H33F-0883 : Reducing structural uncertainty in AMSR2 soil moisture using a model combination approach

Seokhyeon Kim [a,*], Yi. Y. Liu [b], Fiona M. Johnson [a], Robert M. Parinussa [a, c], Ashish Sharma [a]

[a] *School of Civil and Environmental Engineering, University of New South Wales, Sydney, Australia*

[b] *ARC Centre of Excellence for Climate Systems Science & Climate Change Research Centre, University of New South Wales, Sydney, Australia*

[c] *Earth & Climate Cluster, Department of Earth Sciences, VU University Amsterdam, Amsterdam, Netherlands*

* ***seokhyeon.kim@student.unsw.edu.au***

I. Introduction

- Soil moisture is an important variable in hydrological systems
- Direct applications of remotely sensed soil moisture have been limited due to the coarse spatial resolution and uncertainties resulting from a number of complex factors that affect the radiative transfer model
- Two soil moisture products from AMSR2 observations, retrieved by the JAXA and LPRM algorithms are assessed
- *As it is found that the two products are complementary, a combinatorial approach is presented to improve the soil moisture data*

II. Data for comparisons

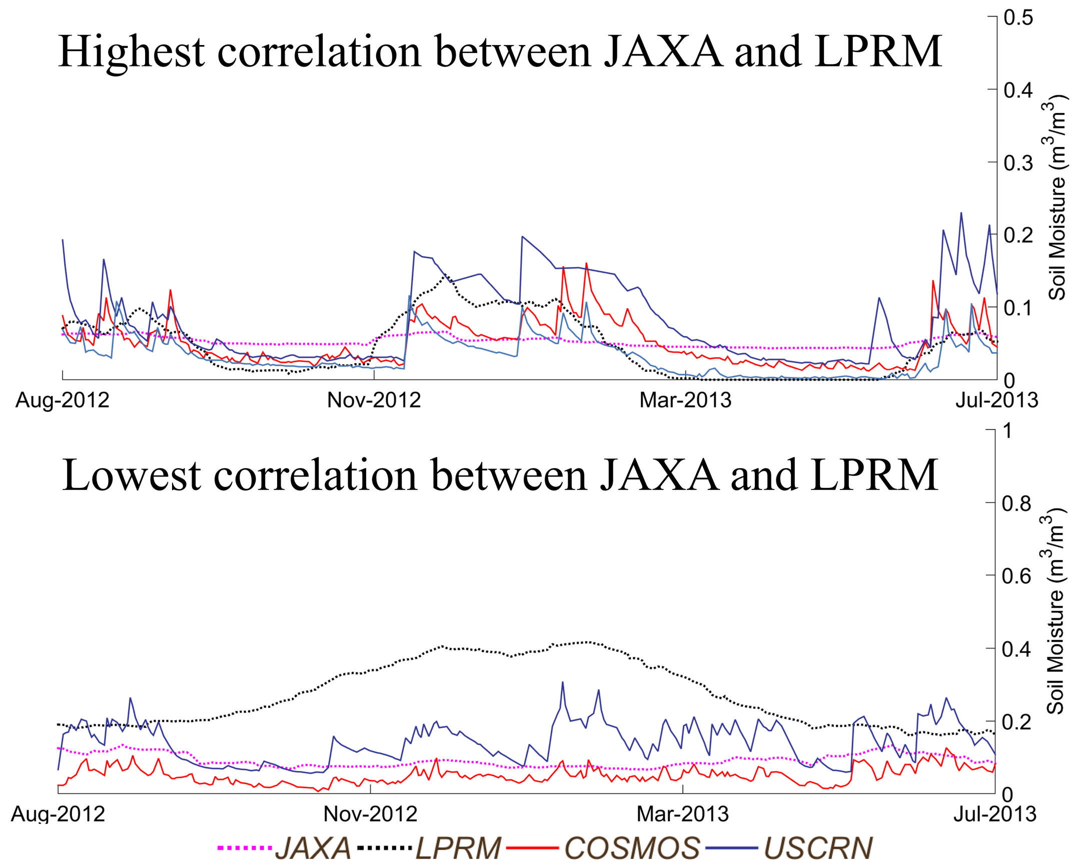

Fig. 1. Example time series of soil moisture where correlation coefficients between JAXA and LPRM product are highest (top) and lowest (bottom) among 47 COSMOS stations

Study period	01/08/2012 - 31/07/2013
Satellite soil moisture	AMSR2 - JAXA and LPRM
Ground soil moisture	47 COSMOS stations and 17 USCRN stations

References

Kim, S., Liu, Y. Y., Johnson, F. M., Parinussa, R. M., & Sharma, A. (Revised). A global comparison of alternate AMSR2 soil moisture products: Why do they differ? *Remote Sensing of Environment*.

