The Inter-Sectoral Impact Model Intercomparison Project (ISIMIP)
Mission & Implementation Document

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ISIMIP Mission statement

ISIMIP aims to improve global and regional risk management by advancing knowledge of the risks of climate change through integrating climate impacts across sectors and scales in a multi-impact model framework.

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1 Introduction

Climate change poses risks to society on myriad interconnected fronts. Changing climate and weather patterns threaten biophysical, social and economic systems both directly, and through their interdependence. Currently, simulations of the impacts of climate change are in general forced by different climate inputs, which poses a fundamental limitation, for example as illustrated by the aggregation of the effects of extreme events across different categories. Extremes in different sectors will not occur independently but will be spatially and temporally correlated. For example, the El Nino Southern Oscillation (ENSO) influences crop yields (Iizumi et al., 2014), flood events (Ward et al., 2014), tropical cyclones (Kossin et al., 2010; Wang and Chan, 2002), coral bleaching (Glynn et al., 2001), and fisheries (McPhaden et al., 2006), but these impacts play out differently in different affected countries (Cashin et al. 2014).

In general, a particular realisation of, say, a flooding event in a specific year in the future is inconsistent with available projections of other impacts such as on crop yields or the occurrence of hurricanes within the given year, since these projections are generally forced by other weather realisations. This inconsistency does not only render the analysis of interactions between these events extremely challenging, it also precludes a simple addition of associated multi-sectoral damages, or aggregation of extreme events, affected people or damages within one country and time period across different sectors. This is a fundamental limitation to the applicability of climate-impact projections, since an increased coincidence of sub-national disasters (e.g., in space or time, within one budget cycle) can reduce tax receipts through industrial disruption as well as potentially overwhelming recovery budgets and insurance payouts.

This fundamental problem of current impacts projections can only be overcome by introducing a consistent scenario design, which has a common climate forcing data set at its core. The Inter-Sectoral Impact Model Intercomparison Project (ISIMIPISIMIP) is designed to primarily address this need.

The aggregation of the effects of extreme events across different sectors is just one example of critical cross-sectoral questions that can only be addressed using a cross-sectorally consistent modelling framework. The water-energy-food nexus is another prime example of inter-sectoral interactions that are receiving increasing attention from researchers and decision makers due to its relevance to ensuring basic human needs are covered. Primary links include:

- changing water availability for agricultural irrigation;
- changes in water demand for irrigation;
- competition for land between bio-fuels, afforestation and agriculture;
- changing water temperatures in the face of rising cooling demands over t from power plants. affecting cooling of power plants when cooling demands may rise at the same time;
- changing hydropower potentials due to changes in river flow or sediment transport and its connection to irrigation water withdrawal;
- energy demand for irrigation;
- fertilizer input and its impacts on water quality and fisheries.

There are also many inter-sectoral links associated with the impacts of climate change on human health:

- changes in agricultural production or fisheries and their effects on food security:
- changes in the availability of clean fresh water and their effects on health;
- occurrence of malaria related to changes in water availability or changes in natural vegetation;
- occurrence of flood events and its association with injuries or the spread of infectious diseases.

Without an inclusion of these inter-sectoral impacts it is extremely difficult to grasp the full extent of the impacts of different levels of global warming. Without progress in this regard, core questions in climate impacts research may remained unanswered, including:

- Where do climate change impacts prompt competing responses (e.g. expansion of agricultural land at the cost of natural vegetation and associated carbon sinks; increase of fertilizer input at the risk of reduced drinking-water quality)?
- At which level of global warming does the frequency and intensity of extreme events across different sectors (floods + crop failure + tropical cyclones + heat-induced wild fires) overwhelm the coping capacities of individual regions?
- How do multiple stresses from different kinds of extreme events and long-term changes affect the national and global economies?

