



## Generic Atmospheric Correction Online Service for InSAR (GACOS)

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The tremendous development of InSAR missions (e.g., Sentinel-1A/1B, ALOS-2, TerraSAR-X/TanDEM-X, COSMO-SkyMED, RADARSAT-2, and Gaofen-3) in recent years facilitates the study of smaller amplitude ground deformation using longer time series and over greater spatial scale, and this trend is set to continue with Sentinel-1C/D, Gaofen-3B/C, RADARSAT Constellation planned for launch during 2018-2025. This poses more challenges for correcting interferograms for atmospheric (tropospheric) effects since the spatial and temporal variations of tropospheric delay may dominate over large scales and can cause errors comparable in magnitude to those associated with crustal deformation. In previous attempts, observations from GPS and Numerical Weather Models (NWM) have been used to reduce atmospheric effects on InSAR measurements, but GPS-based correction models are limited by the availability (and distribution) of GPS stations, and for NWM-based correction models, there might be a time difference between NWM and radar observations.

To overcome this, we have developed a generic InSAR atmospheric correction model whose notable features comprise: (i) global coverage, (ii) all-weather, all-time useability, (iii) correction maps available in near real-time, and (iv) indicators to assess the correction performance and feasibility. The model integrates operational high resolution ECMWF data (0.125 degree grid, 137 vertical levels, 6-hour interval) and continuous GPS tropospheric delay estimates (every 5 minutes) using an iterative tropospheric decomposition model. The model's performance for InSAR atmospheric correction was tested using globally-distributed interferograms, encompassing both flat and mountainous topographies, mid-latitude and near polar regions, monsoon and oceanic climate systems, achieving a phase precision and displacement accuracy of approximately 1 cm for the corrected interferograms. Indicators describing the model's performance including (i) GPS network and ECMWF cross-RMS, (ii) phase-delay correlations, (iii) ECMWF time differences, and (iv) topography variations, were developed to provide quality control for subsequent automatic processing, and provide insights of the confidence level with which the generated atmospheric correction maps may be applied.

We have released the Generic Atmospheric Correction Online Service (GACOS) based on model developed (<http://ceg-research.ncl.ac.uk/v2/gacos/>). This service aims to provide InSAR atmospheric correction maps in a convenient way with all features discussed above. The website was released on 6th June 2017 and has received over ten thousand requests from all over the world. Given the convenience and the real-time availability, the website has rapidly responded to recent events such as the Maoxian Landslide (24 June 2017) and the Xinjiang Earthquake (8 August 2017) by providing the atmospheric corrections used in the generation of near real-time deformation fields to identify surface damages and contribute to rescue and recovery operations, which have been reported and highlighted by over 20 social media outlets and organizations.