FishMIP: Towards model improvement and cross-sectoral linkages

Higher trophic levels and exploitable fisheries

Lower trophic levels (LTL)

Large consumers

Medium consumers

Small consumers

Meso-zooplankton

Micro-zooplankton

Diatoms

Pico-phytoplankton

Size

10 m

0.2 um

Ecosystem models
Fisheries Ecosystem Model Inter-comparison Project
FISHMIP

Earth system models
Coupled Model Inter-comparison Project
CMIP
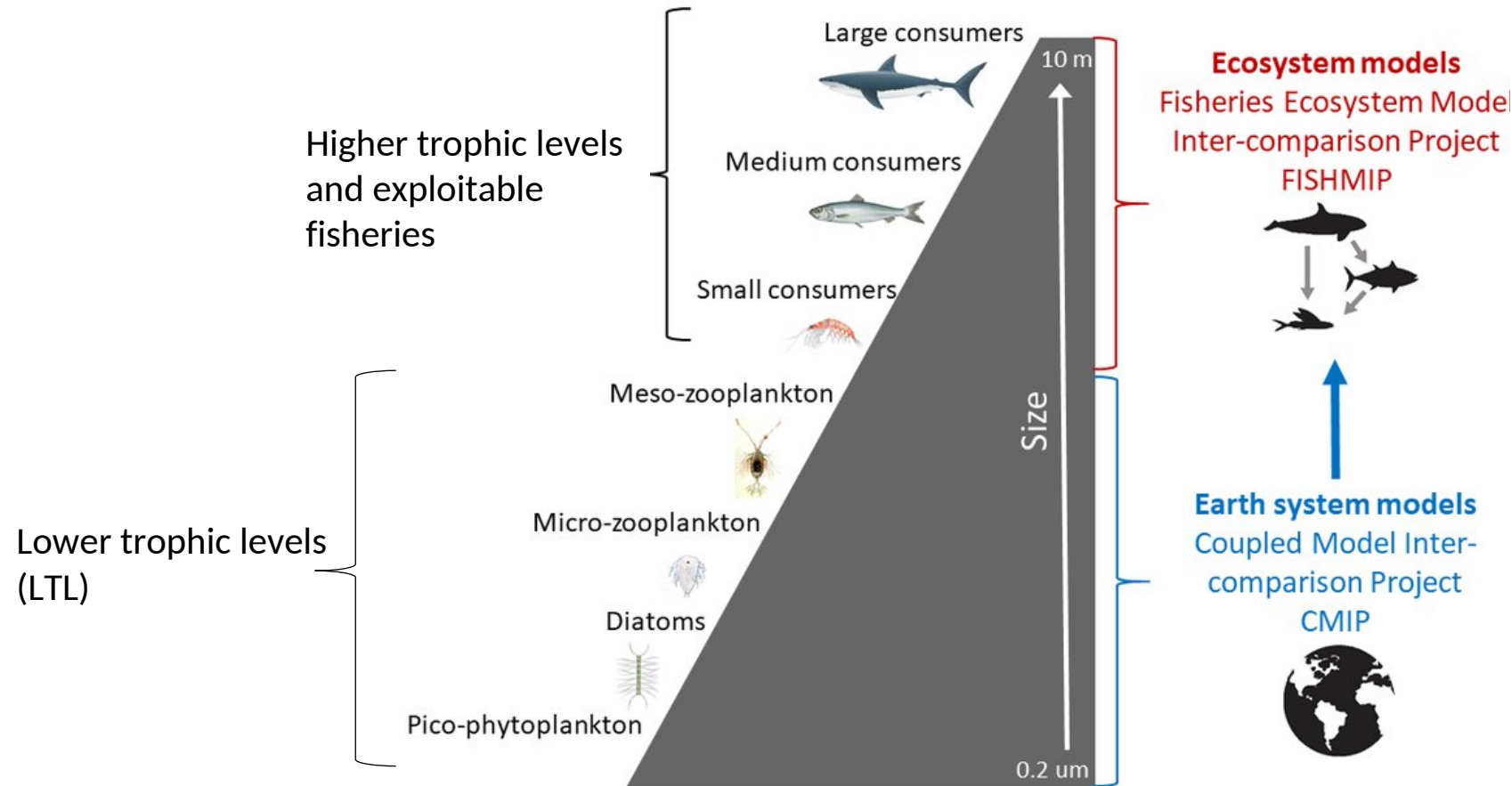
Julia Blanchard

