionals.



### **1.3. Objectives of the task**

Task 4.3 – *Improvement of existing and development of new training material* has the objectives of providing training material that can be used in the EO4GEO training actions. Particular emphasis is put on the following aspects:

- Development of training material for concepts/skills as identified in the business process analysis:
  - Use of latest EO\*GI technology in the training material
  - Development of instructive training material using Jupyter Notebooks and related technologies
  - Emphasis of Copernicus services and related tools/platforms
  - Coverage of a variety of educational levels
  - Provision of material covering conceptual parts of case-based learning material to be used in EO4GEO training actions
- Development of material also considers future skills in the EO\*GI sector, which were reported by employers (public & private sectors) on basis of the interviews conducted by NEREUS in March 2020 (Nereus 2020).
- Innovative and consistent design of training material.
- Collaborative development and provision of training material on an extensible platform.
- Documentation of training material with metadata.
- Retrieving of specific training material in a dedicated catalogue.
- Integration of training material with the EO4GEO toolset, especially the [BoK Matching Tool](#).

### **1.4. Purpose of the document**

This document is a supplement to the online training material that is provided on GitHub for developers of training material and in the training material catalogue on the EO4GEO website as catalogue for users. Users in the context of this document are mostly teachers and instructors; some training materials are directly targeting learners and are classified as learning material rather than teaching material (in contrast to learning material, teaching material is designed to be used as material for presentations by teachers/instructors). The document briefly summarizes how the objectives outlined above have been realized. The links to the developed web resources are:

- GitHub repository of training material: <https://github.com/eo4geocourses>
- Training material catalogue: <http://www.eo4geo.eu/training-material-catalogue/>

### **1.5. Structure of the document**

The document briefly introduces the approach and design decisions applied in the process of training material development (section 2). Subsequently, it presents the content of training materials developed at the time of writing this document (section 3), the technical infrastructure for providing and maintaining training material (section 4) and the resources provided for training material development (section 4). It ends with section 6 that contains conclusions and an outlook to next steps.



## 2. Approach and Design Decisions

One of the first decisions taken was to move to an innovative and open approach as a means to develop and share training material and to avoid commercial software packages such as Microsoft PowerPoint. The main reasons for this decision are platform independence, ease of management in online repositories and avoiding formats that might become obsolete. The choice made was a html / javascript based framework called *reveal.js* that is used for providing training material in a form that is platform independent, ready to annotate, extensible and easy-to-use in web environments. This choice comes in handy in times of virtual trainings.

The decision to introduce a new framework for material development lead to the conception of a technical infrastructure for developing and maintaining training material in an open and collaborative way. Our requirements seemed to be best supported by GitHub repositories that allow collaboration, versioning and exchange of training material.

The third essential element of our approach is to require metadata or annotations of the created training material; the metadata do include reference to BoK concepts of course besides other pieces of information. These metadata are extracted from the GitHub repositories in an automated way and used to feed the training material catalogue as well as the BoK Matching tool. Metadata are the essential ingredient to support users searching for specific training material. The subsequent sections introduce the named components and the training material itself in more detail.

Limitations concerning *reveal.js* might concern the increased effort for familiarizing with the working environment and principles of html based slides, which was counteracted with video instructions and the provision of templates. In addition, the updating of an existing html-based slide set seems to require a little more effort that updating PowerPoint slides.

## 3. Training Material

This section introduces the choice of existing material to be revised and new material to be developed. A key element in the decisions about training material development was the cooperation with partners organising EO4GEO training actions as the training material shall be used in these training actions.

WP4 aimed to prepare material introducing key concepts and methods required for case-based learning in EO4GEO training actions. When the training material development started, the training actions had not been well enough defined in order to prepare material to be used by highly specific application cases. Therefore, it has been decided to consider steps of workflows in the work with EO and GI data and develop material that focuses on concepts and methods generally required in EO\*GI work (the knowledge about these workflows was grounded in the previous analysis of business processes).

With the general direction for training material development in mind, partners from WP5 provided a list of required training material and partners of T4.3 provided offers of training material. These two lists were aligned and summarized in a table ([public version of this available here](#)). The table served as planning instrument and as means to document the training material assignment to partners and the progress made during material revision and development.

The training material serves as a pool of material available to project partners (and other users) to choose from for their specific topics covered in training actions. Because the material focuses on



introducing concepts and methods in the course of training actions, it is mostly designed for use by a trainer/educator rather than self-learning material – we refer to this type of training material as *teaching material*. There are some materials, however, that can be used for self-learning; these materials are referred to as *learning material*, e.g. recordings of webinars held as part of the training actions.

The *training material catalogue* that is designed in WP4 is used as interface to provide access to teaching and learning materials. The training material catalogue offers the opportunity to differentiate between those categories through search-functionalities.

The following sub-sections present some facts and figures about the developed training material. The basis for these measures are provided by the 23 training material sets that were ready for publication by end of October 2020 (plus one additional slide set for the general introduction to EO4GEO). The development of training material will continue over the coming months of the project; training material development is tightly linked to training action implementation that has started in November 2020 and the training material collection will also receive training material developed as specifically for EO4GEO training actions.

### **3.1. Thematic coverage of training material**

The 23 training material sets have been developed to cover various EO\*GI related topics in accordance with requests from partners developing EO4GEO training actions. The detailed list of training material sets developed by end of October and their interrelations with tasks of WP5 is shown in Annex A or available in the [online version of the respective table](#). On top of that, the training materials are designed for different target audiences.

Figure 1 shows a general categorization of training material according to terms that were identified as relevant in the context of future skills in a survey of Nereus (2020). The terms *best practices in EO* and *best practices in GI* obviously summarize a series of topics like pre-processing of (satellite) data, general introduction to principles and workflows in EO, Copernicus services as well as general principles of geoinformatics and SDI. The training material summarized by these two terms mostly addresses subjects that were identified as relevant in the context of business process analysis for the general workflow with satellite imagery or other types of spatial data.

