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Application of ERS-ENVISAT Tandem data for sea ice, ice shelf and glacier in Amery Ice Shelf region, east Antarctica

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ERS – ENVISAT Tandem (EET) data are SAR data pairs acquired by the ERS-2 and ENVISAT ASAR instruments from approximately the same orbits within 28 minutes. During the dedicated campaigns in 2010/2011 ESA specifically acquired EET pairs with baselines suited for cross-interferometry (CInSAR) in east Antarctica. Amery Ice Shelf is among the largest ice shelves in Antarctica. Five continuous frames of EET data over this ice shelf are collected for study.

At perpendicular baselines of about 2km the frequency difference and baseline effects on the reflectivity spectrum compensate and so coherent interferograms can be obtained. Shelf ice has usually a relatively flat surface and so EET interferometry with about 2km perpendicular baselines is most suitable for the high-definition surface topography mapping and grounding line extraction. Comparing to existing DEMs (Gtopo30 DEM, RAMP DEM, ASTER GDEM and GLAS DEM) in this region, EET DEM reveals the most detailed shelf surface features and proves to be the best. Centimeter scale motion at the shelf front region occurring during the 28 minute interval results in deformation phase, which should be removed for ice-surface topography mapping and while useful for those flat sea ice and shelf front regions to derive motions. Motion at this rate is often observed for sea and shelf ice and is of interest to understand dynamics and stress occurring. Over those more open sea where sea ice moves at much higher rates and even rotation occurs in the 28-minutes, EET coherence is typically lost but offset tracking may be used to retrieve motion fields.

The sensitivity of EET cross-interferometry is in the order of 1/20 of a SAR image pixel. So in azimuth direction this translates to about 20cm per 28 minutes interval and in cross-track direction to about 1m per 28 minutes interval. On the other hand maximum rates which can reliably be retrieved correspond to offsets of several pixels between the two acquisitions corresponding to rates up to the order of 100m per 28 minutes interval. With the short-interval EET data, wide-area flat topography over fast-moving glacier and faster motion rates can be investigated.