

ISIMIP3b Group III Launch

Webinar 8. + 15.7.2024

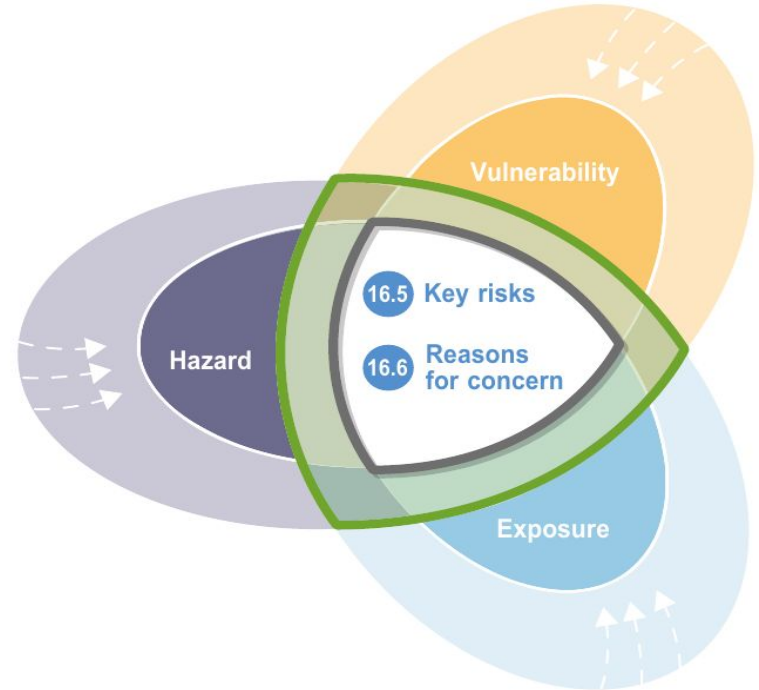


PROGRAM:

- **Why another set of ISIMIP future projections?**
- **What is a group III simulation?**
 - Available forcing data sets
- **What is the difference between an adaptation / no-adaptation experiment?**
- **In which order to run the simulations?**
- **Q/A session**

Severity of Key Risk Depends on Direct Human Forcing and Adaptation

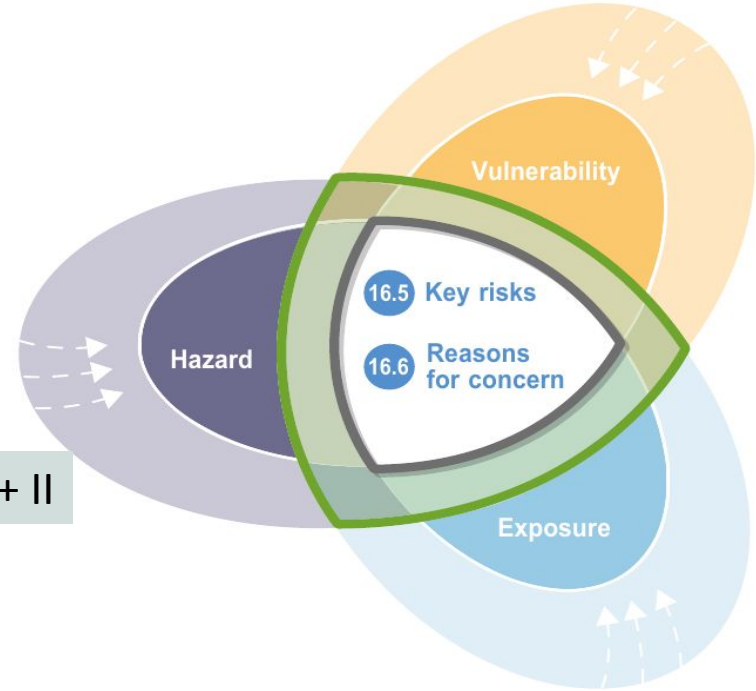
- › *“Representative key risks are expected to increase in the coming decades and will depend strongly **not only on how much climate change occurs, but also on how the exposure and vulnerability of society changes, as well as on the extent to which adaptation efforts will be effective enough to substantially reduce the magnitude of severe risks.**”*
- › key risks are by definition cross-sectoral and depend on the changing direct human forcing, e.g. Risk to peace and human mobility, food security, human health, living standards, critical infrastructures, networks and services



Why another set of ISIMIP future simulations?

- Integration of mitigation measures and remaining impacts (e.g. bioenergy crops, hydropower dams...)
- Development of adaptation scenario
- Evaluation of various adaptation measures (AC deployment, seawater desalination...)

