Use of local ancillary data to customize global SMOS Level 2 soil moisture product over crop areas of Argentina

Evaluation of SMOS soil moisture product using Rvalue analysis

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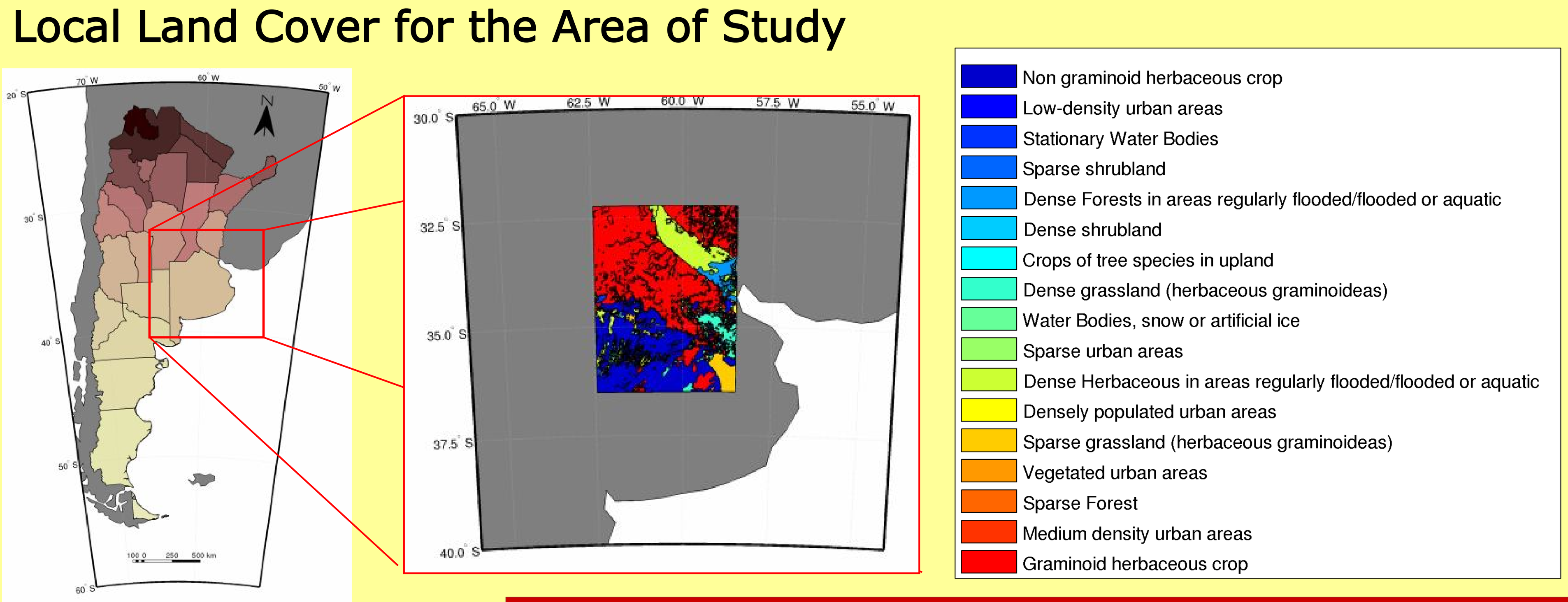
Framework

Local Land Cover for the Area of Study



Ref: INTA http://geointa.inta.gov.ar/visor/?p=model_lccs3

The Argentina's Pampas region is located in the center-east of Argentina where the main agricultural activities are cereal production and cattle-raising. It accounts for more than 90% of the national grain production. Soybean, wheat, maize and sunflower are the main crops. Weather is among the most important and uncontrollable elements affecting agriculture in this region.

Within the area of study, the main land covers are graminoid (wheat, maize and sunflower) and non graminoid (soybean).

