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D 5.6 – Summer Schools

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Work package / Task:

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

T5.6 – Feedback and lessons learned from the testing and validation

Short Description:

Report from designing and organizing (joint effort of the consortium) two Summer Schools linking sub-sector scenarios to further explore cross-fertilization between space and geospatial applications to address skills gaps.

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Dissemination Level		
PU	Public	X
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CO	Confidential, only for members of the consortium (including EACEA and Commission services and project reviewers)	

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Executive Summary

The report reflects on the two summer school conducted in 2021 by PLUS/UNEP-Grid and UNIBAS as part of the EO4GEO training actions. The two summer schools were based on different formats and target groups: 1) The PLUS summer school on Intelligent Earth Observation was designed as international summer school with a broad audience, completely conducted in a virtual environment; 2) The UNIBAS summer school on Introduction to Satellite Remote Sensing was designed as a local/regional summer school with a limited pre-selected audience, conducted in presence (in Potenza) allowing remote attendance too.

Besides an outline of the structure and content of the summer schools, the report comprises insights on the evaluation and feedback results, provided by the participants at the end of the training actions.

Evaluation and feedback related to the organizational format and the content of the summer schools were also strongly focused on the achievement of learning outcomes.

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Acronyms

Acronym	Description
AI4EO	Artificial Intelligence for Earth Observation
BoK	Body of Knowledge
EACEA	Education, Audio-visual, Culture Executive Agency
EO	Earth Observation (incl. Meteorology)
EO*GI	EO and GI sectors
EU	European Union
GEOF	Faculty of Geodesy, University of Zagreb
GI	Geographic Information
GIB	Geografiska Informationsbyrån AB
ICT	Information Computer Technology
KU Leuven	Catholic University of Leuven
LPAs	Local Public Administrations
PLUS	Paris Lodron University of Salzburg
SpaSe	Spatial Services
UNIBAS	University of Basilicata
UPAT	University of Patras

Glossary

- **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.
- **Earth Observation (EO) related services** is 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.
- **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.
- **Information and communication technologies (ICT)** are the infrastructure and components that enable modern computing.
- 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.
- **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, fasilitatora) / 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.

- A **Module** is a collection of courses grouped because courses ran over the same year or semester, or tackle the same topic.
- **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.

1. Introduction

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 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 sub-sectors - integrated applications, smart cities and climate change to test and validate the approach. Finally, a long-term Action Plan will be developed and endorsed to roll-out and sustain the proposed solutions.

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

1.1. Objectives of the 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.

1.2. Objectives of the task

The task on feedback and lessons learned from the testing and validation covers two main objectives:

1) Test and validate implemented Training Actions,
2) Provide the necessary input to help defining the Long-term Action Plan.

The testing and validation was performed by involving the education/training providers, the space geoinformation industry and public sector players, the end-users of the Alliance and other relevant stakeholders. It outlines achievements and challenges of the EO4GEO approach.

In order to assess the testing and validation phase even more effectively, the organization of two summer schools provided a comprehensive training including group work to test and validate the usability and reusability of the curricula and training materials in other settings.

The task on feedback and lessons learned from the testing and validation consisted of the following activities:

- Accompany and advise the design and implementation of the training actions in the three sub-sectors with the objective to ascertain the impact of EO4GEO in regard to the sector skills strategy
- Evaluate effectiveness and efficiency of the actions
- Assess the impact, the relevance and the sustainability of the actions

- Design and organize (joint effort of the consortium) two Summer Schools linking sub-sector scenarios to further explore cross-fertilization between space and geospatial applications to address skills gaps
- Compile extensive feedback for the definition of the Long-term Action Plan.

1.3. Methodology: A common storyline - The EO4GEO training approach

The skills strategy of the GI and EO sector has been established and followed by the development of an EO/GI Body of Knowledge (BoK). Beyond comprising a common vocabulary for the GI and EO sector, the BoK provides a structured overview of the related necessary skills for the EO/GI workforce to do business.

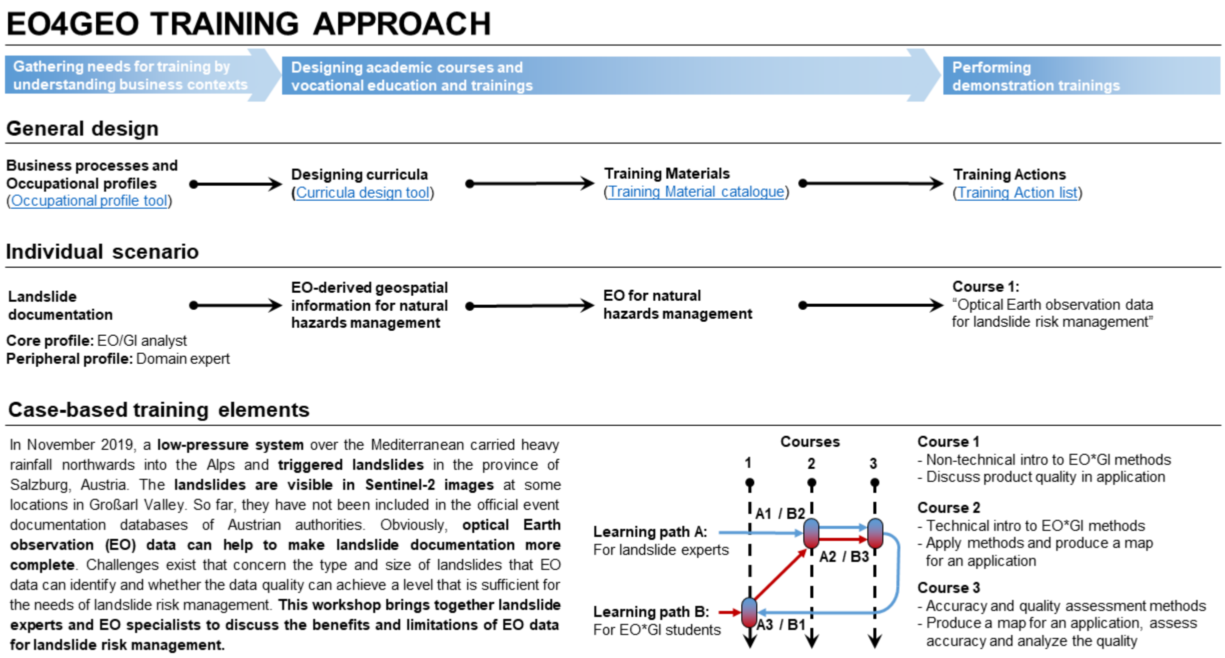


Figure 1 The EO4GEO Training Approach - A skills strategy for the GI and EO sector

A need for training occurs where there is a gap between the demand in certain business processes and their occupational profiles that cannot be met by the members of the workforce. Therefore, the gathering of needs for training requires an understanding of the business processes and the involved occupational profiles that define the skill requirements. Designs of curricula related to business processes and occupation profiles relevant to Copernicus were created which led to specific training material for the EO/GI sector. The training actions were used to test the material and the development of an integrated platform of collaborative tools and of curricula in support of Copernicus within the EO4GEO training approach.

1.4. Purpose of the document

The purpose of the document is to present two Summer Schools linking sub-sector scenarios that were designed and organized as joint effort of the consortium to further explore cross-fertilization between space and geospatial applications to address skills gaps.

1.5. Structure of the document

This report consists of four sections. The **introduction** part (chapter 1) is followed by description, methodology and evaluation of **EO4GEO Summer School: Intelligent Earth Observation** (chapter 2) with **EO4GEO Summer School: Introduction to Satellite Remote Sensing** in chapter 3. Conclusions can be found in chapter 4.

The report also include **appendixes**: detailed agendas (Annex A&C) and feedback on content and format of the Summer School on Intelligent Earth Observation (Annex B) .

2. EO4GEO Summer School: Intelligent Earth Observation

The virtual EO4GEO International Summer School: Intelligent Earth Observation took place from 8th of June and lasted until 6th of July 2021. The summer school was orchestrated by PLUS, with assistance of UNEP-Grid Warsaw.

2.1. 2.1. Didactic Concept and Implementation

2.1.1. Structure, Design and Content of the Summer school

The virtual summer school made use of/employed an innovative educational design approach. It consisted of three phases exhibiting different learning modes, allowing to build upon and expand existing training materials provided by the EO4GEO project (detailed agenda in Annex A).

The three phases are explained in the following:

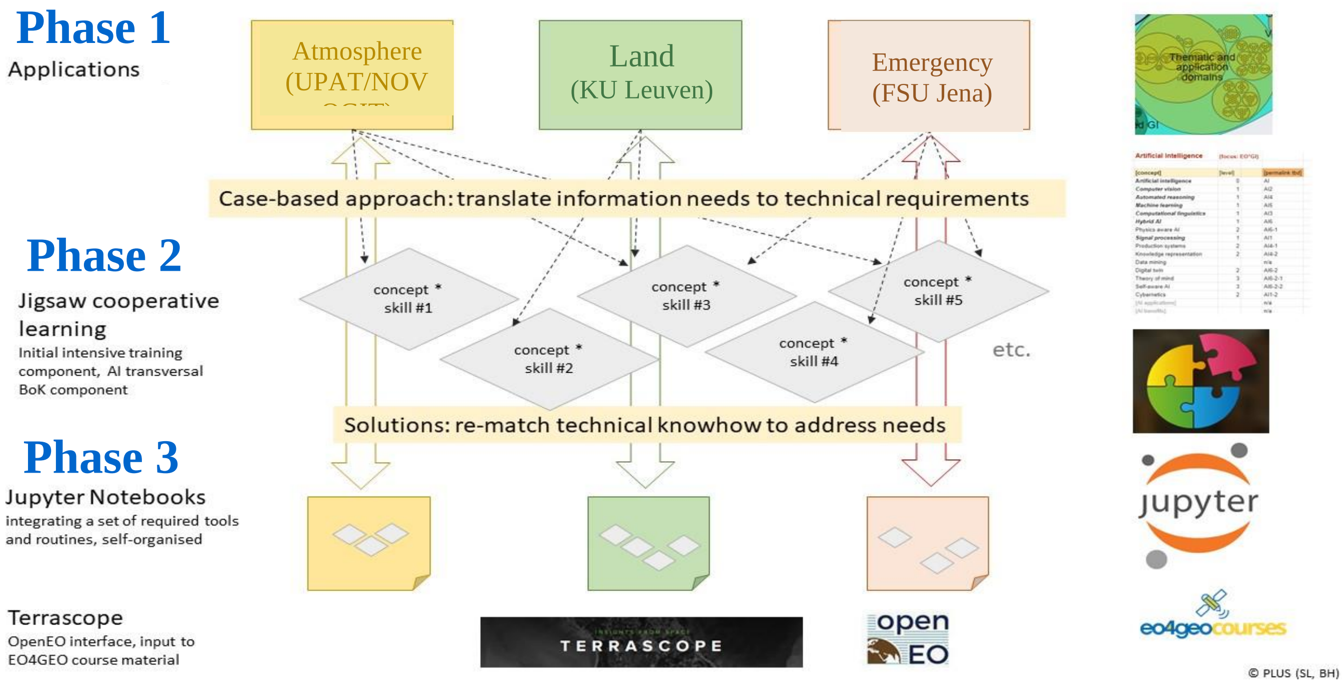


Figure 2 Three phases of Intelligent Earth Observation Summer School

Phase 1: ***Making a case***. A structured set of thematic applications domains input sessions served as starting points to derive information needs. Translating needs into technical requirements. Moderated case-based approach to distill group work cases.
In this first phase, the different application topics were introduced in the following sessions, conducted by EO4GEO partners and associates:

Applications

- PLUS/UNEP-Grid: Introduction to the summer school and to the EO4GEO project, administrative information
- Eva Missoni (PLUS): Introduction of participants on a platform (Lucidspark): Skills and interests
- Florian Albrecht (PLUS): Introduction to BOK Application Domains and BOK AI-Concepts
- Anders Östman (NOVOGIT): CO^2 Budgets
- Greger Lindeberg (GIB): Climate Change - Urban Heat
- Danny Vandenbroucke/Marc Olijslagers (KU Leuven): Garden Monitoring - Land
- Carsten Pathe (FSU Jena): Emergency and Radar Remote Sensing
- Stefan Lang (PLUS): What is Copernicus?
- Stefan Lang (PLUS): Translation of application areas to 4 application cases for student works, group formation and choice of one application area

Phase 2: ***Concepts2skills.*** In the instructor-driven **Phase 2** participants were undergoing training in specific technical building blocks (concepts and tools). Participants chose the specific technical elements they are most interested in and where they want to become 'experts'.
Sessions of Phase 2:

Methods and tools

- Stefan Lang (PLUS): EO data sources
- Andrija Krtalic (GEOF): Pre-processing
- Gao Yunya, Getachew Workineh (PLUS): Classification and accuracy assessment
- Carsten Pathe (FSU Jena): Radar Remote Sensing
- Tobias Langanke (EEA): Copernicus Land Monitoring Service: Context, portfolio and latest developments
- Martin Sudmanns (PLUS): Data Cubes
- Nicolo Taggio (Planetek): The rise of AI for EO
- Miguel Castro Gómez (SERCO): Crop Classification with Sentinel-2 and Machine Learning
- Erdem Hande (VITO): Introduction to Jupyter Notebooks
- Barbara Hofer (PLUS): Reproducibility in scientific research

Phase 3: ***Creating Solutions.*** In **Phase 3**, self-organised and supervised group work tasks were in the foreground. Students had the chance to receive feedback on their proceedings in dedicated feedback-sessions and the interim presentation before the final presentation at the ISDE. It was intended to achieve target-driven Jupyter notebooks as a joint endeavor of expert collaboration and the sharing of the work on a platform (Terrascope or similar). Sessions in **Phase 3** were mainly targeted at provision of feedback for group works and the final presentation:

- Stefan Lang, Barbara Hofer (PLUS): Q&A-Session for Group Works
- Participants: Group works Interim Presentations and Feedback Session
- Kevin Ramirez (Climate KIC): Introducing Climate KIC and Outreach
- Final Presentation of group work results at the ISDE Conference

2.1.2. Learning Outcomes

The following learning outcomes are associated with the three phase-design of the summer school. Participants of the summer school are enabled to …

- *select* and acquire data necessary for a predefined case study.
- *apply* preprocessing, classification, accuracy assessment and further steps of the satellite data analysis workflow.
- *develop* EO-based applications in Jupyter Notebooks.
- *explain* key principles of artificial intelligence in the context of Earth observation.
- *summarize* the current work procedures with satellite data and indicate future developments.
- *distribute* tasks in a team to achieve defined objectives.

2.1.3. EO Data and Analysis Platform: Terrascope

The use of VITOs platform Terrascope was promoted for the elaboration of the group work cases. Terrascope offers access to data provided by VITO as well as access to further open data sources by the openEO interface; it also offers an environment for developing and running scripts and access to relevant tools like SNAP and QGIS. The pre-requirements to use Terrascope like registration of participants, software versions, size of virtual machines etc. were sorted out in collaboration with VITO. For each group, a powerful virtual machine was set up with latest versions of required software programmes.

2.1.4. From group formation to group work

In the initial stage, interaction was supported by the use of Lucidspark Boards to share personal introduction and first ideas in one common place. On these boards:

Figure 3 Intelligent Earth Observation Summer School: Lucidspark Boards

1. Participants had the chance to introduce themselves, their interests and special skills
2. Participants suggested a topic, related to the inputs of Phase 1 on application areas, that could be of interest for group work and elaborate which data could be used, which methods could be applied to address the case and to propose a rough approach.

A dedicated session for group work formation at the end of the first week took up the suggestions by summarizing the essence of the topics on the board, clustering them along common interests and discussing possible teams.

