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Assimilation of Turkish Ground-based GPS Network Data with WRF 3DVAR: A case study of a heavy snow event in March 2011

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A ground-based GPS network in Turkey has been implemented in May 2009, as a result of the "Project of Research and Implementation Related to the Establishment of Network Based Stationary Real-Time Kinematic GPS Terminals and Determination of Cellular Transformation Parameters" (CORS-TR / TUSAGA-Aktif) proposal of Istanbul Kültür University, General Command of Mapping and the General Directorate of Land Registry and Cadastre. The main purpose of the project was serving data for geodetic, terrestrial mapping and cadastre applications. The network consists of approximately 147 uniformly distributed stations. General Command of Mapping and Turkish State Meteorological Service have been estimating GPS-based precipitable water (PW) values by using TUSAGA-Aktif system since 23rd of October 2010 according to a protocol signed between them on 21st of July 2009. The PW data has approximately 80 km horizontal and a very high temporal resolution (can be reduced to 1 minute) and were validated by radiosonde and surface observations.

This study aims variational assimilation of the PW data into a regional model in order to improve forecast skills of short range weather forecasts, especially in terms of precipitation field. Application is performed for a heavy snow case over Turkey using WRF-3DVAR, with NCEP GFS data as input. On 7th of March 2011, a sharp through over the Balkans with a cold tongue is tilted and a cut-off low is formed as a strong high pressure system over Eastern Europe approached the region. The low pressure system over Eastern Mediterranean moved inlands of Anatolia, resulting high amounts of snow over the country until 10th of March 2011. Three days snowfall exceeded 45 cm in some regions. Two domains with 24 km and 8 km horizontal resolutions and 27 vertical levels are set with one-way nesting option for the numerical simulation. WRF-ARW v3.3 is used as dynamical core, and the physical options are chosen according to a sensitivity analysis. Surface observations are used for verification. The impact of the assimilation was reasonably well, biases of basic variables are reduced for whole domain and a more realistic spatial structure of precipitation forecasts over Turkey are obtained.