

Opportunities for SMAP applications in South America: an argentinean perspective

Haydee Karszenbaum

Instituto de Astronomía y Física del Espacio (IAFE)

Remote Sensing Laboratory

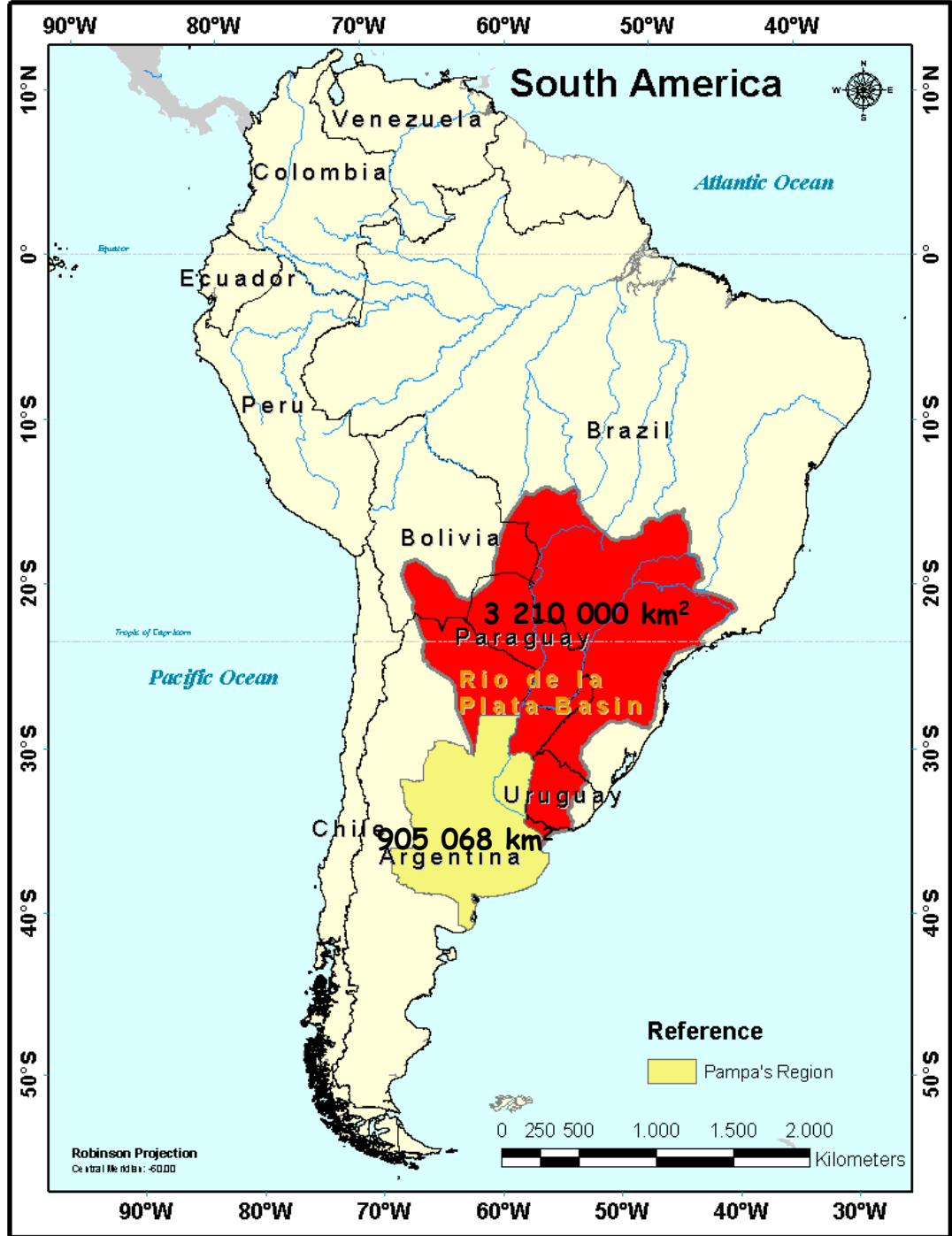
Francisco Grings, Mercedes Salvia, Matias Barber, Mariano Franco,
Cintia Bruscantini, Veronica Barraza, Federico Carballo, Ezequiel
Smucler, Pablo Perna

Contents

- South America: countries and potential users (institutions)
- Hydrological Applications
- Agricultural Applications
- Ongoing activities and interested users

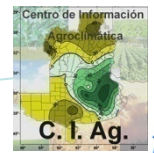
Contents

- South America: countries and potential users (institutions)
- Hydrological Applications
- Agricultural Applications
- Ongoing activities and interested users





National and Regional Meteorological & Hydrological Services in South America





Bolivia

SENAMHI | Servicio Nacional de Meteorología e Hidrología
Website <http://www.senamhi.gob.bo/>



Chile

MeteoChile | Dirección Meteorologica de Chile
Website <http://www.meteochile.gob.cl/>



Colombia

IDEAM | Instituto de Hidrología, Meteorología y Estudios Ambientales
Website <http://www.ideam.gov.co/>



Ecuador

INAMHI | Instituto Nacional de Meteorología e Hidrología
Website <http://www.serviciometeorologico.gob.ec/>



Peru

SENAMHI | Servicio Nacional de Meteorología e Hidrología
Website <http://www.senamhi.gob.pe/>



Venezuela

INAMHI | Instituto Nacional de Meteorología e Hidrología
Website <http://www.inameh.gob.ve/>



Uruguay

INIA | Instituto Nacional de Investigación Agropecuaria
Website <http://www.inia.org.uy/>



Paraguay

DMH - DINAC | Dirección de Meteorología e Hidrología
Website <http://www.meteorologia.gov.py/>



Brazil

INMET | Instituto Nacional de Meteorologia
Website <http://www.inmet.gov.br/>

CPTEC - INPE | Centro de Previsao de tempo e estudos climáticos
Website <http://www.cptec.inpe.br/>

Agri tempo | Sistema de Monitoramento Agrometeorológico
Website <http://www.agritempo.gov.br/>

FUNCEME | Fundacao Cearense de Meteorologia e Recursos Hidricos
Website <http://www.funceme.br/>

INFOSECA | Centro de Monitoramento e Mitigacao de Seca e Adversidades Hidrometeorologicas
Website <http://www.infoseca.sp.gov.br/>



Argentina

SMN / Servicio Meteorológico Nacional
Website <http://www.smn.gov.ar/>

SC / Servicios Climáticos (SMN)
Website <http://www.smn.gov.ar/serviciosclimaticos/>

CREAN / Centro de Relevamiento y Evaluación de Recursos Agrícolas y Naturales
Website <http://www.crean.unc.edu.ar/>

SIIA / Sistema Integrado de Información Agropecuaria
Website <http://www.siaa.gov.ar/>

CIAG / Centro de Información Agroclimática (FAUBA)
Website <http://www.agro.uba.ar/centros/ciag>

INA / Instituto Nacional del Agua
Website <http://www.ina.gov.ar/>

INTA / Instituto Nacional de Tecnología Agropecuaria
Website <http://inta.gob.ar/>

ORA / Oficina de Riesgo Agropecuario
Website <http://www.ora.gov.ar/>

AACREA / Asociación Argentina de Consorcios Regionales de Experimentación Agrícola
Website <http://www.aacrea.org.ar/>

IAFE / Instituto de Astronomía y Física del Espacio (CONICET-UBA)
Website <http://www.iafe.uba.ar/>

CONAE / Comisión Nacional de Actividades Espaciales
Website <http://www.conae.gov.ar/>

✓ **Microwave** satellite missions applications are strongly driven by **CONAE missions and related AO projects**

1. SACD Aquarius mission (NASA/CONAE)

Aquarius L-band radiometer (1,41 GHz) and scatterometer (1,26 GHz), MWR Ka and K band radiometer.