ISIMIP3b group I + II



ISIMIP3b group III

ISIMIP3b group III

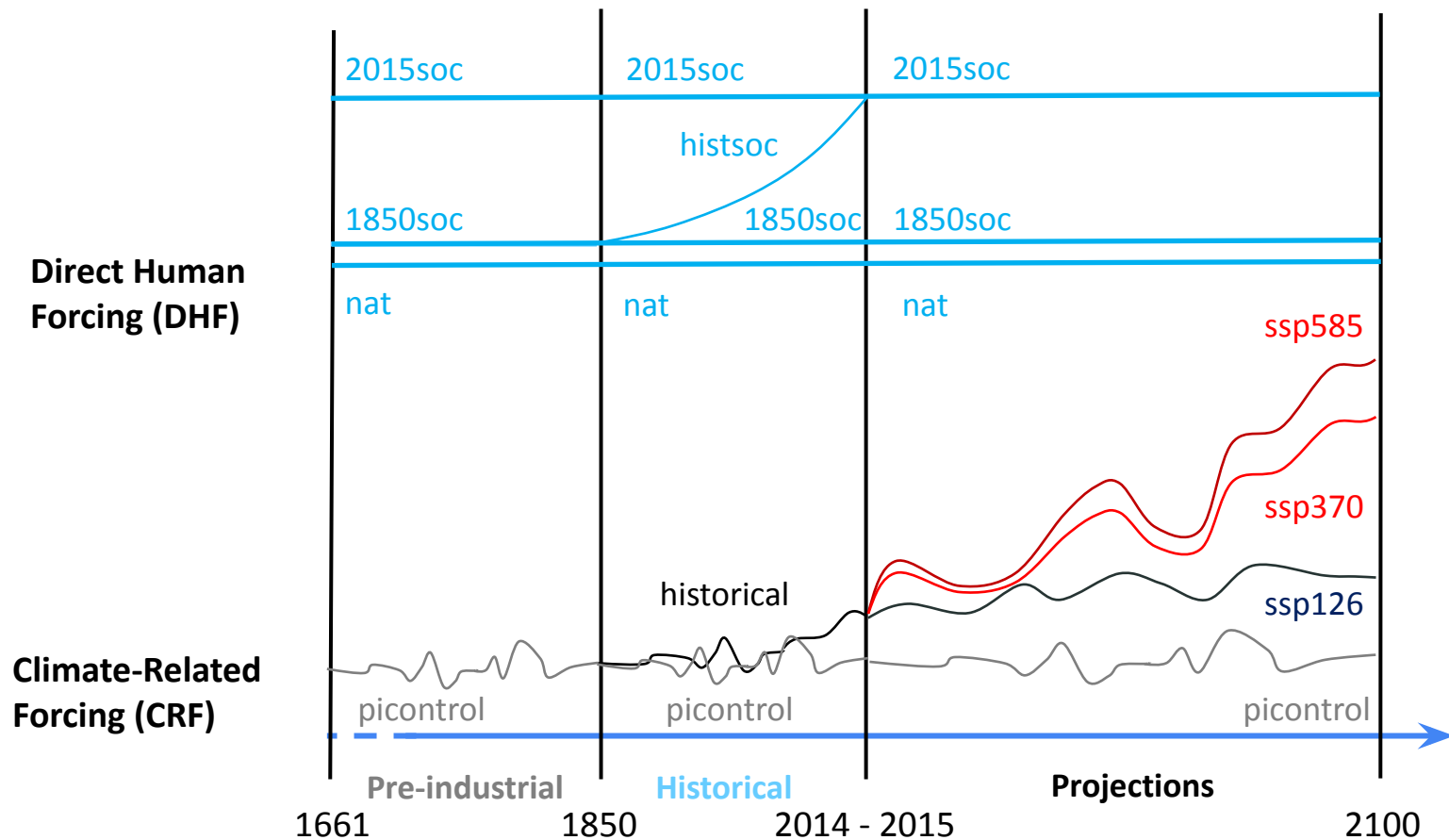
Why another set of ISIMIP future simulations?

ISIMIP3b, group I, II: GCM-based impact simulations

ISIMIP3b

- group I: historical simulations, observed DHF
- group II: future projections, constant 2015 DHF

