Performance comparison between two high resolution COSMO-CLM regional climate models for daily and sub-daily precipitation over the Alpine Region

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INTRODUCTION

A crucial issue in climate study is nowadays represented by the reduction of scale gap between time-spatial data projected by climate models and requirements of practitioners which adopt this data as input for impact models to support the management processes of stakeholders and policy-makers. This is a fundamental point since impact models adopt, as input, data on climatological timescales at spatial and temporal resolutions that are not readily available from current standard climate simulations.
In order to quantify the differences and the potential added value that could arise adopting climate data at different horizontal resolution, in this work we present a comparison among two climate simulations performed by CMCC and characterized by different configurations of the regional climate model COSMO-CLM at spatial resolution of 8 km and 2.2 km. The comparisons are performed in terms of precipitation at the daily and sub-daily scale over the Alpine Region.

MODEL AND DATA

CCLM 8

- Spatial resolution of 0.0715° (about 8 km), driven by ERA-Interim and covering the Italian peninsula and part of the neighboring states (1981-2010)

CCLM 2.2

- Spatial resolution of 0.02° (about 2.2 km), nested into CCLM 8 and covering a smaller area centered over the Alpine space (1981-2010)

EURO4M

- Daily precipitation high-resolution gridded dataset (spacing of about 5 km) (1980-2009).

LOCAL DATA

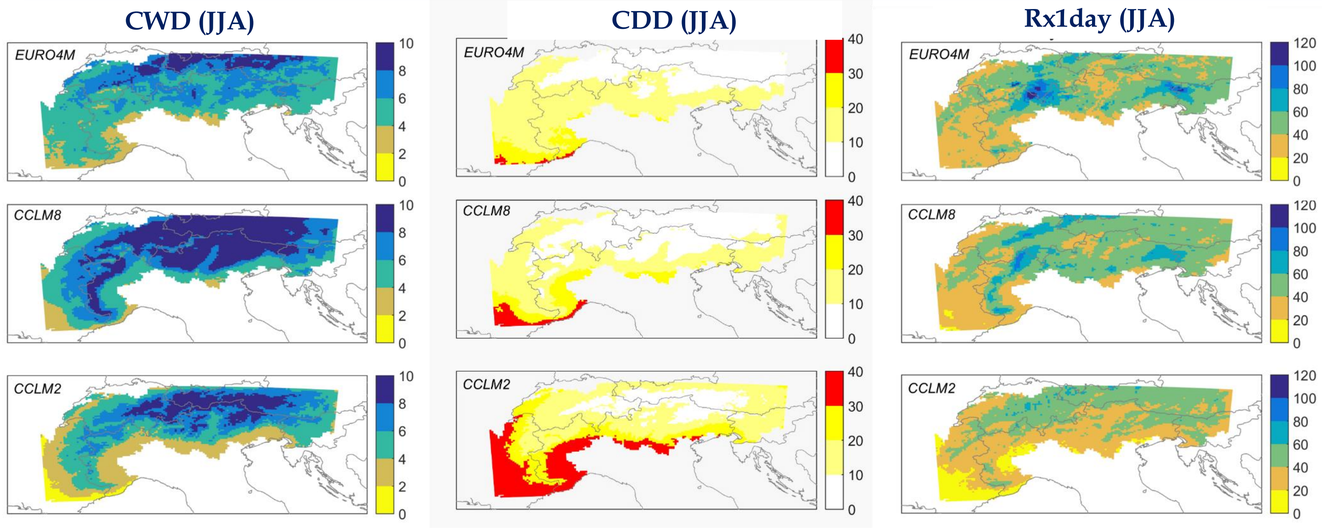
- Dataset of hourly precipitation obtained from automatic local weather station managed by ArpaLombardia (1995-2010)

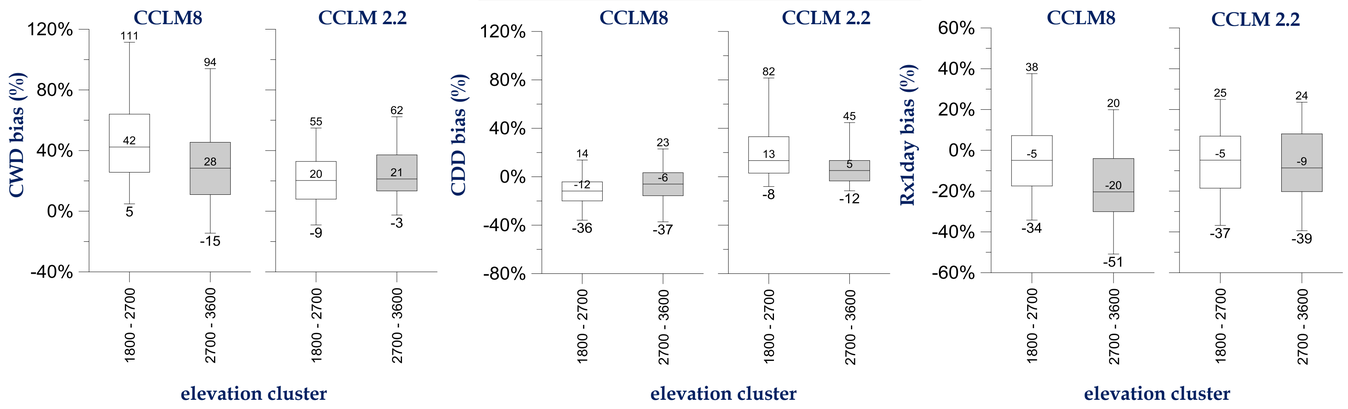
	CCLM 8	CCLM 2.2
Driving data	ERA-Interim Reanalysis	CCLM 8
Horizontal resolution	0.0715° (about 8 km)	0.02° (about 2 km)
Number of grid points	224 x 230	390 x 230
Time step	40 s	10 s
Convection scheme	Tiedke	Shallow convection based on Tiedke
Frequency of radiatio computation	1 hour	15 min
Maximal turbulent length scale	500 m	150 m
Critical value for normalized over saturation	4	1.6

Main differences between the implemented COSMO-CLM configurations.

