

# Modeling Northern South America and Caribbean climate using PRECIS and WRF for climate variability and change studies

Guillermo Eduardo Armenta

José Daniel Pabón

“Weather, Climate, and Society” Research Group  
Department of Geography, National University of Colombia



UNIVERSIDAD  
NACIONAL  
DE COLOMBIA



## **The Research Group “Weather, Climate and Society”**

The main objective of the group is to generate knowledge about weather and climate (variability & change), as such as the relationship climate – society. With this purpose the group organizes their activities in the following mainstreams:

- Historical Climatology and history of climate (for the Colombian territory)
- Atmosphere and climate numerical modeling
- Interaction between different components of the climate system
- Socioeconomic impacts of climatic variability
- Socioeconomic impacts of climate change

For describing and study the atmosphere and climate in the region numerical models have been tested and used. The output from numerical models running have been applied in different ways to explore the regional features of atmosphere, climate variability and change.

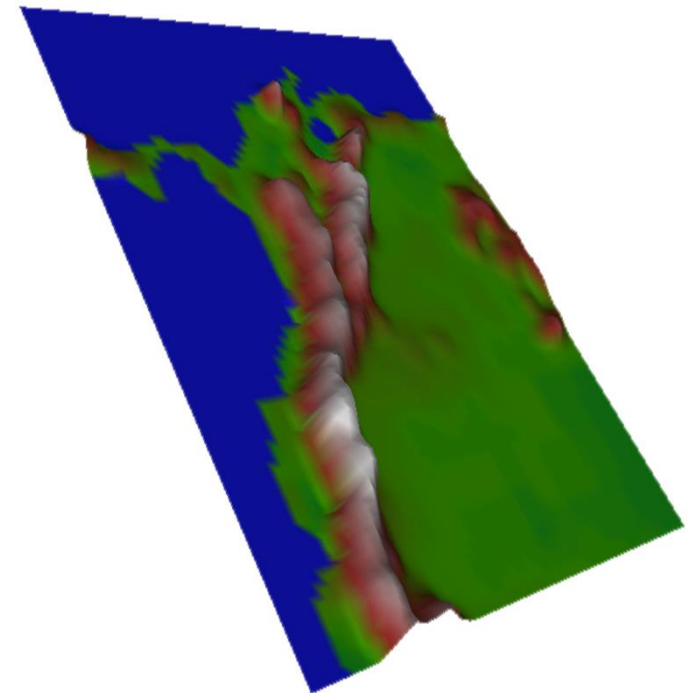
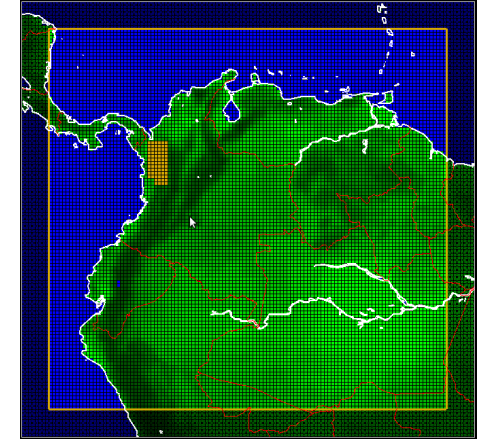
# Modeling regional atmosphere and climate

The regional community is demanding knowledge (not only data) about atmospheric processes and climate for different science and application purposes. To study the atmosphere and climate, the primary source on which the analysis is based is the recorded data in meteorological stations. However, in the region data historically provided by observations and measurements are scarce and have many failures (few series, data sets are incomplete, limited spatial coverage, heterogeneity). An optional way to solve this problem is the data generation using numerical models.

