GFDL and the IPCC Special Report on The Ocean and Cryosphere in a Changing Climate (IPCC/SROCC)

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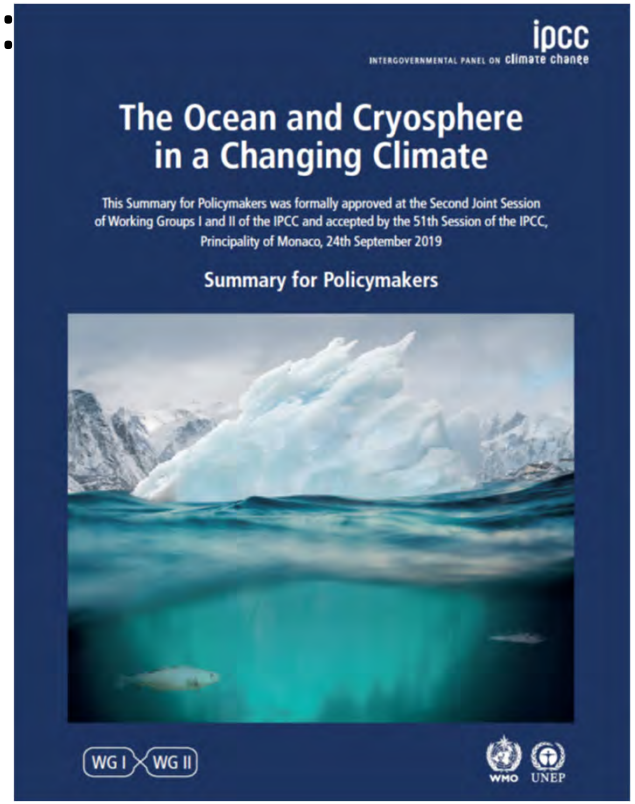
GFDL Contributions to IPCC

GFDL contributes to IPCC assessments via:

- Coupled Models & Earth System Models
- Model output (e.g., CMIP)
- Published studies of the climate system
- Authors in all 6 IPCC Assessment Reports
- 5 GFDL IPCC authors / editors in AR6:
  - Land Report – SRCCL (E. Shevliakova)
  - Ocean Report – SROCC (R. Hallberg)
  - Physical Climate – AR6 WG-I (J. Dunne, V. Naik, V. Ramaswamy)
- Numerous scientific reviewers and contributing authors

