

A satellite view of Earth from space, showing a large wetland area in the center. The wetland is characterized by a complex network of water bodies and land, with a prominent yellowish-brown color. The surrounding land is dark green, and the ocean is a deep blue. The Earth's horizon is visible at the top and bottom of the frame, with a thin layer of white clouds. The background is a dark, starry space.

# Characterization of Tropical Wetlands Ecosystems with Radar Remote Sensing

CREST HIRES Summer 2016 Research  
Project

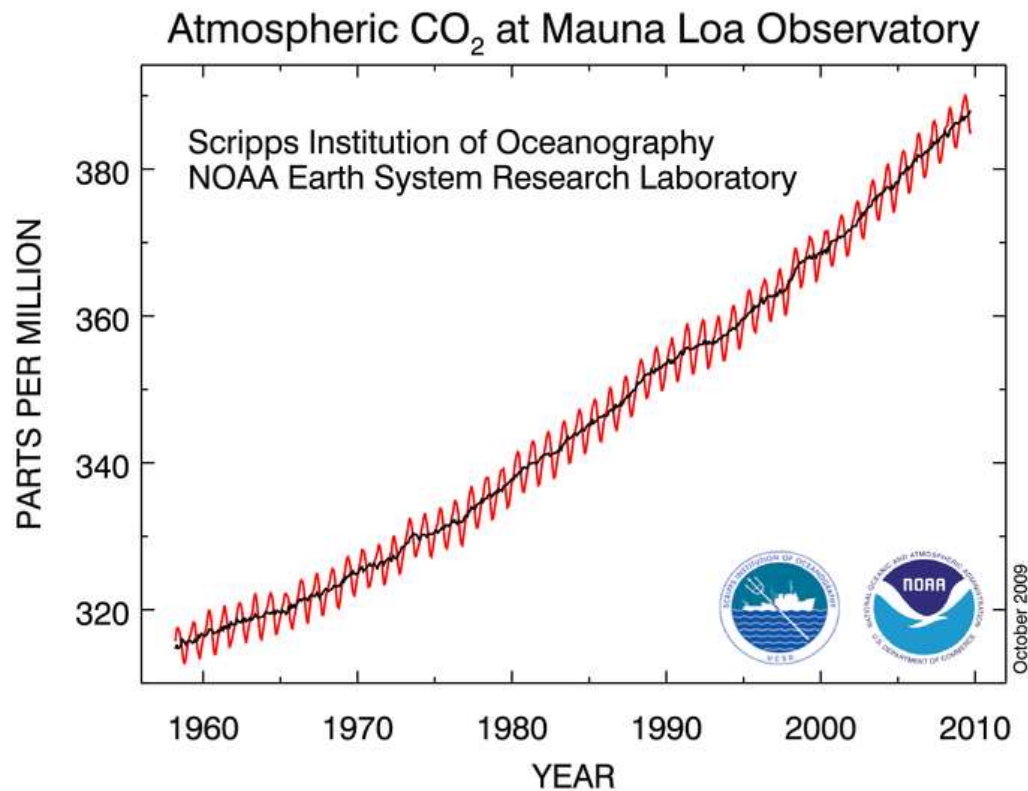
BY:

Jessika Alvarez (Prof. Kyle McDonald)

Research Group/Theme:

