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EO4GEO – Towards an innovative strategy for skills development and capacity building in the space geo-information sector supporting Copernicus User Uptake

With the support of the Erasmus+ Programme of the European Union Sector Skills Alliances N° 591991-EPP-1-2017-1-IT-EPPKA2-SSA-B

D5.1 Case-based learning scenarios for three sub-sectors

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Work package / Task:

WP5 - Testing and validating the strategy based on three case-based learning scenarios

T5.1 - Developing a method for designing case-based scenarios for three sub-sectors

Short Description:

This deliverable describes the way of defining the case-based scenarios for the three sub-sectors integrated applications, smart cities, and climate change. Starting with the mapping of relevant actors, a set of scenarios is derived. They are used to define appropriate training actions which the different actors can provide.

Keywords:

Case-based learning; Climate change; Smart cities; Integrated applications; Body of Knowledge (BoK); VET; Learning path; geospatial; data analysis

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RE	Restricted to other programme participants (including Commission services and project reviewers)	
CO	Confidential, only for members of the consortium (including EACEA and Commission services and project reviewers)	

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Executive summary

The report presents a method to specify training actions that cover a broad range of topics in the EO/GI field. The training actions can be included into curricula identified in WP4. Resulting from the method, 13 training actions were chosen to be carried out within the EO4GEO project. Their detailed descriptions are attached to the document.

The method presented includes scanning the actors involved and the target group. Both actors and target groups can be from different sectors. By addressing different sectors, training actions will have a wide reach. Also, different knowledge levels are considered. Thus, people can take part in training at different levels during education.

From the scanning of actors and target groups, relevant training actions are derived. To subsequently include them into curricula, training actions are designed in a modular way. So, training paths can be built that are in accordance with the curricula, the actors who deliver the products, and target groups.

The selected training actions that will be carried out within the EO4GEO project are connected to the BoK concepts, skills, transversal skills and learning outcomes. In this way training actions can be found with or used as reference in the EO4GEO tools.

In the next steps after this deliverable, the selected training actions are worked out in detail, carried out and analysed after receiving feedback from both actors and target groups.

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Acronyms

EO	Earth Observation
GI	Geographic Information
BoK	Body of Knowledge
VET	Vocational Education and Training
MOOC	Massive Open Online Courses
EQF	European Qualifications Framework
BPMN	Business Process Model and Notation

Glossary

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.

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.

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 and processing 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 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 combined 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 computerised tool designed for storing, analysing, and consulting data where geographic location is an important characteristic or critical to the analysis.

Information and communication technologies (ICT) are the infrastructure and components that enable modern computing.

Massive Open Online Courses (MOOC) are free online courses available and provide an affordable and flexible way to learn new skills, advance your career and deliver quality educational experiences at scale

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 **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 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, Audio-visual 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 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 scenarios in three subsectors - 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

While WP4 designs a series of curricula related to business processes and occupation profiles relevant to Copernicus, WP5 specifies specific curricula based on case-based scenarios for three sub-sectors, and tests and validates them in concrete training actions (including on-the-job training and summer schools). In this context remote sensing and related techniques are considered as supporting or horizontal competencies needed for conducting the case-based scenarios. The training actions are prepared in detail by mixed task forces.

Case-based learning starts from 'real-world' problems or scenarios, rather than from the 'solutions' or supporting technologies. Class-takers learn to analyse a problem, explore how GI and EO techniques can be used for a solution and more particularly how Copernicus data and information can help in the particular case. This approach allows to demonstrate how complex infrastructures can support different users and different types of usage, rather than focusing on the mere set-up and maintenance of the infrastructures themselves. The selection, acquisition, and preparation of the GI and EO data, their (pre)processing and integration, and their transformation into information readily usable for problem-solving are important parts of the teaching/learning process.

The work package has the following specific objectives:

- To clearly define one or more scenarios for each of the sub-sectors, i.e. to identify a 'real-world' problem – e.g. 'the timely detection of leaks in oil pipelines' – that will be solved by using GI and EO techniques.
- To select one or more curricula which are designed in WP4 from which a selection can be made, and a learning path defined for a collaborative learning process (consisting of different steps).
- To identify such learning paths for different types of people involved: managers and decision makers, technicians, data experts, content/thematic experts, etc.
- To prepare the detailed training actions for each of the three sub-sectors with the identification of the tutors and other actors to be involved, the timeline, detailed methods, selected materials, etc.
- To conduct the training actions and to collect feedback on the learning process, and to evaluate through self-tests and other mechanisms whether the learning outcomes have been achieved.

- To draft lessons-learned from the training actions in terms of what worked well, the methods, the feasibility, the training materials, and scenarios described.

The testing and validation are performed by involving the education/training providers, the space/geospatial industry and public sector players, the end-users of the Alliance and other relevant stakeholders. For each sub-sector, a taskforce of at least three partners with relevant expertise are designing the training actions applicable on national and transnational levels and involving multiple disciplines. The space/geospatial sector and the education/training providers work closely together to prepare, conduct, and evaluate the training actions.

WP5 started at month 25 of the project. In the meantime, a skills strategy of the GI and EO sector has been established (WP1), followed by the development of an EO/GI Body of Knowledge (WP2). This development is still ongoing and needs some iterations with input from other work packages including WP5. The development of an integrated platform of collaborative tools and of curricula in support of Copernicus (WP3) is ongoing as they are directly tied to WP5.

Within the document links to other work packages are made, below they are listed in detail

Table 0.1: Work packages referred to in the document

WP 4: Designing GI and EO curricula in support of Copernicus	T4.1	Identifying business processes and occupational profiles
	T4.2	Design of EO and related curricula
WP 5: Testing and validating the strategy based on case-based learning scenarios in three sub-sectors	T5.2	Defining the role of Remote Sensing and related techniques in the scenarios
	T5.3	Integrated Applications
	T5.4	Smart Cities
	T5.5.	Climate Change monitoring and adaption
	T5.6	Feedback and lessons learned from the testing and validation

1.3. Objectives of the task

For the three sub-sectors (integrated applications, smart cities, climate change monitoring and adaptation) a mapping of relevant actors and issues is carried out with the objective to derive a set of scenarios to be addressed by appropriate training measures.

Issues are pre-selected by EO4GEO experts for the particular sub-sector and evaluated with the respective community-of-practice regarding their relevance. For key issues, the following design process is conducted:

- Mapping involved actors in local/regional authorities and agencies, service providers, and academia; assessing existing responsibilities, workflows, capacities, and skills (following the respective BPMNs)
- Assessing achievements & challenges regarding the use of geospatial information derived from different sources for problem solving

Understand the working environment and tasks/responsibilities of actors, the relevant expertise/capacity of service providers, and potential offerings of researchers is an important element of the design process. Integrating the output from WP1 to WP4 training based on the set of scenarios acts as a gateway to EO and GI applications, bridges different disciplines and sectors, and facilitates the exchange and cooperation between users, providers, and developers. Working out the case-based scenarios and the design of the appropriate training/learning actions involves not only the community of experts and stakeholders in the EO4GEO consortium, but also reaches out to encompass the members of the Copernicus Academy Network to ascertain the cross-sectorial and –national validity of EO4GEO activities. To this end, a joint activity between this task and the respective task 4.2 (Support, link, harvest on EO4GEO educational and skills development activities) in the project CopHub.AC is designed to link policy regulation (such as the EC Green Deal) with BoK concepts, skills requirements, occupational profiles and curricula.

The task consists of the following activities:

- Mapping of actors and achievements & challenges in geospatial data analysis for the scenarios selected.
- Identify the different methods for case-based learning including the experiences of the giCASES project and methods applied by different consortium partners (collaboration education institutions and private sector).
- Identify and describe the learning process and the different collaborative patterns for the case-based scenarios for the three sub-sectors.

- Define a method to develop a learning path for the different occupational profiles, i.e. to describe the learning process in terms of time-line, content (training building blocks) and format (blended courses, training-on-the-job), which might be different for different occupational profiles.
- To refine the curricula designed in WP4 in view of supporting these concrete learning paths.
- To identify missing pieces in the adapted curricula.
- To prepare templates, forms, and guidelines for the three sub-sectors for the planning, conducting and evaluation of their case-based learning actions.

The method and related guidelines are prepared by a dedicated task force of educational partners of the consortium with input from the private and public sector partners.

Within the EO4GEO project the different scenarios are divided into the three sub-sectors integrated applications, smart cities and climate change monitoring and adaption. In the integrated applications sub-sector, the focus lies on multifaceted challenges, e.g. the pressure of expanding cities on our environment and the impact they have on changing transport and mobility patterns. Smart cities will focus on the use of EO and GI data and algorithms to meet the needs of growing cities. Finally, climate change scenarios are going to address the linkage of climate change adaptation and disaster risk reduction which leads to climate risk management. By creating scenarios in the three sub-sectors, the different training modules cover up-to-date questionings of broad-ranging applications.

1.4. Purpose of the document

The purpose of the document is to specify a set of scenarios which later will be addressed by appropriate training actions. The purpose is also to describe the process that has led to the selection and specification of the scenarios. Additionally, it points out the cross connections to other work packages and tasks. Task 5.1 is ending with this deliverable; the results are forwarded to the subsequent tasks dealing with the role of Remote Sensing and related techniques in the scenarios and the elaboration of the different learning actions for the three sub-sectors.

1.5. Structure of the document

After the introductory part, the mapping of relevant actors is described. The findings in this chapter provide a basis for the development of scenarios, as they define what type of training the different actors can provide. The mapping of relevant actors is followed by the third section describing the learning process for case-based scenarios. Here, a description of the target groups, different methods for case-based learning, and a method to develop a learning path is given. In chapter 4 a cross connection to the curricula design in WP4 is given. Finally, the selection of scenarios is presented. The selection is justified for each subsector.

2. Methodology

The selection of the scenarios was based on the BPMNs diagrams specified in Task 4.1. They represent the expertise of the different partners of EO4GEO. During the project, the partners are responsible for the implementation of the training action. Due to the broad range of expertise a large part of the EO/GI sector is covered, and current problems are addressed. Additionally, similar training actions can easily be developed according to the designed method.

To define the type of training action both tutors that provide the training measure, as well as the target groups must be analysed. The target group determines the education level of the training, the prerequisites that can be assumed and the learning objectives. According to this, the tutors must provide an appropriate training content. By clearly defining learning objectives, prerequisites and EQF level, it can be guaranteed that the expectations of the target group can be met.

Knowing the needs and opportunities of both groups, the best training action can be identified for each training action.

All those criteria were converted into a template that is shown below. Additionally, to the criteria mentioned above, transversal skills, BoK concepts, data and software are also listed. This facilitates the embedding in the Curriculum Design Tool and the further work in T5.2, the role of remote sensing in the three sub-sectors. The responsible partners filled out the template for each training action. The filled templates can be found in the appendix.

Specification of training action

Title

Background

Target group

EQF level

EO*GI relation

☐ core profile

☐ managerial profile

☐ complementary profile

☐ peripheral or linked profile

Type of training action

Learning objectives

Transversal skills

Relevant existing EO4GEO BoK concepts

Relevant missing EO4GEO BoK concepts

Content

Data

Software

Learning outcome

Figure 0.1: Template for the specification of training actions

3. Learning process and objectives for the case-based scenarios

To specify a scenario means that ‘real-world’ problems are identified and described, which will be solved by using GI and EO techniques during the learning process. But specifying a learning process also includes identifying different target groups (stakeholder/actors) of the training action, to design the learning action in a modular way and to choose appropriate types of didactic methodologies.

We may illustrate this entire the process by using the case of ***Evaluation and planning of urban green structures to increase quality of life and support ecosystem services in urban environments’*** as an example. With the objective to frame the case-based scenario within a real-world setting, the overarching context represents the requirements posed to local authorities by the new EU Green Deal. Municipalities/cities need to assess, monitor, and enlarge green areas and increase biodiversity in urban areas.

