Geophysical Research Abstracts
Vol. 17, EGU2015-13521-1, 2015
EGU General Assembly 2015

Evaluation of different C20 coefficients for the determination of ice mass loss in Antarctica and Greenland

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Large ice sheets cover the regions at North Pole and South Pole, Arctic and Antarctica. Due to global warming, these ice sheets experience changes. Depending on the location, ice sheets are melting or accumulating ice. These changes can be detected using geodetic space techniques like altimetry and satellite gravimetry. The CryoSat-2 mission is a special altimetry mission to observe the Earth's cryosphere and detect ice mass changes. It was launched in 2010. The satellite gravimetry missions GRACE and GOCE started earlier in 2003 and 2009. Both techniques, altimetry and gravimetry, provide data to compute the ice mass changes. The main observable of altimetry is the elevation change caused by melting and accumulating ice, whereas gravimetry observes changes in the Earth's gravity field due to mass changes.

In our study we use data of GRACE and GOCE for a period between November 2010 and September 2013. This allows to directly compare the results with results obtained from CryoSat-2 mission. GRACE is suitable to measure the long wavelength part of the Earth's gravity field, whereas GOCE is projected to detect its shorter wavelength parts. Gravity gradients derived from GRACE monthly fields are combined with directly measured GOCE gradients by filtering the data along the orbit. GRACE is used up to 10 mHz, GOCE from 10 mHz up to 150 mHz. This data set does not include the polar gap of GOCE, which is filled up with GRACE only data.

We use this data set to compute monthly solutions of spheric harmonic coefficients, which are then transformed to equivalent water height (EWH) values on a grid. In addition, they are summed up to obtain ice mass loss. Therefore, the pole regions are divided into smaller basins. As both gravimetry missions are not suited to detect the spheric harmonic coefficient C20 with sufficient accuracy, it has to be replaced. The coefficient C20 describes the flattening of the Earth and has therefore a large influence at the polar regions. We use time series for C20 from Center for Space Research (CSR), USA and DGFI, where both institutes use satellite laser ranging (SLR) to obtain the coefficient, as SLR is a highly suitable technique for C20 determination.

In this study, we analyse different scenarios of C20 replacement to detect the effect of C20 on ice mass loss. The focus will be on the one hand Antarctica, where glaciers in the western part and the Antarctic Peninsula experience large ice mass loss and on the other hand Greenland.