Stakeholder Survey Report

Authors - survey report:
Stakeholder Engagement Team:
Quentin Lejeune, Gina Maskell, Inga Menke, Samuel Pleeck

Authors - responses from the ISIMIP impact modelling community:
Responses are provided by the ISIMIP Cross-Sectoral Science Team, iteratively with the ISIMIP Sectoral Coordinators and adjusted based on comments by:
Kristie Ebi, Anne Gädeke, Simon N. Gosling, Veronika Huber, Felix John, Valentina Krysanova, Rafa Marcé, Hannes Müller Schmied, Sam Rabin, Jacob Schewe

Table of Contents

Bundesministerium für Bildung und Forschung

With the financial support of

Executive Summary

ISIpedia, the Inter-Sectoral Impact Encyclopedia, is intended to provide open access to i) the raw climate impact simulation data generated within ISIMIP (Inter-Sectoral Model Intercomparison Project, www.isimip.org), ii) sectoral and cross-sectoral national impact assessments with global coverage, based on model simulations generated within ISIMIP, and iii) initiate a transfer of regional information about management, protection measures, or planned adaptation measures from regional experts to climate impact modellers, who could use the data as input to improve the regional relevance of impact simulations.

The survey, whose results are reported here, was primarily designed to identify the characteristics and features that will make ISIpedia and the assessments highly relevant for a wide range of stakeholders: from international public servants (e.g. the World Bank, the International Monetary Fund, or World Food Programme), to government staff and scientific consultants, e.g. working on national adaptation plans, to climate impact researchers working on topics ranging from biophysical impacts to implementing these impacts in economic model, as well as employees from companies (such as reinsurance companies and rating agencies), whose activities are impacted by climate disasters. In order to ensure a relevant design and content for this spectrum of targeted stakeholders, a survey was launched with the purpose of understanding their needs for climate-impact information, and their current possibilities and impediments to accessing such information.

The survey included 27 questions, of which 131 received answers were usable for informing the progression of the ISIpedia project and the development of the platform. The respondents came from various regions in the world, with a stronger share originating from Europe, but also with a strong showing from the focus regions of the project (West Africa and Eastern Europe), which make up 19.3% and 10% of the respondents, respectively. Diverse organisation types are represented amongst the survey participants, with 43% working in academic or research institutions and others in administrative bodies (18%), international institutions (17%), non-governmental organisations (16%) and the private sector (8%). In terms of further outreach for the stakeholder engagement process, the survey demonstrates a need to build out on a budding network in Eastern Europe, seek out stakeholders in world regions not yet covered (Oceania), and continue onboarding stakeholders from non-academic sectors.

From the survey, specific platform features that respondents would find most helpful for their work-related activities were identified. The respondents expressed that it would be advantageous to be able to access climate-impact information presented in a way that is understandable, easily downloadable, and directly usable (for example in the form of a slide deck, or a downloadable data file with clear processing instructions). Another feature respondents reacted positively to is the option to explore the presented data (to a certain extent), by comparing indicators across regions and filtering in and out defined layers of information. Notably, respondents would like to have access to the raw and processed data used to derive the presented assessments, while they seem less interested in engaging with the expert scientists who produce them. All of these features were taken into account into

the initial web frames and the open call for a design company for the ISIpedia portal, e.g. including a ranking of countries according to different impact indicators as a central element.

In terms of content housed on the ISIpedia portal, insights emerged on user preferences and needs on content elements for national and global assessments, as well as methodological background information. Answers demonstrated that the respondents have very broad interests in this regard, suggesting that ISIpedia should include information on more than just the impacts of climate change but also provide the climatic and socio-economic context to understand these. Moreover, transparency regarding the methodology and assumptions used to derive the presented information is considered to be very important for the respondents. They overall expressed a strong interest in climate-impact information for the current period (i.e., observed impacts) and a lower one for a relatively distant future (by 2100 and beyond). This can orientate the upcoming discussions on which periods of time should be covered by the model simulations conducted within the next modelling round of ISIMIP (ISIMIP3).

The wide panel of interests still leaves room for the selection of a topic which could translate in the focus topic for ISIMIP3. The question that aimed to gather input on the seed suggestions for focus topics (coming out of the ISIpedia kick-off workshop) ended up garnering responses that were generally positive, without clear preferences for one given option. However, in parallel, the survey provides valuable information about relevant cross-cutting themes for the respondents, or the sources of climate-impact information they currently use as well as the pros and cons of these sources. In particular, useful insights can be drawn from the main barriers to accessing climate-impact information, which were mentioned across many regions as being a lack of high-precision or high-accuracy information, too coarse spatial scale and costs to accessing climate-impact information or data. Additionally, some regions face specific issues, such as unstable internet connection in West Africa. Addressing this demand, a discussion will be initiated among the sector coordinators about options towards increasing the regional relevance of impact model simulations, in particular for smaller countries. A range of aspects contribute to this challenge, from the spatial resolution of the climate input to an adequate representation of regional management conditions and other direct human influences. The latter can be addressed in further close cooperation with regional representatives. The barrier of cost (to accessing climate information) is already addressed in the ISIpedia project as the portal will be open access.

Overall, the survey reached a significant panel of respondents among the targeted audience, to eventually allow the extraction of useful and concrete conclusions for recommendations on i) the design of ISIMIP3, ii) the ISIpedia stakeholder engagement process and iii) the design and content of national assessments. It received enthusiastic support from many respondents, and a majority of them expressed their interest to stay updated on and/or to participate in future ISIpedia activities. The survey sheds light on the expectations placed on the ISIpedia project by its potential end-users and the feedback given in the survey builds a strong basis for achieving the objective of co-development of policy-relevant, climate-impact information by scientists and stakeholders.

The report will be shared with the ISIMIP sectoral coordinators to inform the selection process for the ISIMIP3 focus topic (and the impact indicators that should be provided). The associated suggestions will form the basis for discussions within individual sectors, which will then be fed into larger discussions among all sectoral coordinators and the Cross-sectoral Scientist Team (CSST) at PIK. This will facilitate a convergence to a new focus topic to be addressed within ISIMIP3, as well as the development of a corresponding modelling protocol. The first steps for decision on the new focus topic and protocol has been started at the ISIMIP Strategy Meeting in Potsdam in September, 2018.

Bundesministerium
für Bildung
und Forschung

With the financial support of

1. Introduction: Background, Aim and Intended Audience of the Survey

This report gives an overview of the ISIpedia Stakeholder Survey, as a means to synthesize and report on key stakeholder interests, preferences and needs regarding climate-impact information, as well as what they perceived to be the current barriers to access this information. The ultimate goals of the survey are to inform 1) the process of developing ISIpedia, a user-friendly online platform including national-level climate-impact assessments with global coverage and designed to be relevant for the work and activities of a range of stakeholders, and 2) the development of the next modelling phase of the Inter-Sectoral Impact Modelling Intercomparison Project (ISIMIP), which provides the data from which the climate-impact information presented on ISIpedia will be derived.

Roughly 100 impact models currently contribute to ISIMIP by running simulations of historical and future climate impacts, following a protocol that is common to all 13 covered modelling sectors: agriculture, water (global), water (regional), regional forests, global biomes, biodiversity, agro-economic modelling, permafrost, coastal infrastructure, health, energy supply & demand, lakes, and fisheries & marine ecosystems. This allows a consistent comparison of climate impacts between models within one sector, but also a consistent identification of hotspots of climate impacts and an aggregation of effects across sectors. Each new phase of ISIMIP is organised around a focus topic, which reflects a broad research question in the field. In order to address the focus topic, a simulation protocol common to all sectors is designed, which defines a common set of simulation scenarios and associated climate and socio-economic forcing data. These data come from global-scale climate and land-use datasets (0.5° resolution, so far), as well as other socio-economic datasets (e.g., GDP or population growth rates), based on country-level information. ISIMIP covers global-scale simulations as well as regional simulations, only covering individual watersheds or forest stands but providing a more detailed representation of regional conditions.

Given the broad sectoral coverage of ISIMIP simulations, the audience of ISIpedia has the potential to include a diverse body of stakeholders, whose activities can and should span as many ISIMIP sectors and cross-cutting themes as possible. The survey was therefore intended to reach a body of respondents diverse in terms of 1) type of organisation, 2) sector of activity and 3) geographic distribution, with a strong effort to include people from the two project focus regions: West Africa and Eastern Europe. Given current limitations of the global ISIMIP simulations regarding the detailed representation of regional conditions (due to resolution of the climate forcing, missing information on direct human influences and calibration of model simulations on the global scale), an emphasis was put on stakeholders working at the national, transnational, international or global scale.

The targeted audience of the survey therefore eventually included a wide range of stakeholders: from international public servants (e.g. the World Bank and the World Food Programme), to government staff and other scientific consultants, e.g. working on national adaptation plans, to climate-impact researchers investigating the biophysical impact projections and also economists implementing these impacts in economic models, as well as employees from companies whose activities are impacted by climate disasters (such as reinsurance companies and rating agencies).

2. Methods

The survey was launched on March 12 and stayed open for 4 weeks until April 9, 2018. The survey was distributed to relevant stakeholders gathered through professional contacts, networks, and other online databases such as RINGO and the UNFCCC focal points. Stakeholders were then 'mapped out' in order to ensure that the survey audience aligns with the project's intended audience. Eventually, more than one thousand emails were sent to distribute the survey. A total of 187 people responded to the survey, of which 131 answers were usable.

2.1. Stakeholder Mapping and Survey Outreach

Before launching the survey, the Climate Analytics Stakeholder Engagement Team conducted a thorough stakeholder mapping to ensure a global scope and specific coverage of the focus regions Eastern Europe and West Africa, as well as a balance of organisational sectors (NGOs, international organisations, private companies, etc).

Kumu (*kumu.io*), an online stakeholder analysis tool, was used for ISIpedia stakeholder mapping (*Figure 1*). Contacts (potential stakeholders) could be assigned and sorted according to user-defined categories such as geographical area, type of organisation or how the contact was acquired. The visualisation helped to extend the circle of stakeholders and to identify and bolster certain groups of stakeholders missing from the initial network. The mapping process also informed the team on language needs of ISIpedia contacts, resulting in the translation of the survey into French, Spanish and Chinese (from the original English version). Stakeholder mapping enabled more than 1000 emails being sent directly by the ISIpedia Stakeholder Engagement Team and many further emails shared through ISIpedia partners and other related projects and mailing lists, where the project teams had contacts (such as through the African Climate and Development Initiative mailing list). The emails were prepared using the marketing automation platform MailChimp (*https://mailchimp.com*), and in case the recipients did not open the email within a few days automatic reminders were sent via the add-on for Gmail called Boomerang (*https://www.boomeranggmail.com*). Additionally, the survey was published on the ISIMIP website and visitors were invited to participate.

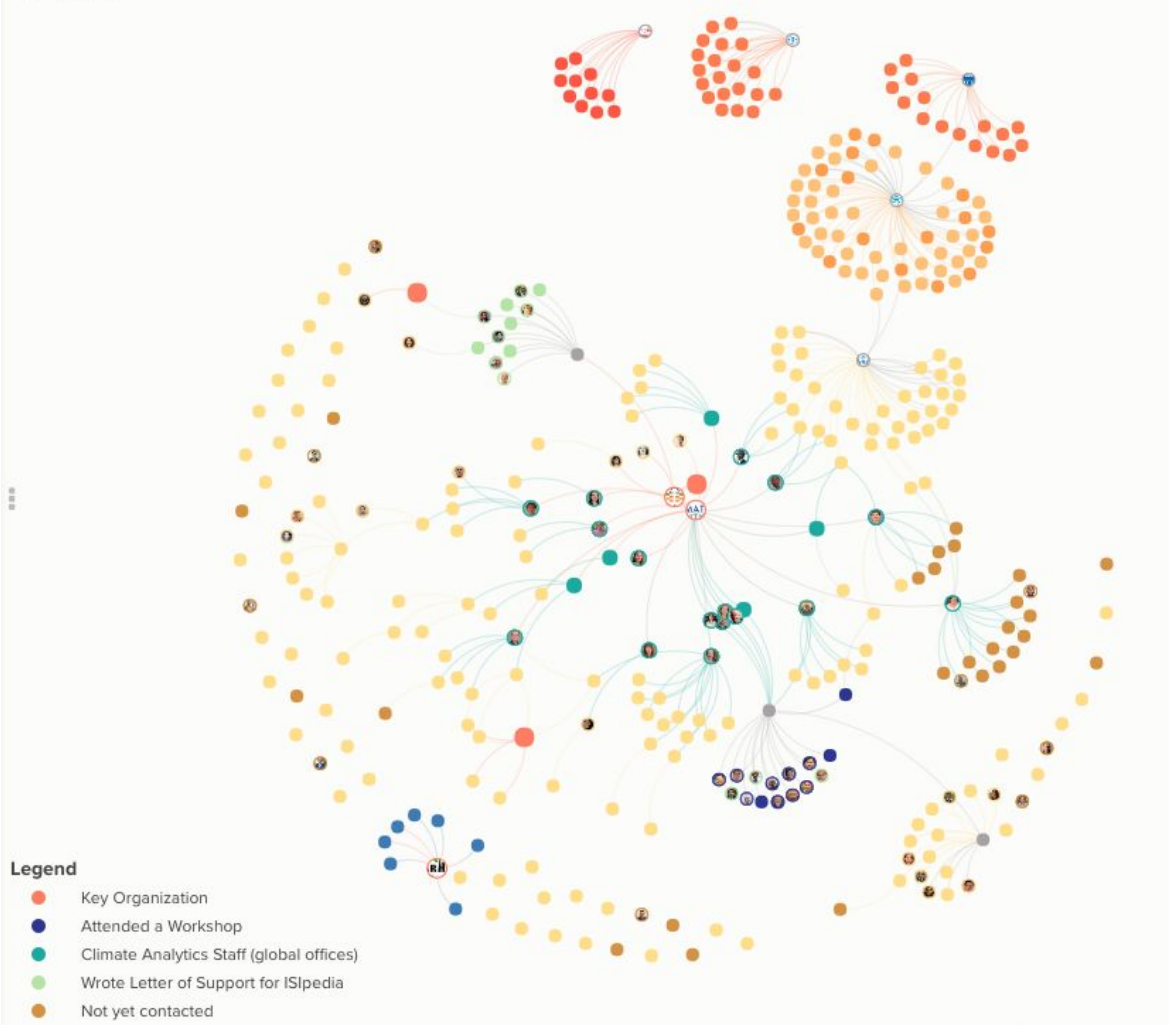

Figure 1: Example of stakeholder mapping visualised on Kumu.

2.2. Survey Technicalities and Analysis

The survey consisted of 27 questions (19 close-ended and 8 open-ended) divided in 6 pages. It was accessible exclusively online via SurveyMonkey (surveymonkey.com). The analysis of the results of the survey have been conducted at Climate Analytics (Berlin, GER) using filtering and tagging functions on SurveyMonkey as well as Excel files extracted from SurveyMonkey. These Excel files extracted from SurveyMonkey contained "text" answers for the open-ended questions and number of times each given option was chosen by a respondent for close-ended questions. Also included in the downloaded Excel file were any tags or filters (to text answers) applied during a pre-analysis phase conducted directly on SurveyMonkey, and the total number of respondents who answered each question (as only 7 questions were mandatory).

For close-ended questions, depending on how many choices (one or multiple) respondents were able to choose and if the average respondent chose multiple options, percentages were calculated either based on the **total number of responses or answers** ($n_{responses}$) or on the **total number of respondents** (n). The maximum number of respondents n is 131. For questions where respondents *could* choose multiple answers but the majority of respondents did not, such as question on (a) operating scale and (b) the purpose for which

respondents use climate-impact information, percentages are derived by dividing by the total number of **responses**, ($n_{responses}$; *Appendix 9.1*, Q4 and Q7 respectively). For questions which asked respondents to choose topics they are interested in, and where respondents were able to tick multiple choices (and often did), for example relevant ISIMIP sectors or cross-sectoral themes (*Appendix 9.1*, Q8 and Q9), percentages were calculated by the **number of respondents** (n), per organisation type. This latter percentage was then represented in the form of radar charts (such as *Figure 5*).

To conduct the analysis on the open-ended question "What was the last question or issue you wanted to address which required climate-impact information?" (*Appendix 9.1*, Q6), thematic tags (e.g. health, adaptation, vulnerability, outreach & education, etc. *Appendix 9.2*) were assigned to all of the answers using a tagging function available in SurveyMonkey. Responses dealing with multiple themes were given multiple tags. These tags were then counted for each organisation type for which the respondents identified themselves. Responses that did not belong to any of the tags (because they were too general or did not fit into any of the defined categories) were not taken into account in this analysis.

For questions where the respondents were asked to rank the importance of a list of possible options, each possible answer ("very important", "moderately important", and "not important") was attributed a weight of 3, 2 and 1, respectively, from which average scores were calculated.

Cross-analysis was carried out for many questions, i.e. the answers were looked at with respect to one of the two following variables: (1) the type of organisation at which the respondents work or (2) their geographic region. For the latter, the text answers of where respondents' offices are based (*Appendix 9.1*, Q3) were tagged to be integrated into one of the following regions: North America, Caribbean, Central America, South America, Eastern Europe, Europe (not Eastern), West Africa, Africa (not West) and Asia. When a city or country was not specified but an organisation name was, a region was assigned based on the office location of that organisation. One respondent is based in both Europe and Eastern Europe and is counted in both regions. 117 survey responses could be assigned a continental region and one respondent was assigned 2 regions, as such, for figures that compare answers based on region, the maximum n_{region} is 118. For the question where organisation type was used to analyse data, maximum n_{org} is 142. 6 respondents commented in "other," not indicating one of the given organisation types. These responses were excluded from this cross analysis. Additionally, 15 respondents indicated multiple organisation types. These responses were "duplicated" and counted under each organisation type specified. This duplication does not substantially affect the results.

3. Background and Interests of Survey Respondents

Survey responses came from a diversity of professionals working across many regions, organisation types, and sectors. The next section provides a profile of survey respondents, their fields of work and interests.

3.1. Geographical Distribution

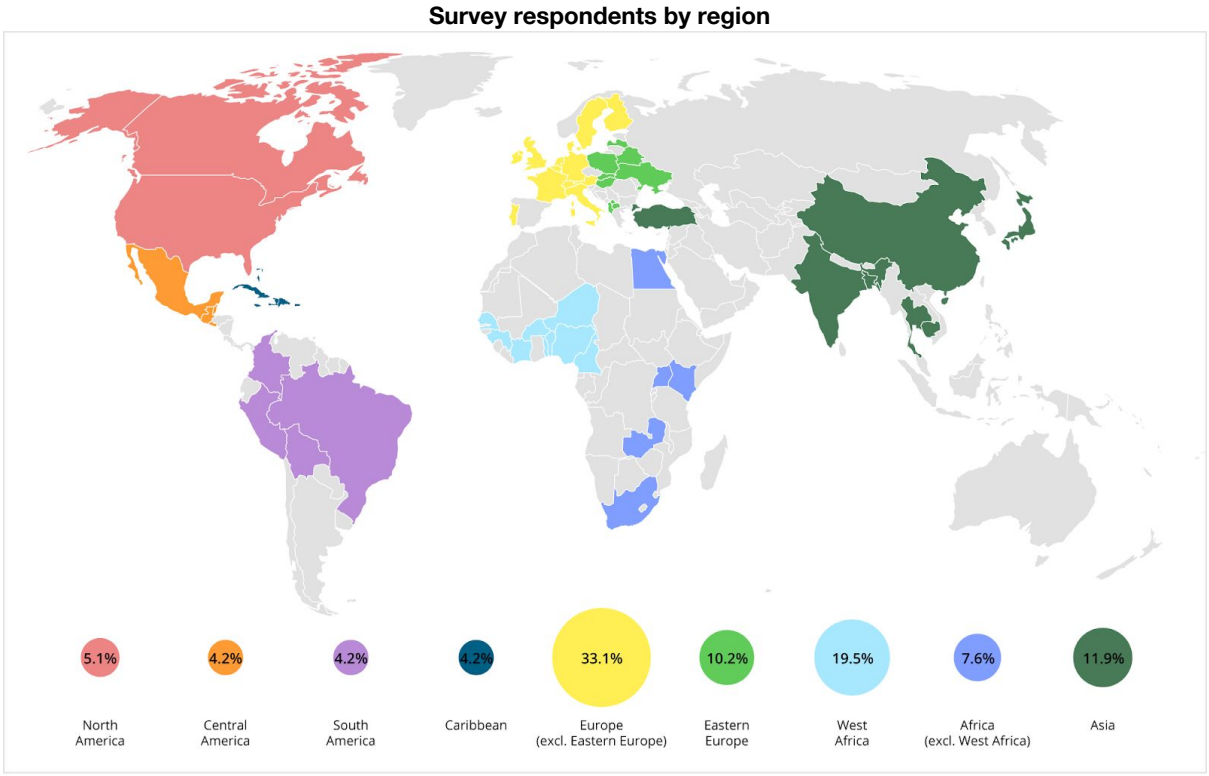

Figure 2: Overview of geographic distribution of survey respondents (n=119). Regions represented: North America (pink), Central America (orange), South America (purple), Caribbean (teal), Europe (not Eastern; yellow), Eastern Europe (and Caucasia, including Russia; light green), West Africa (light blue), Africa (not Western; dark blue), and Asia (dark green).

187 survey responses were collected and 131 of them were directly usable, roughly representing a response of ~10-20% considering the number of emails sent by the Stakeholder Engagement Team and the collaborators who further disseminated it. The survey reached and elicited responses from many continental regions of the world (missing Oceania), with a majority of responses coming from Europe and a substantial proportion of answers coming from Africa. *Figure 2* shows that the whole of Europe (41.1%) and the whole African continent (26.9%) represent overall approximately two-third of the respondents (68%). Inside these continents, the two focus regions Eastern Europe (with responses from Serbia, Hungary, Kosovo, Macedonia and Poland) and West Africa (with responses from Senegal, Burkina Faso, Benin, Togo, Côte d'Ivoire, Cameroon, Niger) account for 10% and 19.3% of the total respondents, respectively.

The strong share of respondents from Western Europe does not come as a surprise as the project partners are based in this region. For West Africa, a notable share of the respondents (43.5% of the 19.3%) come from Senegal. This strong presence of stakeholders in West Africa, and specifically Senegal was facilitated by and possible only with the support of a number of Climate Analytics staff, projects and partners in the region, who acted as distribution nodes for further dissemination of the survey. On the other hand, Climate Analytics lacks similar strong existing ties in Eastern Europe, therefore stakeholders of this region were integrated into the stakeholder consultation through unsolicited emailing

and building relationships with specific receptive organisations. The lower response rate in this region compared to West Africa is therefore not surprising.

The lack of and reduced response rate from Oceania, the Caribbean and the Americas can be attributed at least partially to limited outreach in those regions, as the Stakeholder Engagement Team designated more time and resources to gathering feedback from the focus regions of Eastern Europe and West Africa. The lack of responses from Russia could partially be attributed to language, as the survey was not translated into Russian (because of time constraints and lack of financial resources).

Looking at the geographic scale of the respondents' work, *Figure 3* demonstrates that most respondents work at the national level (56.7%) and/or global level (35.1%), while less than a quarter work at the local level (20.9%) or below. Although stakeholders belonging to organisations operating at national scale may require information at subnational level for some of their activities, these numbers overall affirm an alignment in geographical scope between the climate-impact information that will be provided by the ISIpedia platform and the targeted users.

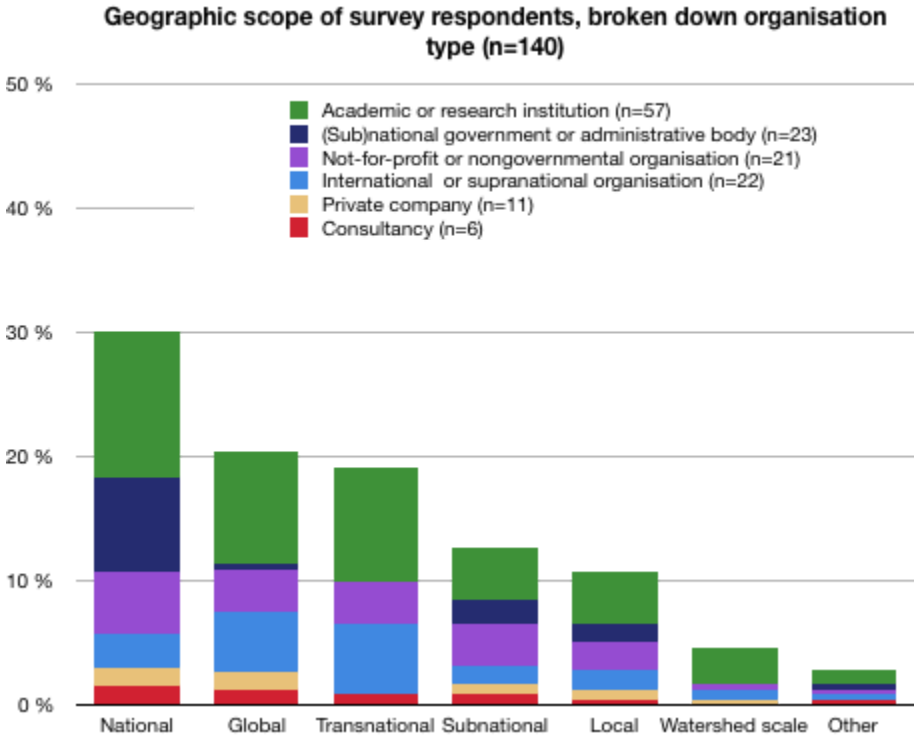

Figure 3: Geographical scope of survey respondents by organisation type (n_{org}=140). This stacked bar graph was calculated using the total number of responses for this specific question, $n_{responses}$= 263.

