SIMULATION OF A HIGH IMPACT WEATHER EVENT OVER ISRAEL WITH THE WRF-RTFDDA SYSTEM

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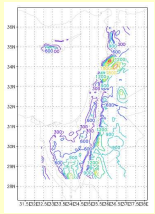
1. MOTIVATION

The feasibility of using the NCAR/RAL WRF-RTFDDA system (Liu *et al*.) at a high horizontal resolution, including assimilation of conventional and non-conventional observations, over the Israel area was studied for a high-impact weather event.

a. Geographic characteristics of the region

The geographical nature of the region, mainly characterized by the sea-land interfaces along the Mediterranean and Red-Sea coasts, complex topography, mostly to the north and west, and a mosaic of land characteristics including different types of vegetations, urban and dessert areas, results in complex mesoscale and microscale flows. In addition, the synoptic flow patterns of the region lead to a wide variety of weather regimes

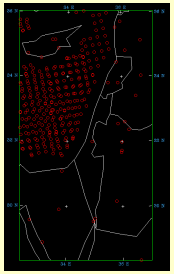
GIS physical map of the area.



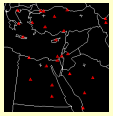
Model terrain at 3.3 km resolution

b. Observations availability in the region.

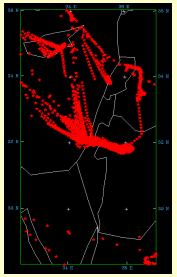
In the area of Israel and its surroundings, surface and upper air in-situ observations are sparse, both over the Mediterranean Sea and over land areas. A competent data assimilation (DA) system applied to this area should be capable of assimilating other than in-situ conventional direct observations.



A representative map of available WMO surface observations and NASA QuikScat sea surface winds in the 3.3 km resolution domain



A representative map of available WMO radiosonde-soundings in the area



A representative map of available AMDAR aircrafts observations in the 3.3 km resolution domain.

2. WRF-RTFDDA SET UP

Three domains, with grid sizes of 30, 10 and 3.33-km, were used in the numerical study, and the fine meshes were two-way nested in the coarser domains. The fine mesh domain is 450X850 km^2, covering Israel, and neighboring areas and coastal regions. The WRF-RTFDDA system was cycled at 6 hour intervals, generating hourly analyses and forecasts for nearly 4 days, from 00Z Feb. 6 to 18Z Feb. 9, 2006.

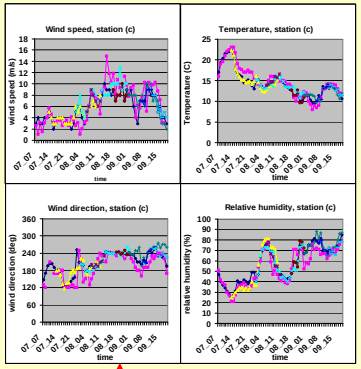
3. EVENT WEATHER: FEB 7, 18Z – FEB 9, 12Z, 2006

The simulated period was dominated by a surface low pressure system and a 500 hPa trough, which caused unusually strong winds, sand storms, precipitation and thunder storms.

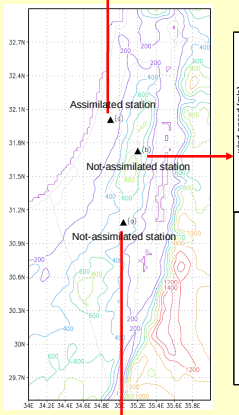
4. RESULTS

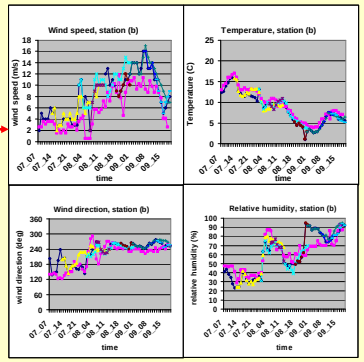
The ability of the WRF-RTFDDA system in reproducing the evolving weather processes including strong winds and precipitation is evaluated

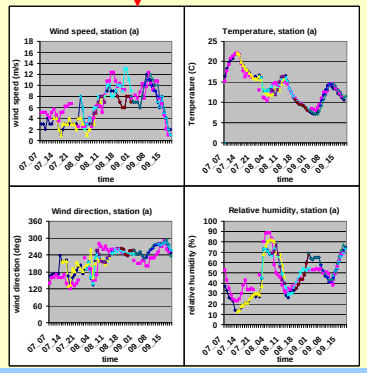
4.1. Verification against surface observations.



Time series of surface observations at three stations. Shown: observations, model analyses, and model forecasts. Model forecasts identified by their starting hour and date, e.g., "0712" stands for Feb 7 12Z.



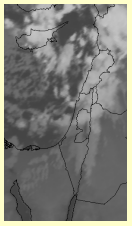




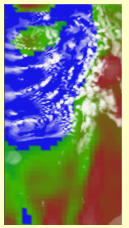
- The model captured the effect of the synoptic flow and the effect of local characteristics at each of the station locations.
- Little difference is found between analyses and forecasted results, indicating the benefit of the "spun-up" analyses of the continuous FDDA process.
- Similar verification results are observed for station "c", which was assimilated by the model, and for the other two stations that were not.

4.2. Rain/cloud **qualitative** verification

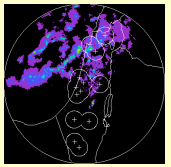
a. 03 UTC 09 Feb



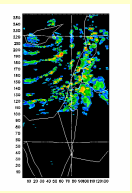
IR 10.8 imagery



Top-view of volume-display of simulated clouds

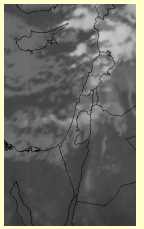


Radar reflectivity

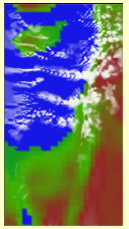


Modeled radar reflectivity

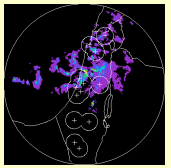
b. 08 UTC 09 Feb



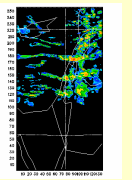
IR 10.8 imagery



Top-view of volume-display of simulated clouds



Radar reflectivity



Modeled radar reflectivity

- The model captured the rain bands aligned with the stream associated with the low.
- Since the flow is normal to the mountain ranges, the upper slope effect intensifies the precipitation along the mountains.
- The model reflects the local underlying forcing features.
- The topographic effect seems to be overestimated by the model.

5. SUMMARY

- The NCAR/RAL WRF-RTFDDA system was used to study a high-impact weather event over the Israel area, at a high horizontal resolution and with assimilation of conventional and non-conventional observations.
- The model results showed reasonably good agreement with surface observations and satellite/radar images.
- This first numerical experiment shows the potential of using the system operationally over this region.

6. FUTURE WORK

- Evaluate the model system performance on different weather regimes and seasonal evolutions.
- Assess the relative impact of the different components of the system on the forecasts, i.e., the DA procedure (including the use of variational assimilation schemes), the different types of observations, the horizontal and vertical resolutions, and the physical-process parameterizations schemes.