Wasko, C., Sharma, A., & Rasmussen, P. (2013). Improved spatial prediction: A combinatorial approach. *Water Resources Research, 49*(7), 3927-3935. doi: 10.1002/wrcr.20290

III. How are JAXA and LPRM different ?

① Algorithmic differences

Parameter	JAXA	LPRM
Physical temperatures	Constant (293K)	Retrieved trough $T_{b(37GHz[V])}$
Surface roughness	Local experiments	Educated guess
Vegetation	$\tau = b \cdot W_c$ $f_c = f(NDVI)$	$\tau = f(MPDI, k, u, \omega)$
Dielectric mixing model	Dobson + Four-stream fast	Wang & Schumugge

τ: optical depth, W_c: vegetation water content, b: vegetation parameter, f_c: fractional vegetation coverage, **k**: dielectric constant, **u**: incidence angle, **ω**: single scattering albedo, **NDVI**: Normalized Difference Vegetation Index, **MPDI** : Microwave Polarization Difference Index

②Correlation coefficients between JAXA and LPRM

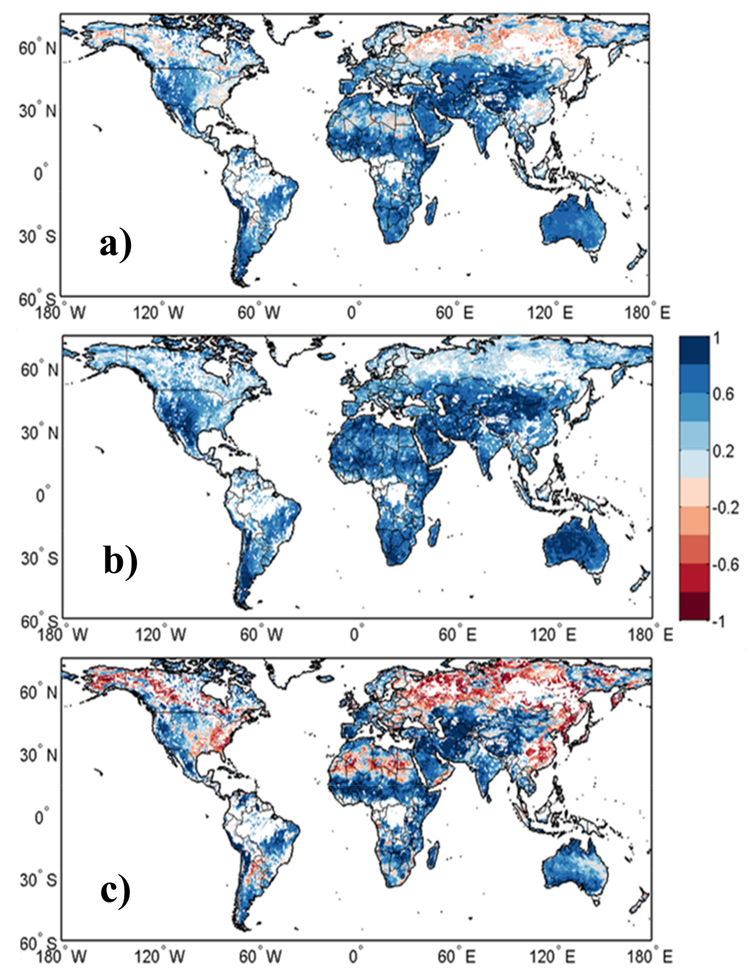

Fig. 2. Pearson R between daily JAXA and LPRM soil moisture

a) Raw: Moderately positively correlated, but low or negative correlations over several regions

b) Anomaly: Highly positively correlated, which means that both products have similar responses to rainfall events