- Sea Surface Salinity
 - Soil Moisture

- MWR rain rate
- MWR wind speed
- The use of MWR surface temperature for SM retrieval algorithm

✓ **Microwave** satellite missions applications are strongly driven by **CONAE missions and related AO projects**

2. SAOCOM mission (CONAE)

a constellation of two identical satellites, SAOCOM 1A and SAOCOM 1B, carrying each one a **polarimetric L-band SAR instrument (1,275 GHz)**. Launch: SAOCOM 1A: 2015; SAOCOM 1B: 2016.

Strategic Applications

- Surface Soil Moisture **Products** from individual strips
- Surface Soil Moisture **Mosaics** (over **Pampas Region**)

Derived products for Agriculture:

- Decision Support Data (local information)
- Fusarium Progression Calculation Processing (regional map)
 - User Fusarium Calculation (local information)

Derived products for Hydrology:

- Flood Guidance
- Deterministic Hydrologic Forecasts
- Medium and Long Term Probabilistic Forecasts

Contents

- South America: countries and potential users (institutions)
- **Hydrological Applications**
- Agricultural Applications
- Ongoing activities and interested users

Paraná - Paraguay Basin Monitoring Flood extend and water level in the floodplain combining active and passive data



- Part of the Plata Basin (largest sub-basin)
- Covers 1.7 million Km² in 4 Countries
- Densely populated (70 million)
- One of the richest agricultural regions in SA
- Its floodplains provide irreplaceable ecological/hydrological functions

- mitigating large floods and droughts
- recharging aquifers
- supplying high quality fresh water.

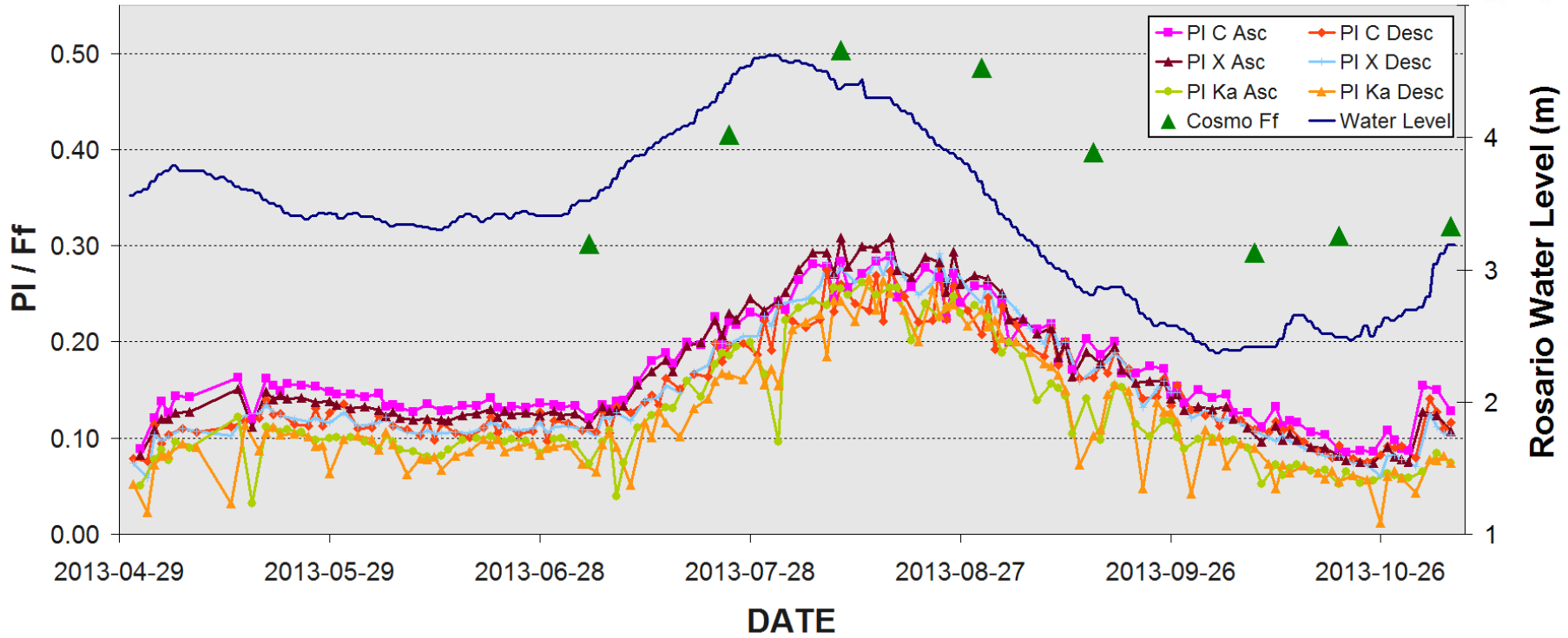
Available Data

Sensor	Data used	Dates	Variable obtained
Aquarius (L Band)	L2 V2 Tb	2013/01 – 2013/11	PI
SMOS (L Band)	SCLF1C Tb	2013/05 – 2013/11	PI (35 to 45° average)
AMSR2 (C, X and Ka Bands)	L1B Tb	2013/01 – 2013/11	PI
Cosmo Skymed (X Band)	HH σ^0	2013/07/05 , 2013/07/25 2013/08/10 , 2013/08/30 2013/09/15 , 2013/10/08 2013/10/20 , 2013/11/05	Flooded area maps
Auxiliary data	Water level in Rosario Port, Land cover map, emission model results		
Emission model	Ferrazzoli and Guerriero, 1996		

$$PI = \frac{2 * (Tb_V - Tb_H)}{(Tb_V + Tb_H)}$$

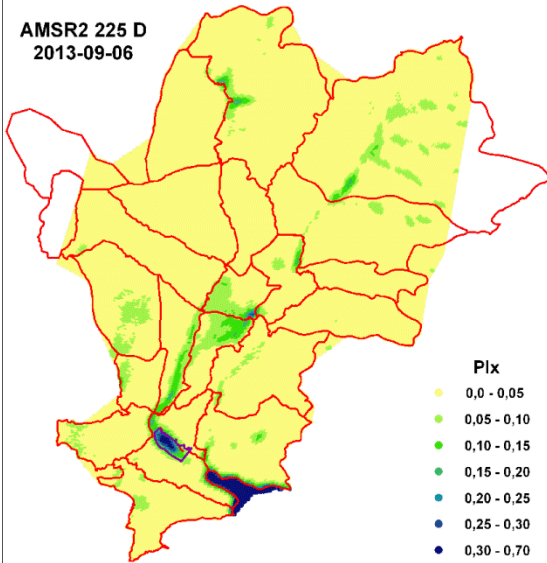
Salvia et al 2011, Hess vol. 15 p.
 2679 - 2692

AMSR2

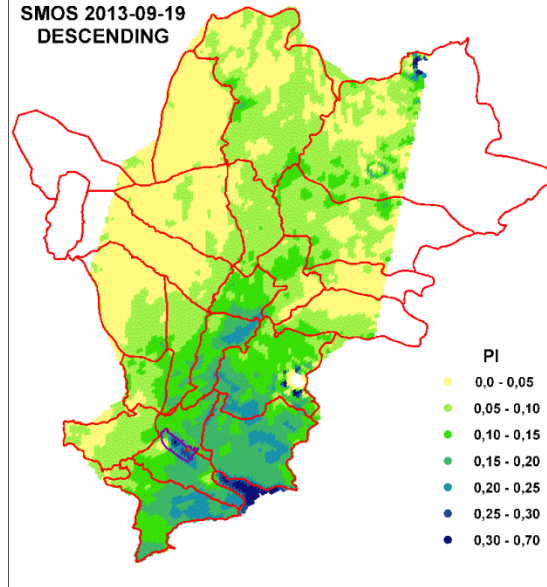


- AMSR2 derived PI shows a good agreement with flooded area fraction estimations from Cosmo Skymed higher resolution SAR images
- Ka band data are noisier than X and C band data