The remaining categories (*programming/scripting, automation, machine learning and cloud computing*) stem from specific topics of interest by the EO\*GI community in the context of up-skilling and re-skilling. Roughly a quarter of the developed training materials targets these specific concepts and skills. Especially in the context of machine learning and automation, the training materials are developed for people who have background knowledge in the EO domain before undergoing training on these subjects. Concerning cloud computing, which is emphasized in training material introducing the Terrascope platform in particular, no specific prior knowledge in EO\*GI is necessary.

The distribution of training material across different target groups is shown in Figure 2. This diagram highlights the band width of potential users of the trainings based on the training material (with training material covering both learning and teaching material). There is training material introducing basic concepts of geoinformatics for pupils, several training materials targeting a high-level introduction to key contributions of the domain for managers and/or the general public and specific training units for students and practitioners, who either follow vocational education and training or academic education.

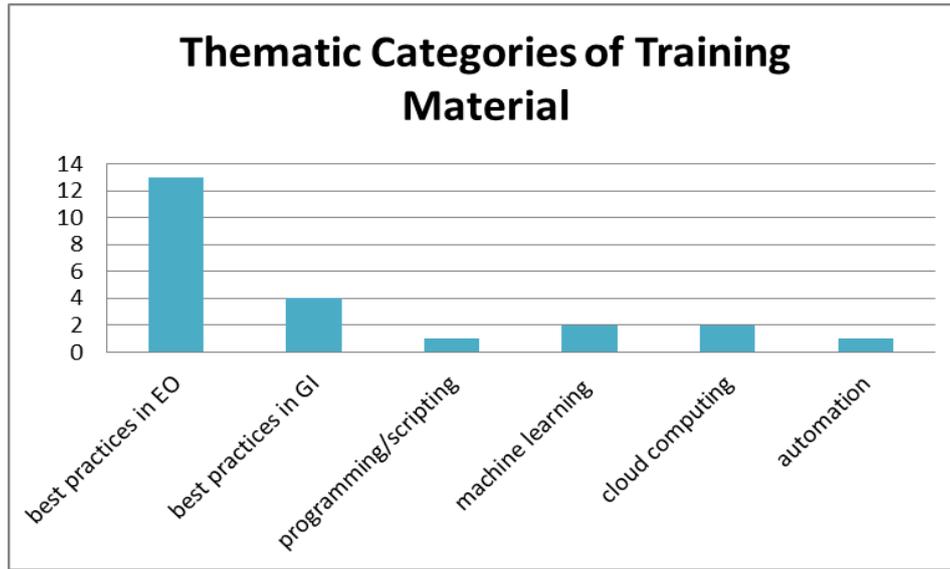


Figure 1: Thematic categories of training material with an emphasis of demanded concepts and skills in EO\*GI.

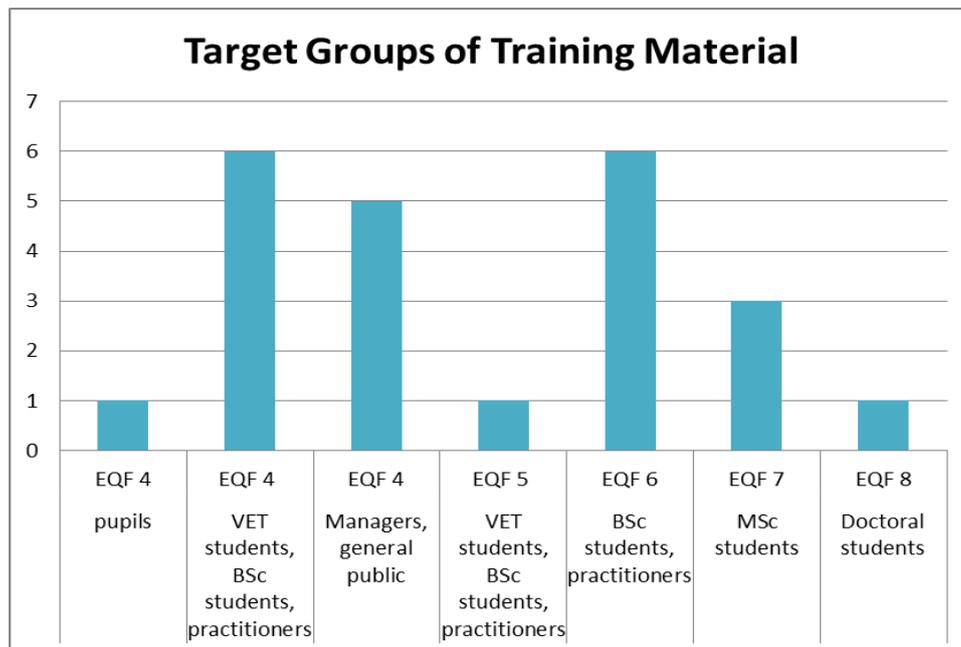


Figure 2: Target groups of users of training material covering the whole range of general public and pupils to doctoral students in the EO\*GI domain.

The specific content of the single 23 training material sets can be investigated by visiting the training material catalogue. This catalogue presents a concise description of the content of each training material set including the reference to concepts of the Body of Knowledge (BoK) relevant in the training material etc. The following figure, Figure 3, shows an illustration of one exemplary training material set in the training material catalogue (<http://www.eo4geo.eu/training-material-catalogue/>):



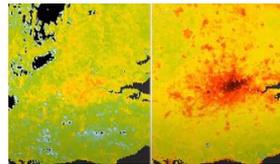
## Identification of local heat islands to support city planning

Basic GIS knowledge vector and raster data

This is a lesson on monitoring the urban heat islands. This beginner's lesson introduces the student to GIS and vector/raster data.

