From global to regional: Advancing the simulation of the Moroccan climate with a variable resolution GCM

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With the contribution of:
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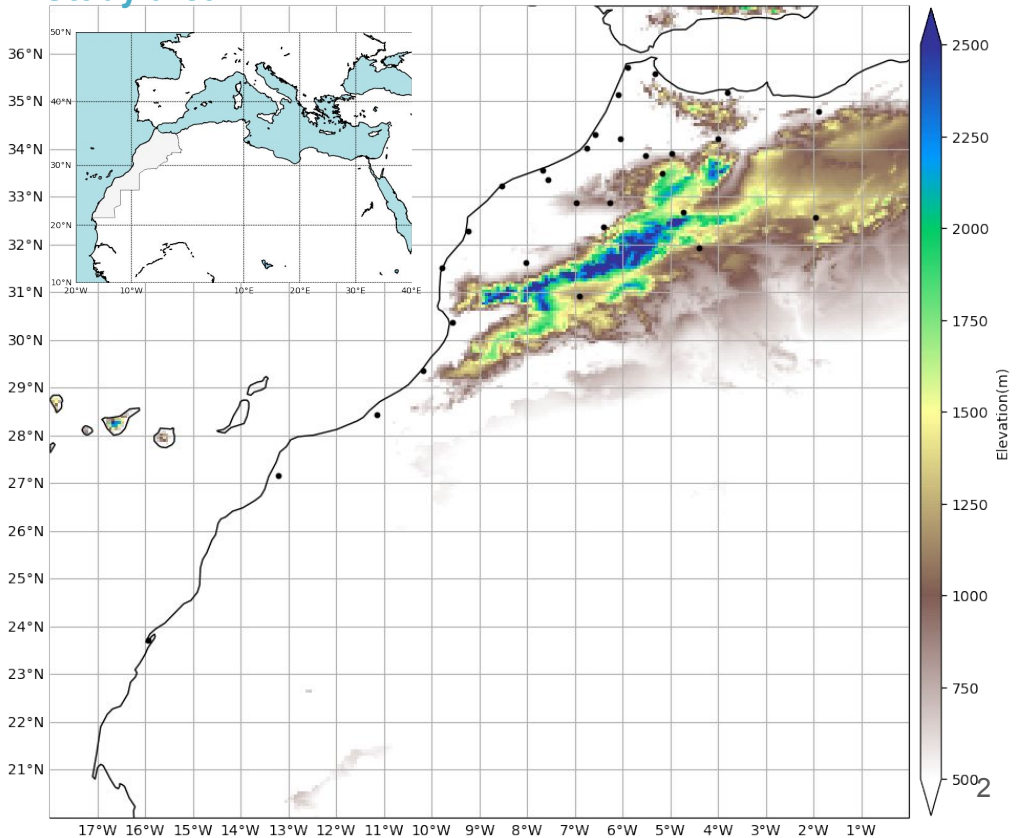
Why using a global model for regional purposes?

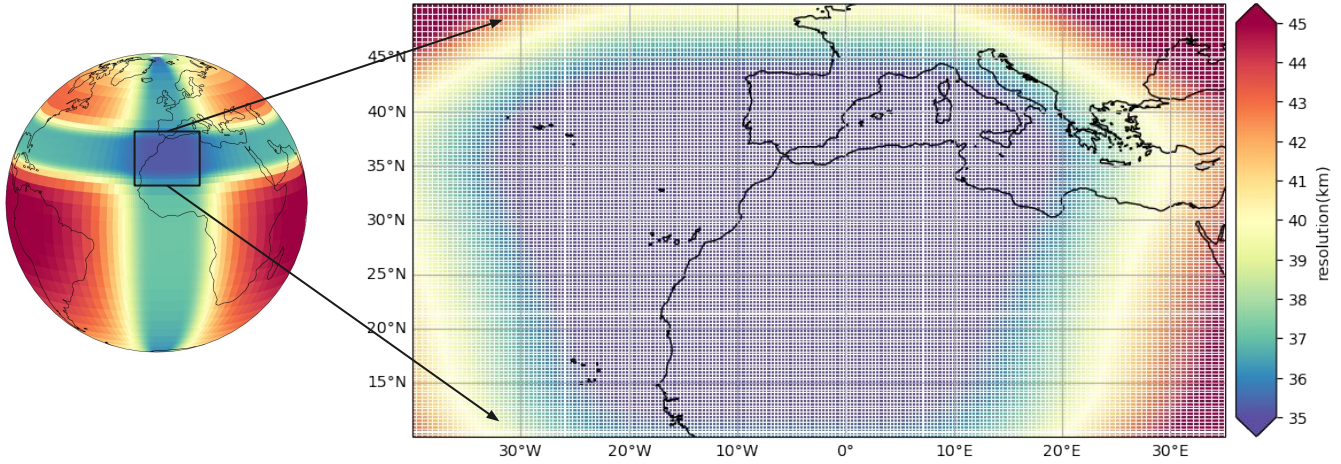
- **RCMs** allow a better representation of many processes including mesoscale circulation and orographic effects…
- **GCMs** ensure the coherence between the global and regional scales

