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D 5.5 – Climate Change

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Work package / Task:

WP5 – Testing and validating the strategy bases on case-based learning in 3 sub-sectors

T5.5 – Climate Change

Short Description:

This deliverable describes the training actions withing the 'Climate Change' subsector. All training actions are built upon the concept of case-based learning.

Keywords:

Climate Change; Case-based learning; Climate adaption; Training Actions (TA); Body of Knowledge (BoK); learning outcomes; Earth Observations (EO)

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PU	Public	X
RE	Restricted to other programme participants (including Commission services and project reviewers)	
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Executive Summary

The report presents the training actions performed within Task 5.5 ‘Climate Change’, under the frame of the EO4GEO project. Eight training actions were carried out in 2021, covering different subjects of the climate change sector, such as urban and regional atmospheric pollution, urban greenery, carbon dioxide concentrations, and more. The detailed descriptions of the training actions are attached to the document.

The methodology followed for designing the training actions is based on setting specific problems within the climate change context (problem-based learning elements) and then proposing particular solutions for their confrontation or performing relevant exercises (case-based learning elements) for their optimal exploitation. In this case, the aim is not only to transfer knowledge to the participants but also to transfer skills.

In general, eight TAs were designed to present use cases of adaptation planning at local and regional levels. As imposed by the pandemic crisis, TAs were mainly held in a webinar form, leading to wide participation of various partners and collaborating organizations. All TAs were promoted to attract respective communities and the number of participants exceeded the original target.

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Acronyms

Acronym	Description
BoK	Body of Knowledge
BPMN	Business Process Model and Notation
CAMS	Copernicus Atmosphere Monitoring Service
CCA	Climate Change Adaptation
CDT	Curriculum Design Tool
CRM	Climate Risk Management
DRR	Disaster Risk Reduction
ECTS	European Credit Transfer and Accumulation System
EO	Earth Observation (including Meteorology)
EO*GI	EO and GI sectors
EQF	European Qualifications Framework
ESA	European Space Agency
GI	Geographic Information
GIS	Geographic Information Systems
SDG	Sustainable Development Goals
SLSTR	Sea and Land Surface Temperature Radiometer
SNAP	SentiNel Application Platform
TA	Training Action
WP	Work Package

Glossary

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

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

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

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

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

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

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

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

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

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

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

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

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.

Skill means the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualifications Framework, skills are described as cognitive or practical skills.

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

1. Introduction

1.1. EO4GEO project

EO4GEO is an **Erasmus+ Sector Skills Alliance** gathering **25 partners from 13 EU countries**, most of which are part of the **Copernicus Academy Network**. Be they from academia, public or private sector, they are all active in the education and training fields of the space / geospatial sector. The project is also supported by a strong group of Associated Partners mostly consisting of associations or networks active in space/geospatial domain. The project started on January 1st, 2018, upon approval by the EU Education, Audiovisual and Culture Executive Agency (EACEA) and runs over four years.

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

EO4GEO defines a long-term and sustainable strategy to fill the gap between supply of and demand for space/geospatial education and training taking into account the current and expected technological and non-technological developments in the space/geospatial and related sectors (e.g. ICT).

The strategy is implemented by: creating and maintaining an ontology-based Body of Knowledge for the space/geospatial sector based on previous efforts; developing and integrating a dynamic collaborative platform with associated tools; designing and developing a series of curricula and a rich portfolio of training modules directly usable in the context of Copernicus and other relevant programmes and conducting a series of training actions for a selected set of scenario's in three sub-sectors - integrated applications, smart cities and climate change to test and validate the approach. Finally a long-term Action Plan will be developed and endorsed to roll-out and sustain the proposed solutions

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

1.2. Objectives of the work package

The scope of work package 5 is testing and validating the (EO4GEO) strategy based on case-based learning scenarios in three sub sectors. The three sub sectors are “Integrated Applications”, “Smart Cities” and “Climate Change”.

The work package specifies curricula based on case-based scenarios for the sub-sectors, and tests and validates them in concrete training actions. These training actions included on-the-job training like webinars and workshops but also (academic-) courses and summer schools. In this context remote sensing and related techniques were considered as supporting or horizontal competencies needed for conducting the case-based scenarios. The training actions were prepared in detail by mixed task forces. Each training action is complete in terms of learning objectives and content and thus is independent. This assures that in a single training action a complete lesson is learnt, and well-defined learning outcomes are achieved. Nonetheless, the different training actions are part of learning paths that link them to related training actions. Trainees can choose a learning path that guides them through training actions that are relevant for their interests.

For each sub-sector, a taskforce of at least three partners with relevant expertise were 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. Testing and validation were 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.

Case-based learning

Case-based learning starts from ‘real-world’ problems or scenarios, rather than from the ‘solutions’ or supporting technologies. Training action participants 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 to support different users and different types of usage. 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.

1.3. Objectives of the task

While there are still considerable uncertainties regarding the exact contribution of anthropogenic climate change to disaster risk and related impacts, increasing losses from extreme events – globally and in Europe –the need for comprehensively addressing climate-related risks has increased. This calls for an increased focus for linking climate change adaptation (CCA) and disaster risk reduction (DRR), leading to what has been broadly referred to as climate risk management (CRM). Such focus is in line with international disaster risk and climate policy frameworks as well as the UN's Sustainable Development Goals (SDG). In addition, CRM has been suggested to foster comprehensively managing climate-related risks at the national level and to support the implementation of adaptation measures as defined in National Adaptation strategies. In general, there is good and increasing understanding that joint action in terms of building multi-stakeholder partnerships between private and public actors is essential, yet their respective and collective roles and responsibilities are blurry and subject to negotiation - actions undertaken by one actor may limit or widen the room to manoeuvre of the actions expected from other actors. Hence, appropriate methods and tools to disentangle the complex distribution of competencies and responsibilities, are needed to take CRM to more effective levels and identifying efficient and acceptable interventions based on the recurrence of hazards causing either frequent events with minor impacts or infrequent but devastating catastrophes. Not all disaster risk can be eliminated, and it is imperative to know which risks should be reduced, which insured against and which will require governmental or international assistance.

