SEISMIC ACTIVITY MONITORING AND LITHOSPHERE DEFORMATION DETECTION BY RADAR INTERFEROMETRY IN CHINA AND SURROUNDING REGIONS

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Topic Nr.	PIs	Title
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EXECUTIVE SUMMARY

With 12-year continuous study of tectonic deformation of China and surrounding regions under Dragon projects, we are ushered to the Dragon 4 project. In this project, the new-generation satellites with new sensor built on Sentinel family satellites will bring great opportunities for lithosphere deformation monitoring. The Sentinel radar missions, such as Sentinel-1A/1B, would greatly improve the precision of subtle deformation detection during interseismic or postseismic stage of earthquake cycles, and also be possible for retrieval coseismic deformation of most future earthquakes. The rich archived SAR data, such as the ERS-1/2 and Envisat catalogs will be also essential for long-term deformation signal retrieval. In summary, the new data with the archived data from old satellites will provide a unique source for tectonic deformation studies. As an independent measurement, GPS networks, such as the CMONOC, will provide reliable constrains to InSAR measurements, and lithosphere deformation process. In addition to the CMONOC, we also have different projects, funded by Nation Science Foundation of China and China Earthquake Administration, focusing on geodetic strain measurements of specific faults or areas, being supplemental to InSAR measurements over the target areas. The tectonic environment of China and surrounding regions, including such as Nepal, Myanmar, Pakistan, India etc., depend mostly on the collision of Indo and Eurosia plates. Tibetan plateau is the most active unit, and most of the large continental earthquakes occurred there, such as the 2015 Nepal Mw 7.8 event and the 2008 Wenchuan, China Mw 7.9 earthquake. In contrast to the subduction systems elsewhere, the interseismc signals along major faults here are small, mostly < 1 cm/year, hence it would be challenge to extract deformation signals. The GPS network had been deployed since 1990s (Wang et al, 2001, Science). However, the sites are still limited across the region, though experiencing several times of extension, leading to big uncertainties for measuring strain accumulations. In complementary to GPS surveys, InSAR provides alternation for measuring strains of large fault zones, e.g, interseismic deformation study of the Haiyuan fault at the northeastern edge of Tibetan Plateau by our previous Dragon projects. In Dragon 4, we will still focusing on faults, such as the Haiyuan, Kunlun, Longriba, Altyn Tagh, Xianshuihe, Nujiang fault systems around Tibet, and also the large fault zone in east China, the Tanlu fault. During Dragon 4, seismic events will certainly occur irregularly. With the timely SAR acquisitions by Sentinel-1A/1B satellites, it is potential for obtaining vast high quality data over the affected regions, and they will be unique for hazard analysis and earthquake physics research. It is also vital to understand the lithosphere deformation mechanisms after large earthquakes, which provide important clues for the rheology properties of lower curst, or upper mantle. The deformation detection by InSAR/GPS data is probably the most effective way for it. Moreover, the lithosphere rheology could also be inferred from deformation of lake shores, produced by lake level rise or subsidence, e.g., the Silin Co lake study by Doin et al., 2015 under our Dragon team. In all, seismic deformation related with fault zones of different tectonic units will always be our topic for Dragon projects.

ABSTRACT 32431_1: "Seismic activity monitoring and lithosphere deformation detection by radar interferometry in China and surrounding regions"

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The tectonic environment of China and surrounding regions, including such as Nepal, Myanmar, Pakistan, India etc., depend mostly on the collision of Indo and Eurosia plates. Tibetan plateau is the most active unit, and most of the large continental earthquakes occurred there. In order to better understand the deformation mechanism of China, our objective of Dragon 4 will be analyzing the strain distribution along majors faults and the stress releasing by large earthquakes, particularly inside and around Tibet.

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During Dragon 4, seismic events will certainly occur irregularly. With the timely SAR acquisitions by Sentinel-1A/1B satellites, it is potential for obtaining vast high quality data over the affected regions, and they will be unique for hazard analysis and earthquake physics research. It is also vital to understand the lithosphere deformation mechanisms after large earthquakes, which provide important clues for the rheology properties of lower curst, or upper mantle. The deformation detection by InSAR/GPS data is probably the most effective way for it. Moreover, the lithosphere rheology could also be inferred from deformation of lake shores, produced by lake level rise or subsidence, e.g., the Siling Co lake study by Doin et al., 2015 under our Dragon team. In all, seismic deformation related with fault zones of different tectonic units will always be our topic for Dragon projects. The work is supported by several NSFC and CEA projects, and will be funded by some new projects during the Dragon 4 period.

In the methodology aspects, we developed a number of methods for extracting deformation signals in the past Dragon projects, such as SAR data alignment, DEM-related error and orbital error corrections, atmospheric noise estimate by weather models etc. These methods are useful for extracting high quality results on both single-pair and time-series InSAR data. The new sensors go forward a great step over those built on ERS/Envisat satellites. The most useful TOPS mode of Sentinel data is innovative, which is different with the strip-map or ScanSAR mode of the ERS/Envsat data. Hence the data requires more complicated alignment techniques for interferometric processing. Some open codes and programs are available for the purpose, but they are still not fluent more or less. We rely on the SNAP software from ESA for processing now. Some unsolved problems related with the code exist. We will try to improve the code for deformation detection. In addition, the package is short on time-series analysis and atmospheric noise removal. We will develop new code or transfer old code to SNAP for processing. A PhD student and/or a master student will be funded on InSAR technique, including time-series analysis with TOPS data, and atmospheric noise correction using weather models etc.