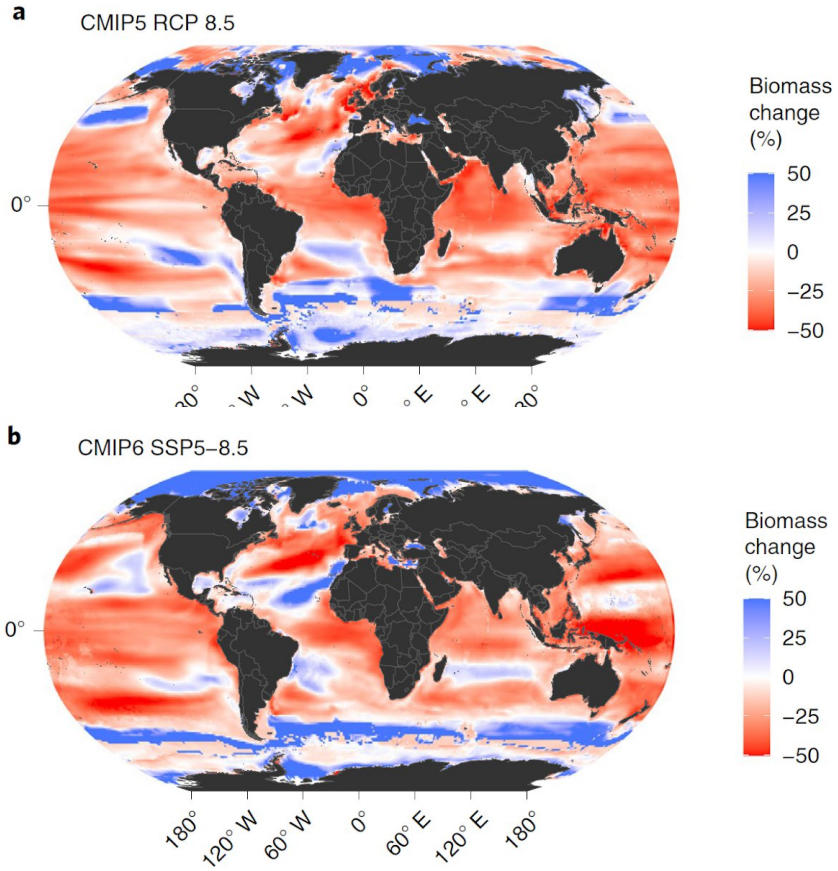
FishMIP regional marine ecosystem models
ISIMIP3a simulation updates

Kelly Ortega-Cisneros, Denisse Fierros-Arcos, FishMIP team and Julia Blanchard

FishMIP
Fisheries & Marine Ecosystem
Model Intercomparison Project

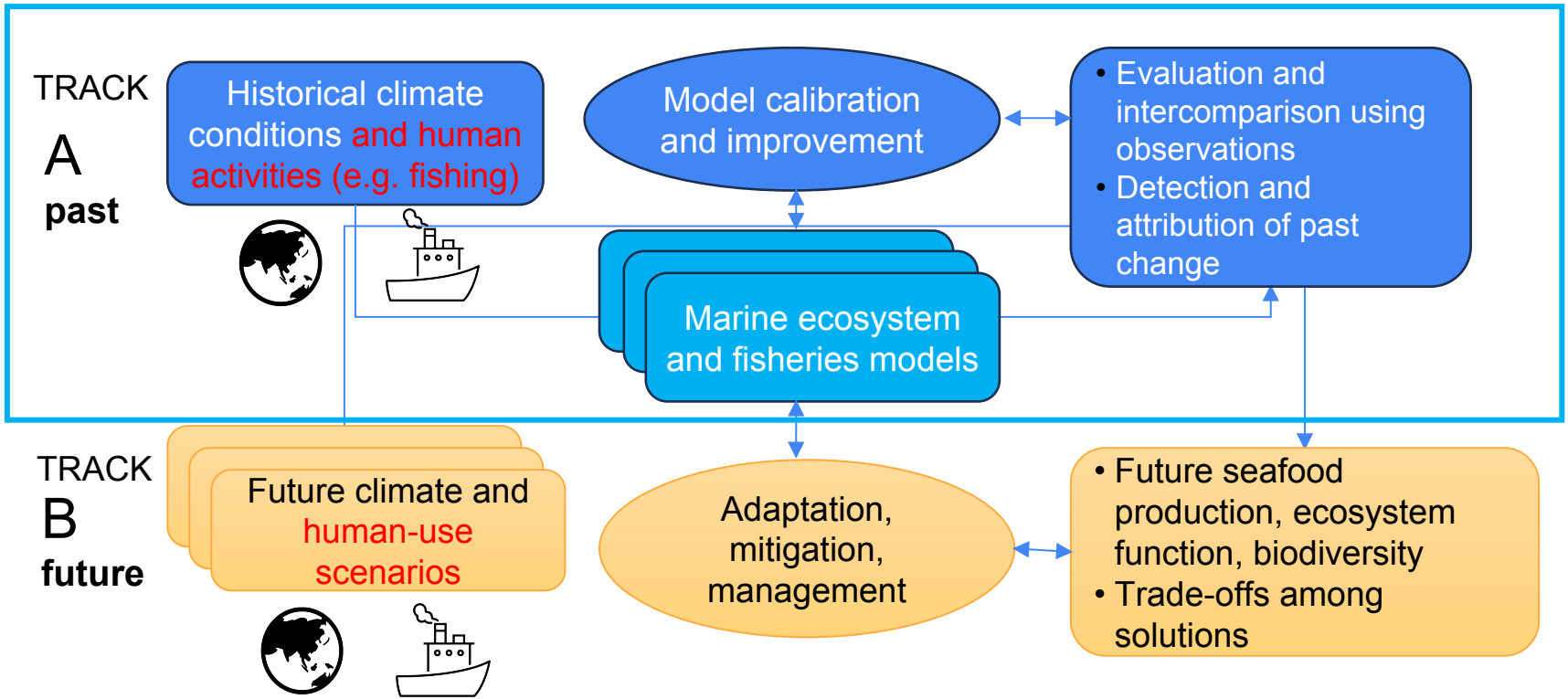
Introduction

- FishMIP's vision for regional models includes regional-global model comparisons and regional model ensembles.
- Priority: develop guidelines for regional MEM simulations that improve the workflow in modelling experiments.
- Developed a workflow to implement FishMIP runs for regional MEMs to translate the FishMIP protocol into practical steps for modelling groups.