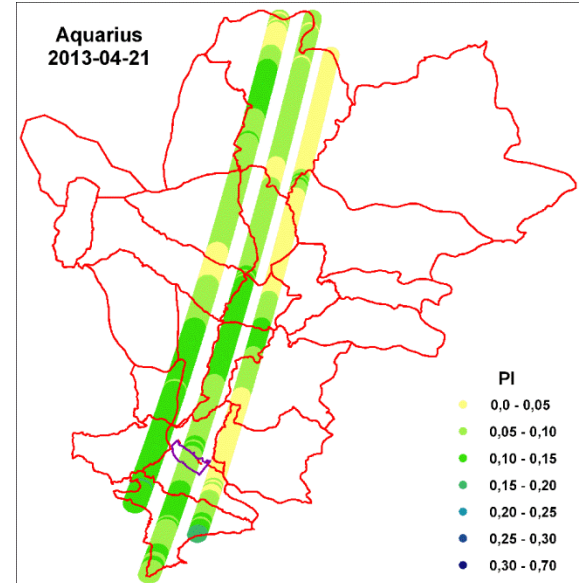
AMSR2 225 D
2013-09-06



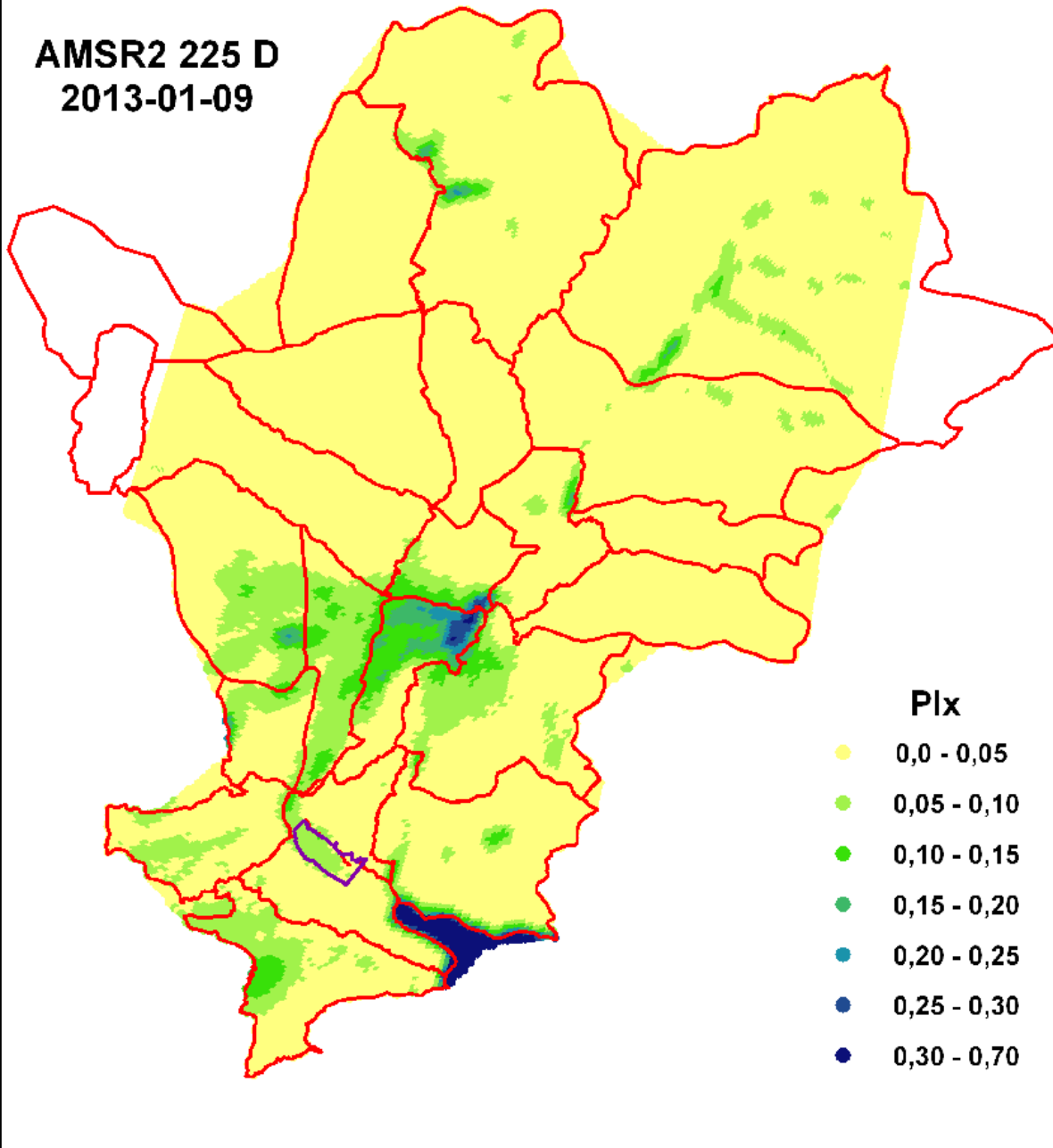
SMOS 2013-09-19
DESCENDING



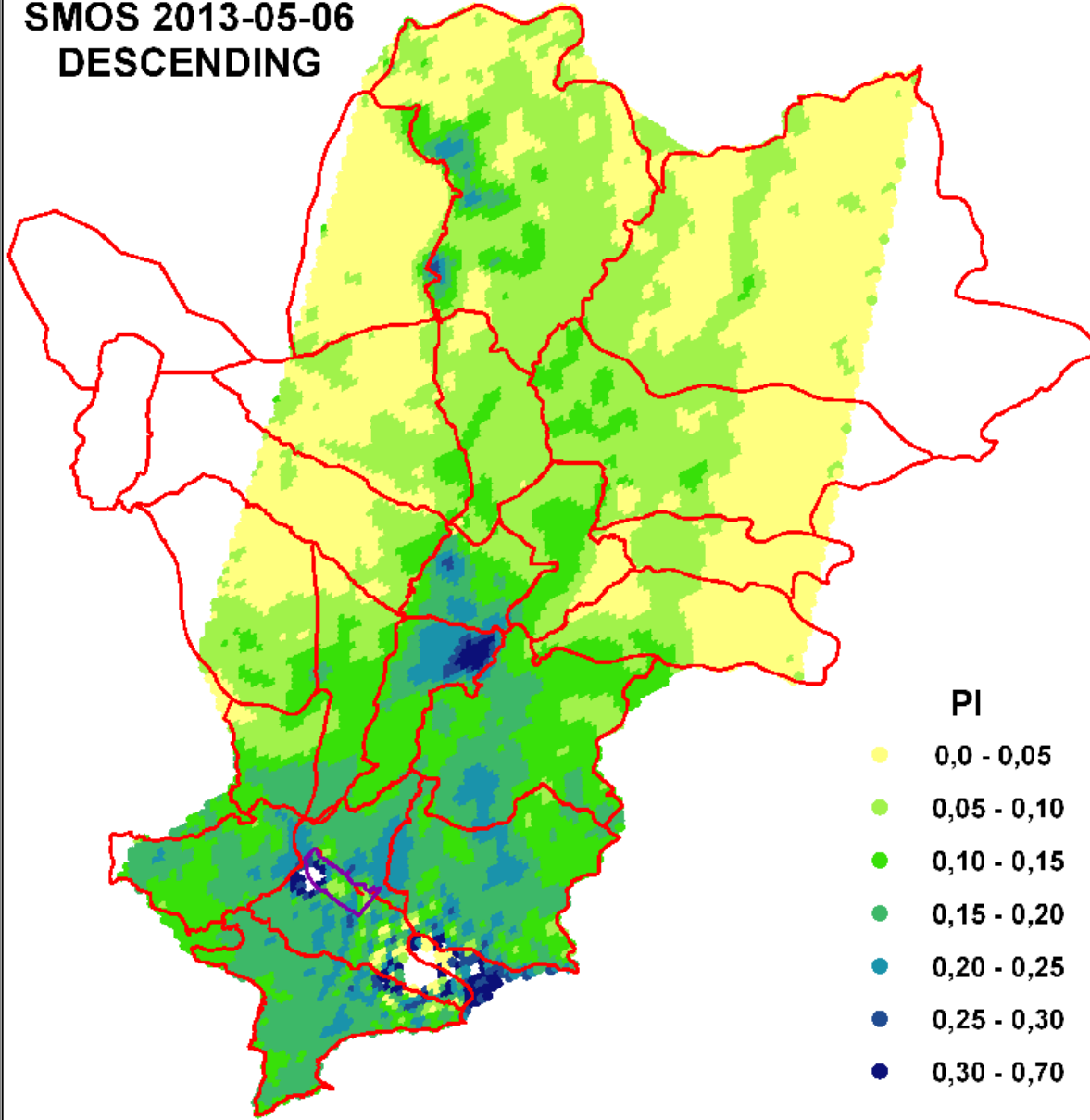
Aquarius
2013-04-21



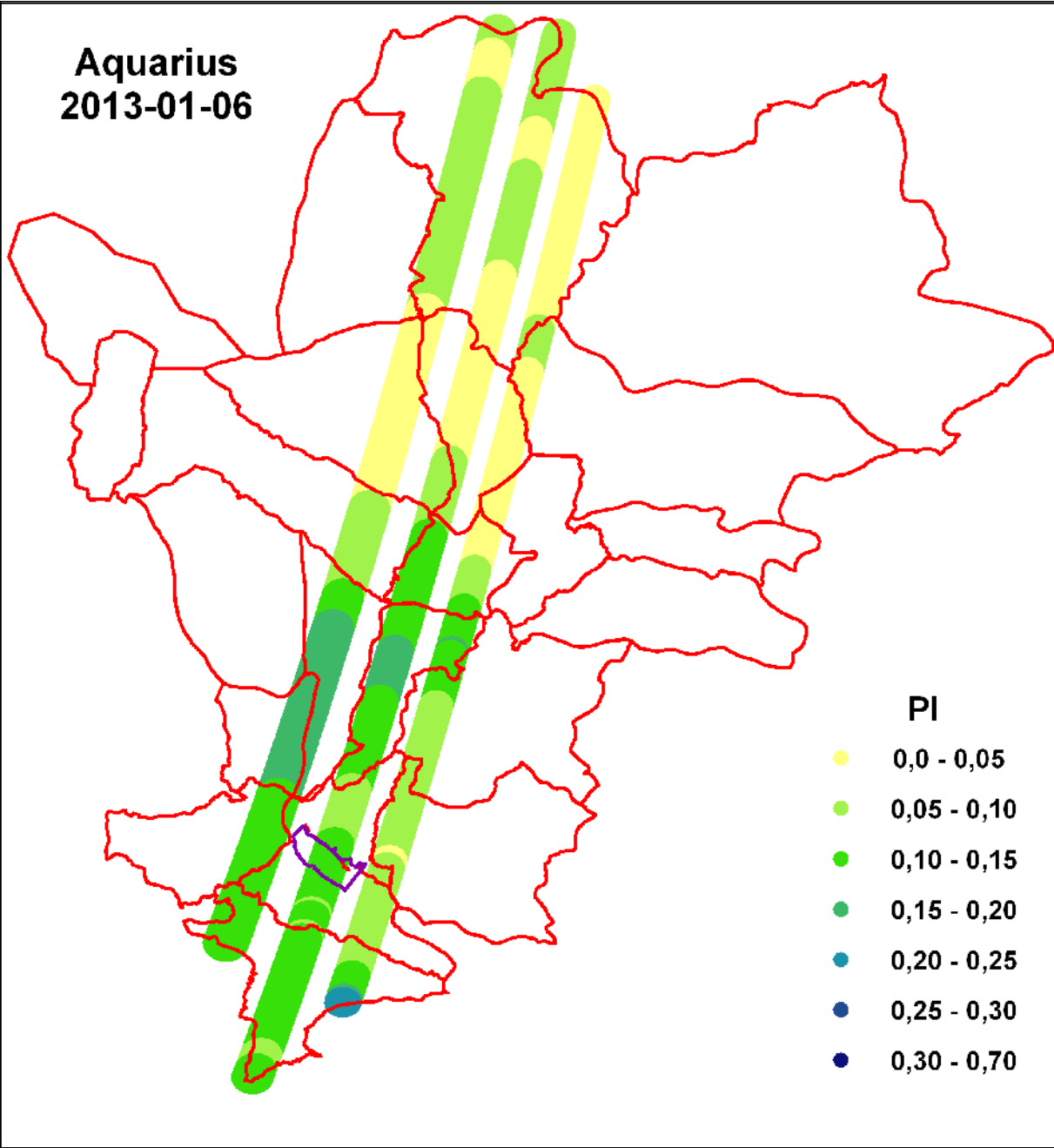
AMSR2 225 D
2013-01-09



SMOS 2013-05-06
DESCENDING



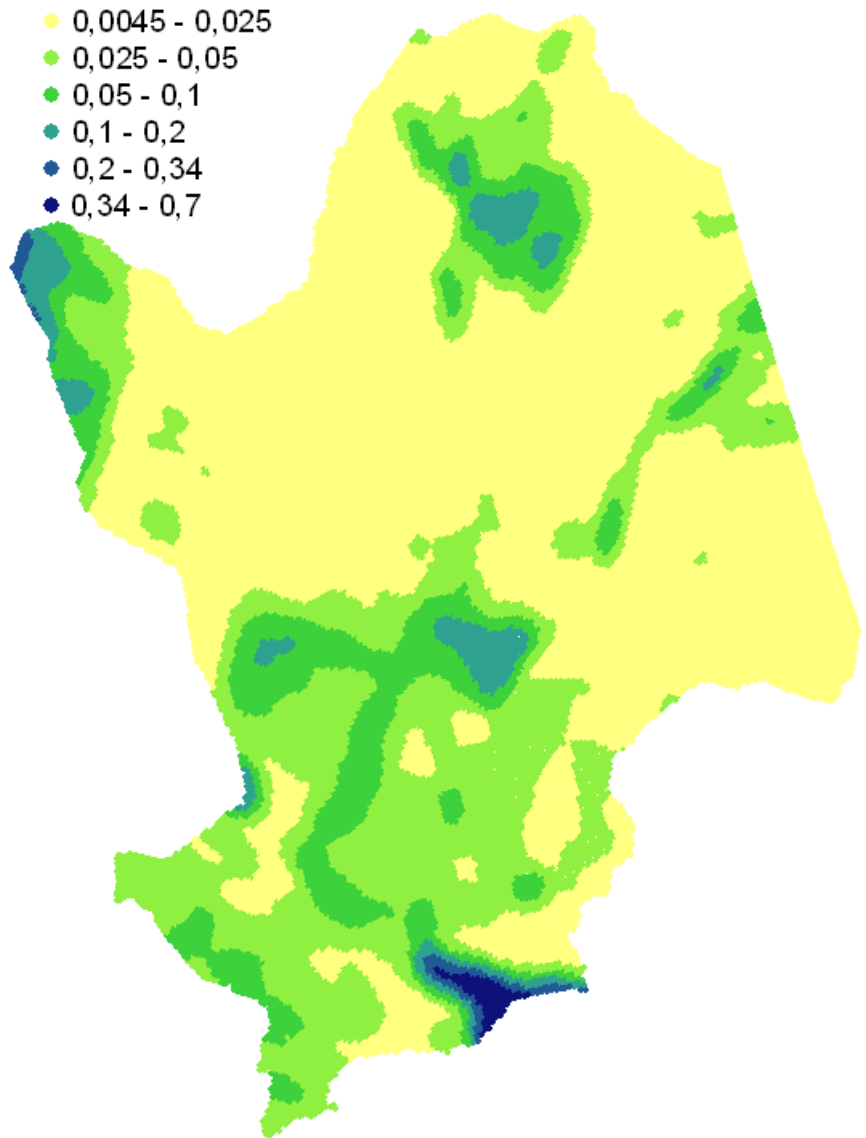
Aquarius