Data Description

Dates: 01/14/2010-09/30/2012

- SMOS
  - L2 V501
- TRMM
  - 3B42RT (Real-time product based on the combination of passive microwave with microwave calibrated infrared satellite data derived from different sensors)
  - 3B42 (Benchmark – similar to 3B42RT but includes a retrospective correction based on monthly rain gauge data)

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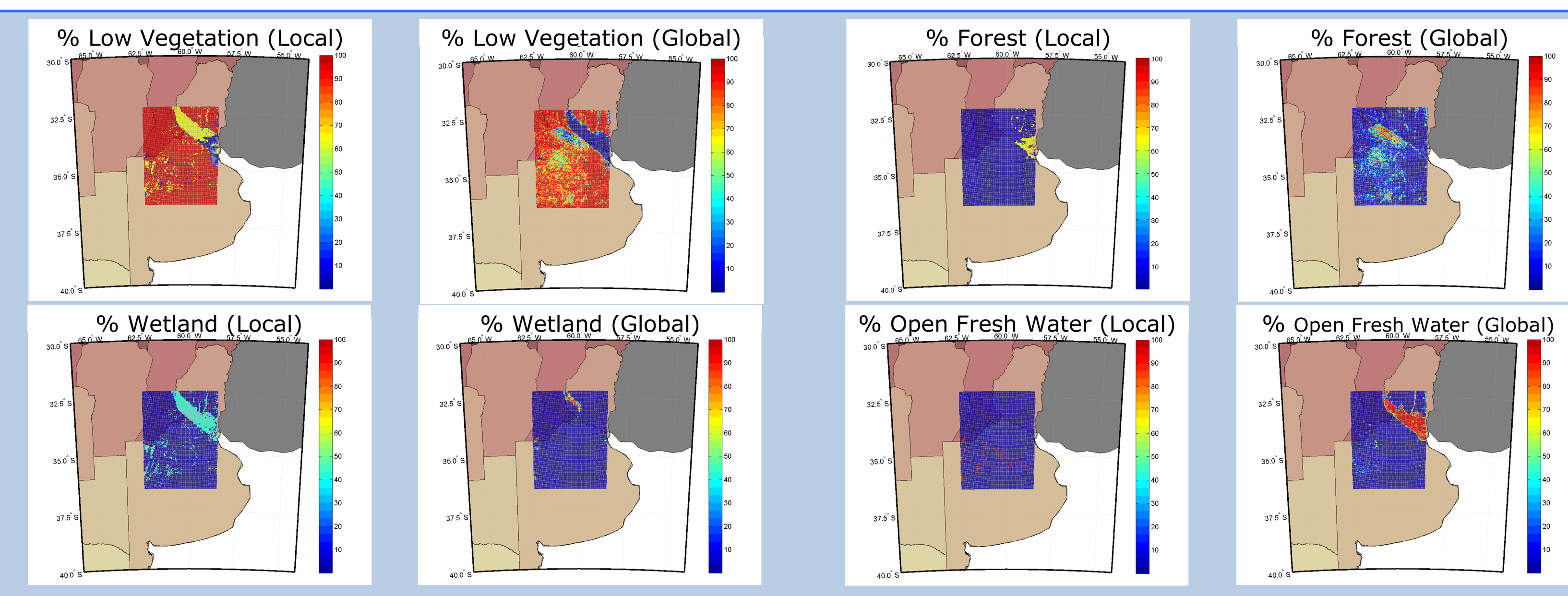
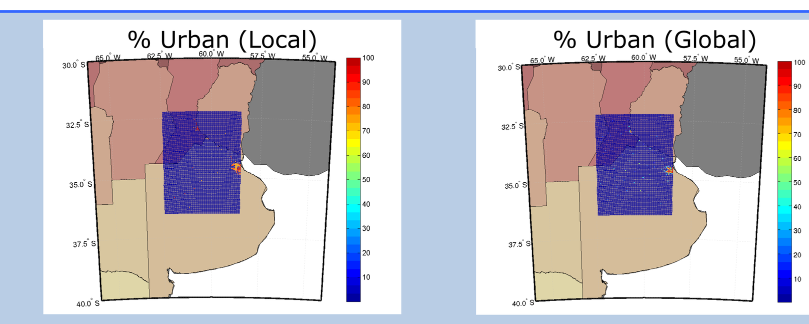
Land Cover Analysis

Methodology

A customized soil moisture product for Pampas Plains was derived by replacing the global land cover map (Global) used in the SMOS Soil Moisture Level 2 Prototype Processor (SML2PP) with the local land cover (Local) provided by INTA generated through the FAO LCCS.

