NCAR COMMUNITY EARTH SYSTEM MODEL CESM

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BGCWG Updates

Co-Chairs:
Abigail Swann (U. Washington)
Gretchen Keppel-Aleks (U. Michigan)
Kristen Krumhardt (NCAR)

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BGCWG

- biogeochemical cycles coupled within the Earth system
- That means BGCWG is the group that covers full Earth system coupling (not directly covered by other working groups!)
- Emissions-driven simulations are core BGC activities

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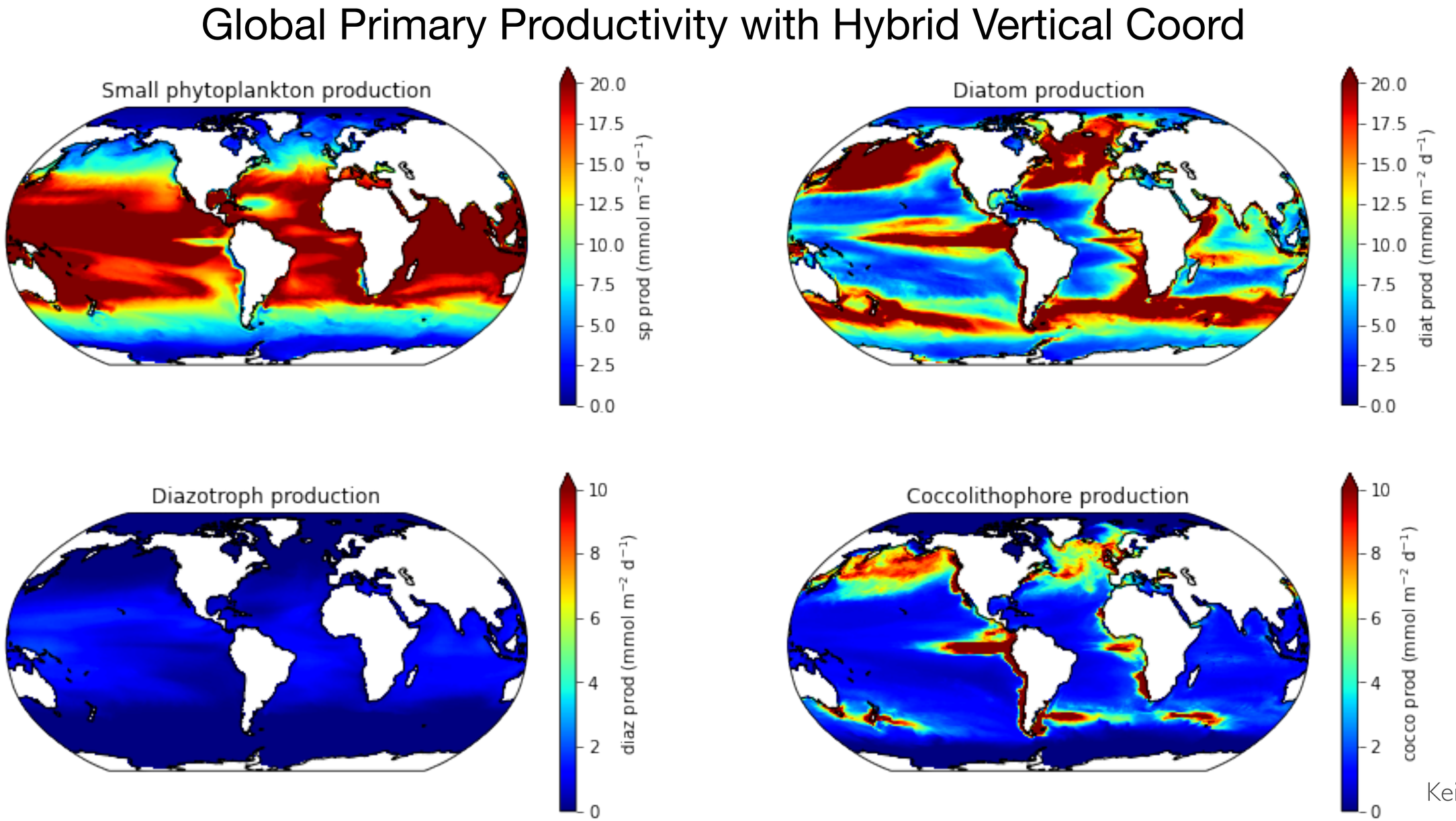
- Emissions-driven simulations are core BGC activities

Tutorial on running emissions-driven simulatons as part of the winter working group meeting

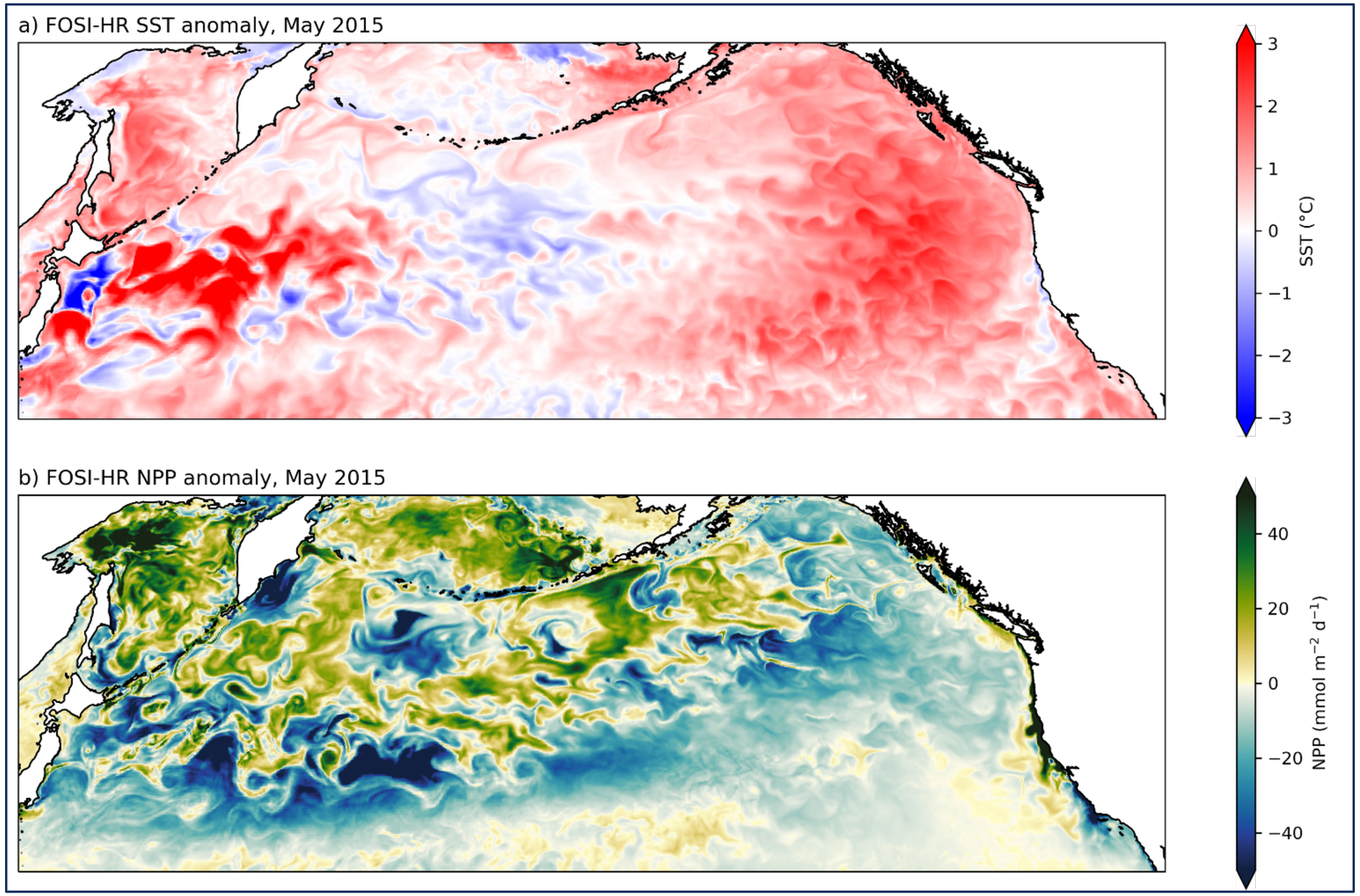
New ocean component MOM6 running globally w/ BGC



Keith Lindsay

Global high resolution Ocean BGC (0.1°)