Task 5.5 aims to prepare detailed training actions for the case-based scenarios of the climate change subsector to improve skills for applying space and geospatial data in support of climate change adaptation and the reduction of climate induced impacts.

The task includes the following types of activities:

- Identify the components of interdisciplinary and inter-sectorial scenarios (i.e. climate change information from science, adaptation planning on local level, regional development agencies)
- Based on the methodology established in T5.1, assess the requirements for integrating data and information from various sources (i.e. economic factors, agriculture, water resources, climate information) by exploring Copernicus and INSPIRE infrastructures (i.e. Copernicus Climate Service, Land Monitoring Service, the Atmosphere Service, socio-economic data)
- Select appropriate curricula and training methods (WP 2, 3, and 4) to address the specific nature and skills needs of the community to be involved (i.e. district planners, climate change research, national Met-offices, farmers)
- Decide on the format of training actions (i.e. workshop, internships, exchange program of experts)
- Advertise the training action(s) to attract participants from the respective communities (per discipline, sector (public/private), pan-European)
- Implement the training action(s) with the objective to provide a best-practise example (i.e. for climate change adaptation at local level).

1.4. Purpose of the document

This document reports the Learning Scenarios for the Training Actions (TA) performed within Task 5.5 – Climate Change under the frame of the EO4GEO project. The TAs derived from the EO*GI skill analysis and based on the training support tools from the previous phases of the Project (EO4GEO Tools, BPMN modeling). In the next paragraphs, the TAs that carried out are descibed. Moreover, the experiences and lessons learned from the implementation of the TAs are presented.

1.5. Structure of the document

The document consists of four sections after the introductory section, which describes the EO4GEO project, the objectives of WP5 and Task 5.5 – Climate Change. Section 2 (**'Methodology'**) describes the basic methodology for implementing the TAs. The **Results** section (Chapter 3) gives an overview of the TAs, presenting the structure of TAs and the expected Learning Objectives. Chapter 4 (**"Wokflow of the Training Actions"**) discusses problem-based and case-based learning scenarios, accompanied by primary results for the evaluation processes. Finally, Chapter 5 (**"Conclusions"**) summarizes the results and Task 5.5.

2. Methodology

2.1. The EO4GEO training approach

The skills strategy of the EO*GI sector has been established and based on a Body of Knowledge (BoK) which provides a structured overview of the necessary concepts and related skills for the EO/GI workforce to do business.

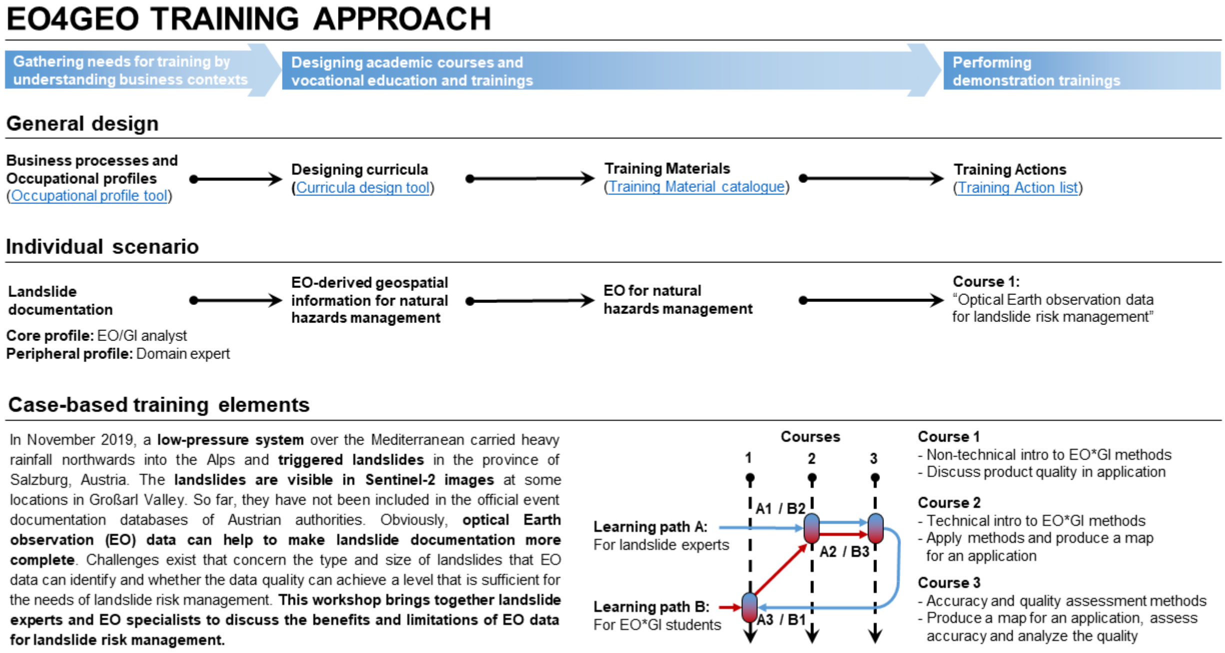

Fig. 1: The EO4GEO Training Approach - A skills strategy for the GI and EO sector

The curricula were designed based on the business processes and occupation profiles relevant to Copernicus, leading to specific training material for the EO/GI sector. The training actions act to test the material and the development of an integrated platform of collaborative tools and curricula in support of Copernicus within the EO4GEO training approach.

2.2. Preliminary information for training actions

Task 5.5 realized eight training actions evaluated in 2021, reaching a total number of 710 participants and 27 tutors. Due to the COVID-19 pandemic crisis, the implementation of thesis or internships was not feasible, and the majority of the training actions were performed online in the form of webinars, online workshops and online courses. Only one TA (Air Quality Monitoring and Management - advanced) within Task 5.5 – Climate Change held in vivo with a specific number of trainees (~46) imposed by pandemic regulations. The following table summarizes general information on different learning scenarios conducted by Organizer Partners as Training Actions for Climate Change sub-sector.

