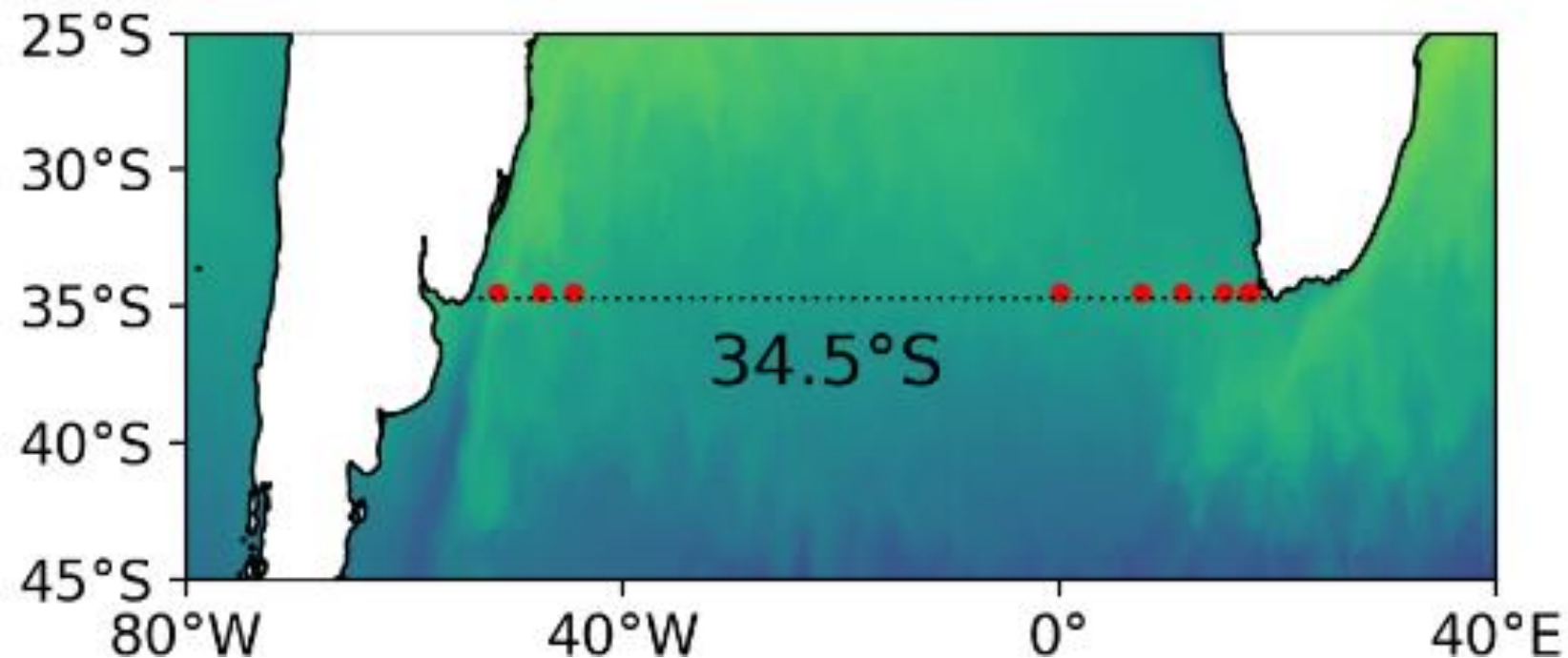


South Atlantic overturning and heat transport variations in ocean reanalyses and observation-based estimates

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Doroteaciro Iovino, Hao Zuo, Renellys Perez, Shenfu Dong, Marion Kersalé,
Michael Mayer, Johannes Mayer, Sabrina Speich, Tarron Lamont



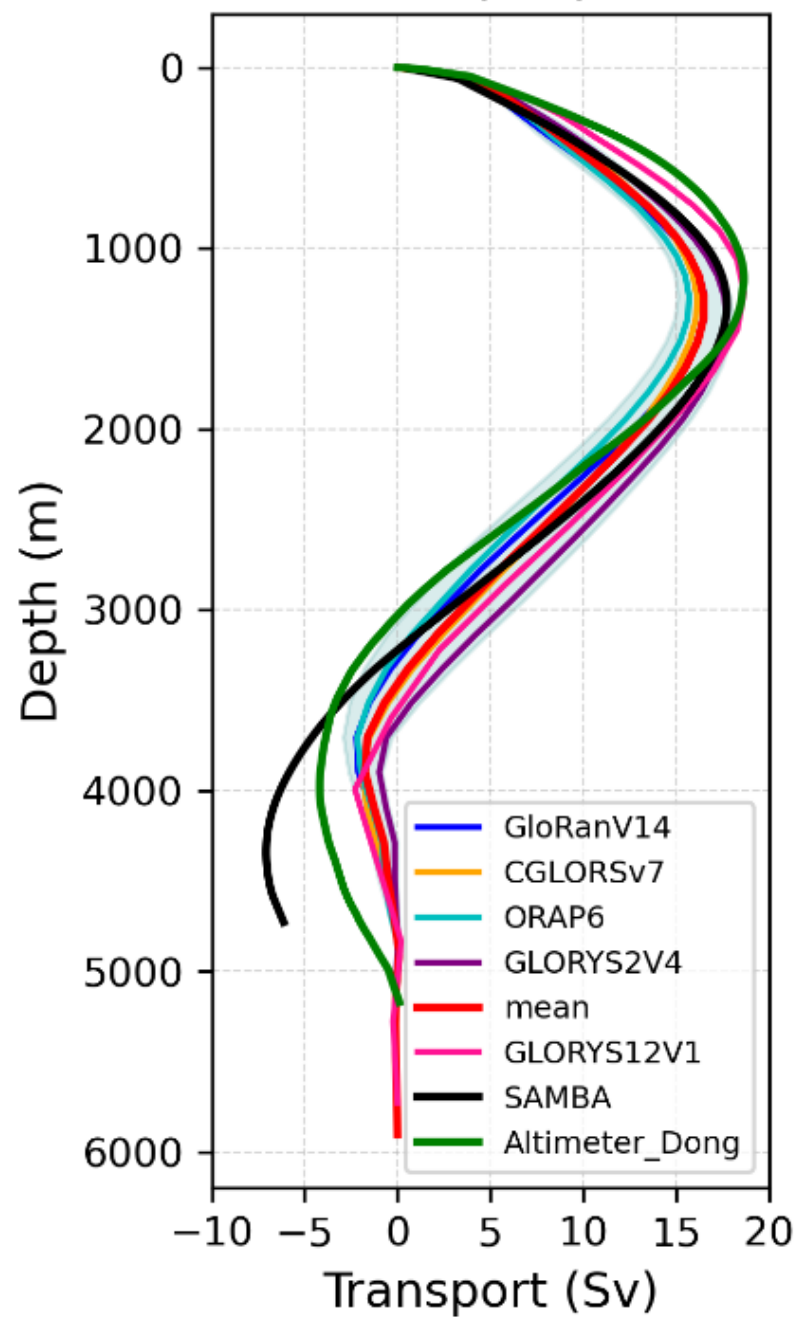
MOC and MHT estimates

- SAMBA observations 2013-2017 (Kersalé et al., 2020, 2021)
- CMEMS ¼ degree global ocean ensemble physics reanalysis, 1993-2020:
 - C-GLORSv7, GLORYS2V4, ORAP6 and GloRanV14,
- CMEMS 1/12 degree global ocean reanalysis, GLORYS12V1, 1993-2019
- All use NEMO ocean model but sea-ice model and DA techniques differ
- Assimilate SST, sea level anomalies, sea-ice concentrations and in-situ temperature and salinity.
- Altimeter-based estimate 1993-2021 (Dong et al., 2021)
- Energy-budget estimates of MHT:
 - two estimates of Mayer et al., 2022 based on OHC tendencies from ORAS5 and ORAP6.
 - Trenberth et al., 2019