Problem-based learning or training process may follow the following sequence:

- **What is the problem (Fig. 3.1)?**
  Describe the problem in a cause-effect relationship to facilitate the understanding of the different root causes which need to be addressed. The problem analysis is the starting point of the training.

  The related learning objectives (Anderson’s taxonomy) may be formulated as:
  - Understanding the policy context
  - Applying policy objectives to the local level
  - Analysing and understanding a problematic situation

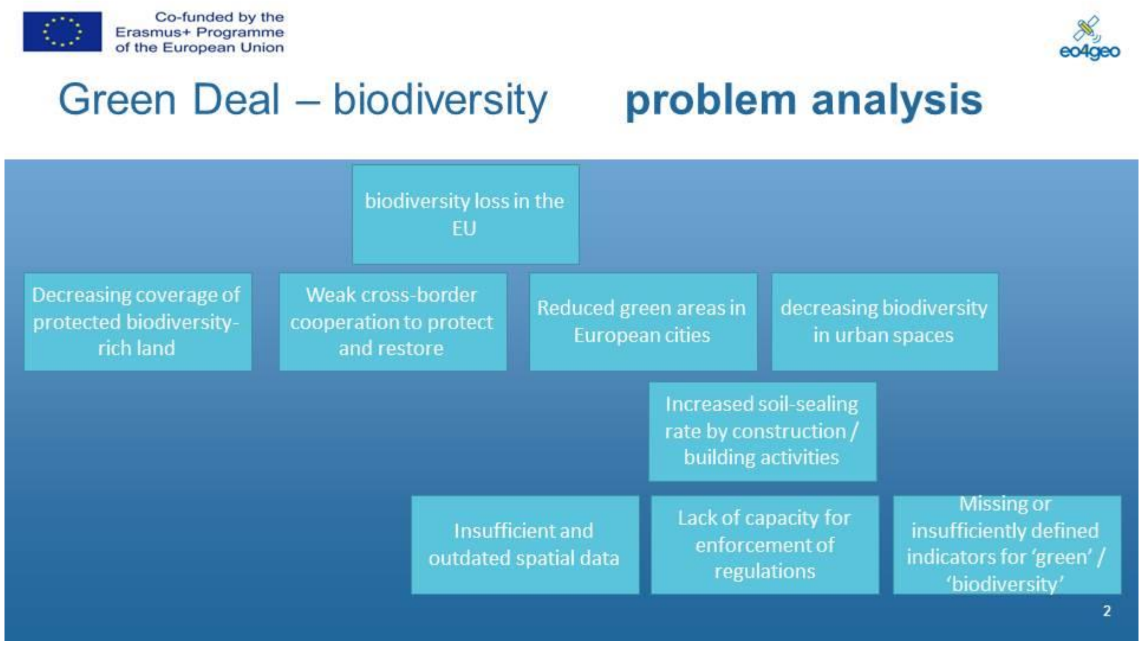

Figure 0.2: Problem analysis of biodiversity loss.

- **What is the best strategy for providing a solution (Fig. 3.2, 3.3)? Only one or more?**
  The choice of the appropriate strategy to address the causes of the problem or a part of the causes strongly depends on (a) the communication with the user(s)/client(s), and (b) the technical capacity of the service provider. What can be done and what cannot be done? This is the crucial step which will be evaluated after the product/service has been delivered regarding the relevance of the solution for the user/client.

  The related learning objectives (Anderson's taxonomy) may be formulated as:
  - Understanding how to arrive from problems to objectives
  - Creating a strategy for action
  - Evaluating own capability and skills

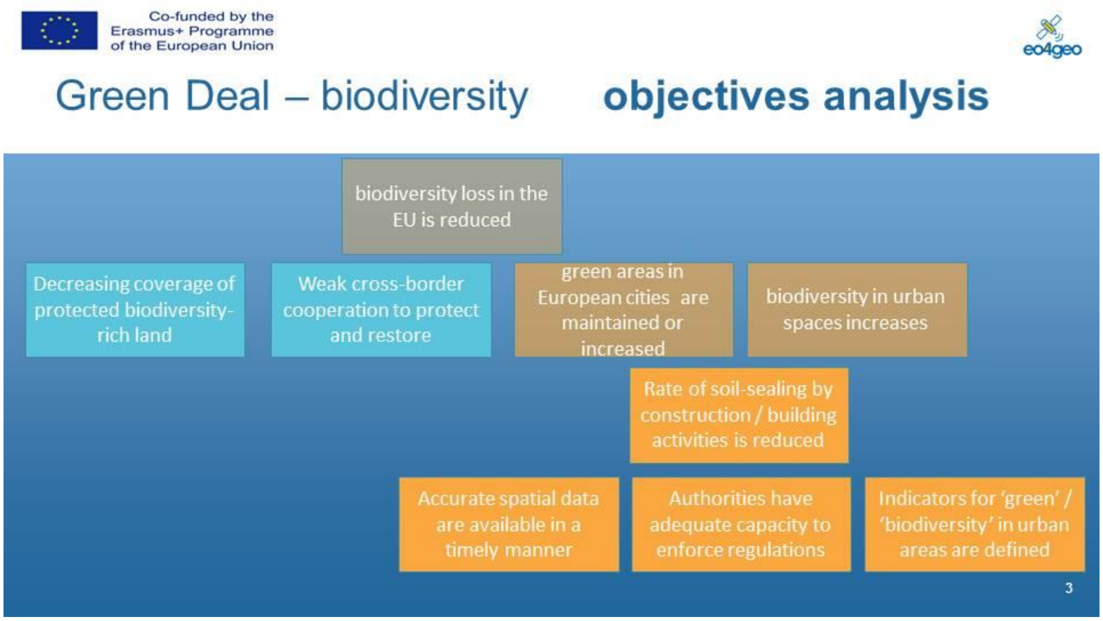

Figure 0.3: Objectives analysis of reduced biodiversity loss.

To be read from the bottom:

If

accurate spatial data are available in a timely manner and t*he authorities have the adequate capacity to enforce regulations* and *the indicators to monitor green areas / biodiversity in urban areas are well defined*

Then

The rate of soils sealing by construction / building activities can be reduced

This will contribute to

Green areas in EU cities are maintained or increased and *biodiversity in urban spaces increases*

And - together with other objectives will contribute that

Biodiversity loss in the EU is reduced

The related learning objectives (Anderson's taxonomy) may be formulated as:

- Evaluating what can be done (e.g. by EO/GI applications) and what cannot be done
- Analysing the interrelationship between objectives at different levels

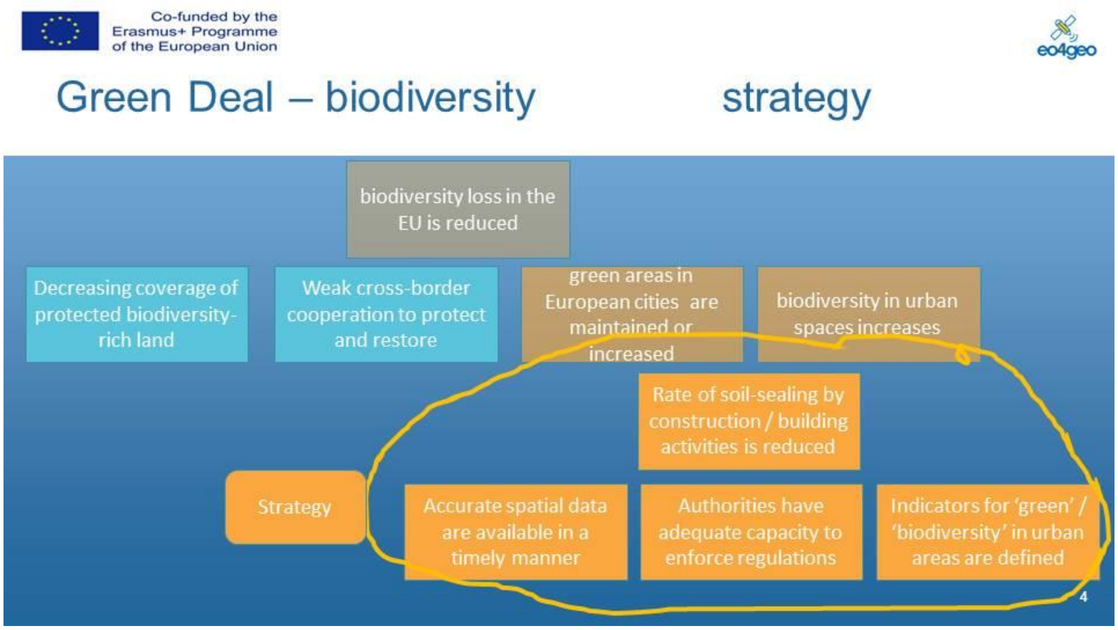

Figure 0.4: Strategy to reduce biodiversity loss.

- **What are the outputs/results to be achieved for the selected solution?**
  The outputs need to be formulated in a means-end relationship and structure the entire workflow from user consultation via production to product delivery.

- **What are the activities/tasks to be carried out to achieve the outputs/results (Fig. 3.4-3.7)?** By whom (actors)? By what means (tools, algorithms, applications, data)? For whom (clients/users)? These tasks are the same as already defined in the BPMN - and the interface to the BoK.

  The related learning objectives (Anderson's taxonomy) may be formulated as:
  - Creating a stakeholder analysis
  - Understanding the difference between stakeholder, client, actor

Figure 0.5: Stakeholders of the Green Deal.

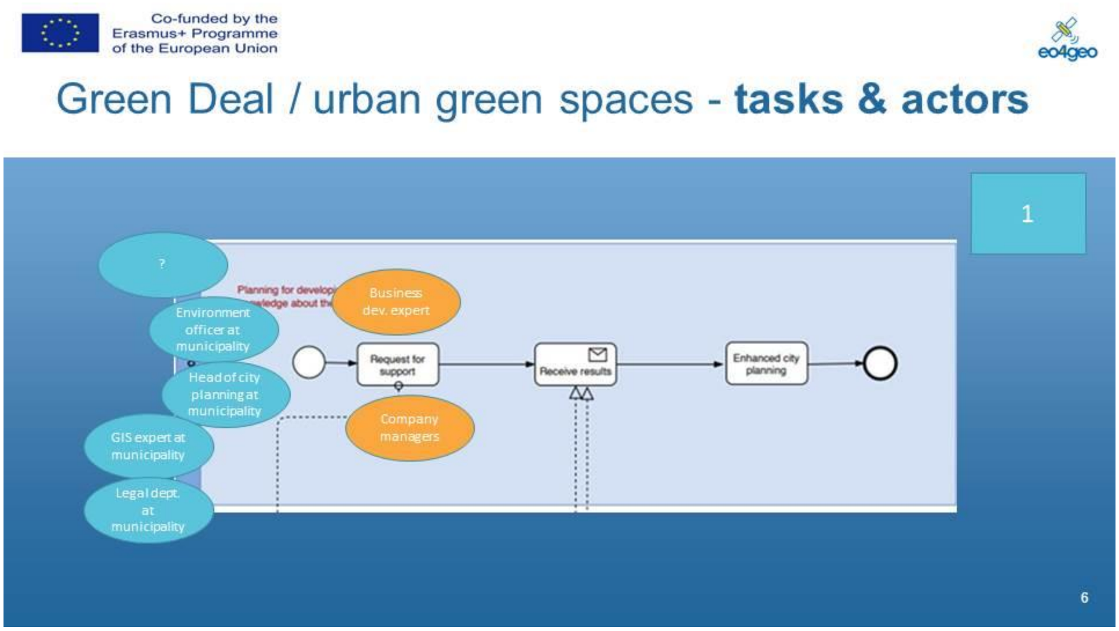

Figure 0.6: Task and actors of the Green Deal (1).

