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Statistical evaluation of the simulated convective activity over Central Greece

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Introduction

The main objective of the **project DAPHNE** (www.daphne-meteo.gr) is the assessment of the agricultural drought in the region of Thessaly (Fig.1), in central Greece by means of Weather Modification.

The goal of this research is to investigate the impact of very high spatial resolution topography and land use data in the predictability of the convective activity and model performance, using the WRF-ARW modelling system.

Data and Methodology

Numerical Model:	WRF-ARW (ver.3.5.1), 2-way telescoping nesting (Fig. 1)
Grid increment:	15km x 15km (d01) - Europe
	5km x 5km (d02) - Greece
	1km x 1km (d03) - Central Greece – Thessaly region
Initial time:	1200 UTC before each day of interest
Duration:	36 hours
Vertical levels:	39 sigma levels (up to 50 hPa)
Initial and lateral boundary conditions:	6-hourly ECMWF operational analyses (0.25°x0.25° lat.-long.)
Sea-Surface Temperatures:	NCEP (1/12°x1/12° lat.-long.)
Microphysics:	WRF Single Moment 6-classes (WSM6)
Cumulus convection:	Kain-Fritsch
Longwave/ Shortwave Radiation:	RRTMG
Surface Layer:	Monin-Obukhov (MM5) scheme
Boundary layer:	Yonsei University
Soil Processes:	NOAH Unified model
Topography data:	USGS (30 sec – default)
	SRTM (3s, Shuttle Radar Topography Mission v.4)
Land use data:	USGS (30 sec – default)
	CORINE Land Cover 2000 raster data (3 sec, v.17)

- Six (6) representative days with different upper-air prevailing synoptic conditions from previous work, where selected in order to investigate the impact of topography and land use representation in the forecast skill score, using a grid of available meteorological stations in the area of Thessaly.
- The (6) prevailing upper-air synoptic circulation types over Greece were: 1) zonal flow (ZON), 2) northwest flow (NW), 3) closed low (CLO), 4) cut-off low (CUT), 5) southwest flow (SW), 6) open trough (L1).
- High resolution elevation data (SRTM) in conjunction with better representation of land use (CORINE data set) are ingested into the innermost domain (Fig.1b).

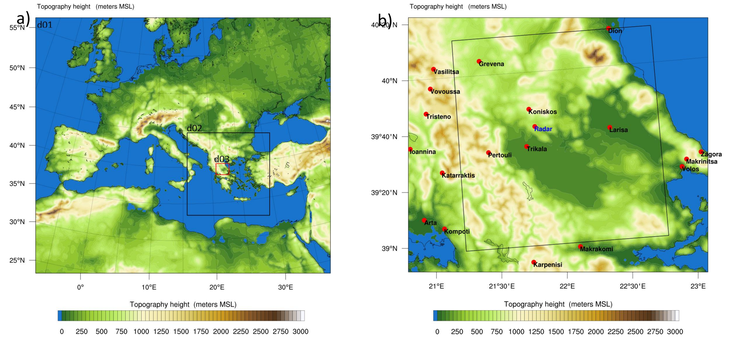
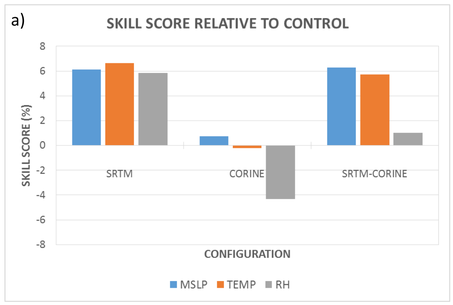


Figure 1. Domain configuration (a) with topography height and the inner domain (b) of Thessaly region. The red dots in (b) indicate the locations of available NOA stations, while the location of the weather radar is shown with the black frame encompassing the radar data.

Results



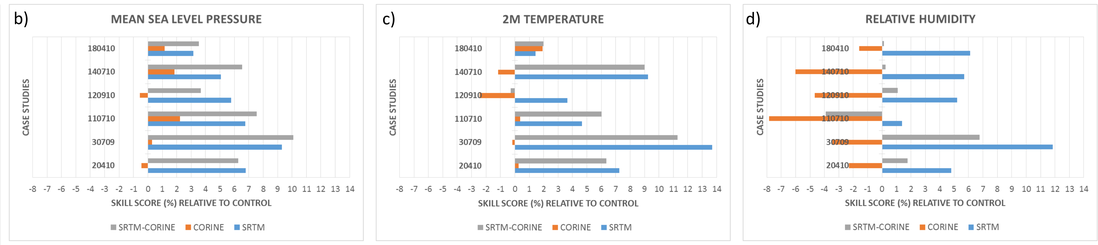


Figure 2. Skill score a) of the three (3) topography – land use configurations for WRF-d03, relative to CONTROL, using the NOA stations (Fig. 1b), for all six (6) case studies. Skill score (WRF-d03) of b) MSPL, c) 2m temperature and d) relative humidity for each case study, relative to CONTROL setup. CONTROL configuration uses the USGS (30s) topography and land use data set.

