



8<sup>th</sup> Workshop on the theory and use of Regional Climate Models ICTP, Trieste 23-03 May 2016

A Process-based study of a regional climate model added value over West Africa: application to the projected changes

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### I/ Background and Motivation

Simulation Domain and Topography (meters)



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### I/ Background and Motivation

- West African Monsoon System



### (Meteo France)

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- How to select GCMs to downscale?
- How to assess added value

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## II/ Model Setup

### □ ICTP/RegCM4:

Historical, RCP4.5 and RCP8.5

**•** 25 km

West Africa

CLM3.5

Emanuel, SUBEX, Zeng …

MPI-ESM, HadGEM2-ES and GFDL-ESM2M







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°C/km

NCEP Temperature Gradient

70

°C/km

ERA-Interim Temperature Gradient

100

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30°N

25°N

20°N

15°N

10°N

5°N

0

5°S

30°N

25°N

20°N

15°N

10°N

5°N

0 5°S



U Wind



U Wind

m/s

GCM-MME



NCEP

m/s

U Wind

m/s

- Consistent to the temperature gradient distribution
- Consistent to the precipitation distribution

ERA-Interim

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IPV

GFDL-ESM-2M

C

30°N

25°N

20°N

15°N

10°N 5°N

0°

5°S





IPV

PVU

GCM-MME

5°S

20°W

PVU

10°E

10°E

10°E

20°E

30°E

0°

20°E

20°E

30°E

PVU



0°

5°S



 $-0.4 \quad -0.35 \quad -0.3 \quad -0.25 \quad -0.2 \quad -0.15 \quad -0.1 \quad -0.05 \quad 0.05$ 0.15 0.2 0.1 0.25 0.3 0.35 0.4

10°W

20°W

10°W

0°

10°E

20°E

30°E

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**IPV** Gradient

GFDL-ESM-2M

30°N

25°N

20°N

15°N

10°N

5°N

0°

5°S

30°N

25°N

20°N

15°N

10°N

5°N

0°

5°S

20°W

20°W

GFDL-RegCM4

10°W

10°W

0°

0°

IPV Gradient

10°E



0°

5°S

20°W

10°W

0°

10°E

20°E

30°E



NCEP

**IPV** Gradient

PVU/km



0°

10°E

20°E

30°E

**IPV** Gradient

PVU/km

GCM-MME

-0.15 -0.125 -0.1 -0.075 -0.05 -0.025 0.025 0.05 0.075 0.1 0.125 0.15

5°S

20°W

10°W

0°

10°E

20°E

30°E

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10°W

20°W

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10°E

20°E

30°E

25°N

20%

15°N

10°N

5°N

0.

5°S

25°N

20°N 15°N

10°N

5°N

0° 5°S



 $m^2/s^2$ 

NCEP 3-5 days AEW Activity

 $m^2/s^2$ 

- Consistent to the IPV gradient
- Consistent to the precipitation distribution

ERA-Interim 3-5 days AEW Activity

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- Projected changes
  - Decreased precipitation



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- Decreased vertical motion





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- Positive changes in potential temperature in the upper layers

Block the ascent and induce subsidence









#### 2-10 days AEW Activity



## IV/ Conclusion ...

- Different performances of the driving GCMs
- RegCM4 improves all of them
- MPI-ESM and MPI-ESM/RegCM4: best simulations
- Better simulations of the interactions between the different monsoon features
- Each experiments is internally consistent
- How to select a set of GCM to downscale?
- A set of GCMs that capture the monsoon dynamics?
- A set of GCMs with different bias (wet, average and dry?)



# Thank you for your attention



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