- Morocco is one of the most vulnerable territories to climate change in the Mediterranean and North Africa
- The moroccan climate is influenced by the Atlantic Ocean, the Mediterranean Sea and the Sahara ⇒ sub-humid to semi-arid climate in the north and arid to desertic climate in the south

Study area



Refined grid configuration



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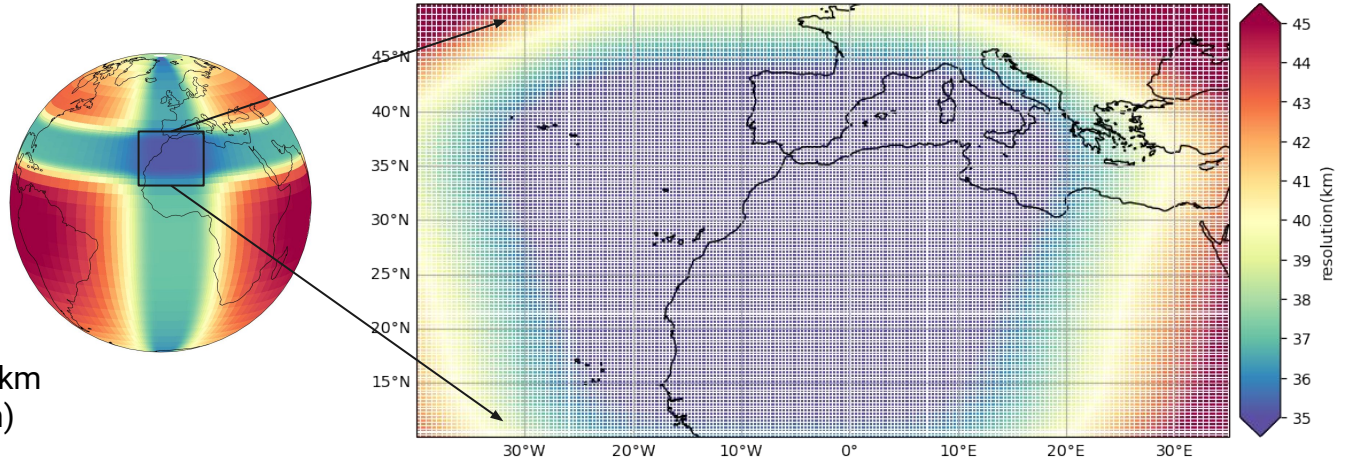


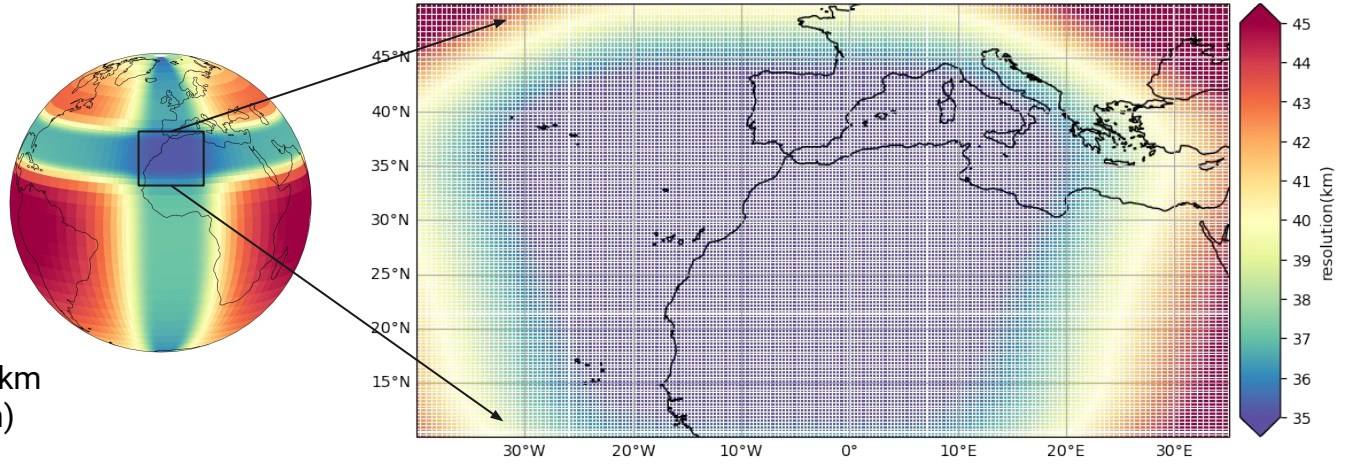
Developed configuration:

- Initial regular grid: 384x220x79
- Resolution over zoom area~ 35km (comparable to ERA5 resolution)
- Resolution outside zoom area ~ CMIP6/LR(~250km)
- Stable over 36 years of simulation, <u>without nudging</u>

Refined grid configuration

Developed configuration:

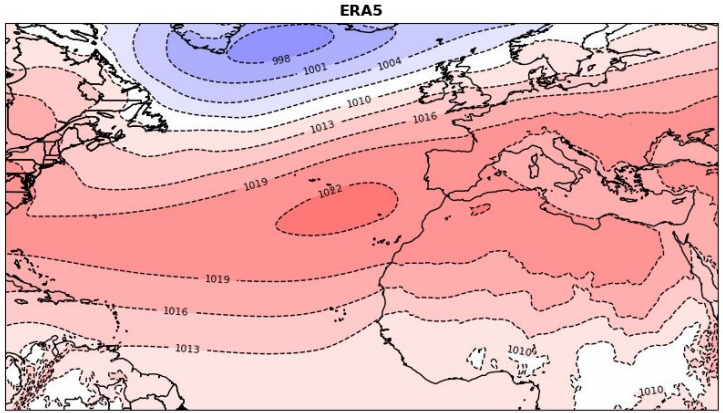
- Initial regular grid: 384x220x79
- Resolution over zoom area~ 35km (comparable to ERA5 resolution)
- Resolution outside zoom area ~ CMIP6/LR(~200km)
- Stable over 36 years of simulation, <u>without nudging</u>

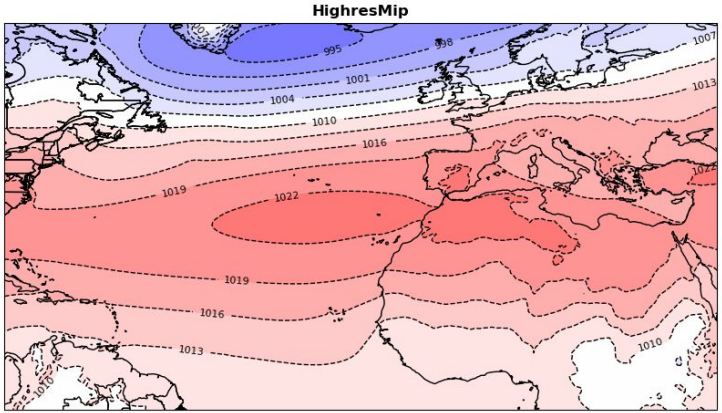


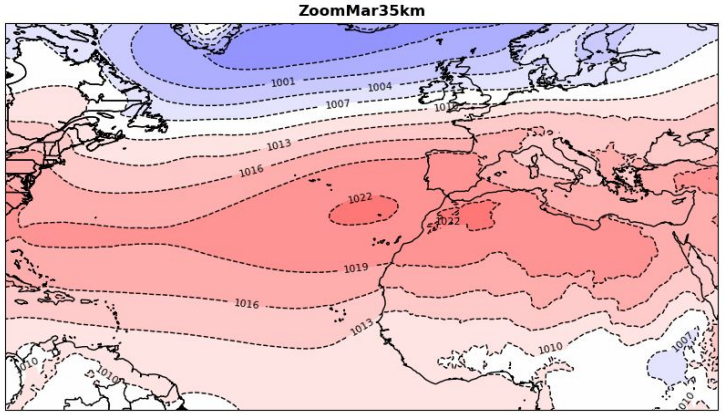
Acronym	Description	Resolution
Amip	land-atmosphere simulation, forced by observed sea surface temperature (SST) and sea ice concentration (SIC)	~ 250km
HighresMip	land-atmosphere with high resolution	~ 50Km
ZoomMar35km	land-atmosphere simulations with the new regional configuration	~ 35 km