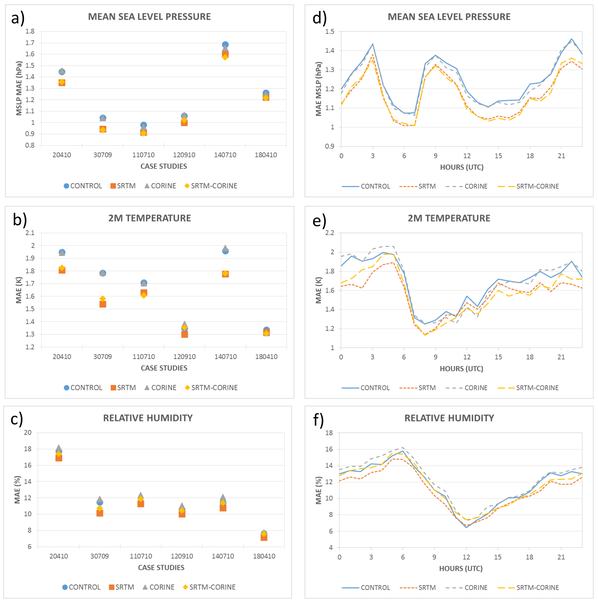


Figure 3. The Mean Absolute Error of a) MSLP, b) 2m temperature, c) 2m relative humidity (WRF-d03), for each case study and the MAE of d) MSLP, e) 2m temperature, f) 2m relative humidity, as a function of time for each setup.

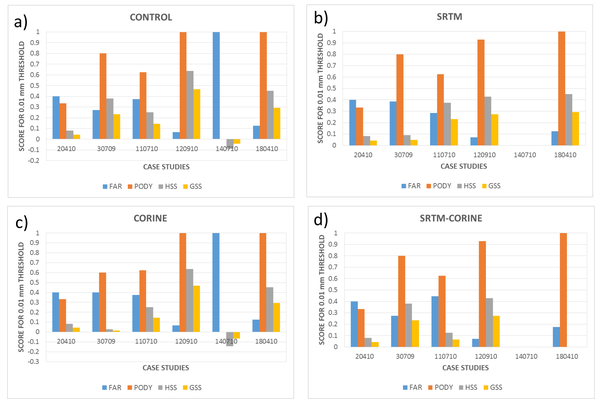


Figure 4. False Alarm Ratio (FAR), Probability of Detection (PODY), Heidke Skill Score (HSS) and Gilbert Skill Score (GSS) of precipitation occurrence (0.01mm threshold) at d03 (Fig. 1b), from 00UTC of each representative day to 00UTC (T+12 – T+36), for a) CONTROL, b) SRTM, c) CORINE and d) SRTM-CORINE model configurations. T+0 at 12UTC of the previous day.

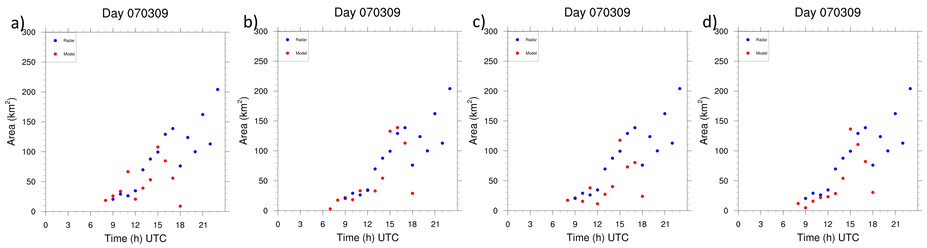


Figure 5. Time series of hourly values of average convective area, at locations with > 35dbz (d03-black frame in Fig. 1b), on 03 July 2009, for a) CONTROL, b) SRTM, c) CORINE and d) SRTM-CORINE model configurations.

Discussion

- The use of high resolution elevation data, SRTM configuration, (Fig. 2a) seems to improve the overall forecast (WRF-d03), in terms of mean sea level pressure, 2m temperature and 2m relative humidity. The statistical evaluation performed for 24 hours starting at 00UTC of each representative day (T+12-T+36).
- SRTM configuration gives better representation of MSLP (Fig. 3d), 2m temperature (Fig. 3e) and 2m relative humidity (Fig. 3f), during the day, for all six (6) cases. Greater MAEs are produced for the 2m relative humidity, in CORINE setup (Fig. 3f), a variable which is overestimated the most by the model.
- The best scores of precipitation occurrence are obtained in 120910 case study (Fig. 4), for CONTROL and CORINE configurations. Work in progress tries to estimate the overall behavior.
- The representative case of 03 July 2009 (Fig. 5), despite some discrepancies on the onset and termination of convective activity, was simulated quite well by the model in terms of average convective area, for all configurations. However, differences occurred in the intensity of the phenomena.

ACKNOWLEDGMENTS

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