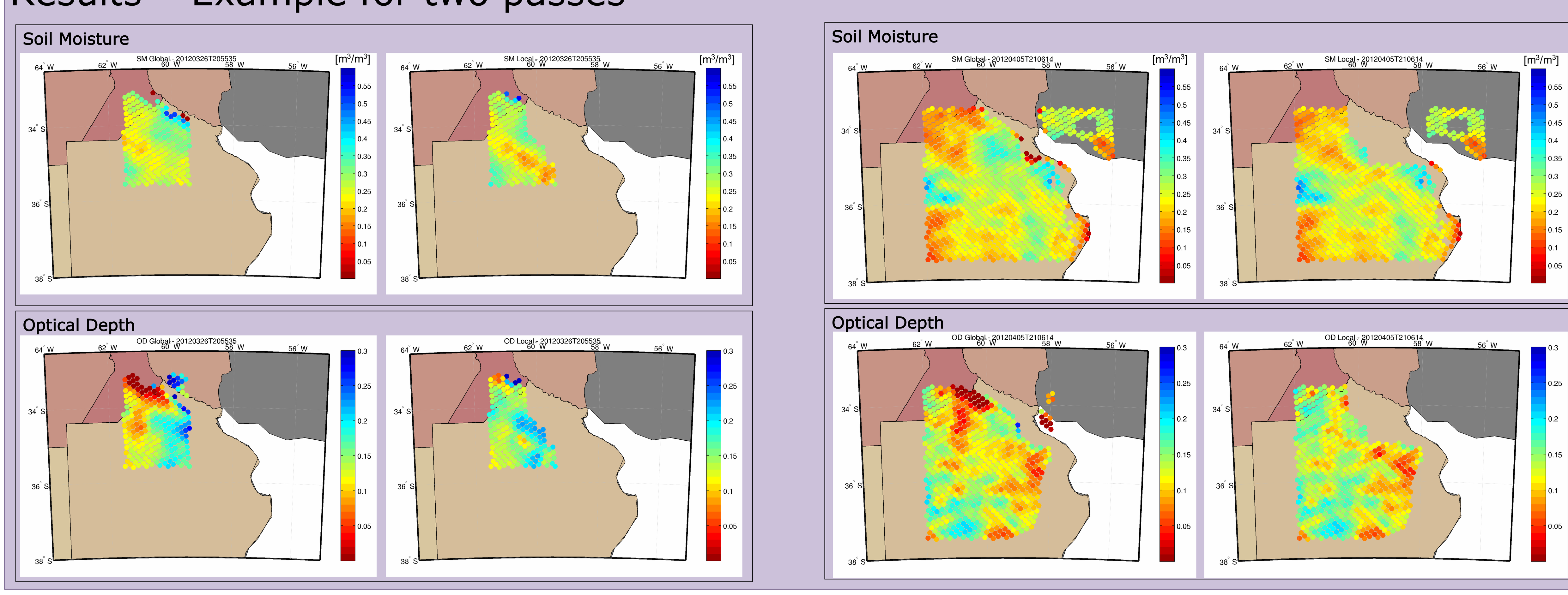
Land Cover Fractions Comparison



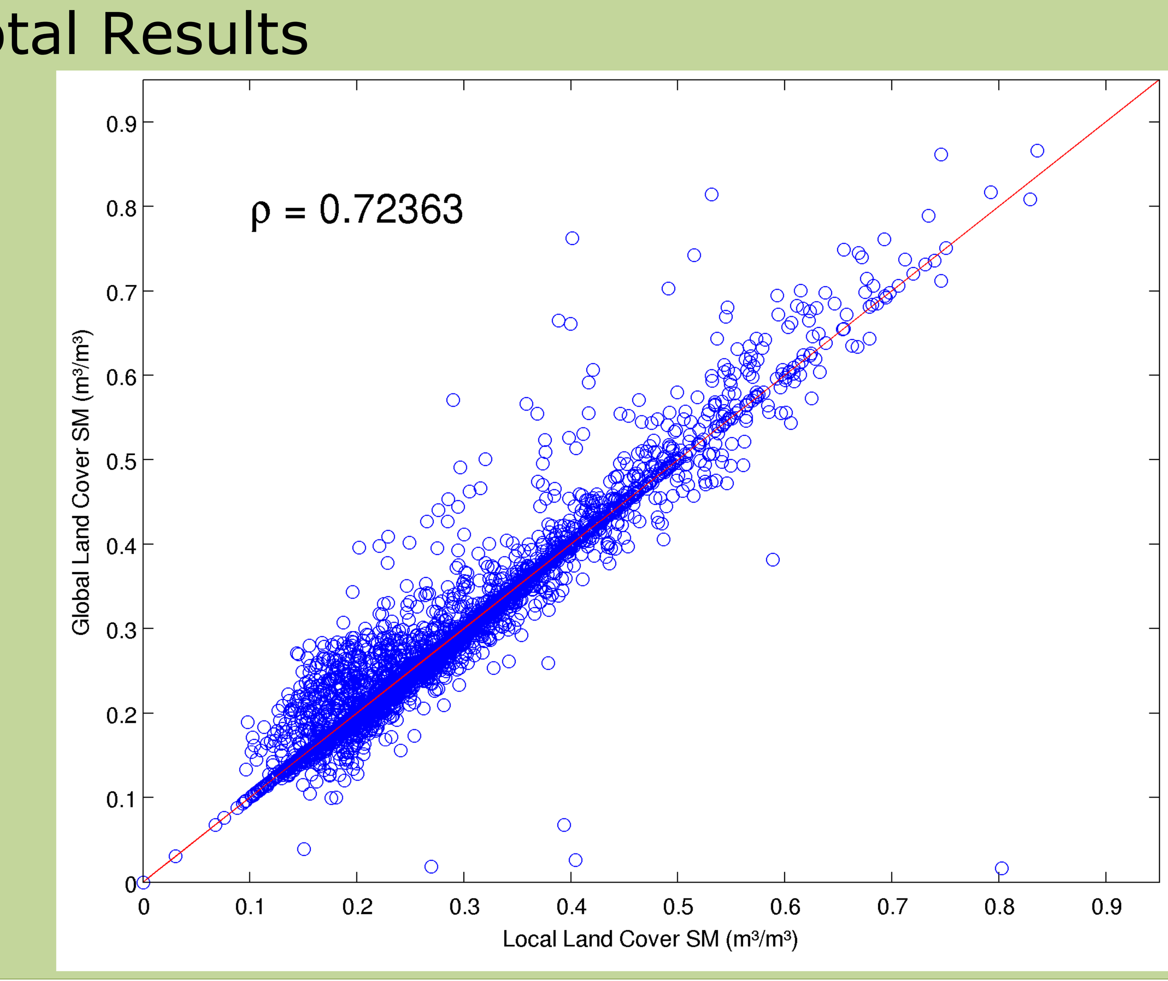


Ref: Y. H. Kerr, P. Waldteufel, P. Richaume, J. P. Wigneron, P. Ferrazzoli, A. Mahmoodi, A. Al Bitar, F. Cabot, C. Gruhier, S. E. Juglea, D. Leroux, A. Mialon, S Delwart, "The SMOS Soil Moisture Retrieval Algorithm", IEEE Trans. Geosci. Remote Sensing, vol. 50, pp. 1367-1383, 2012. Doi 10.1109/TGRS.2012.2184548

Results – Example for two passes



Total Results



Rvalue

Methodology

This approach involves the assimilation of soil moisture retrievals (θ_{RS}, SMOS L2) into a simple surface water balance model driven by satellite-based precipitation (P) products (3B42 and 3B42RT, TRMM).