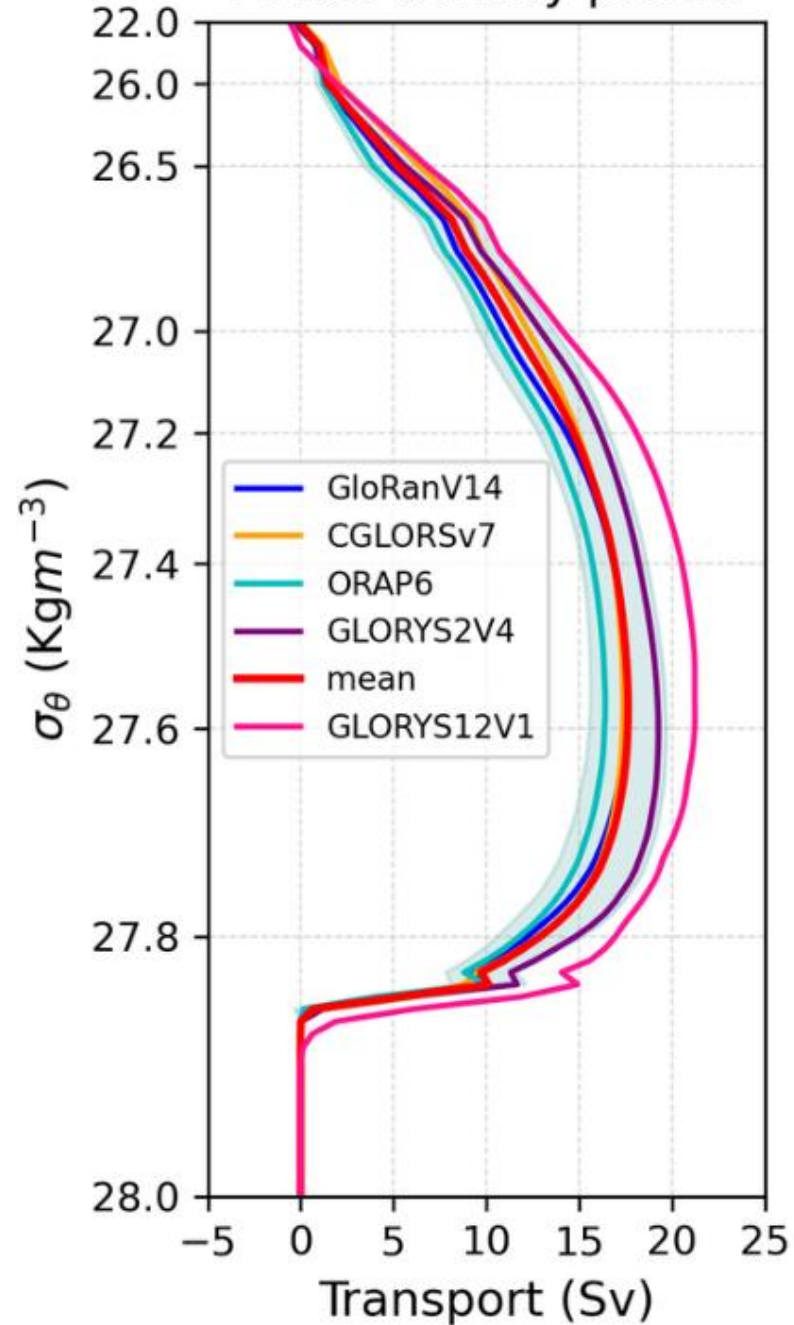
Questions

- What is the vertical structure of the AMOC at 34°S?
- How does the time-mean and variability of volume and heat transports in reanalyses compare with SAMBA and other estimates?
- What causes the similarities and differences between the datasets and how can they be improved to reduce uncertainty?
- Can reanalyses be used to infer past changes in transports?