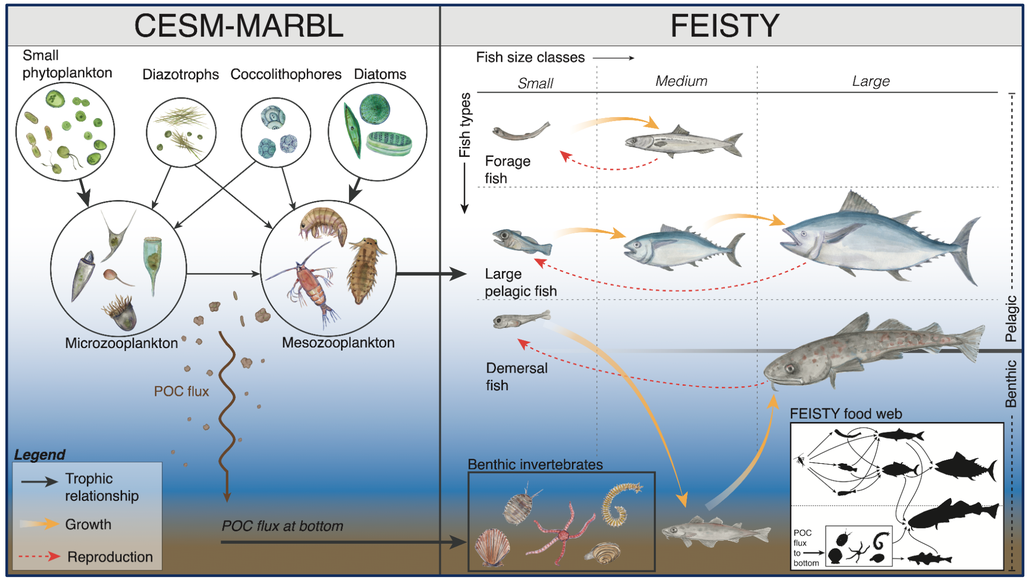
- Global high resolution ocean bgc (first time!)
- Cacluates anthropogenic components of carbon and other bgc aspects (this is novel relative to other modeling groups)
- Can be used to drive offline impacts models



Krumhardt et al., under review at *Progress in Oceanography*

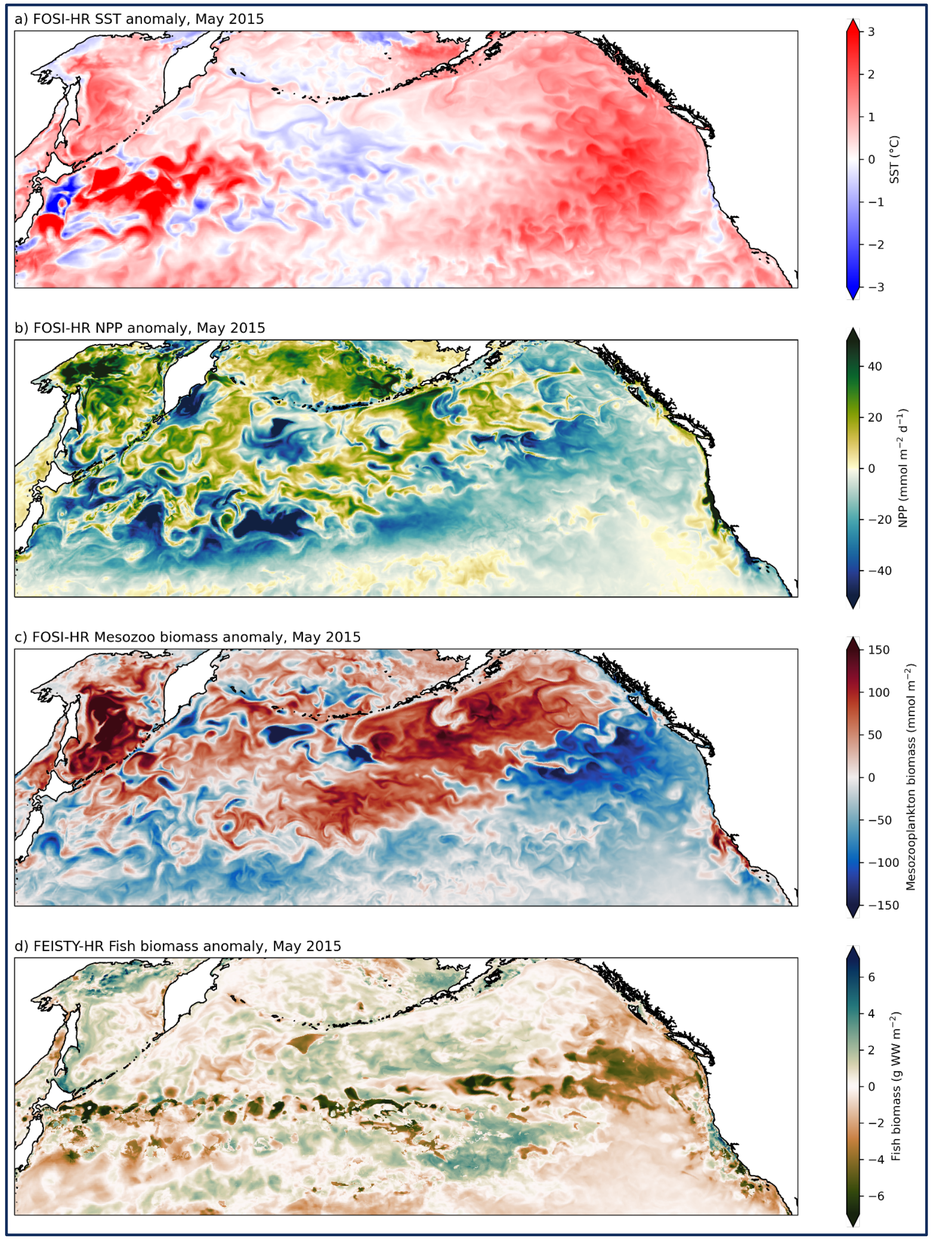
New high resolution (0.1°) CESM hindcast with fish model

- Forced by JRA reanalysis, 1958 to 2021
- New MARBL ecosystem with 2 zooplankton
- Linked to offline fish model called FEISTY
- Publicly available, offers opportunities for research on the influence of mesoscale dynamics on marine biogeochemistry and ecosystems, from nutrients to fish, in a global context.



Marine ecosystem schematic

BGC/ecosystem anomalies during “the blob” MHW in 2015



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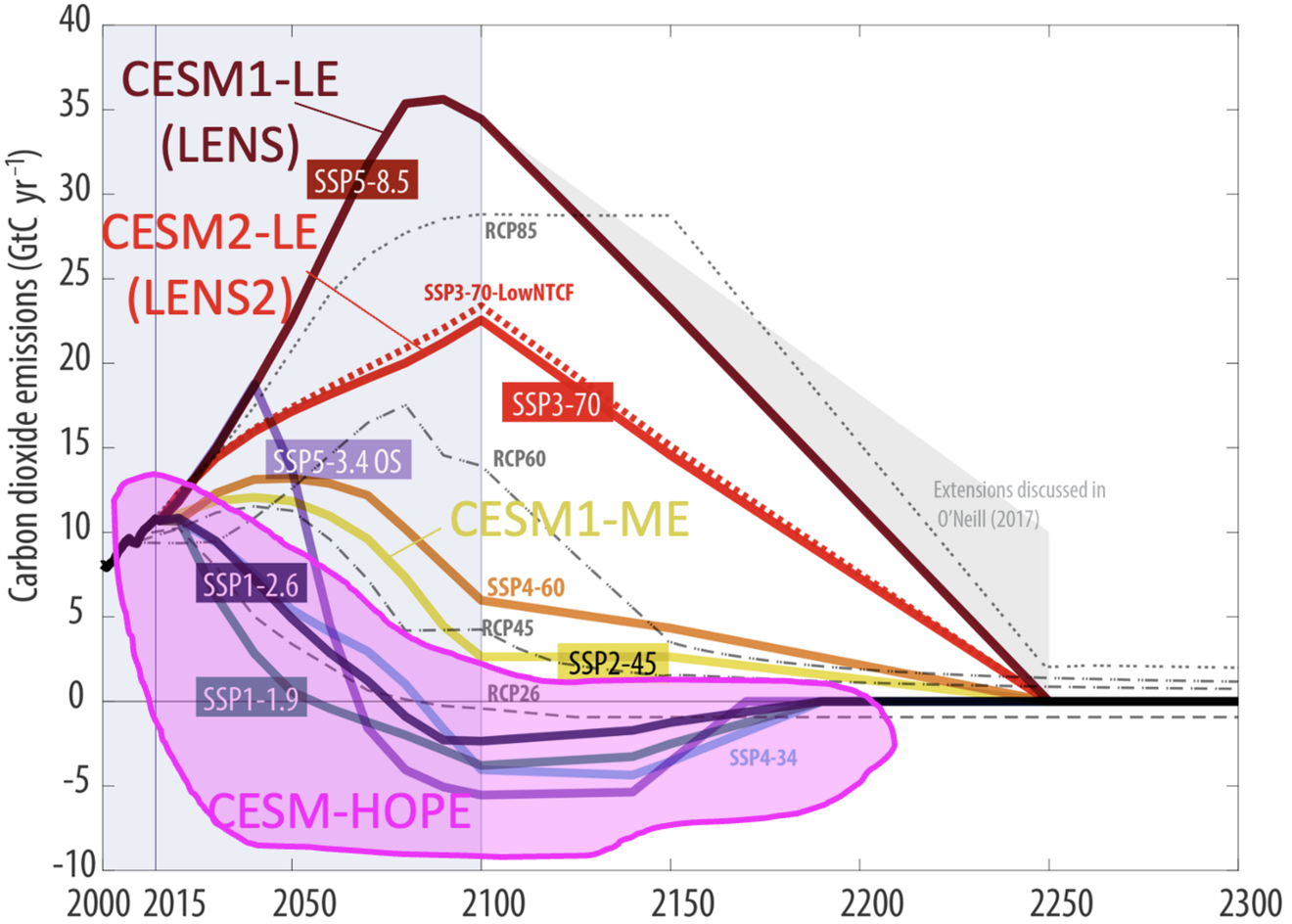
CESM-HOPE (Highly Optimistic Projection Ensemble) project

