JASMIN

The **J**oint **A**ssessment of **S**oil **M**oisture **In**dicators Project

A community effort to respond to
user needs in agriculture and water resources

Hugo Berbery

and coauthors:

Adriana Basualdo, Celeste Saulo, Federico Bert, Haydee Karszenbaum, M. Elena Fernández Long, Mauro Holzman, Pablo Spennemann, Raúl Rivas, Roberto De Ruyver, Gloria Pujol , Omar Müller, Leandro Sgroi, Francisco Grings, Lorena Ferreira, Danilo Dadamia, Laura Frulla, Alvaro Soldano

Satellite soil moisture
validation & application workshop
Amsterdam, The Netherlands, 10 - 11 July 2014

CONTEXT

IAI - CRN3035

Towards usable climate science – Informing sustainable decisions and provision of climate services to the agriculture and water sectors of southeastern South America

Overall objectives

*(i) conducting research and outreach to **inform resilient decision-making** in climate-sensitive sectors such as agricultural production and water resources management in southeastern South America (SESA)*

***(ii) facilitating sustainable societal adaptation** to a varying and changing climate.*

Project activities are organized around four main research foci:

a. **production**, interpretation, assessment, and synthesis of diagnostic and forecast climate information on multiple time scales;

b. "**tailoring**," communication, and dissemination of that information;

c. "**translation**" of climate information into plausible impacts and outcomes of viable adaptive actions in agricultural production and water management;

d. **exploration** of the institutional structures needed to support the provision of climate services.

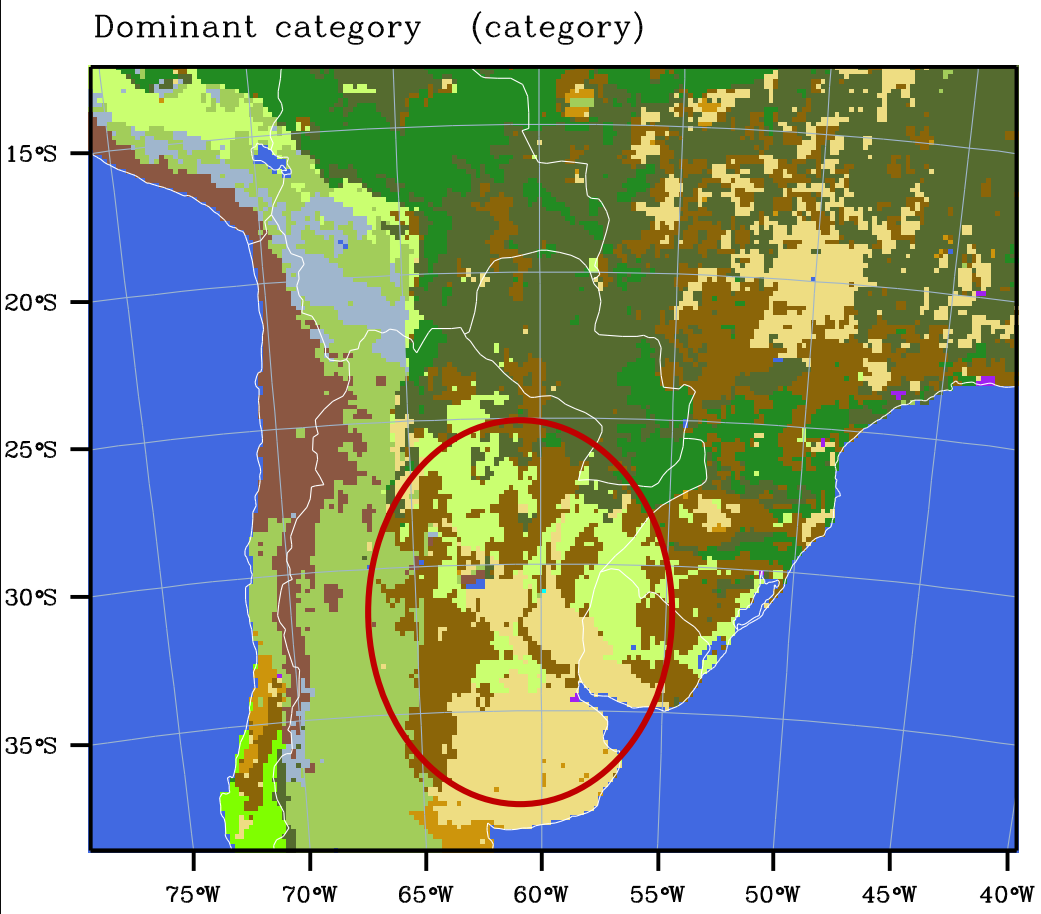
Motivation for JASMIN

- Southern South America is a region with large expanses of rainfed agriculture and as such it is highly dependent on soil moisture
- Adequate estimates of soil moisture are critical for crop management and planning purposes
- Stakeholders in agriculture are in need of a reliable product describing current soil moisture as a drought indicator
- Several initiatives to estimate SM are in place, but they are unrelated and based on different approaches

Objectives

- Bring together a community that so far has been working for the most part independently,
- Document methods and assess strengths and weaknesses of the different soil moisture estimates,
- Explore ways of harmonizing current estimates into a consistent product that can be easier to interpret than the individual components.
- Assess the quality of satellite products and develop soil moisture estimates from multiple sources by data assimilation