2013-01-06



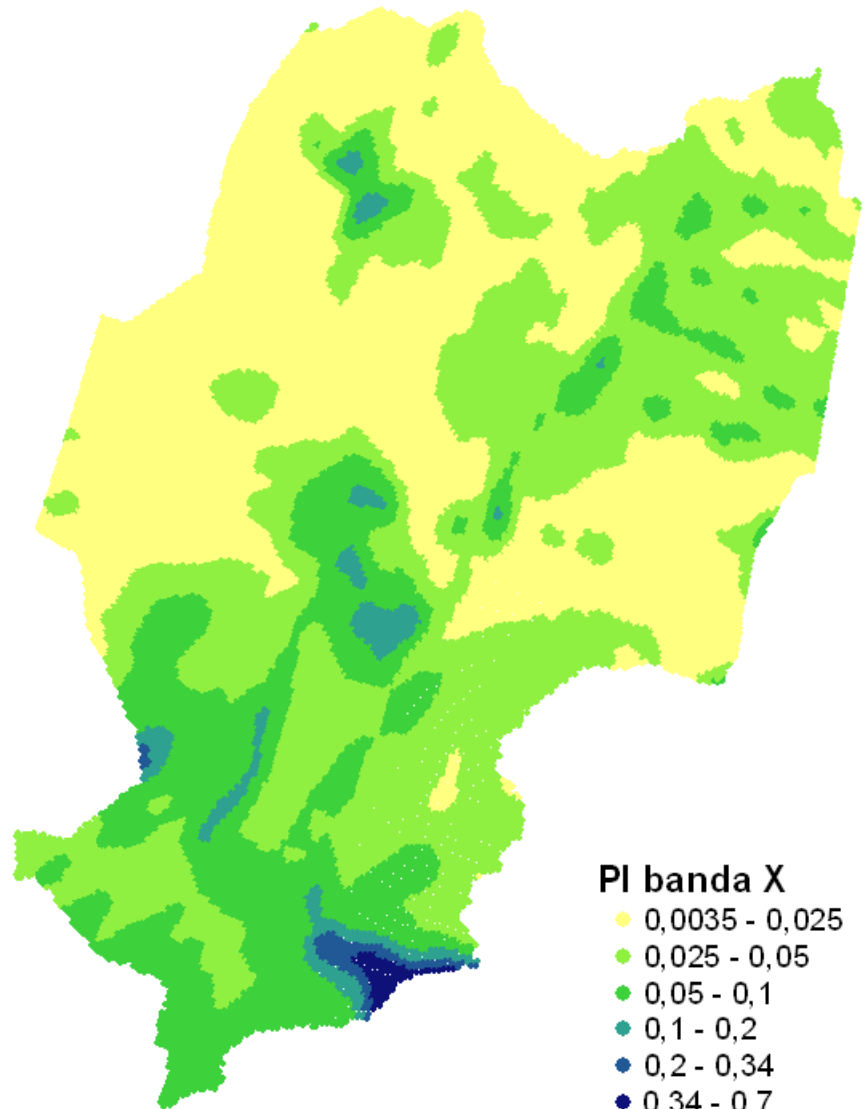
- PI**
- 0,0 - 0,05
 - 0,05 - 0,10
 - 0,10 - 0,15
 - 0,15 - 0,20
 - 0,20 - 0,25
 - 0,25 - 0,30
 - 0,30 - 0,70

PI banda X

- 0,0045 - 0,025
- 0,025 - 0,05
- 0,05 - 0,1
- 0,1 - 0,2
- 0,2 - 0,34
- 0,34 - 0,7



AMSRE 109A 12/01/2007



PI banda X

- 0,0035 - 0,025
- 0,025 - 0,05
- 0,05 - 0,1