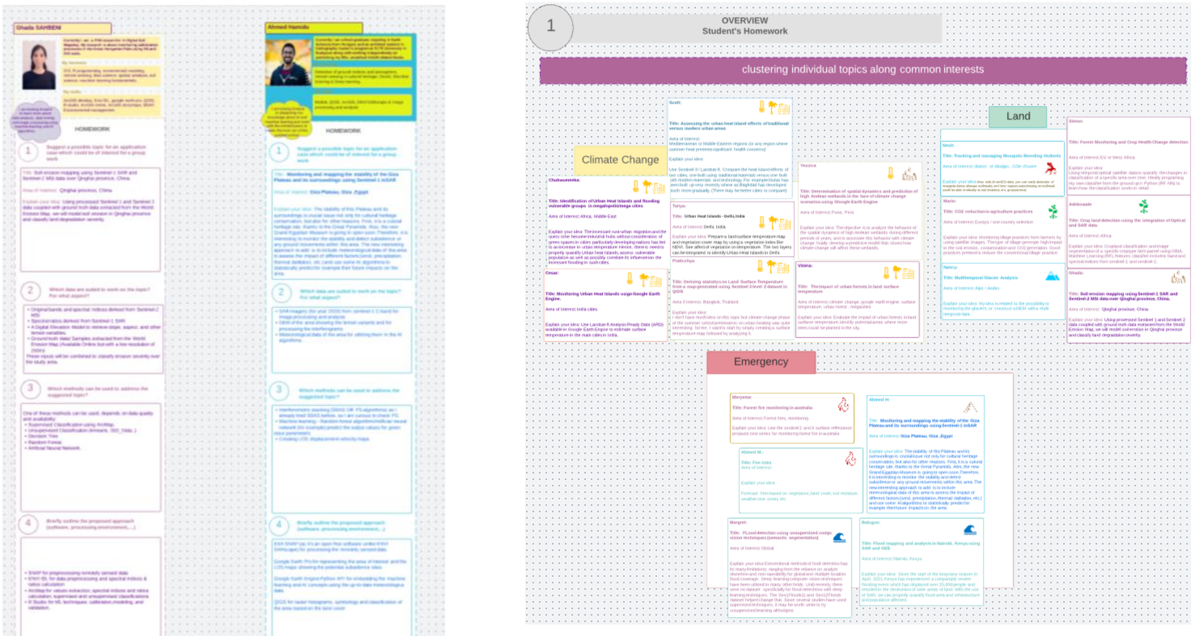
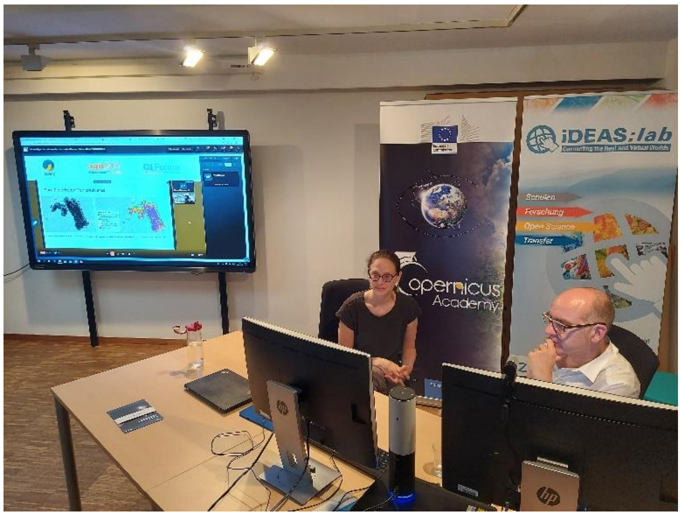


Figure 4 Intelligent Earth Observation Summer School: Lucidspark Boards

2.2. Topics of Group Works

After two weeks of input, participants were asked to work on practical applications on the topics specified in the group formation process. This phase of the summer school lasted three weeks, was supported by exchanges between the groups and led to the final presentations of the results during the ISDE conference.

Thematic application domains and problem statements included:



Thematic application domain	Topic	Problem statement	Data / Tools
Climate change	urban heat islands	land surface temperature in the study area Lunel (F)	Landsat 8 imagery, ArcGIS Pro
Climate change	urban heat islands	land surface temperature in the study area Paris (F)	Landsat 8 imagery, Google Earth Engine, Terrascope
Emergency	forest fire impacts	Mapping burn severity for Californian wildfires	Sentinel 2, Google Earth Engine

Land	subsidence of Giza plateau	Monitoring the Stability of Giza Plateau and its Surroundings using SAR interferometry	Sentinel 1 data, the SNAP toolbox, Google Earth Pro
Land	agricultural yield	crop yield prediction over agricultural areas in Kenya	Sentinel-1 SAR and Sentinel-2 MSI time series data; Terrascope, ArcGIS, Jupyter notebooks

The teams chose ambitious topics that required a broad set of skills. The request of working in online scripting environments like Jupyter notebooks has been followed by four out of five groups. The workflows did imply machine learning approaches, where useful.

As an example, here is the workflow adopted by the team working on analysing agricultural yield integrating EO and auxiliary data:

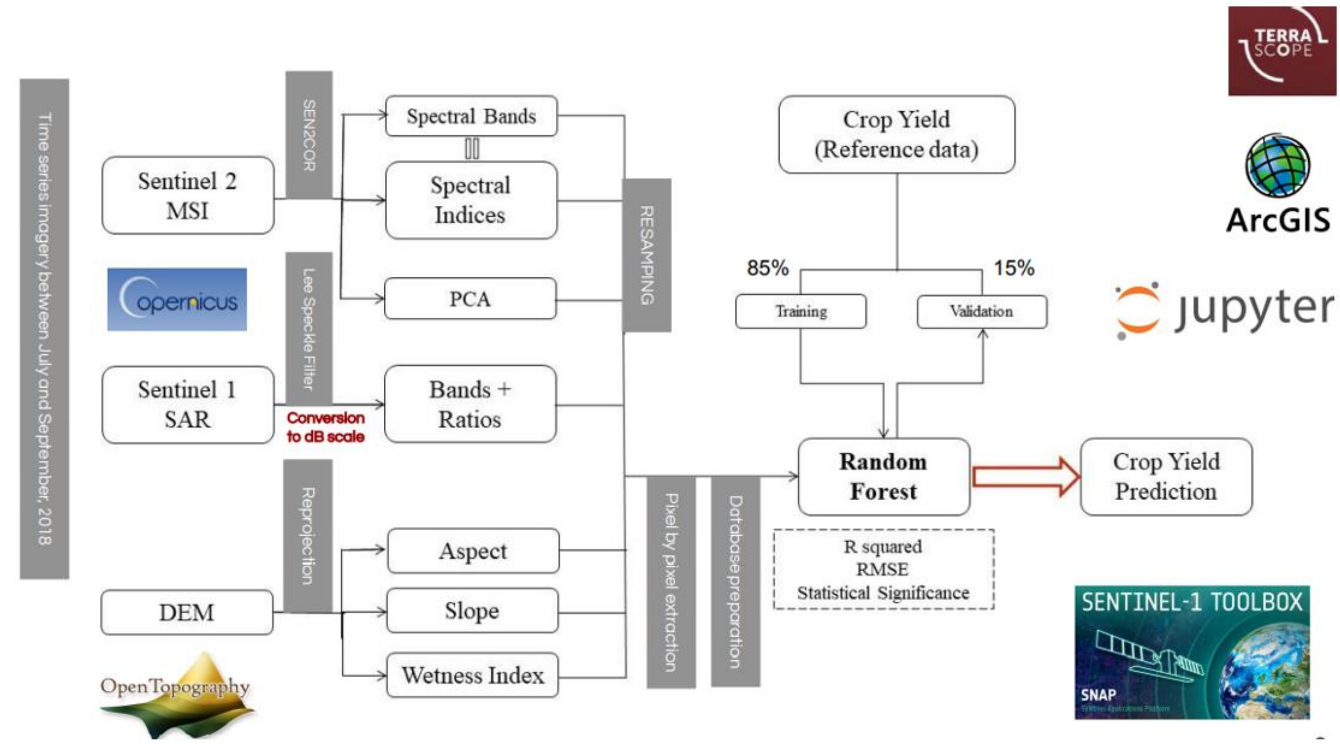


Figure 5 Intelligent Earth Observation Summer School: Methodological Diagram of the study

2.3. Assessment and Evaluation

Assessment and Evaluation

Feedback and evaluation of the summer school took place in a dedicated session subsequent to the final presentation on July 6th, 2021. For the evaluation, a 3-steps-approach was chosen to cover different aspects worth to be assessed to receive detailed information on different aspects of the summer school.

Step 1: In the *EO4GEO Summer School: Evaluation and Feedback Form*, participants provided feedback on questions specifically related to the content (application area and methodological setup) and format of the summer school and to assess in what way the training met the targeted learning outcomes.

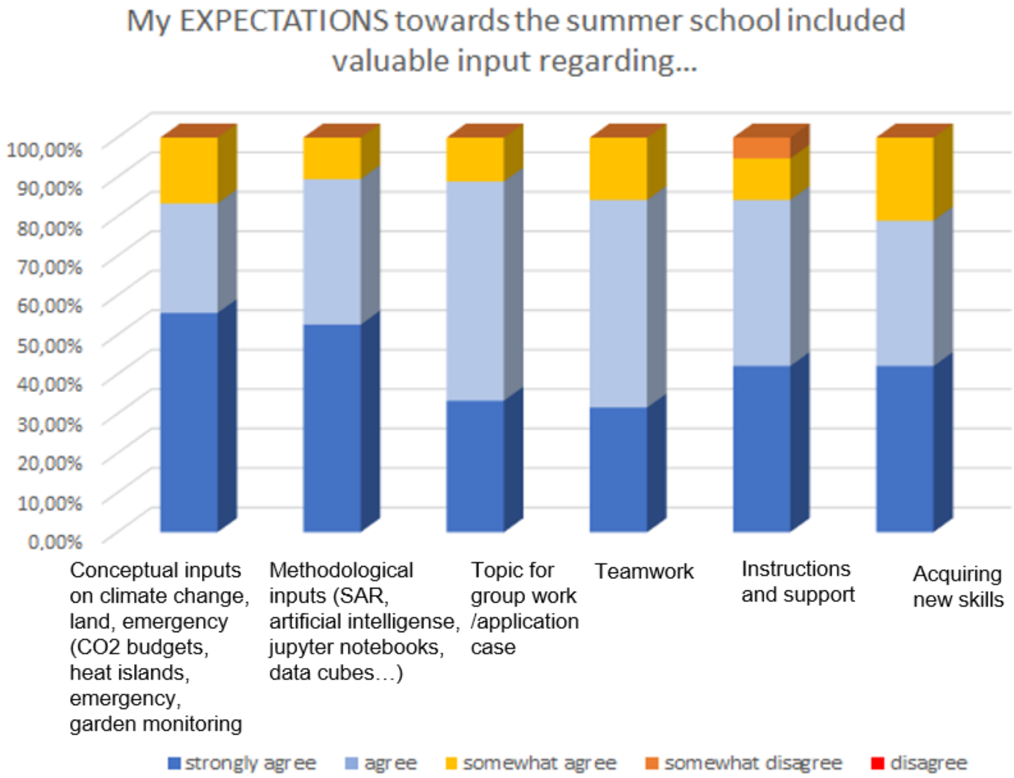
This included questions regarding: *a) expected and experienced input; b) learnings from a methodological/teamwork/social point of view; c) use of tools to support teamwork; d) experiences with team-work; e) value of application cases; f) consultation and exchange with experts/instructors; g) the use of data and chosen workflow for application cases (reflection of group work targeting the assessment learning outcomes for single participants); h) use of Jupyter Notebooks*.

This first questionnaire served the purpose of a self-assessment of the learning outcomes of the summer school. Because no formal assessment in the form of an exam and grades was implemented for this summer school, the self-assessment served the purpose of understanding in how far the learning outcomes have been achieved – in addition to what can be observed based on the results from group work. The learning outcomes mainly targeted the translation of information provided in the first two weeks into practical applications. Therefore, the self-assessment questions related to the use of data, the implemented workflow and the use of Jupyter notebooks in the participants' applications.

The responses to the questions do show differences that suggest a different level of understanding of participants. The detail provided on the questions reflects observations made on more active participants in the various occasions with direct exchange between teams and instructors. Nevertheless, all participants seem to have learned from the summer school in regards of the expected learning outcomes.

Another intended learning outcome of the summer school was to work in a team on a specified application case. The procedure targeted interdisciplinary collaboration through group works in teams of 3-4 participants. The approach aimed to foster self-management and task distribution amongst team members, mimicking a real-world working environment to a certain degree. While the overall experience of teamwork was rated as good, issues in task distribution were also mentioned frequently.

The charts below show two questions of the survey; detailed questions and answers are provided in Annex B.



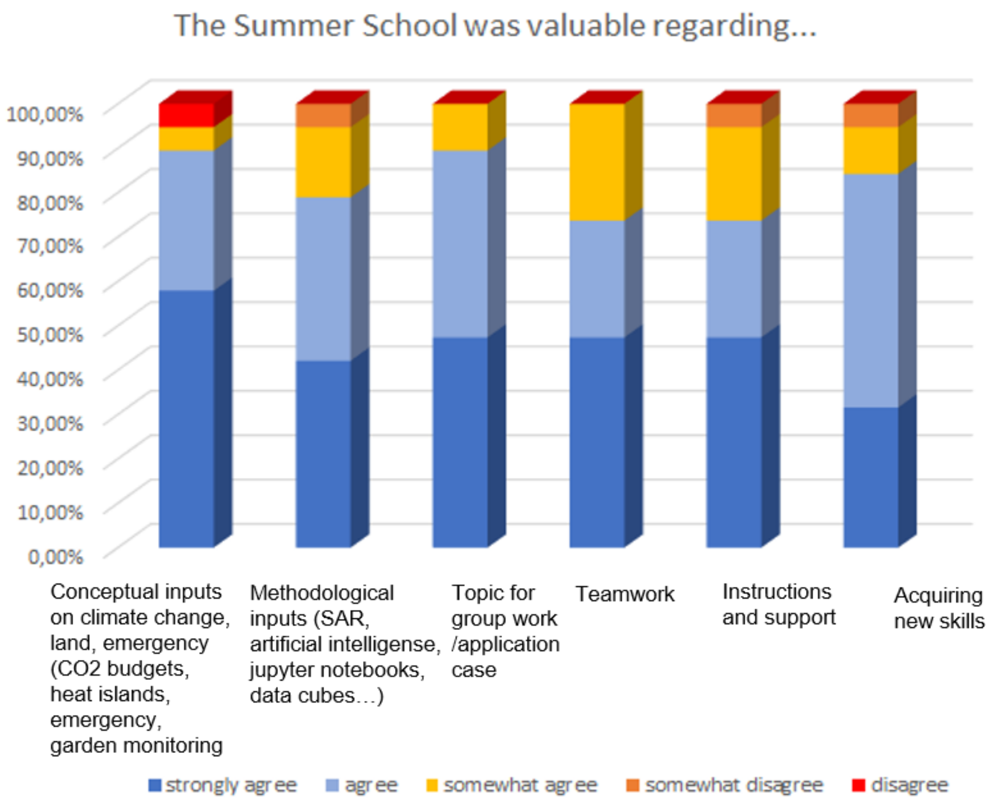


Figure 6 Intelligent Earth Observation Summer School: feedback

Step 2: On a Lucidspark-Board, general qualitative Feedback on the summer school was collected and discussed in the plenum.
Regarding aspects that were particularly appreciated in the summer school, answers were manifold, pointing out lectures and group work. The same applied to the question about aspects participants would have liked to learn more about, where answers were presumably strongly related to prior knowledge, experiences and interests. Nevertheless, there seemed to be a certain common desire to upskill further on Jupyter Notebooks and Terrascope for several participants. Comparing group-work topics with the topics that rose special interest and comments from the Evaluation and Feedback Form, participants showed particular interest in topics that they also had the chance to work on in their chosen application cases.
Group works were well appreciated, but also reflected critically with regard to shared responsibilities and team dynamics.
Several participants would have also liked to attend the summer school in an on-site format. On the other side it has to be noted that the online format of the summer school offered the possibility to attend from all over the world.

