Uncertainty evaluation of the AMOC transport calculation at 11°S

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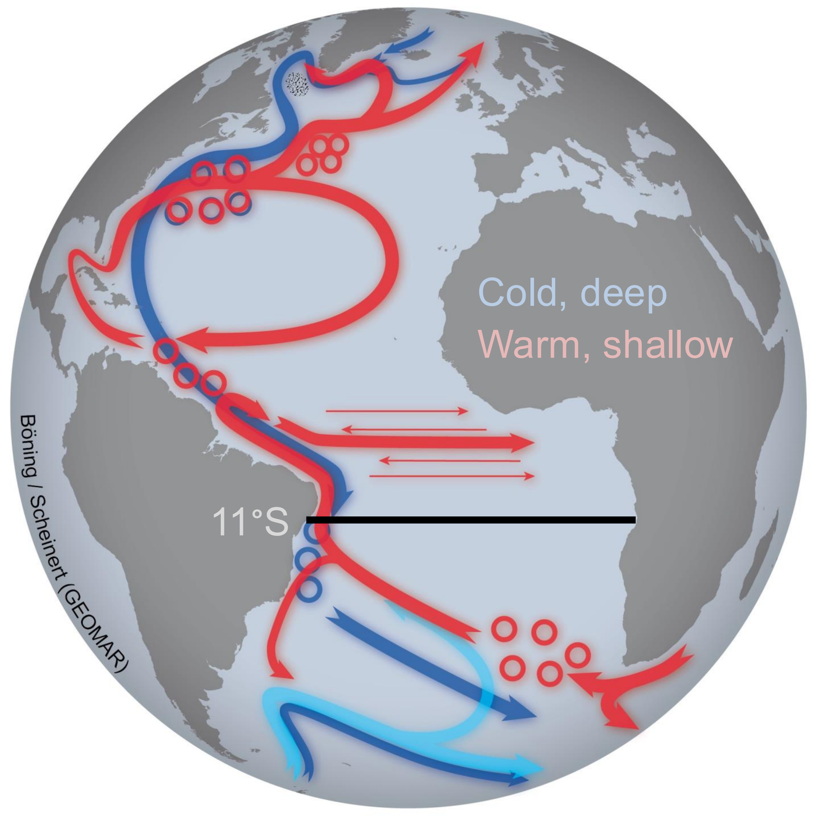
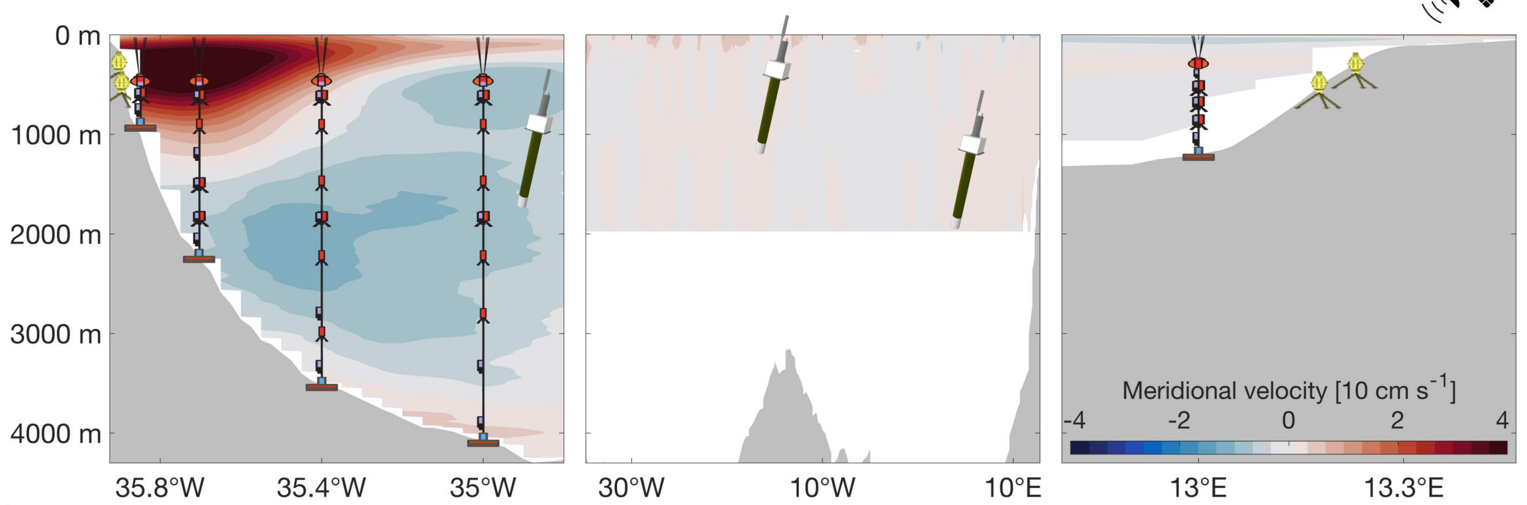


Research question:
What uncertainties are associated with the AMOC estimate at 11°S?