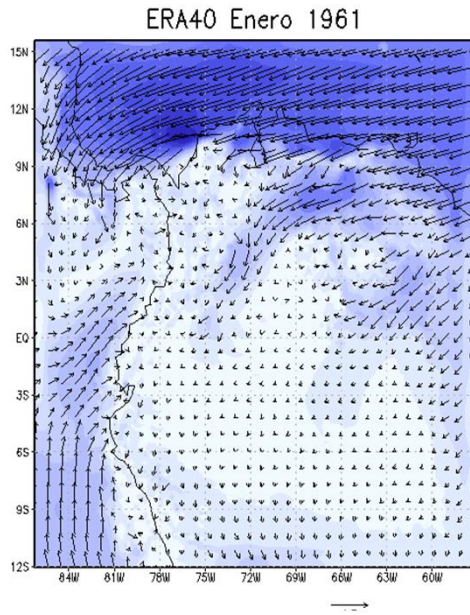
To attend demand of the regional atmosphere and climate studies on relative high spatial resolution data, numerical models were applied to simulate the regional processes over the northern South America and South Caribbean.

# Using PRECIS model

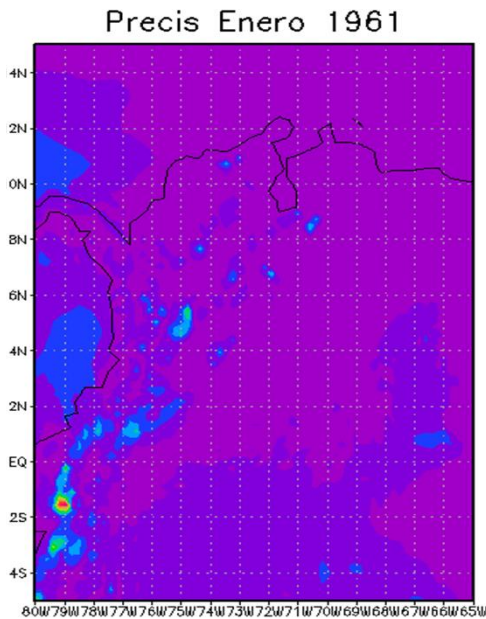
- With PRECIS, model data for the 1961-2000 period were generated with ERA40 baseline. Also, datasets for climate IPCC SRES A2 and B2 for 2011-2040, 2041-2070, and 2071-2100 periods were generated.
- These data were used for construction for climate change scenarios and climate variability studies.
- Space resolution 25x25Km (128x133 cells).
- 21 of over 150 variables were selected for studies.



Monthly surface wind during the 1961-2000 period



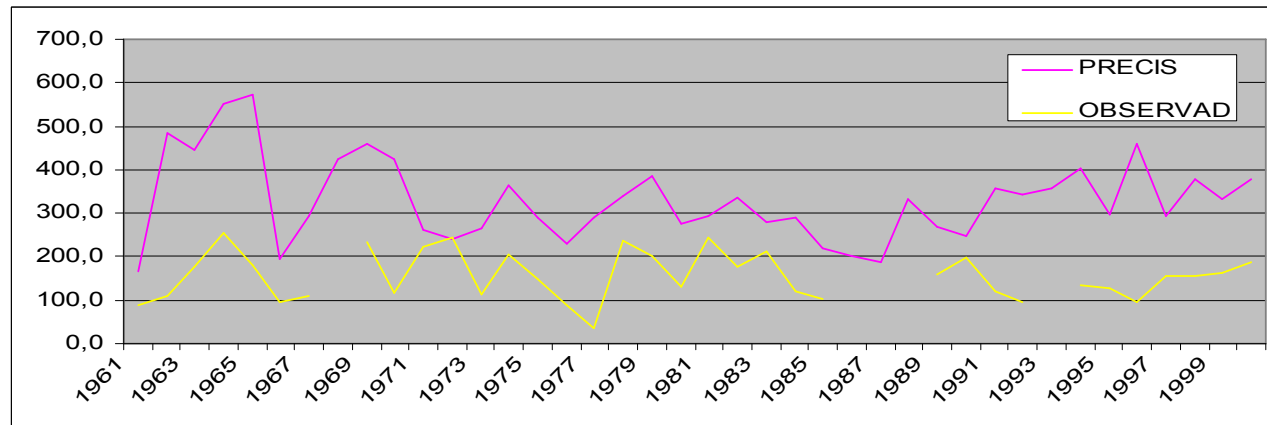
Monthly precipitation during the 1961-2000 period