- 0,1 - 0,2
- 0,2 - 0,34
- 0,34 - 0,7

AMSRE 225D 25/07/2009

Assimilation of Soil Moisture Estimates into Flow Forecasting Hydrological Models

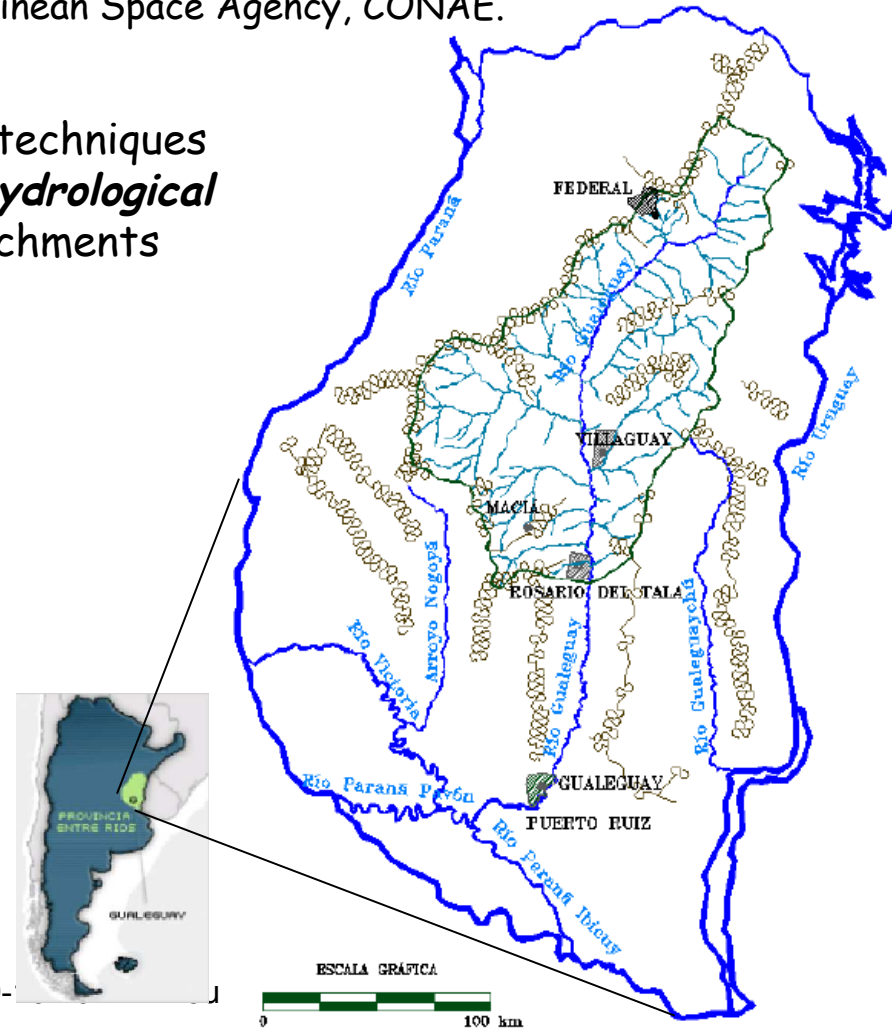


Application developed by the National Water Institute Early Warning Office (Instituto Nacional del Agua, INA) and the Argentinean Space Agency, CONAE.