Lead coordinator FishMIP

CMIP5 ensemble projected overall global declines in fish biomass

a

Change in total biomass [%]

- Historical
- RCP2.6
- RCP4.5
- RCP6.0
- RCP8.5

b

- GFDL-ESM2M
- IPSL-CM5A-LR
- APECOSM
- BOATS
- DBEM
- DPBM
- EcoOcean
- Macroecological

Apecosm
DBPM

BOATS
Macroecological
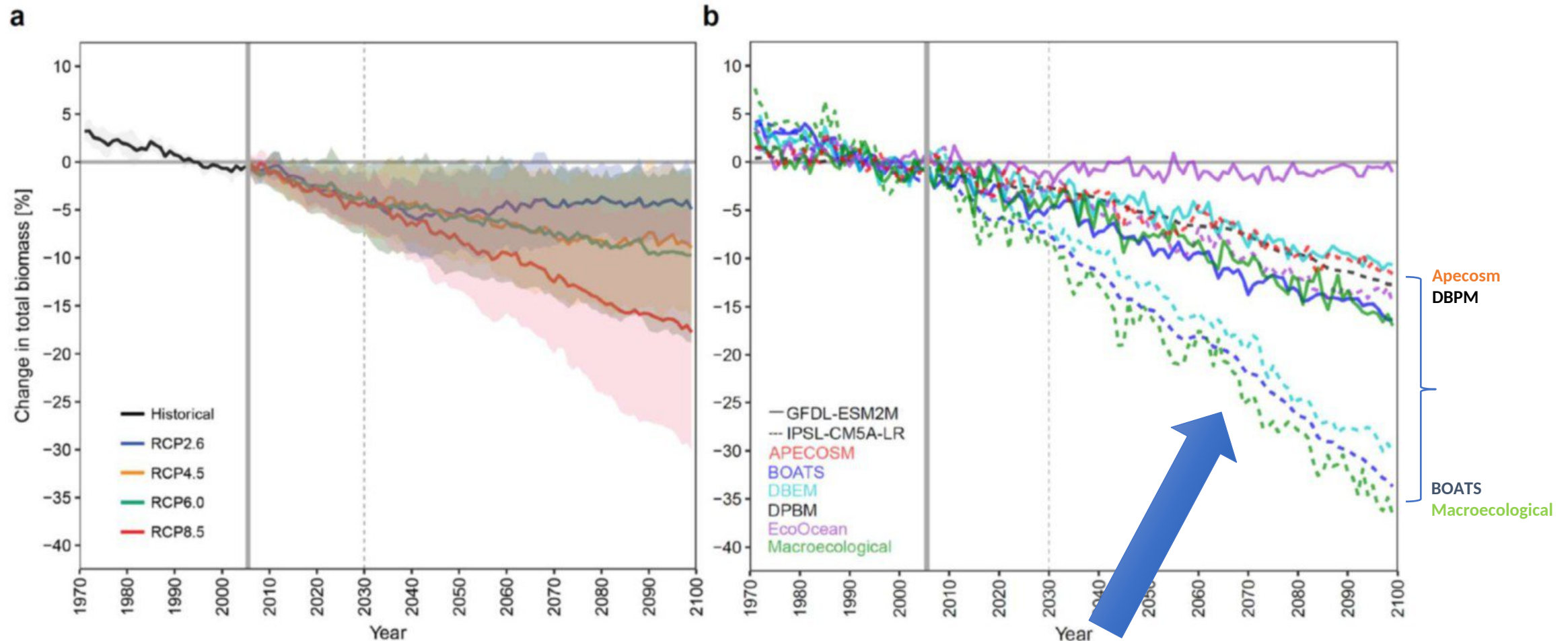
large across model variation

Lotze et al. 2019 PNAS

What drives across model variation?

