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A GNSS-based bayesian technique for atmospheric profiling in extended area

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The scientific community has long been experimented several techniques for profiling atmospheric meteorological parameters, such as radiosounding observations (RAOB), laser radars (LIDARS), Fourier Transform Infrared Spectrometers (in absence of clouds), MW based radiometers and GNSS based techniques. All these instruments have been widely investigated and their applicability is well known. However all the listed techniques, except GNSS ones, have the disadvantage of requiring onerous implementation costs for different reasons. Cheapness and worldwide avaiability are undoubtedly a key strength of GNSS observations including the ones applied to meteorology, which led over the years to the development of a number of retrieval techniques primarily focused on the atmosphere humidity content estimation.

A newly proposed GNSS meteorology technique is described in this work for the retrieval of vertical atmospheric parameters, specifically humidity, temperature and pressure.

A Bayesian technique is adopted, which combines the surface observation of a weather station and a GNSS receiver with the output fields of a Numerical Weather Prediction (NWP) model over a more than ten years dataset. The output of this combination is an empirical relationship to be exploited in the likelihood function. Once these likelihood functions are obtained for different points, they are compared to test the possibility of their jointly use for a more general validity in an extended area. Thus, when a new set of surface (GNSS+weather) observations is available, this Bayesian approach directly allows finding out a set of possible atmospheric profiles with an associated probability. The results are shown for a full year dataset over three sites in the west Mediterranean area, with different meteo-climatic and geographical features and assessed through the comparison with radiosounding observations.

The encouraging results show the applicability of the method for retrieving profiles of humidity, but also of temperature and pressure.