

IS-ENES3 Milestone M3.2

Evaluation of the IS-ENES3 online Autumn School ‘Climate data use for impact assessments’ 4 November -11 December 2020

Authors: Judith Klostermann, Janette Bessembinder

Reviewers: Sophie Morellon, Sylvie Joussaume

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ABSTRACT

In November and December 2020 the IS-ENES3 consortium organized an Autumn School on ‘Climate data use for impact assessments’. In October 2020, 20 participants were selected from a total of 74 applicants. The participants have valued the course highly and especially the work on the case studies, including the support from lecturers with those case studies. All lectures were seen as useful or very useful. The more practical lectures were valued the highest: how to use a data platform; what steps to take in a case study, how to estimate a climate impact with the data and tools that are available, even when the data are not ideal. Some participants would have preferred a live school, others the online version. Online meant a run time of six weeks, so they could spend more time on the case studies. This report evaluates the course and draws lessons for the coming Spring and Summer schools to be organized in 2021.



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1. Objectives

1.1 Context: the IS-ENES3 project

The IS-ENES3 project (Infrastructure for the European Network for Earth System Modelling, 2019 - 2022) is a Horizon 2020 project. It is the third phase of the distributed e-infrastructure of the European Network for Earth System Modelling (ENES). The project fosters collaboration between 22 European climate research institutions. The community aims to develop a better understanding of past, present and future climate. IS-ENES3 projects future variability and changes of the climate through the development and sharing of model components, modelling tools and data infrastructure. The IS-ENES3 three main objectives are to:

- Pursue the integration of the Earth's climate system modelling community and will prepare the sustainability of its infrastructure;
- Foster the common development of models and tools, and the efficient use of HPC;
- Support the exploitation of model data by the Earth system science community, the climate change impact community and the climate service community.

As part of the original project plan, the work package on “Community engagement” (WP3-NA2), Task 2: Training and resources: nurturing the community, the following was planned:

“Schools on the interface between climate and impact models. Climate and impact modelling communities show little overlap, as typical intercomparison experiments concentrate on one of these realms. However, proper climate change impact analysis governed by projections require a good understanding of the propagation of uncertainty, predictability and information content through the chain between climate drivers, climate projections, downscaling activities and impact assessments. Two interdisciplinary schools (1 week each and about 30 persons per school, mo18 and mo30) concentrating on this chain of model assessments with the help of realistic case studies will contribute to building a network of experts that can oversee and connect this chain.”

The first school was originally planned to take place around June 2020. Since the update and restructuring of the Climate4Impact took longer than expected, it was decided in 2019 to postpone it to the autumn of 2020. This first school was planned to take place in Prague in the second half of October 2020. This location was selected because one of our partners in the IS-ENES3 project is located in Prague (Charles University) and because we wanted to attract participants from Eastern Europe especially. Due to the COVID-19 pandemic it was decided in July-August 2020 to convert the 2 physical schools into 3 virtual schools.

30 persons for a virtual climate impact school was considered too much for good interaction with all participants. In order to foster interactions between participants and collaborative work on case studies, we proposed to let them work in pairs of 2 and we decided to have a maximum of 20

persons per school. In order to reach the originally planned 60 persons, it was decided to organize 3 virtual schools.

1.2 Aims and learning objectives of the Autumn School

In November and December 2020 the IS-ENES3 consortium organized a virtual Autumn School ‘Climate data use for impact assessments’. This relates to the third objective of the IS-ENES3 project mentioned above, where also specific emphasis is put on extending the network in Eastern Europe. Researchers from the IS-ENES3 consortium interacted directly with the participants. With this school the IS-ENES3 consortium formulated three aims which were translated to five learning aims for the participants, as listed below.

Aims of the Autumn school

- To make knowledge of the IS-ENES consortium available for future scientists all over Europe;
- To give VIA-researchers (Vulnerability, Impact and Adaptation), climate services providers, etc. basic knowledge for working with climate data
- To enhance interaction between climate scientists and impact researchers.

Learning objectives

- What the advantages and limitations are of the various climate data sources, and consequently, how the various sources can be used and how they cannot be used (Observations (ground observations, satellite, radar, etc.), re-analysis, (sub)seasonal to decadal predictions, climate model projections)
- How climate models work (basic principles, assumptions, required hardware and time...)
- How impact models work, what methods and tools are available (general introduction on types of impact models such as statistical and dynamical models, examples for some sectors)
- Steps required for climate impact studies (quality checks, downscaling, bias adjustments, processing into indices, etc.)
- Challenges for working in inter/transdisciplinary projects, how to create understanding between different types of researchers, demonstrate the value of interaction
- How to assure good quality of climate services
- Learning to understand each other’s way of working to make future cooperation more effective.

This was the first in a series of three IS-ENES Schools on “Climate data for impact assessments”. Applicants who could not be placed in the first School may be placed in the Spring (March-April) or Summer (May-June) schools in 2021.

2. Description of work: Methodology

2.1. Communication on the Autumn school

The workshop was announced on the IS-ENES3 project website (see box for a summary of the text). It was communicated through different channels (twitter, announcements on websites, in newsletters, through personal contacts):

- IS-ENES3 network and networks of the Partners, Climate4Impact
- PANNEX¹ network (through IS-ENES3 partners in Eastern Europe)
- EU-projects networks, websites and twitter: Climateurope², PRIMAVERA³, ICOS RI⁴, Copernicus⁵
- ISlopedia/ISIMIP⁶
- JPI-Climate/ERA4CS⁷, ClimateADAPT⁸, ECCA2021⁹
- Climate-KIC¹⁰, SENSE¹¹
- CLIMLIST¹²

Box: Summary of announcement text

First IS-ENES3 virtual Autumn School on Climate data use for impact assessments

The aim of the School is to help researchers make better use of available climate data and knowledge, in order to produce higher quality research outputs and services. This, in turn, will help to combat and adapt to climate change. Other aims are to develop a network of researchers who can turn to each other in the future for advice and cooperation.

When? The school will be organized as a virtual course **with 2 online sessions during six weeks** (from **Nov. 4th to Dec. 11th, 2020**), combined with self-study and case studies in small groups. Researchers from **the IS-ENES consortium** will interact directly with the participants. The IS-ENES3 consortium is involved in producing the CMIP6 data which will underpin the next IPCC report, expected in 2021-2022. Through the Schools, the IS-ENES consortium intends to make its knowledge available for scientists all over Europe.

¹ sites.google.com/site/projectpannex/home

² www.climateurope.eu/

³ www.primavera-h2020.eu/

⁴ www.icos-cp.eu/

⁵ www.copernicus.eu/en, especially through contact via Copernicus Climate Change Services

⁶ www.isimip.org/; www.isimip.org/isipedia/

⁷ www.jpi-climate.eu/ERA4CS

⁸ climate-adapt.eea.europa.eu/

⁹ www.jpi-climate.eu/ecca2021

¹⁰ www.climate-kic.org/

¹¹ www.sense.nl/

¹² climlist.wku.edu/

The target groups of this virtual School are **climate scientists, Vulnerability, Impact and Adaptation (VIA) researchers and consultants offering climate services**. We aim to create a mix of these different disciplines so that participants can learn from each other. As a result, climate scientists will better understand what kind of outputs VIA researchers need. VIA researchers will learn how to use the products of climate science in an effective and valid way. Participants can be PhD students, Postdocs, professionals and consultants, including climate services providers. An MSc in the natural sciences is required for fruitful participation.

This is the first in a series of three IS-ENES Schools. Applicants who cannot be placed in the first School may be placed in the **Spring** (February-March)¹³ or **Summer** (May-June) schools in **2021**. If the development of the Covid-19 pandemic allows, the case-study work in the schools in 2021 may be converted to a 3-day face-to-face meeting.

(<https://is.enes.org/events/trainings-and-education/first-is-enes-autumn-school-on-climate-data-use-for-impact-and-adaptation-assessments>)

2.2. Target groups and participants

The target groups of this virtual School are climate scientists interested in providing climate services and working with people from other disciplines, Vulnerability, Impact and Adaptation (VIA) researchers and consultants offering climate services. We aimed at creating a mix of these different disciplines so that participants can learn from each other. As a result, climate scientists will better understand what kind of outputs VIA researchers need, while VIA researchers will learn how to use the products of climate science in an effective and valid way. Participants can be PhD students, Postdocs, professionals and consultants, including climate services providers. We considered an MSc in the natural sciences required for fruitful participation.