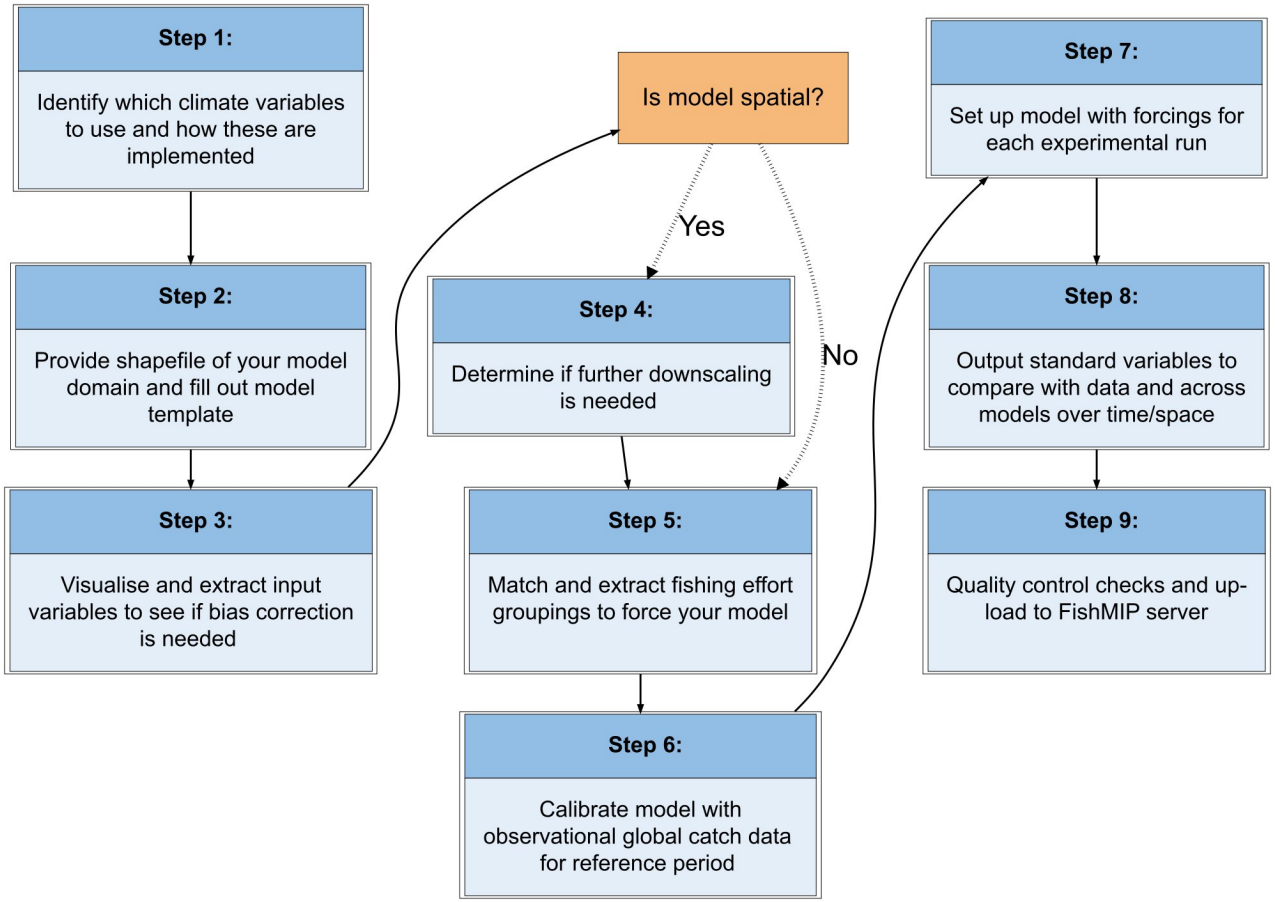


Tittensor et al. 2021

FishMIP 2.0

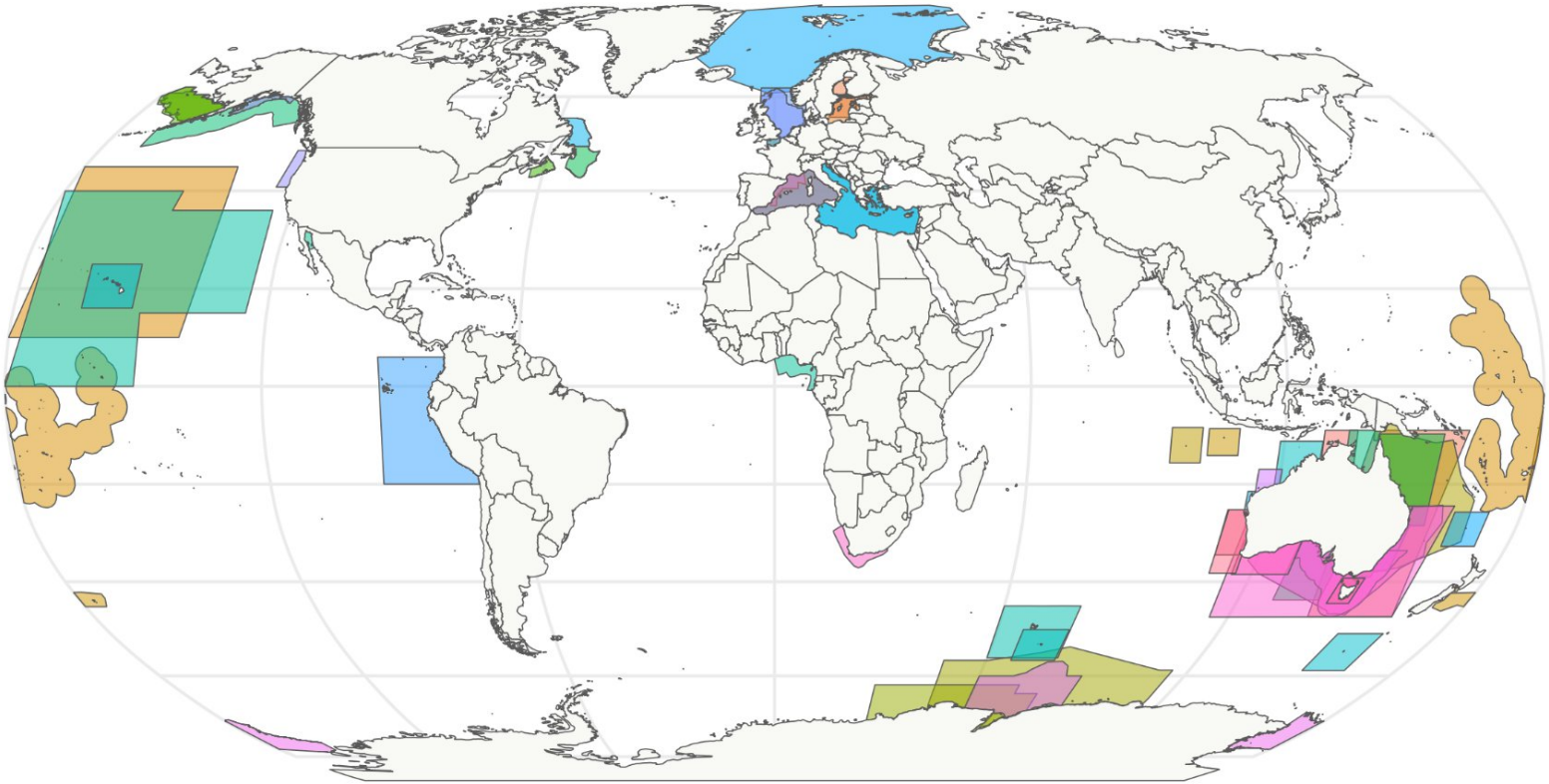


Source: Blanchard et al. 2024



Workflow to implement protocol FishMIP 3a in regional MEMs

Ortega-Cisneros et al. 2025



FishMIP: 60 Regional MEMs

https://github.com/Fish-MIP/FishMIP_regions/blob/main/outputs/FishMIP_regional_models.png

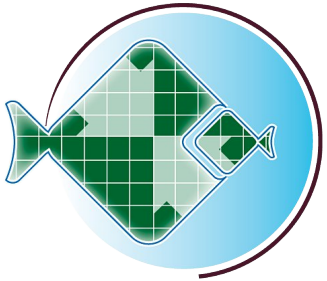
Regional MEM types

Atlantis

Ecopath, Ecosim and Ecospace

ECOTRAN

Mizer



OSMOSE

Model of Intermediate Complexity for Ecosystem Assessments (MICE)

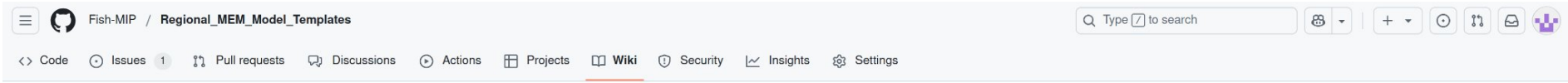
Step 2: Provide shapefile of your model domain and complete model templates

- Model spatial boundaries to extract all climate variables available in **GFDL-MOM6-COBALTv2**.
- Tools available at FishMIP GitHub repositories.
- Model templates requesting information about model set-up and calibration.

https://github.com/Fish-MIP/FishMIP2.0_TrackA_ISIMIP3a

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	Specifier	Unit	Resolution	Datasets
Mass Concentration of Total Phytoplankton Expressed as Chlorophyll	**chl**	kg m-3	0.25° , 1° grid	GFDL-MOM6-COBALT2
Sea Floor Depth	**deptho**	m	0.25° , 1° grid	GFDL-MOM6-COBALT2
Downward Flux of Particulate Organic Carbon	**expc-bot**	mol m-2 s-1	0.25° , 1° grid	GFDL-MOM6-COBALT2
Particulate Organic Carbon Content	**intpoc**	kg m-2	0.25° , 1° grid	GFDL-MOM6-COBALT2
Primary Organic Carbon Production by All Types of Phytoplankton	**intpp**	mol m-2 s-1	0.25° , 1° grid	GFDL-MOM6-COBALT2
Net Primary Organic Carbon Production by Diatoms	**intppdiat**	mol m-2 s-1	0.25° , 1° grid	GFDL-MOM6-COBALT2
Net Primary Mole Productivity of Carbon by Diazotrophs	**intppdiaz**	mol m-2 s-1	0.25° , 1° grid	GFDL-MOM6-COBALT2
Net Primary Mole Productivity of Carbon by Picophytoplankton	**intpppico**	mol m-2 s-1	0.25° , 1° grid	GFDL-MOM6-COBALT2



Home

kortegac edited this page on Mar 3 · 11 revisions

Edit | New page

Welcome to the ISIMIP3a Workflow for Regional Ecosystem Models wiki!