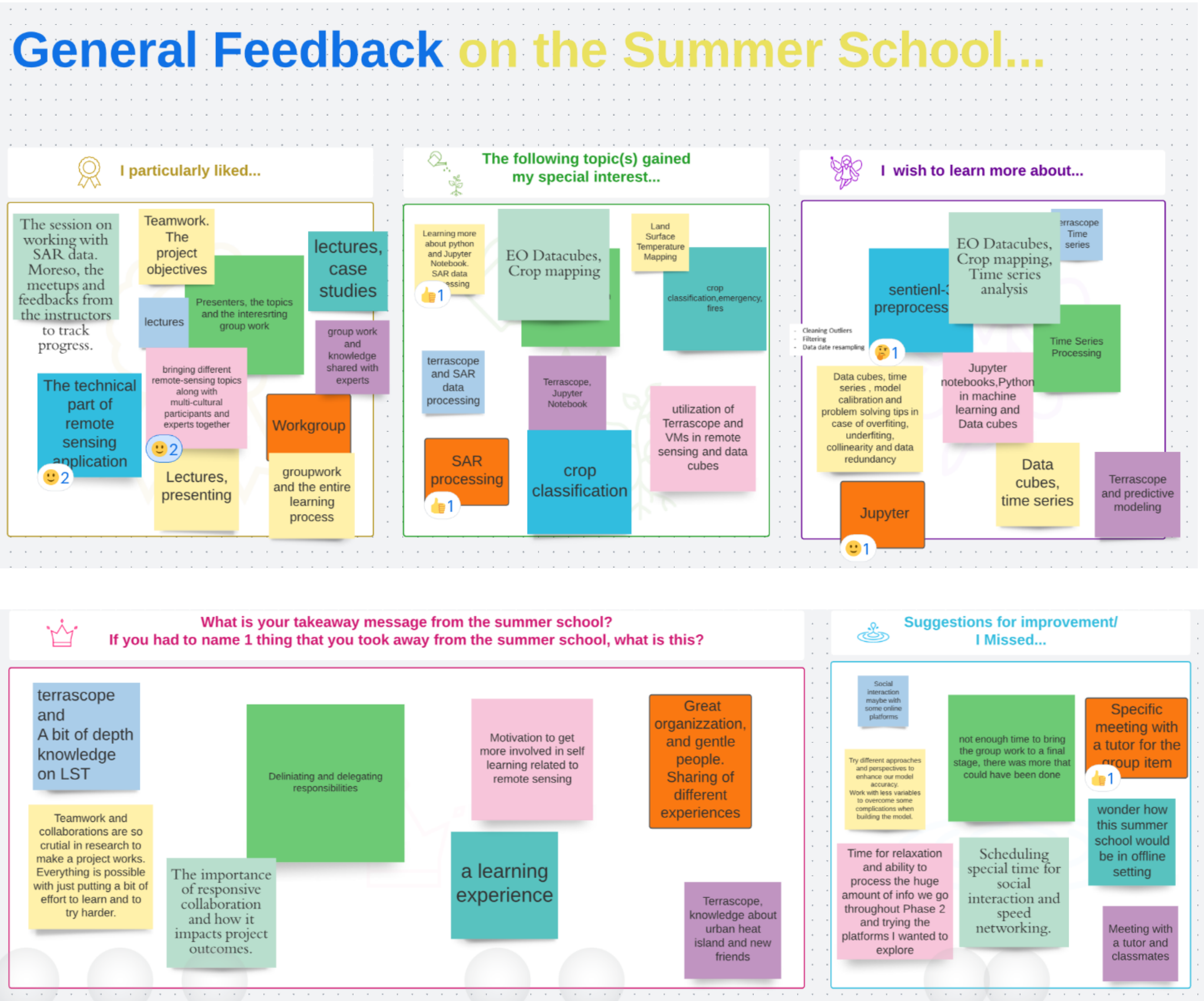


Figure 7 Intelligent Earth Observation Summer School: general feedback

Step 3: The standardized EO4GEO Training Action Evaluation Form *Evaluation of EO4GEO summer school PLUS/UNEP GRID* was announced by Krzystof Zych (UNEP-GRID) in the evaluation session and sent out to participants via email. Filling the form allows for requesting the Certificate of Attendance for the summer school, being worth 3 ECTS.

2.4. Organisational Aspects

Admission of participants

Initially, the summer school faced 130+ preregistrations from all over the world, while the summer school was designed for a maximum capacity of 35 participants. In a selection process, around 50 participants were preselected based on different criteria such as field of expertise, skills, gender, professional experience and motivation to participate in the summer school. Pre-selected participants were informed to be accepted upon a first-come-first-served principle, implying their continuous contribution at the summer school would be desired. A significant number of applicants did not follow up on the next steps of admission or withdrew their interest due to overlaps with other (educational) duties. Finally, 20 participants (14 nationalities) fulfilled the requirements and were accepted.

Learning platform

Moodle was used as a learning platform for the entire summer school. Presentations, discussions, contacts, links to relevant documents etc. were all provided on Moodle: https://www.eduacademy.at/eo4geo/course/view.php?id=12

3. EO4GEO Summer School: Introduction to Satellite Remote Sensing

The Summer School "Introduction to Satellite Remote Sensing", was held in Potenza (Italy) in semi-virtual mode from 15 to 17 June 2021. The school was addressed to employees of Local Public Administrations (LPAs), aiming at increasing their level of knowledge of the Earth Observation (EO) fundamentals and their awareness about the potential of satellite-based remote sensing technologies/applications. Together with UNIBAS (member of the Copernicus Academy Network) the school was also supported by CNR-IMAA on behalf of the local Copernicus Relay member TeRN who is an EO4GEO associated partner.

3.1. Target, Scope, Didactic Concept and Implementation

The technological progress recorded in the latest years, in addition to specific investments at the national/international level in the space economy/sector, like the Copernicus Programme, have enlarged the current capabilities of observing natural phenomena by satellites, in terms of spatial, temporal, and spectral capabilities, allowing for their comprehensive investigation.

Local Public Administration (LPAs) are expected to be among the main beneficiary of the everyday increasing offer of data and services originated by the Copernicus Programme, however, their, not just episodic, but routinely implementation by LPAs is still very slowly growing up. The lack of the basic skills required to appropriately evaluate and to fully appreciate the actual advantages and potentials, related to the integration/substitution of traditional methods with the ones based on EO, has been identified as one of the main limitations of their uptake by LPAs. It could generate, in the most deeply rooted employees who rely their work (and acquired roles) mostly on traditional technologies, the reluctance to open to new technologies that could represent an actual barrier to the introduction of EO-based data & services in their day-by-day work.

The Summer School offered then, to the technical personnel and managers of the LPAs attending the course, those basic elements of knowledge that actually permit them - going through specific study cases - to fully understand, compare, imagine, the possible advantages coming from the introduction of EO-based solutions in their routinely work. In particular the consequences of climatological changes at the regional scale (usually not perceived as the most relevant to Local Authorities) have been clarified for their strict link to the ordinary prevention and monitoring activity already in charge to LPAs. This offered also the occasion to discover the unique role of available long-term global EO data-set. Pro and Cons were related to the particular target addressed by the school:

Cons: difficult to obtain the availability of LPAs course attendants for a long-term period

Pro: technical personnel and managers of the LPAs (the ones that can actually take decisions on technical changes) already have a medium-high scientific-technical background.

The school has the ambition to increase the motivation toward the use of EO-based technologies providing a basic, non-trivial, education on EO related physical principles, technologies and applications.

The main challenge, very well supported by the available EO4GEO tools, was to well calibrate suitable contents in a relatively short course time.

3.2. Structure, Design and Content of the Summer school

The school was addressed to LPA employees (selected by direct interaction with the Directors of considered Public Administrations) and was in Italian language to facilitate participants comprehension and stimulate their interaction with teachers (all Italians too). The main goal was to offer to the technical personnel and managers of the LPAs, those fundamentals that are necessary to fully understand, compare, wonder, the possible advantages coming from the introduction of EO-based solutions in their routinely work. The school offered also the occasion to discover the unique role of available long-term global EO dataset to evaluate historical variations.

Besides the up-skilling and re-skilling of employees, the school was a good occasion to establish a direct link between potential service providers (i.e., UNIBAS students and researchers) and LPAs users. During the course, tools and resources developed in the framework of the EO4GEO project were also tested, proving useful for achieving the school goals.

To also pursue this additional objective a strategy, in three successive steps, was conceived and realized:

STEP 1: Representatives of LPAs were invited to meet students of the ordinary Satellite Remote Sensing course offered by UNIBAS, proposing and discussing with them their needs at local and regional level.

Two main results were expected from these meetings: 1) for the Summer School organizers: better selection of the study cases to propose during the summer school focusing on actual needs of LPAs increasing, this way, the potential interest of attendants; 2) for summer school attendants: the possibility to fully appreciate, after the summer school, the solutions proposed by UNIBAS students (during their Copernicus Young Ambassador Day) in response to the specific needs they proposed during the meetings.

At the 1 June 2021 meeting at UNIBAS when the Scientific Director of Regional Agency for Environment of Basilicata Region (dott. Achille Palma) was invited to illustrate to the UNIBAS students (partly remotely connected) the activities of his Agency and those observational needs potentially achievable by Copernicus-based products/services.

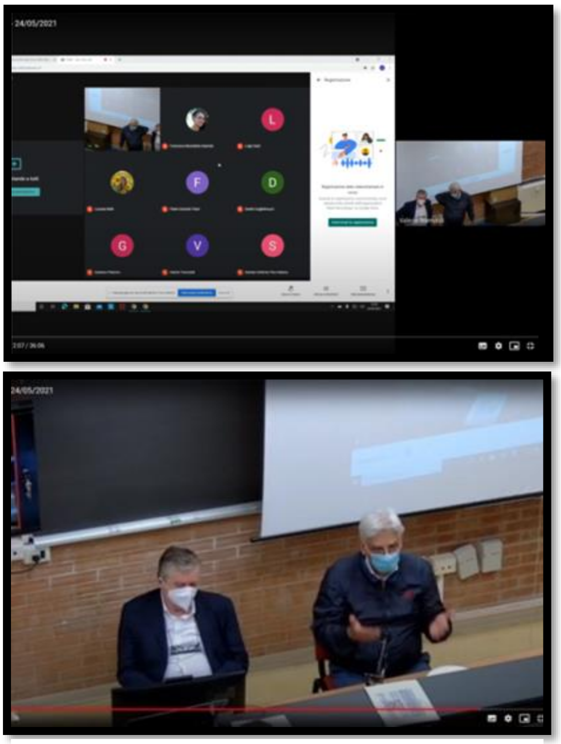


Figure 8 1 June 2021 meeting at UNIBAS

STEP 2: The Summer School for LPAs

The School lasted 3 full days (plus 1 additional for a side event discussed in STEP 3). Such a scheduling represented the best trade-off between saving fundamental contents and allowing LPAs workforce to participate actively within the activities. To facilitate learning in such a short time, the material necessary for the course together with the in-depth studies were circulated before the school started. It is worth noting that the selection of the attending did not take place through a specific call, but the Local Administrations Managers were invited to propose the employers to be involved: namely the people more motivated and/or those who, for the work done, most could have benefited from the use of satellite

data in their work. The need to obtain an effective up-skilling of professionals was also the reason why the course took place in Italian language, so that language represented not a barrier to anyone's learning.

The school was structured as described in the following (program translated in English language is in the picture).

Each day was divided in morning and afternoon sessions: during the morning (4h) the lectures were all about fundaments of remote sensing, while the afternoon (2h) was dedicated to application activities about the contents discussed in the first part of the day. The theory part had the main goal to offer to LPAs employers basic elements of knowledge on EO technologies in order to autonomously perform cost-benefit analyses and appropriately evaluate the alternative/complementary EO-based solutions in comparison with traditional approaches. All the lectures and laboratory activities were video-registered and made available together with the training material to be consulted at any time even after school (see in Annex C the detailed Summer School Program).

For the School development a huge effort has been needed:

- 2 dedicated teachers (UNIBAS professors), and 6 tutors (senior/junior researchers).
- More than 300 slides and 20 demonstrations of use prepared (mostly) from scratch.
- Video and slides of lessons as well as related deepening material (theory, sw & Copernicus data and services info, etc.) provided in the Google Classroom environment and replicated in the EO4GEO Moodle
- 2 tests for learning assessment and 1 for course quality evaluation, administered

The course had a great response with a good number of participants, in total 21 (10% in presence), 40% of whom were women. They were all from offices of relevant Local (Basilicata) Regional Administrations here listed:

- Regional Environmental Agency (ARPAB)
- Environment and Energy Department
- Environment and Energy Department / Water cycle office
- Regional Civil Protection
- Decentralized Functional Centre
- Presidence Office

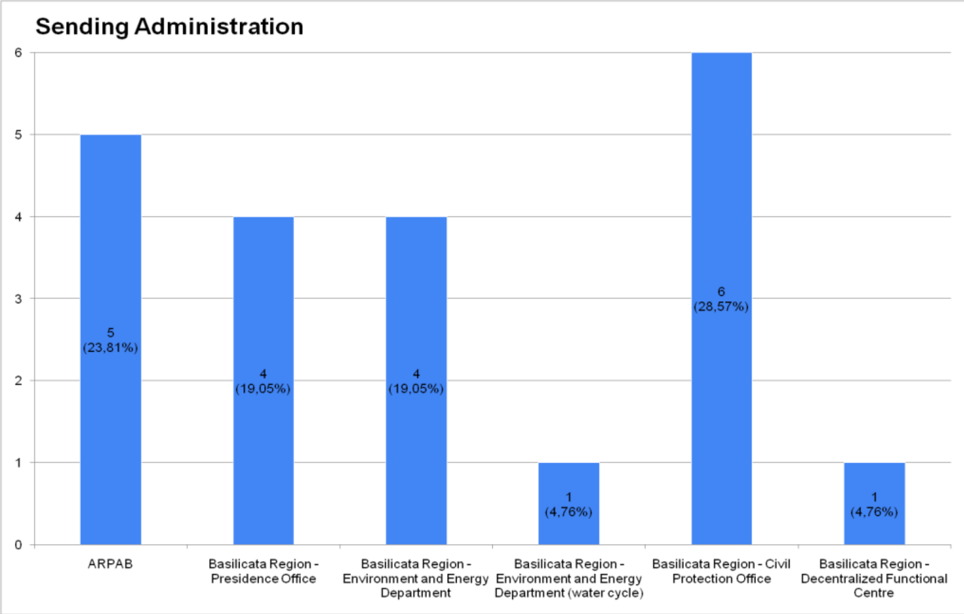


Figure 9 Introduction to Satellite Remote Sensing Summer School: Participants offices

All the participants had quite high background, most of them had at least a degree, to them are added participants with a PhD or Master Degree.

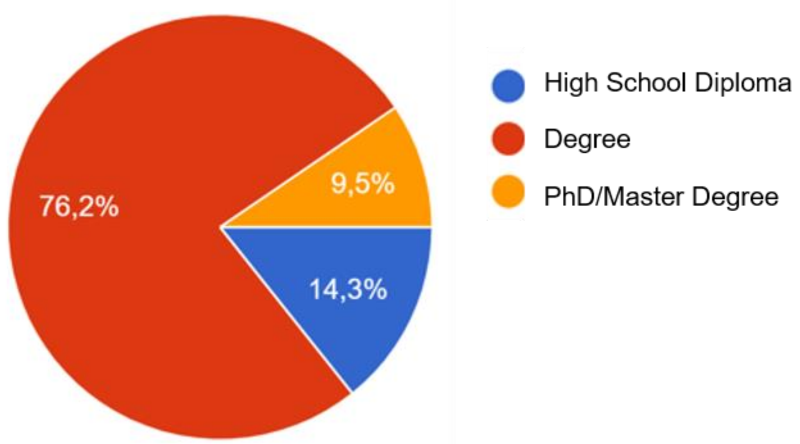


Figure 10 Introduction to Satellite Remote Sensing Summer School: Participants education level

The participants age range was wide, but over 50% of them are over 50 years old with a 10% which fall in the over 60 years old class.

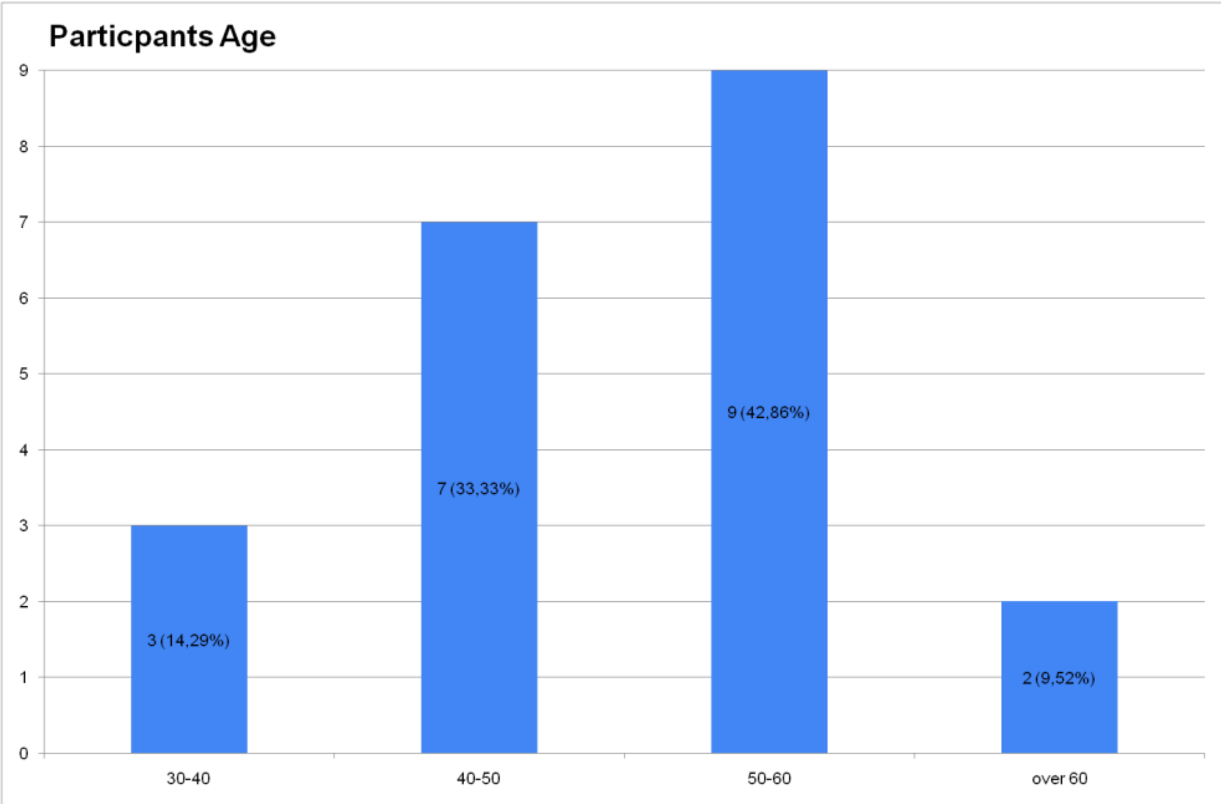


Figure 11 Introduction to Satellite Remote Sensing Summer School: Participants age

This was the audience of participants that the school wanted to reach: younger (<50) who probably didn't know/use satellite data due to a lack of knowledge in their training course, and older (>50) that is workers who have been working within the administrations for long time with traditional data and who appear to be the most reluctant to move to the use of innovative data and techniques such as those from satellite. At the end of the School, certificates of attendance (one example on the left) were distributed to all LPAs personnel who attended it.

