Soil Moisture: Argentine application projects

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Collaboration: Dr. Ines Velasco (Atmospheric Sciences, UBA), Dr Paolo Ferrazzoli (Tor Vergata), Dr. Francisco Grings (IAFE)
To generate soil moisture maps in different areas (different sub-basin ecosystems) of the basin using:

- SAC-D instruments,
- existing and/or to be developed land cover-land use maps and auxiliary data, interaction models and retrieval schemes (IAFE).

SMOS data is also available (AO).

➢ To include soil moisture information in hydrological models and evaluate the improvements in forecast capabilities (INA).

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**La Plata Basin floods and droughts: Contribution of microwave remote sensing in monitoring and prediction (IAFE–INA) (PIs: H. Karszenbaum – D. Goniadzki)**

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**Extreme Hydrological events (EHE) (Floods and droughts)**

**Extension**
Aprox 3,200,000 km²

**5 Countries**
Argentina (downstream), Bolivia, Brazil (upstream), Paraguay, Uruguay

**Main rivers**
- Paraná, Paraguay
- Uruguay, Iguazú
- Pilcomayo, Bermejo

**Population**: 100,000,000 inhabitants

**Economy**: 80% of the GNP of the 5 countries is produced in the basin
Del Plata Basin: Paraguay_Paraná wetlands corridor – Fraction of flooded area

6th Aquarius/SAC-D Science meeting
19-21 July, Seattle, USA
Soil moisture retrieval in Chaco Forest: motivation

Characteristics

- The total extent is of more than 100 millions of hectares.
- There is a wide variability of climatic conditions and botanical species.
- The forest is continuous, but the biomass is moderate.

Extensive measurements, with a sampling interval of 0.5° x 0.5°, indicate biomass values typically in the range 70-125 t/ha.

Climatology

Mesoscale Convective Systems (MCCs) - South American low-level jet (SALLJ)

- Heavy rainfalls associated with floods and or lack of rainfalls.

- Try to understand the interactions between physical landscape and synoptic and mesoscale processes.

- Soil moisture strongly influences the boundary layer conditions and acts as a strong control of the partitioning between sensible and latent heat flux, modulating precipitation.
Soil moisture retrieval in Chaco Forest: motivation - Test site: Las Lomitas

➢ Availability of daily precipitation data

➢ Existence of large and continuous forest patches

➢ Land cover and biomass maps

➢ Systematic field trips for forest cover updates (UMSEF)
Comparison between SMOS and AMSR-E (C band) Polarization Ratios collected at Las Lomitas (Ferrazzoli et al, 2010, EGU 2010)

- Much better sensitivity at L band
- Good temporal correspondence

Soil moisture retrieval in Chaco Forest: motivation - SACD Aquarius potentials
Impact of deep moist convection on MWR, development of techniques to detect an estimate deep convection (PI: Paola Salio)

The general objectives of this study is to:

Advance in the characterization of deep moist convection over SESA.

SPECIFIC OBJECTIVES

1. Compare the results of observations obtained in microwave channels of 36.5 GHz with observations of the 37 GHz channel of the Tropical Rainfall Meassurement Mission on the area of La Plata Basin in order

2. To obtain comparisons for the detection of intense convection, based on the ice scattering generated by deep clouds.

3. Define and obtain the corrected polarized temperature in the 36.5 GHz channel and test its performance in situations of severe convection.

4. Search for thresholds to determine intense deep convection in the 23 GHz channel considering the wide dispersion of ice.

Extreme rain precipitation features centroid associated with volumetric precipitation. From Vidal and Salio (2009). The main rainfall source in this area are mesoscale convective systems (MCSs), which contribute about 60% to total rainfall and are the main causes of severe phenomena in the region.

Requested products from Aquarius and MRW radiometers

To implement conceptual lumped hydrologic models of the continuous type in catchments within the Del Plata Basin, such as those of the Gualeguay River (14,800 sq. km) and the Pergamino Brook (1,200 sq. km).

Implementation includes calibration, verification and set up for running in an updating mode (i.e. with remote data assimilation) for operational use.

To improve / adapt available soil-moisture retrieval algorithms from L-band microwave (1.2-1.4 GHz) measurements, with due account of ancillary data.

To develop applications for assimilating the SAC-D measurements into hydrological models.
The Pergamino Brook is one of the two main tributaries of the Arrecifes River, which in turn meets the Parana River. Its basin is located in the northern Buenos Aires Province (Pampa Húmeda).

