GEO-ICTs FOR GOOD: A MOOC ON GISCIENCE FOR CLIMATE JUSTICE

D. Codato[1]*, C. Tha[2], S. E. Pappalardo[1], F. Peroni[1], F. Facchinelli[1], E. Crescini[1], M. De Marchi[1]

[1] Jean Monnet Centre of Excellence on Climate Justice, Department of Civil, Environmental and Architectural Engineering, University of Padova, Padova, Italy – (daniele.codato, salvatore.pappalardo, francesca.peroni, francesco.facchinelli, edoardo.crescini, massimo.de-marchi)@unipd.it

[2] Advanced Master on GIScience and Unmanned System for the integrated management of the territory and the natural resources, Department of Civil, Environmental and Architectural Engineering, University of Padova, Padova, Italy – cristina.tha92@gmail.com

Commission IV, WG IV/4

KEY WORDS: Geo-ICTs, Climate Justice, MOOC, open-source, GIScience, Climate Change

ABSTRACT:

The last two decades have seen the development and diffusion of new technologies that can help in managing geographic information. This has led to a proliferation of grassroots processes for exploring, creating and sharing geographical data as a way for citizens to take part in decision making in different kinds of processes.
However, these ongoing processes are facing technological, cognitive and economic barriers. Universities with the use of open-source geospatial information and communication technologies (Geo-ICTs) should be the primary actors in supporting students and citizens in developing their own spatial thinking and abilities in a more effective and engaging way.
In this framework, the Jean Monnet Centre of Excellence on Climate Justice (University of Padova) is developing the massive open online course (MOOC) 'GIScience for Climate Justice', here with the use of open-source and freeware Geo-ICTs that will be freely available for all before the end of 2022.
By completing the MOOC, students will learn how to increase their knowledge of climate change and climate justice issues autonomously. Practical activities will improve their skills in obtaining and using geodata and information produced by European institutions, which can lead to them producing and sharing their own data and preparing and managing collaborative projects for sustainability and environmental monitoring.
In this contribution, the theoretical background and entire methodology for the preparation and dissemination of the MOOC are presented and discussed, with the aim of disseminating and sharing this experience to actors interested in developing similar activities of using Geo-ICTs for good.

1. INTRODUCTION

1.1 Geo-ICTs for a Good Education

The last two decades have seen the development and diffusion of new technologies and digital ecosystems for managing geographic data, including smartphones, GPS, drones and open-access satellites, on the one hand, and web 4.0, GIS, WebGIS, geo-app and georeferenced data, both open-source or proprietary, on the other hand. This great variety of tools, accompanied by the sharing of new digital knowledge and skills, has made the creation and management of spatial information much more accessible than before.
This phenomenon has led to a proliferation of grassroots practices for exploring, creating and sharing geographical data. Citizens assume the role of neogeographers or prosumers, becoming active actors in volunteered geographic information and citizen science actions while taking part in decision making related to territorial, environmental and climate change issues (Pristeri et al, 2019, Haklay and Francis, 2018, See et al., 2016).
However, these ongoing processes are facing technological, cognitive and economic barriers. To enhance geographical learning, universities can use open-source geospatial information and communication technologies (Geo-ICTs), hence becoming the primary actors in supporting students and citizens in developing their own spatial thinking and abilities while helping them in overcoming the digital divide in a more effective and engaging way (Käyhkö et al., 2021). This issue is also noted in Sustainable Development Goal (SDG) 4 of United Nations as 'to ensure quality, inclusive and equitable education and promote lifelong learning opportunities for all'. Moreover, many universities have signed the Higher Education Sustainability Initiative (HESI) to integrate the concepts of sustainable development into their curricula (De Marchi et al., 2019). In Italy, all universities have to meet the 'third mission' demanding universities to interact outside the campus, here in its sociocultural sphere, as a way to reach civil society to increase its cultural and educational welfare (Gambazza and Morazzoni, 2019).
Nowadays, universities have different pedagogical and ICT tools responding to this call for interaction with society. Among others, one of the most promising is massive online open courses (MOOCs). MOOCs can be defined as online distance courses that are accessible to anyone with an internet connection. Therefore, the acronym contains all the main characteristics of this innovative ICT tool, that is, to be massive for all users, offering different possibilities of interaction between them; open, being shared and sometimes editable by those enrolled; and to be completed autonomously online, often with flexible registration (Delgado-Algarra et al., 2019, Belgiu et al., 2015). MOOCs have found widespread diffusion in recent years: since 2012, with the creation of platforms dedicated to MOOCs and supported by universities such as Coursera or Edx Project and together with ICTs in general because of COVID19 lockdowns and the