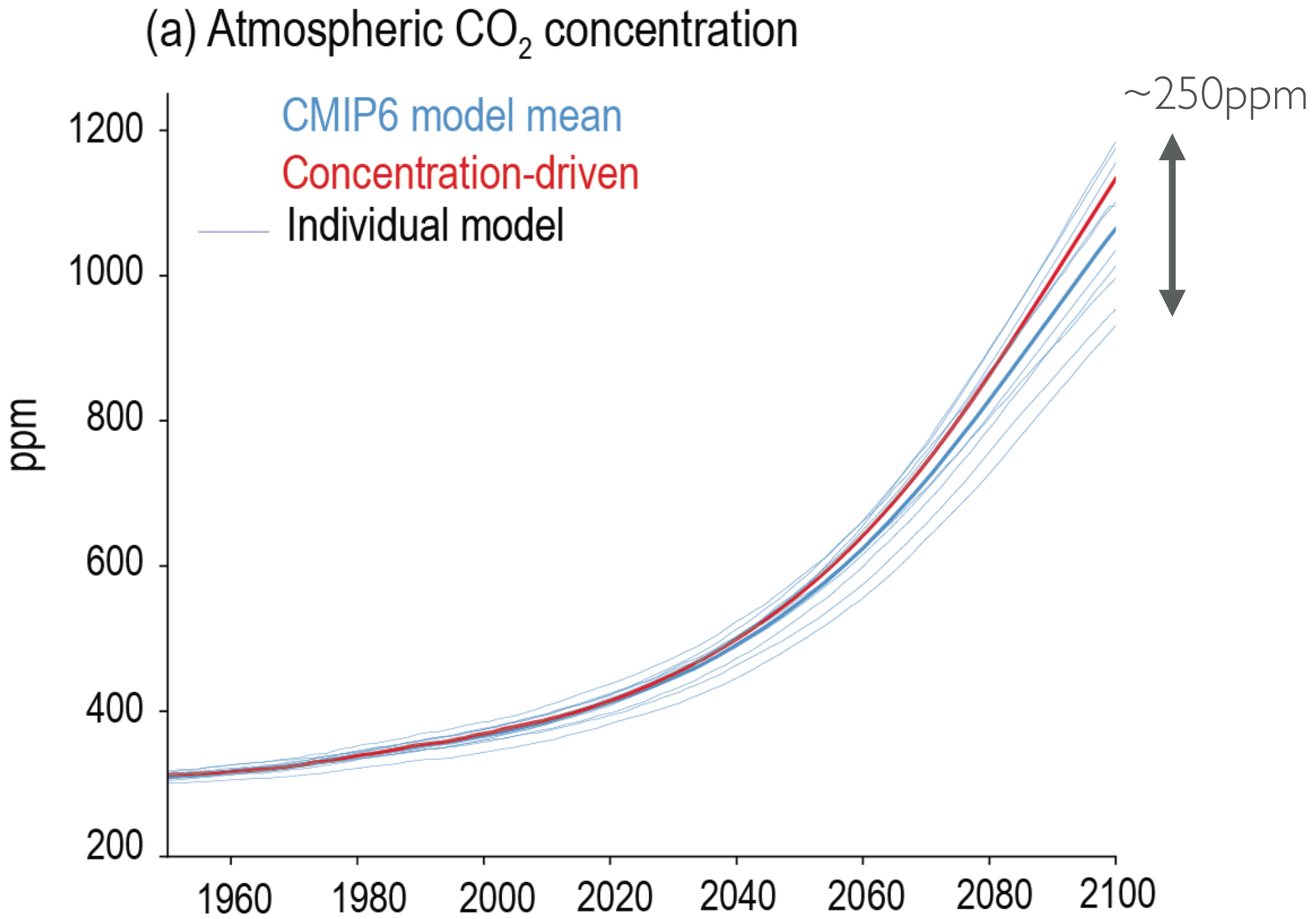
- Ensemble of **emissions-driven** SSP1-1.9 simulations with CESM2, proposed by Nikki Lovenduski at SSC meeting at CESM Workshop in 2023
- CDR (forestation, BECCS) required in SSP1-1.9 scenario
- Status: Getting an SSP1-1.9 emissions-driven simulation going now, leveraging runs for NSF Growing Convergence project on Climate Intervention



Slide from D. Lawerence

CMIP7 will have more emissions-driven simulations

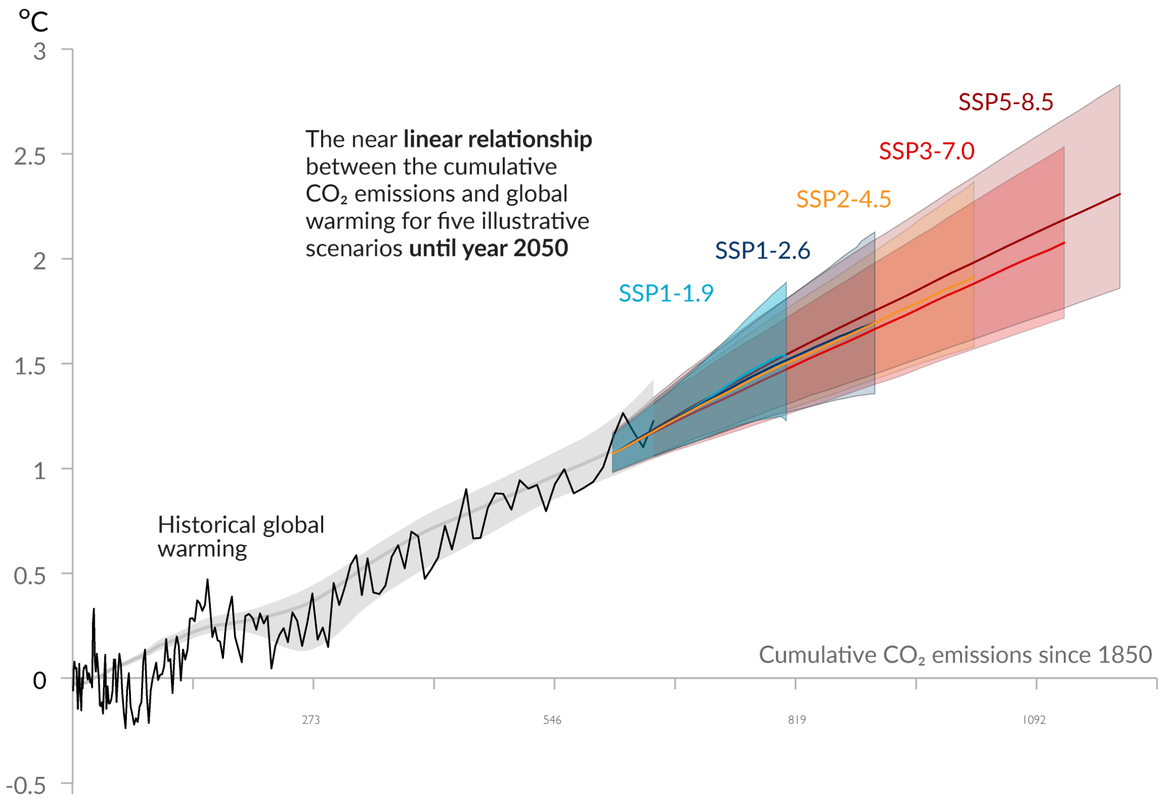
CMIP6 had a limited number of runs as part of C4MIP (~12 models)