### Learning outcomes

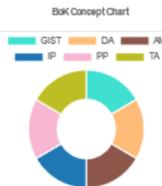
- ✓ Design and develop methods for local heat islands detection to support city planning.
- ✓ Understand basics of RS/EO/GI knowledge.
- ✓ Identify RS methods for dummies.
- ✓ Modify spatial data.
- ✓ Understand GIS vector and raster data.



### BoK concepts

Links to concepts from the EO4GEO Body of Knowledge used in this course:

- > DA | Design and Setup of Geographic Information Systems
  - > DA3 | Architectural design of a GIS system
    - > DA3-7 | Desktop GIS, GIS libraries
- > AM | Analytical Methods
  - > AM13 | Representation transformation
    - > AM13-4 | Vector-to-raster and raster-to-vector conversions
- > IP | Image processing and analysis
  - > IP3 | Image understanding
    - > IP3-11 | Time series analysis
- > PP | Physical principles
  - > PP1 | Basics of Optical Remote Sensing
    - > PP1-7 | Basics of Thermodynamics
      - > PP1-7-1 | Temperature and heat
- > TA | Thematic and application domains
  - > TA13 | EO services and applications
    - > TA13-5 | Monitor the built environment
      - > TA13-5-1 | Monitor urban areas



### Ownership

Designed and developed by: Marijan Grgic, University of Zagreb, Faculty of Geodesy. License: Creative Commons Attribution-ShareAlike.

### Education level

EQF 6 (what is this?)

### Language

English

### Access

Find below a direct link to the HTML presentation.

[ACCESS THE PRESENTATION](#)

Find below a link to the GitHub repository where you can download the presentation.

[DOWNLOAD THE PRESENTATION](#)

Share this course.



### Material preview

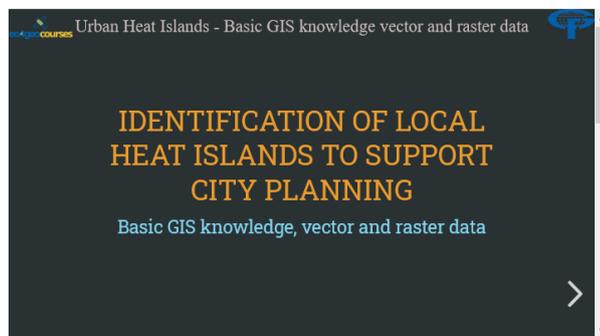


Figure 3: Exemplary training material set as presented in the training material catalogue (<http://www.eo4geo.eu/training/identification-of-local-heat-islands-to-support-city-planning-gis/>).



### 3.2. *Html slides and other types of training material*

Most of the training material sets follow the innovative approach developed for this task by providing slides prepared with *reveal.js*. However, not all training material for the envisioned training contexts can make use of slides. Therefore, the training material sets also include material prepared as and is not limited to:

- Videos (e.g., image videos for introducing EO to managers),
- Jupyter Notebooks (e.g., material demonstrating specific methods in an interactive way),
- H5P components (e.g., interactive elements of training materials like quizzes).

The infrastructure developed in this task is open to all different kinds of training material. This is emphasized by the previously discussed separation between teaching material and learning material: videos and Jupyter Notebooks serve the purpose of self-study; the slides prepared as input for EO4GEO training actions are rather meant to be used in face-to-face training with an educator.

*Reveal.js* is a javascript application programming interface (API) for creating html based slides: <https://revealjs.com/>. It is open source and the template used can be adapted to specific looks and feels. The functionality it provides is extensive and not fully exploited in all training material sets as it can be combined with additional APIs like jquery to implement sophisticated forms of navigation through slides etc.

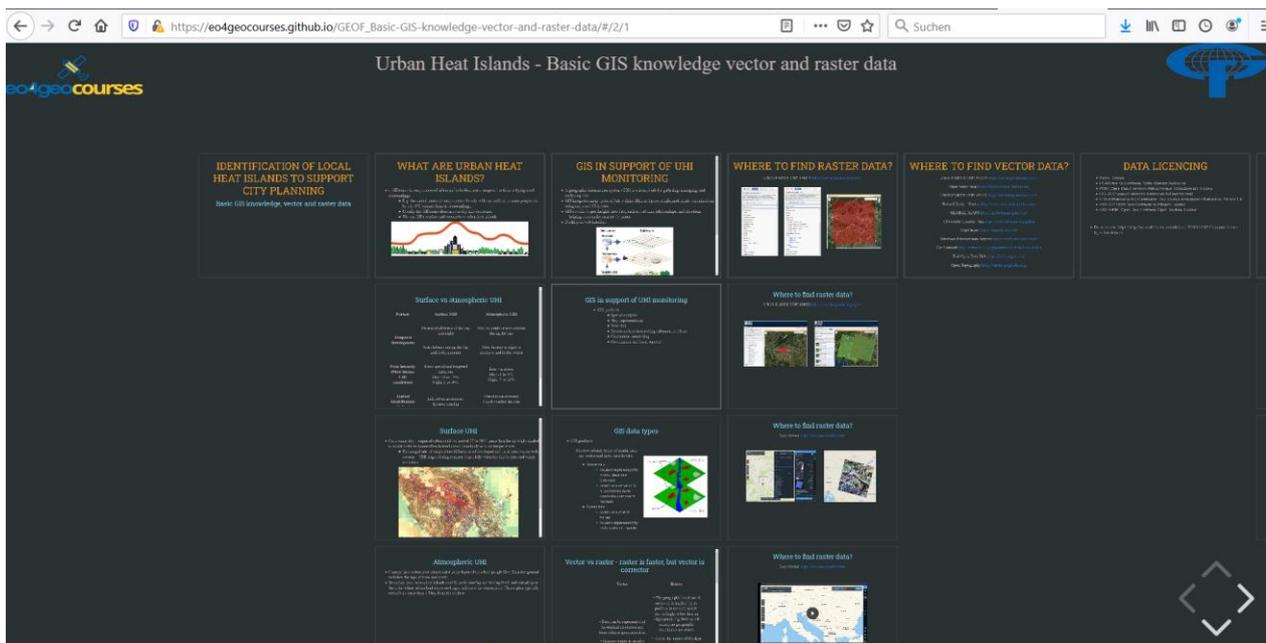


Figure 4: Horizontal and vertical structure of slides created with reveal.js.

