

Assessment of the spatial variability of the added value on precipitation of convection-permitting simulation over the Iberian Peninsula using the RegIPSL regional earth system model

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European Climate Prediction system



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Model domain and Terrain height (m)

Model used:

Coupled atmosphere-land
RegIPSL regional earth system
model (WRF + ORCHIDEE)

Simulations: (1999-2009)

ERA-Interim driven: → EUR20
(20 km) → SWE3 (3 km)

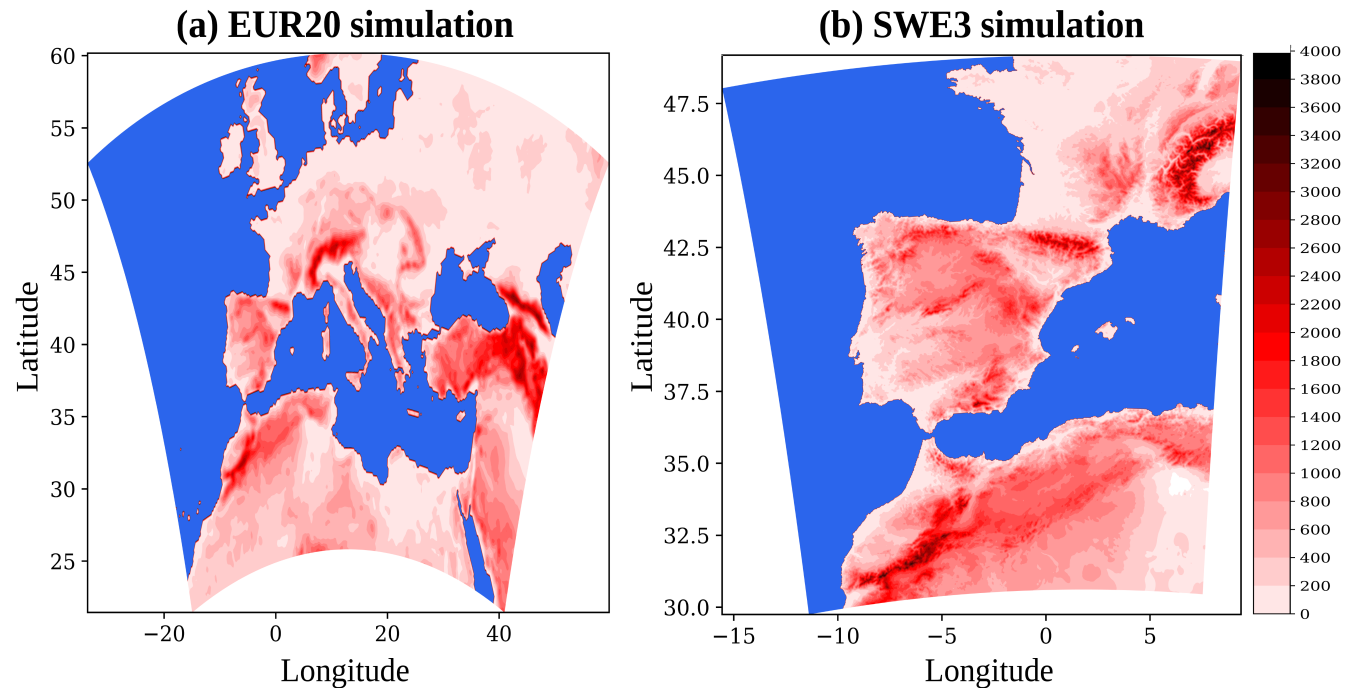
Observed datasets:

SPREAD (5 km; Serrano Notivoli et al., 2017)

<https://doi.org/10.5194/essd-9-721-2017>

IBERIA01 (10 km; Herrera et al., 2019)