IPCC AR6 WGI, Fig. 4.3

Key metrics - TCRE and ZEC

Transient Climate Response to Emissions TCRE



IPCC AR6 WGI, Fig. SPM 10

IPCC AR6 WGI Fig. 4.39

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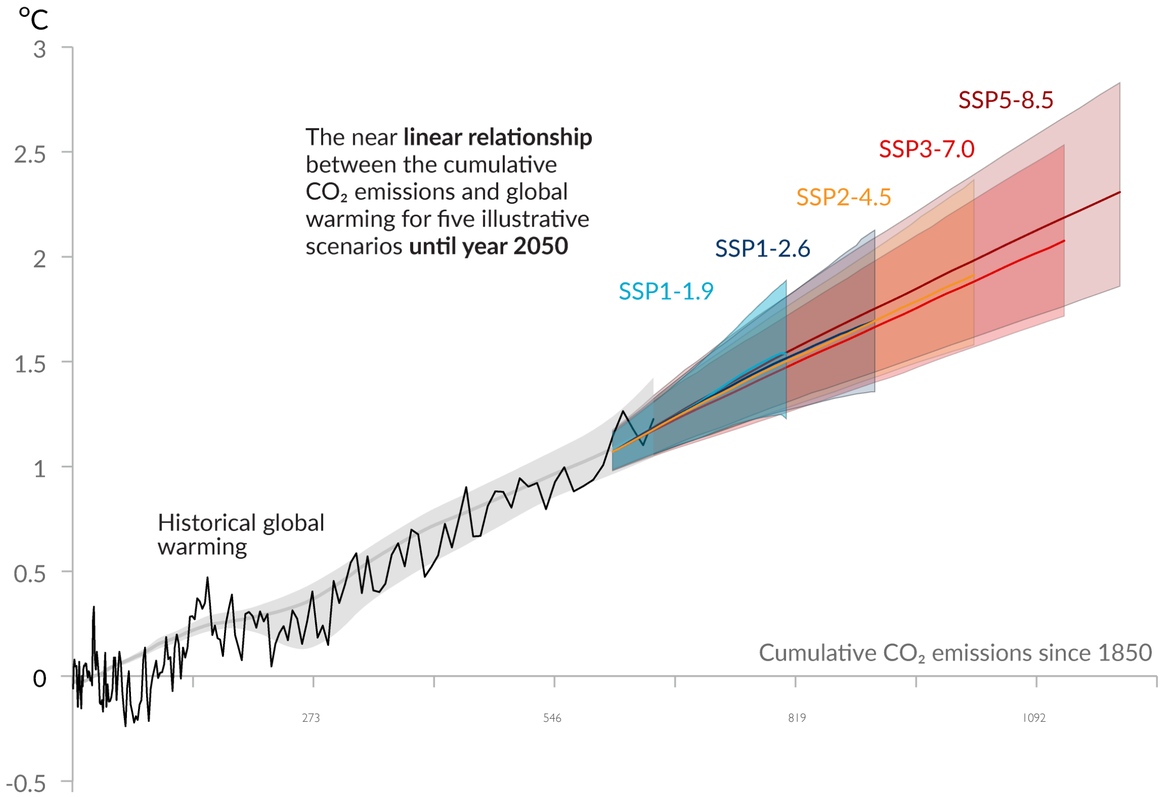
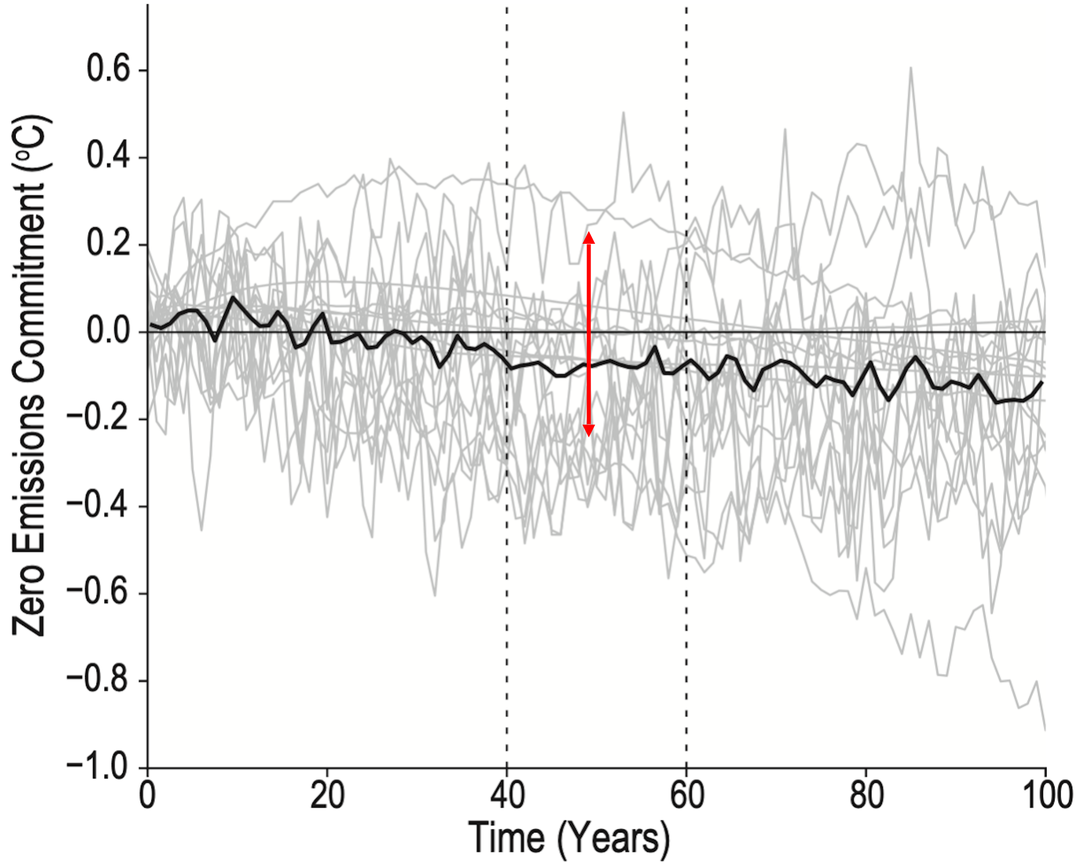
Transient Climate Response to Emissions TCRE



