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SDI and EO Education and Training for North Africa

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# D2.4 Training of teachers at partner universities

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**Work Package / Task:**

WP2 – Development of SDI and EO curriculum and capacity building

T2.4 - Training of teachers

**Short Description:**

This report summarizes the training actions implemented during the SEED4NA programme for training of teachers and other experts in SDI, EO and related topics.

**Keywords:**

Training programme, capacity building, training actions, SDI, EO

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# 1. Introduction

## 1.1. The SEED4NA project

For many of the societal and environmental challenges that governments are facing, decision-makers strongly rely on spatial and earth observation data, to better target, monitor, and assess their actions and interventions. These data are now becoming more and more available through the establishment of data infrastructures and platforms, which aim to improve access to, sharing and use of data. The effective use of these data requires that professionals in the public, private and academic sector have the relevant knowledge and skills on spatial data infrastructures (SDI), earth observation (EO) and related technologies. This means that higher education institutions must have the knowledge and capacities to provide modern education to their students and offer professionals the right training programmes to raise the overall level of expertise in SDI & EO.

Initiatives to promote and coordinate the sharing of EO and spatial data are also emerging in the region of Northern Africa, at the local, national and regional level. Despite the growing availability and accessibility of data, there still are several barriers and challenges hindering the uptake and use of these data in policy making and implementation. Among these barriers and challenges is a lack of skills and knowledge on SDI and EO among practitioners, decision-makers and other key stakeholders. Therefore, it is essential that academic institutions in the North African countries raise their capacities regarding SDI and EO.

The main objective of SEED4NA is to improve the quality of higher education in North Africa in the fields of SDI and EO, and to enhance its relevance for the labour market and society through the development of new and innovative SDI/EO curricula. The SEED4NA project aims to: 1) develop the required knowledge, skills and competencies on SDI & EO within partner universities; 2) help introducing modern SDI & EO courses in engineering and agriculture/forestry studies; 3) implement supporting relevant vocational training programmes; 4) help partner universities to support the development of SDI in their country and 5) promote a European approach to SDI & EO.

SEED4NA will result in the establishment of capable, well-trained pools of experts within the involved North African academic institutions, which will introduce a modern approach in academic and VET education on SDI & EO in their respective countries, thereby becoming promotors of SDI development and EO use.

## 1.2. Training of teachers

WP2 of the SEED4NA project deals with the development of the SEED4NA curriculum on SDI and EO and building up capacity at the partner organisations. The work package has the following specific objectives:

- To develop a project SDI curriculum with courses, content of courses, outcomes, methods of teaching and all other necessary elements;
- To develop a model of VET courses with content and methods of teaching;
- To acquire and install equipment for SDI/EO courses at partner universities;
- To train the teachers at the partner organisations in SDI and EO and about to teach about it

Task 2.4 of SEED4NA dealt with the design and implementation of a train-the-teacher programme, with the aim to provide the teachers at the partner organisations with the required knowledge and skills on SDI & EO and how to teach about SDI and EO. Training of the teachers at the partner organisation was done via a multi-stage training programme, consisting of online and in-person training actions, covering basic and more advanced

topics related to SDI and EO. In this report an overview is provided of the various training actions implemented as part of the SEED4NA project.

## 1.3. Structure of the document

After this introductory chapter, the next chapter discusses the overall approach methodology of designing and implementing the SEED4NA training programme. The third chapter reports on the first Virtual SEED4NA Summer School, which was implemented in May 2021. A summary of the online Technical Training, organised from December 2021 to May 2022, is provided in chapter four. In the fifth chapter, a report is provided on the SEED4NA Summer School, which took place in May 2022. The national trainings provided under SEED4NA are presented in chapter six. The seventh and final chapter of this report provides some general conclusions about the SEED4NA training actions.

## 2. Methodology

The aim of the SEED4NA training programme was to provide the teachers at the partner organisations who would be in charge of the development and implementation of courses on SDI, EO and related topics with the required knowledge, skills and competencies. To achieve this aim, a comprehensive, multi-stage training programme was designed and implemented, consisting of different types of training actions. While most of the trainings were provided by the experts and teachers from the EU partners of SEED4NA (KU Leuven, University of Zagreb, Bochum University of Applied Sciences, University of Twente and NOVOGIT), also the North-African partners were actively engaged in the provision of training to their colleagues.

Due to the COVID-19 pandemic, some changes were made to the original training plan, with the inclusion of several online training actions and some changes in the planning of the trainings. The – new – SEED4NA training programme consisted of four main training actions:

- The first Virtual SEED4NA Summer School (May 2021) which was organised as a 4-day online training programme
- The SEED4NA series of online Technical Trainings (December 2021 – May 2022) which consisted of 5 online trainings, each covering a key topic of the SEED4NA project
- The in-person SEED4NA Summer School (May 2022), which consisted of a full week of trainings on the main topics of SEED4NA
- The SEED4NA national trainings, which focused on specific needs of some partner organisations and partner countries