Coherence global/regional scale

DJF mean sea level pressure (hPa) climatology over 1979-2014

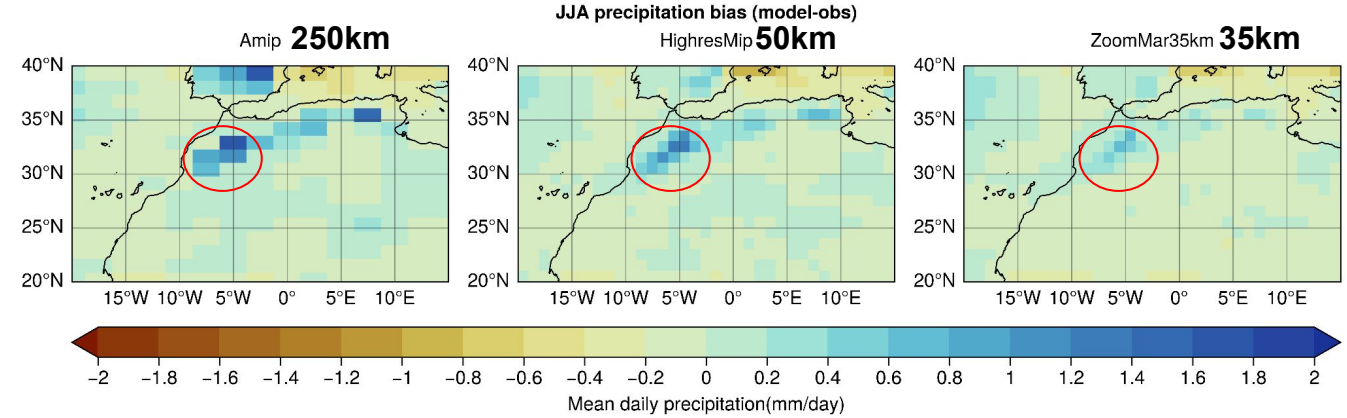


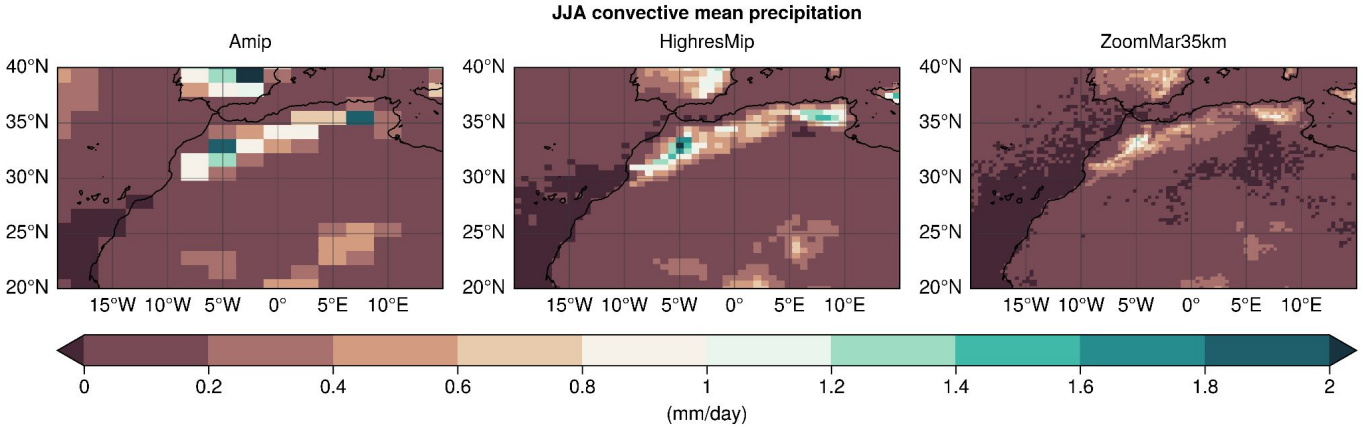




- Ensured consistency of the general circulation
- Similar structures compared to a global 50km simulation, more expensive(nearly 20%) than the refined grid simulation

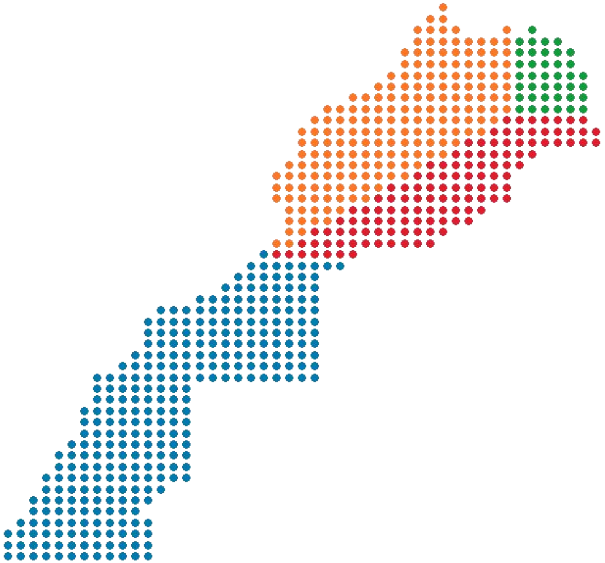
Reduced wet bias over the Atlas during summer





- Overestimation strongly reduced with the refined grid simulation
- Explained mainly by reduced convective precipitation