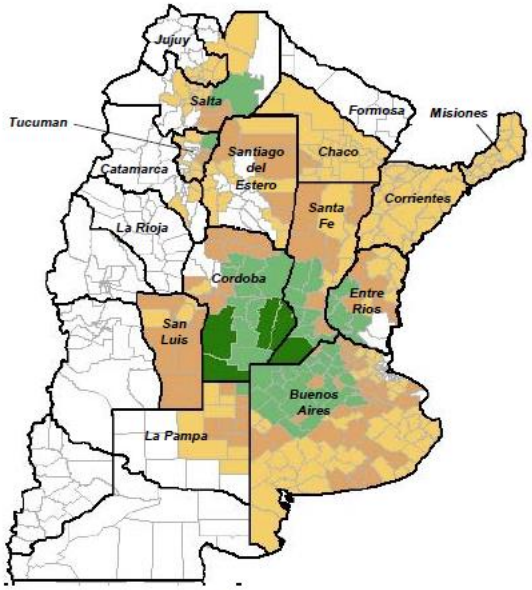
Land cover dominant category

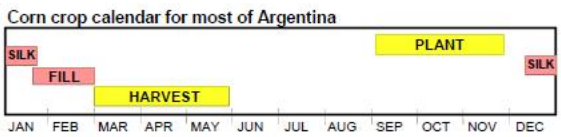


1: Urban and Built-Up Land
2: Dryland Cropland and Pasture
5: Cropland/Grassland Mosaic
6: Cropland/Woodland Mosaic
7: Grassland
8: Shrubland
10: Savanna
13: Evergreen Broadleaf Forest
15: Mixed Forest
16: Water Bodies
18: Wooded Wetland
19: Barren or Sparsely Vegetated
21: Wooded Tundra

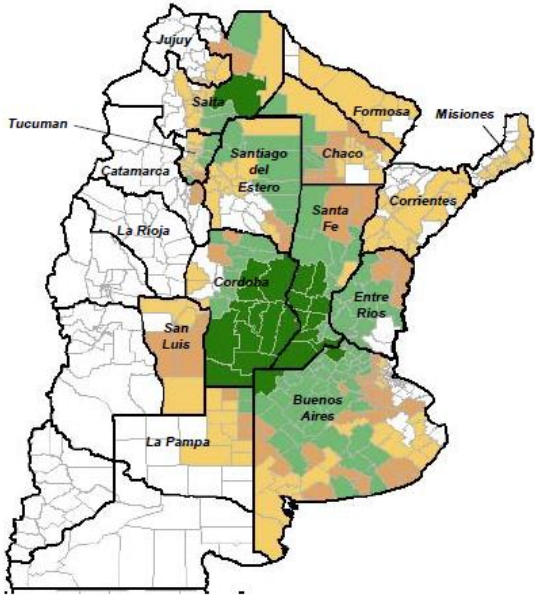
Main crops

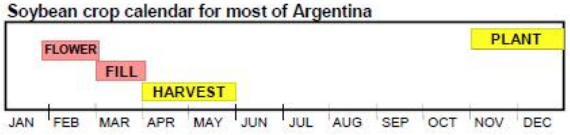
Corn



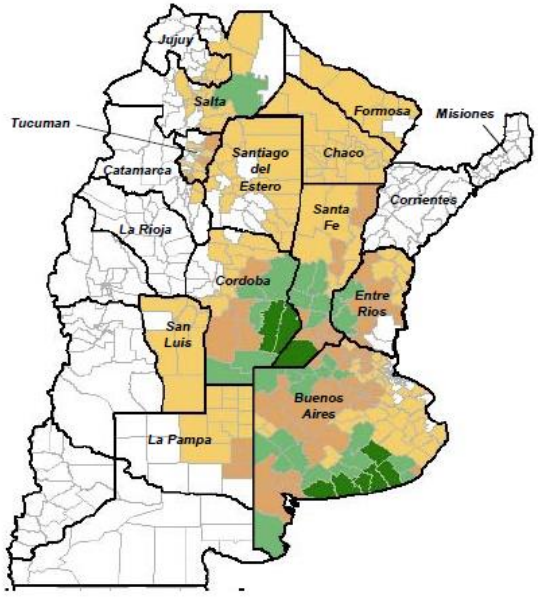


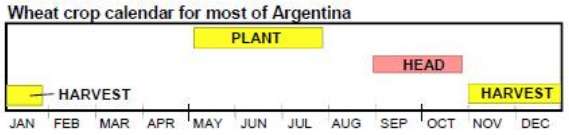
Soybean





Wheat





Participating groups

- Argentine Agricultural Agency (INTA)
- Argentine Space Agency (CONAE)
- Argentine National Weather Service
- Office of Agricultural Risks (Ministry of Agriculture)

Working w/ end users and stakeholders

- School of Agriculture (UBA)
- Center for Research of the Sea and Atmosphere (CIMA, CONICET/UBA)
- University of Maryland
- Universidad Nacional del Litoral
- Institute for Plains Hydrology “Dr. Eduardo J. Usunoff” (UNICEN)
- Institute for Research in Astronomy and Astrophysics (CONICET/UBA)

UNIVERSITY OF MARYLAND

INTA

UNL UNIVERSIDAD NACIONAL DEL LITORAL SANTA FE, ARGENTINA

ORA Oficina de Riesgo Agropecuario

SERVICIO METEOROLÓGICO NACIONAL ARGENTINA

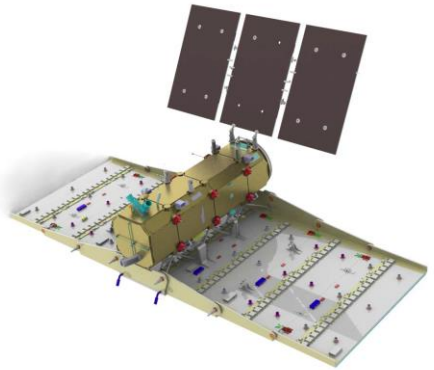
CONAE

CIMA ISSN 1853-6255

I A F E CONICET U B A

Argentine Space Agency

CONAE / SAOCOM Mission



SAOCOM: Spanish for *Argentine Microwaves Observation Satellite*

Two identical satellites, SAOCOM 1A and SAOCOM 1B, carrying on-board an L-band polarimetric SAR instrument