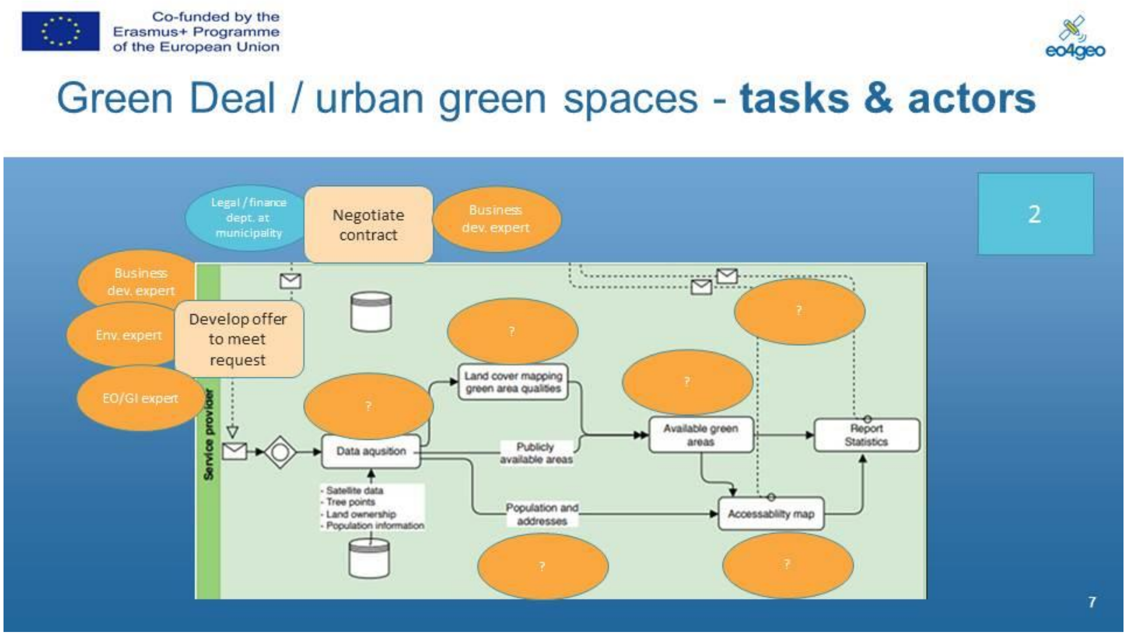

Figure 0.7: Task and actors of the Green Deal (2).

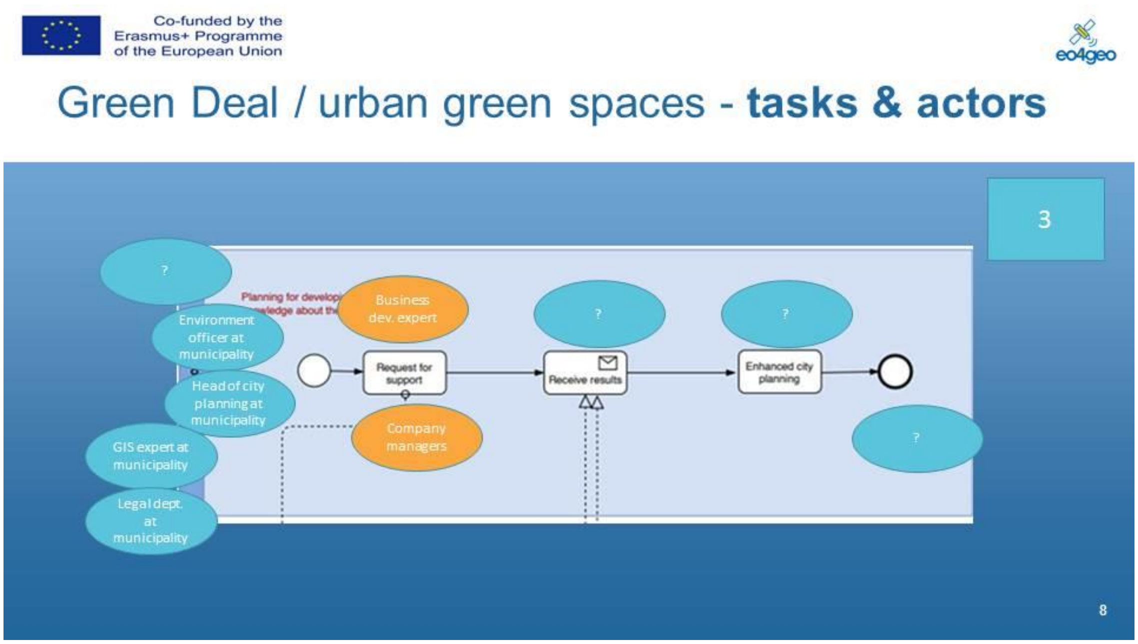

Figure 0.8: Task and actors of the Green Deal (3).

The related learning objectives (Anderson's taxonomy) may be formulated as:

- Understanding who needs to do what?

- Understanding the required skills for different actors
- Creating contractual agreements (e.g. tender specifications)
- Applying negotiations skills (e.g. preparation of bids)

3.1. Training providers

Tutors are the persons who are responsible for presenting the training material or supervising the learning. They can come from different sectors like academia/VET, public authorities, or the private sector. In the following for each sector, an example is given

Authorities
Local, regional, national, or international authorities often must present findings to the public. The role of authorities is very important for informing the population about relevant topics. This type of training provider should have the skill to provide information without requiring specific knowledge on the topic or using technical terms. Here, mostly there's little time to convey knowledge.

Commercial
Agencies and service providers can provide courses and internships for their customers/learners. The customers often have a clear idea about what they want to learn. As it is a work-based learning, there should be hands-on sessions included in the training. As well time is limited here to train the customers. Continuing VET (C-VET) training is an example for this kind of training (European Commission, accessed 12 May 2020a).

Academia/VET
The most obvious tutors are from academia and VET, teaching students, trainees, or scientists/researchers. They can present specific topics in classes or workshops. However, not only can an expert audience be reached, but also an interdisciplinary one. There is a long-time span to convey knowledge in program courses, in dedicated workshops knowledge transfer must be condensed.

3.2. Target groups

To reach as many people as possible different types of people are planned to be involved. As outlined in chapter 3.1 training providers can be divided into the three sectors: authorities, commercial service providers/VET, and academia. The designated target group of training actions include students, academic teachers, data experts, technicians, public authorities, city planners, managers, and decision makers. According to their expertise their state of knowledge is different as well as their learning objectives. In Task 4.1 the target groups were divided into EO*GI *core profiles*, EO*GI *managerial profiles*, EO*GI *peripheral profiles*, and EO*GI *complementary profiles*. There might be overlaps between the target groups in terms of the aspired EO*GI profile and according to their background. The following target groups are distinguished to illustrate the diversity within the groups and the complementarity thereof.

- EO*GI core profiles (EO*GI *CorP*): EO*GI students, EO*GI academics, EO*GI data experts
- EO*GI managerial profiles (EO*GI *ManP*): EO*GI data experts, city planners, public authorities, managers, decision makers
- EO*GI peripheral profiles (EO*GI *PerP*): city planners, public authorities, managers, decision makers
- EO*GI complementary profiles (EO*GI *ComP*): managers, decision makers, technicians, or administrative staff

Additionally, we used the European Qualifications Framework (EQF) to define the level of knowledge. Within the presented training actions, the EQF levels range from 3 (Knowledge of facts, principles, processes and general concepts, in a field of work or study) to 8 (Knowledge at the most advanced frontier of a field of work or study and at the interface between fields) (European Commission, accessed 12 May 2020b).

Choosing the learning material in accordance with the profiles and their expected levels of pre-knowledge, it is possible to start a training action with different levels of (prior) knowledge. As well, it is also possible to run through different learning paths as described in Section 3.2.

3.3. Requirements of the training actions

The aim for this task is to present the selected scenarios in a searchable format to reflect the selection process, the actors, and the underlying issues, to best support the design of appropriate training measures. Therefore, a well-structured approach is needed.

3.3.1. Modular structure of the training to create learning paths

Each training action should be complete in terms of learning objectives and content and thus be independent of other training actions. This assures that in a single training action a complete lesson is learnt, and well-defined learning outcomes are achieved. Nonetheless, the different modules should be combinable to provide learning paths. They can be chosen individually according to the trainee’s interests. One opportunity could be to combine the training actions using the same software. Or, to choose the same scenario, but different approaches. Of course, in both cases, an increasing EQF level is reasonable.

3.3.2. Use of EO4GEO Tools

Within WP2 of the EO4GEO project, a Body of Knowledge (BoK) for the EO/GI sector is being developed. The BoK consists of concepts that describe theories, methods, or technologies. The concepts are interrelated and can thus be represented as a map (EO4GEO, accessed 12 May 2020). The BoK forms the basis for tools that were also developed in the project. The tools include a curricula design tool (CDT), a job offer tool, and an occupational profile tool.
For the creation of training actions, the CDT can be used. In the CDT, a training action is defined by its target group, learning objectives, content, workload, EQF level, pre- and post-requisites, and learning outcome. Links to the BoK via concepts are used to gain a common understanding of the content.

3.4. Types of training applied in EO4GEO

A basic distinction must be made between two types of training: academic education and training and vocational education and training (VET). While academic education and training is designed to equip students with a theoretical foundation of a subject through research-based teaching at a university, VET is a key element of lifelong learning systems. VET targets more practical forms of training and on the job training to equip young professionals, mangers, citizens among others with knowledge, skills and competences required in particular occupations and on the labour market.

For both training types different implementations of the training measure can be applied. The specific implementation of a training measure depends on the learning outcomes that are meant to be achieved. In the giCASES project different methods of knowledge transfer were tested with an emphasis of case-based learning techniques (giCASES, accessed 12 May 2020). Case-based learning thereby starts from a real-world problem that needs to be solved by people with a certain occupation and the trainings aim at equipping students with the necessary knowledge and skills to solve the problem. On the online platform of the giCASES project, self-learning as well as blended learning or tutor-led modules are available that are combined in such a way to optimise the efficiency of learning and teaching As giCASES demonstrates, training can require physical presence, but also online learning or mobilities to achieve an anticipated outcome.

To develop training actions that cover different methods and different learning intensities we decided to choose ***theses, internships, program courses, short courses, summer schools, workshops, webinars, and MOOCs*** as exemplary training actions. Of course, the different training actions pose different requirement on learning material and on the availability of teaching staff. In the following, the definitions of the chosen training actions are introduced;

these definitions are indicatory and support the distinction between different types of training. The different training actions (long- and short-term, online and presented live by a person) also need different kind of assessment tools, methods and evaluation indicators that can be used for each of the training actions to collect feedback from participants and evaluate training materials and approach. Guidelines for the assessment of specific training actions will be further developed within T5.6.

Definition of trainings actions

Program course
A program course is a series of regular lectures, practical exercises, assignments and tests over a period of several weeks or months. The type course can be used for teaching theoretical as well as practical content; depending on the specific subject of the course and its theoretic or practical nature the assessment of learners is done with an exam or through the assessment of assignments. Courses are usually held by a single lecturer or a few lecturers to assure that the lectures build on each other. A course is given at a certain time period for a fixed set of students.

Short course
A short course has the same general characteristics as a program course. The difference is the amount of time to complete the course. A short course is typically finished within 2-3 days.

Workshop
A workshop is a physical meeting of people to discuss and/or perform practical work in a subject or activity (Cambridge University Press, accessed 12 May 2020a). A workshop is moderated by a person that is responsible for directing the discussion/work towards a goal.

Project work
In general terms, project work is usually a practical application of acquired knowledge to a given problem/question in a specific field, as part of a learning path. You need the problem, the methodology, the results, and the conclusions. The problem/questions are proposed and agreed between the student(s), the university, and the company.
The project can be implemented individually or in a team.
The activities during project work are guided by both the academic and the company tutors.
Project work can be performed either individually (also as part of an internship) or as a teamwork. In this last case, it could be also transnational and/or multidisciplinary, depending on the project to be developed and on the involved partners.