We will update this site with information about the FishMIP3a Workflow for Regional Ecosystem Models described here.

Implementation workflow

To facilitate the implementation of the FishMIP3a workflow, the FishMIP Regional Climate Forcing Data Explorer was developed. Our implementation workflow consists of nine steps. Steps 3 and 5 are considered the most challenging steps of the workflow and a number of specific guidelines and sub-steps have been developed to ensure the standardised application of our protocol. More information on these sub-steps can be found here.

Accessing climate data from the Shiny app (step 3 of workflow)

1. Go to the FishMIP Data Explorer.
2. Under the 'GFDL model outputs' tab, select your regional model, the environmental variable of interest (e.g., Sea water Potential Temperature) and any depth bin. Please note the shiny app offers data for the entire water column as a download. You will download a `.zip` folder containing a `zarr` file with temperature data from 1961-2010 for your model area. Please check the 'About' tab on the Shiny app for more info on `zarr` files.
3. Under the 'Model outputs against observations' tab, select your regional model, the environmental variable (Sea water Potential Temperature) and any depth bin. You will download a `.zip` folder containing a monthly climatology from i) GFDL and ii) World Ocean Atlas from 1981-2010 for the entire water column, iii) the depth and iv) the area of each grid point within your model area.
4. If your model is non-spatial, use this example script to process the data downloaded from the shiny app. The example provided is for the Baltic Sea Mizer model using seawater temperature at 2.5 m depth, but it can be adapted to any region and any depth.
5. If your model is spatial and depth-resolved, use this example script to process the data downloaded from the shiny app. The example provided is for the southern Benguela Atlantis model, in which the model area is divided into 18 model polygons and has from one to four depth layers

+ Add a custom sidebar

Clone this wiki locally

https://github.com/Fish-MIP/Regio

https://github.com/Fish-MIP/Regional_MEM_Model_Templates/wiki

Step 3: Visualize and extract input variables to see if bias correction is needed

Regional Climate Forcing Data Explorer

GFDL model outputs | World Ocean Atlas 2023 data | Model outputs against observations | Fishing effort and catch data | About

Instructions:

1. Select a FishMIP regional model:

East Bass Strait

2. Select an environmental variable:

Sea Surface Temperature

3a. Click on the **Climatological map** tab on the right to see a map of the climatological mean (1961-2010).

3b. Click on the **Time series plot** tab to see a time series of the area-weighted monthly mean and the linear temporal trend.

Optional: Get a copy of the data used to create these plots by clicking the 'Download' button below. Note that variables that are three dimensional (i.e., have multiple depth levels) will be downloaded as *.zarr* files. Refer to the **About** tab for details on how to open this file format in R.

DOWNLOAD

All figures shown in this tab are based on the *Observation-based climate related forcing* (obsclim) outputs from the GFDL-MOM6-COBALT2 model. These data were originally obtained from the ISIMIP Data Repository.

The *Climatological map* tab below shows the mean climatology (1961-2010) for the environmental variable and within the boundaries of the regional model of interest selected on the left.

The *Time series plot* tab below shows the area-weighted monthly mean between 1961 and 2010.

Note: The variable names and units shown in the dropdown list and plots come from the GFDL-MOM6-COBALT2 model. We have chosen not apply any transformation to the original model outputs. Instead, we summarised data so we could create the map and time series plots within the limits of all FishMIP regional models. If your model requires environmental data to be in a unit or grid that is different to the one available in the GFDL-MOM6-COBALT2 model, you can download the data from this website and post-process it to meet your needs.

Denisse Fierro Arcos

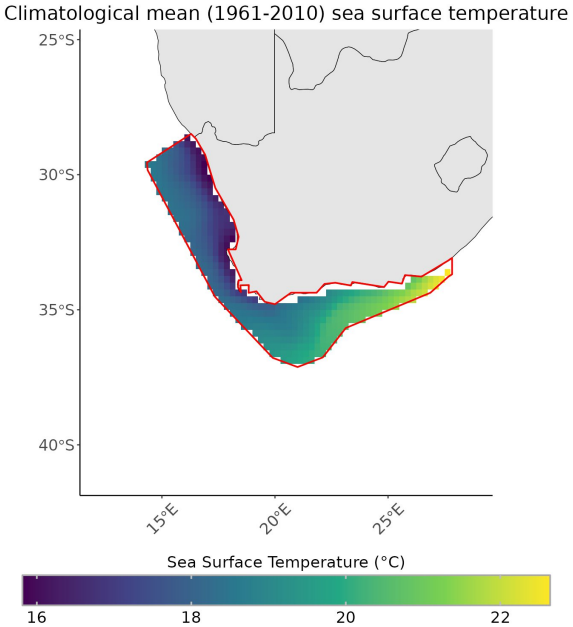
University of Tasmania

https://rstudio.global-ecosystem-model.cloud.edu.au/shiny/FishMIP_Input_Explorer/

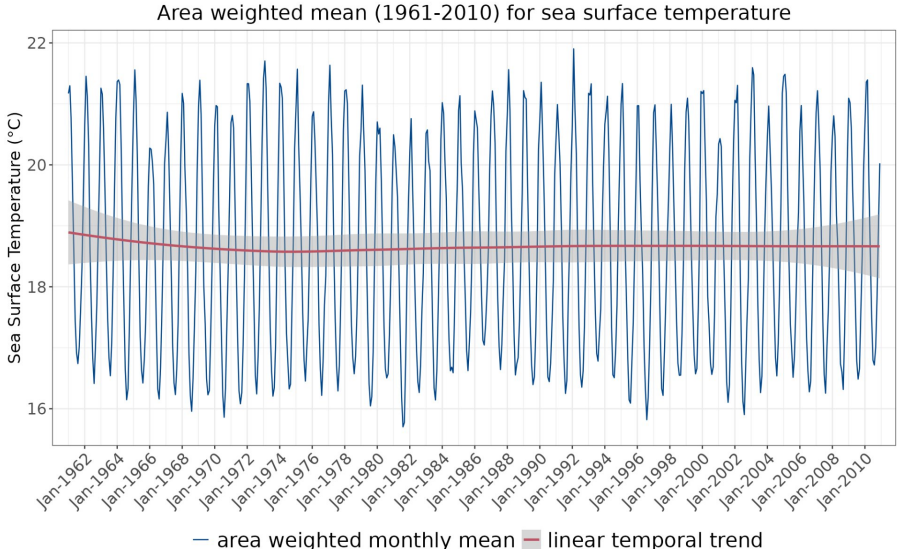
FishMIP
Fisheries & Marine Ecosystem Model Intercomparison Project

Regional Climate Forcing Data Explorer

Climatological map | Time series plot



Climatological map | Time series plot



GFDL-MOM6-COBALT2 outputs

Regional Climate Forcing Data Explorer

GFDL model outputs | World Ocean Atlas 2023 data | Model outputs against observations | Fishing effort and catch data | About

Instructions:

1. Select a FishMIP regional model:

East Bass Strait

2. Select an environmental variable:

Sea Water Temperature

Choose depth you want to visualise:

0

3a. Click on the **Climatological map** tab on the right to see a map of the climatological mean (1981-2010) of observations.

