Abrupt Change in Ice Loss Rate of Alaska's Glaciers Observed from GRACE and GRACE-FO Data

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Subpolar glaciers in the Gulf of Alaska and northwestern Canada are one of the important contributors to sea level rise from global warming. The Gravity Recovery and Climate Experiment (GRACE) data can be extensively used to determine mass changes of the world’s land ice. Using satellite data, I estimated mass changes of glaciers and rate change in the long-term variations of ice mass in the Gulf of Alaska region during the study period of 2002-2020. It is also found that there was an abrupt change in ice loss rate starting in 2012. I investigated if this was mostly induced by changes in precipitation. GRACE and GRACE-FO satellites’ monthly data were analyzed over the period 04/2002–10/2020. A linear regression determined the long-term mass loss rate. The Global Precipitation Climatology Project (GPCP) monthly precipitation data were analyzed over the period 01/1979–10/2020 to investigate any correlation with the ice-mass data. The mass changes of glaciers in the Gulf of Alaska region showed a clear annual cycle of spring-fall with the maximum in autumn and the minimum in spring. The annual pattern of precipitation matched the annual mass fluctuations observed by GRACE. The long-term mass loss rate of these glaciers was approximately 16.47 gigatons per year over the period 2002-2020. Notably, a tipping point seems to have occurred in 2012 with a clear change in the ice-mass loss rate. Prior to 2012 the loss rate was 15.6 Gton/year and after 2012 it was 24.9 Gton/year. However, the precipitation showed changes in long-term trends different with GRACE observations. Precipitation did not directly cause the strong decline of glaciers after 2012. Other factors must have caused the ice loss of Alaska's glaciers, especially over the period 2012-2020.

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