Internship

With internship it is referred here to the traditional mobility flow from a sending organization (university or VET institution) to a host organization (normally a company or another public or private non-academic body). The knowledge lies within the practical area as this is typical work-based learning. It gives the trainee the possibility to “taste” a real working environment, to put in practice knowledge acquired during his/her studies and to develop soft skills. The trainee is supervised by an experienced employee and by his/her tutor at the sending institution. The mobility flow can be transnational or not.

A typical example of transnational internships is given by the ERASMUS+ placements.

Summer school or short intensive programme

A summer school or short intensive programme is a training that happens during holiday periods (Cambridge University Press, accessed 12 May 2020b). In a summer school a mixed group of participants comes together for a rather short time and can improve their knowledge on a specific topic. There are parts of theoretical input as well as more practical parts like hands on sessions. Different units are held by different persons, hands on sessions additionally are supervised by tutors.

Webinar

A webinar is an online opportunity to reach many people. The duration is only a few hours in which trainers are presenting a specific topic. To provide a completed topic, a good preparation of training material and a good time management is needed.

MOOC

A massive open online course (MOOC) is an online course created to reach a large number of people .MOOCs typically have a predefined starting date and run over a couple of weeks; during that time the participants can follow the learning material at a time they chose and at their own speed. The training material is not presented live by a person, but within self-explaining presentations, videos, etc. Participants can have different background knowledge. Sometimes, modules can be skipped by more advanced people.

Thesis

A thesis is a scientific piece of work that requires review of literature, the design of a methodology for solving a well specified problem and the analysis and discussion of results. By writing a thesis one student becomes an expert of a specific topic. It generally serves the purpose of learning how to work scientifically. Theses are generally part of academic education and therefore need to follow the specifications provided in an academic curriculum. The work on the methodological part of a thesis can be done in a company or public organisation but does not have to.

4. Relation between Curricula and training actions

The term curriculum has a strong academic connotation. However, in the EO4GEO project the definition of curriculum is not only restricted to academic educational programmes but extended to VET programmes and courses. So, a curriculum is the overall structure and content taught in a programme or course.

Within a curriculum different courses are included. Those courses can be implemented as different training actions, for example program courses, summer schools or internships. Like proposed in WP4 the content of courses within a curriculum can target core, managerial, peripheral, or complementary occupational profiles. Ideally, the single courses build on each other. Table 4.1 shows the intermediate results of identified curricula from Task 4.2 and their possibility to apply different types of training and training actions.

Table 0.2: Needed qualification and possible training actions for specific curricula.

Curriculum name	Type of training	Training action type	EQF/EO*GI
Earth Observation and Remote Sensing (EO)	Academic	Thesis, internship, project work, summer school, program course, short course, workshop, webinar, MOOC	EQF 3-7 EO*GI CorP
Geoinformatics (GI)	Academic	Thesis, internship, project work, summer school, program course, short course, workshop, webinar, MOOC	EQF 3-7 EO*GI CorP
Geospatial Engineering (EO/GI)	Academic	Thesis, internship, project work, summer school, program course, short course, workshop, webinar, MOOC	EQF 5-7 EO*GI CorP
EO/GI for Land Monitoring	Academic, VET	Thesis, internship, project work, summer school, program course, short course, workshop, webinar, MOOC	EQF 5-7 EO*GI CorP
EO/GI for Geospatial Management	Academic, VET	Thesis, internship, project work, summer school, program course, short course, workshop, webinar, MOOC	EQF 5-8 EO*GI CorP
EO/GI for Natural Risk Management	Academic, VET	Thesis, internship, project work, summer school, program course, short course, workshop, webinar, MOOC	EQF 5-8 EO*GI CorP
(EO/GI for) Land hazard Monitoring and Management	Academic, VET	Internship, project work, summer school, program course, short course, workshop, webinar, MOOC	EQF 5-7 EO*GI ManP

EO/GI for Climate Monitoring	Academic, VET	Internship, project work, summer school, program course, short course, workshop, webinar, MOOC	EQF 4-7 EO*GI ManP
EO/GI for Urban Monitoring and Management	Academic, VET	Internship, project work, summer school, program course, short course, workshop, webinar, MOOC	EQF 4-7 EO*GI PerP/ManP
EO/GI for Hydrology and Hydro-technics	Academic, VET	Project work, summer school, short course, workshop, webinar, MOOC	EQF 5-7 EO*GI PerP
EO/GI for Agriculture	Academic, VET	Project work, summer school, short course, workshop, webinar, MOOC	EQF 5-7 EO*GI PerP
EO/GI for Transport and Traffics	Academic, VET	Project work, summer school, short course, workshop, webinar, MOOC	EQF 5-7 EO*GI PerP
EO/GI for Energy Planning	Academic, VET	Project work, summer school, short course, workshop, webinar, MOOC	EQF 5-7 EO*GI PerP
EO/GI for Society	Academic, VET	Project work, summer school, short course, workshop, webinar, MOOC	EQF 4-8 EO*GI PerP
Economical aspects of EO/GI	Academic, VET	Short course, workshop, webinar, MOOC	EQF 4-7 EO*GI ComP
Legal aspects of EO/GI	Academic, VET	Short course, workshop, webinar, MOOC	EQF 5-7 EO*GI ComP
EO/GI for Security	Academic, VET	Short course, workshop, webinar, MOOC	EQF 5-7 EO*GI ComP

A learning path can be seen on two different levels. At a higher level, a learning path is aligning different curricula required to acquire skills and knowledge required for a certain occupational profile. Another approach is within one curriculum, where a learning path is created by combining courses which combined provide the students/trainees specified skills and knowledge. Based on the second definition of a learning path, Table 4.2 specifies two exemplary learning paths to acquire certain skills. The first one, providing profound knowledge in data management, is for a core profile. The learning path might be part of an academic education. Starting with an introductory academic course, that provides basic knowledge in the field, advanced training actions can be taken. The duration of this learning path is one or more semesters. The second one shows how to gain special knowledge in the field of urban planning. It is suitable for VET for peripheral profiles. Here a workshop would be the initial training action that might be extended. The duration of this training actions is much shorter than for the academic training path. It only takes a few weeks.

Table 0.3: Exemplary learning paths.

Learning objectives/skill	**EQF/EO*GI**	**Introductory/ Main training action**	**Following (optional) training actions**			**can be part of Curriculum**
Data management (database, combination of different data sources, data interchange format); web services/visualisation; spatiotemporal analysis; interpretation of model results; privacy policy	EQF 6-7 EO*GI CorP	Geospatial data and technologies applications for monitoring land use change Academic course EQF 7/ EO*GI PerP	EO-based agro monitoring to support regional decision-making MOOC EQF 6-7/ EO*GI CorP	Evaluation and planning of urban green structures to increase quality of life and support ecosystem services in urban environments; workshop EQF 6/ EO*GI CorP	Improving sustainability of cities to storm and water Thesis EQF 6-7/ EO*GI CorP	Academic: EO/GI for Geospatial Management
Knowledge of data sources/pre-processing/visualisation; Use of EO and GIS software to access and analyse vegetation and meteorological data; communicating results to e.g. city planners or managers	EQF 4-6 EO*GI PerP	Evaluation and planning of urban green structures to increase quality of life and support ecosystem services in urban environments Workshop EQF 4/ EO*GI PerP	Identification of local heat islands to support city planning Webinar EQF 4/ EO*GI ComP	Air quality management in support of satellite-based data Workshop EQF 5-6/ EO*GI ComP		VET: EO/GI for Urban Monitoring and Management

5. Selection of scenarios for the three sub-sectors

Starting from the selection of BPMN's described in Task 4.1 the scenarios were selected according to the method described in Section 2, addressing a wide range of significant topics and their associated skills. The business processes being described already represented a good spread over different applications in the sub-sectors. However, sometimes the titles of the BPMN diagrams have been concretised and some scenarios were added to broaden the range of topics.

Table 5.1 shows an overview of the selected scenarios. The selection of the training action types for a specific scenario has been made according to the possibilities of the tutors and with the intention of offering as many different training action types as possible. The cells containing the selected training action types are highlighted in yellow. The training action types which are carried out within the project are used to assess the impact, the relevance, and the sustainability of the trainings. This evaluation is part of T5.6.

Besides the scenarios the training action types, and the target groups are listed in Table 0.4. In the following subchapters which are related to the different sub-sectors, reasons for choosing those exemplary scenarios are given.

Like in T4.1 and described in chapter 3.4 we divided the target group into

- EO*GI core profiles (EO*GI CorP),
- EO*GI managerial profiles (EO*GI ManP),
- EO*GI peripheral profiles (EO*GI PerP),
- EO*GI complementary profiles (EO*GI ComP).

Additionally, we introduced the level of knowledge of the target group according to the European Qualifications Framework (EQF). The selected training actions have levels ranging from 3 (Knowledge of facts, principles, processes and general concepts, in a field of work or study) to 8 (Knowledge at the most advanced frontier of a field of work or study and at the interface between fields) (European Commission, accessed 12 May 2020b).

Table 0.4: Selected scenarios, training action types and target groups.

Sub-sector	Scenario	Target groups and training action type							
		Thesis	Internship	Project work	Academic course	Summer school	Workshop	Webinar	MOOC
Integrated Applications	Landslide affecting Cultural Heritage sites - Baia Archaeological Park (Naples)		EQF 6-8/ EO*GI CorP	EQF 4/ EO*GI PerP	EQF 7/ EO*GI CorP				EQF 6-7/ EO*GI ManP
	Landslides documentation supported with an EO-based service (PLUS)	EQF 5/ EO*GI CorP					EQF 4/ EO*GI ManP		
	Geospatial data and technologies applications for monitoring land use change (ROSA)			EQF 6/ EO*GI ManP	EQF 7/ EO*GI PerP				
	EO-based agro monitoring to support regional decision-making					EQF 4/ EO*GI ManP	EQF 6-7/ EO*GI CorP		
Smart cities	Identification of local heat islands to support city planning		EQF 5/ EO*GI ManP					EQF 4/ EO*GI ComP	
	Evaluation and planning of urban green structures to increase quality of life and support ecosystem services in urban environments						EQF 4/ EO*GI PerP; EQF 6/ EO*GI CorP		
	Improving sustainability of cities to storm and water	EQF 6-7/ EO*GI CorP		EQF 6/ EO*GI ManP					
Climate	Air quality management in support of						EQF 5-6/	EQF 3/	

change	satellite-based data						EO*GI ComP	EO*GI ComP	
	Efficient planning and operation of solar energy farms		EQF 4/ EO*GI PerP		EQF 6/ EO*GI ComP				
	Impact-based weather forecast service for risk evaluation			EQF 6/ EO*GI CorP			EQF 3/ EO*GI ManP		
	Precision farming for vineyard							EQF 3-4/ EO*GI PerP	EQF 3/ EO*GI PerP

5.1. Integrated applications

The sub-sector Integrated Applications deals with multi-faceted, usually multi-sector and often on cross-border challenges, for instance to connect the domain of geo-hazard monitoring and assessment with the ones of sustainable development of anthropogenic settlement. Main expected results within Task 5.3 will be to define standard methodologies to implement risk scenarios on selected exposed elements using open and free EO data. ISPRA will, in the framework of this task, develop and coordinate different scenarios fostering the uptake of EO data, services, and standardised methodologies of analysis. Available EO data provided from different satellite missions, both European and international (e.g. Sentinel from Copernicus program, COSMO-Sky-Med from ASI), will be tested to evaluate their effectiveness and efficiency in the field of geo-hazard monitoring and risk assessment.

