



ESA - MOST Dragon 2 Programme

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# Project Summary id. 5305 Seismology

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## Main Results

- We have studied the **2010 Mw6.9 Yushu earthquake** that ruptured ~70 km of the western section of the Xian Shui He fault in Qinghai (slip distribution along 3 fault segments)
- **Based on long and dense time series of InSAR data** and some methodological refinements (time series analysis including corrections of DEM and stratified tropospheric delays...), we were able :
  - to **detect and model along-strike variations of interseismic coupling** along the left-lateral Haiyuan fault in NE Tibet (we identify a ~30km-long section of shallow creep in the junction zone between a seismic gap and the M8 1920 rupture),
  - but also to **capture the temporal evolution of this shallow creep**, with an acceleration at mid-2007 that could have been triggered by microseismicity
  - to **detect and model the average interseismic loading at unfavorable sites** such as the Himalaya front range (low coherence, high topography gradients, topography-deformation correlation)

- **GPS** data covering a large part of the Tibetan plateau (large gaps remain) and available average velocity maps derived from **InSAR** (still sparse at the scale of Tibet) were jointly inverted to derive a preliminary velocity field and strain rate map at the scale of the Plateau.  
This shows the **great potential of combining both geodetic data sets at large scale** for improving our understanding of **continental deformation mechanisms**.
- The time series analysis of the **surface deformation associated with the Siling Co lake level fluctuations** were also used to **probe the rheology of the lithosphere** in central Tibet.

## Issues and Recommendations

It is critical to analyse dense and long time series to retrieve complex, 3D deformation signals at different space and time scales, associated with the earthquake cycle and continental deformation processes.

For these reasons, our main recommendations are :

- to continue to provide access to the complete archive of ERS and Envisat radar data, as it is still under exploited over China.
- Future missions such as Sentinel 1 should focus on acquiring such dense and long time series, in a unique interferometric mode of acquisition along descending and ascending tracks.

## List of Publications

-Jolivet, R., C. Lasserre, M.-P. Doin, S. Guillaso, G. Peltzer, R. Dailu, and J. Sun, ZK Shen, X. Xu, Shallow creep on the Haiyuan fault (Gansu, China) revealed by InSAR, submitted to *J. of Geophys. Res.*, **2011**.

-Méger N., R. Jolivet, C. Lasserre, E. Trouvé, C. Rigotti, F. Lodge, M-P. Doin, S. Guillaso, A. Julea and Ph. Bolon, Spatiotemporal mining of Envisat SAR interferogram time series over the Haiyuan fault in China, submitted, *MultiTemp*, **2011**

-Hua Wang, Tim Wright, Satellite geodetic imaging reveals internal deformation of western Tibet, *Nature Geosciences*, in review, **2011**.

-Sun Jianbao, Zheng-Kang Shen, Roland Burgmann, Min Wang, Lixhun Chen, and Xiwei Xu, Slip distribution of the April 14, 2010 Mw6.9 Yushu (Qinghai, China) earthquake constrained using InSAR observations, *J. of Geophys. Res.*, in review, **2011**.

-Ducret, G., MP. Doin, R. Grandin, C. Lasserre, S. Guillaso, DEM corrections before unwrapping in a small baseline strategy for insar time series analysis, *IGARSS*, **2011**

-Sun J., Johnson K., Cao Z. et al., Mechanical constraints on inversion of coseismic geodetic data for fault slip and geometry: Example from InSAR observation of the 6 October 2008 Mw 6.3 Dangxiong-Yangyi (Tibet) earthquake, *J. of Geophys. Res.*, 116, B01406, 20 pp., doi:10.1029/2010JB007849, **2011**

- J. R. Elliott, B. Parsons, J. A. Jackson, X. Shan, R. A. Sloan and R. T. Walker, Rapid Reoccurrence of Large Earthquakes due to Depth Segmentation of the Seismogenic Crust GRL, doi:10.1029/2011GL046897, **2011**
- J. R. Elliott, R. J. Walters, P. C. England, J. A. Jackson, Z. Li and B. Parsons, Extension on the Tibetan plateau: recent normal faulting measured by InSAR and body wave seismology, GJI, v. 183, 503-555, doi:10.1111/j.1365-246X.2010.04754.x, **2010**
- Feng, W., L. Xu, and Z. Li, Fault Parameters of the October 2008 Damxung Earthquake from InSAR Inversion and its Tectonic Implications, Chinese Journal of Geophysics - Chinese Edition, 53(5), 1134-1142, **2010**.
- Xu, C., Wang, J., Li, Z. & Drummond, J.. Applying the Coulomb failure function with an optimally oriented plane to the 2008 Mw 7.9 Wenchuan earthquake triggering, Tectonophysics, 491(1-4), 119-126. **2010**.

## Project Planning – 2011 and 2012

- Earthquakes studies : postseismic deformation of the Mw6.9 Yushu earthquake
- Interseismic studies :
  - Haiyuan fault : study of shallow creep in relation with fault microseismicity and geometry/geology/rugosity;
  - Kunlun and Altyn Tagh faults : similar analysis as Haiyuan fault;
  - Himalaya : extending the survey area
- Continental deformation : more InSAR data will be incorporated as the archive is being exploited.
- Lithosphere rheology: finalization of the Siling Co study.
- Visit of Hua Wang, Sun Jianbao, Xinjian Shan to Europe in autumn 2011.