Response from the Stakeholder Engagement Team:

Expanding stakeholder networks in Eastern Europe
While we have got a relatively high number of responses from our West Africa focus region, the number of responses from Eastern Europe is considerably less. To build out our contacts in this focus region, we will continue strengthening stakeholder networks through attending regional conferences and other events and through regional contacts or ambassadors that help promote ISIpedia, e.g. the Regional Environmental Center (REC). We will reach out to relevant organisations and contacts in Russia, Eastern Europe and Central Asia, and other areas where contact points

are lacking such as through more targeted communication with the Climate Action Network in Eastern European, Caucasus and Central Asia (CAN EECCA) and the Aarhus Center. Both of these organisations were invited to our indicator development workshop in November 2018.

One of our first steps has already been a meeting with the REC Serbia office (preceding the International Scientific Conference on Climate Change Adaptation in Banja Luka in July 2018) to start understanding how REC operates and establishing a partnership. The Stakeholder Engagement Team will then continue building the partnership, in terms of participation in a planned indicator development workshop (November 2018) and possibility to co-host a capacity-development workshop (2019).

As the survey also reached professionals that the stakeholder team had not yet contacted, a database was set up with survey respondents who indicated further interest in engaging with ISIpedia. Those who are based in or working in our focus regions were tagged especially as potential stakeholders for participation in the planned regional workshops.

For the stakeholder process contributing to the development of the ISIpedia platform, outreach will specifically occur in the two focus regions (Eastern Europe and West Africa). However for dissemination of ISIpedia assessments (after the launch of the portal), outreach will be done worldwide, with the goal of reaching relevant stakeholders in all continental regions. This will perhaps rely on initial contacts from non-focus-regions made during the first phase of stakeholder engagement.

Expanding outreach in non-focus regions
As there were world regions with more limited representation in the stakeholder survey and the engagement process, there will be less tailoring to specific needs of these regions, and potentially also less uptake (i.e. in Oceania, Caribbean). This can potentially be addressed in exploring synergies with other climate service projects (that have a focus and/or stakeholder processes) in regions such as the Caribbean or Oceania. One such project focusing on Pacific island states has been identified.

Another mean of increasing uptake in non-focus-region areas is through use of ISIpedia ambassadors or regional stakeholders who help to disseminate ISIpedia to further interested stakeholders in their respective regions. These could take the form of a “guest program” where regional experts are invited to contribute to assessments. These guest researchers could potentially act as regional promoters. The ISIpedia team has applied for funding to implement this program.

And a third outreach method is to make ISIpedia more visible at other relevant meetings and events, such as international conferences or politically-relevant committee or working group meetings. Notably, a side-event will be held at COP24 in Katowice in collaboration with the Burkinabè government, a Togolese NGO and another project dealing with climate adaptation in West Africa and in which Climate Analytics is involved.

Language
Making ISIpedia assessments accessible to the general public in Eastern Europe (in particular in Russia and for other Russian-speaking stakeholders), West Africa (francophone countries), Latin America, and Asia (in particular China) may largely be constrained by language barriers. Like the survey, the ISIpedia platform and all national assessments will be first written in English. It would then be necessary to prioritise the translation of francophone West African national assessments to French and Russian-speaking Eastern European assessments to Russian. While it will be beyond the project capacities to translate all reports, the translation of individual reports could be done based on requests from and in partnership with stakeholders. For example, the ISIpedia team could take the example from translation hubs and crowd-sourcing efforts, where a specific community (in this case climate science and policy), volunteers for at-request translations of specific documents (or in this case national assessment).

3.2. Field of Work

As one of the main purposes of ISIpedia is to bridge a gap between scientists and decision-makers in the field of climate impacts, it was fundamental to collect responses from both of these groups. The spread of respondents according to their organisation type reveals that the survey respondents, while covering all organisation types, heavily originate from academia or the research community (43.5%, *Figure 4*). This is mostly due to the history of the ISIpedia project, its resulting ties to the robust community of impact modellers who supported the distribution of the survey, as well as the fact that most of the ISIpedia partners are research organisations. Nevertheless, 68.7% of the respondents are decision-makers and practitioners from the public, private or third sector (numbers do not add up to 100% as some respondents identified themselves as belonging to several organisation types, see Section 2.2). Among these decision-makers, three types of organisation clearly stand out at above 10% of the total. These are the representatives of a government or administrative body (17.6%), staff from international organisations (16.8%) and the staff from non-for-profit or non-governmental organisations (NGO, 16.0%). Employees working in private companies (8.4%) and/or consultancies (4.6%) represent together less than 15% of the total number of respondents.

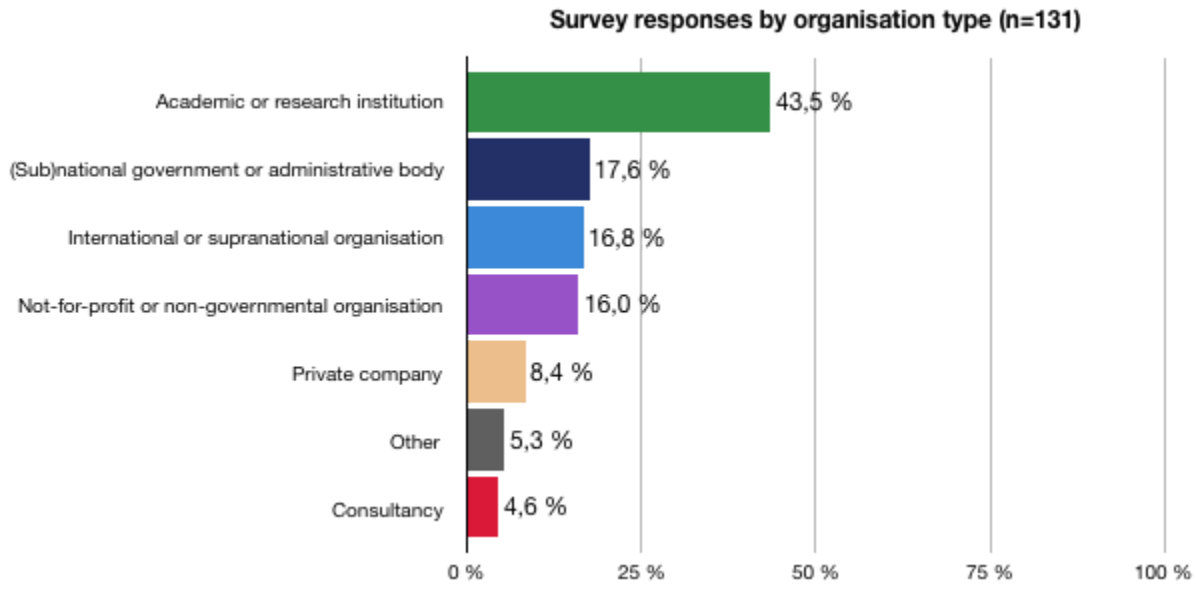

Figure 4: Overview of survey responses, divided by organisation type (n=131).

Responses from the Stakeholder Engagement Team:

High response rate from research community
Researchers are an important group of stakeholders for ISIpedia. Not only did they comprise a large percentage of the survey respondents but are also represented in one of ISIpedia's overarching goals: providing more convenient access to the ISIMIP simulation data. This is considered a critical service to the impact modelling community particularly and includes researchers from social sciences who are not directly involved in the biophysical modelling but may need the data to estimate the economic or social consequences for societies (amongst other uses). From this point of view it is understandable and positive to have reached a high response rate from this group of interested stakeholders.

Increasing outreach in non-research spheres
At the same time we aim to introduce ISIpedia to a new group of non-scientific stakeholders. We consider it successful that over half of the survey respondents come from other organisation types, especially since the survey was the first outreach to many of these stakeholders (not necessarily the case with scientific stakeholders who were already familiar with and have been involved in ISIMIP). As the survey was a first step, the ISIpedia Stakeholder Engagement Team particularly aims to further expand the involvement from decision-makers and practitioners working in the public and private sector or non-governmental organizations and other non-profit organisations (in addition to the already established participation of researchers). This entails increasing awareness of the portal through i) the publication of both a journal article on results of the survey as well as more blog-style pieces, and ii) presentation at climate-related conferences and events (both high-level and public events), iii) maintaining communication on updates on the project with already involved stakeholders, through a newsletter and social media.

Back-checking user-friendliness of the ISIpedia platform
In addition, we will intensively work together with a small group of stakeholders to facilitate a detailed discussion about the ISIpedia design and content, based on the starter suggestions made by the web company, responsible for the design and technical implementation of the platform, and the ISIpedia Cross-Sectoral Science and Assessment and Editorial Team. This is implemented in order to back-check that recommendations derived from the survey and workshops are meeting stakeholders' needs and that any modifications made are still understandable and usable.

Bundesministerium
für Bildung
und Forschung

With the financial support of

3.3. Sectors and Thematic Interest

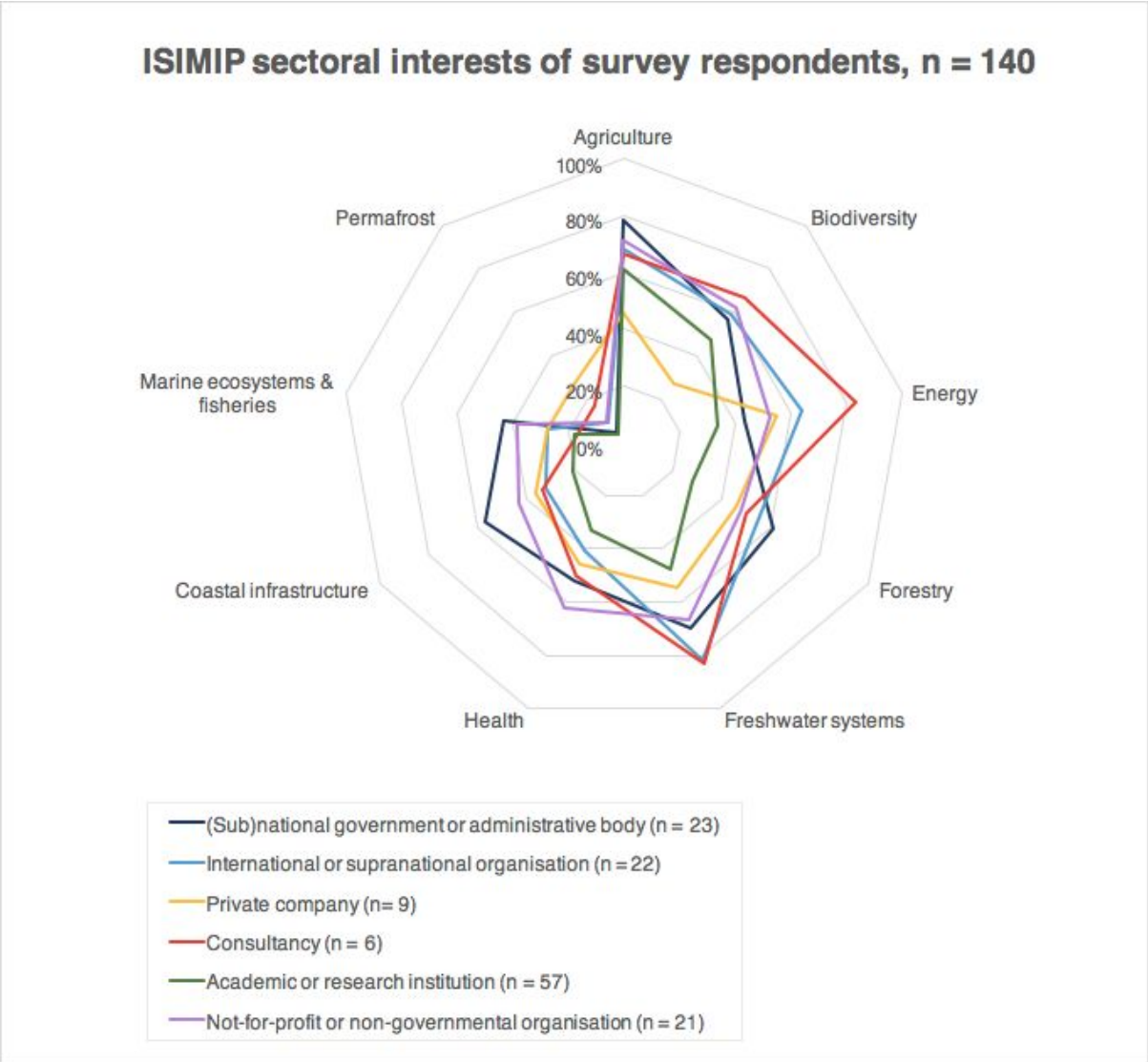

Figure 5: *ISIMIP sectoral interest of the survey respondents (n_{org}=140), divided by organisation type*

Figure 5 reveals a higher number of survey respondents that have a high interest in **agriculture**, **freshwater systems** and **biodiversity**. This interest cannot explicitly be characterised as a general trend in professional or research interest, but could be dependent on the composition of survey respondents, their geographical research focus, pressures from funding or other influences. Concerning the other sectors, some variations in interest can be observed between types of organisation. Other findings include a marked interest of NGO respondents for climate impacts on health (compared to other organisation types) and a government administration interest for coastal infrastructure and marine ecosystems & fisheries, as well as a comparatively high interest in energy from consultancies and international organisations. The private sector and academia respondents exhibit relatively balanced radar charts, with a relatively balanced interest across many sectors. Many strong peaks can be noted for consultancies (in red), however the small number of respondents who identified as consultant (6) prevents from drawing robust conclusions in this regard.

The same exercise was carried out with the responses to the question asking for the cross-cutting themes linked to climate impacts relevant for the stakeholders' work. Two themes distinctly appear as relevant for a majority of respondents across organisation types: the **Sustainable Development Goals (SDGs)** and the **Disaster Risk Reduction**. NGO respondents specifically exhibit a more balanced radar chart demonstrating interest across many themes. Government administration respondents show a specific interest in food security and livelihoods, two themes with links to the ISIMIP sector agriculture, thereby confirming interest from governments for this sectoral topic as well (*Figures 5 and 6*). Lastly, the private sector respondents show a strong interest in infrastructure compared to other organisation types.

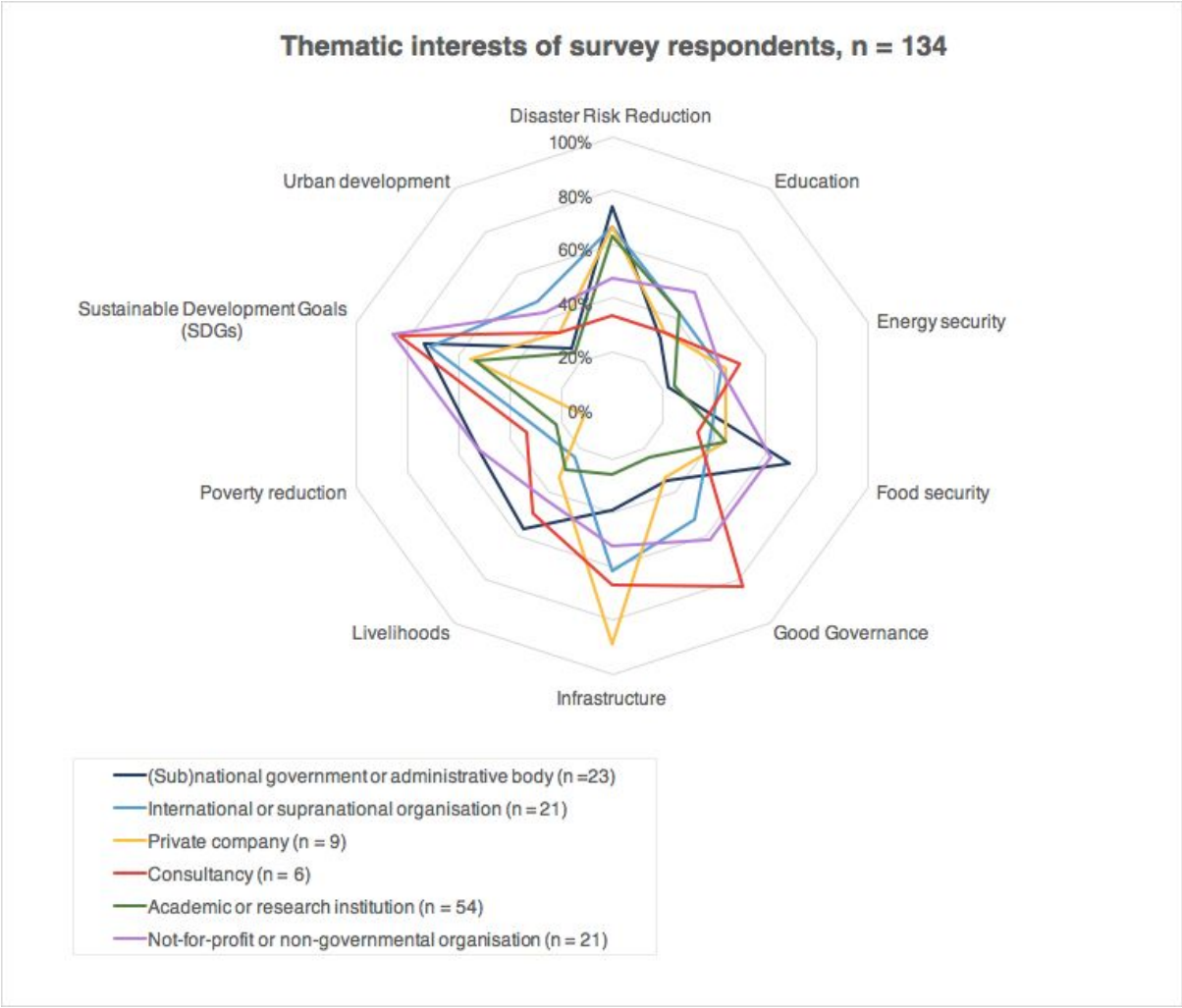

Figure 6: *Thematic interest of the survey respondents (n_{org}=134), divided by organisation type*

Response by the CSST and the Sectoral ISIMIP Coordinators:

The cross-cutting topics shown in *Figure 6* still pose a considerable challenge to the impact modelling community, because they go far beyond the mostly biophysical indicators directly generated by the impact models. The CSST and the sectoral coordinators will discuss how to develop approaches to address the topics as directly as possible.

ISIpedia will (at a minimum) categorise the developed impact indicators according to broader

topics. The topics will be selected and informed by the demand indicated here. Given the expertise and preparatory work at the involved institutes, we will be able to address: the **impact of climate change on disaster risks,** by providing historical analysis and future projections of areas affected by and people exposed to tropical cyclones, river floods, crop failure, wildfires, heat waves and drought. In addition, we will work on the development of damage functions allowing for estimating the associated direct economic losses. Additional work is planned to develop a better understanding and projections of associated longer-term poverty risks in conflict with the Sustainable Development Goals.

Regarding sectoral interests (*Figure 5*), it is interesting to see that two of the most well-studied sectors in ISIMIP - agriculture and freshwater systems - are also of high interest to many different groups of stakeholders. However, these responses certainly only reflect the scope of the respondents reached by the ISIpedia survey. Additionally the number of people in the different groups can be rather small. This underscores the relevance of existing ISIMIP-based research for a diverse group of users. At the same time, there is high interest in some sectors where modelling in ISIMIP has been more limited - such as coastal infrastructure and energy; we will aim to support and strengthen those sectors in the future.

In addition to the work currently planned at the involved institutes the ISIpedia Assessment and Editorial team will focus on inviting external contributions to ISIpedia that address the critical topics listed above. To motivate analyses aimed at addressing one of the most relevant topics shown in *Figure 6* the ISIMIP coordination team will discuss the organisation of an associated Special Issue with the sectoral ISIMIP coordinators after the ISIMIP3 simulation phase.

3.4. Use of Climate-Impact Information by Survey Respondents

Survey respondents were first introduced to the section “Use of Climate Impact Information” with a question asking for the “last question or issue they answered or addressed with climate-impact information” (*Appendix 9.1*, Q6). Additionally, survey respondents also keyed in (a) how they generally use climate-impact information, (b) how often and (c) what sources they currently use, as well as the advantages and disadvantages of these sources.

Unsurprisingly, with 43.5% (*Figure 4*) of survey respondents coming from academia or research, over 50% of responses indicated that they use climate-impact information as “*input for academic research*” (*Figure 7; nota bene*: respondents could choose multiple answers). Disregarding academic survey respondents (in green), climate-impact information is mostly used to “*support development of National Adaptation Plans*” and for “*public outreach and education*.” The two other options, “*lobbying decision-makers*” and “*organisational strategic development and economic planning*” account for 25% of the responses each.

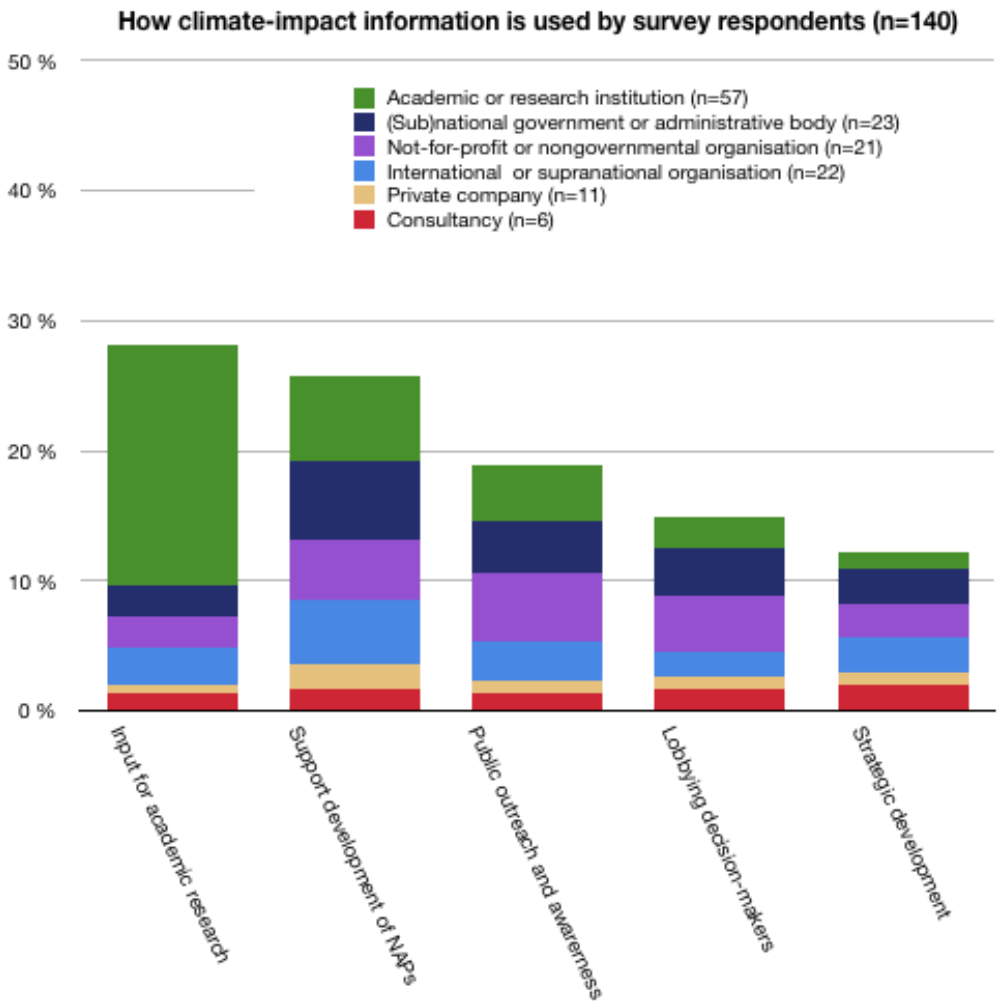

Figure 7: *Overview of how climate-impact information is used by survey respondents, split up by organisation types (n_{org}=140). Percentages were derived by dividing by the total number of responses ($n_{responses}$= 302). NAP stands for National Adaptation Plan.*

Response by the CSST and the Sectoral ISIMIP Coordinators:

Climate-impact information is being used for a wide range of tasks, according to *Figure 7*. We see a number of ways in which ISIpedia could make such information even more useful for some of these tasks.

Input for Academic Research
ISIpedia is intended to further facilitate the use of the ISIMIP simulations within academic research in particular regarding the use of data across sectors (e.g. for economic assessments covering impacts on multiple sectors) by providing a more convenient access to the raw simulation data, i.e. a more intuitive search for data that provides easy access for researchers that are not directly involved in ISIMIP or one specific sector.