To achieve these targets, the BPMNs proposed by Project Partners in the WP 4 have been considered in the first place. All these BPMNs, based on the application field and the content, were clustered in 4 Application Domains. Then, for each Application Domain, four BPMNs have been selected as a Scenario, basing on the different stakeholders involved, EO data, monitoring and analysis activities carried out. The following table shows the result of the selection.

Table 0.5: Selected scenarios for the sub-sector of integrated applications.

Application Domain	**Scenario**	**Partner (Lead)**
Ground Motion	Landslide affecting Cultural Heritage sites - Baia Archaeological Park	ISPRA
Agro Monitoring System	EO-based agro monitoring to support regional decision-making	UJI
Land Change	Geospatial data and technologies applications for	ROSA

Detection	monitoring land use change	
Geohazard Zoning	Landslides documentation supported with an EO-based service	PLUS

Selected scenarios represent a valid panorama of the application of different EO data analysis techniques. The first scenario deals with SAR Interferometry coupled with in situ monitoring for the conservation and management of Cultural Heritage. The second scenario is an example of a regional DSS in agriculture based on EO data analysis. The third scenario integrates EO data and geospatial data to identify land use changes in order to plan a correct land management. The last scenario provides the development and implementation of a landslide inventory by integrating EO data and field survey, for the geo-hazard analysis and natural risk management. Each scenario takes into consideration the stakeholders' needs and interests, mainly in the public sector.

For all scenarios according to the target group different learning objectives have been defined. They span from the knowledge of different EO and geospatial data and their relative sources and availabilities, to the understanding of specific analysis techniques for each kind of data (radar, optical, DEM, field survey),and to the integration of all interdisciplinary data for the problem-solving of environmental threats.

5.2. Smart cities

Cases within Smart cities sub sector focus on how efficient planning can make cities more resilient and adaptable to e.g. climate change and extreme weather events. Careful planning and nature-based solutions can help to enhance and reinforce ecosystem services in the city. Together this will shape future cities and make them more attractive and sustainable.

The use of GI and Earth observation data is of crucial importance for analysing and assessing many important values in the city. As an example, vegetation indices derived from EO-data can be used to measure and evaluate the amount of green spaces in the city, a key indicator of many ecosystem services. Urbanisation is a prevailing trend, and many cities are expanding swiftly, sometimes at the expense of green spaces, resulting in loss of important ecosystem services.

EO and GI data can help to keep track of change in land-cover and land-use, making it easier for planners to make the right decisions. In these scenarios we use a variety of data sources and methods to do e.g. screening for vulnerable areas, analysing effects on ecosystem services and human well-being, assessing accessibility to green spaces, identifying areas prone to flooding, and identifying areas important for interception, infiltration and groundwater recharge.

Three scenarios were selected of which all are connected to strengthen urban resilience and sustainability, with an apparent connection to both subsectors Climate change and Integrated applications. These scenarios also illustrate the need of spatial data and analysis in a very educational way.

Application Domain	**Scenario**	**Partner (Lead)**
Urban heat	Identification of local heat islands to support city planning	GIB
Urban ecosystem services	Evaluation and planning of urban green structures to increase quality of life and support ecosystem services in urban environments	GIB
Urban stormwater	Improving sustainability of cities to storm and water	GIB, FSU-EO

For these scenarios we use standard GIS techniques like overlay analysis and visualisation, together with more demanding concepts like EO time-series and advanced LIDAR processing.

Depending on the educational levels of the target groups, examples of learning outcomes are e.g.:

- Planner learning to interpret land cover maps and surface temperature maps derived from EO data
- Master student in geomatics learning how to prepare a composite satellite image or to perform time-series analyses
- Student processing of LIDAR data to prepare a DTM or DEM for hydrological analysis

5.3. Climate change monitoring and adaptation

Earth's climate changes at different timescales, thus impacting numerous societal and environmental aspects, including safety, health, food security and energy. The sub-sector Climate change monitoring and adaptation aims to provide the needed information to experts and stakeholders for detailed monitoring and effective planning to respond to variations in the frequency, intensity and location of extreme weather and climate events. This is particularly true in the case of air pollution, heat waves, droughts, heavy precipitation, and flooding. It also encompasses making the most of any potential beneficial opportunities associated with climate change (for example, longer growing seasons or increased yields in some regions and increased power production from renewable energy sources).

A climate change monitoring and adaptation system integrates satellite observations, ground-based data and forecast models to monitor and forecast changes in the weather and climate. The better the information available, the more the current conditions can be monitored, and the more accurately future conditions can be assessed, at the local, regional, national, and global level.

The partners involved in this Subtask selected four scenarios (five training actions) as well as EO platform and databases for different educational levels of the target groups. The scenarios are related to air quality monitoring and management, impact-based weather forecast services for risk evaluation, solar energy forecasting for efficient planning and operation of solar energy farms and precision farming for vineyard.

Application Domain	Scenario	Partner (Lead)
Air quality	Air quality monitoring and management	UPAT
Solar energy	Solar energy forecasting for efficient planning and operation of solar energy farms	UPAT
Severe weather events	Impact-based weather forecast services for risk evaluation	UPAT
Farming	Precision farming for vineyard (Precision viticulture)	UPAT, Planetek

For the selected scenarios target groups range from authorities, to students, to farmers. According to the target group, learning objectives include the demonstration of existing EO services, the application of satellite-derived and ground-based data, and the critical understanding of meteorological data and their environmental impact.

5.4. Rationale for the selection of scenarios

The selection of the scenarios for the three subsectors was guided by several criteria. First and foremost, the task lead and the contributors proposed scenarios based on previous or on-going activities, so that they feel confident to access the relevant data and to involve known stakeholders. In the second evaluation phase, the optimal spread of involved actors – occupational profiles: managers, EO/GI experts, technicians, data analysts, assistants – offered by the selected scenarios were considered to enable the use of relevant training measures based on scientific as well as VET curricula.

During a third round of evaluations, the relation of the scenarios to higher political objectives was considered. Problem-based learning (see chapter 3) requires understanding the context of planned actions or development interventions. These contexts are generally defined by policy objectives either in the form of acts to be implemented or to monitor the compliance to regulations.

The core topics of the selected scenarios can be attributed to three key policy objectives either in the EU (Green Deal) or globally (Paris Agreement, Sendai Framework).

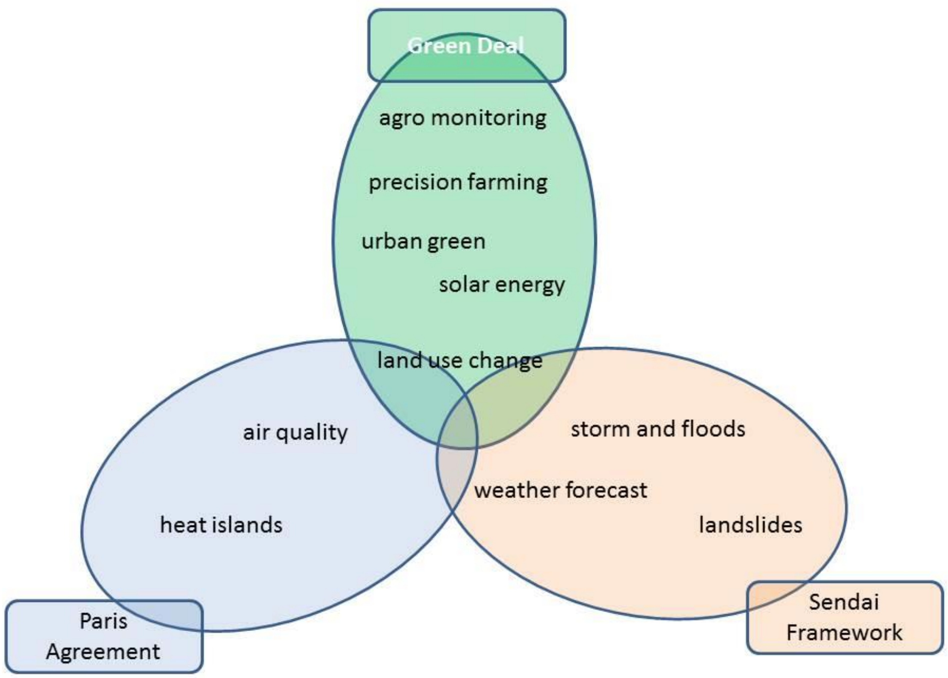

Figure 0.9: Core topics of selected scenarios and related policy objectives.

Sendai Framework

Landslide affecting Cultural Heritage sites - Baia Archaeological Park (Naples)
Landslides documentation supported with an EO-based service (PLUS)
Improving sustainability of cities to storm and water
Impact-based weather forecast service for risk evaluation

Paris Agreement

Identification of local heat islands to support city planning
Satellite-based data support for air quality management

Green Deal
EO-based agro monitoring to support regional decision-making
Precision farming for vineyard
Evaluation and planning of urban green structures to increase quality of life and support ecosystem services in urban environments
Efficient planning and operation of solar energy farms
Geospatial data and technologies applications for monitoring land use change (ROSA)

6. Summary and next steps

The training actions for the three sub-sectors have been selected. They were developed out of the collection of BPMN diagrams and are chosen according to the expertise of the partners. The decision for a specific training action was made due to the possibilities of the target group and the tutors. The training actions cover both academic and VET training types. Each training action was specified by a template to ensure a standardised approach. Within the template a link to the BoK was made. Additionally, examples of learning paths by combining some training actions and a link to related curricula were shown.

In the next task of the work package the role of remote sensing in the three sub-sectors will be analysed. The single training actions will be worked out and integrated in the curricula that are developed in WP4. After the implementation of the training actions, the impact, the relevance, and the sustainability of the trainings will be assessed.

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Appendix

Smart Cities (GIB)

1

Title

Identification of local heat islands to support city planning

Background

Urbanization and a changing climate have a great impact on city microclimate. Densification and loss of green spaces emphasise the important role of trees and vegetated spaces to create thermal comfort, global warming, surface temperature. Cl

Target group

city planner

EQF level

4

EO*GI relation

☐ core profile

☐ managerial profile

☑ complementary profile

☐ peripheral or linked profile

Type of training action

webinar

Learning objectives

Learning to interpret EO-derived temperature maps for use in urban planning. Learning to identify local heat islands and analyse them in an urban planning context. Discuss how EO-derived temperature maps can be used in spatial planning and how this information can be used when planning for particularly vulnerable groups (pre-school children, elderly).

Transversal skills

Communication, teamwork

Relevant existing EO4GEO BoK concepts

[PS2-2-2-3-2-4-8] Landsat-8, [PS2-2-2-3-2-4-20] Sentinel-3, [PP1-6-5] Thermal infrared radiation transfer in the atmosphere, [IP3-11] Time series analysis,

Relevant missing EO4GEO BoK concepts

Content

Presentation of Thermal infrared time series, calibrated to surface temperatures, e.g. 5-year maximum summer temperature. Discuss how different urban planning principles can affect microclimate, and how green structure and water surfaces have a cooling effect. Discuss how nature-based solutions in planning can have a positive impact on the microclimate.

Data

Landsat 8 Thermal infrared
Orto-photos
Vector data (Schools, Health facilities, demographic census data)

Software

GIS software e.g. QGIS, GEE, Stadsträd.se

Learning outcome

Be able to interpret EO surface temperature maps in a spatial planning context. Be aware of the resolution and limitations of the data. Discuss how the data can be useful in a planning context.

2 a

Title

Evaluation and planning of urban green structures to increase quality of life and support ecosystem services in urban environments

Background

The values provided by the green infrastructure are often overlooked in the early stages of planning processes. That, and the fact it is often difficult to estimate and argue for green values in comparison to other values with a more commercial direction demands for an easy way to visualise green values at early stages. These could be used for calculating costs for compensation.

Target group

urban planner

EQF level

4

EO*GI relation

☐ core profile

☐ managerial profile

☑ complementary profile

☐ peripheral or linked profile

Type of training action

workshop (1 day)

Learning objectives

Learning to analyse the context of green infrastructure given vegetation cover or tree points. Learning to interpret different types of data overlays.