## 1961-2000 period reconstruction

Datasets with  $u$  and  $v$  (m/s), HR (%),  $T(^{\circ}\text{C})$ , and Precipitation (mm) were generated and validated. Satisfactory results were obtained for Eastern plains, Eastern Cordillera, Magdalena valley and Caribbean sector.

Data were used in calculating the 1961-1990 reference period in climate scenarios constructing. Currently, data still are used in applied studies of meso- and local climate, and to analyze climate variability.

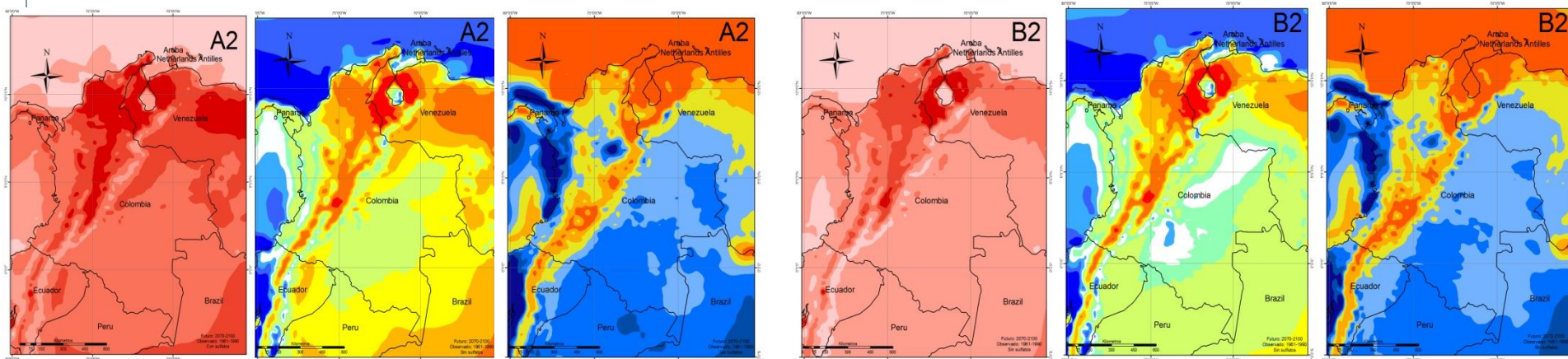


# CLIMATE CHANGE SCENARIOS FOR THE REGION USING PRECIS

2070-2100 A2 and B2 SRES IPCC projections

