TROPICAL-FOREST STRUCTURE AND ITS RELATION TO BIOMASS ESTIMATION FROM L-BAND REPEAT-TRACK INTERFEROMETRIC SAR AND LIDAR

R. N. Treuhaft[1], F. G. Gonçalves[1], B. D. Chapman[1], J. B. Drake[2], J. R. dos Santos[3], L. V. Dutra[3], P. M. L. A. Graça[4], G. H. Purcell[1]

[1]Jet Propulsion Laboratory, California Institute of Technology

[2]USDA Forest Service

[3]Instituto Nacional de Pesquisas Espaciais

[4]Instituto Nacional de Pesquisas da Amazonia

1. INTRODUCTION

Tropical forests contain approximately 60% of the Earth's aboveground forested biomass. They represent a particularly challenging target for structural remote sensing. Proposed and existing spaceborne sensors will make repeat-track polarimetric interferometric SAR (PolInSAR) measurements at L-band. Lidar is currently available in space and is also proposed as a future spaceborne option. This study addresses the accuracy of vertical-structure parameters estimated from L-band, repeat-track polarimetric interferometric SAR (PolInSAR) and lidar data taken over La Selva Biological Station in Costa Rica. The PolInSAR data were acquired with AirSAR in 2004 and the lidar with LVIS [1] in 2005. This paper 1) will present the repeat-track L-band PolInSAR and lidar data over La Selva's tropical wet forests, estimating various height and profile characteristics from the PolInSAR and lidar and 2) will show the utility of other, higher spatial frequency characteristics of the vegetation profiles besides height for estimating forest biomass.

2. ESTIMATING FOREST HEIGHT AND PROFILE CHARACTERISTICS

Using a random-volume-over-ground model [2,3], we will estimate total vegetation height at La Selva, assuming a uniform vegetation distribution. This involves using polarimetric signatures to isolate and remove effects from ground returns. Passes with small temporal decorrelation will be examined first. Next, a volume-temporal-decorrelation parameter will be introduced to try to estimate and remove the effects of motion of the scene between passes [4]. This approach will assume that the ground characteristics do not change between radar passes. We will also estimate a mean vegetation height, weighted by the strength of the radar returns, including the ground return, by using the phase of fixed-baseline L-band nonpolarimetric interferometric SAR (InSAR) data with much smaller baselines than those in Figure 1. In order to estimate this latter mean height, we note that height can be expressed in terms of very low vertical Fourier frequencies, or high vertical scales/short baselines as in Figure 1.

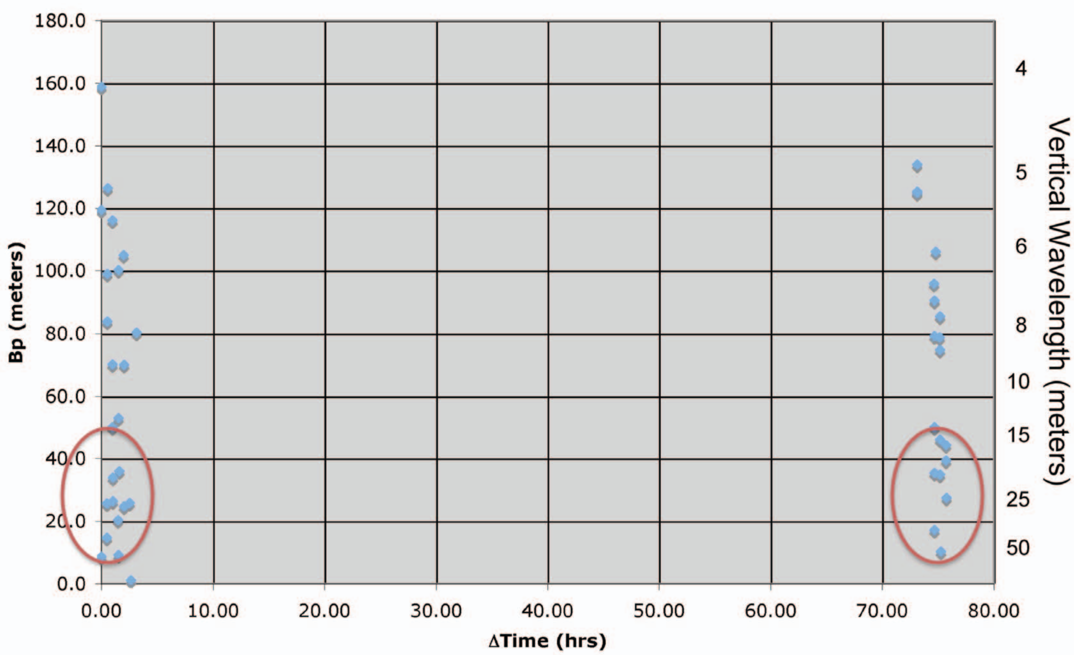

Figure 1: *Baseline lengths and corresponding vertical wavelengths for AirSAR at L-band at La Selva Biological Station, Costa Rica, versus time between flights for repeat-track PolInSAR data. Red ovals show vertical wavelengths most useful for biomass estimation at C-band.*

3. L-BAND POLINSAR VERTICAL WAVELENGTHS AND BIOMASS ESTIMATION

It has recently been shown that at C-band, InSAR, lidar, and field measurements produce good agreement for the bulk, low-frequency (means, standard deviations) components of profiles [5]. It has also been shown that for lidar, and InSAR at C-band for this data set, higher biomass estimation accuracy is obtained using higher vertical frequencies, with vertical wavelengths between 15 and 50 m [6]. These wavelengths and the corresponding baseline lengths at L-band for AirSAR are indicated by red circles in Figure 1, for short and long intervals between passes. This study will examine the performance of L-band biomass estimation at a range of vertical frequencies from the PolInSAR to determine if the optimal spatial frequencies are the same as those of C-band. Each baseline of PolInSAR, once the effects of the ground have been removed, constitutes a volume Fourier transform in the vertical direction. A central conclusion of this work will be to find the best vertical spatial frequencies for biomass estimation by using a few baselines from Figure 1, and to evaluate the degree to which temporal decorrelation inhibits biomass estimation for repeat-track PolInSAR. We will repeat the above exercise leaving ground return effects in the PolInSAR coherence. The reason for this is to duplicate what has been done before with lidar heights, in which ground returns have not been removed for biomass estimation (e.g. [7]).

4. REFERENCES

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