ISIMIP3 simulation protocol

ISIMIP3b protocol for all sectors

Last updated: 09 February 2023

Commit hash: 0daa077316c15c134577e460fe8b0b4f57e42e37

Direct link for this selection: https://protocol.isimip.org/#ISIMIP3b

1. Introduction

1.1 General concept

The Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) provides a framework for the collation of a consistent set of climate impact data across sectors and scales. It also provides a unique opportunity for considering interactions between climate change impacts across sectors through consistent scenarios.

ISIMIP is intended to be structured in successive rounds connected to the different phases of the climate model intercomparison CMIP (ISIMIP Mission & Implementation document).

The main components of the ISIMIP framework are:

- A common set of climate and other forcing data which will be distributed via a central database;
- A common modelling protocol to ensure consistency across sectors and scales in terms of data, format and experiment set-up;
- A central archive where the output data will be collected and made available to the scientific community.

1.2 Simulation round

GCM-based simulations assuming fixed 2015 direct human influences for the future ISIMIP3b

The ISIMIP3b part of the third simulation round is dedicated to a quantification of climate-related risks at different levels of climate change and direct human forcing. The Group 1 simulations refer to the pre-industrial and historical period of the CMIP6-based climate simulations. Group 2 covers all future projections assuming fixed 2015 levels of direct human forcing and different future projections of climate (SSP1-2.6, SSP3-7.0 and SSP5-8.5). Group 3 simulations account for future changes in the direct human forcing and are intended to be started once the corresponding direct human forcing input data is available.

To ensure consistency between ISIMIP3a and ISIMIP3b as well as the different experiments within a simulation round, we require that modelling groups use the same version of an impact model for the experiments in ISIMIP3a and ISIMIP3b.

1.3 Simulation protocol

In this protocol we describe the experiments, the different input datasets, the output variables, and how to report model results.

Throughout the protocol we use **specifiers** that denote a particular experiment, variable or other parameter. We use these specifiers in the tables below, in the filenames of the input data sets, and ask you to use the same specifiers in your output files. More on reporting data can be found at the end of this document.

2. Experiments

2.1 Experiments

In Table 2.1, we describe the different experiments for ISIMIP3. Each default experiment is defined by its **climate related forcing (CRF)** and the assumptions regarding **direct human forcing (DHF)**. The associated specifications all have a label such as `obsclim` or `histsoc` that are provided in Table 2.1 and further specified in Tables 2.2 and 2.3. These specifiers are used in the file names of the corresponding input files and should also be used for the names of the output files (see report model results [report model results](#)). Sensitivity experiments are described as deviation from a default experiment and represented by labels that are used as a third specifier of the experiments. Their specific meanings are defined in Table 2.4.

Please note that the experiments are different for ISIMIP3a and ISIMIP3b and some are sector specific. You can use the menu on the top-right of the page to select the sumulation round and sectors you are interested in.

Table 2.1: Experiment set-up. Each experiment is specified by the climate related forcing (top row) and the direct human forcing (bottom row).

Experiment	**Period: Pre-industrial** **1601-1849**	**Period: Historical** **1850-2014**	**Period: Future** **2015-2100**
Pre-industrial control 2015soc-from-histsoc **1st priority** ISIMIP3b agriculture biodiversity biomes diarrhea fire health coastal labour lakes_global lakes_local marine-fishery_global marine-fishery_regional peat permafrost water_global water_regional	**picontrol** **1850soc**	**picontrol** **histsoc**	**picontrol** **2015soc-from-histsoc**
Pre-industrial control 2015soc **1st priority** ISIMIP3b agriculture biodiversity biomes diarrhea fire health coastal labour lakes_global lakes_local peat permafrost water_global water_regional	Does not have to be simulated, spin-up should be based on the 2015 DHF (see note below the table).	**picontrol** **2015soc**	**picontrol** **2015soc**
Pre-industrial control 1850soc **2nd priority** ISIMIP3b biomes lakes_global lakes_local peat permafrost water_global	Identical to the similar **picontrol/1850soc** run above.	**picontrol** **1850soc**	**picontrol** **1850soc**
Pre-industrial control nat **2nd priority** ISIMIP3b biomes marine-fishery_global marine-fishery_regional peat	Does not have to be simulated, spin-up should not use any DHF (see note below the table).	**picontrol** **nat**	**picontrol** **nat**
RCP2.6 2015soc-from-histsoc **1st priority** ISIMIP3b agriculture biodiversity biomes diarrhea fire health coastal labour lakes_global lakes_local marine-fishery_global marine-fishery_regional peat permafrost water_global water_regional	Identical to the similar **picontrol/1850soc** run above.	**historical** **histsoc**	**ssp126** **2015soc-from-histsoc**
RCP2.6 2015soc **1st priority** ISIMIP3b agriculture biodiversity biomes coastal diarrhea fire health coastal labour lakes_global lakes_local peat permafrost water_global water_regional	Does not have to be simulated, spin-up should be based on the 2015 DHF (see note below the table).	**historical** **2015soc**	**ssp126** **2015soc**

RCP2.6 1850soc **2nd priority** ISIMIP3b biomes lakes_global lakes_local peat permafrost water_global	Identical to the similar **picontrol/1850soc** run above.	**historical** **1850soc**	**ssp126** **1850soc**
RCP2.6 nat **2nd priority** ISIMIP3b biomes peat marine-fishery_global marine-fishery_regional	Does not have to be simulated, spin-up should not use any DHF (see note below the table).	**historical** **nat**	**ssp126** **nat**
CO_2 sensitivity RCP2.6 2015soc-from-histsoc **2nd priority** ISIMIP3b agriculture biomes peat permafrost	Identical to the similar **picontrol/1850soc** run above.	Identical to the similar **historical/histsoc** run above.	**ssp126** **Sensitivity experiment: 2015co2** **2015soc-from-histsoc**
RCP7.0 2015soc-from-histsoc **1st priority** ISIMIP3b agriculture biodiversity biomes diarrhea fire health coastal labour lakes_global lakes_local peat permafrost water_global water_regional	Identical to the similar **picontrol/1850soc** run above.	Identical to the similar **historical/histsoc** run above.	**ssp370** **2015soc-from-histsoc**
RCP7.0 2015soc **1st priority** ISIMIP3b agriculture biodiversity biomes coastal diarrhea fire health coastal labour lakes_global lakes_local peat permafrost water_global water_regional	Does not have to be simulated, spin-up should be based on the 2015 DHF (see note below the table).	Identical to the similar **historical/2015soc** run above.	**ssp370** **2015soc**
RCP7.0 1850soc **2nd priority** ISIMIP3b biomes lakes_global lakes_local peat permafrost water_global	Identical to the similar **picontrol/1850soc** run above.	Identical to the similar **historical/1850soc** run above.	**ssp370** **1850soc**
RCP7.0 nat **2nd priority** ISIMIP3b biomes peat	Does not have to be simulated, spin-up should not use any DHF (see note below the table).	Identical to the similar **historical/nat** run above.	**ssp370** **nat**

