USING POLARIMETRIC INTERFEROMETRIC ALOS/PALSAR DATA TO ESTIMATE STEM VOLUME IN THE AMAZON REGION

F.G. Gonçalves[1,2], R.N. Treuhaft[2], B.D. Chapman[2], B.E. Law[1], J.R. Santos[3], L.V. Dutra[3]

[1] Department of Forest Ecosystems and Society, Oregon State University, USA

[2] Jet Propulsion Laboratory, California Institute of Technology, USA

[3] Instituto Nacional de Pesquisas Espaciais, Brazil

1. INTRODUCTION

In the Brazilian Amazon, where the forest sector plays a particularly important role in the economy [1], a better understanding of stem volume distribution is necessary to support those who manage forests for wood production during strategic planning, resource allocation and operational decisions. In addition, international agreements are underway for developing global observation systems to assess changes in forest biomass within countries, particularly tropical regions where deforestation contributes 12% of greenhouse gas emissions. It is part of the agreement on reducing deforestation and forest degradation (REDD). This requires advancing the integration of in situ observations and remote sensing techniques for operational monitoring (GEO Carbon Report 2009), which can be challenging in remote regions.

It has been suggested that L-band, high incidence angle data from airborne SAR systems can be used to estimate stem volume in the Amazon forest with RMS errors of less than 15% [2]. The approach involves fitting regression models in which stem volume is predicted by using the combined information of multiple polarimetric attributes based on both power and phase measurements. In this study, we determine whether these models are still appropriate when using polarimetric data acquired by the L-band spaceborne radar PALSAR [3]. We also use polarimetric interferometry to estimate canopy height and other structural characteristics [4,5] to determine if structural information improves PALSAR stem volume estimates.

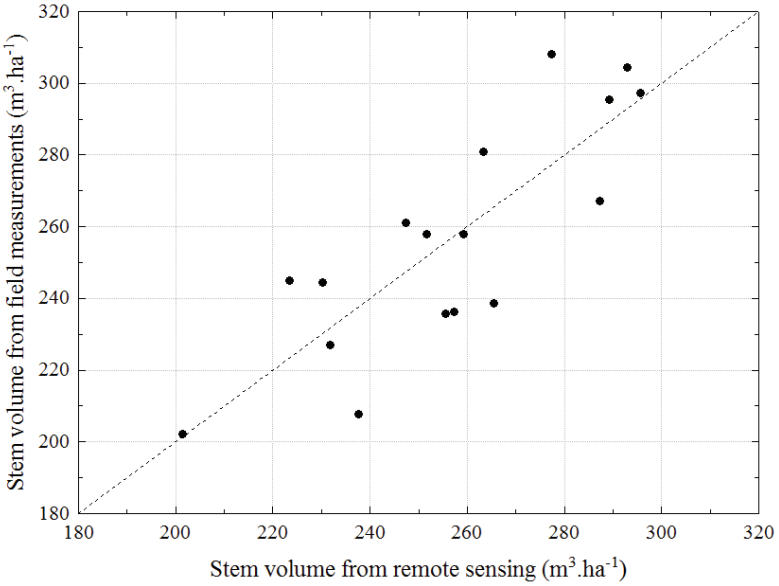

Figure 1. Scatterplot of field-measured stem volume versus remotely sensed volume in the Tapajos National Forest, PA, Brazil. Source: [2]

2. METHODS

The experiment will be conducted with repeat-track polarimetric interferometric PALSAR data taken over the Tapajós National Forest (central Amazon) in 2007. Using information from previous forest inventories, we will estimate stem volume for a number of primary, secondary, and selectively logged stands, including those shown in Figure 1. As indicated in section 1, the first objective will be achieved by regressing polarimetric attributes derived from PALSAR (e.g. backscattering coefficient, cross-polarized ratio, HH-VV phase difference, polarimetric coherence) to field-measured stem volume and then testing the predictive capacity of the resulting models with a set of independent data. In order to achieve the second objective, we will (1) develop InSAR processing approaches needed to extract phase and coherence in the presence of temporal decorrelation, (2) estimate structural moments (e.g. height, standard deviation) from single- and few-baseline PALSAR data and compare to existing field measurements, and (3) include the structural moments in the stem volume regression analysis to determine whether they improve the performance of the models.

3. EXPECTED RESULTS

Because of its lower spatial resolution (~10x), the polarimetric PALSAR data will likely produce less accurate stem volume estimates than those achieved with airborne data. Nevertheless, this effect may be

offset by the inclusion of interferometric measurements in the modeling process. It is important to note that PALSAR interferometry is acquired with a repeat time of 46 days. Therefore, an important outcome of this study will be an assessment of temporal decorrelation effects on the extraction of structural parameters [6]. We focus on spaceborne data because they provide virtually the only means of monitoring forest ecosystems at regional and global scales.

4. REFERENCES

[1] LENTINI, M., D. PEREIRA, D. CELENTANO, and R. PEREIRA, *Fatos florestais da Amazônia 2005*, Imazon, Belém, 2005.

[2] F. G. GONÇALVES, J. R. SANTOS, and R. N. TREUHAFT, "Stem volume of tropical forests from polarimetric radar," *International Journal of Remote Sensing*, in press.

[3] M. SHIMADA, "SAR programmes in JAXA: from JERS-1 to the future," *IEE Proceedings Radar, Sonar, and Navigation*, vol. 153, pp. 122–128, 2006.

[4] R. N. TREUHAFT and P. R. SIQUEIRA, "Vertical structure of vegetated land surfaces from interferometric and polarimetric radar," *Radio Science*, vol. 35, pp. 141–177, 2000.

[5] K. P. PAPATHANASSIOU and S. R. CLOUDE, "Single-baseline polarimetric SAR interferometry," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 39, pp. 2352–2362, 2001.

[6] K. P. PAPATHANASSIOU and S. R. CLOUDE, The effect of temporal decorrelation on the inversion of forest parameters from Pol-InSAR data, *Proceedings of IGARSS 2003*, pp. 1429–1431, 2003.