<https://doi.org/10.5194/essd-11-1947-2019>



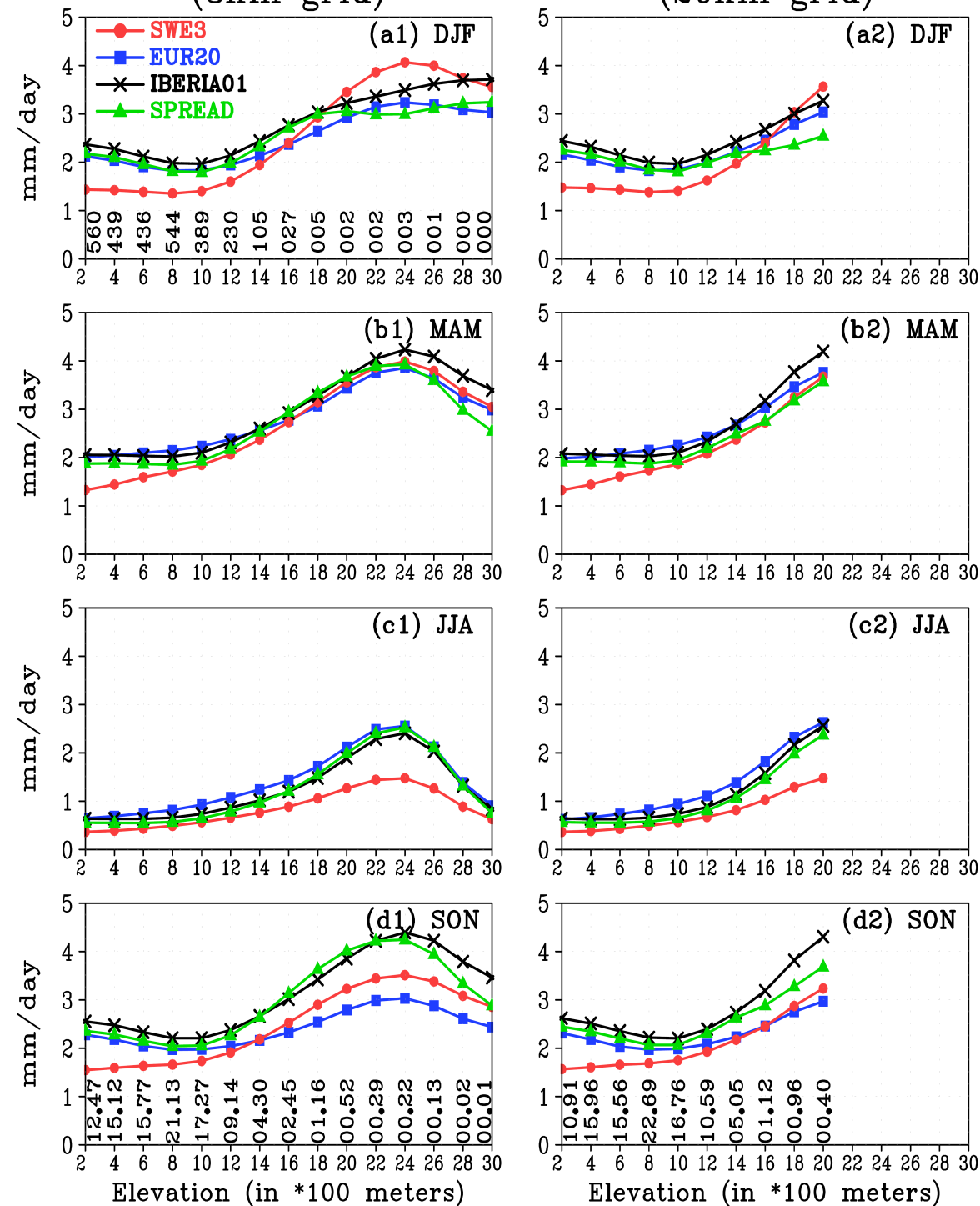
Description of model configurations

Description	Selection	
	EUR20 simulation	SWE3 simulation
WRF version	3.7.1	3.7.1
Dynamic solver	ARW	ARW
Horizontal grid spacing	20 km	3 km
Grid dimensions	301 × 193	581 × 651
Vertical levels	46 (top 50 hPa)	46 (top 70 hPa)
Integration time	90s	10s
Radiation (Shortwave and Longwave)	RRTMG Scheme (Integration TS = 30 min)	RRTMG Scheme (Integration TS = 5 min)
Microphysics	WRF Single-Moment (WSM) 5-class scheme	Thompson Scheme
Atmospheric surface layer	MYNN surface layer	MYNN surface layer
Land surface	ORCHIDEE	ORCHIDEE
Planetary Boundary Layer (PBL)	MYNN 2.5 level TKE scheme	MYNN 2.5 level TKE scheme
Cumulus	Kain-Fritsch scheme	no cumulus scheme is used

