



Determination of mass variations in the Siberian permafrost regions using GRACE monthly solutions

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The Gravity Recovery and Climate Experiment (GRACE) satellite mission is now in orbit for about 7 years. A number of studies regarding periodic signals as well as long-term trends have been carried out so far. For the trends, it is/was focused on regions with large signals such as Greenland and Antarctica for ice melt and North America and Fennoscandia for glacial rebound-induced mass variations. The long time span now also allows detecting smaller secular trends of mass variations as well as long-periodic signals. Here, several regions can be found that are still insufficiently investigated. In our study, we have selected the permafrost-regime in Siberia, Russia, for further investigation, using the GRACE monthly solutions from the three main analysis centres GFZ, CSR and JPL. The results show that observed positive trends of mass changes are related to large Siberian rivers such as Ob, Lena and Yenisei. Two major trends with amplitudes of about $0.3 \mu\text{Gal}/\text{yr}$ can be clearly identified – one concerning the lower Ob basin, the other centered on the river Lena northeast of Lake Baikal. These trends seem to be caused by long-term hydrological changes, especially since no other geophysical explanation is found yet. The identified trends show different spatial and temporal behaviors due to different climate and permafrost conditions. Earlier terrestrial investigations analysing river discharge data found out that discharge of Siberian rivers increased due to climate warming over the past decades, which supports our findings. A positive trend of about $0.2 \mu\text{Gal}/\text{yr}$ for the third major Siberian river, the Yenisei, can only be detected with GFZ monthly solutions and is therefore not identified as a significant result. However, earlier independent studies also show an increase at Yenisei, and thus further investigation is needed.