* Corresponding author

increasing demand for distance learning solutions (Delgado-Algarra, et al., 2019; Käyhkö et al., 2021; Kienast et al., 2020). The offer of MOOCs is wide and concerns various issues of interest such as geography, GIS, Remote Sensing and open geodata (Belgiu et al., 2015, Bill et al., 2020, Ferrario et al., 2019), and socio-environmental and sustainable development issues (Delgado-Algarra et al., 2019). Recently, in the climate change debate, MOOCs have also been recognised as key educational tools that can help improve climate literacy (Ferrari-Lagos et al., 2020, Senevirathne et al., 2022, Otto et al., 2019). Besides courses on climate change science, sustainability and SDGs, adaptation, mitigation and resilience strategies, these online programmes increasingly must include essential aspects related to the promotion of active eco-citizenship on the issue of climate justice. This means opening space for reflections about fair transitions; providing new tools to understand climate change from the perspective of justice; focusing on human rights and glocal responsibilities by protecting the rights of the most vulnerable people; and sharing the burdens and benefits of climate change and its impacts equitably and fairly.
However, the development of successful MOOCs still must consider challenges such as issues related to the online-delayed modality, which could impede the learning process when compared with traditional face-to-face teaching, and the completion rate, which is quite lower compared with the enrolment rate (Azevedo and Morais Marques, 2017, Kienast et al., 2020).

1.2 Europe, Civil Society and the Climate Challenge

In 2019, the European Parliament declared a 'climate emergency', recognising climate change as a major threat to the earth and human well-being (European Parliament, 2019). Through the Green Deal (2019), the European Union (EU) set out a new ambitious strategy aiming that by 2050, Europe will be the first carbon-neutral continent by implementing decarbonisation and energy transition policies and green technologies. It aims to enhance its natural capital and protect the health of citizens from climate-related impacts (European Commission, 2019). The role of climate justice from the perspective of civil society in the EU is also highlighted by the European Economic and Social Committee (EESC), which includes human rights and responsibility for climate change among the most vulnerable people (EESC, 2017). Recently, the goals for a climate-neutral, green, fair and social Europe were included in the four priorities in the Strategic Agenda 2019–2024 (European Council, 2019). Moreover, in January 2020, the roadmap for implementing the first European 'Climate Law' was launched by the European Commission (European Commission, 2020). Some actions to promote climate justice for the dialogue between academy and society and policy makers have been addressed, including the carbon footprint and unburnable carbon concepts, the EU policies and the value of climate-related ecosystem services and local mitigation/compensation measures. However, the integration in national policies of climate-related social issues such as justice and human rights still need to be strengthened and reinforced, which includes the involvement of educational institutions, local and state-level policy makers and different actors from civil society. From the grassroots side, various organisations from civil society like the Friday for Future Network, Climate Justice Now and Extinction Rebellion are active in the area of climate justice, carrying out different actions, demonstrations and projects, often criticising the unsustainable economic system (The Lancet Planetary Health, 2022). Supporting these efforts and increasing citizens' awareness about climate change–related issues through educational lifelong learning activities can improve individuals' critical thinking, active participation and the ability as 'public opinion' to place pressure on policymakers and private companies (Otto et al., 2019, Delgado-Algarra et al., 2019). At the same time, a better understanding of EU efforts for environmental and human rights protection and a better knowledge and ability of using the vast amount of (geo)data produced and available for free can improve citizen's confidence in this institution. Hence, exploring new possible pathways for a fair energy transition and making citizens aware of the added value of applying climate justice in various domestic policies is paramount at any level of society.

1.3 The Centre of Excellence on Climate Justice and its MOOCs

This framework also involves the Department of Civil, Environmental and Architectural Engineering of the University of Padova (Italy), with its Jean Monnet Centre of Excellence on Climate Justice (hereafter CoE, Jean Monnet Erasmus+ project 2021–2023), which is led by the research group 'Climate Change, Territories, Diversities' (https://www.climate-justice.earth/). For 10 years, this research group has led a cross-cutting teaching and research programme on climate justice. The interdisciplinary research is based on investigating the criteria for decarbonisation and fair energy transition policies, focusing on the fossil fuel supply side by adopting concepts such as 'unburnable carbon', that is, oil and gas that should be left underground according to different (geographical) criteria, to protect human rights and biodiversity (Codato et al., 2019). Moreover, since 2015, the academic activities of the research group have included the development of an advanced master in 'GIScience and Unmanned System for the Integrated Management of the Territory and the Natural Resources' (De Marchi et al., 2016), which increases the expertise of the members of the group concerning GIS and open-source software teaching and their network of actors involved in the Italian GFOSS (Geographic Free and Open-Source Software) association. The creation of the CoE is a natural evolution of the activities of the research group, with the ambitious aim to respond to the need to bring the issues of climate justice and just transition from the EU Green Deal framework into the dialogue among the academic world, society and policy makers, focusing on a geographical perspective. To do this, the centre is carrying out different research, communicational and didactical activities, among which include the development of two complementary MOOCs: the first one is called 'Climate Change and Adaptations in Ecosystems and Societies' and runs for about 48 hours; this course aims to set the theoretical basis about the climate change debate and policies at the international, European and national (Italy) levels, such as adaptation, mitigation and resilience strategies, impacts on socioecological systems, supply- and demand-side policies, actors involved and best practices related to climate justice and just transition, among others. The second (about 24 hours) is called 'GIScience for Climate Justice' (hereafter called MOOC on GIScience) and will develop more practical lessons with a learning-by-doing approach, integrating the concepts presented in the first MOOC with open-source and freeware Geo-ICTs. The MOOC on GIScience will be a sort of toolbox for students, teachers and civil society in general, showing 1) how to autonomously update and increase their knowledge on climate change and climate justice issues, in particular at the European and national (Italy) levels; 2) how to create, obtain and use (geographical and not) information and data; and 3) how to prepare and manage collaborative projects under the umbrella of citizen science and volunteered geographic information for sustainability and environmental monitoring. Both MOOCs will be freely available for all (only registration is required) before the end of 2022 in the Moodle platform of the University of Padova:

https://unipd.link/climatejusticemoocs.
In the current article, the theoretical background, the entire methodology and workflow process for the preparation and dissemination of the MOOC on GIScience is presented and discussed, with the aim of disseminating and sharing this experience to actors interested in developing similar activities of using Geo-ICTs for good.

