FishMIP_2023_3b_Protocol

Contents

Goal

The goal of the FishMIP "Ocean Futures" Protocol is to extend 3b CMIP climate projections to include:

2) exploring fishing impacts in addition to those of climate, including future projections with fishing under a range of socio-economic scenarios (aligned with SSPs, Maury et al. IN PREP);
3) comparison to a no-climate change preindustrial control baseline (which was not available for the last round of simulations), and
4) if possible, building on the 3a model evaluation simulation round, model benchmarking against observed catches.

Note that this FishMIP Phase 2 CMIP6 protocol builds on the Phase 1 CMIP6 protocol which began in 2020 and focussed primarily on results without fishing for inclusion in the IPCC 6th Assessment.

Modellers are welcome to redo all previous 3b runs that have had improvements following the 3a model evaluation round, also long as the version of their model outputs are all appropriately annotated.

Timelines for simulations

Scenarios	Models	Date
histsoc, 2015soc	global, regional	July 1st 2024
OSP1soc, OSP2soc	global, regional	Oct 1st, 2024

To aid with progress we will hold specific technical workshops to:

- Ensure correct OSP integration inputs and access
- Ensure fishing drivers work (separate global and regional breakaway groups)
- Tool sharing & troubleshooting
- Check model outputs/issues

In this document we describe the general experimental and scenario set-up (Section 3). Further down in Section 4 we include the details of the specific **input** variables that modellers can use to implement scenarios. In Section 5 we describe the set of **outputs** to be created. Finally in Sections 6-7 we provide further **notes** and **instructions** on how to report and upload model results.

Further information on this protocol can be found here:

https://protocol.isimip.org/#ISIMIP3b/marine-fishery_regional/marine-fishery_global

For this simulation round, we are asking you to run XXXXXXXX

Experiments & Scenarios

Each model experiment is a set of model simulations that has a particular goal (e.g. combined fishing and climate scenario projections). A scenario is a particular setting for forcing drivers that describes how each model run should be set up in the experiment, including both the type of climate forcing (CF) and the type of direct human forcing (DHF).

Below we summarise the simulation experiments for both Phase 1 and Phase 2 of the 3b simulation round. Modellers that have already completed Phase 1 can skip to Phase 2. below. Please prioritize the core runs below, and provide the 'optional' if possible.

Table 1: Experiment set-up. Each experiment is specified by the climate forcing (CF) and Direct Human Forcing (DHF).

	E xperiment	Short de scription	H istorical	Future
1	**Pr e-i ndustrial control** nat	**C limate**: No climate change, fixed 1850s CO_2 levels **F ishing**: No fishing	picontrol nat	picontrol nat
2	**Pr e-i ndustrial control** histsoc	**C limate**: No climate change, fixed 1850s CO_2 levels **F ishing**: H istorical fishing effort, then future fixed at 2015 levels	picontrol histsoc	picontrol 2015soc

	E xperiment	Short de scription	H istorical	Future
3	**S SP1 -RCP2.6** nat	**C limate**: Simulated h istorical climate, then SS P1-RCP2.6 climate **Fis hing**:No fishing	h istorical nat	ssp126 nat
4	**S SP1 -RCP2.6** histsoc	**C limate**: Simulated h istorical climate, then SS P1-RCP2.6 climate **F ishing**: H istorical fishing effort, then future fixed at 2015 levels	h istorical histsoc	ssp126 2015soc
5	**S SP1 -RCP2.6** OSP1	**C limate**: Simulated h istorical climate, then SS P1-RCP2.6 climate **F ishing**: H istorical fishing effort, then change driven by OSP1	h istorical histsoc	ssp126 OSP1soc
6	**S SP5 -RCP8.5** nat	**C limate**: Simulated h istorical climate, then SS P5-RCP2.6 climate **F ishing**: No fishing	h istorical nat	ssp585 nat
7	**S SP5 -RCP8.5** histsoc	**C limate**: Simulated h istorical climate, then SS P5-RCP8.5 climate **F ishing**: H istorical fishing effort, then held fixed at 2015 levels	h istorical histsoc	ssp585 2015soc

	E xperiment	Short de scription	H istorical	Future
8	**S SP5 -RCP8.5** OSP2soc?	**C limate**: Simulated h istorical climate, then SS P5-RCP8.5 climate **F ishing**: H istorical fishing effort, then change driven by OSP2	h istorical histsoc	ssp585 OSP2soc

NEEDS UPDATE: Note on spin-up and transition period (1841-1960), and historical (experiment) period 1961-2010 The focal historical period for this model evaluation experiment spans 1961-2010. To capture the transition from a pre-industrial spin-up to 1961 we also provide input for a gradual increase in fishing and environmental variability for the pre-industrial period to 1961.