AMOC depth profile

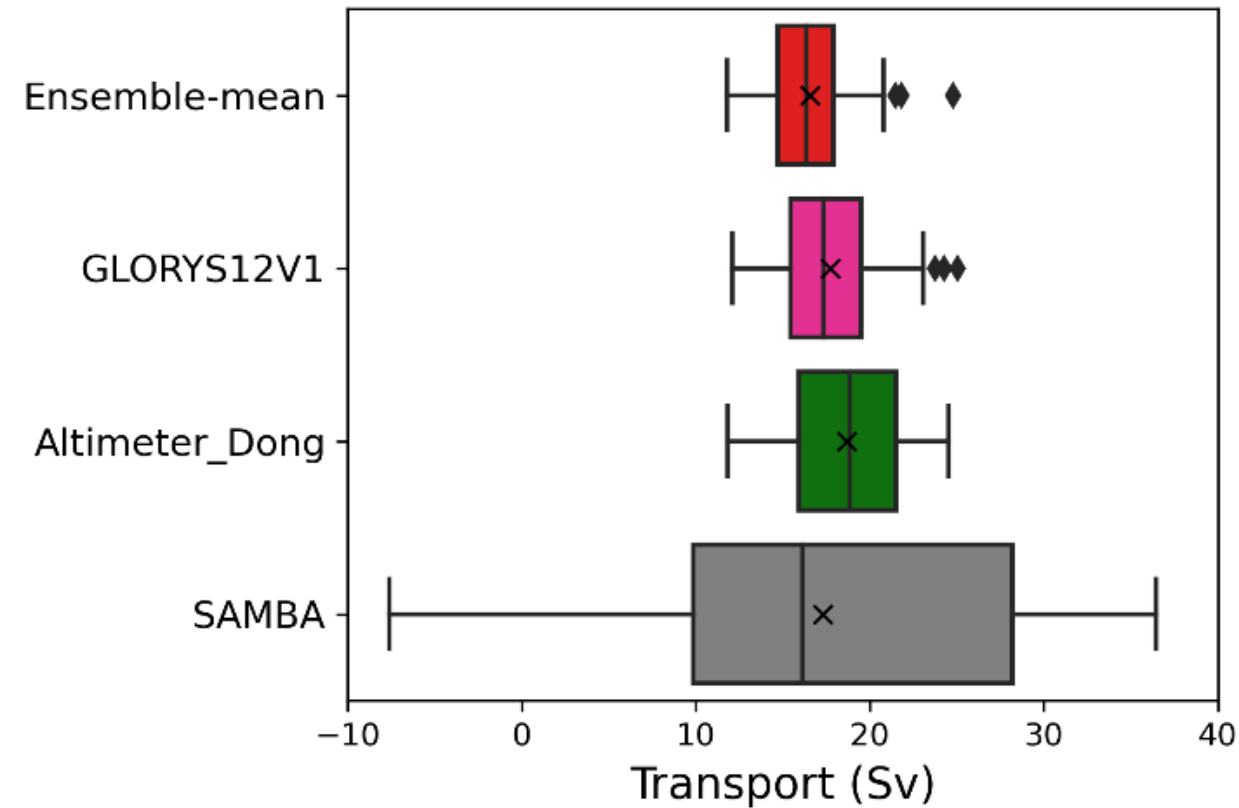


AMOC density profile

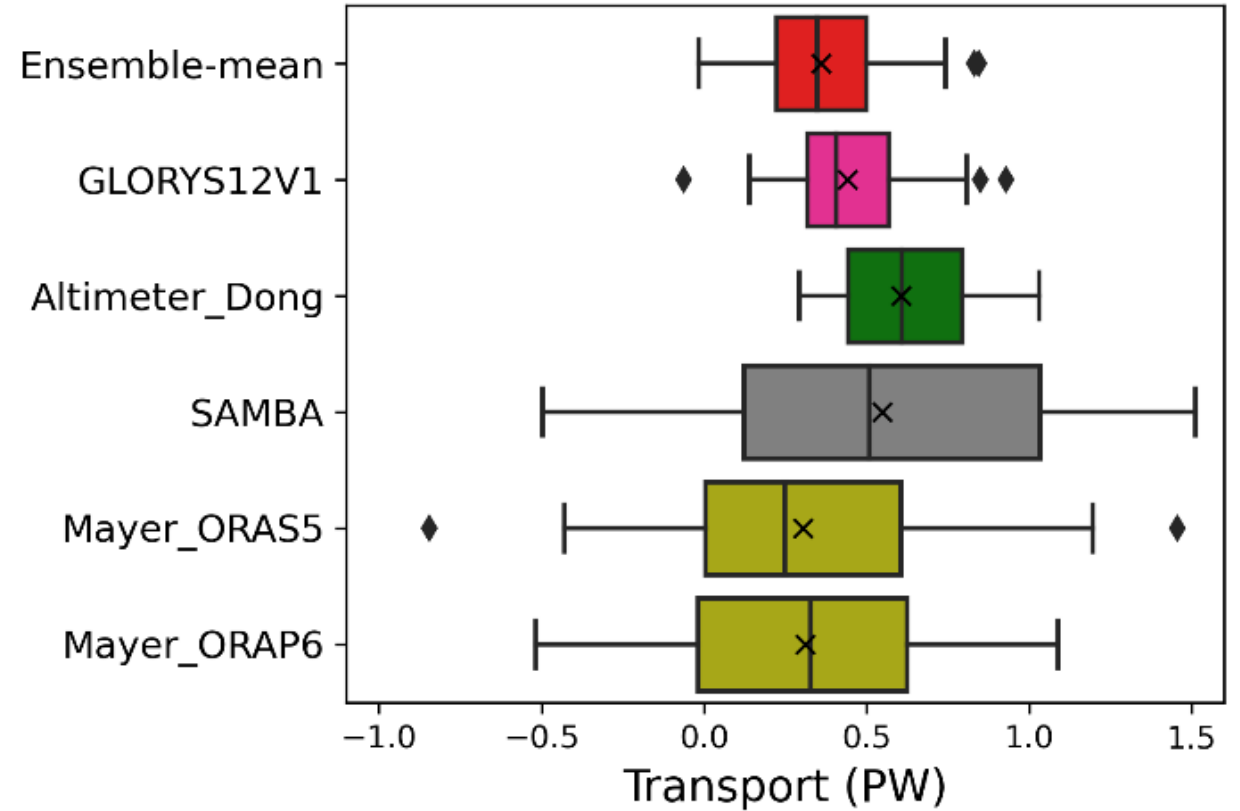


Monthly-mean variability

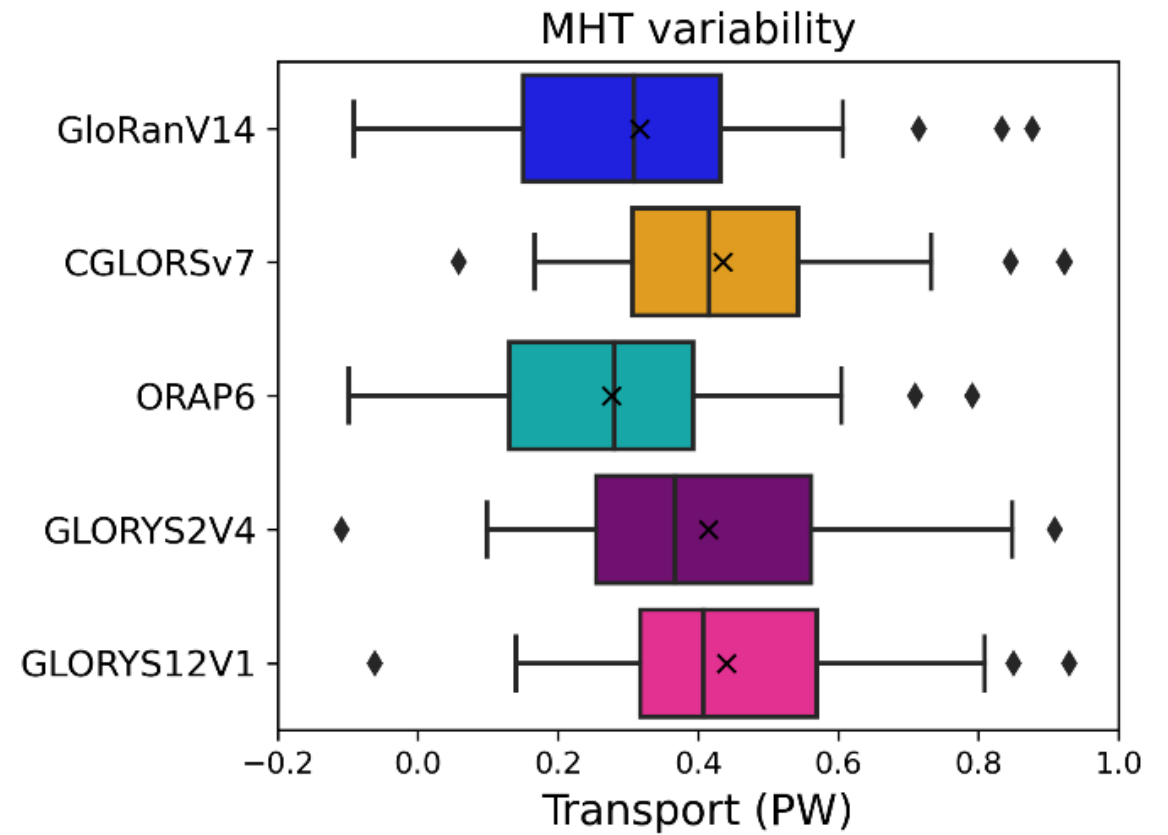
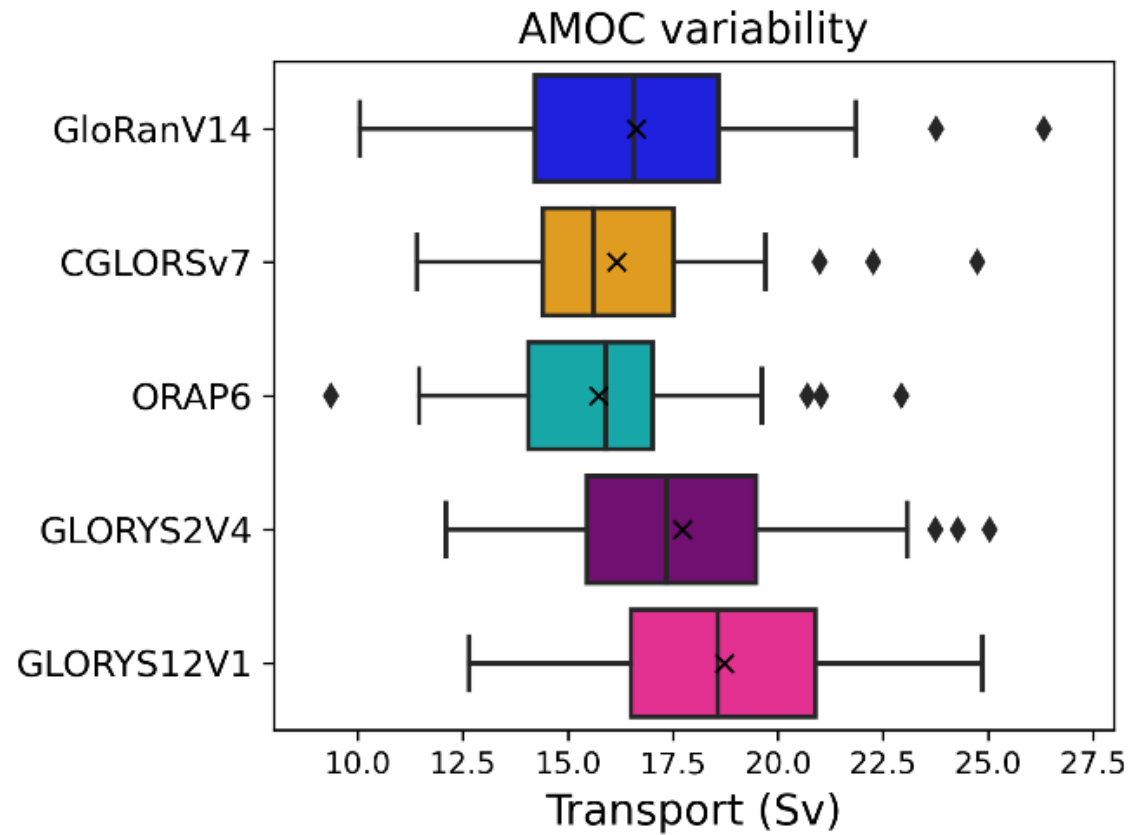
AMOC variability