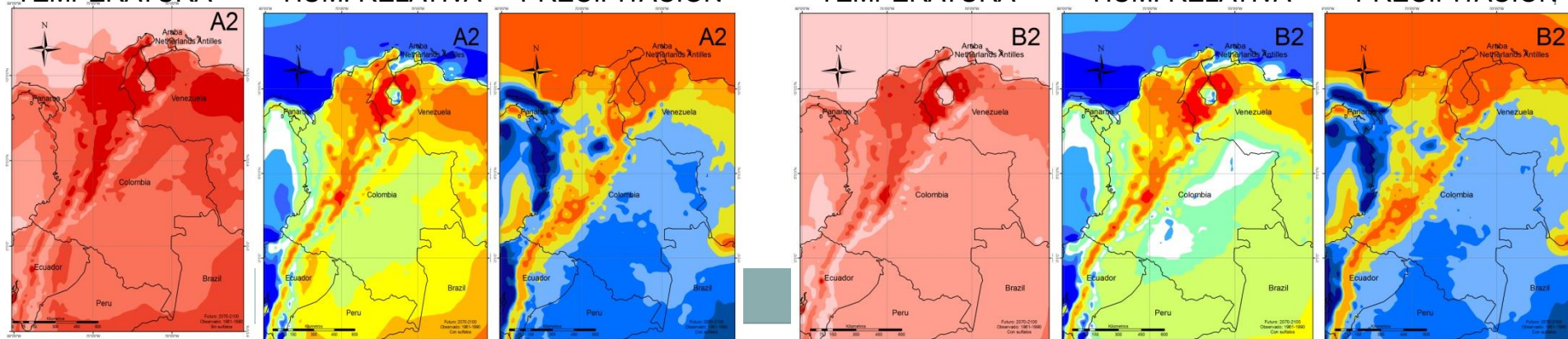
Without Sulphures

TEMPERATURA HUM. RELATIVA PRECIPITACION TEMPERATURA HUM. RELATIVA PRECIPITACION



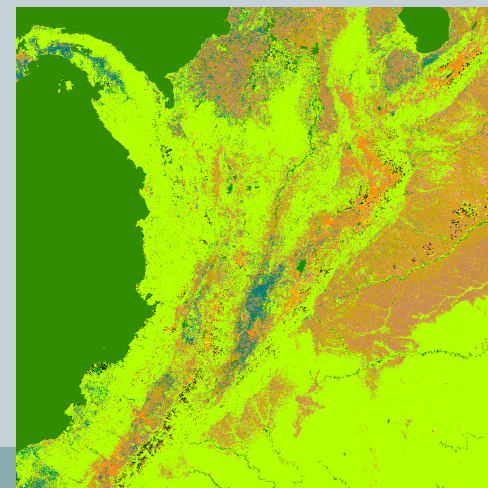
With Sulphures

TEMPERATURA HUM. RELATIVA PRECIPITACION TEMPERATURA HUM. RELATIVA PRECIPITACION



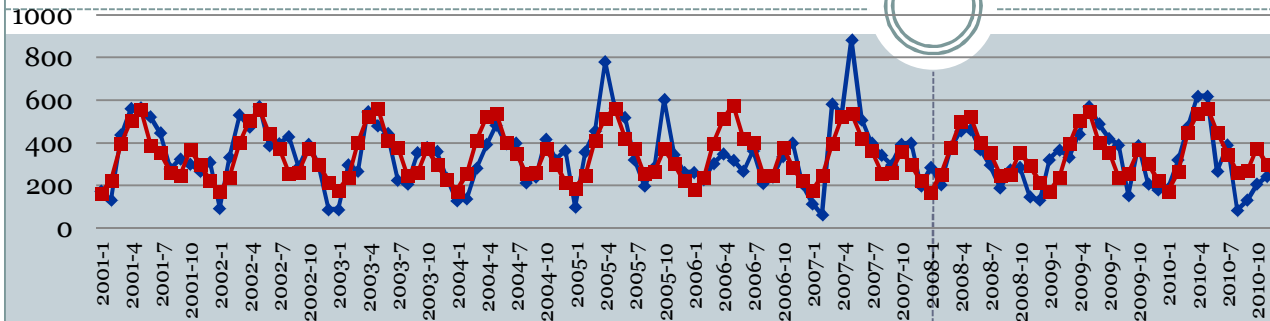
# Work with WRF

- Work with WRF model v3.2.1 in climate mode.
- History reconstruction with CFSR to generate the high resolution reanalysis (1981-2010).
- A single domain of 10km of horizontal resolution.
- Outputs every 3 hours.
- The results are used in many works (Magister thesis, hydrologic studies, storms, extreme events, etc.)