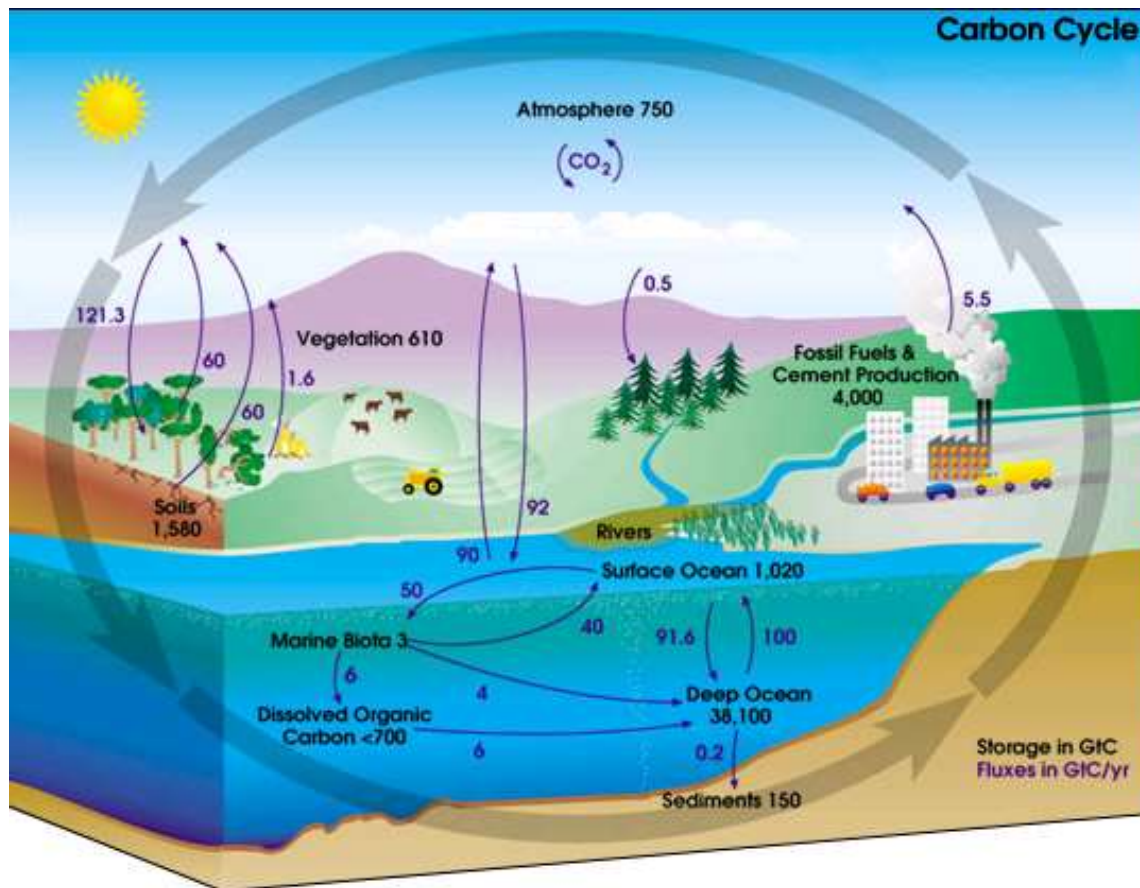
Terrestrial Ecosystems/Land Surface Hydrology (wetlands)

