Geophysical Research Abstracts
Vol. 18, EGU2016-6038, 2016
EGU General Assembly 2016

Separation of hydrological effects from GNSS time series on regional and local scale

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Continuous GNSS networks provide unique information about the crustal displacements, of use for studies concerning gravity field, plate motions, tectonic processes, and earthquake cycle understanding. For these purposes, overall in the case of regions with slow deformation strain, we have to individuate and separate all the possible contributions, at the various frequencies. Among the others, hydrological loading effects can be present over a wide frequency range and have to be accurately modelled.
The present work is aimed to test, whether the GNSS signal is sensitive to hydrological effects at a regional or a more local scale. The dataset we chose for the tests is ideal: it relates to a relatively small region, where the active collisional processes generate a moderate seismic activity and is characterized by high rainfall rate and significant hydrological phenomena.
The data belong to the Friuli Regional Deformation Network (FReDNet) of OGS (Istituto Nazionale di Oceanografia e Geofisica Sperimentale), consisting of 16 GNSS permanent sites distributed on the northern edge of the Adria microplate (NE-Italy). The data set includes the time series from the 10 GNSS permanent sites of the Marussi network of the Friuli-Venezia Giulia Regional Council.
The time-span covered by the network overcomes in many cases the twelve years, giving the possibility to study the various terms superimposed to the linear one, due to the plate motion.
After a first processing of the GPS data of the longest time series, using GAMIT/GLOBK, eliminating the outliers, and filling eventual short gaps in the data through linear interpolation, we corrected them for the annual and seasonal terms and the displacements due to hydrological mass loading effects on multiyear timescales.
For our test, we first addressed the regional level problem. Following the approach of Chamoli et al. (2014), we separated the annual, semiannual, and pluriannual terms of the displacements excited by the hydrological loading (Gegout et al., 2010). We estimated the amplitude of the various terms for each of the GNSS time series and used for their correction.
For the local hydrological effects, we estimated the percentage of correlation between the remaining signal and the hydraulic balance, calculated in the surroundings of the station, by correcting the detrended cumulative curves of the rainfall for the estimated evapo-transpiration, using the Thornthwaite (1948) formula.