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On the benefit of next-generation gravity missions for sea level and ocean mass applications

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Today, the analysis of the Earth's time-variable gravity field plays a key role in Earth system research. The GRACE observables provide an almost direct measurement of the mass that is redistributed at or near the surface of the planet. Yet, important questions such as closing the sea level budget from GRACE, altimetry and steric data still pose a challenge, even after 9 years of GRACE.

Promising approaches have been developed that combine multisensor data and/or model output, e.g. to estimate ocean warming/cooling, calibrate hydrological models or to improve geo-centre motion estimates. However, in the view of the authors, the biggest challenge in climate applications such as sea level studies is the problem of signal separation. This problem involves separating signal and noise stemming from the measurement systems and/or background modelling, as well as separating mass flux patterns originating from different or the same compartments of the Earth system (the leakage problem in ice sheet mass balance from GRACE, sea level rise partitioning, teleconnections in the hydrological cycle, trends in continental hydrology vs. GIA).

Here we will first review the state of the art in addressing the signal separation problem after 10 years of GRACE. Then, we will discuss the potential of a number of candidate schemes for future gravity missions that were investigated in the recent ESA-funded Next Generation Gravity Mission (NG2) study.