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Post-K&C – First Report

Characterization of Amazon floodplain forest habitats and inundation dynamics using PALSAR-2 time series

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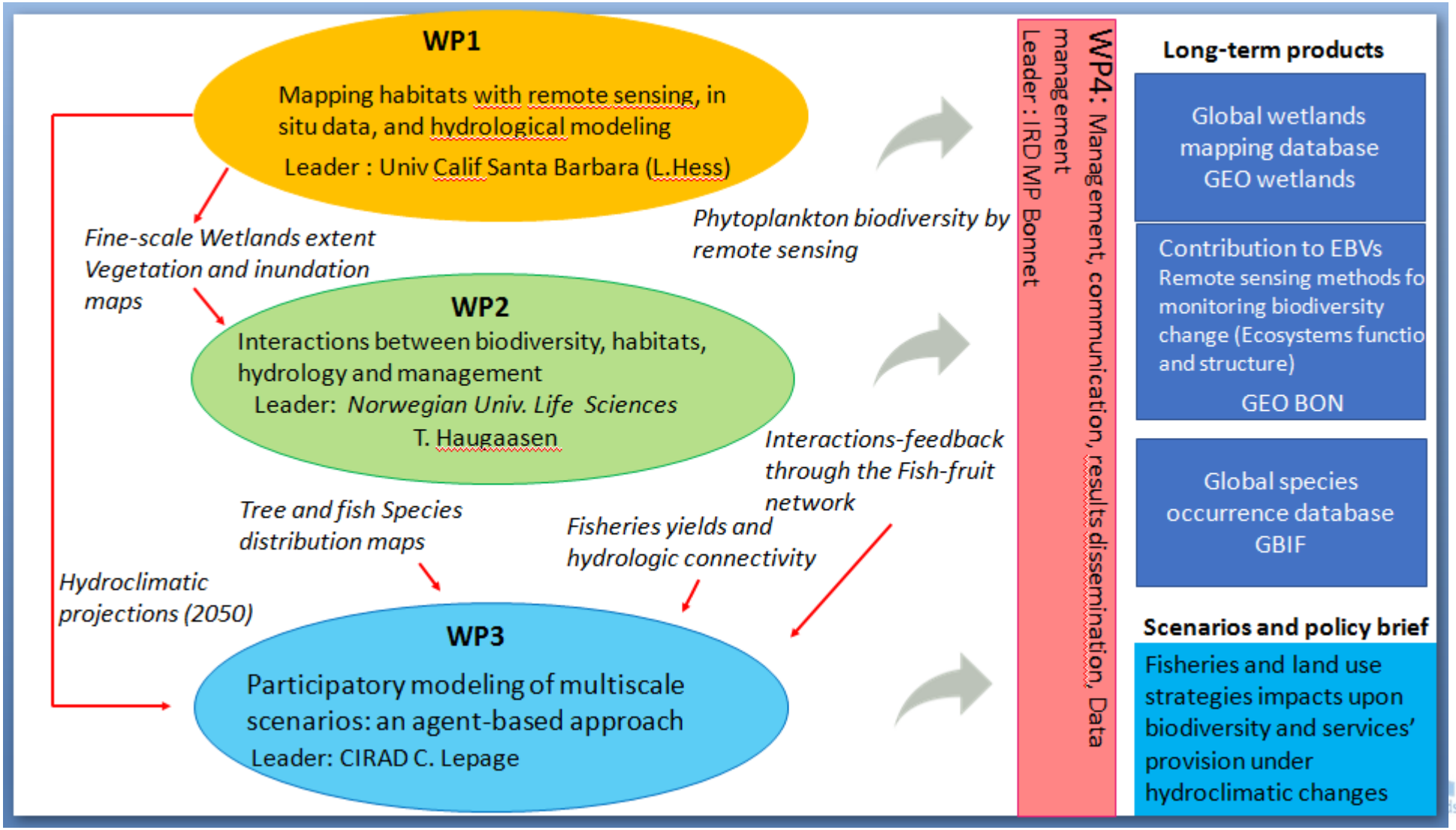
Carlos Peres (Univ. of East Anglia, UK)

