Comparing the OCO-2 MIP inversion ensemble to the TRENDY dynamic vegetation models in the tropics and extratropics

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Evaluating the v11 MIP against TRENDY

TRENDY: Mechanistic PBMs simulating land carbon cycle dynamics to provide independent estimates of the global land carbon sink for GCP.

Version: v13

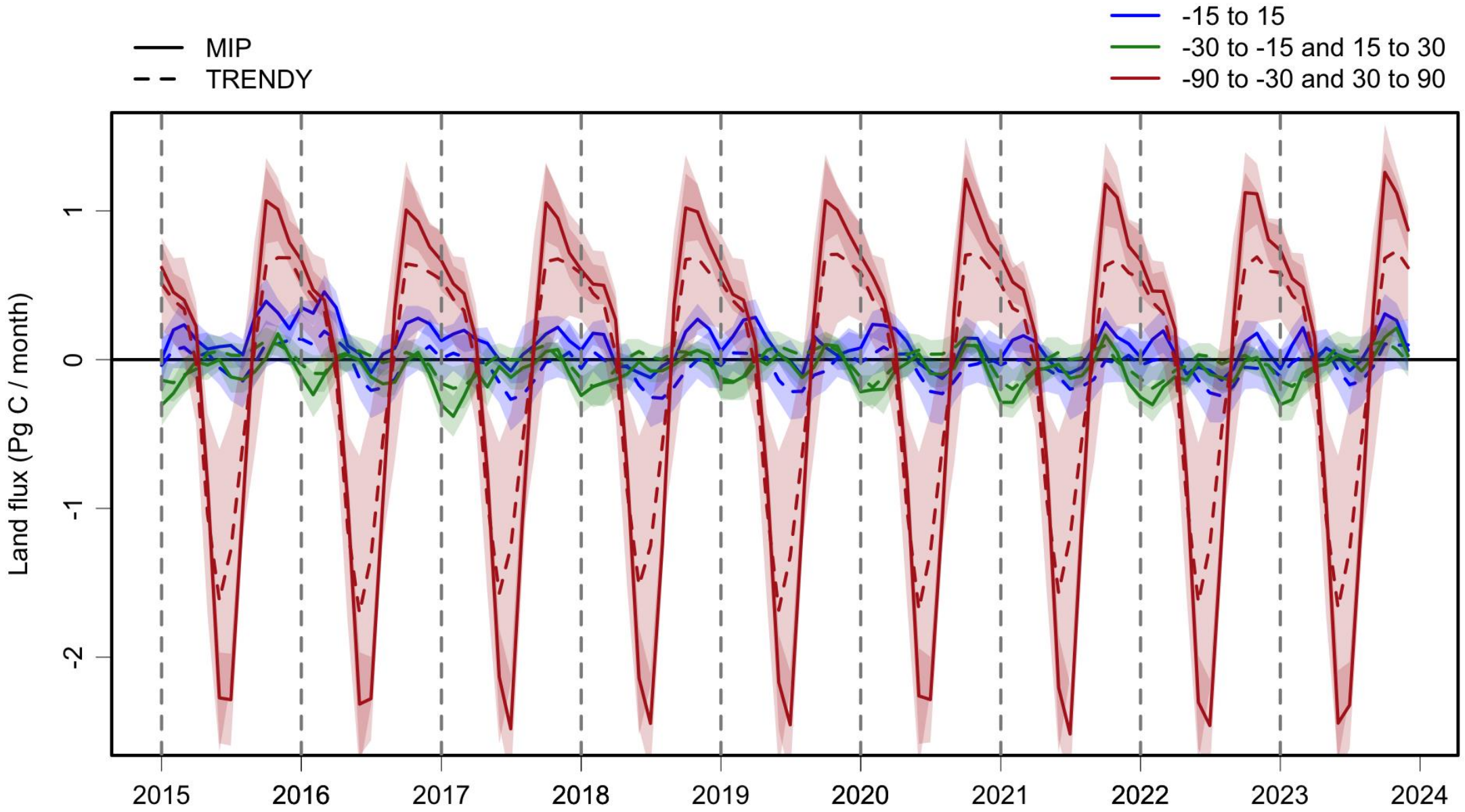
Models: ~20+ (LPJ-GUESS, ORCHIDEE, JULES, VISIT, CARDAMOM, CABLE, ...)

Time period: 1700-2023 with annual updates

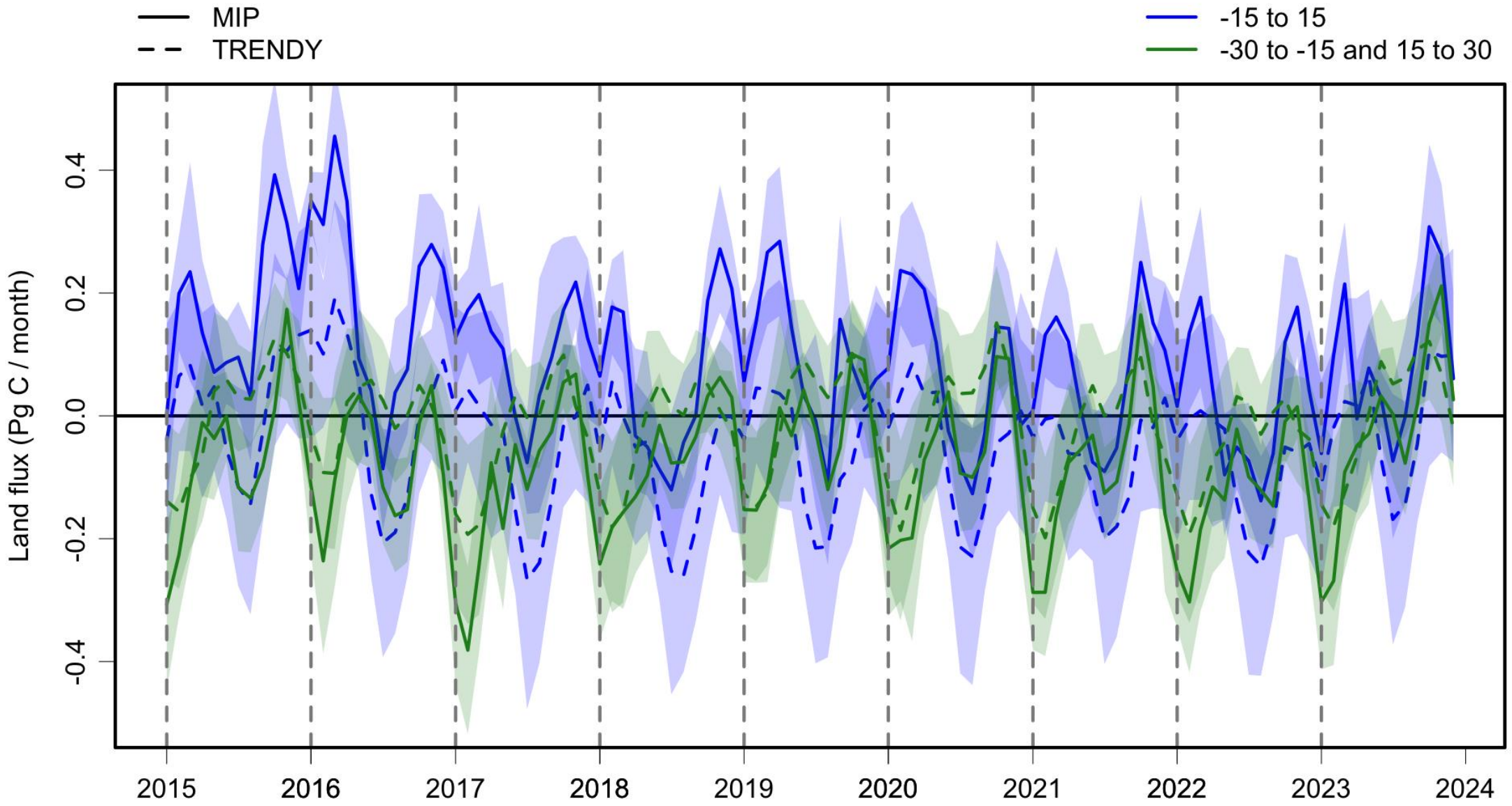
We will focus on NBP as the flux variable. TRENDY defines positive flux as atmosphere --> land. We multiply TRENDY fluxes by –1 so that all positive fluxes are land --> atmosphere.

For the purposes of this talk, we will show results comparing v11 MIP land flux and TRENDY ensemble NBP in the tropics (15S – 15N) and extratropics.

Setting the stage: monthly time series



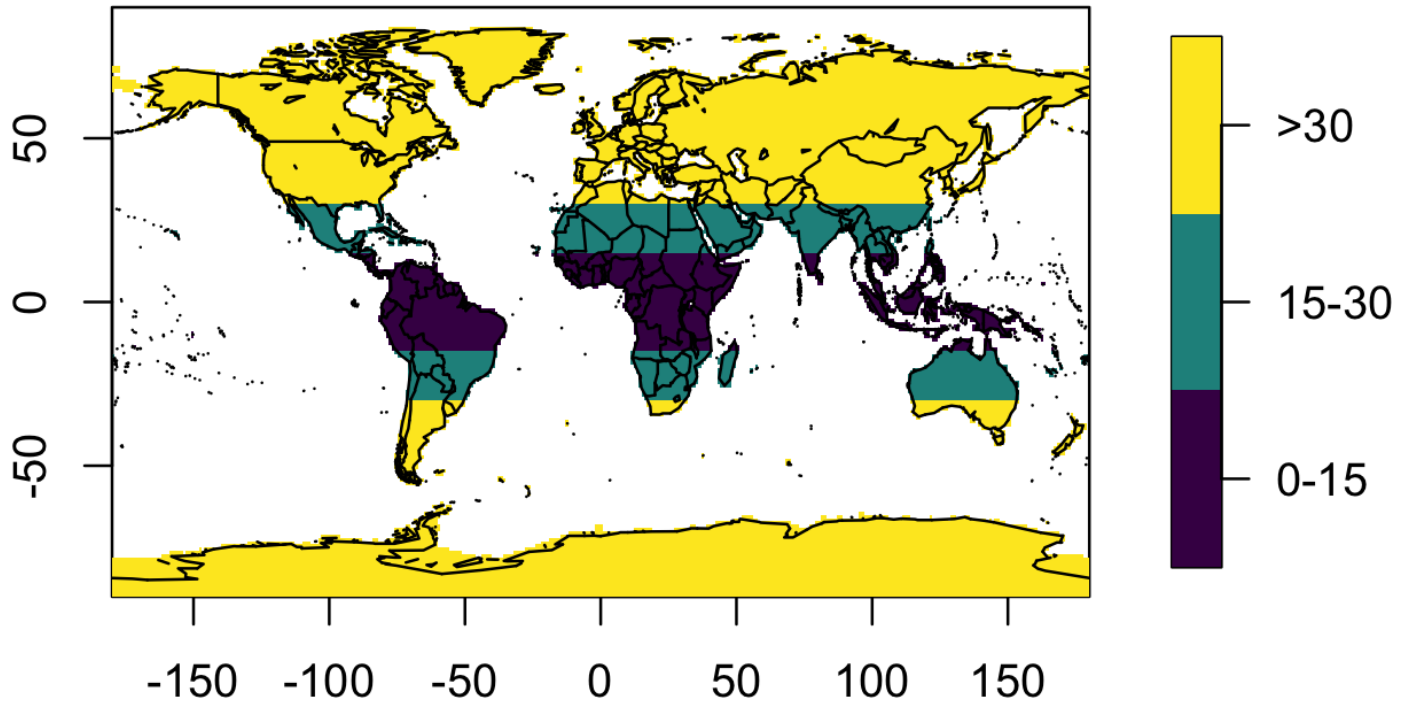
Setting the stage: monthly time series



Overview: tropics and extratropics

Region definitions

- 0-15 = -15 to 15
- 15-30 = [-30, -15] U [15, 30]
- >30 = [-90, -30] U [30, 90]