2. MOOC ON GISCIENCE STRUCTURE

2.1 The Ideas Behind

Maps have strong communicative and visual power, but they are two faces of the same coin: on the one side, they can be used to give power to control and for propaganda, but on the other side, they can become a useful tool to empower citizens and minorities in their grassroots social and environmental fights (Crampton, 2010). The MOOC is being created within the framework of academic and civil society efforts to keep the dialogue about climate-related social issues active. It is a trial to answer the educational need to empower citizens' spatial thinking and abilities. As mentioned in the introduction, nowadays, citizens have the role of neogeographers, but most of the time, they do not have or have basic geographical and informatic knowledge; thus, GIS technical courses might be too advanced for them.
The first idea behind this MOOC is to provide people with affordable and useful tools and technologies to collect environmental and social data and create maps that can give a voice to their rights and fight to be able to influence decision-making processes. The second is to connect citizens to European institutions working on environmental and climate change issues, producing and sharing valuable (geo)data and (geo)information. In fact, because of various factors (lack of trust, difficulty in finding information, communication channels that do not adequately reach the target audience, etc.), petabytes of remote sensing imagery and spatial and statistical data, which are provided for free through very user-friendly platforms, are not known or not exploited to their full potential. This represents a further obstacle to the possibility of cooperation between institutions (at least those engaged in socioenvironmental issues) and citizens. Adequate educational and communicative tools could help close this gap, thereby increasing synergies for climate justice and a just transition.
The innovative and relevant aspect of this MOOC is the improvement of skills related to the data management cycle (from data collection to data management, visualisation and return) concerning climate change and climate justice issues, focusing on collaborative processes and open-source technologies so that people without any GIS knowledge background could autonomously collect, share and provide geographical, environmental and social data.

2.2 General Structure

The MOOC is structured in five (more one) modules (see Figure 1), answering fundamental questions concerning the use of GIScience for climate change–related issues, such as the following: Where can I get (geo)data? How can I produce my own data for collaborative and citizen science projects? How can I consult, visualise and share maps and data on the web? Each module is thought to have the first part dedicated to people without any GIS knowledge, and the second part requires a basic GIS background (how to import data in QGIS, knowledge about vectors and raster format, how to customise symbology, etc.). Moreover, the MOOC will be a dynamic tool where modules can be implemented and other modules can be created and added, according to the user's feedback. In the following, an explanation of the contents of each module is provided.