Figure 12 Introduction to Satellite Remote Sensing Summer School: Certificate of attendance

STEP 3: Linking potential users and potential EO services developers

On the fourth additional day the event "Copernicus Young Ambassadors Day" took place.

The event was then a perfect occasion to establish a contact between potential users and providers. In this particular case UNIBAS students played the role of potential providers, being more informed about technologies and applications offered by EO data, suggesting their solutions to the potential users (LPAs personnel) who, on the other hand, better know what the needs of the market are. The school course attended by LPAs in the STEP 2 has been crucial to allow them to fully appreciate the proposed solutions and this is the reason why the process chosen for the up-skilling and re-skilling of professional was built the days before.

This stage was also related to STEP 1 during which "user needs" were proposed to UNIBAS students by the LPAs representatives later attending the Summer School.

Figure 13 Introduction to Satellite Remote Sensing Summer School: Copernicus Young Ambassador Day

The participation of the Summer School attendants also to the Copernicus Young Ambassador Day was then a completion of their education itinerary and a further opportunity to promote the Copernicus Uptake among LPAs. They were warmly invited to participate to this event mostly for the following reasons:

a) To continue their education by attending the presentation of a several proposed EO-based applications most of them originated by LPAs needs collected in STEP 1

b) To put in practice the knowledge acquired during the Summer School engaging discussions with students presenting their projects and evaluating from a different (operational) point of view the actual feasibility of the proposed solutions

c) To put them in a direct contact with potential EO professionals who, in perspective, can both become EO-based services developers (as researchers or SME technicians) or customers, perhaps in the same Public Administrations.

An important result of such a process was the strengthening of relationships among, potentially strong, EO-solutions customers (like LPAs) and the researchers locally working on that in prevision of further collaborations.

Among the EO applications proposed by the UNIBAS students it was easy to find 13 very local (solicited at the STEP 1 and reported in bold in the list) up to quite global EO-based solutions:

June 18th 2021 Young Copernicus Ambassadors' presentations
When the lung burns: tracing burnt areas in the Amazon with GOES techniques.
Detection of areas subject to the uncontrolled abandonment of waste by means of the integrated application of remote sensing systems
Potential of MSG-SEVIRI to characterize the flare-ups of the torch COVA of Viggiano
Monitoring of the erosion phenomenon of the Ionian coast on Sentinel-2 data
Ship traffic monitoring at the Suez Canal following the blockade of the cargo ship Ever Given
Monitoring with Sentinel-2 techniques of the vegetation cover in the areas crossed by fire in the Vesuvius National Park
Mapping of algal blooms from Sentinel-2 satellite images: the case of Pertusillo
LANDSAT image analysis for the definition of the flooded areas in the territory Metapontino between 30 November and 2 December 2013
Monitoring with Sentinel-2 satellite techniques of the melting of the glaciers: the Adamello case
Analysis of Sentinel-2 satellite images to support the perimeter of areas crossed by fire: the event of 30 July 2017 in Viggianello
Analysis of the territorial fragmentation due to the installation of plants wind farms in Basilicata
Impact of industrial anthropogenic activities on a stable bioindicator: the case of San Nicola di Melfi
Satellite techniques for the analysis of forest cover in Basilicata
Urban green maintenance - Municipality of Senise
Real-time monitoring of the progress of the fire line in the fire of Irvine (California) of 26 October 2020
When the lung burns: tracing burnt areas in the Amazon with GOES techniques.

Detection of areas subject to the uncontrolled abandonment of waste by means of the integrated application of remote sensing systems
Potential of MSG-SEVIRI to characterize the flare-ups of the torch COVA of Viggiano
Monitoring of the erosion phenomenon of the Ionian coast on Sentinel-2 data

At the end of the event the Young Copernicus Ambassadors awards were provided to the students (in the pictures with their teachers and tutors) presenting the best EO-based solutions.

Figure 14 Introduction to Satellite Remote Sensing Summer School: Young Copernicus Ambassadors Awards

3.3. The EOGEO tools: Body of Knowledge + Curriculum Design

The selection of Summer School concepts was fully based on the EO4GEO BoK. Its organization in different modules and study cases was easily made by using the EO4GEO CD-tools.

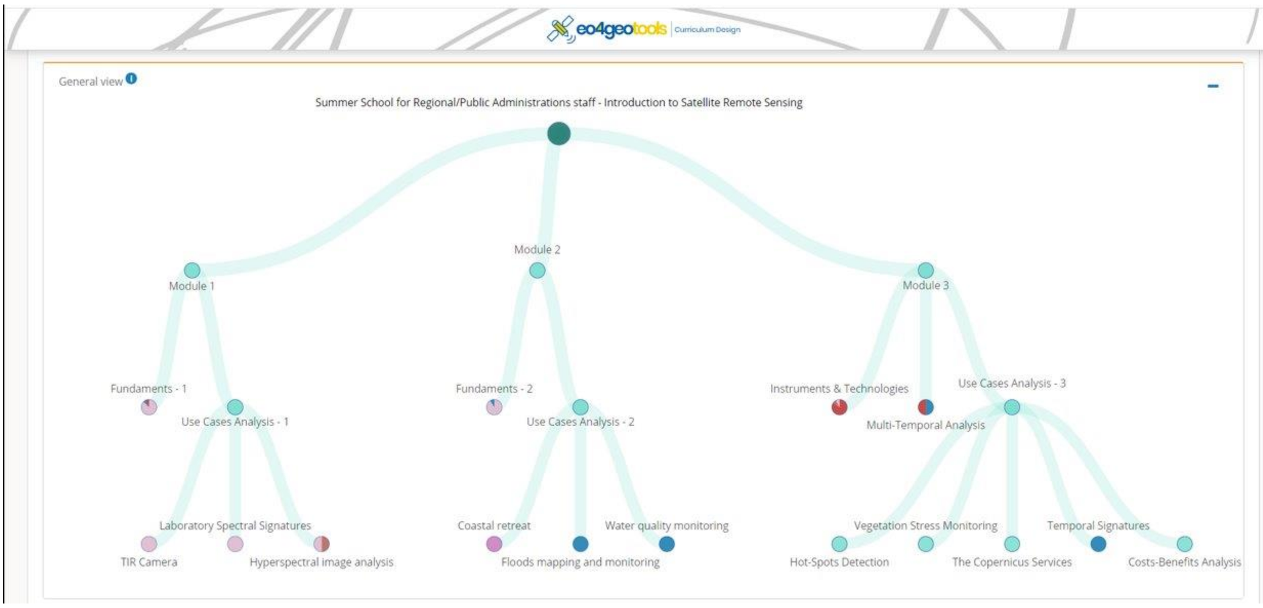


Figure 15 Introduction to Satellite Remote Sensing Summer School: Curriculum Design

Most of the training materials was provided using and extending EO4GEO resources.

Basic knowledge was available by participants through one of the main products of the project, the Body of Knowledge – BoK, which collects all the notions/topics about Earth Observation and Geo Informatic (EO/GI) study areas. Besides providing a description, insights and references related to principal topics of the course, the BoK was useful also for the UNIBAS staff, in the planning phase, to set the basic contents of the course, facilitating the choice of topics and helping to develop interconnections between contents.

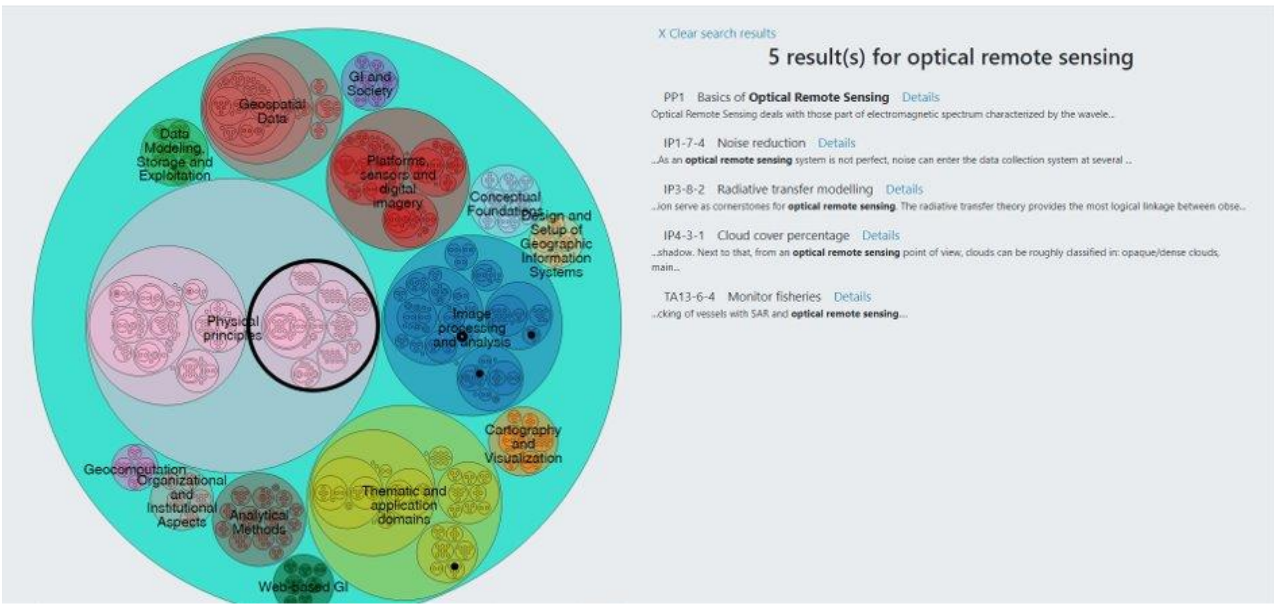


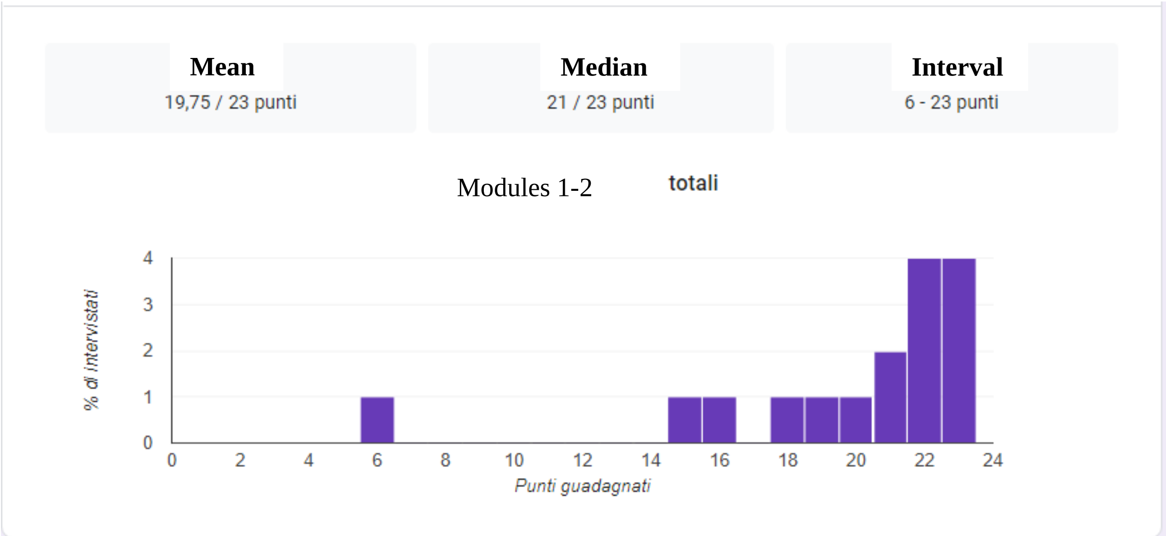
Figure 16 Introduction to Satellite Remote Sensing Summer School: Body of Knowledge

Additional and more extensive material was provided using the EO4GEO on-line catalogue, in particular an on-line course by UNIBAS “Fundaments of optical remote sensing” (http://www.eo4geo.eu/training/fundaments-of-optical-remote-sensing/), and through the moodle platform, in which new training material specifically developed was collected and made available.

Figure 17 EO4GEO on-line catalogue

3.4. Assessment and Evaluation

School contents and their effectiveness in terms of learning outcome were tested through two surveys distributed to the participants (one on the first two modules and the other one on the third module) who had to answer several questions on the topics addressed during the course. For each right answer the participant collected one point, for a max of 23 points for the first survey and 11 for the second one. The results were very satisfactory in both cases with most of the audience answering in the right way to most of the questions of the tests. The median score was 21/23 for the first 2 modules and 10/11 for the 3rd one!



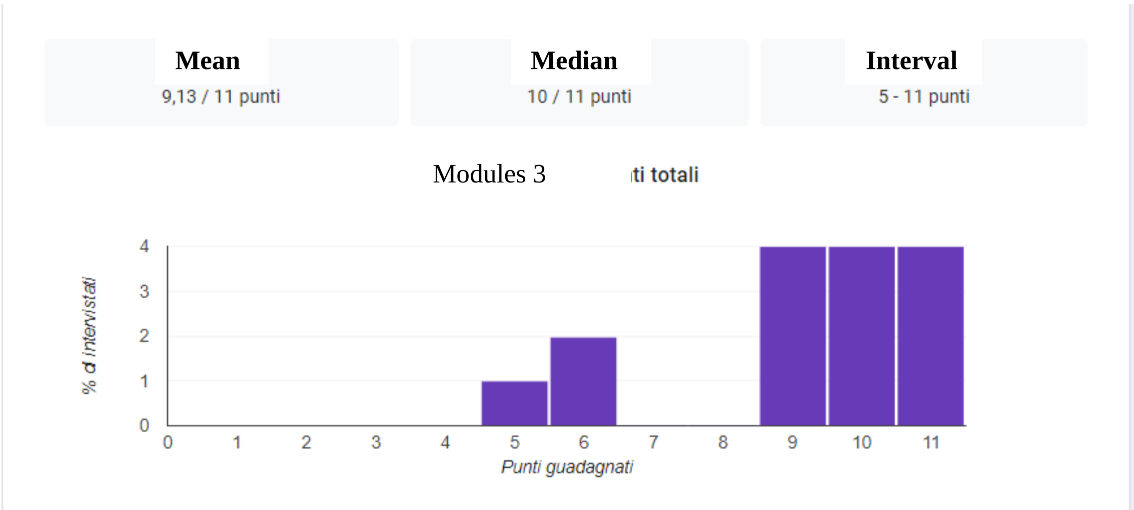


Figure 18 Introduction to Satellite Remote Sensing Summer School: assessment of learning outcome

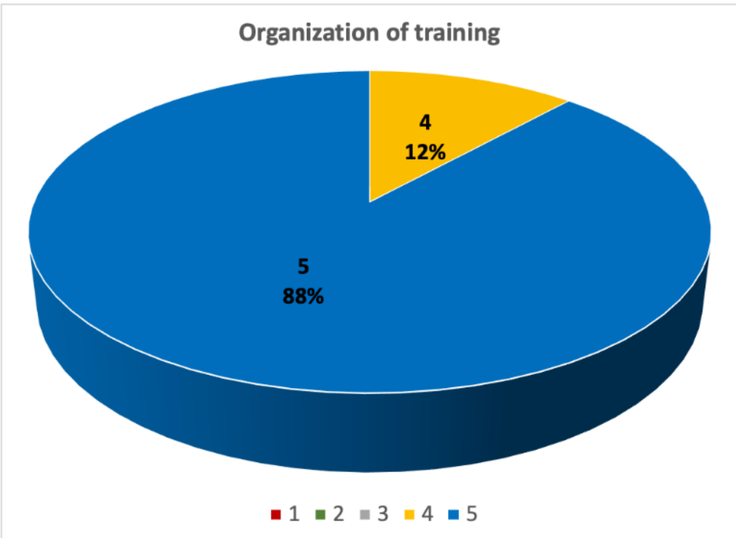
Feedback and evaluation of the summer school took place in a dedicated session subsequent to the last day on June 17th 2021. The detailed results of such evaluation (performed on the base of the common EO4GEO questionnaire) is reported in the following.