Support development of National Adaptation Plans
We hope to inform national adaptation planning by at least providing climate impact projections under fixed present day socio-economic conditions as part of the already available ISIMIP2b simulations. While this is certainly not yet an assessment of different adaptation measures the projections could be used to estimate the purely climate-induced pressure on existing systems in a quantitative manner. This way ISIpedia would potentially contribute to the first step towards adaptation planning, namely climate risk assessment.

With regard to informing adaptation decisions it would be ideal if national adaptation plans could be translated into measures that can be implemented into the impact models participating in ISIMIP (e.g. higher fertilizer input, more irrigation, higher levels of flood protection, etc.). In this way it would become possible to test the effectiveness of the proposed measures in a quantitative way. In many sectors, however, the representation of adaptation options and processes in the models is challenging and may particularly build on their ability to reproduce observed variations in impact indicators under present day management and socio-economic conditions. The spatial resolution also poses some constraints on local adaptation planning (see discussion in *section 3.5*).
Despite these challenges, a better basis for the analysis of adaptation options will be discussed within the strategy group as one of the potential contributions of ISIMIP3.

Public Outreach and Awareness
To make climate-impacts information even more useful for public outreach and awareness-building, ISIpedia aims to translate scientific findings into national impact assessments that are easily accessible to the general public. There will be a strong focus on the development of intuitive graphics and metrics (such as the ranking of countries according to specific climate related risks). ISIpedia will also focus on supporting a basic understanding of the underlying processes to promote a "sustainable" awareness, less guided by short-term media attention or opinions but rather allowing for critical reflections.

We will discuss the idea of involving scientific communication experts into a review process for the ISIpedia articles to ensure that information is understandable and usable by stakeholders and the general public. The Stakeholder Engagement Team is planning regional capacity-building trainings for using ISIpedia to also include, more generally, interpreting and employing climate-impact data. The SET is also exploring the organisation of additional trainings through development of online capacity building activities.

Also within the survey section "Use of Climate-impact Information", survey respondents were asked to mention the last work-related questions for which they required climate-impact information (*Appendix 9.1, Q6*). The main result that can be extracted from the topic categories ('tags') assigned to each answer (see *Section 2.2* for methods) is that the respondents have a broad thematic interest for climate-impact information and can potentially make use of it for multiple purposes, consistent with the broad interests shown in *Figure 5 and 6* (*Figure 8*). In terms of aggregated percentages across organisation types, the results to this question align very much with the question on sectoral interest (*Figure 5)*, with freshwater systems (14%), river basins (7%) and agriculture (8%) having the three highest percentages. Some insights can also be derived by looking at the topic categories that were most mentioned by the stakeholders from specific organisation types, although the relatively low number of responses collected for some organisation types may reduce the relevance of such interpretation. Interestingly however, the only topic covered across all organisation types is **policy focus** with responses such as "national climate strategy" and "compliance with the Aichi Targets of the Convention on Biological Diversity." Notably, a larger percentage of NGO respondents' last question addressed **adaptation** and many of the topics last addressed by government administration, international organisations, and private companies deal with **freshwater availability** and **river basins**. Within academia, agriculture and health were two major topics. Health alone was mentioned by 8 respondents, all from academia. It should also be noted that some answers are not displayed in this graphic if they were not specific enough, or if they were only mentioned by one respondent.

Topic categories where climate-impact information was last used to answer a [work-related] question

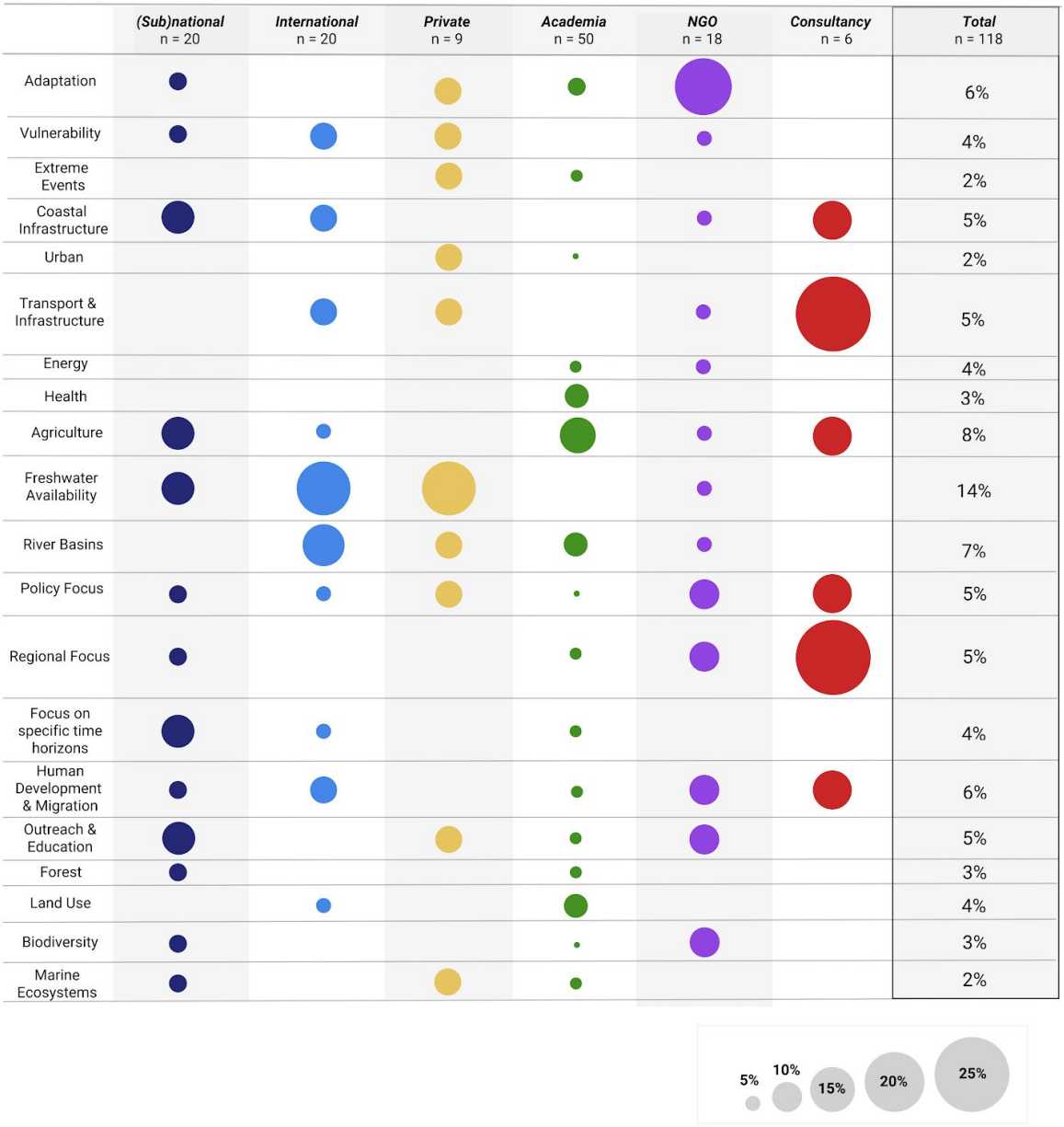

Figure 8: *Overview of topic categories where climate-impact information was last used to answer a work-related question, subdivided by organisation types where respondents work.*[1]
*** Note that this question asked only for the last question or activity that survey respondents used climate-impact information for (open-ended). This does not represent all topics that each organisation type deals with. It is rather a "hot topic" snapshot.*

While survey respondents use climate-impact information for a variety of purposes across many sectors, what is consistent is that they are using climate-impact information regularly. The majority of the survey respondents use climate-impact information daily, weekly or monthly (83%, *Figure 9*), confirming that the survey reached actual potential users of a climate-impact encyclopedia.

[1] Percentages in column "overall" fall just short of 100%, as three topics that were addressed only by one person each were left out.

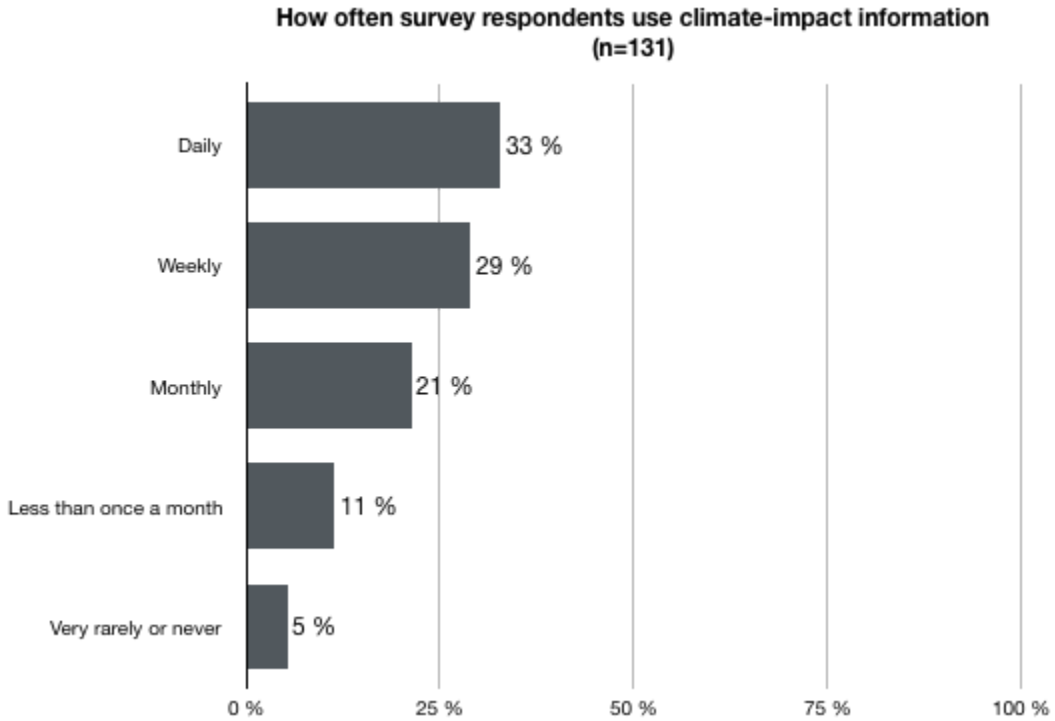

Figure 9: *Use of climate-impact information by survey respondents (n=131)*.

The two most common sources of climate-impact information that survey respondents currently use are articles in scientific journals (60%) and IPCC reports (44%, *Figure 10*). The respondents were also asked to list the advantages and disadvantages of the sources of such information they most use (*Table 1*). Advantages of the IPCC mentioned include that it is a "reliable" and "authoritative" source, however disadvantages include lack of specific information to a local scale or in specific regions such as Latin America and Caribbean.

Addressing these specific pros and cons, ISIpedia will offer high scientific quality by providing reputable and rigorous material, based on peer-reviewed literature and provided by scientific experts in the field. At the same time, in its national-level assessments ISIpedia will target information with a greater level of spatial detail than the IPCC. It will therefore provide potentially very useful material to complement existing reports published by national governments or serve as a basis for the elaboration of future ones, as they were identified by some respondents as "not detailed enough." In particular, it will deliver climate-impact information in regions where respondents have reported that it is critically lacking, such as Eastern Europe, Caucasus and Central Asia (EECCA) countries. Nevertheless, it should be noted that the limited spatial resolution of the ISIMIP climate impact models (that produce the results to be presented in ISIpedia) may not yet have the capacity to provide magnified enough assessments (for example in geographically small countries like the Small Island Developing States). In these cases, other regional and sector-specific climate services may have the potential to fill this gap.

In comparison to articles in scientific journals which were criticised by some respondents because they are "hard to understand for decision makers and for the general public," ISIpedia will address a broader, potentially non-expert audience. It should therefore be ensured that the information conveyed on the portal is understandable for this non-scientific audience. For this purpose, the content uploaded on the ISIpedia could be preemptively examined by a science communication expert.

Some respondents from Eastern Europe have also noted the lack of appropriate climate-impact information in Russian, which appears to be necessary for some of their outreach activities. Although the version of ISIpedia that will be made public at the end of the three-year phase (Fall 2020) will be in English only, its future extension to other languages should be made possible.

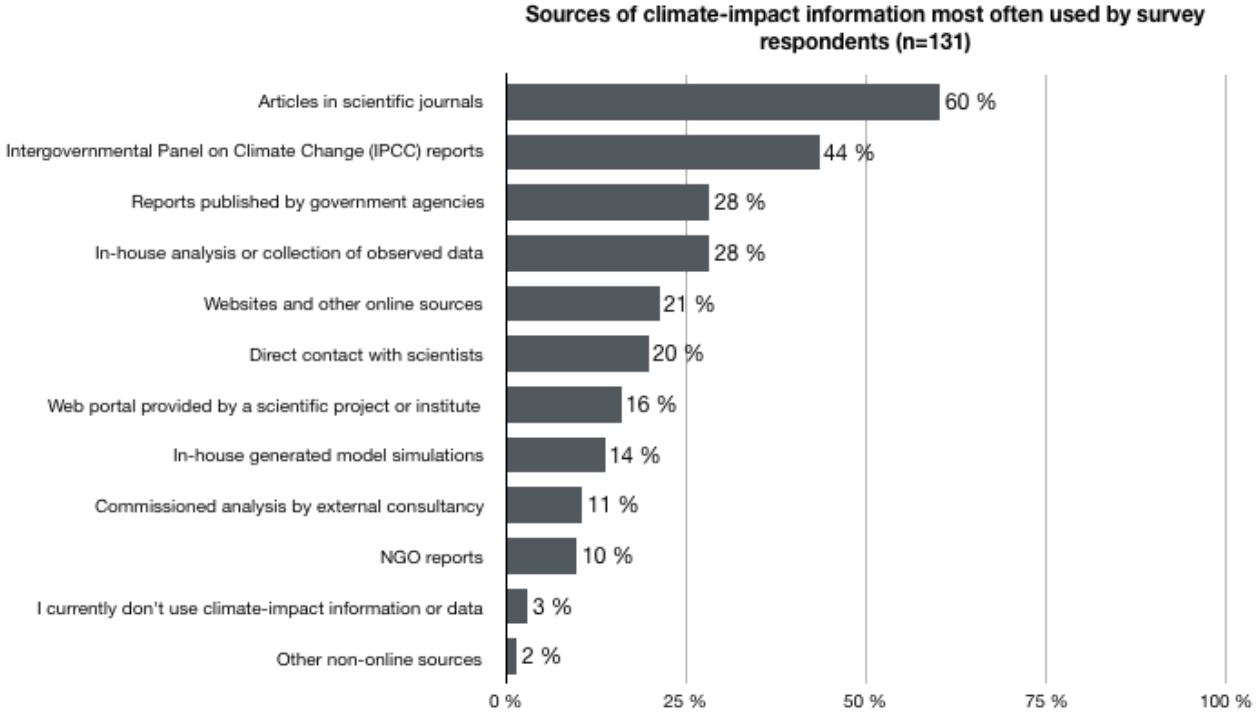

Figure 10: Source of climate-impact information most often used by survey respondents (n=131). Respondents had the possibility to select up to three choices.

Table 1: Overview of the advantages and disadvantages of sources for climate-impact information according to the survey respondents

Overview advantages and disadvantages of sources for climate-impact information		
Source	**Advantages**	**Disadvantages**
IPCC	• Well written, very wide scope, authoritative source • Most reliable scientific information	• Not practical for local scale planning • Limited information in Russian • Lack of information on Latin America and the Caribbean and even less data at local scale
Reports published by governmental, EU and UN agencies	• Provide measures oriented information	• No or little information on climate change impact mechanisms
Reports published by national governments	• Locally relevant	• Not detailed enough Potentially flawed
http://climate-adapt.eea.europa.eu and other EEA reports	• Comprehensive source of information • High relevance to the target audiences • Good visualisation	• Not very reader friendly, hard to find information you need • Limited information on EECCA regions and no information in Russian

Reports from ADB, USAID and other international agencies	• The report produces recent analysis	• There is no downscaled projection or assessment to specific location of the country
Articles in scientific journals		• Information is hard to understand for decision makers and for the general public
Reports from Regional scientific institutes (AGRHYMET, WASCAL, CRES, …)	• Directly applicable in the regional context to raise awareness about impacts of climate change • Multiple climate change scenarios available	• Use of global models, while regional scale needed • Cost to access information

Responses by the CSST and the Sectoral ISIMIP Coordinators:

Scientific standards
To ensure high scientific standards of the assessments ISIpedia assessments will be based on peer-reviewed literature and provided by scientific experts in the field.

Regional detail
ISIpedia intends to partly overcome the problem of the regional detail associated with IPCC assessments. The assessments will explicitly focus on national scale and offer information on all countries (see more detailed discussion on the spatial scale in *section 3.5*).

Translation into other languages
ISIpedia may need to be translated to other languages in the future to ensure its uptake in specific regions (e.g., West Africa and EECCA). The ISIpedia Stakeholder Engagement Team will explore options for at-request and crowdsourced translations (as mentioned above), with a particular attention and priority given to countries in the two ISIpedia focus regions that would need French and Russian translations. In general we would like to be able to provide translations of at least the relevant national assessments into Arabic, Chinese, French, Russian, and Spanish, e.g. the IPCC Reports are also translated in. However, that would require capacities not covered by the current ISIpedia project.

3.5. Barriers to Accessing Climate-impact Information

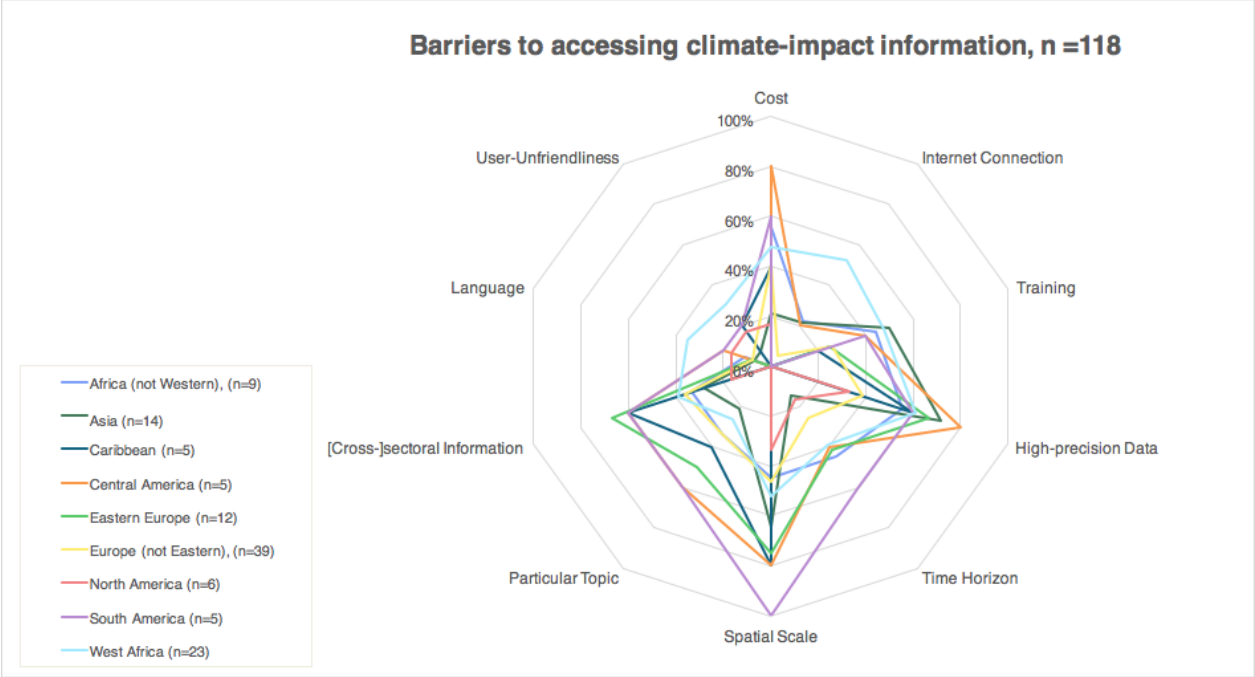

Figure 11: Topics presenting the barriers for the survey respondents (n_{region}=118), by region where the respondents are based.

One other crucial objective of the survey was to identify what currently restrains the capacity for scientists and decision makers to access relevant climate-impact information. Based on the assumption that barriers are often region-specific (due to regional data access, language, regionally-relevant sectors, etc) answers to this question have been cross-referenced with regional locations. *Figure 11* shows that two barriers seem to be present across several regions: (1) the lack of high-precision/accuracy in the data and (2) the lack of adequate spatial scale. Beyond these relatively common issues, certain obstacles are region-specific. For example, the cost of accessing climate-impact data (such as data behind a paywall or costs for subscriptions to scientific journals) in Central America, South America and West Africa, the lack of sector-specific data in Eastern Europe, the Caribbean and South America, and the absence of stable internet connection in West Africa.

Responses by the CSST and the Sectoral ISIMIP Coordinators:

1. Costs
ISIpedia impact assessments will be provided as a free climate service.

2. Spatial scale
Increasing the regional relevance of the climate impact simulations has a number of aspects, discussed below.

2.1 Resolution of climate projections
So far, the ISIMIP impact simulations are based on climate input data generated with Global

Climate Models (GCMs) at resolutions that range from 1° to 3° on a regular longitude-latitude grid (~100km - 300km at the equator). On this scale the GCMs do not provide a detailed representation of the orography and physical processes (such as convection or those that determine the dynamics of the midlatitude jet stream and the associated extratropical storms). These processes are implemented only in a simplified manner, if at all. So far, the GCM data were always interpolated to the finer 0.5° x 0.5° grid and then bias-adjusted such that long-term weather statistics over the historical period match the observations. This, to some extent, allows for a representation of climate (change) patterns on the finer grid but does not alter the representation of physical processes in the underlying climate model simulations.

However, there are regional climate models that use the coarse information from the GCMs for a dynamical downscaling to higher spatial resolution. In this case the relevant equations are solved on the finer grid allowing for a more detailed representation of orographic effects, land-sea wind, and urban effects on daily time scale (20 - 200km resolution) or even thunderstorms and sub-daily urban effects (2 - 20km resolution). However, these climate simulations are computationally expensive and generally only cover individual regions. Intercomparison projects such as CORDEX collect regional simulations to eventually provide high resolution simulations (about 0.5° x 0.5°) that cover the entire globe. However, these simulations are usually not globally consistent in the sense that the underlying global simulations stem from the same GCMs. Instead the regional simulations for different regions are usually provided by different modelling groups who used different global climate simulations to force their high-resolution regional climate models. As the global simulations have their own individual internal variability, this could mean that one year could be simulated as an El Niño year while in specific regional simulations, it is not an El Niño year. Even large-scale, long-term trends in the regional simulations are not consistent across regions, as they stem from different global simulations. As a guiding principle of ISIMIP, global and regional impact simulations have to be forced by the same climate input data. This is to a) allow for cross-scale comparison to learn to what degree more detailed regional *impact* simulations deviate from the representation of regional impacts in global impact models and to b) generally ensure global consistency of the impact simulations, allowing for impacts assessments that also account for global interactions of regional effects e.g. induced by trade (such as spikes in crop prices triggered by simultaneous crop failure in multiple regions), supply chain failures that may affect remote regions not originally subject to production losses, but also effects of climate change on e.g. global inequality and migration.

The ISIMIP team will discuss the issue of spatial resolution of the climate input data with the sectoral coordinators to identify a potential “target resolution” that can ensure that the ISIMIP3 climate input data i) have a substantially better representation of regional features of climate change than the climate input data provided in earlier project rounds, ii) cover the entire globe, iii) are bias-adjusted based on observational climate data with the same high resolution, and iv) can be handled as input for the global impacts models.

Regarding iii): The new re-analysis product ERA5 is announced to be released in late 2018. The follow-up of the ERA-Interim product, it will comprise the required list of variables and cover the period from 1979 to today with a horizontal resolution of 31 km. For ISIMIP3, it could be combined with MSWEP (Multi-Source Weighted-Ensemble Precipitation) observational precipitation data with a horizontal resolution of 0.1° and be used as the reference dataset for bias adjustment and to force historical simulations.

The generation of these data will most likely go beyond the capacities within the team. So the team will, in a second step, have to explore the option to work together with other partners who could generate the data. Thus, it is currently unclear whether such data will be available for ISIMIP3. The decision will critically depend on the decision whether ISIMIP3 simulation data and analyses should be available as input for the IPCC AR6. The current submission deadline for the associated impact analyses (**literature cut-off for WGII contribution to AR6: 1 July 2020**, TBC) seems to be too tight, specifically considering CMIP6 ScenarioMIP output will likely only become available on the ESGF (Earth System Grid Federation) in **~Feb/March 2019** (see also response(s) to *Figure 13*). Alternatively or additionally, ISIMIP3 simulations could be based on the output of

high-resolution simulations planned within CMIP6 *HighResMIP*. Note however that HighResMIP will primarily focus on a set of scenarios (the so-called DECK and historical simulations) that are not designed along future socio-economic storylines. The DECK consists of pre-industrial and historical simulations as well as experiments assuming i) an abrupt quadrupling of CO2 concentration and ii) a 1% per year CO2 concentration increase. If contributing to AR6 was given priority, then ISIMIP3 simulations could also be based directly on the DECK and historical simulations since output of those is the first to be published in CMIP6.