ISIMIP3b group I + II



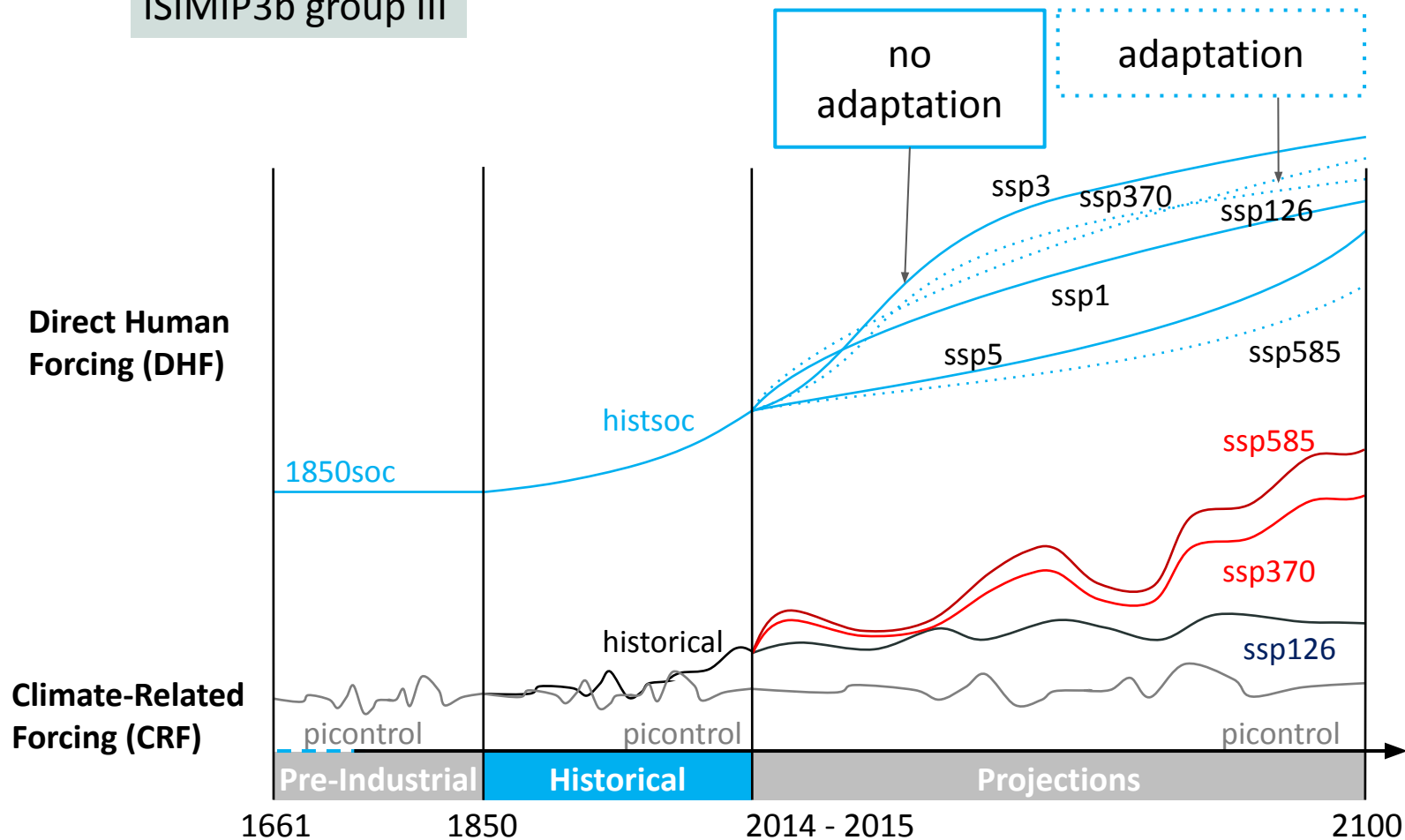
Why another set of ISIMIP future simulations?

ISIMIP3b, group III: Future projections with varying direct human forcing (DHF)

ISIMIP3b Group III

- group III: future projections, future DHF

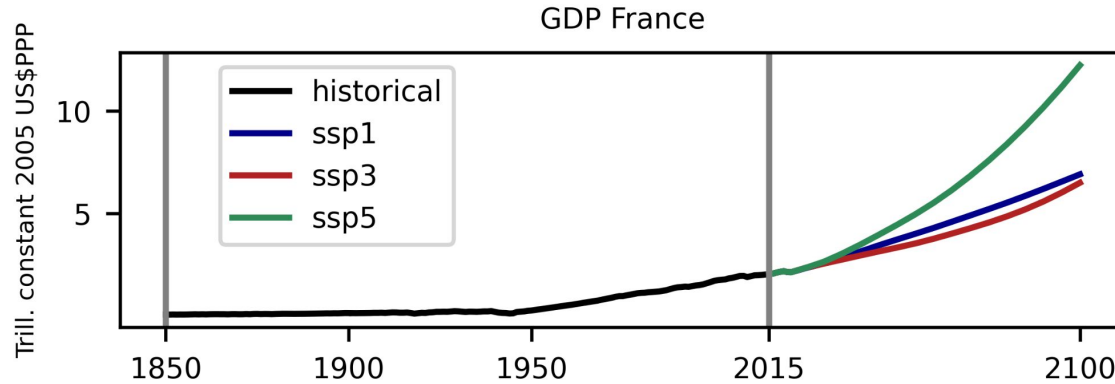
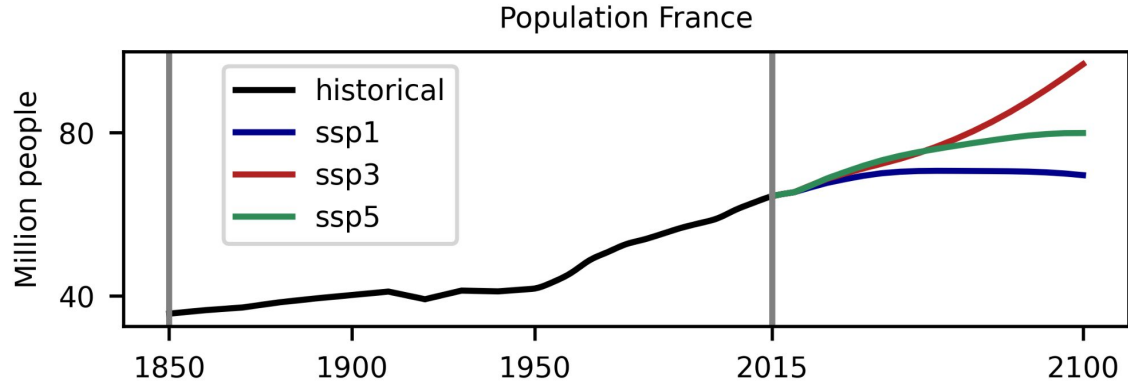
ISIMIP3b group III