Launch date: 2015/16

- Surface Soil Moisture Products from individual strips
- Surface Soil Moisture Mosaics (over the Pampas Region)
- Derived products for Agriculture:
- Decision Support Data

Approaches being used

WATER BUDGETS

- Argentine National Weather Service
- Office of Agricultural Risks (Ministry of Agriculture)
- School of Agriculture (UBA)

COUPLED AND UNCOUPLED LAND SURFACE MODELS

- Center for Research of the Sea and Atmosphere (CIMA, CONICET/UBA)
- University of Maryland – Universidad Nacional del Litoral

IN SITU MEASUREMENTS

- Argentine Agricultural Agency (INTA)
- Argentine Space Agency (CONAE)

SATELLITE ESTIMATES (ASCAT, SMOS, AMSR-E, AMSR2…)

- Argentine National Weather Service
- Institute for Plains Hidrology “Dr. Eduardo J. Usunoff” (UNICEN)
- Institute for Research in Astronomy and Astrophysics (CONICET/UBA)

Product documentation

NOMBRE DEL PRODUCTO	BHOA (Balance Hidrológico Operativo para el Agro)	SISTEMA DE MONITOREO Y ALERTA TEMPRANA DEL ESTADO HÍDRICO DE LOS CULTIVOS	BALANCE OPERATIVO DEL SMN	PRODUCTOS DE SUELO RUTINARIOS DE UMD-UNL	GLOBAL LAND DATA ASSIMILATION SYSTEM	PRODUCTO SM	ÍNDICE DE ESTRÉS HÍDRICO	HUMEDAD DEL SUELO , INDICES DE VEGETACIÓN: NDVI Y EVI
INSTITUCIÓN	FACULTAD DE AGRONOMÍA UBA	OFICINA DE RIESGO AGROPECUARIO- MINISTERIO DE AGRICULTURA GANADERÍA Y PESCA DE LA NACIÓN	SERVICIO METEOROLÓGICO NACIONAL	UNIVERSIDAD DE MARYLAND Y UNIVERSIDAD NACIONAL DEL LITORAL	CENTRO DE INVESTIGACIÓN DEL MAR Y LA ATMÓSFEERA (CIMA)- DEPARTAMENTO DE CIENCIAS DE LA ATMÓSFERA Y LOS OCEANOS (DCAO)	IAFE INSTITUTO DE ASTROFÍSICA Y FÍSICA DEL ESPACIO	INSTITUTO DE HIDROLOGÍA DE LLANURA	SERVICIO METEOROLÓGICO NACIONAL
TIPO	BALANCE HÍDRICO	BALANCE HÍDRICO	BALANCE HÍDRICO	MODELO DE SUELO ACOPLADO CON MODELO ATMOSFÉRICO	BALANCE HÍDRICO, MODELOS DE SUELO	SATELITAL	SATELITAL	SATELITAL

Template

- Product name
- Organization
- Type of estimate
- Period
- Output variables
- Domain
- Time scale
- Spatial resolution
- Input data (if applicable)
- Output format
- Strengths
- Weaknesses
- Users
- Contact person

Product documentation

SISTEMA DE MONITOREO Y ALERTA TEMPRANA

DEL ESTADO HÍDRICO DE LOS CULTIVOS

OFICINA DE RIESGO AGROPECUARIO

MINISTERIO DE AGRICULTURA GANADERÍA Y PESCA DE LA NACIÓN

Basualdo, Adriana - adrianabasualdo@fibertel.com.ar / Occhiuzzi, Sandra – socchi@minagri.gob.ar

TIPO DE ESTIMACIÓN	BALANCE HÍDRICO
DOMINIO	ARGENTINA (MENOS PATAGONIA) EN ESCALA 1:500000, REGIÓN PAMPEANA Y CHACO 1:100000
PERIODO	1970-2013
VARIABLES DE SALIDA	CONTENIDO DE AGUA EN EL SUELO EN mm, EXCESOS HÍDRICOS, ESCURRIMIENTO
RESOLUCIÓN ESPACIAL	POR UNIDAD DE SUELO (FUNCIÓN DE LA ESCALA DE SUELO DISPONIBLE)
RESOLUCIÓN TEMPORAL	PASO DIARIO

1. OBJETIVO

El contenido de agua en el suelo es un parámetro del que se infiere un diagnóstico del estado presente de la vegetación. El desarrollo de un balance hídrico operativo, que tenga en cuenta las variables atmosféricas, el tipo de suelo y determinada cobertura vegetal, se ha diseñado para permitir el monitoreo permanente de la situación hídrica de la producción agropecuaria a lo largo del año o la campaña agrícola.

El objetivo principal es modelar adecuadamente el contenido de humedad en la capa de la superficie del terreno, hasta donde tienen actividad normalmente la mayor proporción de los sistemas de raíces de las pasturas naturales, implantadas y los cultivos. Los resultados deberán tener una presentación de fácil interpretación, que permita su comparación con los valores normales para cada momento de la campaña.