2.2 Representation of current regional socio-economic conditions and direct human influences in the impact models

The resolution of the climate input data isn't the only one issue affecting the regional relevance of the climate impact simulations. Additionally there is the representation of (present-day) regional management, infrastructure, and potential other direct human activities that determine exposure and vulnerability to climate change, therefore having an influence on many socio-economically relevant climate-impact indicators considered in the ISIpedia project.

Although these conditions and practices are expected to change in the future, a detailed representation of present-day conditions is a critical first step. It allows future projections to start from as-realistic-as-possible initial conditions, to estimate future risks and to estimate the demand for adaptation under the assumption of present-day, baseline socio-economic conditions. The representation of these conditions in the impact model simulations is still quite limited, particularly due to missing regional information that is centrally accessible to be implemented into global and regional climate impact models. While there is already a range of projects such as OpenStreetMap or GeoWiki, where information about infrastructure or land use patterns is collected, there is much more information needed to increase the regional detail of climate impact simulations. These data could range from information about sowing and harvesting dates or fertiliser input, to protection against flood events, local pollution affecting coastal or lake ecosystems, forest management potentially influencing the occurrence of wildfires, implementation of heat health action plans, etc. Collecting these data and making them accessible to the impact modelling community is a long-term processes that can only be initiated by ISIpedia.

The national impact assessments provided by ISIpedia are intended to include a section on model evaluation where historical simulations, forced by observed weather, will be compared to observational data such as crop yields, observed discharge, flooded areas, lakes' water quality, etc. These sections are planned to include a discussion on the most relevant, but currently missing, information about socio-economic drivers that may help to reduce the deviations between observed and simulated impact indicators. Stakeholders and regional experts will be invited to get into contact with the ISIpedia team if they can provide data that may help to fill the gaps. ISIpedia will provide the facilities for data upload and the ISIpedia team will (within the framework of current resources) support the transformation of the data into common file formats that are easy-to-use for the modellers. Ideally, the incoming data would step-by-step replace current default assumptions in global data sets, currently used as input for impact simulations. The database could slowly develop into a centrally accessible source of data that may help to raise to a new level the implementation of regional socio-economic conditions and direct human influences on impact indicators. Such a process means a long-term effort that critically depends on stakeholders' feedback and potential constraints on data sharing. However, ISIpedia will take the first steps. In addition, we will explore the options to collaborate with existing projects, such as GeoWiki or OpenStreetMaps, and explore the options of making this new ancillary data usable for impact modellers.

ISIpedia particularly invites regional scientists to contribute to the national assessments of their countries. We are seeking funding to establish a guest researcher program that could provide at least a limited support for scientists who would like to work together with the different teams at PIK, IIASA, or CA to develop national assessments based on the ISIMIP simulation data and their detailed knowledge about their country.

2.3 Calibration and validation of the impact models

An adequate representation of present day initial conditions does not only depend on the resolution of the input data but also on i) the processes resolved in impact models themselves and ii) the adjustment of uncertain model parameters to match historical observations.

For example, global hydrological simulations do not usually account for variable flow velocities, global crop models only partly account for nutrient constraints and fertilizer inputs, biome models do not account for individual species (and their potential extinction) but only for groups of plants (so called plant functional types). This causes some constraints regarding the conclusions that can be drawn from the models particularly on regional scales. On the other hand, a certain reduction of complexity in processes resolved is necessary in the models to reduce computational costs and allow for global-scale or long-term simulations. The limitations will be explicitly discussed in the model evaluation sections of ISIpedia. Those sections will include a comparison with historical observations, as one indication whether unresolved processes have had a strong regional influence on the considered impact indicators so far. In addition, whenever there are regional simulations available that additionally resolve potentially relevant regional processes, the global simulations will also be compared to the regional ones to get an idea of the limitation of the global models.

The consistency of global and regional model simulations would even allow for a partial and optional replacement of global simulation data by regional simulations, i.e. the potential generation of a global data set implementing the “best” regional information available.

In addition, global impact models are only calibrated to a very limited extent (e.g. global crop models are often calibrated to match long-term average levels of nationally aggregated crop yields), while regional impact model simulations such as for individual lakes and river basins are usually subject to a detailed calibration. Again, the evaluation of the global models will comprise a comparison to the regional simulations where available. A comprehensive model evaluation and an approach to increase robustness of the simulated impacts at the regional and river basin scales suggested recently (Krysanova et al., HSJ, 63:5, 696-720, 2018) will be tested by the regional and global water modellers.

3. Sectoral coverage
As an intersectoral impact model intercomparison project, ISIMIP is intended to cover as many sectors as possible. Ultimately, the coverage depends on the availability of models and on ISIMIP’s attractiveness for modelling groups to contribute results and make them freely available.

4. Precision of data
Precision of climate impacts projections is limited by the spread between impact models and between climate models, ultimately representing prevailing knowledge gaps of different kinds. Some of the existing knowledge gaps have been mentioned above; others include complex atmosphere-ocean dynamics that prevent, to date, a reliable simulation of precipitation changes in some parts of the world. ISIMIP embraces its role in advancing climate impacts science to reduce the knowledge gaps pertaining to climate impacts modelling, while initiatives like CMIP are focusing on improving climate models.

Nonetheless, climate impact information will always come with some uncertainty. Therefore, a central aim of ISIpedia will be a proper, understandable representation of the uncertainty associated with the information provided. See *section 4.3*.

5. Selection of topics
ISIpedia aims at addressing the user needs as far as possible. This survey is intended to develop a better understanding of the demands. Our initial responses are e.g. given in *section 3.3*.

4. Input on Content Elements

The future ISIpedia platform primarily intends to deliver global-scale as well as national-level impact assessments with global coverage on the multi-sectoral and cross-sectoral impacts of climate change. Beyond the identification of the topics of highest interest to the targeted group of stakeholders (see *Section 6*), one of the purposes of the survey was to understand how the information provided on the future ISIpedia platform should be framed in order to best match the needs of its users. Concretely, a couple of questions were included to ask what content elements should be included, how uncertainty should be presented, what time horizons and spatial scales should be addressed by the assessments, and which climate-impact indicators are of interest to the survey respondents.

Response by the CSST and the Sectoral ISIMIP Coordinators:

The Responses given in *Section 4.1* "Potential Elements and Background Information in ISIpedia Assessments Reports" and *Section 4.2* "Time Horizons" have already informed the decision on the content elements that will be considered. They represent the basis for the published tender by which we are seeking a web company that will be responsible for the technical development of the portal and the implementation of the following content elements forming individual sections of the national impact reports:

Categories of ISIpedia national impact assessments

1. *Description of present-day conditions*: This category provides access to observed or reported information on current socio-economic conditions (e.g., national population, national GDP, number of people employed in agriculture, development index, etc.) and bio-physical indicators (e.g., national wheat production, number of people currently living under water scarcity, number of people affected by hunger, etc.)
2. *Historical impact observations (detection and attribution)*: This part of the assessment will describe observed trends or historical extreme events in climate-impact indicators and particularly address the question to what degree these trends or events can be attributed to weather variations or other direct human drivers, such as historical changes in agricultural management practices. The analyses may be based on historical impact models simulations forced by observed historical climate.
3. *ISIMIP impact projections*: This part of the assessment will include the analyses of the future projections generated within ISIMIP. All impact simulations discussed here will be based on climate *simulations* instead of climate *observations* used for the previous type of analysis. The considered climate and socio-economic scenarios will all follow the ISIMIP simulation protocol.
4. *Paris projections of impacts*: In this section the ISIMIP-based impact simulations will be interpolated to a climate change scenario that is derived from the the most-up to date mitigation targets submitted within the UN climate negotiations, i.e., under the Paris agreement. As soon as a country decides to update its pledges we will estimate the expected effect on global mean temperature development and adjust the expected impacts accordingly.
5. *Model evaluation*: This category is dedicated to different types of model evaluations, such as difference between reported national crop production and the associated historical simulations, capacity of models to reproduce the extent of historical flood events, and a discussion of the potential reasons for associated discrepancies, such as insufficient knowledge about direct human influences, etc.
6. *News*: Here we will collect impact-relevant news, such as information about the water crisis in South Africa, but also on critical progress in climate impact research, or the

publication of an important impact-related report or an important decision within the UN negotiation context.

The individual elements will be presented in more detail and in response to the demands described by the stakeholders below.

4.1. Potential Elements and Background Information in ISIpedia Assessment Reports

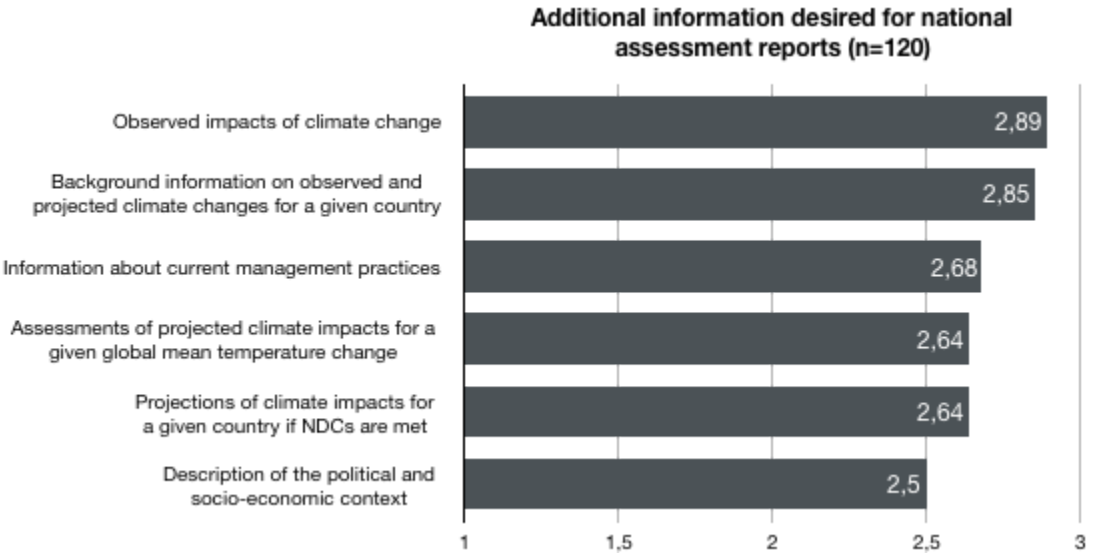

Figure 12: Rankings of topics that should be addressed by ISIpedia (n=120). For each topic, the answers were weighted (very important = 3, moderately important= 2, not important= 1) to calculate the average score.

One survey question drew a list of additional content elements that could potentially be added to the global-scale and national-level assessments. These elements are suggested as a method to put the information on climate impacts into a broader context, or to present it in an alternative and potentially useful way. A majority of the 120 respondents considered it very important to include information on all of the listed options (*Figure 12*). While all the options had high rankings (2.5 or above), meaning that the majority of respondents considered them important to have, the choices on **observed and current impacts** and **observed and projected climate changes** were more highly ranked than information on projected impacts for a given global mean temperature change or in case all countries achieve the promises to reduce greenhouse gas emissions they expressed in their Nationally Determined Contributions (NDCs, as part of the Paris Agreement). The option *"Description of the political and socio-economic context"* was overall considered to be slightly less important.

Similarly high overall rankings were found in the responses to another similarly framed question, which suggested a list of background information and methodological information elements that could be included to help in understanding the climate-impact information presented on the ISIpedia platform. All the suggested options on model reliability,

assumptions underlying models, and how the models work were considered as being very important by the majority of the 121 survey respondents to this question (*Figure 13*).

Response by the CSST and the Sectoral ISIMIP Coordinators:

Observed impacts of climate change
Given the strong demand for the analysis of observed impacts, the national impact assessments generated within ISIpedia will include a section on "observed impacts" that is intended to combine observed extreme events or trends in impact indicators with impact simulations forced by observed climate. This is to identify the drivers of the observed features, i.e. to address if these observed features were mainly caused by direct human influences (such as water crisis caused by increasing depletion of reservoirs due to higher demand for industrial or domestic use) or weather variations (such as persistent drought).

The high demand for analyses of observed impacts of climate change provides an indication to include a set of historical simulations forced by observational climate input into the ISIMIP3 protocol. While ISIMIP2a already covers this kind of historical simulations it seems to be relevant to update them to track the progress in impact model development and potentially adjust the scenario set-up to e.g. address the attribution question. This could be done in two different set-ups:

A - Impact model simulations forced by
i) observed climate and observed direct human influences and
ii) a potential realisation of pre-industrial climate generated by detrending the observational time series and observed direct human influences
B - Impact model simulations forced by
i) observed climate and observed direct human influences and
ii) observed climate and fixed direct human influences

Moreover, historical simulations should be extended in time as more recent observational climate data become available.

Simulations could be forced by high resolution historical data (up to 0.3° x 0.3° if doable, see discussion of a high resolution target data, set for the bias-adjustment of climate projections in response to *Figure 11*).

The suggestion will be discussed with the sectoral coordinators and a decision will be taken at the ISIMIP Strategy Group Meeting in September.

Background information on observed and projected regional climate change
The demand will be met by ISIpedia by ensuring that each figure showing changes and variations in impact indicators is accompanied by a figure showing the associated changes and variations in temperature and precipitation. While the impacts-related figure will be the first layer of information, users will be able to access the background information on climate by a link directly related to the first layer figure. The climate information will be provided for both historical observations as well as climate simulations. For the simulations we will not only show the reduced set of climate data that has been used to force the considered impact simulations but also put it into context of the entire ensemble of climate simulations generated within the climate model intercomparison project CMIP. While the impact simulations generated within ISIMIP will not cover the entire range of climate model simulations, this comparison will allow the user to at least evaluate whether the considered climate models shows, for instance, a rather strong reduction in precipitation compared to other climate model simulations.

I**nformation about current management practices**
The background information on observed and projected regional socio-economic drivers

considered within the models will be displayed in a similar way on the secondary "information layer" of ISIpedia. Such drivers include population and land use changes, freshwater demand, fertilizer input for agriculture, or crop-specific growing seasons, among others. In contrast to the climate model data, the accounting for these drivers will differ from impact model to impact model, i.e. the associated plots will contain individual impact model specific graphs or maps. The considered global data sets on present day management are often rather coarse. Users will be invited to provide better data if they identify deviations from actual practices (see *section 2.2* of our response to *Figure 11*).

Impact projections in terms of global mean temperature and for NDC-based pathways
It has been shown that a number of *biophysical* impact indicators show a rather direct response to global mean temperature changes that does not strongly depend on the underlying emission scenario. In other words, plotting simulated regional impacts against the global mean temperature change often shows some kind of functional relationship between both variables that is identical for different emission scenarios, i.e. data points from different scenarios more or less fall on one line. In these cases, impacts can easily be translated from one global mean temperature pathway to another, including pathways based on NDC emission reductions. We plan to follow this approach to generate NDC-based assessments for ISIpedia. In addition, simulated impacts will also be shown for different fixed global mean temperature levels such as 1.5°C, 2°C and 3°C. To this end, simulated impacts from considered emission scenarios will be "grouped" according to their global mean temperature levels and averaged accordingly.

There is also a group of *biophysical* impacts where the indicator does not show a simple relationship with global mean temperature changes, but e.g. shows an additional dependence on time. For example, the full sea-level rise caused by a given level of global warming will only be realised over hundreds of years. In these cases it may still be possible to derive a—more complicated—functional relationship accounting for global mean temperature change and timing. Where available (e.g. for sea level rise) we will apply these approaches for an NDC-based assessment of impacts.

On the other hand socio-economic impact indicators such as "number of people exposed to extreme events", "economic losses induced by flooding" etc. do not only depend on global mean temperature levels but also on the underlying socio-economic conditions such as population patterns or economic development etc. which could stem from different socio-economic projections (e.g. the Shared Socioeconomic Pathways, SSP) and will be selected according to the ISIMIP protocol.

Description of political and socio-economic context
ISIpedia is intended to provide a basic description of these backgrounds as part of each national impact assessment. While an in depth description is beyond the capacities of the ISIpedia team it may at least partly be provided by invited experts. A basic description giving some information about the national background will be based on available indicators such as population densities, GDP, World Development Indicators collected by the World Bank, employment in agriculture, but also current levels of impact indicators such as national crop production, or a ranking according to the current Global Climate Risk Index derived by Germanwatch. While certainly not comprehensive, the provided political and socio-economic context is intended to focus on indicators that help to estimate the countries' sensitivity or vulnerability to climate impacts.

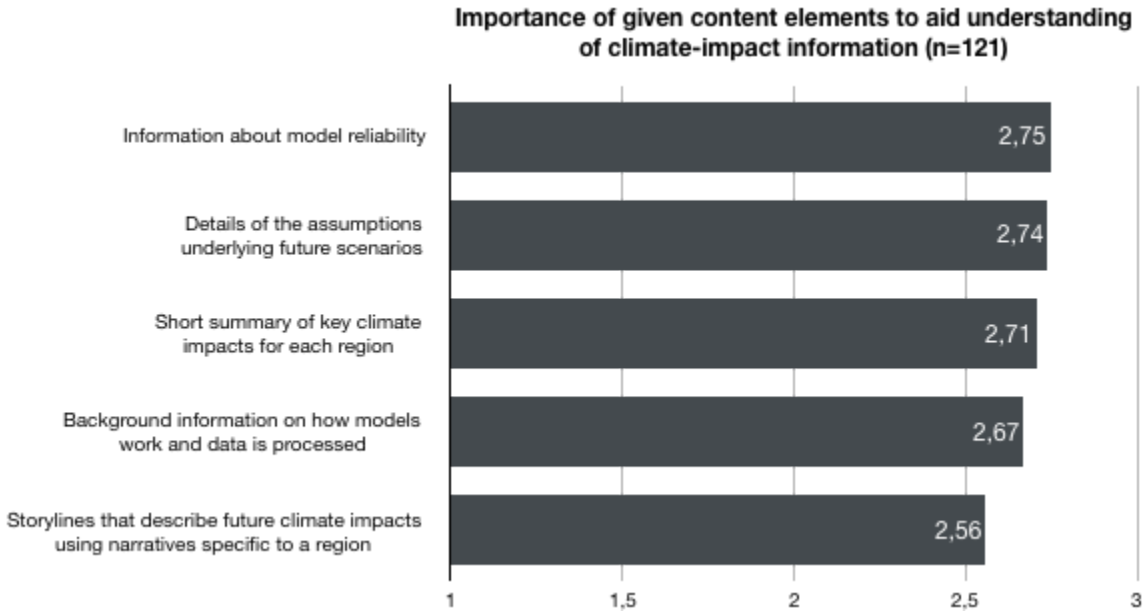

Figure 13: Interest of the survey respondents (n=121) in being able to access information on the listed options on the ISIpedia platform. The scores are averages for each possible answer ("very important", "moderately important", and "not important"), which were attributed a weight of 3, 2 and 1, respectively.

Response by the CSST and the Sectoral ISIMIP Coordinators:

The fact that the provision of background information about models and scenarios is ranked as very important by stakeholders (*Figure 13*) supports ISIpedia's approach of going beyond a mere presentation of best-guess results and providing several layers of context.

Information about model reliability
Model evaluation is intended be an important part of the ISIpedia national assessments (see box on ISIpedia content elements).

Details of the assumption underlying future scenarios
Each Figure describing simulated and observed changes in impact will be accompanied by the associated background information on observed or simulated climate and socio-economic drivers (see response to *Figure 12*).

Short summary of key climate impacts for each region
Each national or global assessment will start from a short summary of key climate impacts. The key message will partly be automatically generated based on a ranking of impacts across all countries. That means that a statement about a certain national-level impact will become a "key message" in the associated country assessment if the impact is e.g. among the 10 highest across all countries.

Background information on how models work and data is processed
This information about the process representation in the models will become part of the "model evaluation" section which will include a discussion on model (and data) limitations (see e.g *Section 2.2 and 2.3* of our response to *Figure 11* above). The information about the calculation of the considered impact indicator will be directly linked to the displayed figures. Similar to the information about the background climate and the background socio-economic development it will be accessible through a button providing access to the second layer of information behind each figure of impact indicators. The same kind of background information will be provided for the indicators, describing the current socio-economic conditions such as the Human Development

Index, etc. ISIpedia will be designed to present all information as transparently as possible, because only a good understanding of the provided information really makes it applicable.

Storylines that describe future climate impacts using narratives specific to regions
Developing relevant socio-economic storylines for future impact projections may be one of the major challenges for ISIMIP3. Ideally the development will be done in close interaction with regional experts and stakeholders. Within the scientific community five specific storylines, the so called Shared Socio-economic Pathways (SSPs), have been established. They are designed to describe the range of different potential future challenges for mitigation and adaptation:

- SSP1 Sustainability ("Taking the Green Road"): low challenges for mitigation (resource efficiency) and adaptation (rapid development)
- SSP2 Middle of the Road: Intermediate challenges regarding mitigation and adaptation
- SSP3 Regional Rivalry ("A Rocky Road"): high challenges for mitigation (regionalized energy / land policies) and adaptation (slow development)
- SSP4 Inequality ("A Road Divided"): low challenges for mitigation (global high tech economy), high for adaptation (regional low tech economies)
- SSP5 Fossil-Fueled Development ("Taking the Highway"): high challenges for mitigation (resource / fossil fuel intensive) and low for adaptation (rapid development)

All these storylines have been translated into some kind of quantitative data, such as population distributions or national GDP, that can be used to force future impact simulations. Within ISIMIP2b we managed to generate SSP-consistent projections of land use changes and fertilizer input in cooperation with Integrated Assessment modellers. SSP-based scenarios of future freshwater demands and withdrawals are available from the Water Futures and Solutions (WFaS) project, and may be developed further by the hydrological modelling teams. However, for other relevant aspects, in particular regarding the implementation of adaptation options, scenarios are still only qualitative or do not exist at all (see discussion on National Adaptation Plans in context of *Figure 7*).

At the recent Lead Author Meeting of IPCC Working Group I (27 June 2018), it was decided for the following scenarios to be common across all future projection chapters and the Atlas of the WGI contribution to the IPCC AR6:

From Tier 1 of CMIP6 ScenarioMIP (climate projections probably becoming available in March 2019)

- SSP1-2.6 (SSP1 + strong mitigation scenario reaching 2.6 W/m2 radiative forcing from greenhouse gases and other forcing agents above pre-industrial levels in 2100, mean warming of 1.6°C in 2081-2100 compared to pre-industrial levels according to CMIP5 ensemble)
- SSP2-4.5 (SSP2 + intermediate mitigation scenario reaching 4.5 W/m2 radiative forcing from greenhouse gases and other forcing agents above pre-industrial levels in 2100, roughly 2.4°C of global warming in 2081-2100 compared to pre-industrial levels according to CMIP5 ensemble),
- SSP3-7 (SSP3 + high emission scenario reaching 7 W/m2 from greenhouse gases and other forcing agents above pre-industrial levels in 2100, not yet considered in CMIP5),
- SSP5-8.5 (SSP5 + very high emission scenario reaching 8.5 W/m2 radiative forcing from greenhouse gases and other forcing agents above pre-industrial levels in 2100 roughly 4.3°C of global warming according to CMIP5)

From Tier 2 of CMIP6 ScenarioMIP

- SSP1-1.9 (SSP1 + very ambitious emission scenario reaching 1.9 W/m2 from greenhouse gases and other forcing agents above pre-industrial levels in 2100, not yet considered in CMIP5 but designed to represent a 1.5°C scenario).

It is to reach a high degree of scenario consistency across the new IPCC-AR6. Thus these scenarios are likely to become central for the WGII contribution to the AR6 on climate change

impacts, too. ISIMIP may support this process by at least partly covering the adopted scenario set-up. This will be discussed with the sectoral coordinators to come to a final agreement at the ISIMIP Strategy group meeting.

The combination of different climate change and socio-economic scenarios makes it particularly difficult to derive the pure effect of climate change on climate indicators. Thus, the ISIMIP3 protocol may have to include additional simulations where the socio-economy is fixed at present day levels and only climate varies according to the selected scenarios. This aspect will also be discussed with the sectoral coordinators in preparation of the Strategy Group Meeting. Such a setting would particularly allow for a "fast track" of simulations that do not depend on the translation of the SSP storylines into impact-model inputs and therefore leave some extra-time to work on these translations while a first set, based on fixed socio-economic conditions, may still become available in time for the IPCC AR6.

Finally, the **timeline** for the AR6 must be considered: Cutoff date for paper submissions for WG2 is 01 July 2020, however it is advisable to submit papers already by spring 2019 so that IPCC authors can include them in the internal draft (due 26 April 2019).

