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DEM corrections on series of wrapped interferograms as a tool to improve deformation monitoring around Siling Co lake in Tibet.

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In order to increase our knowledge on the lithosphere rheological structure under the Tibetan plateau, we study the loading response due to lake Siling Co water level changes. The challenge here is to measure the deformation with an accuracy good enough to obtain a correct sensivity to model parameters. InSAR method in theory allow to observe the spatio-temporal pattern of deformation, however its exploitation is limited by unwrapping difficulties linked with temporal decorrelation and DEM errors in sloppy and partially incoherent areas.

This lake is a large endhoreic lake at 4500∼m elevation located North of the strike-slip right lateral Gyaring Co fault, and just to the south of the Bangong Nujiang suture zone, on which numerous left-lateral strike slip are branching. The Siling Co lake water level has strongly changed in the past, as testified by numerous traces of palaeo-shorelines, clearly marked until 60 m above present-day level. In the last years, the water level in this lake increased by about 1∼m/yr, a remarkably fast rate given the large lake surface (1600∼km2).

The present-day ground subsidence associated to the water level increase is studied by InSAR using all ERS and Envisat archived data on track 219, obtained through the Dragon cooperation program. We chose to compute 750∼km long differential interferograms centered on the lake to provide a good constraint on the reference. A redundant network of small baseline interferograms is computed with perpendicular baseline smaller than 500∼m. The coherence is quickly lost with time (over one year), particularly to the North of the lake because of freeze-thaw cycles. Unwrapping thus becomes hazardous in this configuration, and fails on phase jumps created by DEM contrasts.

The first work is to improve the simulated elevation field in radar geometry from the Digital Elevation Model (here SRTM) in order to exploit the interferometric phase in layover areas. Then, to estimate DEM error, we mix the Permanent Scattered and Small Baseline methods. The aim is to improve spatial and temporal coherence. We use as a reference strong and stable amplitude points or spatially coherent areas, scattered within the SAR scene. We calculate the relative elevation error of every point in the neighbourhood of reference points. A global inversion allows to perform spatial integration of local errors at the radar image scale. Finally, we evaluate how the DEM correct ion of wrapped interferograms improves the unwrapping step. Furthermore, to help unwrapping we also compute and then remove from the wrapped interferograms the residual orbital trend and the phase-elevation relationship due variations in atmospheric stratification.

Stack of unwrapped small baseline interferograms show clearly the average subsidence rate around the lake of about 4 mm/yr associated to the present-day water level increase. To compare the observed deformation to the water level elevation changes, we extract from satellite images in the period 1972 to 2009 the water level changes. The deformation signal is discussed in terms of end-members visco-elastic models of the lithosphere and uppermost mantle.