Assessment of the synoptic forcing associated with extreme precipitation events over Southeastern South America as depicted by RCMs at convective permitting resolution performed within a CORDEX FPS

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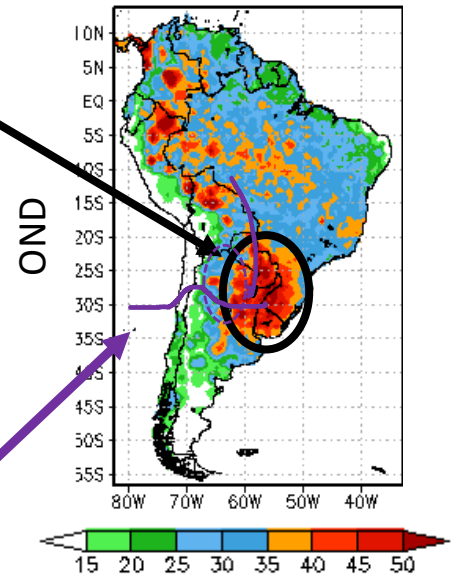
Background

- Southeastern South America (SESA) is one of the regions of the world where the deepest and most intense convective storms develop;
- More than 80% of the warm season precipitation is accounted for extreme precipitating systems;
- Ingredients:
  - Moisture supply via the South American Low Level Jet (LLJ) together
  - An orographic low at lower levels
  - a mid level through over the Andes range

95th percentile of daily precipitation



CPC data (1979-2017) (mm/day)

Challenge

To adequately simulate the occurrence of organized deep convection and the associated heavy precipitation

- ⇨ CORDEX Flagship Pilot Study focused on modelling extreme precipitation events in SESA by means of a variety of tools, including Convection Permitting Models-

Modeling set up

RCMs

- WRF3.8-UCAN (Santander, Spain)
- RegCM4-USP (USP, Brazil)
- WRF3.9-CIMA (CIMA, Argentina)

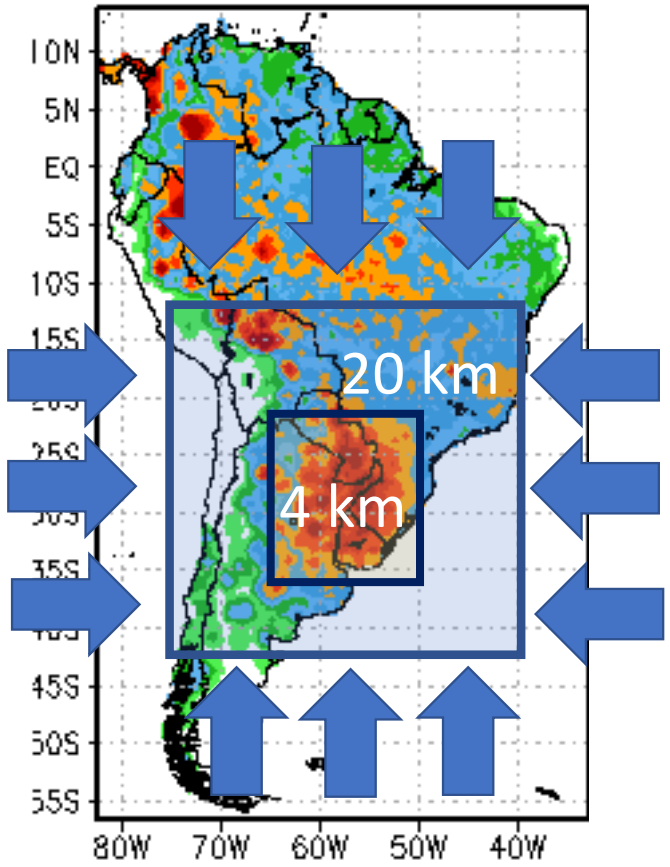
Boundary Conditions: ERA-Interim

- 20 km resolution
- 4 km resolution (Convection Permitting)

Simulations:

WL - 72 hs simulations of selected extreme events

CM – 6-month lenght simulations



Selected season:

- ONDJFM 2009-2010
- 3 selected extreme events (Daily precip > 95th percentile)