Land use is mainly agriculture (80%), being mostly devoted to soybean. The basin is well inserted in one of the richest and agriculturally most productive areas of the country.

Annual precipitation is approximately 1,000mm, while annual potential evapotranspiration is about 800mm.
Contribution form the SAC-D Aquarius Observatory for a better understanding of environmental variables (C. Serafini)

The general objective of this proposal is to evaluate the potential use of data provided by the SAC-D Aquarius Observatory and their comparison with data from other sensors in an area of the Pampaeana plain.

Specific objectives
- Analyze the relationship between conditions of soil moisture, obtained through data from the Aquarius sensor and Vegetation indexes generated through data from NOAA / AVHRR

- Compare the temperature maps generated with NIRST data, with information provided through standard products for the detection of hot spots from TERRA/ MODIS.

- Establish the relationship between the contributions of the SAC-D Aquarius Observatory and the observation "in the field" provided by the Data Collection System (DCS).

- Assess the synergy of the products generated from data from different sensors.

Details in poster presentation
Validation of data from the SAC-D / AQUARIUS mission: Application to the knowledge of vegetation water stress (PIs: Rivas-Venturini)

**General Objective**
The goal of this project is to validate the SAC-D /Aquarius LST product, as well as the SM product.

We also propose to use the previously validated variables, i.e. LST and SM, to derive vegetation water stress, which would be also validated

**Specific Objectives**
1. To obtain the equation to estimate the LST.
2. To validate the LST estimates with *in situ* observation.
3. To contrast the SAC-D /Aquarius LST product with similar product derived from others sensors, such as MODIS, AVHRR.
4. To estimate the SM from the Aquarius sensor.
5. To estimate the latent flux (LE) and vegetation water stress from the SAC-D /Aquarius products.
6. To install 3 ground stations with instruments to observe meteorological and energy data *in situ.*
Validation of data from the SAC-D / AQUARIUS mission: Application to the knowledge of vegetation water stress (PIs: Rivas-Venturini)

Agricultural region in Buenos Aires province

Azul City
Olavarría City
Tandil City

(T_{10.85}-IRC-VIS)
IRC-VIS Modis sensor (300 m x 300 m)

DCS Station + LST (NIRST)

Operational map

Spatial Resolution in this example is 300 m by 300 m.
The objective of this work is to develop a simple algorithm to determine $\varepsilon_{vh}(f)$ at a regional scale.

The relationship between $\varepsilon_{vh}(f)$ and $D(f)=T_{bv}(f) - T_{bh}(f)$ and the relation between $\varepsilon_{vh}(f)$ and $PR$ were evaluated. The analysis was done on frequencies of the MWR of Aquarius/SAC-D mission.

**Fig. 1**: Relations $PR-\varepsilon_{h}(f)$ and $D-\varepsilon_{h}(f)$ for day 020 2009: (a) $PR-\varepsilon_{h}(f)$ at 23.8 Ghz, (b) at 36.5 Ghz. (c) $D-\varepsilon_{h}(f)$ at 23.8 Ghz y (d) the same of (c) at 36.5 Ghz.
Links among projects (five)

Two major subjects:

- **Hydrological and climatic applications**
  
  Develop procedures for improvement of predictions of floods and droughs on subbasins of Del Plata Basin (IAFE, INA, CIMA)

  - alternative algorithms for soil moisture retrieval and fraction of flooded areas (IAFE)
  
  - improve of hydrological models through soil moisture data assimilation (INA)
  
  - better understanding of MCSs in SESA (CIMA)

- **Agricultural and environmental (early warnings) applications**

  exploitation of Aquarius SACD Observatory data to assess environmental conditions in large areas over the Pampas plains for early warning to guide decision making (Serafini) (Pampa Húmeda)

  exploitation of radiometers and NIRST data for surface emission determination and vegetation water stress assessment (Venturini-Rivas) (Pampa Húmeda)
Projects addressed the use of the **SACD Observatory**, mainly MWR, NIRST and Aquarius.

PIs are completely aware of the **limitations** (spatial resolution) of **Aquarius instrument** for small basins and or sites, nevertheless, it is under consideration its use for environmental assessment.

Projects objectives show **interesting synergies** that may provide outcomes not foreseen in each individual project.