2. METODOLOGIA

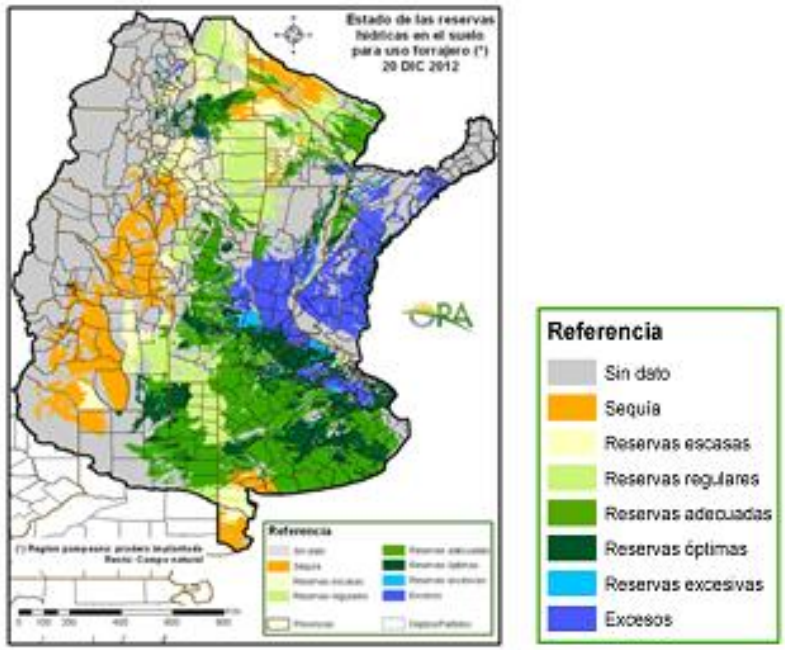
La metodología relaciona básicamente con el balance hídrico desarrollado por los Ing. Agr. J. A. Forte Lay y J. J. Burgos, al cual se le ha incorporado la evapotranspiración de la cobertura vegetal de acuerdo a la metodología propuesta por la FAO (1998). Además, se han incorporado términos de escurrimiento superficial y percolación profunda, y la posibilidad de retención

3. PRODUCTO

El producto se ha validado comparando los valores diarios estimados durante el periodo 01/01/12 al 30/04/12 con mediciones de humedad en el suelo realizadas con sondas a diferentes profundidades en la localidad de Los Toldos, provincia de Buenos Aires. Los valores puntuales estimados por el método mostraron un coeficiente de correlación con los valores medidos de R=0.94.

Actualmente se trabaja en la validación del método mediante la comparación con mediciones de sondas en nueve localidades de la región pampeana, con muy diversas características climáticas y de suelos.

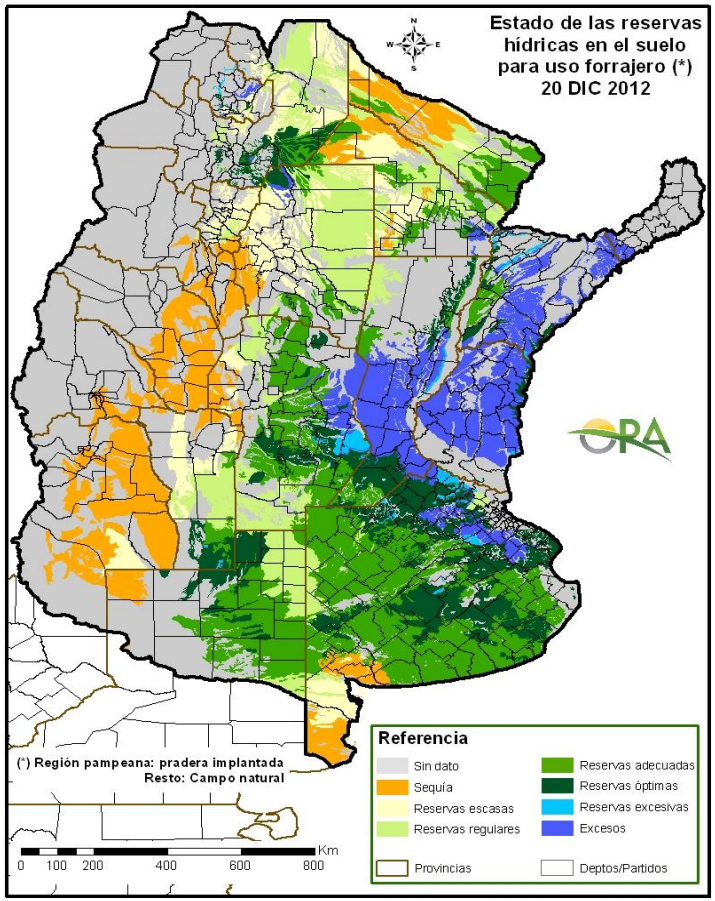
Se espera que este producto sea utilizado para el diagnóstico del estado de los cultivos o de las pasturas para consumo del ganado, para la evaluación temprana de pérdidas productivas, determinación de niveles de riesgo de sequía o excesos hídricos, declaración de emergencia agropecuaria, desarrollo de seguros índice, y otras aplicaciones.



Water balance estimates

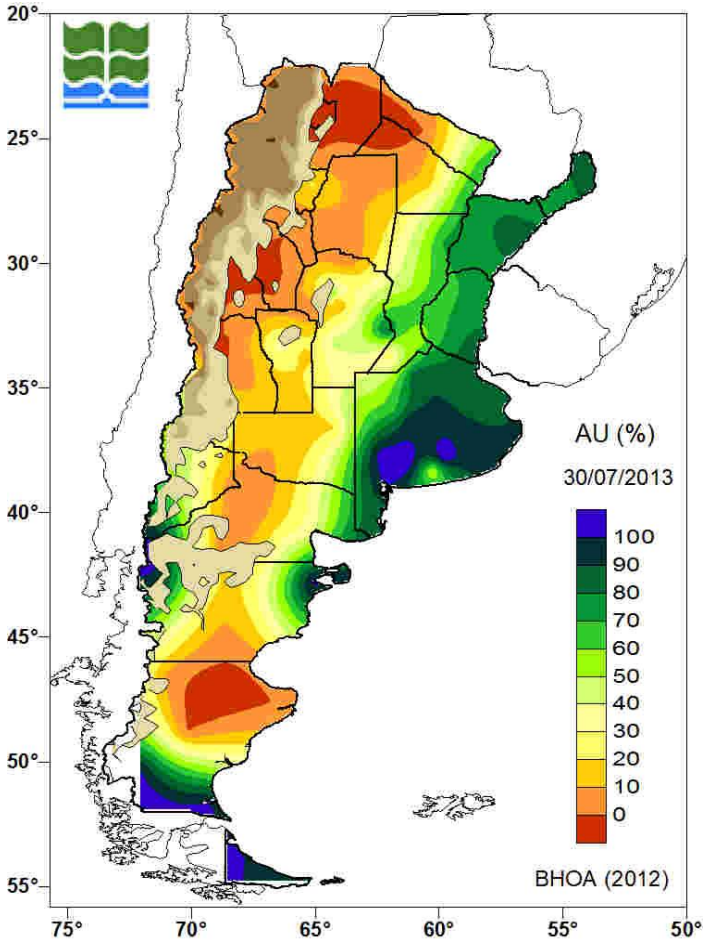
$$nZr\frac{dS}{dt} = I(S,t) - L(S) - T(S) - E(S)$$