In total there was room for 20 participants. The number was limited to achieve full commitment of the participants and active participation during the meetings. The application procedure comprised a motivation letter and a CV explaining the applicant's relevant background. There was no fee for participation. IS-ENES wants to reach out especially to Eastern and Southern Europe, so participants from these regions were encouraged to apply.

The selection of participants was done by a selection committee, which consisted of Tomáš Halenka, Vladimir Djurdjevic, Judith Klostermann and Janette Bessembinder. In October 2020, participants were selected from a total of 74 applicants. An application evaluation format was developed based on the following criteria:

- Currently based in Eastern Europe or Southern Europe
- Has an MSc in natural sciences

¹³ This was the original plan, but the spring school now takes place in March-April 2021.

- Good English language level
- CV quality (at least some experience with using climate data)
- Motivation quality (clear aims, interested in impact study/interdisciplinary work)

About 50 of the 74 applicants fulfilled these criteria so we proceeded with selecting a group of 20 participants that would fit well together. We created a group consisting of 10 climate scientists and 10 VIA researchers/climate service providers, who were either advanced beginners or professionals in using climate data. We also focused on those interested in impacts on water, agriculture and/or forestry, and chose a few participants interested in developing climate services. We selected a mix of persons so they could experience what challenges one may encounter when working together. We also took care of the gender balance.

We had 27 applications from outside Europe; 23 from Eastern Europe, 14 from North-western Europe, and 10 from Southern Europe. We selected 14 participants from Eastern Europe; 4 from Southern Europe; and 2 from Northwestern Europe. The applications from outside of Europe may have come in through CLIMLIST and we decided not to use this list for the next round to avoid applicants with little chance for success. Several of the applicants from outside Europe fitted the quality criteria but unfortunately they were not the first target group of the IS-ENES3 project.

2.3. Program of the Autumn School

One of the challenges in the organization of the course is the potential difference between participants in background knowledge on climate data, climate modelling, impact modelling and climate services. Allowing the less experienced participants to gain some additional knowledge, we asked them to prepare for our course by following several online lessons of the User Learning Service (ULS) of the Copernicus Climate Change Service (C3S; uls.climate.copernicus.eu/).

For the VIA-researchers/climate service providers we suggested these lessons to get some basic knowledge on climate data:

- Data resources: introduction
- Data resources: climate models
- Data resources: re-analysis
- Climate change uncertainties
- Data resources: observations (optional)
- Bias correction and downscaling (optional)
- Climate projections (optional)

For the climate scientists we suggested the following lessons on impacts in different sectors:

- Sectoral application: agriculture

10:30-11:30	<ul style="list-style-type: none"> • Further questions and discussion on how to use the presented information for climate impact studies • Wrap-up: what do the participants consider the most important information/messages for their case study and what information is missing? <p>Led by: Judith Klostermann</p>
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Week 2: climate impacts and climate services	
Webinar 3 (9:00-11:30 CET) Wednesday 11th November	
9:00-9:20	Interactive session (wrap up of the preparation material from C3S ULS lessons): Led by: Janette Bessembinder
9:20-10:40	Presentations <ul style="list-style-type: none"> • Rutger Dankers (30 min): approaches used in impact modelling • break (10 min) • Rutger Dankers (20 min): examples of impact studies for water • Vladimir Djurdjevic (20 min): examples of impact studies for agriculture/forestry
10:40-11:30	Further questions and discussion on how to use the presented information for climate impact studies Led by: Judith Klostermann
Webinar 4 (9:00-11:30 CET) Friday 13th November	
9:00 – 9:15	Interactive session on climate services Led by: Janette Bessembinder
9:15 – 10:40	Presentations <ul style="list-style-type: none"> • Rutger Dankers (45 min): Climate services • break (10 min) • Christian Pagé (30 min): landscape of portals, tools with climate data and other data
10:40-11:30	<ul style="list-style-type: none"> • Further questions and discussion on how to use the presented information for climate impact studies • Wrap-up: what do the participants consider the most important information/messages for their case study, work, study and what information is missing? <p>Led by: Judith Klostermann</p>

Week 5: Work on case studies	
Meeting (9:00 – 11:30 CET; optional) Wednesday 2nd and Friday 4th December	
9:00-11:30	Session to answer questions of participants (participants are asked to send in questions as much as possible in advance) A few groups are asked to present some of their ongoing work and to discuss this with the group.

Week 6: Work on case studies and presentations on the case studies	
Meeting (9:00 – 11:30 CET) Wednesday 9th December	
9:00-9:30	Session to answer last questions of participants.
9:30-11:00	Presenting and discussing case studies 1-5
Meeting (9:00 – 11:30 CET) Friday 11th December	
9:00-10:30	Presenting and discussing case studies 6-10
10:30-12:00	Evaluation of the course Handing over the certificates and closing words by Sylvie Jousaume

3. Description of work: Results

This section presents the way we tried to optimize the learning **process** during the course, with special attention to the fact that the whole school was online. The next paragraphs both contain the measures we took beforehand and the measures we learned while we were underway. Regarding the **content** of the course we refer to the learning materials available online: PowerPoint presentations and videos¹⁴.

3.1. Lecturers and presentations

The course lecturers were all from the IS-ENES3 team. Although experienced lecturers can improvise with numerous slides, we wanted to be in control for two reasons: in an online course, the lecturer receives virtually no feedback from the audience if the messages are well-understood; and the lecture is recorded, so for a good quality video the lecture should be well prepared. A lecture should fit in the time frame and have a clear beginning, structure, and end. When revisiting the PowerPoint file, participants should not discover unrepresented slides. The content of the presentations was discussed with all lecturers. Due to limited time the length and exact content of the final presentations could not always be checked. Most presentations from the Autumn school can be re-used directly in the Spring and Summer School, while a few need some shortening or slight adjustments to make them more attractive or usable for the participants. The examples of case studies in week 2 can also be adjusted, depending on the background of the participants.

Interaction between lecturer and participants is important for the learning process, so the lecture itself should not take more than 2/3 of the allocated time. The personal contact with experts is one of the added values of the sessions. If not all questions of the participants can be answered during the session, we emphasized that the remaining questions could be answered during a later session or by e-mail.

An advantage of the online course was that all sessions were recorded and became available before the next session. This gave the participants the option to listen to the presentations and discussions again. In few instances, participants could not join during a session, so they could watch the video and be prepared for the next session.

Although the set of lectures was composed with care, we had not explained the structure to the participants. Because of this, some of the lectures (e.g. the one on standards) may have seemed to have no or little connection with the rest of the presentations for some participants. Standards are

¹⁴ is.enes.org/events/trainings-and-education/first-is-enes-autumn-school-on-climate-data-use-for-impact-and-adaptation-assessments;
www.youtube.com/watch?v=_42ltTQzY30&list=PLFvev1W5vG7NDEZhxObXDd1Bc5rnBpYrk&index=2

very important for how climate data can be exchanged. For the next course we will create a mind map of how the different lectures are connected and present this in the introduction session.

In weeks 4 and 5 a few short lectures/additional explanations were added based on our own informal session evaluations:

- Extra Q&A on the Climate4Impact portal;
- Additional information on other data portals next to C4I: a lecture on the Climate Data Store and the Climate Explorer; and one short lecture on the CDS API;
- Additional session on visualization of results (and pitfalls); also how to deal with journalists/media.

Additional advice for preparing the lectures:

- Always ask a draft presentation and comment on its length, accessibility and attractiveness (illustrations) to avoid overlap between lectures and to safeguard the space for interaction.
- Discourage ‘extra slides because you never know if you need them’. Instead, presenters may provide suggestions for further reading (especially interesting for those who have already a considerable background in certain subjects).
- Make sure the organizers also have a copy of the presentations. In case of technical problems at the presenter side, the host of the virtual meeting can show the presentation.
- Discourage animated slides and pdf-version of the presentations. In case of animated slides the presenter will have to ask the host very often to “go to the next slide”. In case of pdf-versions, the presentation cannot always be presented in an optimal way.