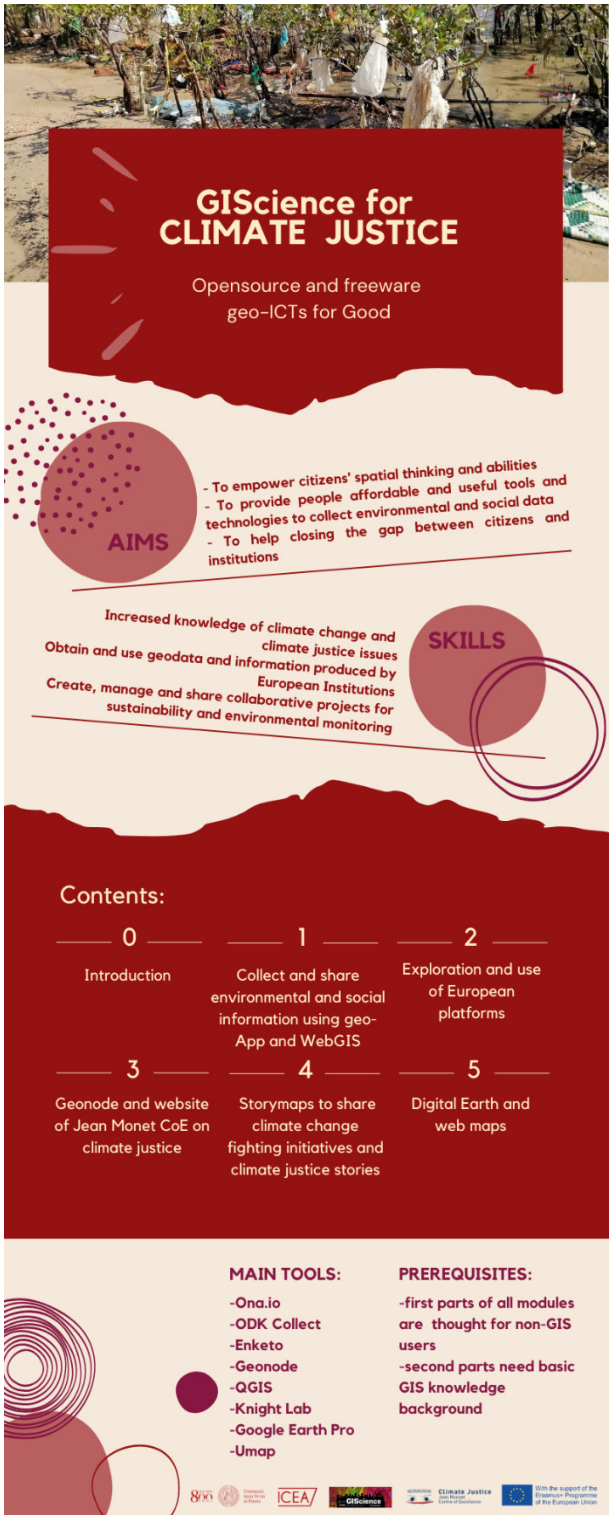

Figure 1. Draft of the graphical abstract of the entire MOOC on GIScience.

Module -1 – User guide.
General instructions about how to use the Moodle platform, the MOOC and the two forums that are available for interactions among participants and among users and MOOC providers.
Module 0 – Introduction to the general structure of the MOOC.

This part contains a graphical abstract with the content of each module, summary of teaching hours and skills developed are provided. This is accompanied by an introductory video that connects topics covered by the first MOOC 'Climate Change and Adaptations in Ecosystems and Societies' to the role of GIS when applied to climate justice issues. It is recommended, but not mandatory, to previously attend the other MOOC and consult it for any more in-depth information related to climate change.

Module 1 – Collect and share environmental and social information using geo-App and WebGIS.

The aim of this module is to provide user-friendly tools to facilitate participatory geodata collection and teach how to design and manage collaborative projects with different field applications, from environmental monitoring to social fight empowerment.

After a brief theoretical introduction on field data collection, participatory mapping projects and a presentation of available open-source and freeware tools and platforms, here starting from a specific case study, students will practice and learn how to use the ONA platform (https://ona.io/home/) and design questionnaires with its Form Builder, including how to collect georeferenced data with ODK Collect Android App and Enketo webform, how to visualise and export data from the ONA platform and how to import them in QGIS.

Module 2 – Exploration and use of European platforms.

The aim of this module is to provide an overview of the main European and, in some cases, national platforms and atlas for where to look for and get data related to environmental and social issues, focusing on data quality and reliability. Attendees will learn new open-data repositories as a source for their research. Moreover, attention is given to the importance of contributing to open-access platforms and spreading and sharing ground information.

The first part of the module focuses on user-friendly platforms that allow users to browse georeferenced data and customise a map with thematic layers, while the second part focuses on platforms where it is possible to download vectors and satellite data. A space is given to collaborative platforms for both nontechnical and GIS users. Among others, particular attention is given to the Eurostat, INSPIRE and Copernicus geo-platforms and to the Italian national geoportal.

Module 3 – Geonode and website of Jean Monet CoE on Climate Justice.

This module explains the importance of creating an online collaborative space and spreading and sharing geographical information related to specific topics. The main focus is the Jean Monet CoE website and Geonode (https://research.climate-justice.earth/). Students will learn what the open-source Geonode project is and how to browse layers and create maps in this open geospatial content management system; more advanced users will learn how to create and upload layers and maps from QGIS to Geonode and to edit metadata and download data from Geonode. The module also explores the Climate Justice Atlas and its collection of climate justice best practices as an example of a collaborative approach to collect and share data.

Module 4 – Storymaps to share climate change fighting initiatives and climate justice stories.

To highlight the communicative power of maps, this module explores the use of storymaps coupled with storytelling methodologies as visual tools to share and return data, to tell the evolution of the processes and fights as geographical stories. Students will learn how to create and share a storymap using two tools: the storymaps function included in the Geonode of the CoE and the storymaps free tool (https://storymap.knightlab.com/) provided by the Northwestern University Knight Lab. Students will be asked to create a new story or pick one of the maps created in previous modules, either with QGIS or with one of the open geo-platforms presented, and to use it as a frame to give voice to actions related to environmental and social issues, starting from data included in their map.

Module 5 – Digital Earth and web maps

The aim of the module is to explore the functions of Google Earth Pro (https://www.google.com/earth/about/) and the OpenStreetMap project Umap (https://umap.openstreetmap.fr/it/), as tools to visualise and create data and maps and to explore geographic spaces. Students will learn how to upload data created with ONA in Module 1 or with QGIS or downloaded from other geo-platforms in Module 2. Moreover, they will learn how to create georeferenced geometries, to make measurements, to run diachronic analyses using satellite images and to customise and share their own maps.

2.3 Road Map and Tools

The teaching methodology leans on challenge-based learning and the learning-by-doing approach (Tucci et al., 2020). Through the case study presented at the beginning of each module, students will be asked to solve different real-life challenges related to climate change and climate justice issues. To solve each challenge, they have to put into practice the concepts and tools explained within each chapter of the module. This methodology will help students better assimilate concepts and procedures.