Table 1 Basic information for the training actions

Organizer	Training action	Implementation	Date	Number of participants
UNEP-GRID	EO for urban greenery management	Webinar	2021-04-26	54
UPAT	Air quality monitoring and management	Webinar	2021-05-25	156

	Early warning for disease epidemics at regional level	Webinar	2021-06-11	122
EIT CLIMATE-KIC	Spark! - Earth observation and geographic Information: a crucial tool to monitor and tackle climate change	Workshop	2021-10-26	80
SERCO	Active fire detection with Sentinel-3	Webinar	2021-10-28	39
UPAT	Solar potential maps at municipal level	Webinar	2021-11-09	~200
NOVOGIT	CO_2 budgets for municipalities	Open Online Course (OOC)	November/ December 2021	13
UPAT	Air Quality Monitoring and Management – advanced	Workshop	2021-12-17	46

Many partners and external bodies have collaborated and contributed to evaluating each TA. The training material regarding the individual TAs has been designed and used by the following organizations:

- EIT CLIMATE-KIC
- NOVOGIT
- SERCO ***(external body)***
- UNEP/GRID Warsaw
- UPAT
- ISPRA
- ROSA
- UNIBAS

The webinar on "Solar potential maps in municipality level" was organized by ***UPAT*** (in the framework of EO4GEO project) in collaboration with the ***e-shape*** project. The webinar on "Early warning disease epidemics at regional level" was performed by ***UPAT*** (in the frame of EO4GEO project) in collaboration with the ***BEYOND EO Center*** and the ***EuroGEO Action Group "Earth Observation for Epidemics of Vector-borne Diseases"***. In both cases, collaborating groups presented their recent activities and outcomes: state-of-the-art methodologies and new datasets were presented. Moreover, numerous use cases and good practices were presented.

Support on all organizational aspects has been provided by WP5 lead ***Spatial Services*** and project lead ***GISIG***. A brief description of the Learning Scenarios (Table 1), highlighting relevant topics and the context of application, is reported in the following paragraphs.

EO for urban greenery management

The webinar is dedicated to use remote sensing data in the management of urban greenery. Urban greenery is a key element of a healthy human environment. When properly designed and nurtured, it generates a variety of benefits for the purpose of climate change mitigation and adaptation in urban spaces. In the coming years, urban green management will put more focus on biodiversity conservation, protecting ecosystems and using a nature-based solution, including green infrastructure. By participating in the webinar, the students understand how to acquire data on urban greenery using remote sensing methods and how such collected data can be used to improve urban greenery management, especially in the context of climate change adaptation.

Air quality monitoring and management

The webinar aims to provide basic knowledge about air quality monitoring and management. The participants are able to understand the effects and principal factors of air pollution, the linkages to the urban environment and public health, and methods to qualitatively explore the air pollution patterns over a specific area. The webinar is mainly non-technical and targets planners on a regional, city and municipal scale and professionals with no extensive experience in air quality. The following topics are mainly addressed,

- EO technologies and data to collect spatiotemporal measurements and forecasts of air pollution.
- Satellite-derived and ground-based data for air quality planning and decision making.
- Relationships between emission sources, meteorological conditions, monitoring and modelling of air pollution for practical applications.

Early warning for disease epidemics at regional level

The webinar aims to provide the participants basic knowledge about the development and application of an early warning system to help prevent outbreaks of mosquito-borne diseases. The participants are able to understand the basics of the development of an early warning system for mosquito-borne diseases. The development of an early warning system and its benefits on disease outbreaks will be presented for selected cases at regional and municipal levels. The webinar is mainly non-technical and targets planners on regional, city, and municipal scales as well professionals with no extensive experience on early warning systems.

Spark! - Earth observation and geographic Information: a crucial tool to monitor and tackle climate change

This online workshop is focused on the use and applications of satellite data in climate-change-related challenges. Institutional, academic, and private stakeholders give context to the Earth Observation and Geographic Information sector and ongoing initiatives. Use cases where Earth observation and geographic information to tackle climate change are provided. The workshop is targeted to Master and PhD European students from various backgrounds (also non-technical), young professionals and citizens.

Active fire detection with Sentinel-3

Wildfires are a recurrent hazard in Europe and at the global level. They cause significant economic and environmental damages and often result in the loss of human lives. It is thus essential to provide early warning and increase preparedness to prevent wildfires and, when this is not possible, minimize the damages caused by them. Losses by wildfires in Europe are conservatively estimated at about 2.700.000 Million Euro every year. Vegetation fires are usually very dynamic in their magnitude, impact, and location. That is the reason why early information about active fires in remote areas such as forests or grasslands is very important. Satellite imagery provides an ideal tool for large-scale active fire monitoring due to its spatial and temporal coverage. Furthermore, data acquired from Copernicus Sentinel satellites are provided under an open and free policy for all applications and uses. This webinar focuses on the basics of image processing for active fire detection, showing how to download, process, analyze, and visualize the free data acquired by the Copernicus satellites. The ESA SNAP Sentinel-3 Toolbox is used to demonstrate the methodology to detect active fires with the SLSTR instrument onboard Sentinel-3.

Solar potential maps at municipal level
The webinar designates the potential role of solar energy resources and forecasting in solar farms' efficient planning and operation. The participants are able to understand the principles of solar resources and forecasting as well as the benefits of Earth Observation systems to the solar energy sector. State-of-the-art solar energy forecasting tools from European to municipality scale are presented for selected cases. The webinar is mainly non-technical and targets planners on regional/city/municipal scale as well professionals with no extensive experience in solar energy.