Transversal skills

Communication, teamwork

Relevant EO4GEO BoK concepts

[PS3-4] Properties of digital imagery, [PS2-2-2-3-2-4-19] Sentinel-2, [CF4-4b] Categories, [CV2] Data considerations,
[CV3] Design principles, [CV6] Usability,

Relevant missing EO4GEO BoK concepts

Content

Presentation of and hands-on investigation:

- Introduction: ecosystem services provided by urban greenery and trees
- Access to green areas (population, statistics)
- Green infrastructure, creating habitat network for forest birds
- Group session: How to introduce green areas and trees at early stages of the planning process

Data

- Tree points (vector),
- socio-economic layers (point, polygon),
- land cover map,
- plan delineation

Software

stadstrad.se, QGIS, Excel

Learning outcome

Be able to prioritize and choose between different data sources and analyses available for a spatial planning context. Be aware of the resolution and limitations of the “green values” data. Discuss and find out how the data can be useful in a planning context.

2 b

Title

Evaluation and planning of urban green structures to increase quality of life and support ecosystem services in urban environments

Background

The values provided by the green infrastructure are often overlooked in the early stages of planning processes. That, and the fact it is often difficult to estimate and argue for green values in comparison to other values with a more commercial direction demands for an easy way to visualise green values at early stages. These could be used for calculating costs for compensation.

Target group

bachelor/master student

EQF level

6

EO*GI relation

☑ core profile

☐ managerial profile

☐ complementary profile

☐ peripheral or linked profile

Type of training action

workshop (2 days)

Learning objectives

Learn how to classify a satellite image to achieve vegetation cover. Know where to find suitable satellite data.

Learn how to analyse green infrastructure from a specific species point of view.

Learn how to analyse and visualize land cover and socio-economic data to get an understanding about the current situation.

Know the basics about ecosystem services and use algorithms for computing values for:

- Carbon dioxide storage
- Water interception
- Air pollutant removal

Transversal skills

Communication, presentation (visual and text),

Relevant EO4GEO BoK concepts

[PS3-4] Properties of digital imagery, [PS2-2-2-3-2-4-19] Sentinel-2, [IP1] Image pre-processing, [IP3-1] Band maths,
[CF4-4b] Categories, [CV2] Data considerations, [CV3] Design principles, [CV6] Usability,

Relevant missing EO4GEO BoK concepts

Content

Presentation of and hands-on analyses:

- Introduction: ecosystem services provided by urban greenery and trees
    - Compute EST values
- Access to green areas (population, statistics)
    - Prepare a layer of vegetation cover
    - Create and visualise access maps
- Green infrastructure, creating habitat network for forest birds
    - Perform analysis for a specific specie
- How to introduce green areas and trees at early stages of the planning process
    - Prepare maps and report according to the above subjects, for a specific plan

Data

- Satellite data, Sentinel-2
- Tree points
- Population data
- Properties (boundaries)
- Plan delineation

Software

stadstrad.se, QGIS/ArcGIS, Excel

Learning outcome

Data sources - where to find relevant geodata, and how to access it
Data pre-processing - how to pre-process data to use it for further analysis (includes transformations, reformatting, and harmonisation)
Data analysis - using software for e.g. computation of ecosystem services values, overlay analysis, buffer analysis, vegetation indexes etc.
Data visualisation - visualise data and analysis results in a pedagogic manner
Reporting - technical and non-technical, communicating results to e.g. city planners or managers

3

Title

Improving sustainability of cities to extreme precipitation and flooding events

Background

The urban environment is especially sensitive to heavy rain events, since large parts of the land area is covered with impermeable materials. Prolonged rainfall can also cause flooding of rivers and watercourses in the city. Many cities are densified because of the high prices of housing and premises in central locations. This, in combination with a changing climate, may lead to an increased need of managing stormwater effectively. This can be done by an enhancement of the technical stormwater systems, and/or by supplementing the technical systems with nature-based solutions. Using nature-based solutions is definitely a future trend for solving urban stormwater issues. It also requires in-depth knowledge of catchments, infiltration capacity, soils, and vegetation inception. By the use of GIS- and remote sensing data, cities can effectively be screened for; areas prone to riverine flooding, areas sensitive to short rainfall events, important areas for inception, infiltration, and groundwater recharge.

Target group

master/bachelor student

EQF level

6,7

EO*GI relation

☑ core profile

☐ managerial profile

☐ complementary profile

☐ peripheral or linked profile

Type of training action

(Thesis), MOOC

Learning objectives

How to use eo/geodata for screening urban areas and the sensitivity to heavy rainfall events / flash floods. Using different tools to process and analyse large amounts of geodata effectively. Visualisation of results and communication.

Transversal skills

Creative thinking, teamworking, communication

Relevant EO4GEO BoK concepts

[AM13-2] Data model and format conversion, [AM13-4] Vector-to-raster and raster-to-vector conversions, [AM13-6] Coordinate transformations, [AM4] Basic analytical operations, [AM6] Analysis of terrain models, [EO] Data formats, [EO] Remote Sensing data and imagery. [PP2-3-6] Synthetic Aperture Radar (SAR)

Relevant missing EO4GEO BoK concepts

LIDAR data and processing, Processing raster datasets for hydrological analyses, Basic hydrological modelling concepts (may be/ or not be the scope of the BoK)

Content

Problem formulation and demarcation.
Data collection, formatting, and transformation
Data pre-processing
Data analysis
Data visualisation
Technical reporting
Reporting and communication of results

Data

Remote sensing data, e.g. Sentinel 2. LIDAR-data, Hydrological network, Geology, Vegetation/Land-cover

Software

GIS software, e.g QGIS, Saga. Open source e.g. TauDEM, Whitebox. Sentinel-2 toolbox. SWMM toolbox (EPA). Optionally commercial software like MIKE Urban may be of interest

Learning outcome

Data management - how to handle large amounts of geodata effectively Data sources - where to find relevant geodata, and how to access it Data pre-processing - how to pre-process data to use it for further analysis (includes transformations, reformatting, and harmonisation) Data analysis - using software for e.g. delineating catchments, rainfall analysis Data visualisation - visualise data and analysis results in a pedagogic manner Reporting - technical and non-technical, communicating results to e.g. city planners or managers

Climate Change monitoring and adaptation (UPAT)

4a

Title

Air quality monitoring and management

Background

The management of near-surface air quality is essential due to its possible implications for public health, agricultural output, visibility, and aesthetic and cultural values. However, the intricacy in the availability of ground-based data makes the entire process of air-quality management difficult and uneconomic. Satellite-based observations reduce uncertainties in spatial distribution of air pollutants and the associated phenomena affecting them over synoptic and geospatial context. The estimation of ground-level pollutant concentration using space-based observations is one of the foremost applications of remote sensing, which has recently been used for air quality management.

Problem-based learning elements

What is the problem? The management of near-surface air quality is essential due to its possible implications for public health, agricultural output, visibility, and aesthetic and cultural values. However, the intricacy in the availability of ground-based data makes the entire process of air-quality management difficult and uneconomic.
What is a strategy for solution? Satellite-based observations reduce uncertainties in spatial distribution of air pollutants and the associated phenomena affecting them over synoptic and geospatial context. The estimation of ground-level pollutant concentration using space-based observations is one of the foremost applications of remote sensing, which has recently been used for air quality management.
What are the objectives of the selected strategy? Demonstrate/Collect existing EO technologies and data to collect spatiotemporal measurements and forecasts of air pollution; Apply satellite-derived and ground-based data into air quality planning and decision making usable information; Understand relationships among emission sources, meteorological conditions, monitoring and modelling of air pollution for practical applications.

Target group

Regional agencies/authorities, emergency responders, Stakeholders for air quality planning, abatement strategy and decision making

EQF level

3

EO*GI relation

☐ core profile

☐ managerial profile

☐ complementary profile

☑ peripheral or linked profile

Type of training action

webinar

Learning objectives

Demonstrate/Collect existing EO technologies and data to collect spatiotemporal measurements and forecasts of air pollution Apply satellite-derived and ground-based data into air quality planning and decision-making usable information Understand Relationships among emission sources, meteorological conditions, monitoring and modelling of air pollution for practical applications

Transversal skills

Communication, team working

Relevant EO4GEO BoK concepts

CF4b] Fundamentals of Geographic Information

[DM1] Foundations for Data Modelling Storage and Exploitation

[CV2] Data considerations

[GD2] Data Collection

[IP3] Image understanding

[OI1] Organizational structures, procedures, and management

[PS3] Remote Sensing data and imagery

[TA1] Atmosphere Monitoring [TA2] Climate Change Monitoring

Relevant missing EO4GEO BoK concepts

Content

Types and Sources of Air Pollution Effects of Air Pollution Air quality planning Air Quality Measurement Role of air quality monitoring Developing Control Strategies Monitoring & modelling Air quality management tools

Data

Sentinel 3&5, CAMS, Meteorological forecasts

Software

Open software for mapping and visualization

Learning outcome

Identify air pollution and its effects Plan measurement and monitoring of air pollutants Develop emission inventories and evaluate results Correlate effects of meteorology on air pollution Discuss air pollution modelling

4b

Title

Air quality monitoring and management

Background

The management of near-surface air quality is essential due to its possible implications for public health, agricultural output, visibility, and aesthetic and cultural values. However, the intricacy in the availability of ground-based data makes the entire process of air-quality management difficult and uneconomic. Satellite-based observations reduce uncertainties in spatial distribution of air pollutants and the associated phenomena affecting them over synoptic and geospatial context. The estimation of ground-level pollutant concentration using space-based observations is one of the foremost applications of remote sensing, which has recently been used for air quality management.

Problem-based learning elements

What is the problem? The management of near-surface air quality is essential due to its possible implications for public health, agricultural output, visibility, and aesthetic and cultural values. However, the intricacy in the availability of ground-based data makes the entire process of air-quality management difficult and uneconomic.
What is a strategy for solution? Satellite-based observations reduce uncertainties in spatial distribution of air pollutants and the associated phenomena affecting them over synoptic and geospatial context. The estimation of ground-level pollutant concentration using space-based observations is one of the foremost applications of remote sensing, which has recently been used for air quality management.
What are the objectives of the selected strategy? Demonstrate/Collect existing EO technologies and data to collect spatiotemporal measurements and forecasts of air pollution; Apply satellite-derived and ground-based data into air quality planning and decision making usable information; Understand relationships among emission sources, meteorological conditions, monitoring and modelling of air pollution for practical applications.

Target group

Bachelor/Master students

EQF level

5-6

EO*GI relation

☐ core profile

☐ managerial profile

☐complementary profile

☑peripheral or linked profile

Type of training action

2 days workshop

Learning objectives

Search, analysis, and synthesis, as well as a critical understanding of air pollution data and information E existing EO technologies and data to collect spatiotemporal measurements and forecasts of air pollution Construct/model satellite-derived and ground-based data into usable information Determine relationships among emission sources, meteorological conditions, monitoring and modelling of air pollution for practical applications

Transversal skills

Communication, team working

Relevant EO4GEO BoK concepts

[AM10] Data mining

- [AM8] Geostatistics
- [CV1] History and trends
- [CV2] Data considerations
- [CV5] Map production
- [CV6] Usability
- [IP2] Data assimilation
- [PP1-5] Basic of Optics and Modern Physics of Sensors
- [PP1-6] Basics of Atmospheric Physics
- [PS1] Remote Sensing Sensors
- [PS2] Remote Sensing Platforms and Systems
- [PS3] Remote Sensing data and imagery
- [PS4] Satellite and Airborne Sensors and Missions Databases
- [TA1] Atmosphere Monitoring
- [TA2] Climate Change Monitoring

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Relevant missing EO4GEO BoK concepts

Content

Air Pollutants: Properties, emissions, primary and secondary Pollutants, photochemical smog

Airborne particles: Properties, emission sources, optical Properties, direct and indirect effect on climate change

Air pollution measuring techniques: Receiving and analysing samples, differential absorption spectroscopy, light detection and ranging

Air pollution remote sensing from space: the Sentinels

Global/Regional products from Copernicus Atmospheric Service and their evaluation

Air pollution modelling: Emission inventories, Atmospheric dispersion models

Air pollution management

Environmental legislation in Europe in the field of Air Quality

Data

Copernicus Atmospheric Service, Sentinel 1, 2, 3, 5P, Meteosat Second Generation, high resolution topography and land use, emission inventory, meteorological forecasts, ground-based air quality datasets

Software

Python software for data analysis, mapping, and visualization

Learning outcome

Recognize the basic atmospheric pollutants and their impact on climate and health
Demonstrate knowledge of the natural processes involved in gas and particulate pollutants
Apply this cognitive knowledge to explain state-of-the-art problems
Process environmental information for the estimation of air pollution from individual sources

Know computational tools and databases to record / visualize air pollution

5

Title

Solar energy forecasting for efficient planning and operation of solar energy farms

Background

As solar-energy generation systems and smart-grid technology become more abundant, information about the future output of this power source become essential to operating the solar farms as wells as the electric grid economically and reliably. One of the most immediate needs is accurate forecasting for utility-scale solar facilities.