3.2. Climate4Impact website

Christian Pagé showed the current Climate4Impact website and explained access (including the need to create accounts to get access to specific climate data sets) as well as the use of the website. This website was recommended to be used in the case studies. The C4I portal still functions, but is not actively maintained anymore (available time is spent on the new version of the portal). In some cases the portal did not work properly. However, it was arranged that CMIP6 data and data for EUROCORDEX (also bias-adjusted) were available through the C4I portal. We had postponed the course from summer school to autumn school so the new C4I portal might be ready, however, unfortunately the new C4I website was not operational yet at the end of 2020.

Alessandro Spinuso showed the new C4I portal for which the publicly accessible beta version is expected in June 2021. It was helpful to see the website in action, the warning of a large amount of data, the time it took to run the request (15min?) and how it broke down the first time. For now it is accessible to persons who want to be alpha testers; the participants were invited. Janette explained this in an email after the session. One participant offered to be an alpha tester.

Alessandro did some polls to which participants responded in the chat:

- Familiar with Python? 14x no/very little, 2 have some experience. Other languages are used such as R, Fortran, IDL.
- Familiar with Jupyter? 3x yes, 1x just a bit.
- Familiar with Gitlab? 6x no.

We prepared screenshots of how to use C4I portal, so they could see what they should visualize when using it. Also Christian was available for another half hour on Wednesday 2 December to answer questions from the participants, and he provided support during the rest of the time for the case studies. To compensate for the difficulties with C4I, we decided to add information on two other data portals, the Copernicus Climate Data Store¹⁵ (although the CDS does not have CMIP6 data nor CORDEX adjusted data) and the Climate Explorer¹⁶ that was developed at KNMI and is now hosted by WMO. Furthermore, Rutger introduced the CDS API on Friday December 4th.

The case studies showed that many participants had used the C4I, some the CDS, while a few also used the CDO¹⁷ tools to process climate data. Data downloading was successfully performed by all teams. Processing the data was more difficult; online options were not always functioning. CDO is a solution to do it locally; but this is only for those who can program in Python. A limited internet connection can also be a barrier. Tools such as API and CDO take time to get acquainted with, but then processing becomes easier. The CDS Toolbox can be used to play around with datasets and check them before downloading. This can also be done with the C4I portal. Both portals give access to somewhat different climate data sets.

3.3. Case studies

In the case study the information from the lectures could be applied step-by-step. As a first assignment we asked them to write half a page about what impact study they would want to perform in the areas of water, nature, agriculture or forestry; this half page was used to look for combinations of one impact researcher and one climate scientist. We chose to create subgroups of only two persons to maximize each person's involvement as they would be dependent on each other's knowledge. Creating subgroups was a bit of a puzzle based on the proposed case studies; Climate scientists focused more on water, the impact scientists more on agriculture and forestry. We also made matches by combining more experienced with less experienced participants, and by combining participants from different countries. We sent the participants into a breakout session to compare their proposals and decide what case study they would work on together. After the

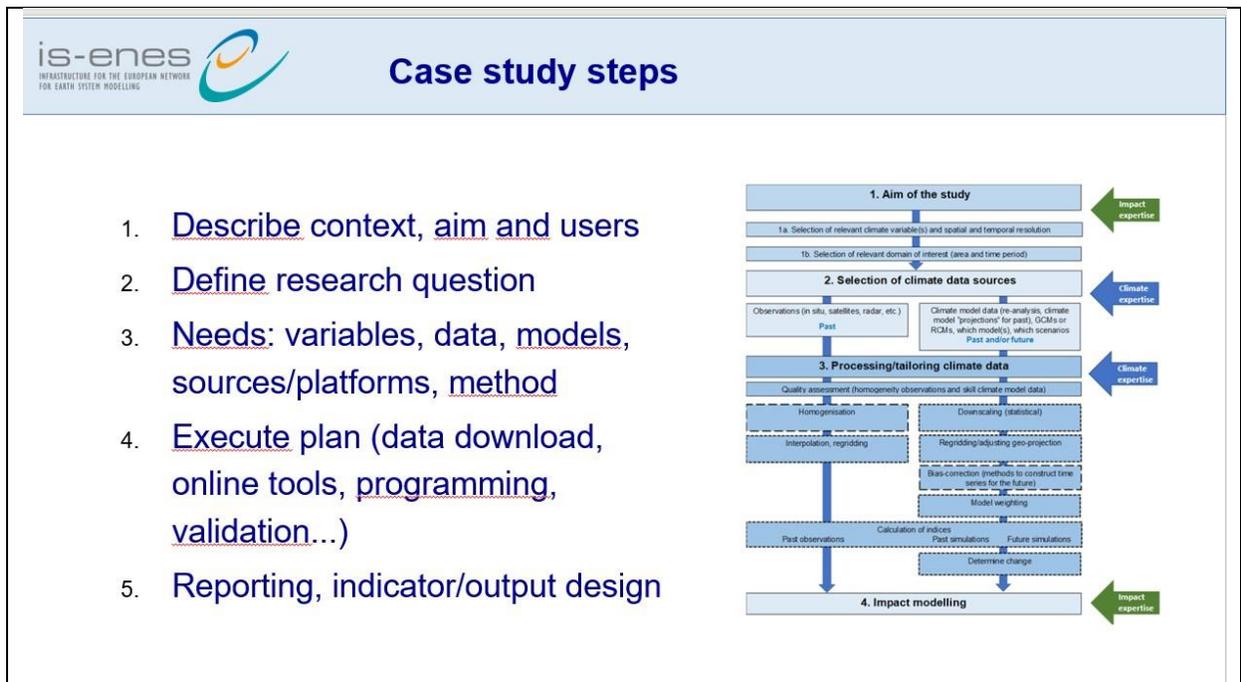
¹⁵ cds.climate.copernicus.eu/

¹⁶ climexp.knmi.nl/start.cgi

¹⁷ code.mpimet.mpg.de/projects/cdo/wiki

breakout session in which the ten groups discussed the potential case study, it seemed to have worked. They all had decided on an idea. Sometimes the idea was too broad, so we had to encourage them to tighten the focus of their topic.

Since case studies can take a lot of time and they had relatively little time available, we tried to indicate what we expected from the case studies and what we did not. The following figure was used for this:



We indicated that we considered it important that they acquire some experience with all the 5 steps mentioned above. The participants regularly had problems limiting their case study to e.g. one climate index, or limiting the number of climate runs that they analyzed. We had to remind them that it was not necessary to do a full case study, but that it was sufficient if they only analyzed one of the relevant climate indices, or only one of the climate models that they had selected for their case study. For the next course we will develop an example of how a case study can be simplified for the purpose of this course.

Four lecturers also participated in the guidance of the case study groups. To lower the threshold for asking questions about the case studies we assigned 2-3 participant groups to each of the four lecturers, based on their expertise on water, agriculture, or forestry.

To keep them involved during the weeks 4 and 5 we communicated that the Wednesdays were optional but they were all expected to be there on the Fridays. This way we could also plan the

additional information sessions on the Fridays. On Wednesday 25th of November we had 12 participants, for example, and on Friday 27th of November we had 14 (someone from each of the 10 case studies). On Friday 4th of December there were 18 participants. In these weeks we asked them to present their ongoing work. Some structure was needed in the open sessions, so going through case studies helped. A break was also needed in those less structured sessions. We kept a record who had presented and asked the others for next time. This was not meant as a control measure, but to encourage to ask for advice and to learn from the other groups; some brave participants set the example for the others so they could experience how that worked. Since we had a mix of less and more experienced participants, this led to participants helping each other. Challenges and questions from one case study were often also interesting for other case studies. Some of the returning questions was how to focus on just one research question or just one index; how to present uncertainties.

