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Two MERIS and MODIS combination water vapour correction models for InSAR measurements

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Atmospheric water vapour effects represent one of the major limitations of repeat-pass interferometric SAR (InSAR), especially for small amplitude geophysical signals with long wavelengths including interseismic deformation and some anthropogenic processes. Space-based monitoring is an effective way to obtain a measurement of water vapour distribution on a global basis with a high spatial resolution, and calibration techniques to spatially reduce path delays using either the NASA Moderate Resolution Imaging Spectroradiometer (MODIS) or the ESA's MEdium Resolution Imaging Spectrometer (MERIS) data have been demonstrated [Li et al., 2005; 2006a].

On the one hand, MERIS is acquired at the same time as ASAR data, whilst there is usually a time difference between MODIS and SAR data; MERIS has better spatial resolution, up to 0.3 km against 1 km for MODIS; and MERIS near IR water vapour product agrees more closely with GPS than MODIS, particularly under moderate conditions [Li et al., 2006b]. On the other hand, it appears that the MODIS cloud mask is more robust to detect clouds than the MERIS cloud mask; MODIS data is free for the public to access in a short time (usually $<$2 days) after acquisitions, whilst it often takes at least 2 weeks to receive MERIS data even with an ESA data grant. In this paper, two MERIS/MODIS combination water vapour correction models are investigated:

(1) MERIS data collected on date 1 and MODIS data collected on date 2, or in a reversible way, are used to produce Zenith Path Delay Difference Maps (ZPDDM), which is designated as MERIS/MODIS combination correction model (MMCC for short). The MMCC model can be applied when either MERIS or MODIS data is not

available for some reasons, or when their cloud masks don't work well for specific days.

(2) When both MERIS and MODIS data are available and the time difference between them can be considered negligible, simple averaging of both water vapour fields helps to reduce the noise. If the noise level in the water vapour fields is the same, averaging of 2 independent images will statistically reduce noise by 1/sqrt(2), which is designated as MERIS/MODIS stacking correction model (MMSC for short).

Preliminary results show that the order of water vapour effects on interferograms can be reduced from ˜10 mm to ˜5 mm using the MMCC or the MMSC models. This indicates that the MMCC and MMSC models work as efficiently as the GPS/MODIS integrated [Li et al., 2005] and/or the MERIS models [Li et al., 2006a]. It is expected that these two combination water vapour correction models will expand the application of MODIS/MERIS-based water vapour correction models.

References:

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