4.2. Time Horizons of Interest

The survey respondents indicated overall that climate-impact information for *the current period* was most relevant to their work (option chosen by 59% of the respondents, *Figure 14*). The answer of second highest relevance was "by *2050*" (50%), followed by *"in 10-20 years"* (44%), *"by 2100"* (38%), *"the historical period (from the mid-19th century up to the current period)"* (37%), *"in 5-10 years"* (33%), *"in 1-5 years"* (31%), *"up to one year in the future"* (16%), *"the pre-industrial period (before the 19th century)"* (11%), and *"by 2300"* (5%).

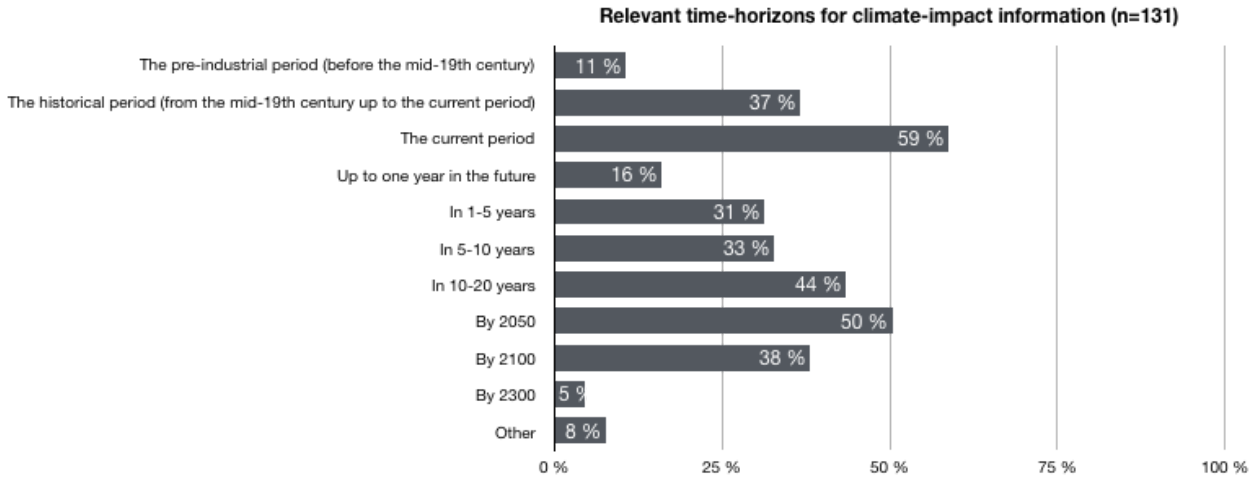

Figure 14: Relevant time-horizons for climate-impact information for survey respondents (n=131).

This distribution is fairly similar across the regions of interest (*Figure 15*), with distinct peak for current projection, but still exhibits some variations across regions. Some regional peaks occur for the time scale 1-10 years, however, the relatively small number of respondents for each region precludes drawing robust conclusions on these regional differences.

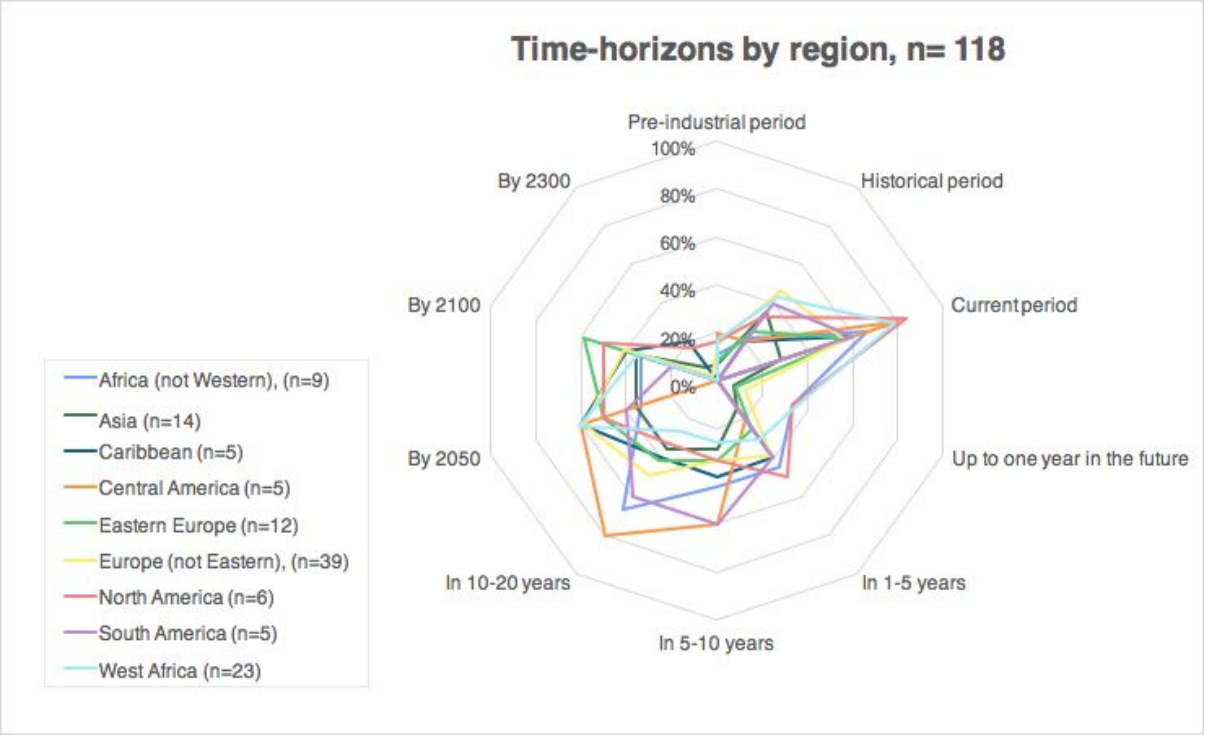

Figure 15: Time horizon of highest relevance for the survey respondents (n_{region}=118), divided by region of origin of the respondents

Compared to other group of respondents, employees from private companies, consultants and NGO members are more interested in near-term information (*Figure 16*). While the focus of respondents is on the current and near future, the historical period was also marked as relevant for over a third of respondents.

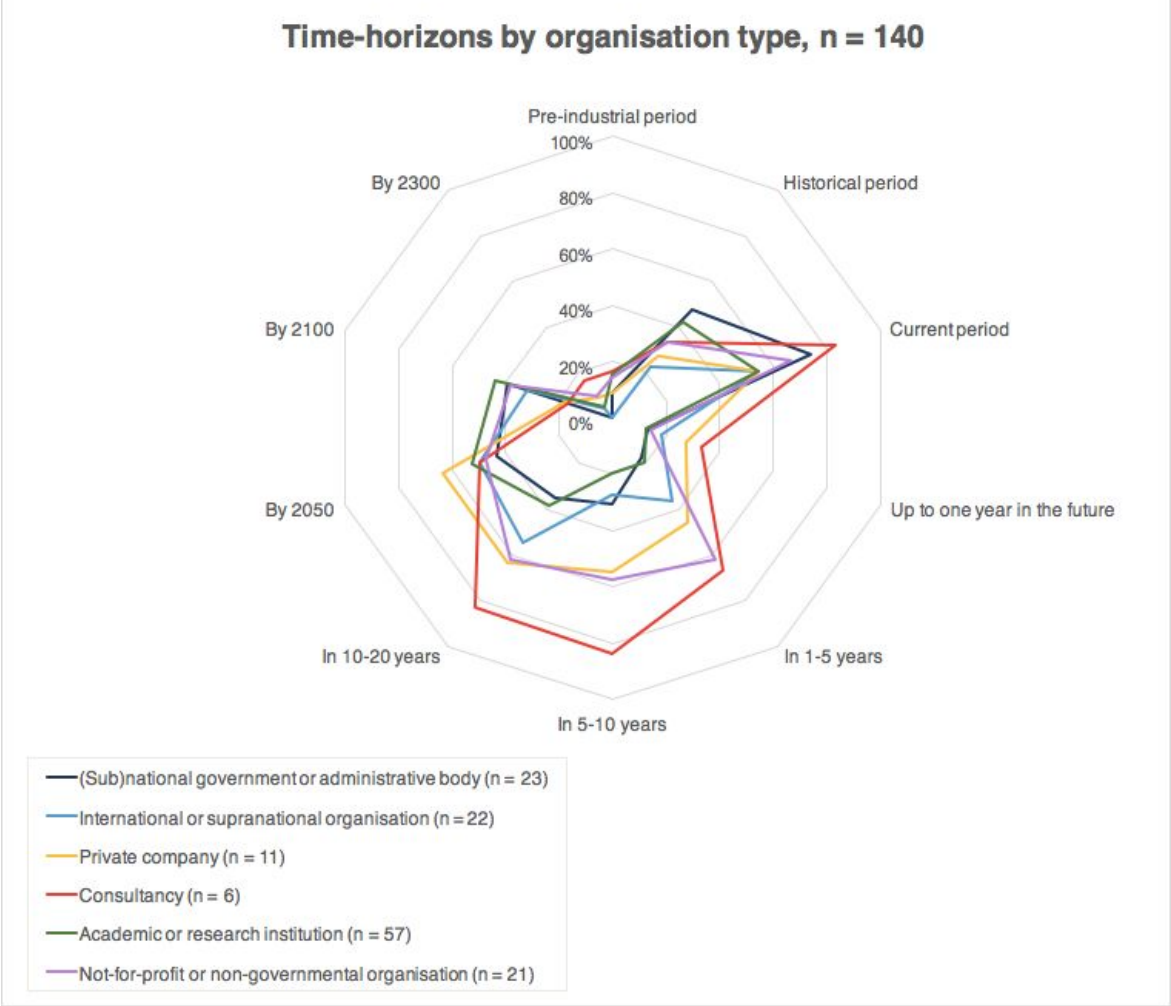

Figure 16: Time horizon of highest relevance for the survey respondents (n_{org}=140), divided by region of origin of the respondents.

Responses by the CSST and the Sectoral ISIMIP Coordinators:

We clearly recognize the demand for historical simulations and short- to medium-term future projections.

The first demand could be addressed by the inclusion of historical impact simulations forced by observed climate, as they were conducted in ISIMIP2a. This also helps address the demand for model evaluation.

Regarding the demand for short- to medium-term future projections, there are a few issues to be considered: The climate simulations generated within the CMIP6 ScenarioMIP do not provide climate *predictions* in the sense that the simulated weather, in e.g. 2020, may not correspond to the actual weather in 2020. Even the historical simulations do not match the observed variability of weather or fluctuations such as the El-Niño-La-Niña cycle. Instead the climate models generate

their own internal variability of weather. They are not constrained by the observed variability designed to provide projections of long term changes in trends and variability. 1-10 year predictions of climate impacts would be very challenging and complex. The strategy group may discuss whether and how results from the WCRP Decadal Climate Prediction Project or other relevant exercises could be applied in impacts modelling.

4.3. Communication of Uncertainty

The proper communication of uncertainty is crucial for supporting ISIpedia users' experience with and usability of climate-impact information presented. One survey question specifically intended to understand how the respondents prefer to receive information on uncertainty (*Appendix 9.1*, Q19). The results to this question indicate a clear preference for getting information on uncertainty in graphical and quantitative forms, rather than in text and qualitative forms (*Figure 17*).

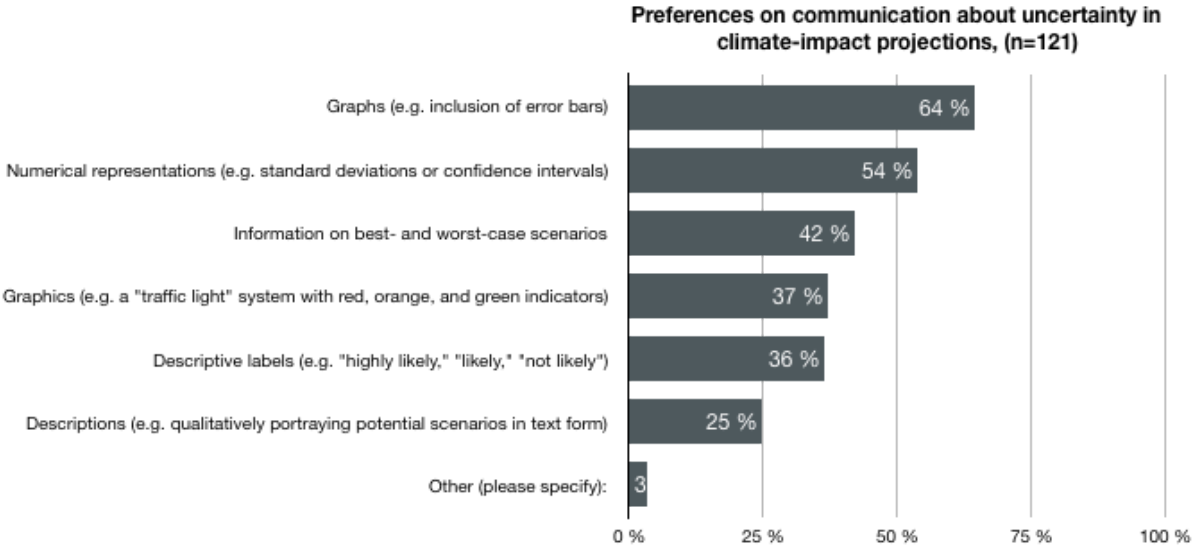

Figure 17: Preferences of the survey respondents on communication about uncertainty in climate-impact projections (n=121).

The inclusion of information on uncertainty in *graphs* was requested by at least 50% of the respondents from all organisation types listed in Section 3 (*Figure 18*). However, some variations in the results can be observed depending on the type of organisation the respondents belong to. Employees from private companies have a higher preference for quantitative information, while the consultants have a clear interest in *information on best and worst-case scenarios*. There also exist strong variations in the interests for *graphics* and *descriptive labels* between the various groups of respondents, with NGOs exhibiting a higher percentage of respondents who prefer qualitative communication of uncertainty and private company with the least preference for qualitative forms.

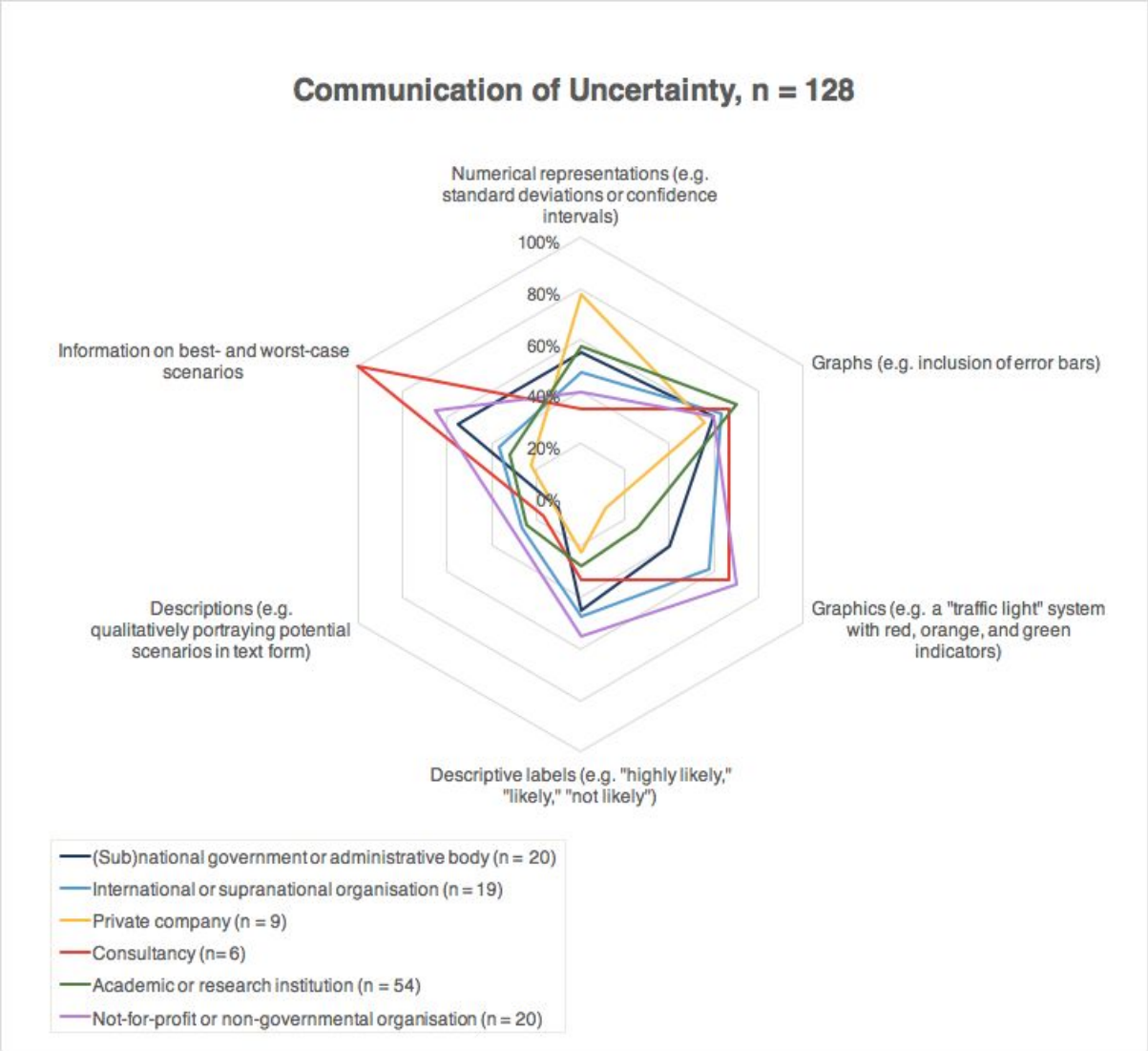

Figure 18: Preferred means to receive information on uncertainty according to the survey respondents (n_{org}=128), divided by the organisation types to which they belong.

Response by the CSST and the Sectoral ISIMIP Coordinators:

As a first step ISIpedia will include a very basic set of plots partly including information about uncertainties. The implementation of the following visualisations are included in the ISIpedia tender for a web company:

1. Ranking of countries according to the considered indicators
Much of the impact or socio-economic information will be provided as a rank of the country according to the considered indicator (e.g., relative reduction in crop production projected for a given level of global warming etc). The visualisation will have to be designed by the web company and should display the range of rankings derived from different climate and impact model projections as a measure of uncertainty.

2. Global maps of impacts on national level
Interactive global map where each country gets a color according to e.g. the projected change in wheat yields at a selected level of global mean temperature change. At mouse-over, a country specific panel will pop up to provide some information about the spread of the underlying multi-model simulation data. By clicking on the country, the user should be guided to the

associated country assessments. The world maps and "uncertainty panels" still have to be designed in cooperation with the Fachhochschule Potsdam (Potsdam University of Applied Sciences).

3. National time series of changes in impact indicators
The national assessments will also include time series of impact simulations, i.e., a figure showing model-specific lines describing the projected changes of a considered indicator against time. Again the figures (and associated interactive features such as pop-up labels providing the name of the underlying impact model on mouse-over) still have to be designed in cooperation with the Fachochschule Potsdam.

4 National global mean temperature series of changes in certain indicators
The national assessments will also comprise figures where the changes in the considered impact indicators will be plotted against the underlying global mean temperature change instead of time (e.g., national changes in wheat yields at 0, 1.5, 2, 2.5, 3, 3.5, and 4°C of global warming). The figures will be designed and pre-processed as the ones described above.

5 National maps of gridded impact data
The national assessment will also comprise national maps of impacts (observed or projected multi-model medians or means for a given time period or global mean temperature level). These maps will also be generated in cooperation with the Fachochschule Potsdam and a specific design for the representation of uncertainties still has to be developed.

Different versions of these plots will be developed in the course of the project and shared with the Stakeholder Engagement Team to find an appropriate solution fulfilling the stakeholder demands regarding the representation of uncertainties.

While the figures will only represent uncertainties as represented by the spread of simulation results across different climate and climate impact models, other levels of uncertainty such as a general limitation in process representation will be discussed in the model evaluation section.

4.4. Indicators

One survey question asked respondents for the sector-specific indicators that they use for their work, for the sectors for which they had previously indicated their interest (see *Section 3.3*). Due to the open-ended nature of the question, a wide range of answers were collected in various languages. Although a definition of climate-impact indicators was included in the survey, some answers related to climate variables or vulnerability were listed instead of impact indicators. This may illustrate some misunderstanding about what climate-impact assessments can provide, or that the respondents' interests and needs lean towards a more comprehensive approach, i.e. potentially going all the way down the impact assessments chain, from the analysis of climate changes to vulnerability assessments.

Even though the respondents expressed interest in a long list of indicators, some of them clearly appear to be more important, as they were mentioned more often. For brevity's sake we include a list of those for each sector in *Table 2*, which provides an overview of the respondents' priorities (the full list is included in *Appendix 8.3*). This can also constitute a basis for the indicator workshops to be held at the end of 2018 and early 2019 in the focus regions of ISIpedia, and which aim at identifying climate-impact indicators of highest relevance for the stakeholders of these regions.

Table 2: List of sectoral indicators mentioned most often by the survey respondents as being used in their work

	# usable answers	Indicators (# of mentions)	Minimal # of mentions for the indicators to be listed
Agriculture	57	Crop yield (41), growing season (14), livestock production (10), agricultural prices (7)	5
Freshwater systems	42	Water availability (20), flood frequency (15), drought frequency (12), water quality (9), runoff (8), flood intensity (8), flood duration (6), drought intensity (6)	5
Biodiversity	41	Species richness (14), Biodiversity (10), Species distribution (5), Forest degradation (4)	4
Forestry	37	Carbon sequestration (5), Species distribution (5), Fires (5), forest area (4), forest production (4)	4
Health	33	Air quality (9), temperature-related mortality (9), disease prevalence (9), food security (6) water quality (5), nutritional value of food (5)	5
Energy	31	Share of renewables in the market (8), Hydropower (6), water use intensity (5), Energy availability (4), Energy mix (4)	4
Coastal infrastructure	25	Sea-level rise (6), Sea intrusion (3)	3
Marine ecosystems and fisheries	19	Fishery production or total catch (4)	3
Permafrost	4	Melting rate (2)	2

Given the possibility to conduct analyses of climate impacts across various sectors with ISIMIP data, one question was also included to understand the interests of the survey respondents for indicators derived from such cross-sectoral analyses. A list of cross-sectoral indicators was thus suggested. All of the suggested options were considered as very helpful by at least 50% of the respondents, with weighted averages all above 2.4 (out of 3, *Figure 19*).

Response by CSST and the Sectoral ISIMIP Coordinators:

Most of the listed indicators are model outputs and are available in ISIMIP2b or are expected to become available within ISIMIP3. However, so far we *cannot* directly provide estimates for:

- Livestock production,
- agricultural prices,
- water and air quality,
- disease prevalence,
- food security,
- nutritional value of food.

It partly needs the participation of other modelling teams, e.g. for livestock production and for health aspects other than temperature-related mortality. The ISIMIP team will try to get these other modelling teams involved. Food security is another problem that has many dimensions. We will most likely only address individual dimensions, such as food production and potentially agricultural prices or nutritional value of food.

Changes in water quality are still very difficult to address at global scale due to i) data availability (water quality, infrastructure, etc) and ii) processes, that occur on much higher spatial scale than 0.5° and iii) the cross-sectoral character of the topic that needs a close integration of the agriculture and water sector. Providing the opportunity for these linkages is certainly at the core of ISIMIP. However, it will probably be first realised at the regional scale. The lake sector is planning to address the issue in potential cooperation with the regional water modellers since lake water quality can hardly be isolated from tributaries' water quality. This may lead to simulations where river and lake water quality are solved together.

Regarding disease prevalences there is at least one EU proposal submitted that could provide required funding for for some health modeling groups to run ISIMIP simulation.

Most of these suggestions echo ongoing work or planned efforts based on existing ISIMIP data. However, the derivation of information on the "cost of adaptation measures" does not seem feasible for most sectors in the current ISIMIP setup, and would require substantial conceptual modifications (see also the discussion in *Section 6*).