For fishing effort prior to 1961, we provide input for a nominal spin-up (1841-1860, fishing held constant at 1861 levels) and pre-industrial transition period (1861-1960, reconstructed fishing effort).

To set-up climate-forcing variables for the entire 1841-1960 period, we ask modellers to use the "control run" (ctrlclim) monthly output for the years 1961-1980 (inclusive) on repeat for six cycles. These years have been selected because they correspond with an entire ENSO cycle and because no climate trend is detectable prior to 1980 from the GFDL model.

For models that require longer spin-up prior to 1841, please keep 1841 levels of fishing effort constant and, if needed, repeat the ENSO cycle (e.g. monthly values for 1961-1980 inclusive from ctrlclim) for as many times necessary.

For the 'no fishing' runs (nat), the spin-up and pre-industrial transition should not use any fishing effort.

We ask modellers to include all outputs from 1841 onwards for use in our evaluation assessment of model drift. Each output should be saved as two files, the first covering the spin-up and transition period (1841-1960) and the second covering the histirical (experiment) period (1961-2010).

Scenario definitions Throughout the protocol we use 'specifiers' that are shortened names used to denote a particular scenario, variables, or other parameter in the filenames of model inputs and outputs. It is crucial that you also use the same specifiers in your output files.

Correct formatting and naming of output files are essential for model intercomparison and analysis.

Tables 2-4 describe the different scenarios for the model runs described in Table 1. 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 7. Reporting model results).

Table 2: Climate scenario specifiers (climate-scenario).

Scenario specifier	Description
picontrol	Pre-industrial climate as simulated by the Earth System Models (ESMs)
historical	Historical climate as simulated by the ESMs, starting in 1950.
ssp126	SSP1-RCP2.6 climate as simulated by the ESMs
ssp585	SSP5-RCP8.5 climate as simulated by the ESMs.

Scenario specifier	Description
sspXXX	ANY OTHERS?

Table 3: Socio-economic scenario specifiers (soc-scenario).

Scenario specifier	Description
histsoc	Varying direct human influences in the historical period (1850-2014) (i.e. historical estimates of fishing effort).
2015soc	Fixed year-2015 direct human influences (i.e. fishing effort).
OSPXsoc	Future fishing determined by SSP1 and OSP driver forcings for OSPX
OSPXsoc	Future fishing determined by SSP5 and OSP driver forcings for OSPX
nat	No fishing (naturalized run).

Please remember to use these same specifiers in your output files. More on reporting data can be found at the end of this document.

Input data

For modellers new to FishMIP: to access all input data you first need to set up an account with ISIMIP to access the DKRZ server. Please follow the instructions here: https://www.isimip.org/dashboard/accessing-isimip-data-dkrz-server/

Climate forcing

Table 5: Climate forcing

Title	Spec ifiers	Institution	Or iginal reso lution
GF DLESM4	gf dlesm4	National Oceanic and Atmospheric Administration, Geophysical Fluid Dynamics Laboratory, Princeton, NJ 08540, USA	2 88x180
IPSL CM6ALR	ipslc m6a-lr	Institut Pierre Simon Laplace, Paris 75252, France	1 44x143
OT HERS??			

MATTHIAS/CHERYL:CROSS CHECK WHAT WE HAVE Vs WHAT IS BELOW

Table 6. Climate forcing variables and units for FishMIP 3a simulations. All variables are available on a 0.25 and 1 degree horizontal grid, monthly and annual resolutions. Note: Some variables are available as specific layers extracted from vertically resolved data. Their variable names have been suffixed with -bot (ocean bottom, e.g. o2-bot), -surf (surface values, e.g. pH-surf) or -vint (vertically integrated, e.g. phyc-vint), respectively, or prefixed with int (vertically integrated, e.g. intpp). Temperature is suffixed with b or s for bottom (e.g. tob) or surface (e.g. tos) layers, respectively.