CO_2 budgets for municipalities
CO_2 budgets are now increasingly being introduced at the municipal level as a tool for planning, initiating, and monitoring activities impacting climate change. A global CO_2 budget (carbon budget) is the upper limit of CO_2 emissions to remain below a specific average global temperature. The global CO_2 budget can be split in space and time, such as a national CO_2 budget for 2020 – 2050. The budget may also include targets and a plan on how to reach the goals. This open online course is focused on using different data sources to manage and analyze CO_2 budgets. Participants will learn more about what a CO_2 budget is, some data problems related to impact modelling and monitoring of CO_2 emissions, limitations of Copernicus Climate Change Services and some basic principles of forecasting. The webinar is mainly targeting planners and GIS technicians at different levels in cities or municipalities.

Air Quality Monitoring and Management – advanced
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 air-quality management in general difficult and uneconomic. Satellite-based observations reduce uncertainties in the spatial distribution of air pollutants and the associated phenomena affecting them over synoptic and geospatial contexts. The estimation of ground-level pollutant concentration using space-borne observations is one of the foremost applications of remote sensing, which has recently been applied for air quality management. This 1-day workshop aims to provide advanced knowledge about air quality monitoring and management principles. The workshop is mainly targeting bachelor and master students.

2.3. Target Groups and profiles

A need for training occurs when there is a gap between the demand in specific business processes and their occupational profiles that the workforce members cannot meet. Therefore, the gathering of needs for training requires an understanding of the business processes and the involved occupational profiles that define the skill requirements.

Table 2 Description of the target groups and profiles in each TA.

Training action	Target group	Target profile
EO for urban greenery management	Students interested in urban studies	CorP
Air Quality Monitoring and management	Students interested in air quality, regional agencies/authorities, emergency responders, Stakeholders for air quality planning, abatement strategy and decision making	CorP ManP PerP ComP
Early warning for mosquito-borne epidemics at regional level	Regional agencies/authorities, emergency responders, stakeholders for mitigation strategies and decision making	PerP ComP
Spark! - Earth observation and geographic Information: a crucial tool to monitor and tackle climate change	Master and PhD European students from various backgrounds (also non-technical), Young professionals, citizens	CorP
Active fire detection with Sentinel 3	Students, researchers, environmentalists interested in active fire detection and applications of Sentinel-3 data	CorP
Solar resource and forecasting at municipality level	Students with various backgrounds, regional agencies/authorities, Stakeholders for solar energy planning and decision making	CorP ManP
CO_2 budgets for municipalities	Urban planners, GIS engineers	PerP
Air Quality Monitoring and management – advanced	Bachelor/Master students	CorP

The meaning of the target profiles in the EO/GI sectors (adapted from WP4) is given as,

- **Core Profiles (CorP)**: Involve task completion related to Earth Observation and Geoinformatics. Performing persons of core profiles either have a high level proficiency in EO*GI and a high degree of work time is dedicated to EO*GI tasks or spend most of their worktime with EO*GI-related tasks with a medium level of required skills in EO*GI (and get supervised by a project manager, etc).

- **Managerial profiles (ManP)**: Can be found in different sectors of application-oriented businesses dedicated to a certain field and covering EO*GI-Tasks as one important field of their work. This involves for example the distribution of tasks in a service provider setting or tender specification in a client setting.

- **Peripheral profiles (PerP)**: Apply to those who realise need for EO*GI support and demand a service (which is provided by one of the first two types) and then use the results of the service to proceed with their domain-related specific tasks.

- **Complementary profiles (ComP)**: Technical or administrative profiles, which need to have a certain idea of EO*GI-related business processes happening in their company or department while a deeper understanding is not necessary to fulfil their tasks.

2.4. Learning Objectives

The Training Actions aim to transfer new and fundamental knowledge as proposed by the Training Material and develop new skills required by the rapid growth of the EO*GI sector. The new skills are posed at the beginning of each TA using the concept of **Learning Objectives**.

Learning Objectives are brief statements describing what the trainees will be expected to do ('skill transfer') after completing an instruction process. The Learning Objectives enable the instructors to design and efficiently implement a TA and help them perform the necessary evaluation and assessment strategies. Table 3 represents the Learning Objectives of each TA involved in Task 5.5 – Climate Change.

Table 3 Description of the Learning Objectives in each TA.

Training action	Learning Objectives
EO for urban greenery management	• Explain the basic concepts of EO data usage for the analysis of the green infrastructure in a city. • Discuss remote sensing, image properties, ecosystem services, greenery management.
Air Quality Monitoring and management	• Discuss air pollution concepts. • Explore existing EO technologies and data to collect spatiotemporal measurements and forecasts of air pollution. • Assemble satellite-derived data and ground-based observations into usable information. • Demonstrate relationships among emission sources, meteorological conditions, monitoring and modelling of air pollution for practical applications.
Early warning for mosquito-borne epidemics at regional level	• Recognize existing EO technologies and data for monitoring, and modeling in case of disease epidemics. • Assemble satellite-derived and ground-based data into usable information for early warning systems and decision making. • Demonstrate relationships among monitoring/modelling of weather conditions and EO/GI systems for practical applications.

Spark! - Earth observation and geographic Information: a crucial tool to monitor and tackle climate change	• Discuss the concepts of Earth Observation and geographic information. • Explain how the data are collected, transformed and used for solving different issues. • Recognize the main stakeholders for support to tackle climate challenges. • Distinguish possible applications and sectors where EO*GI is useful.
Active fire detection with Sentinel 3	• Explain the basic principles of data processing • Discuss the concept and characteristics of the Sentinel-3 SLSTR instrument and the data it provides • Describe the concept of active fire detection using Sentinel-3 data (night and day-time detection) • Develop a fire detection algorithm (night and day-time) for visualizing areas with active fires. • Compare results with operational monitoring from Global Wildfire Information System.
Solar resource and forecasting at municipality level	• Discuss the concepts of Energy Meteorology and what it offers to the solar sector. • Recognize the main atmospheric and solar-related parameters that contribute to the efficient use of PV and CSP systems. • Explain the basic principles of solar forecasting. • Discuss Earth observations for solar nowcasting and forecasting. • Describe PV nowcasting and short-term forecasting on an urban scale. • Use solar energy tools for urban scale applications.
CO_2 budgets for municipalities	• Explain what a CO_2 budget is. • Describe the basic content of a CO_2 budget. • Describe how CO_2 budgets may be used. • Describe different methods for setting targets. • Explain some data problems related to impact modelling.

