AMSR-E Soil Moisture Algorithm

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Background

- The at-launch soil moisture algorithm was based on iterative inversion of forward model using 6.9, 10.7, and 18.7 GHz V & H (6 channels) to estimate 3 parameters (soil moisture, vegetation water content (VWC), and surface temperature (LST)
  - Eliminated need for ancillary VWC and LST information by solving for these (Njoku and Li, *IEEE TGRS, 37,* 1999)
  - A variant of this approach was used later by Li for the WindSat soil moisture algorithm (Li et al., *IEEE TGRS, 48,* 2010) using 10.7, 18.7 and 37 GHz V & H (w. water vapor climatology)
- RFI encountered post-launch, and desire to maintain global algorithm, led to decision to drop 6.9 GHz channels from algorithm
  - A 4-channel algorithm could not reliably estimate LST – hence the algorithm was changed to an index-based algorithm (already coded pre-launch as a backup)
- New algorithm used 10.7 GHz polarization index, PR = $(TB_V-TB_H)/(TB_V+TB_H)$ as primary measurement observable – insensitive to LST (other indices were also proposed by other authors)
  - A regression approach used 18 GHz channels to estimate a VWC correction to $PR_{10.7}$ and estimate soil moisture; this was found to be noisy and was later modified to use external NDVI ancillary data input
- This algorithm has been used for the main duration of the AMSR-E data processing
  - Described in NSIDC DAAC on-line guide; annotated code available through NSIDC

Status

- Soil moisture data archived at NSIDC have been used in a variety of studies and publications (e.g., Reichle, et al. (2007), Crow, W. T. and X. Zhan (2007), Gruhier, C., P. de Rosnay, S. Hasenauer, et al. (2010)
- Results have shown that:
  - Soil moisture product can improve flux estimates and model predictions when assimilated in land surface models but must be renormalized (CDF-matched to model climatology)
  - $PR_{10.7}$ lacks sensitivity to soil moisture signal (coefficient can be scaled but increases noise)
  - Algorithm biased high in many regions (bias dependence on surface type not well modeled)
- A variety of alternate algorithms have been proposed and published recently using single-channel TB with NDVI-based VWC correction and LST from land surface model (LSM) or 37 GHz V channel
  - Use of ancillary LST data avoids need to use normalized indices as algorithm basis
  - The SMAP L-band soil moisture retrieval algorithm plans to incorporate near-real time LST from either ECMWF, NCEP, or GMAO model output (algorithm intercomparison in progress)
  - Based on current knowledge an updated algorithm should be implemented in the AMSR-E production stream to reprocess the AMSR-E NSIDC archived soil moisture product
  - Should be done if possible with community consensus – proposed ongoing project

Soil Moisture Product Intercomparisons

(Example, Sahel: Gruhier et al., 2010)

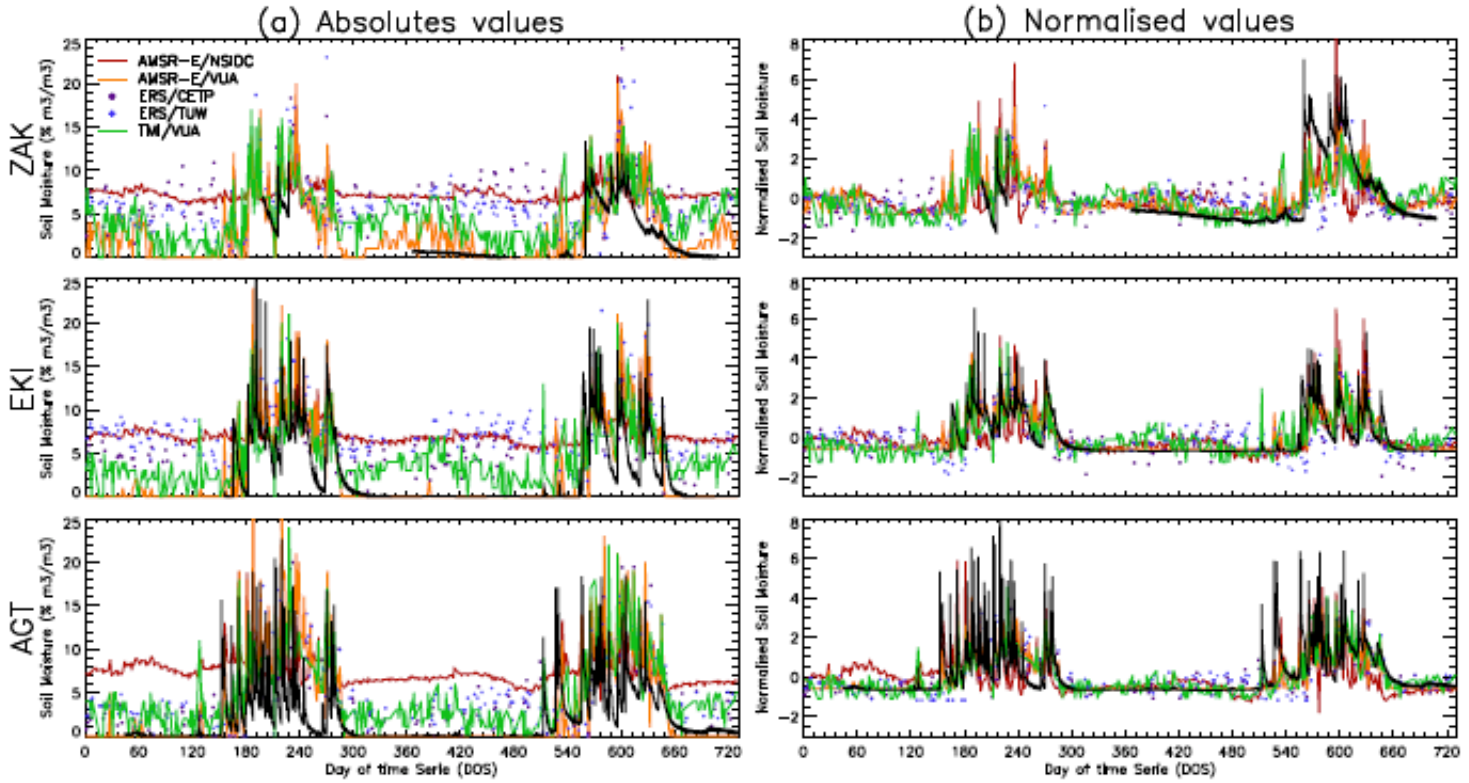

Fig. 10. Soil moisture values from all soil moisture products over the three ground stations for 2005 and 2006. The ground measurements are represented by the black line while soil moisture products are shown by color lines (ASMR-E/NSIDC, AMSR-E/VUA, TMI/VUA) and color dots (ERS/CETP, ERS/TUW).