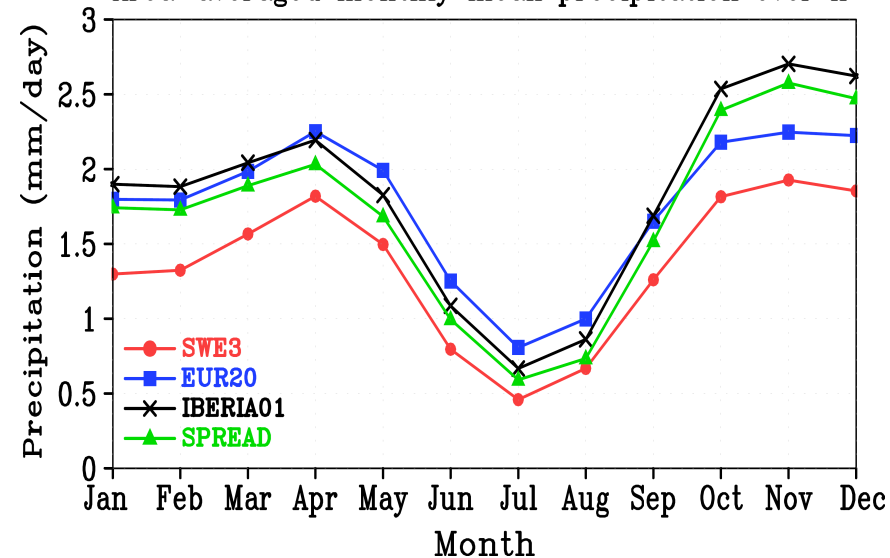
Altitudinal variation of mean precipitation

(3km grid)

(20km grid)



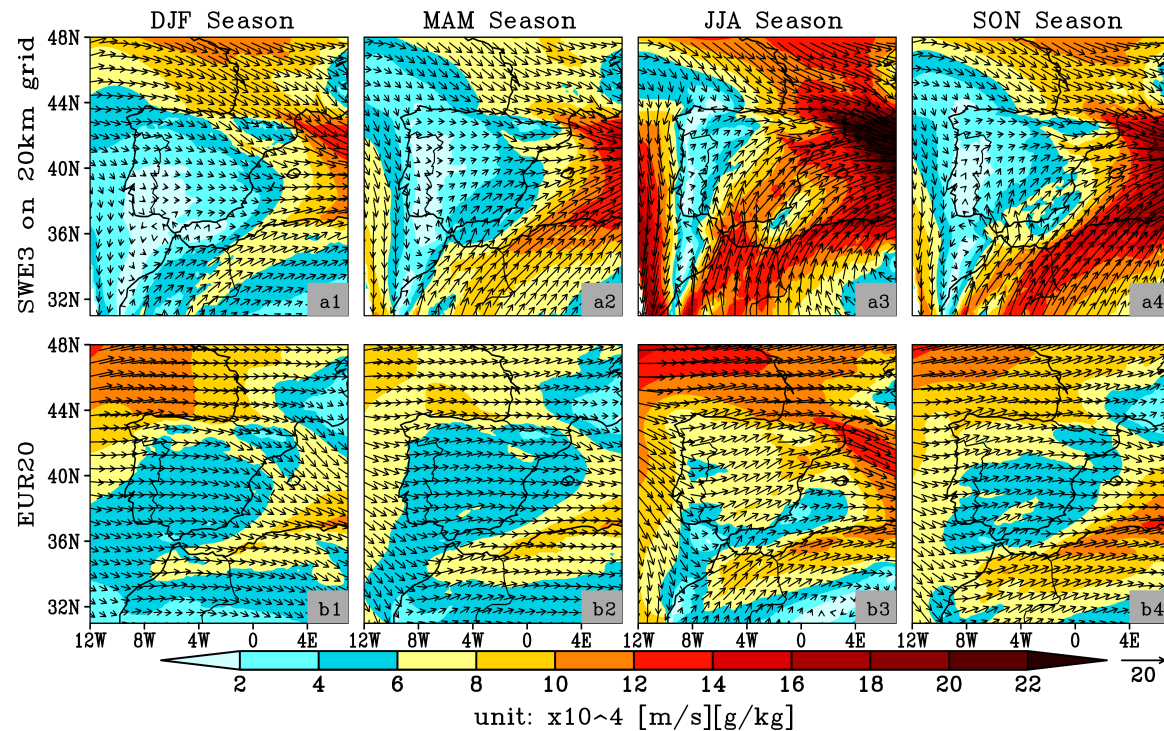
Area-averaged monthly mean precipitation over IP