$$API_i^- = \gamma \, API_{i-1}^+ + P_i$$
$$T_i^- = \gamma^2 \, T_{i-1}^+ + Q$$

Prediction

$$K_i = b \, T_i^- / (b^2 \, T_i^- + S)$$

Kalman Gain

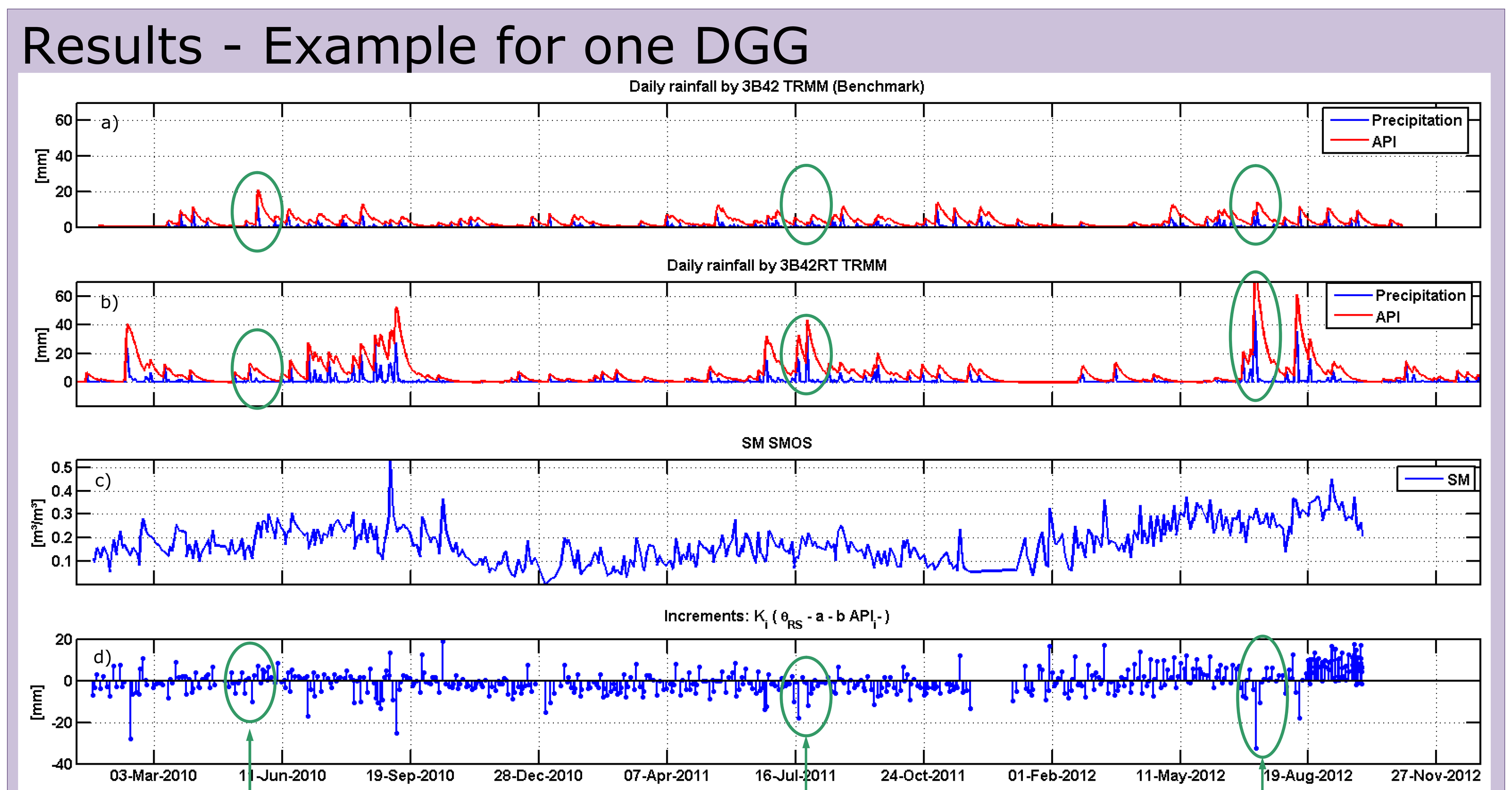
$$API_i^+ = API_i^- + K_i (\theta_{RSi} - a - b \, API_i^-)$$
$$T_i^+ = (1 - b \, K_i) \, T_i^-$$