Important for:
- reducing the current differences between modelled and observed AMOC estimates.
- comparing observations at various latitudes.

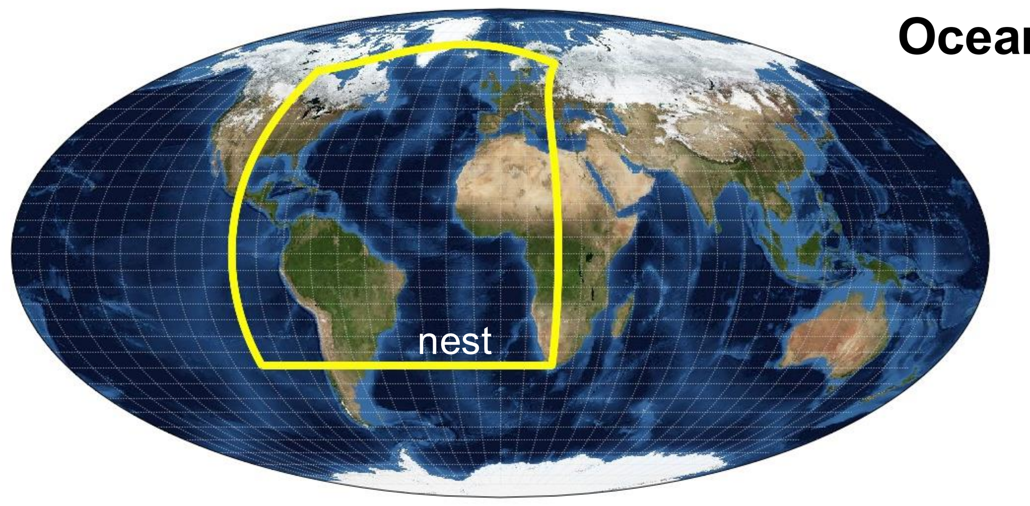
What is the AMOC?
- Atlantic Meridional Overturning Circulation
- Key feature of the oceanic circulation
- Important for regional weather and global climate
- Sum of geostrophic transport and Ekman transport (roughly)

TRACOS observing system at 11°S



The observing system consists of moorings and bottom pressure recorders (BPRs) at the western and eastern boundary.

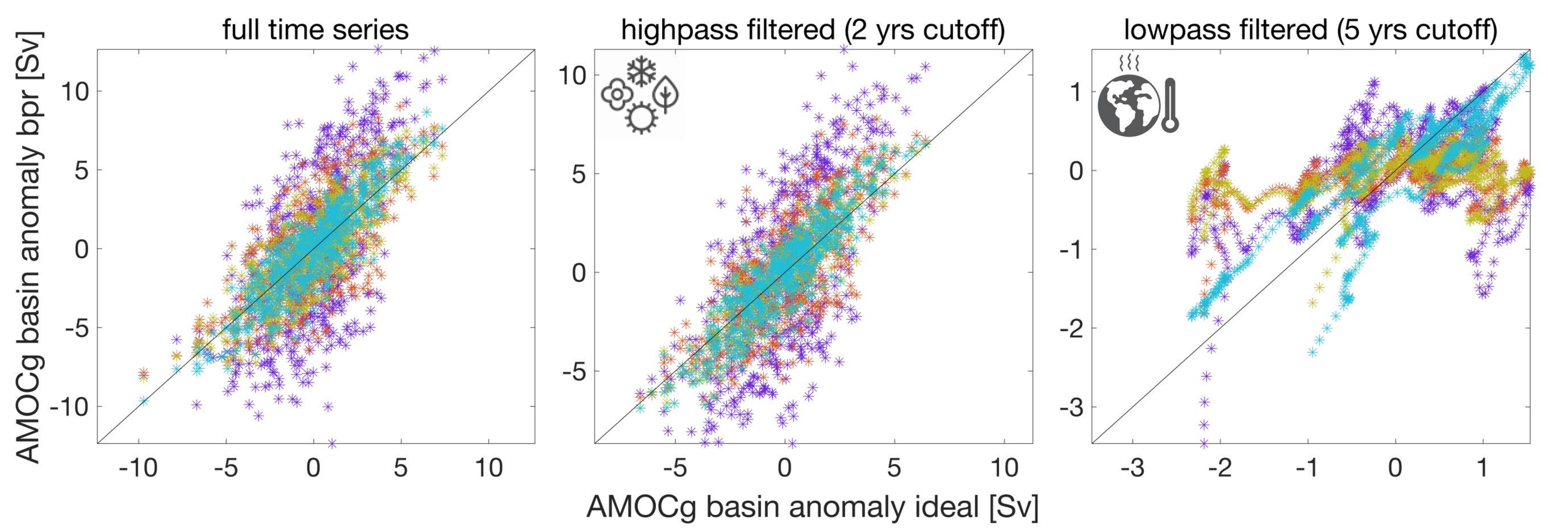
Subsampling the observational array in an ocean model to evaluate uncertainties