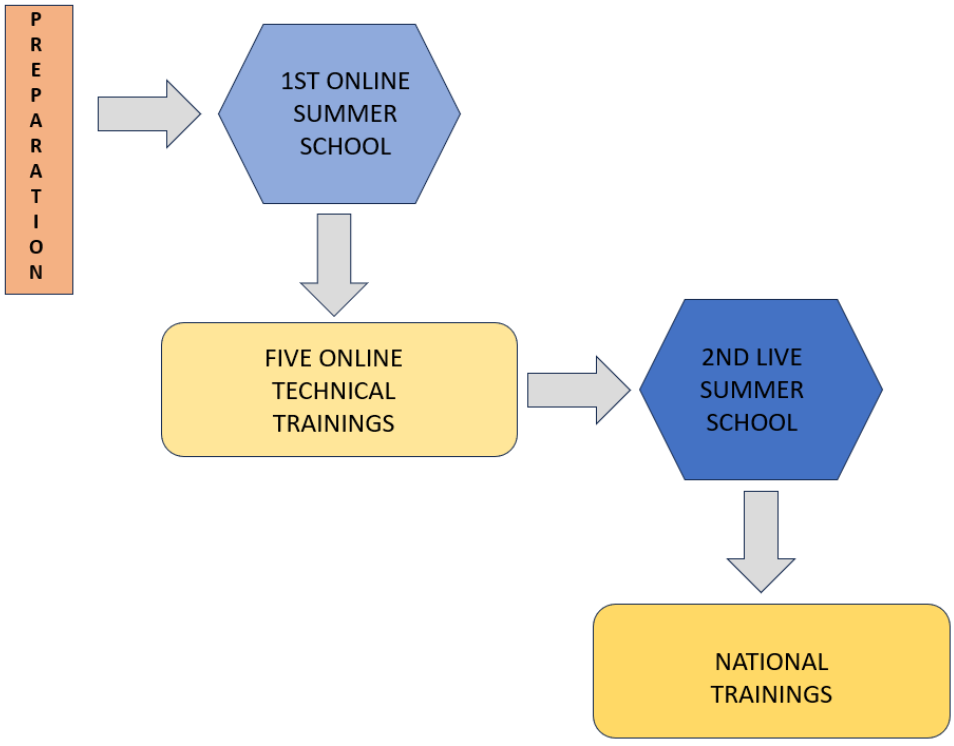


Figure 1. Workflow of the training programme

## 3. First Virtual SEED4NA Summer School

Due to the ongoing COVID 19 pandemic and extensive travel restrictions, the first SEED4NA summer school was organised as an online training programme for four days: 18, 20, 25 and 27 May 2021. The virtual summer school was targeted at teachers and staff members of higher education institutions in the four North Africa partner countries of the project and consisted of four sessions covering different topics related to SDI/EO education and practice. The main objective of these courses was the transfer of knowledge in the field of SDI/EO with the aim to:

- introduce relevant topics – from basic to in-depth views,
- inform about latest developments,
- share experiences in teaching.

The **first session** on Tuesday 18 May was focused on practices, developments and education in the field of Spatial Data Infrastructures through presentation of:

- Andreas Wytzisk-Arens (HSBO) who introduced Spatial Data Infrastructures (SDI), with a particular focus on the Europe-an INSPIRE approach.
- Anders Ostman (Novogit), who emphasised and explained the multi-disciplinarity of SDIs. Joep Crompvoets (KU Leuven) who firstly provided an overview of existing academic education and teaching initiatives on SDI, followed by a case on SDI education in the context of EduServ, the educational service of EuroSDR.
- Željko Bačić, (UNIZG) who presented the SDI curriculum developed by the BESTSDI project, as an example of a complete curriculum on SDI and related topics.

In the **second session** on Thursday 20 May participants were introduced into the field of EO, with several presentations on key concepts and developments in the field and on education and teaching in this field. Presentations was performed as follow:

- Lucas De Oto (University of Twente) first provided an introduction to EO, in which he gave an overview of the relevant topics and concepts in this field. In his second presentation, he showed how EO could be relevant in application domains beyond 'geo', by presenting a case on EO for food security.
- Andrija Krtalić (UNIZG) focused on the process of transforming images into to maps and objects. One of the main topics in this presentation were the different classification methods.
- Ansgar Greiwe (HSBO) presented how Earth Observation is integrated in current teaching at HSBO, focusing especially on the lab course activities. He showed how various Remote Sensing Software packages and tools are used in EO education at HSBO and provided practical advice on how to prepare lab courses.

Topic of the **third session** on Thursday 25 May was curriculum design in the field of SDI/EO. In this session presenters were:

- Danny Vandenbroucke (KU Leuven) who first introduced the Body of Knowledge on EO and GI, which is currently being developed under the Erasmus+ Skills Alliance EO4GEO. He presented the overall concept of the Body of Knowledge, how it is developed and how it could be used in support of various activities, including curriculum design.

- Marijan Grgić (UNIZG) showed the use of the body of Knowledge for design curricula, with a real example on a MSc Programme on EO/GI for Land Monitoring. He explained the different steps in the process of designing curricula, and showed how the EO4GEO CD Tool and Body of Knowledge could support this process.

The fourth and final session on **Thursday 27 May** was focused on the design of courses and the use of innovative teaching methods. Presenters were Lucas De Oto (University of Twente) and Glenn Vancauwenberghe (KU Leuven) who provided several presentations on the design of courses in the fields of SDI/EO in which they shared several approaches, methods, and real examples. Topics covered in this session included the ADDIE approach, constructive alignment, blended course de-sign, experiential learning, and collaborative learning.

| **Session 1 „SDI basics and education“ (18/05/2021, 15:30 - 18:00h)** |
|---|
| 1. Introduction to SDI and the European INSPIRE approach (Andreas Wytzisk-Arens, HSBO) |
| 2. Importance of SDI and its multidisciplinarity (Anders Ostman, Novogit) |
| 3. SDI in academic education – a sample case (Joep Crompvoets, KU Leuven) |
| 4. SDI curriculum developed by BESTSDI project (Željko Bačić, UNIZG) |
| **Session 2 „EO basics and education“ (20/05/2021, 15:30 - 18:00h)** |
| 1. Introduction to Earth Observation - An Overview (Lucas de Oto, UT) |
| 2. Earth observation and its role for application domains beyond “geo” - A food security case (Lucas de Oto, UT) |
| 3. From images to maps and objects (classification and object detection basics) (Andrija Krtalić, UNIZG) |
| 4. Earth Observation in academic education – a sample case (Ansgar Greiwe, HSBO) |
| **Session 3 „Curriculum design - From concepts to detailed descriptions“ (25/05/2021, 15:30 - 18:00h)** |
| 1. EO4GEO Today of Knowledge - concept, establishment of BoK other tools (Danny Vandenbrouke, KU Leuven) |
| 2. CDTool - How to create a curriculum? (Marijan Grgić, UNIZG) |
| **Session 4 „Curriculum implementation - From descriptions to courses“ (27/05/2021, 15:30 - 18:00h)** |
| 1. From module descriptions to lectures - Designing courses (Lucas de Oto, UT) |
| 2. Sample cases (working title) (Glenn Vancauwenberghe, KU Leuven) |

*Table 1 Programme of the Virtual SEED4NA Summer School*

The training sessions were mainly targeting teachers and experts at the partner organisations, but were also open to other stakeholders, such as professionals and students. In total there were 349 registrations for the training.