ORA



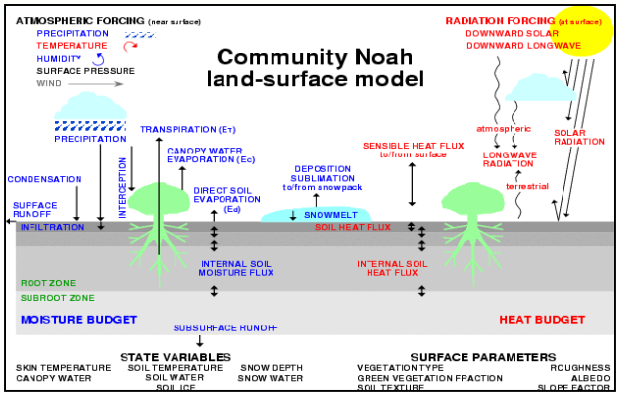
Courtesy of Adriana Basualdo

Ag School, UBA

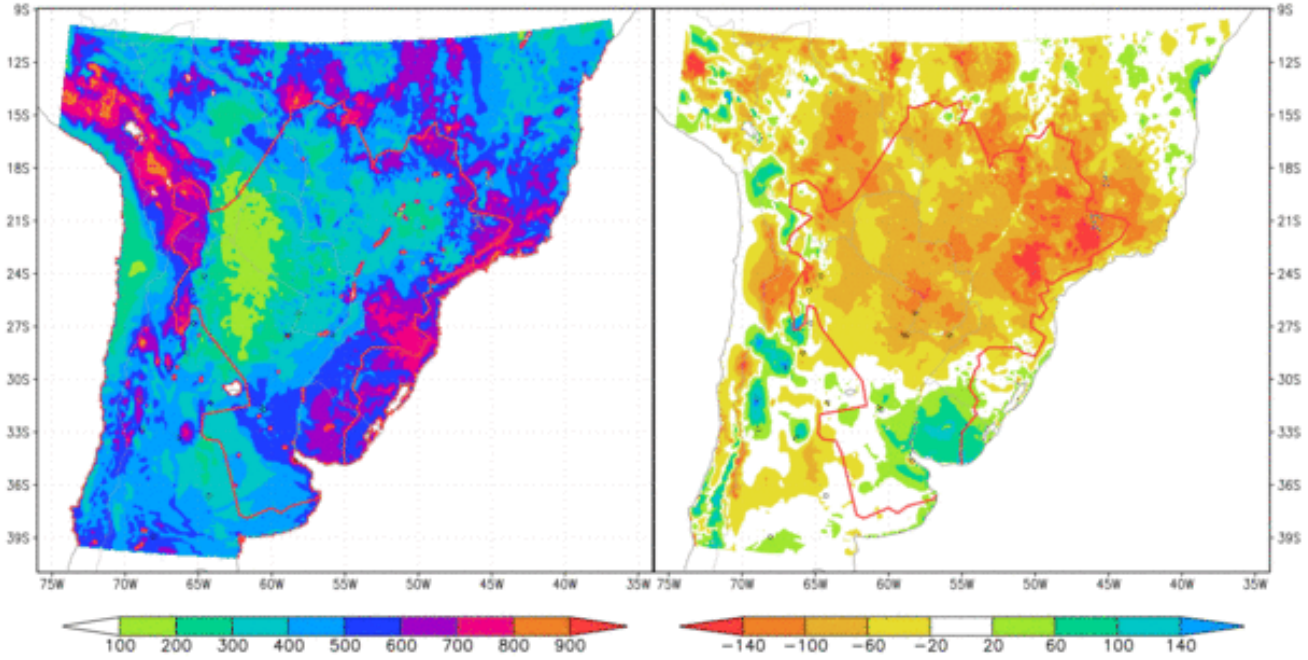


Courtesy of Mele Fernandez Long

Coupled atmosphere-land surface model estimates

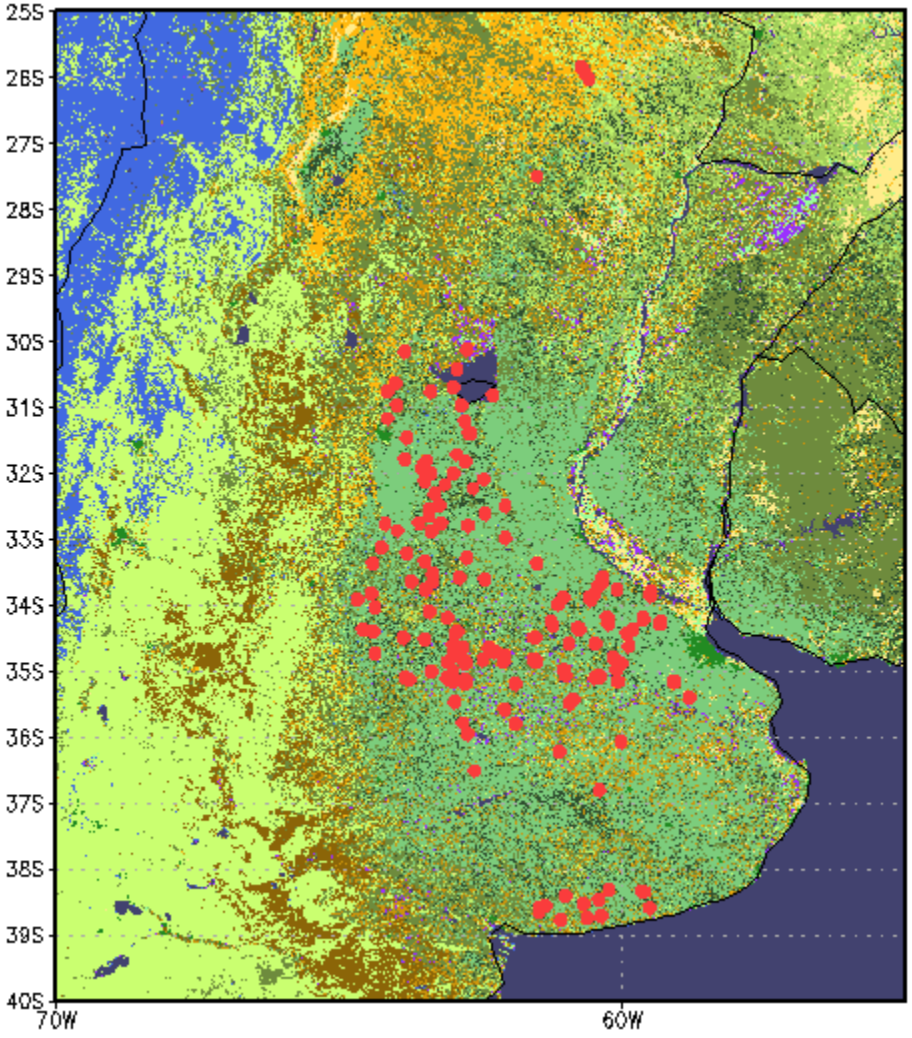