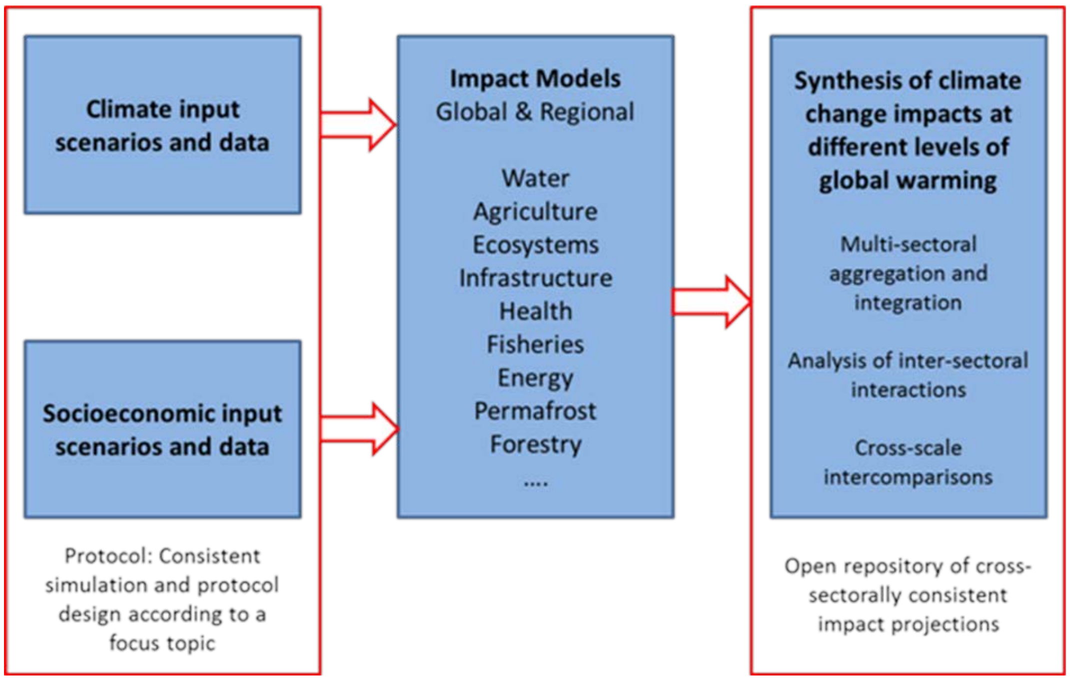

Figure 1 General structure of the key elements of the ISIMIPISIMIP process and mission

This document outlines ISIMIPISIMIP's goals and methods. This first section (Mission) describes the objectives of ISIMIPISIMIP in more detail, the means to meet them, and the core outputs. The second section (Implementation) provides a description of the practical implementation required to fulfill the mission.

Throughout this document the definition of the term "impacts" follows the definition provided in the glossary of the contribution of Working Group 2 to the IPCC AR5 (Barros et al. 2014). It describes impacts of climate change on geophysical systems, including floods, droughts, and sea level rise as so called "physical impacts", as well as effects stemming from change in climate variability on natural and human systems emerging from the interplay of physical and biological changes, exposure and vulnerability of the exposed systems.

2 Mission

2.1 Objectives

ISIMIP aims to provide a consistent framework for multi-model climate-impact simulations across sectors, and across temporal and spatial scales. This unique cross-sectoral, cross-scale organization is designed to complement intra-sectoral research efforts to ultimately provide a comprehensive picture of climate change risks at different levels of global warming (Schellnhuber et al., 2013b; Warren, 2011). ISIMIP employs multi-model ensembles so that uncertainties at the different modeling stages considered can be assessed quantitatively. Differences between the models can be used to identify important processes and parameterizations and to inform model-improvement efforts. Both the model improvement and the quantification of uncertainties are crucial in making the synthesis of climate risks robust and informative. The key features of the mission and process of ISIMIP are shown in Figure 1.

A central consideration of the ISIMIP protocol-design process are the potential user and relevant stakeholder groups. These parties range from research scientists also addressing on climate-impacts questions, through to economists, government and non-government decision-makers at regional and global levels, and the general public. These groups, and how ISIMIP endeavours to provide research products relevant to their specific needs, are described in more detail in section 4.

The key research opportunities presented by a consistent integration are fourfold:

2.1.1 Aggregation of climate impacts across different sectors (multi-sectoral)

The term "multi-sectoral" refers to studies where the spatial patterns of impacts in different sectors are overlaid to e.g. highlight 'hot-spot' regions likely to experience multiple impacts, but where the analysis does not consider interactions between sectors, except in terms of their cumulative impact. An example is the basic aggregation of potential direct damages, mortalities, or displaced people induced by different kinds of extreme events within a given region and time span as mentioned in the introduction. It can be used to identify regions subject to changing frequencies of multiple hazards from extreme events, such as heavy precipitation events and heat waves. This can be determined by overlaying independent sectoral analyses, so long as these are carried out using consistent future scenarios and compatible spatial regions. Results from the ISIMIP Fast-Track facilitated this type of 'hotspot' analysis (Piontek et al., 2014).

The ISIMIP Fast Track provided a first building block of a global archive of consistent impact projections covering the agriculture, water, biomes, health (malaria) and coastal infrastructure sectors. Other sectors that need to be considered include fisheries, energy, permafrost, biodiversity, forestry, tourism, health beyond malaria and cities. A natural outcome of the sector-specific analyses is the opportunity to analyse the allocation of the uncertainty budget for impact projections to uncertainty in the climate projections, and that arising from the impact models themselves.

ISIMIP provides a basis for this kind of multi-sectoral integration of climate change impacts through consistent impact data. A cross-sectoral science team (see section 3.1.4) will provide support for the post-processing of biophysical impacts into indicators such as "the number of affected people" or "direct economic damages". Therefore, changes in exposure and vulnerability under different socioeconomic-development storylines such as those provided by the Shared Socioeconomic Pathways (SSPs) will be taken into account (O'Neill, et al. 2015).