All training materials were made available via the project website[1] and the project communication platform.

[1] See https://seed4na.eu/news18/

# 4. Online Technical Trainings

Between December 2021 and May 2022 a series of technical trainings was organised covering Earth Observation/Remote Sensing, Spatial Data Infrastructure, GIS, Long-Life Learning, modern concepts in academic teaching and interdisciplinary topics. Each month, three training session were organised focused on one particular topic.

Participation in these training sessions was free of charge and open to anyone interested in SDI, EO and related topics. Especially academic staff, researchers, students and professionals from Algeria, Egypt, Morocco and Tunisia, the four partner countries of SEED4NA, were invited and encouraged to participate in the trainings.

## 4.1. Basics of Earth Observation and Remote Sensing technical training

This first technical training was organised by the University of Zagreb, and took place from December 13–15, 2021. The Basics of Earth Observation and Remote Sensing training was a three-day course covering this topic to academic and professional staff using or intending to use EO/RS technology in their daily work as a powerful tool for spatial analysis and interpretation of occurrences on Earth's surface. Each of the sessions covered a particular topic.

The first session focused on basic theory coverage of Earth Observation and Remote Sensing, and provided examples of their utilization in real world. Some acknowledgements of electromagnetic spectrum were also explained, and a brief history of remote sensing was provided.

In the second session, which was held on Tuesday, December 14th, the main topics were sensors used in RS, their construction types, and different types of images as their products. Process of generation of digital image where also explained. The detailed list of online platforms used for Remote Sensing was provided to the participants, together with list of satellite missions that are commonly used for these purposes. In the second part of the second day, the resolution types of images and spectral signatures of objects on them were explained.

The last day of training, Wednesday December 15th was demonstrating preprocessing and processing of RS Images, spectral characteristics, and vegetation indices of objects. Very throughout explanations and examples of different types of classification were displayed in the context of different applications of RS and in what applications are methods used.

The programme of the training session is shown in table 2.

| **The Basics of Earth Observation and Remote Sensing**<br>**December 13–15, 2021** | |
|---|---|
| Monday 13 December, 13:00 – 16:00 CET | Earth Observation and Remote Sensing, electromagnetic spectrum |
| Tuesday 14 December, 13:00 – 16:00 CET | Sensors and Platforms in Remote Sensing |
| Wednesday 15 December 13:00-16:00 CET | Pre-processing and processing of Remote Sensing Images, Application of Remote Sensing Methods, way of teaching Earth Observation and Remote Sensing basic courses |

*Table 2 Programme of the first SEED4NA Technical Training*

All sessions were given by Associated Professor Andrija Krtalić from the Faculty of Geodesy University of Zagreb. After the training, all materials (presentations and videos) were made available through the SEED4NA project website[2] and the project collaboration platform.

The training was open to anyone interested in education about Earth Observation and Remote Sensing. The training was attended by 150 participants, including representatives from the partner organizations but also other stakeholders, especially from the four partner countries (Algeria, Egypt, Tunisia and Morocco). All participants received a certificate of attendance.

## 4.2. Basics of Spatial Data Infrastructures (SDI)

The second Technical Training was focused on the topic of Spatial Data Infrastructures. The training, which was organised by KU Leuven, was held from January 24 to January 26 2022. The training was delivered in the format of a three-day course covering both technical and non-technical aspects of Spatial Data Infrastructures (SDI), including topics such as standards, catalogues, metadata, governance and business models. Each day consisted of three one-hour sessions provided by different professors and experts.

On Monday, January 24th, the first session was focused on standards, web services, and governance. Participants were introduced to the notions of interoperability and the role of standards in achieving it. Then participants were presented descriptions and examples of web services and the interaction workflow between a Web Map/ Feature Service and a client. The first day ended with session on the importance of good governance and the role of SDIs for a "smart world."

The second session, which was held on Tuesday, January 25th, was dedicated to non-technical aspects of SDI that are assessment and business and fundings models. Participants learned about SDI assessment criteria and how to interpret and discuss assessment results. Then, the participants were introduced to the notion of business models and how they can be applied to SDI. Different costs of SDI were also presented. Finally, participants were initiated to the importance of metadata and the use of portals.

The last day of training, Wednesday, January 26th, focused first on data harmonization. Participants learned about the different steps to achieve harmonization and to identify and explain the most important elements of a geospatial data model. Participants were then introduced to the different usage of SDI services and metadata and to a method for finding suitable geospatial data sets. The training ended with a conclusion session that included an opening perspective on the current development of SDI as a "network".

The trainings were prepared and given by SDI experts from various project partners, including KU Leuven (Glenn Vancauwenberghe, Danny Vandenbroucke, Marc Olijslagers, Joep Crompvoets & Lisa Lacroix), Bochum University of Applied Sciences (Carsten Kessler) and Novigit AB (Anders Ostman).

Recordings and presentations from all sessions were made available via the project website[3] and the project collaboration platform.