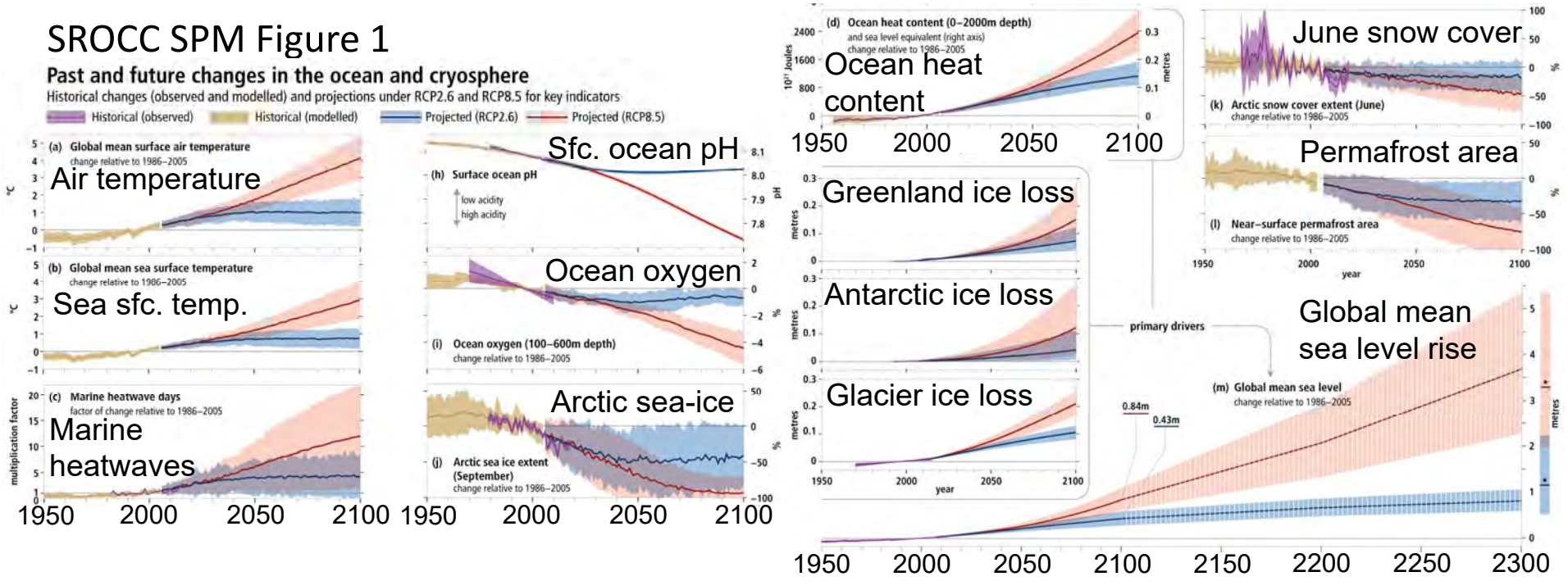


GFDL scientists provide a comprehensive perspective on the climate system derived from our experience with climate model development.

Overview of Key SROCC Findings

- The cryosphere is shrinking; the oceans are warming, acidifying, expanding, stratifying, losing oxygen and exhibiting shifting biological ranges.
- Many changes in the oceans and cryosphere have been observed to be accelerating, consistent with CMIP5 coupled model historical simulations.
- 21st Century changes are committed, but can be limited by restricting CO2 emissions.
- Coastal blue-carbon storage is intensive, but at most a small fraction (<2%) of emissions.
- GFDL is a key contributor to underlying science, projections and detection/attribution.

SROCC SPM Figure 1



Projected Changes in the Ocean

SROCC details a series of robust physical changes

Globally the ocean is warming and acidifying

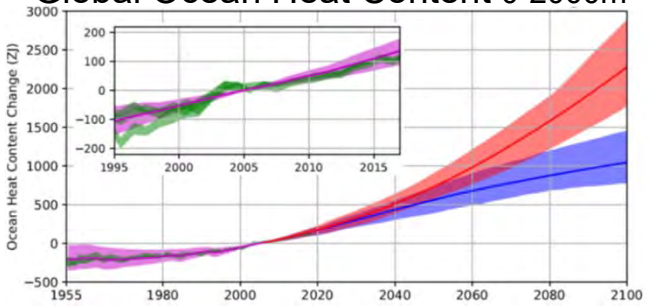
- Surface intensified changes increase density stratification
  - ↳ Reducing subsurface dissolved oxygen
  - ↳ Reducing supply of nutrients to the ocean surface
    - ↳ Reducing net primary productivity (varies regionally)

For RCP8.5, novel conditions in all 5 variables occur in 60% of ocean area prior to 2100; 30% of area for RCP2.6.