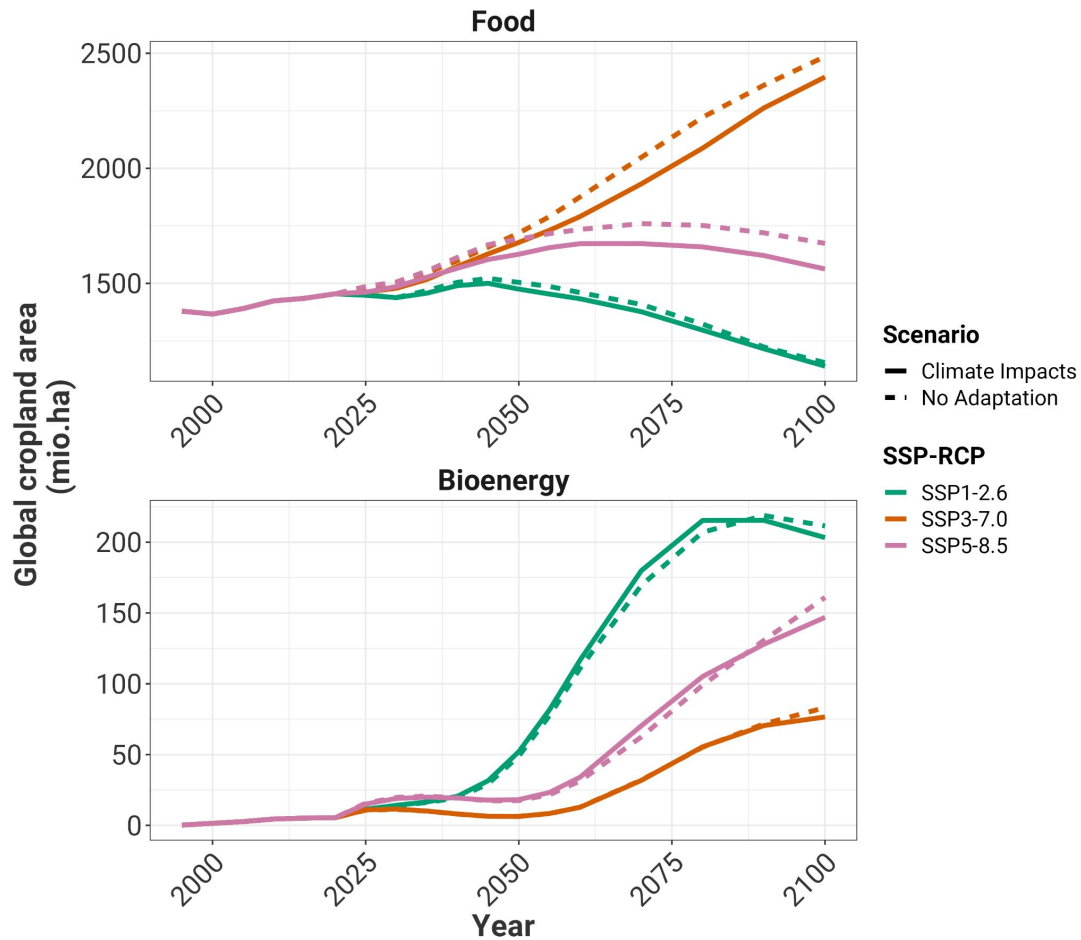
Important definitions and group III data sets

What characterizes an ISIMIP3b group III simulation?

