



DALHOUSIE UNIVERSITY

# CLIMATE CHANGE IMPACTS ON GLOBAL FISH BIOMASS – MULTI-MODEL PROJECTIONS ON AN OCEAN BASIN SCALE –

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## Background

Climate change impacts in the ocean include changes in primary production, species distribution and abundance with consequences for marine ecosystem structure and functioning, and the support of marine fisheries.

How does climate change impact marine ecosystems and fish abundance on an ocean basin scale?

To inform ocean governance and fisheries management in a changing ocean it is critical to understand possible future trajectories of regional and global fish production in terms of species distribution, biomass and abundance. This will also inform the United Nation's Sustainable Development Goals for zero hunger (SDG 2), good health and well-being (SDG 3), climate action (SDG 13), and life below water (SDG 14).

Implications for current and future fisheries are paramount to achieve UN Sustainable Development Goals

Modelling climate change impacts on global marine ecosystems is a relatively new research field. The Fisheries and Marine Ecosystem Model Inter-comparison Project (Fish-MIP) uses standardized climate change scenarios to derive projections of fish biomass across multiple global ecosystem models.

Using multi-model projections can help understand variability of climate change effects in the global ocean

## Objectives

Using Fish-MIP results, we analyzed trends in fish biomass in response to projected climate scenarios in different ocean basins to understand the regional climate change impacts on marine ecosystems and their associated fisheries and management implications.

## Methods

### 4 EMISSION SCENARIOS

RCP 2.6 RCP 4.5 RCP 6.0 RCP 8.5

### 2 EARTH SYSTEM MODELS

GFDL-ESM2M & IPSL-CM5A-LR

### 6 IMPACT MODELS

NO-FISHING

Total Fish Biomass  
Fish Biomass > 10cm  
Fish Biomass > 30cm

## References:

Tittensor et al. 2017, A protocol for the intercomparison of marine fishery and ecosystem models: Fish-MIP v1.0. GMD (accepted as discussion paper, <https://doi.org/10.5194/gmd-2017-209>).  
Pecl et al. 2017, Biodiversity redistribution under climate change: Impacts on ecosystems and well-being. Science.  
Payne et al. 2016, Uncertainties in projecting climate-change impacts in marine ecosystems, ICES Journal of Marine Science.