Variable	Sp ecifier	Unit	Res olution	ESM datasets
Mass Con centration of Total Phy toplankton Expressed as C hlorophyll	**chl**	kg m-3	0.25° , 1° grid	GFDL, IPSL
Sea Floor Depth	• * deptho**	m	0.25° , 1° grid	GFDL, IPSL
Downward Flux of P articulate Organic Carbon	**exp c-bot**	mol m-2 s-1	0.25° , 1° grid	GFDL, IPSL
P articulate Organic Carbon Content	• * intpoc**	kg m-2	0.25° , 1° grid	GFDL, IPSL
Primary Organic Carbon Production by All Types of Phy toplankton	**intpp**	mol m-2 s-1	0.25° , 1° grid	GFDL, IPSL
Net Primary Organic Carbon Production by Diatoms	**intp pdiat**	mol m-2 s-1	0.25° , 1° grid	GFDL, IPSL
Net Primary Mole Pr oductivity of Carbon by D iazotrophs	**intp pdiaz**	mol m-2 s-1	0.25° , 1° grid	GFDL, IPSL
Net Primary Mole Pr oductivity of Carbon by Pico phy toplankton	**intp ppico**	mol m-2 s-1	0.25° , 1° grid	GFDL, IPSL
Maximum Ocean Mixed Layer Thickness Defined by Sigma T	• *mlotst -0125**	m m	0.25° , 1° grid	GFDL, IPSL
Dissolved Oxygen Con centration	**o2,** **o 2-bot** **o2 -surf**	mol m-3 mol m-2 mol m-2	0.25° , 1° grid	GFDL, IPSL
pH	**ph** **p h-bot** **ph -surf**	1 1 1	0.25° , 1° grid	GFDL, IPSL
Phy toplankton Carbon Con centration	• *phyc** **phyc -vint**	mol m-3 mol m-2	0.25° , 1° grid	GFDL, IPSL

Variable	Sp ecifier	Unit	Res olution	ESM datasets
Mole Con centration of Diatoms expressed as Carbon in sea water	**ph ydiat** **phydiat -vint**	mol m-3 mol m-2	0.25° , 1° grid	GFDL, IPSL
Mole Con centration of D iazotrophs Expressed as Carbon in Sea Water	**ph ydiaz** **phydiaz -vint**	mol m-3 mol m-2	0.25° , 1° grid	GFDL, IPSL
Mole Con centration of Pico phy toplankton Expressed as Carbon in Sea Water	**ph ypico** **phypico -vint**	mol m-3 mol m-2	0.25° , 1° grid	GFDL, IPSL
Sea Water Salinity	**so** **s o-bot** **so -surf**	‰ ‰ ‰	0.25° , 1° grid	GFDL, IPSL
Sea Water Potential T emperature	**t hetao**	°C	0.25° , 1° grid	GFDL, IPSL
Ocean Model Cell Thickness	**thk cello**	m	0.25° , 1° grid	GFDL, IPSL
Sea Water Potential T emperature at Sea Floor	**tob**	°C	0.25° , 1° grid	GFDL, IPSL
Sea Surface T emperature	**tos**	°C	0.25° , 1° grid	GFDL, IPSL
Sea Water X Velocity	**uo**	m s-1	0.25° , 1° grid	GFDL, IPSL
Sea Water Y Velocity	**vo**	m s-1	0.25° , 1° grid	GFDL, IPSL
Mole Con centration of Me soz ooplankton expressed as Carbon in sea water	**zmeso** **zmeso -vint**	mol m-3 mol m-2	0.25° , 1° grid	GFDL, IPSL
Mole Con centration of Mic roz ooplankton expressed as Carbon in sea water	**z micro** • *zmicro -vint**	mol m-3 mol m-2	0.25° , 1° grid	GFDL, IPSL
Z ooplankton Carbon Con centration	• *zooc** **zooc -vint**	mol m-3 mol m-2	0.25° , 1° grid	GFDL, IPSL