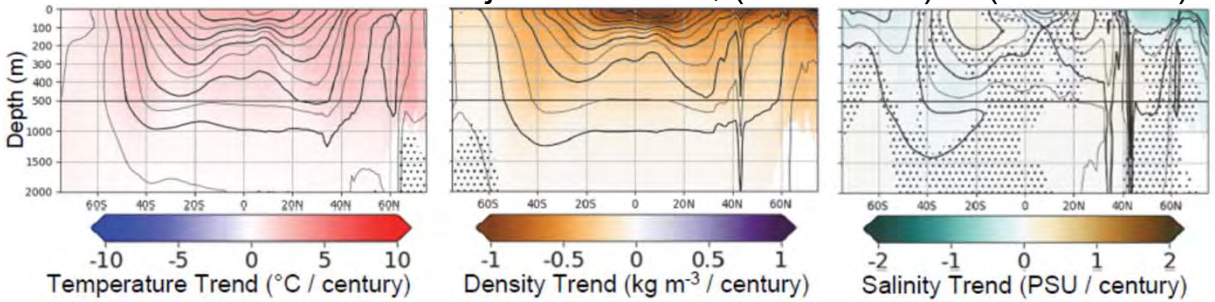
Regional Changes

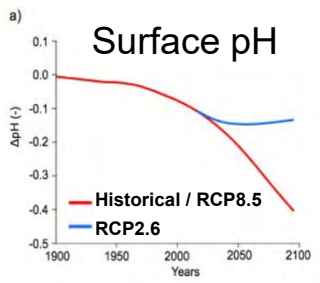
- Expanded hypoxia
- Reduced overturning
- Regional variations in sea level rise
- Tidal amplitudes

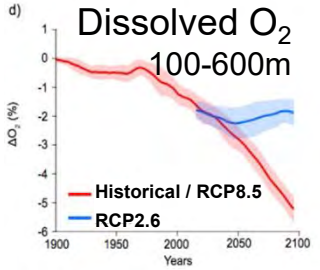
Global Ocean Heat Content 0-2000m

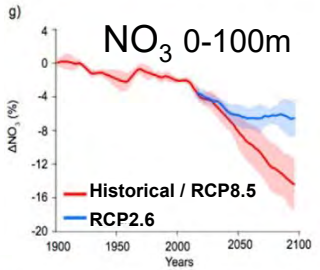


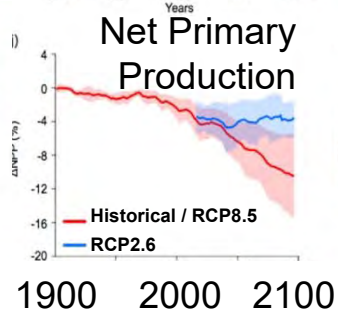
RCP8.5 Zonal Mean Projected Trends, (1986-2005) to (2081-2100)