Ocean model VIKING20X
- Based on NEMO code
- 1/20° nest, embedded in a global 1/4° ocean model [1]

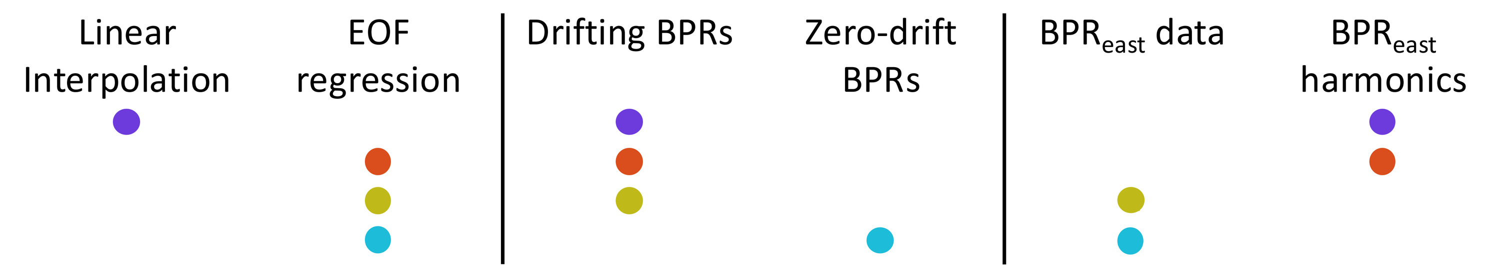
Geostrophic transport (AMOCg) via bottom pressure method

Using zonal pressure gradients from simulated BPRs at 300m and 500m depth and sea level anomalies at the boundaries and utilising a level of no motion at 1200m for the basin-wide transport [2]:



Explained variance:
40%, 51%, 69%, 81% I 45%, 57%, 82%, 83% I 9%, 12%, 12%, 80%

Uncertainties are analysed related to the used vertical structure I the usage of drifting or zero-drift BPRs I filling of data gaps at the eastern boundary with annual harmonics:



⇒ This method is sufficient to capture basin-wide geostrophic AMOC transport.
⇒ Eastern boundary BPR data improve short-term variability.
⇒ Zero-drift pressure sensors are necessary at the western boundary for long-term variability.

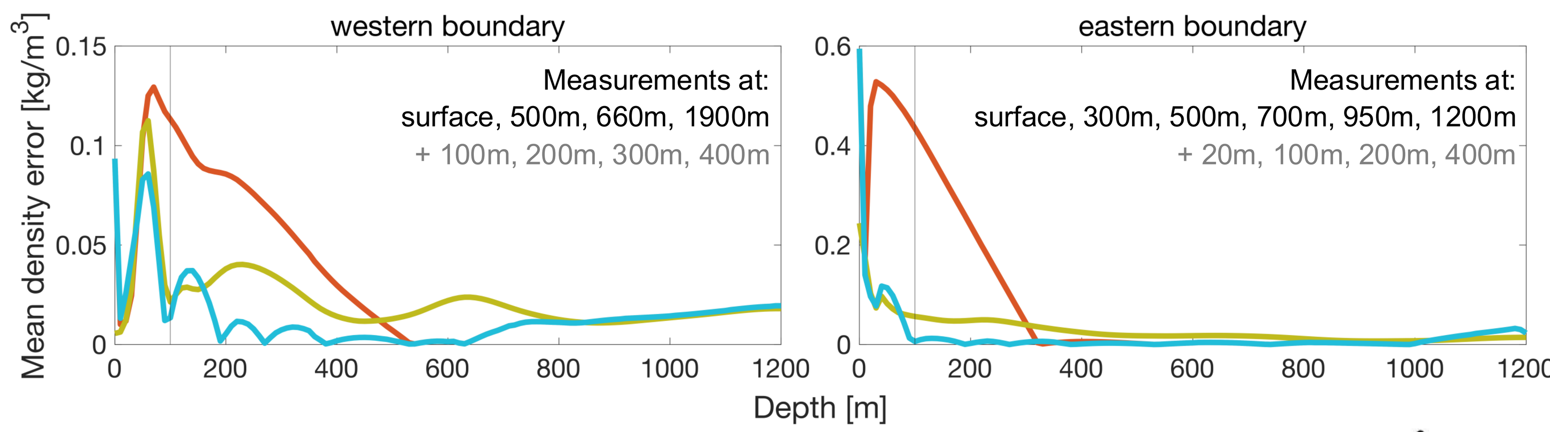
Geostrophic transport (AMOCg) via moored density method

