

Radar-enhanced passive microwave retrievals of precipitation over spatially and temporally variable land surfaces

NASA Award Number: NNX13AG49G

Year-1 Progress Report

Period covered: 5/01/2013 – 4/30/2014

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Overview

This report summarizes research conducted in the first year of a three-year grant.

The grant supports the following general research objective related to the optimal detection and estimation of precipitation over land surfaces by passive microwave radiometers:

Continue contributing toward the development and refinement of the standard algorithm for retrieving global precipitation information from the Global Precipitation Measurement (GPM) Microwave Imager (GMI) as well as the legacy Tropical Rainfall Measuring Mission (TRMM) microwave radiometer (TMI) and the Special Sensor Microwave Imager Sounder (SSM/IS).

Supported by the previous grant, we developed an empirical dimensional reduction technique that (1) improves the robustness of the solution matching algorithm and (2) greatly reduces sensitivity to extraneous geophysical noise, especially that associated with surface variability (Petty 2013, Petty and Li 2013a). Petty and Li (2013b) demonstrated that the method markedly improves TMI retrievals, relative to the previous standard TRMM rainfall product, over both ocean and land surfaces, especially problematic areas such as coastlines, deserts, and high plateaus.

The new methods serve as the basis for "surface blind" (a.k.a. S0-style) retrievals for the GMI, complementing S1- and S2-style retrievals that require more detailed information and/or models concerning surface emissivities. Some elements of the approach have already been incorporated into the standard algorithm for TMI and GMI.

Work completed

The initial focus in the first year was on working with the PMM Radiometer Team to finalize a Day One rain rate algorithm for GMI in preparation for the 27 February 2014 launch of the GPM Core Observatory. This work was based mainly on various proxy data sets provided to us by other Science Team members. These data sets included

- Model-simulated GMI microwave brightness temperatures matched to real SSMIS, AMSR-E, and CloudSat observations.
- Real SSMIS observations matched to NMQ radar analyses of the continental U.S.

Both of the above data sets proved problematic as proxies for GMI data, but the model-simulated data in particular proved completely unusable for our particular application because of an unrealistic lack of degrees of freedom in the observations. We therefore generated pre-launch algorithms based on the SSMIS-NQM matchup data.

Ongoing activities

After launch, our focus will be on quickly generating new empirical database from actual combined GMI and DPR observations and on validation over the most difficult surface

types, including snow and ice, which were not adequately represented in the TRMM data on which the original algorithm was based. Thereafter, we will undertake regional validation and calibration studies with the aim of characterizing uncertainties in the surface precipitation retrievals under various conditions.

Publications under this grant

Completed

n/a

In preparation

Petty, G.W., 2014: Unsupervised classification of multi-dimensional data based on both means and covariances. (manuscript in preparation, journal TBD)

Petty, G.W., 2014: Unsupervised classification of land surface types and temporal variability based on multichannel passive microwave emissivities. (manuscript in preparation, journal TBD)

Petty, G.W. and N. Neutkens, 2014: Improved passive microwave retrievals of rain rate over land and ocean. Part III: Application to land and coast precipitation retrievals from TMI. (manuscript in preparation, *J. Atmos. Ocean. Tech*)

References

Petty, G. W., 2013: Dimensionality reduction in Bayesian estimation algorithms. *Atmos. Meas. Tech.*, 6, 2267-2276. [Abstract](#) [Paper](#) (PDF, 2487 KB)

Petty, G. W., and K. Li, 2013: Improved Passive Microwave Retrievals of Rain Rate over Land and Ocean. Part I: Algorithm Description. *J. Atmos. Ocean. Tech.*, **30**, 2493-2508. doi: <http://dx.doi.org/10.1175/JTECH-D-12-00144.1>, [[Abstract](#)] [[Full Text](#)] [[PDF \(2220 KB\)](#)]

Petty, G.W., and K. Li, 2013: Improved passive microwave retrievals of rain rate over land and ocean. Part II: Validation and intercomparison. *J. Atmos. Ocean. Tech.*, **30**, 2509-2526. doi: <http://dx.doi.org/10.1175/JTECH-D-12-00184.1>. [[Abstract](#)] [[Full Text](#)] [[PDF \(4389 KB\)](#)]