# Characterization of Tropical Wetlands Ecosystems with Radar Remote Sensing



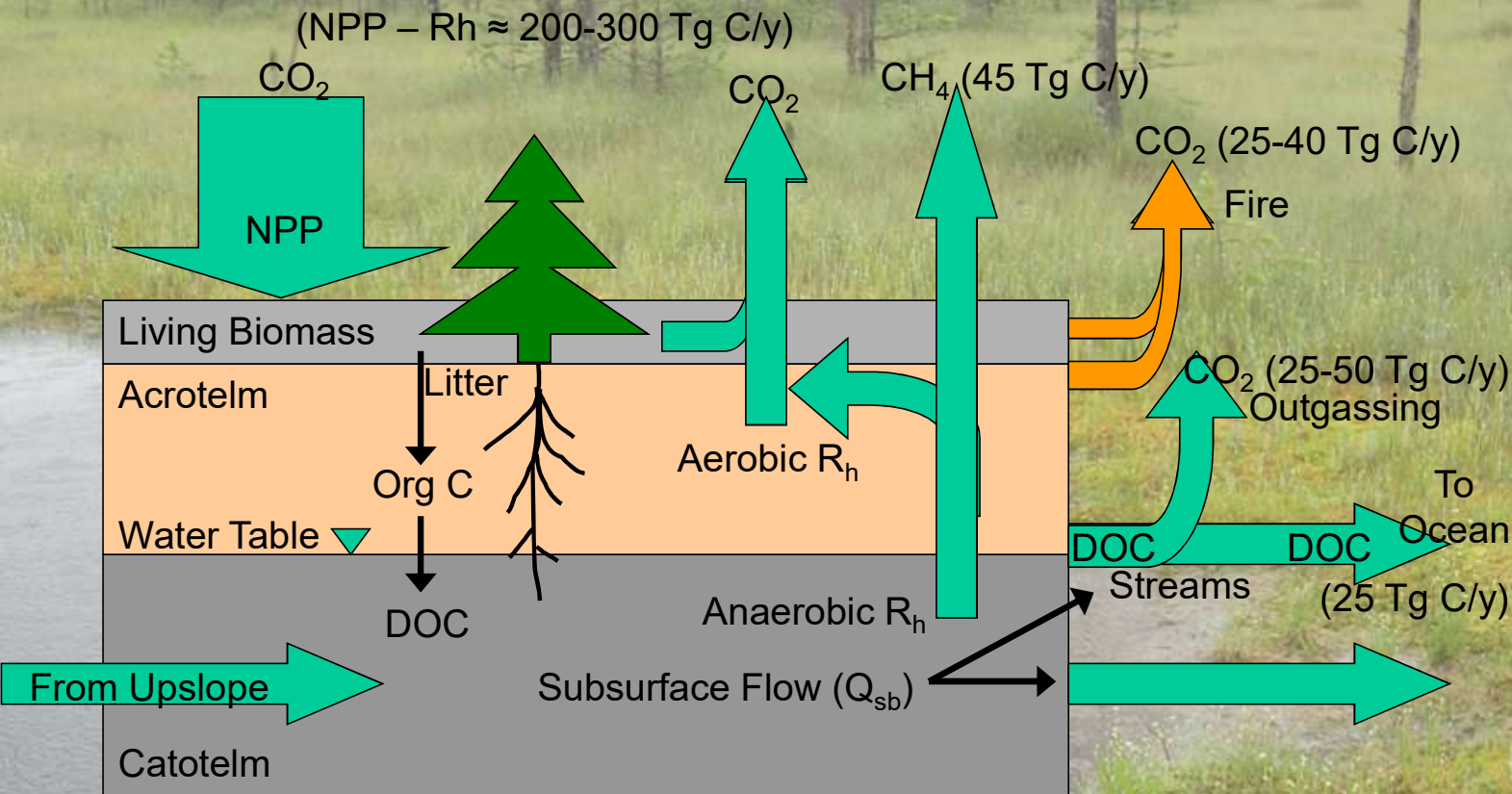
- The Earth System is changing in ways that are not fully understood. An example is the anthropogenically-driven changes in Earth's carbon cycle.

# Characterization of Tropical Wetlands Ecosystems with Radar Remote Sensing



- Earth's carbon cycle is changing in ways that have important effects on climate and weather.
- Earth's carbon cycle can be depicted in terms of storages (carbon stocks) and the exchange of carbon between these storage components (carbon fluxes).

## Wetlands Carbon Budget\*



Wetlands ecosystems play an important role in carbon storage and fluxes, related to land-atmosphere exchange of  $CO_2$  and methane, important atmospheric greenhouse gases that contribute to warming.

**Carbon balance = f(NPP, T, water table, fire, DOC export)**

\* Extremely crude estimates!

# Characterization of Tropical Wetlands Ecosystems with Radar Remote Sensing

## Objective:

- Employ combined datasets from Earth-orbiting remote sensing satellites, NASA aircraft and ground measurements to characterize tropical wetlands in the Pacaya-Samiria National Reserve, Peru



# Pacaya-Samiria National Reserve, Peru



- Most extensive tropical flooded forest in the Peruvian Amazon
- Spans area of more than 20,000 km<sup>2</sup>
- Hosts rich biodiversity!
- Home to palm swamp wetlands



# Characterization of Tropical Wetlands Ecosystems with Radar Remote Sensing

- Research group:

  - Jessika Alvarez: HIREES Graduate student mentor

  - Kat Jensen (ESE PhD Student)

  - Natalia Quinteros (Biology PhD Student)