Simulation protocol:

8 global marine ecosystem models all forced by a single CESM1-BGC time-series (pre-industrial -> historical -> RCP8.5)

4 comparative runs
temperature and LTL (primary and secondary production) climate change effects in isolation and combined

Results:

- Greater maximal reductions due to temperature
- Mostly additive effects

Heneghan et al. Geoscientific Model Development submitted
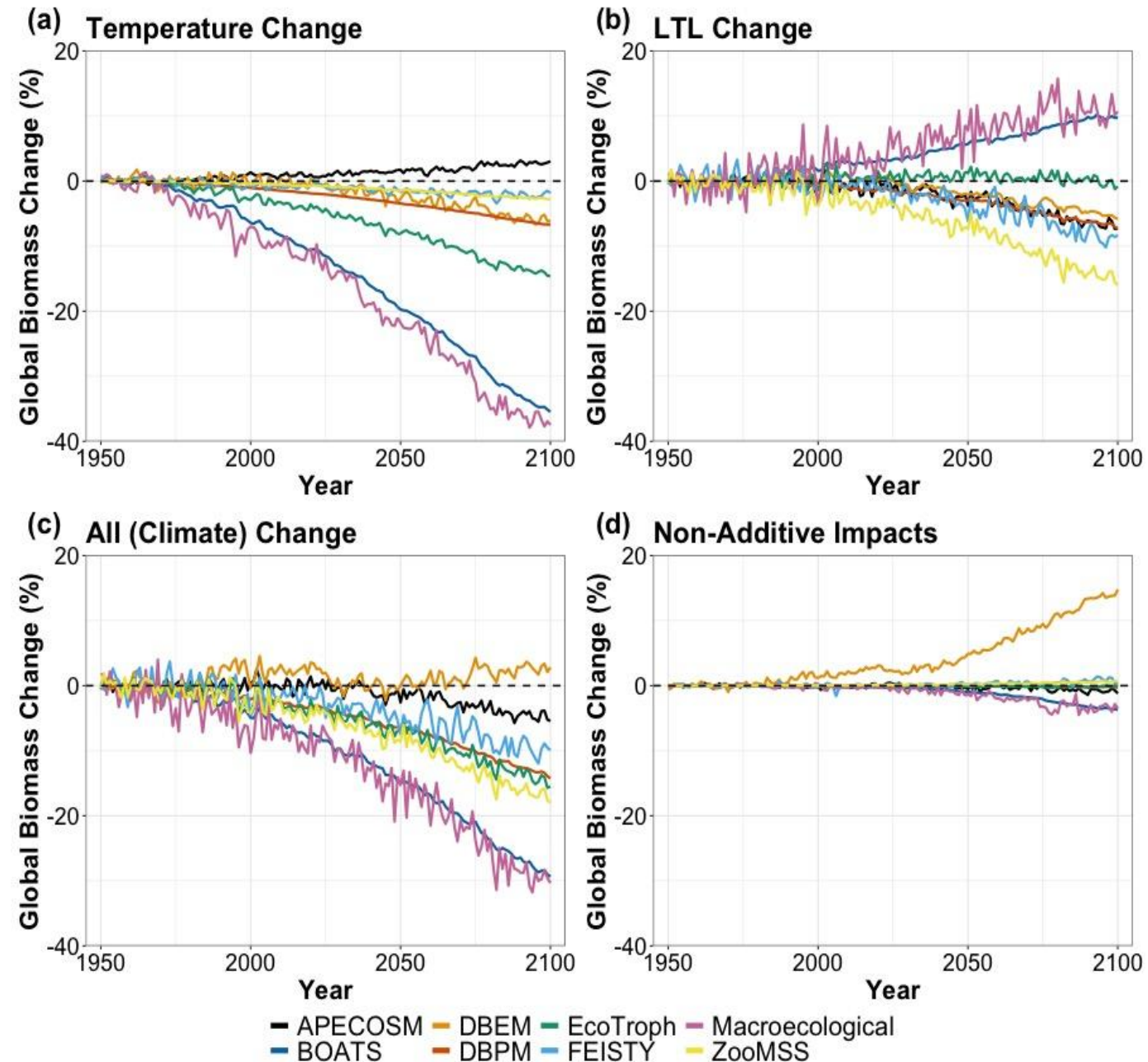
Results cont'd:

