Climate Change Simulations over the Tropical Americas Using a Regional Model: Temperature and Precipitation Changes under the RCP8.5

Outline

• The context of CORDEX simulations at UECE
• Model and Data
• Results for RCP 8.5, including extremes
• Final Remarks
CORDEX domains
CORDEX simulations at UECE

• Focus over Northeast Brazil
  – Water resources
  – Agriculture
  – Renewable Energy

• CORDEX domains (at least two global models)
  – Central America
  – South America
  – Africa
Model and Data

- Regional Model: RAMS 6.0
  - Model Domain: slightly extended “Central America” CORDEX domain
  - Grid: 252 x 136 horizontal points (50 km grid spacing), 29 levels, with model top at 21 km.
  - Physical parameterizations: Radiation (Chen-Cotton), Cloud Microphysics (Walko et al.), Turbulence (Mellor-Yamada), Surface Processes (LEAF) and Convection

- Forcing data: ERA-Interim (1989-2007), HadGEM2-ES (historical run and RCP 8.5, 1st member)

- Validation data: CRU, Delaware, CMAP, GPCP, MERRA, ...
Historical Run

- RAMS forced by HadGEM2-ES r1i1p1 historical run
- Baseline period: 1985-2005 (presented by Domingo C. Sales)
Historical Run

Annual Cycle
Historical Run

Monthy PDFs
RCP 8.5

Annual Cycle
RCP 8.5

Monthly PDFs
Changes in the Occurrence of Extreme Precipitation Events
Changes in the Occurrence of Extreme Precipitation Events

Historical

R10

R20

R30

R50

Short

Mid

Long

Legend:

- 200
- 160
- 120
- 90
- 70
- 50
- 30
- 20
- 16
- 12
- 9
- 7
- 5
- 3
- 1

- 80
- 55
- 42
- 32
- 22
- 16
- 11
- 7
- 4.5
- 2
- 0.75
- 0.5
- 1.75
- 4
- 6.5
- 10
- 15
- 20
- 30
- 40
- 50
- 75
- 100
Changes in Consecutive Dry and Wet Days

Historical

CDD

CWD

Short

Mid

Long
Final Remarks

• Validation runs using ERA-Interim data allowed us to attain a best model configuration
• The regional model have systematic errors even when forced by ideal boundary conditions
• Putting RCM and GCM outputs side by side, there is no clear superiority in the RCM results, but these can be regarded as another member to produce a very large ensemble
Final Remarks

- RCP 8.5 projections include a very large and accelerated warming throughout the 21st century
- Projected warming by the RCM is significantly larger over the land areas, and is greater than the one projected by the GCM
- The larger warming is expected over the Amazon (up to 8 degrees over some spots in the annual average for the 2079-2099 period)
- Warming is associated with a simple dislocation of the PDF in some regions whereas other regions show changes in the width and in the tail of the temperature distribution
Final Remarks

• Projections also include significant changes in precipitation patterns especially at the end of the 21st century, including:
  – More significant “mid-summer drought” over Mexico, Caribbean and Central America
  – Overall reduction of the precipitation over the Caribbean
  – Overall increase in NEB’s rainfall, particularly in the pre-season
  – Increase in the southern Amazon precipitation except for the SON season
Final Remarks

• Significant changes are projected regarding extremes:
  – Wide temperature monthly PDFs in South America, especially in SAM (heat waves).
  – Very high monthly temperature values over SAM and, especially, over NEB
  – Overall tendency of increased daily extreme precipitation, except over the Caribbean
  – Enhanced occurrence of those extremes already in the short-term projection for some regions (MEX and CAM)
  – Significant changes in both Dry and Wet spells in the long term projection: longer dry spells over Northern and Eastern Amazon and NEB; longer wet spells over the ITCZ region and NEB, shorter wet spells in Eastern Amazon and Southern Central America
Thank you!
Long Term Circulation Changes

DJF

850 hPa

200 hPA

JJA