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Using Swarm to derive global sea level budgets

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The Swarm satellite mission offers the promising opportunity to close the gap between the Gravity Recovery and Climate Experiment (GRACE) mission and its successor GRACE Follow-On (GRACE-FO). We were able to monitor mass changes within the Earth system for more than 15 years using GRACE time-variable gravity fields. This time series has been interrupted with the mission‘s decommissioning in October 2017. GRACE-FO has been launched in May 2018 and we are facing a gap of more than one year depending on when the first gravity fields will be available. Deriving time-variable gravity fields from the kinematic orbits of the three Swarm satellites allows us to investigate mass changes in a lower resolution of approximately a few 1000 kms.

It has already been shown in earlier studies that monthly global mean ocean mass changes can be derived from Swarm with a root mean square error of 4.0 mm with respect to GRACE. This is an important finding, because estimates of ocean mass change are necessary to separate steric sea level change from sea level measured with satellite altimetry.

Furthermore, a combination of GRACE and altimetry has already been used in a joint inversion to split total sea level change into its individual components, such as GIA, melting of ice sheets and glaciers, steric changes, hydrology, etc.

We will show preliminary results of integrating Swarm into a global fingerprint inversion. This will allow to estimate sea level budgets for the gap between GRACE and GRACE-FO as well as in the monthly GRACE gaps. We will show three experiments: (1) using all available degrees of GRACE (2) using GRACE until degree 12 to mimic the Swarm resolution and (3) using Swarm until degree 12. In this way, we can assess the influence of the resolution as well as the measurement principle.