The field of solar (PV and CSP) energy forecasting is rapidly evolving for time horizons ranging from a few minutes ahead to several days ahead. Diverse resources are used to generate solar energy forecasts, ranging from measured weather and operation system data to satellite observations of clouds and weather forecasting models. The usefulness of these resources varies depending on the forecast horizon considered: very short-term forecasts (0.5 to 6 hours ahead) perform best when they make use of satellite data, while weather forecasting models become essential for forecast horizons beyond approximately six hours.

Problem-based learning elements

What is the problem? As solar-energy generation systems and smart-grid technology become more abundant, information about the future output of this power source become essential to operating the solar farms as wells as the electric grid economically and reliably. One of the most immediate needs is accurate forecasting for utility-scale solar facilities.
What is a strategy for solution? The field of solar (PV and CSP) energy forecasting is rapidly evolving for time horizons ranging from a few minutes ahead to several days ahead. Diverse resources will be used to generate solar energy forecasts, ranging from measured weather and operation system data to satellite observations of clouds and weather forecasting models. The usefulness of these resources varies depending on the forecast horizon considered: very short-term forecasts (0.5 to 6 hours ahead) perform best when they make use of satellite data, while weather forecasting models become essential for forecast horizons beyond approximately six hours.
What are the objectives of the selected strategy? Search, analysis, and synthesis, as well as a

critical understanding of solar energy meteorology data and information; Explore existing EO technologies and data to collect spatiotemporal measurements and forecasts of solar energy; Construct/model satellite-derived and ground-based data into usable information for Solar energy forecasting for efficient planning and operation of solar energy farms.

Target group

master student

EQF level

6

EO*GI relation

☐ core profile

☐ managerial profile

☐ complementary profile

☑ peripheral or linked profile

Type of training action

Academic course

Learning objectives

Search, analysis, and synthesis, as well as a critical understanding of solar energy meteorology data and information

Explore existing EO technologies and data to collect spatiotemporal measurements and forecasts of solar energy

Construct/model satellite-derived and ground-based data into usable information for Solar energy forecasting for efficient planning and operation of solar energy farms

Transversal skills

Communication, team working

Relevant EO4GEO BoK concepts

[AM10] Data mining

- [AM8] Geostatistics
- [CV1] History and trends
- [CV2] Data considerations

[CV5] Map production [CV6] Usability [IP2] Data assimilation [PP1-5] Basic of Optics and Modern Physics of Sensors [PP1-6] Basics of Atmospheric Physics [PS1] Remote Sensing Sensors [PS2] Remote Sensing Platforms and Systems [PS3] Remote Sensing data and imagery [TA1] Atmosphere Monitoring [TA2] Climate Change Monitoring [PP1] Basics of Electromagnetism

Relevant missing EO4GEO BoK concepts

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Content

Terms and Definitions

Short-term solar power forecasting based on satellite

Images: Semi-Empirical Satellite Models, Physically Based Satellite Methods

Bankable Solar-Radiation Datasets

Solar Resource Variability

Quantifying and Simulating Solar-Plant Variability Using Irradiance Data

Overview of Solar-Forecasting Methods and a Metric for Accuracy Evaluation

Sky-Imaging Systems for Short-Term Forecasting

Forecasting Solar Irradiance with Numerical Weather Prediction Models

Characterization of forecast errors and benchmarking of renewable energy forecasts

Data

Copernicus Atmospheric Service, Sentinel 1, 2, 3, 5P, Meteosat Second Generation. Copernicus C3S

Software

Python/R software for data analysis, mapping, and visualization

Learning outcome

Evaluate the significance of atmospheric science in the transition to a renewable energy future

Discuss how the weather impacts solar energy integration and operations

Discuss meteorology impacts to the system — transmission and generation

Identify strategic and technical meteorology needs in solar energy systems

Review best practices

Combine forecasting and data analytics

Review solar resource assessment and forecasting

Compare processes of deterministic and probabilistic forecasting

Assess best practices to bridge the gap between atmospheric science and utility industries

6

Title

Impact-based weather forecast services for risk evaluation

Background

Each year the impacts of severe meteorological events around the world give rise to multiple casualties and significant damage to property and infrastructure, with adverse economic consequence for

communities, which can persist for many years. All this happens despite good forecasts of many of these severe events, with accurate warning information disseminated in a timely fashion by the responsible meteorological services and disaster management agencies.

The reasons for this apparent disconnect lie in the gap between forecasts and warnings of meteorological events and an understanding of their potential impacts, by the meteorological services, by the authorities responsible for civil protection / emergency management, by the sectors impacted, and by the population at large. Put simply, while there is a realization of what the hazard might be, there is frequently a lack of understanding of what the hazard might do.

Problem-based learning elements

What is the problem? Each year the impacts of severe meteorological events around the world give rise to multiple casualties and significant damage to property and infrastructure, with adverse economic consequence for communities, which can persist for many years. All this happens despite good forecasts of many of these severe events, with accurate warning information disseminated in a timely fashion by the responsible meteorological services and disaster management agencies.
What is a strategy for solution? We will try to bridge the gap between forecasts and warnings of meteorological events and an understanding of their potential impacts, by the meteorological services, by the authorities responsible for civil protection / emergency management, by the sectors impacted, and by the population at large. The solution strategy is based on the realization of what the hazard might be and the detailed exploration of causes that lead to lack of understanding of what the hazard might do.
What are the objectives of the selected strategy? Demonstrate existing EO technologies and

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data for monitoring, and forecasting in case of severe weather events; Apply satellite-derived and ground-based data into usable information for warning systems and decision making; Determine relationships among monitoring/modelling of weather conditions and EO/GI systems for practical applications

Target group

Regional agencies/authorities, emergency responders, stakeholders severe weather effects mitigation strategies and decision making

EQF level

3

EO*GI relation

☐ core profile

☑ managerial profile

☐ complementary profile

☐ peripheral or linked profile

Type of training action

workshop

Learning objectives

Demonstrate existing EO technologies and data for monitoring, and forecasting in case of severe weather events Apply satellite-derived and ground-based data into usable information for warning systems and decision making Determine relationships among monitoring/modelling of weather conditions and EO/GI systems for practical applications

Transversal skills

Communication, teamwork

Relevant EO4GEO BoK concepts

[AM8] Geostatistics [CV2] Data considerations [CV6] Usability [PP1-6] Basics of Atmospheric Physics [PS3] Remote Sensing data and imagery [TA1] Atmosphere Monitoring [TA2] Climate Change Monitoring

Relevant missing EO4GEO BoK concepts

Content

Basics in synoptic/dynamic meteorology and typical weather services

Diagnosing thunderstorms and lightnings (radar information, lightning networks)

Satellite and ground-based weather information

Key weather parameters that are important for risk evaluation

Coupled Weather-Fire information: Fire-weather indices, intensity and spread rates

Coupled Weather-Hydro information: Flood mapping

Coupled Weather-Urban information: Heat wave mapping, Human thermal comfort indices

Extreme weather services for risk evaluation around the world: best practices

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Data

Copernicus Atmospheric Monitoring Service, radar, GPS, lightning, Mesoscale/High resolution weather forecast, DEM, ground-based measurements, Sentinel-1,2,3, 5P, Copernicus Land Monitoring Service

Software

Open software for mapping and visualization

Learning outcome

Recognize and explain at a basic level fundamental use of weather monitoring/forecasting for risk evaluation

Be able to interpret EO surface environmental maps in a spatial planning context, useful for warning systems and decision making, taking into account the resolution and limitations of the data.

7

Title

Precision farming for vineyard (Precision viticulture)

Background

In agriculture, information-based systems that were unimaginable a generation ago are improving crop and farm management today. Precision Agriculture, for instance, is one area where sensor technology brings new capabilities that solve age-old problems.

In the vineyard, devastating diseases and pests adversely affect wine grape production and cause enormous economic damages annually. Unfortunately, traditional treatments incur additional costs for growers and are largely inefficient.

Problem-based learning elements

What is the problem? In agriculture, information-based systems that were unimaginable a generation ago are improving crop and farm management today. Precision Agriculture, for instance, is one area where sensor technology brings new capabilities that solve age-old problems. In the vineyard, devastating diseases and pests adversely affect wine grape production and cause enormous economic damages annually. Unfortunately, traditional treatments incur additional costs for growers and are largely inefficient.
What is a strategy for solution? We will try to demonstrate the added value of EO products and services in precision viticulture workflow. The fundamental principles of remote sensing and precision viticulture environmental data monitoring will be explained, accompanied by user-friendly ways to find, access and process relevant data in state-of-the-art vegetation mapping and decision making.
What are the objectives of the selected strategy? Demonstrate existing EO technologies and data to collect spatial soil, canopy, and crop data; Apply satellite-derived and ground-based data into usable viticulture information; Understand Relationships from sensors and mapping to the vineyard for practical applications

Target group

Grape producers, Vineyard managers

EQF level

3-4

EO*GI relation

☐ core profile

☐ managerial profile

☑ complementary profile

☐peripheral or linked profile

Type of training action

webinar

Learning objectives

Demonstrate existing EO technologies and data to collect spatial soil, canopy, and crop data

Collect Spatial/temporal data

Apply satellite-derived and ground-based data into usable viticulture information

Understand Relationships from sensors and mapping to the vineyard for practical applications

Transversal skills

Communication, teamwork

Relevant EO4GEO BoK concepts

[AM8] Geostatistics

[CV2] Data considerations

[CV6] Usability

[CF5] Elements of geographic information

[GS3] Use of geospatial information

[TA3] Land Monitoring

Relevant missing EO4GEO BoK concepts

Content

Basics on Measuring/estimating the soil properties

Solar radiation, meteorological conditions and NDVI estimation

Basics of yield monitoring from space and ground

GPS/GIS/DEM tools for satellite-based georeferencing and map-based analysis

Remote sensing and ground monitoring of climatic factors important for vine growth and grape ripening

Field Topography Analysis and Yield Trends

Data

Sentinel-1,2,3, DEM, ground-based measurements. SPOT6

Software

Learning outcome

Recognize and explain at a basic level fundamental physical principles of remote sensing

Recognize and explain at a basic level fundamental physical principles of precision viticulture environmental data monitoring

Data sources - where to find relevant data, and how to access it

Data pre-processing - how to pre-process data to use it for further analysis

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Integrated Applications (ISPRA)

8

Ground Motion Domain

Title

Landslide affecting Cultural Heritage sites - Baia Archaeological Park (Naples)

Background

[GD] Geospatial Data [GD2-2] Remote sensing [GIST] Geographic Information Science and Technology

Target group

EO students - master's degree

EQF level

7

EO*GI relation

☑ core profile

☐ managerial profile

☐ complementary profile

☐ peripheral or linked profile

Type of training action

Master course in EO and Remote Sensing, thesis about the application of InSAR techniques for one or more selected case studies.