	• Describe data sources for monitoring of CO_2 emissions and content. • Describe data sources of related sectors (air quality, traffic, ...). • Explain pro's and con's of Copernicus Climate Change Services. • Explain basic principles of forecasting.
Air Quality Monitoring and management - advanced	• Explore existing EO technologies and data to collect spatiotemporal measurements and forecasts of air pollution. • Assemble satellite-derived and ground-based data into usable information. • Demonstrate relationships among emission sources, meteorological conditions, monitoring and modelling of air pollution for practical applications.

2.5. Relationship with BoK

Training Actions within Task 5.5 – Climate Change were designed using EO4GEO tools such as the Body of Knowledge (BoK) and the Curriculum Design Tool (CDT). As already stated in the 'Methodology' section, a TA is based on a real use-case, identifying its solution's workflow (BPMN). The components of each case are explained by the BoK concepts, leading the participants to recognize and use well-known elements. More specifically, CDT provides the knowledge link, indicating the logical path to acquire the right skills for executing the tasks drawn in the scenario. The EQF for each TA were determined through the target profiles of Table 3.

Table 4 BoK concepts, EQF and ECTS for the TAs within 'Climate Change' sector

Training Action	BoK Concepts	EQF	ECTS
EO for urban greenery management	[CF] Conceptual Foundations [DM1] Foundations for Data Modelling Storage and Exploitation [GS3-4] Use of geospatial information in environmental issues [TA12] EO for societal and environmental challenges [TA12-10] EO for sustainable urban development	3	

Air quality monitoring and management	[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	3	
Early warning for mosquito-borne epidemics at regional level	[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	3	
Spark! - Earth observation and geographic Information: a crucial tool to monitor and tackle climate change	[CF] Conceptual Foundations [GS] GI and Society [GS3-4] Use of geospatial information in environmental issues [OI] Organizational and Institutional Aspects, [OI5-1] GI organization at the European Commission [IP] Image processing and analysis [TA] Thematic and application domains [TA12] EO for societal and environmental challenges	3-4	0.2
Active fire detection with Sentinel 3	[CF] Conceptual Foundations [IP6] Image processing (value) chain [GS3-4] Use of geospatial information in environmental issues [TA12] EO for societal and environmental challenges [TA12-1] EO for climate change mitigation & adaptation [TA13] EO services and applications [TA13-3] Assess disasters & geohazards [TA13-3-2] Detect and monitor wildfires	3	
Solar resource and forecasting at municipality	[AM10] Data mining [CV2] Data considerations [CV5] Map production	3	

level	[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 [TA1] Atmosphere Monitoring [TA2] Climate Change Monitoring		
CO_2 budgets for municipalities	[IP5-3-1] Data and information access service (DIAS) [DM4-5] Examples of important application model	3-4	0.5
Air quality monitoring and management – advanced	[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	5-6	1

3. Workflow of the training actions

3.1. Problem-based learning elements of TAs

All training actions have been designed focusing on a) the problem-based learning elements and b) case-based learning scenarios. The problem-based learning elements are mandatory for each training action and aim to answer generic questions regarding the definition of the problem and the strategies that could be followed to explain the problem in-depth. In this case, the participants could adequately understand each problem covered by TAs and recognize how and what type of

EO/GI data could be used to tackle the problem. Table 5 summarizes the problem-based learning elements covered in each TA of Task 5.5, including the definition of the problem, the strategy for a possible solution, and the selected strategy's objectives.

Table 5 Problem-based learning elements covered in each TA.

Training Actions	Problem-based learning elements
EO for urban greenery management	**What is the problem?** Urban greenery is a crucial element of a healthy human environment. When properly managed, urban trees generate various benefits for city dwellers. In order to facilitate optimal management of urban greenery, possessing complete and up-to-date knowledge about trees growing in the city is needed. The problem is that the inventory of one tree usually takes about 15 minutes and there are usually millions of trees in large cities which would have to be inspected. In such circumstances, after completing such tree inventory, a large part of the collected data would be already out of date. **What is a strategy for solution?** An alternative solution to the traditional way of collecting tree data by field inspection is turning to modern remote sensing technologies. An example of remotely sensed data that can be successfully used in urban green management are Sentinel-2 data . As remote sensing data constantly improves in quality and becomes more widely available, it becomes more and more important to educate future urban greenery managers with its use. **What are the objectives of the selected strategy?** • Learn how to acquire remote sensing data, including Copernicus data. • Understand how to use data for improving greenery management w.r.t. climate change.
Air Quality Monitoring and management	**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 high-quality 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 and 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.
Early warning for mosquito-borne epidemics at regional level	**What is the problem?** Vector borne diseases, among them the West Nile Virus (WNV), are a global health threat causing more than 700,000 deaths globally each year with significant economic and social impacts. All this happens due to the absence of human vaccine indicating that early warning is the alternative strategy. **What is a strategy for solution?** The development and the utilization of an early warning system for WNV provides the best tool for bridging the gap between early warning for WNV outbreaks and an understanding of their potential impacts, by the environmental services, by the authorities responsible for civil protection / emergency management, by the sectors impacted, and by the population at large. **What are the objectives of the selected strategy?** • Demonstrate existing EO technologies and data for monitoring, and predicting in case of vector-borne diseases. • Apply meteorological and ground-based observations into usable information for early warning systems and decision making • Determine relationships among monitoring/modelling of weather conditions and EO/GI systems for epidemiological applications
Spark! - Earth observation and geographic Information: a crucial tool to monitor and tackle climate change	**What is the problem?** Climate change has dire consequences on many sectors and EO*GI provides tools and solutions to take climate action. However the awareness and knowledge of students and citizens outside the EO*GI sector on the applications and use of satellite and remote sensing data is still limited. **What is a strategy for solution?** Inspire students and young professionals from various sectors and backgrounds to include EO*GI in their reflection when thinking about local or global climate change challenges. **What are the objectives of the selected strategy?** • Learn the applications of EO*GI and include it in reflections and strategies.
Active fire detection with Sentinel 3	**What is the problem?** Open vegetation fires are critical elements acting as a driving force by modifying land cover, consuming terrestrial vegetation and reducing ecosystem services. Such fires act across all vegetated areas, but is usually very dynamic in its magnitude, impact and specific location. That is why the information about active fires in remote areas such as forest or areas covered by vegetation is very important. Systems for early warning of fire exists and are used in the forests, however we cannot use them to see the magnitude of the event. Using airborne lidar or UAV is usually costly so in the areas where forest managers cannot use these tools the unique solution is using satellite imagery. Images can be acquired totally for free, and they will allow real time detection of areas actively burning, helping also to estimate the extent of the damages