The advantages of moving from a coarser resolution (8 km) to a finer one (2.2 km) consist in a better representation of real topography and the possibility of switching off the deep convection parameterization, improving the reproduction of the mesoscale circulation dynamics and the possible elevation dependencies of the near-surface climate change.

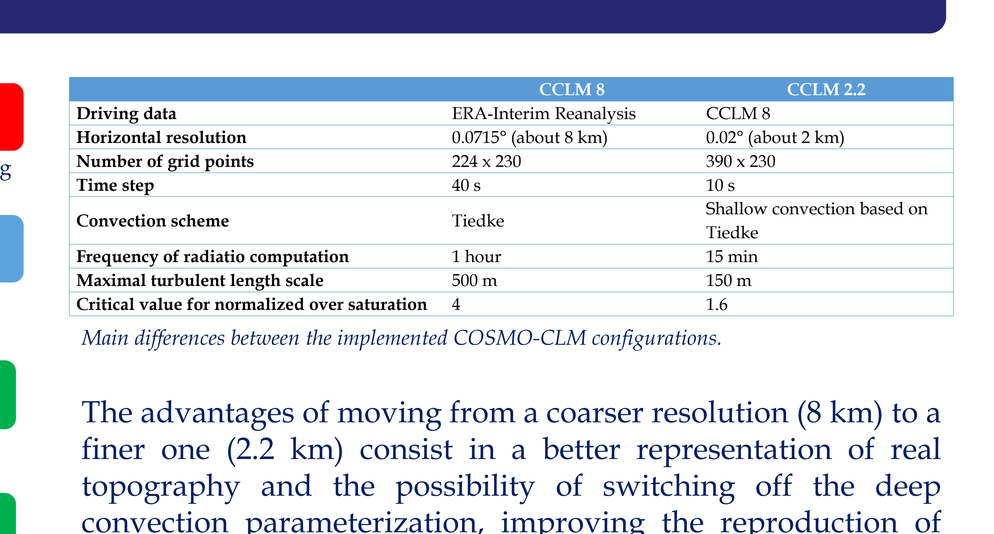
RESULTS



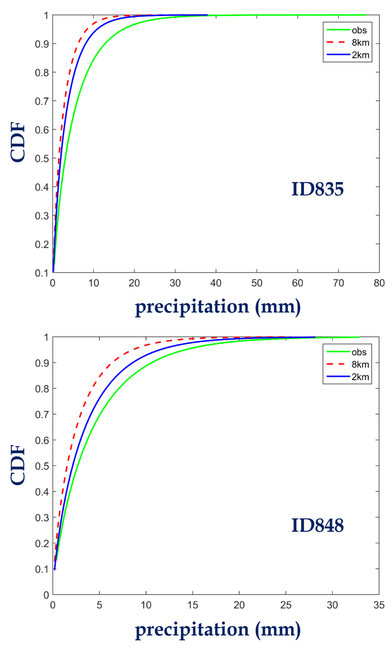


Upper part: Comparison between EURO4M, CCLM8 and CCLM2.2 for CWD, CDD and Rx1day over JJA (1981-2009)
Lower part: The same comparison clustering results on the basis of orography (box-whisker plot diagram)

All datasets, remapped with bilinear interpolation over the EURO4m grid, are analyzed clustering results on the basis of altitude to investigate the effect of orography. Data are elaborated for the JJA. The results highlight that CCLM 2.2 provides in some cases a better agreement with observation data, improving projections especially for mountain areas. In this case, however, a limit is provided by the horizontal resolution of the observational dataset (5 km) that compared to the CCLM 2.2 (2.2 km) may not capture all the dynamics of the finer resolution.



Upper part; Comparison of elevation and Rx1day between CCLM 8, CCLM 2.2 and data provided by WEATHER STATION (1995-2010); Lower part: gamma distribution for ID835 and ID848



The position of local stations is considered to select a corresponding grid point from the CCLM 8.8 and CCLM 2.2 grids using the nearest neighbor interpolation with a specific refinement for the CCLM 2.2 for which also an altitude constraint is introduced. In terms of orography, CCLM 2.2 returns a good agreement with local station position. This improves the prediction of precipitation patterns as reflected by the local analysis of Rx1day. Finally, the statistical distribution of precipitation is evaluated fitting data at time resolution of 6hr through Gamma distribution. The results show a better representation of CCLM 2.2 dynamics at the sub-daily scale compared to the CCLM 8 simulation.

CONCLUSION

This activity, such as others performed in the same way, returns encouraging findings suggesting the development and using of finer high-resolution climate models for regional and local impact studies.
Preliminary results of a sensitivity activity demonstrate how the configuration is very sensitive to the usage of a different microphysics parameterization scheme for grid scale precipitation.

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