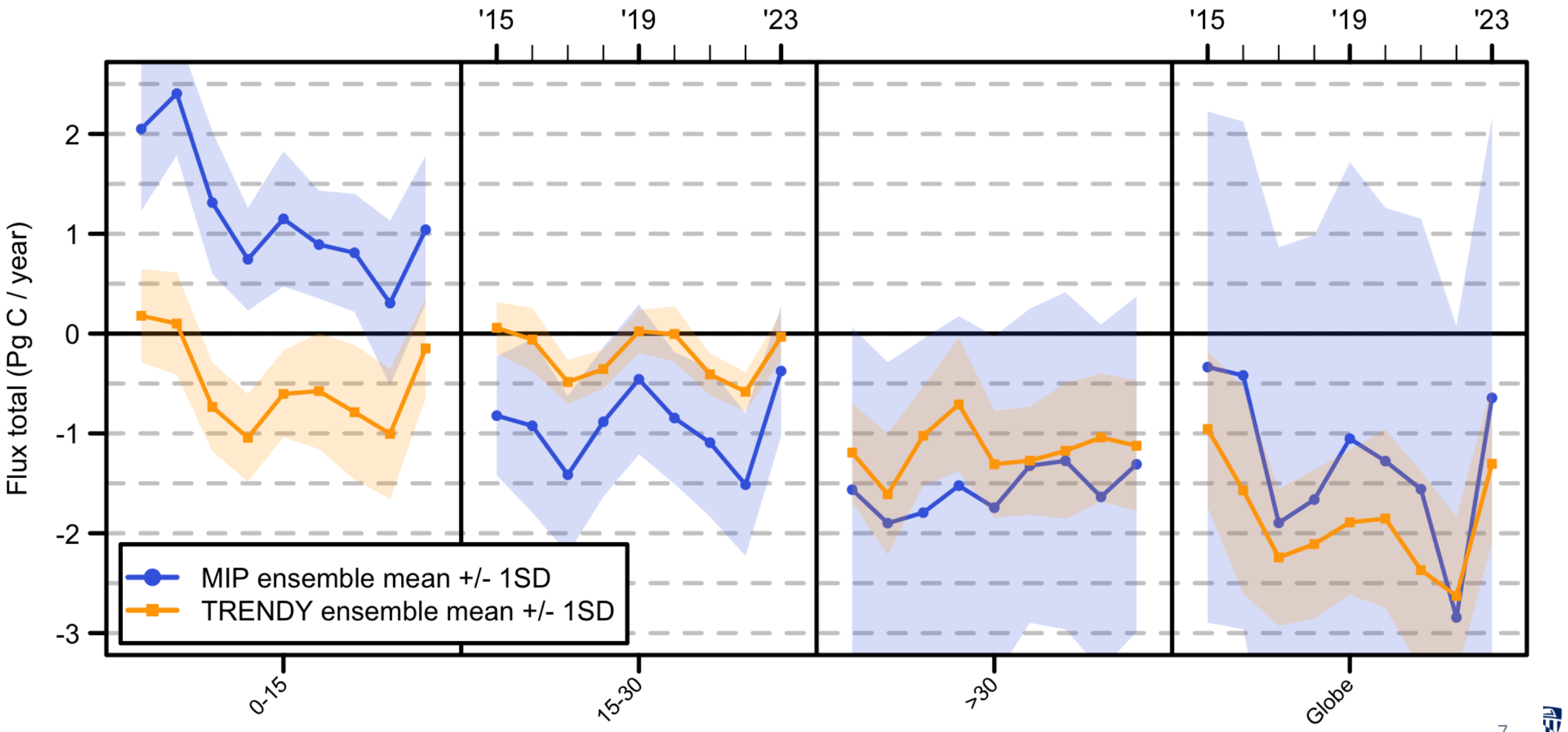


Plots

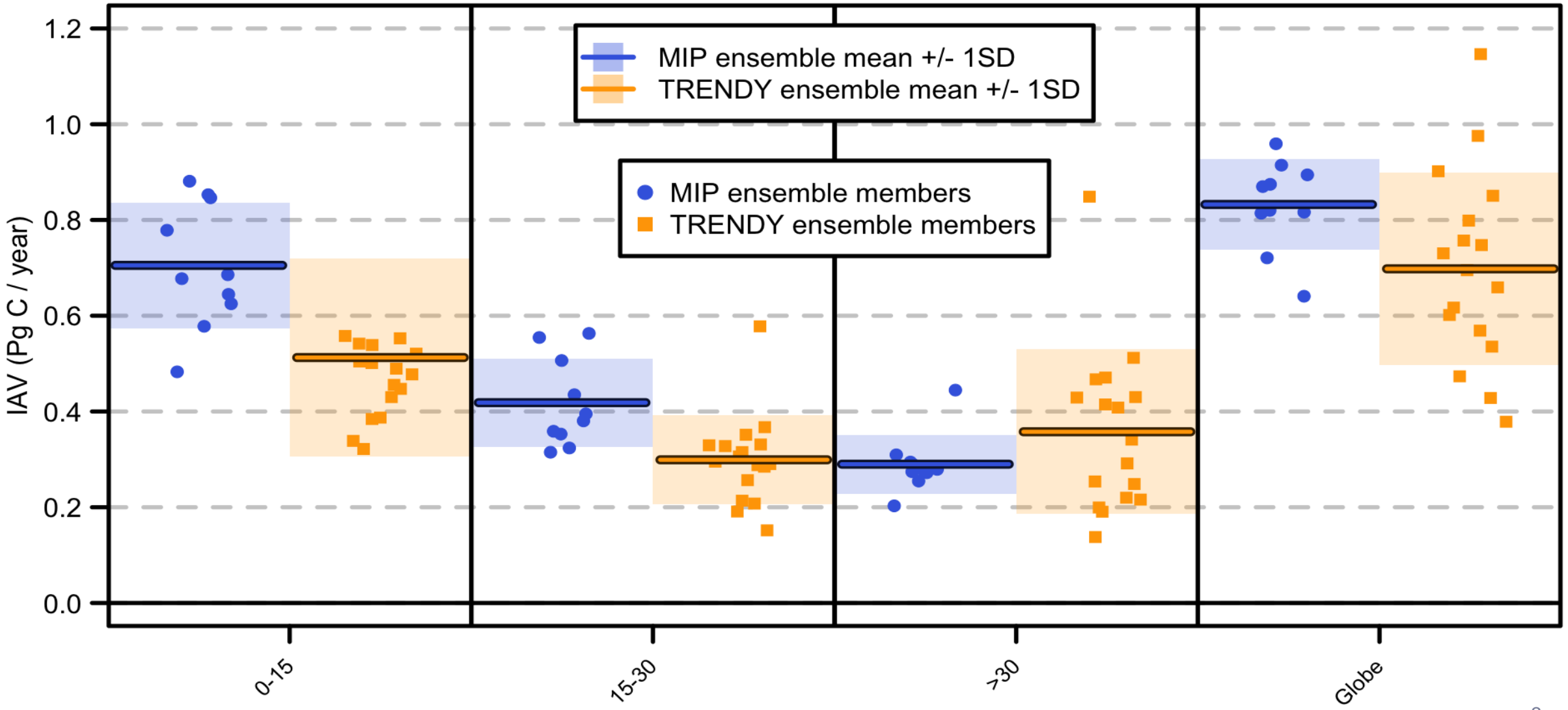
- Yearly flux totals
- Interannual variability (IAV)
  - SD of yearly totals
- Contribution to global IAV
  - Definition from Ahlström et al., 2015:

$$c_j = \frac{\sum_t \frac{f_{jt}|F_t|}{F_t}}{\sum_t |F_t|}$$

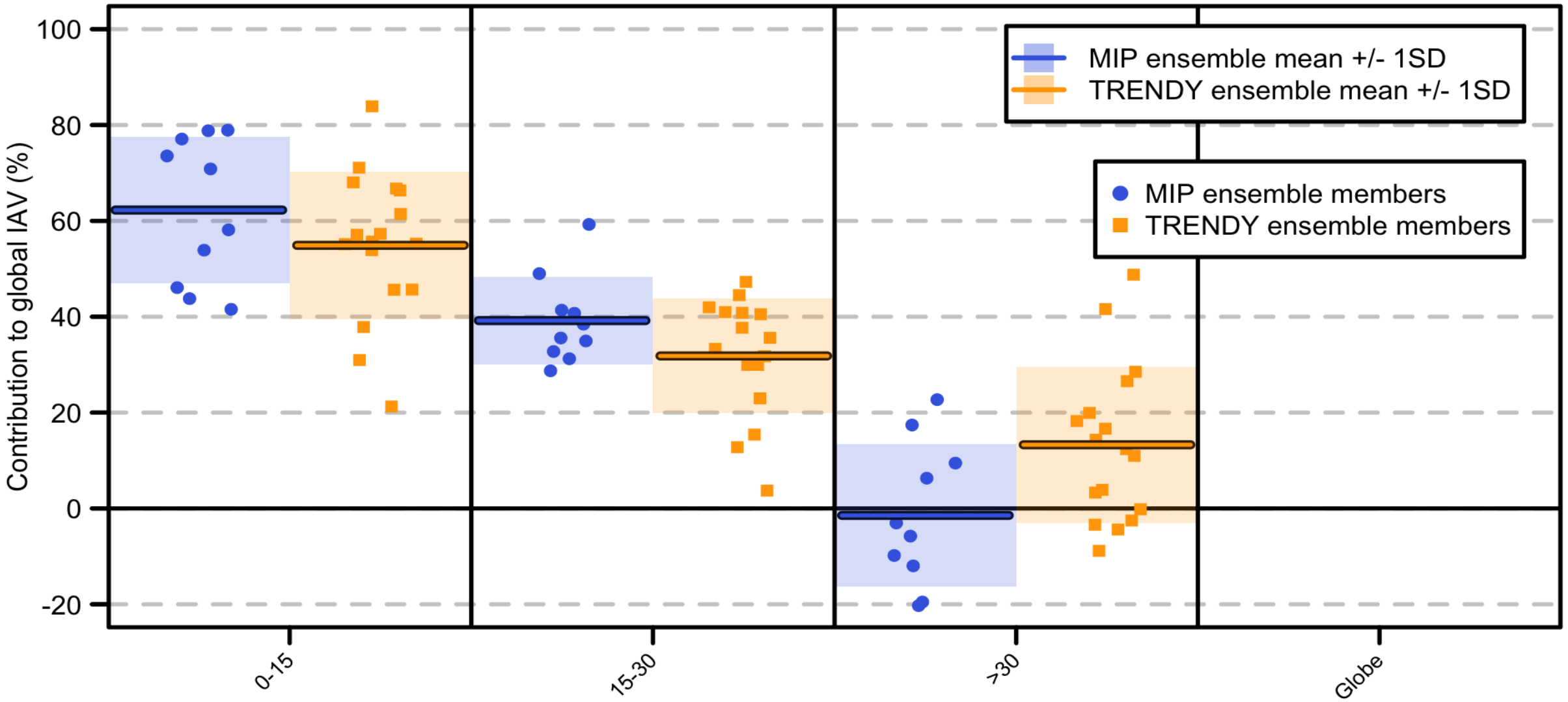
Yearly flux totals: tropics and extratropics



IAV: tropics and extratropics

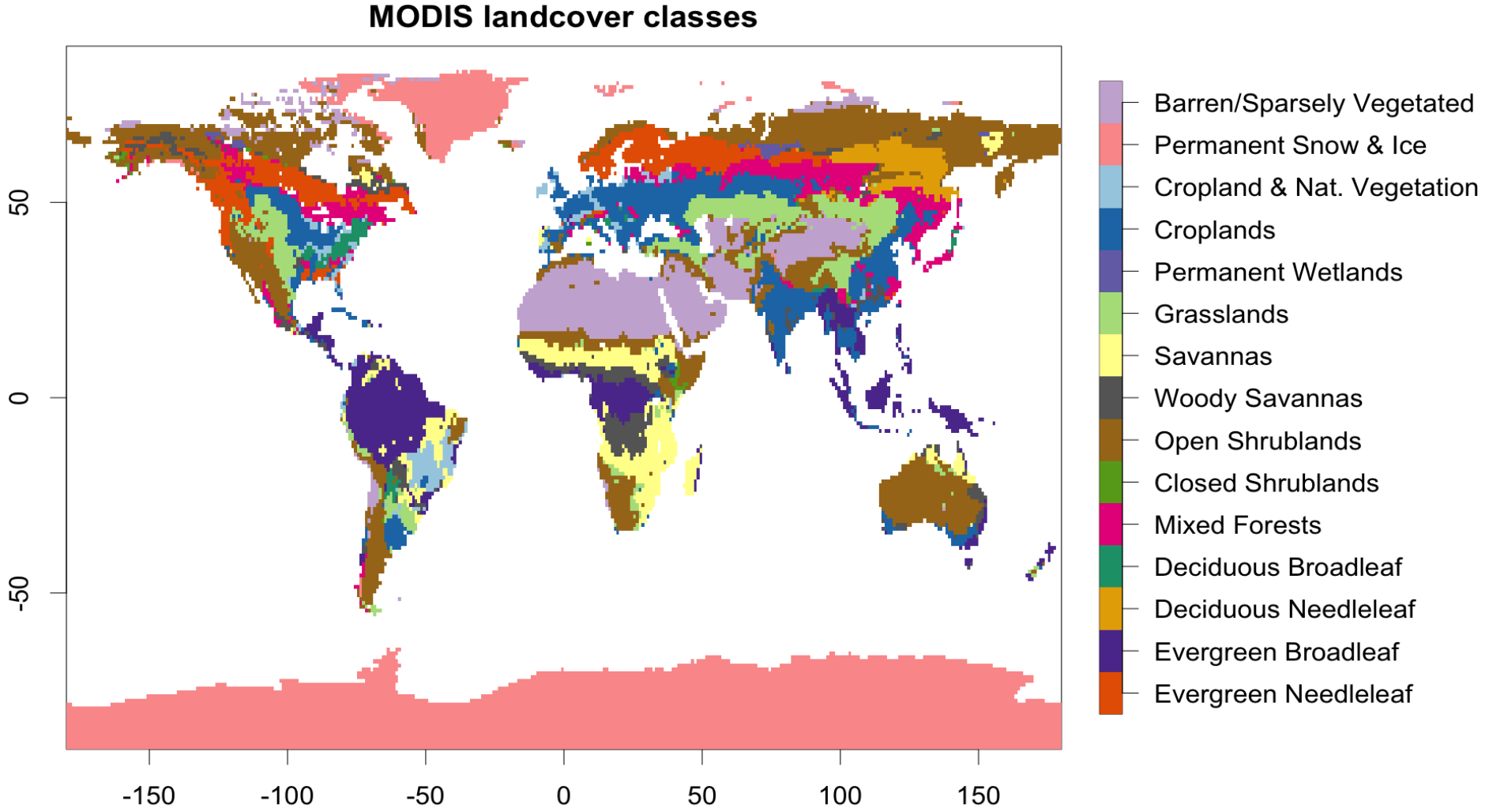


Contribution to global IAV: tropics and extratropics

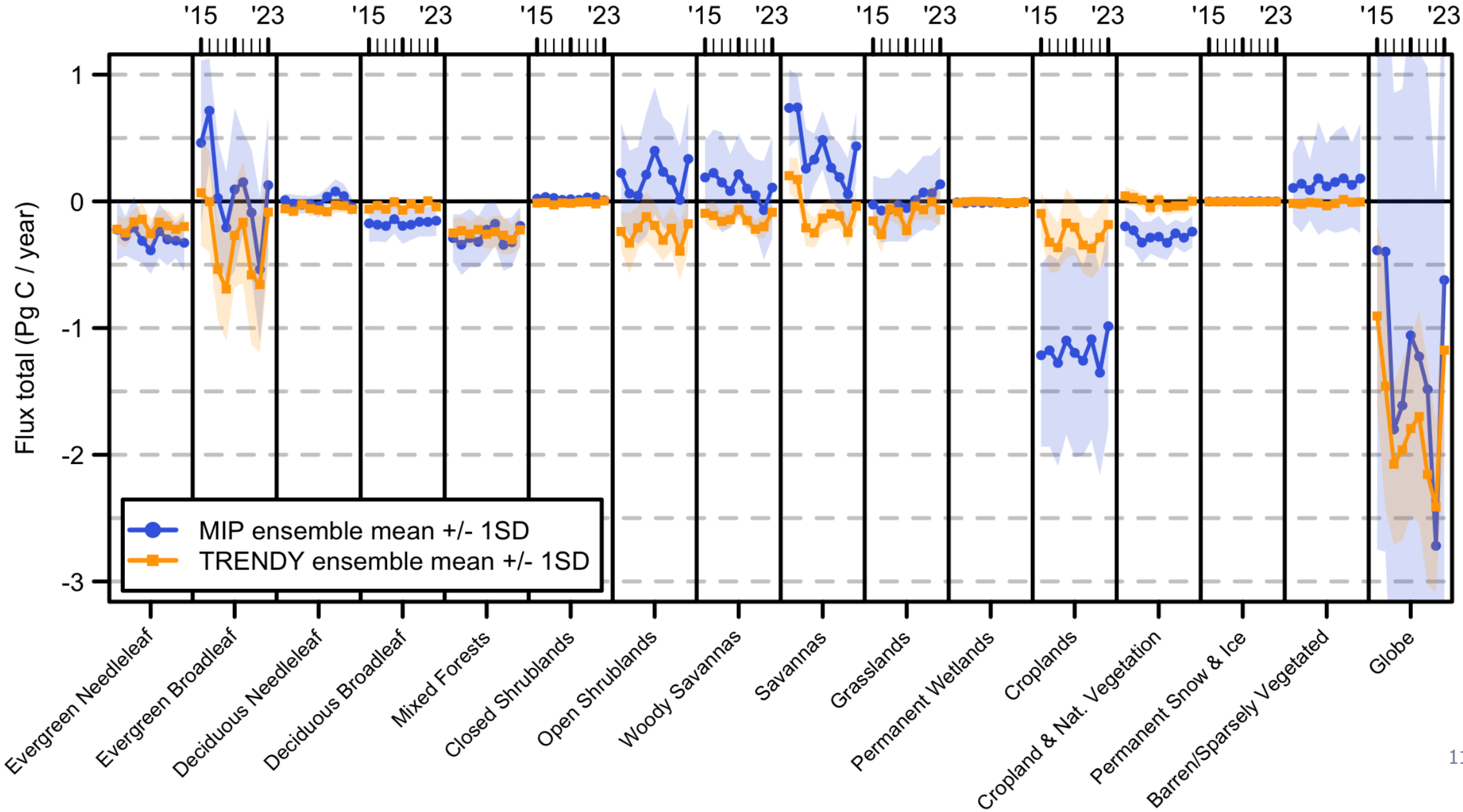


Overview: MODIS landcover classes

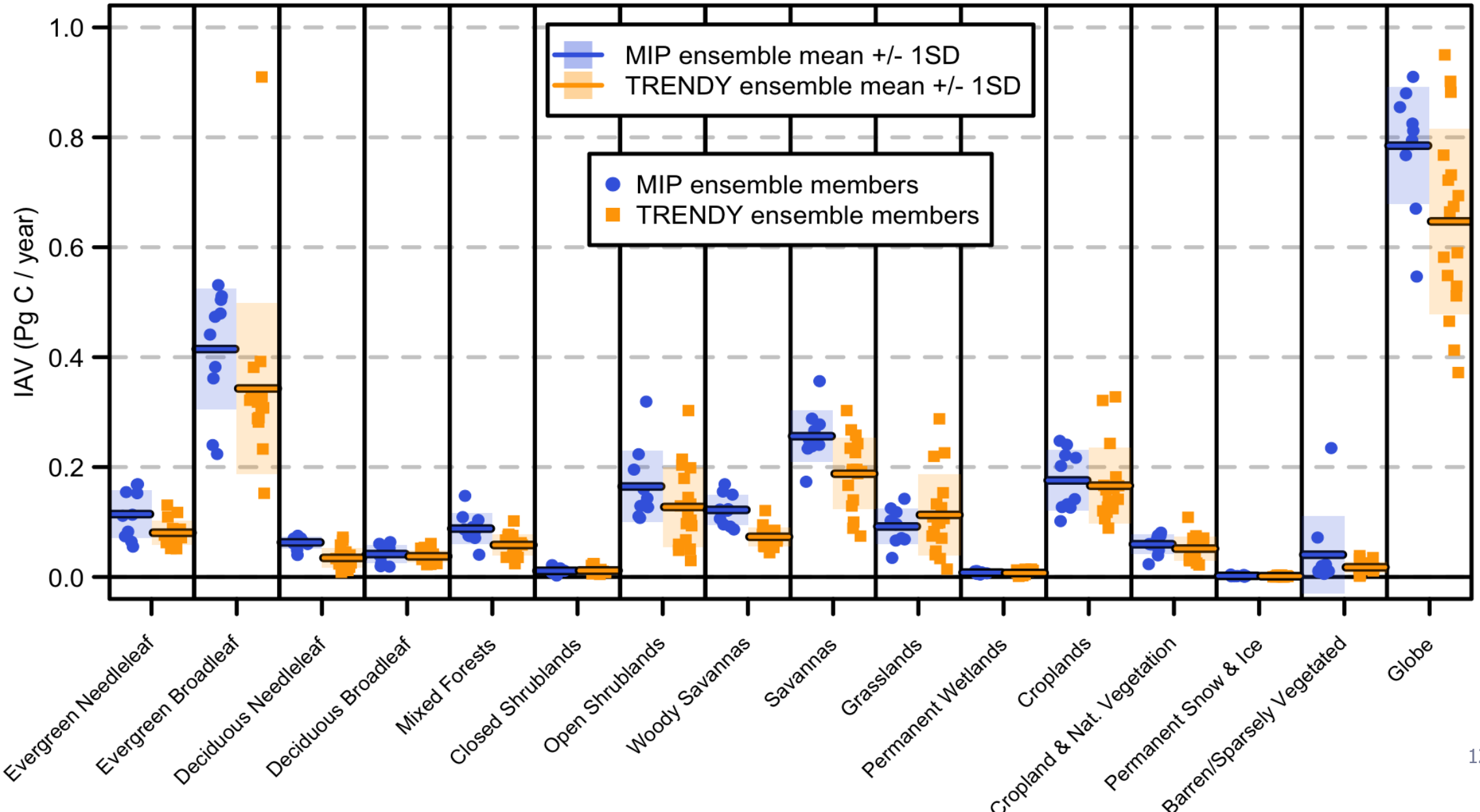
Can we better pinpoint differences between TRENDY and MIP by using more granular region definitions?