One characteristic of *reveal.js* is that it natively supports horizontal and vertical structuring of slides: slides organized horizontally are representing different sections of the material and the slides that are organised vertically represent details of each section (a section is thereby possibly associated with different concepts). This arrangement of slides opens the realm to structuring the material for the use with different target audiences – the horizontal structure lists the different concepts and the vertical slides provide general and more detailed information on the concepts. A



navigation bar in the bottom right of each slide supports navigation through the slides. Figure 4 shows an example of the specific reveal slide organisation.

The slides created with reveal.js are in html format and can be readily viewed in any browser – locally or over the web. Various resources have been provided to the project partners to support the learning process of the new approach to slides; the resources provided are introduced in section 5 of this report.

### **3.3. Languages of training material**

The main language in which training materials are provided is English. This is due to the fact that most of the training actions will be held in English. A few resources that are also used for local markets so to say, are available in other languages too. The slideset for introducing the EO4GEO-Project is currently available in English, Italian, Spanish and German.

### **3.4. Usage and licenses of training material**

The training material is provided under the *Creative Commons license CC-BY-SA* (unless not otherwise indicated). Thus, it is free to be shared, distributed, adapted and remixed for any purpose, also commercially, provided that the reuse obeys the following:

- Attribution: the materials must be credited appropriately, provide a link to the license and indication if changes were made.
- Share alike: when building upon the existing material, remixing or transforming it, the contribution has to be under the same license (CC-BY-SA).
- Details for this license can be seen from: <https://creativecommons.org/licenses/by-sa/4.0/deed.en>

## **4. Technical Infrastructure for Providing and Maintaining Training Material**

A topic of equal importance to the development of training material is how the material is provided to its users and how it is maintained. Times of having unstructured collections of PowerPoint files on some machine with potentially outdated content and documentation are past in the era of collaborative web-based infrastructures. One of the key reasons for introducing the html / javascript based approach for training material development was the potential of this approach for reuse, updating and sharing. These objectives have been translated into the *training material infrastructure* of T4.3, which is graphically depicted in Figure 5 and outlined in the following.

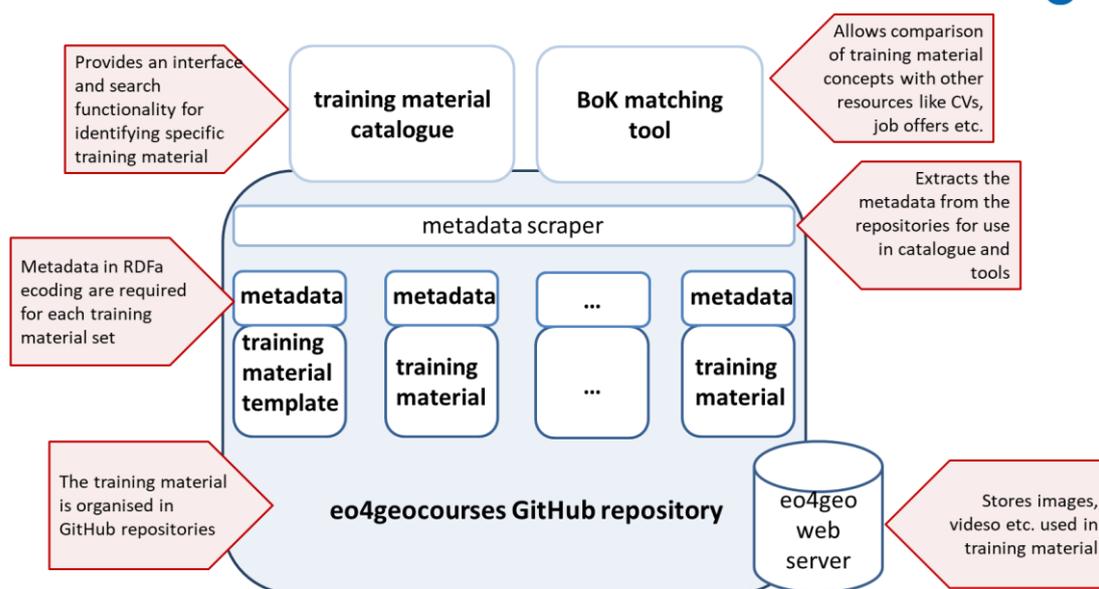


Figure 5: Sketch of the technical infrastructure for training material development and maintenance.

### eo4geocourses GitHub repository

At the core of the technical infrastructure is the use of GitHub, an online platform for the collaborative development and sharing of code with a sophisticated versioning system. GitHub is organised in repositories, i.e. uniquely identifiable elements of work (in the context of T4.3 each training material set is included in one repository). GitHub natively supports branching of repositories, which means that a copy of a specific repository is created for someone else to develop the content further; merging of the master repository and the branch are possible at later stages of development. (The idea of branches is used for updating existing material – a copy of the existing material is created as branch, necessary edits are made and when completed merged with the original repository; GitHub supports revision and collaboration on material development excellently as the branching mechanism shows.) GitHub also provides user and rights management, which comes in handy for providing access to repositories to those who need it and preventing others from messing around with repositories.