Post-KC Science Team meeting #1
Tokyo, Japan, January 20-24, 2020

BONDS
Biodiversity scenarios in Amazonian wetlands

BONDS: Balancing biOdiversity conservatioN with Development in Amazon wetlandS



Project outline and objectives

1. Land cover and inundation dynamics mapping
2. Vegetation structure (height, canopy cover, AGB) mapping
3. *Estimation of water storage and water slopes across the floodplain*

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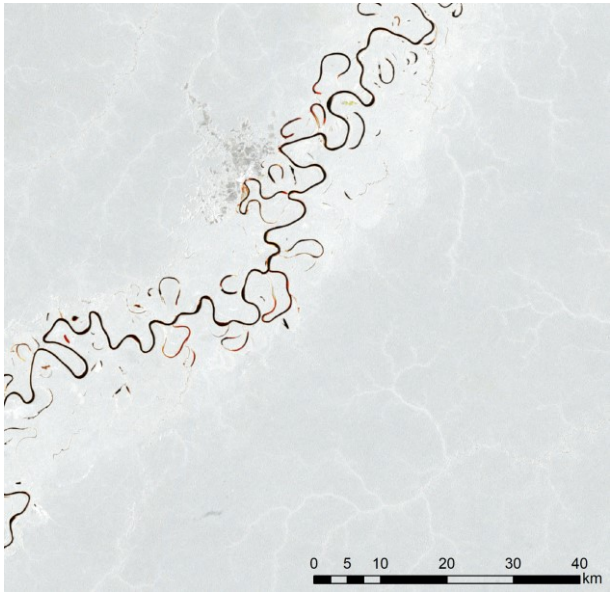
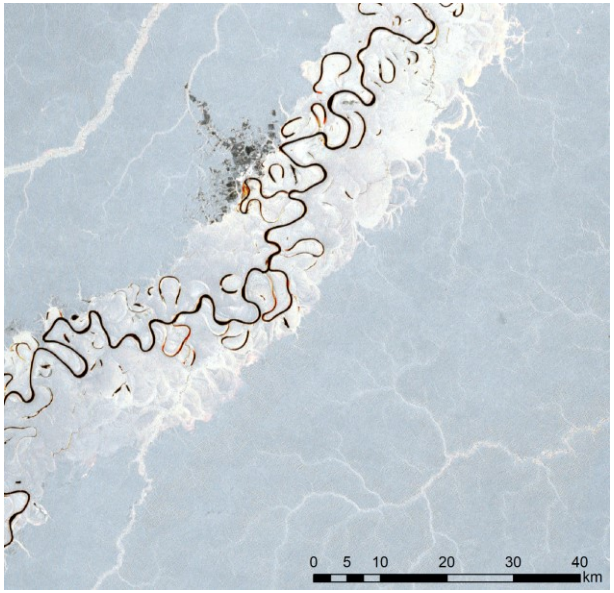
Study areas