CO_2 sensitivity RCP70 2015soc-from-histsoc **2nd priority** ISIMIP3b agriculture biomes peat permafrost	Identical to the similar **picontrol/1850soc** run above.	Identical to the similar **historical/histsoc** run above.	**ssp370** **Sensitivity experiment: 2015co2** **2015soc-from-histsoc**
RCP8.5 2015soc-from-histsoc **1st priority** ISIMIP3b agriculture biodiversity biomes diarrhea fire health coastal labour lakes_global lakes_local marine-fishery_global marine-fishery_regional peat permafrost water_global water_regional	Identical to the similar **picontrol/1850soc** run above.	Identical to the similar **historical/histsoc** run above.	**ssp585** **2015soc-from-histsoc**
RCP8.5 2015soc **1st priority** ISIMIP3b agriculture biodiversity biomes coastal diarrhea fire health coastal labour lakes_global lakes_local peat permafrost water_global water_regional	Does not have to be simulated, spin-up should be based on the 2015 DHF (see note below the table).	Identical to the similar **historical/2015soc** run above.	**ssp585** **2015soc**
RCP8.5 1850soc **2nd priority** ISIMIP3b biomes lakes_global lakes_local peat permafrost water_global	Identical to the similar **picontrol/1850soc** run above.	Identical to the similar **historical/1850soc** run above.	**ssp585** **1850soc**
RCP8.5 nat **2nd priority** ISIMIP3b biomes marine-fishery_global marine-fishery_regional peat	Does not have to be simulated, spin-up should not use any DHF (see note below the table).	Identical to the similar **historical/nat** run above.	**ssp585** **nat**
CO_2 sensitivity RCP8.5 2015soc-from-histsoc **1st priority** ISIMIP3b agriculture biomes fire lakes_global lakes_local peat permafrost water_global water_regional	Identical to the similar **picontrol/1850soc** run above.	Identical to the similar **historical/histsoc** run above.	**ssp585** **Sensitivity experiment: 2015co2** **2015soc-from-histsoc**
CO_2 sensitivity RCP8.5 2015soc **1st priority** ISIMIP3b agriculture biomes fire lakes_global lakes_local permafrost water_global water_regional	Does not have to be simulated, spin-up should be based on the 2015 DHF (see note below the table).	Identical to the similar **historical/2015soc** run above.	**ssp585** **Sensitivity experiment: 2015co2** **2015soc**

CO_2 sensitivity RCP8.5 1850soc **2nd priority** ISIMIP3b biomes lakes_global lakes_local permafrost water_global	Identical to the similar **picontrol/1850soc** run above.	Identical to the similar **historical/1850soc** run above.	**ssp585** **Sensitivity experiment: 2015co2** **1850soc**
CO_2 sensitivity RCP8.5 nat **1st priority** ISIMIP3b biomes	Does not have to be simulated, spin-up should not use any DHF (see note below the table).	Identical to the similar **historical/nat** run above.	**ssp585** **Sensitivity experiment: 2015co2** **nat**
Climate sensitivity RCP2.6 with RCP8.5 CO_2 2015soc-from-histsoc **2nd priority** ISIMIP3b peat	Identical to the similar **picontrol/1850soc** run above.	Identical to the similar **historical/histsoc** run above.	**ssp126** **Sensitivity experiment: ssp585co2** **2015soc-from-histsoc**
Nitrogen deposition sensitivity RCP8.5 2015soc-from-histsoc **2nd priority** ISIMIP3b biomes	Identical to the similar **picontrol/1850soc** run above.	Identical to the similar **historical/histsoc** run above.	**ssp585** **2015soc-from-histsoc** **Sensitivity experiment: ssp585ndep**
No nitrogen cycling sensitivity RCP8.5 2015soc-from-histsoc **2nd priority** ISIMIP3b biomes	Does not have to be simulated, spin-up should not include any nitrogen cycling (see note below the table).	**historical** **histsoc** **Sensitivity experiment: nondep**	**ssp585** **2015soc-from-histsoc** **Sensitivity experiment: nondep**
No nitrogen cycling and CO_2 sensitivity RCP8.5 2015soc-from-histsoc **2nd priority** ISIMIP3b biomes	Does not have to be simulated, spin-up should not include any nitrogen cycling (see note below the table).	Identical to the similar **historical/histsoc/nondep** run above.	**ssp585** **2015soc-from-histsoc** **Sensitivity experiment: nondep2015co2**
Future lightning sensitivity RCP2.6 2015soc-from-histsoc **2nd priority** ISIMIP3b fire	Identical to the similar **picontrol/1850soc** run above.	Identical to the similar **historical/histsoc** run above.	**ssp126** **Sensitivity experiment: varlightning** **2015soc-from-histsoc**

Future lightning sensitivity RCP7.0 2015soc-from-histsoc **2nd priority** ISIMIP3b fire	Identical to the similar **picontrol/1850soc** run above.	Identical to the similar **historical/histsoc** run above.	**ssp370** **Sensitivity experiment: varlightning** **2015soc-from-histsoc**
Future lightning sensitivity RCP8.5 2015soc-from-histsoc **2nd priority** ISIMIP3b fire	Identical to the similar **picontrol/1850soc** run above.	Identical to the similar **historical/histsoc** run above.	**ssp585** **Sensitivity experiment: varlightning** **2015soc-from-histsoc**

Note regarding models requiring spin-up

For models requiring spin-up, please use the pre-industrial control data and CO_2 concentration and DHF fixed at 1850 levels ISIMIP3b for the spin up as long as needed.

Please note that the "pre-industrial control run" from 1601-1849 is part of the regular experiments that should be reported and hence the spin-up has to be finished before that.

For experiments with fixed year-2015 direct human influences (`2015soc`), spin-up should be based on the 2015 DHF.

For sector-specific experiments without direct human influence (nat), the spin-up should not use any DHF as well.