Precipitation seasonal cycles



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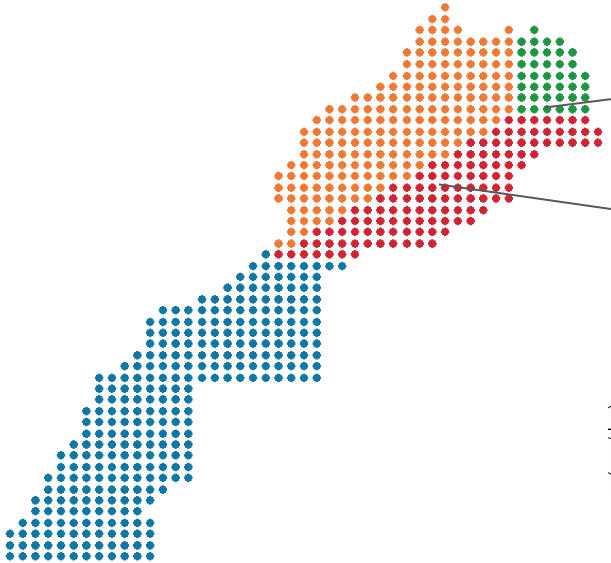

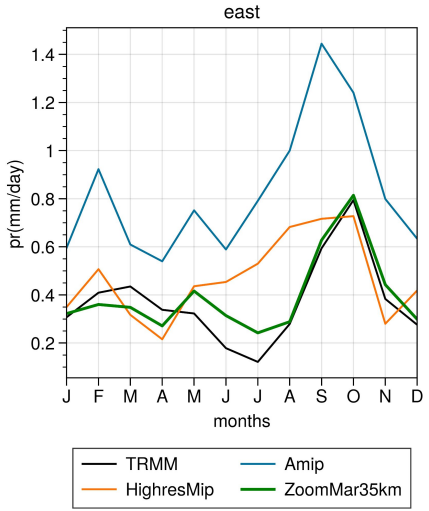

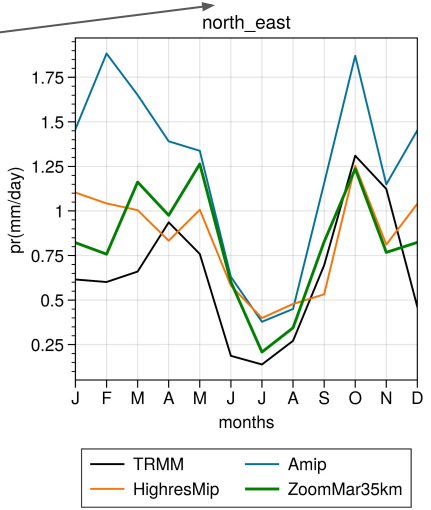

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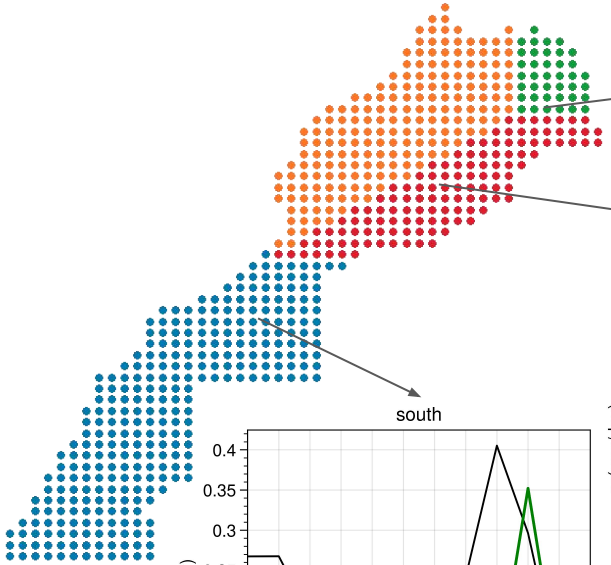