The MOOC has a simple and repetitive structure. Each module presents three elements:

- the introduction, where a graphical abstract of the module, specific case study and video with the introduction of the main topic are provided;
- single chapters where explanation of topics, procedures and exercises are provided; and
- deliverables with dedicated space where students are asked to upload the deliverables produced during the exercises of the module. Moreover, a self-evaluation quiz is provided.

The graphical abstract has the same structure for all the modules, including the aims, skills developed within the module, prerequisites and a summary of the contents of each chapter and of the tools used. At the beginning of the module, a specific case study is provided. This is used as the starting point for all explanations and exercises. A case study has to be a real example that students can apply in their context to try to solve the environmental problems that surround them. The general structure of the MOOC is organised so that the deliverables produced in previous modules can be used as inputs for the exercise of the next ones, even if this is not mandatory, leaving users the decision of what to complete and in what order.

Interactions between enrolled students and between students and the providers of the MOOC have aligned the MOOC to between two forms recognized in literature: xMOOCs (self-managed, without interactions between students) and cMOOCs (different degrees of interactions such as virtual collaborative learning) (Delgado-Algarra et al., 2019, Azevedo and Morais Marques, 2017). In fact, it is thought as a self-made course that a user can enjoy anytime, deciding which modules to complete based on one's interests and whether to carry out a self-evaluation or not; but there will also be two kinds of forums, one to communicate with the providers of the MOOC and the other for interactions between users, especially in the case of training for civil society groups.

In addition, there is also the possibility of applying for a certificate of completion provided by the CoE (Open Badge). In this case, the student must complete all the modules, and it will be verified based on the completion of the requested deliverables. Moreover, during its development, each module will be tested with selected students, and feedback will used to improve it.

A single chapter of each module includes the following:

- one or two short videos of explanation, maximum ten minutes, during which students are guided step by step to develop the exercise to reach the goal of the case study;
- one task in PDF format, where all the steps shown in the video are summarised with screenshots, schemes and short text explanations; and
- supplementary materials in PDF format, which include links to websites, scientific papers or relevant readings related to the topic of the chapter/module.

All technological tools used to create the MOOC and the ones explained within the course are open-source or freeware software (Figure 2). The selection of the tools listed in Figure 2 is based on their stability, maturity, community-based support and user-friendly interface. On the other hand, Windows 10 is used in the videos because of most users' familiarity with this operating system. The hosting of the MOOC in the University Moodle platform will guarantee easier use for most students who already familiar with it, moreover a simple user guide will be available. Moreover, the centre will provide the server space to use the Geonode platform and its storymaps tool.

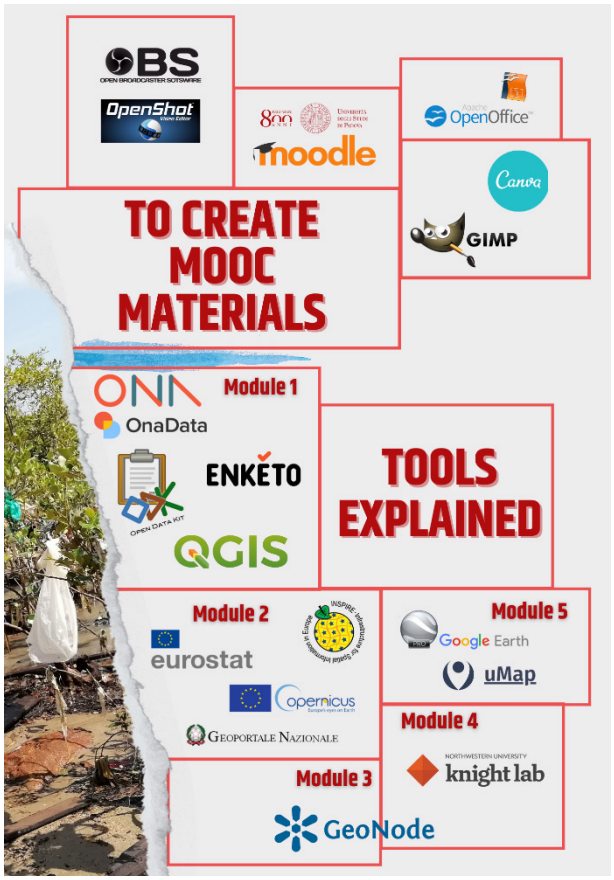

Figure 2. Draft of the figure presenting the tools of the MOOC on GIScience.

For the first version of the course, the Italian population is the target; therefore, to facilitate the learning process, the language used is Italian. However, all materials, including the written text of the voice of the videos, are thought to be easily editable and translatable to other languages, such as English and Spanish. In this way, it will be possible to prepare other editions of the same MOOC in a short time, making it available to most people of other nationalities.

Finally, it is worth mentioning the communication strategy, which is essential to spread the presence of this novel opportunity of distance learning and reach as many interested actors as possible. A proper campaign will be set-up, and all communication channels of the CoE will be used to publicise the MOOC (both MOOCs), such as social networks (Facebook, Twitter, Instagram, etc.), the newsletter and the website of the Centre. Moreover, partners, collaborators and the University of Padova will be involved with their communication channels.