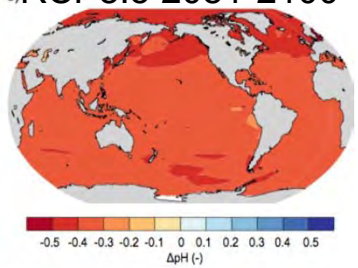


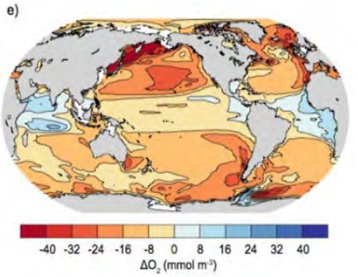


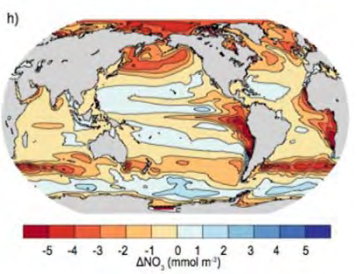


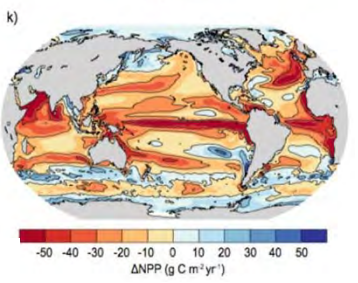












Physical Changes Lead to Ecosystem Impacts

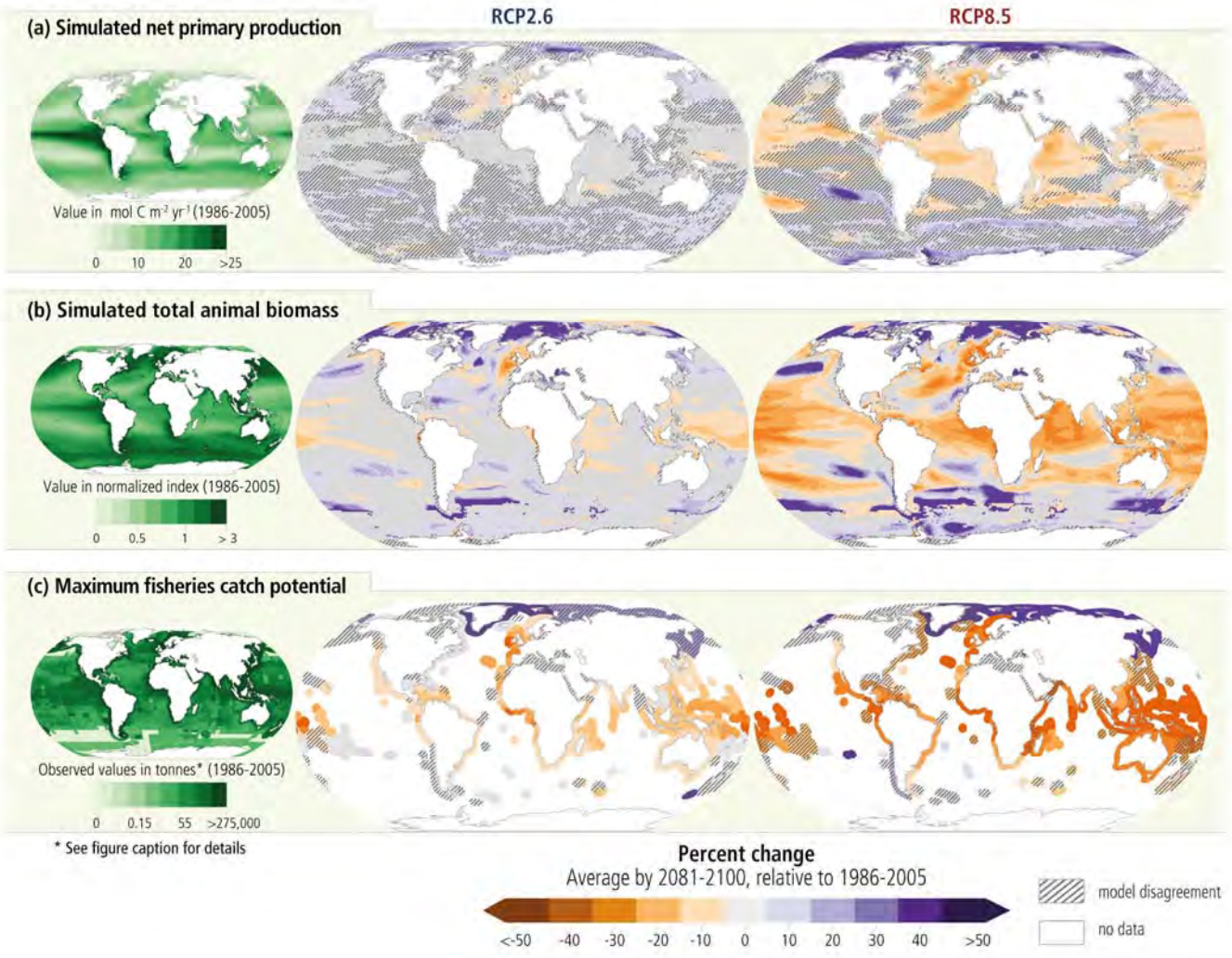
SROCC SPM Fig. 3: **Projected changes, impacts and risks for ocean ecosystems as a result of climate change**

Global Net Primary Production is projected to *very likely* decrease by 4% to 11% by 2100 under RCP8.5.