- Driver-response relationships differed markedly across models, reflecting the different model structures, their links to drivers and and their ecological feedbacks

- Key differences attributed to the type of LTL 1-way forcing used: greater declines and stronger temperature effects for models forced by net primary production rather than biomass of LTL

- Highlights scope for model improvement with: 2-way coupling or improved 1-way forcing and need for more detailed validation against observations (ISIMIP 3a)
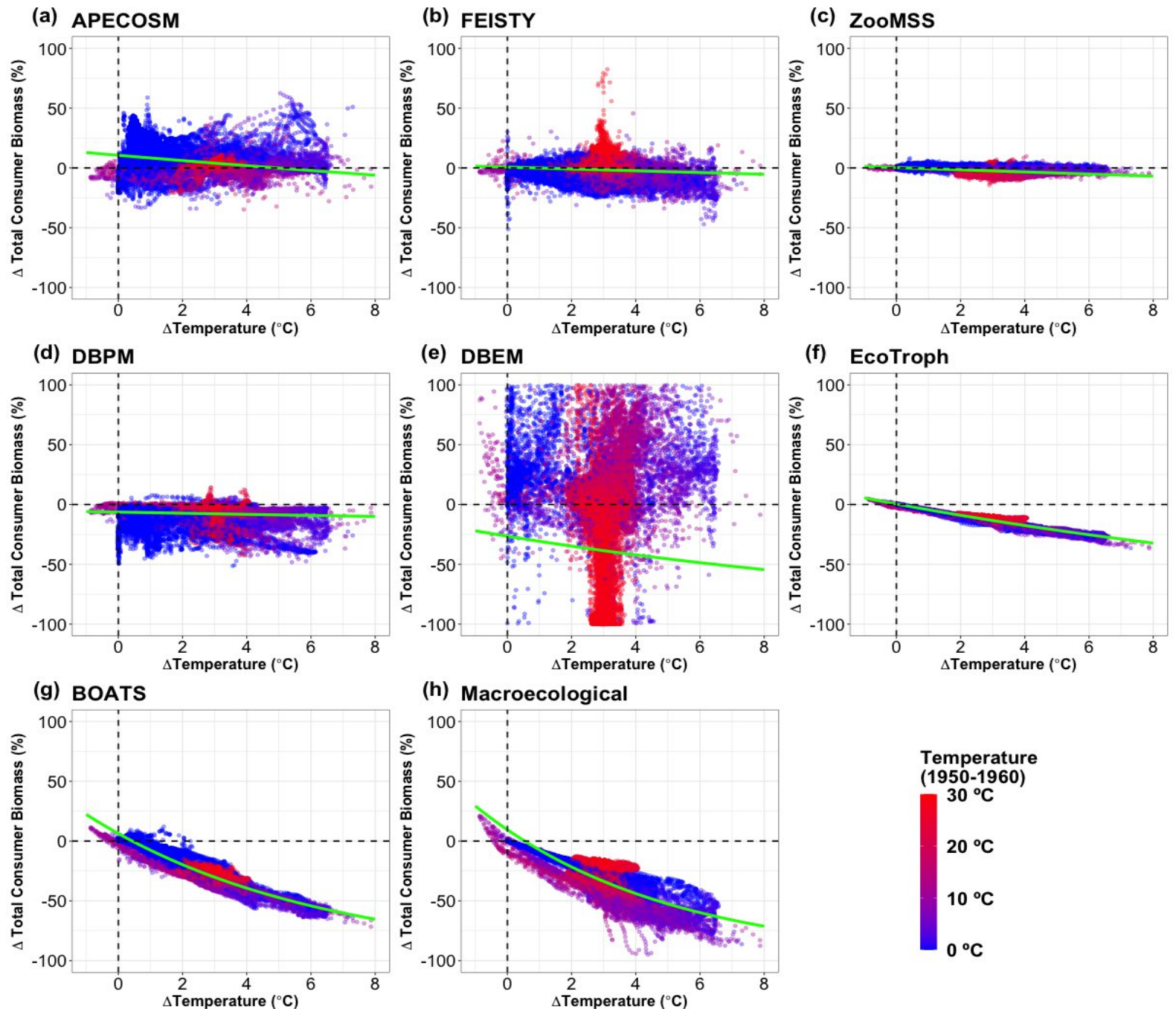
# How does model development contribute to uncertainty?

