Quality evaluation of continental water storage models

Zhao Li (University of Luxembourg), Tonie van Dam (University of Luxembourg), Xavier Collilieux, Zuheir Altamimi, Jim Ray (NOAA/NGS), Paul Rebischung, Samuel Nahmani

In many instances, the primary parameter of interest from the Global Navigation Satellite System (GNSS) coordinate time series is the long term trend that is used to study postglacial rebound, sea level rise etc. Environmentally driven surface displacements (atmosphere, non-tidal ocean, and continental water) adding noise to the data being used to investigate these processes. To remove this environmental noise from the GNSS data, the environmentally driven displacements are forward modeled using surface mass models. However, these global mass models are often not consistent with one another and with the motions in the GNSS data. The problem then is that we do not know when the models are in error and when we are adding noise rather than removing noise from our GNSS data sets. The goal of quantifying the errors in the environmental mass models used to remove the mass-loading signal from geodetic data has become a priority within the geodetic community. Without also providing an error assessment of the models, the value of the environmentally driven surface displacements is somewhat limited.

Previous research has already confirmed the strong correlation between Continental Water Storage (CWS) induced surface displacement and the GPS height time series. Currently, the most frequent used models that describes the CWS are the National Centers for Environmental Prediction (NCEP), the Global Land Data Assimilation System (GLDAS), together with the Gravity Recovery and Climate Experiment (GRACE) estimates for the soil moisture and snow depth. Up to now, the Modern-Era Retrospective Analysis for Research and Applications (MERRA) and the European Center for Medium-Range Weather Forcasts (ECMWF) operational and reanalysis hydrological models provide us with new opportunities to calculate surface displacements using CWS estimates at much higher spatial resolution. Moreover, the Land Dynamics World (LadWorld), the Soil Moisture and Ocean Salinity (SMOS) mission, the PCRaster GLOBal Water Balance (PCR-GLOBWB) model, etc, could also provide CWS estimates.

In this presentation, we will compare the above CWS models making full use of various modern time series analysis techniques. We will attempt to assess the quality of each loading model by inter-comparing similar models with each other and with the latest IGS combined weekly GPS coordinate time series. During the process, the horizontal GPS coordinates will be considered to assess the quality of the loading models, since the GPS horizontal coordinates are much more precise than the vertical components, which could be used to add insight into the causes of the inconsistency between observations and predictions. Thus, by comparing GPS observations with the predicted load in all 3-components we can perhaps get a better estimate of when and where the mass models are in error. Finally, a combined mass field for CWS will be generated using different models through the three-corned hat method to see whether a combined model would have less errors than individual models.