Using zonal gradients from dynamic height profiles from interpolated [3] simulated moored density measurements and SLA for the interior transport:

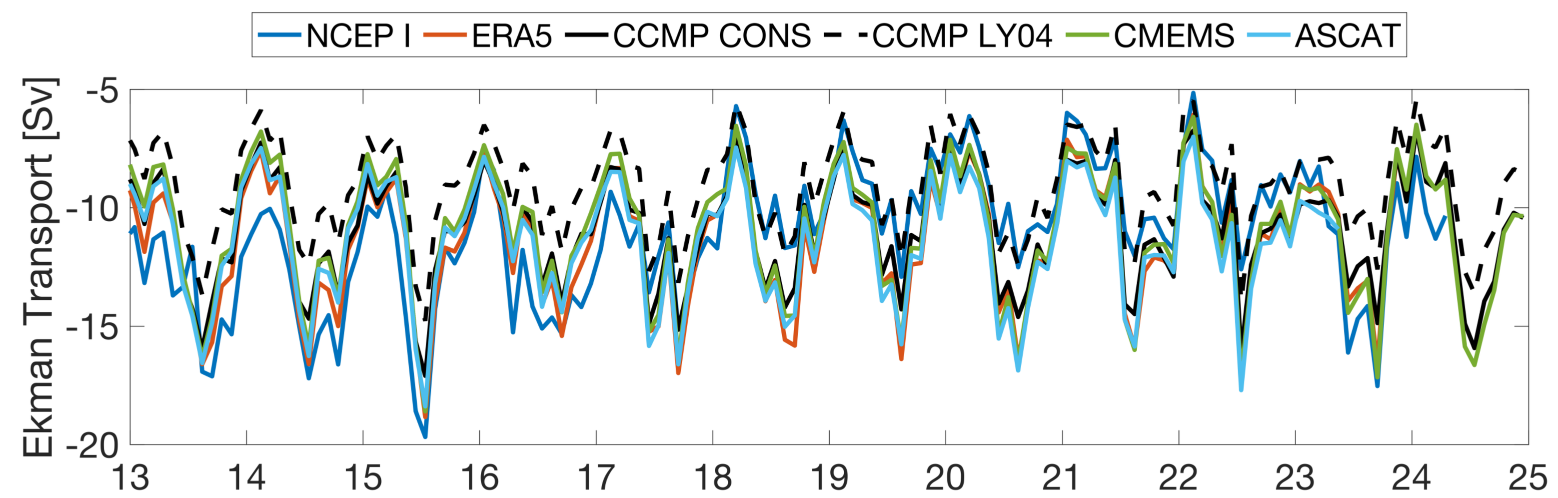
Explained variance for the resulting transport:
0%, 24%, 68% I 0%, 23%, 76% I 0%, 22%, 32%

⇒ An enhanced mooring setup is necessary to capture the interior geostrophic AMOC transport.
⇒ Interpolation of climatological gradients is the best choice for reconstructing density profiles.

Uncertainties are analysed related to the used vertical structure I the vertical position of measurements:



Ekman transport



Uncertainty due to choice of data set:
- Spread in mean value: 2.3 Sv (22%)
- Spread in annual amplitude / phase: 1.8 Sv (34%) / 10 days
- Linear trend: 3.2 I 0.8 I (0.6 I 0.6) I 0.2 I 0.3 Sv/decade

⇒ A large uncertainty factor for the Ekman transport is the choice of wind product and wind stress parameterisation.

Further reading:
[1] Biastoch et al. (2021). Regional imprints of changes in the Atlantic Meridional Overturning Circulation in the eddy-rich ocean model VIKING20X, *Ocean Science*
[2] Herrford et al. (2021). Seasonal variability of the Atlantic Meridional Overturning Circulation at 11°S inferred from bottom pressure measurements, *Ocean Science*
[3] McCarthy et al. (2015). Measuring the Atlantic Meridional Overturning Circulation at 26°N, *Progress in Oceanography*
Note: Icons from Flaticon.com are used.

Link to this poster:

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