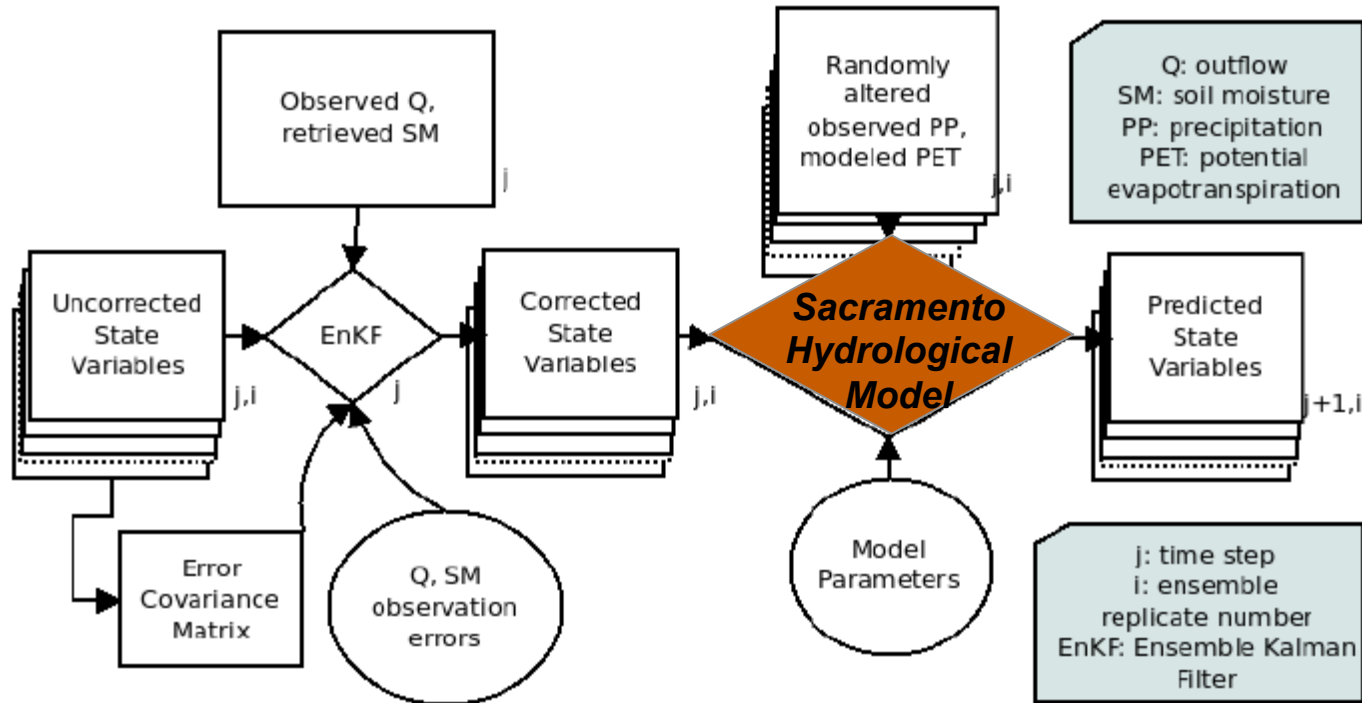
The project aims at developing *assimilation* techniques of soil moisture retrievals into operational *hydrological models* for simulation and forecast at catchments within the Del Plata basin.

Assimilated soil moisture retrievals
AMSR-E (NASA/LPRM)
SMOS
Ongoing work
Aquarius
Future work
SMAP

Ref: "Assimilation of Soil Moisture Estimates into Flow Forecasting Hydrologic Models", Goniadzki, D., Thibeault, M., Lozza, H., Uriburu Quirno, M., Dadamia, D., Bianchi, J.



Daily series of spaceborne soil moisture estimation, observed outflow, TRMM mean areal precipitation and rain gauge-derived mean areal precipitation have been produced for the Gualeguay river basin.



Ensemble Kalman Filter data assimilation scheme

A modified **Sacramento hydrological model** has been calibrated and validated for this basin using precipitation and outflow data. The modeled soil moisture is compared with spaceborne soil moisture.

A **data assimilation** algorithm is incorporated into the hydrological model. Observed outflow and retrieved soil moisture are assimilated through this technique.

Contents

➤ South America: countries and potential users (institutions)

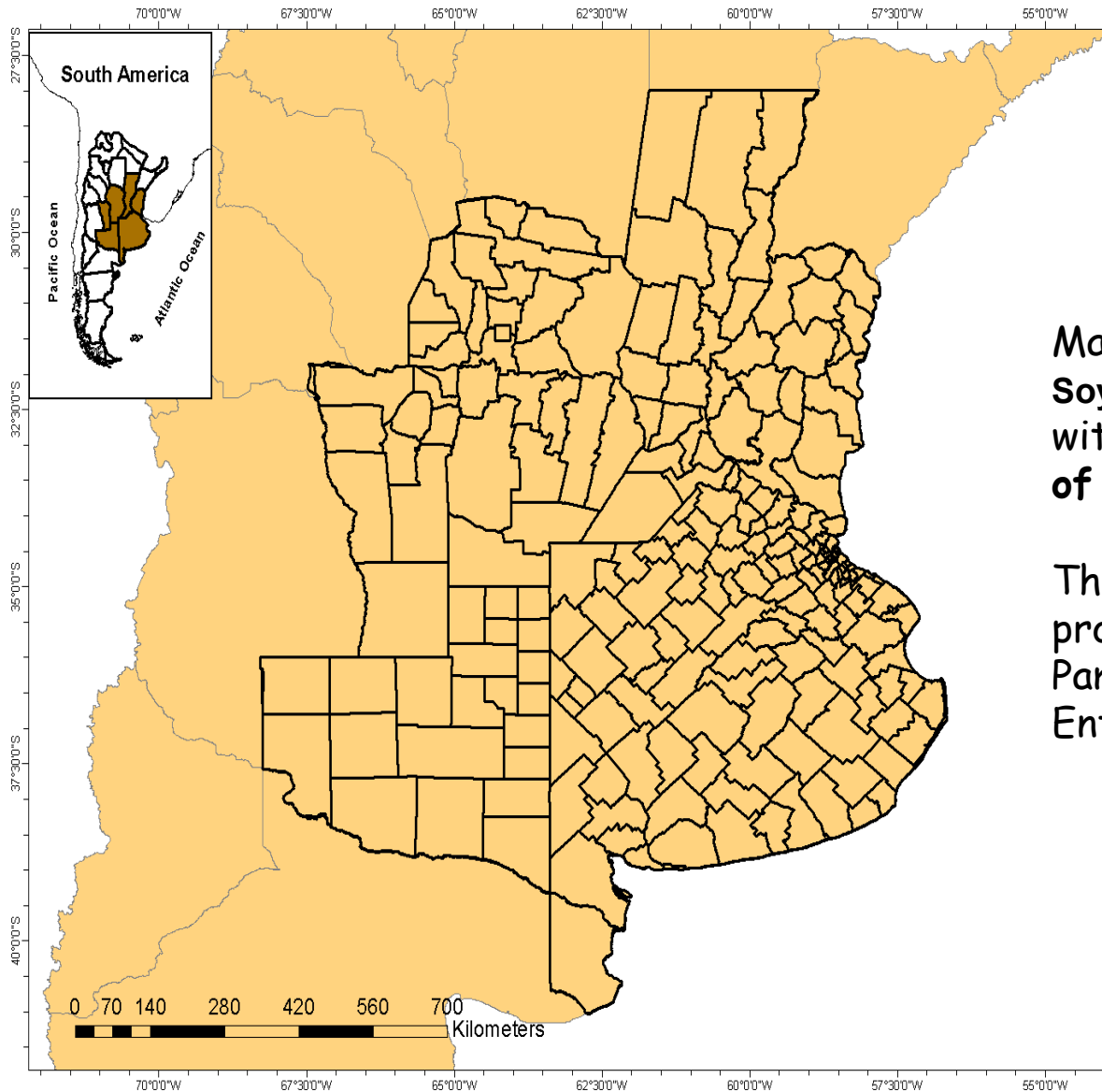
➤ Hydrological Applications

➤ Agricultural Applications

➤ Ongoing activities and interested users



Pampa's Region Counties (230 counties)



Main cropland (Maize Sunflower, Soy, Wheat) area of Argentina with approximately **83 millions of hectares**.

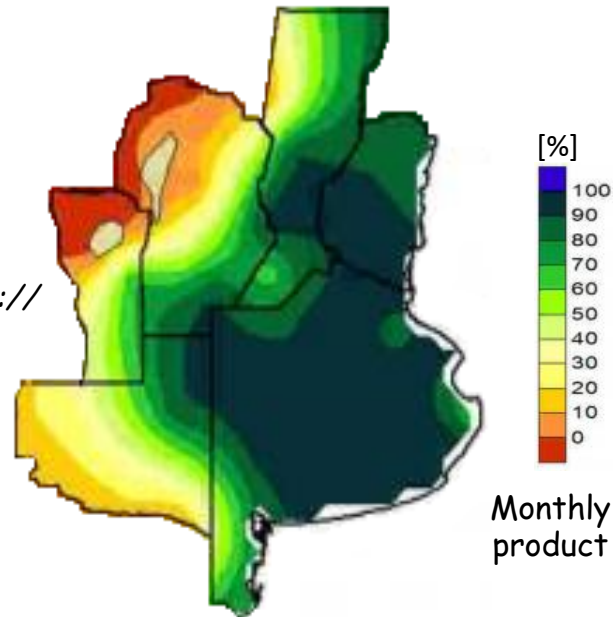
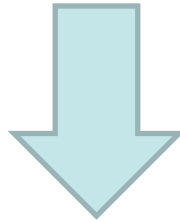
The region includes the provinces of Buenos Aires, La Pampa, Santa Fe, Córdoba, and Entre Ríos.