3. AN EXAMPLE: MODULE 1

In this chapter, we provide an example of a module and its structure. The title of this module is 'Collect and Share Environmental and Social Information Using geo-App and WebGIS'

3.1 Introduction and case study

Have you ever asked yourself how to collect your group data directly in a unique database while you are in the field? Or how to involve a group of people or citizens in the collection of information related to problems or peculiarities of their own areas? To do so, you do not need a complex tool; you just need a server to aggregate data (ONA platform, chapter 1.1), a properly structured questionnaire (ONA Form Builder, chapter 1.2) and a user-friendly application to collect data when in the field (ODK Collect, chapter 1.3). In this module, we investigate open-source tools that satisfy these requirements and that allow you to easily design and organise your collaborative data collection. Once you have these concepts and mechanisms, you can apply them to different types of contexts, from monitoring to citizen science actions to providing support and validation for your own social fight.

Before the beginning of the module, a short theoretical background and following case study are introduced (chapter 1.0):

'The association that you are a part of has decided to begin a process of participatory mapping to locate the most degraded areas in your city from an environmental perspective. The aim is to create a tool that citizens can easily use to report single cases and produce data that they can use to put pressure on public administration so that these administrations can plan the priority of interventions according to the environmental decline and social context.

The previous month, the spokesperson of each suburb met in a public meeting and decided the type of data that must be collected with the questionnaire and how to categorise different items. The following data need to be collected: geolocation, date, user code, level of urbanisation, type of decline, extent of decline, picture and free comment.

You are asked to create the questionnaire, that citizens must be able to access it through the ODK Collect app or through webform.

Following the steps shown within each chapter of this module, build the questionnaire using the ONA platform and set up the type of questions that better respond to your aim.'

3.2 Structure and contents

Like all other modules, this one will be accessible to non-GIS users from chapter 1.1 to 1.4 and part of 1.5, while the other parts (1.5 and 1.6) will be dedicated to GIS users.

1.1 – Settings to begin with mobile data collection—server registration.

To collect your collective data in a unique database, you need to register to a platform that provides free server space for your database. In this chapter, the ONA platform is explored. In particular, the following is explained: how to register to the platform, creating your own account and setting up your profile; how to create new projects and how to set visibility and sharing options (what private/public projects are, how to add collaborators and set their limitations). Moreover, importance is given to consultation with the ONA user guide. In supplementary materials, links to the ONA and ONA help centre are provided, along with links to other similar tools such as Kobotoolbox, QField and ODK Central.

1.2 – Create your data collection form.

There are two possible ways to create a questionnaire in ONA: building an .xls file or with the help of ONA Form Builder or other similar user-friendly tools. The first one is not analysed in this chapter, but in the supplementary materials, the link to XLSForm and to the summary of possible widgets can be found. The latter is the focus of this chapter. The video shows how to create new forms, how to add and edit questions and how to add skip logic options. For the most common types of questions (such as single and multiple choice, geo-points, range, rating, taking pictures, etc.), practical examples are provided. The video also shows all the essential steps to build a questionnaire that tries to respond to the aim expressed in the case study. In supplementary material, there are links to other similar tools such as Kobotolbox Form Builder, ODK Build XForm and Enketo. Also, a file that summarises all types of widgets in Enketo is available.

1.3 – Collect data in the field through webforms and mobile apps.

Once you have created your questionnaire, it is time to go into the field. The first step is to download the app ODK Collect on your device; then, the video explains how to connect to the server that hosts the questionnaire, how to edit settings about display, form management, user interface and identity and how to download, fill and send finalised forms. Moreover, the chapter also highlights the possibility of filling out the form through the Enketo webform. In the supplementary materials, links to explanations on how to change the base map or add an offline one are provided.

1.4 – Back from the field: aggregate and visualise collected data.

While different contributors are collecting and uploading data through ODK Collect or the webform, you can start visualising the data in ONA. The video guides you through an overview of the form, where you can check submissions and downloads; then, it shows how to visualise and aggregate data in ONA WebGIS, how to run basic statistics and create charts and how to obtain a graphical report assembling a dashboard.

1.5 – Download your data.

If you would like to run further and more in-depth analyses, this chapter explains how to download data and compare the different formats available. In particular, it focuses on .xls, .kml and .csv formats, how to open them and how to visualise and edit data.

1.6 – Import data in GIS and customise.

As with the previous one, this chapter is for GIS users. It shows how to upload data from the database in ONA to QGIS, how to aggregate data and customise the symbology and how to add a base map and check data in the attribute table.

3.3 Deliverables and self-evaluation

At the end of the module, you are asked to upload the outputs of the exercises that you have completed. The upload is mandatory only if you want to get a certificate of completion.

In particular, the deliverables to be uploaded are as follows:

- file .xls of the form
- file .pdf with the link to the webform you created
- file .kml or file .csv with the data collected through your form

Moreover, other information and self-evaluation form (not mandatory) will be available.

4. CONCLUSIONS

Climate change and climate justice issues have an intrinsic spatial component, respecting the geographical rule that 'place matters'. When coupled with GIScience literacy conveyed through MOOCs and the use of Geo-ICTs, climate literacy can be very effective in improving knowledge, critical thinking and practical abilities, hence supporting citizens as active protagonists of policies and projects. In its efforts against climate change, the EU has remarked on the importance of (lifelong) learning opportunities and citizens' involvement (European Commission, 2022); moreover, several European institutions are committed to the production of data and information to improve sustainable decision-making processes.