Variable	Sp ecifier	Unit	Res olution	ESM datasets
Net Downward Shortwave Radiation at Sea Water Surface	**r sntds**	W m-2	0.25° , 1° grid	GFDL, IPSL
Sea Ice Area Fraction	**s iconc**	%	0.25° , 1° grid	GFDL, IPSL

Climate forcing file locations

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

```
levante:/work/bb0820/ISIMIP/ISIMIP3b/InputData/climate/ocean/uncorrected/<glob
al or regional>/monthly/<climate-scenario>/<climate-forcing>/<climateforcing>_<ensemble-member>_<climat
```

The variables **deptho** and **thkcello** are fixed through time and can be found in the "fixed/" folder (rather than monthly/).

Note on phytoplankton size structure inputs Production and carbon data for large and small phytoplankton can be derived from the variables in Table 1 by the following:

large = diatoms + diazotrophs

small = picophytoplankton

The GFDL model treats diazotrophs as large phytoplankton as part of their food-web processes.

CHECK SHOULD THE TEXT INSTEAD BE:

* **Small phytoplankton carbon/production data** are not available on the server, but can be made by modellers by subtracting diatom carbon/production from total phytoplankton carbon/production.

Note on regional model spatial extractions For regional models, only specific grid cells will be needed from the above global outputs. Please let us know if you require assistance to extract results (e.g. using bounding boxes, masks or shapefiles). This functionality is now partially available (bounding box) through the ISIMIP web-based data portal.

A simple worked example on how to do this for specific regions in R is provided here: UPDATE FOR PROJECTIONS, ASK MATTHIAS ABOUT GETTING SHAPEFILES ADDED TO DATA PORTAL

Fishing effort forcing - NEEDS TO BE UPDATED - OSPs

Table 7: Fishing effort forcing files and variables for FishMIP 3b simulations.

Specifier	Included variables (short names) and definitions	Time pe riod /Resolution	Filename
histsoc	NomActive = Nominal fishing effort of the active fleet dis-aggregated by: • eez_country_name = The exclusive economic zone/high seas name in which fishing effort is occurring • LME = A number code of the Large Marine ecosystem in which the Effort is occurring • SAUP = A number code for the fishing country, following Sea Around Us numbering • Gear = the fishing gear • FGroup = the targeted functional group • Sector = the fishing sector defined by the law of the country	• 1850-2015 • Annual	
2015soc	Final year of values from histsoc repeated until 2100	• 2015-2100 • Annual	
OSP1soc	Which variables? Determined from % change relative to 2015 in SSP1Population, SSP1GDP and relative change to 2015 (drivers of?) fishing effort	• 2015-2100 • Annual	
OSP2soc	Which variables? Determined from % change relative to 2015 in SSP5Population, SSP5GDP and relative change to 2015 (drivers of?) fishing effort	• 2015-2100 • Annual	
H istorical P opulation			
H istorical GDP			
OTHERS?			
SSP1 P opulation			
SSP1 GDP			
SSP5 P opulation			
SSP5 GDP			

Table 8: Metadata for histsoc fishing effort variables.

Va riable Name	Long name	Unit	Description/notes
Year	(End of the) year when the f ishing effort is occ urring	Number code	
Sector	The f ishing sector d efined by the law of the c ountry	Name code	I = Industrial and A = artisanal, where artisanal include powered and unpowered artisanal fleets

Va riable Name	Long name	Unit	Description/notes
LME	Large Marine Eco system Number	Number code	A number code of the Large Marine ecosystem in which the Effort is occurring
eez_ countr y_name	Exc lusive Ec onomic Zone	Name code	The country-level exclusive economic zone (or high seas) name in which fishing effort is occurring
SAUP	A number code for the f ishing co untry, fol lowing Sea Around Us num bering	Number code	Ex supranational entities (USSR, Yugoslavia) are disaggregated to their constituent countries. Serbian Fishing Effort included with Montenegro. Crimea included with Ukrainian.
Gear	The f ishing gear	Name code	Gear names
FGroup	The ta rgeted func tional group	Name code	Functional groups are in accordance with those used by the Sea Around Us Project
Nom Active	N ominal f ishing effort (i.e., not inc luding the t echnol ogical creep) of the active fleet	Days at sea X kW	NomActive (of the active fleet; i.e., total) = P (engine power of active the fleet; i.e., total) x DAS (average days at sea of one vessel). Average DAS for one vessel ~ 200 DAS/year. NomActive corresponds to the total (reported, IUU, discards) catch. To find NomActive in DAS do (NomActive/P) X NV

Table 9: Details for OSP relative change in drivers of fishing effort variables.