Learning objectives

The first objective is to spread and encourage the use of satellite radar data for deformation analyses, not only in geological and environmental applications but also in the management and conservation of built heritage in cultural sites. The use case aims at proposing a simple and easy-to-use methodology to exploit Persistent Scatterer Interferometry (PSI) data related to the Baia Archaeological Park.

Furthermore, the PSI processing will allow to perform PS spatial and velocity analysis focused on the detection of historical and recent deformation.

Transversal skills

[GD] Geospatial Data

[GD2-2] Remote sensing

[PS1-3-4-1] Radar Scatterometers

[GIST] Geographic Information Science and Technology

Relevant EO4GEO BoK concepts

[GIST] Geographic Information Science and Technology

[IP1] Image pre-processing

[IP1-5] Interferometry

[CV] Cartography and Visualization

[PS] Platforms, sensors, and digital imagery

[PS1-1] History of Remote Sensing Sensors

[PS1-3] Active Sensors

[PS1-3-4-1] Radar Scatterometers

[GD] Geospatial Data [GD2] Data Collection [GD2-2] Remote sensing [GD11] Satellite and shipboard remote sensing [GD11-4] Ground verification and accuracy assessment [GD11-3] Algorithms and processing

Relevant missing EO4GEO BoK concepts

none

Content

The Baia Archaeological Park is located in Bacoli municipality (Naples), close by the Phlegrean Fields caldera, representing a unique example of volcanic-related subsidence with unrest cycles characterized by intense ground uplift and down lift; it extends exactly along the inner side of the western sector of the volcanic building of Baia. The particular location of the site, along the steep internal slopes of the volcano, required a strong control over the area development with massive terracing works. The instability phenomena seem to be related to the very high acclivity values of top sector of the slope favouring the activation of modest collapse phenomena as well as by ordinary management and maintenance of the area (e.g. invasive vegetation, absence of drainage systems). Preliminary InSAR analysis were performed exploiting ERS and COSMO Sky-Med datasets; the first dataset show ground lowering phenomena, highlighting that subsidence affected areas close Phlegrean Fields during that period (1993 – 2003). The deformation rates (5-10 mm/yr) recorded in the investigated time interval are consistent with the general down lift cycle, while time series show some small uplift events. InSAR data processing will take into consideration ERS and COSMO Sky-Med datasets and the most recent SENTINEL-1 data, allowing us to assess the instability phenomena evolution of the area in a recent time interval.

Data

EO data (optical, SAR interferometry): Sentinel 1 A-B data, ERS, COSMO-SkyMED, field survey and geological data

Software

- SNAP Sentinel Application Platform, ESA open source platform for all the Sentinel Toolbox ideal for Earth Observation processing and analysis and STAMPS Stanford Method of Persistent Scatterer open source software packages to perform PSI processing.
- R shiny, Shiny is an R package that makes it easy to build interactive web apps straight from
- MATLAB, NOT open source, useful to analyse and design the systems and products
- ArcGIS or QGIS NOT and open source respectively, mapping and analytics platforms.

Learning outcome

- recognize and explain at a basic level fundamental physical principles of remote sensing;
- recognize and explain basic computational properties of remote sensing data acquisition;
- evaluate the qualitative/quantitative uncertainty and limitations of data;
- schematically diagram what is happening to data in a particular analyses or set of analyses and analyse how that influences interpretation of results;
- carry out hypothesis-driven analyses involving spatially referenced data, interpret the results, analyse uncertainties and limitations of interpretations.
- critically analyse pre-existing data.
- Carry out pre-processing and processing of InSAR data.

9

Geohazard zoning domain

Title

Landslides documentation supported with an EO-based service (PLUS)

Background

Application domain knowledge: General knowledge in geohazards (which types exist, where they occur, i.e. which ones are relevant in a particular study area), etc. Concerning EO/GI concepts: [GD] Geospatial Data, [GD2-2] Remote sensing, [GIST] Geographic Information Science and Technology

Target group

National and federal geological services, federal survey authorities, infrastructure providers, regional emergency responders

EQF level

4

EO*GI relation

☐ core profile

☑ managerial profile

☐complementary profile

☐ peripheral or linked profile

Type of training action

Workshop for getting an overview of EO for landslide mapping

Learning objectives

Participants shall get familiar to different types of EO satellite images (both optical and SAR data) and related processing methods that are capable of mapping landslides. By using online platforms for classifying satellite images, they will learn how to process optical satellite images and derive landslide information on their own. They will use reference data to understand the accuracy that EO derived maps can achieve. They will learn use landslide maps to assess where infrastructure is affected.

Transversal skills

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Relevant EO4GEO BoK concepts

[PS3-7-1] Optical data, [PS3-7-2] SAR data,

[IP3-4] Image classification,

[IP4-2-1] Accuracy assessment,

[TA6-2-2] Vulnerability assessment

Relevant missing EO4GEO BoK concepts

Content

Mountainous regions are particularly prone to alpine geohazards like landslides. Landslides occur every year and cause significant damages. Therefore, a sound basis of landslide information is necessary to support tasks of landslide mitigation, preparedness, response, and recovery, e.g. hazard zone planning or eligibility checking for insurance claims. In the last couple of decades, public authorities performed systematic acquisition of information about alpine geohazards and enabled a better understanding of the hazard and the risk.

Earth observation (EO) data and innovative processing methods such as object-based image analysis (OBIA) provide the opportunity to produce landslide maps. A landslide documentation service for inventory updates after triggering events is described that produces EO-derived landslide information enhanced with in-situ verification.

Data

EO data (optical, SAR): Sentinel-1, Sentinel-2, Pléiades (or similar VHR data) Other Geodata: landslide inventories, infrastructure data

Software

Geohazards TEP, Google Earth Engine ArcGIS or QGIS

Learning outcome

- Understand how EO data exploits physical principles of electromagnetic waves (light, RADAR) to identify spectral signatures or surface roughness that distinguishes landslides from other surfaces;
- Apply EO processing methods to extract landslide information from satellite images;
- Evaluate the qualitative/quantitative uncertainty and limitations of data;
- Compare landslide maps to infrastructure data and evaluate the amount of affected infrastructure.

10

Land Change Detection

Title

Geospatial data and technologies applications for monitoring land use change (ROSA)

Background

[GD] Geospatial Data [GD2-2] Remote sensing [GIST] Geographic Information Science and Technology

Target group

Students

EQF level

7

EO*GI relation

☐ core profile

☐ managerial profile

☑ complementary profile

☐ peripheral or linked profile

Type of training action

academic course

Learning objectives

The overall objective is to conduct the necessary research and development activities for gradually achieving a scientific, technological, and socio-economic state where the necessary information for coverage and land use, as required in the various policies, are constantly updated and accessible. The specific objectives for achieving the overall objective aim to select and develop the most appropriate procedures for the permanent collection and analysis of user requirements in order to facilitate the design, implementation and validation of basic services relevant for monitoring land use. The concept of the project is based on providing the tools and services needed to manage spatial remote sensing data or data collected in the field and ancillary data required to generate information about coverage and land use, as they are required for users who implement policies related to land use monitoring.

Transversal skills

[GD] Geospatial Data [GD2-2] Remote sensing [GIST] Geographic Information Science and Technology

Relevant EO4GEO BoK concepts

[GIST] Geographic Information Science and Technology [IP1] Image pre-processing [GD] Geospatial Data [GD2] Data Collection [GD2-2] Remote sensing [GD11-3] Algorithms and processing Change detection

Relevant missing EO4GEO BoK concepts

Content

One of the main objectives of GMES (Global Monitoring for Environment and Security) is to provide timely and effective services to support the environmental monitoring and security, as required by the political programs in this field. Monitoring land use is a complex task given the resources involved and the demands coming from different areas: soil, water, agriculture, forests, ecology, energy and utilities, urban development, recreation, transport and communications infrastructure. In this respect, MUTER aims to create a prototype service for monitoring land use taking into account the requirements for integrating such services of this type of national services with similar European services. To achieve this goal the most technically mature resources will be used to create basic services and to create conditions for the development of derived services for monitoring land use, according to the specific requirements identified at the national level and at the user or applications level.

Data

EO data (optical), field survey, in-situ data, geological data, LCCS (Land Cover Classification System), CORINE Land Cover

Software

eCognition

Learning outcome

- recognize and explain at a basic level fundamental physical principles of remote sensing;

- recognize and explain basic computational properties of remote sensing data acquisition;

- carry out processing of optical data;

- recognize and explain remote sensing data from independent operational sources at national level (5 – 60m resolution) and also at local level (below 2.5 m resolution), data pre-processed at different levels, including ortho-rectified or mosaic;

- recognize and explain the required field data for satellite data processing, including information calibration, classification, and validation on land use – land cover;

11

Agro Monitoring Domain

Title

EO-based agro monitoring system to support regional decision-making (UJI)

Background

[PS1 Remote sensing sensors]

[PS3 Remote sensing data and imagery]

[DM Data modelling, storage, and exploitation]

[DM3 Tessellation data models]

[WB1 Web services]

[TA3 Land monitoring]

[OI3b Spatial Data Infrastructure]

Target group

- Computer scientist with interest in Geospatial technologies or
- People with agro/land-background with interest (and some previous knowledge) in GIS or
- People with EO-background with interest in developing downstream services

EQF level

6/7

EO*GI relation

☑ core profile

☐ managerial profile

☐ complementary profile

☐ peripheral or linked profile

Type of training action

MOOC

Learning objectives

Transversal skills

Relevant EO4GEO BoK concepts

[DM3-2] The raster model

[DA4] Database design

[WB7] Web application development elements

[WB7-3] Web application frameworks and geoportal frameworks

[WB5] Application development via Data Integration

[CV4-1] Thematic mapping

[CV4-4] Visualization of temporal geographic data

[CV4-5] Dynamic and interactive displays

[CV4-6] Web mapping

[AM13-4] Vector to raster and raster-to-vector

[AM13-3] Interpolation

[CF5-3b] Events and processes

[GD2-3] Crowdsourced data collection

[GS1-3] Privacy and security

Relevant missing EO4GEO BoK concepts

Crop monitoring

Precision agriculture

Programming – this is too related to Computer Science it shouldn't be included in the BoK

Content

This training is addressed to non-experts in EO and modelling, but for people in charge of developing and implementing a Geoportal for interacting with products to monitor crops or in relation with precision agriculture. The learner will learn how to create a geoportal that allows users to select different products (vegetation, NDVI…), compare products in different dates in the same area, see the evolution (in graphic format) about certain points to know the value of an individual pixel over time (NDVI, biomass, leaf area index …)

Data

Sentinel 1 and Sentinel 2A (Rice surface maps)

Landsat OLI (Rice surface maps)

Proba-V (Phenological maps)

MODIS 250 m EVI time series (Phenological maps)

TIGGE time series (Meteorological maps)

Potential risk for rice blast infection (Risk maps)

Data crowdsourced by local farmers (fumigating, irrigating…)

Software

ArcGIS

R

PostGIS Java script Python

Learning outcome

- Create a map-based web application
- Create geospatial web services [EAM1]
- Represent processed data by means of web visualisations
- Understand SDI's
- Apply SDI's
- Choose an appropriate data interchange format
- Create a temporal sequence representing a dynamic geospatial process
- Illustrate how the adding time-series data reveals (or does not reveal) patterns not evident in a cross-sectional data
- Design a geospatial database
- Combine different data sources
- Interpret model results
- Create results Create estimated tessellated data sets from point samples using interpolation operations that are appropriate to the specific situation
- Understand the importance of privacy in terms of collecting personal data