Please note that there is no "pre-industrial control run" from 1601-1849 for these experiments (`2015soc`, `nat`) and hence the spin-up links directly to the historical period.

The simulations with nitrogen cycling turned off should also be spun up with nitrogen cycling turned off.

2.2 Experiment specifiers

Tables 2.2-2.4 describe the different specifiers for the different experiments as described in Table 2.1. They are used in the file names of the corresponding input files and should also be used for the names of the output files (see report model results).

All ISMIP experiments are described by specifying the underlying set of climate-related forcings and direct human forcings. Some of the forcing data sets are mandatory: i.e. if impact models account for the forcing, the specified dataset must be used; if an alternative input data set is used instead, the run cannot be considered an ISIMIP simulation.

Table 2.2: Experiment specifiers: Climate-Related Forcings (`climate-scenario`).

Experiment specifier	Forcing	Status	Datasets
picontrol ISIMIP3b all sectors	GCM-based pre-industrial climate related forcing, CO_2 and CH_4 concentrations fixed at 1850 levels.		
historical ISIMIP3b all sectors	GCM-based historical climate related forcing, historical changes in CO_2 and CH_4 concentrations.		

ssp126 ISIMIP3b all sectors	GCM-based climate related forcing according to SSP1-2.6.		
	GCM-based climate forcing according to SSP1-2.6	mandatory	https://doi.org/10.48364/ISIMIP.842396.1 Bias-adjusted data, generated by GFDL-ESM4, IPSL-CM6A-LR, MPI-ESM1-2-HR, MRI-ESM2-0, and UKESM1-0-LL within CMIP6.
	Tropical cyclone tracks and windfields	under development	Synthetic tropical cyclone tracks derived from the five CMIP6 GCMs considered within ISIMIP3b (GFDL-ESM4, IPSL-CM6A-LR, MPI-ESM1-2-HR, MRI-ESM2-0, UKESM1-0-LL) and by two different statistical downscaling approaches (Emanuel et al., 2008 and the Columbia HAZard model (CHAZ), Lee et al. (2018));
	Lightning	mandatory	https://doi.org/10.5067/LIS/LIS-OTD/DATA303 Flash Rate Monthly Climatology from Cecil (2006).
	GCM-based oceanic climate forcing according to SSP1-2.6	mandatory	https://data.isimip.org/10.48364/ISIMIP.575744.2 Generated by GFDL-ESM4, IPSL-CM6A-LR, MPI-ESM1-2-HR, and UKESM1-0-LL within CMIP6. The data has been mapped to a 1° regular grid.
	Coastal water levels	under development	Not available yet, but we plan to provide hourly water levels derived from the atmospheric forcings described above combined with long-term sea-level trends.
	Atmospheric CO_2 concentration according to SSP1-2.6	mandatory	https://doi.org/10.48364/ISIMIP.482153.1 From Meinshausen et al. (2020)
	Atmospheric CH_4 concentration according to SSP1-2.6	mandatory	https://doi.org/10.48364/ISIMIP.482153.1 From Meinshausen et al. (2020)
ssp370 ISIMIP3b all sectors	GCM-based climate related forcing according to SSP3-7.0.		
ssp585 ISIMIP3b all sectors	GCM-based climate related forcing according to SSP5-8.5.		

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

Experiment specifier	Forcing	Status	Datasets
histsoc ISIMIP3a ISIMIP3b all sectors	Varying direct human influences in the historical period. Please label your model run `histsoc` **even if** it only partly accounts for varying direct human forcings while another part of the the direct human forcing is considered constant or is ignored.		
1850soc ISIMIP3b agriculture biodiversity biomes diarrhea fire health coastal labour lakes_global lakes_local peat permafrost water_global water_regional	Fixed year-1850 direct human influences (e.g. land use, nitrogen deposition and fertilizer input, fishing effort). Please label your simulations `1850soc` if they do not at all account for historical changes in direct human forcing, but they do represent constant year-1850 levels of direct human forcing for at least some direct human forcings. This scenario may be thought of an approximation of pre-industrial levels of human impacts.		
2015soc ISIMIP3a ISIMIP3b agriculture biodiversity biomes coastal diarrhea energy fire forestry health labour lakes_global lakes_local peat permafrost water_global water_regional	Fixed year-2015 direct human influences (e.g. land use, nitrogen deposition and fertilizer input, fishing effort). Please label your simulations `2015soc` if they do not at all account for historical changes in direct human forcing, but they do represent constant year-2015 levels of direct human forcing for at least some direct human forcings.		

2015soc-from-histsoc ISIMIP3b all sectors	Fixed year-2015 direct human influences (e.g. land use, nitrogen deposition and fertilizer input, fishing effort) for the future period, if the historical period was using varying direct human influences in the historical period. Please label your simulations `2015soc-from-histsoc` for the future period, if your model run extends a historical period which used the `histsoc` scenario. This distinguishes the data from experiments which use both `2015soc` in the past and the future. If your model output is identical for both cases, please only submit the `2015soc` files for the future period.
nat ISIMIP3a ISIMIP3b biomes peat marine-fishery_global marine-fishery_regional	No direct human influences (naturalized run). Please only label your model run `nat` if it does not at all account for any direct human forcings, including e.g. human land use or fishing. For Nitrogen deposition please use 1850soc values or specify which other preindustrial value you used in the model documentation.

Table 2.4: Experiment specifiers: Sensitivity runs (`sens-scenario`).

Experiment specifier	Forcing	Status	Datasets
default ISIMIP3b all sectors	For all experiments other than the sensitivity experiments.		
2015co2 ISIMIP3b all sectors	CO_2 concentration fixed at 2015 levels.		
ssp585co2 ISIMIP3b peat	CO_2 concentration according to SSP5-8.5.		
ssp585ndep ISIMIP3b biomes	Nitrogen deposition according to SSP5-8.5.		
nondep ISIMIP3b biomes	No nitrogen cycling.		
nondep2015co2 ISIMIP3b biomes	No nitrogen cycling and CO_2 concentration fixed at 2015 levels.		
varlightning ISIMIP3b fire	Future RCP-specific lightening data from UKESM. Please note, as the future lightning dataset is produced using UKESM output, modelers should **only perform this sensitivity experiment using UKESM climate forcing**, not with the other climate forcing datasets.		

General note regarding sensitivity experiments

ISIMIP3b

The sensitivity experiments are meant to be deviations from the default settings. So for example if your model does not at all account for changes in CO_2 concentrations (no option to switch it on or off) the run should be labeled as `default` in the sensitivity specifier of the file name even if the run would be identical to the `1850co2` sensitivity setting.