OSP	Variable	Change relative to 2015
OSP1	????	????
OSP2	????	????

Implementation of OSPs TO DO: We provide code examples showing how to implement the OSPs... NEED TO ADD TO GITHUB REPO

Fishing effort forcing file locations The monthly fishing effort forcing files for the spin-up and experiments (Table 1) of this simulation protocol can be found on DKRZ here:

```
levante:/work/bb0820/ISIMIP/ISIMIP3b/InputData/socioeconomic/fishing/histsoc/
```

Note on historical global model fishing effort forcing For **global models**, the above spatially aggregated fishing effort can be spatially allocated into 1.0 grid cells. This can be achieved using different approaches such as a simple gravity model – e.g. see Coll et al. 2020 but details will depend on model structure.

TO UPDATE: We are developing a simplified worked example for global modellers to explore and contribute to. This will be made available on github/FishMIP in due course.

While we recommend using the above spatially aggregated effort, for **global models** that cannot technically carry out spatial allocation of effort, gridded total industrial and artisanal nominal active effort have been provided in the same folder as the file above and are saved as netcdf files. These can be allocated to functional groups (e.g. according to relative biomass) depending on model structure.

Note on regional model fishing effort forcing TO UPDATE/ DEVELOP SEPARATE PROTOCOL FOR: Downscaling of the above fishing effort to match regional model inputs is likely to be needed. We request that regional modellers work together in their specific regions to ensure we have clear and common methodologies.

We are developing a worked example for regional modellers to explore and contribute to for their region which will be made available on github/FishMIP in due course.

Note on model calibration using fishing catch data and model evaluation requirements Modellers are permitted to calibrate or tune their models using historical fisheries catch data (that will also be used for model evaluation) on the condition that **only years up to and including 2004** are used in model calibration/tuning.

Modelling groups **must** keep **detailed documentation** on how their model was calibrated (e.g. input forcing, calibration data, time domain, spatial domain, fish grouping (size, functional types, total), optimization metric(s), weighting schemes, etc.) to be included in manuscript methods. Written description of sources of calibration data and methods used need to be provided with all simulation outputs. A template will be provided for this documentation in due course.

The fisheries catch data .csv file that can be used for model calibration is here:

```
levante:/work/bb0820/ISIMIP/ISIMIP3a/InputData/socioeconomic/fishing/histsoc/calibration_catch_histsoc_
```

The fisheries catch data are already aggregated into the functional groups and spatial zones as the above effort forcing data. The original reference including links to full database is Watson & Tidd, 2018, Marine Policy, 93: 171-177.

Other static geographic information:

Large marine ecosystem (LME) masks in four different spatial resolutions. 0.1°, 0.25°, 0.5° and 1° are available here:

```
/work/bb0820/ISIMIP/ISIMIP3a/InputData/geo_conditions/fishmip_regions/
```

Each region has its own variable within each file.

We have also provided conversion tables that can be used to look up LME and SAUP names according to the numeric codes used in the catch and effort files (e.g. LME 22 – North Sea). These files (SAUPnames.csv and LMEnames.csv) are also available here:

```
/work/bb0820/ISIMIP/ISIMIP3a/InputData/geo_conditions/fishmip_regions/
```

Output data

All spatially gridded outputs should be created as netcdf files. More information on how to prepare these files can be found here. Aspatial regional model results may be saved as .csv files.

UPDATE:In the output files, please label the time variable as "days since 1841-1-1 00:00:00" if the output covers the spin-up and transition period (1841-1960) or "days since 1901-1-1 00:00:00" if the output covers the experiment period (1961-2010).