	it caused, as well as perform time series analysis on the direction of the fire. **What is a strategy for solution?** Solution to this problem can be very high temporal resolution data coming from freely available images from Earth Observation satellite. Sentinel 3 satellite among many sensors it carries, it is equipped in the Sea and Land Surface Temperature Radiometer (SLSTR), which is a dual scan temperature radiometer. Among different channels this sensor has, it provides two dedicated channels for fire and high temperature monitoring at 1 km resolution. Thermal infra-red fire emission bands of this sensor are a great alternative to the use of optical sensors, as very often the images from the optical sensors are influenced by cloud cover, wind or topography of the terrain where the images are taken. **What are the objectives of the selected strategy?** The purpose of this webinar is to focus on the basics of image processing for active fire detection, showing how to process, analyze and visualize the free data acquired by the Copernicus satellites. The European Space Agency (ESA) Sentinel Application Platform (SNAP) Sentinel-3 Toolbox is usedto demonstrate the methodology to detect active fires with the SLSTR instrument onboard Sentinel-3. As the result actively burning areas can be detected faster in near real-time. As data is freely available, the method proposed is cost-effective method which can be applied to any areas where the wildfire occurred. Moreover, thanks to this method the magnitude of the event can be estimated in a very short time and with good accuracy. This also will give possibility to forest managers and owners to estimate the damages the event caused which is important while applying for the subsidies or financial help after natural disaster.
Solar resource and forecasting at municipality level	**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 well 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 (Photovoltaic, PV and Concentrating Solar Panel, 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 (30 min 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.
CO_2 budgets for municipalities	**What is the problem?** The establishment of a CO_2 budget is associated with many different types of problems, such as political issues, economical and financial as well as technological issues. This course is mainly dealing with issues related to the supply of data for making rational decisions on the planning, evaluation and monitoring of different activities within the jurisdiction of a local authority. **What is a strategy for solution?** There is a large variety of data being available, supporting the development and management of a local CO_2 budget. This variety is both a problem and an opportunity, which are not reduced by the increasing amount of new data sources and environmental modelling resources being available. The strategy for addressing these problems and opportunities is to review existing and, if possible, forthcoming data resources and to evaluate their suitability for the management of local CO_2 budgets. The suitability of a specific data source may be expressed as effectiveness (does it answer your needs), efficiency (easy to work with) and user satisfaction. **What are the objectives of the selected strategy?** • Feed existing data into a general model for evaluation of urban development actions and monitoring of climate impact.
Air Quality Monitoring and management - advanced	**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.

3.2. Case-based learning elements of TAs

Instead of giving information about the definition, source, and selected strategy for each problem addressed by the TAs, case-based learning methodologies were applied (Section 4.1). Case-based learning arises from 'real-world' problems or scenarios. The scenarios' design and implementation are critical to 'attract' the audience, transfer both knowledge and skills, and reach the learning objectives set prior to each TA evaluation (Section 3.3). After gaining fundamental knowledge through the problem-based learning elements (sub-section 4.1), the participants of TAs learn how to analyse a problem, explore GI and EO techniques, and the appropriate data to design and implement a solution.

The following table describes the case-based learning elements included in each TA of Task 5.5 – Climate Change. The data and software used are guided by the problem-based learning elements, and they are significant parts of the efficient implementation of the case-based learning scenarios. Most of the TAs within Task 5.5 – Climate Change used open-source programming languages and platforms to generate the results presented in each learning scenario. The data were mainly derived from Copernicus services.

Table 6 Case-based learning elements covered in each TA.

Training Actions	Case-based learning elements
EO for urban greenery management	**Description** Millions of trees in an area spanning over 500 square kilometers are being monitored in Warsaw, Poland. This unprecedented mapping project of the urban green environment, which is based on a unique multi-sensor photogrammetric platform, will result in the Tree Crown Map: an advanced map of individual trees, including recognition of nearly 50 taxa, geometry of their canopies and their health condition. The project meets the city's increasing need for complete and up-to-date knowledge about all trees growing in the area. During the webinar, the case study of Warsaw – the Tree Crown Map, is presented, and the benefits and limitations of EO data for urban greenery management will be discussed. **Data used** • Sentinel-2 RGB satellite imagery Sentinel-2 NDVI image • Sentinel-2 Global Land Cover The Street Tree Layer (STL) High Resolution Layers (HRL) **Software used** • ArcGIS iTree Eco Javascript
Air Quality Monitoring and management	**Description** In this webinar, air quality is examined in a medium-sized coastal city (Patras, Greece)

