A Prototype Bayesian Precipitation Retrieval Algorithm Over Land

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Background

- We have developed a prototype precipitation algorithm by considering both surface condition and precipitation vertical structure.
- Results from SSMIS (imager) based on this prototype algorithm greatly outperform the traditional single database algorithm (You et al., 2015).
- This prototype algorithm is extended to ATMS (sounder). Two major improvements are made including (1) the error associated with the precipitation estimation is calculated; (2) the prototype algorithm is applied to 60°S-60°N region, only using CONUS observations to generate databases.

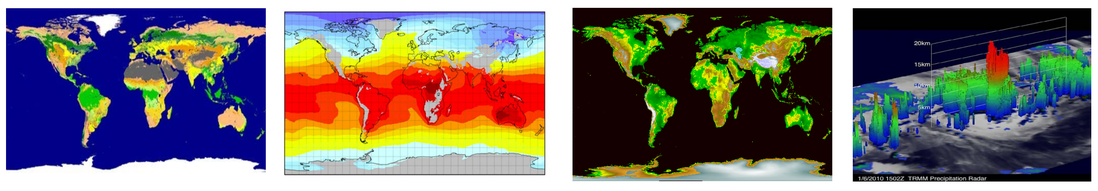
Detection and Retrieval Methods

- The Linear Discriminant Analysis (LDA) is used for precipitation (rainfall/snowfall) detection.
- The Bayesian algorithm based on the Principal Component Analysis (PCA) is employed for precipitation retrieval.
- The PCA is applied to TBs, corresponding to same surface rainrate, which guarantee that the covariance matrix is diagonal.

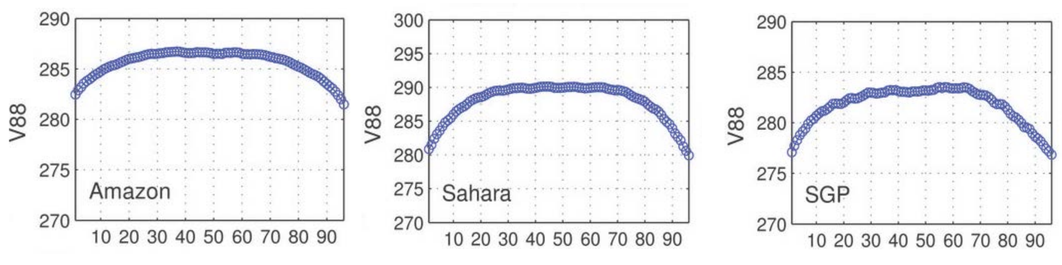
A-priori Database

- 3 years of satellite microwave radiometer observations (conical-scanned SSMIS and crossed-tracked ATMS) and ancillary data over continental US
- Quality –controlled MRMS ground radar surface precipitation rates
- Database is sub-setted with the environment (surface emissivity (ε) , surface temperature (TS)), storm characteristics (ice layer thickness) and radiometer field-of-view for the cross-tracked ATMS

