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Structural and dynamic changes of Wilkins Ice Shelf, Antarctic Peninsula

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Wilkins Ice Shelf (WIS) has shown considerable ice front retreat since 1990. This retreat includes various break-up events, such as recently in 2008 (Feb: 425 km^2, May: 160 km^2, Jul: 1220 km^2) and in 2009 (790 km^2). The break-up events took place under contrasting surface conditions, which indicates potentially different mechanisms for break-up. WIS shows quite specific peculiarities like a high amount of ice rises, highly variable ice thicknesses across the ice shelf, tributary glaciers draining into inlets as well as only limited nourishing by direct inflow from tributary glaciers.

The present study aims to better understand the dynamics and mechanisms leading to disintegration and break-up of WIS. We hence investigate satellite data to reveal changes of glaciological structures like fractures and shear margins, the position of the grounding line, changes of frontal positions and ice surface velocities. Very few in situ measurements are available at WIS, which emphasizes the use of satellite data. Especially Synthetic Aperture Radar (SAR) data show high potential for glaciological purposes.

We use SAR data (ALOS PALSAR, TerraSAR-X, TanDEM-X, ERS-1/2) in order to calculate surface velocities of the ice shelf and its tributaries at different times using SAR offset tracking procedures. The combined use of TanDEM-X InSAR surface elevations and IceSAT, CryoSat and NASA Ice Bridge ATM data enables the estimation of ice thickness assuming a constant ice density.

First results show surface velocities before and after the break-up events in 2008 and 2009 as well as changing flow velocities of tributary glaciers. The combination of InSAR surface elevation and altimeter data allows for a comprehensive estimation of ice thickness across WIS. Both data sets can be used for subsequent ice dynamic modeling and fracture mechanics.