

# ASSESSMENT ON THE IMPROVEMENT OF THE LAND USE/LAND COVER CLASSIFICATION IN AMAZON USING ALOS PALSAR POLARIMETRIC DATA

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## 1. INTRODUCTION

The importance of Microwave Remote Sensing for tropical forest monitoring is well known. The new generation of orbital SAR platforms is capable of delivering several types of polarimetric products, but the full polarimetric mode is of restricted use because of operational limitations. This investigation is focused on determining how much the use of full polarized (HH, VV and HV, no phase information) PALSAR data information can improve, or not, the overall classification accuracy in comparison with the standard products, which for Palsar instrument is the HH (like JERS-1) or the dual polarization product HH-HV. Particular attention is given to the discrimination capability of perceiving land cover alterations of great importance on tropical environment monitoring, like recent deforestation, degraded forest and regeneration, as a function of the channels set used. Several types of supervised classifiers are tested for having, as much as possible, an assessment rather independent of the classifier type. The classification results improvements are statistically tested for significance. Results showed that HH-HV combination has discriminatory power significantly better than using any only one channel, but classification accuracy, using this particular combination, is not significantly better than using all 3 channels, HH, VV and HV. Phase influence is not taken in account in this study yet.

The study area, Tapajós National Forest at the south of Santarém City, in the Brazilian Amazon, Pará State, has being object of intensive scientific observation for more than 15 years.

## 2. MATERIAL AND METHODS

### 2.1. Materials

The Tapajós National Forest (FLONA), is located at the south of Santarém City, in the Brazilian Amazon, Pará State. An ALOS/Palsar polarimetric (PLR) scene (level 1.5), from October 21, 2006, was obtained via the User Remote Sensing Access (URSA) from the Alaska Satellite Facility (ASF). Field work was conducted to collect ground data on October 2005, during a L Band polarimetric airborne mission executed with the Brazilian SIVAM R99 sensor system. The mission was planned for acquiring scenes used for the simulation of the proposed German-Brazilian L-band orbital system MAPSAR. Field data was updated to reflect one year difference by visual interpretation of very clear Landsat scenes acquired on August,21, 2006 and other local eye witness reports.

### 2.2. Methods

The following classifiers have been used in the investigation: the standard maximum likelihood (ML) classifier with equal *a priori*s (only for the three channels case) and a special case of the ML classifier, considering proper distributions for SAR data, for the two polarimetric channels case. The Support Vector Machine classifier (SVM) with Radial Basis Functions Kernel, was selected as the deterministic pixel based classifier representative. Two versions of supervised region based classifiers (segmentation method) were also tested.

For all cases, the standard Gamma speckle filtering method was applied to the radar data in the intensity (power) format (5x5 window) for comparing the results with/without filtering. Also, for all possibilities of two-channel combination cases, the ML classifier considering the SAR data distribution as a special case of the Wishart Distribution, as developed by Lee et al [1], was employed to favor the best modeling construction for pixel based statistical classification.

Region based classification is executed in two phases: firstly, homogenous regions by some criteria are identified into the imagery. Secondly these regions are classified as a whole to one of the known (training) classes. Two different segmentation strategies has been applied: SegSar (acronym: SS) [2][3], which is a specialized radar hierarchical segmentation strategy, where “region growing” is used in the highest compression level and the “split and merge” technique is used in the intermediate levels. Also a border refinement algorithm is applied to each level, before the “split and merge” procedure application, to enhance the region frontier resolution. A standard segmentation methodology available in SPRING system [4] (acronym: SP) was also tested. After the segmentation phase, the Bhattacharyya Distance (BD) [5] which is a measure of statistical distance between Probability Density Distributions (PDF) was used to associate the region with unknown label to one of the training classes having the minimum BD between them.

### 3. RESULTS AND CONCLUSIONS

The set of classes used in this assessment is composed by primary forest, secondary forest, bare soil, agriculture and degraded forest. The best result was obtained using the Region Based Classification approach with the SS segmentation phase and for HH-HV channel combination with 96.7 overall accuracy over training samples. It was possible to observe that SS with no speckle reduction had better performance than with filtering in 2 cases, which maybe explained by the fact that SS is tailored to take in account radar statistics behavior more effectively. Region classification using first a standard segmentation (SP) procedure has showed better performance with filtering than with no filtering which is normally expected. In general, however radar tailored segmentation presented better results than standard segmentation approach which was found statistically different at significance level of 95% in almost all cases. Also, in general, HH-HV channels lead to a better classification, including for degraded forest discrimination from regeneration and primary forest which have special importance in several ecological studies. The best *pixel based* classification was obtained using standard ML classification for the case with the three (3) speckled filtered channels with 91.7 overall accuracy. One year regeneration, which was known existing in this area, was not observed in any PALSAR combination, but still showed in a standard Landsat color composite obtained almost simultaneously with the Palsar scene, which indicates the utility of maintaining the complementary use of optical images when possible.

Initial results indicate that, no phase considered, the dual polarizarition product HH-HV is the better combination for general mapping of the rain forest problem composed by the primary forest, secondary forest, bare soil, agriculture and degraded forest. Region based classification, particularly the one developed to take in account as much as possible the radar statistical behavior, performed better in this experiment. Many more studies are necessary to advance this research to take in account the polarimetric phase information, the scattering mechanisms, more suited classifiers, including the contextual ones, more detailed assessment procedures, etc.

### 4. REFERENCES

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