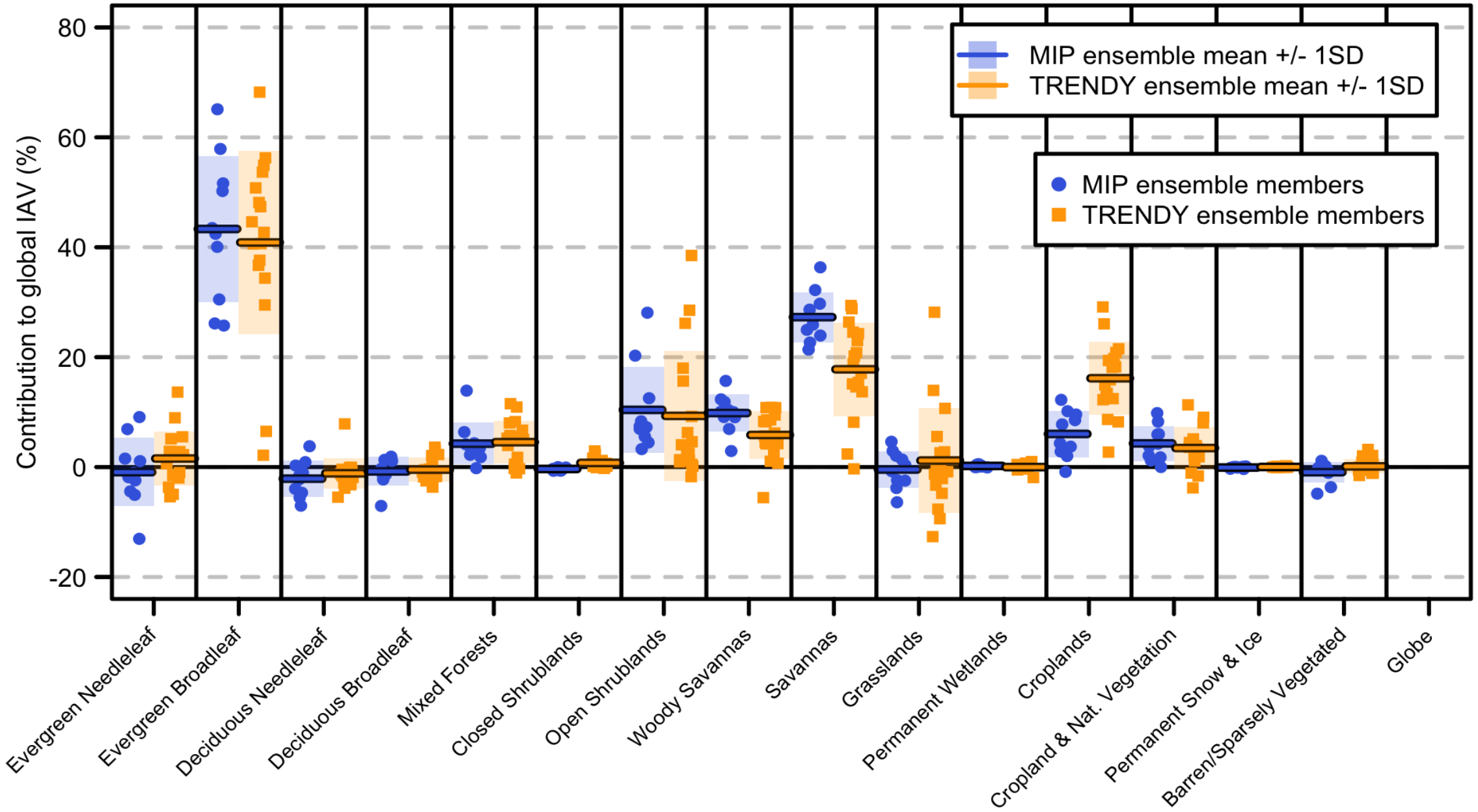
Yearly flux totals: MODIS landcover classes



IAV: MODIS landcover regions



Contribution to global IAV: MODIS landcover classes

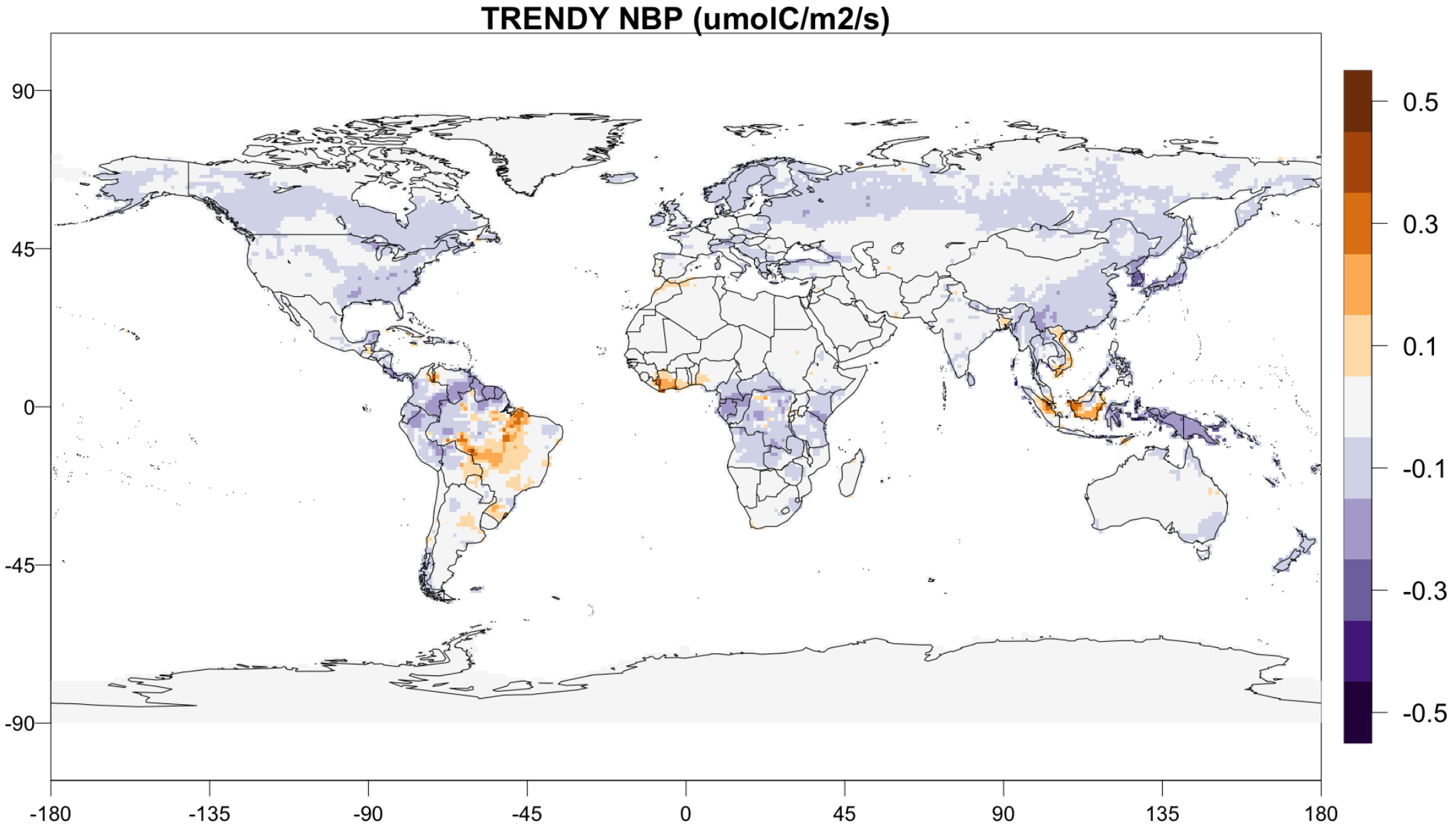


Global map of flux differences

Spatial plots

- TRENDY models regridded onto the MIP 1x1 grid
- Average over ensemble members and time
- I'll show:
  - TRENDY
  - MIP
  - TRENDY - MIP

Global map of flux differences



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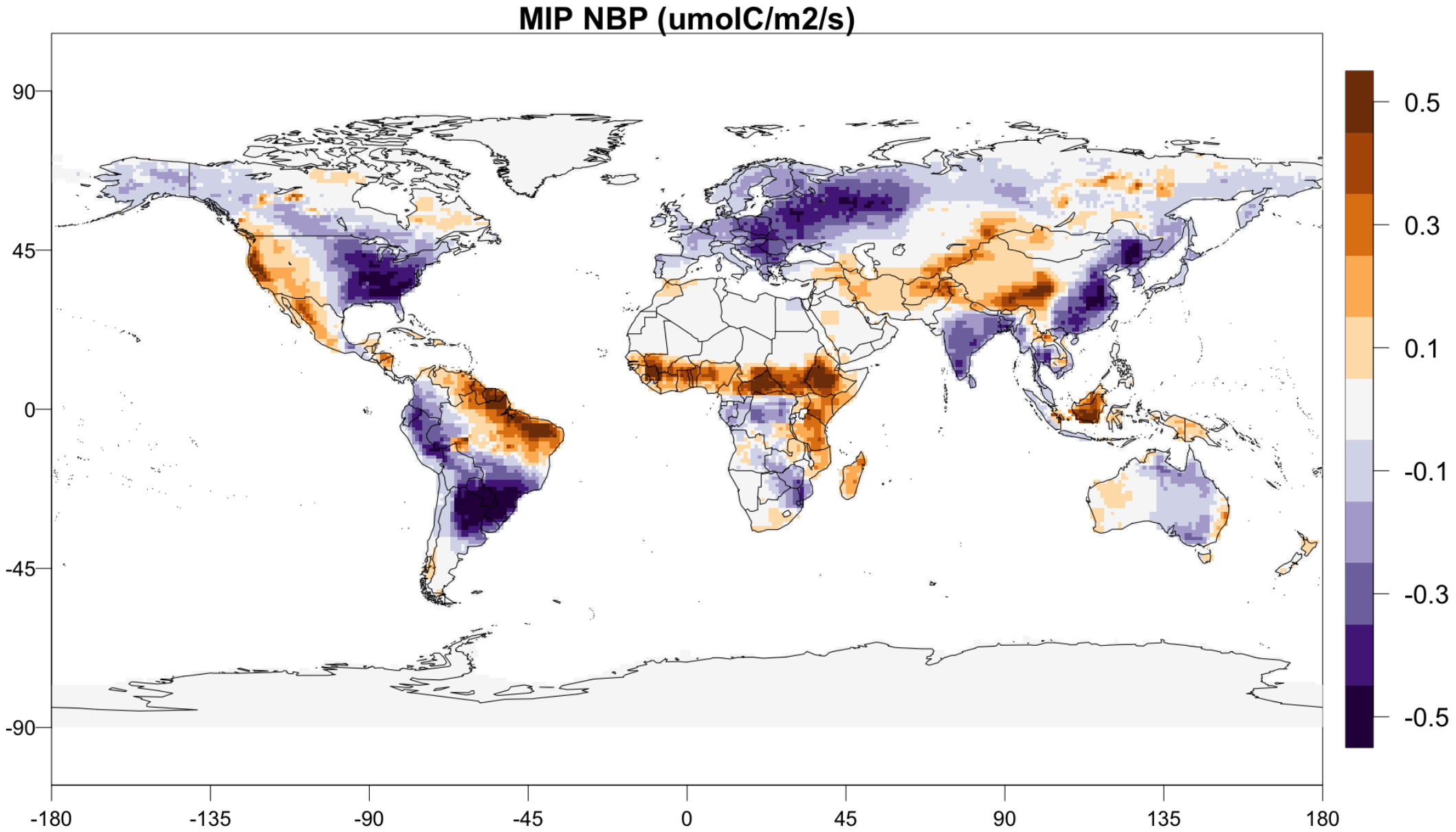

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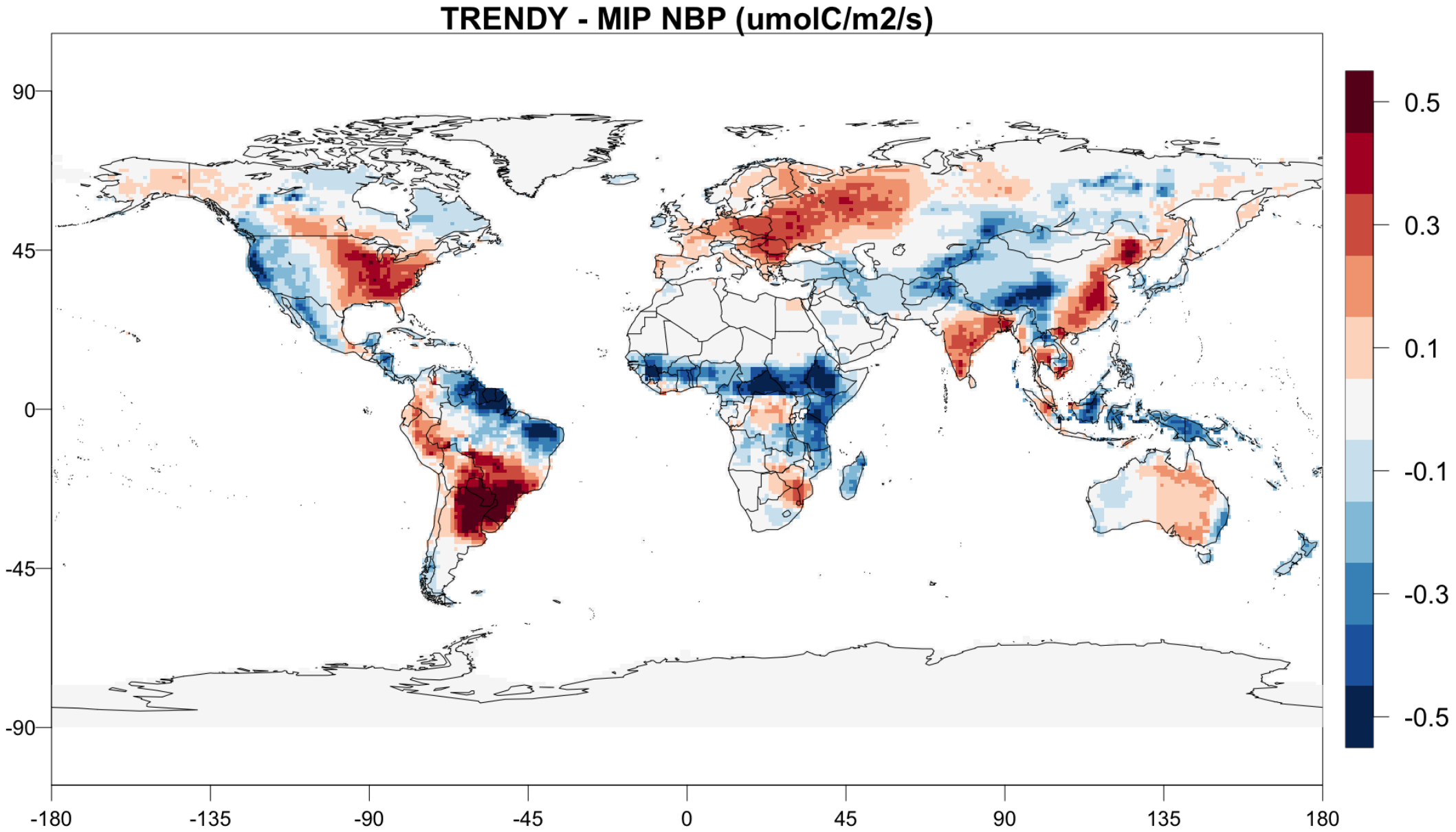

