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The Bruce Plateau Ice Cap: Upstream Dynamics of the Southern Larsen B Ice Shelf

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The Bruce Plateau is a broad, gently undulating ice plateau at 2000 m elevation spanning the divide of the Antarctic Peninsula near 66^{o} S. The western side is the catchment area for the glaciers of numerous inlet fjords such as Beascochea and Barilari Bays. The eastern side is the catchment area for the glaciers of the southern Larsen B Embayment including Flask and Leppard Glaciers and the northern Larsen C Ice Shelf (Atlee and Cabinet Inlet areas). The LARISSA Project, an NSF-funded multi-disciplinary investigation of the region, has a series of observation sites located from the ice divide to the ice shelf: an ice core was drilled to bedrock in 2010 (447 m of ice), and instruments were installed on the Leppard and Flask Glaciers, and the Scar Inlet Ice Shelf of the southern Larsen B Embayment. We present the preliminary results of an observational and modeling analysis of the dynamics of the Bruce Plateau with respect to its role as the source region for the glaciers and ice shelves of the Larsen B Embayment and the western outlet fjords.

We use a suite of data from site installations and remote sensing efforts. Surface topography data from NASA aircraft (IceBridge Project and preceding data collections) were augmented with surface-based GPS profiles. We mapped bedrock topography through a 5 MHz Radio Echo Sounding (RES) survey. Near the divide, we also measured the spatial accumulation pattern and internal structure of the ice to 400 m with a 25 MHz RES survey. We installed weather stations augmented with firn temperature sensors (at several depths up to 120 m), accumulation sounder, cameras, and GPS near the divide, on Flask Glacier and the Scar Inlet Ice Shelf. On upper Leppard and Flask Glaciers we installed continuous GPS stations. We combined these surface velocity observations with InSAR-derived surface velocities.

Bedrock topography of the central Bruce Plateau near the ice core site consists of several hills with relief of several hundred meters. Ice thickness ranges from 200 m above the hills to more than 700 m deep in the troughs. To the west of the hills, bedrock slopes gently downward, while surface elevation increases to the crest. Indicating that the ice divide may be up to 2 km to the west of the local bedrock divide. Our ice-core site is $\sim$ 1km east of the divide crest, with an ice thickness of 450 m and a surface flow speed of 10 ± 4 m/yr. Accumulation at the ice core site averaged $\sim$2 meters of ice per year between 1963 and 2010 (estimated from beta radioactivity). Accumulation rates decrease by at least an order of magnitude towards the Larsen B Embayment. Firn temperatures at the ice core site indicate a recent mean annual temperature of -15.1^{o} C. Basal ice temperature is -11.2^{o} C.

Due to the high accumulation rates and strong orographic precipitation pattern across the Antarctic Peninsula, the Bruce Plateau slopes steeply from the divide and initiates channelized valley glacier flow within less than 5 km of the ice divide. The strong orographic precipitation pattern leads to steep (0.1 mean slope), short (20 km to ocean calving face) glaciers ending in fjords on the warmer, wetter, western side of the Peninsula and more gently sloping (0.025), longer (75 km) glaciers which end in ice shelves on the colder, drier, eastern side of the Peninsula.

Recent warming and western-side sea ice loss has likely led to increased accumulation rates on the western side of the Antarctic Peninsula. Our data suggest a recent (within the top 150 m of internal layering) westward migration of the crest of the ridge. Through a suite a simple experiments using a finite-element model we show preliminary analyses of the westward divide migration.