A main repository for all training material has been created on GitHub and is managed by PLUS. It is named *eo4geocourses*. The main repository includes the template for training materials as well as the complete set of training materials that are currently in a fully developed state as well as those that are under development. A snapshot of the current view on the repository is shown in Figure 6; the link to accessing the repository is: <https://github.com/eo4geocourses>.

### Training material

Each training material set receives a dedicated repository with a unique name in the *eo4geocourses* repository (cf Figure 7). If the content of the repository is still under development, the repository is kept *private* and only the creators of the material have access to the material. Once the material is ready to be published, the repository is made *public*.

Each repository needs to contain metadata about the training material set. The metadata are directly included in the .html file of the material in RDFa encoding. The .html file can consist of a title slide only or a slide pointing to a link that provides the resource described with metadata; **it is not mandatory that the material is created with *reveal.js* for inclusion with the training material repository**. The repository can also serve as container of training material available as



videos, Jupyter Notebooks etc. given that there are metadata on the training material provided in an html file.

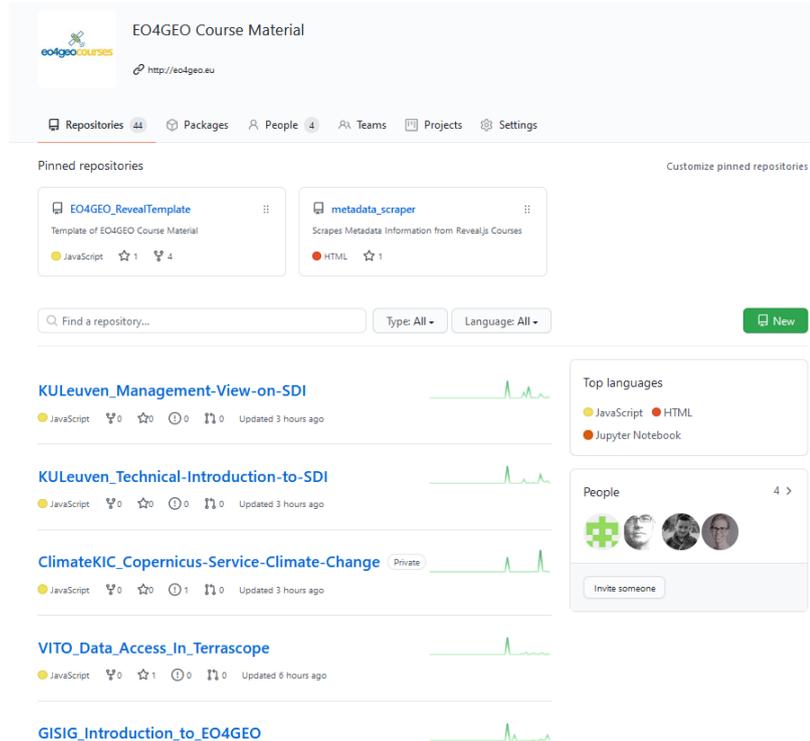


Figure 6: Snapshot of the eo4geocourses GitHub repository (incomplete view).

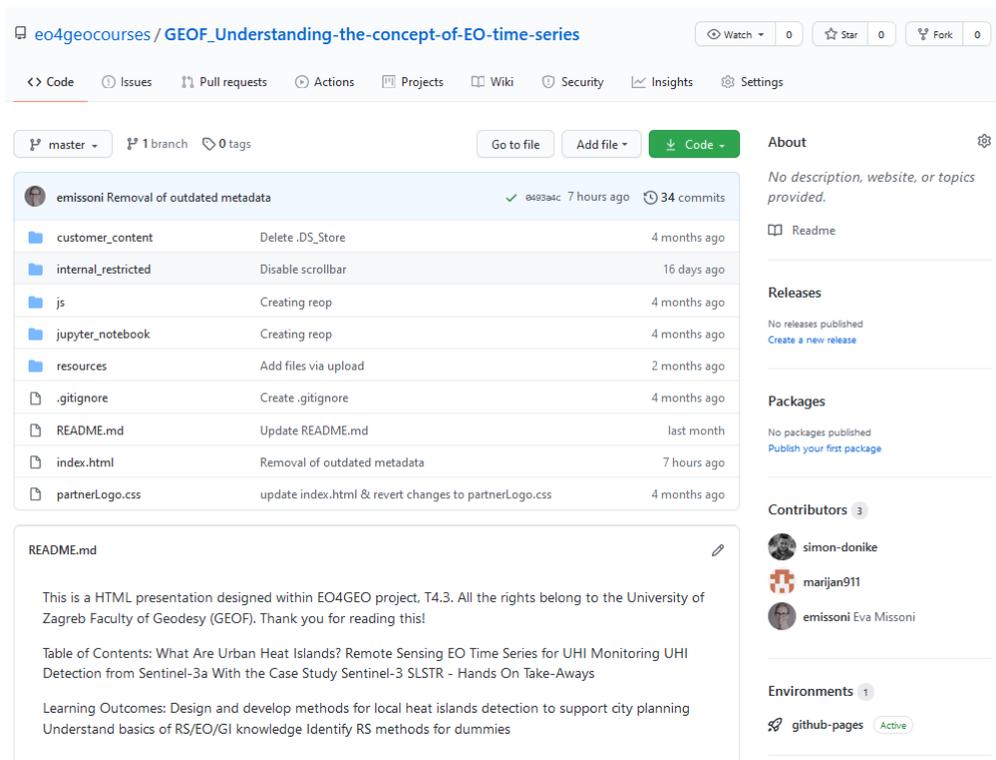


Figure 7: Snapshot of a GitHub repository of one training material set.



As said above, training material can be prepared in a variety of formats. The quest to all involved partners to use the open source API `reveal.js` and produce html slides has led to the fact that most of the training material sets are available as html files.