Doing a climate impact study involves all kinds of technical aspects and difficult choices related to the data to be used. Lots of data are available, but how to use them properly or make a useful selection? Although a lot of tools and portals are developed for climate and impact data processing and for combining datasets, etc. users still need to do a lot of data processing themselves. People with relatively little background knowledge on climate data and programming may experience many practical problems and it would be a pity if these problems would be too big a challenge and prevent people from arriving at the analysis stage. We hope the case studies showed the participants how to handle and solve certain problems and that the course helped to create a network that they can use in case of problems later on. Impact studies often require expertise from different disciplines, therefore it is advisable to ask for help from other disciplines. Knowing when to ask for advice or help is one of the learning aim of this school.

After each session, the organizers evaluated the session: what went well and what problems were identified. For the problems immediate adaptations were made in the program; for example, additional short lectures; more structured involvement of lecturers in the case studies; and modified instructions for the participants. Based on our experiences during the discussion of the case studies we made the following adjustments in the course:

- We wrote some guidance material on how to choose between climate models and sent it to the participants after November, 25. Although no exact instructions can be given, some advice can be given on what aspects should be taken into account (e.g. relevant time horizon) for selection to present the range of climate change in the future (e.g. to avoid a biased selection).
- The spatial scale of climate models is often too coarse to represent all spatial differences in e.g. mountainous areas. Some advice was provided how participants could deal with that.
- We often encouraged participants to focus on just one type of users instead of a broad range. Each user group may have specific and somewhat different information needs, or

information needs to be presented in a different way to be usable. On the 27th of November we presented additional slides about communication with users of climate services.

- Participants were sharing papers and other links with the group through the chat. These papers and links and also some from the lecturers were collected and shared through the Google Drive for the Autumn school.

By the end of week 5, we were positively surprised by the extent of the work accomplished. The groups all seemed to function. There was also some interaction between groups; they did not hesitate to share their knowledge. The sessions also made clear that there is not one way to do a climate impact study; the method depends on what data is available, what the users want to know and how much time is available for the impact study.

In the last week we planned for 2 sessions with 5 presentations. For each case study we reserved 20 minutes: presentation of maximum 10 minutes and 10 minutes for questions and discussion. The schedule for this was shared relatively late; for the next schools the lecturers as well as the participants should be informed early which case study group has to present on which date. This way the lecturer that provided guidance may be able to attend the session in which the case studies of his/her groups are presented. For the final presentations we provided a format:

- Context, users and user needs;
- What data did you want/ which ones did you select/download (data type (observation, reanalysis...) variable, which model, why);
- What processing did you try? (with/ without bias correction...);
- Graph/ map / result/ draft conclusion.

On the 9th of December 2020 we saw 4 nice case studies and on the 11th the remaining 6 case studies. Their time to do the case study had been limited but most achieved results. Most had followed the advised steps. It was also good to see where people struggled; next time we should ask them for one slide on challenges. All did serious work and they also did it together.

3.4. Facilitation of the virtual sessions

Bringing people together in a face-to-face school was a method for enhancing learning and encouraging networking of the participants, that we took for granted in pre-Covid-19 times. Because we had to rely on virtual means for this course, we took several measures to approach the same kind of commitment and bonding as would have happened in a physical course.

Regarding the content of the lectures we tried to stay in control as was already described in the previous paragraph on the lecturers, because in a virtual session there is no non-verbal feedback from the group to the lecturer. During the lecture sessions we reminded them that the lectures might

have overloaded the participants with information, but that everything could be re-watched in between sessions and that everything would be revisited in the case studies. We asked regularly whether the participants could still follow all the lectures. After the second week we asked explicitly whether the participants found it too difficult / too easy / just about right.

Responses to our question on how the participants had experienced the sessions of 4, 6, 11 and 13 November.

- The most important lesson is about bias corrected data and other practical information on using data according to our questions and also various sources from where we can access that data
- Models selection is 100% clear for me now and a lot of practical info from today
- Same thing, the impact part was new for me.
- The unclear thing is selecting the right model and the data
- The climate services presentation was a very practical description of how to use the climate change data
- One surprising information for me was that the plotting and visualisation of the data play such a big role in understanding by users. Are there any best practices in visualisation the data to be understandable in a right way for end-users?
- Information on bias adjustment was really useful
- ISIMIP for impact studies and portal for adaptive data seems to be very interesting to me
- The unclear part for me is how to use the Climate indices
- I found very useful anything about agriculture (...). Bias corrections are very useful for my thesis too
- The presentations and discussions helped me to make clear several aspects in almost all lectures - standards, statistical downscaling, impact modelling, climate services. All the lectures were clear and very useful!
- I think most important to have an efficient communication between the climate scientist/climate services and the users. To provide a documentation about the procedure of the file and result creating. Understand each other's needs.
- I find it very important to know about uncertainties and cautions in climate models, and that choice must also be performed based on the specific impact goal.
- I now know various data sources and tools to access climate for impact studies which is quite beneficial
- Success stories from impact models and climate services is missing.
- By the way, all lessons were useful, so thank you very much!

We took several measures to enhance interaction, because otherwise the aim of networking would have not been achieved. A first measure was to limit the number of participants. A smaller group often results in more interaction, while participants can become invisible in a larger group. We let them cooperate in groups of 2 for the case studies. We took care of combining participants with a lot of expertise in climate data or impact studies with participants with less experience and we also

tried to take their interests into account (while also diverse in gender and nationality). We encouraged full participation in the sessions: appreciating it when they notified us beforehand of any class they could not join (the participants received about 2 weeks before the start the confirmation, and a few already had appointments that they could not change); checking presence during sessions and sending a friendly inquiry after the session if someone was absent; encouraging those who were absent for one session to watch the recordings (we stopped with this from the third week onwards). All 20 participants completed the course.

We started each session with an interactive part: questions about ‘homework’; other questions prepared by us, and an open questions round. We explicitly discussed and encouraged interaction between the participants (not only between participants and lecturers) during the sessions and in emails to: “We enjoyed seeing that you participated actively and that you also started answering each other’s questions!” We formulated ‘asking for help’ as an explicit learning aim. We also emphasized that for impact studies, expertise from different persons is needed and that they should try to use each other’s knowledge. For sufficient interaction between participants it is important that lecturers do not give comments directly, but allow the participants to take the floor.

We encouraged participants to tell about their own experiences (e.g. on experiences with communication, with processing of data), and especially those things that did not go well. This way they could experience that others have similar experiences, or that participants can learn a lot from sharing experiences. We tried to create a safe environment for sharing by giving the example and share our own previous experiences about having doubts on what to do and solving problems.

We made an extra effort to encourage informality (which would have come about naturally in a face-to-face week). We asked participants to put on their camera during the discussions so they could get to know each other. We had informal intermezzo’s like the ‘name game’ in the first session (everyone tells a short narrative about their own name). Another time we made pictures outside of our windows and discussed the weather and the landscape; we made a group picture based on screenshots and made it available on the Drive. For next time, we may invite them to tell us some news about the impact of climate change in their country, for example, based on a picture, graph or website. In a live course, breaks are forced on the group by a catering arrangement; in virtual courses they tend to be forgotten or skipped. However, sufficient breaks are needed for effective learning so 10min breaks were programmed roughly after 1 or 1,5 hours.

Webex was chosen as the online meeting tool, because KNMI has an account and it allows for recording the sessions. It worked well. To be sure the recording started on time we put a physical reminder on our desk to start and stop the recording e.g. a sheet of paper over the keyboard. Because of Webex problems we could not record the session on the 2nd of December (due to storage problems for the recording at KNMI). To retain some memory we made a number of screenshots

during the session. Next time we will check whether there is enough storage capacity to make recordings (at KNMI).

Some people (temporarily) located outside of Europe suffered from connection problems (no sound, connection breaking up etc.). Sometimes we had to rely on the chat function for communication. A good connection may be a criterion to be considered in the selection of participants. For the presentation of the case studies it is also advisable if the course organizers (with better connection) receive the PowerPoint and share the screen, instead of the participants themselves. The case study PowerPoint files tend to be rather big with all the graphs and illustrations.

Due to the fact that the course was virtual, we used some extra technical options that actually had an added value and may be an idea for face-to-face courses as well:

- We encouraged the use of the chat function for participants to raise questions, respond to each other or provide tips and references. Because the chat function is less visible when sharing a screen, one person would lead the session, while another watched the chat and warned the session leader if necessary
- A shared folder was opened on Google Drive where all course items could be shared: ppt presentations, session recordings, written assignments, and the previous chat discussion in a cleaned up version.