The particular sensitivity specifier for an experiment is given in the experiments table above. For most experiments no sensitivity specifier is given, so the `default` label applies.

3. Input data

The base directory for input data at DKRZ is:

```
levante:/work/bb0820/ISIMIP/
```

Further information on accessing ISIMIP data can be found at [ISIMIP - getting started](#).

Note on mandatory datasets

Some of the datasets are tagged as mandatory. This does not mean that the data must be used in all cases, but **if** your models uses input data of this kind, we require to use the specified dataset. If an alternative data set is used instead, we cannot consider it an ISIMIP simulation. If the mandatory label is not given, you may use alternative data (please document this clearly).

3.1 Climate related forcing

The climate forcing input files can be found on DKRZ using the following pattern: ISIMIP3b

```
ISIMIP3b/InputData/climate/atmosphere/bias-adjusted/global/daily/<climate-scenario>/<climate-forcing>/<climate-forcing>_<ensemble-member>_<bias-adjustment>_<climate-scenario>_<climate-variable>_global_daily_<start-year>_<end-year>.nc

# ocean data for marine-fishery
ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_<ensemble-member>_<climate-scenario>_<climate-variable>_onedeg_global_monthly_<start-year>_<end-year>.nc  # 1° grid
ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_<ensemble-member>_<climate-scenario>_<climate-variable>_halfdeg_global_monthly_<start-year>_<end-year>.nc  # 0.5° grid
```

Note on ocean data availability

ISIMIP3b marine-fishery_global marine-fishery_regional

Variable availability is mainly based on the data published in ESGF and may vary between the CMIP experiments.

Some variables are available as extracted versions from vertically resolved data. Their variable names have been suffixed with **-bot** (ocean bottom), **-surf** (surface values) or **-vint** (vertically integrated), respectively.

Climate forcing

Table 3.1: Climate forcing datasets (`climate-forcing`).

Title	Specifier	Institution	Native resolution	Ensemble member	Priority
GFDL-ESM4 ISIMIP3b all sectors	**gfdl-esm4**	National Oceanic and Atmospheric Administration, Geophysical Fluid Dynamics Laboratory, Princeton, NJ 08540, USA	Atmosphere: 288x180 Ocean: 720x576	r1i1p1f1	1
UKESM1-0-LL ISIMIP3b all sectors	**ukesm1-0-ll**	Met Office Hadley Centre, Fitzroy Road, Exeter, Devon, EX1 3PB, UK	Atmosphere: 192x144 Ocean: 360x330	r1i1p1f2	2
MPI-ESM1-2-HR ISIMIP3b all sectors	**mpi-esm1-2-hr**	Max Planck Institute for Meteorology, Hamburg 20146, Germany	Atmosphere: 384x192 Ocean: 802x404	r1i1p1f1	3
IPSL-CM6A-LR ISIMIP3b all sectors	**ipsl-cm6a-lr**	Institut Pierre Simon Laplace, Paris 75252, France	Atmosphere: 144x143 Ocean: 362x332	r1i1p1f1	4
MRI-ESM2-0 ISIMIP3b agriculture biodiversity biomes coastal diarrhea energy fire forestry health labour lakes_global lakes_local permafrost water_global water_regional	**mri-esm2-0**	Meteorological Research Institute, Tsukuba, Ibaraki 305-0052, Japan	Atmosphere: 320x160	r1i1p1f1	5

Note on climate forcing priority

The priority for the different climate forcing datasets is given in the last column of Table 5. If you cannot use all climate forcing datasets, please concentrate on those with a higher priority.

Bias adjustment

ISIMIP3b

Table 3.2: Bias adjustment specifiers.

Specifier	Description
w5e5 all sectors	Refers to W5E5 data used for the bias-correction globally on a 0.5° grid.

nobasd all sectors	Indicates that no bias correction was performed on the climate data (e.g. ocean data).
localbc forestry	Refers to local data from weather stations used for the bias-correction in e.g. the forest sector.

Climate related variables

Table 3.3: Climate related forcing variables.

Variable	Variable specifier	Unit	Resolution	Sectors / Source / Comments
Atmospheric Variables				
Ocean Variables				
Mass Concentration of Total Phytoplankton Expressed as Chlorophyll mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_chl_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	chl	kg m-3	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Downward Flux of Particulate Organic Carbon mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_expc_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	expc-bot	mol m-2 s-1	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Particulate Organic Carbon Content mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_intpoc_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	intpoc	kg m-2	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 MPI-ESM1-2-HR UKESM1-0-LL
Primary Organic Carbon Production by All Types of Phytoplankton mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_intpp_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	intpp	mol m-2 s-1	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Net Primary Organic Carbon Production by Diatoms mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_intppdiat_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	intppdiat	mol m-2 s-1	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR UKESM1-0-LL
Net Primary Mole Productivity of Carbon by Diazotrophs mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_intppdiaz_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	intppdiaz	mol m-2 s-1	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 MPI-ESM1-2-HR
Net Primary Mole Productivity of Carbon by Picophytoplankton mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_intpppico_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	intpppico	mol m-2 s-1	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4

Maximum Ocean Mixed Layer Thickness Defined by Sigma T mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_mlotstmax_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	mlotstmax	m	• 1° grid • monthly	marine-fishery_global marine-fishery_regional IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Dissolved Oxygen Concentration mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_o2_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	o2, o2-bot, o2-surf	mol m-3	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
pH mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_ph_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	ph, ph-bot, ph-surf	1	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Phytoplankton Carbon Concentration mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_phyc_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	phyc, phyc-vint	mol m-3	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Mole Concentration of Diatoms expressed as Carbon in sea water mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_phydiat_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	phydiat, phydiat-vint	mol m-3	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR UKESM1-0-LL
Mole Concentration of Diazotrophs Expressed as Carbon in Sea Water mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_phydiaz_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	phydiaz, phydiaz-vint	mol m-3	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 MPI-ESM1-2-HR
Mole Concentration of Picophytoplankton Expressed as Carbon in Sea Water mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_phypico_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	phypico, phypico-vint	mol m-3	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4
Net Downward Shortwave Radiation at Sea Water Surface mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_rsntds_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	rsntds	W m-2	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR
Sea Ice Area Fraction mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_siconc_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	siconc	%	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL

