PRODUCING SCIENCE-READY RADAR DATASETS FOR THE RETRIEVAL OF FOREST STRUCTURE PARAMETERS FROM BACKSCATTER: CORRECTING FOR TERRAIN TOPOGRAPHY AND CHANGES IN VEGETATION REFLECTIVITY.

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Radar backscatter data contain both geometric and radiometric distortions due to underlying topography and the radar viewing geometry. Our objective is to develop a radiometric correction algorithm specific to the UAVSAR system configuration that would improve retrieval of forest structure parameters. UAVSAR is an airborne L-band radar capable of repeat-pass interferometry producing images with a spatial resolution of 5m. It is characterized by an electronically steerable antenna to compensate for aircraft attitude. Thus, the computation of viewing angles (i.e. look, incidence and projection) must include aircraft attitude angles (i.e. yaw, pitch and roll) in addition to the antenna steering angle. In this presentation, we address two components of radiometric correction: area projection and vegetation reflectivity. The first correction is applied by normalization of the radar backscatter by the local ground area illuminated by the radar beam. The second is a correction due to changes in vegetation reflectivity with viewing geometry.

Generally, the approaches to estimate area projection can be classified into homomorphic and heteromorphic methods. Homomorphic methods assume a one-to-one relationship between the slant range plane and the DEM map geometry and perform the calibration in map geometry. Heteromorphic methods assume a many-to-one relationship, and the DEM is integrated over the radar geometry, where the calibration is performed. Heteromorphic methods have been proven to be more accurate in estimating the illuminated area and are better able to model steep terrain. On the other hand, homormorphic methods are simpler and require less computational time. Due to the complexity of the viewing geometry, we merged the

concepts of the heteromorphic (e.g. facet [1,2]) with the classical homomorphic models (i.e. incidencem[3] or projection angle [4]) to estimate the projection area. To obtain the best performance, we oversampled the input Digital Elevation Model (DEM) and applied the radiometric correction in the radar geometry. We found all methods performed similarly up to illuminated areas of 350m^2. The incidence angle based correction departed significantly from other correction methods. The projection angle based estimates performed within 0.5dB of the facet model.

Radar backscatter changes significantly with viewing geometry and polarization. We derived empirical relationships between backscatter for several vegetation types (i.e. boreal, temperate and tropical) and found significant discrepancies that must be taken into account when deriving vegetation parameters. We used the empirical relationships to define a generic calibration curves as a function of viewing as well as terrain geometry. While the viewing geometry is mainly dependent upon the line of sight, the terrain geometry relates to changes in the target configuration: the relative orientation of the ground and trees. We show this approach is superior to the use of incidence angle. We also discuss and quantify the observed changes of relationship with polarization as well as forest types and estimate their impact on the estimation of forest parameters (e.g. biomass). Radiometric correction accuracy is estimated through comparison of corrected backscatter as seen from opposite directions. The research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

References:

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