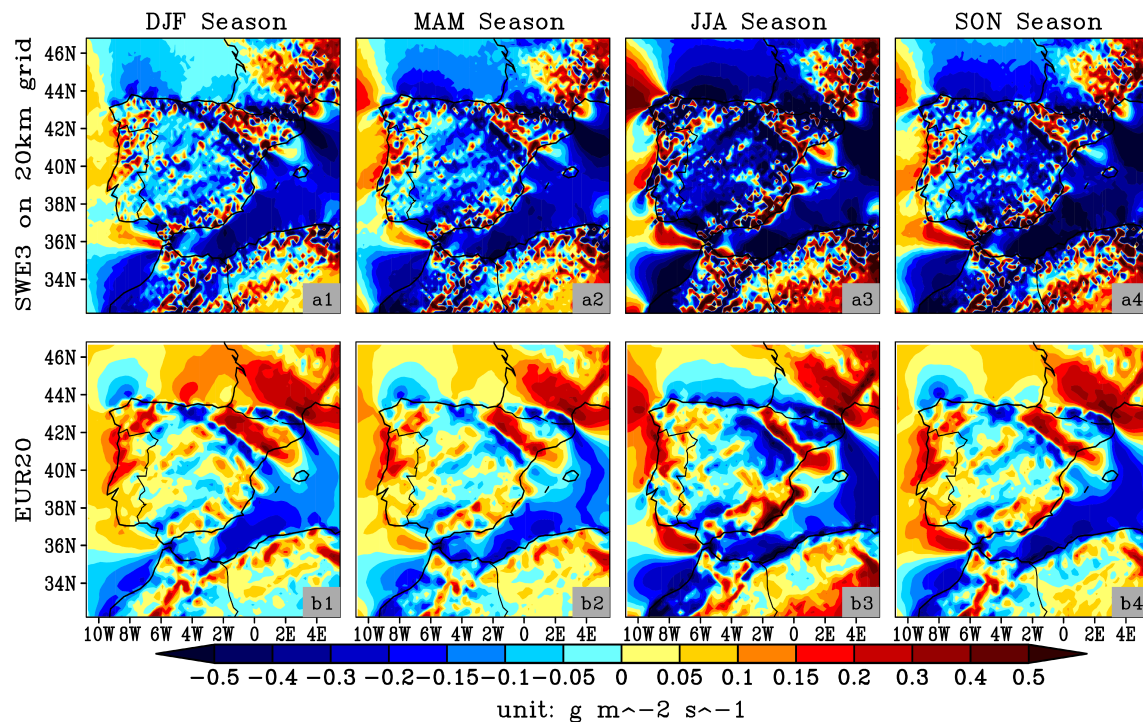
No clear benefit/added-value of the km-scale simulation (3km; SWE3) has been found in the representation of the seasonal mean precipitation of the Iberian Peninsula.