## eo4geo Webserver

A webserver is provided by PLUS as complementary component for training material development. GitHub is not meant to be used as web space; the webserver fulfils this role and provides sufficient space for hosting images used in `reveal.js` slide sets, videos, data etc. all that is required as complementary elements in training material. This keeps Github Repositories lean and allows reuse of code-passages.

## Metadata

Metadata and annotations in RDFa are enclosed in the `reveal.js` slideset. Their completion is mandatory as they form the necessary basis for material to be integrated and displayed in the training material catalogue. The annotations thus allow for searching material along certain parameters and the creation of learning paths (along BoK-concepts). The BoK-Matching-Tool allows the comparison of the own professional profile (CV-Tool) and Job Offers (JOT-Tool), identifying missing skills and provision of adequate educational or training offers to overcome a potential skills gap.

The metadata elements have been selected based on the Dublin core standard and extended with elements for BoK concepts in the Dublin core (DC) relation tag. Figure 8 shows a screenshot of the metadata about the exemplary course used in this report ([https://github.com/eo4geocourses/GEOF\\_Basic-GIS-knowledge-vector-and-raster-data/](https://github.com/eo4geocourses/GEOF_Basic-GIS-knowledge-vector-and-raster-data/)). Details on how to fill these metadata elements are included in the *How to* document referenced in section 5.

```
<meta charset="utf-8">

<title>EO4GEO_GEOF: Basic GIS knowledge vector and raster data</title>
<meta property="dc:title" content="Identification of local heat islands to support city planning - Basic GIS knowledge vector and raster data" />
<meta property="dc:creator" content="Marijan Grgic, mgrgic@geof.hr" />
<meta property="dc:publisher" content="University of Zagreb, Faculty of Geodesy" />
<meta property="dc:subject" content="Copernicus, EO4GEO, WP4, Satellite, Earth Observation" />
<meta property="dc:abstract" content="This is a lesson on monitoring the urban heat islands. This beginner's lesson introduces the student to GIS
<meta property="dc:tableOfContents" content="What is urban heat island?
    How to detect it?
    What are the measuring techniques?
    Which data could be used in GIS for that purpose? Raster vs vector data." />
<meta property="dc:description" content="Design and develop methods for local heat islands detection to support city planning, Understand basics o
<meta property="dc:contributor" content="Marijan Grgic, mgrgic@geof.hr" />
<meta property="dc:created" content="2020-09-20" />
<meta property="dc:type" content="teaching material" />
<meta property="dc:format" content="html" />
<meta property="dc:language" content="EN" />
<meta property="dc:SizeOrDuration" content="45min" />
<meta property="dc:audience" content="students" />
<meta property="dc:educationLevel" content="EQF 6" />
<meta property="dc:source" content="" />
<meta property="dc:rightsToHolder" content="Marijan Grgic, University of Zagreb Faculty of Geodesy" />
<meta property="dc:license" content="https://creativecommons.org/licenses/by-sa/4.0/deed.en" />

<link rel="dc:relation" href="eo4geo:DA3-7" />
<link rel="dc:relation" href="eo4geo:AM13-4" />
<link rel="dc:relation" href="eo4geo:IP3-11" />
<link rel="dc:relation" href="eo4geo:PP1-7-1" />
<link rel="dc:relation" href="eo4geo:TA13-5-1" />
```

Figure 8: Metadata documentation of a specific training material set.



## Metadata scraper

The thorough use of standardised metadata allows an automated scraping of the training material sets to extract the metadata of each training material set. The metadata scraper is a script that is executed each night, accesses all public repositories in the eo4geocourses repository and extracts the metadata. The code of the script is available on GitHub: [https://github.com/eo4geocourses/metadata\\_scraper](https://github.com/eo4geocourses/metadata_scraper).

The metadata scraper creates a csv file that presents metadata elements including BoK concepts that are needed in the training material catalogue and the BoK matching tool: [https://github.com/eo4geocourses/metadata\\_scraper/blob/master/metadata\\_presentations.csv](https://github.com/eo4geocourses/metadata_scraper/blob/master/metadata_presentations.csv).

The automated extraction of metadata of the repositories assures that up-to-date documentation of all available training material sets is available. This documentation is available to the maintainers of the training material catalogue and the BoK matching tool.

## Training material catalogue

The training material catalogue is a collection of web pages that provides a user-friendly interface to the collection of training material sets. The catalogue is designed to search through the pool of material along different search-criteria and get a quick and integrated overview what to expect from the selected material in detailed information pages of each training material set. Figure 9 shows an image of the start page of the training material catalogue; an image of a detailed information pages has been shown in Figure 3. The user of the catalogue can then access the slideshow of html-based material or the GitHub repository for retrieving the underlying code.

Users of the training material catalogue will predominantly be educators or trainers who are looking for training material to use in their training. Therefore, the search functionality allows search for specific concepts of the Body of Knowledge and material designed for specific educational levels. Users of the training material can also include learners, who are looking for learning material like recordings of webinars. A differentiation between teaching material and learning material to easily separate these two types of training material is implemented in the training material catalogue (based on a metadata element provided) (note: currently only teaching material is present in the training material catalogue).

Process to keep the catalogue up-to-date: the metadata scraper provides daily updates of the metadata. The maintainer of the training material catalogue compares the resulting csv document with the current state of the training material catalogue and updates it accordingly. The maintenance of the training material catalogue is managed by the project coordinator GISIG. In a future step the updating of the catalogue can be automated further, as the inserting to and updating of the WordPress-based training material catalogue is presently happening manually.

As addition to the training material developed within EO4GEO, the training material catalogue points to external training material that is useful in the EO\*GI domain. This is shown in Figure 10.