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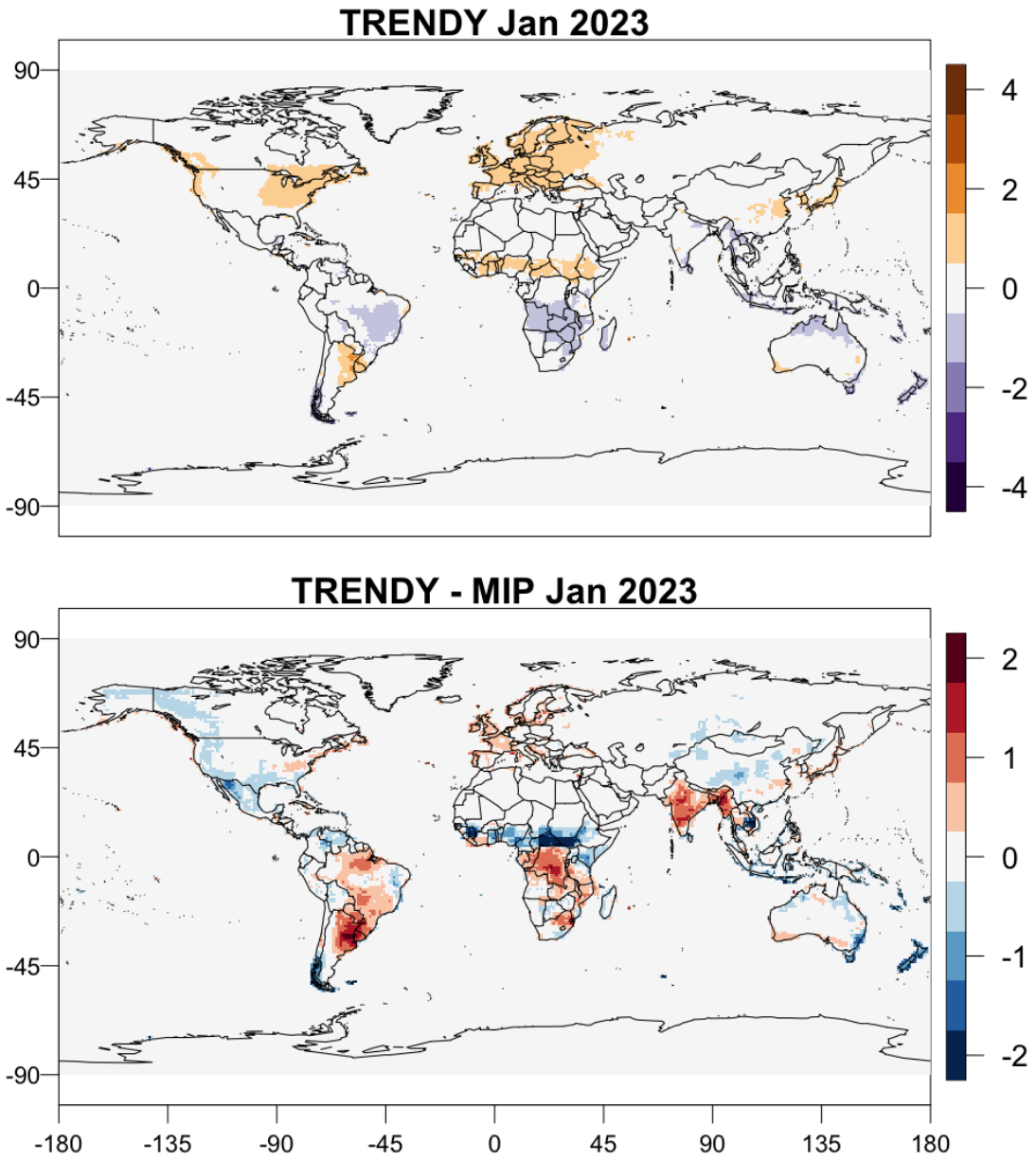

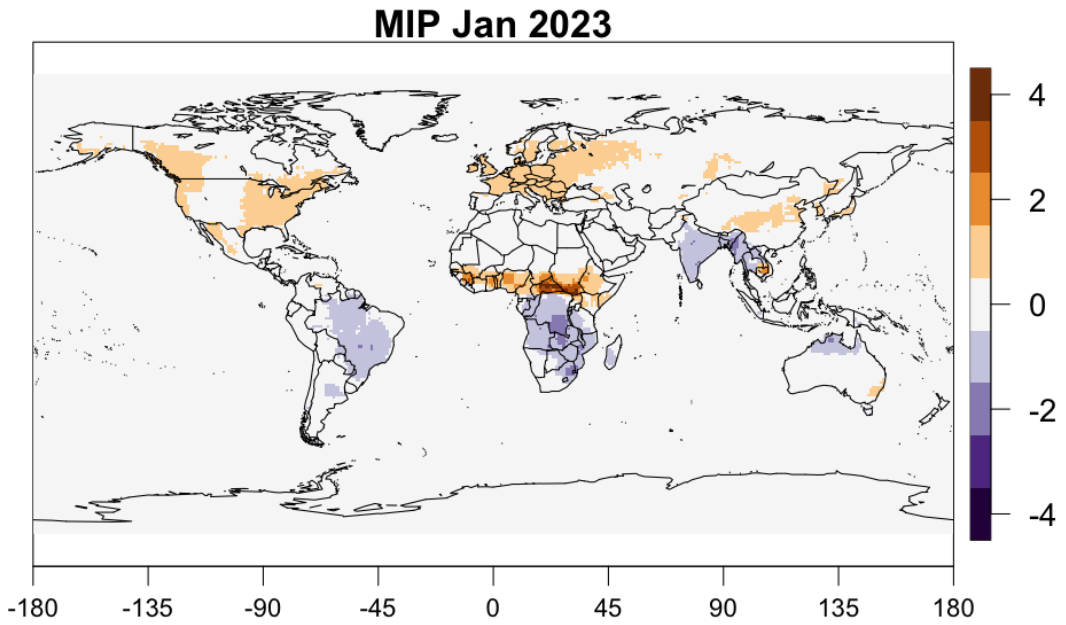

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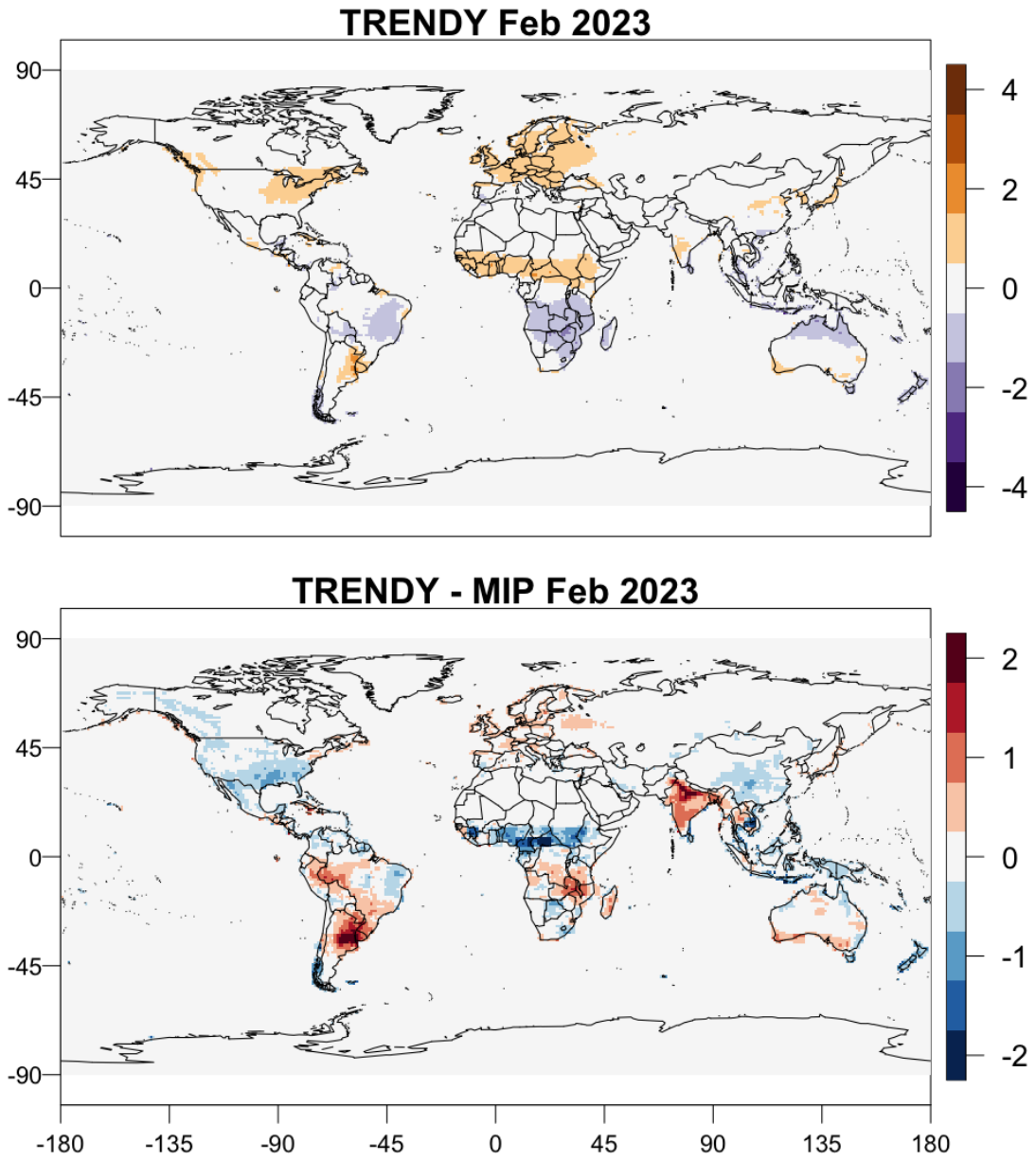

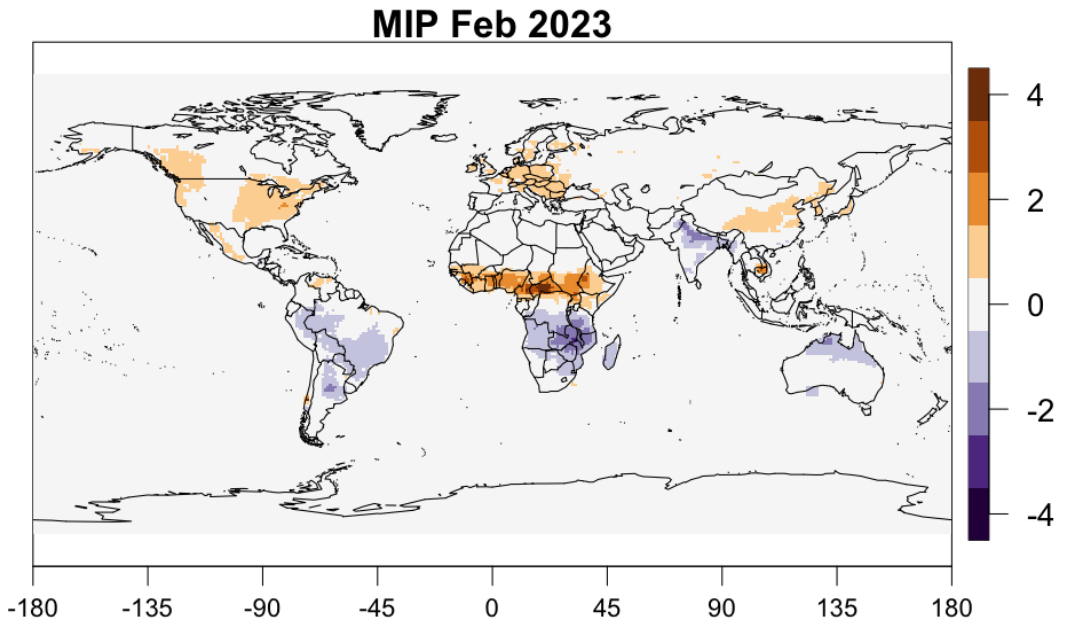

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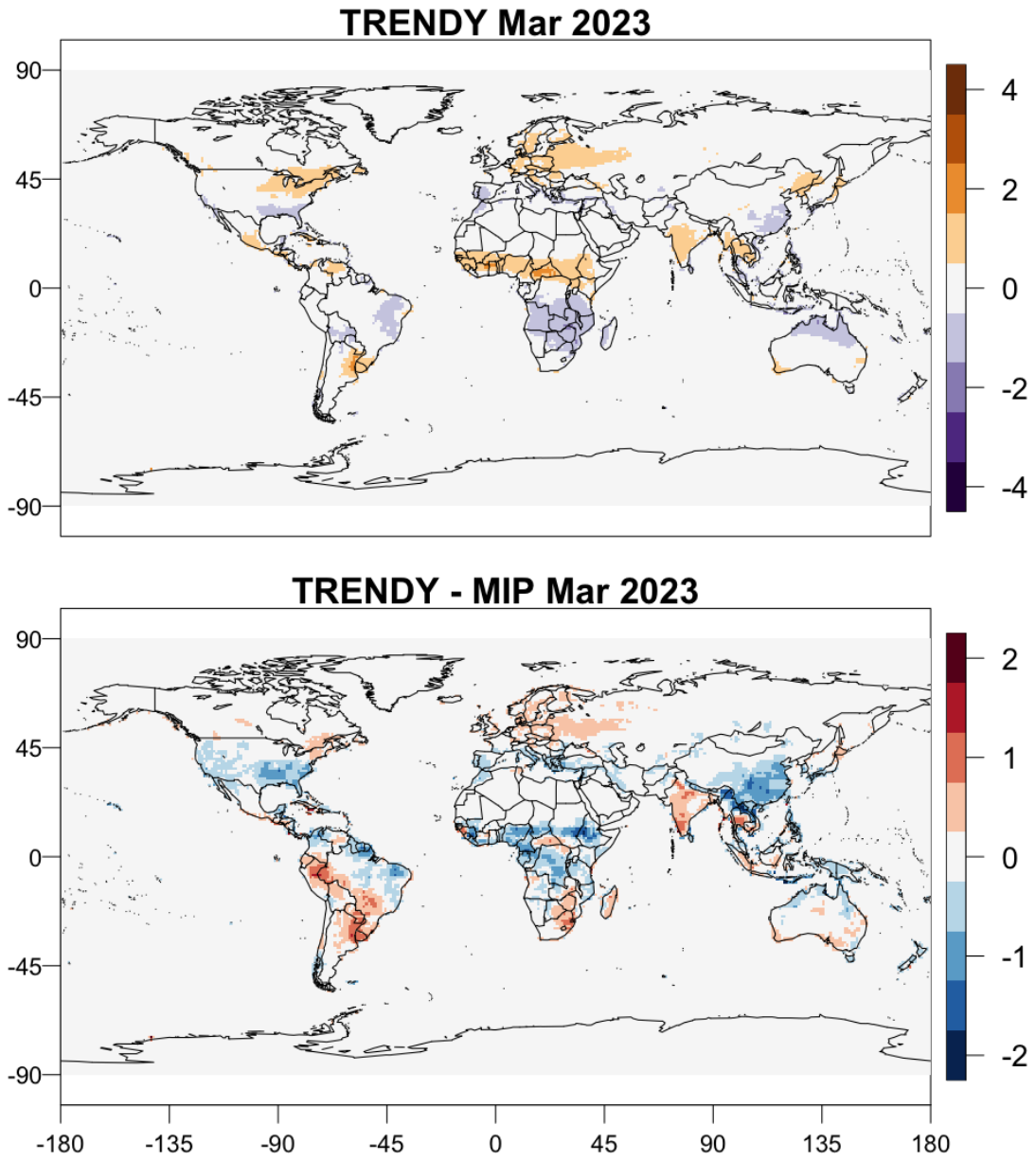

