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# Near-real-time mapping of GNSS products from an area of complex topography for operational meteorology

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Triggering of severe convection is often focalized in areas of moisture convergence. On the other hand, the inflow of wet air usually plays an important role in the fog onset, even in typical events of radiation fog. Therefore, knowledge of the spatial distribution of atmospheric humidity is crucial to the operational forecaster, especially in the weather nowcasting at regions of complex topography. Radiosonde measurements are very sparse and present a limited time resolution of 6 or 12 hours. Near-real-time mapping of the vertically-integrated water vapour (IWV) retrieved from ground-based GNSS observations is an alternative way to present information on the horizontal distribution of humidity with a high time resolution.

On average, nearly half the total atmospheric water is between sea level and a 1.5-km height. Therefore, the horizontal distribution of water vapour is strongly modulated by the topography. In the Iberian Peninsula, an area of complex topography, the penetration of shallow air masses of maritime origin through passes underneath mountain ranges is a common mechanism of moistening the air of inland regions. This fact makes difficult to build a realistic map of IWV without a high-resolution network of GNSS receivers.

A method to smooth the dependence on height of the magnitude to be interpolated is presented here. The method is based on the decomposition of any IWV value into a constant statistical average and a variable part. The mean geographical distribution of IWV is computed from the dataset of daily averages at the different stations. Since this dataset usually presents some gaps, the estimation of the mean values and covariance matrix is performed together with the imputation of the missing values using an iterative method based on a regularized maximization-expectation algorithm. A linear regression yields a model accounting for the statistical dependence of the mean values on latitude, longitude and altitude. The model residuals are then mapped using a kriging technique. Finally, the statistical distribution of IWV is the sum of the values yield by the model and the map of residuals.

The variable component of the IWV is contoured every 15 minutes following a 1DVAR assimilation scheme with the previous map as the background state. A key point of the method is an accurate estimation of the background-error covariances. A covariance matrix is empirically built from successive 15-minute values in a set of stations. The values for every station are then fit to a 2D-gaussian and, finally, the surface parameters are interpolated to a grid mesh.