Objectives

- Assessing the ability of Convective Permitting simualtions in representing:
  1) Triggering mechanisms of extreme precipitation events
  2) Timing, intensity and spatial extent of the precipitating systems
- Evaluating CM/WL simulations

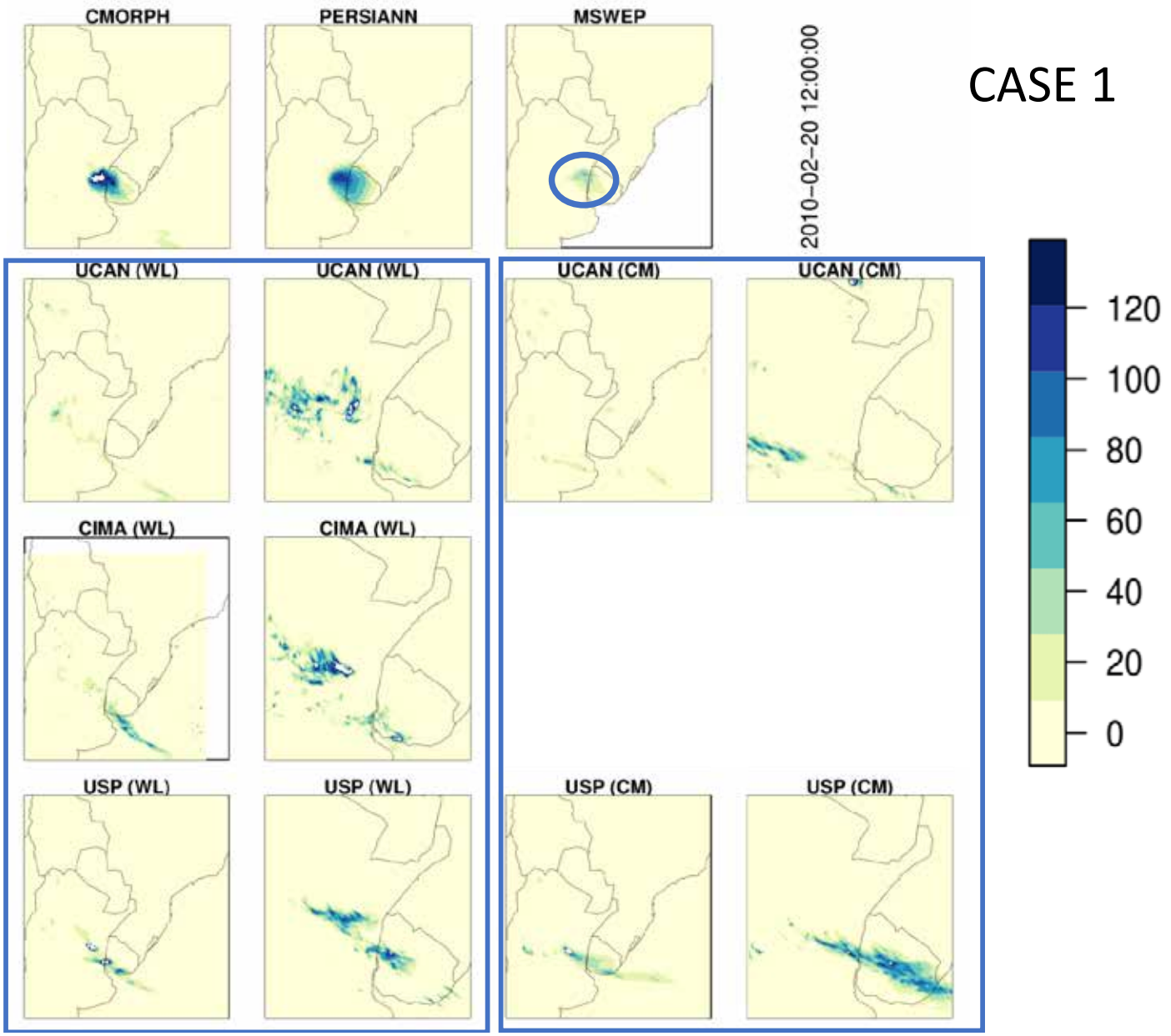
Analysis

- Spatial ditribution of the accumulated precipitation for each extreme event
- Spatial distribution of key drivers: low level circulation
- Timeseries of 6-hourly accumulated precipitation averaged over the 4-km resolution domain
- Objective measure of model performance: the Fractional Skill Score
- Conclusions