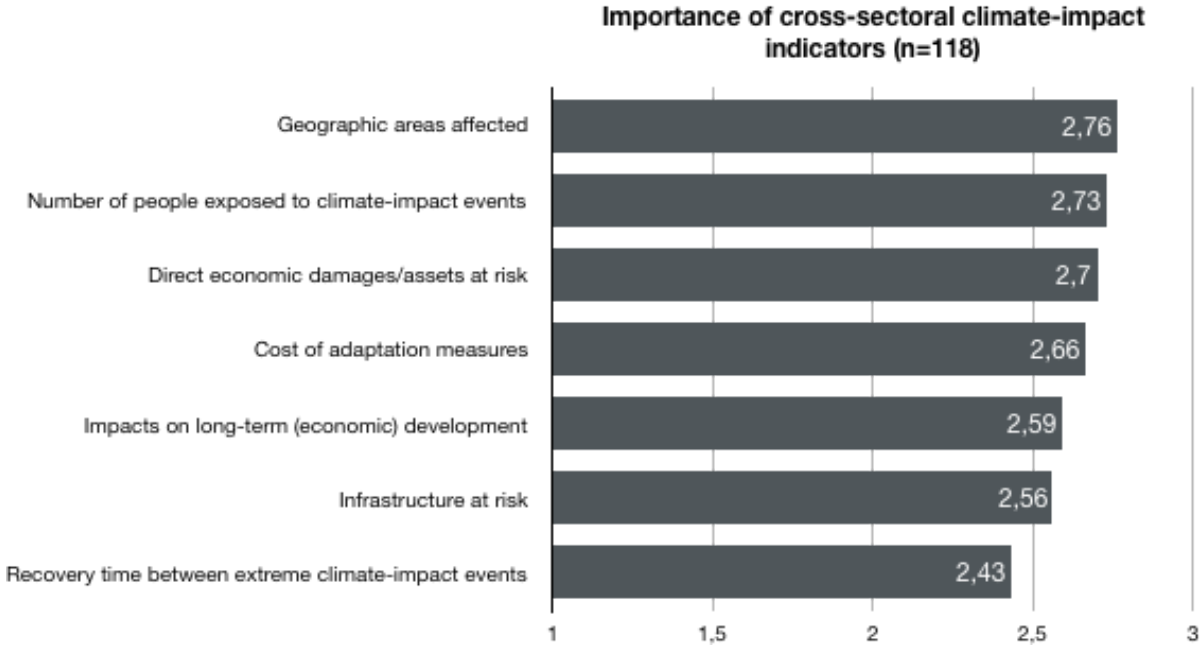

Figure 19: According to the survey respondents (n=118), helpfulness of the given cross-sectoral indicators for their work. Each possible answer ("very important", "moderately important", and "not important") was attributed a weight of 3, 2 and 1, respectively, from which were calculated the displayed average scores

Responses from the CSST and the Sectoral ISIMIP Coordinators:

Based on existing work already done based on the ISIMIP2b simulations we will be able to provide estimates of geographic area affected by extreme events (tropical cyclones + heat waves + droughts + wildfires + river floods + crop failure), the associated number of people exposed, and the recovery times between these events. The derivation of direct economic losses will most likely become available at least for individual types of extremes, starting with tropical cyclones and river floods. The full coverage of the extremes listed above and the derivation of long term economic effects mean considerable additional work that may go beyond the current ISIpedia capacities. However, both components may be addressed in other projects that could finally contribute their results to ISIpedia, too. In contrast, the estimation of adaptation costs is beyond the expertise of at least the ISIpedia team and ISIMIP-CSST at PIK, and may require substantial advances in the adaptation science community.

5. Input on the Features of the ISIpedia Platform

To design a platform that enables users to easily find what they are looking for, questions were included to understand the implied technical requirements as well as the user preferences for presenting climate-impact data. This section gives insight on these matters based on survey responses.

5.1. Technical Facilities for Accessing the Online Platform

The design of the ISIpedia platform must consider the technical equipment from the targeted users, therefore the survey included some questions on the type of devices and of internet browsers they would use to access the ISIpedia platform. Out of 119 respondents, 81% said they would use their laptop, 66% their desktop computer, 23% their smartphone, and 11% a tablet (*Figure 20*).

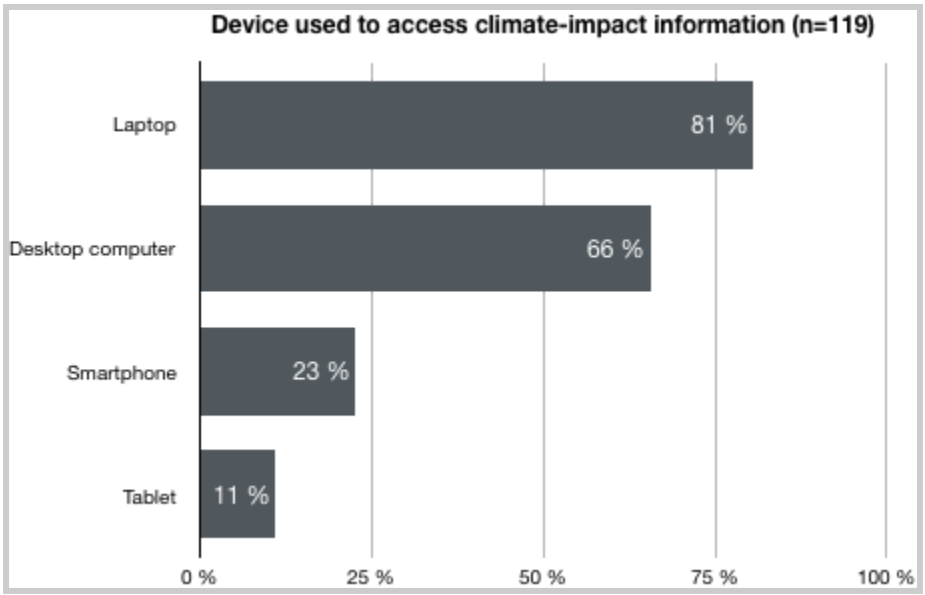

Figure 20: *Electronic devices that would be used by the survey respondents (n=119) to access the ISIpedia platform*

Most of the survey respondents (69%) use Google Chrome, while 44% use Firefox, 26% use Internet Explorer, 19% use Safari, 6% use Microsoft Edge, 3% use Opera and 2% use UC Browser (*Figure 21*).

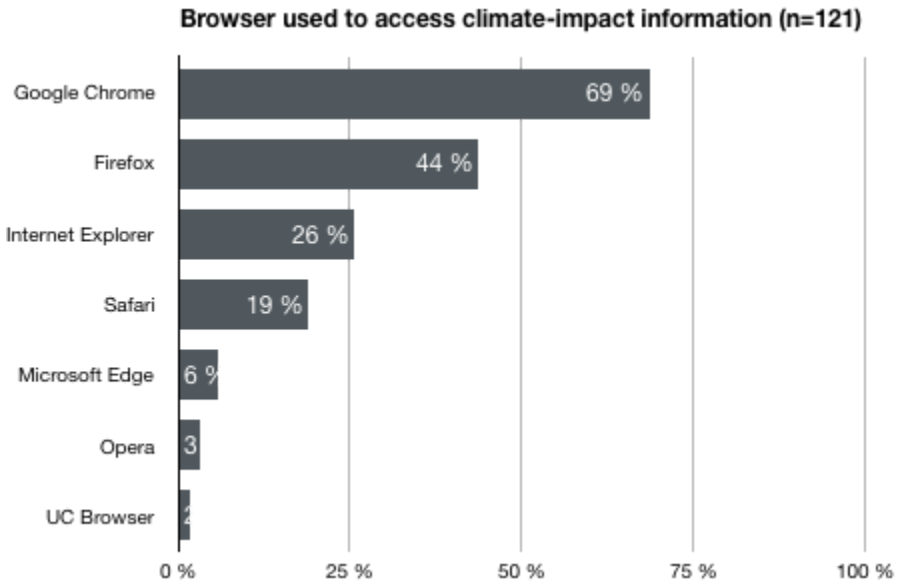

Figure 21: Internet browsers used by the survey respondents (n=121)

Response from the CSST and the Sectoral ISIMIP Coordinators:

The ISIpedia tender document includes the following elements as part of the list of technical requirements:

- responsive design so that all functionalities adapt to different screen size;
- an outstanding performance so that visitors with a slow internet connection can still work with the platforms.

5.2. Ability to Process Climate-impact Data

Due to the various capacities to process climate-impact data, users of climate-impact information may have various capacities in drawing conclusions from existing data that useful to their work. Being aware of these various capacities is useful to understand and anticipate the preferred file type and other data properties.

97 (out of 131) survey respondents stated that their organisation processes climate-impact data. Across all the regions used (other than North America), many of the respondents report that they analyse Excel files (*Figure 22*). Among the respondents from Europe (excluding Eastern Europe), NetCDF is the format analyse most, which reflects the higher share of researchers in these regions (not shown). However, few respondents from regions like Africa and Latin America make use of this data format. Overall, the format that the respondents' organisations analyse least are CSV and GIS data (30% and 29% of the 97 respondents, respectively).

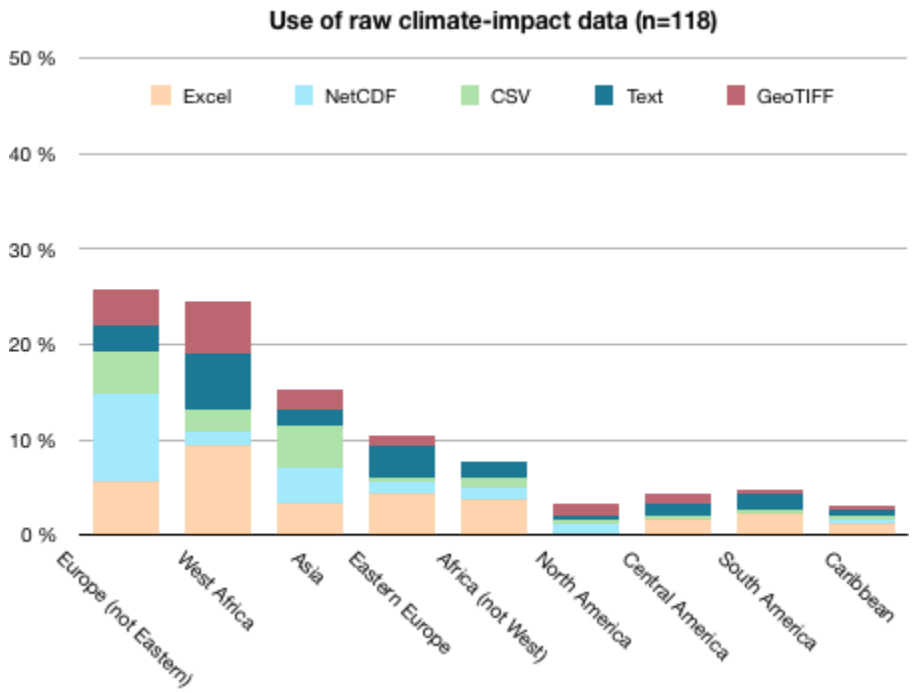

Figure 22: *For the organisations for which the respondents report some processing of climate-impact data (n_{region}=118), data format that is analysed. Each percentage was derived by dividing by total number of responses, $n_{responses}$= 118.*

Responses by the CSST and the Sectoral ISIMIP Coordinators:

The demand is reflected in the ISIpedia tender in the following way:

"All data and figures have to be available for download. The website also has to provide the option to **download assessments reports** where figures, associated texts and background information is automatically combined into a single pdf according to the selected country, indicator, and assessment type."

The survey responses speak in favour of providing data in a format readable with Excel-like softwares on ISIpedia.

5.3. Desired Features for the ISIpedia Platform

A question was included in the survey that aimed at gathering information about the features that would be most important to include on the ISIpedia platform. Although overall the respondents consider most of the suggested features to be important, they expressed a very strong interest in being able to "*compare data sets,"* for example with a tool that allows for direct viewing of two maps or time series for various indicators (*Figure 23*). The possibility to have access to "*explanatory infographics"* was also rated as very important, similar to the "*access to underlying data behind a graph"*. A majority of the respondents, although to a slightly lesser extent, also consider it important to be able to "*filter information according to the technical proficiency and user's needs,"* i.e. to have several layers of information that can match various interests or reflect different levels of complexity. The

possibility to "*download slide decks or presentations* and to "*compare the respondents' climate-impact data with those displayed on the platform"* is also considered as important.

On the other hand, having access to a "*video explanation from scientists/experts"* is rated by only 41% of the respondents as very important. Strikingly, the inclusion of a "*link on the website to contact scientists in the field"* and of an "*online forum to exchange with other users"* is considered by the respondents as being of least importance (*Figure 23*).

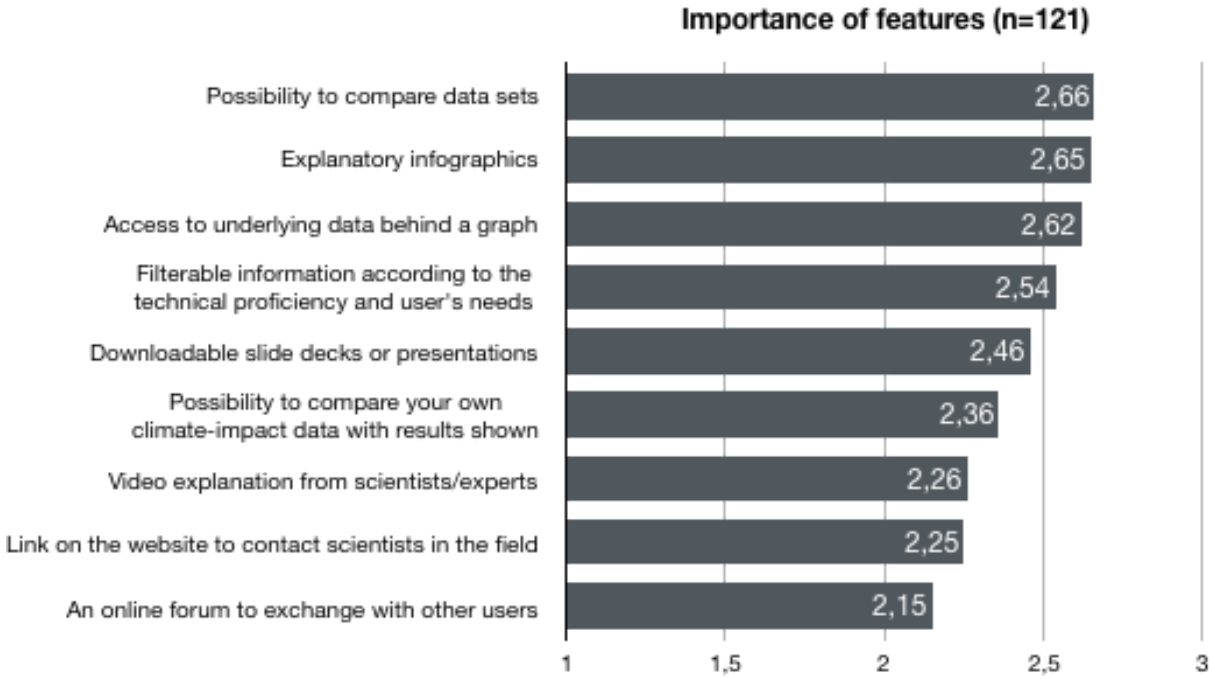

Figure 23: *According to the survey respondents (n=121), importance of a list of possible features for the future ISIpedia platform. The scores are averages for each possible answer ("very important", "moderately important", and "not important"), which were attributed a posteriori a weight of 3, 2 and 1, respectively.*

Overall, these results help to draw a profile of what the future users of the ISIpedia platform will be looking for and doing on the website: accessing understandable climate-impact information, directly downloadable (as a PNG or PDF) for further use, processing (to some extent) the data to extract more tailored information, and in some cases downloading the data behind the graphs displayed on the platform. On the other hand, the survey respondents appear to be less interested in engaging in a dialogue with the experts that provide climate-impact information. Drawing such standard profiles or "user journeys" is particularly useful for the developers of the website and was done as part of the ISIpedia portal design process.

Coming out of initial discussions based on the stakeholder survey and user journeys, one planned feature is a rating of countries according to various indicators, displayed on world maps, where countries are colour coded according to the indicator rating, allowing for comparisons that can also be limited to certain groups of countries. The data or figures could also then be downloaded by the user.

Response by the CSST and the Sectoral ISIMIP Coordinators:

Possibility to compare data sets
The ISIpedia assessments will allow for a direct comparison of countries by translating the extent of national impacts into a ranking of countries (for each indicator). In addition, the following specification has been included in the ISIpedia tender for a web company responsible for the technical implementation of the portal:

"A functionality that is to be implemented by the bidder concerns the comparison of graphs and maps. Users should be able to compare two different graphs or maps with each other. These have to be in the same form, e.g.,

- Compare countries for a given indicator
- Compare indicators for a given country/globe (the indicators don't necessarily have to be from the same topic.)
- Compare time/GMT levels for a given country and indicator. This comparison option will only hold for maps since time/GMT levels are already directly comparable in the plots/graphs.
- each comparison needs to have a unique URL, so that you can share a location of a specific comparison with another person."

Explanatory infographics
The inclusion of infographics, mixed text and image or illustration, will be included as a key component in presenting information on the ISIpedia portal and in the national assessments. It will especially contribute and synergise with the need for multiple levels of information and data access, where infographics will act as a potential entry point to complex information and data that was to design the infographic.

Access to underlying data behind the graphs
See discussion associated to *Figure 12*. The ISIpedia tender document includes the following specifications:

"ISIpedia is very much dedicated to provide the main results of the assessment in a simple graphic, but always wants to provide related **background information**, e.g., on the underlying scenario assumptions (**background climate** and **background socio-economy**), the way the indicator has been calculated (**background methods**), potential limitations of the underlying modelling approaches, knowledge gaps (**background expert judgement**), and finally also a link to the underlying raw data (**background raw data**) stored on the ESGF (Earth System Grid Federation) server."

Behind each figure showing impact indicators "there will be a second layer of information providing background information regarding the underlying climate or socio-economic conditions as well as the applied methods. This information should be accessible, e.g. by clicking on an associated button next to the first layer impact information. The background information should always be closely linked to the associated impact information on the first layer."

Filterable information
The demand is reflected in the ISIpedia tender in the following way:
All elements of impact assessment can be addressed by specifying the country(ies), indicator(s) and assessment category(ies) (see list at the beginning of *Section 4*), i.e., each piece of the assessment can be "labelled" according to these dimensions. The development of a flexible infrastructure to navigate through the information matrix is a central component of this tender.

The other elements are treated with a lower priority.

6. Feedback for ISIMIP3 Modelling Focus

One of the main purposes of the survey was to inform the discussion on the focus topic of the next ISIMIP phase. Several topics were suggested (*Figure 24*), based on the topics discussed during the kick-off workshop, as well as suggestions made by ISIpedia project partners and ISIMIP sector coordinators. The survey respondents were asked to rate the importance of each topic for their work. This section presents an overview of these ratings in the form of weighted scores.

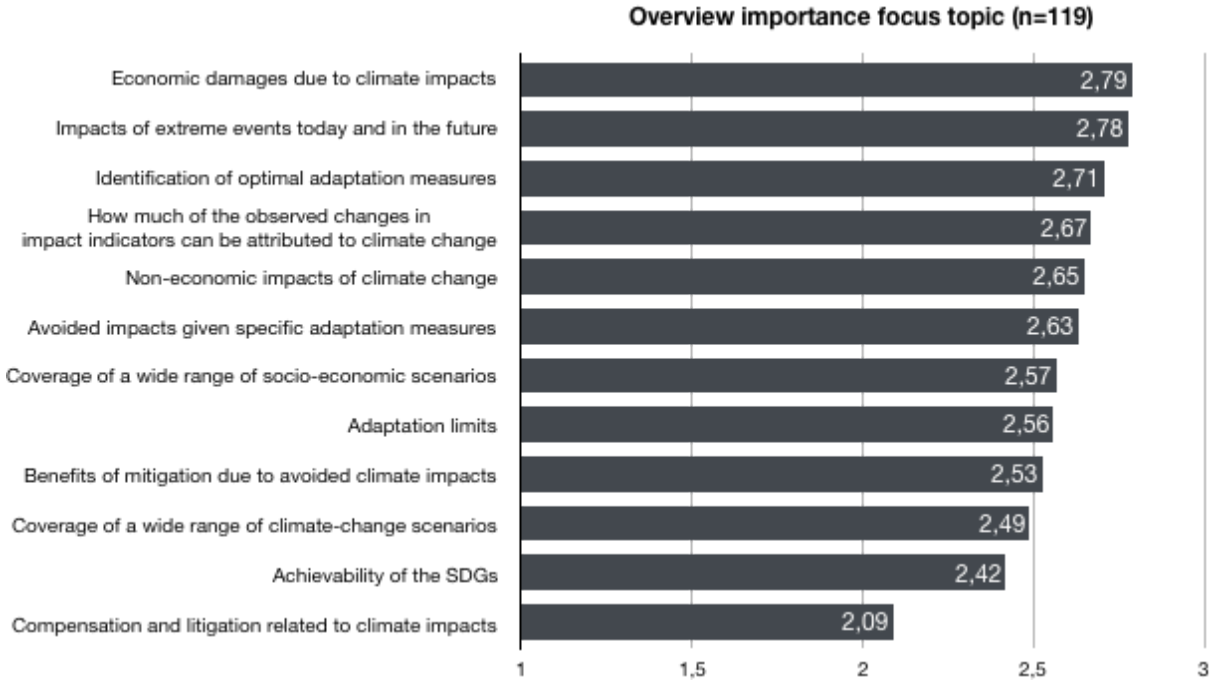

Figure 24: According to the survey respondents (n=119), interest in a focus topic for the ISIMIP3 modelling rounds. The scores are averages for each possible answer ("very important", "moderately important", and "not important"), which were attributed a posteriori a weight of 3, 2 and 1, respectively

The survey respondents (n=119) are, like in other ranking questions, generally interested in most topics. It is somehow surprising that the topic "*achievability of the Sustainable Development Goals (SDGs)*" received less interest than others (but still scoring as high as 2.42), even though a high interest in the SDGs in general had been expressed earlier in the survey by the respondents (see *section 3.3,* "Sectors and Thematic Interests"). In addition, the respondents could provide additional suggestions, which two people did, mentioning the *overlap with "endangered species or ecosystems - threats to wildlife habitat"* and "*dollar values associated with economic and financial impacts"*.

An analysis of the responses to this question by user group was also conducted, but no clear pattern emerged from these as each group of respondents appears to have similar interests (see appendix for details on the preferred focus topics by user groups for each focus topic - *Appendix 9.4, Figures 28 to 39*).

Overall, the responses to this question convey a broad interest of the respondents in terms of content-related information on climate impacts, but no definitive preference for some of the suggested focus topics emerged. It may have been possible to obtain clearer results on that particular point by asking for a ranking of the suggested options, however this type of question is complex to implement and requires a time commitment that would have lowered the response rate. Nevertheless, one way to draw relevant conclusions for the choice of the focus topic of ISIMIP3 could be to look at the results from other questions, for example those on barriers or spatial scales (see *sections 3.1, 3.4 and 3.5*).

Many of the topic ideas listed do not constrain the selection of the climate or socio-economic forcing scenarios (as inputs to model simulations), but rather orientate the analysis of the data. Most of the topics could indeed be addressed by the ISIMIP2a or ISIMIP2b protocol. Notable exceptions are the "identification of optimal adaptation measures," "avoided impacts given certain adaptation measures," and "adaptation limits," which would at least require the representation of some adaptation measures in specific impact modelling simulations not yet covered by ISIMIP2a or ISIMIP2b (even though the climate input could be identical). This appears rather ambitious as it would necessitate substantial development of the participating models, and even an extension of their overall purpose. "Coverage of a wide range of climate scenarios" and "coverage of wide range of socio-economic scenarios" differ from the other topics as they would directly affect the selection of the climate and socio-economic input scenarios. However, both topics are not among the "top 5". This type of characterisation of the topics could help to organize the discussion among the sectoral coordinators.

Response by the CSST and the Sectoral ISIMIP Coordinators:

A general message from *Figure 24* is that all suggested topics were regarded as important or very important. Compensation and litigation was rated somewhat less important than the other topics.

From the top five topics listed in *Figure 24*, ISIpedia will be able to address the “impacts of extreme events today and in the future,” “how much of the observed impacts can be attributed to climate change” and “non-economic impacts of climate change.” The quantification of economic effects of climate change will at least cover direct economic losses induced by certain types of extreme events (tropical cyclones and river floods) others and an assessment of long-term effects on economies may be added (see response to *Figure 12* and *Figure 6*). In contrast, the identification of optimal adaptation options will be particularly difficult (see discussion associated with *Figure 7* and *Figure 19*). Addressing the latter topic would particularly require scenarios that deviate from the IPCC WG1 focus scenarios. Nonetheless, this topic will be discussed with the sectoral coordinators in preparation of a decision about the focus topic at the strategy group meeting in September 2018.

7. Stakeholder Communication

As stakeholder inclusion in feedback and design processes is key for ISIpedia’s success, it was critical for the Stakeholder Engagement Team to evaluate and to take advantage of stakeholder enthusiasm for further cooperation with ISIpedia. Out of the 94 respondents

who answered this question, 92% are interested in receiving a newsletter on the update from ISIpedia and the ISIpedia community, including relevant research on climate change impacts. Nearly half of the respondents (44%) to this question are also interested in providing detailed feedback on the prototype of ISIpedia, including the country-level impact assessments. Respondents from the focus regions also demonstrate great interest in participating in a regional workshop on the co-production of climate-impact indicators and trainings on how to use the platform: 29 respondents in total, 6 from Eastern Europe and 23 from West Africa are willing to participate in such workshops in their respective region.

