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Hydrometeorology and Remote Sensing Laboratory The UNIVERSITY of OKLAHOMA

Working together in water, weather and climate

Bridging NASA GPM and SMAP: Variability of Surface Emissivity, In–Situ and Remote Sensing Perspectives

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Outline

Methodology

□ In-situ-measurement perspective

□ Single parameter modeling

□ Multi-parameter modeling

□ Satellite remote sensing perspective and comparison

Methodology



In-situ measurement: data

- Selected ISMN stations over representative landcover (293 stations in CONUS):
 - Abrams (northern Oklahoma) grassland (#383)
- Match ISMN station measurements with GPM & MODIS overpasses
- Coincident and collocated information:
 - ISMN 5-cm soil moisture, 5-cm soil temperature, 2m air temperature
 - GPM GMI 9-channel emissivity from level-1B product:
 - 10.65Ghz H, 10.65Ghz V, 18.7Ghz H, 18.7Ghz V, 23.8Ghz V,36.5Ghz
 H, 36.5Ghz V, 89.0Ghz H, 89.0Ghz V
 - MODIS Vegetation index
 - Normalized differential vegetation index(NDVI)
 - Enhanced vegetation index(EVI)



Conditional distribution of emissivity

Single parameter modeling





Fig 2. Empirical (left) and Modeled (right) conditional distribution of 10H emissivity with soil moisture as a single parameter

Conditional distribution of emissivity

Single parameter modeling

$$e_{10H} = f(soil\ moisture)$$
 $e_{10H} = f(air\ temperature)$
 $e_{10H} = f(soil\ temperature)$ $e_{10H} = f(NDVI)$



Conditional distribution of emissivity

Multiple parameter modeling

| Single | Тwo | Three | Five |
|--------|--------|---------|-----------|
| Mod 1 | Mod 12 | Mod 124 | Mod 12345 |
| Mod 2 | Mod 13 | Mod 134 | |
| Mod 3 | Mod 14 | Mod 125 | |
| Mod 4 | Mod 15 | Mod 135 | |
| Mod 5 | | | |

Soil moisture—1; Soil temperature—2; Air temperature—3; NDVI—4; EVI—5

How to identity the best combination of variables conditioning the emissivity? How to evaluate these different models?

Model Soil Moisture









Satellite remote sensing: data

- Five types of surface from GMI Level 2
 - Minimal vegetation (index ==7) 710
 - Low vegetation (index ==6) 3274
 - Moderate vegetation (index ==5) 34234
 - High vegetation (index == 4) 87517
 - Maximum vegetation (index ==3) 73681
- Match SMAP soil moisture with GPM & MODIS overpass
- Group all ISMN stations by GMI surface classification
- Coincident and collocated information:
 - SMAP soil moisture and GOES surface temperature
 - 9-channel emissivity from GPM GMI leve1B product:
 - 10.65Ghz H, 10.65Ghz V, 18.7Ghz H, 18.7Ghz V, 23.8Ghz V, 36.5Ghz
 H, 36.5Ghz V, 89.0Ghz H, 89.0Ghz V
 - Vegetation index from MODIS
 - Normalized differential vegetation
 - Enhanced vegetation index(EVI)

Fig 9. surface type indexes from GMI on June 10, 2015





Fig 10. Distribution of emissivity modeled as a function of soil moisture (first column), surface temperature (second column), NDVI (third column) and EVI (fourth column) at 10H GHz channel from remotely sensed data (blue profiles) and from in situ measurement (grey profiles) over maximum vegetation (top) and moderate vegetation (bottom)