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Changing surface hydrology, strain rates and fracture distribution across Nivlisen and Riiser-Larsen Ice Shelves, Queen Maud Land, Antarctica

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The collapse of four major Antarctic Peninsula ice shelves since the 1950s, most notably the catastrophic collapse of the Larsen B Ice Shelf in 2002, has highlighted the need for a greater understanding of the drivers of ice shelf instability under current climate warming trends. In particular, surface and basal melting, ponding, vertical hydrofracturing, horizontal fracture propagation, and ice-shelf edge retreat, have all been identified as factors that may have contributed to past ice shelf collapse events. In order to further investigate the likely precursors to ice-shelf instability, we are making a series of remotely sensed observations of the Nivlisen and Riisen-Larsen Ice Shelves, using a combination of Optical Imagery from Sentinel-2 and Landsat, and Synthetic Aperture Radar (SAR) Imagery from Sentinel-1 and ERS-1 and -2. Using these data, we are developing semi-automated methods for tracking spatial and temporal changes in: i) surface and subsurface meltwater ponding; ii) surface velocity and strain rate patterns; and iii) the density and geometry of surface fracture patterns. The analysis and synthesis of these data should ultimately allow us to identify a vulnerability index to show how close an ice shelf is to instability and collapse, and then how this vulnerability may change under future climate warming scenarios.