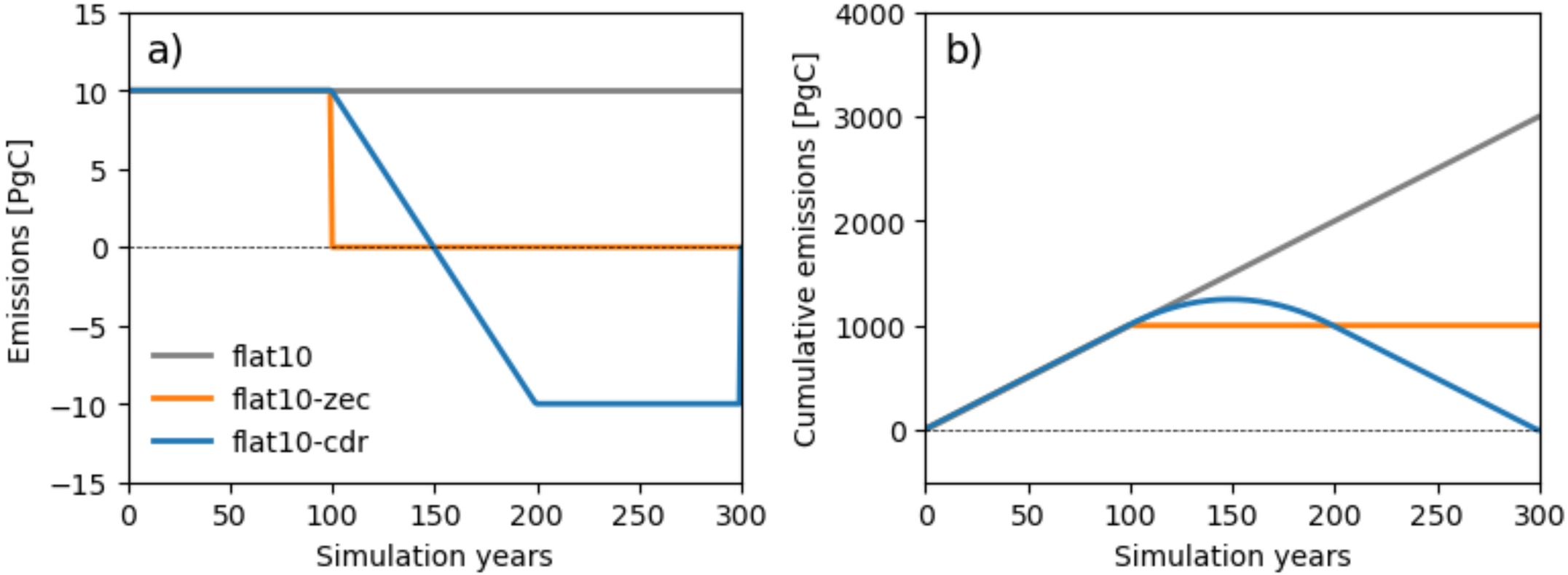
Zero Emissions Committment ZEC



IPCC AR6 WGI, Fig. SPM 10

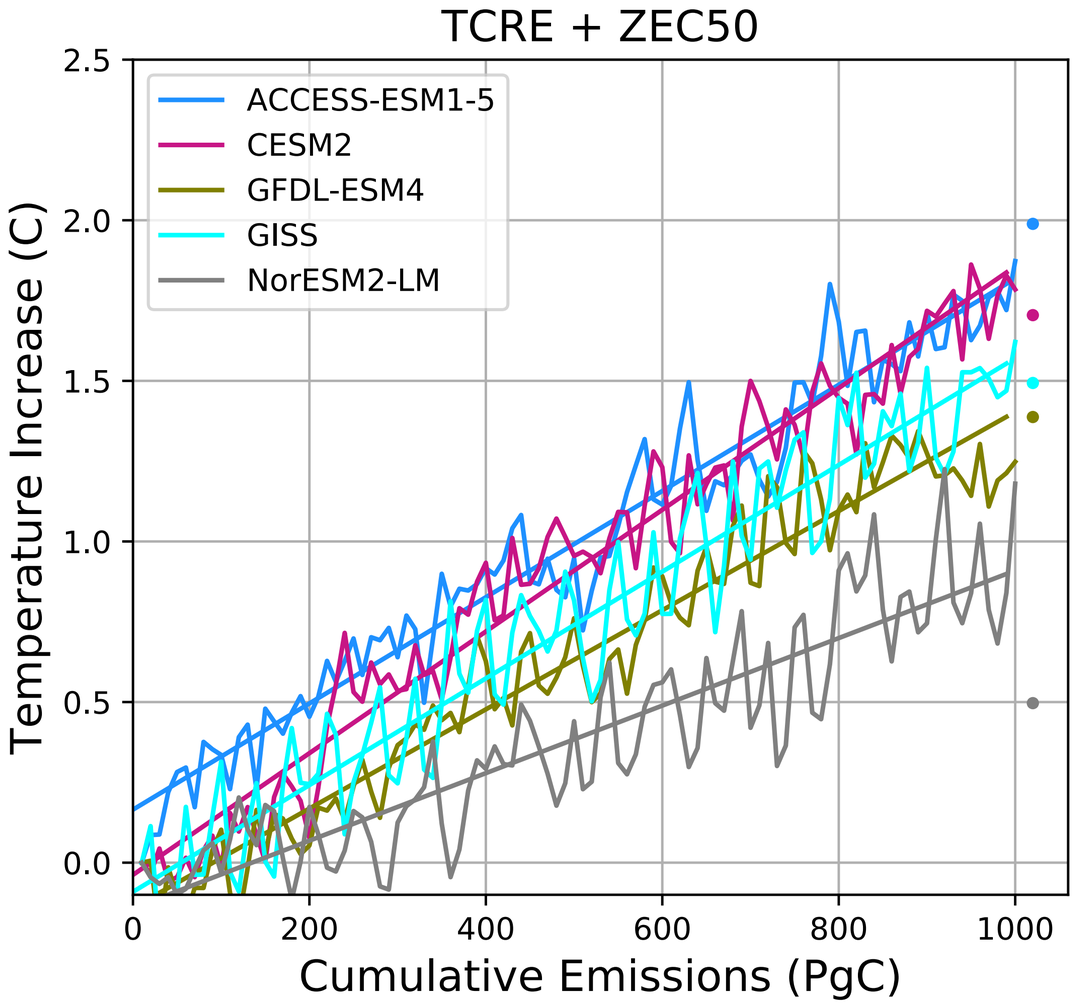
IPCC AR6 WGI Fig. 4.39

Flat10 set of experiments

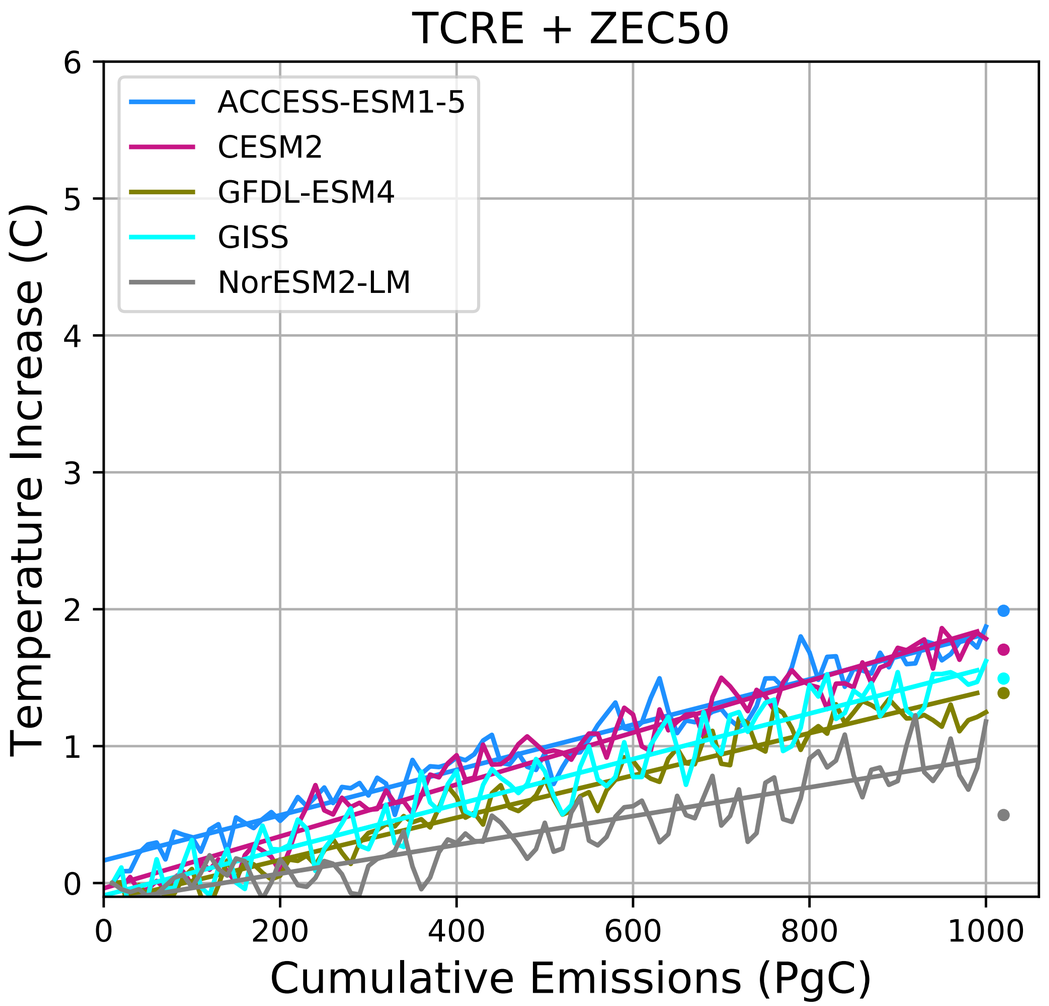


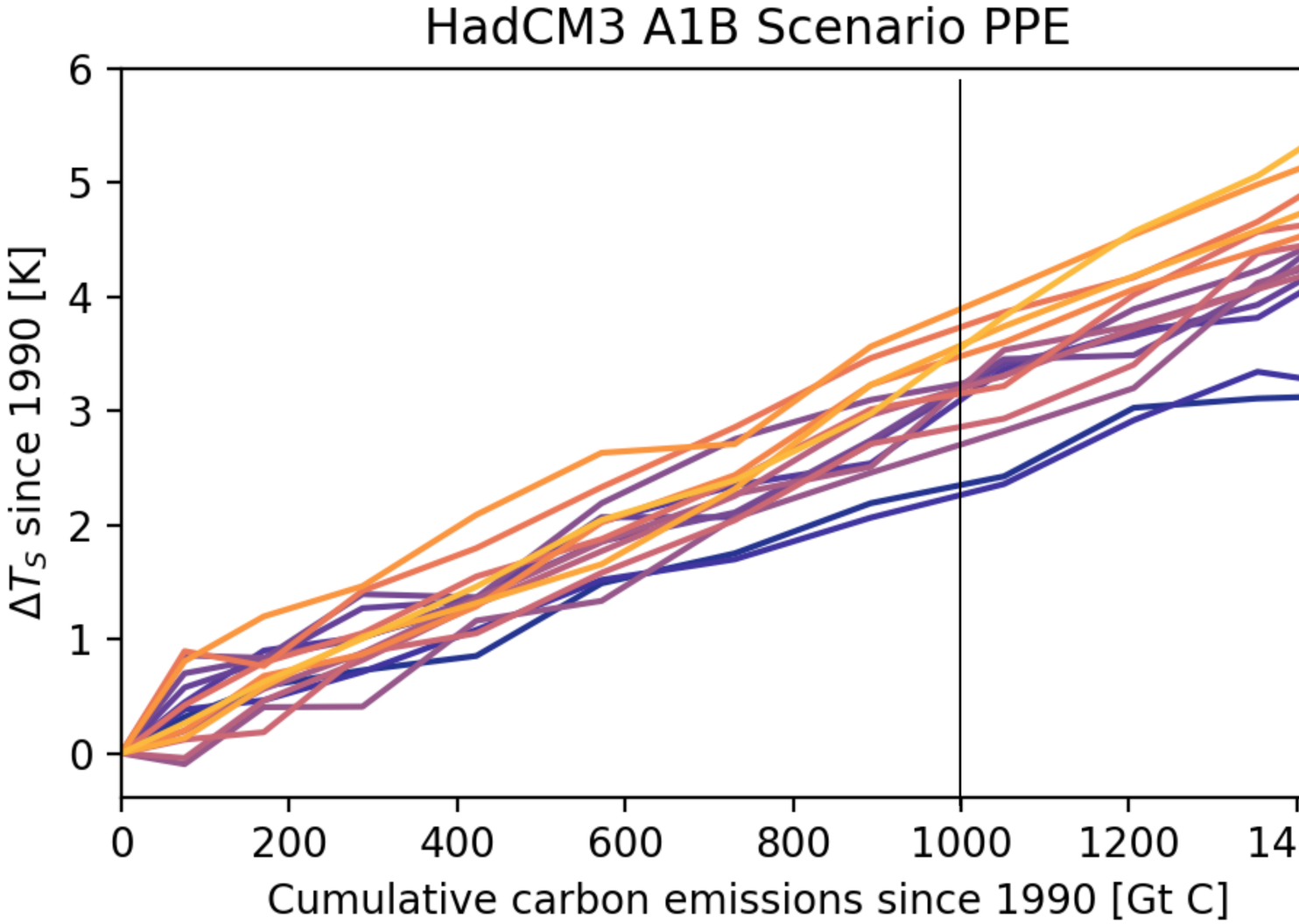
Sanderson et al. in prep