Juruá

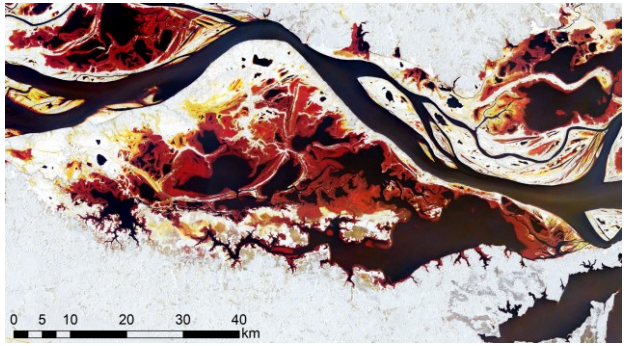
S1 HH RGB



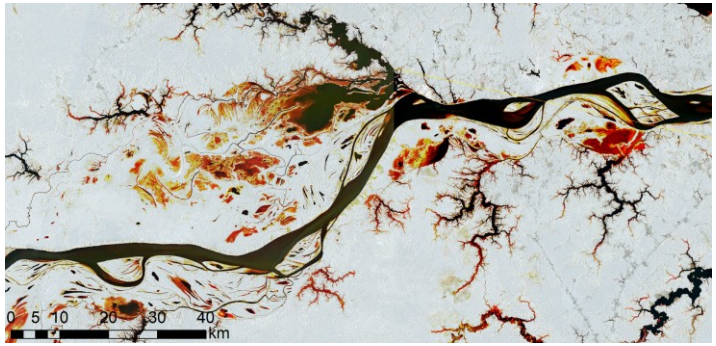
PALSAR-2 ScanSAR HH RGB



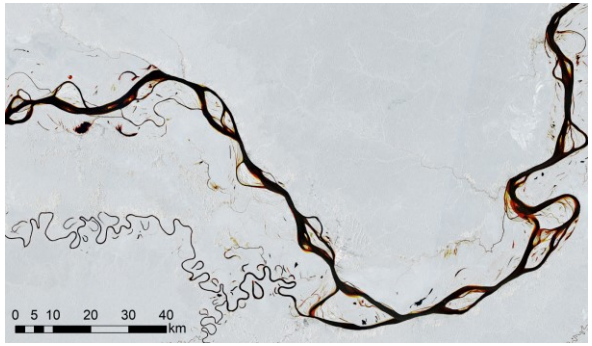
Curuai (S1 VV RGB)



Janauacá (S1 VV RGB)



Leticia (S1 VV RGB)



RGB composites based on multi-temporal backscatter metrics (R: percentile 95, G: median, B: percentile 5)

Project outline and objectives

1. Land cover and inundation dynamics mapping

2. Vegetation structure (height, canopy cover, AGB) mapping

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Classification system

Vegetation Structure

- woodiness
- height
- stem density / canopy cover

+

Hydrology

- inundation depth and duration
- seasonal variability
- interannual variability

10 "Cover States"

- Nonvegetated, nonflooded
- Nonvegetated, flooded
- Herbaceous, nonflooded
- Herbaceous, flooded
- Forest, nonflooded
- Forest, flooded
- Woodland, nonflooded
- Woodland, flooded
- Shrub, nonflooded
- Shrub, flooded

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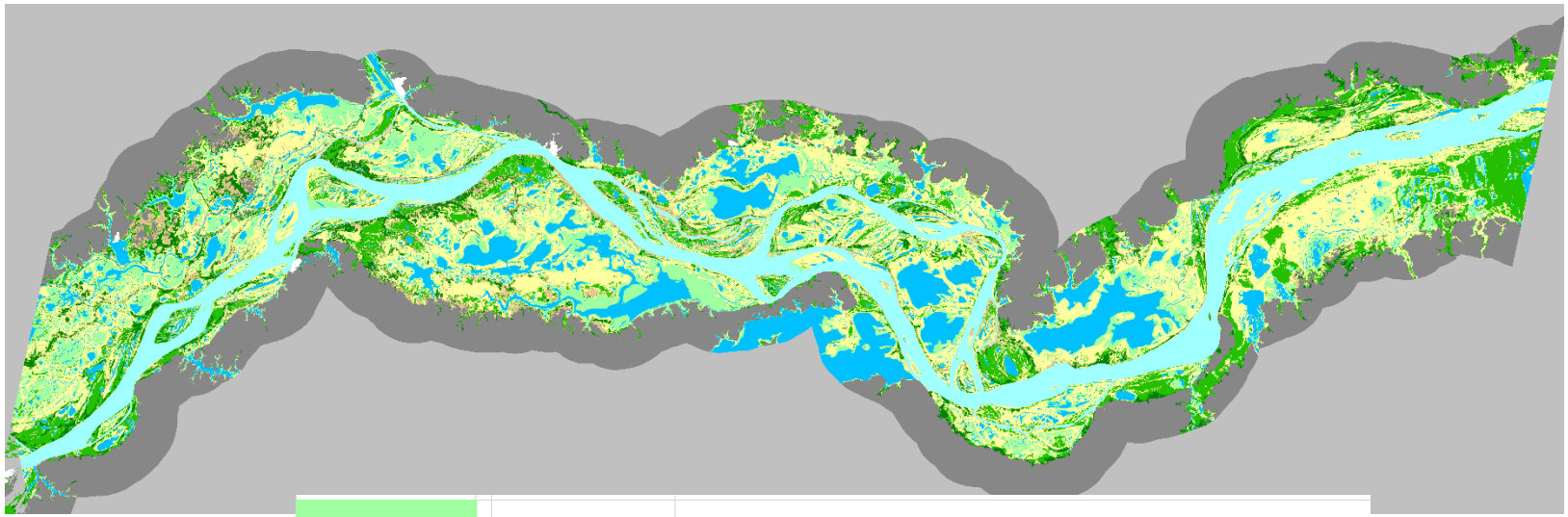
Habitat map based on Landsat

