An ice-flow modeling study for evaluation of sites for an oldest ice core around dome Fuji, Antarctica

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The recovery of a new Antarctic ice core to cover one million years will advance our understandings of the Quaternary climate. Previous ice flow modeling studies indicate that such old ice may exist in inland areas of the Antarctic continent, where the ice is thick enough, accumulation rate is low, basal temperature is well below the pressure melting point, and horizontal ice flow is slow (Pattyn 2010; Fischer et al. 2013; Van Liefferinge and Pattyn 2013; Sun et al. 2014; Parrenin et al. 2017). The 59th Japanese Antarctic Research Expedition (JARE 59, 2017-2018 Antarctic summer) conducted glaciological field surveys for the selection of next deep coring around Dome Fuji. In particular, a set of ground radar surveys were conducted around Dome Fuji for improved mapping of the bedrock topography as well as internal layers of the ice sheet. We have been analyzing the field data and conducting ice flow modelings, under both idealized and realistic simulations constrained by the new data, to estimate the flow and age of ice near the bed of the ice sheet, as the essential parts of the site selection activities.

In the present study, we use an one-dimensional ice flow model to investigate the influence of uncertain model parameters such as ice thickness, accumulation rate, geothermal heat flux, and thinning rate, on the age estimation of ice especially in the lowest few hundred meters. The calculated age and temperature profiles are compared with previous depth-age models and borehole temperature at Dome Fuji for assessing the model performance for our purposes. The one-dimensional model is then applied to the vicinity of Dome Fuji along the transect of JARE 59 surveys, and simulated age profiles are compared with dated internal layers from the observation. The model results will inform the planning of survey areas of the coming international survey within JARE 60 with higher-performance radars. Further investigation with the JARE 60 data and model developed here will be conducted in the next year. In the presentation, we will discuss the evaluation of potential site and the influence of uncertain parameters on the age of the deep ice core.

References

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