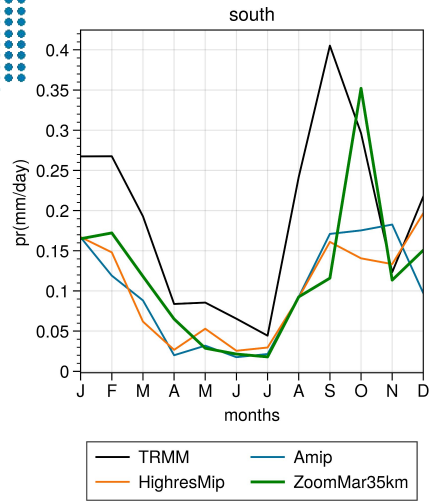

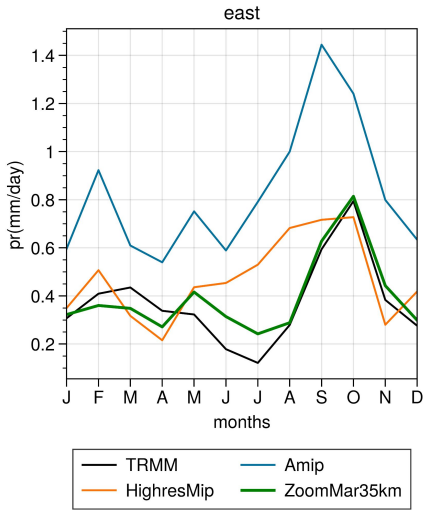

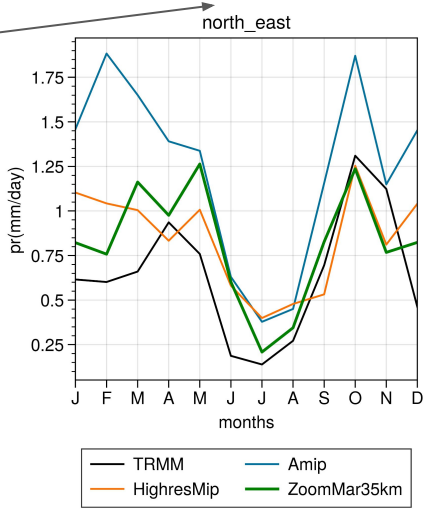

- The seasonal cycle is better simulated by the refined grid simulation
- Verified also with other observational datasets

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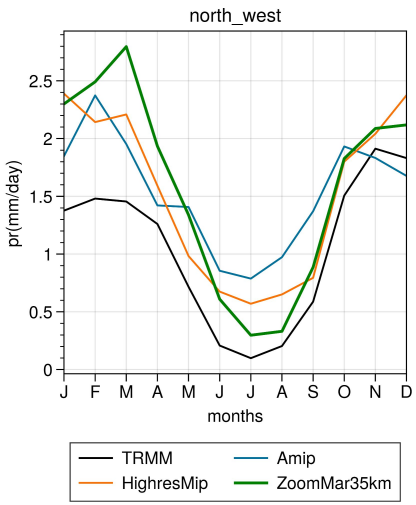

