Topography-correlated atmospheric signal mitigation for InSAR applications in the Tibetan plateau based on global atmospheric models

Yuqing Wang1,2, Ling Chang3, Wanpeng Feng1,2, Sergey Samsonov4, and Wenjun Zheng1,2
1Guangdong Provincial Key Laboratory of Geodynamics and Geohazards, School of Earth Sciences and Engineering, Sun Yat-sen University, Zhuhai, China
2Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai), Zhuhai, China
3Department of Earth Observation Science, University of Twente, Enschede, The Netherlands
4Canada Center for Mapping and Earth Observations, Natural Resources Canada, Ottawa, Canada

Atmospheric heterogeneity mainly exposes itself as tropospheric phase delay in satellite interferometric synthetic aperture radar (InSAR) observations, which smears or even overshadows the deformation component of InSAR measurements. In this study, we estimated the performance of four global atmospheric models (GAMs), i.e. ERA5, ERA-Interim (ERA-I), MERRA2 and GACOS, for tropospheric phase delay reduction in InSAR applications in the Tibetan plateau, of which ERA5 is the latest global atmospheric model released by ECMWF. We demonstrated the effectiveness of atmospheric phase screen (APS) correction using the four GAMs for more than 700 Sentinel-1 TOPS interferograms covering two study areas in the southern (R1) and northwest margins (R2) of the Tibetan plateau. Topography-correlated signals have been widely observed in these interferograms, which are most likely due to the APS effects. We calculated the standard deviations (STD) and correlation coefficients between InSAR Line of Sight (LOS) measurements and topography before and after applying APS correction. The results show that the STDs of non-deformation areas from the GAMs decrease to ~4 mm from ~10 mm and ~12 mm originally on average for R1 and R2, respectively, and the correlation coefficients after the APS correction are reduced below 0.4 from ~0.8 for the selected interferometric pairs. In addition, as the newly released GAM, ERA5 has similar performance with GACOS products and outperforms other models generally. This suggests that GAMs, particularly ERA5, have great potentials in the APS correction for InSAR applications in the Tibetan plateau.