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Modelling of a Zonda wind event in a complex terrain region using WRF

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The air quality modeling in a regional scale requires the coupling to Numerical Weather Prediction (NWP) models, mainly when a high spatial and temporal resolution is required, such as in those cases related to large pollutants emissions episodes or extreme weather events. The Weather Research and Forecasting (WRF) is a last generation NWP model which computes temperature, pressure, humidity and wind fields in high spatial and temporal resolution. In order to perform simulations in complex terrain regions, WRF must be locally configured to obtain a proper representation of the physical processes, and an independent validation must be performed, both under common and extreme conditions. Once the local configuration is obtained, a full atmospheric chemistry modeling can be performed by means of WRF-Chem.

In this work a mesoescale event of Zonda wind (similar to Foehn and Chinook winds) affecting the topographically complex mountainous region of Mendoza (Argentina) on February 15th, 2007 is represented using WRF. The model results are compared to the Argentine National Weather Service (SMN) observations at "El Plumerillo" station (WMO #87418), showing a good performance. A description of the local model configuration and most important physical parameterizations selected for the simulations is given, including the improvement of the default resolution of land use and land cover (LULC) fields. The high resolution modeling domain considered is centered at the city of Mendoza (32° 53' South, 68° 50' West), it extends 200 km N/S $\times$ 160 km E/W and includes a 3-nested domain downscaling of 36, 12 and 4 km resolution, respectively.

The results for the Zonda wind episode show a very good performance of the model both in spatial and temporal scales. The temporal dew point variation (the physical variable that best describes the Zonda wind) shows a good agreement with the measured values, with a sharp decrease of 20 ºC (from 16 ºC to -4 ºC) in 3 hours. A full 3-D regional description of the Zonda wind generation and evolution is also given and related to the synoptic scale conditions prevailing during the modeled period.

The performance of the local WRF configuration has been further analyzed for a 3 months period (January-March 2007) by means of MODIS atmospheric products, radiosounding data and radiometer measurements of water vapor. The differences between radiosondes and WRF temperature vertical profiles are $<$ 1 ºC, with deviations that do not exceed 1.5 ºC for pressure levels above 850 mbar, while near surface differences reach up to 3 ºC. WRF shows good correlation with radiometer and radiosonde tropospheric water vapor content, except for particularly high values retrieved by the radiometer, which may be attributed to the presence of clouds.

Further work will apply the local configuration into WRF-Chem for air quality studies, including a recently developed high-resolution emissions inventory for Mendoza.