We invited the participants to use the shared folder for working on the case studies together.

3.5. Wrap-up of the course

During the last virtual meeting we had an oral evaluation round. We also announced an online list of evaluation questions, asking everyone to fill it after the last session. For the detailed results of both evaluations see Annexes 1 and 2.

Help was offered with their further work on the case studies after the course is over; lecturers could still answer questions and involve others from IS-ENES. We proposed a follow up meeting 2 months later to see what happened with the case studies. There was potential in the case studies, we might push them to put some further work in it, and publish something on the IS-ENES website or newsletter. Some of the case studies may also become an inspiration for constructing notebooks for the new C4I portal.

At the start of the course we had asked if they would appreciate a certificate and more than half of the participants were interested. Therefore, we produced certificates for the whole group with the help of Sylvie Joussaume and Sophie Morellon. Before making the certificate we asked specifically what name they wanted on the certificate.

No goodbye drinks are possible in an online course, but we still wanted to do something special during the final session on Friday the 11th of December. We asked Sylvie for a short speech, and invited Sophie as well. Sophie sent the certificates that morning. After the speech we asked them to check their email and show the certificate on their screen. Some informal closure (“goodbye drinks”) together with the groups would have been good for the contacts among the participants and to create a network, especially since working together and having two sessions a week during 6 weeks was rather intensive.

3.6. Evaluation of the course by the participants

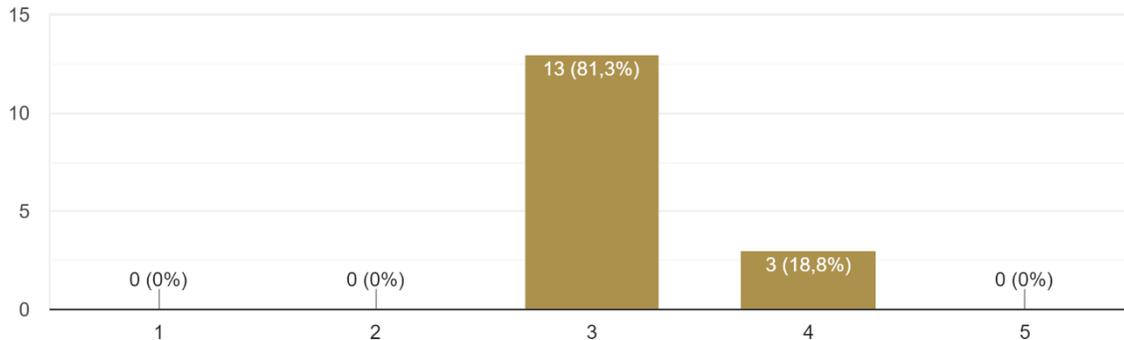
The online evaluation results are presented in Annex 1. They show that the participants have valued the course highly and especially the work on the case studies, including the support from lecturers with those case studies. All lectures were seen as useful or very useful. The more practical lectures were valued the highest: how to use a data platform; what steps to take in a case study, how to estimate a climate impact with the data and tools that are available, even when the data or tools are not ideal.

An important evaluation result is how well the course fitted the participants. The outcome shows that we scored what we wanted: the course was not too easy, and not too difficult for the majority of participants. The good fit was due to a thorough selection procedure on one side (aiming for advanced beginners to proficient users and not for true beginners), and an optimal amount of assistance during the course on the other side. This assistance came not only from dedicated lecturers, but also from the participants among each other. Helping each other was actively encouraged during the course.

Figure 1: Was the school too easy (1), too difficult (5), or just about right (3)?

2. The Autumn School was:

16 antwoorden



The results of the oral evaluation round at the end of the last meeting is shown in Annex 2. A summary of the results: Some participants would have preferred a physical course at location, others the online version. Online meant a run time of six weeks, so they could spend more time on the case studies. The case studies were now limited to the 2person groups. Had it been at location/face to face, they could have cooperated more fluidly in larger groups. We also could have left the formation of case study groups to the participants; with a kind of market. Recording of sessions was an advantage, because they could watch later if needed. With live sessions a video recording is less likely or of poorer quality. The chat also added value that one would not have in a face-to-face course.

3.7. Time investment and costs

We want to reflect briefly on the investment of time and money for an online course relative to a course at location. For participants we estimate that time investment has not been that much more compared to a 1-week course at location. The overall time investment we calculated was 56 hours, including some hours for preparation through ULS lessons, the sessions themselves and about 20 hours for the case study for each participant. Some participants indicated that they invested more time in the case study, since it was divided over 3 weeks. Some indicated that the case study work was difficult to combine with their normal work or study, especially in the busy month of December.

For lecturers we think the virtual course took less time, since they did not need travelling time. For those that helped with the case studies the additional time spent by participants may have led to spending a little more time on assisting the participants.

For the organizers it took more time compared with a 1-week course at location, because we needed to think through the consequences of a virtual school. We had also spent quite some time on

selecting a location in Prague that now became obsolete. Another effect is that we now organize three instead of 2 schools to arrive at the intended number of 60 participants.

Dealing with the recordings took much time. For this we were assisted by Sophie.

The costs of the school became less because there were no travel costs for the participants, no hotel costs or catering costs for the IS-ENES3 project.

4. Difficulties overcome

The original aim was 30 participants in a group at location for one week, and to organize such a school twice (once in Eastern, and once in Southern Europe). Due to Covid-19 the Autumn school was organized as a virtual course with 2 online sessions during six weeks, combined with self-study and case studies in small groups. The number of participants was limited to 20 in order to create a committed group. To achieve the aim of 60 participants, the virtual school will be organized three times. In the selection of participants, applicants from Eastern and Southern Europe will be given priority in all three schools.

In the Autumn course the existing C4I portal was not actively maintained anymore while the new version was not yet operational. For the Spring school, this will still be the case. Maybe for the Summer school there is the possibility that the new portal will be available. To compensate we offered some lectures explaining the Climate Data Store and the Climate Explorer so the participants had more options. We also had an additional Q&A session on the C4I portal to support the participants. When the new C4I portal will become available we can organize separate webinars or short workshops and inform the participants of the schools on “Climate data use for impact assessments” on this.

All difficulties, big or small, were solved thanks to the enthusiastic help by everyone involved from the consortium.

5. Next steps

A follow-up meeting of one half day will be organized 2 months after the Autumn school (February 26, 2021). This will give participants the opportunity to continue the work on their case studies and discuss the results in the group once more.

Based on the feedback of the participants we may also organize some additional webinars or short workshops. We are making preparations for training webinars on bias-adjustments and the ESMValTool.

The results from this evaluation of the Autumn course are used to improve the Spring and Summer schools (preparations started in the beginning of January 2021).

The Spring and Summer schools will be organized in a similar way. Only a few adaptations are needed because the participants valued the course highly as it was. These changes comprise:

- Changes in three or four of the lectures that were either too long or were not valued as highly useful (although interesting);
- Show the connections between the different lectures in the introduction lecture.
- Explain more clearly what we expect from the participants during the case studies and monitor more closely whether they spend too much time on certain steps.

Annex 1: Results of the evaluation survey of the Autumn school

The Autumn school ended on the 11th of December, 2020. On the 14th of December, all 20 participants received an invitation to fill in an evaluation survey with 15 questions. 16 of them answered the questions. The results are shown below. We can conclude that the Autumn school was appreciated very much; that most of the learning aims were achieved; and that a small majority would have preferred a live course over an online course, but that participants also saw some advantages of a virtual course.

Intro: You participated in the IS-ENES3 Autumn School 'Climate data use for impact assessments' from November 4th, 2020 until December 11th, 2020. Through this survey we would like to receive your evaluation of this course and suggestions how we might improve it for the Spring School in 2021.

