Mass balance study on the Greenland ice sheet

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The Greenland ice sheet (GrIS) is the second largest storage of fresh water on earth. The variation of mass balance of the GrIS could affect not only the sea level, but also on global climate through the modulation of the deep water formation in the ocean. The study on the GrIS has therefore a significant importance on studies and projections of global environmental change. In the Arctic, most significant signal of global warming appears by polar amplification, which results in the rapid mass loss of the GrIS. The extreme surface melt event across the entire ice sheet was observed in 2012 (Nghiem et al., 2012). The cause of mass loss can be attributed to the temperature increase, albedo reduction by snow impurities, and also to the ocean warming which induces the enhanced melt at the marginal glaciers (Box et al., 2012; Fettweis et al., 2013). Recent mass loss of the GrIS are mainly caused by an increase of surface melting and acceleration of outlet glacier discharge to the ocean, in which the former effect dominates compared to the latter effect (van den Broeke et al., 2016). These changes of the factors which influence the mass balance are a result of complicated interactions and feedback effects in the components of earth system forced by an increase of green house gases.

Considering such backgrounds, the following studies are needed to make a breakthrough on our understanding of the surface processes and mass balance change of the GrIS and their impacts: (1) expanding of an Automatic Weather Station (AWS) network, (2) physical process study based on the in-situ observations and the process modeling, especially for near-surface radiation process and snow metamorphism, (3) satellite remote sensing of ice sheet surface properties, (4) development of the regional polar system model including these processes, and the validation of the model performance by the satellite observation, (5) ice sheet and GIA (glacial isostatic adjustment) modeling for understanding of the ice sheet dynamics and for projections of the future sea level rise, (6) ice core analyses, borehole measurements and landform observations for understanding of surface mass balance and extent of the GrIS in the past and ice sheet dynamics, which could be also used to constrain ice sheet and GIA models. Although the research community already has started these activities, it is not sufficient. It is needed to organize the research community and built the research project including these research topics.

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