2.1.2 Interactions between sectors (cross-sectoral)

A simple aggregation of sector-specific impacts as described above does not capture the full scale of climate change risks, since cross-sectoral interactions and dependencies between sectors may be amplifying, effectively transferring risks to one another. The term "cross-sectoral" refers to analyses where two or more sectors interact directly through their supply or value chains or competition for resources. Examples include the dependence of urban water supplies on energy networks, but also competition for water for example between agriculture, mining, and the environment in one region, or for land between bioenergy and food. These studies require explicit consideration of the coupling between sectors, potentially leading to simplified 'nexus'-style analyses that integrate more detailed sectoral simulations. The sectoral analyses need a consistent basis, but additional analyses of interactions are also required.

It is at the core of ISIMIP's mission to provide a consistent framework for simulations needed for two kinds of cross-sectoral analyses. Firstly, interactions can be analyzed by combining sectoral projections in post-processing. Examples of this are the studies by Frieler et al. (2014) and Elliott et al. (2013) from the ISIMIP Fast track. The second type involves impacts across sectors in a coupled-model configuration, directly taking into account interactions. An example is a “real-time” integration of projections of the effects of land use or vegetation changes on water discharge in water model simulations.

2.1.3 Indirect interactions via the economy (integrative studies)

The term “integrative” is used for studies of emergent interactions via the economic system. These include net effects on GDP and national tax receipts that are result from multi-sector influences flowing through the economy. An increased coincidence of sub-national disasters (e.g., in space or time, within one budget cycle) could, for example, reduce tax receipts by disrupting industry, as well as potentially overwhelming recovery budgets and insurance, leading to non-linear responses in economic damages. Integrative studies have the potential to address competition for capital among sectors. ISIMIP strives to promote greater exchange between impact modelers and economic modelers by establishing an “economic integration unit” as a forum for the exchange of ideas, methods, and data to integrate the ISIMIP impact projections into economic models. These comprise Computable General Equilibrium (CGE) models (e.g. Ciscar et al. (2011)), Integrated Assessment Models (IAMs, see http://iamconsortium.org/), but also new non-equilibrium analyses e.g. quantifying indirect effects of extreme events along the global supply chain network (Bierkandt et al. (2014) & Wenz et al. (2014)). The cross-sectoral science team (see section 3.1.4) is intended to provide support for this task by 1) translating bio-physical impacts into direct economic damages; or 2) developing simplified representations of impacts in terms of global mean temperature change as the sole indicator of climate change accounted for in IAMs.

2.1.4 Cross-scale intercomparison

Until recently, there was no systematic framework for comparing global and regional model simulations besides the occasional comparison of models operating at different scales (e.g. Kramer and Leinonen, 2002; Luo et al., 2008; Morales et al., 2005) and more structured sectoral approaches (Huntzinger et al., 2013). In a pioneering sector-specific effort, AgMIP is now leading a coordinated global and regional assessment of food security for the IPCC sixth assessment report (AR6).

Regional impact models operate at a higher spatial resolution and often boast a more detailed process representation, thus providing a critical test for process representation in global models. The comparison may help identify the most reliable impact indicators which can be provided by global models (e.g. relative changes in discharge versus absolute values). The integration of regional impact model simulations also provides an important opportunity to zoom into regions identified by global simulations as being at particularly high risk. This requires a careful selection of the focus regions for regional simulations.

2.1.5 Community building

The above scientific objectives rely on the existence of a strong scientific community, both within sectors and across sectors. By encouraging cross-sectoral analyses, in particular through cross-sectoral project workshops and targeted special issues in scientific journals, ISIMIP is instrumental in supporting the establishment of a cross-sectoral climate-impacts research community.

Methods

The cross-sectoral and cross-scale consistency of the impact model simulations is achieved via a **single, common simulation protocol** that is carefully designed to ensure comparability across the sectors and scales.

The selection of ISIMIP-specific simulation tasks is guided by a focus topic, an overarching research theme for each ISIMIP simulation round. Given that the focus topic will change with each round, broad thematic coverage will be achieved over time. Engagement with decision makers and stakeholders will ensure that the chosen focus topics facilitate analyses that address the most relevant questions in impacts science. For example, topics could cover model validation, adaptation options, geo-engineering, attribution of impacts to climate change and other human forces, or specific types of cross-sectoral interactions that require coupled simulations (see second type of cross-sectoral simulation described in section 2.1.2). Selection of focus topics is community and stakeholder driven, with the clear aim of addressing the most relevant societal questions.