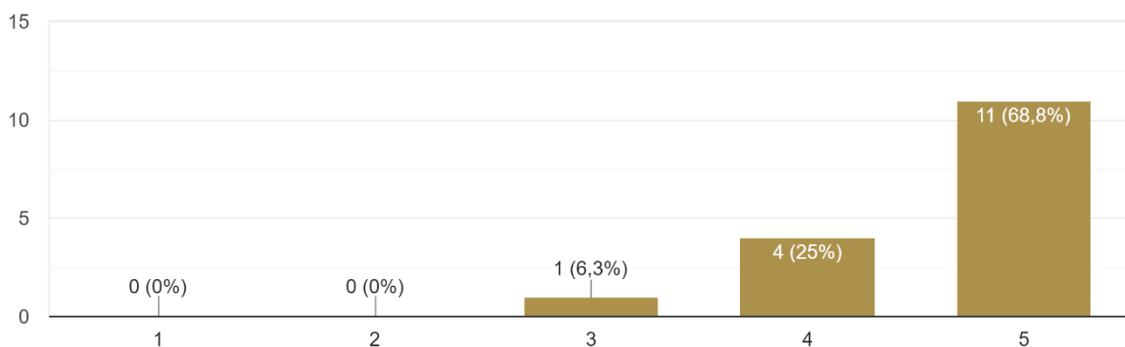
*Mandatory question

1. What is your overall rating for this course? *

Bad quality 1 – 2 – 3 – 4 - 5 Good quality

1. What is your overall rating for this course?

16 antwoorden

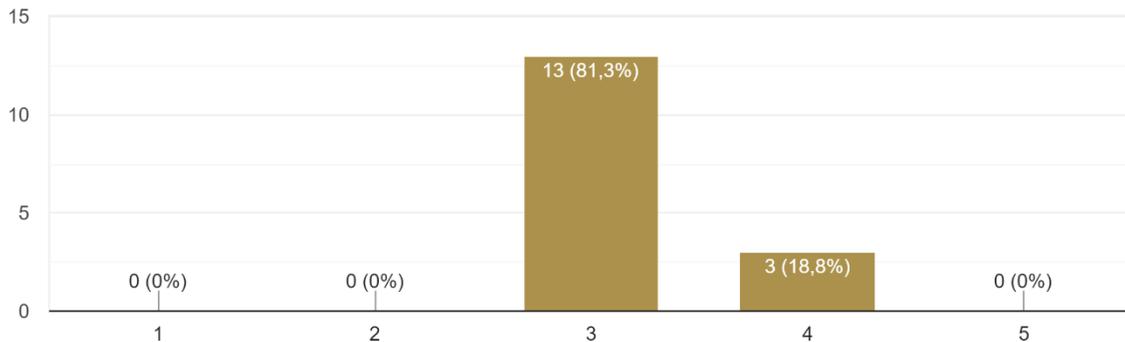


2. The Autumn School was: *

Too easy for me 1 – 2 – 3 – 4 – 5 Too difficult for me

2. The Autumn School was:

16 antwoorden



3. Was anything missing in this Autumn School that you had expected to learn?

Open answers:

- No
- A bias correction exercise
- a real time case study on data manipulation from one of the lecturers
- A bit more about different calculation options.. Which programming language would be recommended for certain computation steps. For example: the name of the R package for bias correction with manual. Maybe a presentation of a small scale test showing the functionality of specific command.
- More details on impact model like good and bad part of impact models
- May be a Tutorial or live examples
- No, the school covered all the important aspects related to climate data.
- Downscaling & bias correction procedures
- No.
- No, I got more than I expected.

4. We estimated the amount of time needed to follow the course at 56 hours.

4a. Was our estimate accurate in your case?

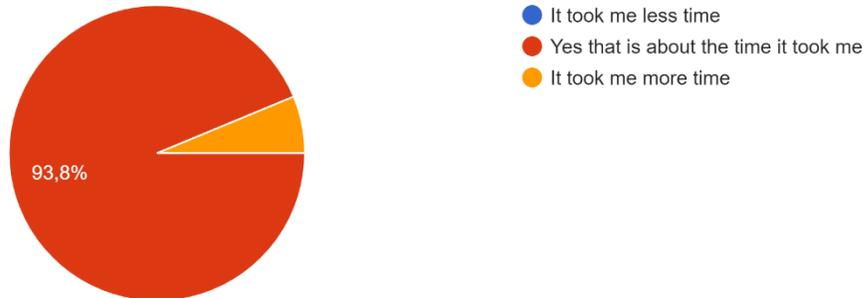
It took me less time

Yes that is about the time it took me

It took me more time

4. We estimated the amount of time needed to follow the course at 56 hours. 4a. Was our estimate accurate in your case?

16 antwoorden

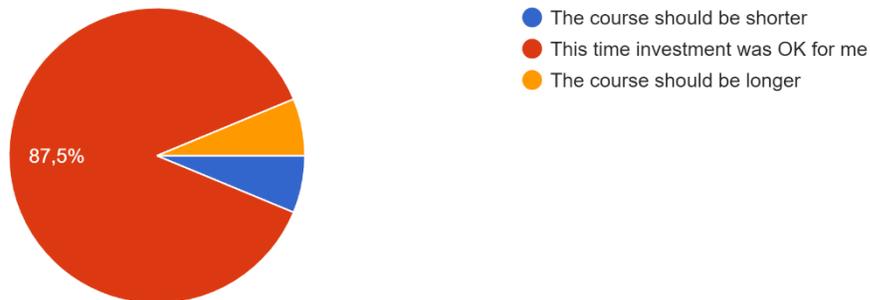


4b. What is your opinion on this time investment for such a course?

- The course should be shorter
- This time investment was OK for me
- The course should be longer

4b. What is your opinion on this time investment for such a course?

16 antwoorden

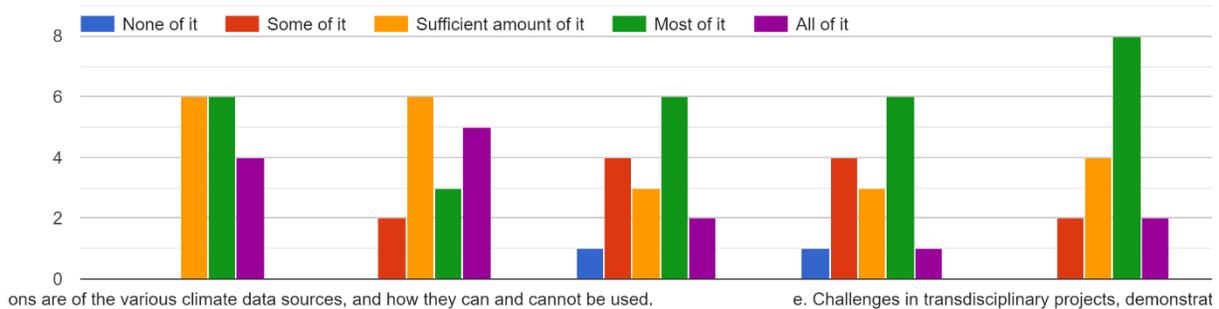


5. Did you achieve the following learning aims?

None of it - Some of it - Sufficient amount of it - Most of it - All of it

- a. What the advantages and limitations are of the various climate data sources, and how they can and cannot be used.
- b. How global and regional climate models work (basic principles, required hardware and time).
- c. How impact models work, methods and tools (e.g. statistical and dynamical models)
- d. Steps required for climate impact studies (quality checks, downscaling, bias adjustments, indices)
- e. Challenges in transdisciplinary projects, demonstrate the value of interaction

5. Did you achieve the following learning aims?



6. How was it to do the school online instead of face to face?

I prefer live

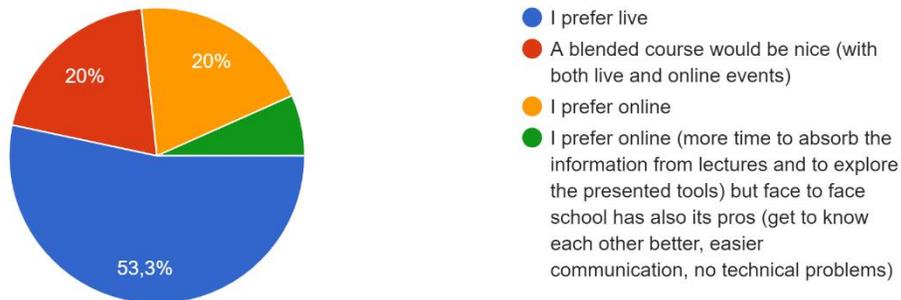
A blended course would be nice (with both live and online events)

