VALIDATION OF FORESTED INUNDATION EXTENT REVEALED BY L-BAND POLARIMETRIC AND INTERFEROMETRIC SAR DATA

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STATEMENT OF THE PROBLEM

UAVSAR, NASA's airborne Synthetic Aperture Radar (SAR), conducted an extended observational campaign in Central and South America in March 2013, primarily related to volcanic deformations along the Andean Mountain Range but also including a large number of flights studying other scientific phenomena. During this campaign, the L-band SAR collected data over the Napo River in Ecuador. The objectives of this experiment were to acquire polarimetric and interferometric L-band SAR data over an inundated tropical forest in Ecuador simultaneously with on-the-ground field work ascertaining the extent of inundation, and to then derive from this data a quantitative estimate for the error in the SAR-derived inundation extent.

In this paper, we will first describe the processing and preliminary analysis of the SAR data. The polarimetric SAR data will be classified by land cover and inundation state. The interferometric SAR data will be used to identify those areas where change in inundation extent occurred, and to measure the change in water level between two observations separated by a week.

Second, we will describe the collection of the field estimates of inundation, and have preliminary comparisons of inundation extent measured in the field field versus that estimated from the SAR data.

METHODOLOGY

UAVSAR imaged the Napo River according to the flight plan shown in figure 1. The two flight lines were acquired twice, about 1 week apart.

The polarimetric data from these two data sets may be used to estimate flooding extent [1]. The water level of the Napo River is highly variable in the March time frame, changing by up to 2-3 meters in a few hours. Depending on the magnitude of the floods, the wetlands directly linked to

the river can flood rapidly. We expect to see these differences in wetland extent in the polarimetric imagery. Therefore, we may estimate both the total inundation extent and the change in inundation between the two observation dates.

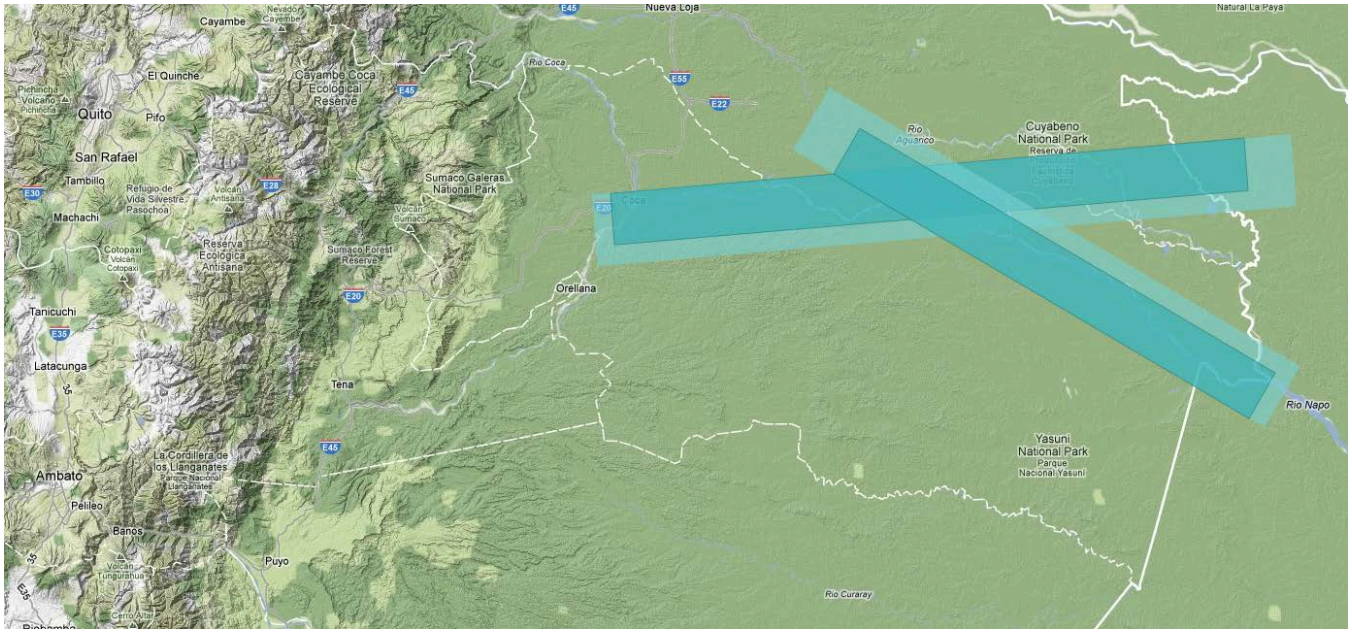

Figure 1: UAVSAR flight plan for imaging the Napo River in Ecuador, March 2013.

The repeat-pass INSAR imagery should also be quite sensitive to the change in inundation extent. In addition, we will be able to directly measure the change in water level [2]. These changes in water level should be directly relatable to the polarimetrically-derived estimates of inundation extent.

On the ground, we measured the extent and depth of inundation along transects that run close to floodplain study sites. Additionally, we collected information on the structure of the vegetation and the topography along these transects, retrieved/re-deployed some existing water level loggers, and collected water samples to confirm the source of inundation. Along these transects we will compare the field measurements of inundation extent and change in inundation with the SAR-derived estimates of inundation and change in inundation.

CONCLUSIONS

The UAVSAR deployment to South America in March 2013 has allowed us to better understand the uncertainty in measuring inundation extent from polarimetric and interferometric SAR data. This is relevant to our NASA funded task to develop an Earth Science Data Record for inundated wetlands. We plan to use this information to quantify the accuracy of ALOS PALSAR derived inundation extent.

ACKNOWLEDGEMENTS

This paper was partially written at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

REFERENCES

[1] Hess, L. L., Melack, J. M., Filoso, S., & Wang, Y. (1995). Delineation of inundated area and vegetation along the Amazon floodplain with the SIR-C synthetic aperture radar. IEEE Transactions on Geoscience and Remote Sensing, 33, 896–904.

[2] Alsdorf,D.E., J. Melack, T. Dunne, L.A.K. Mertes, L.L. Hess, and L.C. Smith, "Interferometric Radar Measurements of Water Level Changes on the Amazon Flood Plain." *Nature*, Vol. 404, Pgs.174-177, 2000.

[3] Celi, Jorge and Steve Hamilton, "Ecological implications of erratic floods in large river floodplains of the Andean Amazon region", 9th Intecol International Wetlands Conference, Orlando, Florida, June, 2012.