Characterization of Tropical Wetlands Ecosystems in Peru

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Introduction

Tropical palm swamp wetland ecosystems form in tropical rainforests with moderate seasonal flooding and consistent surface inundation. The combination of permanently saturated soils, year-round warm temperatures, and low oxygen levels in the palm swamp soils can lead to a large release of carbon into the atmosphere, particularly as methane (CH_4) gas. Methane has a warming potential as a greenhouse gas that is 23 times higher than that of CO_2. However, little is known concerning the contribution of carbon emissions from palm swamps, and scarce information exists about the location and expanse of these ecosystems.

In this project, we have built on previous works to map the palm swamps of the Pacaya-Samiria National Reserve in Peru using high-resolution NASA UAVSAR airborne imaging radar data to map these important biomes. We present a GIS analysis comparing the radar data with georeferenced and digitized land-cover field maps and assess the agreement of vegetation cover.

Materials and Methods

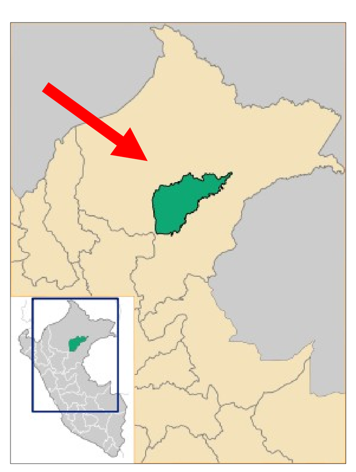


Fig. 1. Pacaya Samiria National Reserve, Peru

Study Area: Pacaya Samiria National Reserve

- Most extensive tropical flooded forest in the Peruvian Amazon
- Spans more than 20,000 km²
- Rich in biodiversity
- Home to palm swamp wetlands, but extent and location not well known

UAVSAR Imaging Radar

- The Uninhabited Aerial Vehicle Synthetic Aperture Radar is a NASA commissioned L-band Synthetic Aperture Radar (SAR) polarimetric instrument mounted on a precision automated Gulfstream-III plane
- The radar is able to transmit and receive vertical (V) and horizontal (H) polarizations which result in the three combinations: HH, HV, VV
- 7 swaths collected on Mar. 17, 2013 over the study area were geocoded, corrected for local incidence angle, and mosaicked at 15m spatial resolution