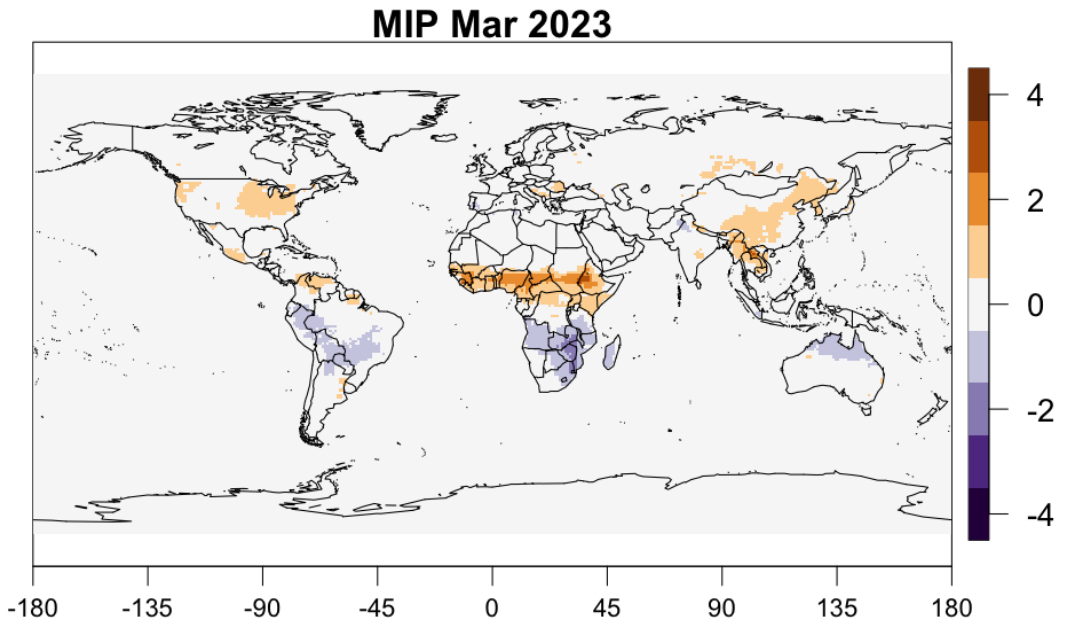

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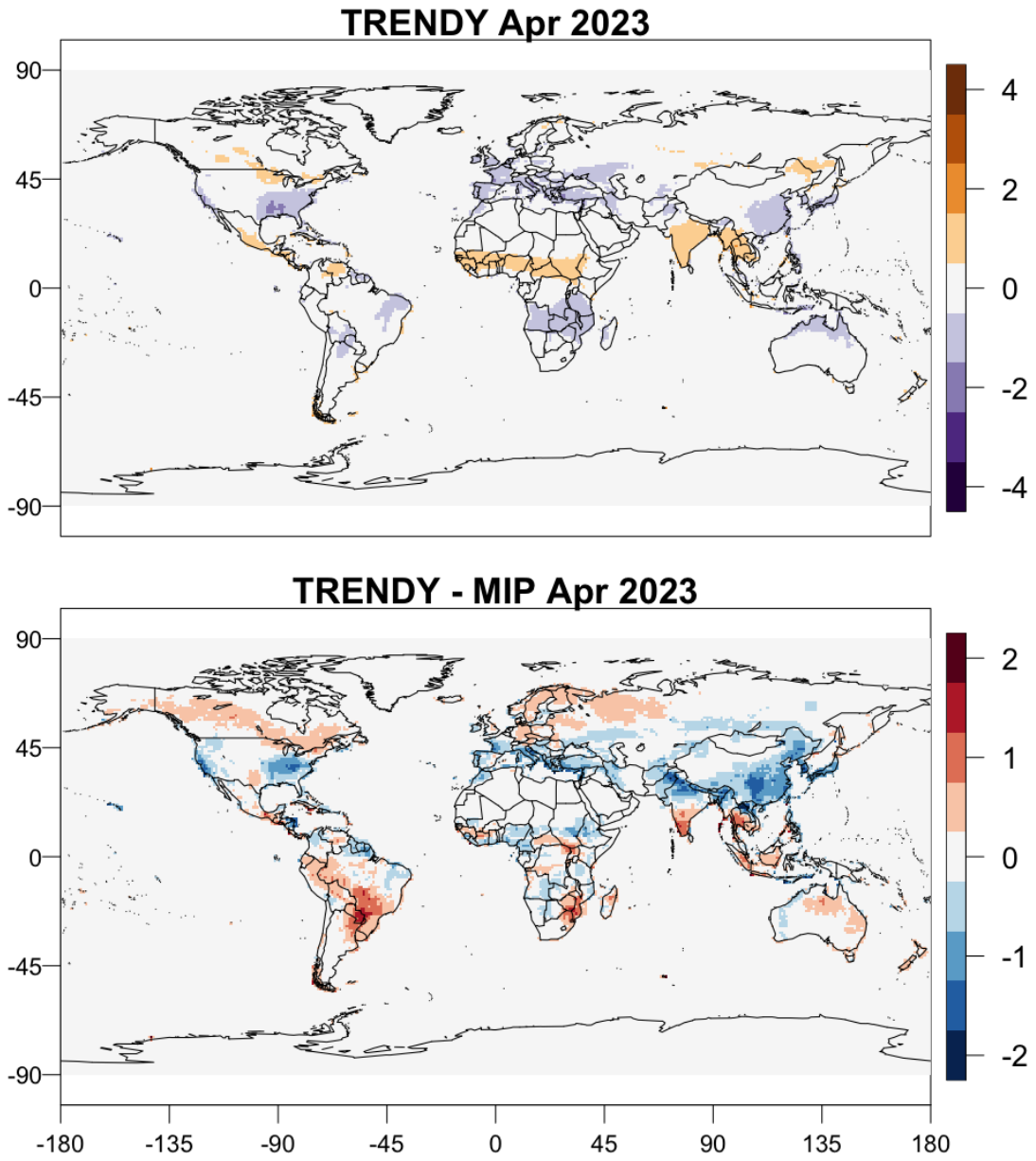

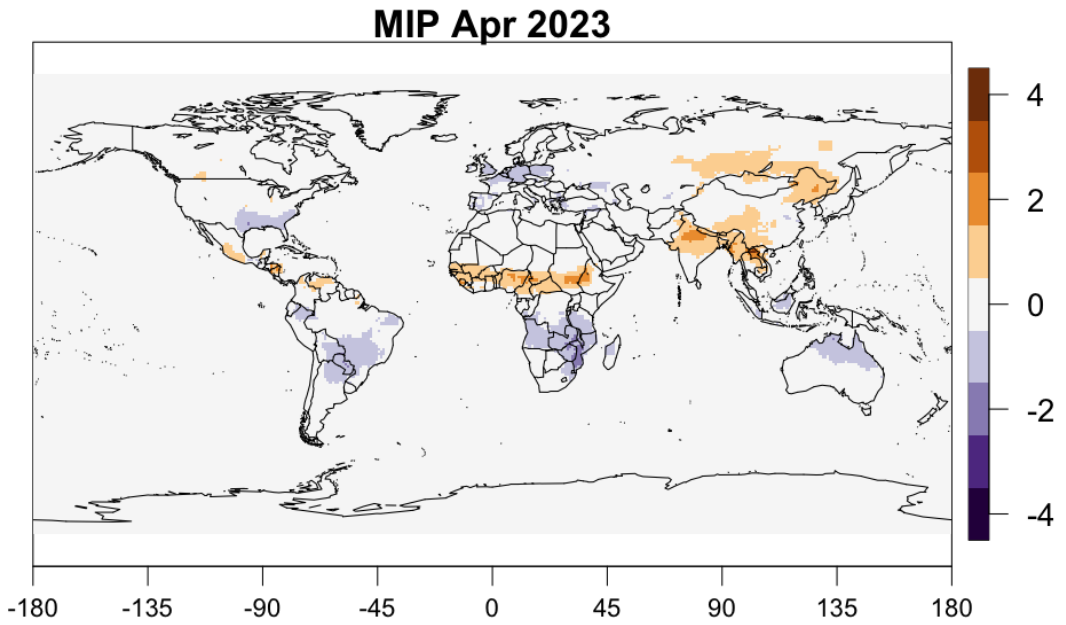

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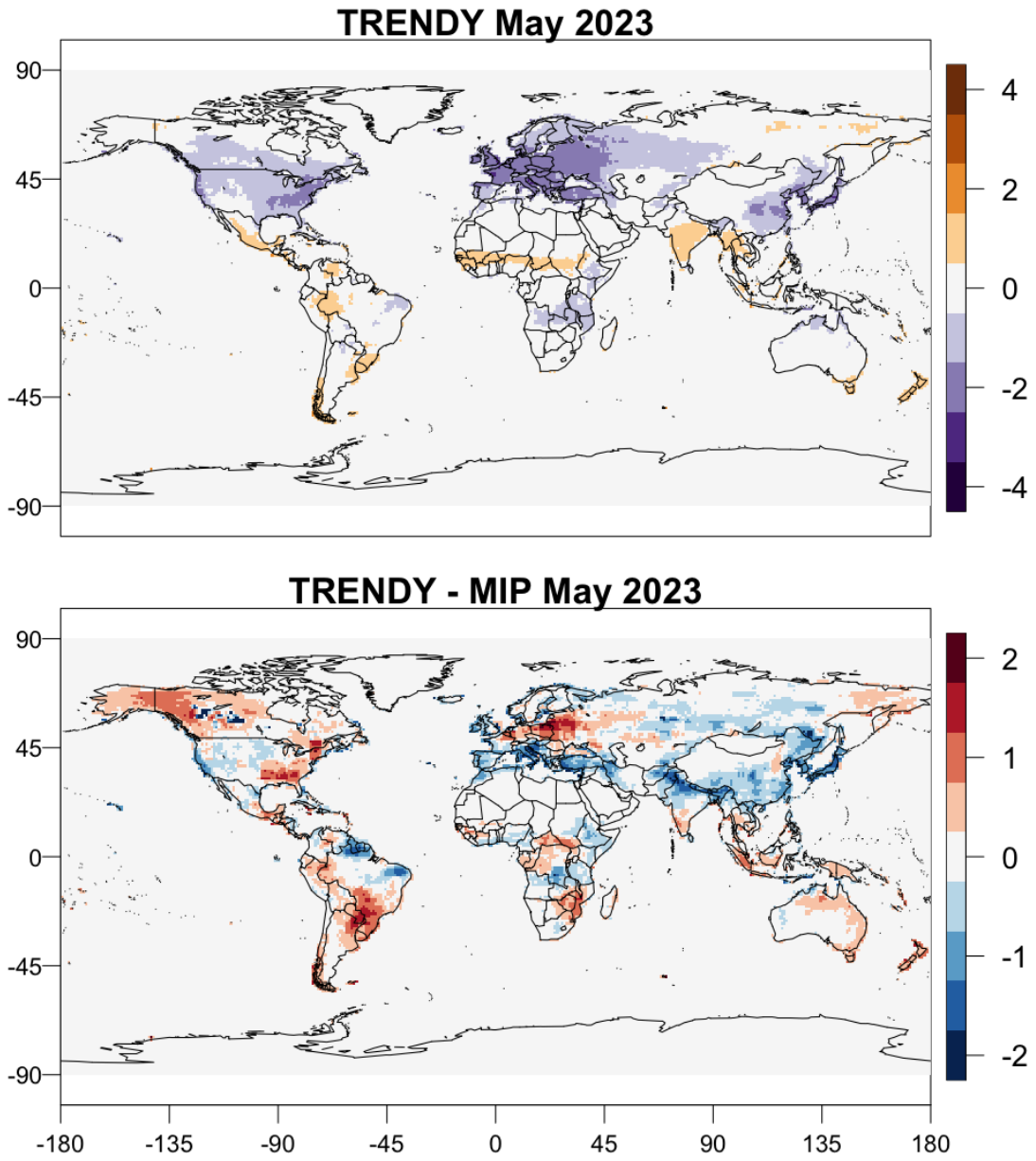

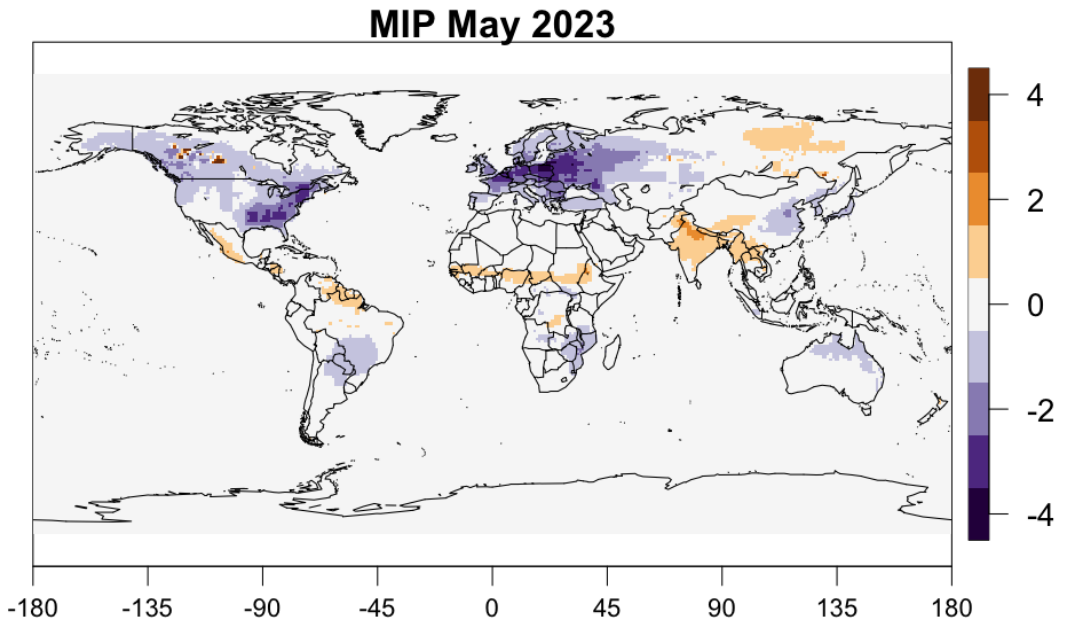

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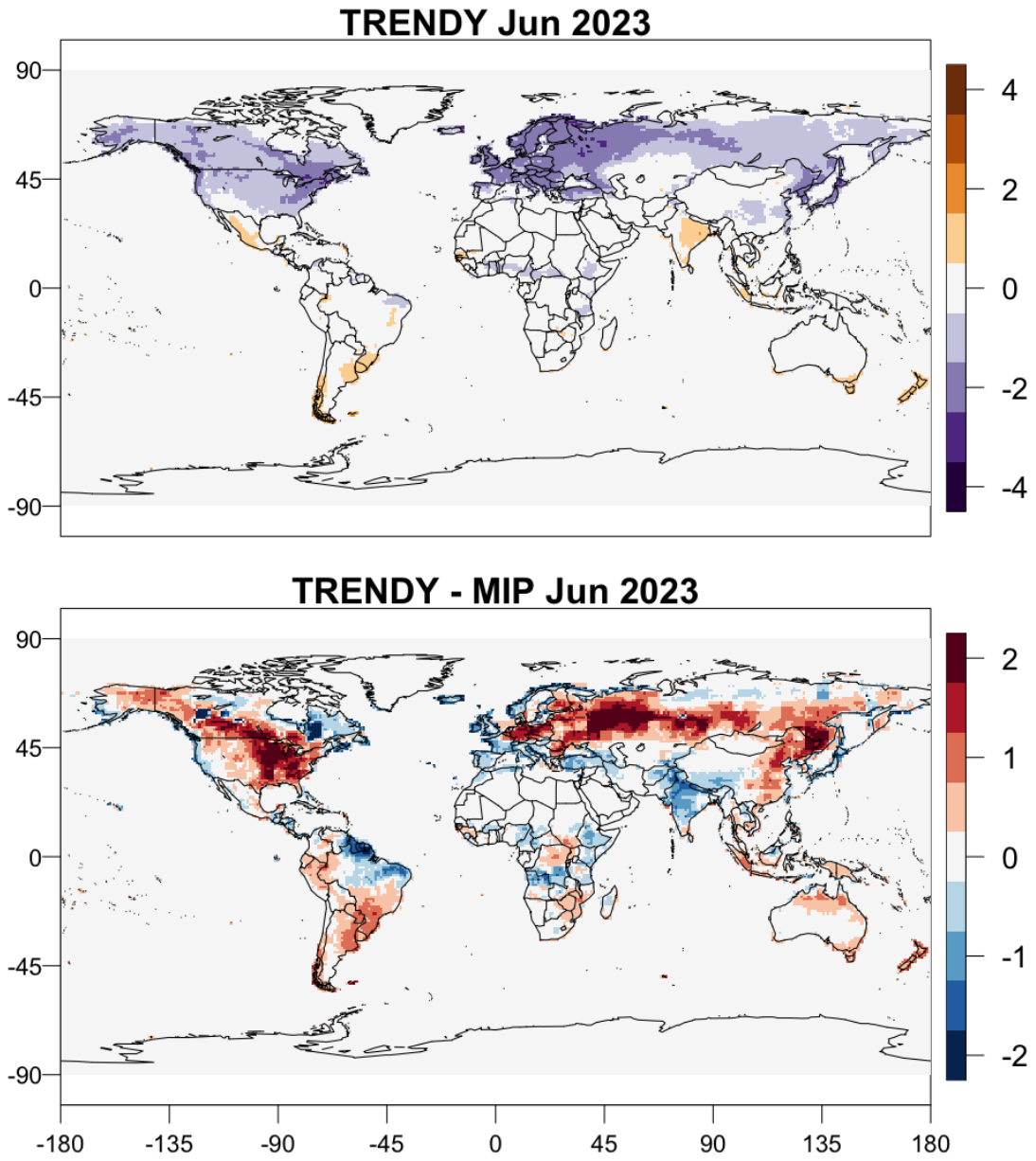