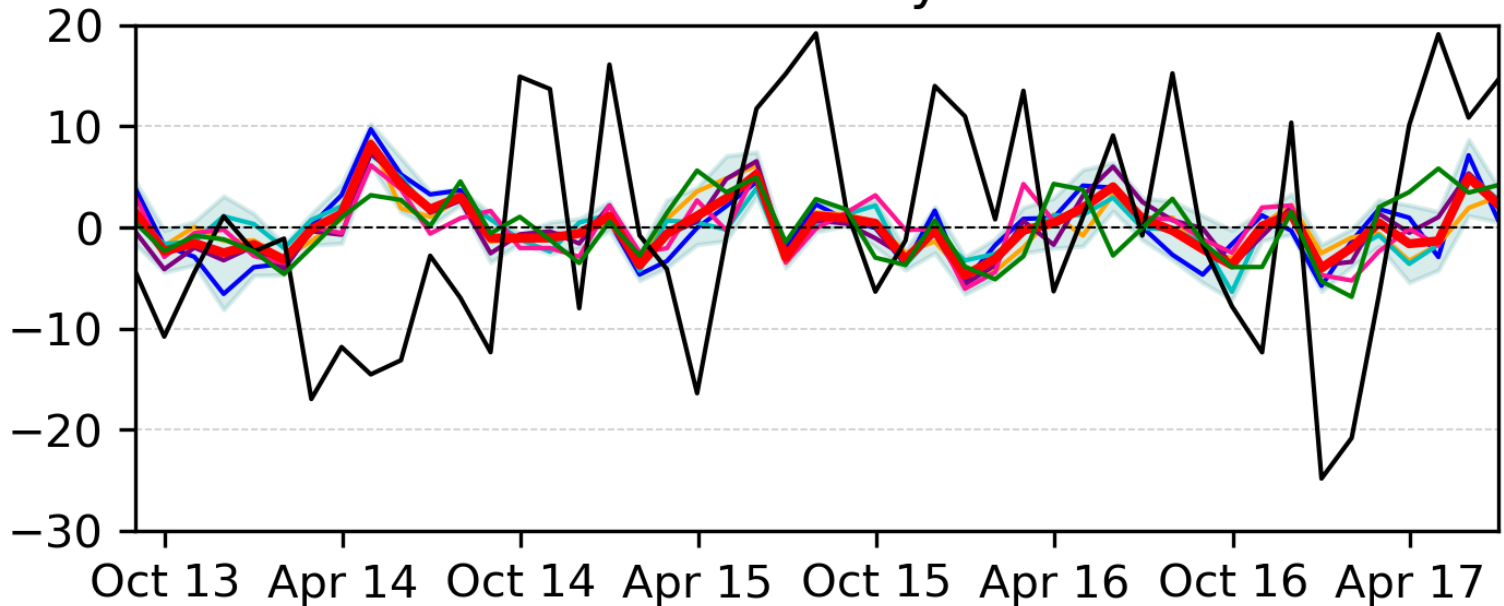
MHT variability



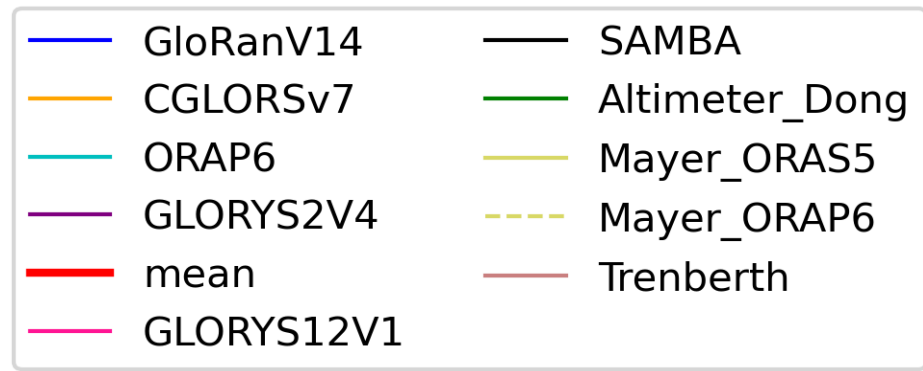
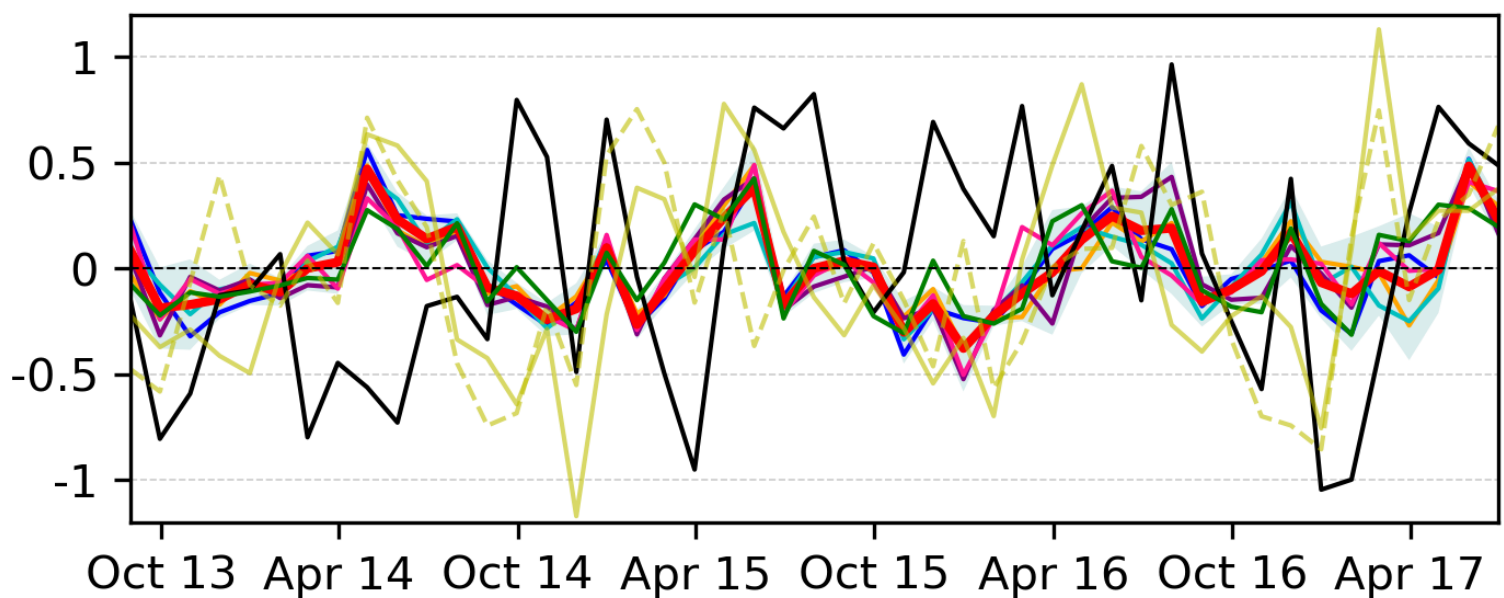
Monthly-mean variability



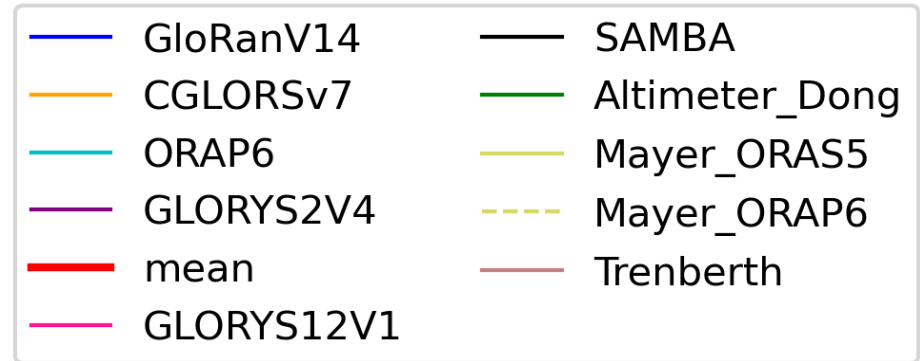
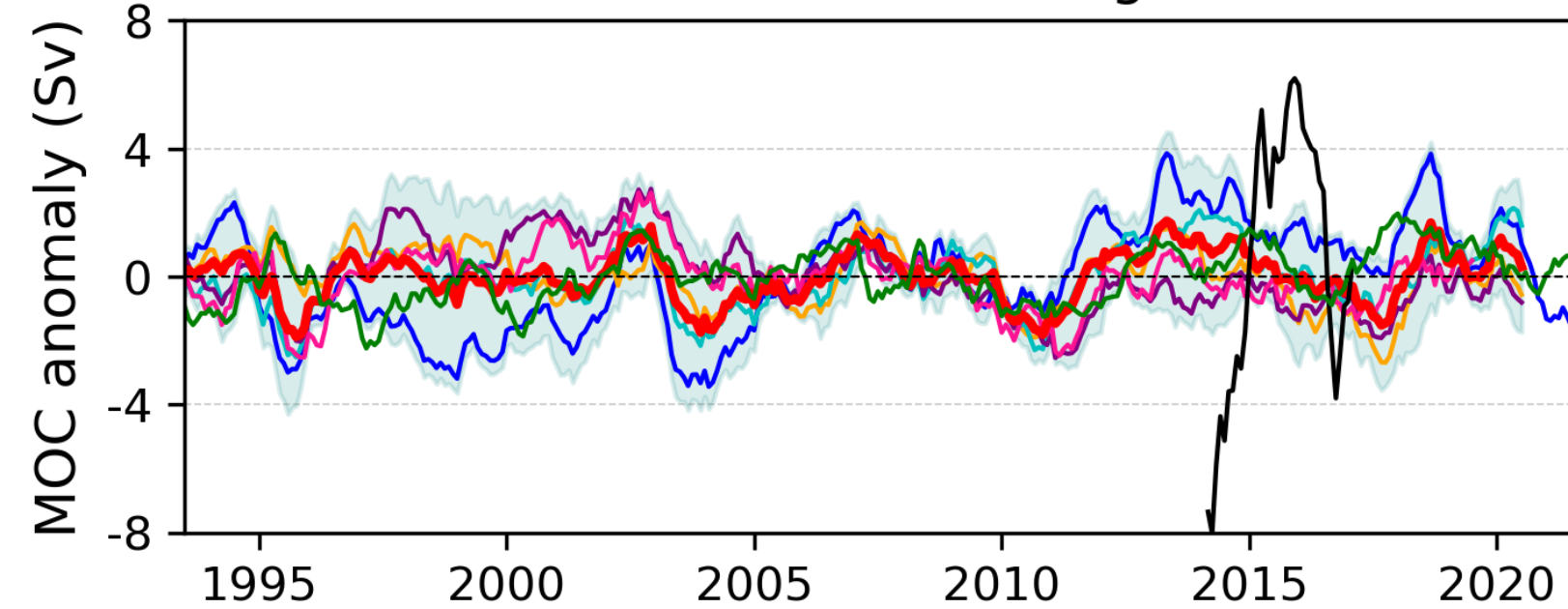
AMOC: monthly-mean