Observations

Maximum 6-hourly precipitation (mm)

RCMs

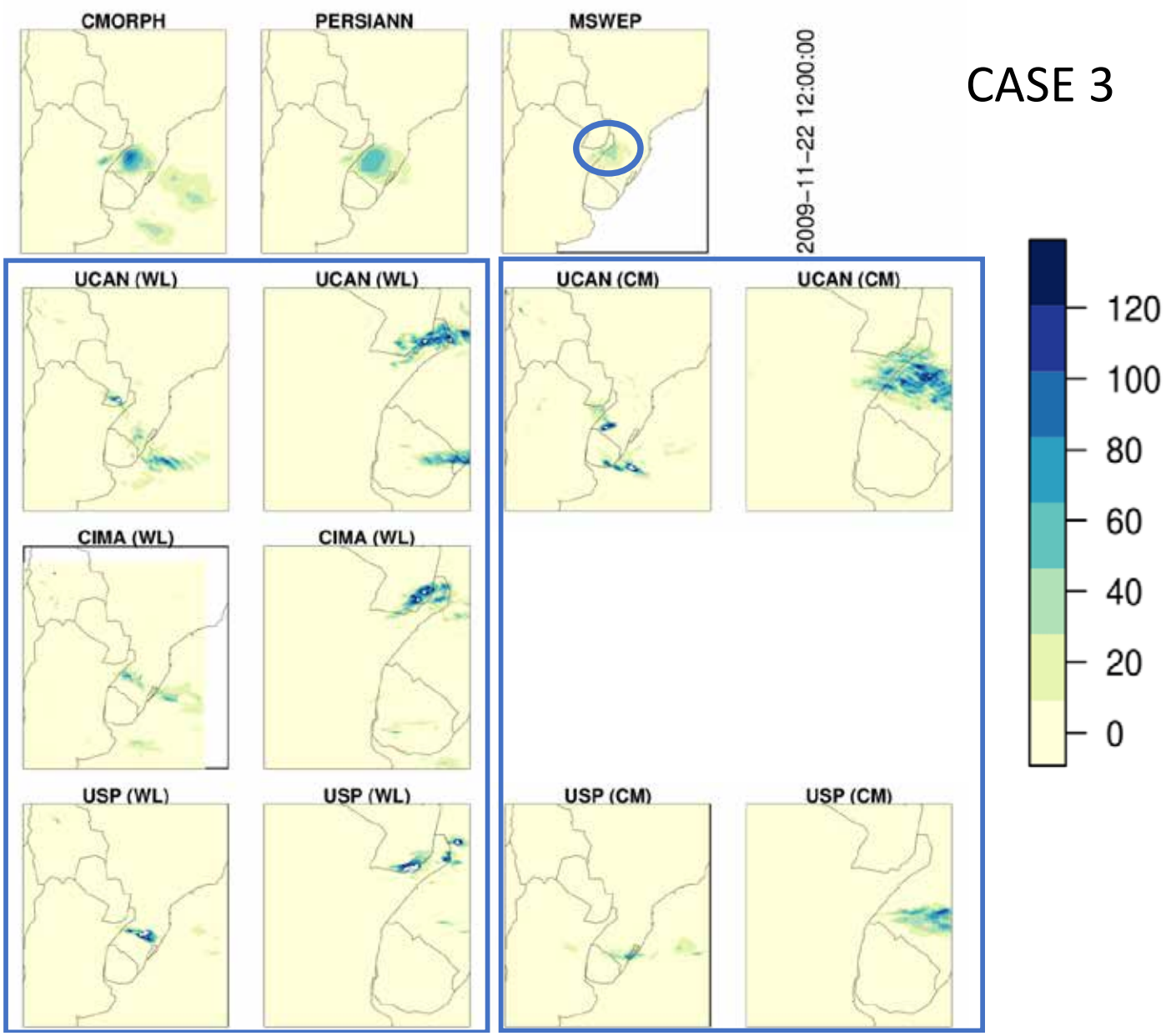


CASE 1

Observations

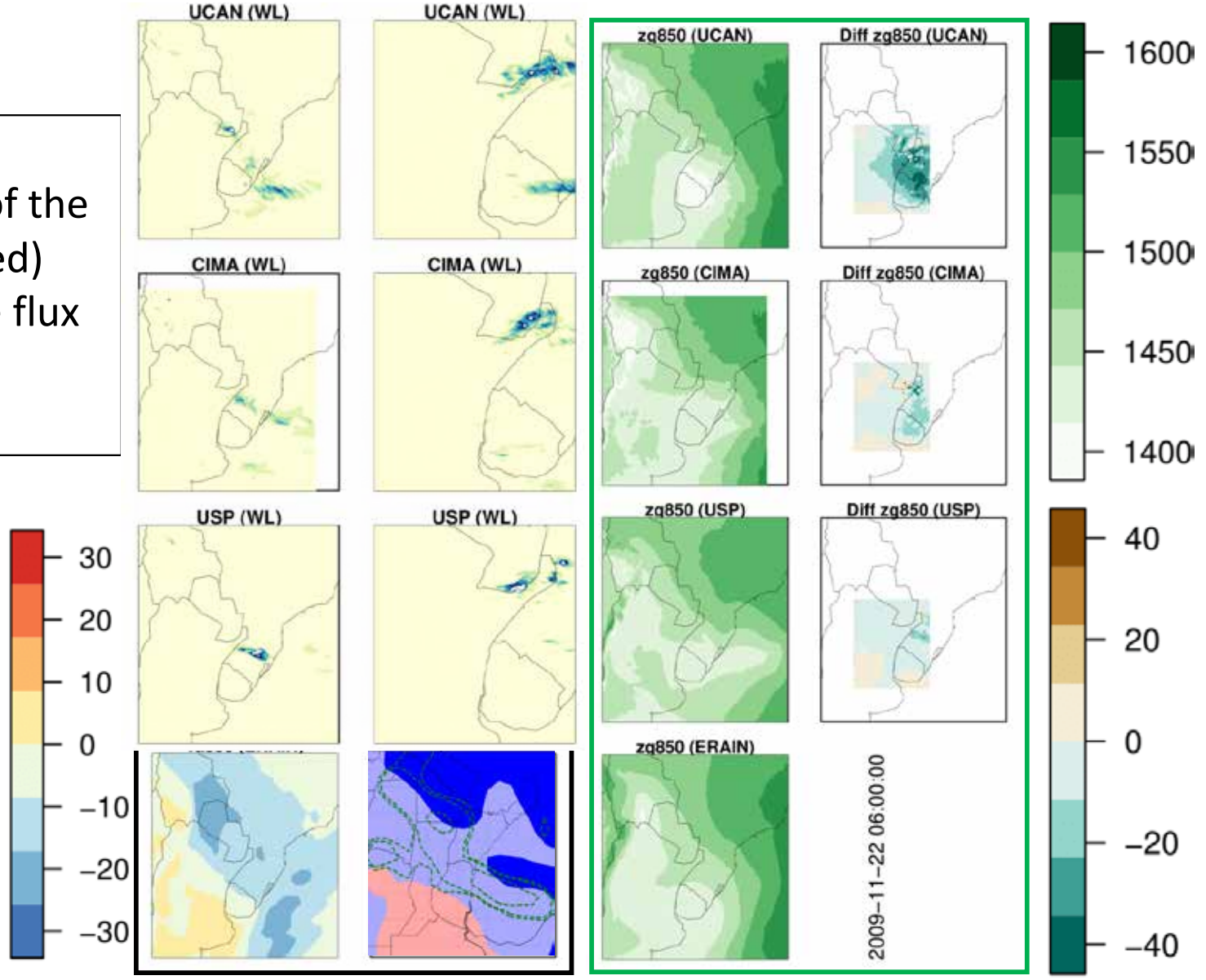
RCMs

Maximum 6-hourly precipitation (mm)



WL

Meridional component of the wind (shadded) and moisture flux convergence (black)