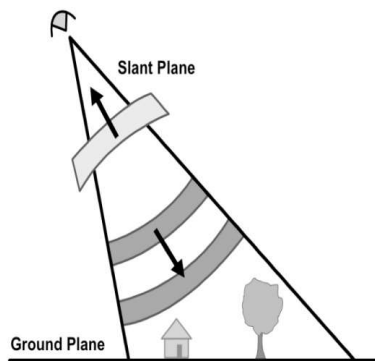
  - Prof Kyle McDonald (EAS Faculty Mentor)

- Lab location:

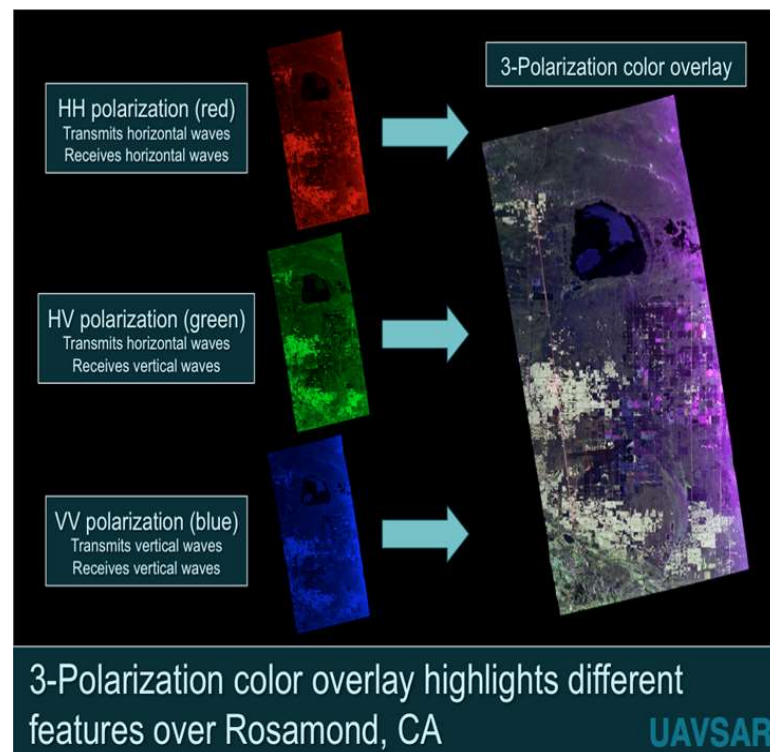
  - Marshak 923 (Ecosystem Science Lab)

  - Marshak 925 (EAS Department Office)