[2] See https://seed4na.eu/tt1

[3] See https://seed4na.eu/tt2/

There were 188 participants to the second technical training, who all received a certificate of attendance.

| **Basics of Spatial Data Infrastructures (SDI)**<br>**January 24th – 26th, 2022.** | |
|---|---|
| Monday 24 January 2022 (13:00 – 16:00 CET | • SDI Standards (Carsten Kessler)<br>• Web Services (Carsten Kessler)<br>• Governance for a smart world (Joep Crompvoets) |
| Tuesday 25 January 2022 (13:00 – 16:00 CET | • Metadata and portals (Marc Olijslagers)<br>• SDI Assessment (Glenn Vancauwenberghe)<br>• Business and funding models (Glenn Vancauwenberghe) |
| Wednesday 26 January 2022 (13:00 – 16:00 CET | • Data models and specifications (Danny Vandenbroucke)<br>• SDI Usage (Anders Ostman)<br>• Network perspective of SDI (Glenn Vancauwenberghe) |

*Table 3 Programme of the second SEED4NA Technical Training*

## 4.3. Lifelong learning (LLL) through high-quality teaching

The third technical training took place from February 21 to February 2022, and was dedicated to the topic of Lifelong learning through high-quality teaching. The training was designed and co-organized by KU Leuven, University of Zagreb, and CRTEAN.

Also this technical training was delivered in the format of a three-days training focusing on different topics such as the Bologna declaration and European higher education area, the Bologna process for curriculum development, quality assurance in university education, educational systems in north Africa, LLL approaches and business models, examples of LLL training and business-academia cooperation in education.

During the first day, UNIZG presented the Bologna process and the challenges of European higher education system in 21st century. 'Quality Assurance in Higher Education' was the second topic addressed on the first day of this training. The content of the training by NOVOGIT was related to the policies for higher education and quality assurance and the European standards and guidelines (ESG).

The second day of the training was devoted to the four North Africa partner countries (Algeria, Egypt, Morocco, and Tunisia), as the educational system of these four countries was explained. After the country presentations there was a discussion about how to better define a specified curricula for each NA partner country.

The third and last day focused on LLL approaches and examples. The session started with a presentation from CRTEAN one of the Tunisian project partners, about their approach, business model and results related to training and lifelong learning. The second part of the session focused on real examples of training provided by CRTEAN. The third and last presentation was from UNIZG and was about the business academia cooperation in education, the Erasmus+ GEOBIZ project was taken as an example.

The presentations and recordings from the training were made available via the project website and communication platform. In total, there were 170 participants in the training.

| **Lifelong learning (LLL) through high-quality teaching**<br>**January 21 – 23, 2022** | |
|---|---|
| Monday 21 February 2022 (13:00 – 16:00 CET | • Bologna Process for Curriculum Development: Course Descriptors, Learning Outcomes and ECTS (Ana Kuveždić-Divjak – UNIZG)<br>• Bologna declaration and European Higher Education Area - challenges of higher education in 21st century (Željko Bačić – UNIZG)<br>• Quality assurance in university education (Anders Östman – NOVOGIT) |
| Tuesday 22 February 2022 (13:00 – 16:00 CET | • North Africa partner countries educational system (NA partners)<br>• Discussion |
| Wednesday 23 February 2022 (13:00 – 16:00 CET | • CRTEAN LLL approach, business model and results – what and how can be implemented at partner universities (CRTEAN)<br>• LLL training example (CRTEAN)<br>• Business-Academia cooperation in education – example GEOBIZ project (Vesna Poslončec-Petrić and Željko Bačić – UNIZG) |

*Table 4 Programme of the third SEED4NA Technical Training*

## 4.4. The Fundamentals of Geospatial Information in SDI: Overview and Teaching Approaches

'The Fundamentals of Geospatial Information in SDI: Overview and Teaching Approaches' was the central topic of the fourth technical training, which was organized by the University of Twente, with support from KU Leuven.

The training consisted of three daily sessions, from March 9 to March 11 2022. The trainings focused on SDIs as "the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data". The sessions focused on the different stages in the geospatial data value chain, with special attention to effective teaching approaches;

- Modelling in the context of Geospatial Information; Representation models, data models, computational models
- Spatial data storage and manipulation; Raster and vector models, data management
- Spatial data analysis; Geospatial workflows and information products

The specific objectives of the course were to 1) structure fundamental contents for a GI introductory course in a SDI context, in a coherent and meaningful way according to the intended academic level, 2) link those con-tents with suitable learning activities and strategies, 3) critically reflect on the relevance, validity and suitability of both contents and teaching strategies of similar courses, and 4) test new approaches to teach similar courses.

All training sessions were delivered by Lucas H. De Oto and Rolf de By from the University of Twente. Training materials were made available via the project website[4] and collaboration platform. Over the three days, 77 persons, mainly from the SEED4NA partner countries, participated in the training. A certificate of attendance was awarded to all participants.

[4] https://seed4na.eu/tt4

| **The Fundamentals of Geospatial Information in SDI: Overview and Teaching Approaches**<br>**March 9–11, 2022.** | |
|---|---|
| Wednesday March 9, 13:00 – 16:00 CET | Modelling in the context of Geospatial Information; Representation models, data models, computational models; Teaching approaches. |
| Thursday March 10, 2022 13:00 – 16:00 CET | Spatial data storage and manipulation; Raster and vector models, data management; Teaching approaches. |
| Friday March 11, 2022 13:00 – 16:00 CET | Spatial data analysis; Geospatial workflows and information products; Teaching Approaches |

*Table 5 Programme of the fourth SEED4NA Technical Training*

## 4.5. SEED4NA curriculum development: Approaches and application areas

The SEED4NA Training programme also aimed to cover the relevance and use of SDI/EO in particular application areas. At the same time, the aim was to also actively engage the North-African partners in the implementation of the training actions. The fifth technical training, which was co-organized by KU Leuven and Bochum University of Applied Sciences, focused on SDI/EO application areas, and approaches for integrating these areas into the curricula.