TCRE+ZEC50 for flat10mip shows spread across models



Spread across PPE is large relative to spread across models



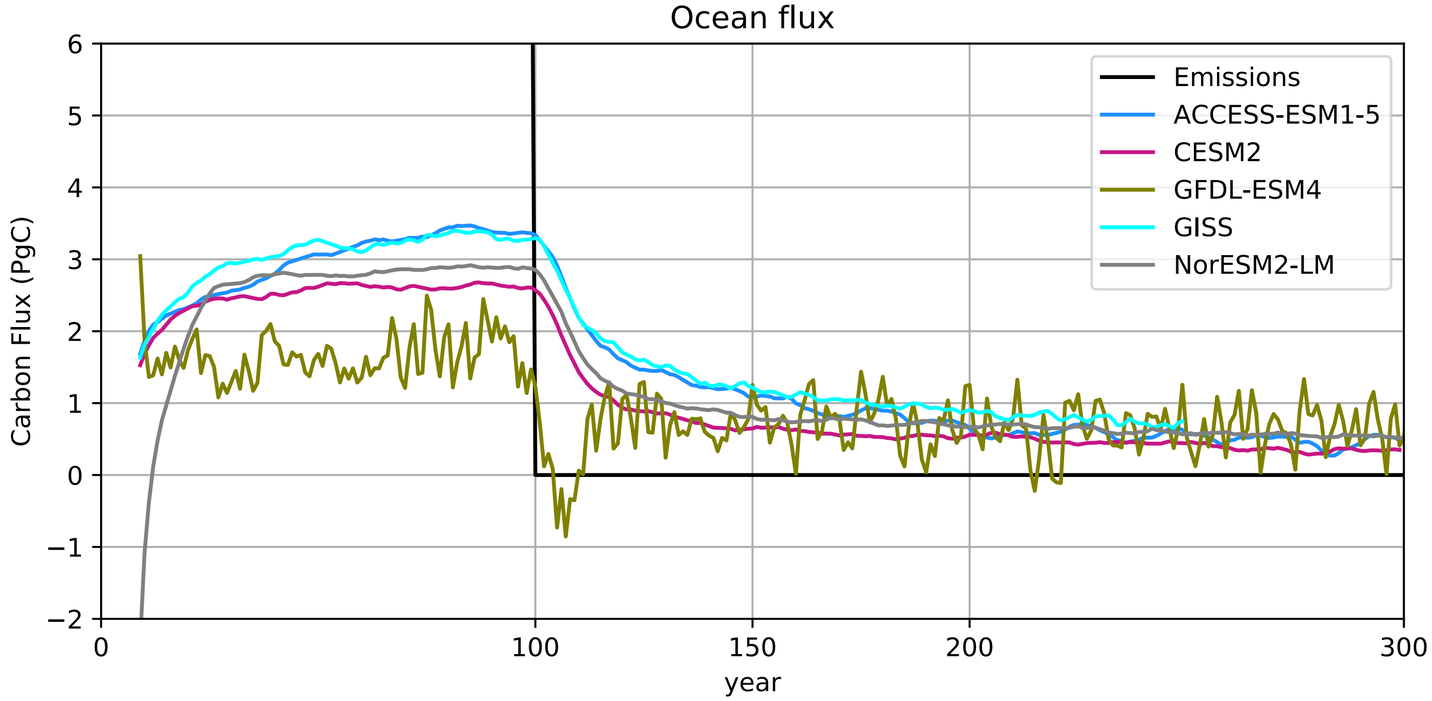


Flat10mip

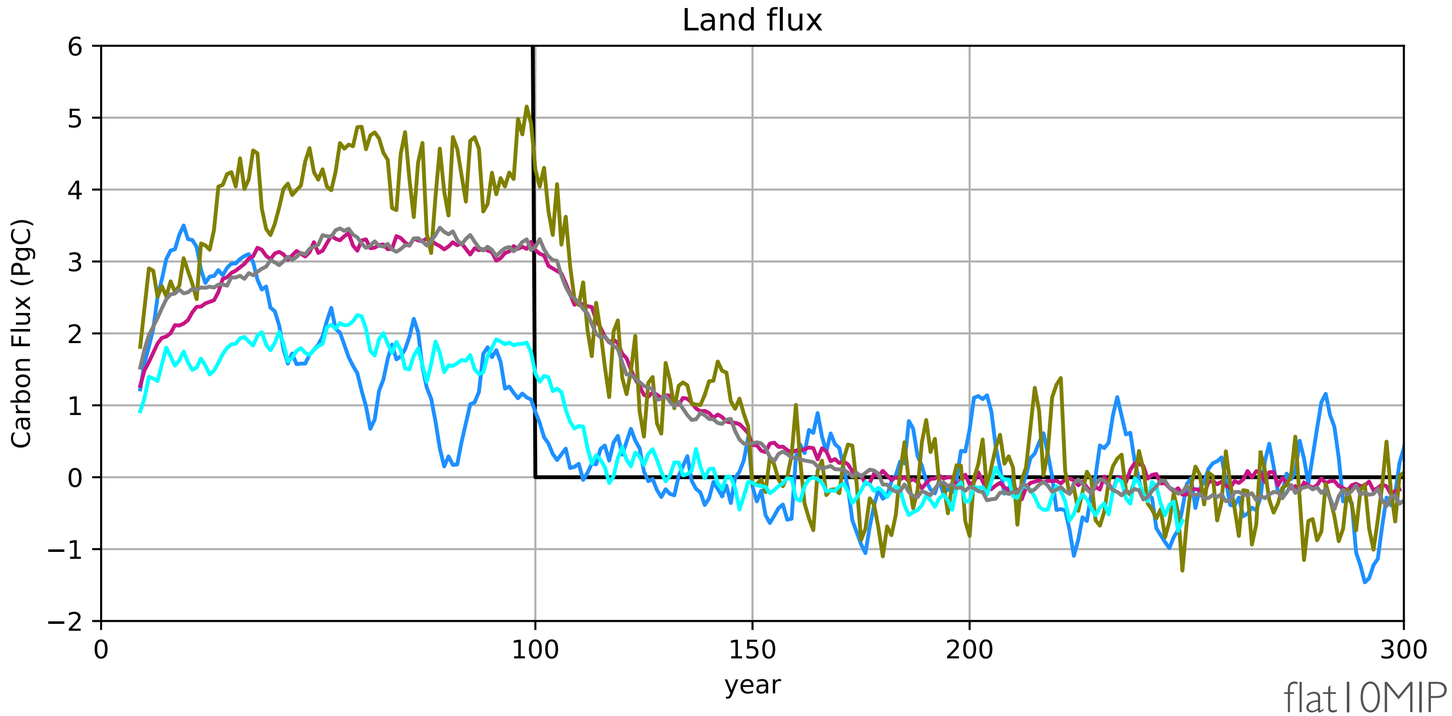
B. Buchovecky, B.Booth

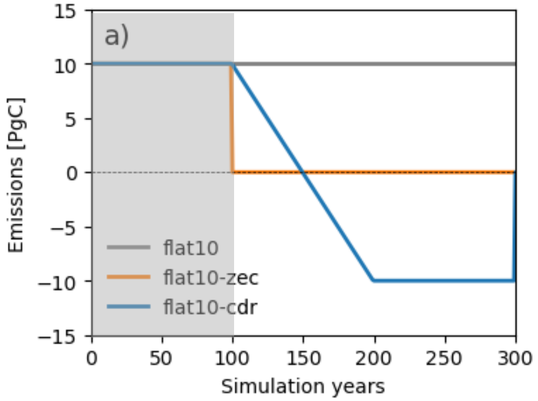
Diversity of land and ocean sink responses to net-zero