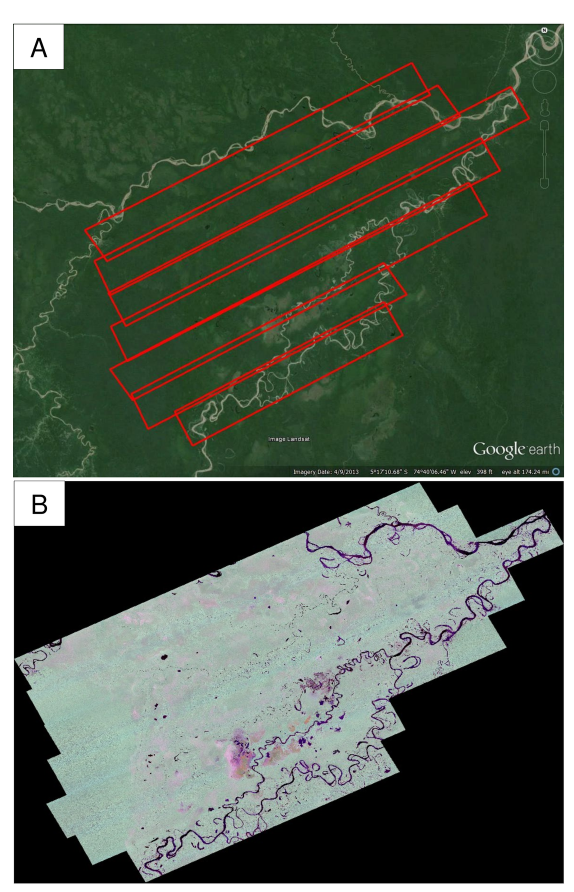


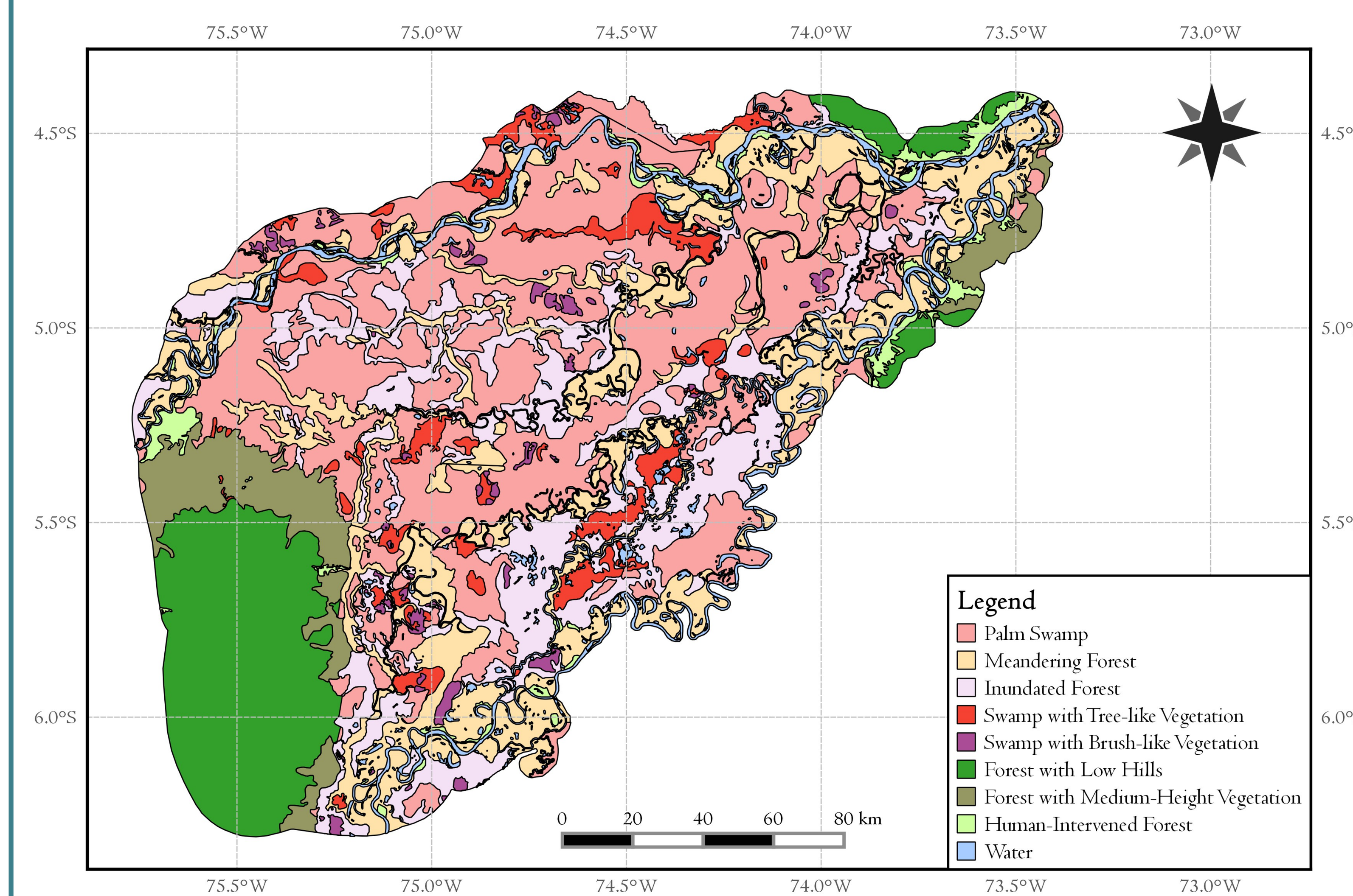
Fig. 2. (A) 7 crosstrack flight paths over the Pacaya Samiria, (B) RGB composite of radar backscatter mosaic, R: HH, G: HV, B: VV,

GIS Analysis

- Two vegetation maps derived from two separate field studies were georeferenced and digitized
- Zonal statistics were aggregated and calculated for all overlapping features and land cover classes