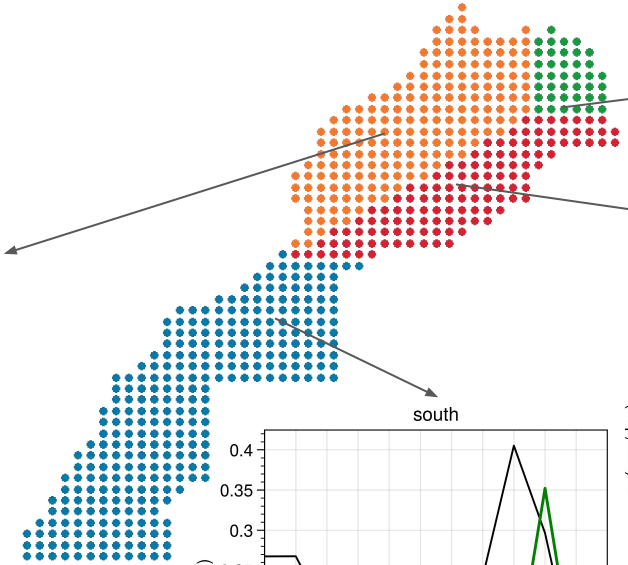

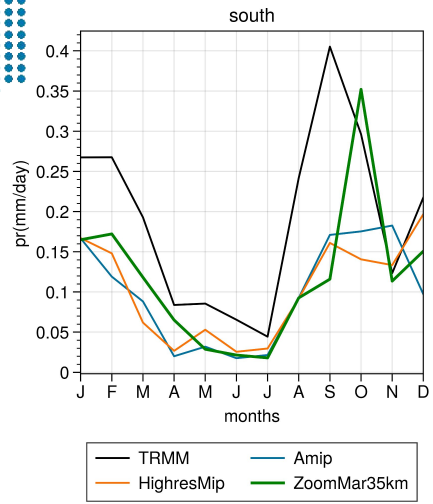

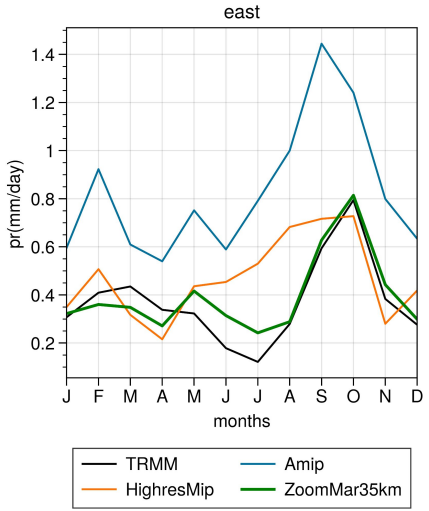

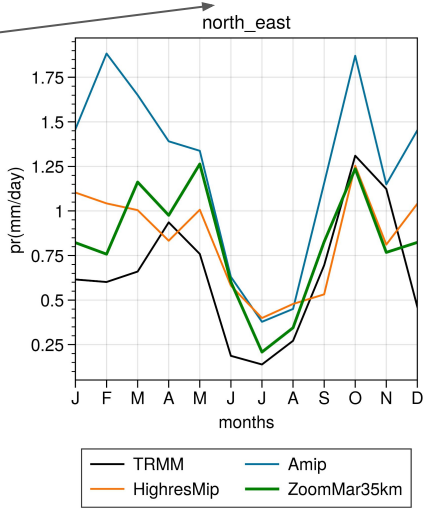

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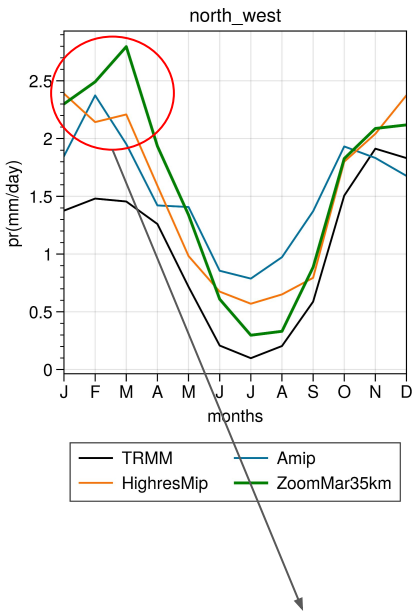
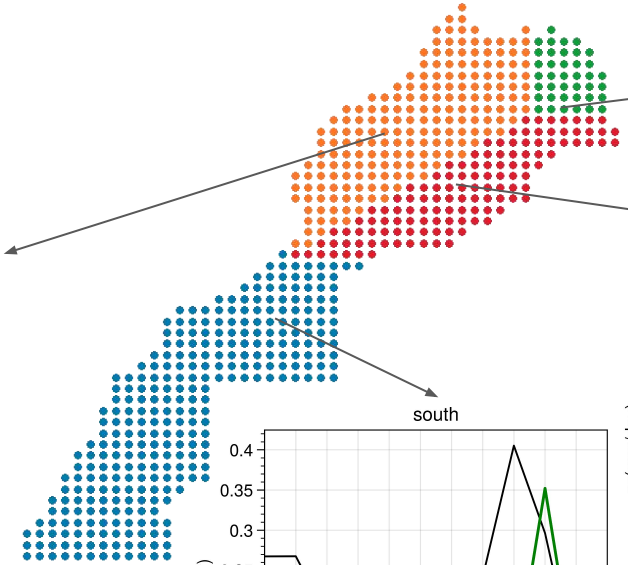
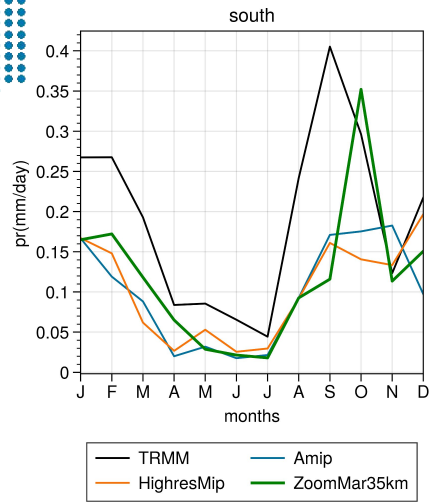
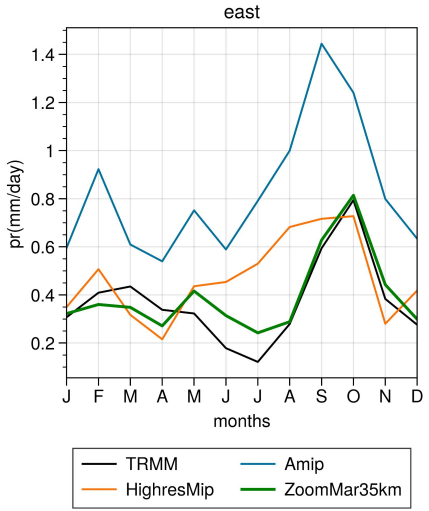
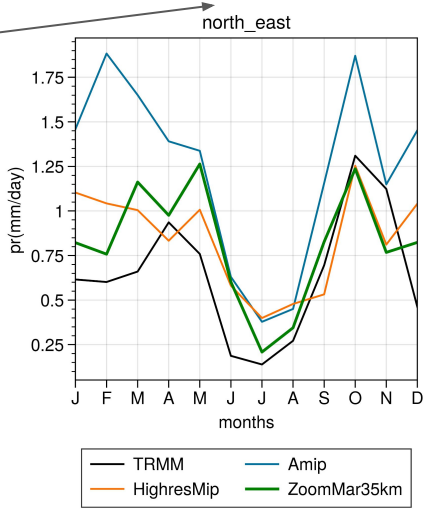