Aside from the inter-sectoral research questions, there are many highly important sector-specific questions that cannot be answered within the ISIMIP framework. Therefore, a close collaboration with existing sector-specific model intercomparison projects (MIPs) and the sparking of new sector-specific initiatives is key to the ISIMIP mission. In particular, ISIMIP simulation tasks could be added to sector-specific protocols of other MIPs, where ideally the design of the ISIMIP protocol is already based on a mutual exchange, allowing for maximum overlap between the sector-specific MIP protocols and the cross-sectorally consistent modeling framework (i.e. common climate and socio-economic scenarios and data). The process of the development of the ISIMIP protocol described in section 3.2 ensures this harmonisation wherever possible, based on the involvement of the sectoral coordinators. For this reason, the ISIMIP protocol is designed in a modular structure (i.e., with sector-specific sections), to ensure that sector-specific intercomparison projects can easily amend an ISIMIP module to their simulation protocols. Importantly, ISIMIP does not intend to coordinate sector-specific MIPs but rather to contribute to them and benefit from the rich pool of expertise and established networks. In many cases, simulations planned within an existing sectoral project are also appropriate for use in ISIMIP with only minimal modifications, resulting in a limited additional workload for participating modelling groups. Thus, close interaction between interested sectoral initiatives and ISIMIP will lead to a more efficient and fruitful process overall.

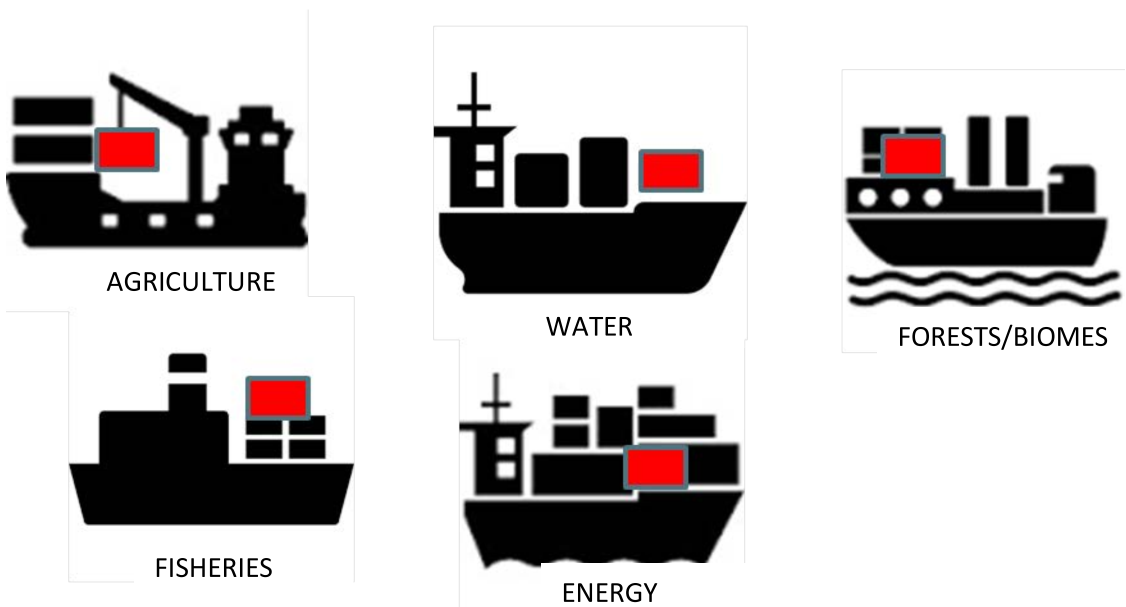

Figure 1 Illustration of the ISIMIP contribution within exemplary sector-specific intercomparison projects represented as ships. Each container represents a simulations task. Sector-specific initiatives could then take an ISIMIP container (red) on board, i.e. an ISIMIP

The integration of high-resolution regional impact models also requires a minimal selection of **focus regions** where these models are run. Similar to the focus topic, the selection is community driven. The selection is expected to represent a compromise between regions at particularly high risk, regions with good availability of observational data, and/or regions that may be representative of other regions or of key processes, such as certain urban infrastructures.

2.2 Output

The key output of ISIMIP is an open-access repository of cross-sectorally consistent, multi-model impacts simulations, analogous to the CMIP archive for global climate model simulations. This archive allows for self-organising research and analysis that contributes to the scientific literature and provides a scientific basis for impacts assessments, such as by the IPCC.

An important consideration in the design of ISIMIP simulation tasks within is the possibility of tracking a set of multi-dimensional indicators such as “number of people affected by extreme events”, “direct economic damages”, “people at risk of hunger” over time. This consistent and regularly-updated set of products would assist in providing knowledge for resilience and transformation decision making as the climate system evolves.

In order to encourage analyses of the ISIMIP simulation data to address the chosen focus topic and other related, societally-relevant themes, efforts will be made to organize special issues in highly-regarded scientific journals dedicated to these themes, and targeted at submissions from the ISIMIP community.