The Jean Monnet Centre of Excellence on Climate Justice recognises these priorities and is dedicating several efforts to prepare two MOOCs, one related to the theoretical basis of climate change issues and the other to the practical use of GIScience tools and methodologies for climate justice. These two MOOCs, which will be available before the end of 2022, are complementary, but they can also be completed separately. In the current article, we have focused on the MOOC on GIScience for Climate Justice, presenting the design process and general structure, showing a module example and highlighting the use of geo-ITC and open-source and freeware software.

MOOCs are not just recorded courses offered online by universities: they have a specific pedagogical design and learning structure based on theoretical references and operational guidelines to be effective. The development of the MOOC on GIScience takes into account the teaching expertise of the research group, feedback from selected students and members of civil society groups and the suggestions available in literature. In particular, Azevedo and Morais Marques (2017) recognise the different factors for a successful MOOC: the focus on topics of interest and both climate and GIScience can be considered 'hot subjects', capturing a wide audience; the attention for the quality of the resources used is important for MOOC preparation, dissemination and the geotools taught in the modules; interactions and feedback during the learning process are given through two forums; the availability and organisation of the content will be kept simple and user-friendly; and the 'timing' is considered, here with the possibility for each user to enrol and complete the MOOC or part of it according to their own needs. To all these factors, we should add the communication strategy, which is as important as the same MOOC. A communication campaign will be designed to effectively reach the possible interested audience, here by using all available channels of the Centre of Excellence and its partners and allies.

Finally, another important aspect planned for the upcoming years is the MOOC's sustainability and updates, which have been guaranteed thanks to the presence of the Centre of Excellence; the use of the Moodle platform of the University of Padova; the modules based on well-developed and stable open-source and freeware software with a strong community behind them; and the European portals developed by consolidated EU institutions.

ACKNOWLEDGEMENTS

We are grateful for the financial support from the "Climate Justice Jean Monnet Centre of Excellence" co-financed by

Erasmus + Programme of the European Union, call for proposals EAC/A02/2019 – Jean Monnet Activities; Decision number 620401; Project number: 620401-EPP-1-2020-1-IT-EPPJMO-CoE. Our thanks also for the organizational support to the Advanced Master on GIScience and Unmanned System for the integrated management of the territory and the natural resources, Department of Civil, Environmental and Architectural Engineering, University of Padova.

REFERENCES

Azevedo, J., Marques, M.M., 2017: MOOC success factors: Proposal of an analysis framework. *Journal of Information Technology Education: Innovations in Practice*, 16, 233-251. doi.org/10.28945/3861

Belgiu, M., Strobl, J., Wallentin, G., 2015: Open Geospatial Education. *ISPRS International Journal of Geo-Information,* 4(2), 697–710. doi.org/10.3390/ijgi4020697.

Bill, R., Lorenzen-Zabel, A., Hinz, M., Kalcher, J., Pfeiffer, A., Brosowski, A., Aberle, H., Hovenbitzer, M., Meinel, G., Sikder, S., Herold, H., 2020: Opengeoedu - a massive open online course on using open geodata. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences,* 5(5), 31–38. doi.org/10.5194/isprs-annals-V-5-2020-31-2020.

Codato, D., Pappalardo, S.E., Diantini, A., Ferrarese, F., Gianoli, F., De Marchi, M., 2019: Oil production, biodiversity conservation and indigenous territories: Towards geographical criteria for unburnable carbon areas in the Amazon rainforest. *Applied Geography*, 102, 28–38. doi.org/10.1016/j.apgeog.2018.12.001.

Crampton, J.W., 2010: Mapping: A Critical Introduction to Cartography and GIS. Wiley-Blackwell, Chicester.

De Marchi, M., Pappalardo, S.E., Codato, D., Gianoli, F., Diantini, A., 2019: Dalla geografia alla GIScience nel contesto accademico italiano: formazione, geo-informazione e sistemi a pilotaggio remoto. In: Salvadori, F. (Eds.), *Atti del XXXII Congresso Geografico Italiano – L'apporto della Geografia tra rivoluzioni e riforme*. A.Ge.I, Roma.

De Marchi, M., Pappalardo, S.E., Codato, D., Diantini, A., 2016: Learning Environment for GIScience in the Era of Flying Robot. *Third European SCGIS Conference 'Geoinformation technologies for natural and cultural heritage conservation', 156-165.*

Delgado-Algarra, E.J., Román Sánchez I.M., Ordóñez Olmedo, E., Lorca-Marín, A.A., 2019: International MOOC Trends in Citizenship, Participation and Sustainability: Analysis of Technical, Didactic and Content Dimensions. *Sustainability,* 11(20), 5860. doi.org/10.3390/su11205860.

European Commission, 2019: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: The European Green Deal, COM(2019) 640 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN (Accessed on May 25th, 2022).

European Commission, 2020: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: *European Climate Law,* COM(2020) 80 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52008DC0030 (Accessed on May 25th, 2022).

European Commission, 2022: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: *Proposal for a Council Recommendation on learning for environmental sustainability*, COM(2022) 11 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0011 (Accessed on May 25th, 2022).