Sea Water Salinity mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_so_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	so, so-bot, so-surf	0.001	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Sea Water Potential Temperature mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_thetao_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	thetao	°C	• 1° grid • 2° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Ocean Model Cell Thickness mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/fixed/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_thkcello_60arcmin_global_fixed.nc			
	thkcello	m	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Sea Water Potential Temperature at Sea Floor mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_tob_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	tob	°C	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Sea Surface Temperature mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_tos_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	tos	°C	• 1° grid • 2° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Sea Water X Velocity mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_uo_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	uo	m s-1	• 1° grid • monthly	marine-fishery_global marine-fishery_regional IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Sea Water Y Velocity mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_vo_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	vo	m s-1	• 1° grid • monthly	marine-fishery_global marine-fishery_regional IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Sea Water Z Velocity mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_wo_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	wo	m s-1	• 1° grid • 2° grid • monthly	marine-fishery_global marine-fishery_regional IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Mole Concentration of Mesozooplankton expressed as Carbon in sea water mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_zmeso_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	zmeso, zmeso-vint	mol m-3	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR UKESM1-0-LL

Mole Concentration of Microzooplankton expressed as Carbon in sea water mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_zmicro_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	zmicro, zmicro-vint	mol m-3	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR UKESM1-0-LL
Zooplankton Carbon Concentration mandatory	ISIMIP3b/InputData/climate/ocean/uncorrected/global/monthly/<climate-scenario>/<climate-forcing>/<climate-forcing>_r1i1p1f1_<climate-scenario>_zooc_60arcmin_global_monthly_<start_year>_<end_year>.nc			
	zooc, zooc-vint	mol m-3	• 1° grid • monthly	marine-fishery_global marine-fishery_regional GFDL-ESM4 IPSL-CM6A-LR MPI-ESM1-2-HR UKESM1-0-LL
Atmospheric composition				
Lightning				

3.2 Direct human forcing

Table 3.4: Direct human forcing variables.

Dataset	Variable specifier	Unit	Covered time period / Resolution	Sectors / Source / Comments
Landuse				
N-fertilizer				
N-deposition				
Crop calendar				
Reservoirs & dams				
Water abstraction				
Fishing				
Forest management				
Lakes				
Population				
GDP				

3.3 Static geographic information

Table 3.5: Geographic data and information.

Dataset	Variable specifier	Unit	Resolution	Sectors / Source / Comments
Land/Sea masks				
Country masks				
Soil				
River routing				
Lakes				

Ocean static properties

4. Output data

4.1 Output dimensions

ISIMIP output variables are usually reported with the dimensions **(time,lat,lon)**. For variables with a number of levels (e.g. layers or depth), an alternative set of dimensions is given in the comment column in the table below. More information about level dimensions can be found here and here on the ISIMIP webpage.

Note on agriculture output

agriculture

For agricultural output, variables are to be reported with the dimensions **(time,lat,lon)** where the time axis' unit is `growing seasons since 1901-01-01 00:00:00` resp. `growing seasons since 1661-01-01 00:00:00` for all variables unless these are reported on a transient time axis, e.g. 'soilmoist1m'. In many cases growing seasons are equivalent to years, as there is always only one planting event per year. However, due to temperature-sensitive growing season lengths, the growing seasons are not fully equivalent to years and users should note the difference. Reported variables on start and end of the growing season are supplied to allow allocating events to transient time axes if desired.

Many variables are defined per area (unit m-2). Typically, and unless otherwise defined, the corresponding reference area is the land area of the grid cell, excluding any water bodies. However, in some cases, it may be necessary or meaningful to report a variable relative to the continental area (including inland water bodies, lakes etc...). For example, evaporation could relate to the land area (excluding water bodies etc.), or to the continental area if the model evaporation occurs over both over land and over water. Also, for some variables, the "per PFT" reporting allows modellers to indicate whether inland water bodies are included in the model or not, and hence, what reference area the variable refers to. In such cases, please specify the reference area in a NetCDF global attribute (e.g. `:reference_area = "continental area (including inland water bodies)"`).

4.2 Output variables

Table 4.1: Output variables (`variable`).

Variable long name	Variable specifier	Unit	Resolution	Comments
Hydrological Variables				
Water management Variables				
Agricultural Variables				
Carbon Pools				
Carbon Fluxes				
Nitrogen Pools				
Nitrogen Fluxes				
Vegetation Cover & Structure				
Fire variables				
Peatland variables				
Forestry Variables				
Hydrothermal Variables				
Water Quality Variables				
Albedo				

Biodiversity Variables
Fisheries and Marine Ecosystems
Temperature-related Mortality
Static output

4.3 Sector specific identifiers

Crop priority and naming

agriculture

Table 4.2: Crop naming and priorities (`crop`).

Crop	Specifier
Major crops	
Other crops	

Irrigation

Table 4.3: Irrigation specifiers (`irrigation`).

Irrigation Type	Specifier
Full irrigation	**firr**
Constrained irrigation	**cirr**
No irrigation (rainfed land)	**noirr**

Harmonization

Table 4.4: Harmonization specifiers (`harmonization`).

Simulation	Specifier	Description
Default	**default**	Model should use their individual “best representation” of the historical period with regard to sowing dates, harvesting dates, fertilizer application rates and crop varieties.
Fully harmonized	**fullharm**	Simulations based on prescribed “present day” fertilization rates (available for download) and fixed planting and harvesting dates (also available for download). Modelers should have planting as closely as possible to these dates, but it may be admissible to use these dates as indicators for planting windows (depending on model specifics).
Harmonized seasons with no N constraints	**harmnon**	For models with an explicit description of the nitrogen cycle: harmnon simulations should be run with nitrogen stress turned off completely or (if that’s not possible) with very high N application rates to make model results comparable between those GGCMs that have explicit N dynamics and those that do not. For models without the nitrogen cycle: harmnon and fullharm simulations are the same and do not need to be duplicated. Please contact the sector coordination to push on with this side branch.

Species

forestry

Table 4.5: Species specifiers (`species`).

Species	Specifier
Fagus sylvatica	**fasy**
Quercus robur	**quro**
Quercus petraea	**qupe**
Pinus sylvestris	**pisy**

Picea abies	**piab**
Pinus pinaster	**pipi**
Larix decidua	**lade**
Acer platanoides	**acpl**
Eucalyptus globulus	**eugl**
Betula pendula	**bepe**
Betula pubescens	**bepu**
Robinia pseudoacacia	**rops**
Fraxinus excelsior	**frex**
Populus nigra	**poni**
Sorbus aucuparia	**soau**
C3 grass	**c3gr**
hard woods	**hawo**
fire	**fi**
wind	**wi**
Insects	**ins**

Forest stands

TableTable 4.6: Forest stand specifiers (`forest-stand`).