CMIP5 vs. CMIP6

<u>ISIMIP 2b vs ISIMIP 3b:</u>

- Geographical reshuffling of biomass changes with new MIP and FishMIP models

- Regions of highest/lowest model agreement also reshuffled

- Addition of 3 new global marine ecosystem models increases variation

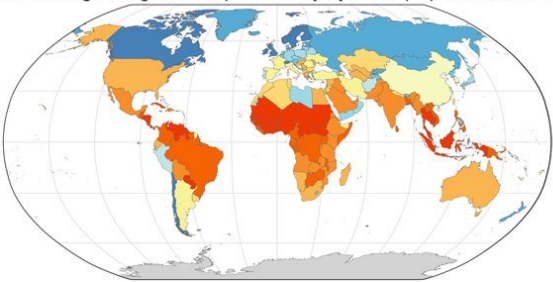- Includes large within model differences due to different Earth System Models

Tittensor et al. in prep
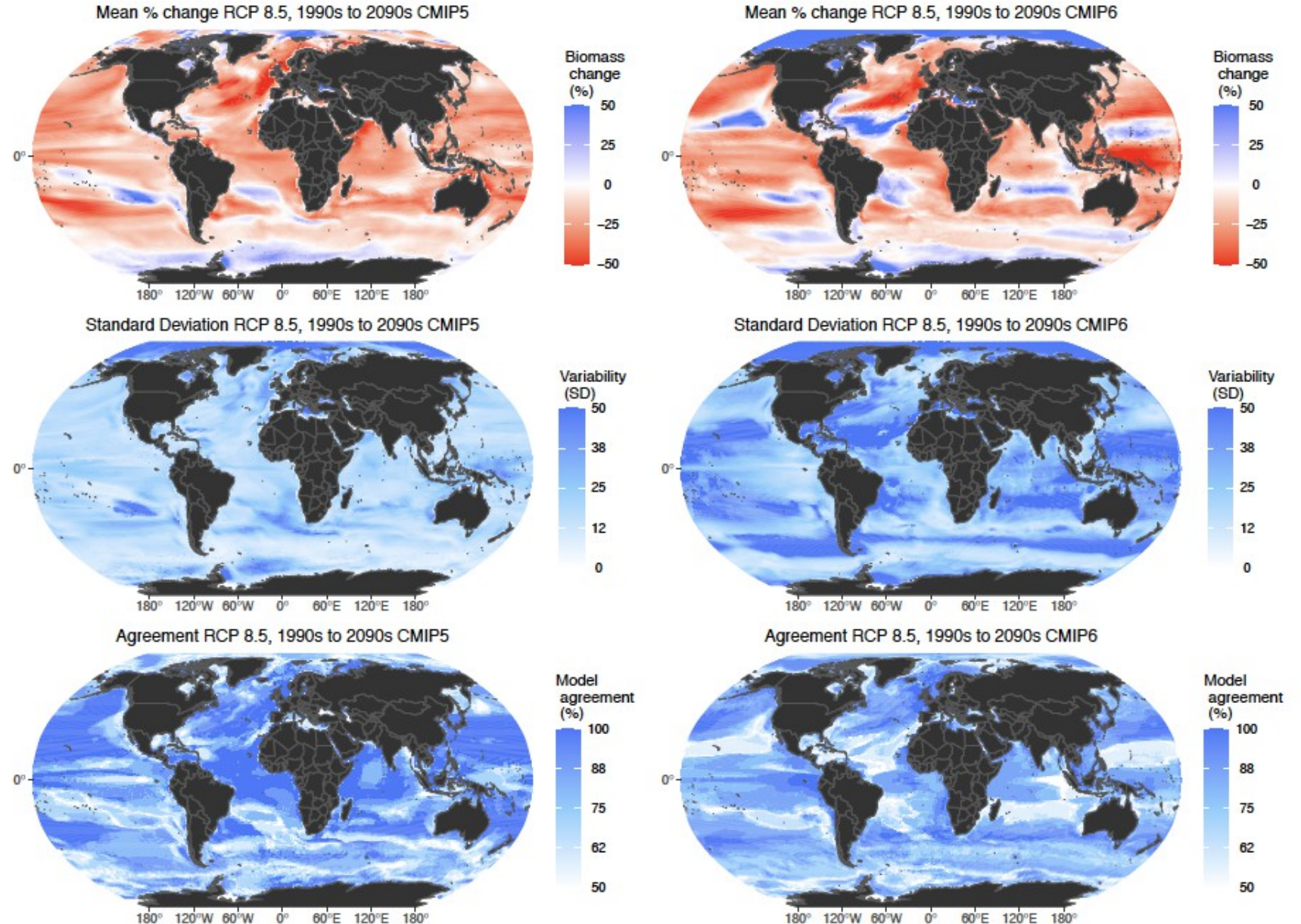
How will these new CMIP6 results alter cross sectoral vulnerabili