Results

Digitized Vegetation Maps



Radar Statistics

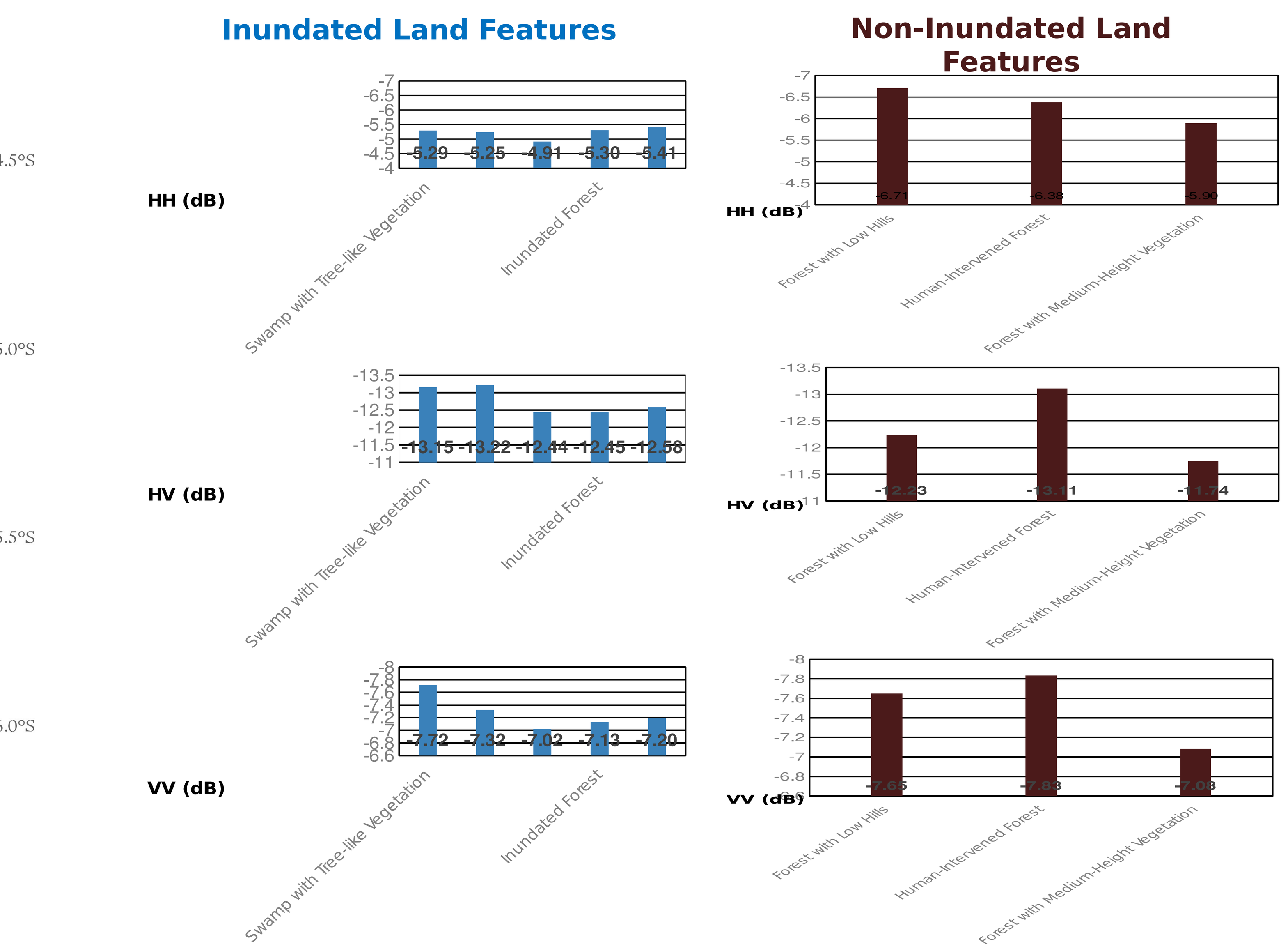
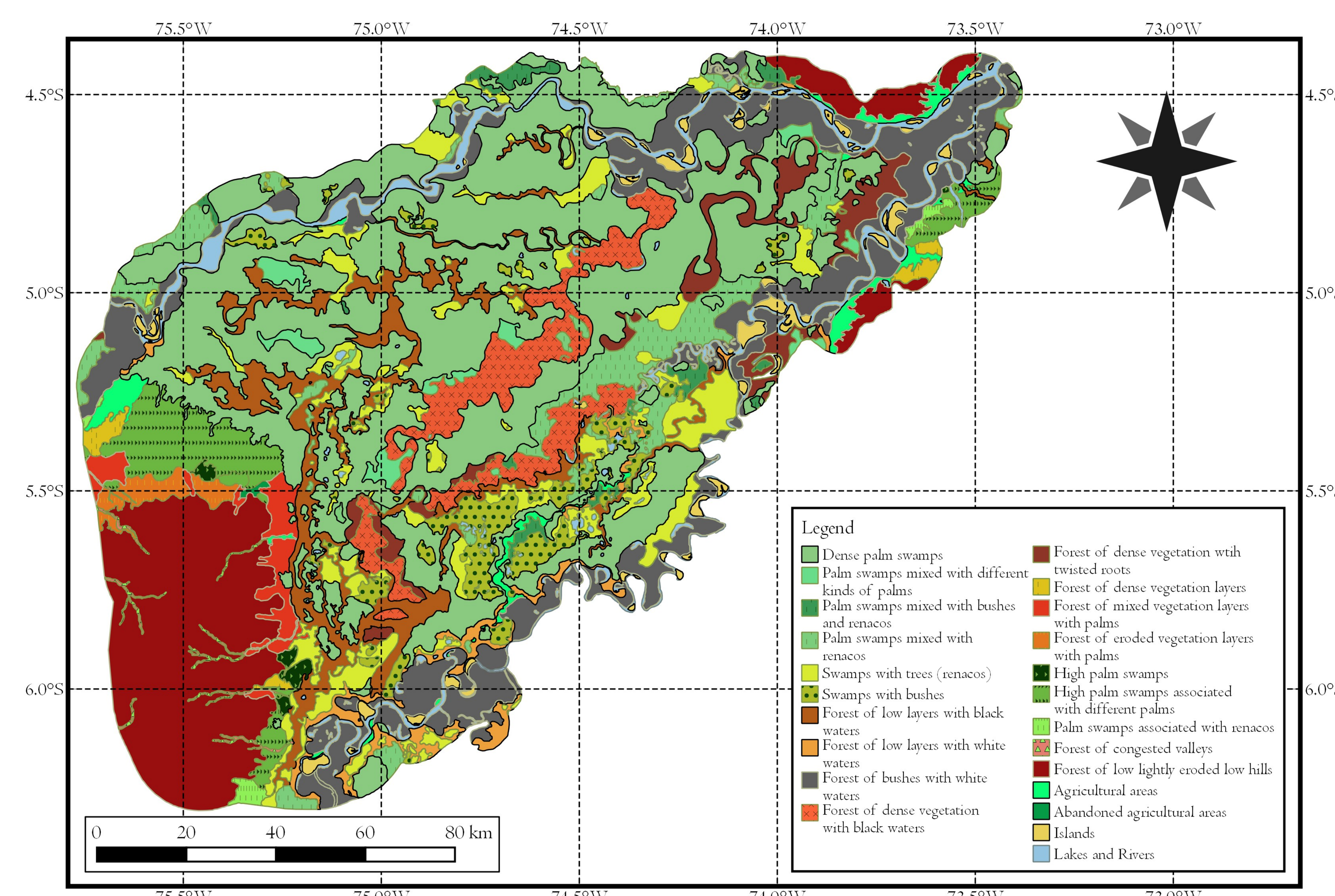