Question 1: What motivates you to participate in this training event?

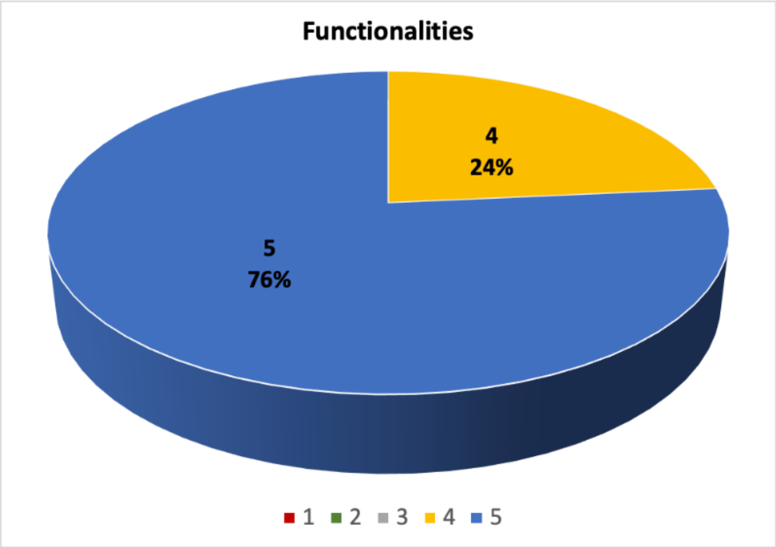
Training knowledge for work purposes
Contribute to the increase in the effectiveness of the planning, management and monitoring activities of the phenomena occurring on the regional territory, with the aim of avoiding the useless waste of economic and human resources and maximizing the benefits for citizens
Increasing knowledge
Professional update
The study of the territory, the evaluation of any changes that it may undergo occupy an important branch of the work that I carry out every day. Furthermore, I work daily with cartographic processing tools such as ArcGis, so I am interested in the possibility of learning

about additional tools that can support innovative studies aimed at the defense and protection of the environment.
Interest in the topic, curiosity, applications in the workplace
Discover new technologies for environmental analyzes
Use of remote sensing techniques for air quality monitoring
Interest connected to the activities of the regional Civil Protection
Enrichment of cultural and professional baggage.
Enrichment of cultural and professional baggage.
A correct interpretation of the data that we constantly use in our profession and a great curiosity in observing the earth and all those aspects that escape the human eye.
Curiosity towards the topics covered, possibility of implementing knowledge useful for my professionalism
Update to improve the performance of their functions at the Decentralized Functional Center - Civil Protection Office.
I have already attended two Remote Sensing courses during my university studies (one with Prof. Tramutoli and the other with Prof. Pergola) and I'm interested in the subject. I also think that these techniques are current and useful in the environmental field.
Understanding the possibilities offered by innovative technologies
The usability of contents and applications in the workplace.

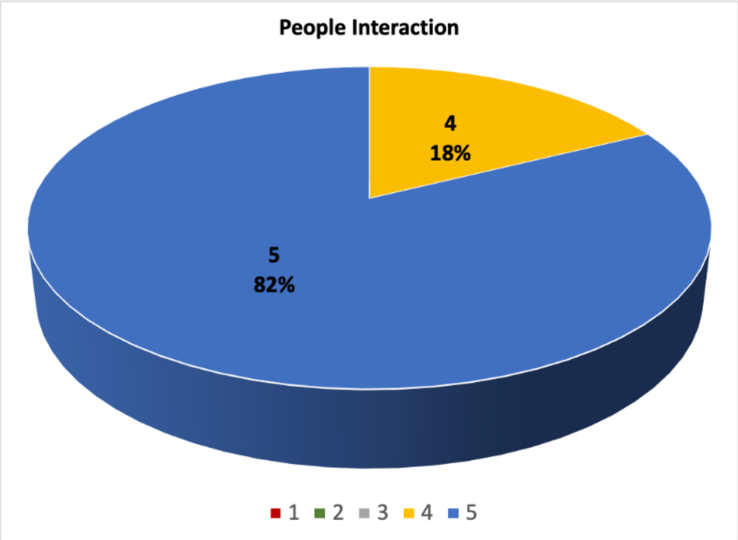
Question 2: How would you rate (from 1 to 5) the organization of training on behalf of the organizer (e.g. Registration platform, contact with the organizer, adequate communication on training details, ...).



Question 3: How would you rate the functionality of the conference tool and the software used (video, audio, other technical aspects, ...) from 1 to 5?



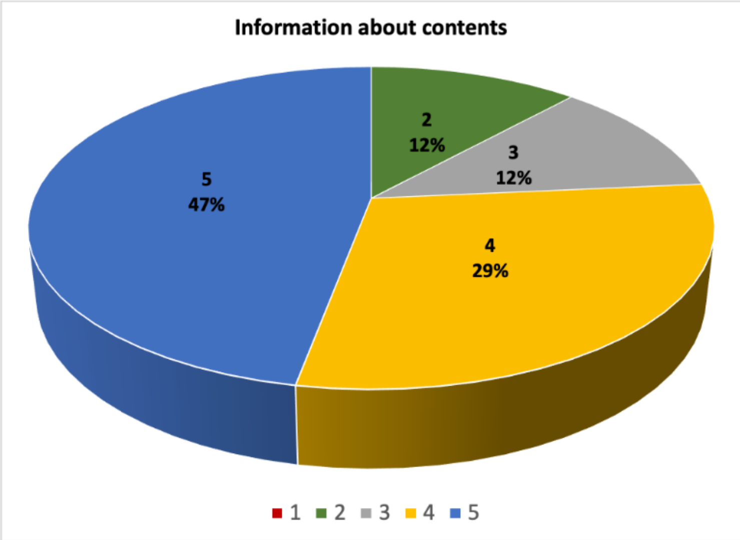
Question 4: How would you rate from 1 to 5 the possibility of exchanging and interacting with tutors and other participants (forums, discussion sessions, questions and answers, ...)?



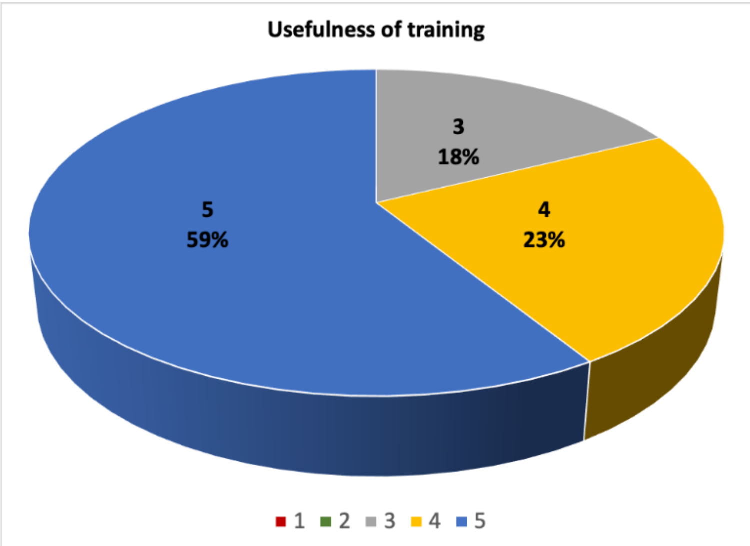
Question 5: Do you have any suggestions or recommendations for improving organizational aspects?

None, the organization was excellent.
No
No
Repeat other courses
I believe that the first access to videoconferencing needs to be improved (perhaps with a more targeted link).
No

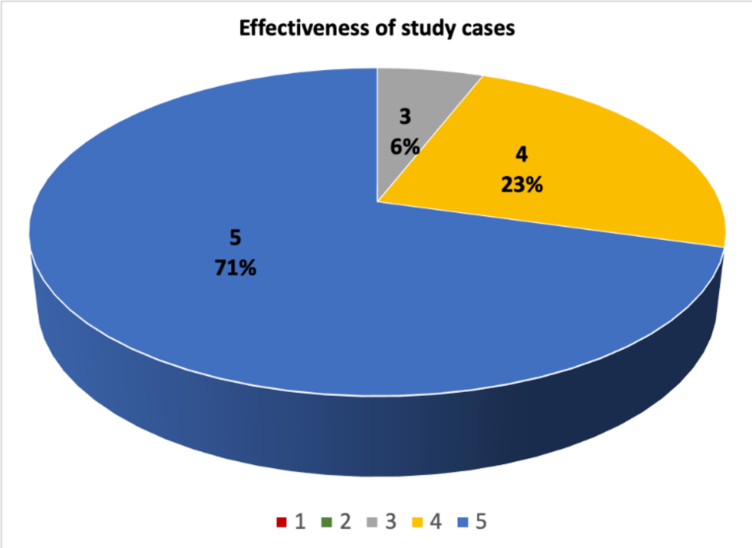
Question 6: When you started the course, were you well informed about the content of the training? Please answer by assigning a value from 1 to 5.



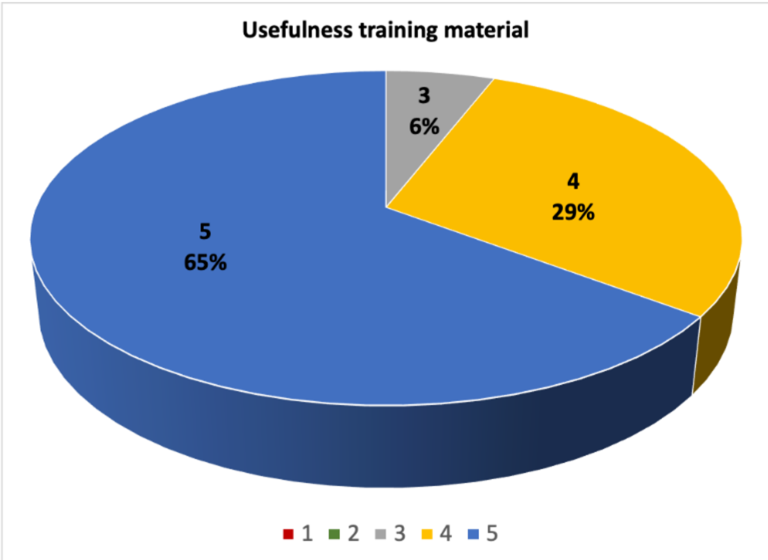
Question 7: Do you find the knowledge and skills you received through the training very useful to you? Please answer by assigning a value from 1 to 5.



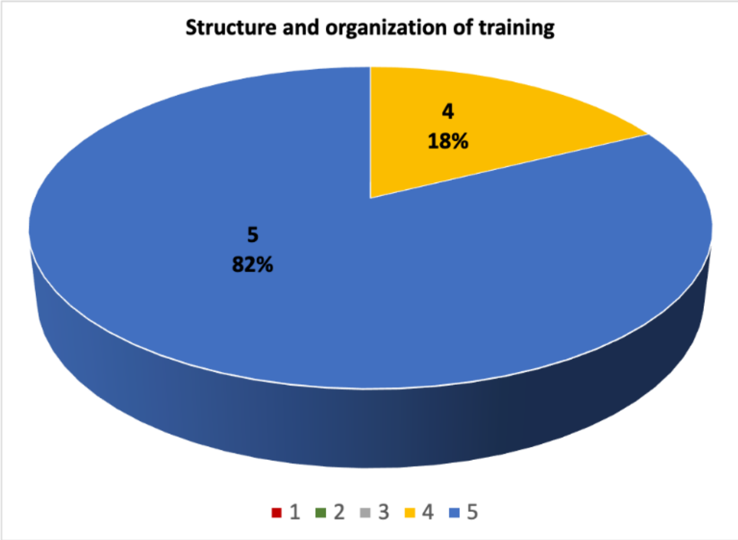
Question 8: Do you think the study cases added high value to the course? Please answer by assigning a value from 1 to 5.



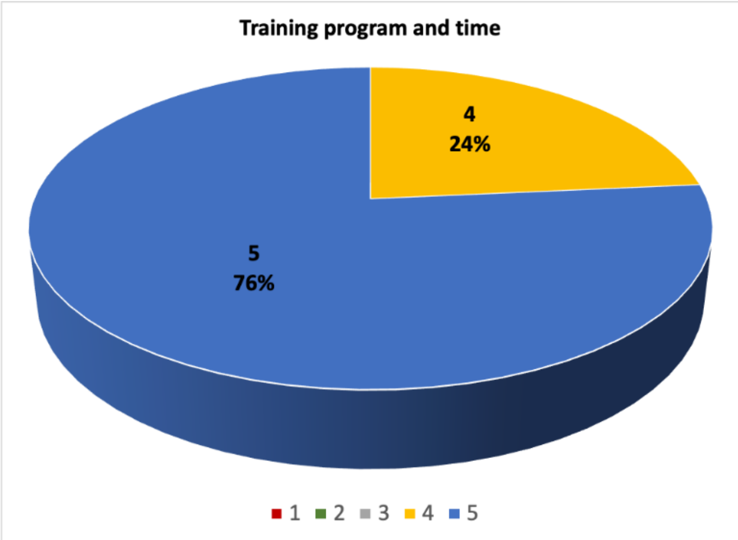
Question 9: Do you consider the available training material useful? Please answer by assigning a value from 1 to 5.



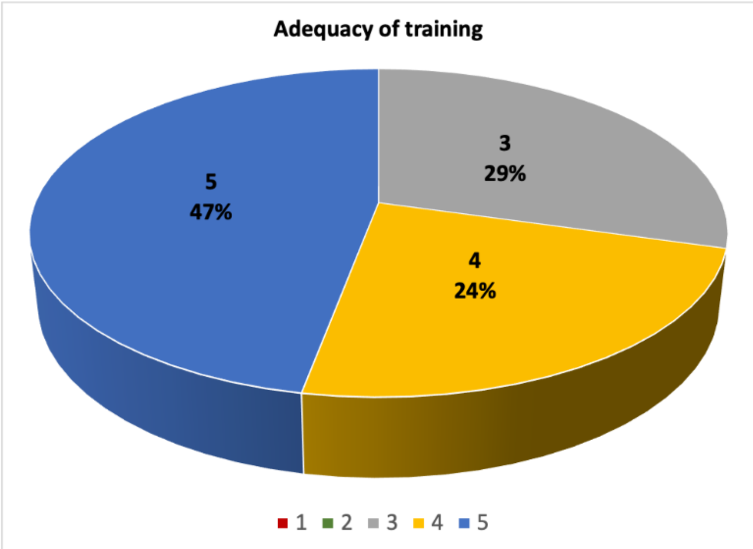
Question 10: Do you think the training was logically well structured and well organized? Please answer by assigning a value from 1 to 5.



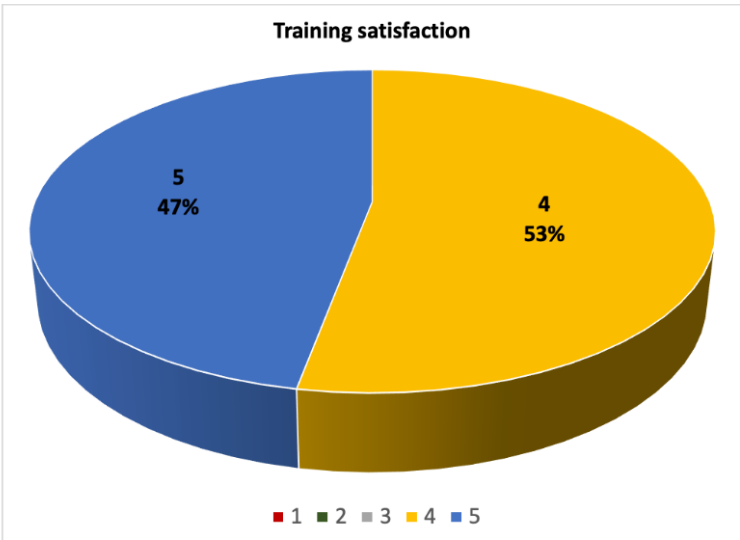
Question 11: Do you think the training program and the time provided were very good? Please answer by assigning a value from 1 to 5.



Question 12: Do you think the training was adequate for your level of experience? Please answer by assigning a value from 1 to 5.



Question 13: Did the training meet your expectations? Please answer by assigning a value from 1 to 5.