I prefer online

Other:

6. How was it to do the school online instead of face to face?

15 antwoorden



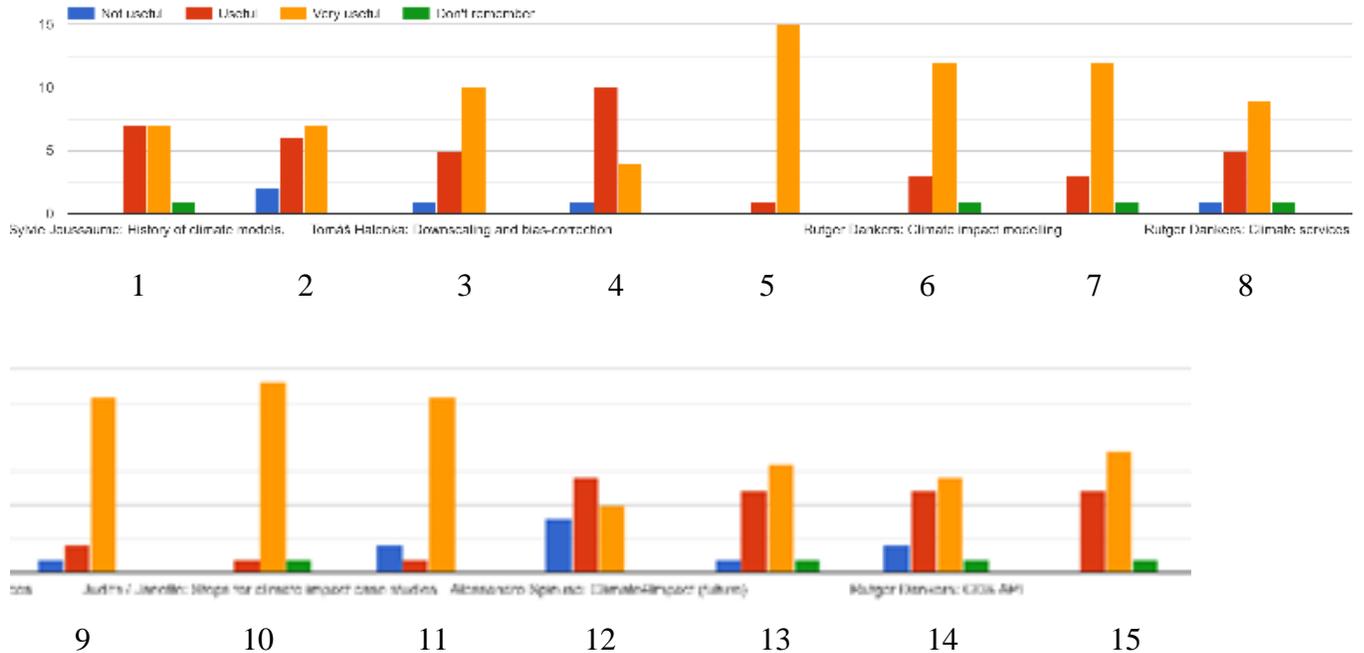
7. Please rate the lectures of the Autumn school in the table below

Not useful – Useful – Very useful - Don't remember

1. Sylvie Joussaume: History of climate models
2. Klaus Zimmermann: ESMValTool
3. Tomáš Halenka: Downscaling and bias-correction
4. Eric Guilyardi: Standards, CMIP experiments
5. Vladimir Djurdjevic: Indices, uncertainties/ensembles
6. Rutger Dankers: Climate impact modelling
7. Vladimir Djurdjevic: Impact studies agriculture/forestry
8. Rutger Dankers: Climate services
9. Christian Pagé: Data portals and tools
10. Judith / Janette: Steps for climate impact case studies
11. Christian Pagé: Climate4Impact portal (present)
12. Alessandro Spinuso: Climate4Impact (future)

13. Janette Bessembinder: CDS data and Toolbox
14. Rutger Dankers: CDS API
15. Janette Bessembinder: Visualizing results

7. Please rate the lectures of the Autumn school in the table below



8. Were there any superfluous elements in the school?

Open answers:

- No
- no
- I don't think so.
- Not at all
- No Thank you for such quality
- Don't remember
- No, all was fine.

9. How was it for you to do a case study in 2by2 groups?

Open answers:

- I think it is a good number to avoid having non-working people in a group
- Good, but it would have been better in person to share the challenges in data manipulation
- Very well. Aside from computational obstacles I didn't have any communication or technical misunderstandings with my team mate.

- It was useful to try working with a new person who has very different knowledge from mine.
- Good experience. In this case face to face will be more fruitful.
- very interesting
- Very useful and we think we can develop strong future partnership
- I expected more interaction with my partner. Maybe it could be helpful in going deeper in some topics. Maybe group of 3 can allow a continuous dialogue even if one of the group have any other commitments to undertake.
- There was limited communication with my partner because he did not have access to reliable internet.
- Good idea. 2 people are enough
- Very nice
- A bit too much work. But OK.
- Useful and pleasant experience.
- Great, I learned a lot and enjoyed sharing experiences.
- It was ok, we hadn't any problems with communication. I enjoyed this work.

10. Was your internet connection a barrier for you to follow the course?

Yes - A bit - No

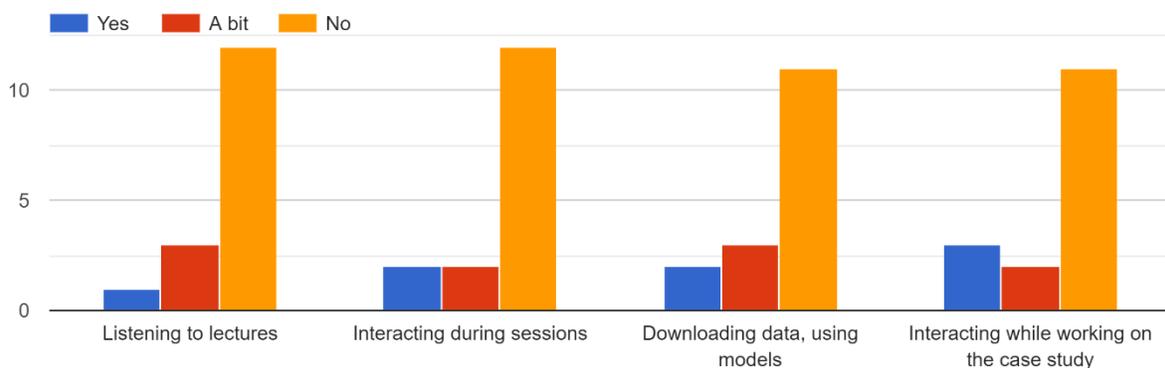
Listening to lectures

Interacting during sessions

Downloading data, using models

Interacting while working on the case study

10. Was your internet connection a barrier for you to follow the course?



11. Did the IS-ENES3 team provide enough help for your case study?

Open answers:

- Yes

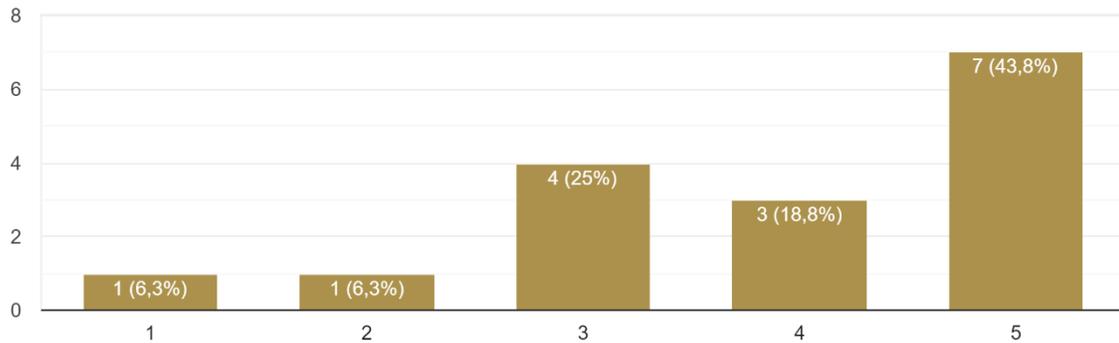
- yes
- Yes. We are grateful for all comments that framed and by that improved our case study.
- Definitely yes
- Jannette was really very helpful to us during our case-study.
- Yes
- Absolutely!!
- Yes.
- More than enough
- Yes, definitely.
- Excellent quality of help (suggestions, comments, solutions, additional documentation).
- Yes, thank you!

