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Influence of geothermal heat variability on enhanced flow and onset of West Antarctic ice streams

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Determining the controls on enhanced ice flow and ice streaming behaviour is a key to understanding ice sheet stability and evolution. The dynamics of the Siple Coast Ice Streams within the West Antarctic Ice Sheet (WAIS) are generally thought to be influenced by bed topography and roughness, basal substrate deformation, basal hydrology etc., but precise controls are less evident. Inferred distribution of geothermal heat flux in Antarctica (Shapiro and Ritzwoller, 2004, doi:10.1016/j.epsl.2004.04.011) shows that mean heat flow in West Antarctica is expected to be nearly three times higher than in East Antarctica and much more variable. This high heat flow may affect the dynamics of West Antarctic ice streams and the stability of the West Antarctic Ice Sheet. We therefore applied the 3D thermomechanical ice-sheet model of Pattyn (doi:10.1029/2002JB002329) to the drainage basin of the ice streams discharging into the Ross Ice Shelf. Experiments were carried out for different values of constant geothermal heat flux (G = 35, 70, 105 mW m^{-2}) as well as a hot spot underneath the Hollick-Kenyon Plateau, as revealed in the most recent heat flow data. These results were compared to the variable heat flux experiments by Johnson (2002) and demonstrate that onset areas are highly influenced by the choice of geothermal boundary condition. Simulating subglacial water transport according to the different scenarios shows an even higher variability and dependence. Finally, dynamic experiments demonstrate the long-term effect on ice streams in the coastal region.