The technical training took place from 25 to 27 April 2022, and mainly consisted of presentations by teachers and experts from the partner organisations, who addressed the relevance of GI, SDI and EO to various application areas, such as water resources management, forest fire modelling, climate change assessments, urban planning and agriculture. Experts from Bochum University of Applied Sciences and KU Leuven positioned these presentations on specific application areas within more general approaches on problem-based learning and active teaching.

As for the previous sessions, this 5th training was delivered in the format of three daily sessions, strongly dedicated to the application areas that are central to SEED4NA project, i.e. the domains and applications SEED4NA aims to cover in its education and training. This especially includes areas that are closely related to the expertise and interests of the North African partners. During the training sessions, several of the North African universities involved in SEED4NA provided an introduction to a particular application area, in which they demonstrated the added value of GI/EO/SDI to address challenges and problems in this area. The training also provided guidance and examples on how to take into consideration these application areas – and their challenges and problems – in the design of education and training.

The full programme of the training is presented in table 6. All training materials – presentations & recordings – were made available via the SEED4NA project website[5] and the project collaboration platform.

The training was attended by 129 participants, mainly representatives from the partner organisations in Algeria, Morocco, Tunisia & Egypt. A certificate of attendance was awarded to all participants.

[5] https://seed4na.eu/t5/

| **Curriculum development: Approaches and application areas**<br>**April 25 – 27, 2022** | |
|---|---|
| Monday 25 April, 2022<br>(13:00 – 16:00 CET | • Problem-based learning: conceptual foundations, best practices and examples (Carsten Keßler, Bo-chum University of Applied Sciences)<br>• Spatial Big Data for telco and Drone usage for photovoltaic inspection (Hicham Hajji et al, Agro-nomic and Veterinary Institute Hassan II)<br>• Water resources management with the Souss Massa region as a case study (Adnane Labbaci & Bouchaou Lhoussaine, Ibn Zohr University) |
| Tuesday 26 April, 2022<br>(13:00 – 16:00 CET | • Spatio-temporel change of steppe landscape : GIS mapping and comparison of landscape and Forest fire modeling With GIS (Ratiba Hourizi, University of Sciences and Technology Houari Boumé-diène)<br>• Smart Water Management: Case study of Medjerda Basin (Fatma Trabelsi & Salsebil Bel Hadj Ali, University of Jendouba)<br>• Monitoring and mapping of groundwater based on geodetic observations (Mohammed Chikh-Baelhadj , University of Sciences and Technology Houari Boumédiène)<br>• Use of EO data in hydrological model and climatic change assessment (Anis Chekirbene, Issam Nouiri & Jamila Tarhouni, Carthage University) |
| Wednesday 27 April, 2022<br>(13:00 – 16:00 CET | • Applications of GI/EO in Precision Farming ( Noureddine Aribi & Mejdi Kaddour, University of Oran 1)<br>• Applications of GI/SDI/EO in agriculture including soil mapping, land evaluation and land use planning (Ali Gaber, Fayoum University)<br>• Application of SDI and EO in Urban Planning (Sarah Abougendia et al, Alexandria University)<br>• Discussion and next steps (Carsten Keßler, Bochum University of Applied Sciences & Glenn Vancauwenberghe, KU Leuven) |

*Table 6 Programme of the fiftht SEED4NA Technical Training*

# 5. Summer School Dubvronik

The goal of the second SEED4NA Summer School was to provide more advanced training on SDI, EO and related topics and to support the teachers from the partner organisations with the design and development of their own SDI/EO courses, which will be implemented in the context of SEED4NA.

The Summer School was organized from May 9-13, 2022, at the University of Zagreb Centre for Advanced Academic Studies (CAAS) in Dubrovnik, Croatia. The Summer School was structured around four main topics, which were covered by the EU partners from SEED4NA:

- SDI Establishment (Glenn Vancauwenberghe & Lisa Lacroix – KU Leuven)
- Drone Usage (Zvonimir Nevistić – UNIZG)
- Spatial Data Science (Carsten Kessler, HSBO)
- AI for EO - GIS applications (Lucas de Oto & Mahdi Khodadadzadeh – University of Twente)

In between of these sessions, the experts actively collaborated with the teachers from the North African partners on the design of their own courses, in terms of learning objectives, teaching practices, teaching matrerials and assessment approaches.

During the first day of training the participants were welcomed by the hosts institution and the project coordinator, after which also some technical and practical aspects of the summer school and training sessions were discussed. During the first training day, training was provided by the KU Leuven team on SDI Establishment and how to design and provide training on SDI. The first day ended with an introduction on the second training topic, drone usage, by Zvonimir Nevistić from UNIZG

The other two training topics were central in the second day of the Summer School, when Mahdi Khodadadzadeh from the University of Twente first gave an overview of AI for EO/GI (Applications), after which Carsten Kessler from HSBO provided a training on Spatial Data Science. ,

The third day of the training consisted of a field trip on Pelješac peninsula where UAV (drone) data collection was presented in the field.

The fourth day of the Summer School continued with the training on AI for EO/GI, with a lecture by Lucas de Oto from University of Twente. After some SEED4NA project management sessions, the day ended with work on the review and completion of the course descriptions prepared by the North African partners, in which they detailed the core elements of their courses.

During the fifth and final day of the Summer School, Zvonimir Nevistić (University of Zagreb) first presented the results of the field exercise in Trstenik (Pelješac). The second part of the day focused again on the course descriptions, under the lead of Željko Bačić (University of Zagreb).

The Dubrovnik Summer school was attended by 27 participants on site, with some participants attended particular sessions remotely. The training materials from the training sessions were made available via the SEED4NA collaboration platform, through which also the detailed course descriptions (prepared by the NA partners and reviewed/revised by the EU experts) were made available.