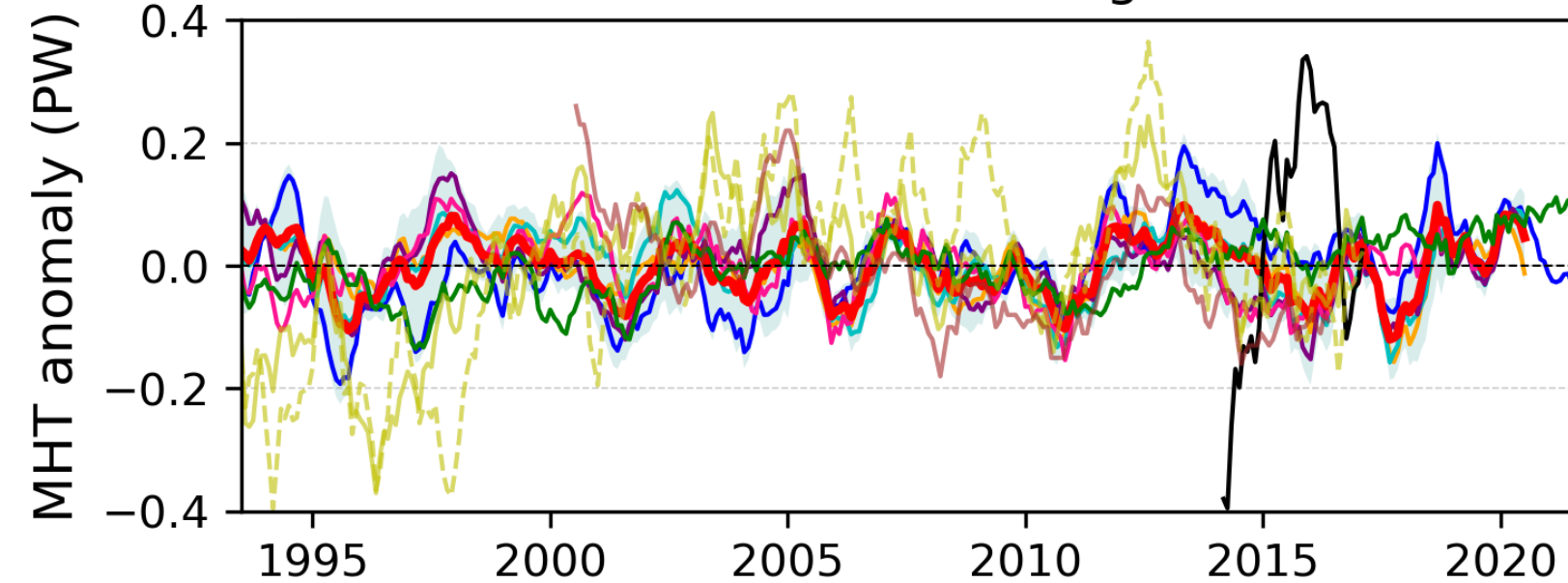
MHT: monthly-mean



AMOC: 12-month running mean

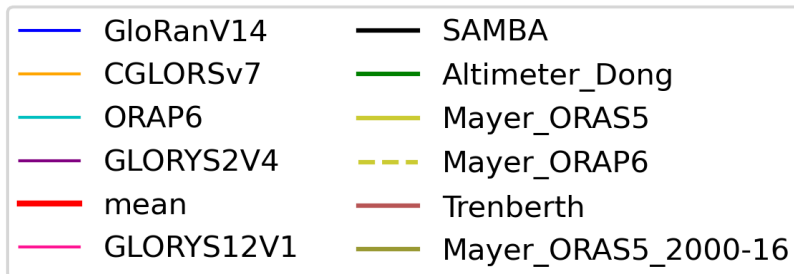
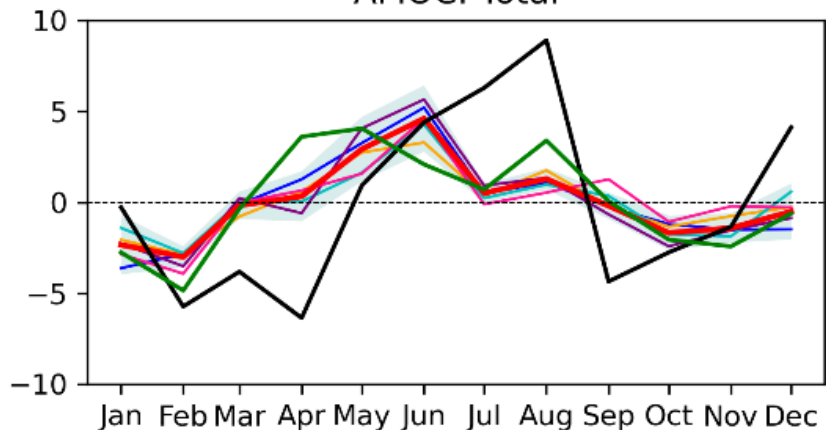