Stand	Specifier	Country	Coordinates (Lat, Lon)	Forest type	Species	Thinning during historical time period	Comment
Hyytiälä	**hyytiala**	FI	61.8475, 24.295	Even-aged conifer	pisy, piab	below	Note that an experimental plot of pine contains a lot of data while footprint of flux tower is larger. Please note that the deciduous admixtures only appear in the data at a later stage and hence do not need to be simulated. Only simulate pine and spruce (no hard-woods) and regenerate as pure pine stand
Peitz	**peitz**	DE	51.9166, 14.35	Even-aged conifer	pisy	below	Managed using a weak thinning from below.
Solling (beech)	**solling-beech**	DE	51.77, 9.57	Even-aged deciduous	fasy	above	
Solling (spruce)	**solling-spruce**	DE	51.77, 9.57	Even-aged conifer	piab	below	
Sorø	**soro**	DK	55.485844, 11.644616	Even-aged deciduous	fasy	above	
Kranzberg Roof Project	**kroof**	DE	48.25, 11.4	Mixed deciduous and conifers	fasy, piab, acpl, lade, pisy, quro	below	Unmanaged/ thinning from below in past 20 years for all species.

Le Bray	**le-bray**	FR	44.71711, -0.7693	Even-aged conifer	pipi	below	
Collelongo	**collelongo**	IT	41.8494, 13.5881	Even-aged deciduous	fasy	above	
Bílý Kříž	**bily-kriz**	CZ	49.3, 18.32	Even-aged conifer	piab	below	

Lake sites

lakes_local

Table 4.7: Lake site specifications for local lake models (`lake-site`).

Lake name	Specifier	Reservoir or lake	Country	Coordinates (Lat, Lon)
Allequash Lake	**allequash-lake**	lake	USA	46.25, -89.75
Alqueva Reservoir	**alqueva**	reservoir	Portugal	38.2, -7.49
Lake Annecy	**annecy**	lake	France	45.87, 6.17
Lake Annie	**annie**	lake	USA	27.21, -81.35
Lake Argyle	**argyle**	reservoir	Australia	-16.31, 128.68
Lake Biel	**biel**	lake	Switzerland	47.08, 7.16
Big Muskellunge Lake	**big-muskellunge-lake**	lake	USA	46.02, -89.61
Black Oak Lake	**black-oak-lake**	lake	USA	46.16, -89.32
Lake Bourget	**bourget**	lake	France	45.76, 5.86
Lake Burley Griffin	**burley-griffin**	reservoir	Australia	-35.3, 149.07
Crystal Lake	**crystal-lake**	lake	USA	46, -89.61
Crystal Bog	**crystal-bog**	lake	USA	46.01, -89.61
Delavan Lake	**delavan**	lake	USA	42.61, -88.6
Dickie Lake	**dickie-lake**	lake	Canada	45.15, -79.09
Eagle Lake	**eagle-lake**	lake	Canada	44.68, -76.7
Ekoln basin of Mälaren	**ekoln-basin-of-malaren**	lake	Sweden	59.75, 17.62
Lake Erken	**erken**	lake	Sweden	59.84, 18.63
Esthwaite Water	**esthwaite-water**	lake	United Kingdom	54.37, -2.99
Falling Creek Reservoir	**falling-creek-reservoir**	reservoir	USA	37.31, -79.84
Lake Feeagh	**feeagh**	lake	Ireland	53.9, -9.5
Fish Lake	**fish-lake**	lake	USA	43.29, -89.65
Lake Geneva	**geneva**	lake	France/Switzerland	46.45, 6.59
Great Pond	**great-pond**	lake	USA	44.53, -69.89
Green Lake	**green-lake**	lake	USA	43.81, -89
Harp Lake	**harp-lake**	lake	Canada	45.38, -79.13
Kilpisjärvi	**kilpisjarvi**	lake	Finland	69.03, 20.77

Lake Kinneret	**kinneret**	lake	Israel	32.49, 35.35
Lake Kivu	**kivu**	lake	Rwanda/DR Congo	-1.73, 29.24
Klicava Reservoir	**klicava**	reservoir	Czechia	50.07, 13.93
Lake Kuivajarvi	**kuivajarvi**	lake	Finland	60.47, 23.51
Lake Langtjern	**langtjern**	lake	Norway	60.37, 9.73
Laramie Lake	**laramie-lake**	lake	USA	40.62, -105.84
Lower Lake Zurich	**lower-zurich**	lake	Switzerland	47.28, 8.58
Lake Mendota	**mendota**	lake	USA	43.1, -89.41
Lake Monona	**monona**	lake	USA	43.06, -89.36
Mozhaysk reservoir	**mozhaysk**	reservoir	Russia	55.59, 35.82
Mt Bold	**mt-bold**	reservoir	Australia	-35.12, 138.71
Lake Müggelsee	**mueggelsee**	lake	Germany	52.43, 13.65
Lake Neuchâtel	**neuchatel**	lake	Switzerland	46.54, 6.52
Ngoring	**ngoring**	lake	China	34.9, 97.7
Lake Nohipalo Mustjärv	**nohipalo-mustjarv**	lake	Estonia	57.93, 27.34
Lake Nohipalo Valgejärv	**nohipalo-valgejarv**	lake	Estonia	57.94, 27.35
North Aral Sea	**north-aral**	lake	Kazakhstan	46.53, 60.16
Okauchee Lake	**okauchee-lake**	lake	USA	43.13, -88.43
Lake Pääjärvi	**paajarvi**	lake	Finland	61.07, 25.13
Qinghai	**qinghai**	lake	China	36.83, 100.33
Rappbode Reservoir	**rappbode-reservoir**	reservoir	Germany	51.74, 10.89
Rimov Reservoir	**rimov**	reservoir	Czechia	48.85, 14.49
Lake Rotorua	**rotorua**	lake	New Zealand	-38.08, 176.28
Lake Sammamish	**sammamish**	lake	USA	47.59, -122.1
Sau Reservoir	**sau-reservoir**	reservoir	Spain	41.97, 2.4
Sparkling Lake	**sparkling-lake**	lake	USA	46.01, -89.7
Lake Stechlin	**stechlin**	lake	Germany	53.17, 13.03
Lake Sunapee	**sunapee**	lake	USA	43.23, -72.5
Lake Tahoe	**tahoe**	reservoir	USA	39.09, -120.03
Lake Tarawera	**tarawera**	lake	New Zealand	-38.21, 176.43
Lake Taupo	**taupo**	lake	New Zealand	-38.8, 175.89
Toolik Lake	**toolik-lake**	lake	USA	68.63, -149.6
Trout Lake	**trout-lake**	lake	USA	46.03, -89.67