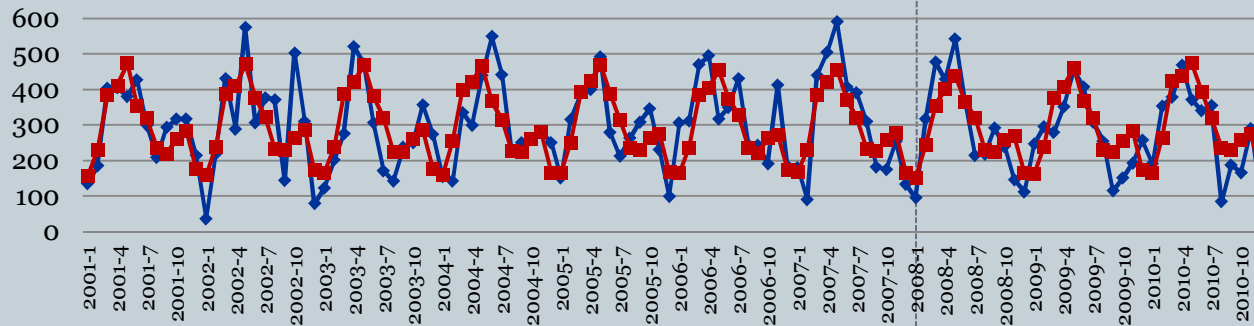


# Validating the WRF-CFSR high resolution reanalysis

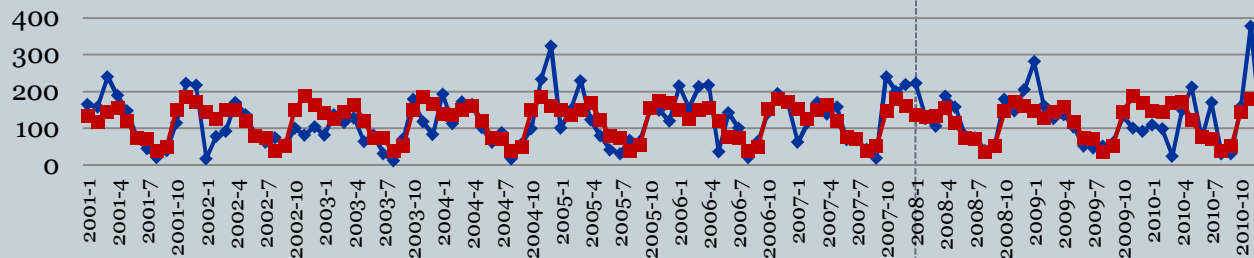
Precipitación Estación 4404501



Precipitación Estación 4404503



Precipitación Estación 2105502

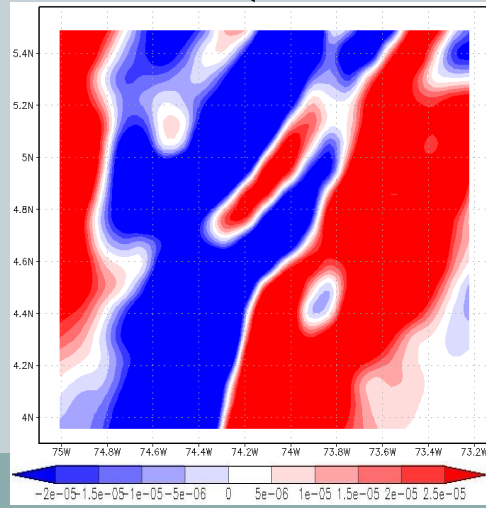
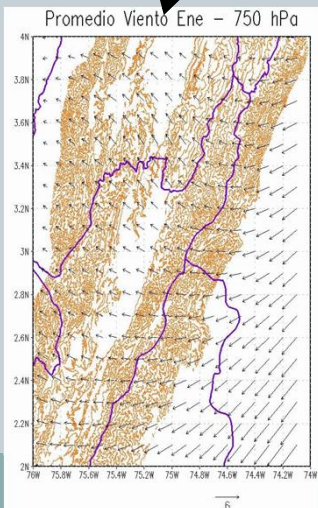
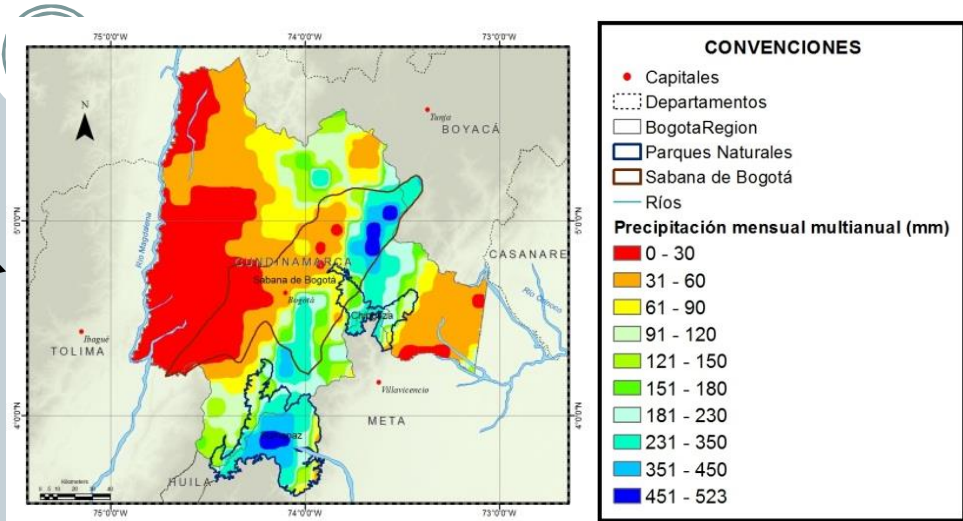
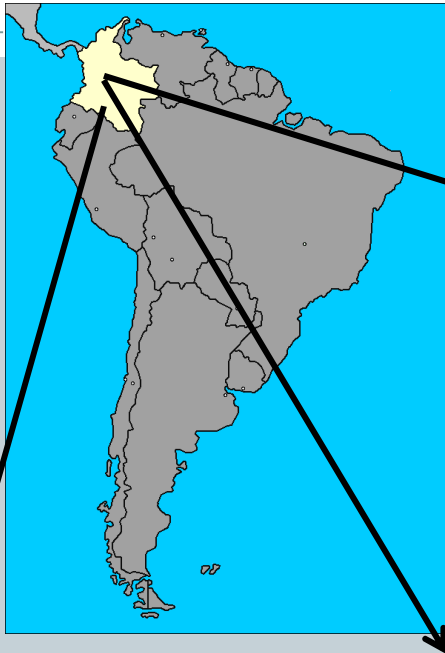


—●— Observado —■— Modelado

- Validation of the data generated by the WRF-CFSR modeling was made using observational data from climate stations located in different places of the region.



# Using WRF-CFSR high resolution reanalysis



- Data obtained with the simulations have been used in multiple studies. Some of them are:
  - Effects of ENSO in the extreme precipitation events over Sabana de Bogotá.
  - Analysis of the Föhn effect generated by Eastern Cordillera over the upper Magdalena River Valley (Huila and Tolima)
  - Effects of land-cover change and climate change in water resources for Bogotá region.

# Future actions



- Use WRF with CMIP5 models to simulate 1981-2010 period.
- Validate the results of these simulations with WRF-CFSR high resolution reanalysis and observational data.
- Generate the regional climate change scenarios using CMIP5 RCP's.

# Future actions



- In 2014, we expect to produce future climate data using PRECIS v2 model with CMIP5 models using historical data from them.
- Validate these results with WRF-CFSR high resolution reanalysis and observational data.
- Determine which models are “the best” representing the climatic variability for Colombia.
- Generate Representative Concentration Pathways (RCP) with CMIP5 models using PRECIS v2.



WCRP VAMOS/CORDEX Workshop on  
Latin-America and Caribbean CORDEX  
LAC: Phase I - South America



THANKS