# NASA's Uninhabited Aerial Vehicle Synthetic Aperture Radar: UAVSAR

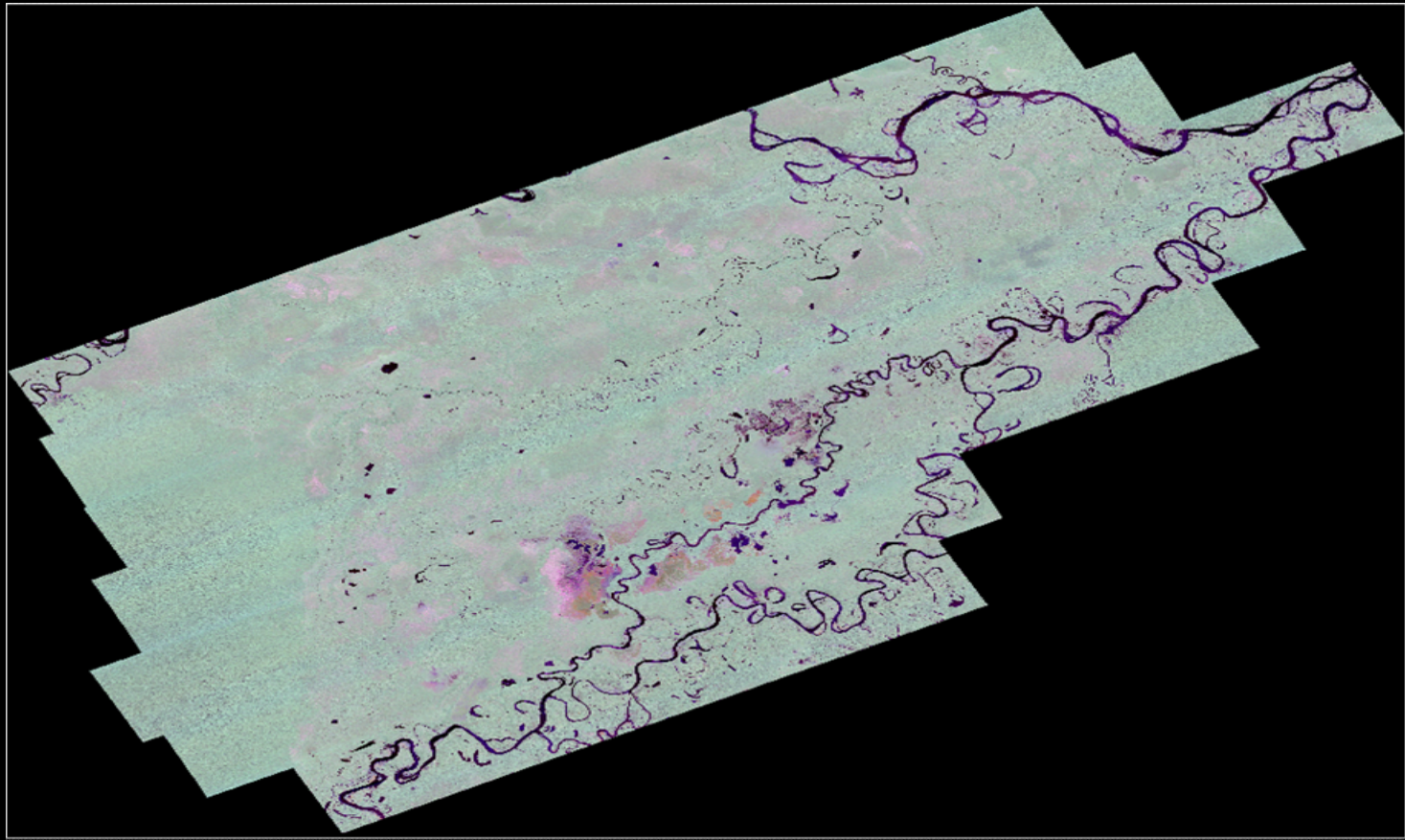


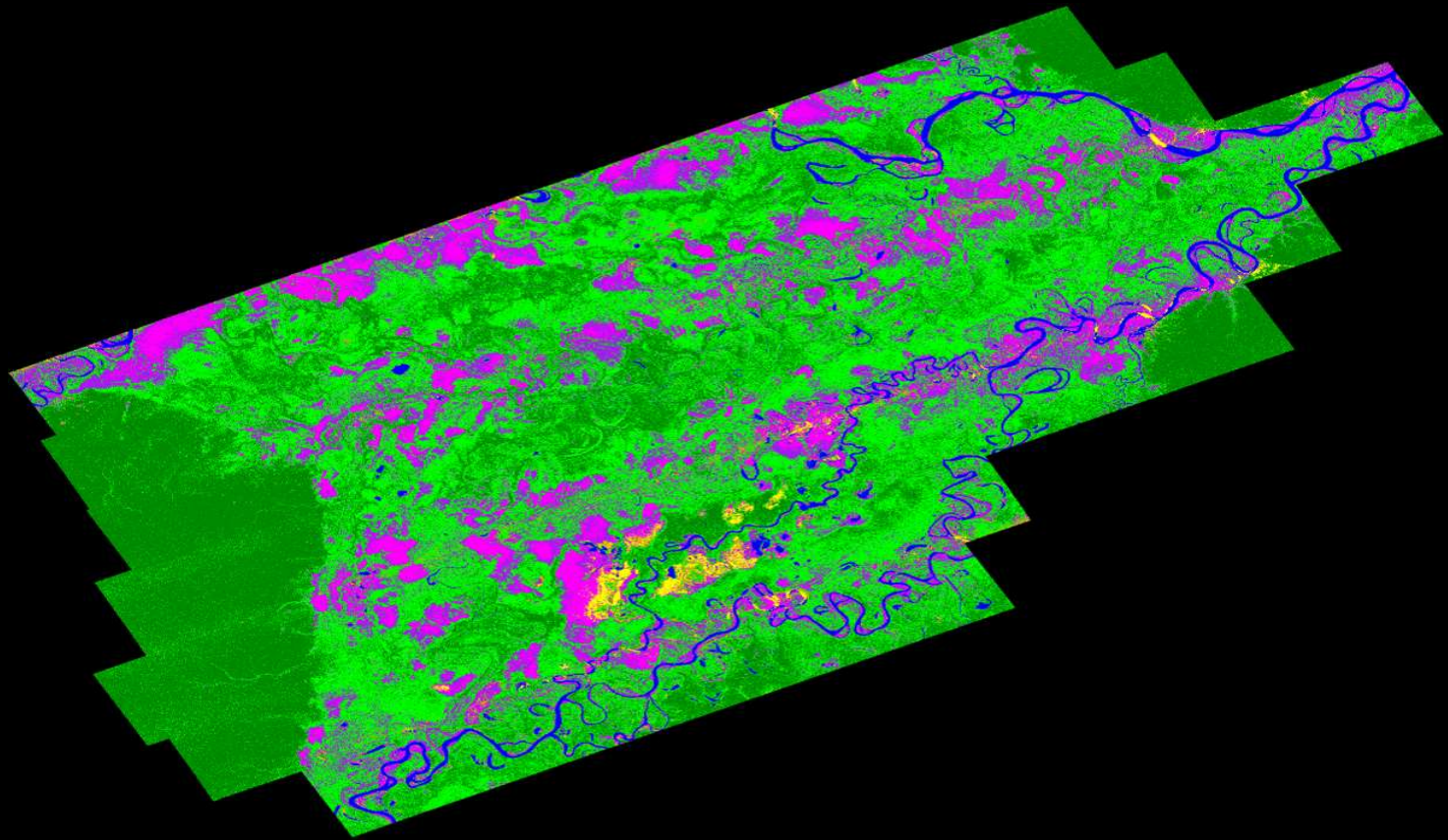
Radar sends and receives radio waves to get information about features on Earth. **UAVSAR**



UAVSAR flies on a Gulfstream-III (G3) jet with a precision autopilot that controls the airplane so that it can fly the same path within 