Ocean

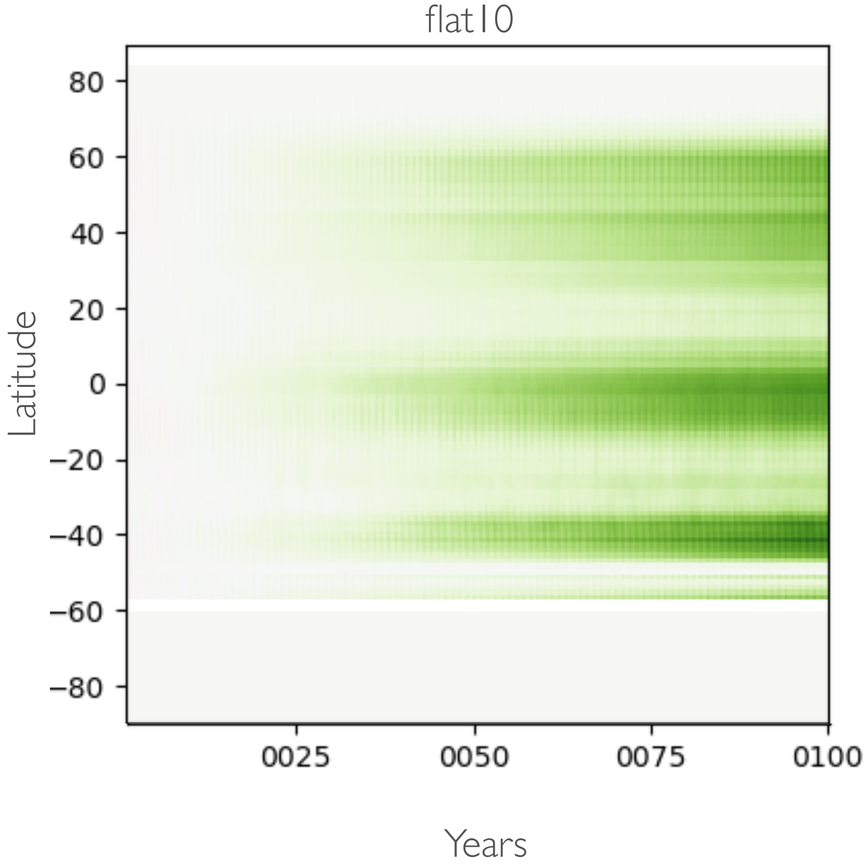


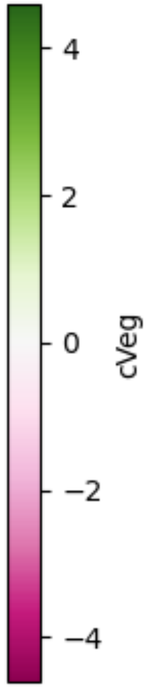
Land



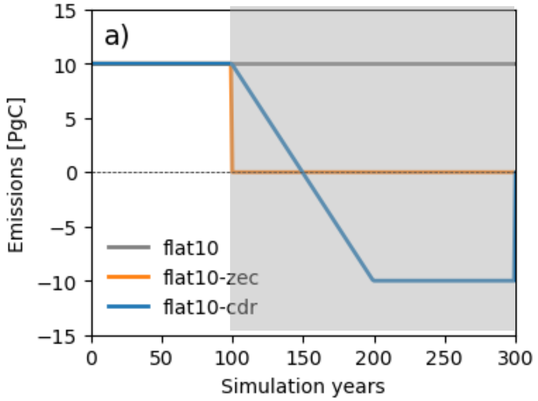


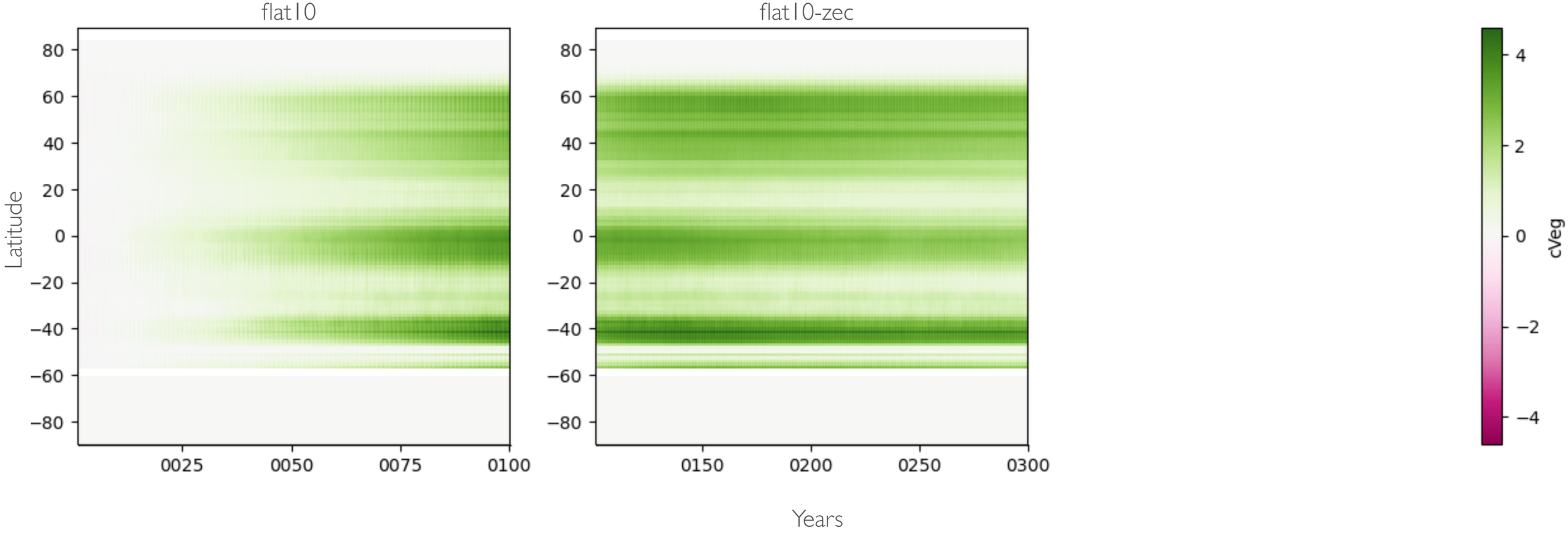
Vegetation carbon accumulates during emissions