The full programme of the Summer School is presented in table 7.

| **SEED4NA Summer school**<br>**Dubrovnik (CRO), May 9th – 13th, 2022**<br>**Location: University of Zagreb Centre for Advanced Academic Studies, Don Frane Bulića 4, Dubrovnik** |
|---|
| **Monday, May 9th** |
| **S1 09:00 - 10:00**<br>**Welcome addresses & Introduction – Chair Zvonimir Nevistić** |
| • University of Zagreb – Ana Tokić, Centre for Advanced academic Studies<br>• University of Zagreb – Vesna Poslončec-Petrić - GEOF Team leader<br>• KU Leuven – Glenn Vancauwenberghe – Project coordinator<br>• Summer school technical instructions – Iva Cibilić, GEOF event organizer |
| Coffee break 10:00-10:30 |
| **S2 10:30 - 12:45**<br>1st case training: SDI establishment – Glenn Vancauwenberghe & Lisa Lacroix, KU Leuven |
| Lunch break 12:45-14:00 |
| **S3 14.00 - 15.30**<br>1st case training: SDI establishment – Glenn Vancauwenberghe & Lisa Lacroix - KU Leuven |
| Pause 15:30-15:45 |
| **S4 15:45 - 17.15**<br>2nd case training: Drone usage -introduction – Zvonimir Nevistić, UNIZG |
| 17: 30 Welcome reception in CAAS Atrium |
| **Tuesday, May 10th** |
| **S5 09:00 - 10:30**<br>WP2 Curriculum design – common and individual project courses / basic and applicative parts – Carsten Kessler, HSBO |
| Coffee break 10:30-11:00 |
| **S6 10:30 - 12:45**<br>4th case training - AI for EO - GIS applications – Mahdi Khodadadzadeh, U Twente (online) |
| Lunch break 12:45-14:00 |
| **S7 14.00 - 15.30**<br>3rd case training – Spatial Data Science - Carsten Kessler, HSBO |
| Pause 15:30-15:45 |
| **S8 15:45 - 17.15**<br>3rd case training – Spatial Data Science - Carsten Kessler, HSBO |
| **Wednesday, May 11th** |
| **09:00 - 18:00**<br>Networking and 2nd case training – Drone usage – practical part (Zvonimir Nevistić) + sightseeing Pelješac peninsula (Ston walls, Trstenik) |
| **Thursday, May 12th** |
| **S9 09:00 - 10:30**<br>4th case training - AI for EO - GIS applications - Lucas de Oto, U Twente |
| Coffee break 10:30-11:00 |
| **S10 11:00 - 12:45**<br>WP6 – management meeting - Glenn Vancauwenberghe - KU Leuven |

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| Lunch break 12:45-14:00 |
| **S11 14:00 - 15:30**<br>WP6 – management meeting - Glenn Vancauwenberghe - KU Leuven |
| Pause 15:30-15:45 |
| **S12 15:45 - 17:15**<br>WP2 Curriculum design – courses descriptions review and finalization – Željko Bačić, UNIZG |
| 20:00 Joint dinner – restaurant Orhan |
| **Friday, May 13th** |
| **S13 09:00 - 10:30**<br>2nd case training: Drone usage -image processing – Zvonimir Nevistić, UNIZG |
| Coffee break 10:30-11:00 |
| **S14 11:00 - 12:00**<br>WP2 Curriculum design – courses descriptions review and finalization – Željko Bačić, UNIZG |
| 12:00-12:45 FREE |
| Lunch break 12:45-14:00 |
| 14:00 - 15:30 FREE |
| **S15 15:30 - 17:00**<br>WP2 Curriculum design – Spare session with UNIZG team and Anders Östman about Curriculum design |

*Table 7 Programme of the SEED4NA Summer School*

# 6. National trainings

In addition to the SEED4NA training targeting the entire consortium, and the NA partners in particular, also some more dedicated trainings took place, targeting the skills and training needs of particular partners. In this section, we briefly present these so-called national trainings.

## 6.1. SPIDER Summer School

In identifying potential topics for national trainings to be designed and implemented, several partners expressed a need for more training about SDI, and especially the latest trends and developments related to SDIs. In the context of the Erasmus+ Strategic Partnership SPIDER, in which several of the European SEED4NA partners were collaborating, a SPIDER Summer School On Open SDI was organized in Zagreb from 22 to 26 August 2022. Together with two other leading universities in SDI education in Europe, the SEED4NA partners UNIZG, KU Leuven, and Bochum University of Applied Sciences, provided a set of active teaching practices on SDI and related topics during the Summer School.

Two SEED4NA partner organisations expressed an interest for more training on SDI, in order to increase their knowledge on and understanding of key developments and trends in the development and implementation of SDIs, which will help them in revising and improving their own SDI courses: University Oran 1 – Ahmen Ben Bella (Algeria) and University of Ibn Zhor Agadir (Morocco). From each of these universities, two staff members participated in the Summer School on Open SDI, together with other students and experts from the SPIDER consortium members.

The main goal of SPIDER was to introduce new trends and innovations in teaching and learning which should lead to better knowledge acquisition and higher competences of the students for the job market. The Open SDI Summer School was designed as an event to present the methodology and content developed through several project phases related to new topics and new teaching and learning methods in open SDI education. The Summer School introduced participants into the concept and state-of-the-art of open SDI and related data with topics ranging from fundamentals to technical and non-technical characteristics. Besides learning the theory, participants worked on practical assignments. Working in groups with people from different backgrounds and under mentoring of experts helped them understand better the new concepts and to get insight into the problem from different perspective.

