



## **What GRACE/GRACE-FO satellite gravity may tell about the atmosphere (and what not)**

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In this presentation we would like to discuss the present benefit and future potential of satellite gravity observations, as obtained from the satellite mission GRACE and its successor GRACE-Follow-On (GRACE-FO), for studying the atmospheric water cycle. In the first part of the presentation, we will show recent results of using GRACE to constrain atmospheric water budgets. GRACE-derived water storage changes (in combination with observed runoff) can be used to solve for the vertical water flux deficit of precipitation (P) minus evapotranspiration (E), which links the terrestrial and the atmospheric water balance equations. This relates gravity change to moisture flux divergence and water vapor change and thus provides, in principle, a link between GRACE/GRACE-FO and (area-averaged) GNSS integrated water vapor observations that may be exploited in the future. We will show that such an independent estimate of P minus E can be used to constrain land-atmosphere fluxes from monthly time scales to decadal trends and even provides meaningful flux information down to daily time steps.

In the second part of the presentation, we would like to give an outlook towards the potential of using satellite gravity data directly for the estimation of atmospheric water mass changes. On the basis of ERA-Interim data, we provide a first assessment which suggests that an anticipated future double-pair gravity mission with enhanced temporal and spatial resolution would be sensitive to 'feeling' atmospheric water mass (water vapor) variations. However, whether these (faster) variations could be separated from dry air mass variations through modeling needs to be investigated. If possible, this would offer a completely new tool for validating atmospheric analyses and for improving energy and mass budgets in models.