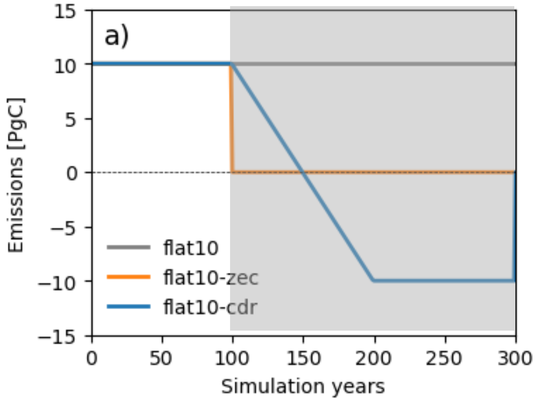




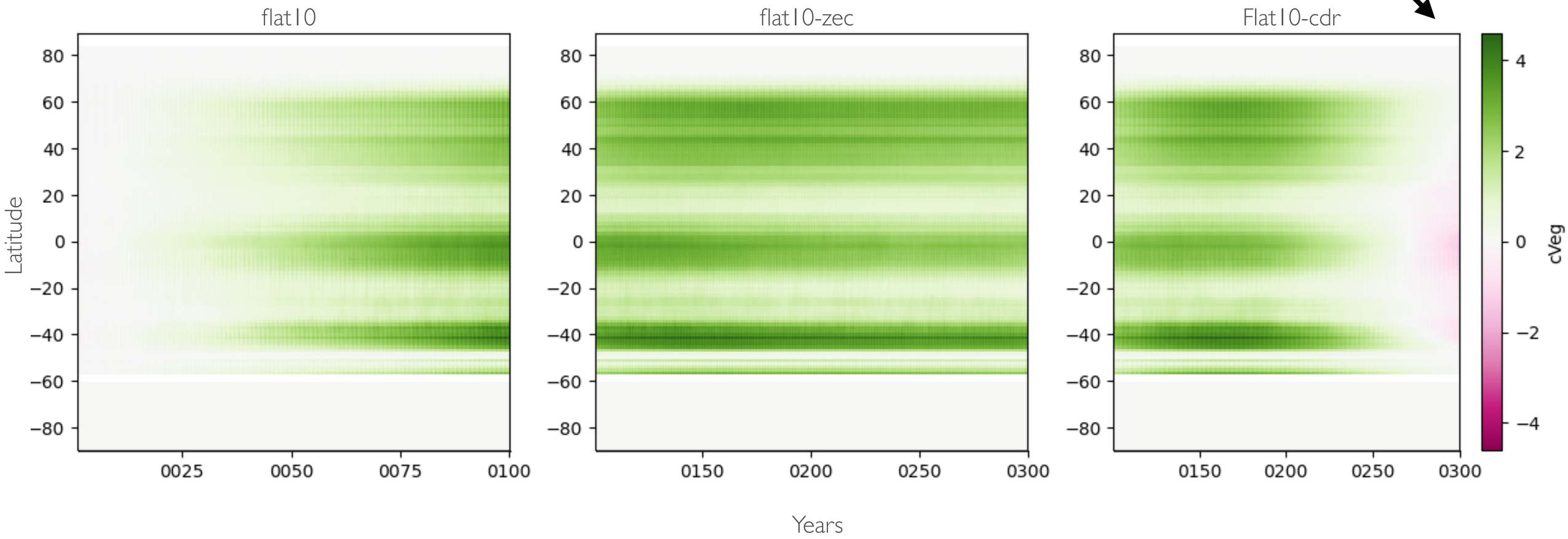
Vegetation carbon starts to decline under zero emissions



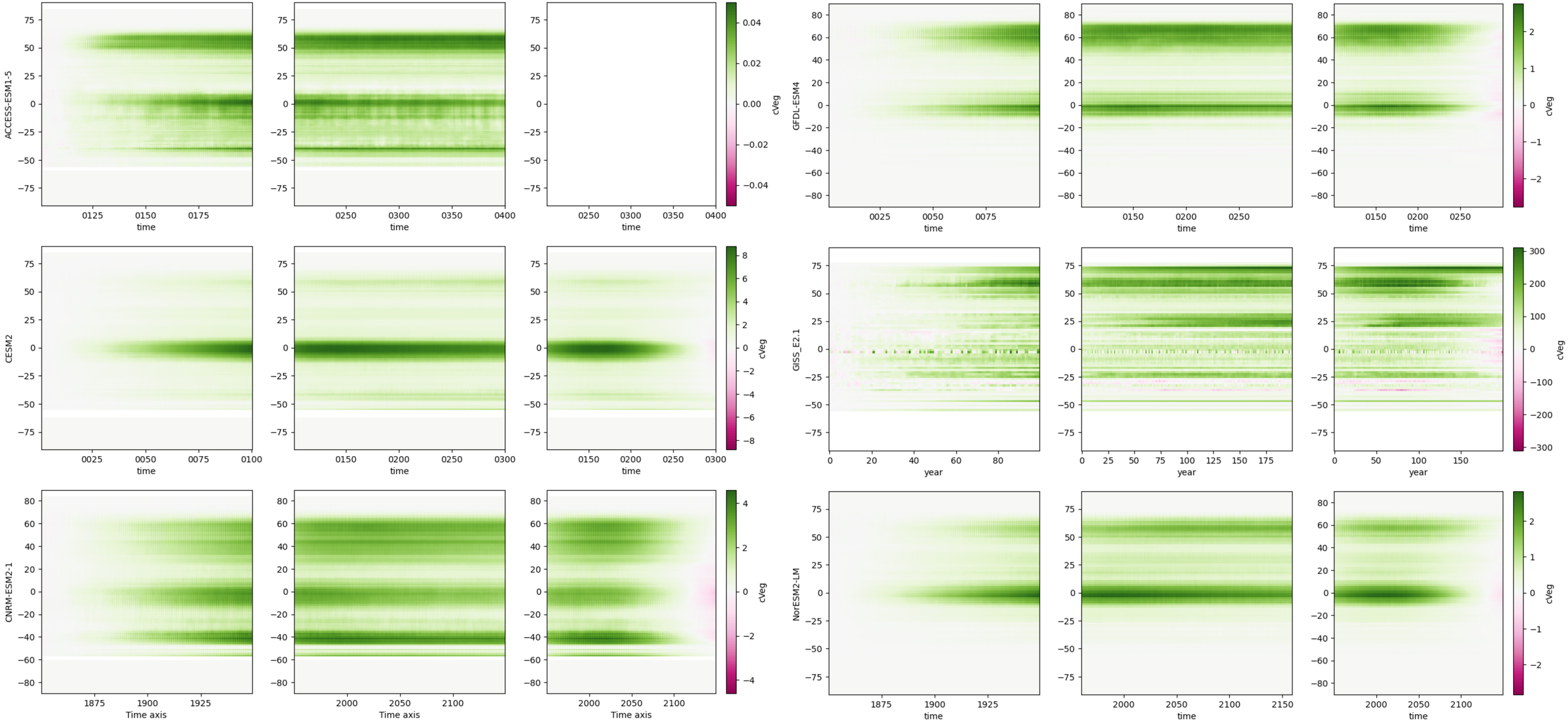




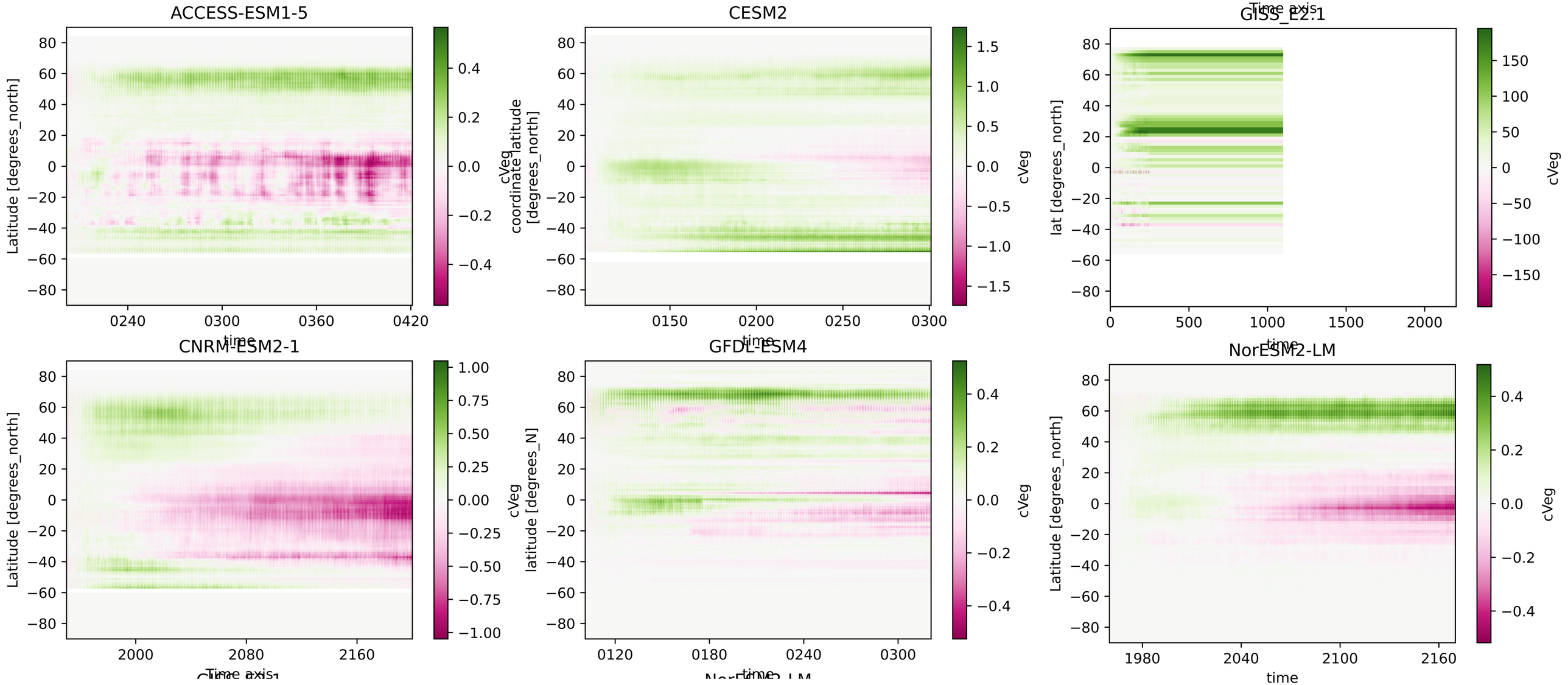
Vegetation carbon ends up lower than preindustrial after CDR



Very different amount and location of land sink across models



Vegetation carbon declines in some (but not all) places during zero emissions



BGCWG Updates

- Time for discussion before both breaks - think of questions and if on zoom type questions in the chat.

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