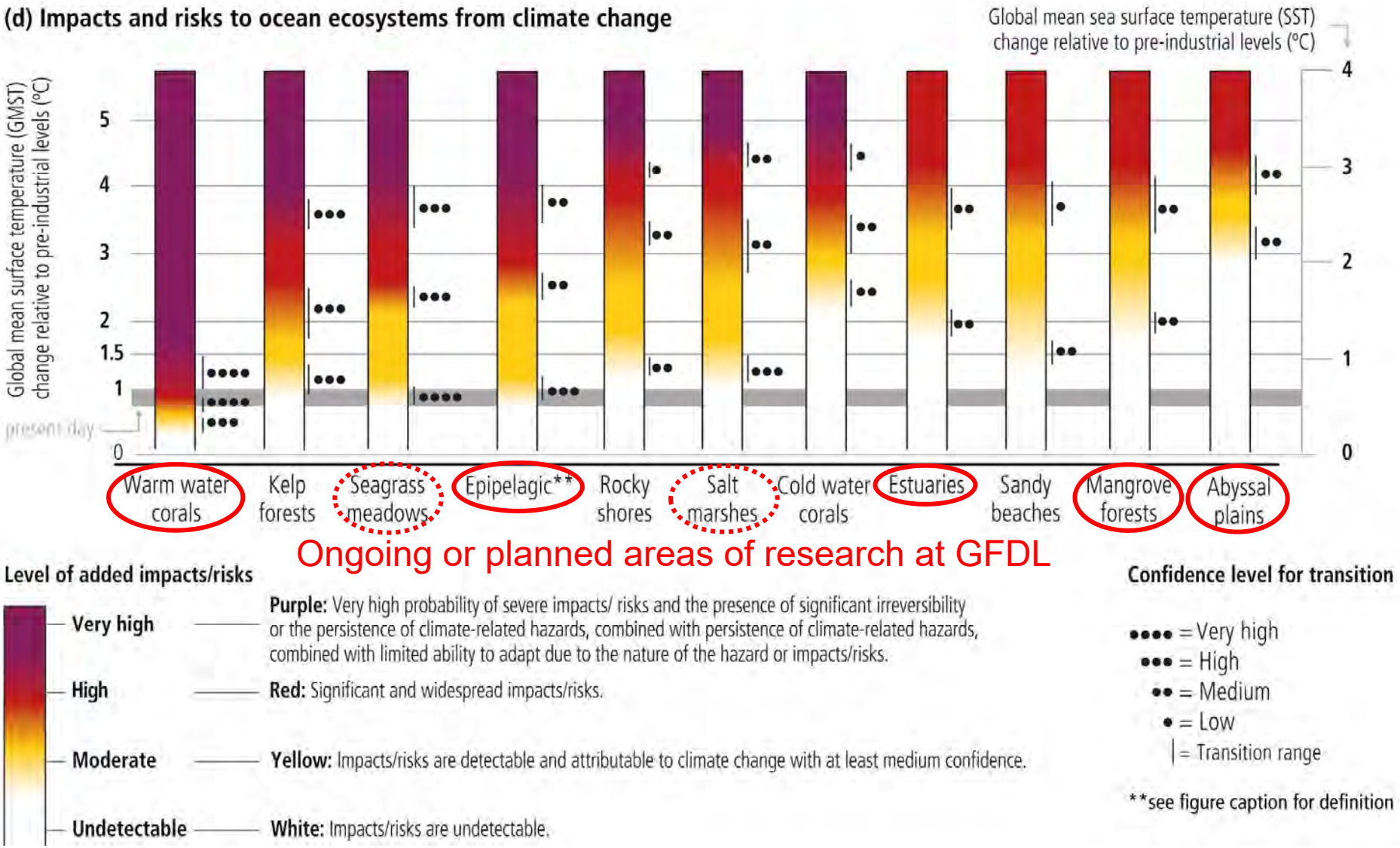
Total animal biomass in the ocean is projected to *very likely* decrease by 15±5.9% by 2100 under RCP8.5.

GFDL Contributed 2 of the 10 Earth System Models that were used here.

Globally integrated maximum fisheries catch potential is projected to decrease by 20.5% to 24.1% by 2100 under RCP8.5.



Ecosystems at Risk from Climate Change



Summary & Future Challenges

- Climate is changing the state of the oceans and cryosphere, with profound consequences for ocean ecosystems and people.
- GFDL's ocean science and scientists address key questions highlighted by IPCC, all in direct alignment with NOAA's mission.
- The IPCC is a strong venue for communicating the consequences of GFDL's policy-relevant science with the world

Emerging challenges:

- Expanding demands for GFDL models and data, especially via numerous Model Intercomparison Projects (MIPs)
- Recruiting and retaining a diverse team of ***scientists at GFDL*** and cultivating ***collaborations*** to address the expanding range of scientific questions about the implications of climate change.