

Interaction of a sea breeze and a moist convection over the northeastern Adriatic coast: an analysis of the sensitivity experiments using the high-resolution mesoscale model



Gabrijela Poljak¹, Maja Telišman Prtenjak¹, Marko Kvakić², Kristina Šariri³ and Željko Večenaj

¹Andrija Mohorovičić Geophysical Institute, Department of Geophysics, Faculty of Science, University of Zagreb, Zagreb, Croatia

²ILRI, Nairobi, Kenya

³Croatian Metrology Institute, Zagreb, Croatia email: poljakica555@yahoo.com & telisman@gfz.hr

Motivation & Aim

- The northeastern (NE) Adriatic, in particular, the Istrian peninsula, represents the most convective area in Croatia especially in warm part of the year (Mikuš et al., 2012). In at least 51% of daytime Cb occurrences, sea
- breezes (SB) develops along the coast. (e.g. Babić et al., 2012; Poljak et al., 2014). The SB characteristics highly depend on
- location and local topographic characteristics. The influence of the size and temperature of the water surface and topography on the SB-Cb interplay at particular Adriatic area is still insufficiently known.



1: The satellite SST and ground Fig. 1. The same lies and ground emperature distribution in the area of interest (the northern Adviatic at 11 CET on 9 July 2006) and measuring sites as white circles (Udine, San Pietro Capofume (SPC), Portorož-Airport, Pazin, Poreč, Pula-airport).

Data

- Three chosen cases from Poljak et al. (2004): (i) 8/June/2003(ii) 9/July/2006
- (iii) 8/August/2006 Radiosounding (Udine & SPC) and near surface data (Fig. 1).

Model WRF-ARW, V3 initial and boundary conditions (every 6 h)

- ECMWF analysis;
- vegetation and land-use data: USGS 24; 3 domains (dx=13.5 km, 4.5 km, 1.5 km) & 2-
- way nesting on a Lambert conformal projection: top of the atmosphere = 50 hPa & 80 sigma
- levels: eral physical options for all domains

- RRTM for the longwave radiation;
- Dudhia scheme for the shortwave radiation; a five-layer thermal diffusion scheme for the
- soil temp.; the Betts-Miller-Janjić cumulus parameterization in 2 outer domain
- PBL schemes: YSU, MYJ and BL Microphysics schemes: Kessler, Lin, WSM6

Sensitivity numerical tests:

(i) a varying SST field provided by the MSG SEVIRI geostationary satellite data (at 5 km) every hour (SST L3C hourly data, Fig. 1); (ii) a modified topography.



References



done by a simple cosine weight function which is zero at the boundary and one in the center, defined over a 100x100 point



Results -> Evaluation of the model

Fig. 3: Taylor diagram for temperature (°C) and mixing ratio (kg/kg) for three selected cases. The acceptable mesoscale model skill could be done if Stdev_WRF 24 22 Stdev_M and RMSD < Stdev_M (Pielke, 2002). This is mostly not valid for Kessler microphysics option. 18



-0.8>-0.9 -0.9>-1.0 -1.0>-1.1 -1.0>-1.1 >-1.2

Fig. 4: Experiments biases for all experiments for speed (m/s) in Pula Airport observed minus each experiment forecast. Regardless model setup, the WRF model always underestimated wind speed.



Fig. 5: Observed versus modelled time series (top) and power spectra (bottom) for Portorož-Airport site for 8/June/2003; (a,f) the horizontal zonal wind (m/s), (b,g) zonal wind component (m/s), (c,h) merdional wind component (m/s), (d,i) temperature (°C), (e,j) mixing ratio (kg/kg). The observed time series and spectrum is presented by black line.

The image moment analysis, IMA (e.g. Sović et al., 2013)





Results -> Sensitivity tests Impact of the SST variability (9/July/2006 at 15 CET) ECMWF SST satellite SST satellite SST



90 100 110 120 130 140 Fig. 6: Distribution of 10-m wind, (wind vectors and speed in m/s) in (a,b), sensible heat flux, W/m^2 (c,d) and 10-m wind with the maximum simulated radar reflectivity factor, dBZ (e,f). More realistic SST distribution caused a larger sea-land temperature maximum difference, stronger SB with larger vertical speeds and stronger deep convection

Impact of the modified topography (MT): 9 July 2006



Fig. 7: Diurnal evolution of the modeled 10-m wind (in m/s) associated with the maximum simulated equivalent radar reflectivity factor (dBZ). The field comparison shows: (i) deeper intrusion of the flows with eastern directions over the peninsula; (ii) later development, smaller humidity advection and slower inland penetration of the western SB (eliminated slope winds); (iii) the mountain ridge control the onset and accelerated the convection.

Summary

- > The application of the three methods in the evaluation of the model and the determination of a model setup did not give a specific conclusion. However a choice of MYJ and Lin for PBL and microphysics options gave satisfactory result in the most cases.
- Sensistivity tests have shown the impact of the SB-Cb interaction. It primarily takes place in the boundary layer due to SB modification and thus

Integration of the second s

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square area affects the convergence zone and the position and the lifespan of convective cells.