The CORDEX-FPS in Southeastern South America: a comparative study of statistical and dynamical downscaling models in simulating daily extreme precipitation events

The FPS in SESA

- Motivation
- Objectives
- Strategies
- Challenges
- Impact on regional networks
- Future steps.
Motivation

In SESA, extreme precipitation events are:

- **typical** features.
- becoming **more frequent** and **more intense**.

- They have large **socio-economic** and **hydrologic impacts**.

- There are **limited ESD studies** in the region.

- There is a need for developing **RCM** and **ESD coordinated actions**.
Motivation

- In SESA, extreme precipitation events are:
  - typical features.
  - becoming more frequent and more intense.
  - having large socio-economic and hydrologic impacts.
- There are limited ESD studies in the region.
- There is a need for developing RCM and ESD coordinated actions.

Although much work has been done to understand these events, it is still a challenge to better identify the factors and mechanisms that determine the location, intensity and frequency of the precipitation extremes and their large hydrologic impacts.
Objectives

- to study multi-scale processes and interactions that result in extreme precipitation events;
- to develop actionable climate information from statistical and dynamical downscaling based on co-production with the impact and user community.
Contributors

- **ARGENTINA**
  - DCAO-University of Buenos Aires
  - CIMA-CONICET
  - Argentine National Weather Service (SMN)

- **BRAZIL**
  - University of São Paulo (USP)
  - São Paulo State University (UNESP)
  - Center for Weather Forecasting and Climate Studies (CPTEC)
  - National Institute for Space Research (INPE)
  - Brazilian Agricultural Research Corporation (EMBRAPA)

- **URUGUAY**
  - Department of Atmospheric Sciences, University of the Republic

- **CZECH REPUBLIC**
  - Charles University in Prague

- **SPAIN**
  - CSIC / University of Cantabria

- **ITALY**
  - Abdus Salam International Centre for Theoretical Physics (ICTP)
Strategy and experimental design

- High number of extreme events during 2009-2010 warm season (October to March).
- Three case studies within that season were selected.
Strategy and experimental design

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**Mean frequency of precipitation extreme events over SESA (MSWEP)**

**Maximum Daily Precipitation in SESA Station Data 2009-10 Warm Season Selected**
Strategy and experimental design

- **Case 1**
  - 3-day event: 2009-11-21 to 23
  - Event peak: 22-11-2009
  - Station max: 155 mm/day

- **Case 2**
  - 3-day event: 2010-01-18 to 20
  - Event peak: 19-01-2010
  - Station max: 165.4 mm/day

- **Case 3**
  - 3-day event: 2010-02-19 to 21
  - Event peak: 20-02-2010
  - Station max: 150 mm/day

3-day accumulated precipitation (mm/day)

The events selected have different **areal extensions and locations**
Strategy and experimental design

RCM Simulations

- **Two simulation types:**
  
  **Weather like mode (WL):** simulation starts ~12 hours before initial phase of each one of three extreme events;
  
  **Climate mode (CM):** continuous simulation (seasonal) starting at 01-10-2009 ending at 31-03-2010.

- **Two domains:**
  
  ~20 (CSAM-20i) and 4 (SESA-4i) km of grid spacing
Strategy and experimental design

RCM Simulations

- Initial and boundary conditions:
  - CSAM-20i experiments are nested in ERA-Interim reanalysis;
  - SESA-4i experiments are nested in CSAMi-20i;

- Models:
  - RegCM4 (USP-UNESP, Brazil)
  - WRF391 (CIMA, Argentina)
  - WRF381 (IFCA/UCAN, Spain)
  - ETA (INPE, Brazil)
Strategy and experimental design

ESD Simulations

- **Training and Test**
  - Training: 1979-2009
  - Test: 2009-2010

- **Predictors:**
  - ERA-Interim reanalysis
  - JRA reanalysis

- **Predictands:**
  - Station Data: daily Pr, Tx and Tn
  - MSWEP: daily Pr

- **Models:**
  - GLM (4)
  - Analogs (3)
The ESD experiment was designed with the aim of comparing the results with the RCM simulations and exploring the performance of ESD in the region with focus on extreme events.
Case: 2010/02

Accumulated Pr 3-day event (mm/day)
Case: 2010/02

All models and simulations are able to capture the extreme events although with a considerable spread in accumulated daily values and location of daily extremes.
Case: 2010/02

ESD.MSWEP

GLM

ANALOGS

STATION

Accumulated Pr 3-day event (mm/day)

ESD.Station

Data

MSWEP
Objectives

- to study multi-scale processes and interactions that result in extreme precipitation events;
- to develop actionable climate information from statistical and dynamical downscaling based on co-production with the impact and user community.
Actionable Climate Information

Uruguay River Basin

- Length ~ 1800 km
- Basin area ~ 365000 km²
- Ave Discharge Paso de los Libres ~ 3000 m³/s

Hydrological Model: VIC Variable Infiltration Capacity
Argentine National Weather Service-University of Buenos Aires
Actionable Climate Information

STREAMFLOW (m3/s)

Garruchos
Challenges

- Financial Resources
  - Low local financial support
  - European financial support: visits and mobility

- Human Resources
  - 3 PhD students: 2 University of Buenos Aires
    1 Physics Institute of Cantabria
Impact on Regional Networks

- Enhanced regional networks
- Enhanced inter-institutional collaboration
- Data sharing
- Proposals submissions
- Capacity building activities
- CORDEX visibility
Future steps

- Finalize simulations and analysis of results
- Establish a protocol for ESD and RCM comparisons and validation framework
- Use of data in impact studies
Upcoming Activities

- ICTP Conference on Regional Climate Modeling and Extreme Events over South America: Results from the CORDEX-Flagship Pilot Study (SMR 3428): 17-19 November 2020, Buenos Aires, Argentina
Thanks!