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ABOVE-GROUND BIOMASS ESTIMATION USING JERS/RADARSAT SAR COMPOSITES

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Abstract:

Synthetic Aperture Radar is known to have a response that is directly related to the amount of living material with which it interacts. It is this property that our research seeks to exploit in order to better understand carbon dynamics in the Amazon. Several complicating factors include: (1) a dependency on vegetation moisture, species, and vegetation density. Moisture has a profound effect on the signal, since microwave scattering properties are largely controlled by the quantity of liquid water molecules contained in the soil and the vegetation cover. The vegetation species, or species mix, also effects the signal due to the differences in plant geometry and canopy structure. Geometry causes subtle differences in radar backscatter that can be exploited for monocultures, but in the case of the Amazon the high species diversity becomes a source of noise in the observed radar signal. Radar backscatter is proportional to vegetation density up to a saturation point that is dependent upon wavelength and polarization of the radar. Beyond this saturation point, further increases in vegetation density can, in certain cases, produce a reduction in net backscatter due to extinction of the signal within the canopy layer. This effect limits the capability of of a given radar (wavelength and polarization) to differentiate aboveground biomass levels beyond the saturation point. The saturation point can be extended somewhat through use of multifrequency and/or multipolarization data.

In this study we use multifrquency composites of L-band (JERS-1) and C-band (Radarsat) data. Radar backscatter from the undisturbed forest generally falls into this saturated region, and hence radar (at L- and C-bands) cannot be used to assess the biomass of those regions, beyond classifying it as greater than or equal to the saturation value. However, areas of regrowth can have a low enough biomass during the first 10 years of regrowth to be accurately assessed using radar. It is in this area where we expect our estimates of biomass to be most useful.

Our efforts involve obtaining appropriate pairs of radar images from a number of sites within the Amazon basin and for both (wet and dry) seasons. Given that JERS-1 and Radarsat have very different viewing geometry, these data are orthorectified using a map and elevation data of the area. Once orthorectified, the data overlay one another with sufficient accuracy to allow reasonably good calibration and incidence angle correction. Without these corrections, the terrain effects would make our analysis too noisy and inaccurate to be useful. The seasonality of the data is used to deal with the moisture sensitivity of the data, and different frequency data (L-band JERS-1 and C-band Radarsat) is used to help classify the data into several classes for use in class-specific biomass estimates.

We have chosen the following sites for our study: Manaus, Rio Branco, Tapajos, Ariquemes, and Brasilia. In order to accomplish the orthorectification step, we have obtained the highest-resolution paper maps of the areas. We have had these maps digitized, so that we have separate layers for roads, rivers, and elevation. A digital elevation map (DEM) has been generated from this data and then used as an integral part of the orthorectification process. In order to classify, as a first step to biomass estimation, we use the JERS (L-band) and RADARSAT (C-band) data at the 2 different seasons to create a 4-channel composite. We can also use several texture measures (lacunarity, entropy, etc..) to further increase the number of vectors for classification. This data is classified into simple land-cover classes (e.g. water, bare soil, short vegetation, and forest) and then biomass estimation is conducted separately for each class. In this paper we report upon progress in the classification and subsequent estimation of aboveground biomass for the study site (each approx. 200-km x 150-km in size).

Keywords: radar, biomass, Amazon, landcover