Curuai site



	CampoLo	Campo habitat, exposed only at very low water
	CampoMid	Campo habitat, flooded at mid water
	CampoHi	Campo habitat, flooded only at high water
	Forest	Trees
	Shrub	Shrub, short trees, or semi-shrub; includes aningais
	WtrOther	Lakes and channels, excluding the mainstem Amazon channel
	WtrMstem	Mainstem channel
	Upland	Upland
	Urban	Urban
	NonStudy	Areas outside study area

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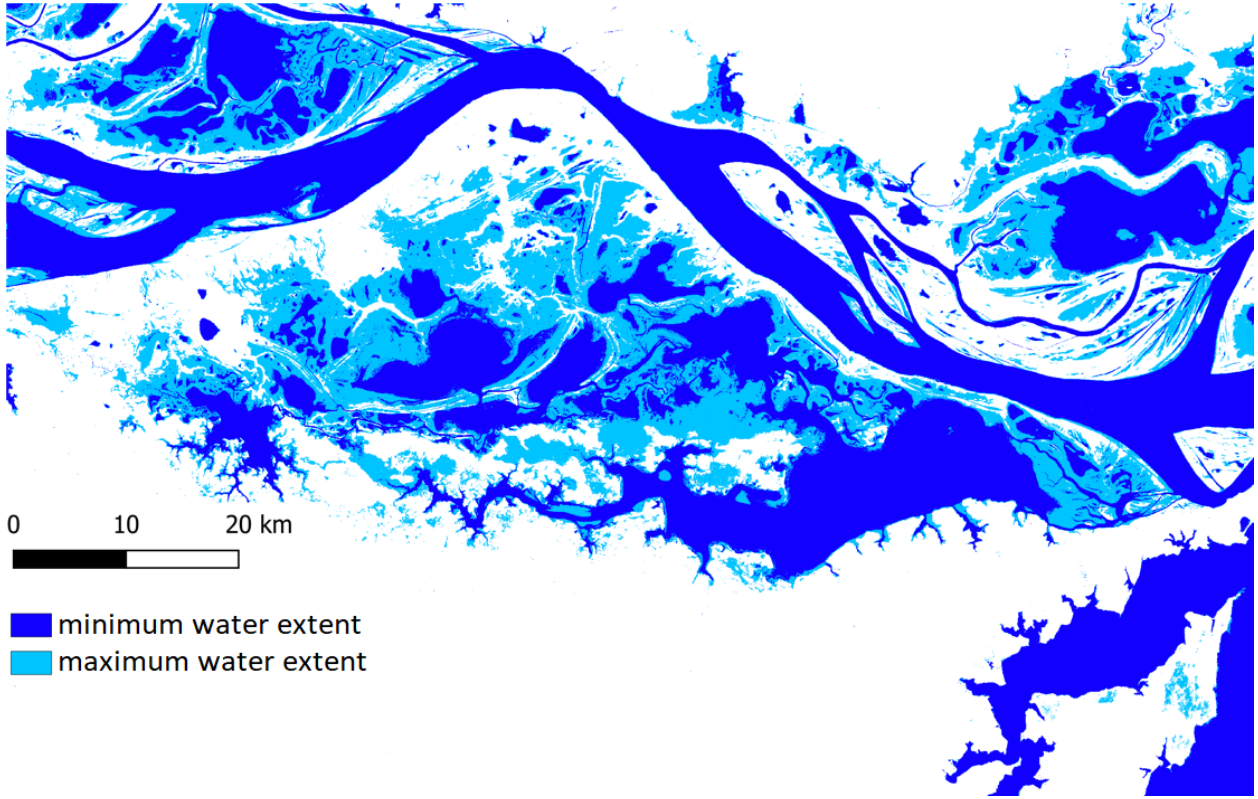
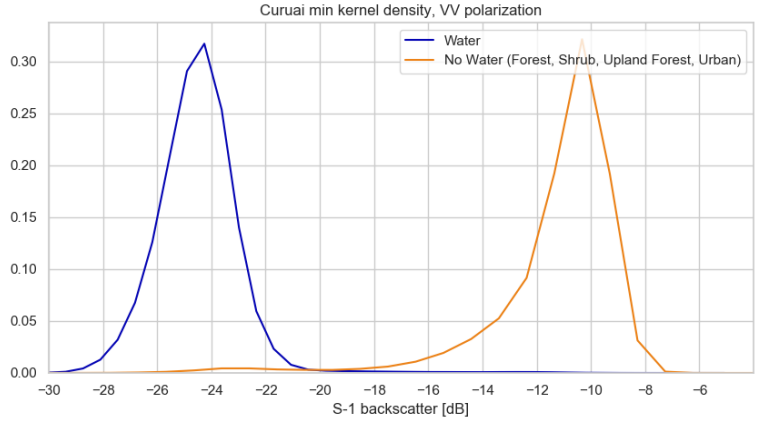
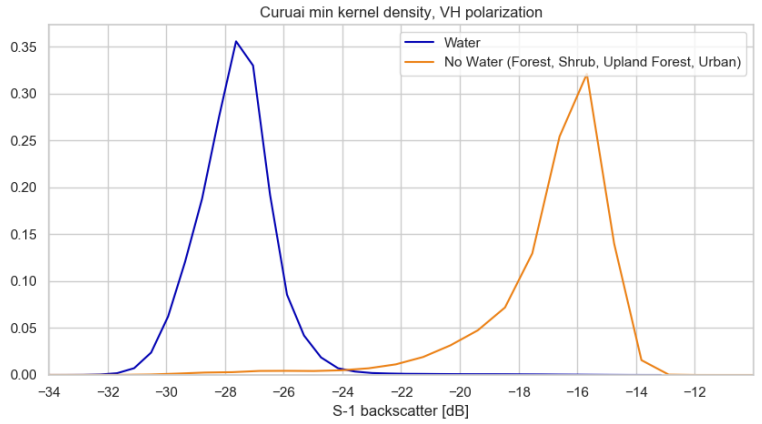
Inundation dynamics mapping with Sentinel-1

