News from ISIMIP

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Outline

• What is ISIMIP?
• Current activities: ISIMIP 2a
• Next step: contribution to 1.5° report (ISIMIP 2b)
• Economic integration
• Links to other communities
• Conclusion: what do we have to offer?
ISIMIP in a nutshell

**Consistent climate input**
Observational (Princeton, GSWP3, WATCH, WFDEI)
Projections (CMIP5)

**Socioeconomic input data**
historical, SSPs

**Protocol**
Consistent scenario design according to a focus topic

**Impact Models**

- **Regional**
  - Water (14)
  - Forestry

- **Global**
  - Water (13)
  - Agriculture (14)
  - Biomes (8)
  - Infrastructure
  - Health
  - Marine ecosystems and fisheries (7)
  - Energy
  - Permafrost

**Open repository of cross-sectoral consistent impact projections**

www.isimip.org
What ISIMIP can provide now:

- **Basic data:**
  - Crop yields, irrigation water withdrawal (annual)
  - Monthly carbon fluxes and pools, net primary production
  - Daily runoff, discharge, irrigation water demand, actual irrigation water withdrawal and consumption
  - Total catch of fish, total ocean biomass density
  - Malaria – climate suitability, length of potential transmission season, population at risk
  - Coastal infrastructure – costs, people affected, adaptation costs
What ISIMIP can provide in the near future:

**Process based models**
- Flooded areas, flood depths
- Reductions in capital stocks due to extreme events (e.g. flood events, tropical cyclones)
- Number of people affected by floods and tropical cyclones
- Changes in agricultural production
- (National) water scarcity indicators, droughts
- Inundation areas due to sea level rise (+ storm surges)

**Based on empirical approaches**
- Changes in heating and cooling demands
- Changes in Labor productivity due to heat
- Heat and cold related mortality

→ What are useful indicators for IAMs? How to aggregate them?
What can be done with this?

- Impact model uncertainty (many papers)
- Cross-sectoral analyses:
  - Impact hotspots (Piontek et al. 2014)
  - Feedbacks/links between sectors (Elliott et al. 2014, Frieler et al. 2015)
- Differential impacts of global warming (Schleussner et al. 2016)
- Efforts under way include links between agriculture and health (malnutrition) or agriculture and fisheries (fish availability for food)
- Input for derivation of socio-economic impacts
Current phase – ISIMIP2a: Model validation regarding extreme events and variability

- **Goal:** understand ability of models to reproduce observed features, identify key areas of improvement

- **Data input:**
  - Climate: PGMFD v.2 (Princeton), GSWP3, WATCH (WFD), WFDEI.GPCC
  - Land use: historical cropland patterns and historical area covered by natural vegetation from HYDE3.1 and MIRCA, soil map

- Simulation time frame: 1971-2012
- 0.5° resolution
Key analyses (ERL Open Special Issue)

- **Water:** Machine-learning approach to create a multi-model combination estimate as an ensemble summary indicator of hydrology models informed by model performance and weighting – more robust than simple ensemble mean (Zaherpour et al.)
- **Biomes:** (Francois et al.): ecosystem productivities under droughts and heat waves in Europe sensitive to model but less to land use change or historical climate data set
- **First FISH-MIP results** (Eddy et al.)
- **Cross-sectoral:** impacts of the 2003 European heat wave (Schewe et al.)
Key analyses (ctd.)

Agriculture: reproduction of statistical results on temperature dependency of crop yields using crop models (Schauberger et al., under review)
Key analyses (ctd.)

Cross-scale: cross-scale comparison of regional and global hydrological models for 12 river basins (Hattermann et al., under review)

River discharge
Next step: ISIMIP 2b – input for 1.5°C Special Report

Key goals:

- Separate impacts of historical warming starting from pre-industrial conditions from other human drivers (e.g. historical land use changes)
- Quantification of additional warming to 1.5°C including potential overshoot and long-term effects up to 2300
- Quantification of pure climate effect with fixed socio-economic conditions

Timeline:

- Bias correction of GCM data and land use patterns under way → data provision by late summer
- Impact results available December 2016/January 2017
- Paper submission deadline September 2017?
Other input data:

- Historical land use: Hurtt
- Future land use: patterns from MAgPIE (and others?)
  - Includes total crop land (irrigated/non-irrigated), grass land, area for 2nd generation biomass, forest (managed/non-managed), natural other vegetation
- Historic population: Hyde3.2
- Future population: SSP2
- GDP: World Bank/SSP2 (country-level)
- Nitrogen deposition
- Sea-level rise projections
Long-term plans

• Broader stakeholder involvement in ISIMIP process (e.g. ISIMIP3 focus topic)
• ISIpedia – online platform providing overview of available ISIMIP data, visualization of key indicators, access to the database, information on performance and uncertainties

Challenges:

• New approaches to include other sectors (health, infrastructure)
• More cross-sectoral analyses
• Economic integration
Economic integration

Costs of Mitigation, adaptation, damages

Economic models

Simple climate model
Damage function

Regionally explicit impact projections

Based on multiple GCMs for few emission scenarios

Global warming
Pattern scaling
Regional climate

Impact model
Impact emulator

High flexibility but no coverage of impact model uncertainty, potentially slow

Maximum flexibility, fast, difficult development

Some flexibility (limited to ISIMIP), fast, easy development

Global warming

GCMs
Examples for emulators in progress: crop yields

- Sub-Saharan Africa
- Centrally planned Asia
- Europe
- Former Soviet Union
- Latin America
- Middle East & North Africa
- North America
- Pacific Oceania
- Pacific Asia
- South Asia

Emulated LPJmL Maize yield changes with CO2 effect for climate model HadGEM2-ES and emulator method 2

- rcp2p5
- rcp4p5
- rcp6p0
- rcp8p5

× simulated decadal mean
○ emulated decadal mean
Examples for emulators in progress: flood volume

Results from LPJmL model driven by bias-corrected HadGEM2-ES forcings

Global Mean Temperature Increase (°C)

Amazonas, Mississippi, Nile, Paraná, Amur, Yangtze, Niger, Ganges, Danube, Indus, Yellow, Pearl

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Economic integration

- Need for increased economic process understanding:
  - What are critical impact channels, what is their dynamics?
  - Are there effects on economic growth?
- Other relevant metrics beyond costs!!