Table 9: Mandatory output variables for Fisheries and Marine Ecosystem models (global and regional). See notes on additional optional model outputs below. Please use the value 1.e+20 for missing data within your output files. All biomasses are in wet weight (not g C).

Variable long name	Va riable spe cifier	Unit	Reso lution	Comments
Total Consumer Biomass Density	• *tcb**	g m-2	1° grid, annual	All consumers (trophic level >1, vertebrates and in vertebrates)
Total Consumer Biomass Density in log10 Weight Bins	**tcbl og10**	g m-2	1° grid, annual	**Level dim ensio ns:** (time, bins, lat, lon). If the model is size -structured, please provide biomass in equal log 10 g weight bins (1-10g, 10-100g, 100g-1kg, 1-10kg, 10-100kg, >100kg)
Total Pelagic Biomass Density	• *tpb**	g m-2	1° grid, annual	All pelagic consumers (trophic level >1, vertebrates and in vertebrates)
Total Demersal Biomass Density	• *tdb**	g m-2	1° grid, annual	All demersal consumers (trophic level >1, vertebrates and in vertebrates)
Total Catch Density (all c ommercial f unctional groups / size classes)	**tc**	g m-2	1° grid, annual	Catch at sea (all catch as a result of all effort including reported and IUU) summed for both Industrial and Artisanal sector.
Total I ndustrial Catch Density (all c ommercial f unctional groups / size classes)	• *tic**	g m-2	1° grid, annual	Catch at sea (all catch as a result of all effort including reported and IUU) for Industrial sector only.
Total Catch Density in log10 Weight Bins across both sectors	**tcl og10**	g m-2	1° grid, annual	**Level dim ensio ns:** (time, bins, lat, lon). If the model is size -structured, please provide biomass in equal log 10 g weight bins (1-10g, 10-100g, 100g-1kg, 1-10kg, 10-100kg, >100kg)
Total Pelagic Density Catch across Artisanal and I ndustrial sectors	• *tpc**	g m-2	1° grid, annual	Catch at sea of all pelagic consumers (trophic level >1, vertebrates and in vertebrates)

Variable long name	Va riable spe cifier	Unit	Reso lution	Comments
Total Demersal Catch Density across Artisanal and I ndustrial sectors • *Optional output from global and regional models. All biomasses are in wet weight, not g C.**	• *tdc**	g m-2	1° grid, annual	Catch at sea of all demersal consumers (trophic level >1, vertebrates and in vertebrates)
Biomass Density of Small Pelagics <30cm	**bp 30cm**	g m-2	1° grid, annual	If a pelagic species and L infinity is <30 cm, include in this variable
Biomass Density of Medium Pelagics >=30cm and <90cm	**bp30to 90cm**	g m-2	1° grid, annual	If a pelagic species and L infinity is >=30 cm and <90cm, include in this variable
Biomass Density of Large Pelagics >=90cm	**bp 90cm**	g m-2	1° grid, annual	If a pelagic species and L infinity is >=90cm, include in this variable
Biomass Density of Small Demersals <30cm	**bd 30cm**	g m-2	1° grid, annual	If a demersal species and L infinity is <30 cm, include in this variable
Biomass Density of Medium Demersals >=30cm and <90cm	**bd30to 90cm**	g m-2	1° grid, annual	If a demersal species and L infinity is >=30 cm and <90cm, include in this variable
Biomass Density of Large Demersals >=90cm	**bd 90cm**	g m-2	1° grid, annual	If a demersal species and L infinity is >=90cm, include in this variable
Catch Density of Small Pelagics <30cm	**cp 30cm**	g m-2	1° grid, annual	Catch at sea of pelagic species with L infinity <30 cm
Catch Density of Medium Pelagics >=30cm and <90cm	**cp30to 90cm**	g m-2	1° grid, annual	Catch at sea of pelagic species with L infinity >=30 cm and <90 cm
Catch Density of Large Pelagics >=90cm	**cp 90cm**	g m-2	1° grid, annual	Catch at sea of pelagic species with L infinity >=90 cm

Variable long name	Va riable spe cifier	Unit	Reso lution	Comments
Catch Density of Small Demersals <30cm	**cd 30cm**	g m-2	1° grid, annual	Catch at sea of demersal species with L infinity <30 cm
Catch Density of Medium Demersals >=30cm and <90cm	**cd30to 90cm**	g m-2	1° grid, annual	Catch at sea of demersal species with L infinity >=30 cm and <90 cm
Catch Density of Large Demersals >=90cm	**cd 90cm**	g m-2	1° grid, annual	Catch at sea of demersal species with L infinity >=90 cm

SEPARATE? Additional notes for Regional FishMIP Models

More specific protocols for each regional model type will be developed through our monthly online regional modeller sessions. Please contact regional FishMIP coordinators for more information.