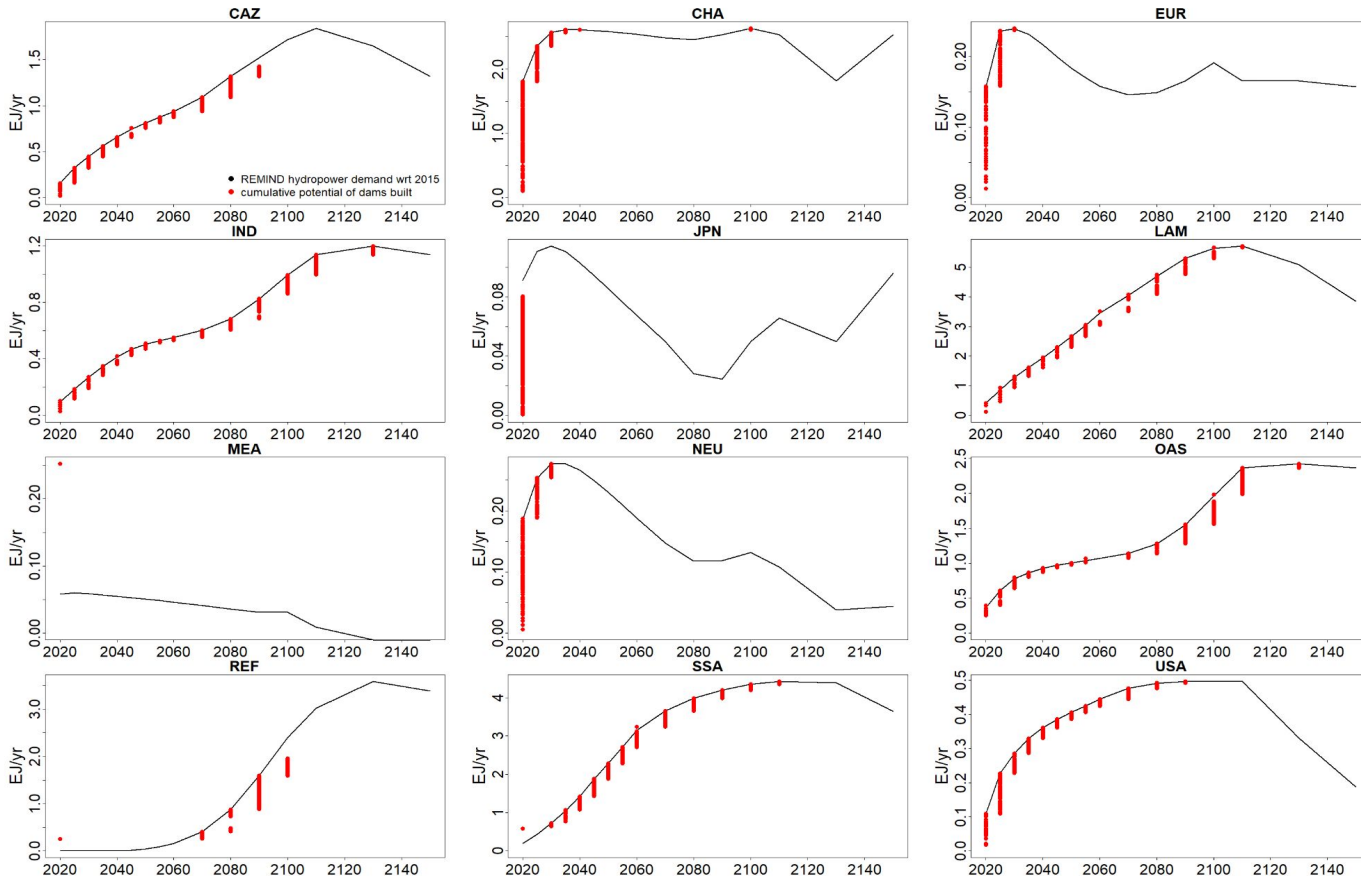
Changes in Direct Human Forcings - Population and GDP



Changes in Direct Human Forcings - Land use



Changes in Direct Human Forcings - Hydropower dams



Changes in
hydropower
demand
(SSP585)

Cumulative
potential of new
dams

Important definitions: Mandatory data sets

ISIMIP Experiments are described by specifying the underlying set of climate-related and direct human forcings.

Some of the forcings are **mandatory**:

→ if impact models account for that kind of forcing data, **the specified dataset must be used**; if an alternative input data set is used instead, the run cannot be considered an ISIMIP simulation.

→ this holds true for all ISIMIP experiments!

ISIMIP3b Group III Direct Human Forcing (DHF)

available on DKRZ

under construction

Direct Human Forcing

Dataset	mandatory/optional	Source, Comments
Gridded Gross domestic product Int\$ PPP 2005 and GDP in MER 2005	mandatory	
National Gross domestic product Int\$ PPP 2005 and GDP in MER 2005	mandatory	Based on SSP GDP per capita scenarios derived from the harmonization between historical WDI (until 2020), short-term projected IMF World Economic Outlook (WEO)(2020-2026), and original SSP income levels in 2100 (Koch and Leimbach 2023).

Direct Human Forcing

Dataset	mandatory/optional	Source, Comments
National/Gridded Population: total, urban, rural (people/yr)	mandatory	<p>National: based on historic population estimates until the year 2021 (UN World Population Prospects (UN, 2019) and complemented by 5-yearly country-level future projections for SSP 1-5.</p> <p>Gridded: downscaled aggregated from national data using gridded population projections at a 30" resolution from the National Center for Atmospheric Research (NCAR) as weights.</p>
Protein uptake per capita (kg/cap/yr)	mandatory	MAGPIE (country-level protein consumption (kg/per capita/year)), IMAGE
Land use (fraction of grid cell)	mandatory	MAGPIE, <i>GLOBIOM</i> , IMAGE
Irrigation (fraction of grid cell)	mandatory	<p>LU patterns arise from SSP specific dynamics (population growth and economic development e.g. changing food demand) and interactions with climate change mitigation measures</p>

Direct Human Forcing

Dataset	mandatory/optional	Source, Comments
Wood harvest	optional	MAGPIE, <i>GLOBIOM</i> , IMAGE (Aggregated at national and annual level. Areas in fractions of total country areas per year, biomass carbon in kg per country and year.)
Land transformation	mandatory	MAGPIE, <i>GLOBIOM</i> , IMAGE (Grid cell area fractions of transitions between different vegetation types)
Synthetic fertilizers N	mandatory	MAGPIE, <i>GLOBIOM</i> , IMAGE (kg/ha, gridded national data for c3ann, c3nfx, c3per, c4ann und c4per and downscaled to)
Synthetic fertilizers (P) on cropland	mandatory	IMAGE-GNM, gridded data (rice legumes, rest; kg P2O5 per gridcell per year)
Synthetic fertilizers (P) on grassland	mandatory	IMAGE-GNM, gridded data (intensively managed; kg P2O5 per gridcell per year)

