Near-surface wind climatology over the eastern Adriatic coast in an ensemble of RCM simulations

Andreina Belušić[1], Ivan Güttler[2], Maja Telišman Prtenjak[1]

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

[2]Meteorological and Hydrological Service, Zagreb, Croatia

email: *andreina.belusic@gfz.hr*

Motivation & Aim

- The eastern Adriatic coast is characterized by the complex coastline, strong topographic gradients and specific wind regime. The most famous typical winds along the Adriatic coast are *bora* (usually blowing in the direction perpendicular to the Dinaric Alps and experiencing a strong influence of the terrain), *sirocco* (usually parallel to the coastline) mostly during the wintertime and *sea/land breezes* (dominantly in the warm part of the year) as a part of the regional Mediterranean wind system.

Aim:

- The Adriatic represents excellent test area for the latest generation of the regional climate models (RCMs) applied for the European domain.
- Near-surface (i.e. 10 m) wind simulated by RCMs:
  - CLMcom-CCLM4-8-17
  - DMI-HIRHAM5
  - IPSL-INERIS-WRF331F
  - KNMI-RACMO22E
  - SMHIRCA4
  - DHMZ-RegCM4

  from the EURO-CORDEX initiative are compared against surface station observations and forcing ERA-Interim reanalysis

Fig. 1: A location of the Adriatic Sea and the area of interest.

Data & Methodology

- 6 RCMs at 12.5 km resolution and 50 km resolution, 6 upscaled models (from 12.5 km to 50 km) and ERA-Interim (~ 85 km resolution) compared to surface station data (here shown: Split Airport and Zagreb Airport).
- Investigated period: 1996-2008.
- Each grid point value is associated with the corresponding surface station using two interpolation approaches; the nearest neighbour (N.N.) and bilinear interpolation (BIL.).
- Modelled and measured data sets are compared using several skill scores (e.g. Brier skill score, Perkins skill score, RMSE, …)
- To better understand and visualize the results Taylor diagram and probability density estimation are also analyzed.
- Except the whole set, the data are divided and analyzed seasonaly (DJF and JJA seasons).

Results

Taylor diagram:

(a)

(b)