Update

Kalman Filter

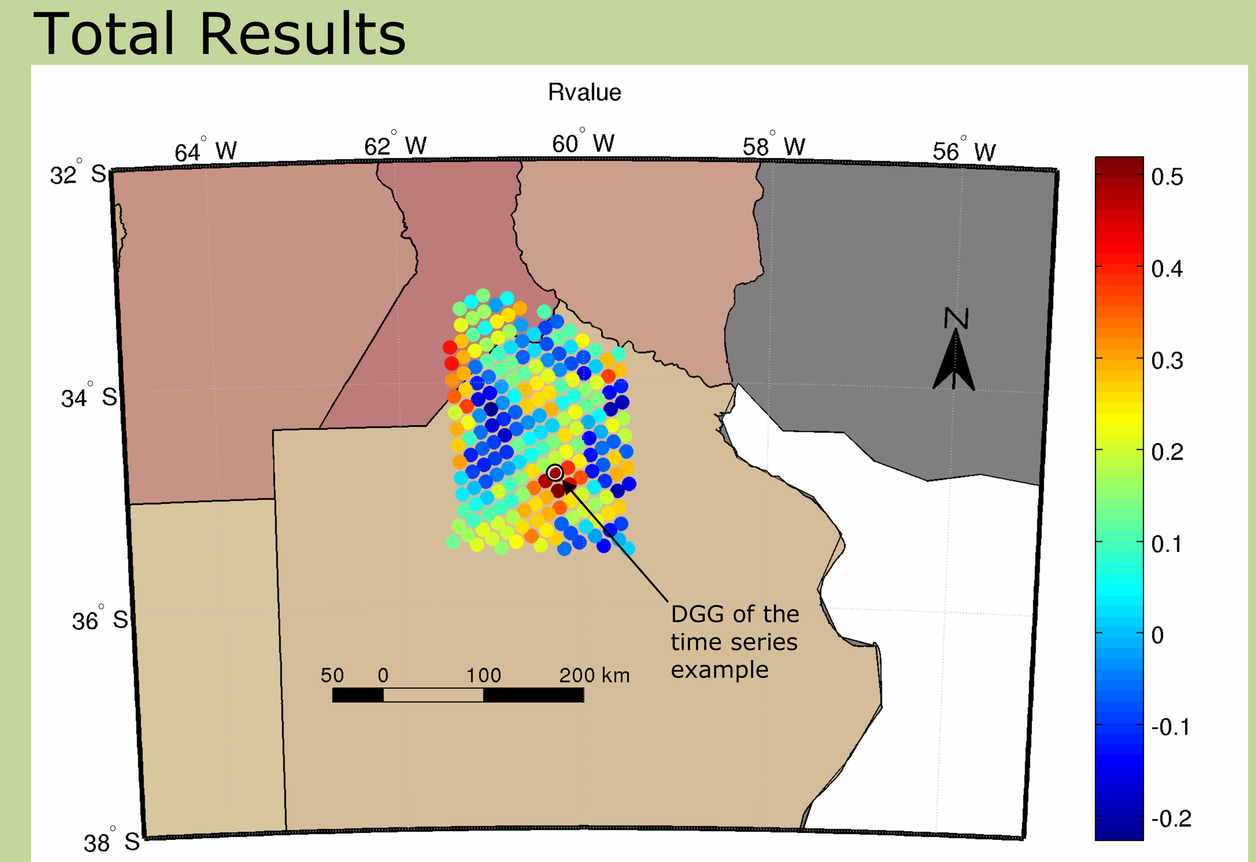
- γ loss coefficient (0.85)
- S observation variance
- Q forecast noise
- T model forecast uncertainty
- a, b, relate API_{3B42} and θ_{RS}

Results - Example for one DGG



Examples of inverse relationship between rainfall errors ($P_{3B42RT} - P_{3B42}$, Fig. a, b) and Kalman filter increments (Fig. d).

Total Results



The **Rvalue** is the **negative of the standard Pearson correlation** coefficient between the 5-day sums of **rainfall errors and filter increments** $K_i(\theta_{RSi} - a - b\,API_i^-)$ lagged by 1 day. It reflects the degree to which temporal API adjustments (made by the Kalman filter in response to uncertain θ_{RS} observations) are correlated with antecedent errors in precipitation products. Typical R_{value} magnitudes range from 0 to 0.7, where higher R_{value} are desirable.

Ref: W. T. Crow, "A Novel Method for Quantifying Value in Spaceborne Soil Moisture Retrievals", Journal of Hydrometeorology, 2007.

Final Comments

In general, low Rvalue values were obtained. This could be due to inaccuracy of the SMOS L2 soil moisture, inaccuracy of the 3B42 TRMM product used as benchmark, or the API model used. On the other hand, no significant changes in soil moisture were accomplished when changing the land cover map in the SML2PP. Therefore, it can be concluded that no significant improves are to be expected in the Rvalues of this customized soil moisture product.