University of Maryland / Universidad Nac. del Litoral



In-situ soil moisture observations

RIAN-INTA



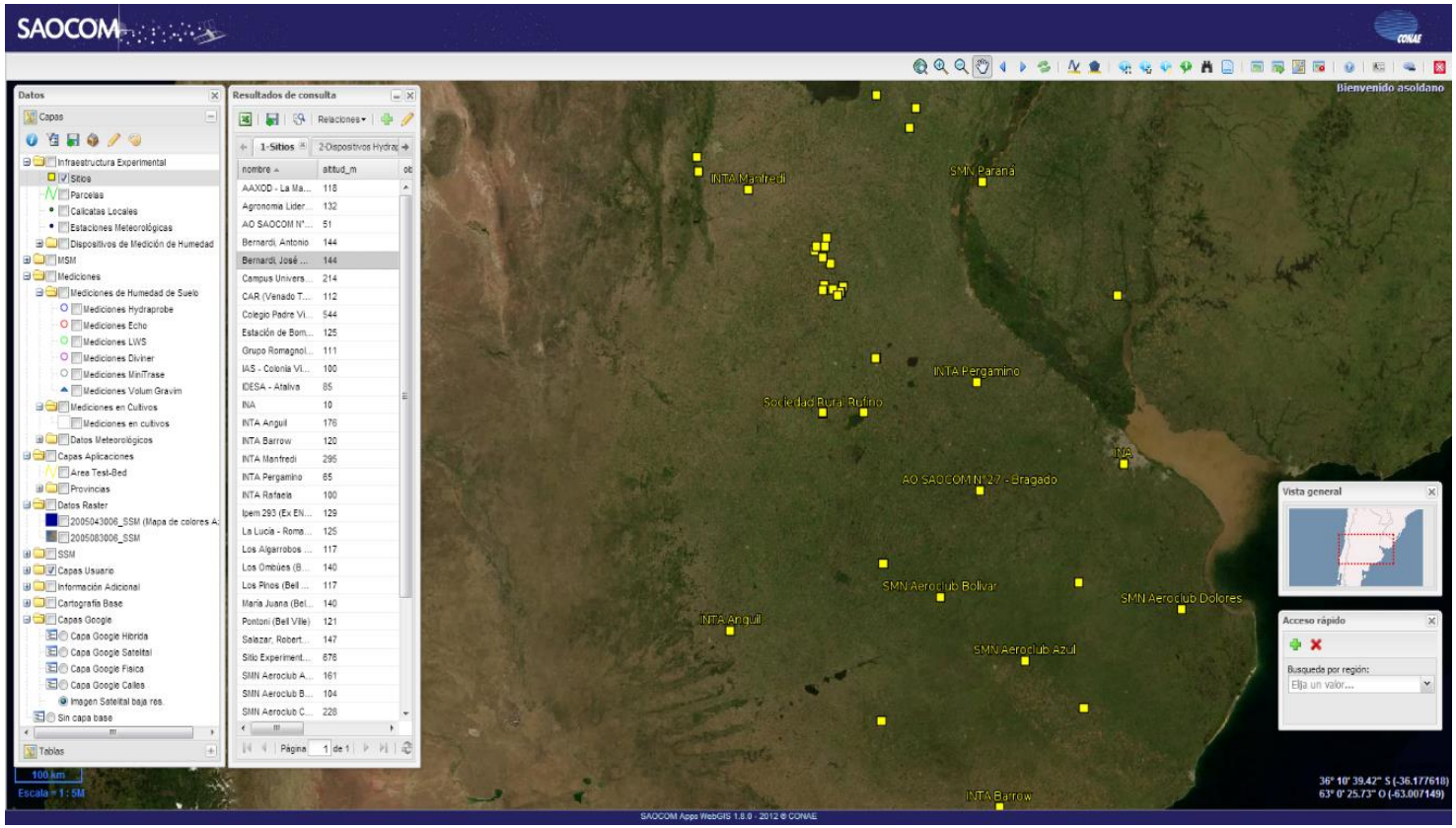
- About 450-500 sites,
- Measurements made ‘as needed’ (related to crop growth)
- Gravimetric method