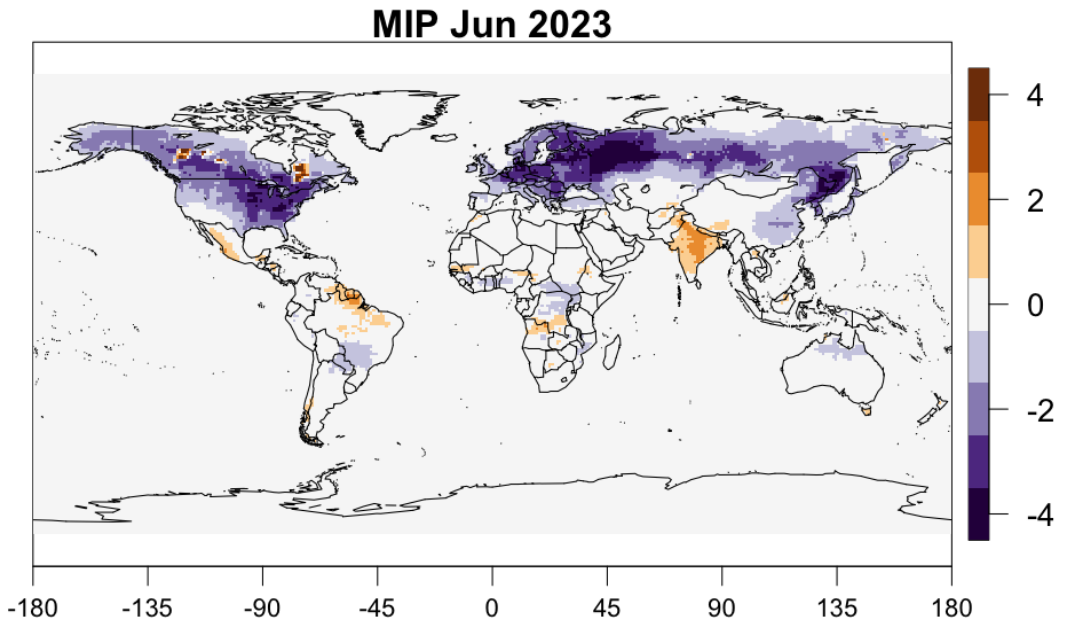

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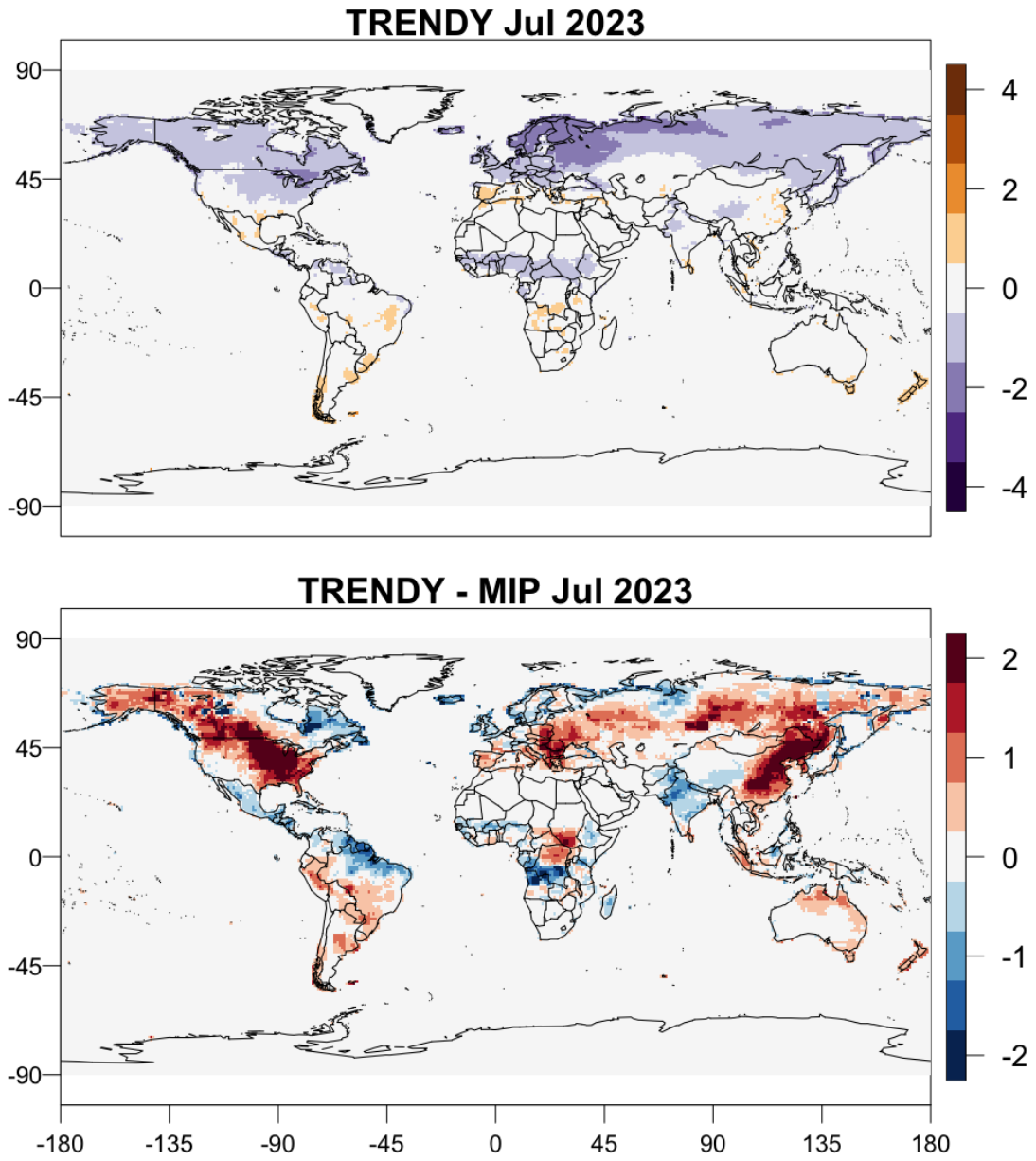

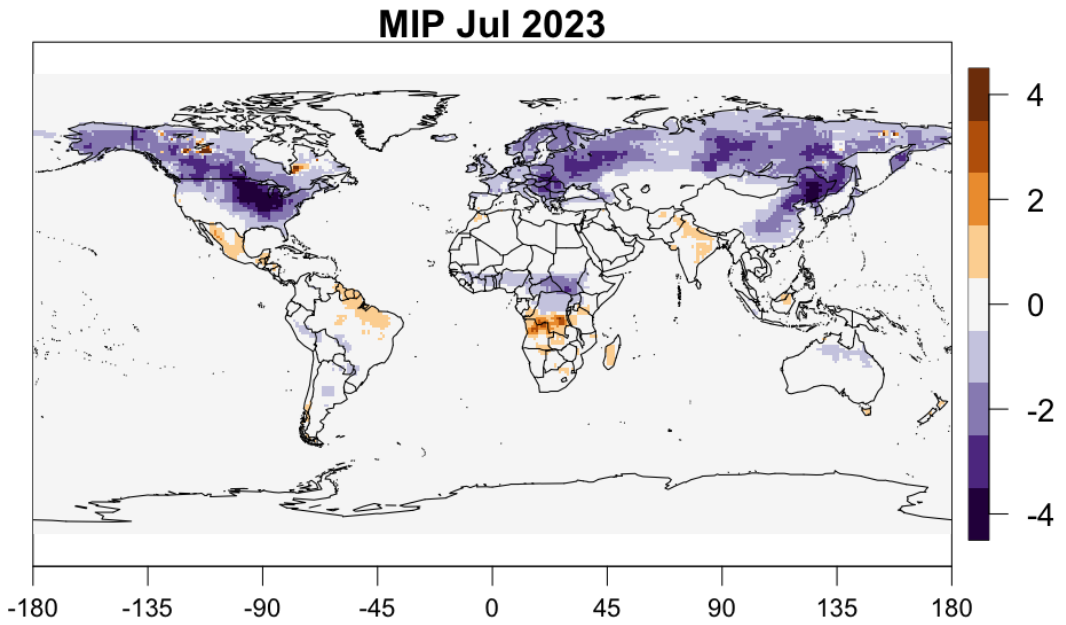

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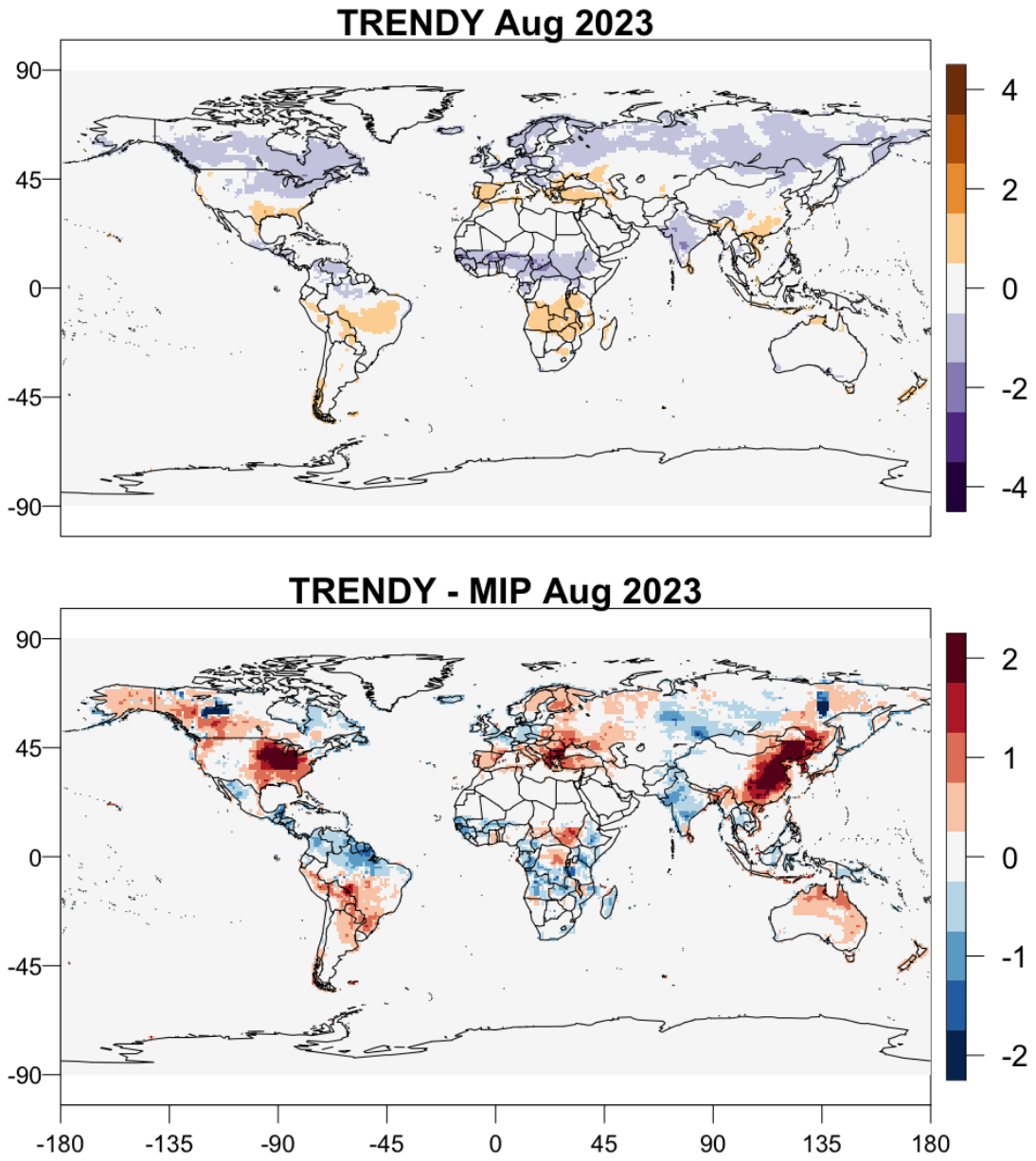