European Council, 2019: Communication from the Council to the European Parliament, the Commission, the European Economic and Social Committee and the Committee of the Regions: *2019-2024 EU Strategic Agenda*. https://www.consilium.europa.eu/media/39914/a-new-strategic-agenda-2019-2024.pdf (Accessed on May 25th, 2022).

EESC, 2017: Communication from Plenary Assembly: Climate Justice (own-initiative opinion), NAT/712 – EESC-2017. https://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/climate-justice-own-initiative-opinion (Accessed on May 25th, 2022).

European Parliament, 2019: Communication from the European Parliament to the European Commission, the Council, the European Economic and Social Committee and the Committee of the Regions: *European Parliament resolution of 28 November 2019 on the climate and environment emergency,* P9_TA(2019)0078. https://www.europarl.europa.eu/doceo/document/TA-9-2019-0078_EN.html (Accessed on May 25th, 2022).

Ferrari-Lagos, E., Martínez-Abad F., Ruíz C., 2020: The Importance of Motivation and Communication in MOOCs as Elements to Increase Completion Rates: A Study at MOOCs on Climate Change. In Eighth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'20). Association for Computing Machinery, New York, 1042–1047. doi.org/10.1145/3434780.3436633.

Ferrario, C., Crocitto L., Codato, D., Pappalardo, S., Peroni, F., De Marchi, M., 2019: Un MOOC sui GIS per i docenti universitari. Esperienza del progetto My Geo. *Atti XXIII Conferenza Nazionale ASITA*, 497-506, ISBN: 978-88-941232-5-8.

Gambazza G., Morazzoni M., 2019: Terza missione, università e comunità di riferimento: il caso di Milano. In: Salvadori, F. (Eds.), *Atti del XXXII Congresso Geografico Italiano – L'apporto della Geografia tra rivoluzioni e riforme*. A.Ge.I, Roma.

Haklay, M., Francis, L., 2018: Participatory GIS and community-based citizen science for environmental justice action, in: Chakraborty, J., Walker, G., Holifield, R. (Eds.), *The Routledge Handbook of Environmental Justice*. Routledge, Abingdon, 297–308.

Käyhkö, N., Mbise, M., Ngereja, Z., Makame, M.O., Mauya, E., Matto, G., Timonen-Kallio, E., Rancken, R., 2021: Social innovations in geo-ict education at tanzanian universities for improved employability (geoict4e). *Int. Arch. Photogramm.*

Remote Sens. Spatial Inf. Sci., XLVI-4/W2-2021, 83–89. doi.org/10.5194/isprs-archives-XLVI-4-W2-2021-83-2021.

Kienast, F., Gosteli, S., Thomas, C., Edwards, T.C.Jr., Martius, G., 2020: Lessons Learned from the First Worldwide Accessible E-Learning in Landscape Ecology. *Landscape Online* 83, 1–14. doi.org/10.3097/LO.202083.

Otto, D., Caeiro, S., Nicolau, P., Disterheft, A., Teixeira, A., Becker, S., Bollmann, A., Kirsten, S., 2019: Can MOOCs Empower People to Critically Think about Climate Change? A Learning Outcome Based Comparison of Two MOOCs. *Journal of Cleaner Production*, 222, 12–21. doi.org/10.1016/j.jclepro.2019.02.190.

Pristeri, G., Peroni, F., Codato, D., Pappalardo, S.E., Crescini, E., De Marchi, M., 2019: Geografia urbana e partecipazione nell'era digitale: tre esperienze a Padova tra GIScience e VGI. *Bollettino dell'Associazione Italiana di Cartografia*, 166, 62–76. doi.org/10.13137/2282-572X/30189.

See L., Mooney, P., Foody, G., Bastin, L., Comber, A., Estima, J., Fritz, S., Kerle, N., Jiang, B., Laakso, M., Liu, H-Y., Milcinski, G., Nikšic, M., Painho, M., Podör, A., Olteanu-Raimond, A-M., Rutzinger, M. 2016: Crowdsourcing, Citizen Science or Volunteered Geographic Information? The Current State of Crowdsourced Geographic Information. *ISPRS International Journal of Geo-Information*, 5(5), 55-77. doi.org/10.3390/ijgi5050055.

Senevirathne, M., Amaratunga D., Haigh R., Kumer D., Kaklauskas A., 2022: A Common Framework for MOOC Curricular Development in Climate Change Education - Findings and Adaptations under the BECK Project for Higher Education Institutions in Europe and Asia. *Progress in Disaster Science*, 14:100222. doi.org/10.1016/j.pdisas.2022.100222.

The Lancet Planetary Health, 2022: Walking the talk? *The Lancet Planetary Health*, 6(5), e380. doi.org/10.1016/S2542-5196(22)00099-7.

Tucci, G., Parisi, E.I., Bonora, V., Fiorini, L., Conti, A., Corongiu, M., Ortiz-Sanz, J.P., Gil-Docampo, M., Rego-Sanmartin, T., Arza-García, M., 2020: Improving quality and inclusive education on photogrammetry: new teaching approaches and multimedia supporting materials. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives*, 43(B5), 257–264. doi.org/10.5194/isprs-archives-XLIII-B5-2020-257-2020.