Glaciological Studies in Antarctica and Patagonia by Means of ERS SAR Interferometry

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Abstract

The dynamic of glaciers and polar ice has been investigated by means of interferometry based on SAR data from ERS-1 three-day repeat orbits and from the ERS-1/ERS-2 tandem mission. The studies are a contribution to the ERS-1/ERS-2 experiment AO2.A101 on "Comparative Investigations of Climate Sensitivity and Dynamics of Glaciers in Antarctica, Patagonia, and the Alps". The investigation areas include the Heimefrontfjella mountain range in Dronning Maud Land, Antarctica, the northern Larsen Ice Shelf and its tributary glaciers on the Antarctic Peninsula, and the Southern Patagonian Icefield, Argentina. In each of these regions comparative field data on ice motion and ice properties are available at specific points. For the Antarctic investigation areas maps of ice motion were generated by means of differential interferometry, showing complex patterns of ice dynamics as an effect of complex surface and sub-surface topography. In addition, for the test area in Dronning Maud Land temporal decorrelation of the interferometric signal for time intervals between 3 and 18 days was investigated, as well as baseline-dependent decorrelation due to volume effects. The coherence study indicated significant differences between various snow and ice types in terms of temporal and baseline-decorrelation resulting from differences in surface/volume backscattering contributions and from different sensitivities to surface erosion due to winds. The meteorological conditions over the Patagonian Icefield are characterized by strong winds and precipitation, and in summer by melting up to the high glacier plateaus. For this reason, and due to the fact that the ERS-1/ERS-2 tandem data have been acquired only during summer, most of the interferometric pairs show no or only very low correlation over the glaciers and icefields. Nevertheless, interferogramms could be generated for major parts of the ice plateau enabling the identification of the ice divides between major glaciers. This is a question of significant glaciological interest because the previously available maps did not allow accurate separation of individual glaciers on the level ice plateau. Over part of the icefield the ERS analysis is complemented by interferometric motion analysis from L-band SIR-C data which had been acquired along a swath across the ice sheet in October 1994. The investigations confirm the unique capabilities of differential interferometry for studying complex patterns of ice dynamics with remarkable detail.

Keywords: Interferometry, ERS, Antarctica, Patagonia, glaciers