The spatial-temporal pattern of the observed seasonal mean precipitation is quantitatively better represented by the EUR20 than the SWE3 simulation.

Vertically Integrated Moisture Transport (VIMT)



Vertically Integrated Moisture Flux Convergence (VIMFC)



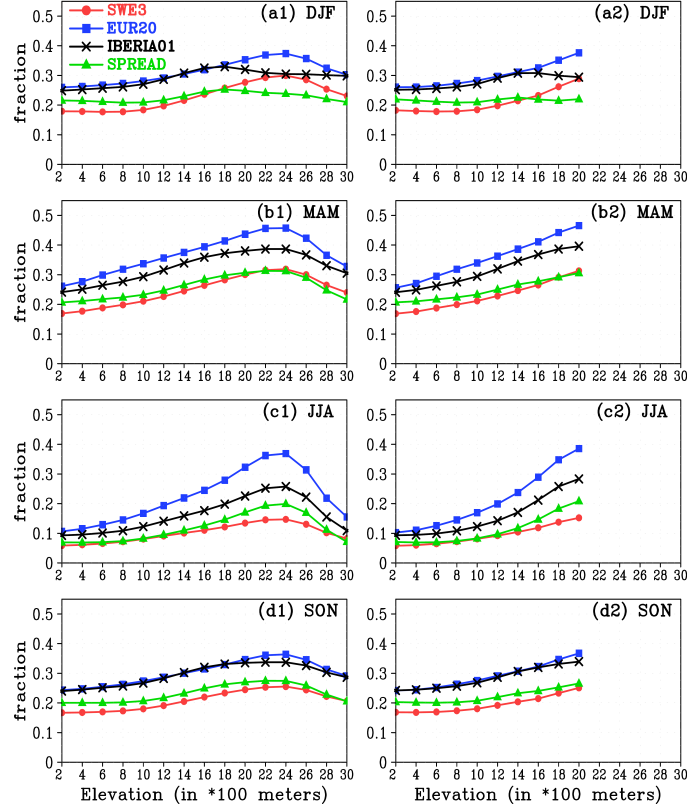
The km-scale simulation substantially underestimates the observed seasonal mean precipitation especially over the western parts of the IP compared to the EUR20 simulation which explains that on average over the whole IP.

The SWE3 simulation shows a southward shift of the westerly winds at the western side of the Iberian peninsula compared to the EUR20 simulation, reflecting/indicating a decrease in moisture transport from the Atlantic Ocean towards the IP leading to a decrease in the precipitation.

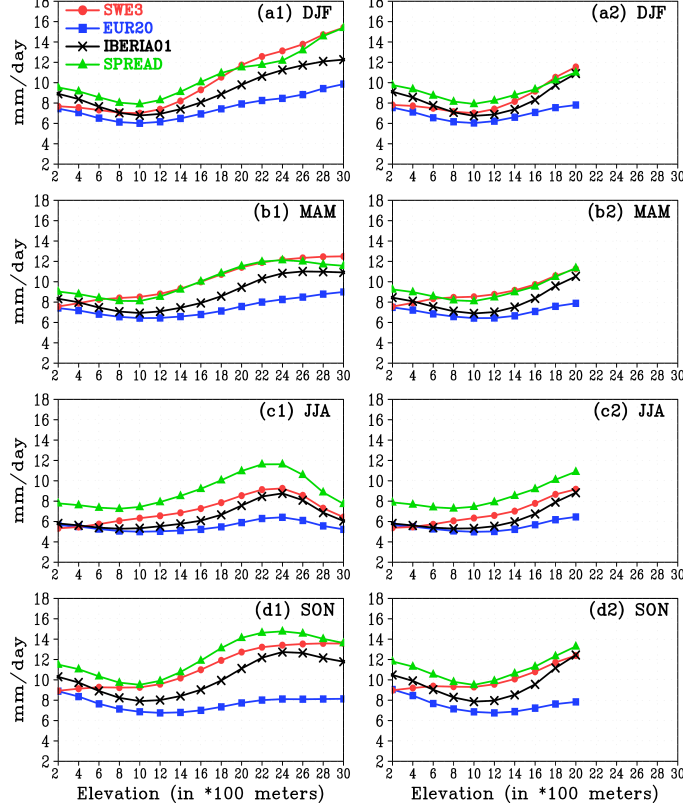
Additionally, the escalation of southerly winds over the IP has also been observed, bringing warm and dry air which further affects moisture transport effectively, leading to a decrease in precipitation.