3b. Click on the **Time series plot** tab to see a time series of area-weighted monthly mean of observations.

Optional: Get a copy of the data used to create climatological maps as a csv file by clicking the 'Download' button below.

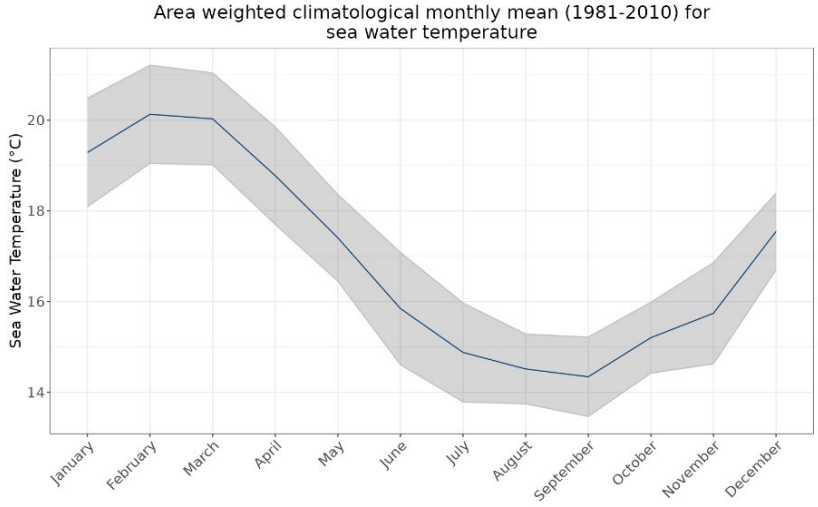
DOWNLOAD

Figures shown in this tab use data from the World Ocean Atlas 2023 (WOA23) . We used the *objectively analysed climatologies* field to create the climatological maps and area-weighted monthly climatology time series plot. While, the *number of observations* variable was used to create the maps shown in the sub-tab under the same name.

Note: The variable names and units shown in the dropdown list and plots come from the WOA23. We have chosen not apply any transformation to the original data. Instead, we summarised data so we could create maps and time series plots within the limits of all FishMIP regional models. If your model requires environmental data to be in a unit or grid that is different to the one available in the WOA23 you can download the data from this website and post-process it to meet your needs.

For some regions, the WOA23 dataset may have a very limited number of observations and so it may not offer the most realistic representation of your area of interest. In this case, you may choose to use a different observational product to assess the performance of GFDL-MOM6-COBALT2 outputs. We have an example notebook showing how you can regrid this data to match the grid used by the GFDL-MOM6-COBALT2 model.

Climatological map | Time series plot | Number of in-situ observations



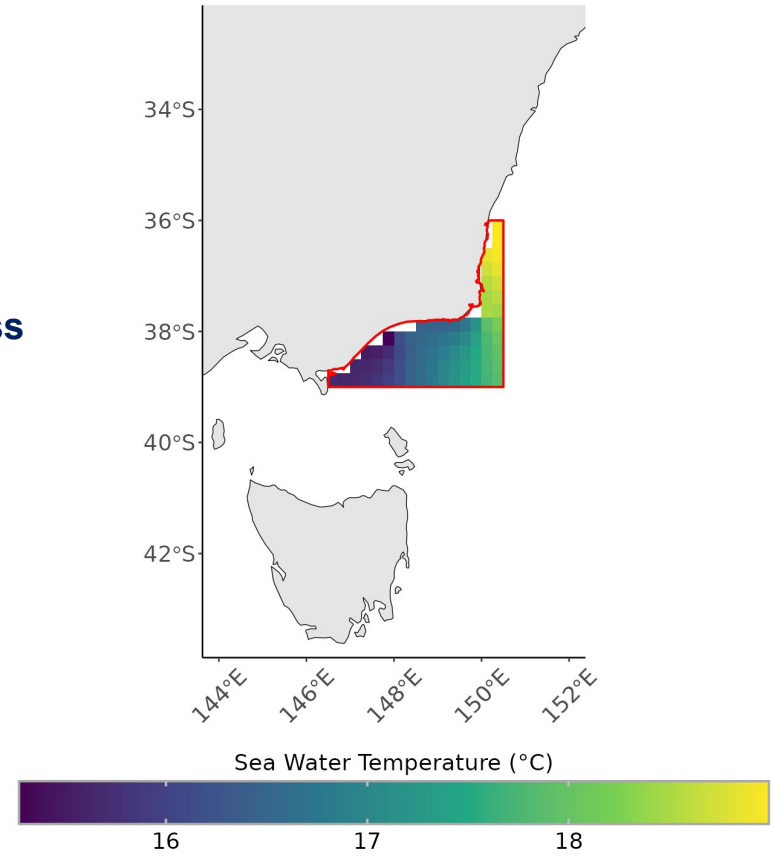
Note: The grey ribbon in the plot above shows the spatial variance in the variable of interest.

Climatological map | Time series plot | Number of in-situ observations

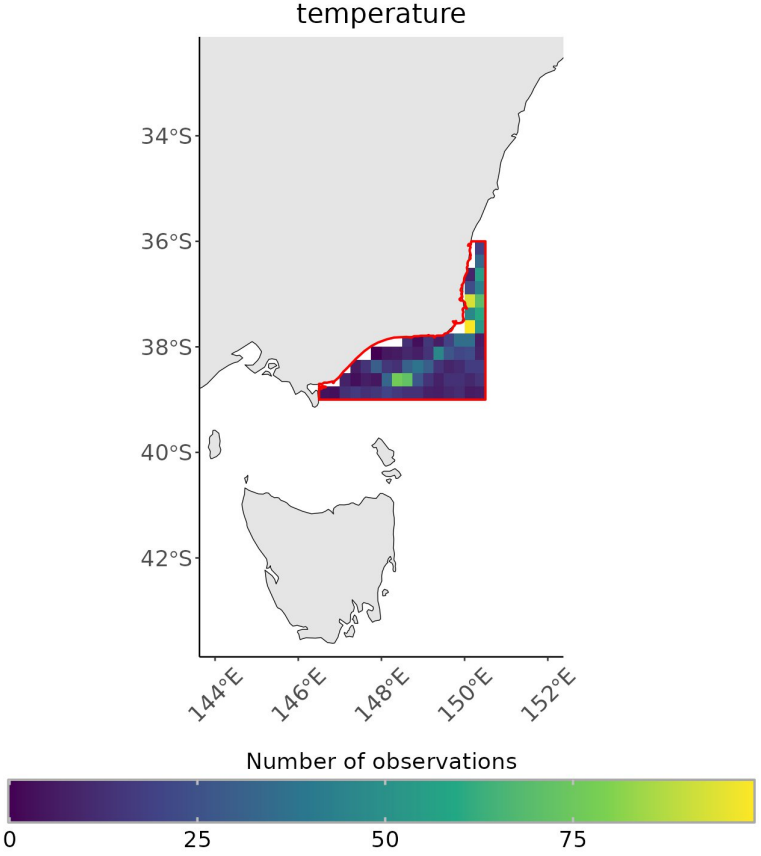
map | Time series plot | Number of in-situ observations

WOA23-East Bass Strait

Climatological mean (1981-2010) sea water temperature



Number of available observations (1981-2010) for sea water temperature



Instructions:

1. Select a FishMIP regional model:

East Bass Strait

2. Select an environmental variable:

Sea Water Temperature

Choose depth you want to visualise:

2.5

3a. Click on the **Climatological map** tab on the right to see a map of the differences in the climatological mean (1981-2010) from the model output and observations.

3b. Click on the **Time series plot** tab to see the difference in climatological monthly area-weighted mean (1981-2010) between the model output and observations.