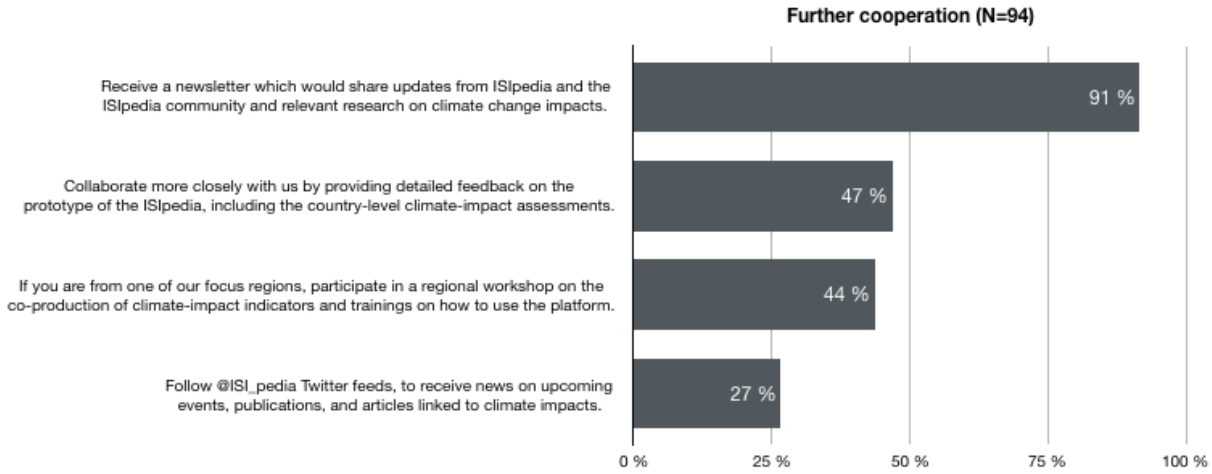

Figure 25: *Interest of survey respondents to further engage in ISIpedia feedback and input elements (n=94)*

Response of the ISIpedia Stakeholder Engagement Team:

As many of the survey respondents (94) indicated an interest in further contact and engagement with ISIpedia, the team will initiate and maintain a newsletter for survey respondents who expressed interest in staying involved in ISIpedia, including updates on the ISIpedia project and platform, news from the ISIpedia community (ISIMIP and stakeholders), and events that ISIpedia is hosting or involved in. The newsletter will be an important means of distributing information on ISIpedia regional workshops.

In addition to the newsletter, there is interest in staying in touch through the ISIpedia Twitter account, which the stakeholder team will maintain with relevant news on climate-impact research, scientific events related to climate impacts and climate services, and climate impacts in general.

As mentioned earlier, in order to build on the initial work onboarding stakeholders (especially in the focus regions), it is beneficial to capitalise on demonstrated interest particularly from stakeholders in the two focus regions when organising regional workshops. This means inviting engaged organisations and persons to participate in, present at, or co-host events. This can include allowing them to also help shape the participant list of the event, broadening both ISIpedia's and the partner organisations' reach and network.

While there is opportunity to give feedback on the user interface of the ISIpedia prototypes, the Stakeholder Engagement Team would like to keep the feedback group relatively small and personable. As not an overwhelming number of respondents expressed interest in a close collaboration with the ISIpedia team in the feedback process, it is feasible to garner this enthusiasm, in whole. A possible next step could be to ask this group for their feedback on the specific recommendations listed in this report.

Bundesministerium
für Bildung
und Forschung

With the financial support of

8. Appendix

8.1. Full Survey PDF

8.2. List of Tags

A) Question 3 - Geographic location

Caribbean
Latin America
Europe (not Eastern)
Eastern Europe
Africa (not West)
West Africa
Asia

B) Question 6 - Last question that required climate-impact information

Adaptation	Freshwater Availability
Vulnerability	River Basins
Extreme Events	Policy Focus
Coastal Infrastructure	Regional Focus
Urban	Focus on a specific time horizons
Transport & Infrastructure	Human Development & Migration
Energy	Outreach & Education
Health	Forest
Agriculture	Land Use
Biodiversity	Marine Ecosystems

8.3. Full List of Indicators

Agriculture (# of usable answers = 57): crop yield (41), growing season (14), livestock production (13), agricultural prices (8), crop suitability (4), Evapotranspiration (4), soil moisture (3), temperature changes (3), precipitation change (3), frequency of extreme events (3), areas destroyed by insects (3), deforestation (3), crop damages (2), food security (2), economic losses due to change in productivity (2), water exploitation (2), migration towards the coast (1), agriculture jobs reconversion (1), home orchards (1), food sovereignty (1), fertilizer use efficiency (1), area of insured crop fields (1), temporal changes in agricultural systems (1), recovery rate of damaged land (1), adaptation rate to new agriculture techniques (1) and sun-induced fluorescence (1). list the indicators here by decreasing order of occurrence, with number of occurrences in brackets

Freshwater systems : (# of usable answers = 42): water availability (20), flood frequency (15), drought frequency (12), water quality (9), flood intensity (8), runoff (8), flood duration (6), drought intensity (6), flood risk (6), drought duration (4), groundwater levels (4), drought risk (3), access to water (3), nutrient load (2), groundwater recharge (2), precipitation totals (2), precipitation intensity (2), high- or low-flow indicators (2), groundwater availability (1), water availability for irrigation (1), urban rivers (1), salinity (1), chlorophyll load (1), water supply (1), precipitation vulnerability (1), frequency of high-intensity precipitations (1), water scarcity (1), water demand (1), water demand for energy (1), environmental flow (1), groundwater contamination (1), water stress (1), seasonality (1), inter-annual variability (1), lake levels (1), water temperature (1).

Biodiversity (# of usable answers = 41): species richness (14), biodiversity losses (10), changes in species distribution (5), forest degradation (4), changes in invasive species (3), threat status of species (3), community access (3), resource repartition (2), migration of species (2), change of habitat (2), change in marine protected areas (2), freshwater availability (2), species well-being (2), rainfall patterns (2), temperature changes (2), occurrence of extreme events (2), erosion (1), number of biodiversity hotspots (1), bare land expansion (1), bees population (1), duration of vegetation periods (1), economic losses due to changes in variety of species (1).

Forestry (# of usable answers = 37): Carbon sequestration (5), species distribution (5), fires (5), forest area (4), forest production (4), carbon stock (3), forest cover loss (3), forest health (3), emission reduction factors (2), forest distribution (2), forest biomass (2), forest cover gain (2), land use change (2), forest disturbance (2), pest outbreaks (2), drought impacts (2), number of forest areas (1), renewed or cultivated forest areas (1), forest protection, sustainable forest management (1), agroforestry (1), forest density (1), biomass production (1), mangrove degradation (1), impact thresholds (1), spatial distribution of impacts (1), forest degradation (1), forest harvest (1), forest mortality (1), availability of forest resources (1), human appropriation of forest resources(1), forest biomass use for energy (1), forest growth (1), forest yield (1), forest nutrient content (1), sun-induced fluorescence (1), vegetation index (1), soil moisture (1), temperature change (1), precipitation change (1).

Coastal infrastructure (# of usable answers = 25): sea level rise (6), sea intrusion (3), mangrove change (2), seagrass change (2), cost damages to critical infrastructure (2), beach and ecosystems protection (2), coastline length (2), erosion (2), level of protection (2), flooded area (2), groundwater quality (2), land losses (2), water temperature (2), coastal

infrastructure losses (1), development planning cost (1), coral health (19, storm surge (1), life expectancy of protection dam (1), atmospheric conditions (1), erosion threat % (1), exposed population (1), change in natural and artificial reefs (1), ocean acidification (1), precipitation change (1).

Health (# of usable answers = 33): disease prevalence and spread (length and area) (9), air quality (8), temperature related mortality (8), food security (6), nutritional value of food (5), water quality (5), malnutrition (4), heat stress (2), demand for medical assistance (2), migration (1), chlorophyll-a (1), heat stress for live stock (1), disease morbidity (1), total health index (1), access to health services (1), smog (1), trajectory of vector-borne disease (1), and adaptation/ protection level (1),

Energy (# of usable answers = 31): amount of renewable energy in energy (8), hydropower (6), water use intensity (5), energy production (4), energy availability (4), energy mix (4), CO2 emissions (4), energy poverty (3), energy demand (2), level of decarbonisation (2), renewable energy potential (2), extreme discharge (2), energy efficiency (2), renewable storage grid (2), dependable flow (1), scalability of renewable energy in disaster risk recovery (1), solar radiation (1), dependence on specific sectors (1), thermal efficiency (1), energy cost (1), losses in energy transportation (1), job availability (1), community energy needs (1), wind energy yields (1), solar energy yields (1), biomass consumption (1), energy prices (1).

Marine ecosystems and fisheries (# of usable answers = 19): fishery production (4), halieutic (2), sustainability of resources (2), species distribution (2), marine protected areas (2), ocean acidification (2), temperature (1), resource renewal (1), fish biomass (1), fish population (1), biodiversity (1), phytoplankton biomass, zooplankton biomass (1), spatial distribution of species (1), malnutrition (1), migration of coastal population (1), mangrove (1), fisheries legislation/policy (1), water quality (1), algae development (1), disease occurrence (1), upwelling strength (1), coral bleaching (1), sea-level rise (1), ocean health (1), chemical composition (1), ocean oxygen content (1), sedimentation (1), coastal dynamics (1), species migration (1), population dependent on fisheries (1), access to halieutic resource (1), distance to capture fish compared to the coasts (1).

Permafrost (# of usable answers = 4): melting indications (2), methane production (1) permafrost depth (1), permafrost temperature (1).

Other (# of usable answers = 11): atmospheric pollution indicators, occurrence of extreme weather events, access to water, desertification, area of disaster risk, water quality indicators, groundwater level, risk for infrastructure, number of people affected, temperature, precipitation, energy demand, acidity, nutrient content, nitrate loss, change in return of financial markets, waste production, urban mobility indicators (2), access to urban services, adaptation of races or pastures, education of stakeholders, green infrastructure, rural road infrastructure, well and toilet deployment

8.4. ISIMIP3 Focus Topic

Overview of answers by user group for each topic

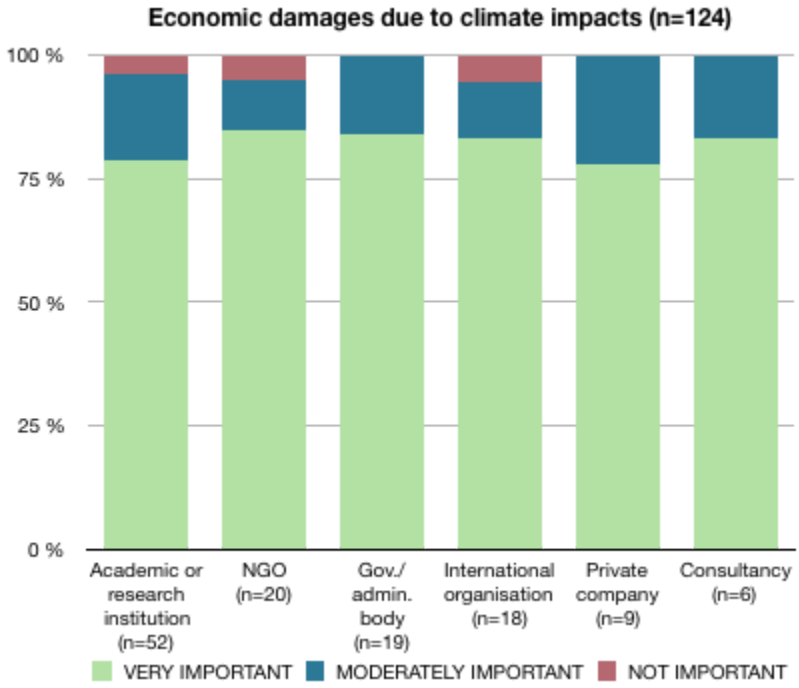

Figure 28: According to the survey respondents (n=124), importance of receiving detailed information on the "Economic damages due to climate impacts". This was suggested to the respondents on a list of possible focus topics for ISIMIP3. The ranking "very important" "moderately important" and "not important" is shown according to distribution by user-group

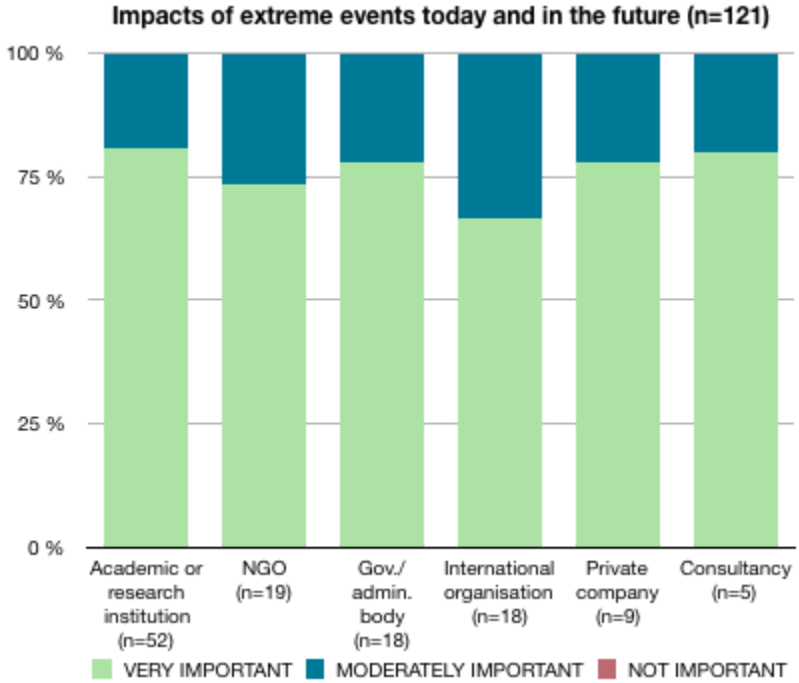

Figure 29: Same as Fig. 28, but for the topic "Impacts of extreme events today and in the future" (n=121)

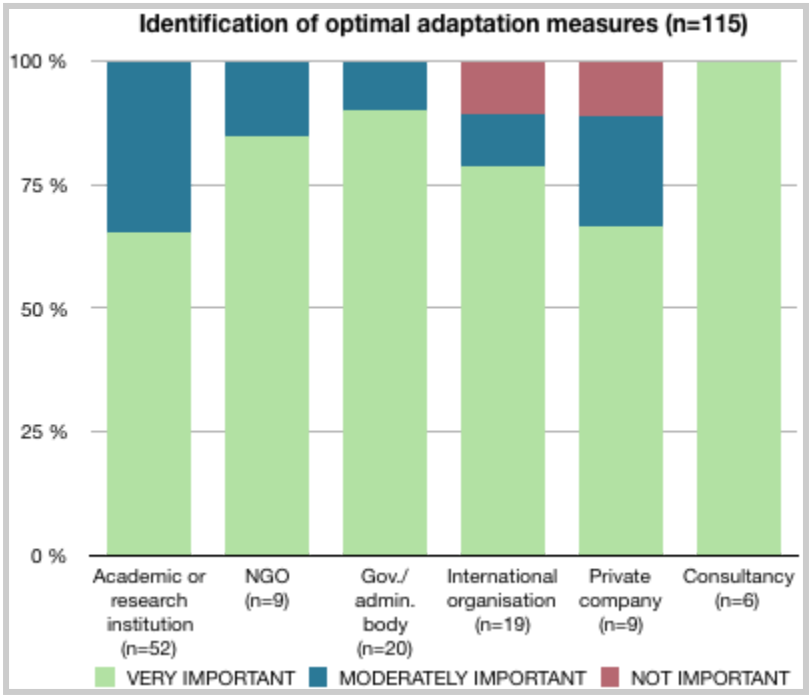

Figure 30: *Same as Fig. 28, but for the topic "Identification of optimal adaptation measures" (n=115)*

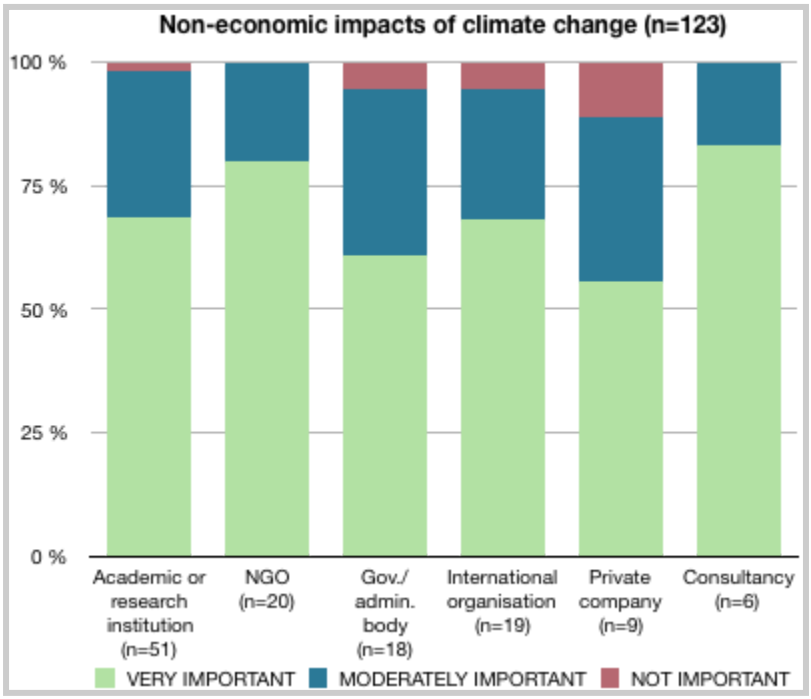

Figure 31: *Same as Fig. 28, but for the topic "Non-economic impacts of climate change" (n=123)*

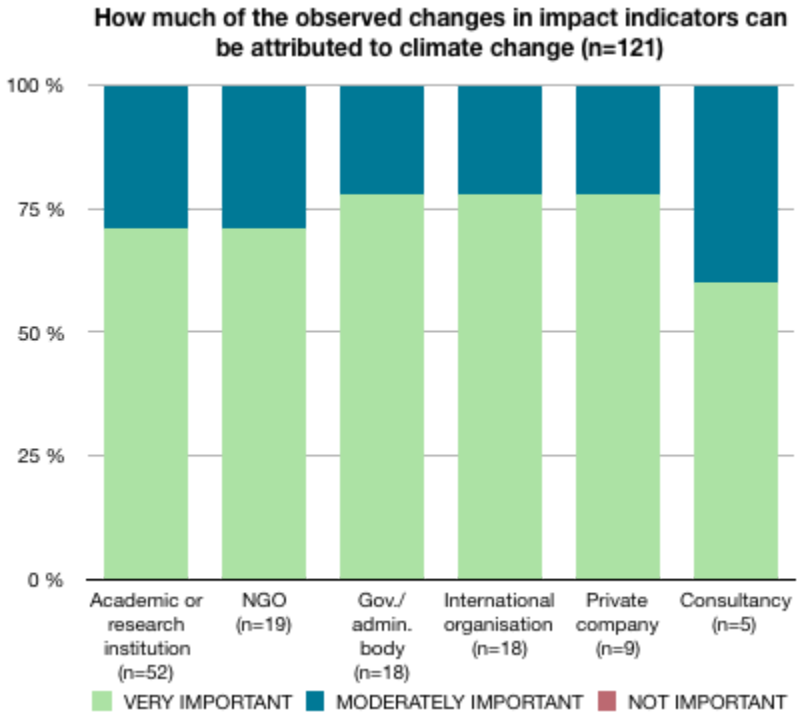

Figure 32: Same as Fig. 28, but for the topic "How much of the observed changes in impact indicators can be attributed to climate change" (n=121)

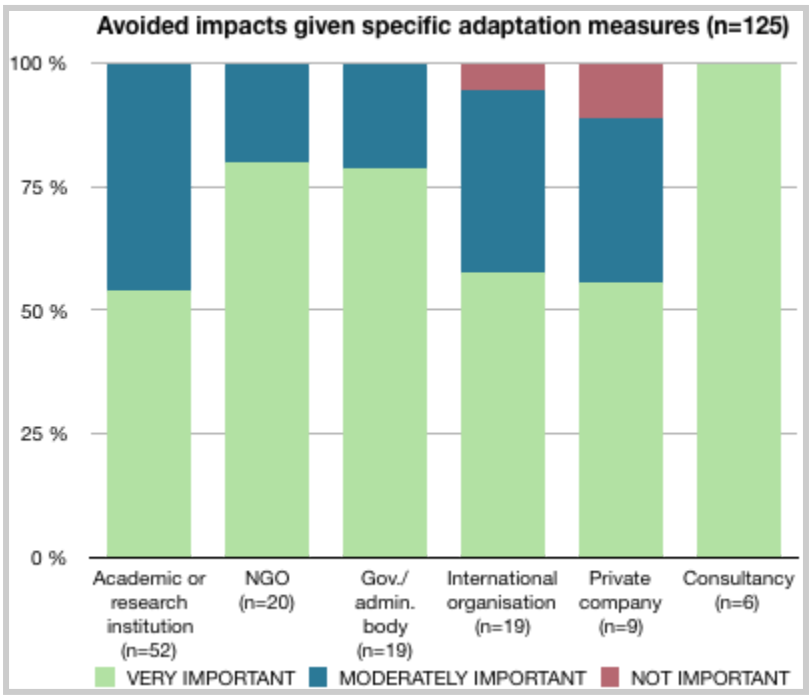

Figure 33: Same as Fig. 28, but for the topic "Avoided impacts given specific adaptation measures" (n=125)

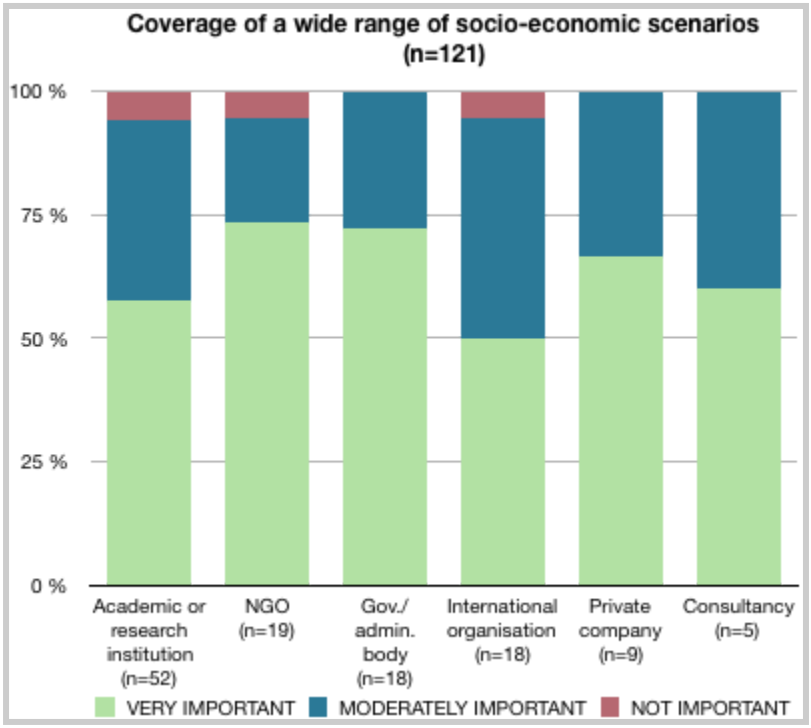

Figure 34: *Same as Fig. 28, but for the topic "Coverage of a wide range of socio-economic scenarios" (n=121)*

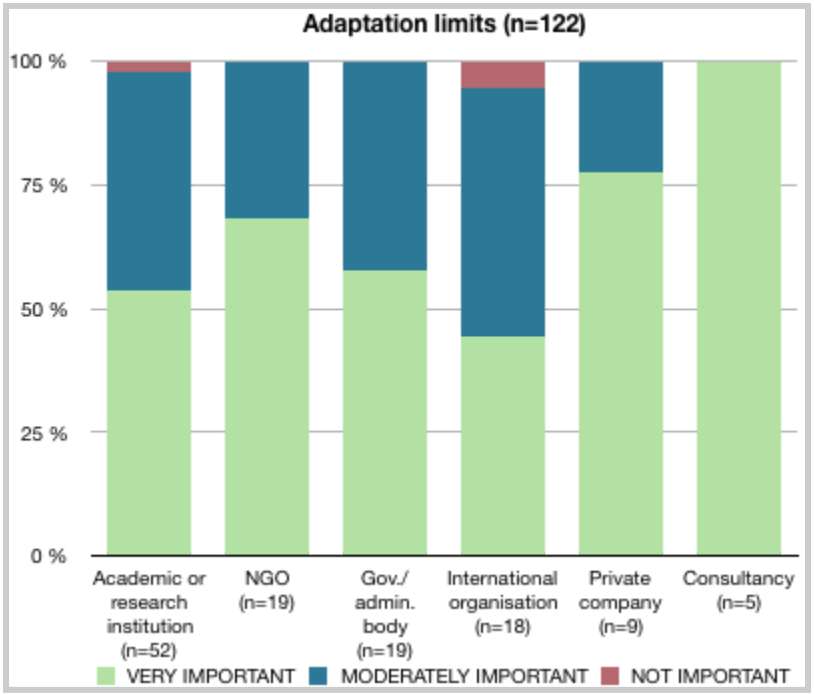

Figure 35: *Same as Fig. 28, but for the topic "Adaptation limits" (n=122)*

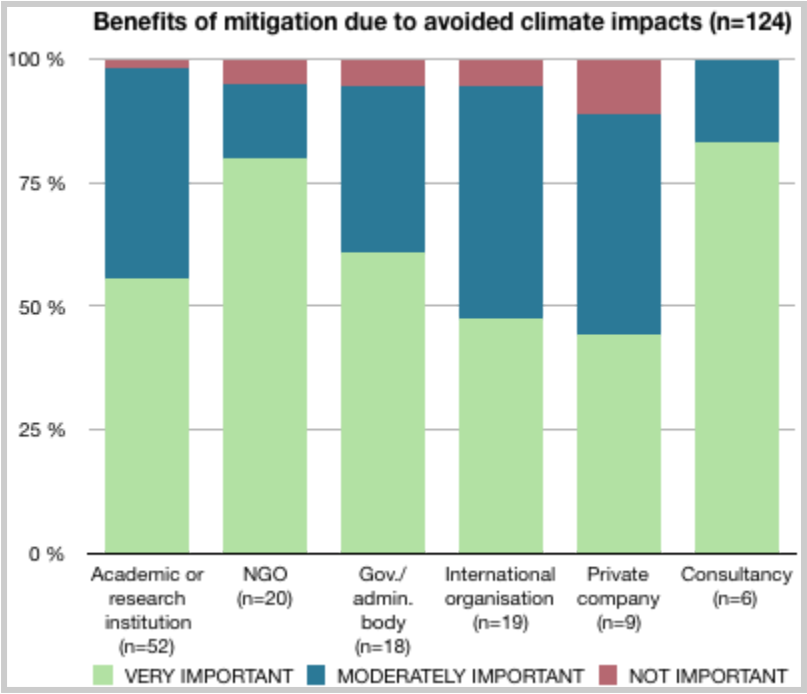

Figure 36: *Same as Fig. 28, but for the topic "Benefits of mitigation due to avoided climate impacts" (n=124)*