The clear improvement of kilometeric-scale simulation over the driving coarser-scale simulation has been found in the representation of the spatio-temporal distribution of the wet-day precipitation frequency and intensity, and also in the reproduction of the heavy precipitation events for each season at both resolutions i.e. downscaled and upscaled.

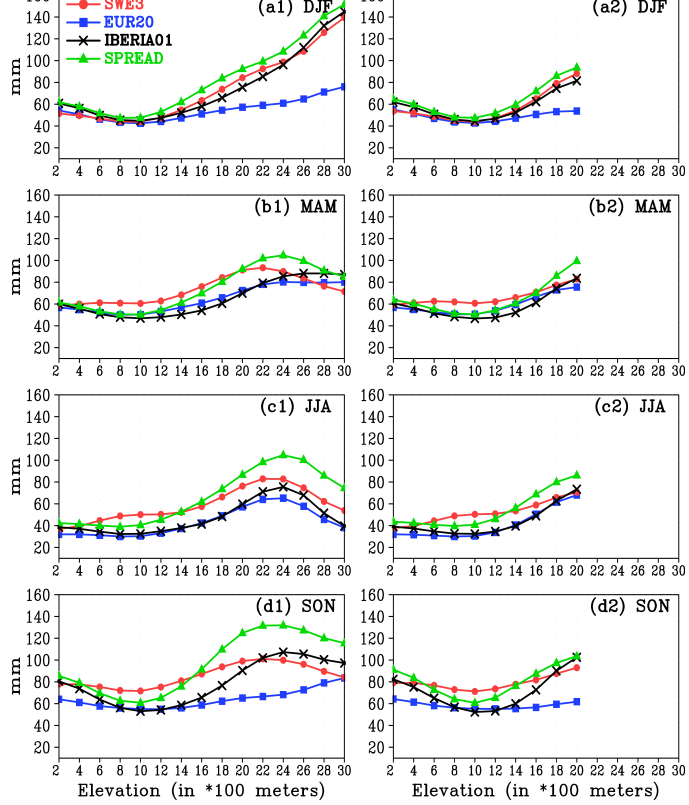
Altitudinal variation of precipitation frequency (pr >= 1mm)
(3km grid) (20km grid)



Altitudinal variation of precipitation intensity (pr >= 1mm)
(3km grid) (20km grid)



Altitudinal variation of maximum one day precipitation amount
(3km grid) (20km grid)



It has also been noted that the spatio-temporal distribution of precipitation for all metrics used varies between the two observational datasets for all seasons.

In quantitative terms, the SPREAD shows less frequent but more intense wet-day precipitation and more intense extreme precipitation amounts than the IBERIA01, and this variation may be due to the different resolutions of the observational datasets, and it also highlights the importance of having high-resolution good-quality observed datasets for regional-to-local scale assessments.

Also, we have observed that the km-scale simulated results are more comparable and closer to the SPREAD than the IBERIA01 and the opposite is true in the case of coarser-scale simulation, which emphasizes the fact that the model simulated precipitation should be compared with similar or nearly identical resolution observational datasets for better evaluation/estimation.

On the other hand, in the mountainous/hilly regions, it is difficult to determine which estimate is correct because observational rain gauge network stations in these areas are very sparse, leading to considerable uncertainty in the measurement of the precipitation.

These results demonstrate a clear advantage of using a RegIPSL model at the kilometric-scale over the Iberian Peninsula in the simulation for high-impact weather events, consistently with previous studies over other areas, and also point towards the need of the very high-resolution good-quality of observational datasets for the accurate evaluation of model-simulated resultss.

Thank You