| **Day 1, Monday 22th August 2022: "Welcome and introduction"** |
|---|
| 9:00 – 10:30 Introduction to Summer School (Carsten Kessler, Hrvoje Tomić, Željko Bačić) |
| 10:30 – 11:00 Coffee break |
| 11:00 – 12:30 Introduction to the concept of open SDI. Lecture & role play (Bastiaan van Loenen) |
| 12:30 – 14:30 Lunch break |
| 13:30 – 14:30 Introduction to assignments. Showcase (Carsten Kessler) |
| 14:30 – 16:00 Student project definition. Group discussion |
| 16:00 – 16:30 Student project proposal. Presentation |

| **Day 2, Tuesday 23th August 2022: "Assessing status of Croatian Open SDI"** |
|---|
| 9:00 – 10:30 Finding open datasets in Croatia: how easy and how open? (Željko Bačić) |
| 10:30 – 11:00 Coffee break |
| 11:00 – 12:30 Crowdsourced noise map: Collecting data yourself. Lecture & exercise (Vesna Poslončec Petrić) |
| 12:30 – 13:30 Lunch break |
| 13:30 – 16:30 Work on student projects. Research |
| 16:30 – 17:00 Work on student projects. Status presentation |
| **Day 3, Wednesday 24th August 2022: "Open technologies"** |
| 9:00 – 10:30 Interoperability and interface standards + QGIS demonstration. Quiz & Exercise (Ali Mansourian, Carsten Kessler) |
| 10:30 – 11:00 Coffee break |
| 11:00 – 12:30 Encoding standards and semantics. Exercise & discussion (Carsten Kessler) |
| 12:30 – 13:30 Lunch break |
| 14:00 - Excursion |
| **Day 4: Thursday 25th August 2022 "Open participation"** |
| 9:00 – 10:30 User needs through co-creation. Lecture & Serious game (Cesar Casiano Flores, Glenn Vancauwenberghe |
| 10:30 – 11:00 Coffee break |
| 11:00 – 12:30 How ethically sound is your solution to the problem? Lecture & open discussion (Stefano Calzati) |
| 12:30 – 13:30 Lunch break |
| 13:30 – 17:00 Work on student projects. Research & status presentation |
| **Day 5: Friday 26th August 2022 "Open SDI Day"** |
| 9:00 – 10:30 Work on student projects. Research |
| 10:30 – 11:00 Coffee break |
| 11:00 – 12:30 Work on student projects. Finalizing |
| 12:30 – 13:30 Lunch break |
| 14:00 – 17:00 European Open SDI Day. SPIDER hybrid event |
| 15:30 – 16:30 Student projects presentations |

*Table 8 Programme of the SPIDER Summer School on Open SDI*

## 6.2. National training Algeria

The University of Sciences and Technology Houari Boumediene (USTHB), one of the two Algerian partners involved in the project, proposed a training programme dedicated to the needs of the teachers and staff members of their organisations. The training programme, which focused on topics related to space geodesy, cartographic synthesis, GIS & data analysis and remote sensing, was developed and implemented by the team from the University of Zagreb.

The training itself was held at the Faculty of Electrical engineering (FGE) of USTHB from 23 to 26 October 2022. The main purpose of training was to support Algerian partner universities in the adoption of new/modernized courses to develop internal capacities to use purchased equipment and teach the courses.

The training started on Day 1 with a welcome by the Dean of the FGE followed by the Vice-Rector of and the USTHB local coordinator of the SEED4NA project. The first session on 23rd October 2022 was on the general topic of 'Space Geodesy & Cartographic Synthesis'. Prof. Željko Bačić introduced first the SEED4NA project aims, the Algiers training objectives and its program, and provided an overview of UNIZG activities and the members involved in the project. Afterwards, the course focused on 1) classification of satellites and orbits, 2) GNSS Principles and Basics. Prof. Vesna Poslončec-Petrić presented the second session on the general topic « GIS & Data Analysis ». The course about Augmented Reality (AR)– Theory & Application introduced first the visualization of AR and its devices, then provided the AR applications (education, tourism, indoor navigation, etc.). Next sessions were related to first topic and presented by Marijan Grgić, PhD, were dedicated to 1) Satellite Altimetry: Principles and Basics Mean sea level determination, and 2) Satellite Gravimetry: Principles and Basics, Space gravity missions (CHAMP, GRACE and GOCE), Gravity field recovery approaches.

During the second training day on October 24th, 2022, Prof. Željko Bačić finished with first topic and provided sessions on 1) Measurement errors, measurement combination, mathematical models, and 2) Sensor integration - INS/GNSS device. Prof. Vesna Poslončec-Petrić closed the second topic and provided two sessions related to 1) Noise mapping & visualization – theory & exercise, and 2) Noise mapping & visualization –exercise & processing. The participants had the opportunity to realize a practical work to generate a voluntary noise map of the USTHB University.

The third and fourth training days on October 25th-26th, 2022, were dedicated to theoretical and practical sessions on RS imagery presented by Prof. Andrija Krtalić (UNIZG). The theory sessions were about 1) spectroscopy, 2) digital images, 3) spectral indices, and 4) spatial interpretation. Each session was followed by a practical session.

The training was attended by about 50 participants coming from the USTHB (teachers and PhD students) as well as from two other SEED4NA partners (UROAN1 and Fayoum University).

All materials from the trainings were made available within the SEED4NA project consortium, via the collaboration platform.

| **Day 1 – 23 October 2022** | | |
|---|---|---|
| 09:00 – 10:30 | S1 | **Course: Space Geodesy & Cartographic Synthesis**<br>Presenter: Željko Bačić<br>• Classification of satellites, orbits<br>• GNSS Principles and Basics |

