Climatological patterns over South America derived from GPS RO data

R. Hierro (1), A. de la Torre (1), P. Llamedo (1) and P. Alexander (2)

(1) Facultad de Ingeniería, Universidad Austral, Buenos Aires, Argentina
(2) FCEN, Universidad de Buenos Aires, Argentina
To evaluate the capability to reproduce global and regional climatological patterns associated to mesoscale processes at low levels with GPS RO from FORMOSAT-3/COSMIC mission data (2006-2010).
Importance of water vapour in the troposphere

- It has a significant influence in the energy transport and circulation within the weather and climate system.
- It is the most important greenhouse gas.
RO data are averaged in lon, lat, z, time cells. For the different scale fields (global, synoptic and regional), diverse cell sizes and formats are designed.
Variables considered at low levels:

\[ z \approx -7.5 \ln \left( \frac{p_f}{p_i} \right) \]

\[ 2km \approx -7.5 \ln \left( \frac{750\,hPa}{1000\,hPa} \right) \]

\[ 3km \approx -7.5 \ln \left( \frac{650\,hPa}{1000\,hPa} \right) \]

“low level” is represented by the 750-650 hPa layer, equivalent roughly to 

\[ 2km \leq z \leq 3km \]

\[ q = \frac{w}{1 + w} \quad \text{specific humidity} \]

\[ \theta_e \approx \left( T + \frac{L_v}{c_p} \cdot w \right) \left( \frac{p_0}{P} \right) \frac{R_d}{c_p} \quad \text{equivalent potential temperature} \]

\[ T_d = \left[ \frac{1}{T} - \frac{R_v}{L_v} \cdot \ln \left( \frac{e}{e_s} \right) \right]^{-1} \quad \text{dew point} \]
**Space and time intervals**

**Global**

(lat,lon): (5°,5°) ; Δz=1km

**Synoptic**

(lat,lon): (2°,2°) ; Δz=1km

(z,lat): (0.1km,1°) ; Δx=2°

**Regional**

(lat,lon): (1°,1°) ; Δz=1km

(z,lon): (0.1km,1°) ; Δy=2°

**GFS**: National Centers for Environmental Prediction Global Forecast System (Final) global analysis (1° x 1°, 27 levels)

**JJA**: June-July-August (2006-2010)

**DJF**: December-January-February (2006-2010)
Results

a) Global scale fields

*Precipitable water column* and *Specific humidity (2-3)km (5ºx5º)*

**JJA:** (1) North American Monsoon System (NAMS), (2) African Monsoon System (AFMS), (3) Indian Monsoon System (IMS), (4) East Asia Monsoon System (EAMS) and (5) Southeast Asia Monsoon System (SEAMS).

**DJF:** (1) South American Monsoon System, (SAMS) and (2) Australian Monsoon System (AMS).
b) Synoptic scale fields

(1) South Pacific Anticyclonic System and (2) South Atlantic Anticyclonic System. Southern displacement during the austral summer (DJF)

Relative high values at midlatitudes over the continent during summer: wet and warm air incoming from tropical latitudes.
Relative high values at midlatitudes over the continent during summer are observed, while a general increase of water vapour is present over the whole continent.

Wet core near the Equator in winter, which moves southward in summer: higher values in the subtropical zone.
c) Regional scale fields

43 severe storms with hail production events over Mendoza (Argentina) were selected between 2006 and 2010.

¿ Troposphere features associated to these events?

Anomalies (Storms – Total) averaged between 65ºW and 69º W

Red colour shows positive anomalies: storm events show higher values of specific humidity than the averaged whole period.
CONCLUSIONS

• The low level variables retrieved from the FORMOSAT-3/COSMIC mission are able to reproduce meteorological fields, providing a real representation of climatological patterns related to global, synoptic and regional scale processes.

• Pressure, specific humidity and equivalent potential temperature show that the water content in the troposphere, as well as the inferred circulation, are well determined by RO measurements, making it possible to use this technique to describe and analyze lower atmosphere events.