12. Were the session recordings useful to you?

Not useful 1 – 2 – 3 – 4 – 5 Very useful

12. Were the session recordings useful to you?

16 antwoorden

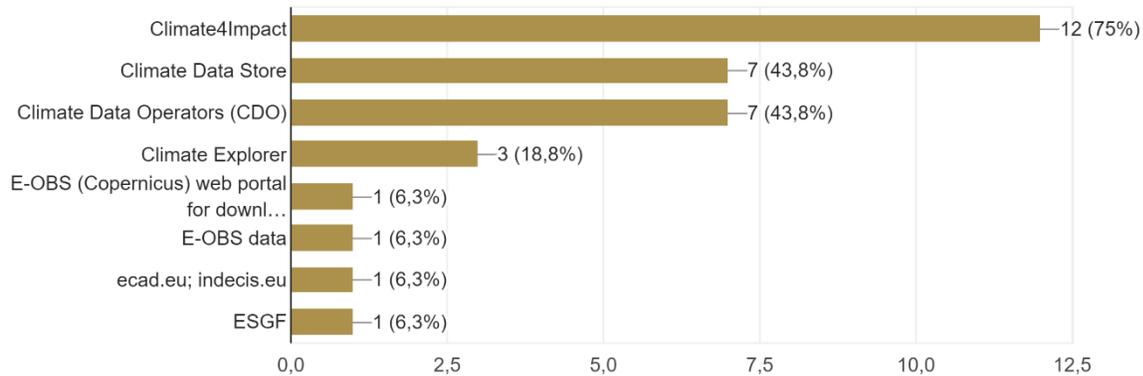


13. Did you use the following tools:

- Climate4Impact
- Climate Data Store
- Climate Data Operators (CDO)
- Climate Explorer
- Other:

13. Did you use the following tools:

16 antwoorden



14. Do you expect to use the things you have learned in the next 6 months?

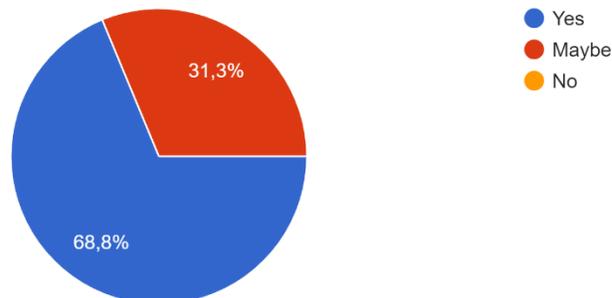
Yes

Maybe

No

14. Do you expect to use the things you have learned in the next 6 months?

16 antwoorden



15. Do you have any other advice for us?

Open answers:

- No
- I liked the small quiz with questions related to the topics, from the beginning of the course. Maybe to improve that part a bit since it shows the direct involvement of all participants and holds the focus on the issue.
- No, you did a great job :)
- Hoping for future collaboration research with the IS-ENS3 team and other participants.
- Let the participants share the codes of their case studies and each one explain step by step how he achieved his work.

- Would be nice if we have some tutorial or some analysis shown live and also a future school on downscaling/bias correction
- Maybe implement some Python or R tools guidance for climate modelling or climate indices computing
- Enjoy Christmas!
- I would have liked a little more time dedicated to interaction with users (e.g. on communication, examples etc.), although this type of information was presented during the course. Overall, the course has been great and answered to all expectations. Thank you!
- No, thank you for the opportunity to be part of a school where a lot could be learned.
- To shift beginning of the course few weeks earlier next year. To add some practical seminars of using giving tools during a week, more working/lessons days during a week.

Annex 2: Results of the oral evaluation of the Autumn school

On the last day of the Autumn school, a 20 minute evaluation round was held. The session was recorded and notes made afterwards.

<i>Respondent nr</i>	<i>Has learned</i>	<i>Advice</i>
1	New variables, new abbreviations, how to communicate with climate professionals	Live would even be better
2	How to assess the models, how to think about projects: more user oriented, in my next project not only climate details but also: what is practical use for users?	Next time finish the course earlier because mid of December it is time for internal reports and it made the case study a challenge.
3	How to present for the users. The importance of bias correction in climate data.	I agree, I also have to do a lot of reporting end of the year.
4	Using climate model data for the first time. How to use climate data models to see climate impacts. I encountered all technical issues for later studies	
5	Climate modelling, data use. All the tools that we discussed I tried and I will use them in my next research	I preferred the virtual way because we could go deeper into the lessons. To do all this in only 2 weeks, then my mind would blow
6	I learned from the impact side, saw interesting case studies, to see what people do with the data, and the misunderstandings about uncertainties and bias correction and the implications of bias correction and how to handle this best	Would have enjoyed a live course, 6-7 weeks was very long to stay focused, work comes in between and when you have one week externally you are forced to focus. And we'd have less internet problems.
7	Tools for downloading climate data and plotting graphs. How to design a case study and how to think about end users	
8	To see the new tools.	I would not have been able to participate in a live school so this was a good opportunity to meet the new generation of climate scientists

		End of year also difficult to do the case study
9	That in the future nothing can be done without climate scientists and maybe we do not have enough of them. You need two persons in every field to work on it properly. That climate scientists also struggle with the data. How to present and communicate results	Better in person next time
10	Started to do a case study, so it got me over the threshold. Practical info about climate data and climate models and how to process data. There are so many options today that I get confused which data to use, how to calculate, how to plot, which programming language to use, there is too much information. The course was a good guide.	Maybe start case study in the first week to ensure early involvement of the participants in the case studies.
11	How to access the data. What the benefit is of different climate models and different approaches. To meet everyone across all the countries.	More about how to correct the data
12	How people from impact studies think about the climate models, and how to use climate data for impact research because I do not come from that field. How to work with model datasets because usually I work with real-time observational datasets, so how to use model data for impact studies. And how to design a case study.	In the future I want to use the datasets to calculate fog appearance
13	Vast amount of knowledge from basic in the first week to more complicated in the second and third week. The tools and the CDS are very helpful. Good to see the diversity of the other case studies.	Meeting after two months would be great. Better to work in a live setting, difficult to communicate online.
14	Available data sources, bias corrections and simplifications, climate downscaling techniques	Next time practical advice from lecturers how to bias-correct sample data.

15	<p>First time study in English. Difficult to follow and took a lot of time. Communicate with scientists of different backgrounds, not be afraid to express if I do not have enough experience and ask for help.</p> <p>Climate data and crop modeling.</p>	<p>Something similar in the future.</p>
16	<p>Well though format. To do impact case study and to work in a team, to explain to a scientist who is not a climate scientist, how to communicate uncertainties and how to manage the simulations. A lot of tools for presentation and practical information how to manage and present data.</p>	<p>Internet allows us to meet people we otherwise would not have met. Live meeting combined with internet would be nice. Meet for the case studies at the end? Agree not to do it in in December</p>
17	<p>I got rid of my fear to use climate data. I thought hundreds of years of data would take so much time. Also I learned how to focus on telling only a few important points to users and not say everything, all details. Not to confuse the users with everything a researcher has done but focus on what is interesting for them.</p>	<p>Virtual is perfectly fine for me.</p>
18	<p>Learned a lot from the impact point of view and communication with the users. I already knew about climate models. I also learned about new tools for climate data.</p>	<p>I liked the virtual school to absorb all the information, it was a big amount of information.</p>
19		<p>I hope to keep in touch for further cooperation</p>
20	<p>New methods for climate projections, how to handle them better for user requests, and how to solve a user request even when you do not have the exact answer. How to still find a solution for what they ask. Good to see all the other case studies; also how to present it, starting from the context, then the approach and then the results.</p>	<p>I liked the online course, but I prefer live interaction.</p>

