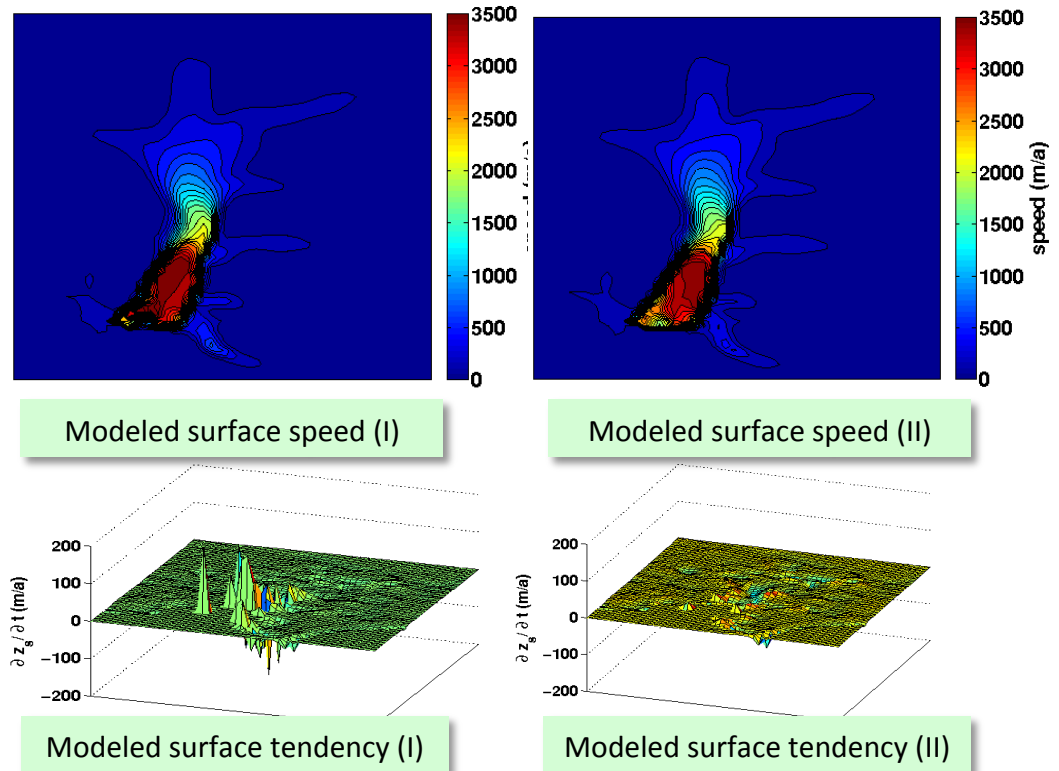# Constraining transient ice sheet models with sparse, diverse observations

Objective

Assimilation of observations into time-evolving ice sheet models is increasingly recognized as a powerful method to infer uncertain model initial conditions that lead to realistic model projections with suppressed artificial drift.

Approach

- Developed exact adjoint of a time-evolving marine ice sheet model that represents floating, fast-sliding, and frozen bed regimes of marine ice sheet
- Solves hybrid shallow shelf-shallow ice stress balance and continuity equation for ice thickness evolution
- Inversion of time-dependent surface elevations for past thicknesses, and simultaneous retrieval of basal traction and topography

Modeled surface speed (I)

Modeled surface speed (II)

Modeled surface tendency (I)

Modeled surface tendency (II)

Impact

The results suggest the feasibility, using real observations, of improved ice sheet state and parameter estimation, initialization of ice sheet models for prediction, and comprehensive sensitivity analysis.

Goldberg, D. N., & Heimbach, P. (2013). Parameter and state estimation with a time-dependent adjoint marine ice sheet model. *The Cryosphere*, 7(6), 1659–1678. doi:10.5194/tc-7-1659-2013