MHT: 12-month running mean

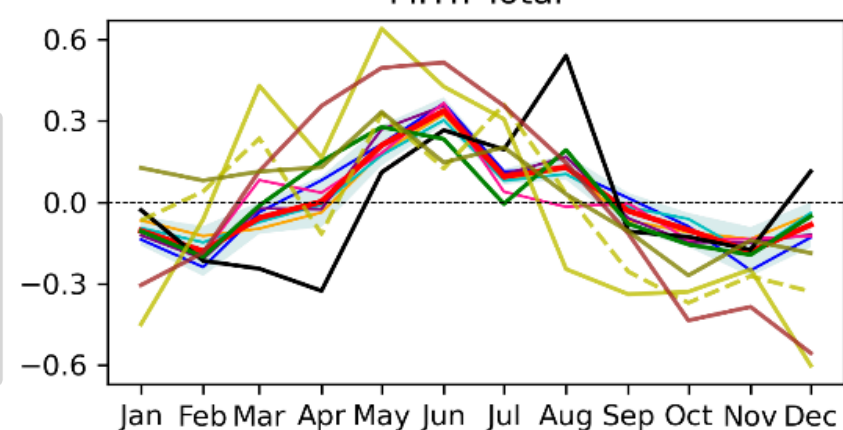


Seasonal Cycles

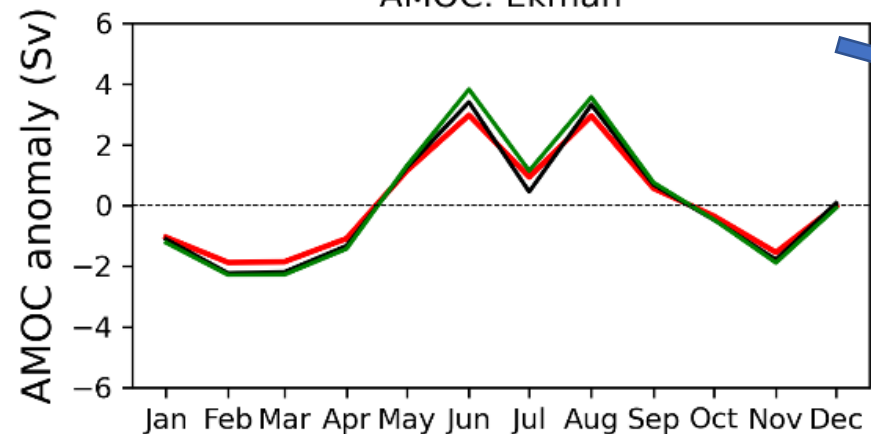
AMOC: Total



MHT: Total



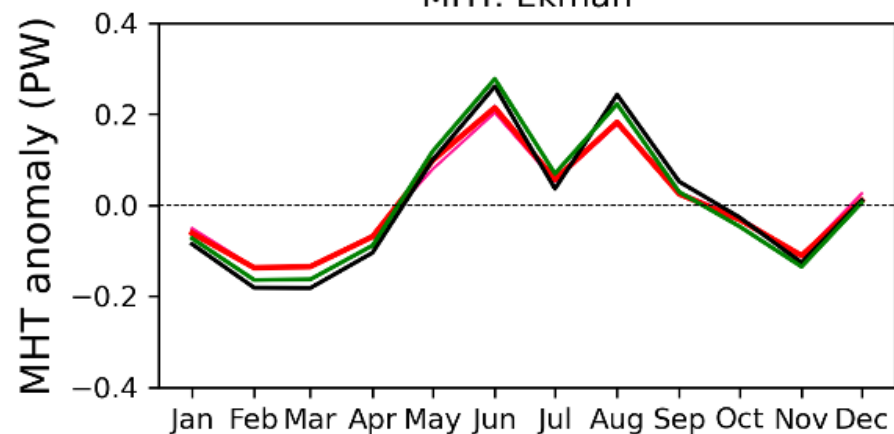
AMOC: Ekman



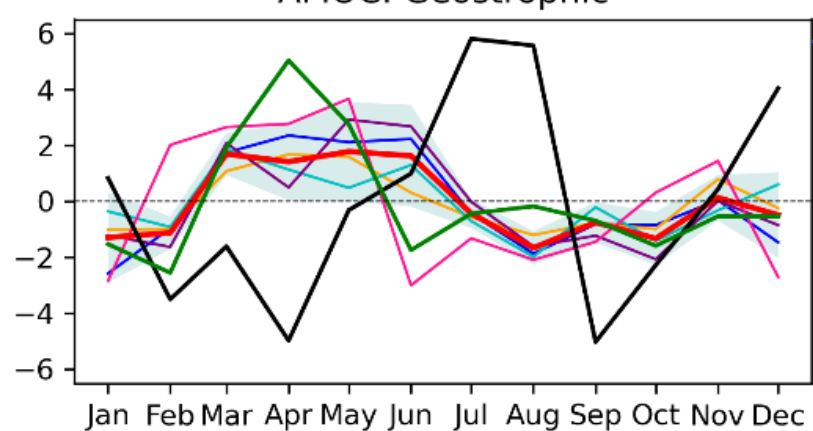
• Ekman components similar

• Geostrophic components differ

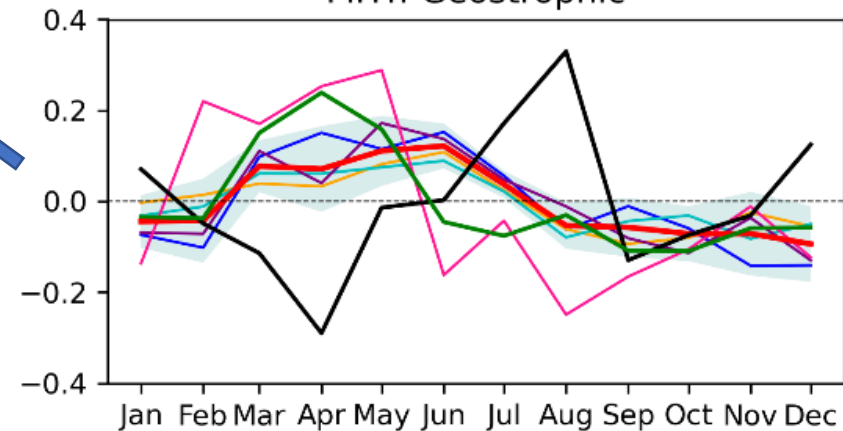
MHT: Ekman



AMOC: Geostrophic



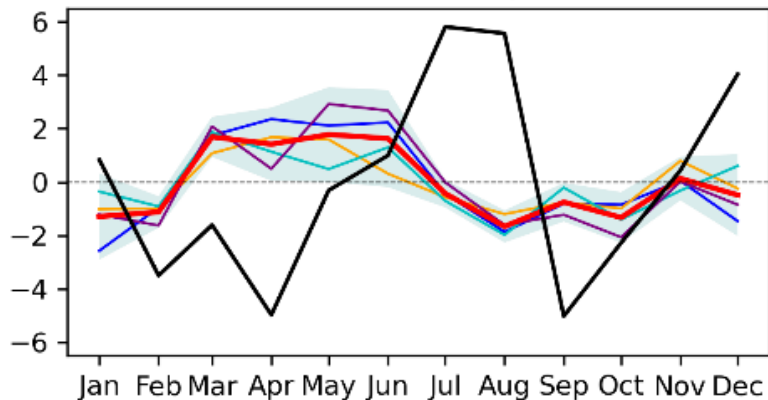
MHT: Geostrophic



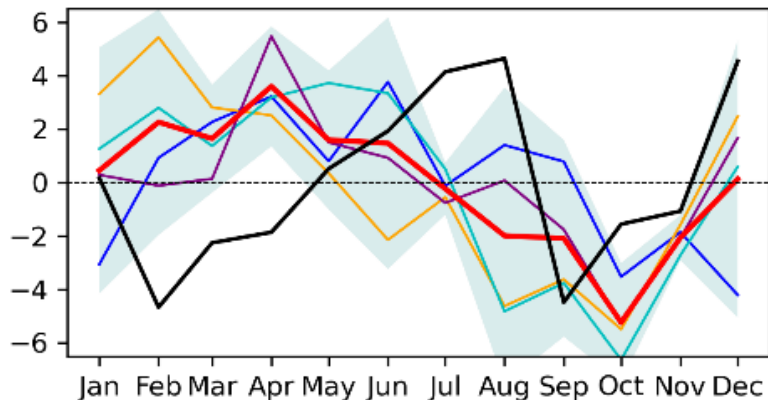
Seasonal Cycles

2013-2017

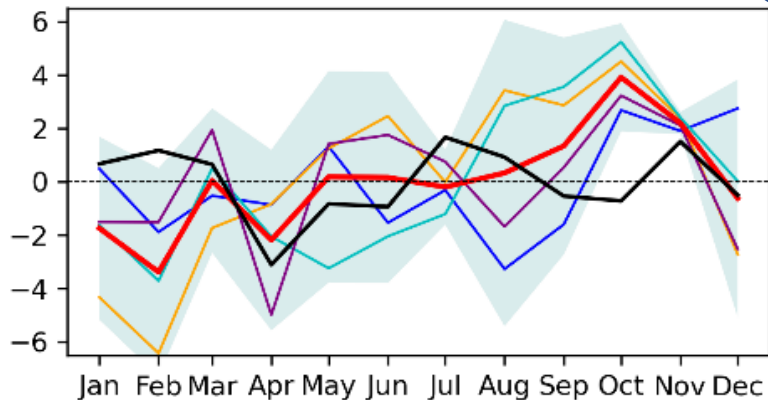
AMOC: Geostrophic



AMOC: Baroclinic

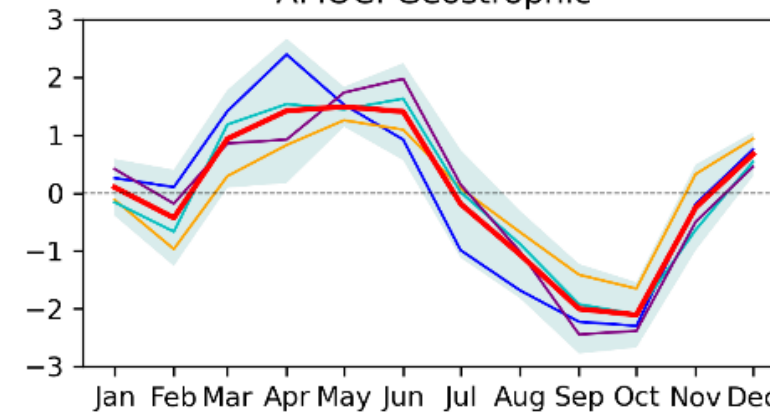


AMOC: Barotropic

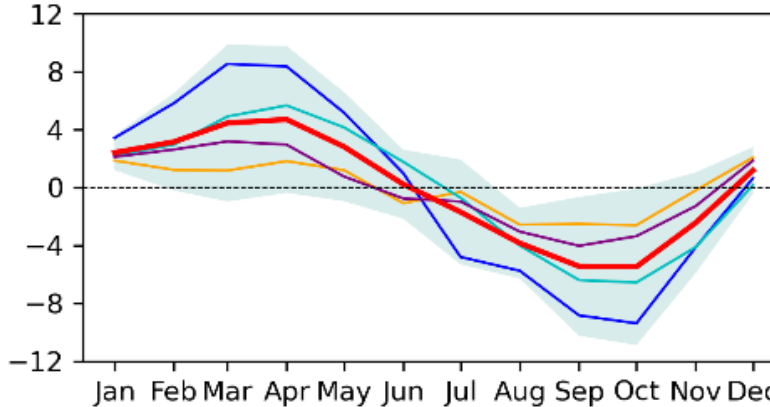


1993-2020

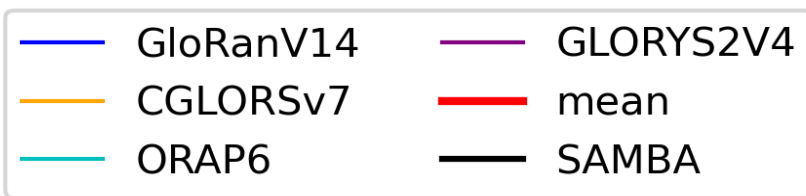
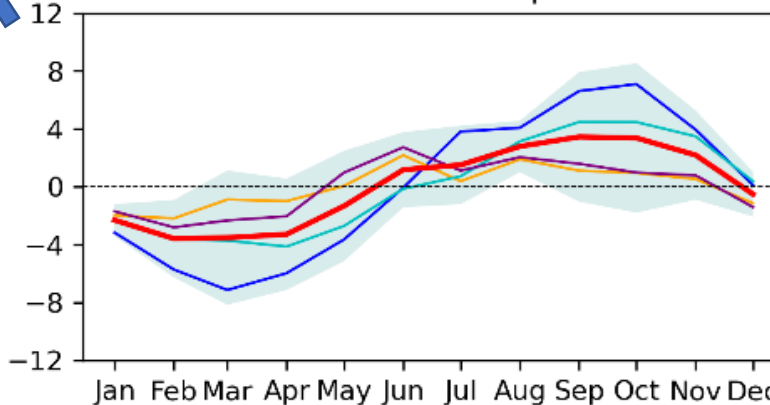
AMOC: Geostrophic



AMOC: Baroclinic



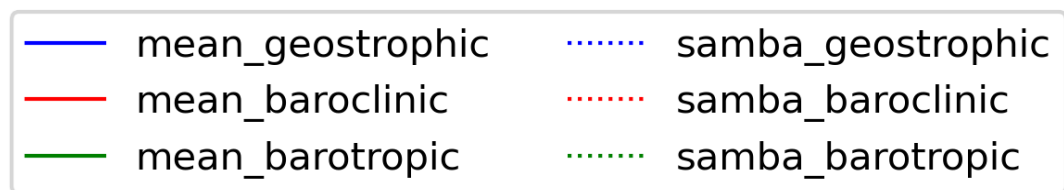
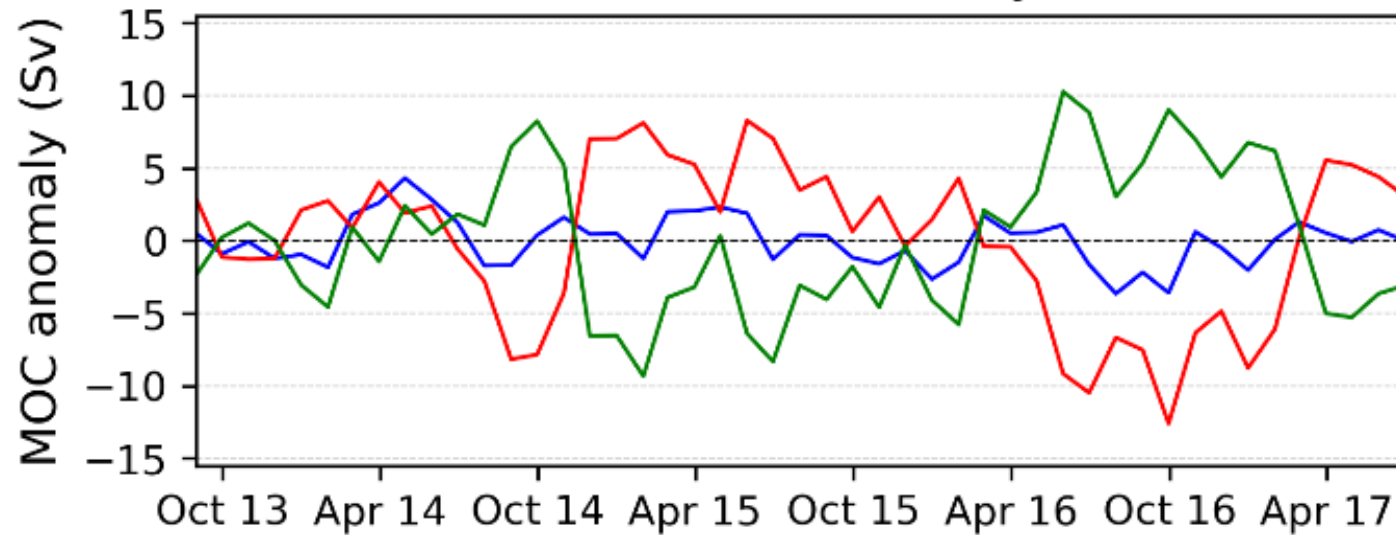
AMOC: Barotropic