| | | |
|---|---|---|
| 10:30 – 11:00 | Group photo & Coffee break | |
| 11:00 – 12:30 | S2 | **Course: GIS & data analysis**<br>Presenter: Vesna Poslončec-Petrić<br>• Augmented reality – theory & application |
| 12:30 – 13:30 | Lunch break | |
| 13:30 – 15:00 | S3 | **Course: Space Geodesy & Cartographic Synthesis**<br>Presenter: Marijan Grgić<br>• Satellite Gravimetry: Principles and Basics<br>• Space gravity missions (CHAMP, GRACE and GOCE)<br>• Gravity field recovery approaches |
| 15:00 – 15:30 | Coffee break | |
| 15:30 – 17:00 | S4 | **Course: Space Geodesy & Cartographic Synthesis**<br>Presenter: Marijan Grgić<br>• Satellite Gravimetry: Principles and Basics<br>• Space gravity missions (CHAMP, GRACE and GOCE)<br>• Gravity field recovery approachs |
| **Day 2 – 24 October 2022** | | |
| 09:00 – 10:30 | S5 | **Course: Space Geodesy & Cartographic Synthesis**<br>Presenter: Željko Bačić<br>• Positioning modes (absolute, relative, startic and kinematic)<br>• GNSS error sources<br>Post processing |
| 10:30 – 11:00 | Group photo & Coffee break | |
| 11:00 – 12:30 | S6 | **Course: GIS & data analysis**<br>Presenter: Vesna Poslončec-Petrić<br>• Noise mapping & visualization – theory & exercise |
| 12:30 – 13:30 | Lunch break | |
| 13:30 – 15:00 | S7 | **Course: GIS & data analysis**<br>Presenter: Vesna Poslončec-Petrić<br>• Noise mapping & visualization –exercise & processing |
| 15:00 – 15:30 | Coffee break | |
| 15:30 – 17:00 | S8 | **Course: GIS & data analysis**<br>Presenter: Željko Bačić<br>• Sensor integration in geominformatics for GIS modelling & analysis |
| **Day 3 – 25 October 2022** | | |
| 09:00 – 10:30 | S9 | **Course: Remote Sensing, Remote Sensing & GIS**<br>Presenter: Andrija Krtalić<br>• Spectroscopy |
| 10:30 – 11:00 | Group photo & Coffee break | |

| | | |
|---|---|---|
| 11:00 – 12:30 | S1 0 | **Course: Remote Sensing, Remote Sensing & GIS**<br>Presenter: Andrija Krtalić<br>• Spectroscopy - Exercises |
| 12:30 – 13:30 | Lunch break | |
| 13:30 – 15:00 | S1 1 | **Course: Remote Sensing, Remote Sensing & GIS**<br>Presenter: Andrija Krtalić<br>• Digital Images |
| 15:00 – 15:30 | Coffee break | |
| 15:30 – 17:00 | S1 2 | **Course: Remote Sensing, Remote Sensing & GIS**<br>Presenter: Andrija Krtalić<br>• Digital Images - Exercises |
| **Day 4 – 26 October 2022** | | |
| 09:00 – 10:30 | S1 3 | **Course: Remote Sensing, Remote Sensing & GIS**<br>Presenter: Andrija Krtalić<br>• Spectral Indices |
| 10:30 – 11:00 | Group photo & Coffee break | |
| 11:00 – 12:30 | S1 4 | **Course: Remote Sensing, Remote Sensing & GIS**<br>Presenter: Andrija Krtalić<br>• Spectral Indices - Exercises |
| 12:30 – 13:30 | Lunch break | |
| 13:30 – 15:00 | S1 5 | **Course: Remote Sensing, Remote Sensing & GIS**<br>Presenter: Andrija Krtalić<br>• Spatial Interpretation |
| 15:00 – 16:00 | Coffee break | |
| 15:30 – 17:00 | S1 6 | **Course: Remote Sensing, Remote Sensing & GIS**<br>Presenter: Andrija Krtalić<br>• Spatial Interpretation - Exercises |

## 6.3. Short trainings

Finally, also some shorter training sessions, focused on very specific topics should be mentioned, as they were provided at the request of specific partners.

During the project meeting in Agadir (September 11-15, 2022), dedicated trainings on 'Noise Mapping' and 'Drones to support the monitoring of citrus trees' were provided by University of Zagreb.

As part of the Workshop on Earth Observation and Geospatial Information: Education and Research Perspectives organised at the University of Oran1 Ahmed Ben Bella on 27-29 May 2023, training was provided on smart sensors, solutions & cities and problem based learning by the University of Zagreb and on advanced spatial databases & pedagogical approaches and instructional design for teaching GI by University of Twente.

During the project meeting in Enschede (June 2023), the University of Twente provided trainings on 'Big Geo Data processing' and 'Teaching materials for SDI'.

# 7. Conclusions

The SEED4NA Training Programme was an important component of the project, as it provided the teachers at the partner organisations with the knowledge, skills and competencies required for developing and implementing high-quality education on SDI and EO.

Training was provided to these teachers – but also to other interested stakeholders - via a comprehensive, multi-faceted training program, consisting of several online and in-person trainings, and covering both the fundamentals of SDI/EO and more advanced topics. Through the training programme, more than 50 teachers and researchers at the eight partner universities significantly improved their knowledge about and skills in teaching and practice on SDI, EO and related topics. In total more than 250 stakeholders from one of the four partner countries (Egypt, Algeria, Morocco and Tunisia) participated in one of the SEED4NA training activities, which were an important element in the dissemination strategy of the project.

The training programme covered various key topics related to SDI and EO, and focused on the theoretical, practical and educational aspects of SDI and EO. Participants were not only introduced into the fundamentals and advanced aspects of SDI and EO, but were also trained in how to teach about these in an effective manner. Educational approaches such as active teaching, constructive alignment and problem-based learning were promoted and applied to the design and implementation of SDI/EO education. The training also looked into SDI/EO as solutions to practical challenges in different domains, such as urban planning, agriculture and water management.

The COVID-19 pandemic demanded for a more flexible and responsive approach for designing and offering the training programme, in line with the training plan as proposed in the project proposal but also meeting the demands and needs from the partner organisations. At the same time, it promoted the implementation of online training methods, which allowed to open the training to a broader group of stakeholders, including practitioners, researchers and students. In this way, the impact of the training programme went much beyond the original expectations. It's direct impact can be seen in the preparation of new teaching practices and materials by the teachers participating in the trainings, and the variety of SDI/EO courses and lectures introduced at the partner organisations.