CASE 3

850 Hpa height and difference between 20 km and 4 km simualtions

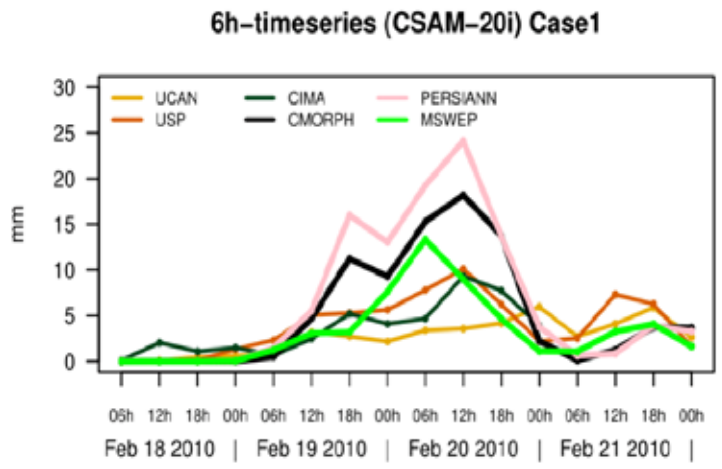
Time of the maximum precipitation intensity

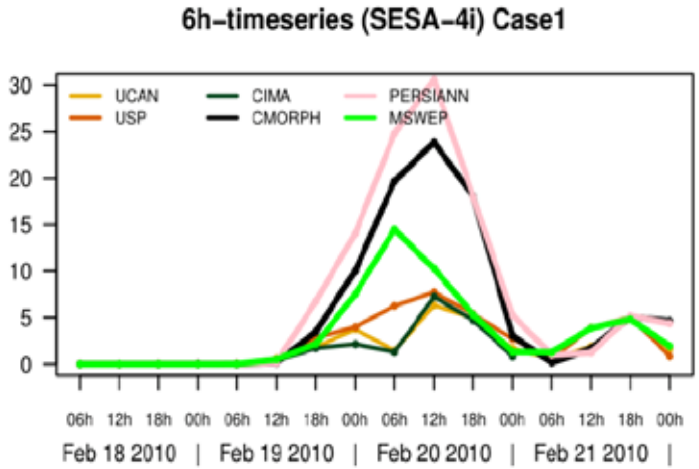
WL

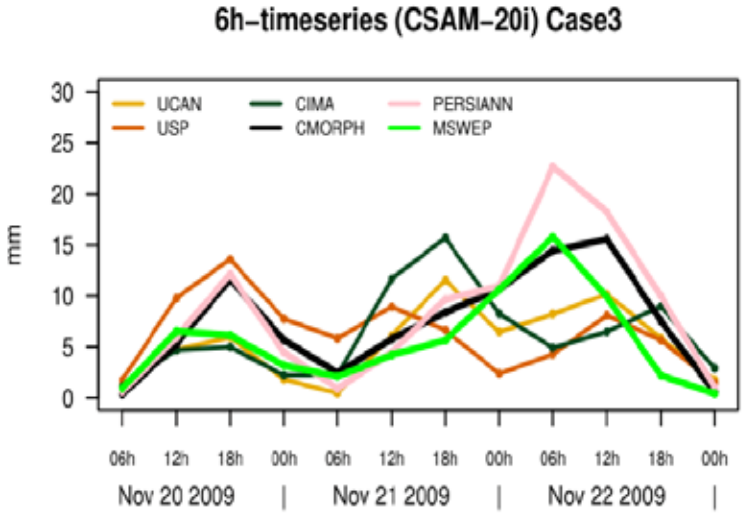
20 km

