Using Surface Classification to Improve SRT Performance Over Land

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Introduction

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- Surface Reference Technique (SRT) is the primary technique for estimating the path integrated attenuation (PIA) in moderate and heavy rainfall
- The PIA is the difference between the measured surface backscatter in the rain and the intrinsic backscatter of that location
- The intrinsic backscatter is not directly measurable; it is estimated by measuring a different, non-raining location at nearly the same time (spatial, along-track) or by measuring the same location at a different time (temporal)
- The along-track method often has difficulty over land, especially near nadir, so the temporal method is normally used
- It will take many months after GPM launch to build a global, dual-frequency surface backscatter database that can be used for the temporal reference (similar to the TRMM database)
- In this work we are investigating use of land classification to improve the performance of the along-track reference over land for use at GPM Day-1

Approach

- Assume errors are caused by using σ0 from one land-use class with a raining measurement from a different class
- Determine whether errors in SRT can be reduced by tracking reference backscatter for each class

Radar surface backscatter for IGBP land use data from USGS, based on 1 km AVHRR data – examine both APR-2 and TRMM

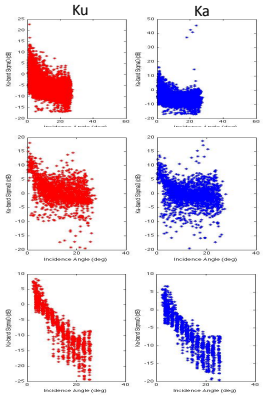
2

IGBP=International Geosphere Biosphere Program

IGBP Classes

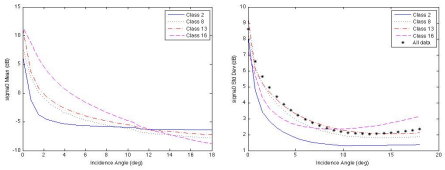
1	Evergreen Needleleaf Forest
2	Evergreen Broadleaf Forest
3	Deciduous Needleleaf Forest
4	Deciduous Broadleaf Forest
5	Mixed Forest
6	Closed Shrublands
7	Open Shrublands
8	Woody Savannas
9	Savannas
10	Grasslands
11	Permanent Wetlands
12	Croplands
13	Urban and Built-Up
14	Cropland/Natural Vegetation Mosaic
15	Snow and Ice
16	Barren or Sparsely Vegetated
17	Water Bodies

APR-2 dual-frequency airborne data

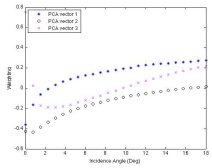


Mean and standard deviation of TRMM PR data for example IGBP classes; within-class standard deviations are typically smaller than all data combined, especially near nadir

3



- An alternative to IGBP classification is to classify using only the radar data – i.e., unsupervised classification, or clustering
- Initial feature vector is TRMM PR σ0 for each incidence angle
- Feature vector with only three components found from principal component analysis (PCA) of original feature vector



- Above - first three PCA vectors. The corresponding principal component is found as the dot product of the 25-element data vector with the PCA vector. Hence, the principal component is the sum of the 25 elements, weighted by the PCA vectors.

First three principal components explain 98% of variance - replace original 25-element vector with 3-elements

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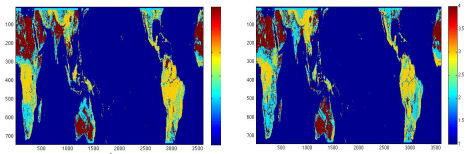
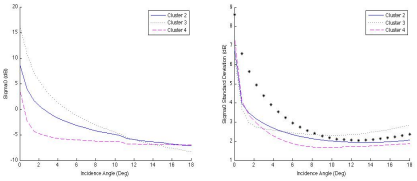
Below are the results of classifying each pixel in the TRMM database with one of three clusters found using kmeans clustering (plus ocean)



July January

- Yellow corresponds to heavily forested areas
- Red is mostly desert
- Blue is moderate vegetation

Mean and standard deviations of TRMM PR data for kmeans clusters; within-cluster standard deviations are typically smaller than total, especially at nadir



- How do we test the impact of classification or clustering of land pixels in the SRT?
- We developed a new code that maintains a 49-element reference vector for each of the kmeans clusters
- Code can be run forward or backward over a TRMM granule
- We expect that the better the SRT implementation is, the closer should be the PIAs estimated from the forward and backwards approaches - we take their difference over land as a measure of error in the SRT
- Figures below show mean and standard deviation of forward/backward difference (error) for new, class-based SRT and current, standard SRT (using 24 TRMM 2A21 granules)

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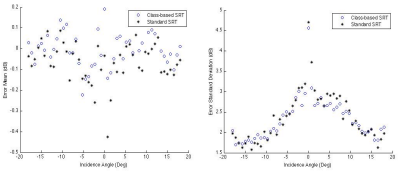

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