assessments?
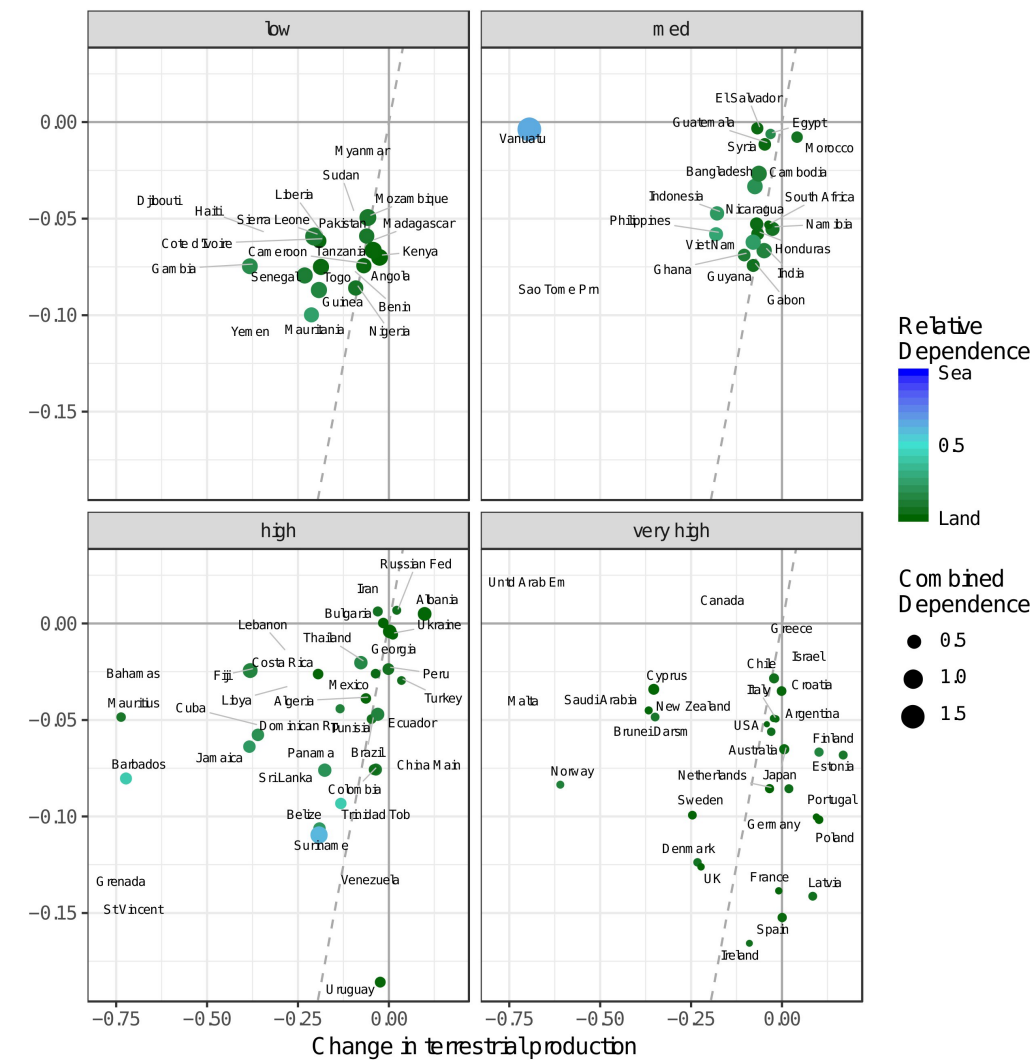
Blanchard et al 2017, Nature Ecol Evo
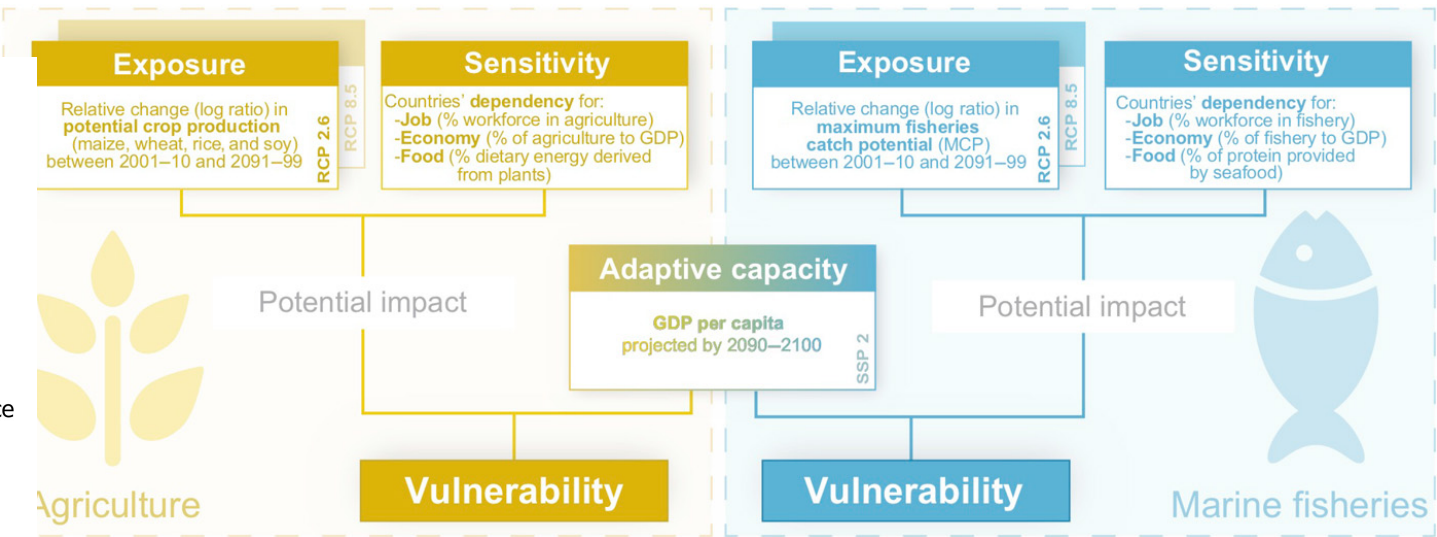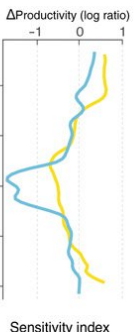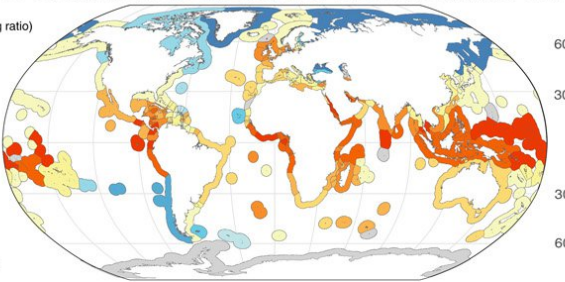
Thiault et al 2019, Sci Adv