Operating water balance model for agriculture (OWBA)

Open Loop Model

Soil Available Water for the plant
(field capacity-wilting point)

Ref: *CIAg, Facultad de Agronomía, UBA.* <http://www.agro.uba.ar/centros/ciag>



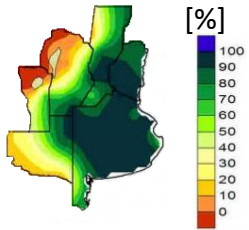
Two Layer Water Balance Model

Assimilating soil moisture estimates

Ref: *Bolten et al. 2009, Data Assimilation for Atmospheric, Oceanic and Hydrological Applications.*

**Very
important
application**

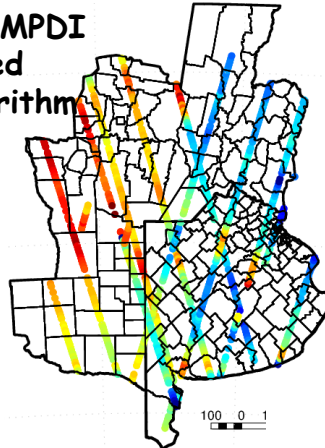
Soil Available Water for the plant



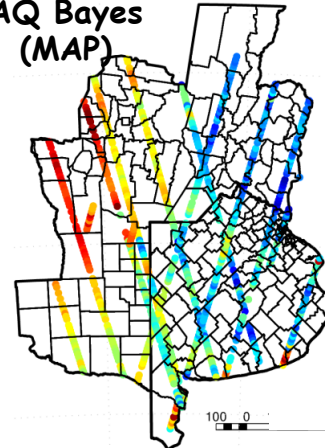
Evaluation of soil moisture algorithms (passive data)

Monthly SM
 August 2012
 (austral winter)

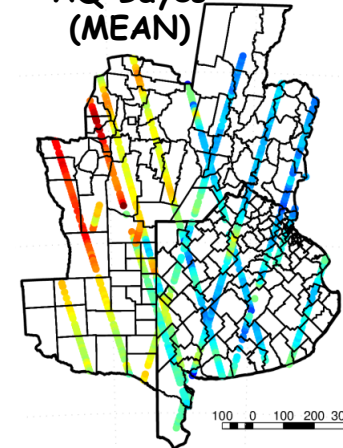
AQ MPDI based algorithm



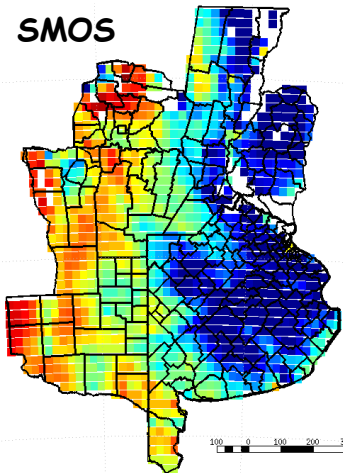
AQ Bayes (MAP)



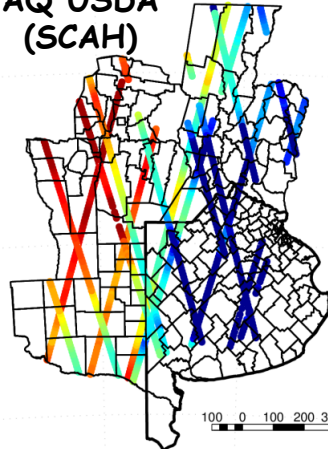
AQ Bayes (MEAN)



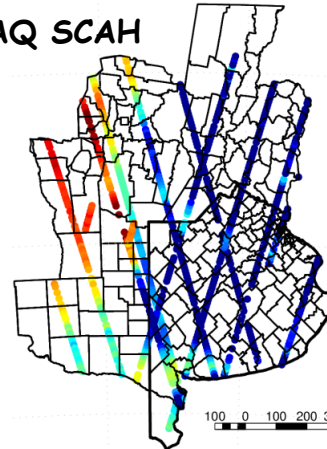
SMOS



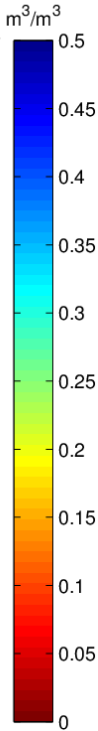
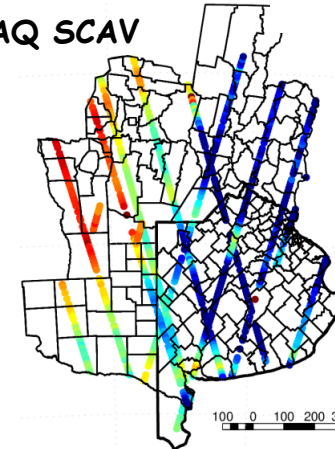
AQ USDA (SCAH)



