ERS-ENVISAT TANDEM CROSS-INTERFEROMETRY APPLICATIONS

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In 2002 ESA launched the ENVISAT satellite with the Advanced SAR (ASAR). The ASAR is operated in the same orbits as the ERS-2, preceding ERS-2 by approximately 28 minutes.One of the ASAR modes, namely IS2 at VV-polarization corresponds closely to the ERS mode, except for the slightly different sensor frequency used. A unique opportunity offered by these two similar SAR instruments operated in the same orbital configuration is ERS-2 – ENVISAT cross-interferometry. The almost simultaneous acquisition of SAR images by the ERS-2 and the ENVISAT satellites allows the generation of a new type of interferogram characterized by a short 28 minutes repeat-pass interval. However, because of the slightly different sensor frequency, cross-interferograms show coherence only under particular conditions. Besides the requirement concerning an at least partial Doppler spectra overlap, only at perpendicular baselines of approximately 2 kilometers can the look-angle effect on the reflectivity spectrum compensate for the carrier frequency difference effect. Given the large baseline and short time interval ERS-ENVISAT cross-interferometry is expected to have a good potential, e.g. for the generation of precise digital elevation models (DEMs) in relatively flat areas.

Between 2002 and mid 2007 only very few adequate ERS-2 ENVISAT pairs were acquired. The few examples presented were enough though to demonstrate the feasibility and to indicate that further investigation would be of high interest. To support further investigation of ERS2 - ASAR cross-interferometry ESA decided in 2007 to operate ERS2 and ENVISAT for a certain time period as a constellation to acquire many additional pairs suited for cross-interferometry. To maximise the number of acquisitions of 28-minute SAR pairs suitable for cross-interferometry, the two satellites were piloted in carefully controlled orbits during so-called ERS2 - Envisat Tandem (EET) Campaigns. A first EET Campaign was between 27 September 2007 and 12 February 2008. A second one took place in late 2008 early 2009 and a third one is foreseen for late 2009. During the first two EET Campaigns, the nominal

perpendicular baseline for mid to high northern latitudes was 2km with ERS-2 observing the area at a slightly higher incidence angle than ASAR, to compensate the slight difference in the carrier frequencies between the two instruments.

The objectives of our related research are on one hand to explore new interferometry applications such as the derivation of very accurate low-relief Digital Elevation Models and velocity maps of fast moving Arctic glaciers and on the other hand to improve the general understanding of interferometry and coherence.

In this contribution results obtained analyzing data of the first two EET Campaigns will be presented. One particular focus will be on the estimation of coherence in areas with high phase gradients. Because of its approximately 2km perpendicular baseline EET cross-interferograms have a very high phase to height sensitivity with ambiguity heights around 5m. As a consequence high spatial phase gradients are present even for small terrain slopes. Different coherence estimators, including noval methodologies, are evaluated. Another focus will be on the validation of EET cross-interferometry DEMs in relatively flat areas.