Fig. 3. Digitized vegetation map #1, derived from field studies and aerial photographs, and corresponding mean radar backscatter values for inundated vs. non-inundated land cover types, for each polarization.



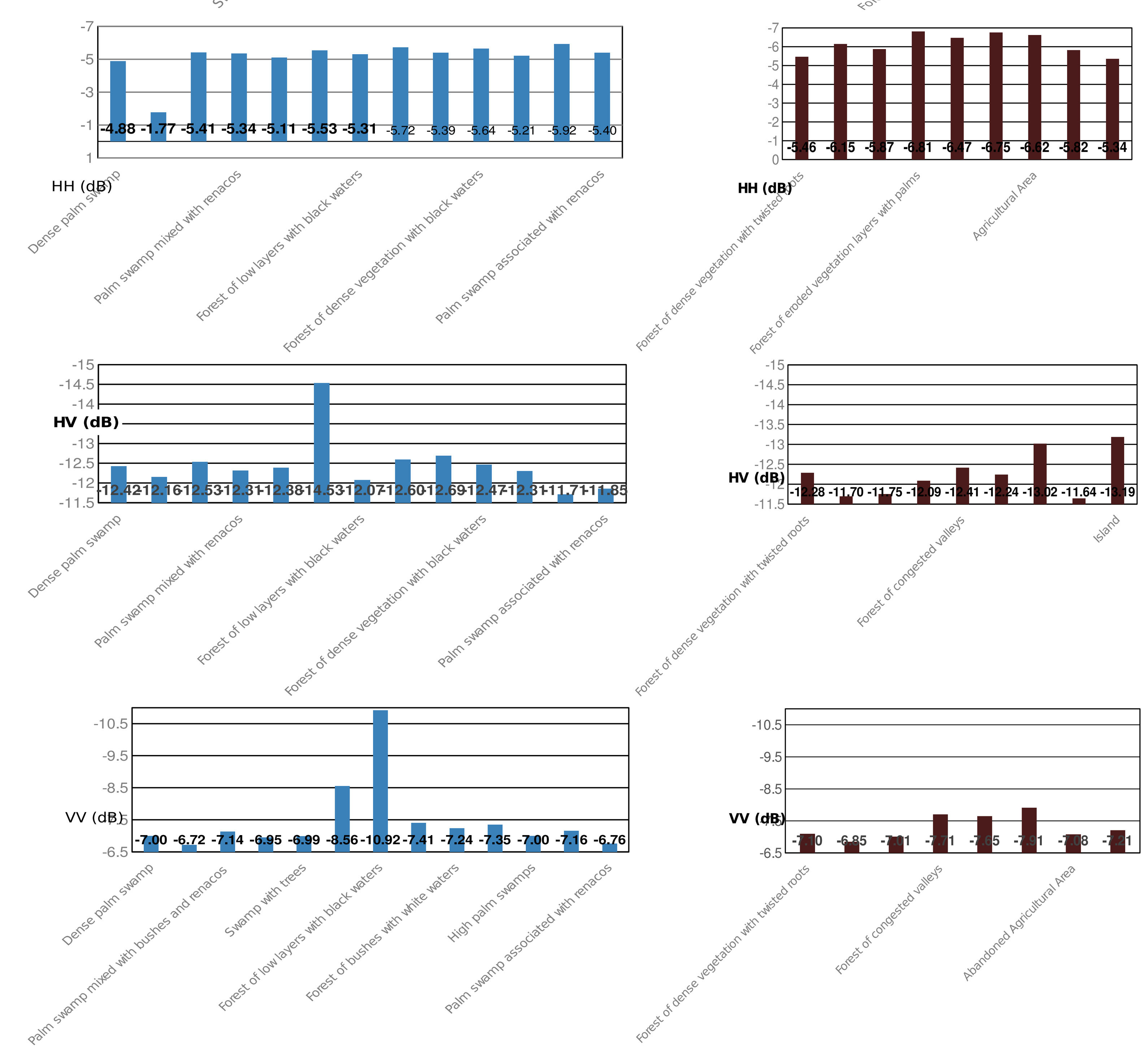


Fig. 4. Digitized vegetation map #2, derived from analysis of Landsat satellite imagery, and corresponding mean radar backscatter values for inundated vs. non-inundated land cover types, for each polarization.

Discussion and Conclusions

- The HH polarization values of the inundated land features are consistently more positive than those of the non-inundated land features (**Fig. 3**). The HV and VV polarizations of both **Fig. 3** and **Fig. 4** do not display any apparent distinctions.
- This noticeable difference in the HH polarization values between the inundated and non-inundated land features in Map #1 is not observed in the Landsat-derived Map #2 (**Fig. 4**), where instead both groups of land features have approximately the same values. This could suggest some inaccuracy in classification in Map #2.
- Future work would include deriving variance across these land cover classes and determining statistic significance using Analysis of Variance (ANOVA)

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