3 Organizational structure and implementation

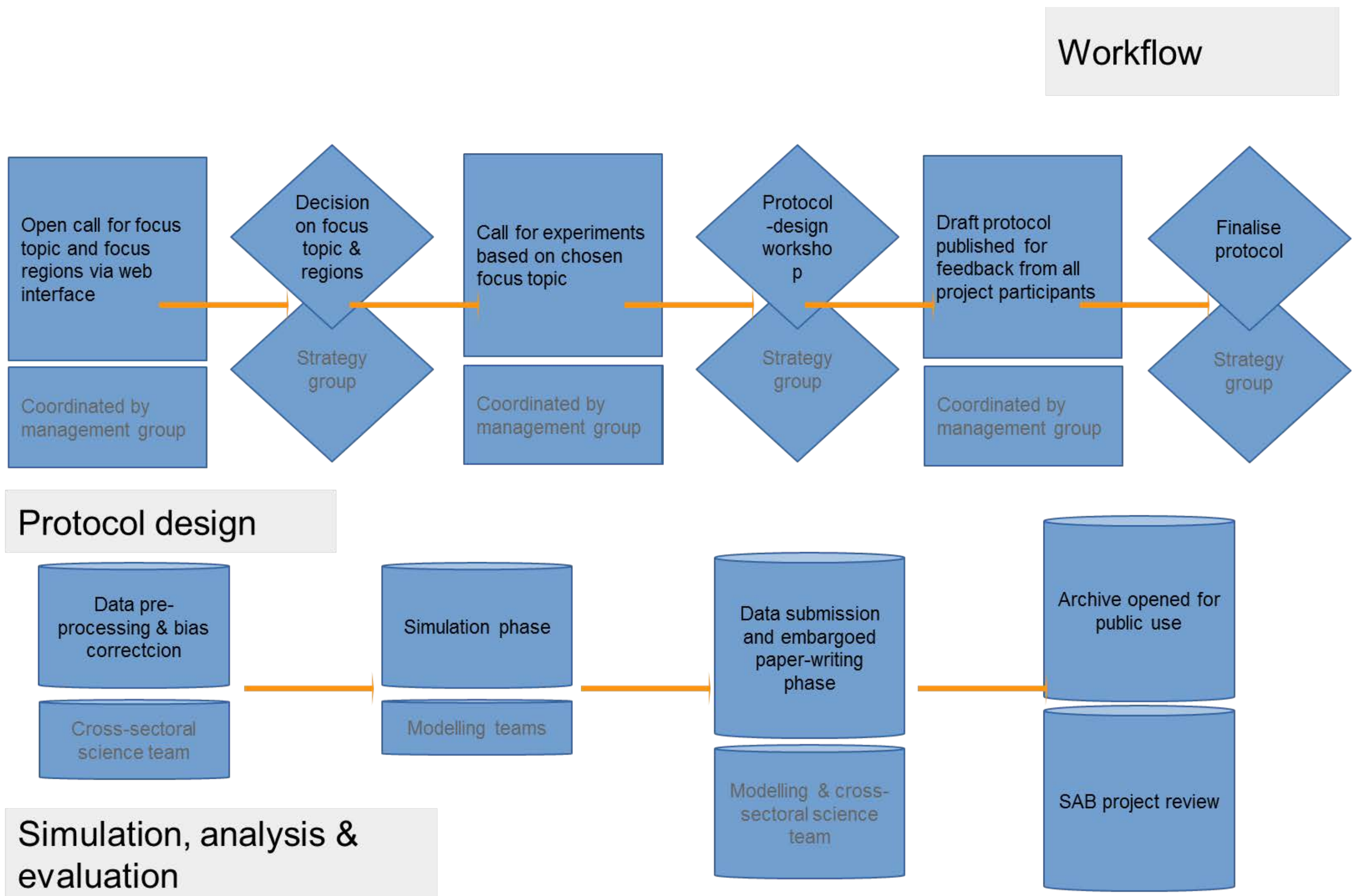

Figure 2 ISIMIP workflow

The ISIMIP organizational structure and workflow as described in this section facilitates the full cycle of model intercomparison and development; including selection of a focus topic and focus regions, design of the simulation protocol, model simulations, analysis, publication opportunities and further outreach. The implementation structure must ensure that ISIMIP is a community-driven initiative building on the broad expertise amongst its participants to open up new approaches to cross-sectoral integration of impact model simulations and synthesis. This section identifies the groups involved and their roles, and outlines an appropriate organizational structure to fulfill the mission described above.

3.1 Organizational structure

ISIMIP is organized in five groups, representatives of which form the strategy group. The members and tasks of each of these groups are summarized in the following diagram.