Direct Human Forcing

Dataset	mandatory/optional	Source, Comments
Animal manure N	mandatory	MAGPIE (national data), IMAGE-GNM (separated for crop and grassland, gridded national data (kg N per gridcell per year))
Animal manure P	mandatory	IMAGE-GNM (separated for crop and grassland, gridded national data (kg P2O5 per gridcell per year))
Livestock numbers	mandatory	IMAGE (regional data + national data potentially), cattle, dairy, poultry, pigs, sheep+ goats, buffaloes, horses
Total N deposition	optional	Extension of simulated ISIMIP3a data (based on chemistry transport models forced as input for CMIP6 simulations) Reduced nitrogen deposition (nhx, gNm ⁻² mon ⁻¹ , monthly), Oxidized nitrogen deposition (noy, gNm ⁻² mon ⁻¹ , monthly)

Direct Human Forcing

Dataset	mandatory/optional	Source, Comments
Crop calendar	mandatory	for the no adaptation case the fixed 2015soc calendar should be used
Marine fishing effort	mandatory	under construction
Dams and reservoirs	mandatory	hydropower dams only (no irrigation dams)
Non-irrigation water use (withdrawal and consumption)	optional	domestic, industrial; multi-model average provided for models that do not have their own water use module
Seawater desalination	optional	desalinated sea water production (SWDP) in $\text{km}^3 \text{y}^{-1}$, and usage (AUSD) (binary)
Inter-basin water transfer	optional	origins and destinations with canals for existing, planned and projects under construction
Irrigation techniques share	optional	

Direct Human Forcing

Dataset	mandatory/optional	Source, Comments
Forest management	mandatory	Management rules for different forest types throughout Europe (only for the regional forest sector)
Residential air conditioning (AC penetration)	optional	gridded data
AC energy consumption	optional	gridded data

Important definitions: Required forcing

Group III

Table 2.6: Direct Human Forcings (DHF) considered in the group III simulations

Forcing	Required	Harmonized	Reference to data sets that are used for the harmonization
...			
Land use	biomes fire forestry groundwater peat permafrost water_global	biomes fire forestry groundwater peat permafrost water_global	<ul style="list-style-type: none">Land use and irrigation data

Required forcings have to be accounted for in the simulations in the given sectors to count as group III simulation (e.g. models in the biomes, fire, etc. sectors **have to account for** changes in land-use)

Important definitions: Harmonized forcing

Group III

Table 2.6: Direct Human Forcings (DHF) considered in the group III simulations

Forcing	Required	Harmonized	Reference to data sets that are used for the harmonization
...			
Land use	biomes fire forestry groundwater peat permafrost water_global	biomes fire forestry groundwater peat permafrost water_global	<ul style="list-style-type: none">Land use and irrigation data

Harmonized forcings: The implementation is prescribed within the sector (e.g. biomes models all **have to use the same** land-use forcing). If a data set is ‘mandatory’ in the previous Table it automatically is ‘harmonized’ here. However, using an ‘optional’ data set can be prescribed for a specific sector here.

