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Investigations on the origins and maintenance of the Scharffenbergbotnen blue ice area by combined surface wind and ice flow simulations

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Using the turbulent flow modeling capabilities of the Finite Element code Elmer we model the spatial and temporal distributions of wind impact speeds caused by a katabatic wind front on the by nunataks surrounded glacier valley of Scharffenbergbotnen (SBB), Dronning Maud Land, East Antarctica. Comparison of these patterns to the steady state mass balance distribution obtained using a prescribed fabric distribution to solve the prognostic ice flow problem with a the full-stress code Elmer/Ice reveal a significant correspondence over the inner part of the valley and in particular the blue ice area (BIA) where the snow and even multi-year firn is removed by very high winds. This leads us to the conclusion that topographically accelerated winds are the dominant factor determining the mass balance of high elevation BIA's. Based on geomorphological evidence we further reconstruct the surface terrain to resemble the situation at the Late Glacial Maximum (LGM), where the ice inside the valley was $\sim$200 m thicker and the nunataks were smoothed out by the ice cover. The same turbulent flow simulation, utilizing the Virtual Multi-Scale (VMS) method, on this altered terrain reveals that the focusing effect of the present day surface did not exist at the LGM. This supports the finding of ice sample ages and flow model results that the inner BIA at SBB was created as a consequence of the lowering ice surface clearly after LGM.