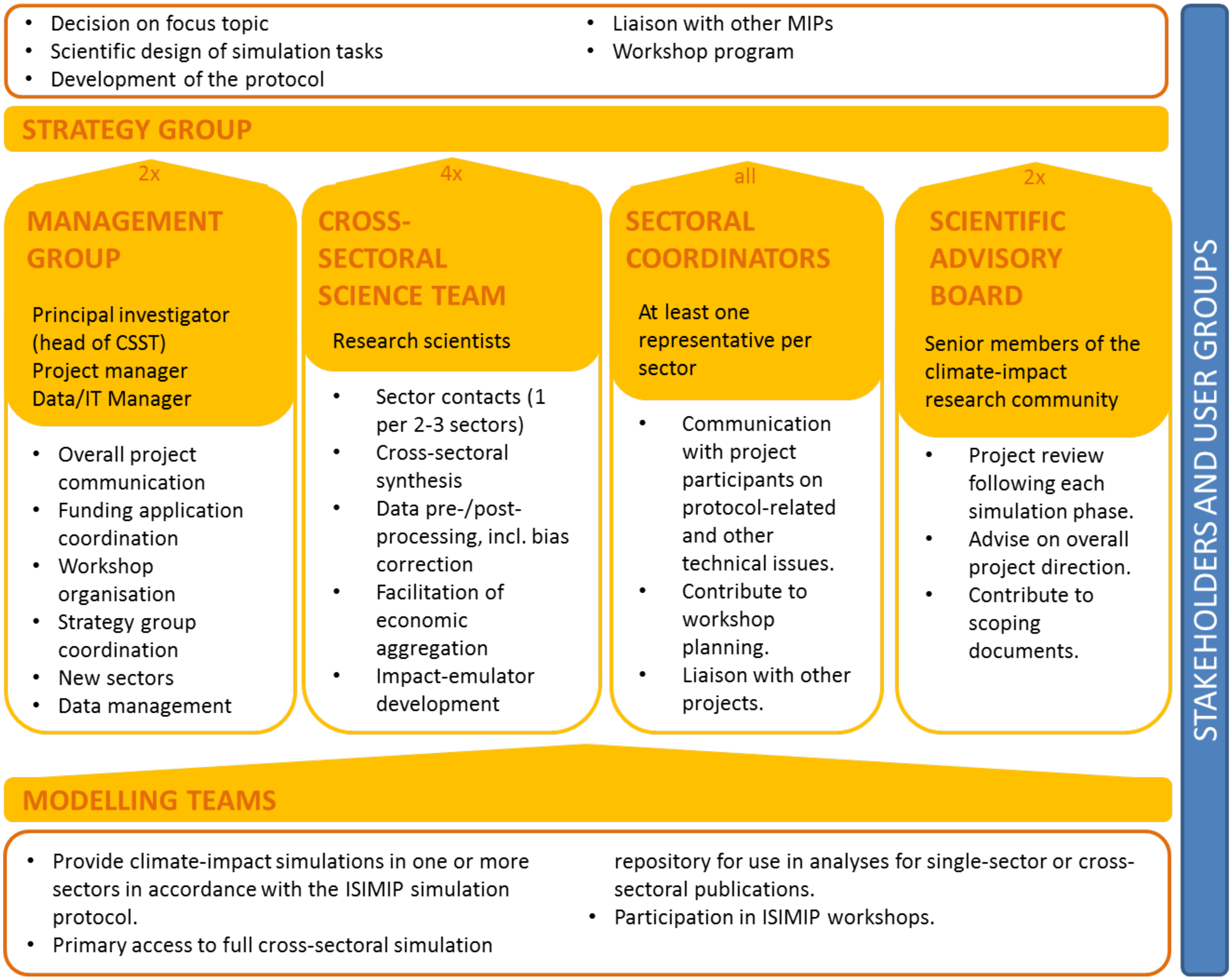

Figure 3 ISIMIP organisational structure

3.1.1 Strategy Group

The strategy group is the central decision-making body. This includes deciding on the focus topic and focus regions for each simulation round and an associated simulation design, based on feedback from the entire project community and stakeholders. The group will develop the ISIMIP protocol, ensuring involvement of the community and stakeholders, based on the workflow described in section 1.5. Other tasks involve liaising with sector-specific model intercomparison projects, and designing the project-workshop program.

Members of the strategy group comprise the project manager and principal investigator, all sectoral coordinators, representatives from the cross-sectoral science team (the contact points for the different sectors, one person per 2-3 sectors), and one representative from the Scientific Advisory Board. The strategy group should meet at least once per year in person, and be in close contact via regular virtual meetings.

3.1.2 Scientific Advisory Board (SAB)

The SAB is a voluntary group of 5-10 internationally renowned scientists (see list in section 1 of the SI) offering oversight and strategic advice to ISIMIP. Their main contributions are:

- Scientific guidance (big questions to answer),
- Suggestions regarding focus topics (see section 3.2),
- Evaluation after each major project phase,
- Suggestions for outreach and dissemination,
- High-level lobbying and liaising on behalf of the project,
- Strategic and scientific support with regard to funding opportunities.

Members of the SAB are invited by the strategy group and appointed for the length of a full simulation round (e.g. ISIMIP2), which lasts approximately four years.

3.1.3 Management Group

The management group comprises the principal investigator, the project manager and the IT manager. The tasks of this group range from overall project communication, both internal and external, through to the organization of workshops and funding proposals to the coordination of the meetings of the strategy group. The management group is the first point of contact for ISIMIP, and ensures that ISIMIP is represented at appropriate conferences and other events.

Management of the ISIMIP data archive is the direct responsibility of the management group. This includes performing quality control on incoming and outgoing data sets, and ensuring consistent formatting of output data for upload.