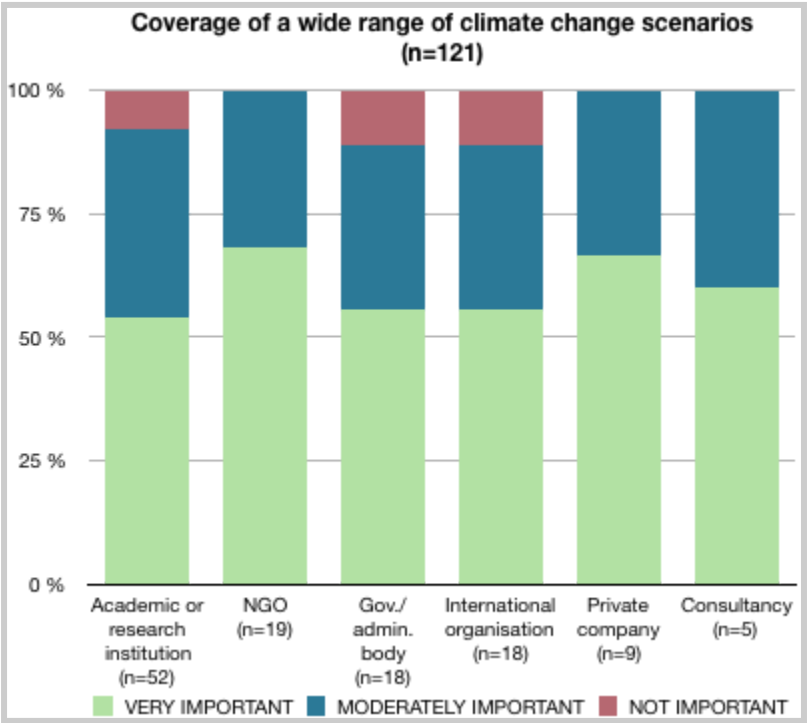

Figure 37: *Same as Fig. 28, but for the topic "Coverage of a wide range of climate change scenarios" (n=121)*

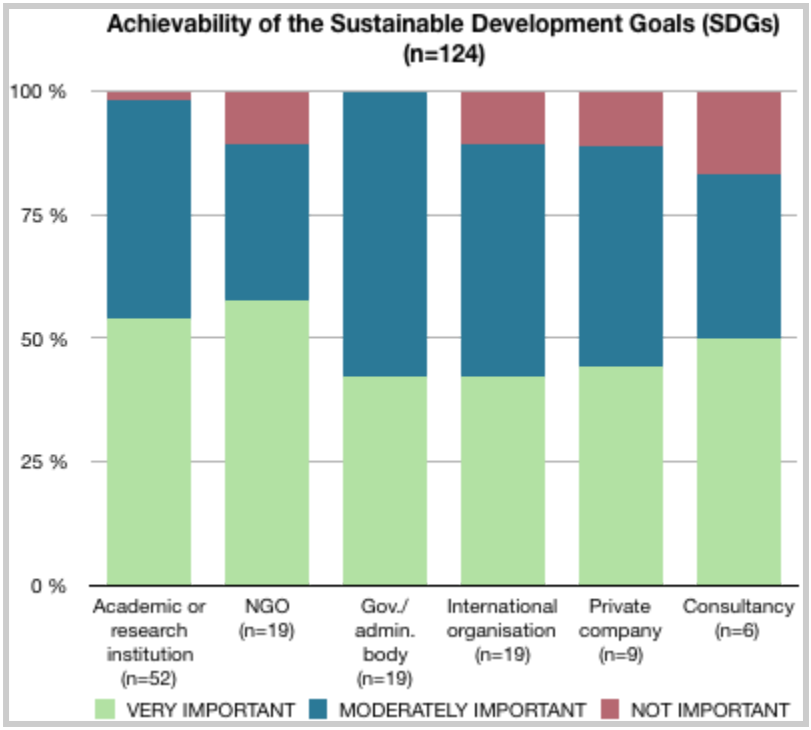

Figure 38: *Same as Fig. 28, but for the topic "Achievability of the Sustainable Development Goals" (n=124)*

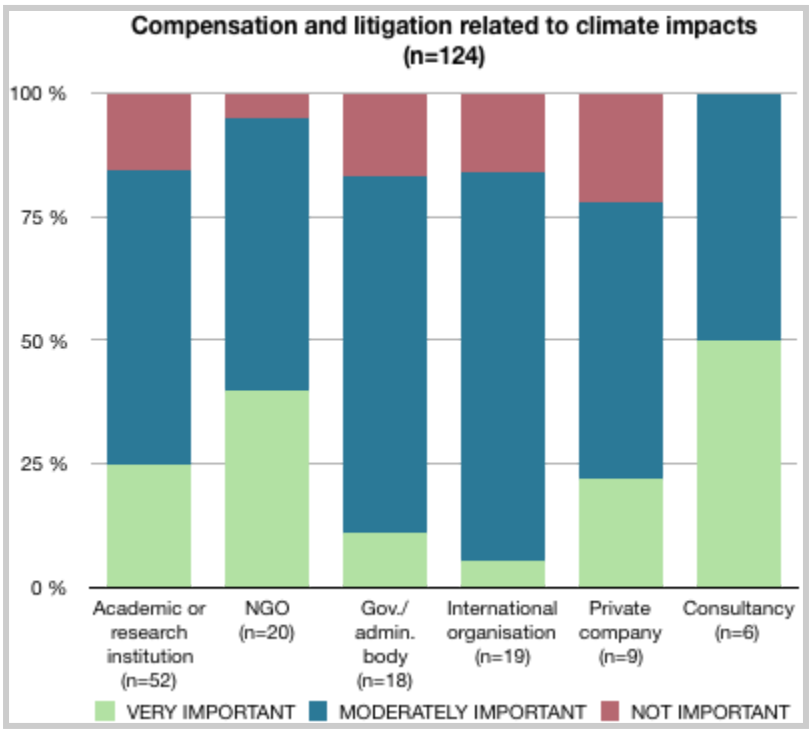

Figure 39: *Same as Fig. 28, but for the topic "Compensation and litigation related to climate impacts" (n=124)*

8.5. Desired features

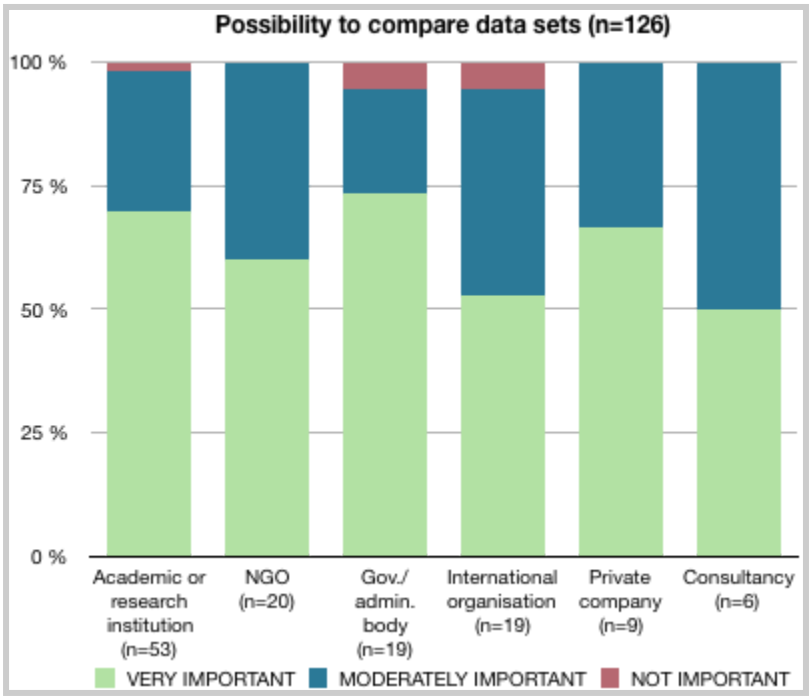

Figure 40: *According to the survey respondents (n=126), importance of possible features for the ISIpedia platform for "Possibility to compare data sets". This was suggested to the respondents on a list of possible features. The ranking "very important" "moderately important" and "not important" is shown according to distribution by user-group*

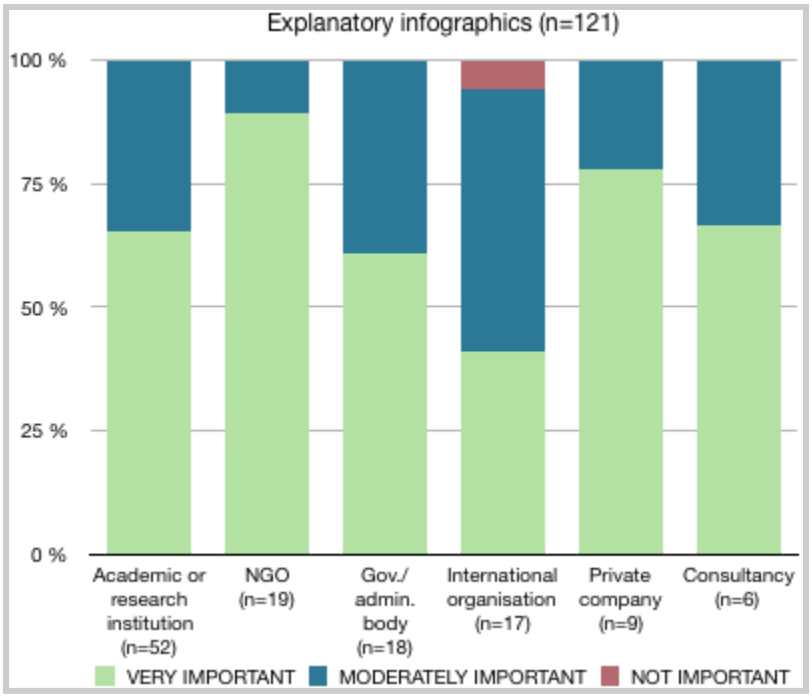

Figure 41: *Same as Fig. 40, but for the topic "Explanatory infographics" (n=121)*

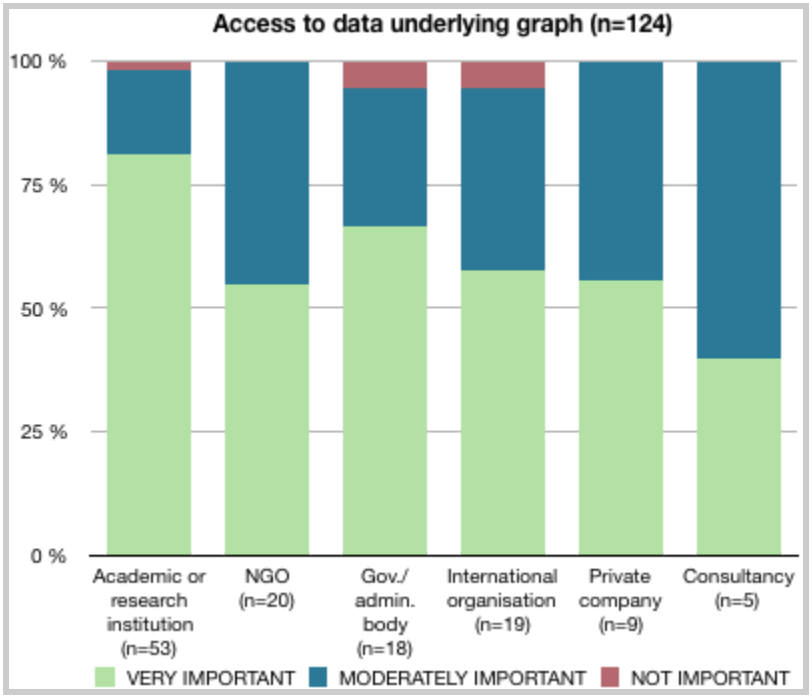

Figure 42: Same as Fig. 40, but for the topic "Access to data underlying graph" (n=124)

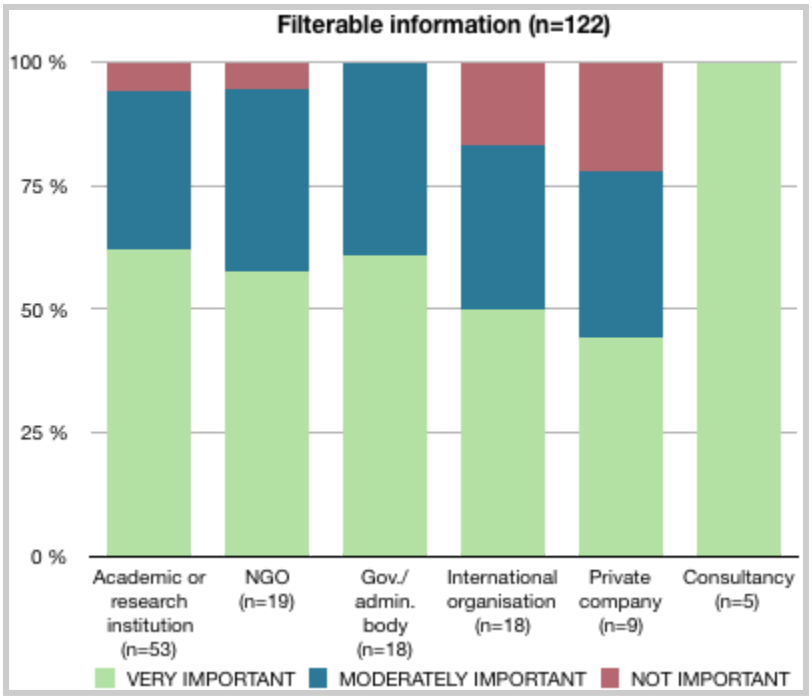

Figure 43: Same as Fig. 40, but for the topic "Filterable information" (n=122)

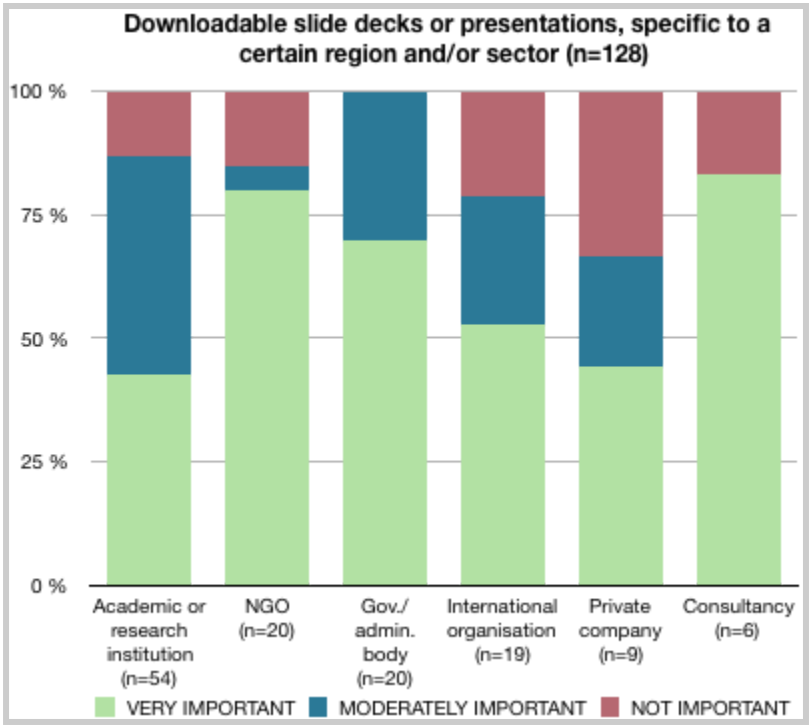

Figure 44: *Same as Fig. 40, but for the topic "Downloadable slide decks or presentations, specific to a certain region and/or sector" (n=128)*

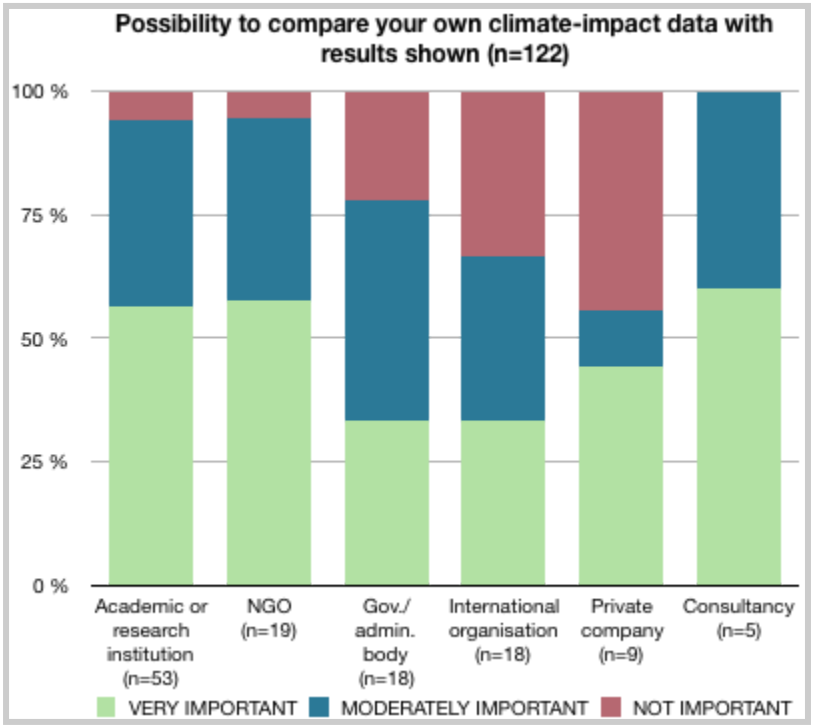

Figure 45: *Same as Fig. 40, but for the topic "Possibility to compare your own climate-impact data with results shown" (n=122)*

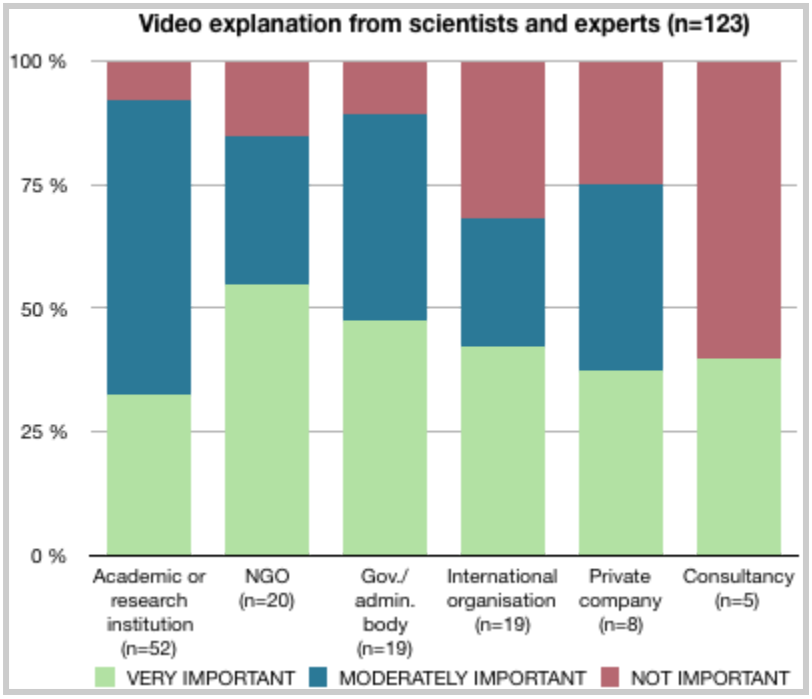

Figure 46: Same as Fig. 40, but for the topic "Video explanation from scientists and experts" (n=123)

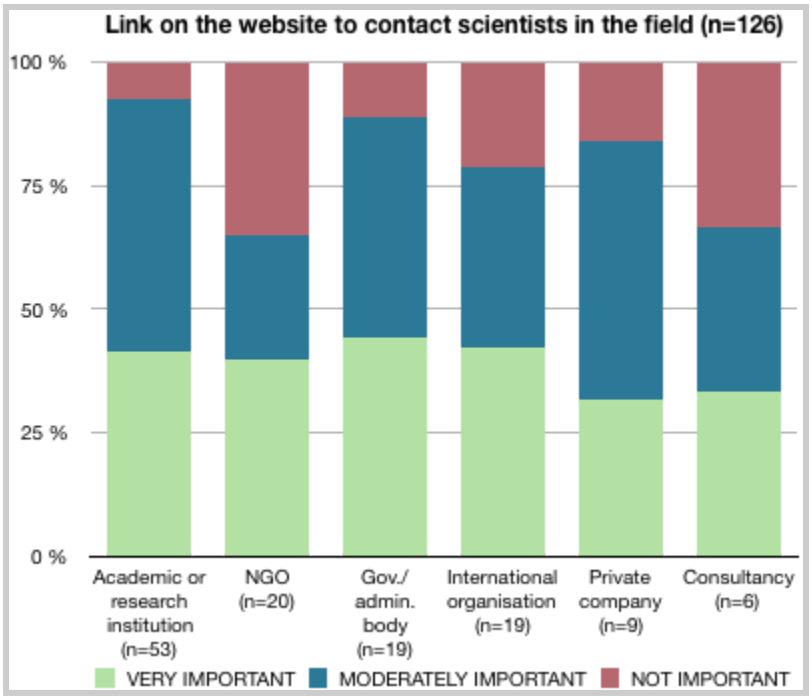

Figure 47: Same as Fig. 40, but for the topic "Link on the website to contact scientists in the field" (n=126)

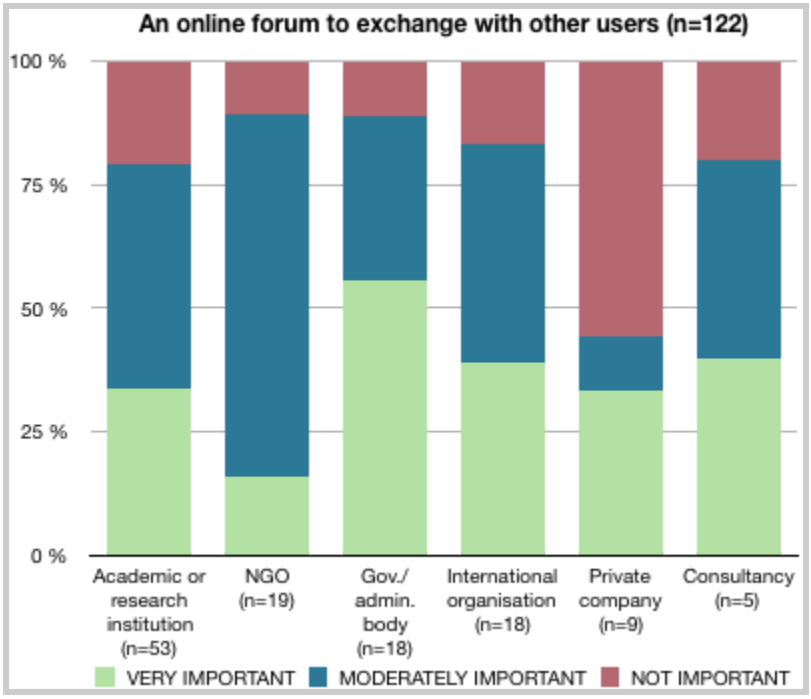

Figure 48: Same as Fig. 40, but for the topic "An online forum to exchange with other users" (n=122)