## Results

### RCP 8.5 BUSINESS AS USUAL SCENARIO

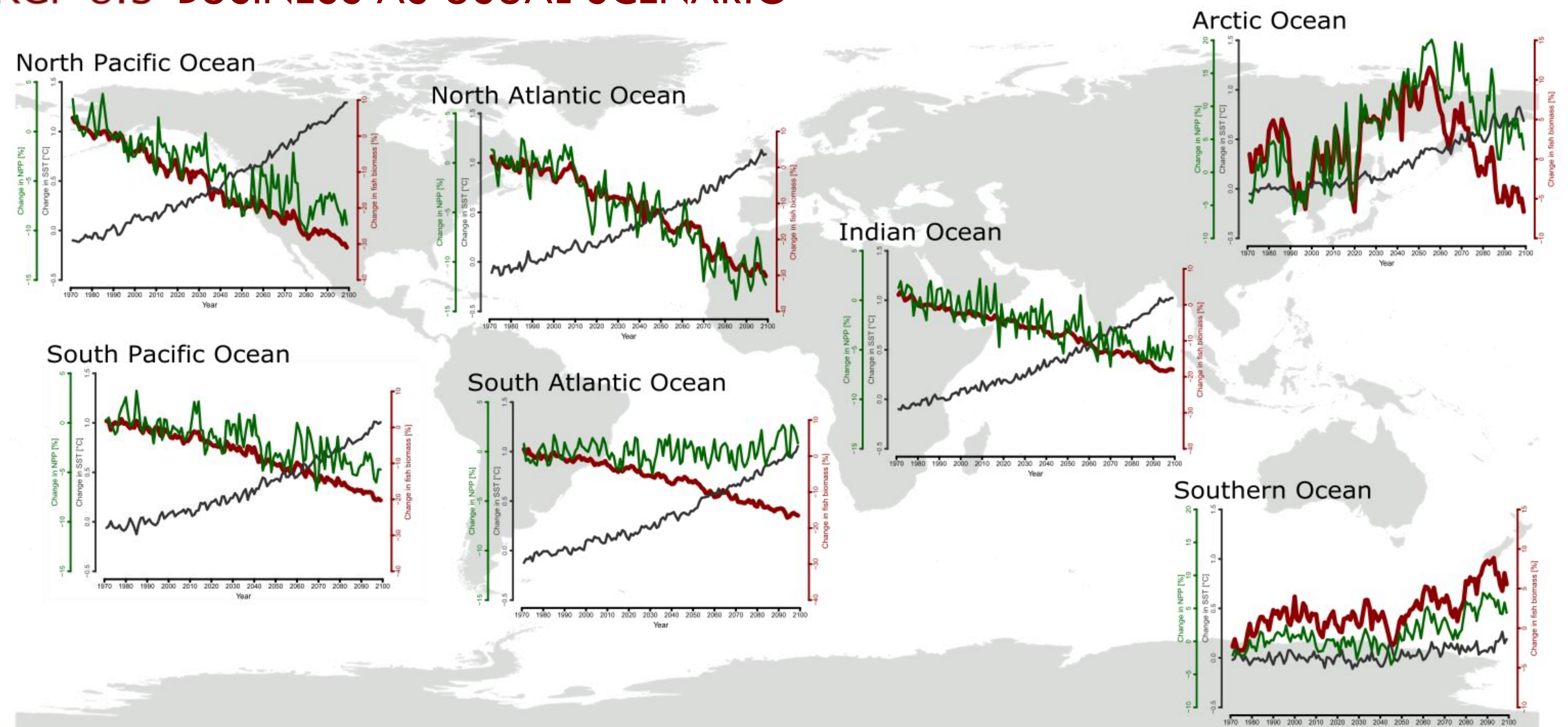


Figure 1: Ensemble projections of total fish biomass, sea surface temperature (SST), and net primary production (NPP) for RCP 8.5 from 1970-2100. All changes are relative to 1990-1999.

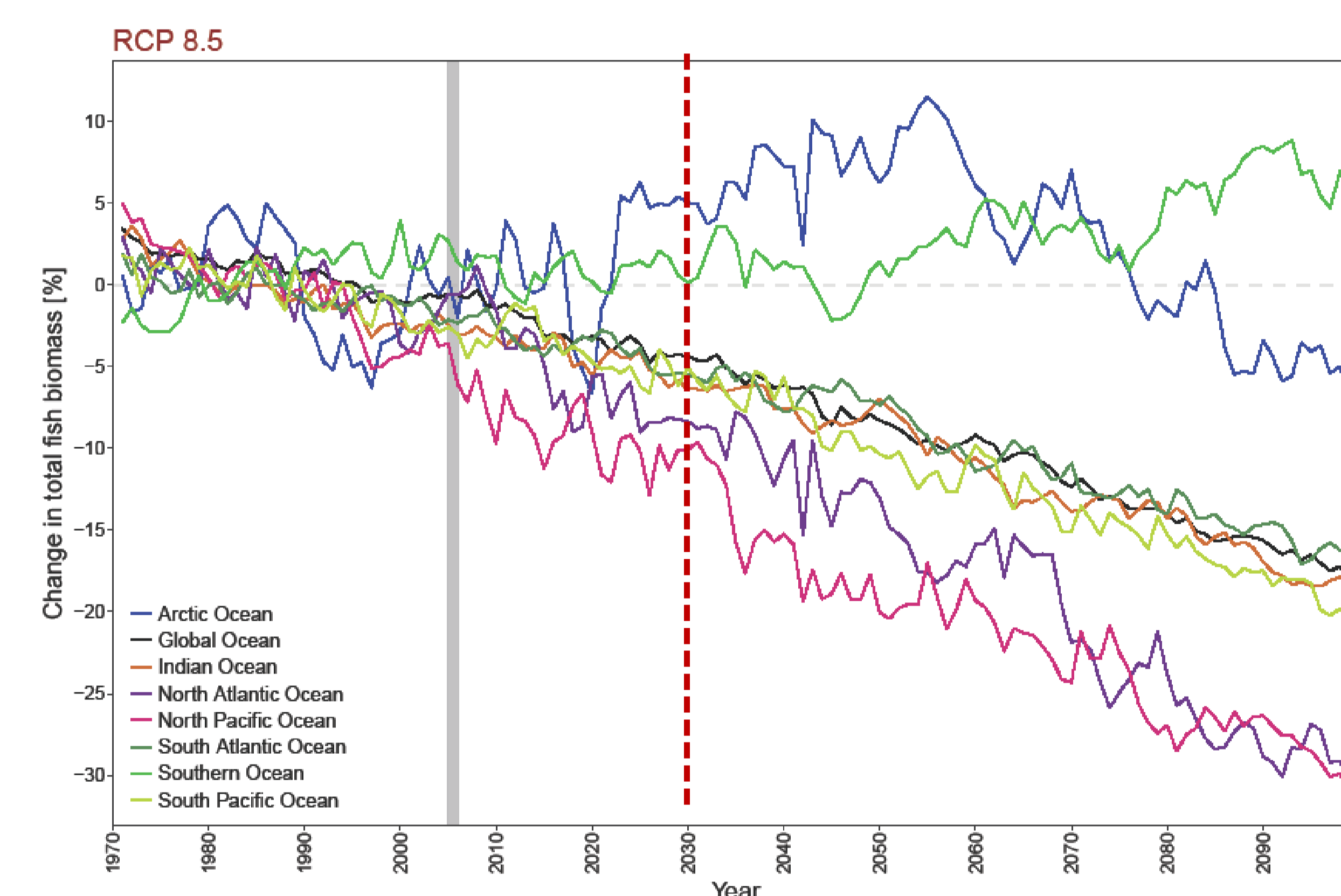


Figure 2: Ensemble projections of total fish biomass in the global ocean and per ocean basin for RCP 8.5 from 1970-2100. All trends are relative to 1990-1999. Vertical grey line: separation of historical and future projections. Dashed red line: target year for achieving the UN Sustainable Development Goals.