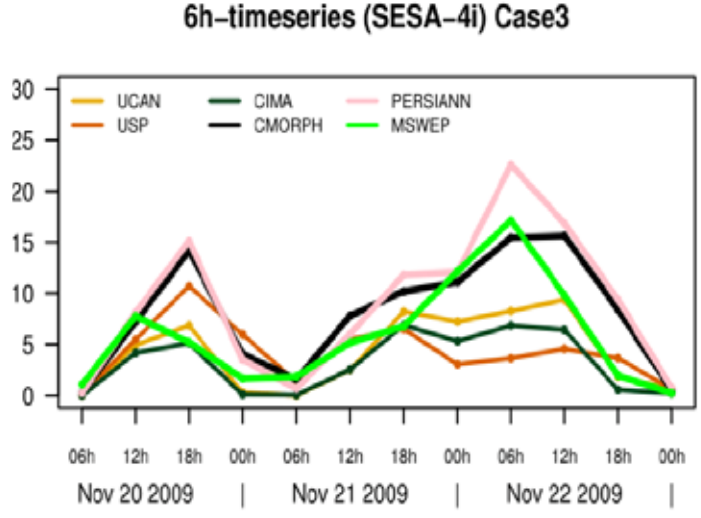
4 km

Timeseries of the 6-hourly accumulated precipitation averaged over the 4km domain







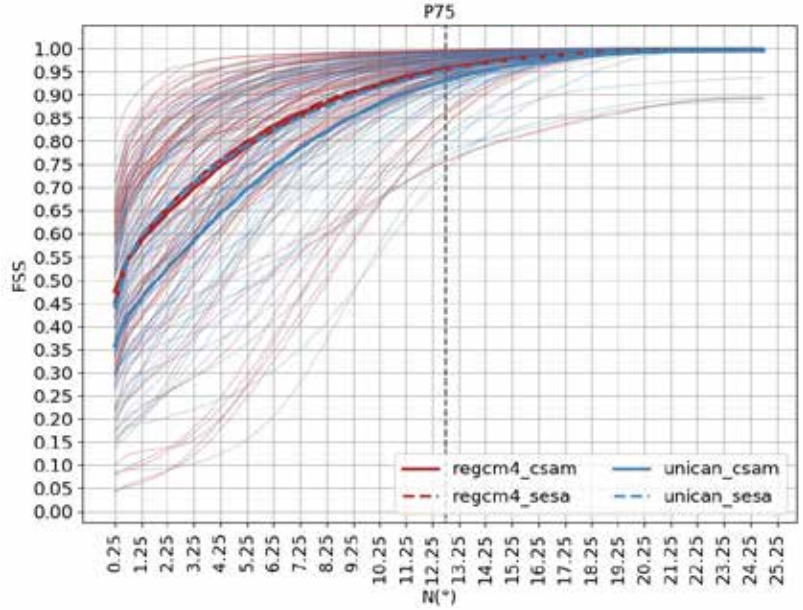


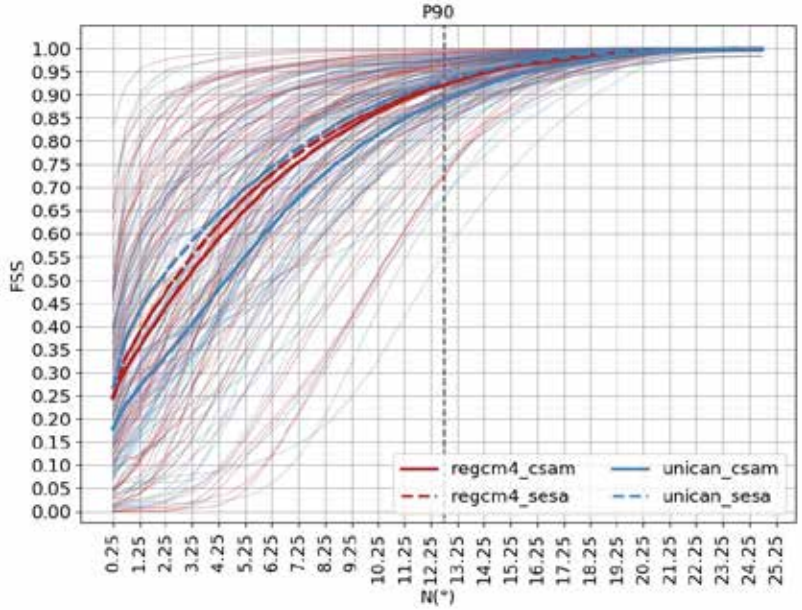
Climate Mode Simualtions ONDJFM 2009-2010

