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Hydrogeological deformation from GPS time series in Northern Morocco.

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Actual ground surface deformation can result from many processes, such as tectonics, different kinds of loading like tides, atmospheric or hydrology, etc... Each of these processes is characterized by rather horizontal or vertical displacements, by specific amplitudes and by spatial and time variations. GPS time series measurements are able to register a local displacement containing all this information. The choice of the GPS data acquisition protocol and of the processing strategy is then fundamental for extracting one particular process with sufficient accuracy.
In this study, a network of three GPS receivers have been installed since 2008 in the plain of Fez-Meknes in Northern Morocco, with the main objective to extract the hydrogeological information from the approximately two years of displacement data available. Indeed, this agricultural and touristic region is supplied with water from a deep confined aquifer that is overexploited in a context of recurrent droughts. GPS survey is a complementary tool to the hydrogeological measurements to monitor ground water. In terms of other deformation processes, this region can be considered tectonically stable with respect to low seismicity. The Atlantic and Mediterranean coast of Morocco induced a significant Ocean Tide Loading within the continent. A differential processing setup with short baselines of few kilometers long is able to filter this OTL signal and atmospheric loading if any. In regards of the seasonal hydrogeological signal, daily solutions are preferred to smallest sampling in order to optimize the accuracy. Signal processing analysis of the three components of the GPS time series has been performed to identify characteristic frequencies that can be associated with hydrogeological processes. The 3D differential displacements of maximum 2cm between the three GPS receivers can be interpreted by the direction of water flow and by the fractioned structure of the deep aquifer. Finally, this kind of survey can isolate local process such as hydrogeology in the displacement GPS signal.