	located in Southern Greece. Particulate Matter in Patras mainly originates from local emission sources such as traffic, harbor activities, and biomass burning, while regional contributions to air quality from the Central/East Europe and the Sahara Desert also exist. PatrasAir is a ground-based network for monitoring air quality (PM_1, $PM_{2.5}$ and PM_{10}), including more than 15 low-cost sensors. Although continuous monitoring meets air quality information needs, forecasting air pollutants is also a significant and challenging aspect. During the webinar, the case study of modeling air pollutants ($PM_{2.5}$ and PM_{10}) in Patras using artificial intelligence methods, ground-based measurements and CAMS forecasts is presented. Station-based experiments and the spatial patterns of air pollution at daily and diurnal scale will be discussed. **Data used** • Ground-based measurements from low-cost sensors • CAMS • Meteorological forecasts **Software used** N/A
Early warning for mosquito-borne epidemics at regional level	**Description** The absence of vaccination for WNV indicates the necessity for the development and evaluation of an early warning system for WNV. In this webinar, an early warning system for vector-borne diseases (in this case WNV) is presented. It is based solely on environmental (temperature), geographical, entomological, demographical, epidemiological data, and Earth Observation systems. It aims to predict human case infections. The early warning system is validated using observed human cases in the municipal (Greece) and regional (Venetto, Italy) levels. In Greece, two major outbreaks of WNV occurred in the decade 2010–2020. The WNV outbreaks in 2010 and 2018 caused a total of 262 and 316 human cases, respectively. In Veneto, 423 human cases were detected in the WNV outbreak of 2018. Both in Greece and Veneto, some of the human infections resulted to West Nile neuroinvasive diseases (WNND) and deaths. The validation process of the early warning system showed that the model correctly identified the location and year for 72% of the observed cases in Greece, while for Veneto, Italy, the relevant probability reached 0.94. **Data used** • CAMS • ERA-5 • demographic and social-based data • ground-based observations **Software used** N/A
Spark! - Earth observation and geographic Information: a crucial tool to	**Description** “Spark!” is an initiative from EIT Climate-KIC to inspire university students, PhD students and citizens to take climate action. For this October edition, EIT Climate-KIC and EO4GEO have partnered to give the participants of “Spark!” an overview of the use and

monitor and tackle climate change	applications of satellite data in climate-change related challenges. This training action aims at the crucial role Earth observation and geographic information plays in monitoring, forecasting, and mitigating climate change in various end-sectors such as forestry, agriculture or urban planning to name a few. Stakeholders from the institutional, academic, and private sector give context on the sector and main ongoing initiatives. They also present their activities and use-cases where they are using Earth observation and geographic information to tackle climate change. **Data used** • Copernicus Atmosphere Monitoring Service solar radiation data from SoDa portal • aerial images • vegetation indexes • land cover **Software used** • Microsoft Excel • Sentinel Playground software
Active fire detection with Sentinel 3	**Description** A series of four initial deadly wildfires erupted across central Portugal in the afternoon of 17 June 2017 within minutes of each other. An intense heat wave preceded the fires, with many areas of Portugal seeing temperatures in excess of 40 °C (104 °F). During the night of 17–18 June, 156 fires erupted across the country, particularly in mountainous areas 200 km (120 mi) northeast of Lisbon. Portugal's fires have burnt 520,000 hectares of forest this year, 52 times the size of Lisbon and representing nearly 60 % of the total area burnt in the entire European Union in 2017. The amount of land burnt is the highest ever in Portugal's history. **Data used** • Two cloud-free Sentinel-3A Level 1B RBT products **Software used** • Internet browser, • SNAP + Sentinel-3 Toolbox • QGIS • Google Earth
Solar resource and forecasting at municipality level	**Description** The use of PV modules (rooftop, parking shades, etc.) in urban areas is very interesting due to the electricity production, the positive impact on Urban Heat Islands, the added value in non-used urban areas, the non-emission of air pollutants and greenhouse gases (GHG) and also the constant and substantially decreasing prices in PV systems installation. The above reasons indicate that solar cadasters are important for analyzing the solar potential of roofs/shades over a city with respect to local electricity consumption and also to provide help to public, private decision-makers and investors.

	During the webinar, the case study of assessing and forecasting solar energy potential in cities (Nantes, France) using earth observations is presented. The objective of the case-study is to evaluate a GIS-tool dedicated to high photovoltaic penetration at urban scale, providing EO based information about urban energy system modeling, electric energy demand profiles and accurate electric production of fleet of a PV rooftop system. The tool is designed in a jupyter notebook, it is open-source and easily accessible, and provides information about the solar irradiance, the efficiency and the power production from the installed PV system. **Data used** • CAMS • Meteosat Second Generation • Copernicus C3S **Software used** • Python software for data analysis, mapping, and visualization • Jupyter notebooks
CO_2 budgets for municipalities	**Description** A global CO_2 budget (carbon budget) is the upper limit of CO_2 emissions in order to remain below a specific average global temperature. The global CO_2 budget can be split in space and time, for instance as a national CO2 budget for the period 2020 – 2050. The budget may also include targets and a plan on how to reach the goals. The concept of local CO_2 budgets are now increasingly being introduced at municipal level, as a tool for planning, initiating and monitoring activities having an impact on climate change and CO_2 emissions. **Data used** N/A **Software used** N/A
Air Quality Monitoring and management - advanced	**Description** Air quality is essential due to its effects on public health, agricultural output, visibility, and aesthetic and cultural values. This workshop aims to address state-of the art air quality problems and to provide advanced knowledge about the primary principles of air quality monitoring and management. The participants will be informed about • EO technologies and data to collect spatiotemporal measurements and forecasts of air pollution • How to make usable satellite-derived and ground-based data into air quality planning and decision • Relationships among emission sources, meteorological conditions, monitoring and modelling of air pollution for practical applications. **Data used** 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 used** • Python software for data analysis, mapping, and visualization

3.3. Assessment and evaluation

The assessment and evaluations of the TAs are useful to extract information about the participants, know if the learning objectives are reached, and verify the success or failure of the instruction process. Questionnaires (organized by Task 5.6) were sent to participants at the end of each action, while polls related to the participants were answered during the TA to extract precise knowledge about the participants' status.

All training actions held online (except for the workshop on Air Quality Monitoring and Management -advanced), covering short time periods. The TAs aimed to transfer knowledge and skills to the participants based on the problem-based learning elements defined in each TA. However, it has been concluded that webinars (preferred option due to COVID-19 pandemic) were a powerful tool to transfer knowledge, although also accompanied by certain limitations to transfer skills.