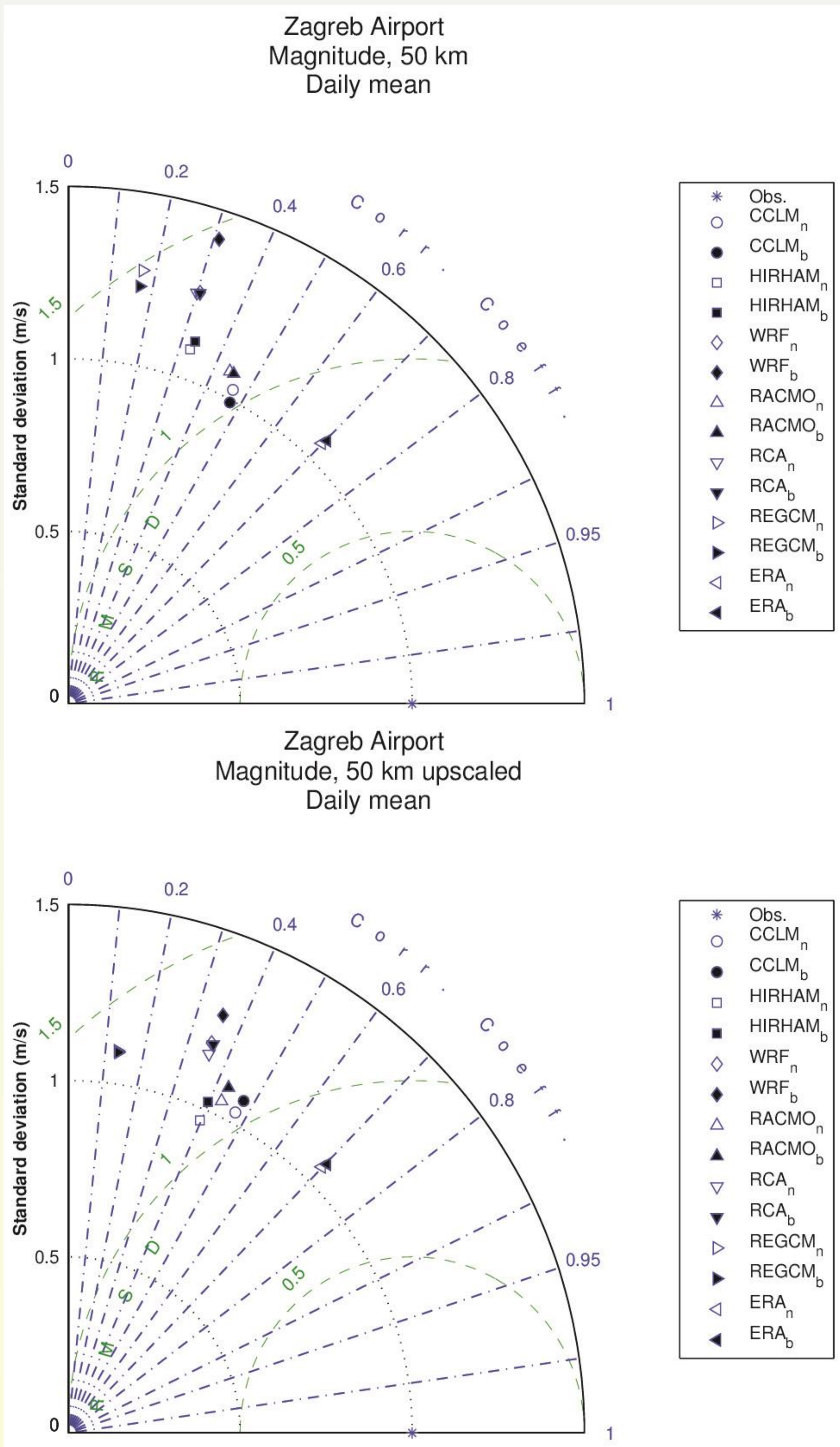

Fig. 2: Taylor diagram for magnitude at (a) 50 km and (b) 12.5 km to 50 km upscaled resolution, Zagreb Airport. The upscaling is done by averaging the 16 neighbouring points in the 12.5 km grid around the associated point in the 50 km grid.

Brier skill score (BSS):

- The error variances (MSD) are computed relative to the same predictand (observations).
- BSS can vary between −1 (reanalysis exactly matches the observations) and +1 (RCM exactly matches the observations). Negative values indicate a better performance of the reanalysis, positive values indicate an added value of the regionally modelled winds in comparison with realalysis time series.

Table 1: BSS comparison between U and V component of the wind for Split Airport. Note the higher score for the V component and for the 12.5 km resolution.

U component 12.5 km	N.N.	BIL.	V component 50 km	N.N.	BIL.
CCLcom-CCLM	-0.12	-0.11	CCLcom-CCLM	0.49	0.49
DMI-HIRHAM	-0.69	-0.63	DMI-HIRHAM	-0.35	-0.20
IPSL-INERIS-WRF	-0.77	-0.76	IPSL-INERIS-WRF	-0.50	-0.47
KNMI-RACMO	-0.33	-0.33	KNMI-RACMO	0.30	0.31
SMHI-RCA	-0.55	-0.54	SMHI-RCA	-0.02	-0.00
DHMZ-REGCM	-0.79	-0.80	DHMZ-REGCM	-0.45	-0.50
50 km			**50 km**		
CCLcom-CCLM	-0.36	-0.02	CCLcom-CCLM	-0.29	0.23
DMI-HIRHAM	-0.78	-0.70	DMI-HIRHAM	-0.65	-0.54
IPSL-INERIS-WRF	-0.80	-0.73	IPSL-INERIS-WRF	-0.66	-0.64
KNMI-RACMO	-0.55	-0.28	KNMI-RACMO	-0.49	-0.08
SMHI-RCA	-0.66	-0.62	SMHI-RCA	-0.48	-0.47
DHMZ-REGCM	-0.83	-0.77	DHMZ-REGCM	-0.63	-0.55

Probability density estimation (PDE):

(a)

(b)