3.1.4 Cross-sectoral science team

The cross-sectoral science team (CSST) is tasked with performing analysis of the ISIMIP simulation data with a clear focus on cross-sectoral issues. This team will ensure that project description papers are written for each simulation round, which can be used as a project-wide reference. The CSST is also responsible for pre-processing of data sets for use within ISIMIP. This includes bias correction of the climate input data, and preparation of data sets which may be used for later analysis, such as observational data sets of climate impacts.

Other scientific tasks include contributing tothe development of simplified impact-model emulators, with the goal of developing new, improved damage estimates for use in integrated assessment models (IAMs). The CSST will also address the particular challenges of characterizing uncertainty in the multi-impact-model, multi-sector and multi-climate-model framework that poses unique challenges for the synthesis of results.

Membership in the CSST is open to anybody from the research community interested in the tasks above. For every 2-3 impact sectors, there is a responsible member of the CSST. This member supports the sectoral coordinators, with a particular focus on ensuring that the activities within each sector remain consistent with those in other sectors. These members are also the representatives of the CSST in the strategy group.

3.1.5 Sectoral Coordinators

The sectoral coordinators are an international group of recognized experts from their respective sectors. Each sector should have at least one coordinator who also represents this sector in the strategy group. Through this role they play a key part in the protocol development (see section 4.2) and contribute valuable sectoral knowledge to the project. The sectoral coordinators are responsible for coordination of simulations in their sector and work closely with the participating modeling teams. The sectoral coordinators play a key role in liaising with other sector-specific initiatives in order to minimize the overall burden on participating modelling groups by eliminating redundancy and where possible harmonising the respective project protocols. As experts in their sector they ensure high sectoral standards and acceptance within their respective scientific communities.

Aside from their role in the strategy group the sectoral coordinators have the following tasks:

- Communication with modelling groups;
- Contribution to workshop organization, in particular sector-specific sessions and cross-sectoral working groups;
- Liaison with other sector-specific projects, including other MIPs;
- Organization of sector overview papers in each modeling round;
- Contributing to multi-sectoral, cross-sectoral and integrative papers.

3.1.6 Modelling Groups

This is an international group of impact modellers, currently covering the water (global + regional), agriculture (global), biomes/forestry (global + regional), health (global), coastal infrastructure (global), marine ecosystems and fisheries (global + regional), permafrost (global), energy (global), agro-economic modelling (global), and biodiversity (global) sectors (see section 6.1).

The modellers form the backbone of the project, delivering simulation data according to the protocol and using these data for sectoral and cross-sectoral analyses. In order to facilitate that, they get exclusive access to the ISIMIP archive during an embargo period in each simulation round.

3.2 Workflow of scenario development and protocol design

An ideal workflow is summarized in the attached diagram and briefly described in the following. It is broadly separated into two parts: protocol design and the simulation/analysis/evaluation phase.

Scenario and protocol design is achieved via these steps:

1. Open call for focus topic via a web interface (open to the scientific community as well as to relevant stakeholders). This may include stakeholder-oriented workshops or online questionnaires *(coordinated by the management group)*.
2. Decision on focus topic *(strategy group)*.
3. The impact-modelling community is invited to suggest experiments based on chosen focus topic *(coordinated by management group)*.
4. Protocol-design workshop *(strategy group)*.
5. Draft protocol published for feedback from all project participants (i.e. impact modellers via their sectoral coordinators) *(coordinated by management group)*.
6. Finalize protocol *(strategy group)*.

The simulation, analysis and evaluation phase:

1. Collection of input data and pre-processing (e.g. bias correction) *(CSST)*.
2. Simulation phase (modelling teams with sectoral coordinators).
3. Data submission and embargoed (data access only for project participants) paper-writing phase *(modelling teams, sectoral coordinators and CSST)*.
4. Archive opened for public use by the wider scientific and stakeholder community *(management team)*.
5. Active and inquiry-based Interaction with stakeholders to assist with using ISIMIP data (*CSST and management team*).
6. SAB reviews progress made in current simulation round and gives advice for the next round *(SAB)*.

3.3 Getting involved

Participation in ISIMIP is open to all climate-impact modellers willing to follow the guidelines laid out in the 'How to join ISIMIP' document, which can be found on the ISIMIP website. This document outlines the conditions under which the ISIMIP input and simulation data may be used. This includes the definition of an embargo period, during which ISIMIP simulation data may only be used for publications with the explicit permission of the relevant modelling groups, who should be also be offered co-authorship, and the recommendation to offer co-authorship to the relevant sectoral coordinators.

In general, modelling groups can contact the management team or the sectoral coordinators. For modelling teams focusing on impacted sectors not yet covered by the ISIMIP protocol, the opportunity exists to develop the appropriate protocol, and thereby establish a new sectoral initiative. The management group and the cross-sectoral science team will provide ongoing support for the establishment of new sectors, and efforts to attract participants in these emerging activities.