Trout Bog	**trout-bog**	lake	USA	46.04, -89.69
Two Sisters Lake	**two-sisters-lake**	lake	USA	45.77, -89.53
Lake Vendyurskoe	**vendyurskoe**	lake	Russia	62.1, 33.1
Lake Victoria	**victoria**	lake	Tanzania/Uganda/Kenya	62.1, 33.1
Lake Võrtsjärv	**vortsjarv**	lake	Estonia	58.31, 26.01
Lake Waahi	**waahi**	lake	New Zealand	37.33, 175.07
Lake Washington	**washington**	lake	USA	47.64, -122.27
Windermere	**windermere**	lake	United Kingdom	54.31, -2.95
Lake Wingra	**wingra**	lake	USA	43.05, -89.43
Zlutice Reservoir	**zlutice**	reservoir	Czechia	50.09, 13.11

A document with additional information is maintained by the sector coordinators and provided at https://docs.google.com/spreadsheets/d/1UY_KSR02o7LtmNoOs6jOgOxdcFEKrf7MmhR2BYDlm-Q/edit#gid=555498854.

Catchment gauging stations

water_regional

Table 4.9: Catchment gauging stations for reporting regional hydrological model results (`river-basin`).

River Basin	Station	Specifier	Coordinates (Lat, Lon)	GRDC Station Code	Data availability (monthly discharge)	Data availability (daily discharge)	Area upstream of gauge (km2) according to GRDC or GIS
Amazon	São Paulo de Olivenca	**amazon-sao-paulo-de-olivenca**	-3.45, -68.75	3623100	1979-1993	1973-2010	990781
Blue Nile	El-Deim, Sudan Border	**blue-nile-el-diem**	11, 35		1961-2002	1900-1982	160000
Blue Nile	Khartoum	**blue-nile-khartoum**	15.62, 32.55	1663100		1900-1982	325000
Danube	Wien-Nußdorf	**danube-wien-nussdorf**	48.25, 16.3	6242500	1828-1899	1900-to date	101700
Ganges	Farakka	**ganges-farakka**	25, 87.92	2846800	1949-1973		835000
Godavari	Tekra	**godavari-tekra**	19.068, 79.9		1964-2017	1964-2017	119781
Indus	Tarbela Reservoir	**indus-tarbela**	72.86, 34.33		2000-2016	2000-2016	173345
Lena	Krestovski	**lena-krestovski**	59.73, 113.17	2903427	1936-2002	1936-1999	440000
Lena	Stolb	**lena-stolb**	72.37, 126.8	2903430	1978-1994	1951-2002	2460000
Mackenzie	Arctic Red River	**mackenzie-arctic-red-river**	67.4583, -133.745	4208025	1972-1996	1972-2015	1660000
Mississippi	Alton	**mississippi-alton**	38.885, -90.1809	4119800	1928-1984	1933-1987	444185
Darling	Louth	**darling-louth**	-30.5318, 145.1144	5204250	1954-2000	1954-2008	489300
Niger	Dire	**niger-dire**	16.2667, -3.3833	1134700	1924-2012	1924-2003	340000
Niger	Koulikoro	**niger-koulikoro**	-30.5318, -7.55	1134100	1907-2012	1907-2006	120000

Niger	Lokoja	**niger-lokoja**	7.8, 6.7667	1834101	2007-2012	1970-2006	2074171
Niger	Tossaye	**niger-tossaye**	16.9416, -0.579166	1134850	1954-1992	1954-1992	348000
Pajeu	Floresta	**pajeu-floresta**	-8.6089, -38.5767				12266
Rhine	Lobith	**rhine-lobith**	51.84, 6.11	6435060	1901-1996	1901-2010	160800
Tagus	Almourol	**tagus-almourol**	39.47, -8.37	6113050	1973-1990	1982-1990	61490
Tagus	Trillo	**tagus-trillo**	40.7, -2.58	6213800	1977-1984	1977-1984	3253
Yangtze	Cuntan	**yangtze-cuntan**	29.616667, 106.6		1987-2006	1987-2006	804859
Yellow, Huang He	Tangnaihai	**yellow-tangnaihai**	35.5, 100.15		1971-2002	1971-2002	121000

4.4 Sector specific notes

Reporting per growing seasons

agriculture

To resolve potential double harvests within one year, crop yields should be reported per growing season and not per calendar year. Thus, in the NetCDF output files, do not use a time dimension but instead a unitless coordinate variable with integer values; more information on how to construct these files is given below and on the ISIMIP website (https://www.isimip.org/protocol/preparing-simulation-files/).

Cumulative growing season variables such as, e.g., actual evapotranspiration or precipitation are to be accumulated over the growing season. The first season in the file (level=0) is then the first complete growing season of the time period provided by the input data without any assumed spin-up data, which equates to the growing season with the first planting after this date. To ensure that data can be matched to individual years in post-processing, it is essential to also provide the actual planting dates (as day of the year), actual planting years (year), anthesis dates (as day of the year), year of anthesis (year), maturity dates (day of the year), and year of maturity (year). This procedure is identical to the GGCMI convention (Elliott et al., 2015, https://doi.org/10.5194/gmd-8-261-2015).

Information about PFT-specific outputs

biomes fire permafrost peat

- Unless otherwise defined, variables in ISIMIP should be reported relative to the grid cell land area.
- The output provided per Plant Functional Type (PFT) should be expressed relative to the respective PFT area so that e.g. sum(gpp-pft*pft-pft)=gpp-total.
- When your model allows several PFTs to grow on the same area and hence the total cover fraction can be more than one, please scale the PFT area to one and report this step in the model documentation on the ISIMIP homepage.
- When your model grows the same PFT on different land-use classes, e.g. the same c3-grass represents grasses growing on natural grasslands, pasture and possible even as crop, please differentiate this in your output by defining land-use specific PFT such as c3-grass-pasture, c3-grass-natural, c3-grass-crop and report this in model documentation on the ISIMIP homepage.