## BoK matching tool

The [BoK Matching Tool](#) is an EO4GEO tool that makes direct use of the metadata about training materials. As the metadata used are standardized within the EO4GEO project, integration of the training material into the BoK matching tool was straightforward. The metadata are fed into the BoK matching tool and can therefore be compared to resources like job offers, a curriculum vitae or training actions to indicate matching and diverging BoK concepts of the two compared resources.



Figure 9: Start page of the training material catalogue.

Figure 10: External training resources included in the training material catalogue.



## 5. Resources for Training Material Development

Using a novel approach to preparation of slides for trainings required substantial efforts on side of the task leader for introducing the new method and on side of the task contributors for implementing the method. To support the partners involved in training material to the highest degree possible, a series of resources have been prepared to ease the use of *reveal.js* and the newly designed training material infrastructure:

- A comprehensive document on how to use *reveal.js* in combination with the elements of the training material infrastructure is provided as guiding document for everyone involved in training material development. The *How-To use Reveal JS* document is available for project-internal usage on Slack (the indication of passwords and access credentials prevent public distribution of the document).
- A template in *reveal.js* has been prepared to provide training material with a common look and feel. This template is available on the dedicated repository (eo4geocourses) on GitHub: [https://github.com/eo4geocourses/EO4GEO\\_RevealTemplate](https://github.com/eo4geocourses/EO4GEO_RevealTemplate)
- The *reveal.js* template includes all metadata elements in the correct RDFa encoding for documenting the training material. Their completion is mandatory as they form the necessary basis for material to be integrated and displayed in the training material catalogue according to the developed structure as shown in Figure 3.
- Introductory videos were created to provide a short and directly usable introduction to key steps in the training material development process. The videos are available for contributing partners on a project Slack Channel *wp4\_reveal\_question\_and\_answer*. The cover the following topics:
  - getting started with *reveal.js*,
  - the use and handling of content in GitHub (Repositories, GitHub Desktop),
  - the hosting of images/videos on the eo4geo webservice.

The creation of additional content can and will take place in dedicated repositories on GitHub. These can be requested by contacting PLUS and will contain a template following the EO4GEO look and feel of the training material.

## 6. Conclusions and Next Steps

Task 4.3 focused on the development of a technical infrastructure for training material development and provision alongside the creation of 23 training material sets plus a general introduction to EO4GEO with a common EO4GEO look and feel. The training material is first to be used for introducing concepts and skills in the EO4GEO training actions.

A next step is the quality assurance of the available training material. Project partners will be asked to review the training material sets according to their expertise. Particular attention will be paid to actuality of content, completeness of content, achievement of specified learning objectives and form of presentation.



The training material collection of EO4GEO is supposed to grow over the remaining time in the project as well as beyond. Case-based training materials from training actions will be fed into the training material repositories and thereby also in the training material catalogue as well as recordings of webinars that are an output of the training actions and serve as learning material.

The infrastructure for training material and especially the thorough documentation of training material sets with metadata are assets in the discussions about sustainability of the project and the long-term action plan.

## **7. Bibliographic references**

NEREUS (2020): Interviews on future skills in the EO/GI sector: A short analysis of responses



**Annex A: Table of training material developed based on a match between requests and offers by EO4GEO partners ([online version](#))**

	Training action	Link to GitHub-repository	Emphasized Skill (No.1)	EQF Level	Target groups	Number of training units (1 unit = 45min of training)	Language	Responsible Partner	WPS relations
1	Introduction to EO4GEO	<a href="https://github.com/eo4geocourses/GISIG_Introduction_to_EO4GEO">https://github.com/eo4geocourses/GISIG_Introduction_to_EO4GEO</a>	/	/	general public	1 unit (45min)	EN, IT, ES, DE	GISIG	T5.3, T5.4, T5.5
2	Introduction to SDI Architecture and Components	<a href="https://github.com/eo4geocourses/KULeuven_Technical-Introduction-to-SDI">https://github.com/eo4geocourses/KULeuven_Technical-Introduction-to-SDI</a>	best practices in GI	4	VET students, BSc students, practitioners	12 (6x90 min)	EN	KULeuven	T5.3
3	Management View on Spatial Data Infrastructures	<a href="https://github.com/eo4geocourses/KULeuven_Management-View-on-SDI">https://github.com/eo4geocourses/KULeuven_Management-View-on-SDI</a>	best practices in GI	4	managers, practitioners	10 (5x90 min)	EN	KULeuven	T5.3
4	Introduction to programming	<a href="https://github.com/eo4geocourses/UJI_Introduction-to-Programming">https://github.com/eo4geocourses/UJI_Introduction-to-Programming</a>	programming/scripting	4	VET students, BSc students, practitioners		ES	UJI	
5	Reproducible research practices for the Geosciences	<a href="https://github.com/eo4geocourses/UJI_Reproducible-Research-Practices-in-Geosciences">https://github.com/eo4geocourses/UJI_Reproducible-Research-Practices-in-Geosciences</a>	best practices in GI	8	doctoral students		EN	UJI	
6	Classification: Decision Trees	<a href="https://github.com/eo4geocourses/UT-ITC_Satellite_Data_Classification_Decision_Trees">https://github.com/eo4geocourses/UT-ITC_Satellite_Data_Classification_Decision_Trees</a>	machine learning	7	MSc students (remote sensing background)	4 units (2x90min)	EN	UT-ITC	T5.3, T5.4, T5.5
7	Classification: Random Forest	<a href="https://github.com/eo4geocourses/UT-ITC_Satellite_Data_Classification_Random_Forests">https://github.com/eo4geocourses/UT-ITC_Satellite_Data_Classification_Random_Forests</a>	machine learning	7	MSc students (remote sensing background)	1 unit (1x90min)	EN	UT-ITC	T5.3, T5.4, T5.5



