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Monitoring the AMOC with GRACE/GRACE-FO - How far can we push the spatial resolution?

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The Atlantic Meridional Overturning Circulation (AMOC) plays a key role in our global climate system and is the main mechanism of northward heat transport for a warm climate in Northern Europe. Despite its crucial role, the AMOC is only scarcely observed, as observations covering all of the Atlantic Ocean for extended time are difficult to obtain. Satellite gravimetry offers key advantages compared to existing in-situ data sources by providing ocean bottom pressure anomalies with global coverage, thus allowing the monitoring of the AMOC in the complete Atlantic Ocean basin. The Gravity Recovery And Climate Experiment (GRACE) satellite mission and its successor GRACE Follow-On have provided a nearly continuous time series of monthly gravity field snapshots since 2002. In contrast to in-situ measurements of ocean bottom pressure, which suffer from inherent drift problems, the temporally stable satellite observations allow investigations of the long-term AMOC behavior.

Preliminary studies have shown that monitoring changes in the AMOC is possible with observations from GRACE and GRACE Follow-On, however, it is pushing the limits of the current data products in resolution and accuracy. To fully exploit the information content in the gravity observations, we implemented a processing chain tailored to the Atlantic Ocean basin. Compared to existing approaches, we perform signal separation, that is the reduction of continental hydrology and glacial isostatic adjustment, on the satellite sensor data level. This has the key advantage that all background models are treated the same, thus are spectrally coherent. Geocenter motion is estimated in combination with an ocean model, as is the state-of-the-art for GRACE/GRACE-FO processing. Ocean bottom pressure anomalies are then computed through least squares collocation, which allows for point distributions tailored to the bathymetry. This consistently processed data record is then used to gauge the performance of satellite gravimetry for monitoring the AMOC.