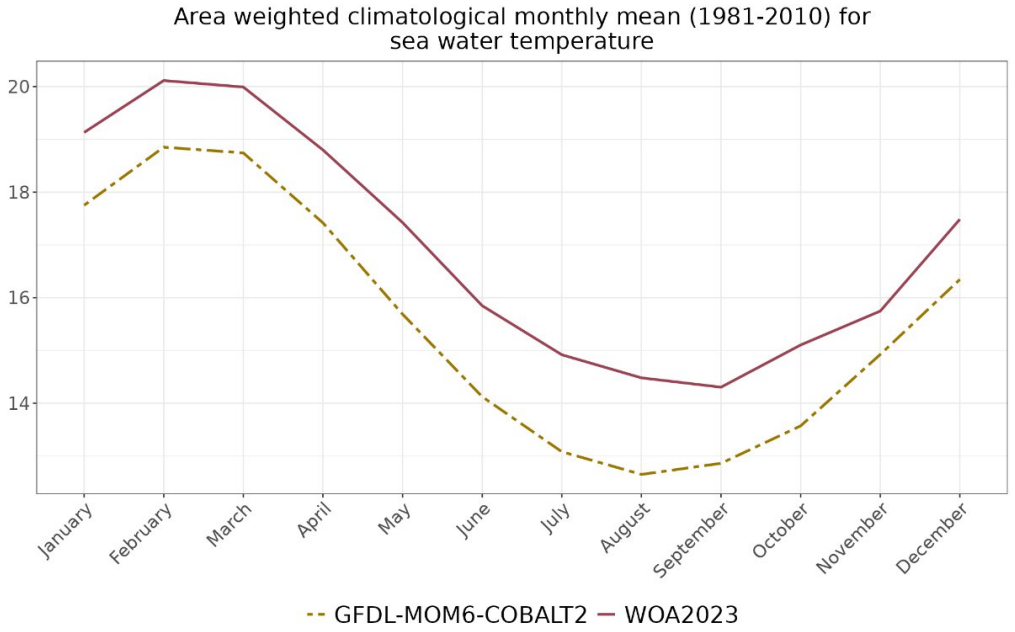
Optional: Get a copy of the data for bias correction (if needed) as a compressed folder (*.zip*) by clicking the 'Download' button below. Note that the *.zip* folder has files in *.parquet* format, which is designed to store and retrieve tabular data in an efficient way. Refer to the **About** tab for details on how to open this file format in R.

DOWNLOAD

The following processing steps were taken before comparing GFDL model outputs and WOA data:
1. Climatological mean was calculated using GFDL outputs between 1981 and 2010.
2. WOA data was regridded to match the GFDL outputs.
3. Difference was calculated by substracting WOA data from GFDL model outputs.

This means that positive values in the maps identify areas where GFDL overestimated mean conditions.

Climatological maps | Time series plot



Step 5: Match and extract fishing effort groupings to force your model

GFDL model outputs | World Ocean Atlas 2023 data | Model outputs against observations | Fishing effort and catch data | About

Instructions:

1. Select a FishMIP regional model:

Gulf Alaska

2. Select dataset to visualise:

- (•) Fishing Effort
- ( ) Fisheries Catch

3. Select how data should be classified in the plot:

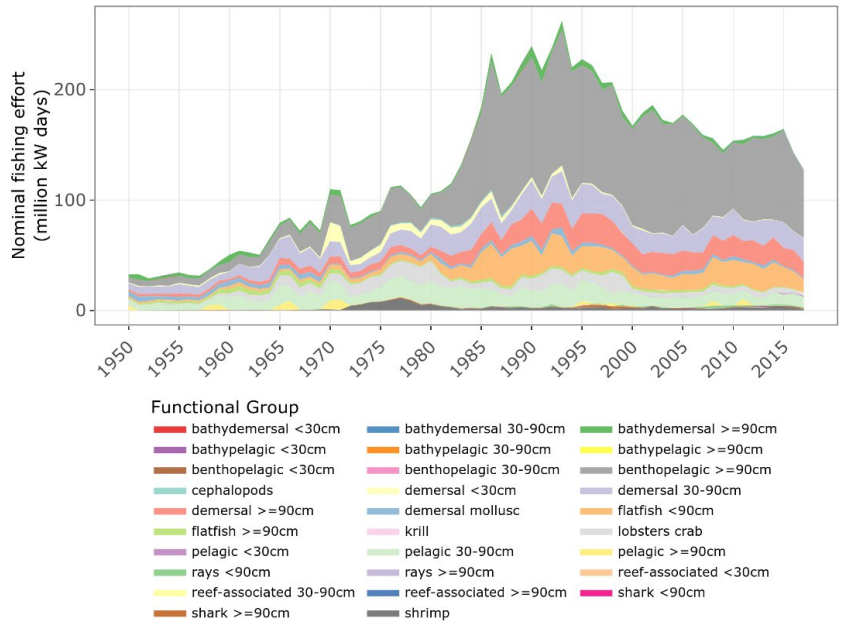
Functional Group

Optional: Get a copy of the data used to create these plots as a compressed folder (*.zip*) by clicking the 'Download' button below. The downloaded folder also includes two dictionaries: one will help you interpret the column names in the fishing data and the other will allow upi to interpret country codes. Note that the *.zip* folder has files in *.parquet* format, which is designed to store and retrieve tabular data in an efficient way. Refer to the **About** tab for details on how to open this file format in R.

DOWNLOAD

The fishing effort and catch data used to create plots in this tab were obtained from 'ISIMIP3a reconstructed fishing activity data (v1.0)' (Novaglio et al. 2024).

The fishing effort and catch data start in 1950, but the fishing effort forcing was reconstructed starting in 1841, which is available for download on the left panel.



Instructions:

1. Select a FishMIP regional model:

Gulf Alaska

2. Select dataset to visualise:

- Fishing Effort
- Fisheries Catch

3. Select how data should be classified in the plot:

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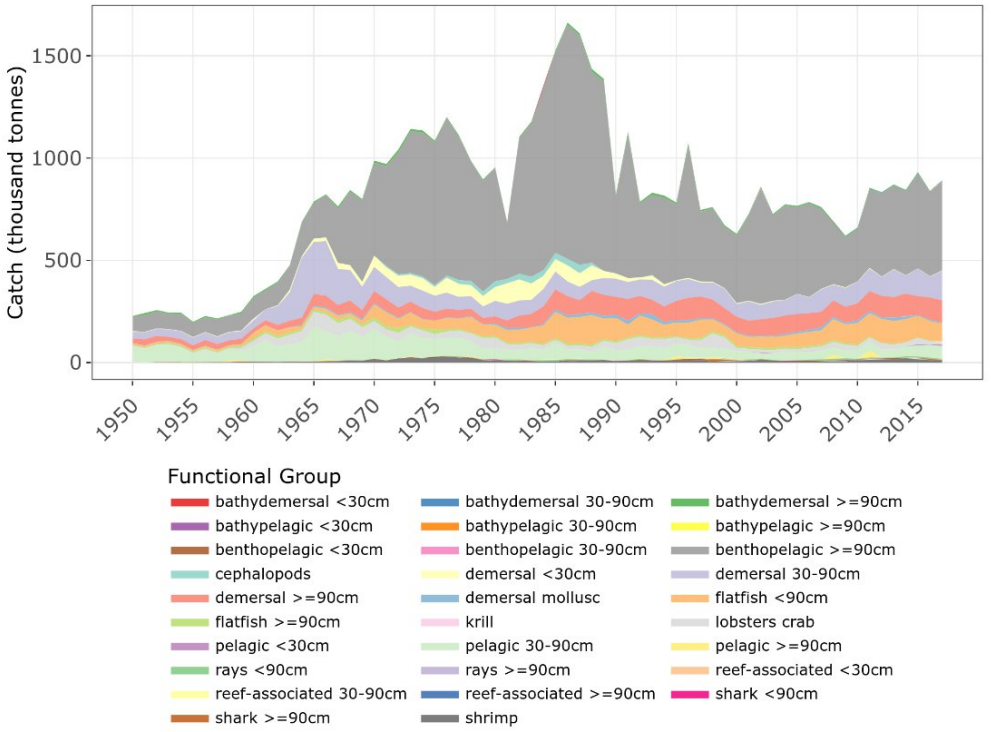
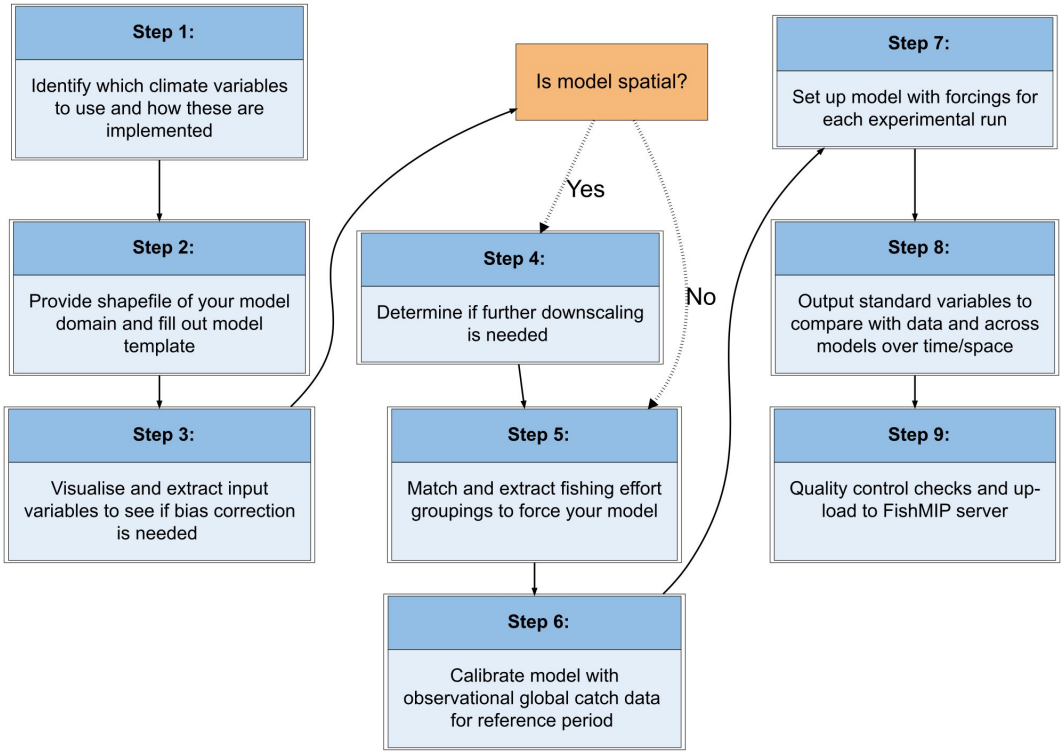


Regional modellers meeting

- Aim: Implement ISIMIP and FishMIP 3a protocol in different regions
- Timeline: December 2024 to June 2025
- 20-25 attendees
- 2 sessions in different time zones



Ortega-Cisneros et al. 2025

Regional models

Gulf of California
Nordic and Barents Sea
southern Benguela

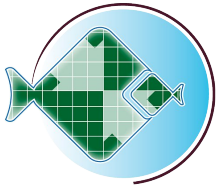
Atlantis

Cook Strait
Western Mediterranean Sea

Ecopath, Ecosim and Ecospace

Baltic Sea
Hawai'i based longline fisheries
Prydz Bay
Tasman and Golden Bay
Chatham Rise

Mizer



Eastern English Channel
North Sea
Peruvian upwelling system

OSMOSE

Progress so far for different model regions

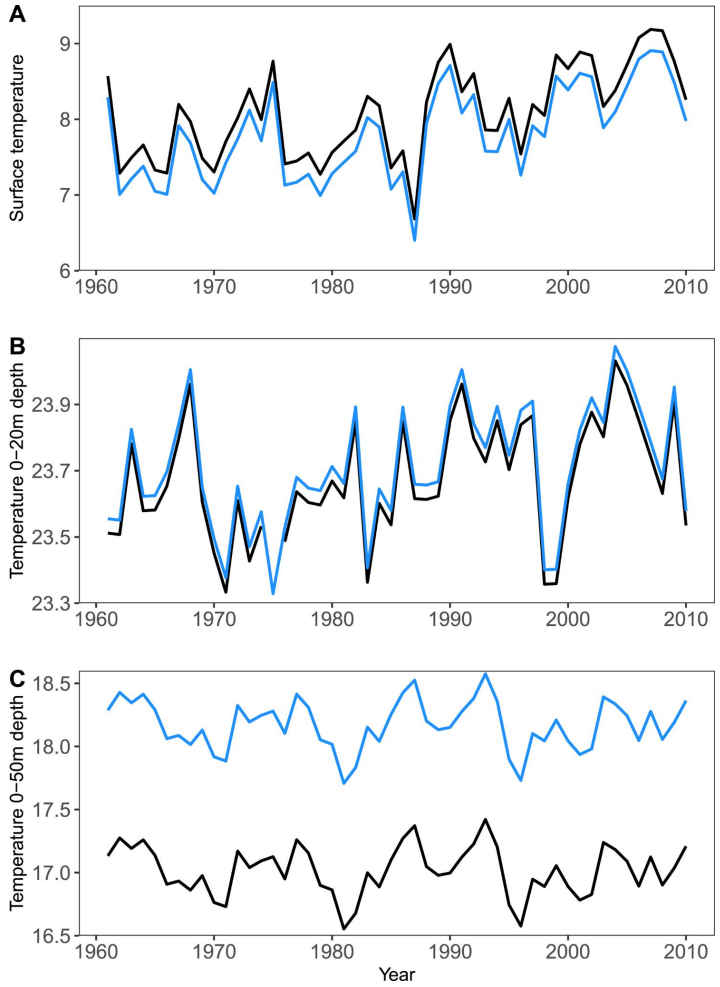
Regional model	Status
Baltic Sea Mizer	*Preliminary runs completed*
Chattam Rise Mizer	Finalising analysis of global forcings
Cook Strait EwE	Finalising analysis of global forcings
Eastern English Channel OSMOSE	Finalising analysis of global forcings
Gulf of California Atlantis	Initial exploration of global forcings
Hawai'i based longline fisheries Mizer	*Runs completed*
Nordic and Barents Sea Atlantis	Finalising analysis of global forcings
North Sea OSMOSE	*Preliminary runs completed*
Peruvian upwelling system OSMOSE	Initial exploration of global forcings
Prydz Bay Mizer	*Preliminary runs completed*
Southern Benguela Atlantis	Finalising analysis of global forcings
Western Mediterranean Sea EwE	Initial exploration of global forcings
Tasman & Golden Bay Mizer	Finalising analysis of global forcings