	Training action	Link to GitHub-repository	Emphasized Skill (No. 1)	EQ F Level	Target groups	of training units (1 unit = 45min of	Lang uage	Respo nsible Partn er	WP5 relation s
8	Remote sensing of Environment	<a href="https://github.com/Geo4geo/UNIBAS_Remote_Sensing_Environment">ub.com/Geo4geo/courses/UNIBAS_Remote_Sensing_Environment</a>	best practices in EO	5	VET students, BSc students, practitioners	6 units + 5 tutorials (6x45 min) + tutorials	EN	UNIBAS	T5.3, T5.4, T5.5
9	Change detection using optical and radar data	<a href="https://github.com/Geo4geo/ROSA_Change-Detection-in-optical-Data">ub.com/Geo4geo/courses/ROSA_Change-Detection-in-optical-Data</a>	best practices in EO	6	BSc students, practitioners		EN	ROSA	T5.3
10	Introduction to GIS	<a href="https://github.com/Geo4geo/UNEP-GRID_Introduction-to-GIS">https://github.com/Geo4geo/courses/UNEP-GRID_Introduction-to-GIS</a>	best practices in GI	4	pupils		EN	UNEP-GRID	T5.4
11		<a href="https://github.com/Geo4geo/GIK_Introduction-to-Remote_Sensing">https://github.com/Geo4geo/courses/GIK_Introduction-to-Remote_Sensing</a>	best practices in EO	4	VET students, BSc students, practitioners	1 unit	EN	GIK	T5.3, T5.4, T5.5
12	Copernicus Service - Land	<a href="https://github.com/Geo4geo/GEOF_Copernicus-Service-Land">https://github.com/Geo4geo/courses/GEOF_Copernicus-Service-Land</a>	best practices in EO	4	general public	1 unit (45min)	EN	GEOF	
13	EO Intro for Managers	<a href="https://github.com/Geo4geo/IES_EO_for-Managers">ub.com/Geo4geo/courses/IES_EO_for-Managers</a>	best practices in EO	4	managers, general public	10 short videos (10-15min each)	EN	IES	
14	TerraScope Training Pack	<a href="https://github.com/Geo4geo/VITO_Cloud_Infrastucture">ub.com/Geo4geo/courses/VITO_Cloud_Infrastucture</a>	cloud computing	4	managers, general public		EN	VITO	T5.3, T5.4, T5.5
15	Data Access in Terrascope	<a href="https://github.com/Geo4geo/VITO_Data_Access_in_Terrascope">ub.com/Geo4geo/courses/VITO_Data_Access_in_Terrascope</a>	cloud computing	4	managers, general public		EN	VITO	T5.3, T5.4, T5.5
16	Identification of local heat islands to support city planning	<a href="https://github.com/Geo4geo/GEOF_Basic-GIS-knowledge-vector-and-raster-data">https://github.com/Geo4geo/courses/GEOF_Basic-GIS-knowledge-vector-and-raster-data</a>	best practices in EO	4	VET students, BSc students, practitioners	1 unit (45 min)	EN	GEOF	T5.4



	Training action	Link to GitHub-repository	Emphasized Skill (No.1)	EQF Level	Target groups	of training units (1 unit = 45min of	Lang uage	Respo nsible Partn er	WP5 relation s
17	Understanding the concept of EO time series	<a href="https://github.com/eo4geocourses/GEOF_Understanding-the-concept-of-EO-time-series">ub.com/eo4geocourses/GEOF_Understanding-the-concept-of-EO-time-series</a>	automation	4	VET students, BSc students, practitioners	1 unit (45min)	EN	GEOF	T5.4
18	Evaluation and planning of urban green structures to increase quality of life and support ecosystem services in urban	<a href="https://github.com/eo4geocourses/IGIK_Sentinel2-Data-and-Vegetation-Indices">https://github.com/eo4geocourses/IGIK_Sentinel2-Data-and-Vegetation-Indices</a>	best practices in EO	4	VET students, BSc students, practitioners	2 units (90mins)	EN	IGIK	T5.4
19	Preprocessing of EO data	<a href="https://github.com/eo4geocourses/GEOF_Preprocessing-of-EO-data">ub.com/eo4geocourses/GEOF_Preprocessing-of-EO-data</a>	best practices in EO	6	BSc students, practitioners		EN	GEOF	T5.3, T5.4, T5.5
20	Validation of EO products	<a href="https://github.com/eo4geocourses/GEOF_Validation-of-EO-products">ub.com/eo4geocourses/GEOF_Validation-of-EO-products</a>	best practices in EO	6	BSc students, practitioners		EN	GEOF	T5.3, T5.4, T5.5
21	EO Data sources	<a href="https://github.com/eo4geocourses/GEOF_EO-Data-sources">https://github.com/eo4geocourses/GEOF_EO-Data-sources</a>	best practices in EO	6	BSc students, practitioners		EN	GEOF	T5.3, T5.4, T5.5
22	OBIA for Operations -	<a href="https://github.com/SpaSe_OBIA-for-Operations-Copernicus-Service-Challenge-Practical-Example/">geocourses.github.io/SpaSe_OBIA-for-Operations-Copernicus-Service-Challenge-Practical-Example/</a>	best practices in EO	7	MSc students, practitioners	2 units (90mins)	EN	SpaSe	T5.3
23	course: Practice: Image processing and analysis	<a href="https://github.com/eo4geocourses/PLUS_Practice-Image-Processing">ub.com/eo4geocourses/PLUS_Practice-Image-Processing</a>	best practices in EO	6	BSc students	10 units (90mins)	EN	PLUS	T5.3, T5.4, T5.5
24	SAR data for flood mapping	<a href="https://github.com/eo4geocourses/FSU-Jena_SAR-Data-for-Flood-Mapping.git">ub.com/eo4geocourses/FSU-Jena_SAR-Data-for-Flood-Mapping.git</a>	best practices in EO	6	BSc students		EN	FSU Jena	