Overall, three out of eight TAs included activities to transfer skills. In the next paragraphs, is checked how and to what extent skills are transferred by these TAs.

Spark! - Earth observation and geographic Information: a crucial tool to monitor and tackle climate change
The participants were divided into groups to implement short projects, including exercises and calculations with real data based on the lessons learned by the lectures. The projects were supervised and corrected by the tutors responsible for the online workshop. This skills evaluation process lasted from 30 to 45 minutes.

CO_2 budgets for municipalities
The trainees answered questionnaires and evaluated to receive a certificate for the Open Online Course. In this case, the participants applied the knowledge received from the lectures to the evaluation report.

Air quality monitoring and management – advanced
After the end of the workshop, the participants worked in groups to apply the knowledge transferred by the problem-based learning elements to real-based exercises. Each team worked with ground-based and Copernicus data to implement short projects. The organizers assessed the participants' projects, and the successful teams-participants received a workshop certificate.

4. Discussion

The workflow provided for the design and the implementation of TAs increased the quality of the TAs substantially, allowing participants to follow the application context, the logical workflow (BPMN modelling, Curriculum Design Tool), the tools (BoK), the roles (Occupation Profile Tool) and the expected outcomes due to knowledge and skill transfers.

The development of eight TAs in Task 5.5 – Climate Change with more than 710 participants and 27 trainers involved largely exceeds the initial target of 5 TAs and 235 participants. This result determines the success of the TAs since the terms due to the pandemic crisis regarding the design, implementation and participation changed dramatically compared to the initial planning.

The change in TA format, from physical to online events, increased organizers' efforts to disseminate, register participants, and implement the online platform for the events. The online format of TAs and open availability of the training material in the Moodle platform led to the use of resources from a broader audience than the one initially foreseen. Also, the online process leads more people with different occupational profiles to be interested and participate, explaining the high number of participants involved in TAs. Another significant part is the cooperation among trainers from various organizations. Finally, the increasing number of TAs is strongly related to the online format of TAs since the easier implementation of events has encouraged partners to propose more TA in additional fields, which has increased both the quantity and quality of the project's training offer.

Instead of the pros of the online TAs, strong drawbacks exist related mainly to the evaluation of TAs. The interaction between the trainers and the audience via Q&A was limited to small-time periods and cannot adequately replace a physical meeting. Interactive remote solutions (i.e., polls, Q&A sessions and questionnaires) were followed for assessing the TA while the tutors answered the questions from the audience at the end of each presentation and the end of each TA.

Lessons learned from TAs regarding the design and evaluation of a TA, collaboration among partners, interaction with the participants etc., are summarized as:

- Preparation of the training material, including polls and questionnaires, is important.
- Collaboration among organizations could benefit the efficient design and the evaluation of the training action.
- Apart from the problem-based generic elements, real examples (case-based learning scenarios) are significant for the better exploitation and the success of TAs
- The lectures must cover all the available information regarding the problem-based learning elements and scenarios in a timely manner. In this case, the participants could gain the available knowledge to reach the learning objectives of TA.
- Evaluation strategies in TA are important to assess if and how skills are transferred to the participants after completing the instruction process.

- Polls can be used to get to know the audience's status.
- Keep time for questions at the conclusion of TA and if it is possible at the end of each presentation.
- Interaction among the audience and the speakers controls the success of the TA and gives feedback about reaching the learning outcomes. The session of questions and answers was fruitful and important. Moreover, the participation of several tutors gave the opportunity to receive and answer questions in real time, parallel to the flow of the event: this interaction was an added value for the TA.

5. Conclusions

- A bouquet of TAs, focused on the contribution of anthropogenic climate change to disaster risk and related impacts, globally and in Europe, was developed. Emphasis was given for for linking climate change adaptation (CCA) and disaster risk reduction (DRR).
- Involved partners and collaborating organizations identified the components of interdisciplinary and inter-sectorial scenarios (i.e. early warning for mosquito-borne epidemics). Emphasis was given to present use cases of adaptation planning at local or regional level.
- Based on the methodology established in T5.1, a variety of data and information from various sources (i.e. Copernicus Climate and Atmospheric Services) were integrated.
- The format of training actions was decided according to the conditions imposed by the pandemic. Most TAs were organized as webinars. The advantage of this format were mainly that it was attracting a wide participation from various sectors. A disadvantage was that the evaluations of the skill transfer were incomplete and difficult to implement.
- All TAs were promoted to attract respective communities and the number of participants exceeded the original target
- All TAs developed and implemented in a way to provide best-practise examples and use cases. For this reason, the collaboration with on-going EU projects, focused on Copernicus user uptake (e.g e-shape) and the EuroGeo initiative was sought.

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7. Annex

EO for urban greenery management	*Date:* April 12th 2022 *Organizers:* UNEP/GRID-Warsaw Centre under the frame of the EO4GEO project in collaboration with Eco-City (pl: Eco-Miasto) project *Objective:* The webinar aims to introduce the topic to use of remote sensing data in the management of urban greenery to Polish authorities and people interested in this issue, as well as spread the word about the EO4GEO project. It has been achieved by presenting the "EO for urban greenery management" Training Action material that took place on April 26th 2021. TA's material has been adjusted to better connect with the target group. The participants were able to learn how remote sensing data is used in a hands-on way by the City of Warsaw, from the Deputy Director of the Environmental Protection Office of the City of Warsaw. *Content – Agenda:* • Introduction to EO4GEO and Eco-Miasto projects • Ecosystem services provided by urban vegetation • Warsaw case study – the Tree Crown Map • The Tree Crown Map in managing the greenery of the City of Warsaw *Webinar Information:* The webinar was held online in polish on Zoom platform. It was attended by 40 participants, out of 66 registrations. Youtube link: https://youtu.be/tNkt8vi_-ww