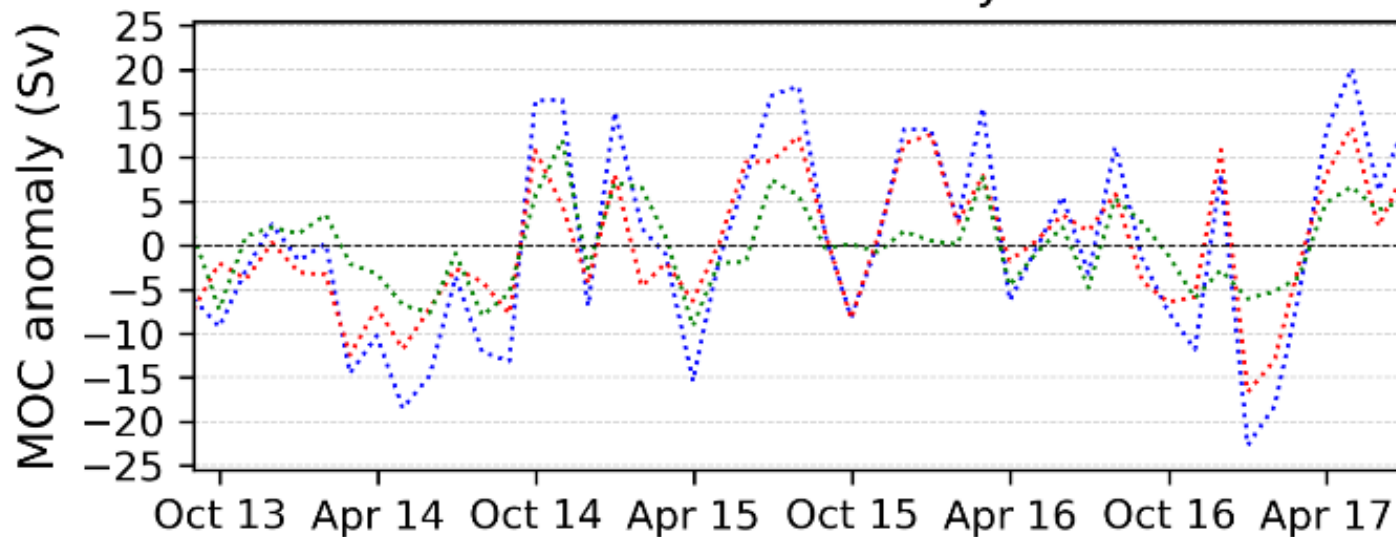
- Baroclinic component dominates geostrophic phase
 - Barotropic component also has a significant impact
 - Baroclinic and barotropic components opposed in reanalysis
- ➔ smaller geostrophic amplitude

AMOC anomaly (Sv)

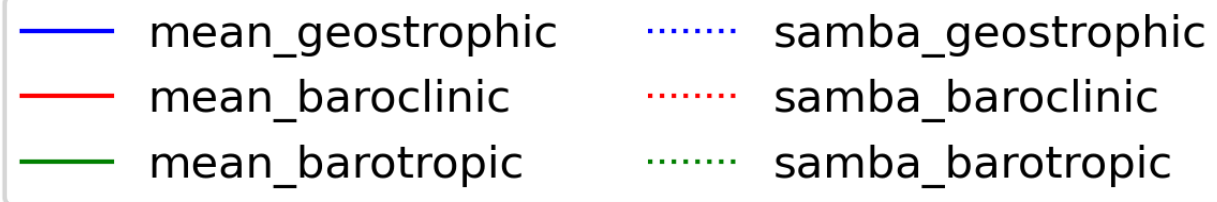
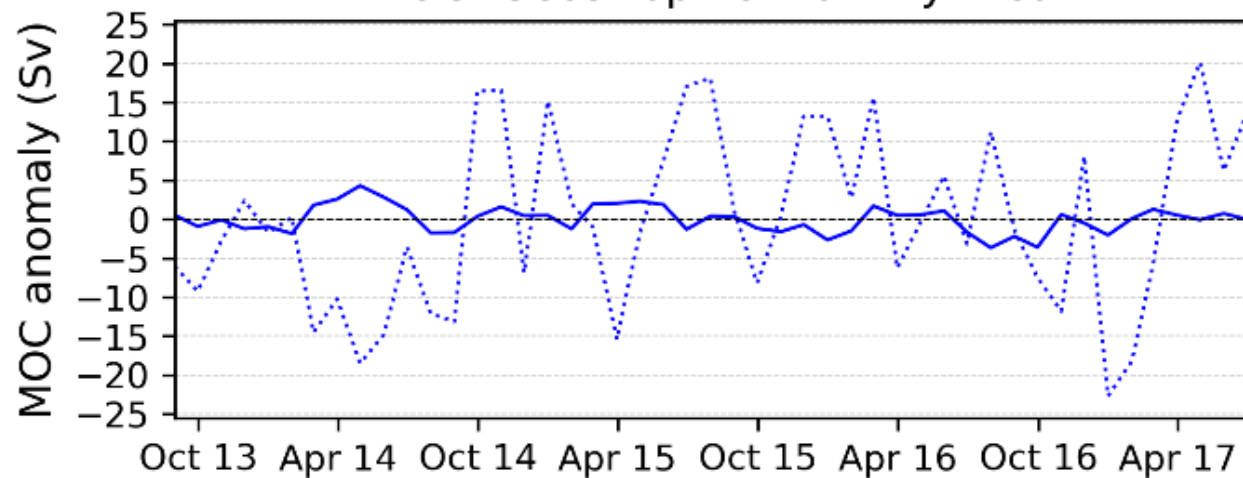
AMOC: Ensemble monthly-mean