AQ SCAH

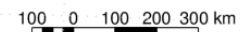


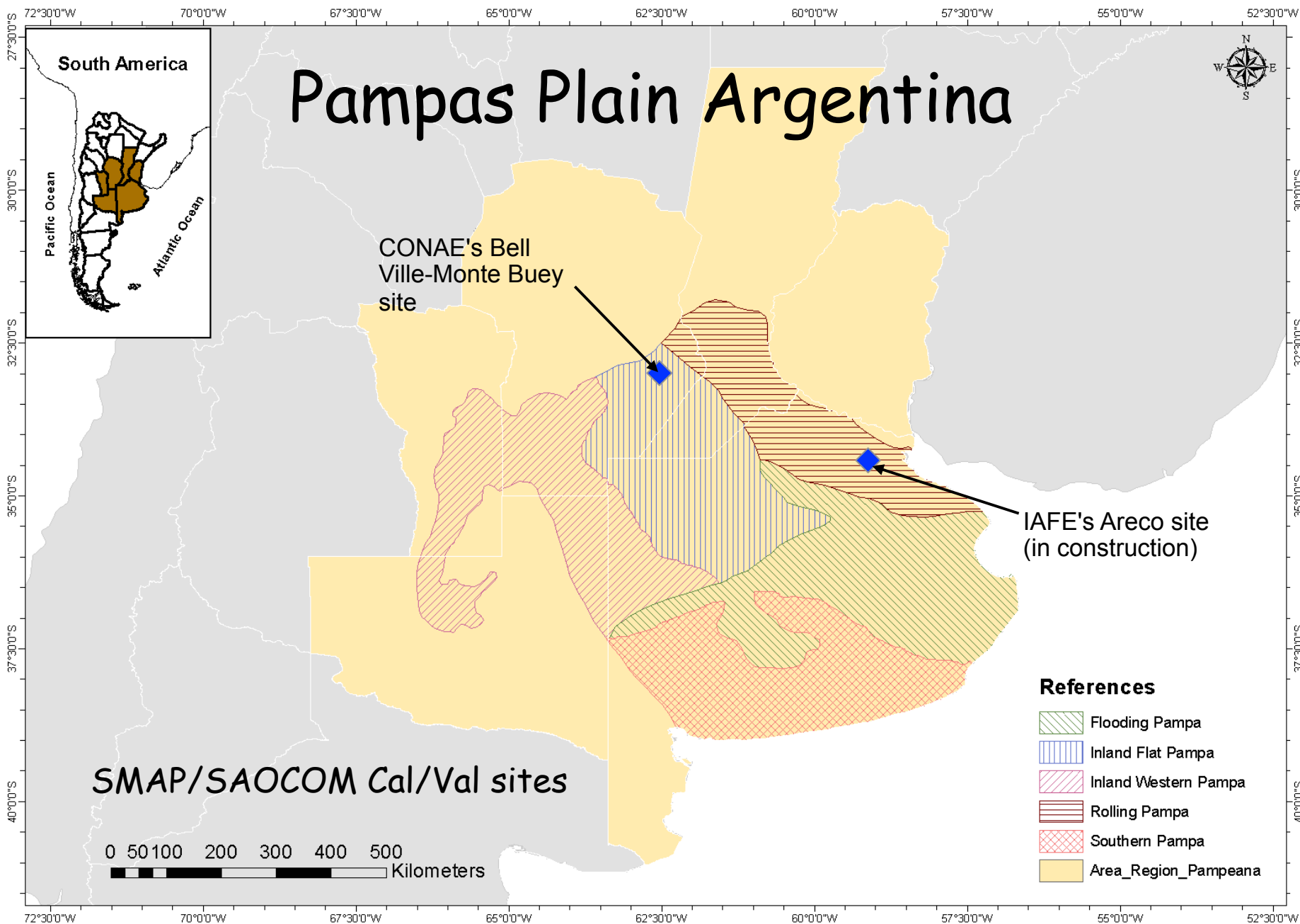
AQ SCAV



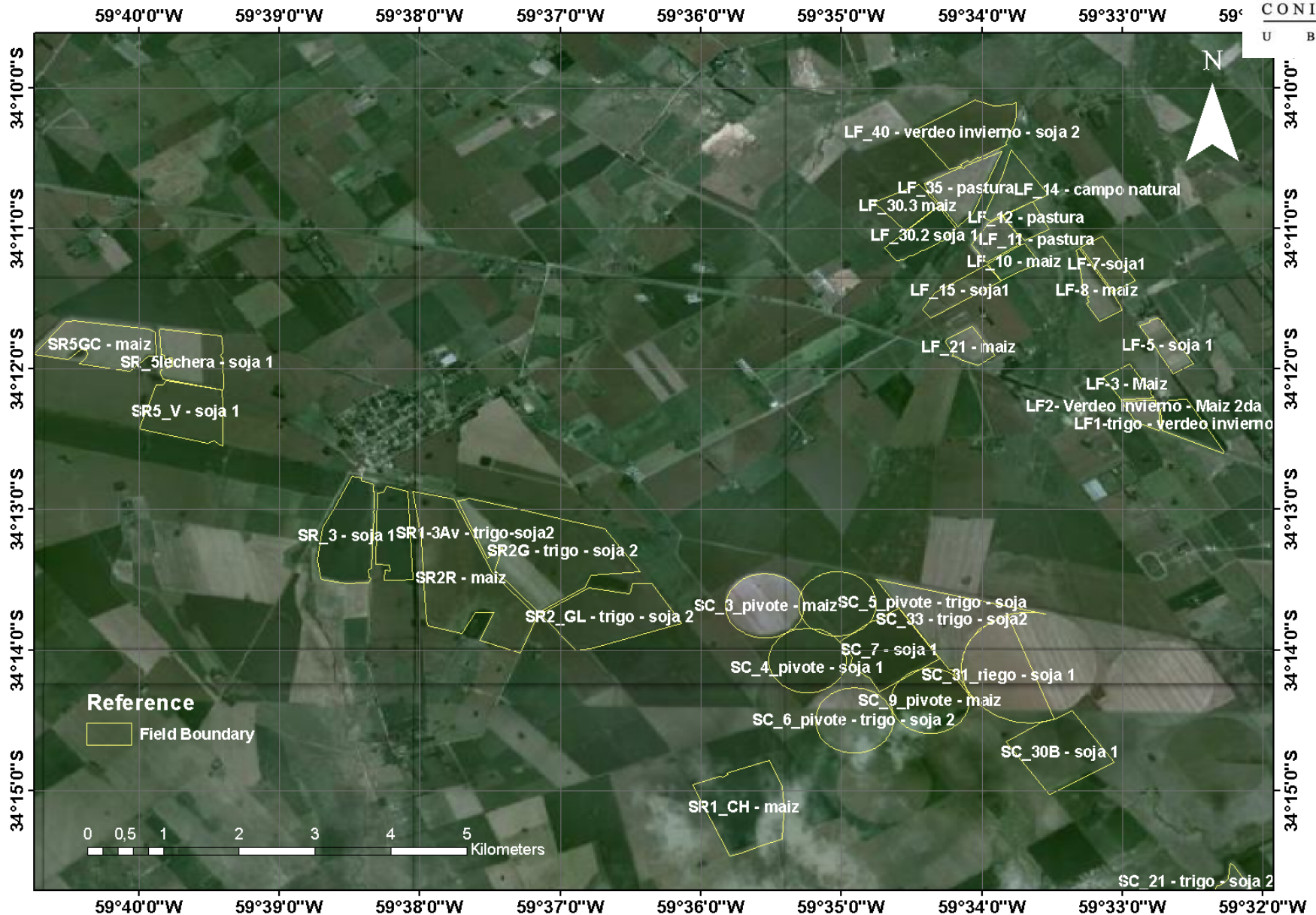
➤ Performance metrics were evaluated for each product (correlation, bias, RMSE, unbiased RMSE). *Bruscantini et al., Microrad 2014.*

➤ For SM products from different systems (SMOS, ASCAT, AMSRE, Aquarius) we are analyzing anomalies, triple colocation, Rvalue. *IGARSS 2014.*





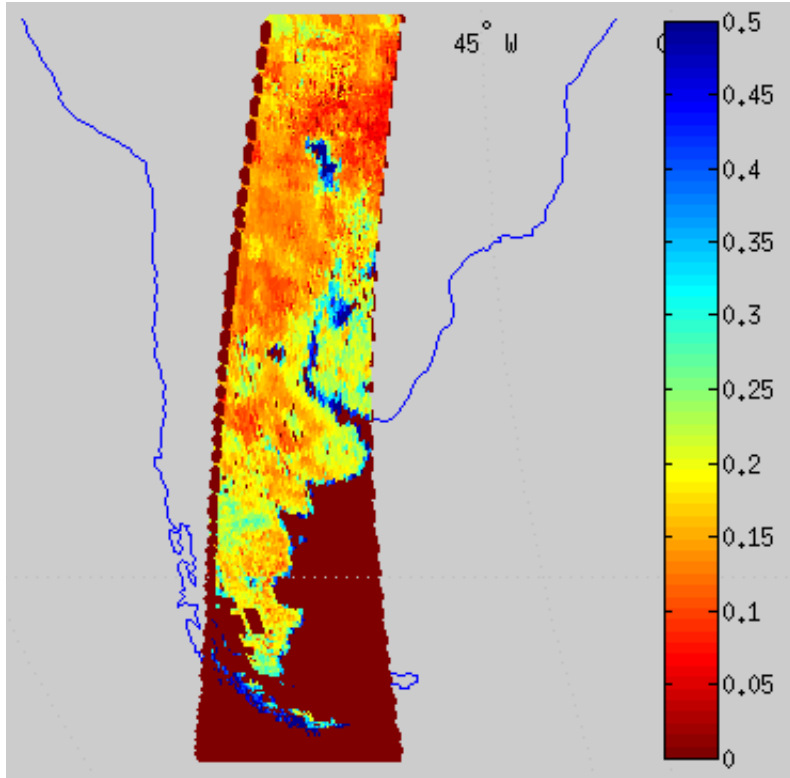
Areco site: Plots distribution



Contents

- South America: countries and potential users (institutions)
- Hydrological Applications
- Agricultural Applications
- Ongoing activities and interested users

Ongoing activities and interested users



- Geophysical retrievals
- Cal/Val site
- Process Models



- Research Institutions
- Government Institutions (CONAE, INA, INTA, SMN, ORA)
- Producers (AACREA)
- Insurance companies

SMAP simulation over South America Active-Passive Product

REF: Short Course on Soil Moisture Trends using SMOS and SMAP Data: Principles and Applications in Numerical and Environmental Modeling. April 8th, 2014.