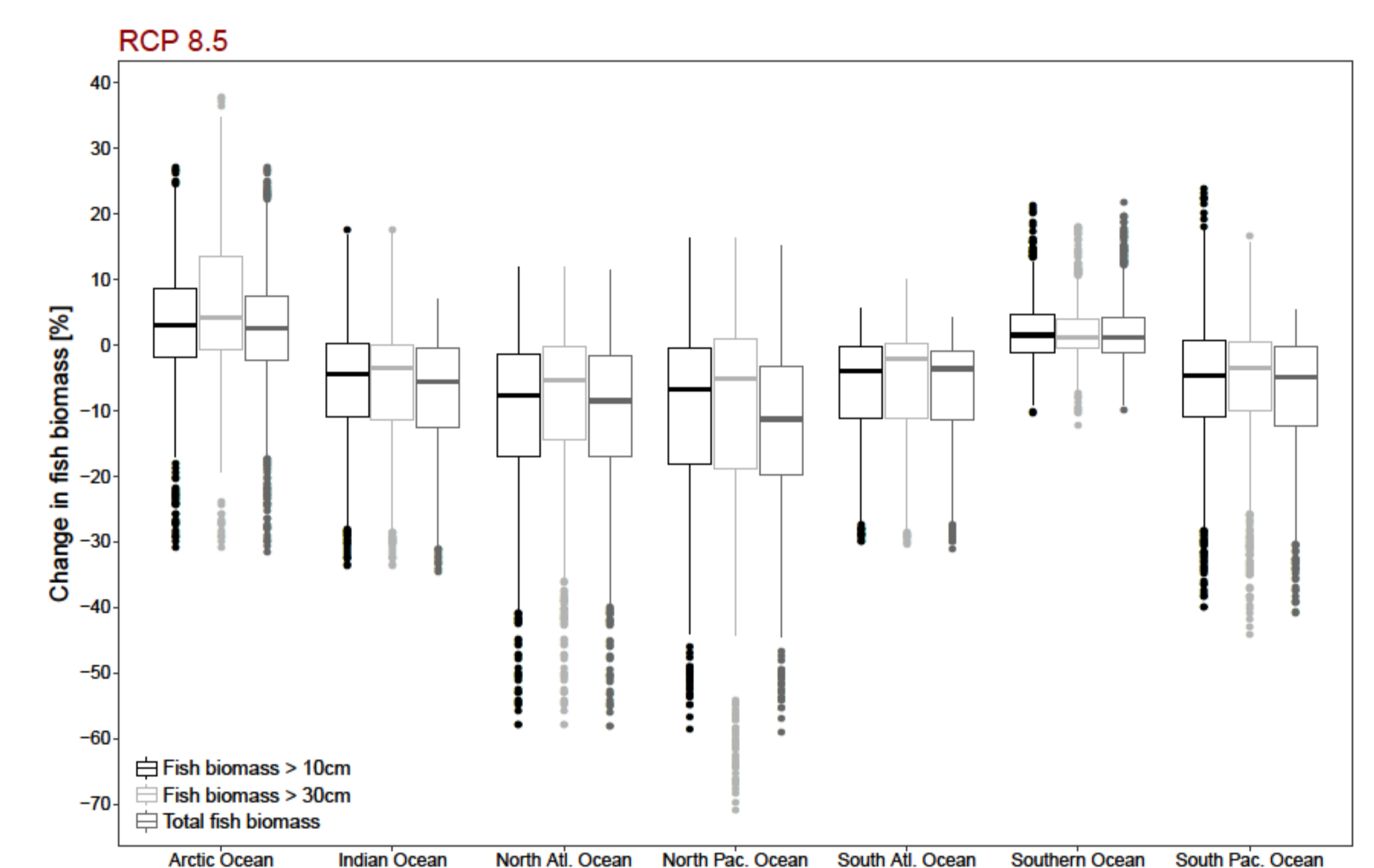


Figure 3: Individual model projections by ocean basin under RCP 8.5 for total fish biomass and fish biomass for two size classes. Changes are relative to 1990-1999.

15 - 30% decrease in total fish biomass across temperate & tropical ocean basins by 2100, 5% increase in Southern ocean, 5% decline in the Arctic ocean

By 2030 total fish biomass decreases by 5 - 10% in temperate & tropical basins, slight increases in polar regions

So far, no significant differences in changes between size classes

## Conclusions

- Fish biomass is expected to decline throughout the 21st century across temperate and tropical oceans which have been historically most important for fisheries, with impacts on seafood supply.
- Polar regions have the potential for some increases in future fish production.
- Geographically uneven climate change impacts require regionally adaptive management systems.

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