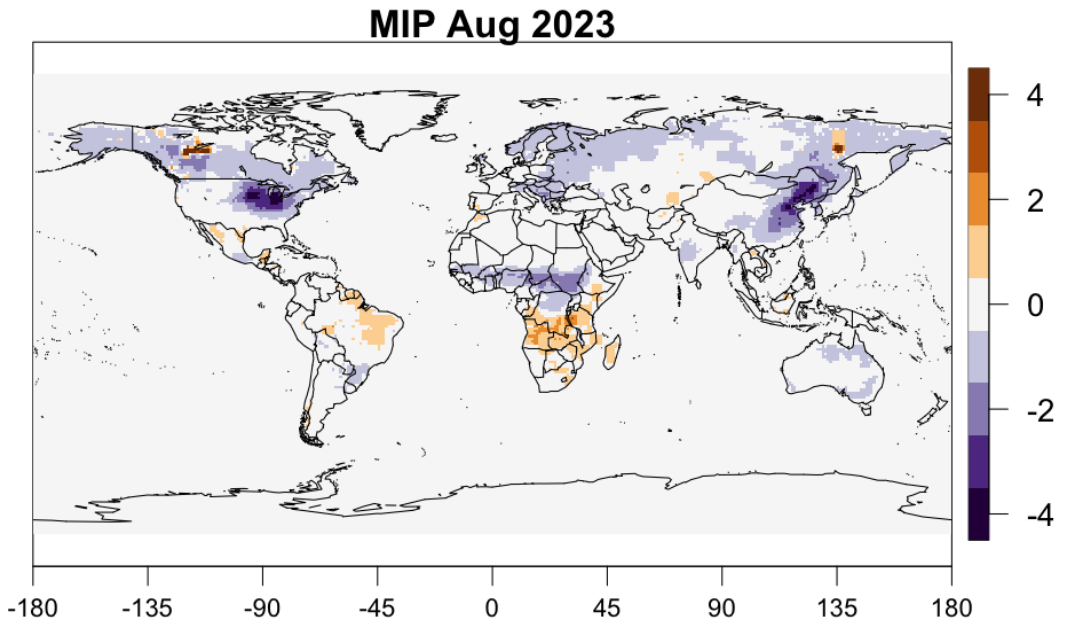

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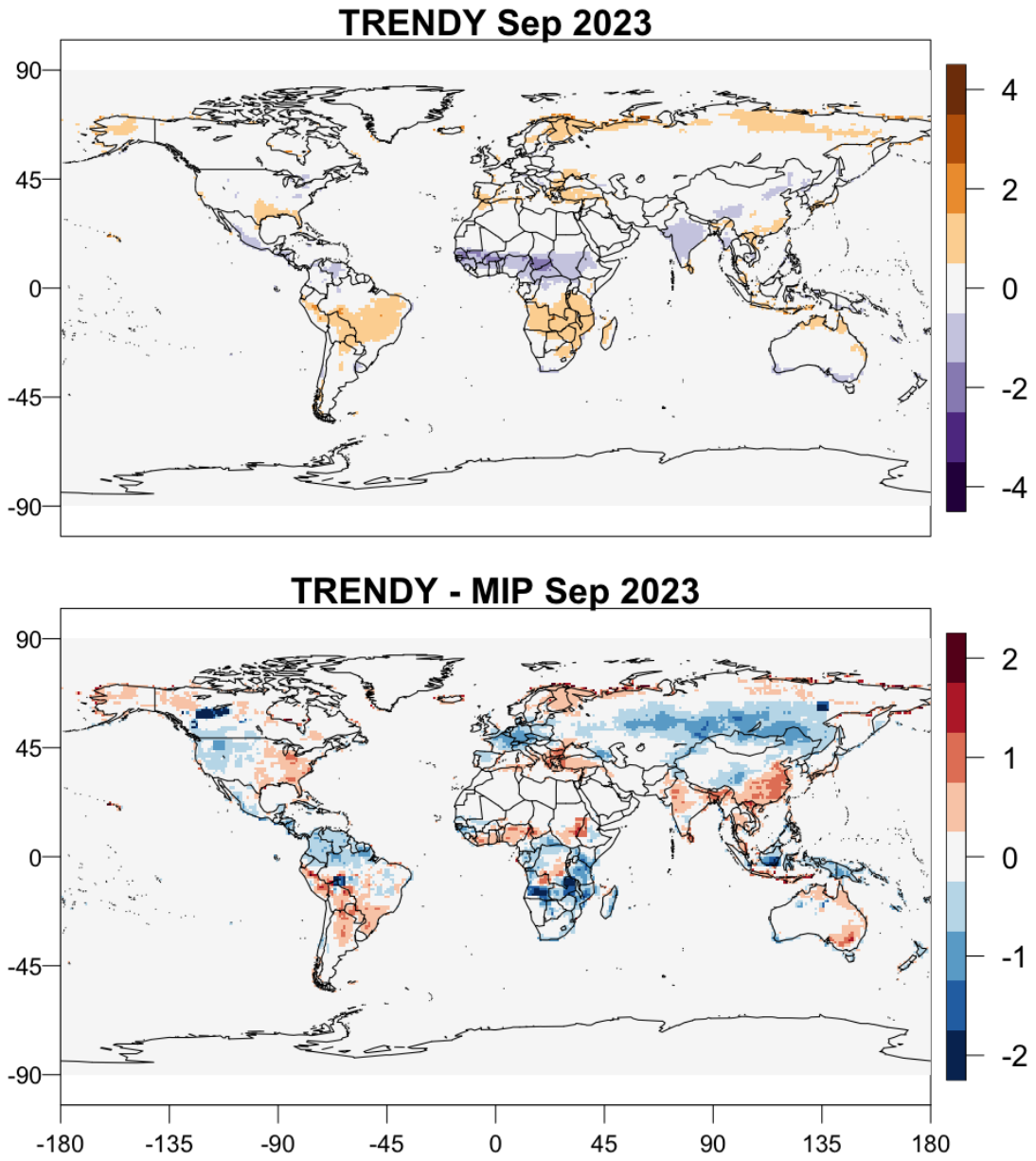

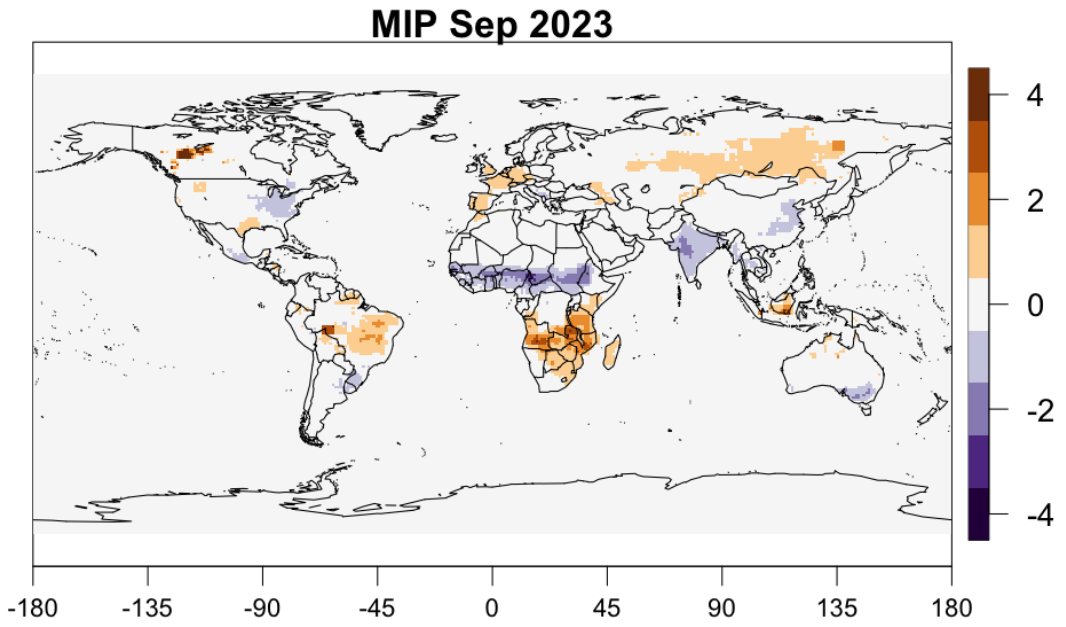

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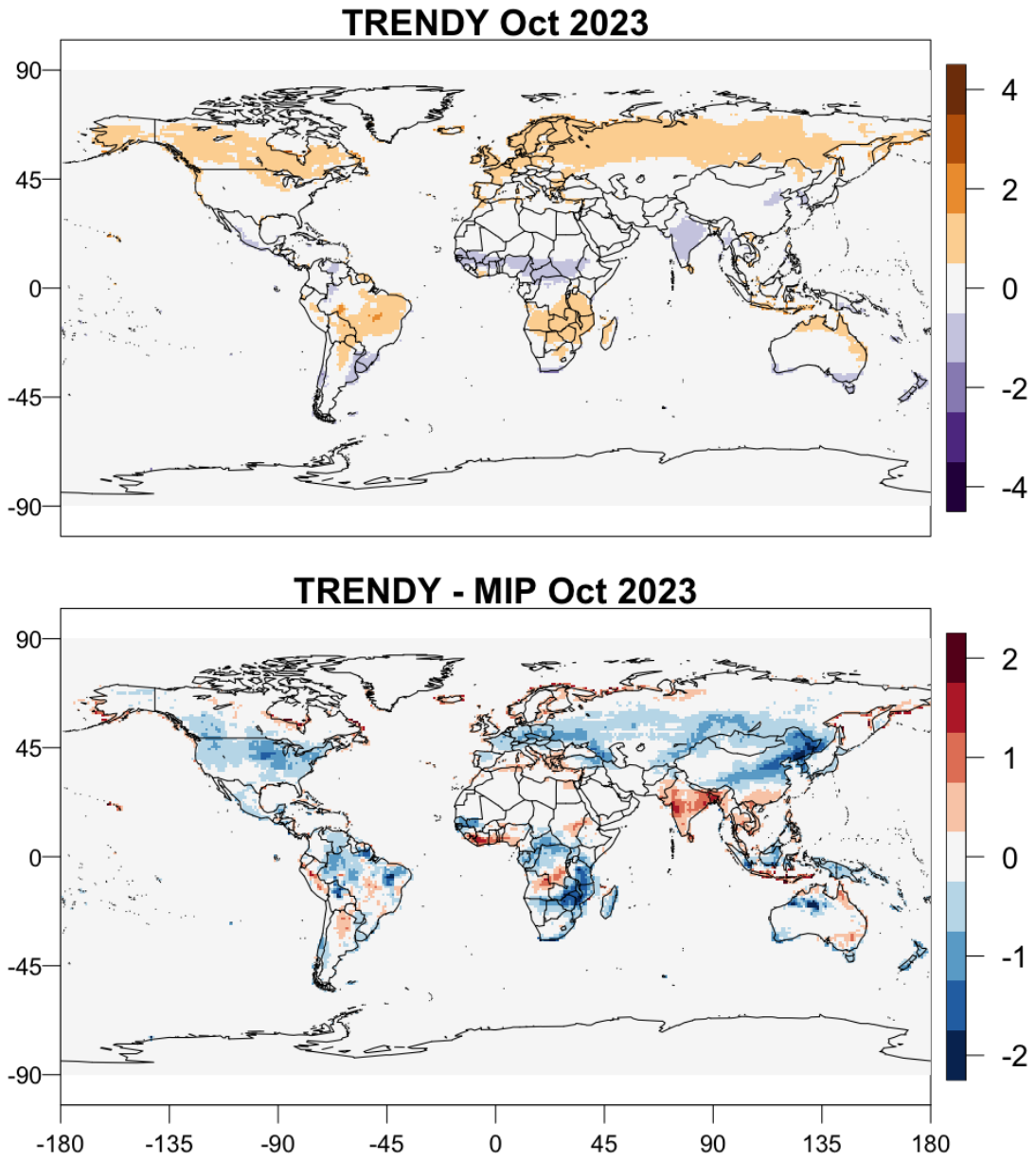

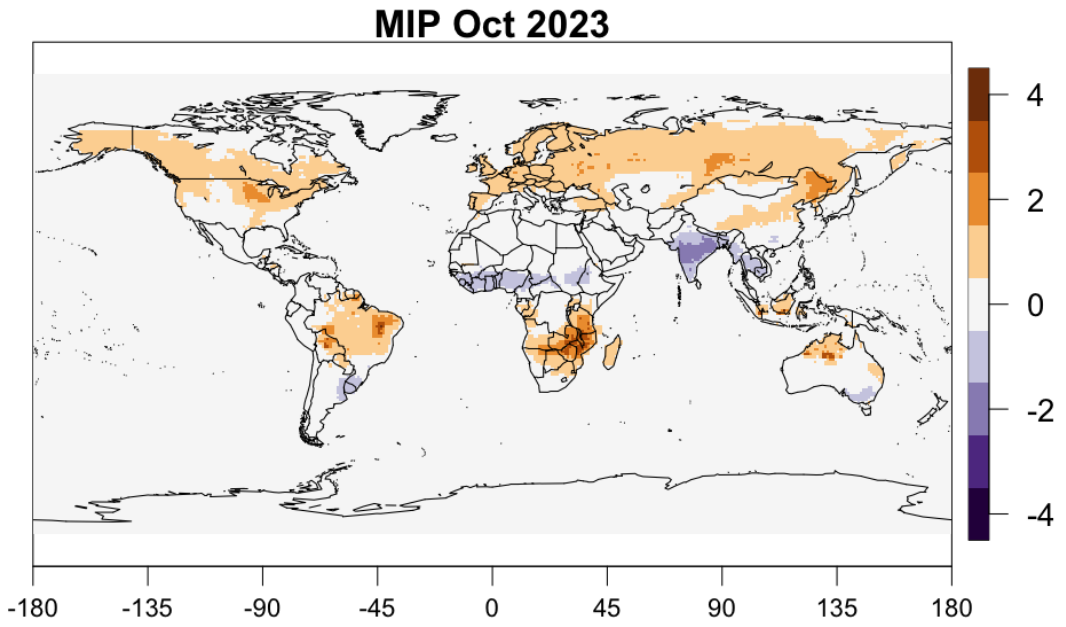

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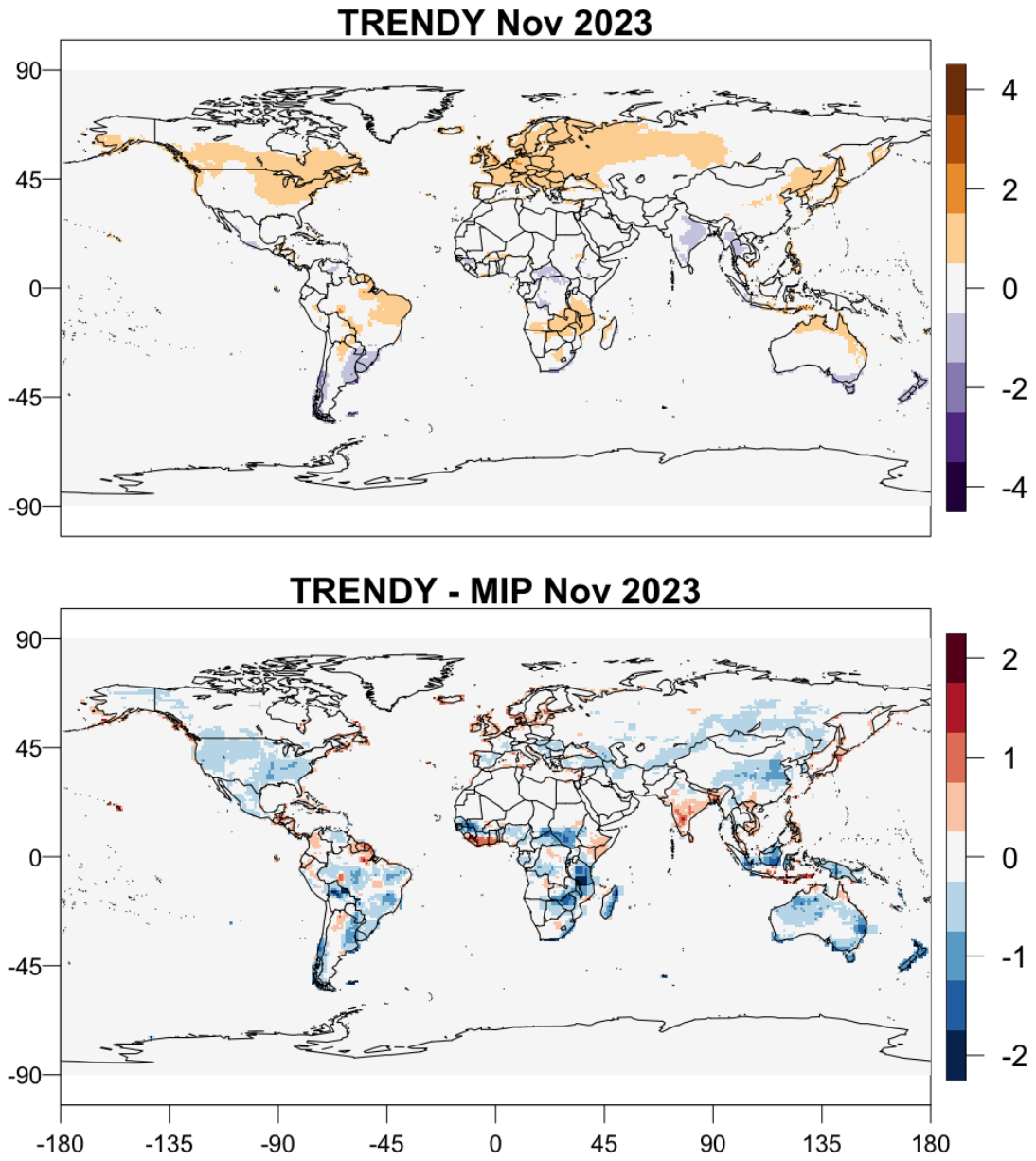