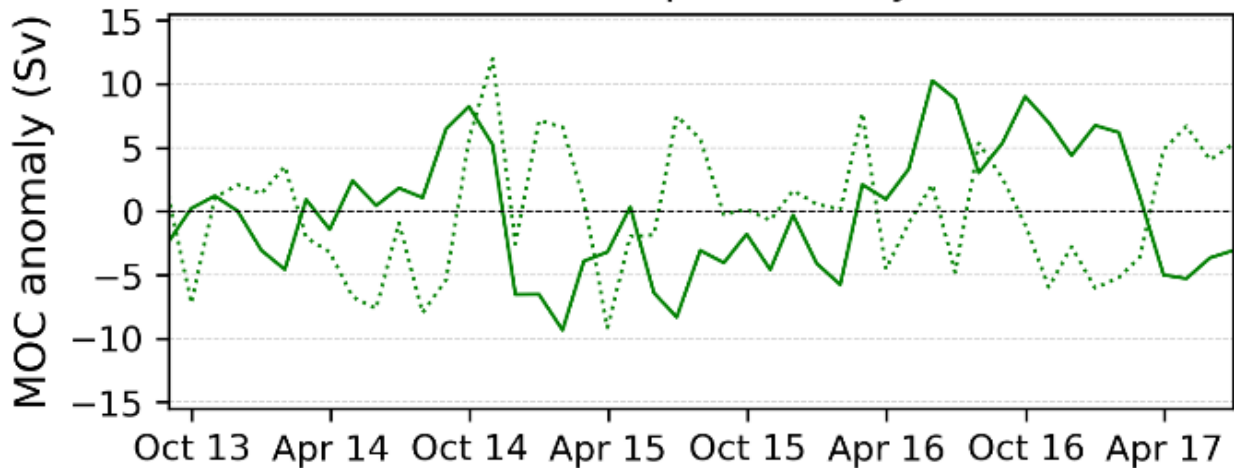
AMOC: SAMBA monthly-mean



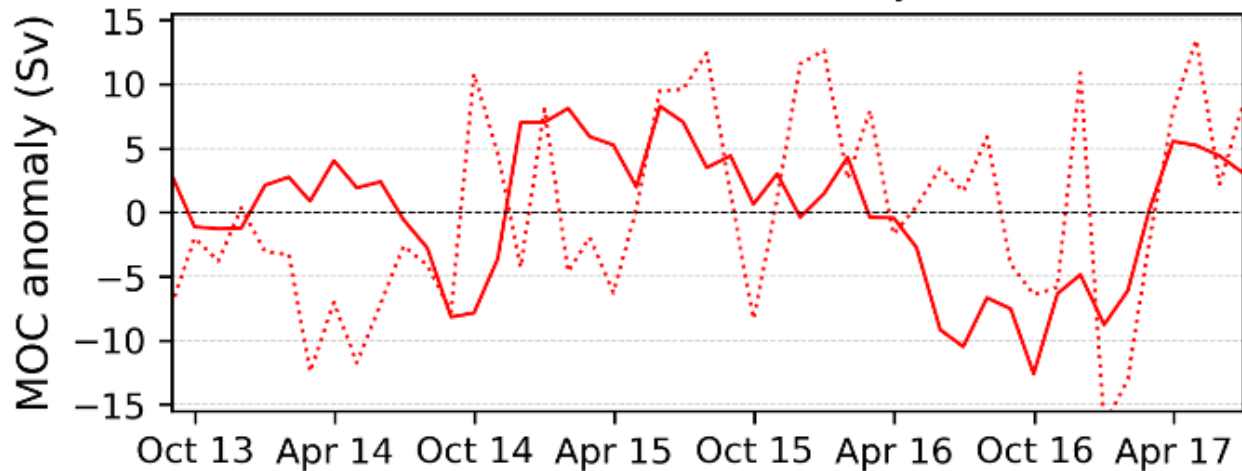
AMOC: Geostrophic monthly-mean



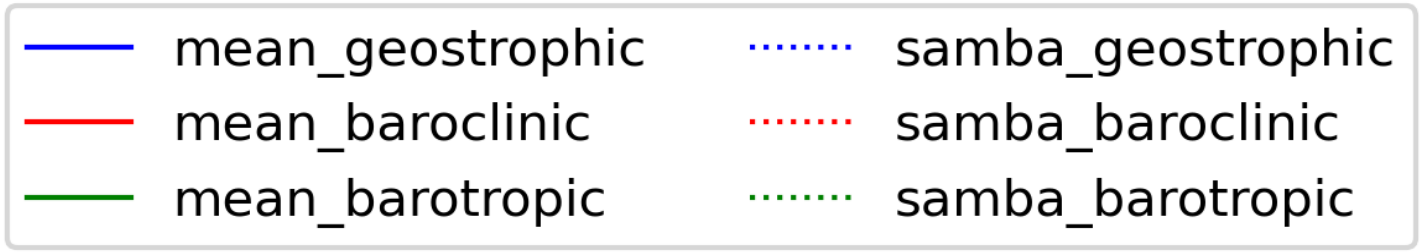
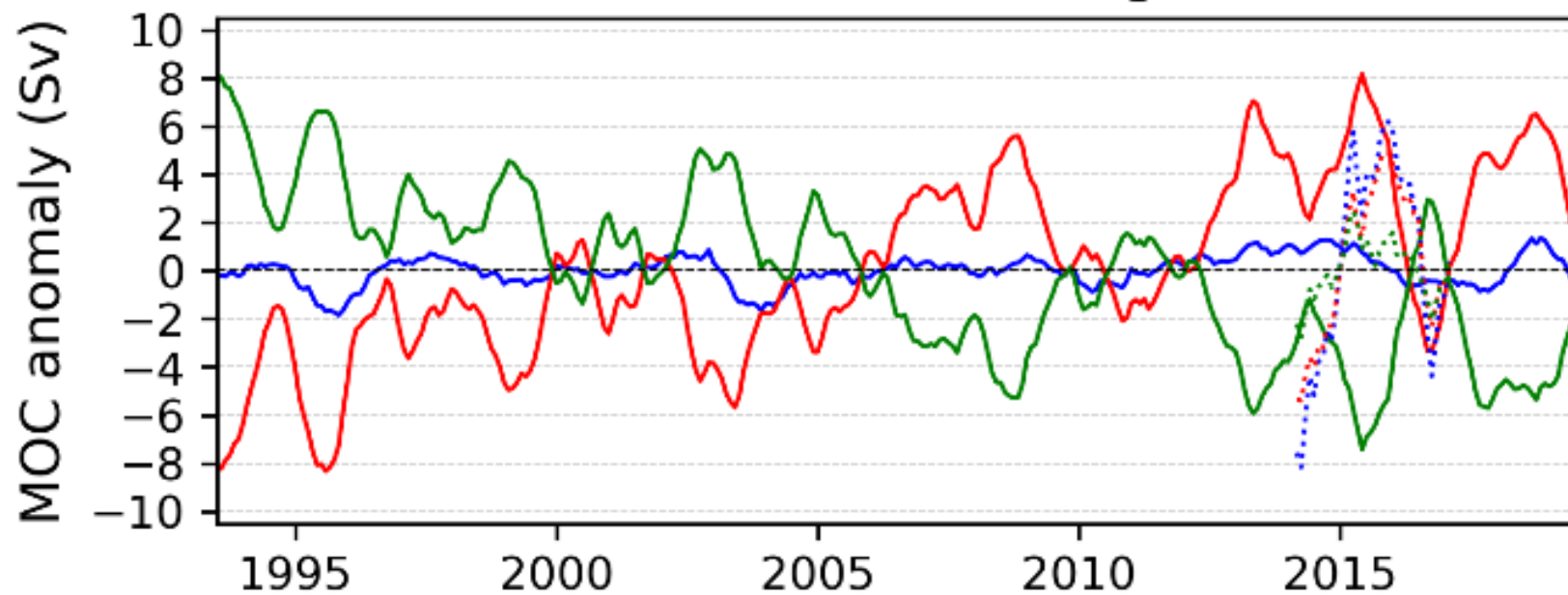
AMOC: Barotropic monthly-mean



AMOC: Baroclinic monthly-mean



AMOC: 12-month running mean



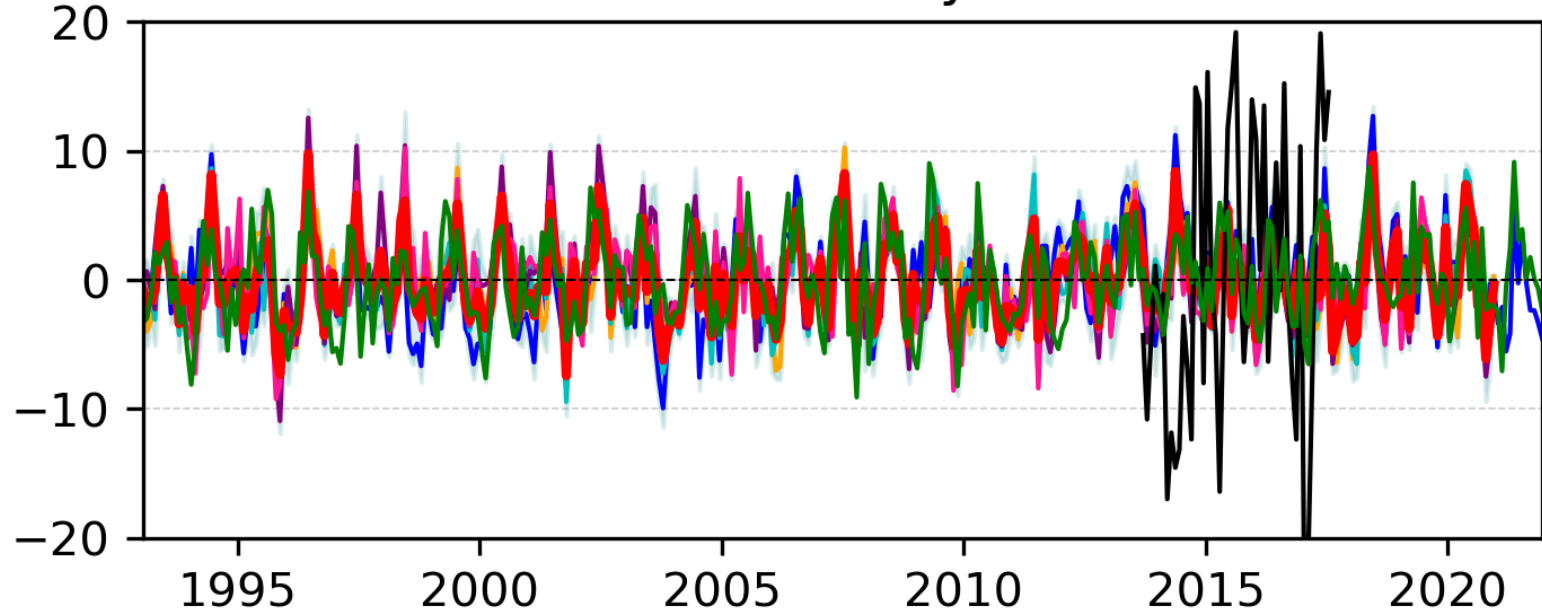
Conclusions

- South Atlantic MOC and heat transport are uncertain
 - Ensemble of reanalyses similar to monthly-mean variability of altimeter-based estimate, but large differences with SAMBA and energy-budget estimates
 - Large differences in time-mean heat transport, but time-mean MOC similar to other estimates
 - Differences due to geostrophic component – both baroclinic and barotropic components differ between estimates
 - Baroclinic component dominates differences in seasonal cycle – perhaps density profiles differ?
 - Baroclinic, barotropic (and Ekman) components augment each other in SAMBA, whereas they counteract each other in other estimates
- ➡ monthly-mean, seasonal and inter-annual MOC anomalies greater in SAMBA.
- Methodologies used need closer inspection
 - Reanalyses useful to understand changes in South Atlantic transports, and identify differences between estimates

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- **New title: South Atlantic overturning and heat transport variations in ocean reanalyses and observation-based estimates [accepted]**
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AMOC: monthly-mean



MHT: monthly-mean