Question 14: What did you like most about the training? (e.g. innovative approach, quality of training materials, case-based learning methods, ...)

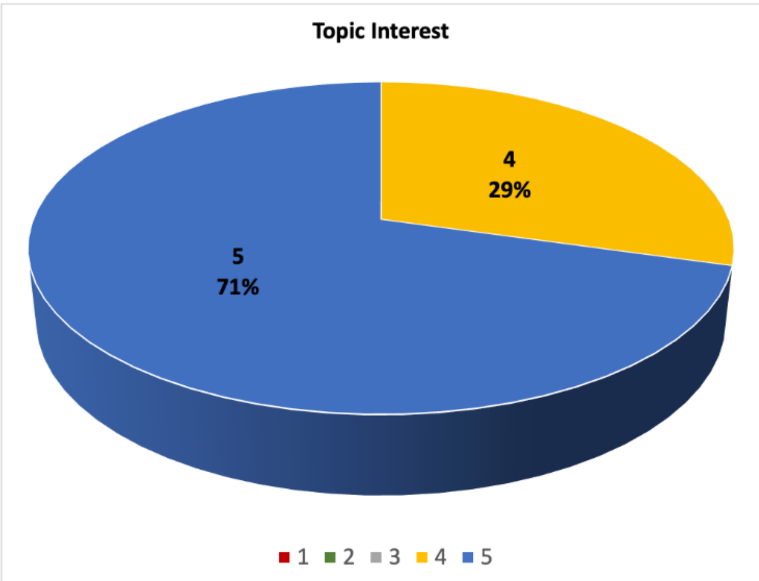
The approach used, based on translating extremely complex concepts into terms appropriate to the level of knowledge. The aim of the course, that is to illustrate the progress made in the field of remote sensing and to stimulate the listener to imagine new planning, management and monitoring approaches, seems to me to have been fully achieved.
Excellent professional value, high quality of the material provided, interesting case studies proposed
Excellent scientific value combined with the ability to transmit and engage in complex topics
Demonstrations of use
Professionalism and clarity of teachers, quality of training materials, learning methods based on cases also of regional interest, innovative approach

Innovative approach
Innovative approach
Very professional, clear, competent approach and with practical feedback.
Specific cases useful for understanding the possibilities of application
Innovative approach
The quality of the training materials and the clarity of the explanations
Application of case studies

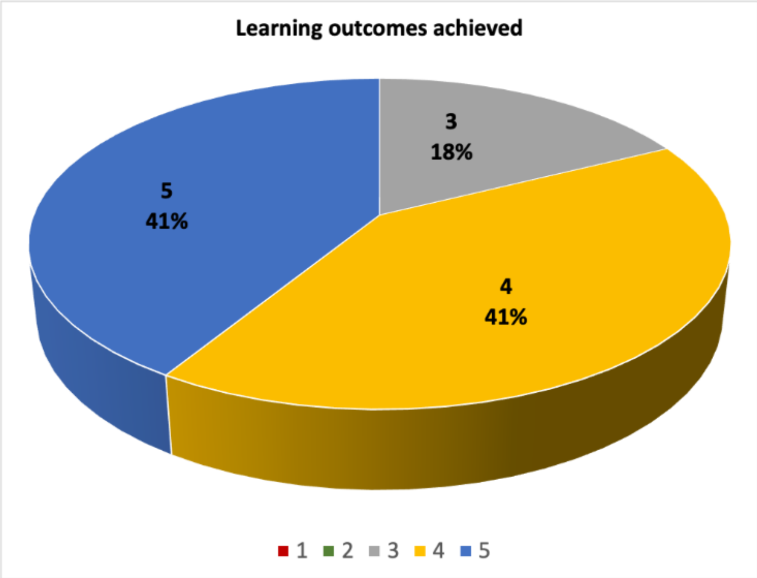
What can be improved in terms of structure, format and material?

Carry out periodic courses or mini-courses and / or for specific topics in order to increase the level of knowledge transfer and dialogue with public administrations.
I do not know
I do not know
face-to-face lessons
Difficulty in accessing the classroom platform
Difficulty in accessing the classroom platform
Nothing, it is hoped only to do them in presence
Sending preparatory material before starting the course in order to facilitate the understanding of the lessons. Making systematic the possibility of updating through periodic lessons (e.g. 1 time/year), also to understand any results of applications put in place"
I have not yet been able to find the material made available
Nothing
Show more application examples

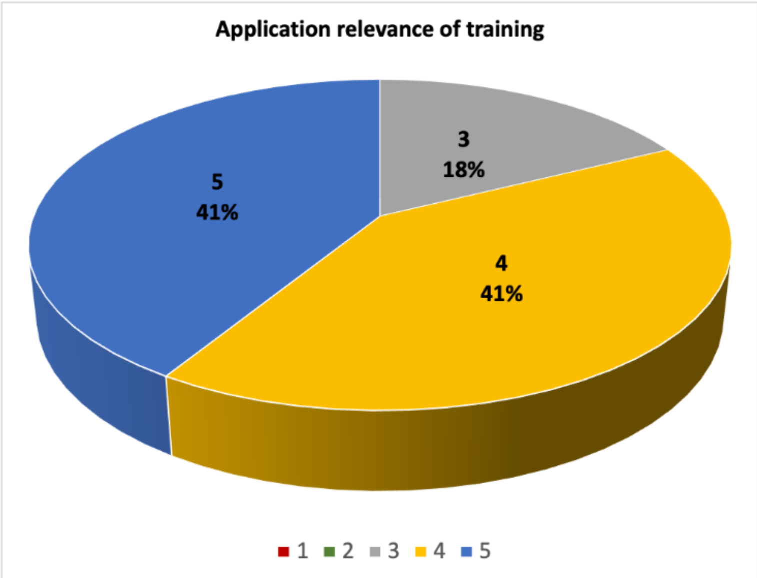
Question 15: Did the training raise your interest in the topic? Please answer by assigning a value from 1 to 5.



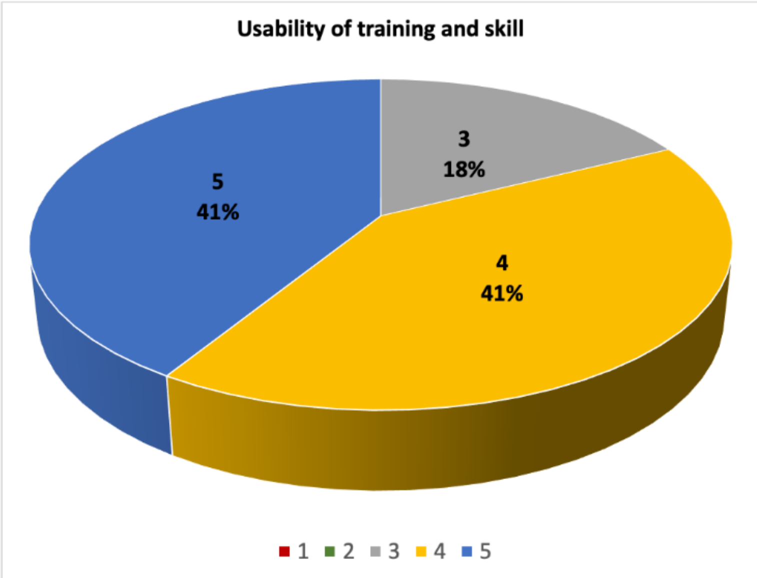
Question 16: Have you achieved the specified learning outcomes? Please answer by assigning a value from 1 to 5.



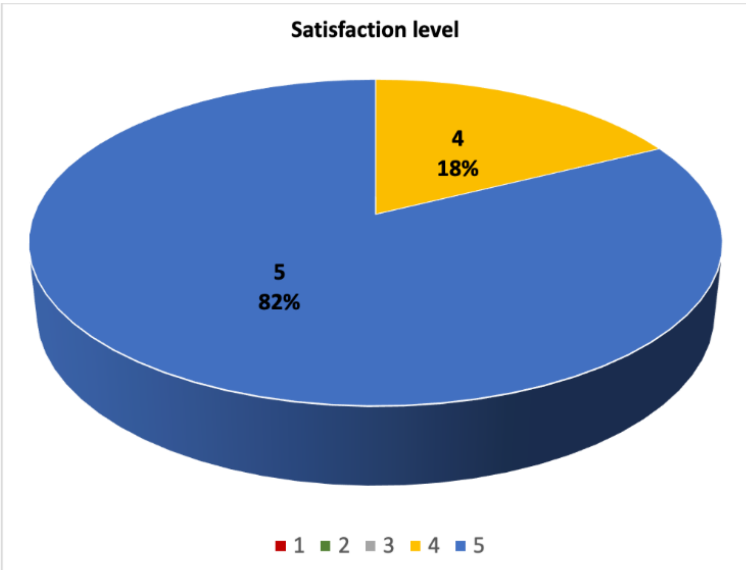
Question 17: Do you think training is relevant to your current homework/studies? Please answer by assigning a value from 1 to 5.



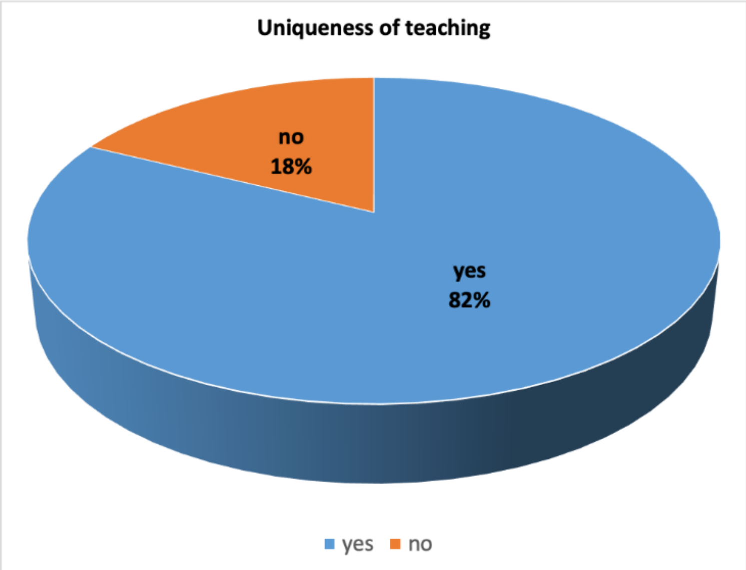
Question 18: Are the knowledge and skills I received in this training valuable to your future job/career or studies? Please answer by assigning a value from 1 to 5.



Question 19: How satisfied are you with the training action? Please answer by assigning a value from 1 to 5.



Question 20: Did you recognize any differences compared to other training courses?



Question 21: If "Yes", where (structure, approach, content, tools, ...)? Do these differences support learning success or motivation to learn?

Absolutely
In this course the competence of the speakers and the perfect alignment of the level of detail with the knowledge of the listeners stood out.
Approach, contents. They certainly support the great success
The differences found both in terms of content and approach were fundamentally due to the success found
In the demonstrations of use, which bring the world of research closer to that of work.
Examples that help to understand the theoretical part
Presentation of study cases
Innovative approach, content, professionalism of teachers, tools made available, intensive structuring of the course, sharing of documents, real-time feedback questionnaires, theory supported by the presentation of real cases or possible insights and developments also related to the local regional reality, space given during the lesson and also on the question and discussion platform, all of which stimulate active participation and motivation to learn.
Specifically, in my opinion, the contents were interesting because they made use of advanced and useful satellite programs and studies for the future.
The course enhanced advanced and useful satellite programs and studies for the future.
Very professional and well prepared theoretical and applicative approach.
Innovative, practical approach
Content, tools
Use of supports and application to real cases

Question 22: Would you recommend the next EO4GEO training action to your friend / colleague?

Question 23: Would you be interested in being included in the project mailing list and receiving more information about the project? You can also subscribe to the mailing list at http://www.eo4geo.eu/contact-us/. YES (100%).

3.5. Organisational Aspects

Admission of participants

The selection of the attendants did not take place through an open call, but through the relevant Local Administrations Managers were invited to propose the employers to be involved: namely the people more motivated and/or those who, for the work done, could have benefited most from the use of satellite data in their work.

All relevant Regional Departments and Agencies (and particularly the ones involved in the management of Environment, Emergencies, Water resources, etc.) were invited to select and propose their candidates. (up to a limit established in 15 units, later enlarged up to 21).

The course was offered free of charge in a mixed form, in presence (at the University of Basilicata premises in Potenza) and remotely by 2 dedicated teachers (UNIBAS professors), and 6 tutors (senior/junior researchers).

It had a great response with a good number of participants, in total 21 (10% in presence), 40% of whom were women. All of them (except 1) were constantly and actively attending and participating to the lessons and lab activities.

Learning platform

Google Classroom was used as a learning platform for the entire summer school. All the school related material was duplicated on the EO4GEO Moodle at:

https://www.eduacademy.at/eo4geo/course/view.php?id=16. In order to avoid whatever barrier all the material of the course and all lessons were given in local (Italian) language. All the material (slides and in-depth studies) were made available on the Google Classroom repository well before the school started.
All the lectures and laboratory activities were video-registered and made immediately available together with the training material (slides of the lessons and related deepening material, useful links to specific sw and/or Copernicus data and services, etc.) to be consulted at any time even after the school ending.

4. Conclusions

The COVID-19 pandemic has significantly affected the course of designing and organizing planned Summer Schools. However, two different formats were used in developing both Summer Schools: 1) The PLUS summer school on Intelligent Earth Observation was designed as international summer school with a broad audience, completely conducted in a virtual environment; 2) The UNIBAS summer school on Introduction to Satellite Remote Sensing was designed as a local/regional summer school with a limited pre-selected audience, conducted in presence (in Potenza) allowing remote attendance too. This diverse approach allowed to test and validate the usability and reusability of the curricula and training materials in various settings.

Through the use of different learning methods and jigsaw learning, the Intelligent Earth Observation Summer School has successfully implemented an innovative educational design. It allowed to build upon and expand existing training materials provided by the EO4GEO project, testing it in different settings for a broad international audience.

The Introduction to Satellite Remote Sensing Summer School took a different approach, and focused on employees of Local Public Administrations (LPAs), aiming at increasing their level of knowledge of the Earth Observation (EO) fundamentals and their awareness about the potential of satellite-based remote sensing technologies/applications. With the following approach it was challenging to provide adequate content of the training action and learning methods for the target group and their background, especially during pandemic period. The goal was to operate in a way that will increase motivation, while avoiding a purely informative effort. The target number of participants for each summer school was 15-20. With 20 and 21 participants this goal has been achieved.

Detailed evaluation of both summer schools provided a clear understanding of the strengths and weaknesses of tested approach. The Intelligent Earth Observation Summer School exceeded expectations about acquiring new skills, but not met them for all participants on conceptual inputs vs previous knowledge. Since from the evaluation form became clear that the most problematic aspect was adjusting the time needed to complete the practical tasks, it's important to adjust it according to the TAs format. It’s more difficult to get tutor’s help during online work than in face-to-face interactions. Both form participants and tutors point of view the virtual setting for this summer school worked well, although social component was significantly missing. Based on the evaluation phase of the Introduction to Satellite Remote Sensing Summer School, participants recognized and appreciated an innovative approach, intensive structuring of the course and case-based learning method.

Despite the difficulties that emerged with the pandemic, new opportunities have arisen from the better use of online resources. Both Summer Schools successfully based their training approach and material on EO4GEO materials and tools, such as BoK and Curriculum Design Tool, proving the usability and reusability of tools developed by the EO4GEO Alliance.