c) Seasonal cycle: Negative values are notable over the above-mentioned regions

③ Compared to field measurements

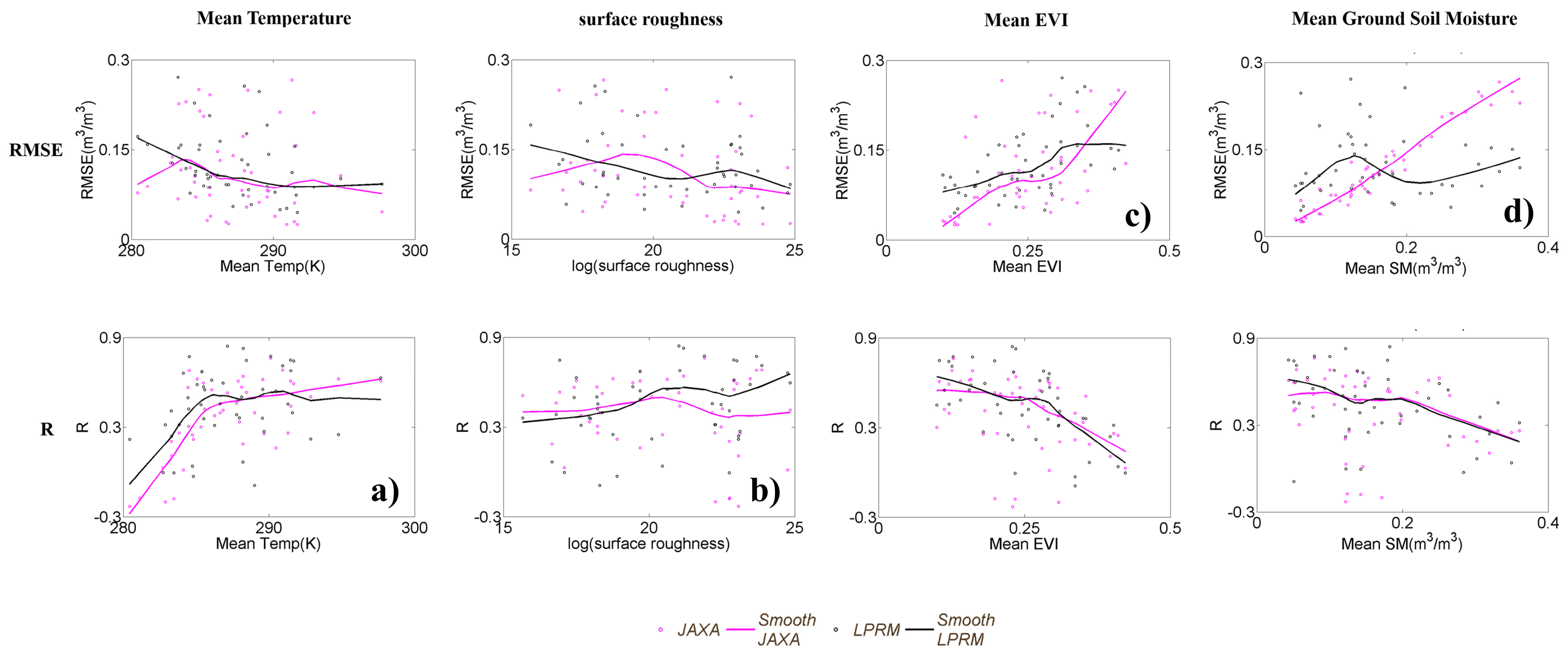

Fig. 3. Smoothed curves of RMSE and correlation coefficients between JAXA (or LPRM) and COSMOS data against mean temperature, coarse scale surface roughness, mean EVI and mean ground soil moisture

a) Correlation coefficients (R) decrease when mean temperature < 290K

b) R of **LPRM** increases with rougher surface whilst R of JAXA decreases

c) Performance of JAXA is affected under dense vegetation (mean EVI > 0.30)

d) JAXA performs better in dry condition for RMSE while **LPRM** performs better in such conditions for R

Can we improve the quality ?