4 Outreach to potential users and stakeholders

The output from ISIMIP is of interest to a broad audience. The groups are relatively diverse with respect to the kind of information they need, ranging from "raw" biophysical impacts projections available in the open-access ISIMIP archive, to estimates of associated economic damages, and a comprehensive assessment of climate change risks with regard to specific issues globally (e.g., the assessment of the 2°C or 1.5°C target within the UNFCCC context, adaptation of the global food supply system) or regionally (e.g., what is the best adaptation strategy for my country/region). Below we provide a list of the requirements of potential users. ISIMIP is not intended to address all of them directly but to provide the framework for the cross-sectorally consistent multi-model simulations needed to address their needs.

As part of the ISIMIP stakeholder process, engagement is envisioned with major public and private sector groups. This will begin with active involvement at major international fora to establish the guiding questions for ISIMIP's benchmark simulations, and continue through regular interactions. Peer-reviewed scientific papers documenting results will inform the IPCC and other assessment processes, and ISIMIP results will feed into summary reports that provide updated risk measures that can be used by decision makers. In the following, the interactions with users and stakeholders are described in more detail for the different groups.

Scientists: Analyses based on the ISIMIP data will contribute to advancing scientific knowledge, in particular in the field of sustainability science with regards to quantification of cross-sectoral interactions and trade-offs. Scientists make use of the "raw" biophysical impacts projections, or require processed data for economic integration. Processing means, for example, the development of scientific approaches for translating extreme events such as floods into economic damages. To a limited extent, the cross-sectoral science team, in close collaboration with the sectoral coordinators, will contribute to this translation of biophysical impacts into economic damages and make the results available on the ISIMIP server as part of their own scientific work. In addition, the CSST and the management team will support the exchange of approaches and requirements between the biophysical and economic modelers via joint workshops, provision of a communication platform and server for an exchange of post-processed data.

Global policy and decision makers (e.g., negotiators in the UNFCCC): Analyses based on the ISIMIP data contribute to estimating the damages and costs of climate impacts, which are necessary to design a framework for dealing with loss and damage claims and to assess the need for ambitious mitigation targets. At the global level, the multi-model setting of ISIMIP facilitates analyses that can also support discussions about and planning of adaptation financing, and adaptation of other global systems, including food supply. Rather than the raw data, this user group needs comprehensive assessments of the projections as provided within the IPCC or other reports targeted at particular societal questions (e.g. Schellnhuber et al., 2012; IPCC, 2014a, 2014b). These reports would benefit strongly from the ISIMIP simulations, which complement the available scientific literature on which these reports are based.

Additional key stakeholders include public sector and private sector groups who offer syntheses of the current state of knowledge. These might include the World Economic Forum (WEF), the Global Environmental Facility (GEF), and the Green Climate Fund of the UN Framework Convention on Climate Change (UNFCCC). Strong existing linkages already exist to the Sustainable Development Solutions Network (SDSN), and emerging efforts such as The World in 2050 and the Energy-Water-Food Nexus projects. Across these initiatives, the provision of consistent, cross-scale and cross-sectoral climate-impacts simulations will provide essential input for robust assessments of climate and development pathways.

Research funding agencies: Analysis of the ISIMIP data can highlight where more targeted, specialized disciplinary research is needed to better understand important system dynamics, which might be poorly covered by current impact models. This group may also need targeted reports such as the UNEP reports on "Research Priorities on Vulnerability, Impacts and Adaptation" (Rosenzweig and Horton, 2013) or "Guidance on Assessing Vulnerability, Impacts and Adaptation to Climate Change" (PROVIA, 2013).

Regional decision makers and stakeholders (e.g., adaptation planners, development agencies): Locally, impact studies may be directly employed for adaptation planning. The group of regional decision makers or stakeholders may use the "raw" data provided in the ISIMIP archive as well as processed data, such as projected flooded areas and inundation depth as derived from ISIMIP runoff projections. For the regional studies, resolution, representation of development choices, local management and protection measures, the time-scale considered and geographical coverage are critical issues that may limit the applicability of the ISIMIP simulations. To what extent ISIMIP simulations can be used for regional adaptation planning will essentially depend of the selection of the focus regions (representativeness) and on the extent to which global models can provide an extrapolation of regional results to other regions. At country scales, ISIMIP results can inform the national adaptation plans that are required periodically by the UNFCCC, through the provision of simulations that feed into reports for SBSTA.

General Public: The key questions driving the ISIMIP simulation and protocol design are also of interest to the wider public. Currently, access to ISIMIP for the general public is restricted to contributions to larger assessment work (IPCC, World Bank reports etc.), and media reports about scientific results based on ISIMIP. Further interactions could be envisioned at scientific-society events such as "the long night of science" in Germany and similar outreach events in other countries. In addition, a large number of ISIMIP participants are on the faculty of universities, where they have the opportunity to put cross-sectoral and interdisciplinary problems and solutions on the agendas of their students and colleagues.

A list of publications based on ISIMIPISIMIP impact simulations, or using the climate input generated within the fast track phase of the project is provided in section 3 of the SI. It also provides examples of associated reports and projects referring to ISIMIPISIMIP data.

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