Annex A – Detailed Agenda of the Summer School on Intelligent Earth Observation

PHASE 3: Group Work, Interim Presentation, Final Presentation

	Monday 21.06.	Tuesday 22.06.	Wednesday 23.06.	**Thursday 24.06.**	Friday 25.06.	Sat-Sun 26.-27.6.	Monday 28.06.	**Tuesday 29.06.**	Wednesday 30.06.	Thursday 01.07.	Friday 02.07.	Sat-Sun 03.-04.07.
13:00								**Participants:** Groupworks Interim Presentations				
13:30												
14:00				**14.00-16:00 Q&A-Session for Group Works**								
14:30								**Kevin Ramirez (ClimateKIC):** Introducing ClimateKIC and Outreach				
15:00												
15:30												
16:00												

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Agenda *EO4GEO International Summer School: Intelligent Earth Observation*

		PHASE 1: Introduction to Applications							PHASE 2: methods, skills, concepts				
	Monday 07.06.	**Tuesday 08.06.**	**Wednesday 09.06.**	**Thursday 10.06.**	**Friday 11.06.**	**Saturday 12.06.**	Sat-Sun 12.-13.6.	Monday 14.06.	**Tuesday 15.06.**	**Wednesday 16.06.**	**Thursday 17.06.**	**Friday 18.06.**	Sat-Sun 19.-20.06.
											11:00h Balancing the skills between industry workforce and training: the need for upskilling and reskilling in the sector (optional)		
13:00		**PLUS/UNEP-Grid:** Introduction to the summerschool (30 min), to the EO4GEO project (15 min), administrative information	**Anders Östman (NOVOGIT)/Andreas Kazantzidis (UPAT):** CO2 Budgets/Atmosphere	**Danny Vandenbroucke/Marc Olijslagers (KU Leuven):** Garden Monitoring - Land		**Stefan Lang (PLUS):** Translation of application areas to 4 application cases for student works			**Stefan (PLUS):** EO data sources	**Carsten Pathe (FSU Jena):** Radar Remote Sensing	**Nicolo (Planetek):** The rise of AI for EO	**Hande Erdem (VITO):** Introduction to Jupyter Notebooks	
13:30									**Andrija Krtalic (GEOF):** Preprocessing (only available on June 15th)				
14:00		**Stefan Lang (PLUS):** What is Copernicus?				**Stefan Lang (PLUS):** Group formation and choice of one application area							
14:30		**PLUS: Introduction of participants** on the platform Lucidspark: Skills and interests	**Greger Lindeberg (GIB):** Climate Change - Urban Heat	**Carsten Pathe (FSU Jena):** Emergency and Radar Remote Sensing	homework	**Groupwork (Breakout-Groups/Lucidspark):** Discussing distribution of roles within groups and draft of a first concept how to address application cases			**Gao Yunya, Getachew Workineh (PLUS):** Classification and accuracy assessment	**Tobias Langanke (EEA):** Copernicus Land Monitoring Service: Context, portfolio and latest developments	**Miguel Castro Gómez (SERCO):** Crop Classification with Sentinel-2 and Machine Learning		
15:00													
15:30		**Florian Albrecht (PLUS):** Introduction to BOK Application Domains and BOK AI-Concepts				Short presentation of drafts and feedback				**Martin Sudmanns (PLUS):** Data Cubes		**Barbara Hofer (PLUS):** Reproducibility	
16:00				**(PLUS):** Instructions for Homework-assignment (5 min)									

	Monday 05.07.	**Tuesday 06.07.**	Wednesday 07.07.	Thursday 08.07.
		PHASE 3: Group Work		
	ISDE			
13:00		Final Presentation at the ISDE		
13:30				
14:00				
14:30				
15:00		Evaluation and Feedback		
15:30				
16:00				

Annex B – Feedback on Content and Format of the Summer School on Intelligent Earth Observation

The questions and answers below are taken from the survey run during the feedback session of the summer school. The survey included questions for the self assessment of participants.

Question *"What did you learn from a methodological point of view?"* Several answers were related to the use of tools like Jupyter Notebooks, Google Earth Engine or encouragement to programming.

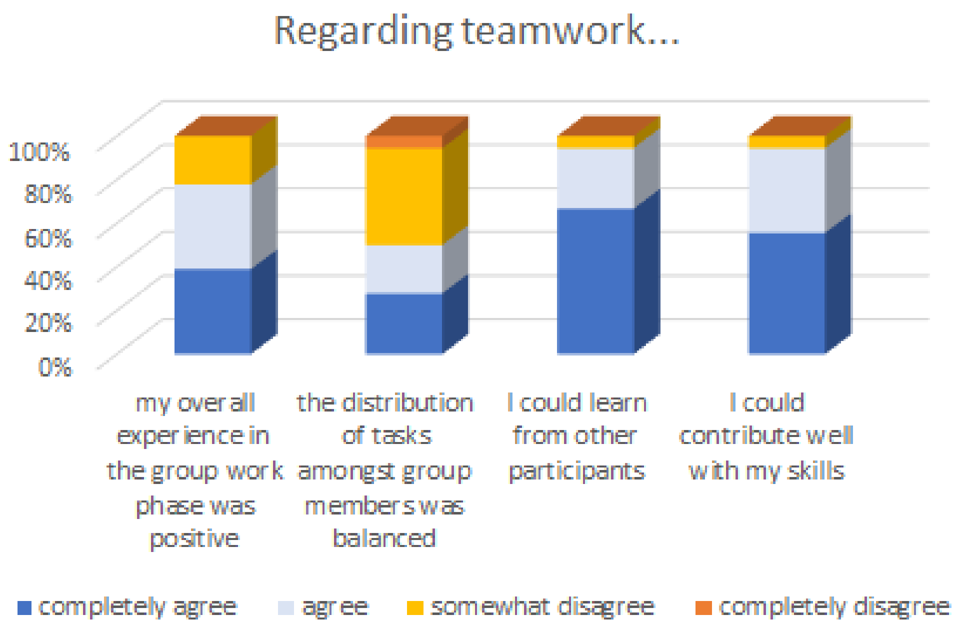
New approaches about the usage of EO DATA and AI
How to extract Land Surface Temperature from sattelite data
Specifically in regard to the group work we did. It was interesting to learn how one topic/problem can be solved following different methodologies in different environments.
I will say I learned key aspects of starting data processing using python. Prior to Summerschool, I had a serious fear of starting any form of geoprocessing using a programming language such as python, but I feel I have found a form of courage to be able to take any of such tasks.
How to obtain and handle Land Surface Temperature
Since my topic was more on Land surface temperature. I learned a lot and while switching in between platform from QGIS to ArcGIS then other opensource it was a learning experience. Apart from my own group topic, I was really insighted with the course on co2 and SAR in the first week on summer school.
That I can use cloud computing platforms for making analysis faster and more scalable. That there is a lot of platform beyond Google Earth Engine.
I learned how to correctly make comparisons of studies and how to apply statistics to have precision in the models that are carried out
How to apply correctly the machine learning concepts and in which cases exactly. It is interesting to see to what extent their outcome can reach for a future assessment whether its environment-related or space-related. Also, accessing different data from different open sources and how to deal with Jupyter Notebooks and Terrascope.
Some input for the use of Jupyter
Use of notebooks and open source data
Methodologically I learned how to work with remote sensing data in a cloud environment. Additionally, the instructional guidelines provided for working with SAR imageries was also helpful.
Teamwork, SAR process and application, Hand-on project on EO & ML.
How to calibrate models, use combined data from different sources and new preprocessing techniques that can improve the quality of data.
Get more into time series data, but the timeframe was too short unfortunately to make big steps.

Question: "What did you learn from a teamwork point of view? "

Good teamwork
That working in a very big team in a distance-mode is very challenging. I personally learn to be more flexible and to discuss the objectives of the work better before splitting the job
Collaboration, Time management, empathy :), perspective, interaction with some really smart people

Teamwork can only be achieved by constant cooperation, effective communication, and being truthful. Dont be afraid to say you dont know and try to make an effort.
It was very complicated at the beginning, we joint a group and it was just too many people. I learned that written communication of what is discussed in video is key to avoid miscommunication
Hhaha, this is a difficult question to answer I would say, as always we had team member who were almost always busy and couldnt make it but some of us were really dedicated in the assignment itself. So it was a mixture experience, sometimes exhausted with too many group meeting and repeating the task whereas it was encouraging seeing others working hard. Overall, it was a good experience everyone has their perspective and shared their knowledge.
Meet and work with talent student around the world.
I learned to share knowledge with people from different parts of the world and to know different methodologies that they use in the field of remote sensing
I learnt to be more flexible, resilient with my teammates thoughts and opinions, collaborate effectively, communicate efficiently and considering each other in terms of personal circumstances and time frames.
I learn a lot, each one of us have different experiences in the use of techniques and methodologies. So it was really great to work in group (at least for my group :))
Working with diverse people in culture, geography and skills. Very valuable experience.
Primarily, clear communication of requirements is important to achieving the teams goal. It is also important to start working of tasks way ahead of deadlines and keep each team member in the loop of the progress made and the limitations faced.
Remote collaboration can happen in asynchronous way when tasks are well defined and separate from each other otherwise it can be helpful to meet and start working together until some clear tasks are defined.
Exchange of skills
How to work on a team, split tasks and discuss issues without taking it personal :D
Deligating work within a group, trust other peoples copentences

A dedicated question on the teamwork confirms the statements. While the overall experience in the grouwork was seen as good, the distribution of tasks was less well rated.



Question *"What did you learn from a social point of view?"* Social learnings from the summer school referred to the exchange of perspectives, ideas and experiences, flexibility in teamwork. The summer school has also been seen as a chance for remotely cooperate and involve with people from all over the world.

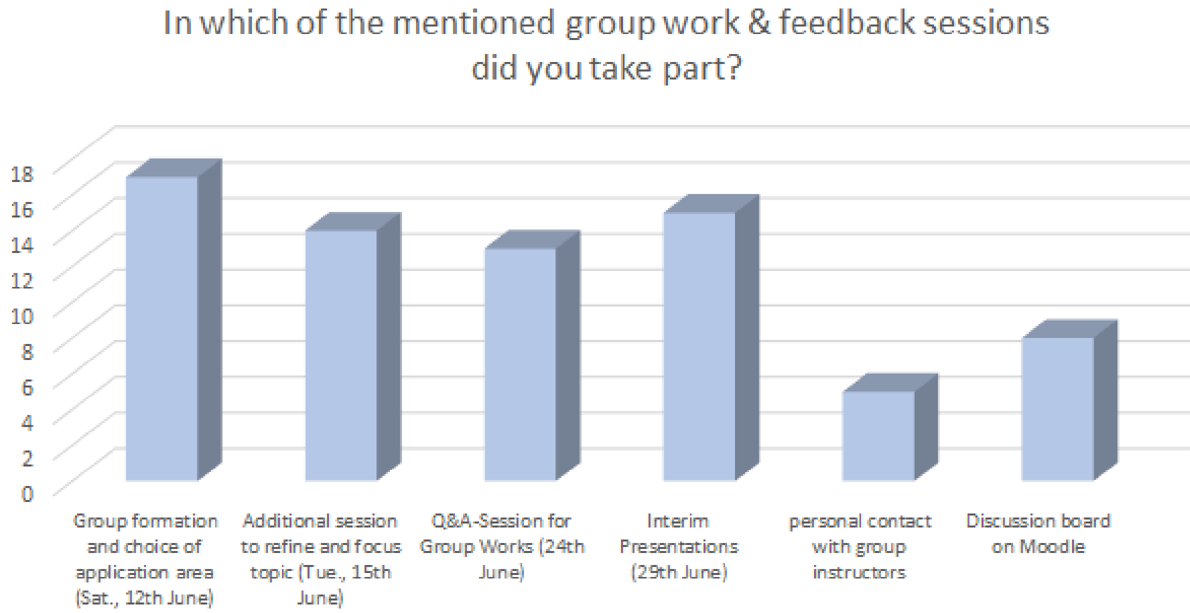
Motivate team
That flexibility is key when working in a big group in a distance mode situation. I learned a lot from others and I think the discussions we had were quite nice.
I guess it is always good and fun to learn from people. It gives insights into how people coming from different parts of the world think. I was a bit introverted at the start but was fun to have good discussions with the people. I believe I will try to interact more with people now.
Genuine communication - the knowledge to communicate with people at where they are, effectively and with consideration and not just talking over them.
You got to be flexible when working online and try to highlight always the decisions made in group meetings for those who could not be there
it was good we shared our different perspective and learned from each other
That some people like to work more than others
I learned to share knowledge about remote sensing
I learnt that despite our different educational backgrounds and countries, we could share same interests and thoughts!
That its better to work in group/other persons, because exchange information its really the best way to improve our knowledge
Different ways at looking at problem. Different experiences.
It was a good experience to meet with new people and exchange ideas on remote sensing topics.
It was fun to interact with people from different backgrounds, I guess it would be even better in real world but ok the online experience can allow some social interactions
Cultural background and a bit of French :)
How to cooperate and share visions with others.
How to agree on a workflow and including peoples competences

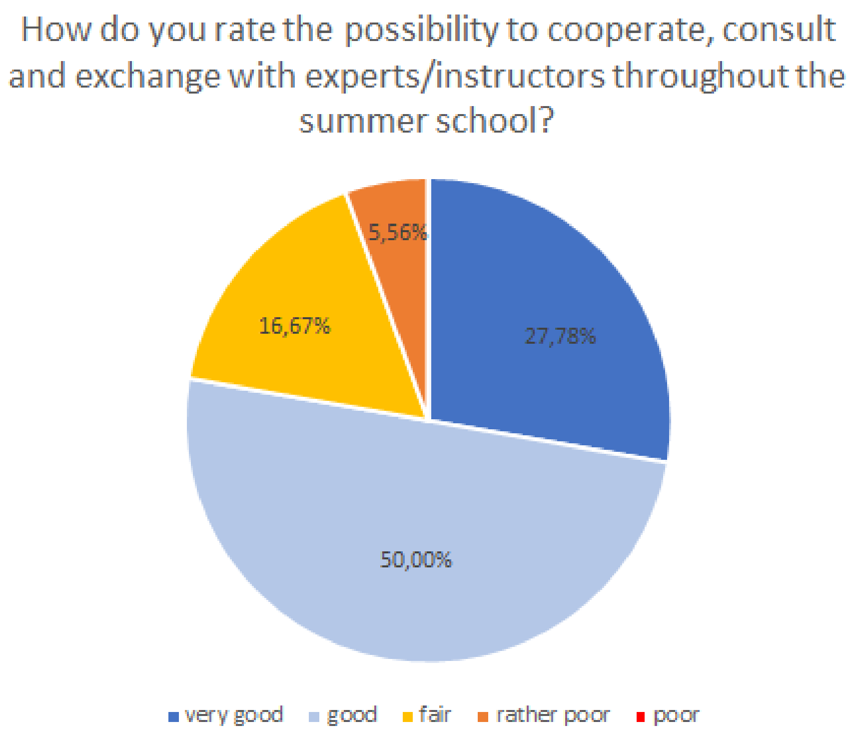
Question *"Did the application cases allow you to try methods or gain insights that are of added value for yourself?"*

Yes
Yes. I have always been curious with how urban heat islands could be detected by using sattelite data, so it was nice to went trough this experience
Yes, it did. Prior to this, I had little expertise in applying python to process earth observation imageries. But with the use application, I figured a good technique to start and reach a reasonable conclusion.
yes
Yes it did. It was very helpful in my case
Absolutely yes, I will try to move my local workflows to a cloud one.
yes, definitely
For trying new methods, not that much unfortunately but somehow yes because most of the technical tasks were made by my other colleagues as our case was a bit puzzling and it took us some time to figure out what we would like to do exactly as our skills were on a different scale and each of us was knowledgeable about a specific area. However, definitely I gained insights on different approaches of achieving things.

Yes, of course. But maybe if we had had a personalized meeting with a tutor for our topic, we could have further improved our knowledge.
Yes, I believe so. Being able to work with data relating to heat islands is very useful.
Yes, they did. The opportunity to try out the OpenEO and Terrascope platforms were very useful added to the comprehensive tutorial on SAR.
yes I enjoyed the crop classification use case which provided some useful insights, I was also impressed with the gardens use case and the draw your garden project which would allow to gather labelled data useful for training ML models for example.
Yes.
yes.
Yes, but unfortunately the time was too short to research, get used to and implement methods that were completely new to me.

Question *"In which of the mentioned group work and feedback sessions did you take part?"*
This question aimed to assess to what degree participants took the chance to attend group-instruction-sessions. As visible from the diagram below, there would have been potential to take part in more feedback offers for many of the participants.





In comparison to that, the question regarding exchange with experts and instructors showed that there would have been still potential to receive feedback.

Question *"Comments/Suggestions on the exchange with experts/instructors"*

Eva was more open to discuss
Personalised sections to each group
I am planning to stay in touch with Gina regarding the Urban heat Island topic. Other than that there were many mediums available to contact the experts/instructors and I personally dont have an issue with it
I think there should be more focus on data/feature engineering, particularly for machine/deep learning training, i.e., how the bands and other predictors are extracted for training. I just feel there is little knowledge on that and most times we lack the confidence to venture into it because we feel we (at least for myself) would be lost.
I would suggest to use some applications like gather town to increase social interaction among participants and develop networking.
I suggest that perhaps you would leave a task of everything that the experts share and share with them the results each one
some of them were hardly reachable actually, however, they gave us an insight on how to shape our case and what approach to follow in order to come out with fruitful results.
Maybe create an specific section with each group
I think the exchanges were as good as possible considering the Covid situation.
I think slack or discord can be considered as an alternative for communication rather than the discussion board on Moodle.
Great presenters with interesting topics, a lot of freedom in finding group work projects/topics and defining our own workflow. Very nice to finish up with the presentation at AGIT, a bit short on time. We had many more interesting ideas that could have been implemented, but due to the time constraints we could not dive into the topic further.

Question *"What data did you used for your case study? Where did you get the data from?"*
This question addressed the learning outcome "select and acquire data necessary for a predefined case study" in a way, that a reflection of the group work steps was necessary.