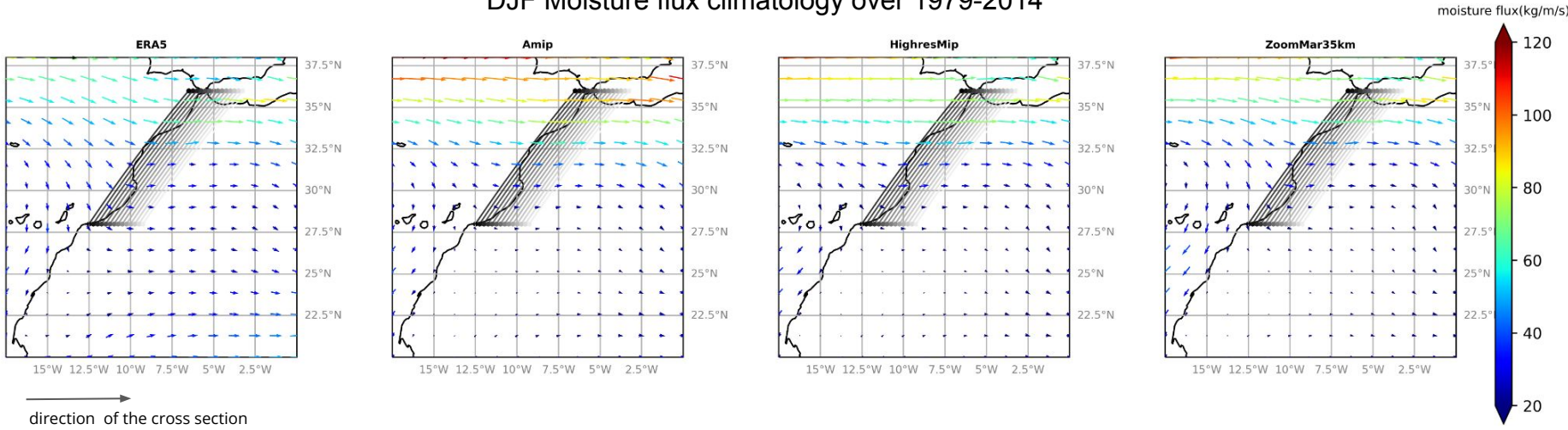


- Is it related to convective precipitation?
- Are we advecting more humidity from ocean?
- Specific precipitation events?

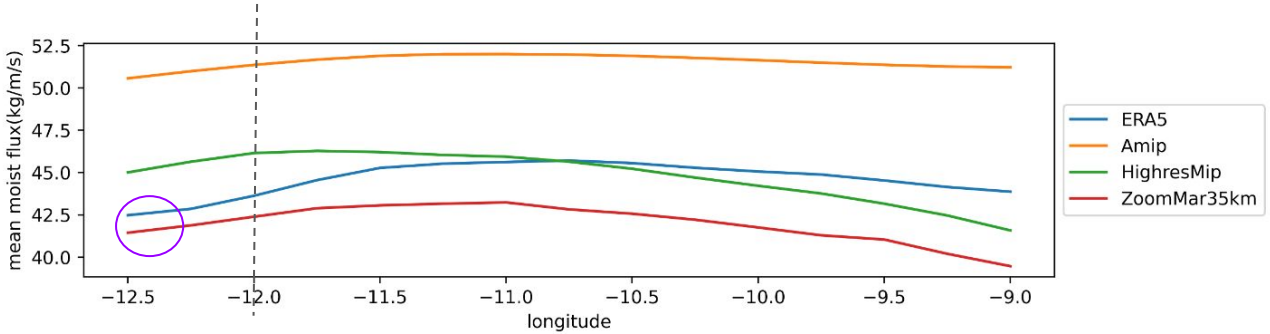
- The seasonal cycle is better simulated by the refined grid simulation
- Verified also with other observational datasets

Entering Humidity fluxes

DJF Moisture flux climatology over 1979-2014



- The advected fluxes by ZoomMar35km are the closest to reanalysis at the entrance of the land



Conclusion and take home messages

- The refined grid configuration (less expensive than fine resolution GCM) is as consistent in terms of mean global circulation fields
- Reduced summer wet bias over the moroccan Atlas (by reducing convection)
- Improvements in precipitation seasonal cycles at regional scale
- Other processes may be involved in the winter wet bias in the west-northern region(ongoing)

THANK YOU

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