Climate forcing intermodel comparison

Baltic Sea - Mizer model

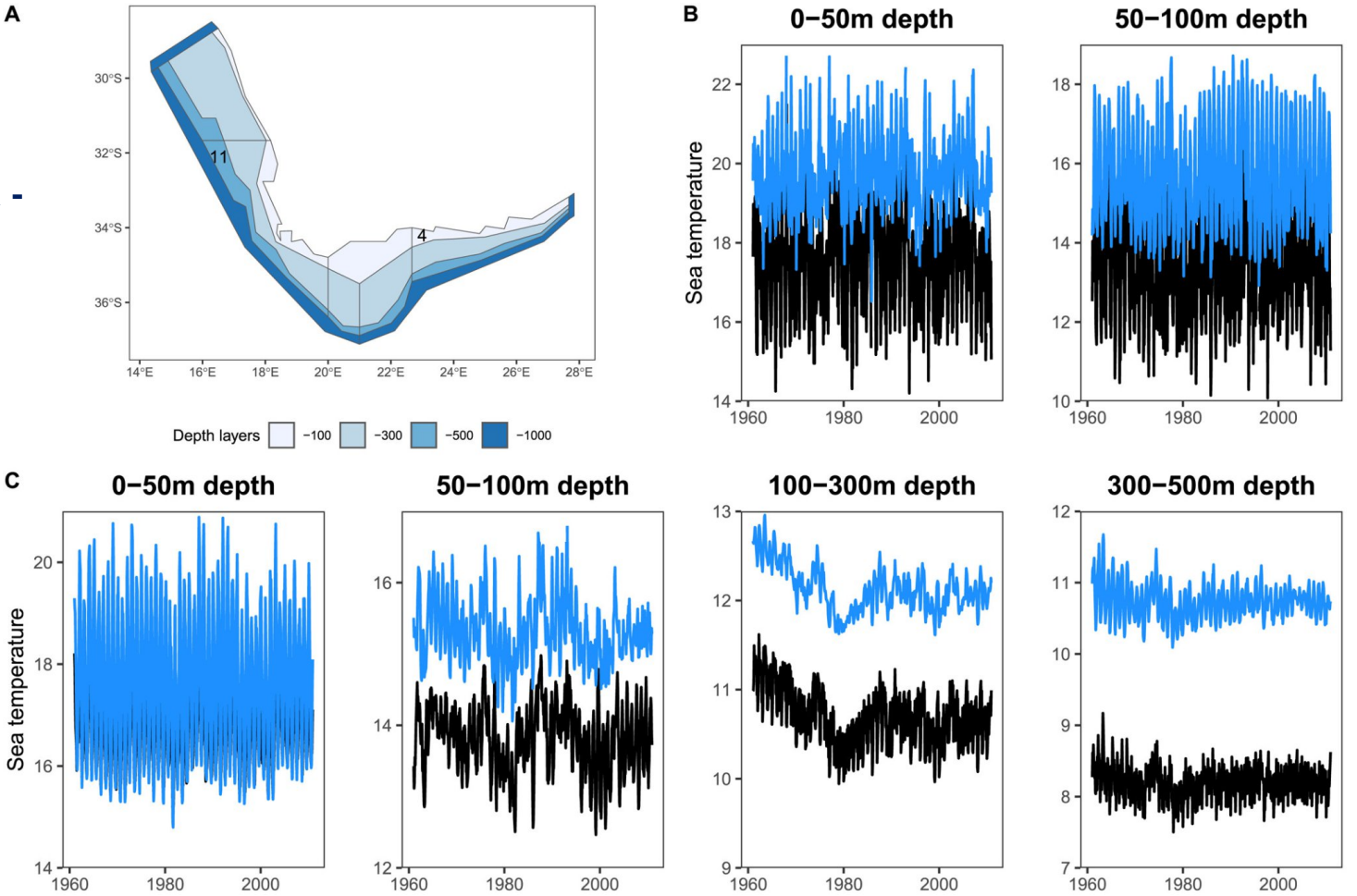
Hawai'i based longline fishery - (ther) Mizer model