As a first step, regional modellers will need to provide shapefiles for their respective model domains for us to help with spatial extraction of the above global climate and fishing effort forcing inputs.

Region-specific climate forcing variables will be made available here:

```
/work/bb0820/ISIMIP/ISIMIP3a/InputData/climate/ocean/<obsclim> or <ctrlclim>/regional/
```

A .csv file with fishing effort extracted for regional model ecosystems is also available in the same folder as the global fishing effort data (`../fishing/histsoc`), for regional models that have provided shapefiles.

Regional modellers may wish to make their raw unaggregated output available for more detailed analyses, including for example, a wider range of functional groups/size classes/species and ecosystem indicators. Please discuss this with FishMIP regional coordinators before uploading files.

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, to facilitate the analysis of your simulation results in the ISIMIP framework. Incorrect formatting can seriously delay analyses. The ISIMIP Team will be glad to assist with the preparation of these files if necessary.

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.
- Data model is NETCDF4_CLASSIC with minimum compression level of 5.

- NetCDF file extension is .nc.
- UPDATE FOR 3B: The relative time axis' reference date is days since 1841-1-1 00:00:00 if the output covers the spin-up and transition period (1841-1960) or days since 1901-1-1 00:00:00 if the output covers the experiment period (1961-2010). We have provided .csv files to be used for the time dimension in creating NetCDF files based on the 365 days calendar. Please see time_axix_spinup.csv and time_axis_experiment.csv in this repository. The script time_axis.r was used to create these files.

Name pattern of output files:

Please name the files in the Fisheries and Marine Ecosystems sector according to the following pattern:

Global models

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable
```

Example:

```
boats_gfdl_none_historical_histsoc_default_tcb_global_monthly_1850_2100.nc
```

Regional models

```
<model>_<climate-forcing>_<bias-adjustment>_<climate-scenario>_<soc-scenario>_<sens-scenario>_<variable
```

Example:

```
osmose_gfdl_none_historical_histsoc_default_tcb_benguela_monthly_1850_2100.nc
```

Please see the climate-scenario, soc-scenario, sens-scenario and variable identifiers given in the tables of this document.

Path to outut files on DKRZ:

Global models

The output files covering the spin-up period (pre-1850) can be saved on DKRZ here:

```
/work/bb0820/ISIMIP/ISIMIP3a/UploadArea/marine-fishery_global/model_name/temp2
```

The output files covering the experiment period (1850-2010) can be saved on DKRZ here

```
/work/bb0820/ISIMIP/ISIMIP3a/UploadArea/marine-fishery_global/model_name/temp
```

Regional models

The output files covering the spin-up period (pre-1850) can be saved on DKRZ here:

```
/work/bb0820/ISIMIP/ISIMIP3a/UploadArea/marine-fishery_regional/model_name/temp2
```

The output files covering the experiment period (1850-2100) can be saved on DKRZ here

```
/work/bb0820/ISIMIP/ISIMIP3a/UploadArea/marine-fishery_regional/model_name/temp
```

Please contact FishMIP coordinators or ISIMIP data managers directly (isimip-data@pikâĂŘpotsdam.de) if you have any questions or clarifications before submitting files or if you do not find your model's path on DKRZ as described above.

Please contact FishMIP coordinators if you would like to participate in this simulation round but have encountered issues with any aspect of the protocol.

(For fishing): please provide all assumptions about catchability, technological creep, and model calibration.

Please provide any conversion factors that you have used to convert units.

Thank you for your contributions to FishMIP and ISI-MIP!

FishMIP is entirely community-driven, and we appreciate the effort of all involved.