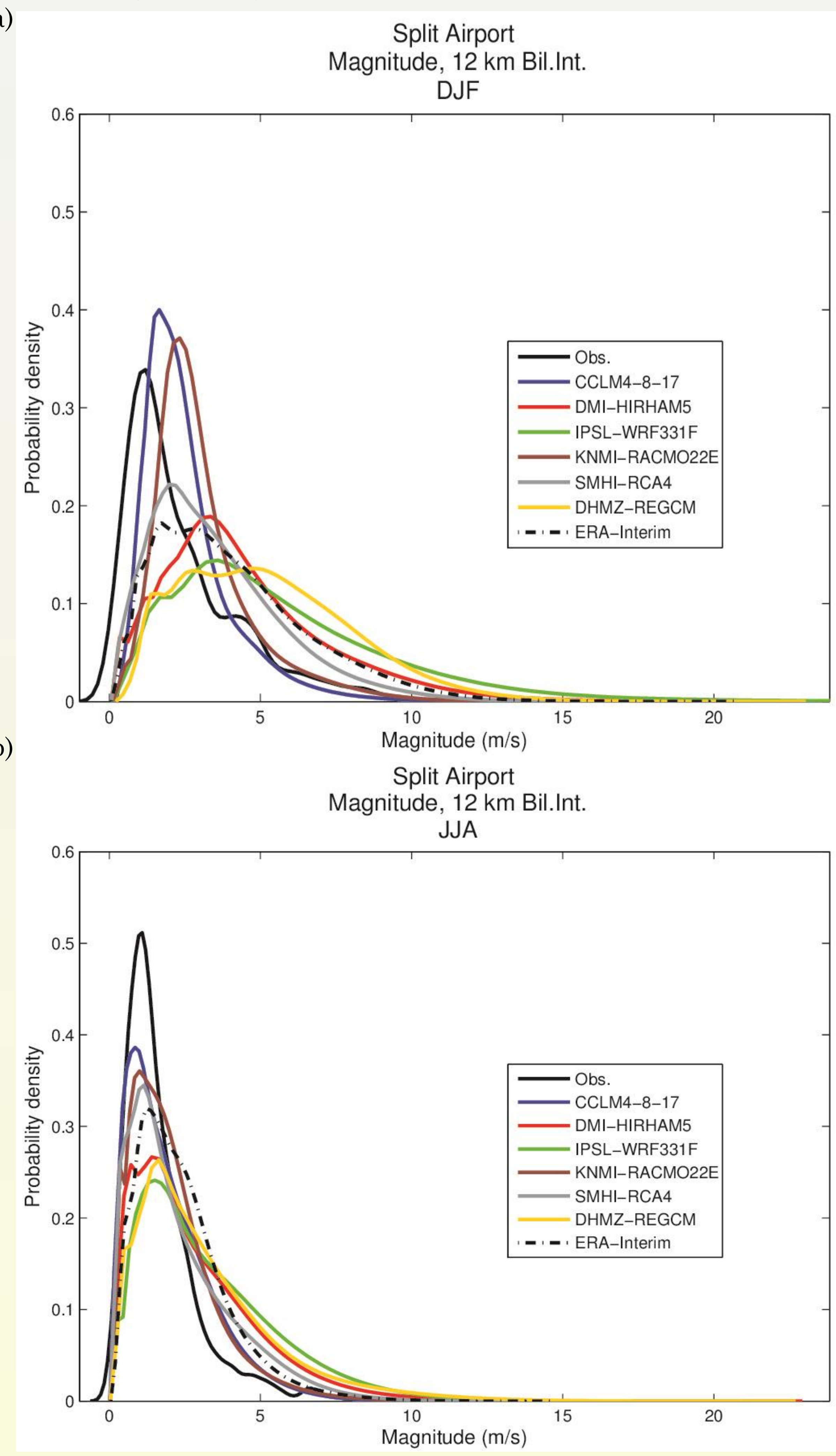

Fig. 3: PDE at 12.5 km resolution for magnitude using bilinear interpolation technique, Split Airport. (a) DJF season and (b) JJA season.

Perkins skill score (PSS):

- Calculates the cumulative minimum value of two distributions of each binned value, measuring the common area between two PDFs. Observed and modelled data are binned around centers determined by the range of the observed data.
- If a model simulates the observed conditions perfectly, the skill score will equal to 1.

Table 2: PSS in V component of the wind for Split Airport. Comparison between resolutions and interpolation approaches.

V component 12 km	N.N.	BIL.	50 km	N.N.	BIL.
CCLcom-CCLM	0.80	0.79	CCLcom-CCLM	0.67	0.73
DMI-HIRHAM	0.66	0.68	DMI-HIRHAM	0.54	0.56
IPSL-INERIS-WRF	0.62	0.62	IPSL-INERIS-WRF	0.54	0.55
KNMI-RACMO	0.76	0.74	KNMI-RACMO	0.61	0.70
SMHI-RCA	0.74	0.73	SMHI-RCA	0.61	0.60
DHMZ-REGCM	0.66	0.67	DHMZ-REGCM	0.59	0.59
ERA-Interim	0.69	0.68	ERA-Interim	0.69	0.68

Conclusions

- Our analysis reveals strong sensitivity of the simulated wind flow and wind pattern to the RCM horizontal resolution (12.5 km vs. 50 km).
- Different (non)dimensional skill measures discussed (e.g. Brier skill score, Perkins skill score) depend on both seasons and locations analyzed.

Acknowledgements

This work has been supported by the **CATURBO** (HRZZ, No. 09/151) project.

References

Winterfeld J, Geyer B, Weisse R (2011): Using QuikSCAT in the added value assessment of dynamically downscaled wind speed. *Int. J. Climatol.* **31**: 1028-1039.

Perkins S E, Pitman A J, Holbrook, N J, McAneney J (2007): Evaluation of the AR4 Climate Models' Simulated Daily Maximum Temperature, Minimum Temperature, and Precipitation over Australia Using Probability Density Functions. *Journal of Climate*, **20:** 4356-4376.