IV. Combination of two AMSR2 products

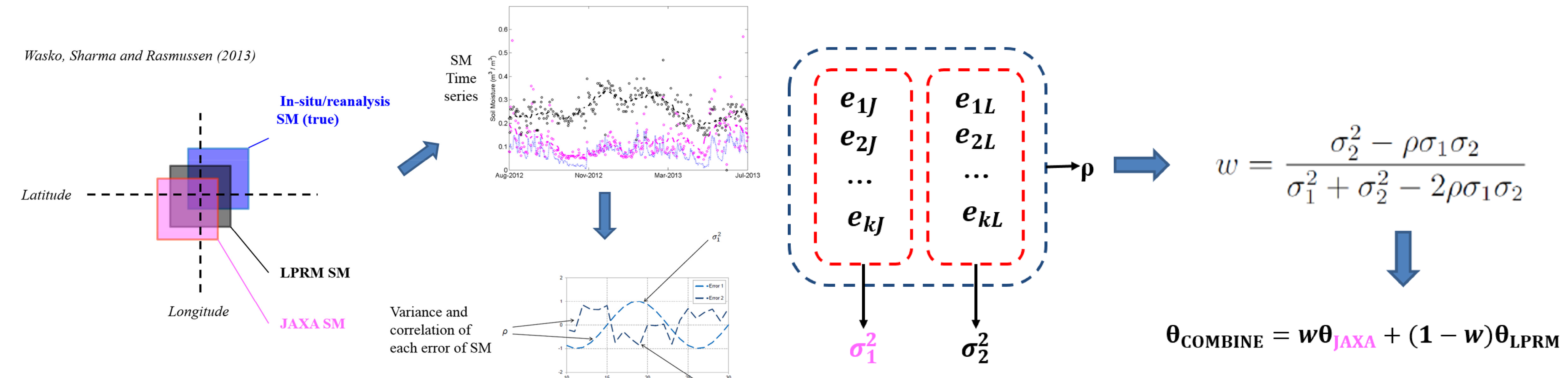

Fig. 4. Schematic concept for combining the two AMSR2 soil moisture products

- Combination by a **weighting factor *w*** minimizing the variance
- w is calculated by variances of errors (σ_1^2, σ_2^2) and error correlation (ρ) against a reference (e.g. ERA Interim)

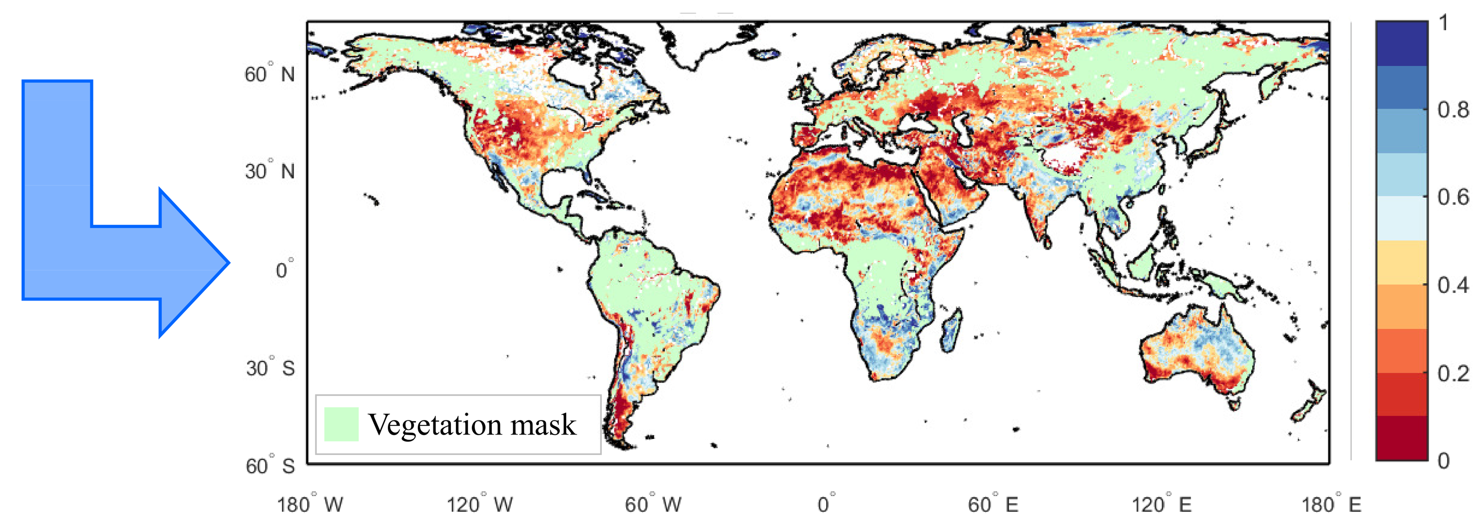

Fig. 5. Spatial distribution of weighting factor w using ERA-Interim as reference

Does it work ?