10 m. The radar provides high-fidelity polarimetry datasets with a spatial resolution better than 5 meters, supporting numerous Earth science disciplines.









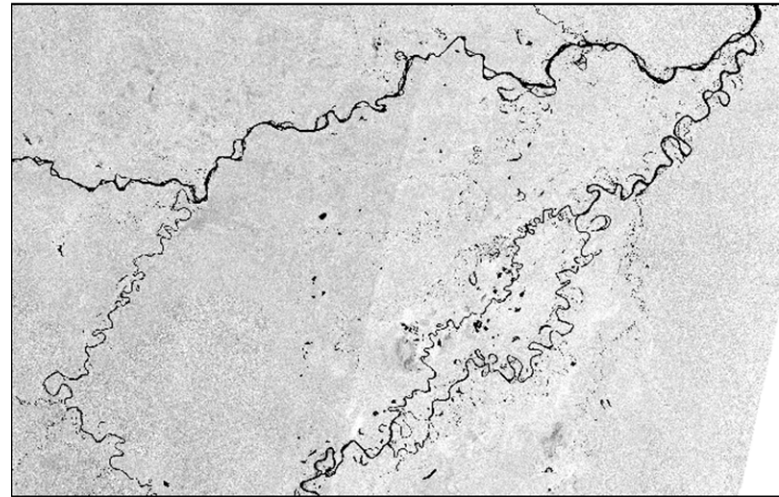
# Sentinel SAR

- Compilation of multi-temporal Sentinel-1 SAR mosaics over entire reserve from Oct 2014 – Mar 2016
  - 2 dual-pol mosaics (VV + VH)
  - 33 single-pol mosaics (VV)

