Fingerprinting past changes to the Ross Ice Shelf

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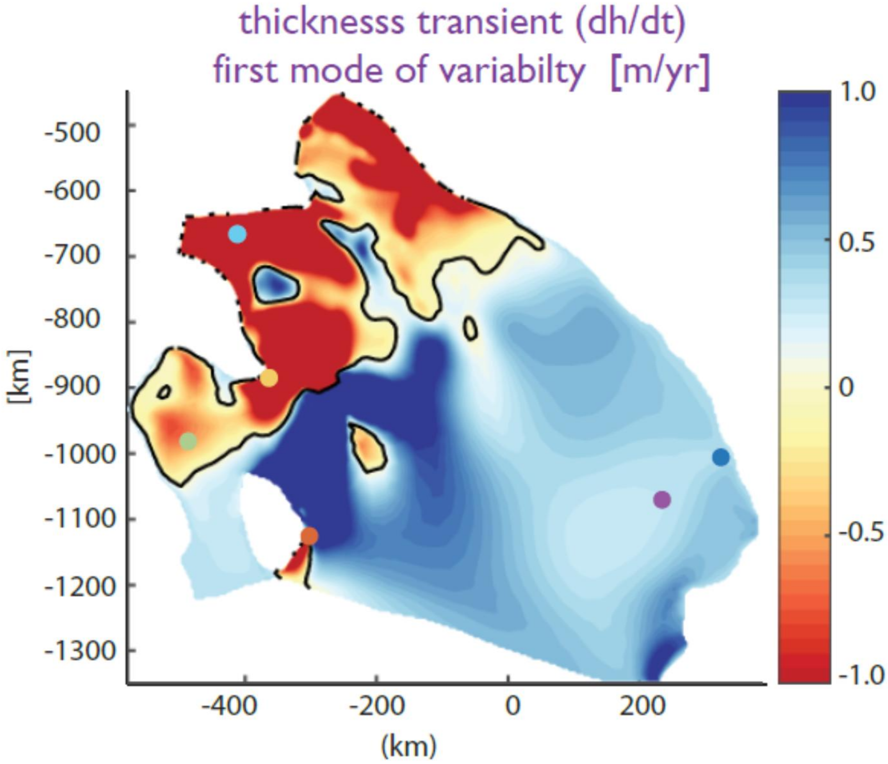

Abstract: The Ross Ice Shelf (RIS) is the gateway through much of the ice in Antarctica passes through before moving into the Ross Sea, either as icebergs or melt-water. Satellite-based observations have recorded changes to the ice shelf during the past few decades. The RIS is the pathway by which climate change can be transmitted by the ocean or atmosphere to the grounded ice sheet. However, there some well-demonstrated examples of changes at the boundaries that produced long-lived effects to the RIS. Thus, when we interpret present-day observations of the RIS, it is important to separate changes that are driven internally (from the ice sheet) from those driven externally (by the ocean or atmosphere).

Do past, internal driven, changes to the RIS have recognizable imprints on the present day observations? How fast do these signals fade? Here we focus on determining the “fingerprints” that past internally driven changes to the RIS have on the present-day observations. Using a model of the RIS, we periodically change boundary conditions to the shelf to simulate acceleration and deceleration of ice streams and glaciers, grounding and ungrounding of ice plains, and the release of tabular icebergs from the shelf’s terminus. Characteristic patterns associated with those perturbations are identified using empirical orthogonal functions (EOFs). The leading EOFs reveal shelf-wide pattern of response to local perturbations that can be interpreted in terms of coupled mass and momentum balance. We calculate decay times at various locations for various perturbations and find that multi-decadal to century time scales are typical. These EOF “fingerprints” are compared to present-day observations of thickness and velocity changes to examine if these signals of past events are persisting into today.

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L1 Lecture Theatre

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