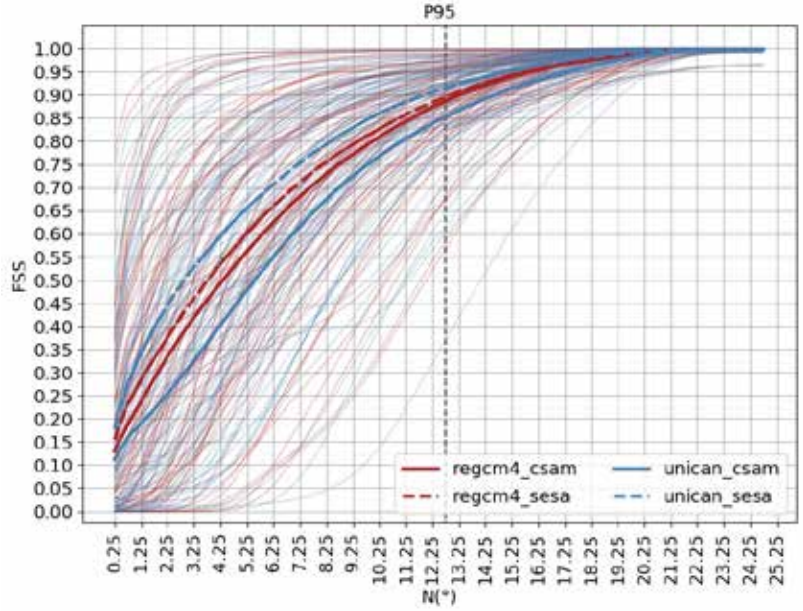
Events with daily precipitation larger than 15 mm/day

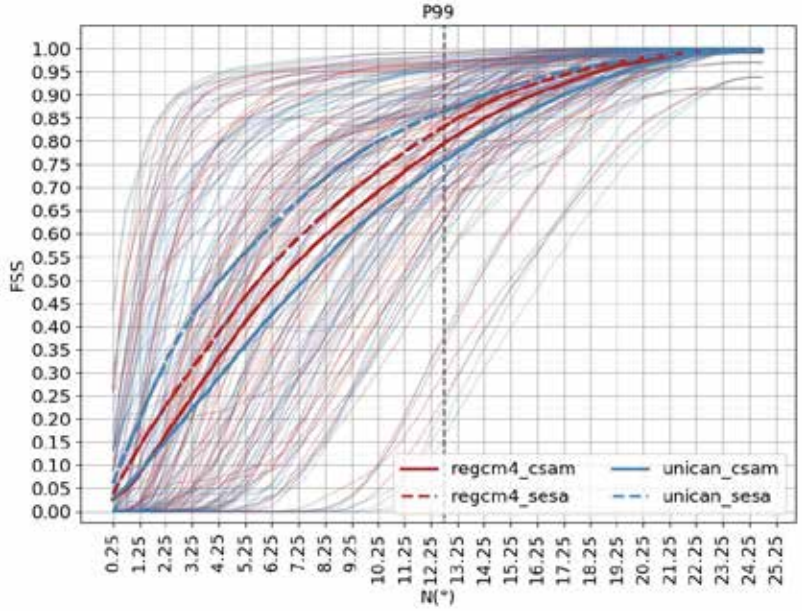
Fractional Skill Score (FSS): Measure of the ability in reproducing the spatial distribution of precipitation above a given threshold for individual events

FSS=1 → Perfect simulation









- FSS for individual events (41) (thin lines)
- Average FSS (thick lines)

Thresholds:
75 percentile
90 percentile
95 percentile
99 percentile

(spatial percentile for the daily accumulated precipitation)

Conclusions

- Models' **precipitation** is located over regions with **moisture flux convergence** independently of whether convection is parameterized or not
- Large differences arise in the low level circulation (including the convergence of low level winds) between the driving and the nested simulations, even for Weather-Like simulations
- These differences explain the differences in the precipitation produced in the simulations
- Inspection of a set of individual heavy precipitation events shows that the **Convective Premitting** simulations **improve** the capability of reproducing extreme events and their triggering mechanisms

Thank you !

谢谢