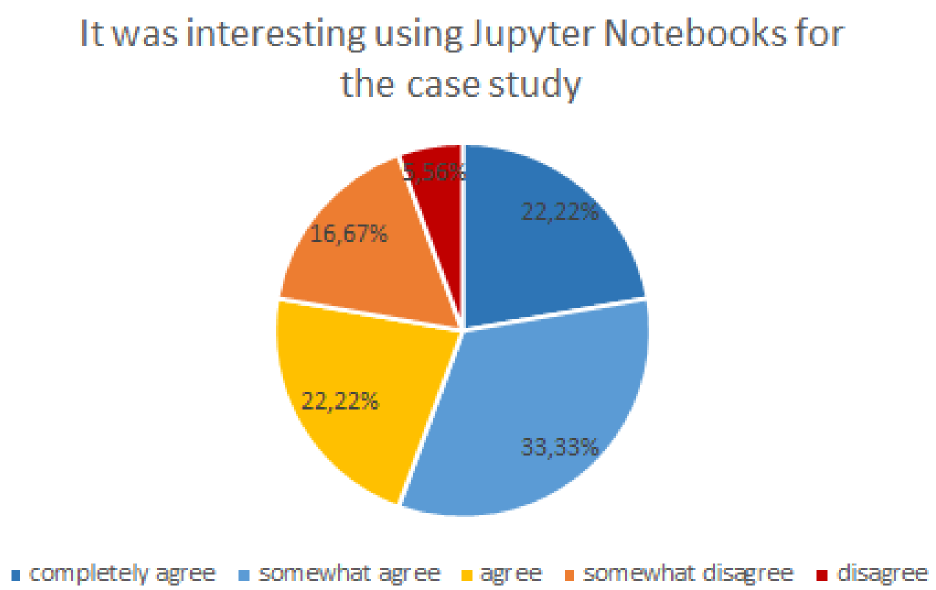
Sentinel from terrascope virtual machine
Landasat data from USGS, also acquired on GEE
We used Landsat 8 data (band 10, 5, and 4)for the case study. Was downloaded from usgs.
We LandSAT 8 OLI/TIRS Band 10, 5 and 4 data. This data was acquired from the USGS earthexplorer (https://earthexplorer.usgs.gov/).
GEE and USGS for acquiring dataParis and Lunel in France as study areas
sentinel 2
We tried initially with Sentinel 3 from Copernicus hub but ultimately use Landsat 8 from USGS
We mainly get the data from Copernicus Hub and GEE.
Landsat 8, Corine Land cover
Sentinel-1 satellite SAR images from Onda Dias along with ancillary data (LST, Soil moisture index & Precipitation) from EO Browser and climate change service.
Sentinel-1 data / EO browser / Scihub /ENVI /SNAP
Google Earth Engine, Terrascope
Sentinel-2, Google Earth EngineGWIS, Google Earth EngineESRI LULC, Google Earth EngineLFMC, https://github.com/kkraoj/lfmc_from_sarAnd other derived data.
We used GEE, most datasets are available on the catalog, else we uploaded missing datasets from different sources. But originally most datasets are either from ESA or NASA
Sentinel 1 and Sentinel 2 - Copernicus SciHub, Crop yield data - One Acre, DEM - USGS
Copernicus Open Hub Access, OpenTopography.
One Acre Fund - FAO,Sentinel 1 & 2, Landsat, SRTM

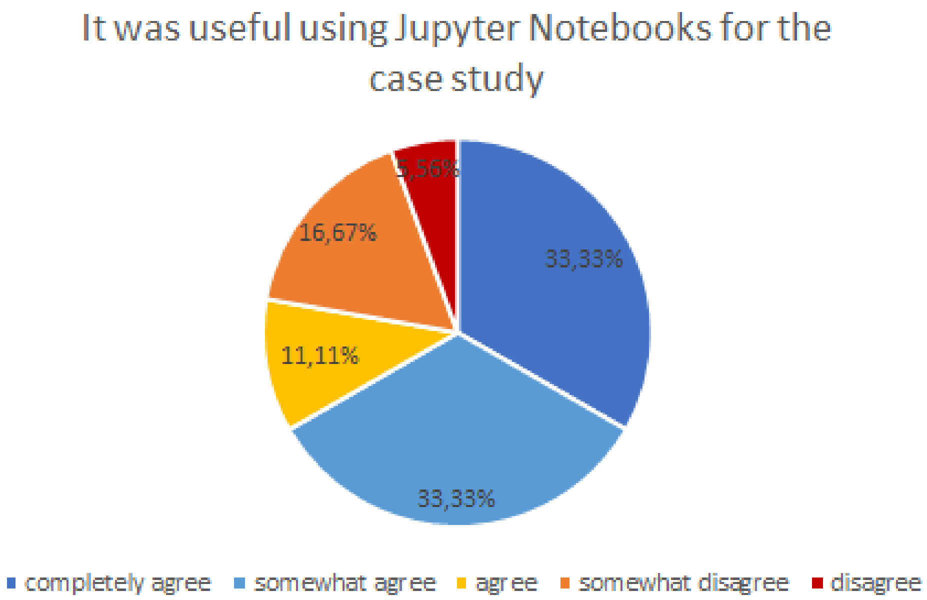
Question *"Shortly describe the applied analysis workflow for your case study:"*
This question addressed the learning outcome "summarize the current work procedures with satellite data and indicate future developments" in a way, that a reflection of the group work steps was necessary. The answers show different levels of detail, from rather vague to quite detailed.

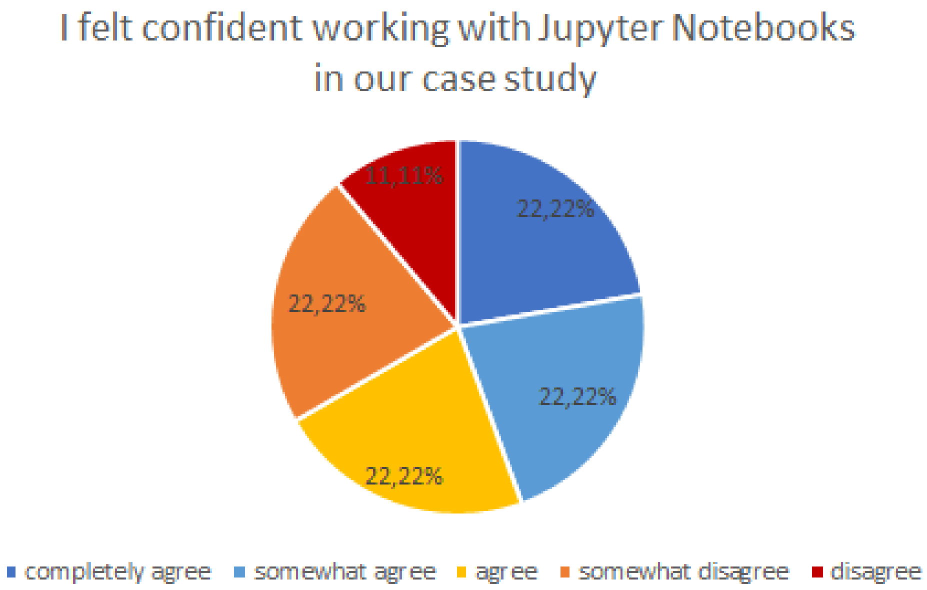
Preprocessing of sentinel images
1. Data collection2. Radiometric correction 3. Obtain brightness values4. Obtain Land emissity values (based o pv values)5. Obtain Land surface temperature6. Identify heat and cold spots7. Obtain Timeseries on these areas on GEE8. Compare the results
In arcgis Pro for LST: For band 10(SWIR) the DN values are converted into TOA reflectance values, which is then converted into brightness temperature. NDVI is calculated from band 5 and 4, which gave the proportion of vegetation and the Land surface emissivity (LSE). The brightness temperature and LSE are used in the formula to get the LST.The time series was computed and analysed using the GEE. The NDVI was computed again in terrascope to compare the software.
Since our task was Climate Change related precisely to the Urban Heat Island, the major analysis workflow was obtaining the Land Surface Temperature (LST) for the city of interest, Lunel, and Paris in France. This was obtained first by converting the digital number (dn) of Band 10 to At satellite temperature. Next, we computed the brightness temperature in degree kelvin. After we computed the NDVI of both areas using NIR (Band 5) and Red (Band 4) bands. From this, the proportion of vegetation (pv) and Land surface emissivity was computed. The final process of LST was achieved by integrating all these values into the model using the researched formula. Other forms of analysis were done via literature review to ascertain what might be responsible for the increase in temperature.
sentinel 2 to predict forest fire
We perform simple Land Surface temperature mapping in a specific study area and learned the methodology behind it from the creation of brightness variable to ndvi, then emissivity to ultimately determine LST. The outcome was compared with different areas and realised the reason behind the variation in the hot and cold spot in those loacations.

We compare time series in hotspot (coldspot) from two cities: Lune and Paris. We got the data using GEE and the land surface temperature module.
Compare LST data in Lunel and Paris (Landsat 8); used ARCGIS PRO: Visualizing the LST and identifying UHI and cold spots;Google Earth Engine: Plotting time series LST; Terrascope
We started with imagery dataset acquisition, after that preprocessing and processing followed by polygons selection and collecting the ancillary data and apply some data engineering (Cleaning Outliers, Filtering, Data date resampling) to come up with time-series and correlation analysis.
We implement the DInSAR data, so: download data>preprocessing (in order to obtain the interferogram (phase / coh)> analyze the resulting information in order to identify the zones with subsidence> correlate the finding zones with the environmental parameters
For our project, we used a remote sensing cloud environment to detect and predict the burn severity for large fires in California. We also tested different machine learning algorithms for predicting burn severity for the area of interest.
Acquisition of Satellite ImageryPreprocessing Spectral indices generate from time-series data from Sentinel 1 & 2 according to the crop calendar of the study area. Data analysis and modelling in the Jupyter notebook
After preprocessing the remotely sensed data, we combine them with reference data and then extract values corresponding to samples. Afterwards we built a random forest regression model in terrascope VM using Jupyter Notebook. Then we chose the best fit model to test on our second study area.
Source Data Exploration -> Data Analysis -> Satellite Imagery and Terrain data acquisition from different Sources -> Data preprocessing, creation of indices -> Comparing ML methods for this specific dataset -> building and comparing models -> performing prediction -> Evaluation of results.

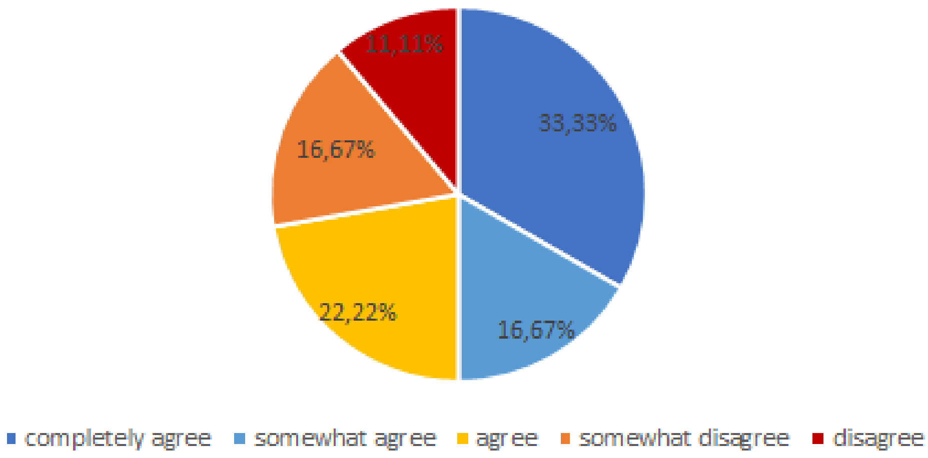
Questions regarding the use of Jupyter Notebooks for the application cases:



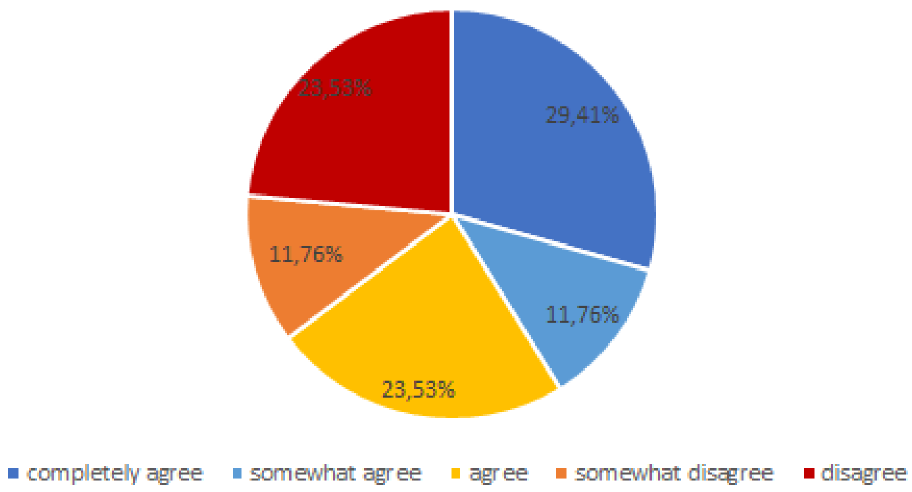

It was useful using Jupyter Notebooks for the case study
5,56%
16,67%
33,33%
11,11%
33,33%
completely agree
somewhat agree
agree
somewhat disagree
disagree


I felt confident working with Jupyter Notebooks in our case study
11,11%
22,22%
22,22%
22,22%
22,22%
completely agree
somewhat agree
agree
somewhat disagree
disagree

I would have needed more skills in Python to actively contribute to Jupyter Notebooks



I would have needed more skills on Jupyter Notebooks to actively contribute on our Jupyter Notebook



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Annex C – Detailed Agenda of the Summer School on Introduction to Satellite Remote Sensing

Summer School

Introduction to Satellite Remote Sensing

Potenza, June 15-17, 2021

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Empowering space data users

Co-funded by the Erasmus+ Programme of the European Union

Preliminary program

e Aula Terzaghi 2nd floor of the Engineering School, remotely here)

Tuesday 15 June 2021

9:30 - 10:00	Greetings	**Ing. Giorgio Saio** - GISIG (Coordinator of the European Project EO4GEO)
	Introduction to the course	**Prof. Valerio Tramutoli** - UNIBAS (School Coordinator)
10:00 - 12:30	**Fundamentals of Remote Sensing - Module 1**	**Prof. Valerio Tramutoli** - UNIBAS
	Lunch break	
15:30 - 17: 30	**Demonstrations of use - 1**	**Tutors**
	Thermal sources - IR thermal camera Spectral Signatures in the Laboratory Hyperspectral Signatures from Airplane	Proff. Valerio Tramutoli and Nicola Pergola with Drr. Alfredo Falconieri, Teodosio Lacava, Carolina Filizzola, Nicola Genzano, Emanuele Ciancia, Roberto Colonna
Wednesday 16 June 2021		
9:30 - 12:30	**Fundamentals of Remote Sensing - Module 2**	**Prof. Valerio Tramutoli** - UNIBAS
	Lunch break	
15:30 - 17: 30	**Demonstrations of use - 2**	**Tutors**
	Coastal retreat over the long (Landsat) and short (Sentinel-2) period. Flood risk monitoring, inventory of flooded areas. Monitoring of surface waters, algal blooms and solid transport (in coastal and inland waters)	Proff. Valerio Tramutoli and Nicola Pergola with Drr. Teodosio Lacava, Carolina Filizzola, Nicola Genzano, Emanuele Ciancia, Roberto Colonna
Thursday 17 June 2021		
9:30 - 12:00	**Optical band satellite remote sensing tools and techniques - Module 3**	**Prof. Nicola Pergola** UNIBAS / IMAA-CNR
12:00 - 13:00	**Advanced applications of multi-temporal analysis - Module 4**	**Prof. Valerio Tramutoli** UNIBAS
	Lunch break	
15:30 - 17: 30	**Demonstrations of use - 3 and Discussion**	**Tutors**
	Identification of hot spots (fires, flames, explosions) Vegetation monitoring (as a bio-indicator of pollution stress, pathogens, climate change) Use of Copernicus Services Temporal signatures of vegetation (e.g. controls of aid in agriculture), precision agriculture, etc. Open discussion on other possible applications (cost-benefit analysis)	Proff. Valerio Tramutoli and Nicola Pergola with, Teodosio Lacava, Carolina Filizzola, Nicola Genzano, Emanuele Ciancia, Roberto Colonna

Friday 18 June 2021

9:30 - 12:30	***Copernicus Young Ambassadors Day (School of Engineering - Aula Terzaghi)***
12:30 - 13:00	Closing ceremony with delivery of certificates to Summer School participants and Copernicus Young Ambassadors