Courtesy of Roberto De Ruyver

CONAE: In situ measurements in support of the upcoming SAOCOM Mission

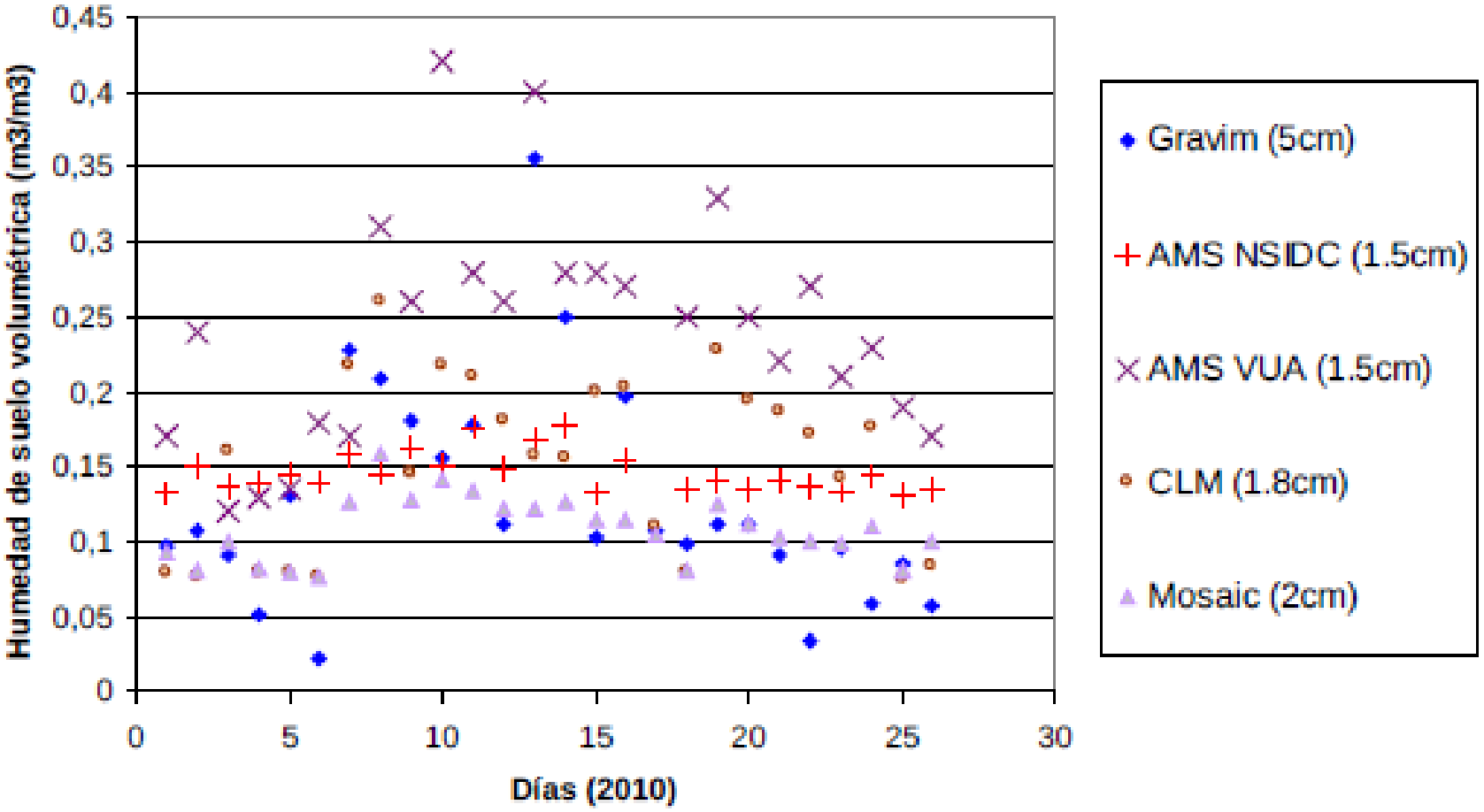
- Field campaigns 2009, 2010

- 34 automatic stations using Hydra Probe II sensors



Courtesy of Danilo Dadamia

Comparison of in situ, AMSR-E and LSM estimates during 2010 CONAE Field Campaign

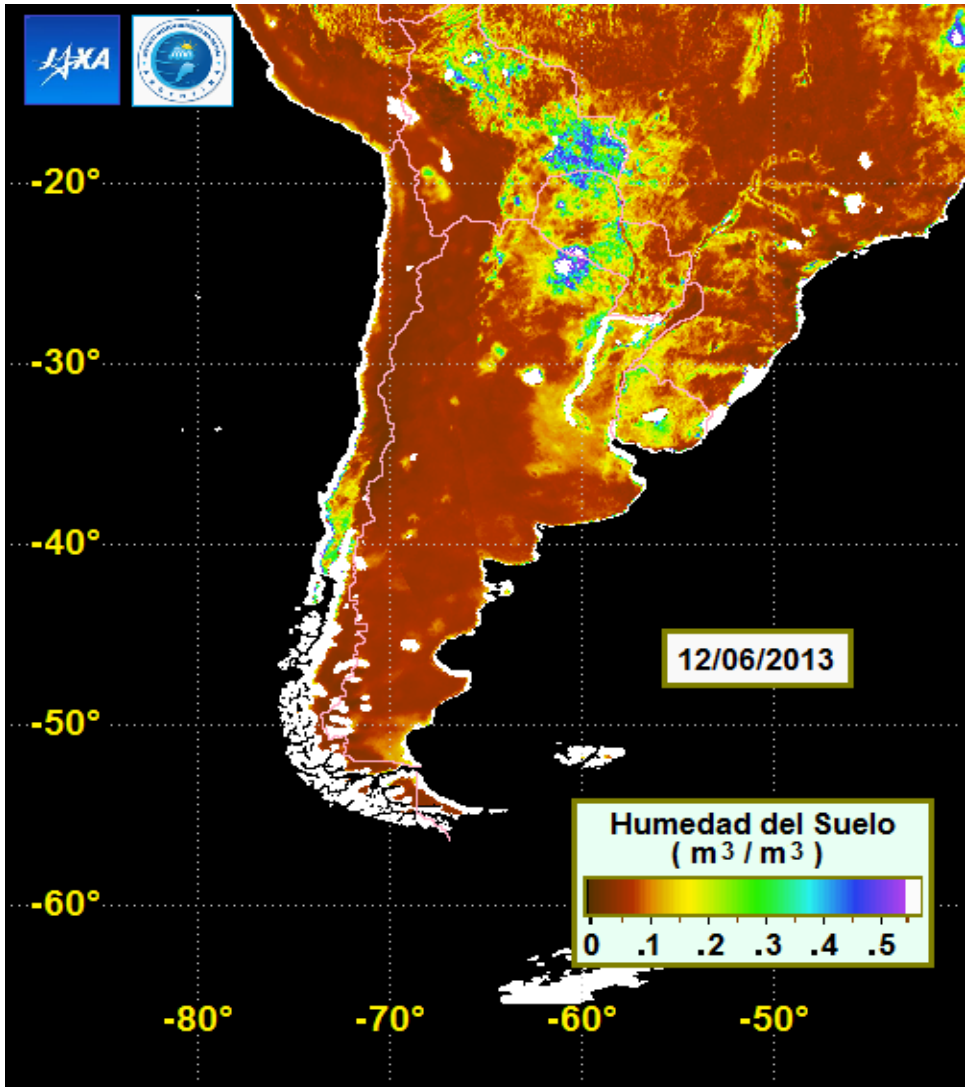


Unprocessed data, not normalized

Courtesy of Maria E. Dillon

Satellite Estimates of Soil Moisture

Argentine National Weather Service



- ASCAT
- AMSR-E
- AMSR2

Courtesy of Gloria Pujol

Satellite Estimates of Soil Moisture

IAFE (Haydee Karszenbaum)

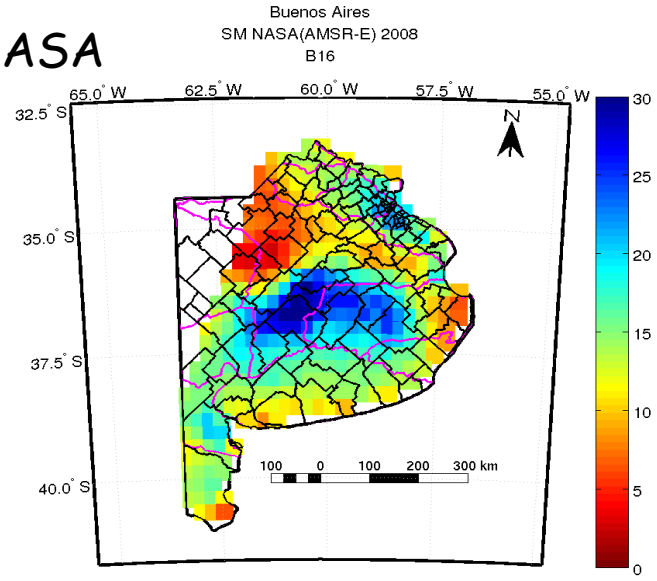
Algorithms

➢NASA (AMSR-E): three variable retrieval simultaneously (Njoku, 2003): soil moisture, vegetation water content and Ts. It uses three frequencies and two polarizations.

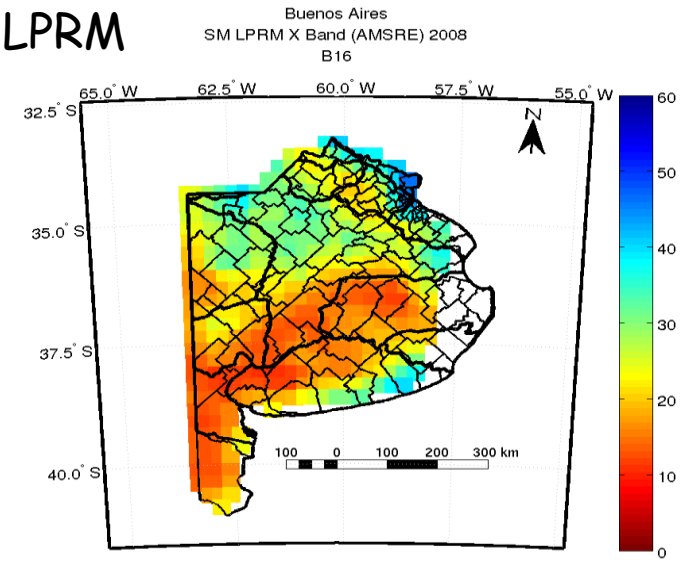
➢LPRM (AMSR-E): retrieval using polarization index and coupled with a LSM model (Owe, 2001).

➢**IAFE** (Aquarius, AMSR-E, SMOS)

NASA



LPRM



This group is working on inversion strategies and evaluation

Summary

1. Two planning meetings have already been held

2. A documentation was completed of the different products and methods being used.

3. Work is being done in the exchange of information between groups with the purpose of developing common protocols for an assessment of the products.

4. A workshop/tutorial will be held in September.

Planned activities

- Validate current remote sensing products for the region.

- Provide a “best” estimate of soil moisture fields from current methodologies for use by stakeholders

- Improve the temporal and spatial representation of soil moisture fields by means of data assimilation, taking advantage of LSMs, in-situ observations and remote sensing products to be used:
  (a) in forcing forecast models, and
  (b) as usable information to help decision making by the stakeholders.

- Provide support to the future CONAE/SAOCOM mission

Thanks!