Costs of Mitigation, adaptation, damages

Economic models

Simple climate model

Highly efficient Impact generator

emissions

global warming

GCMs

Regionally explicit impact projections

Costs of Mitigation, adaptation, damages

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Economic growth impacts of climate change (ENGAGE)

Climate change impact on economic growth?

Role of growth effects in integrated assessment of climate impacts and mitigation?

Integrated assessment of climate change impacts and mitigation (WP4)

Projections of economic damages from floods and tropical cyclones under climate change (WP2)

Macroeconomic dynamics of climate impacts on land (WP3)

Conceptual and empirical analysis of climate change impacts on economic growth (WP1)

Tools & Methods:
- Integrated assessment framework REMIND-MAgPIE, SSPs
- CMIP5, ISI-MIP
- Growth models, econometrics, GAME & NatCatServices data

https://www.pik-potsdam.de/engage
Workshop with empirical and numerical modelers on growth impacts

- More process understanding needed: what shock from what type of impact affects what type of capital in what type of household with what type of loss?
- Mechanisms for growth impacts: human capital effects, permanent destruction of natural resources, lack of capital for reconstruction/adaptation, poverty traps, weak institutions, repressed investments due to high risk aversion
- Need a mix of macro- and micro-level indicators beyond the SCC
- Need to take into account distributional impacts across sectors, households and countries
- Adaptation (high income, macroeconomic dynamics, double counting)
ISIMIP links with other communities

ESMs:
• List of required variables provided to CMIP6
• Special requirements e.g. from energy sector (wind speed at hub height) or FISH-MIP
• ISIMIP3 – test effect of higher resolution input data set
  → Sectors with little experience in dealing with climate data (e.g. health)
  → More critical than climate data is detailed representation of human management (e.g. fertilizer input, dams, ...)

IAMs:
• ENGAGE
• Economic session at last ISIMIP workshop – to be continued at Impacts World 2017 (October 2017, Potsdam)
• Future coordinator of emulator work: Detlef van Vuuren
What ISIMIP has to offer:

- Consistent multi-GCM, multi-impact model data for historical and future periods from a number of sectors.

Impact Model: LPJmL

**Basic information**

- Sector: Water (global)
- Region: Global

Contact Person:
- Dieter Gerten (gerten@pik-potsdam.de) Potsdam Institute for Climate Impact Research

**Simulation Round**: ISIMIP2a

**Reference Paper: Main Reference**: Evaluation of ecosystem dynamics, plant geography and terrestrial carbon cycling in the LPJ dynamic global vegetation model.

**Reference Paper: Other References**:
- Contribution of permafrost soils to the global carbon budget.
What ISIMIP has to offer:

• Consistent multi GCM, multi impact model data for historical and future periods from a number of sectors
• New website with impact model database
• Public data archive with input and output data: https://esg.pik-potsdam.de/projects/isimip-ft/
• Bias corrected climate input
• Support with data processing
• Development of impact emulators
• Access to a multisectoral impacts community
Thank you!
Full organizational structure

- Decision on focus topic
- Scientific design of simulation tasks
- Development of the protocol
- Liaison with other MIPs
- Workshop program

**STRATEGY GROUP**

2x

**MANAGEMENT GROUP**

Principal investigator (head of CSST)
Project manager
Data/IT Manager

- Overall project communication
- Funding application coordination
- Workshop organisation
- Strategy group coordination
- New sectors
- Data management

**CROSS-SECTORAL SCIENCE TEAM**

Research scientists

- Sector contacts (1 per 2-3 sectors)
- Cross-sectoral synthesis
- Data pre-/post-processing, incl. bias correction
- Facilitation of economic aggregation
- Impact-emulator development

**SECTORAL COORDINATORS**

At least one representative per sector

- Communication with project participants on protocol-related and other technical issues.
- Contribute to workshop planning.
- Liaison with other projects.

**SCIENTIFIC ADVISORY BOARD**

Senior members of the climate-impact research community

- Project review following each simulation phase.
- Advise on overall project direction.
- Contribute to scoping documents.

**MODELLING TEAMS**

- Provide climate-impact simulations in one or more sectors in accordance with the ISIMIP simulation protocol.
- Primary access to full cross-sectoral simulation
- Repository for use in analyses for single-sector or cross-sectoral publications.
- Participation in ISIMIP workshops.

www.isimip.org
## Sectoral coordinators

<table>
<thead>
<tr>
<th>Sector</th>
<th>Coordinator for global simulations</th>
<th>Coordinator for regional simulations</th>
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Organizational structure

- Strategy group
- Management group
- Cross-sectoral science team
- Sectoral coordinators
- Scientific Advisory Board
- Impact modelling teams
Setup of runs

- Tier 1
  - Pop, GDP, others
  - Land-use
  - Climate
    - Preindustrial (1661-1860)
    - Historical Reconstruction

- Tier 2
  - Projections: SSP2, SSP2 + RCP2.6, SSP2 + RCP6.0
  - Extended projections: varsoc.2100

- Tier 3
  - Projections: varsoc.2005
  - Extended projections: RCP2.6, RCP6.0
Sea level rise needs another approach

Mengel et al., 2016