Southern Benguela - Atlantis model



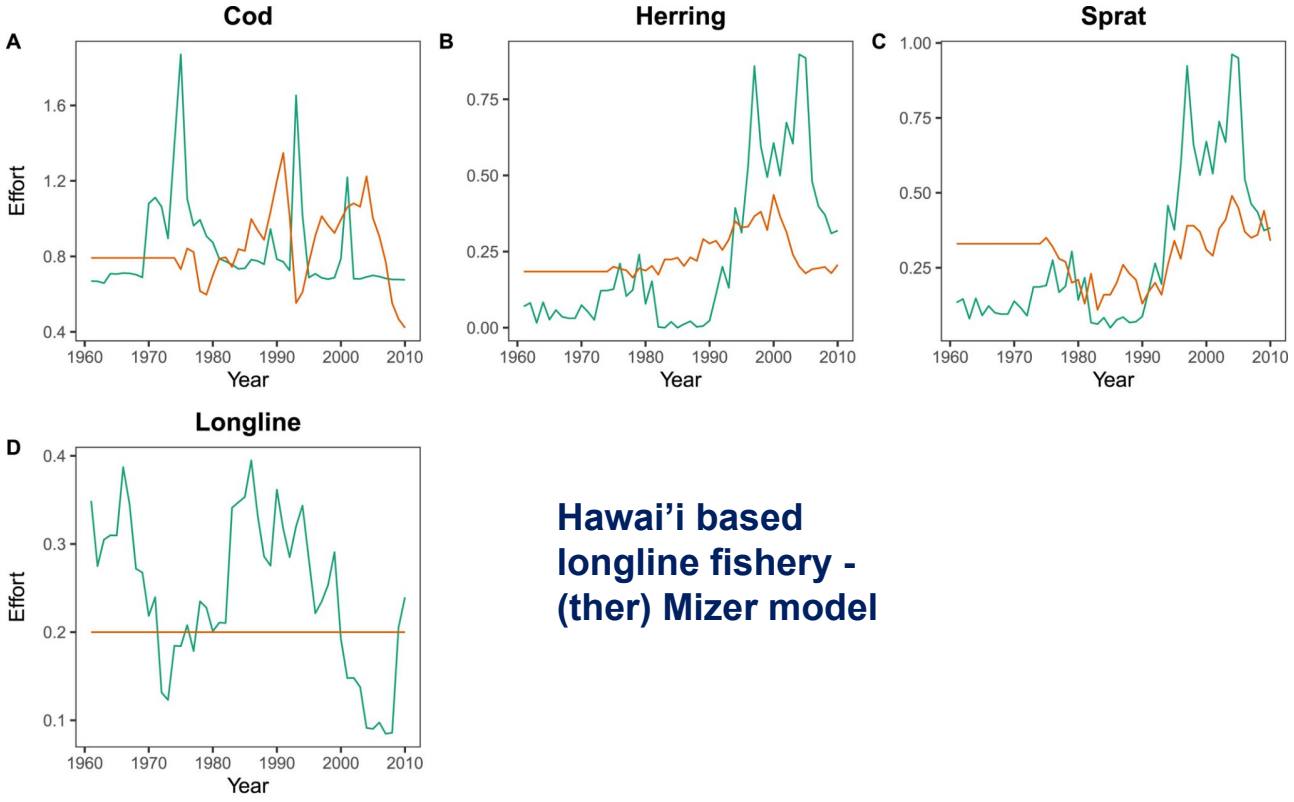
Ortega-Cisneros et al. 2025

Southern Benguela - Atlantis model



Ortega-Cisneros et al. 2025

Fishing effort forcing intermodel comparison

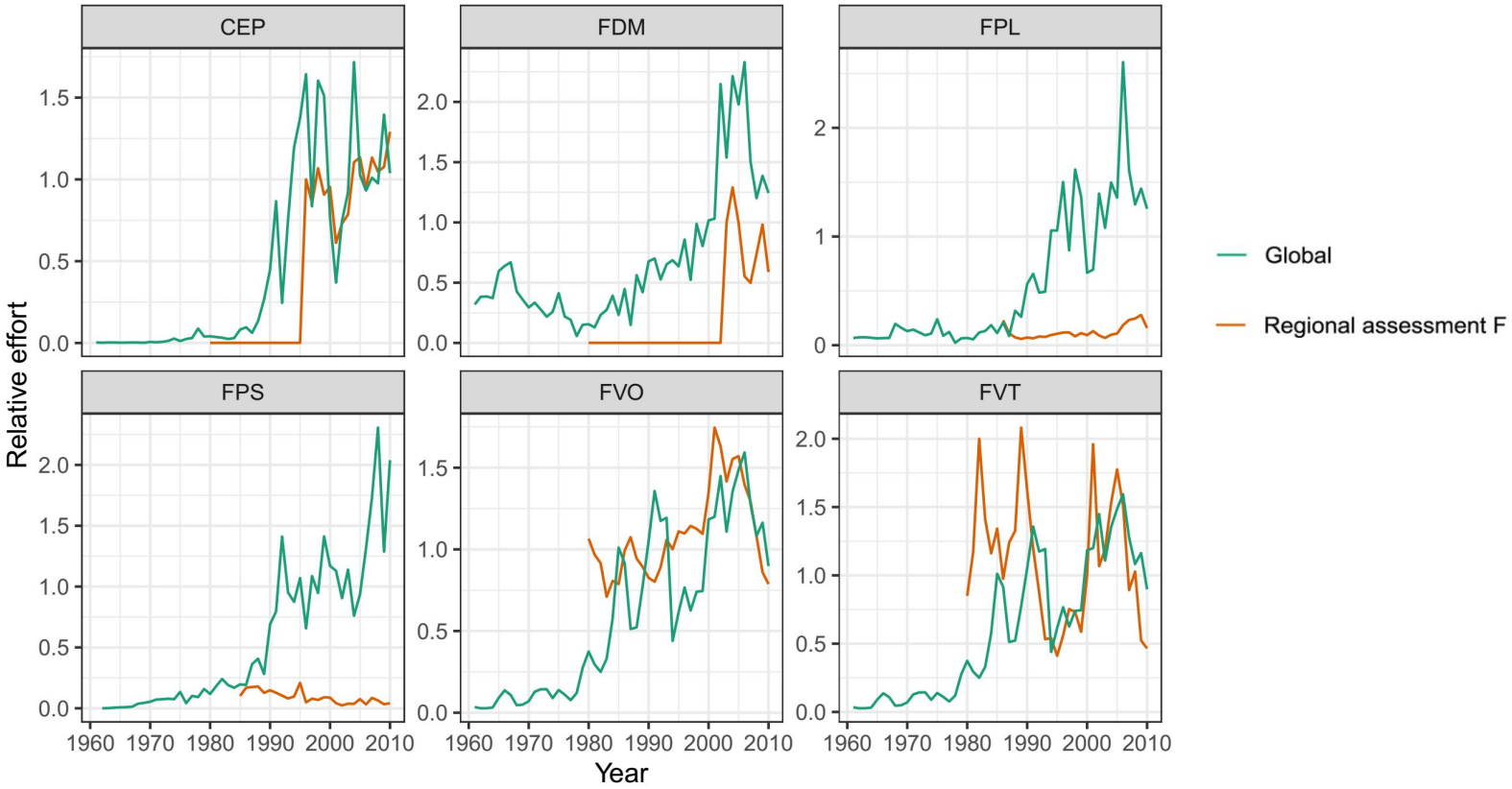


Baltic Sea - Mizer model

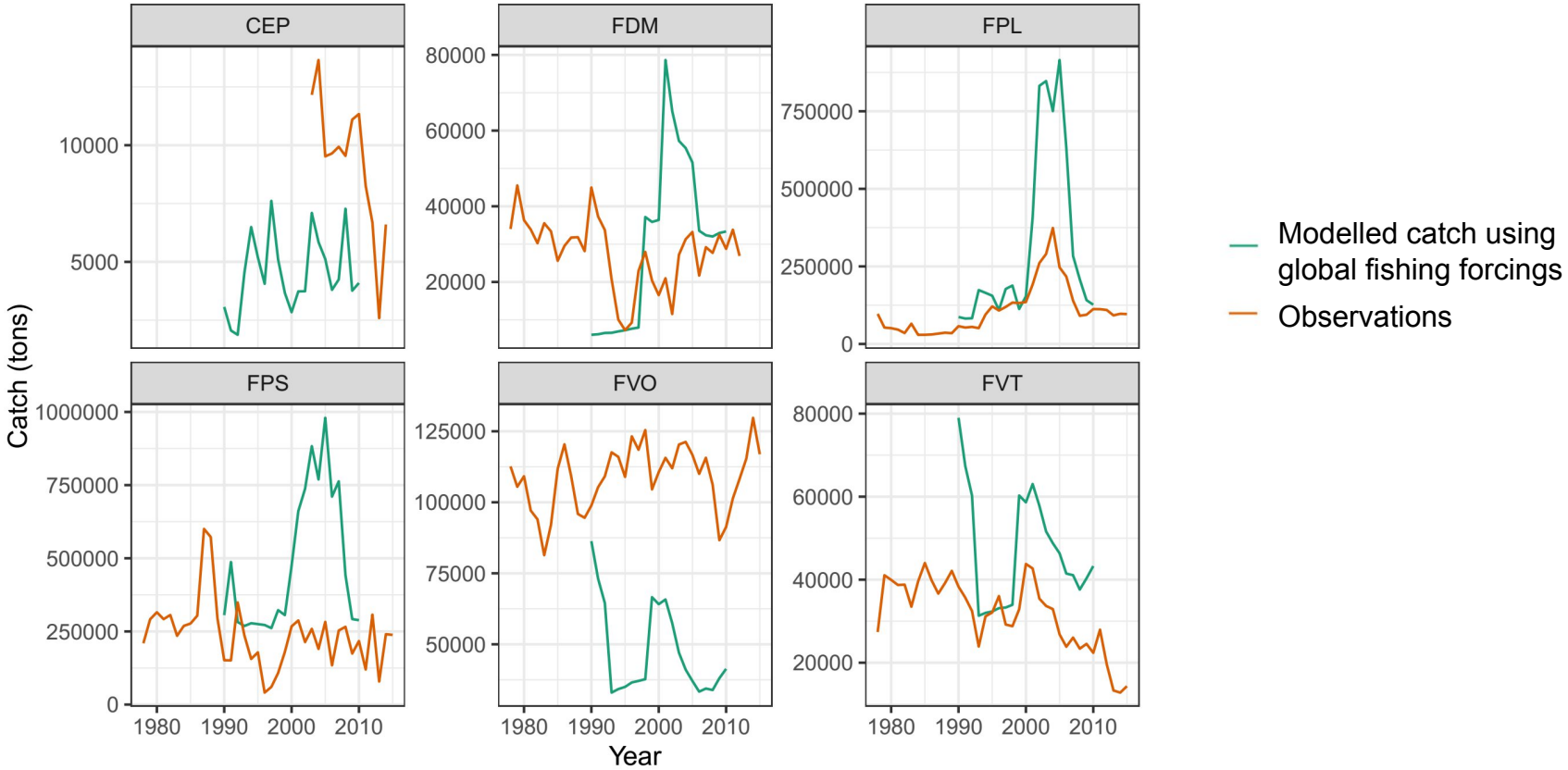
Hawai'i based longline fishery - (ther) Mizer model

Ortega-Cisneros et al. 2025

Fishing effort forcing intermodel comparison - southern Benguela



Preliminary results: Atlantis southern Benguela – Global climate & fishing simulation



Implementing 3a protocol - regional models manuscript outline

Multiple regional marine ecosystem models to determine climate and fishing impacts on marine ecosystems (tentative title)

Research gap: need for an evaluation, detection and attribution protocol within FishMIP models (Novaglio et al., 2024; Blanchard et al., 2024).

This manuscript aims to contribute to filling this gap by presenting an application of protocol 3a at the regional level comparing the impacts of climate and fishing drivers across several regional MEMs.

- what is the impact of fishing and climate as individual drivers in selected marine ecosystems?
- what are the combined impacts of fishing and climate on selected marine ecosystems?

We aim to answer these questions by calculating the relative change in biomass/catch in the combined scenario compared to the control (climate and no fishing).

Advancing Regional Marine Ecosystem Modelling: From Southern Ocean to Global Perspectives
FishMIP Regional Model Workshop

June 24-27, 2025 | University of Tasmania, Hobart

Workshop Focus Areas:

- Synthesising advances in FishMIP regional ecosystem models
- Analysis of outputs from the simulation results for ISIMIP 3a scenarios
- Developing approaches for uncertainty assessment in regional model projections
- Future scenario planning for regional FishMIP marine ecosystem models, aligned with SOMEME and the Ocean System Pathways (OSPs)

Virtual Attendance: Virtual attendance will be facilitated for those unable to join in person: time zone UTC+10 (AEST).

https://docs.google.com/forms/d/e/1FAIpQLSfkJEhbMYCBLqBml654nfgelXjYMdeiPPLPsXCzsl1Zl2tvAw/viewform

Thank you for your attention!

More info: www.fishmip.org
Contact: fishmip.coordinators@gmail.com