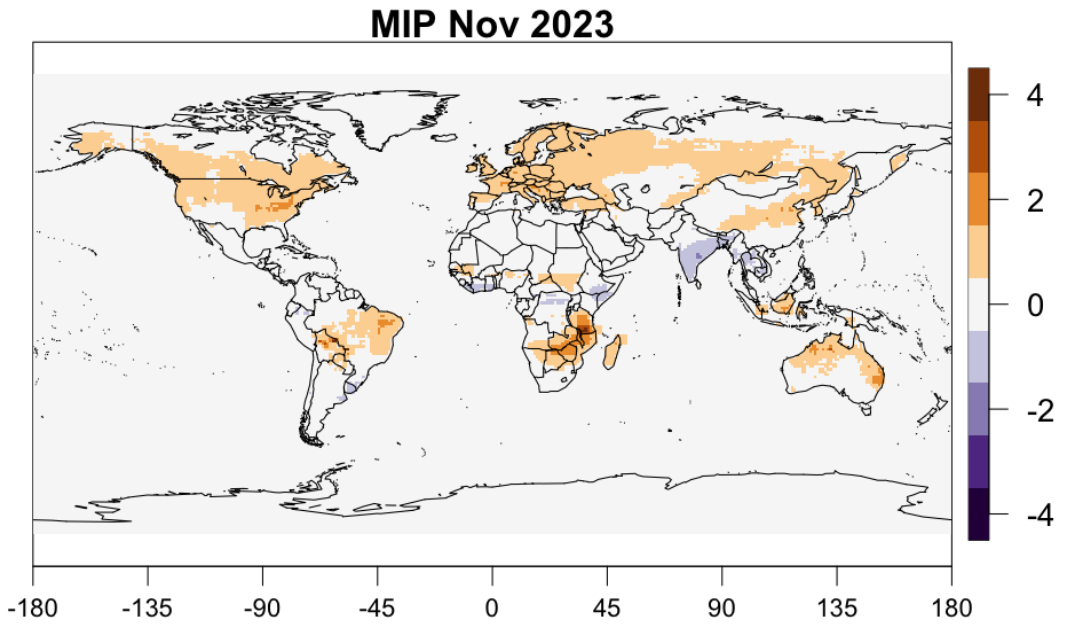

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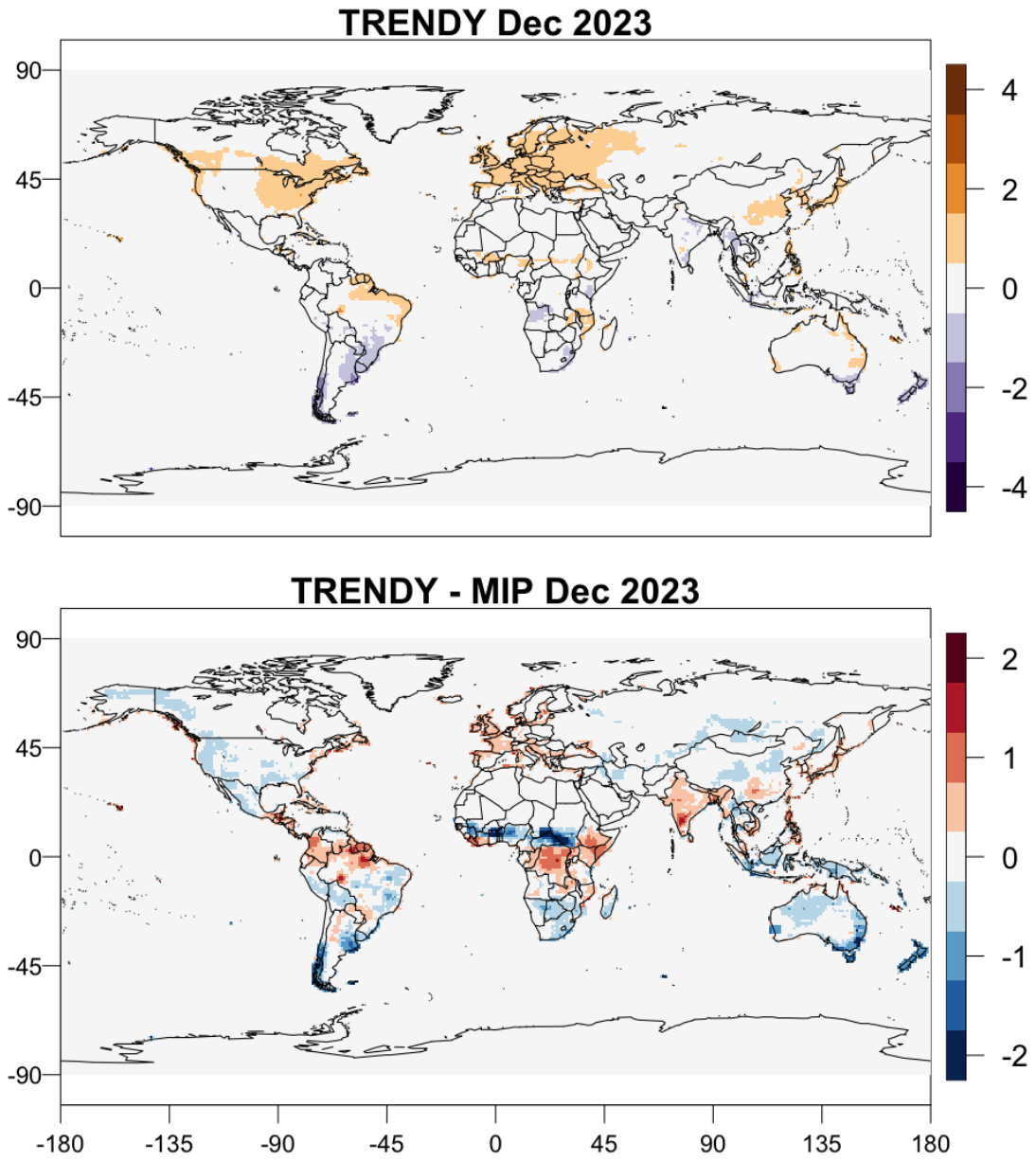
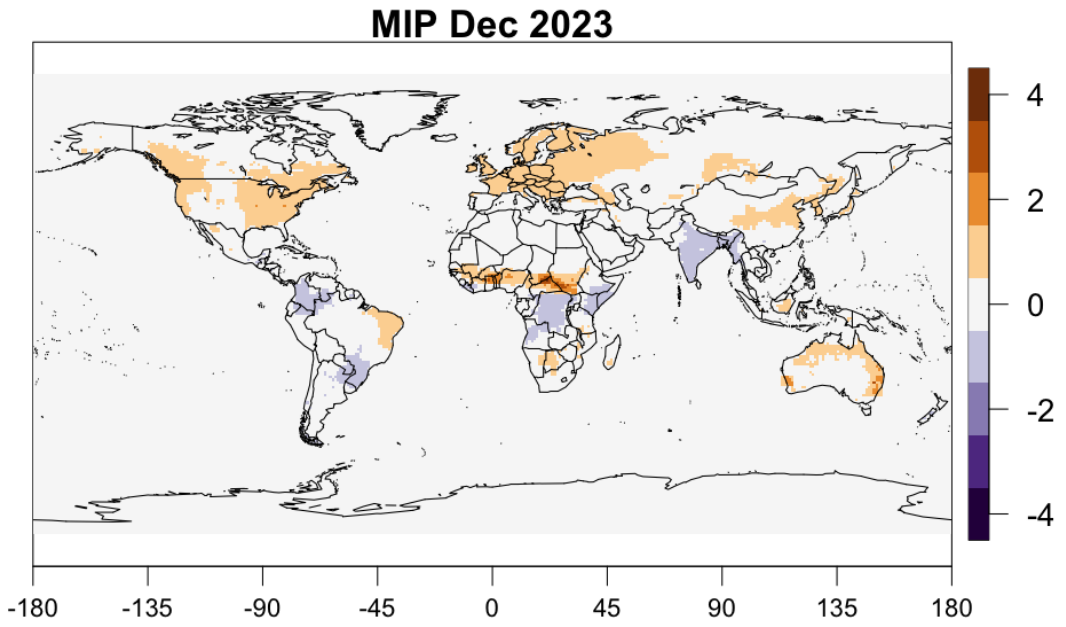
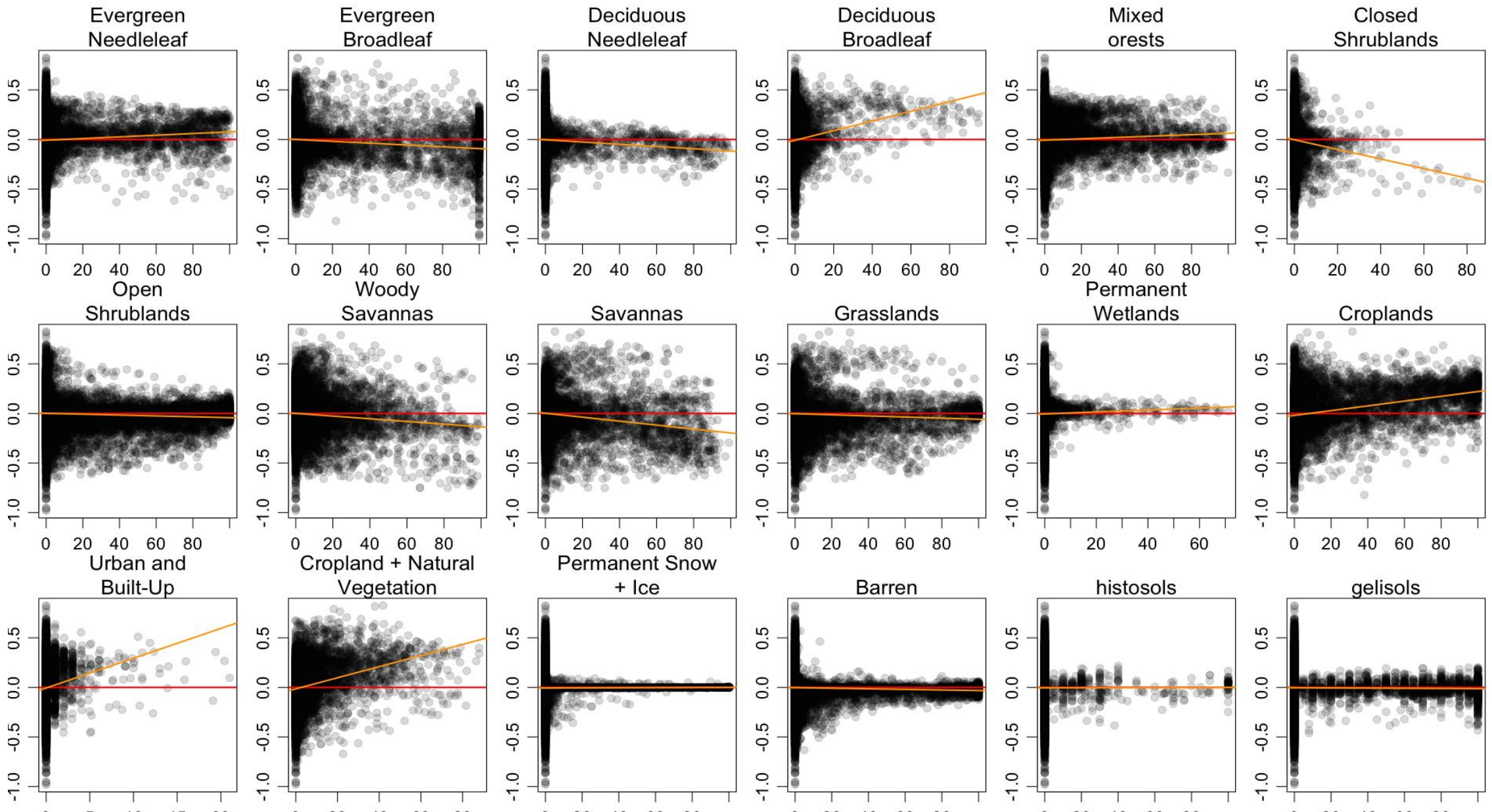




How much of the difference do the MODIS landcovers explain?



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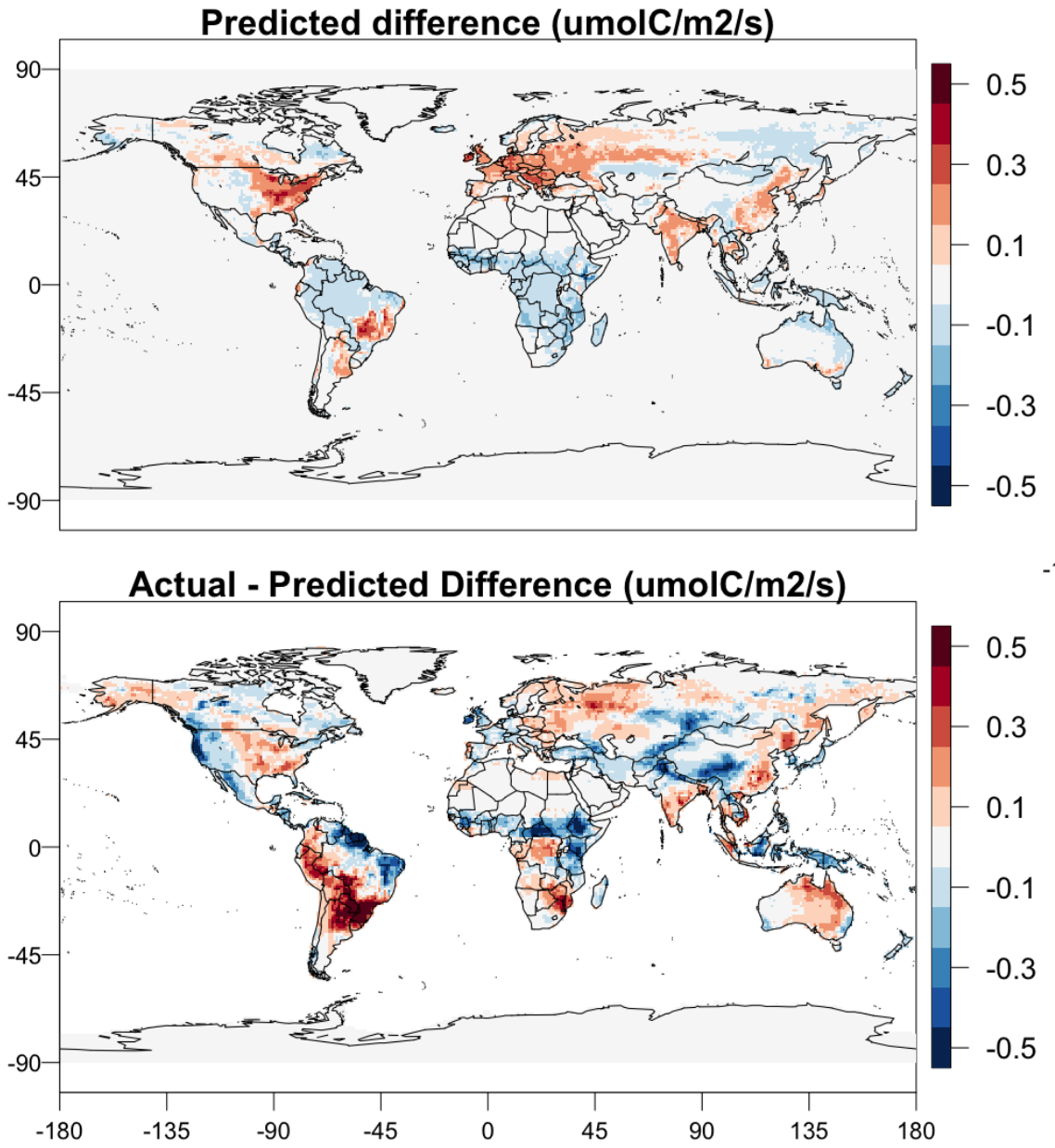

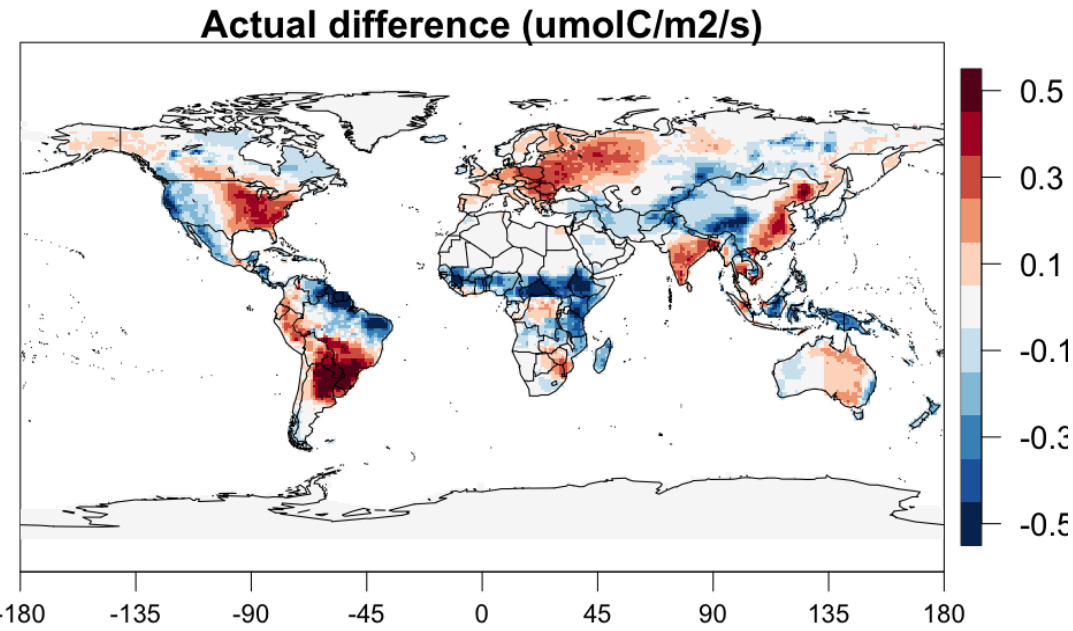

Some, but definitely not all of it.

Next steps

- Filter out regions where OCO-2 provides limited information
- Test for statistically significant differences at the 1x1 grid level
- Use a more sophisticated model to explain differences
- Explore other possible drivers
    - Meteorological variables: temperature, precipitation
    - Climate modes: ENSO, DMI, NAO, etc

Other ideas? Thanks for listening!


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