Once completed, will identify areas with great variation in backscatter

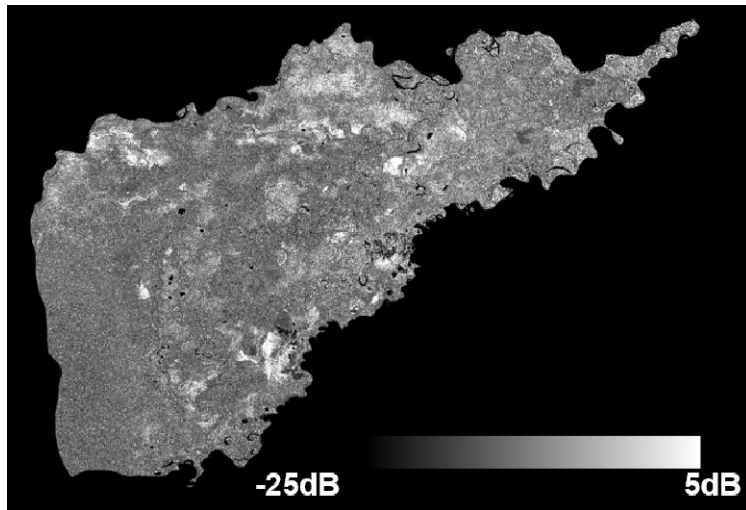
The idea is to use seasonality of inundation as an additional layer for random forest classification

**VV-polarized  $\sigma_0$ , acquired May 14-21 2015**

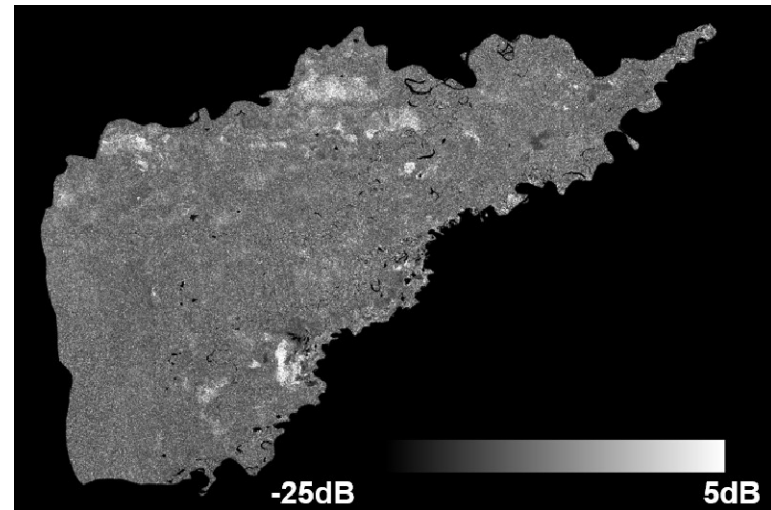


# Seasonality of inundation patterns

**Wet Season [Mar-Apr 2009]  
HH-polarized ALOS PALSAR  
Fine-Beam**



**Dry Season [Jul-Aug 2010]  
HH-polarized ALOS PALSAR  
Fine-Beam**



# Characterization of Tropical Wetlands Ecosystems with Radar Remote Sensing

## What you will do:

- Apply computer-based analysis tools to assemble imaging radar classifications for the Pacaya-Samiria region.
- Work with supplemental dataset to characterize the quality of the products developed from the remote sensing data.
- Examine the seasonality elucidated by the time series data, assessing timings of maximum and minimum inundation conditions and the maximum extent of the wet season inundation
- Examine data from different rainfall stations in order to analyze rain periods that enable identification of wet and dry seasons of the area and how this information is characterized by the radar images.

# Characterization of Tropical Wetlands Ecosystems with Radar Remote Sensing

## What you will learn

- analysis of imaging radar remote sensing data
- physical information contained in radar images of wetlands
- an understanding of the importance of wetlands systems in Earth's carbon cycle and climate