**What is the difference between an adaptation /
no-adaptation experiment?**

Important definitions: adapt / noadapt

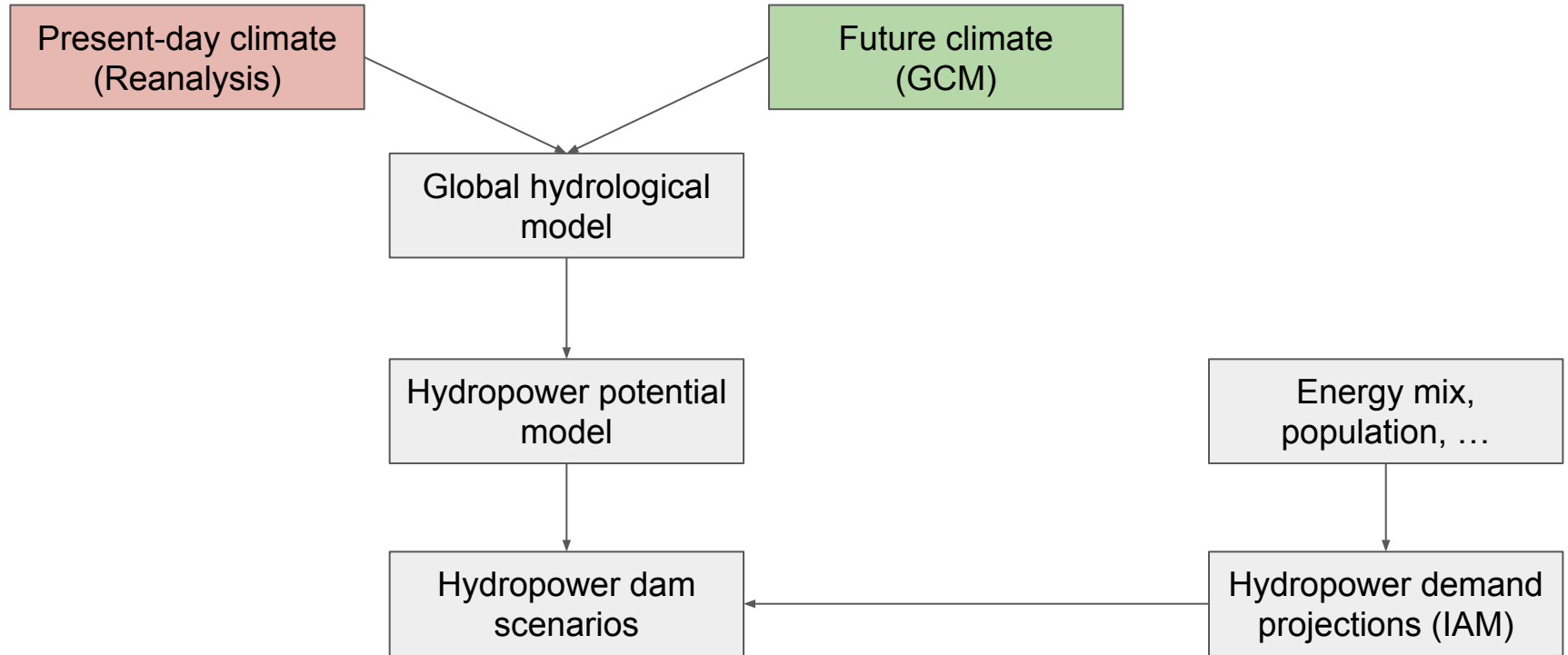
Group III

- no-adaptation: direct human forcings change as they would in a stable climate, driven e.g. by population and GDP growth
- adaptation: climate change is taken into account in decisions e.g. on land use, hydropower dam construction, ...

Example: Hydropower dams

noadapt

adapt



Important definitions: adapt / noadapt

Group III

Table 2.3: Experiment specifiers: Direct Human Forcing (**soc-scenario**)

Experiment specifier	Description
ssp126soc-noadapt ISIMIP3b Group III all sectors	Varying direct human influences in the future period according to the SSP1 scenario, not accounting for the impact of climate change under a RCP2.6 climate.

→ no-adaptation: direct human forcings change as they would in a stable climate, driven e.g. by population and GDP growth

Important definitions: adapt / noadapt

Group III

Table 2.3: Experiment specifiers: Direct Human Forcing (**soc-scenario**)

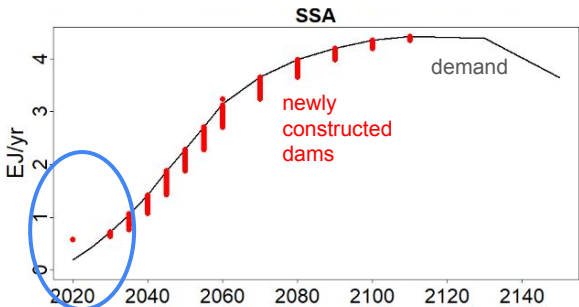
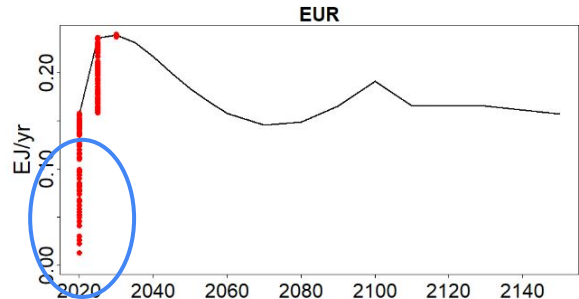
Experiment specifier	Description
ssp126soc-adapt ISIMIP3b Group III all sectors	Varying direct human influences in the future period according to the SSP1 scenario, accounting for the impact of climate change under a RCP2.6 climate.

→ adaptation: climate change is taken into account in decisions e.g. on land use, dam construction, ...

Example: Hydropower dams under SSP5-85

no-adapt

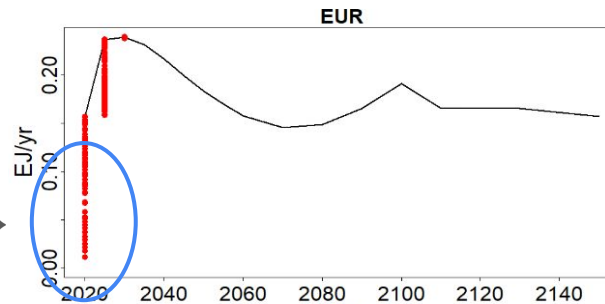
assuming present-day discharge (GSWP3-W5E5)



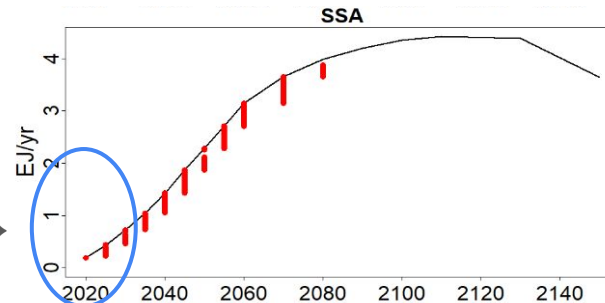
different dams →

adapt

assuming altered future discharge (GFDL-ESM4)