TELSEM ε **TS** **Elevation** **Ice Thickness**

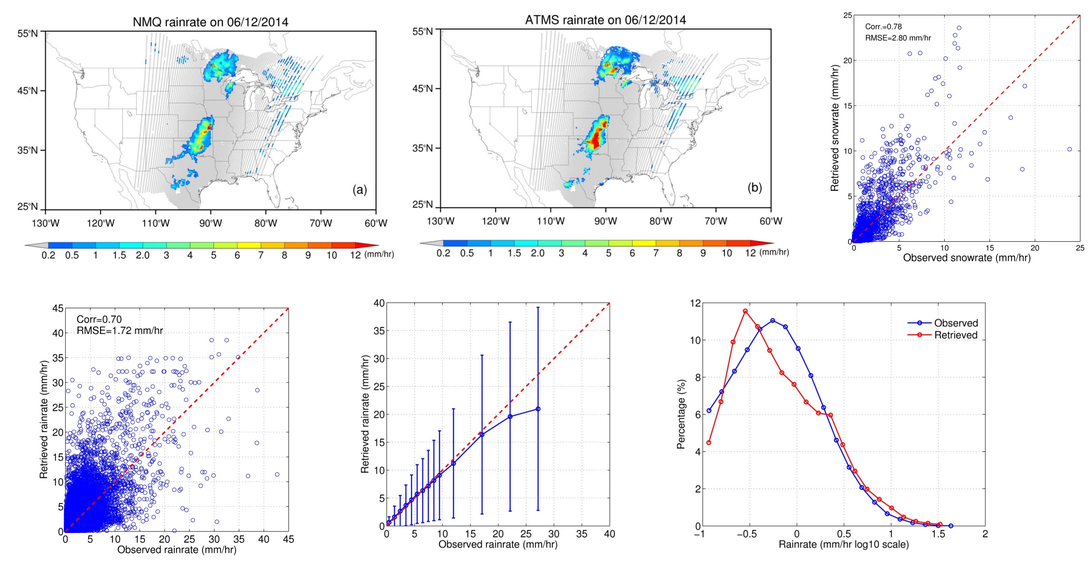


ATMS field of View: center and edge sectors along the scan line

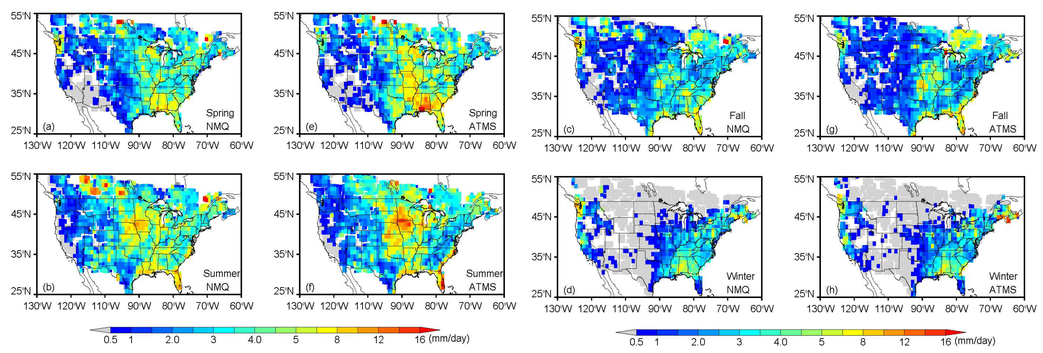


Retrieval Performance

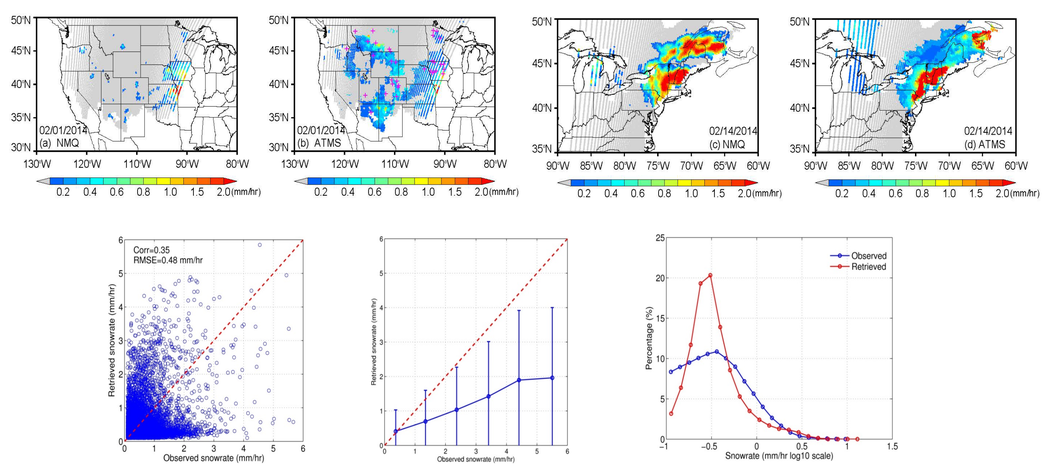
Rain case study: ATMS and MRMS radar statistical comparison



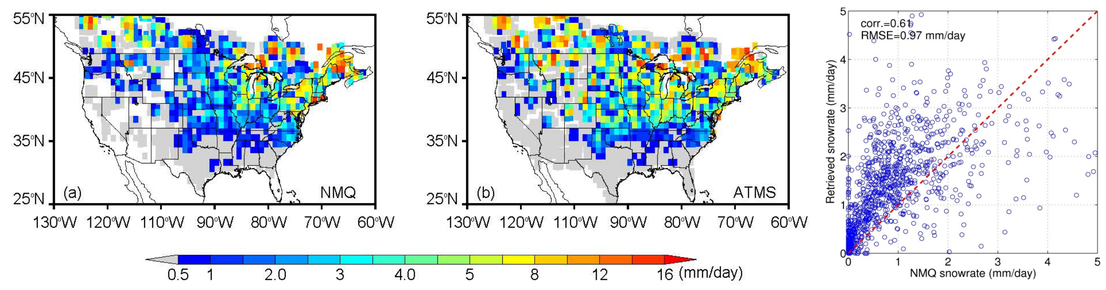
CONUS Rainfall Seasonal Variation



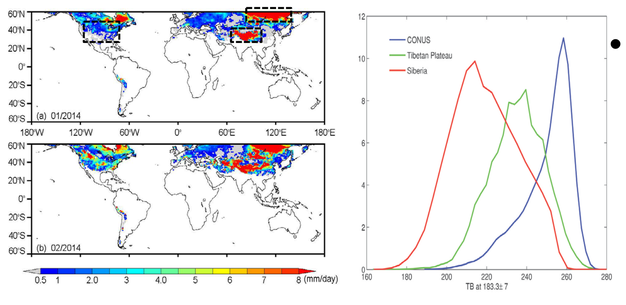
Snow case study: ATMS and MRMS radar statistical comparison



Mean Snowfall in 2014 from ATMS and MRMS radar



Snowfall Bayesian Satellite Retrieval Issus



- Over Tibetan Plateau and Siberia regions, snow is clearly overestimated. TBs are generally much lower than those in the database (from CONUS). This results in frequent false detection and large snowfall overestimation.

References

You Y., N.-Y. Wang, and R. Ferraro, 2015, A prototype Precipitation Retrieval Algorithm Over Land Using Microwave Observations Stratified by Surface Condition and Precipitation Vertical Structure, *JGR, doi:10.1002/2014JD02534.*