Information about soil organic carbon pools of different turnover times

peat permafrost

Some variables can be provided seperately by soil organic carbon pools of different turnover times, if your model simulates those. This is done using the `-<pool>` extension. Please indicate them as `-fast`, `-slow`, and `-passive` and describe your definition of the turnover times in your model description. The extension is used in addition to the extension expressing the Plant Functional Type (PFT) and needs to put before it.

Information about peat outputs

peat

All variables should be reported separately for the peat fraction of the grid cell if they are calculated separately for peat and non-peat grid-cell fractions, with a peattype (`<pt>`) extension to the variable name. This extension can be `-naturalpeat`, `-drainpeat`, `-restorepeat`, or `-minl` for the non-peat (mineral) gridcell fraction. It is used in addition to the extension expressing the Plant Functional Type (PFT) and needs to put before it.

Additional instructions for the health sector

health

- If different realizations of the model are applied, then these should be indicated by the specifier `<r>`. E.g. to reflect a central, upper, and lower estimate of the ERF: `<r> = lower, central, upper`. Please explain the meaning of these realizations in the online model documentation; contact the ISIMIP coordination team in case of questions.

- If data are disaggregated e.g. by age group, gender, etc., they should be reported along an additional dimension, described by an auxiliary coordinate variable, in the NetCDF files. See the example provided at https://www.isimip.org/protocol/preparing-simulation-files/.
- For local (non-gridded) data, locations (cities/regions/countries) should be reported along an additional dimension called location, with the location name given as string in an auxiliary coordinate variable called location_name, in the NetCDF files. In addition, coordinates of the location should be reported in auxiliary variables called location_lat and location_lon. See the example provided at https://www.isimip.org/protocol/preparing-simulation-files/. The `<region>` specifier in the file name should be set to `local`. For gridded data, the `<region>` specifier in the file name should be `global` or indicate a region or country.

5. Reporting model results

The specification on how to submit the data, as well as further information and instructions are given on the ISIMIP website at:

https://www.isimip.org/protocol/preparing-simulation-files

It is important that you comply precisely with the formatting specified there, in order to facilitate the analysis of your simulation results in the ISIMIP framework. Incorrect formatting can seriously delay the analysis. The ISIMIP Team will be glad to assist with the preparation of these files if necessary.

To ensure consistency between ISIMIP3a and ISIMIP3b as well as the different experiments within a simulation round, we require that modelling groups use the same version of an impact model for the experiments in ISIMIP3a and ISIMIP3b. If you cannot fulfill this, please indicate that by using a suffix for your model name (e.g. simple version numbering: MODEL-v1, MODEL-v2 or following semantic versioning: MODEL-2.0.0).

This versioning does not only apply to changes in the computational logic of the model, but also to input parameters, calibration or setup. If model versions are not reported, we will name them according to the simulation round (e.g. MODEL-isimip3a). We require the strict versioning to ensure that differences between model results are fully attributable to the changes in model forcings.

File names consist of a series of identifier, separated by underscores. Things to note:

- Report one variable per file.
- In filenames, use lowercase letters only.
- Use underscore (`_`) to separate identifiers.
- Variable names consist of a single word without hyphens or underscores.
- Use hyphens (`-`) to separate strings within an identifier, e.g. in a model name.
- If no specific `sens-scenario` is given in the experiments table, use `default`.
- Data model is NETCDF4_CLASSIC with minimum compression level of `5`.
- NetCDF file extension is `.nc`.
- The relative time axis' reference year is `1901` for ISIMIP3a and `1601` for ISIMIP3b.
- `!!!`**[modified 2022-12-08]** Use the `standard`, `proleptic_gregorian`, or `365_day` calendar depending on the temporal resolution of your model for **all** types of reported temporal resolutions and write data based on a **daily time index** (`days since ...`). Avoid using the `360_day` calendar for monthly and annual data.
- For fixed variables (e.g. cellarea, contfrac) omit the NetCDF-internal times dimension and the period identifiers in the file name.

Please name the files according to a sector specific pattern:

agriculture

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>-<crop>-<irrigation>_<region>_<time-step>_<start-year>_<end-year>.nc
```

biodiversity

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>_<region>_<time-step>_<start-year>_<end-year>.nc
```

biomes

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>(-<pft>)-<region>_<time-step>_<start-year>_<end-year>.nc
```

coastal

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>_<region>_<time-step>_<start-year>_<end-year>.nc
```

energy

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>_<region>_<time-step>_<start-year>_<end-year>.nc
```

fire

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>(-<crop>-<irrigation>|-<pft>)-<region>_<time-step>_<start-year>_<end-year>.nc
```

forestry

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>(-<species>)-<forest-stand>_<time-step>_<start-year>_<end-year>.nc
```

health

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>(-<r>)-<region>_<time-step>_<start-year>_<end-year>.nc
```

lakes_global

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>_<region>_<time-step>_<start-year>_<end-year>.nc
```

lakes_local

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>_<lake-site>_<time-step>_<start-year>_<end-year>.nc
```

marine-fishery_global

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>_<region>_<time-step>_<start-year>_<end-year>.nc
```

marine-fishery_regional

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>_<ocean-region>_<time-step>_<start-year>_<end-year>.nc
```

peat

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>(-<pt>)(-<pft>)-<region>_<time-step>_<start-year>_<end-year>.nc
```

permafrost

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>(-<crop>-<irrigation>|(-<pool>)-<pft>)-<region>_<time-step>_<start-year>_<end-year>.nc
```

water_global

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>(-<crop>-<irrigation>|-<pft>)-<region>_<time-step>_<start-year>_<end-year>.nc
```

water_regional

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>(-<crop>-<irrigation>|-<pft>)-<river-basin>_<time-step>_<start-year>_<end-year>.nc
```

labour

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>_<region>_<time-step>_<start-year>_<end-year>.nc
```

diarrhea

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable>_<region>_<time-step>_<start-year>_<end-year>.nc
```

and replace the identifiers with the specifiers given in the different tables of this document:

- Experiments: Table 2.2: `climate-scenario`, Table 2.3: `soc-scenario`, Table 2.4: `sens-scenario`
- Input data: Table 3.1: `climate-forcing`, Table 3.2: `bias-adjustment`
- Output data: Table 4.1: `variable`, `resolution`, `time-step`, Table 4.6 - 4.9: `region` (or `global` for most sectors)

For questions or clarifications, please contact info@isimip.org or the data managers directly (isimip-data@pik-potsdam.de) before submitting files.

The Inter-Sectoral Impact Model Intercomparison Project. For questions or clarifications, please contact info@isimip.org.