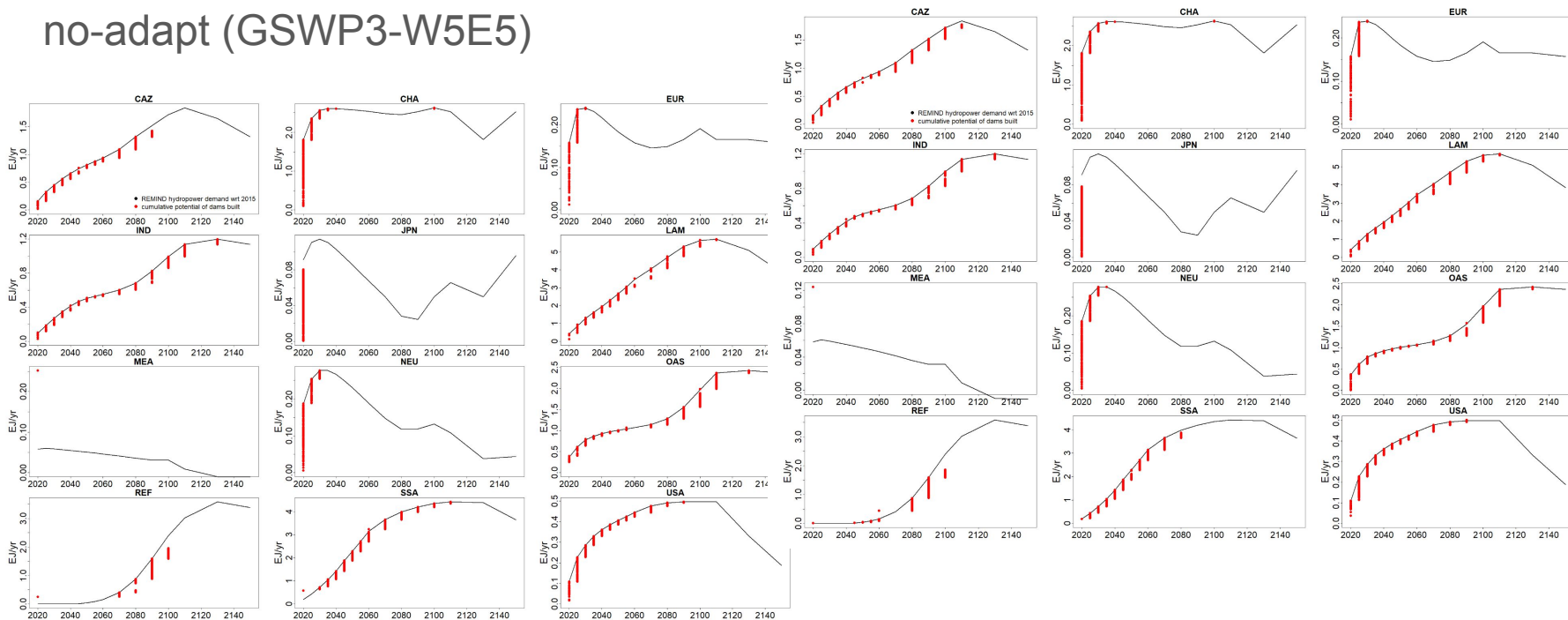
more dams →



Example: Hydropower dams under SSP5

adapt (GFDL-ESM4)

no-adapt (GSWP3-W5E5)



In which order to run your simulations?

CRF + LU model + SSP + no-/adapt = Group III scenarios

Core set (TIER 1)

Priority	GCM	LU model	SSP	no-/adapt
1	GFDL-ESM4	IMAGE	ssp585	noadapt
2	GFDL-ESM4	MAGPIE	ssp585	noadapt
3	GFDL-ESM4	GLOBIOM	ssp585	noadapt
4	GFDL-ESM4	IMAGE	ssp585	adapt
5	UKESM1-0-LL	IMAGE	ssp585	noadapt
6	MPI-ESM1-2-HR	IMAGE	ssp585	noadapt
7	IPSL-CM6A-LR	IMAGE	ssp585	noadapt
8	MRI-ESM2-0	IMAGE	ssp585	noadapt
9	GFDL-ESM4	IMAGE	ssp126	noadapt
10	GFDL-ESM4	IMAGE	ssp126	adapt
11	GFDL-ESM4	IMAGE	ssp370	noadapt
12	GFDL-ESM4	IMAGE	ssp370	adapt

CRF + LU model + SSP + no-/adapt = Group III scenarios

TIER 2-8

Priority	GCM	LU model	SSP	no-/adapt
13-18 (TIER 2)	all	IMAGE (MAgPIE, GLOBIOM)	ssp585	adapt
19-22 (TIER 3)	GFDL-ESM4	MAgPIE, GLOBIOM	ssp126	adapt/noadapt
23-32 (TIER 4)	UKESM1-0-LL	all	ssp126, ssp585	adapt/noadapt
21-30 (TIER 5)	MPI-ESM1-2-HR	all	ssp126, ssp585	adapt/noadapt
31-40 (TIER 6)	IPSL-CM6A-LR	all	ssp126, ssp585	adapt/noadapt
41-50 (TIER 7)	MRI-ESM2-0	all	ssp126, ssp585	adapt/noadapt
51-90 (TIER 8)	all	all	ssp370	adapt/noadapt

Is your sector ready to go?

All models in the sector can start

- group III protocol ready and online
- input data available at DKRZ



Some models in the sector can start

- group III protocol ready and online
- some input data still missing (see Table 3.1) but not all models need it



biomes fire peat
permafrost

Not ready yet

- still issues to be clarified and/or data to be finalized