Towards improved cross-sectoral links

Bridging the land-sea divide in climate impact models
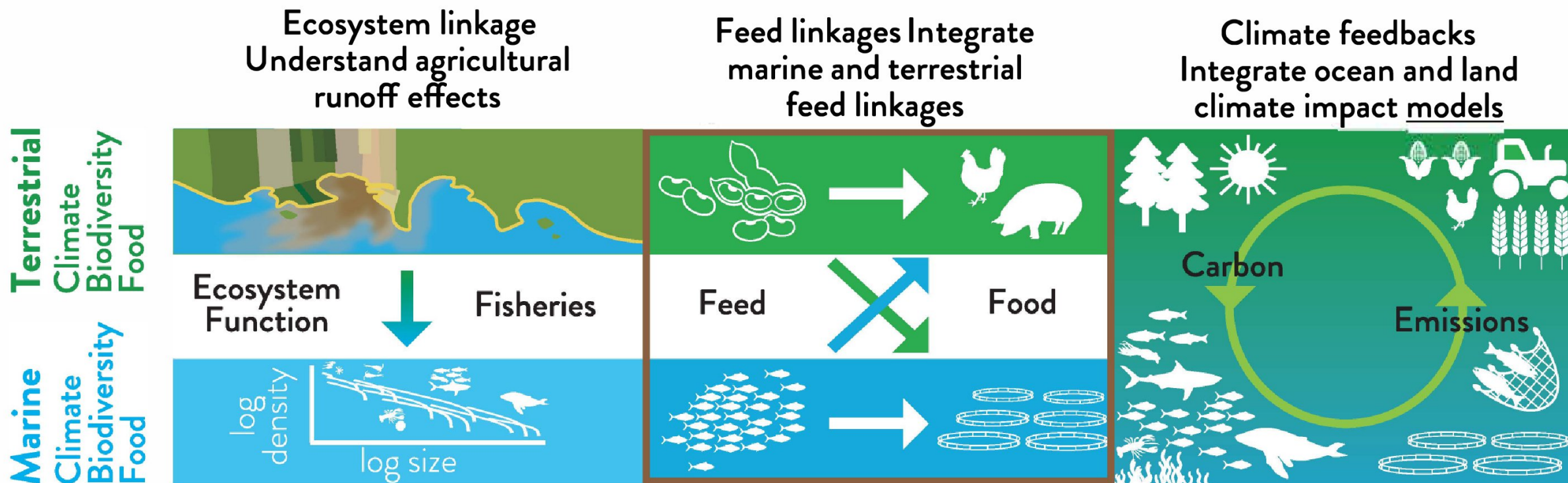
Blanchard et al. in prep

- **Propose a cross-sector Fisheries-Agriculture-Aquaculture-Biodiversity session in 6-12 months**