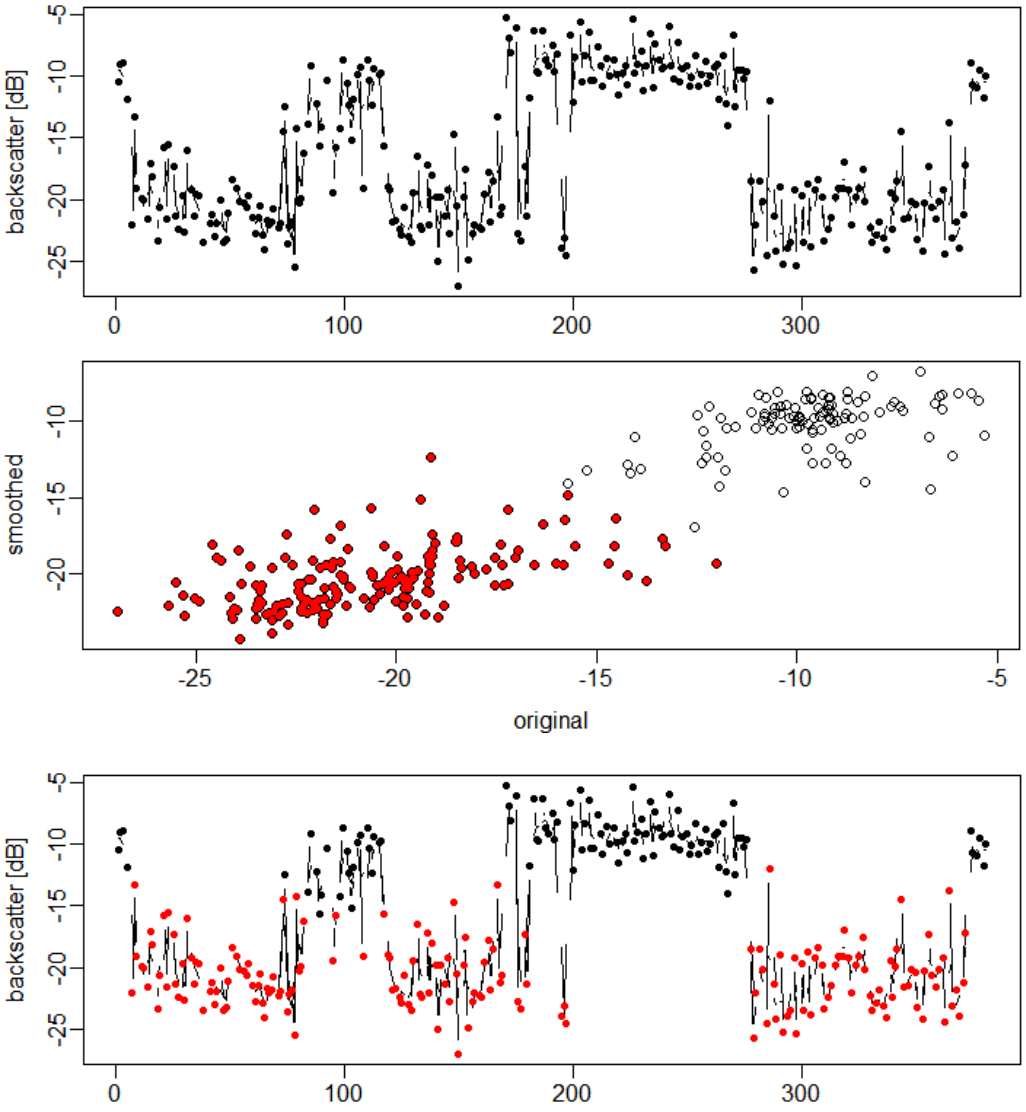
Curuai site



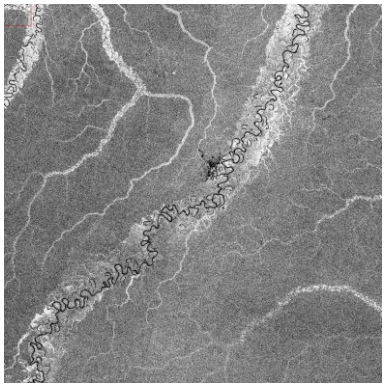




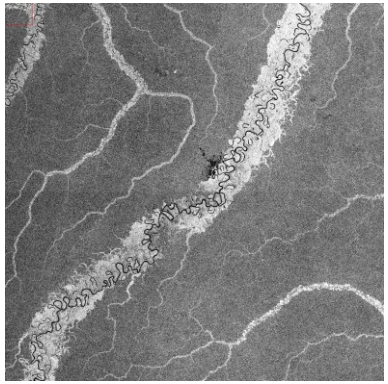
time series clustering



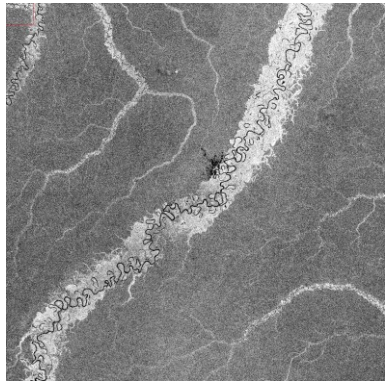
Juruá site



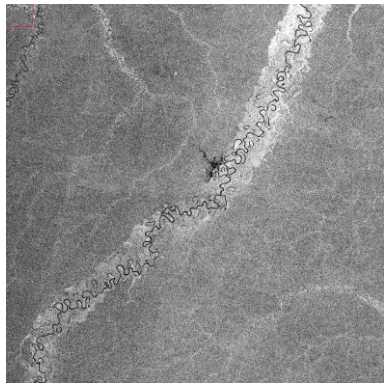
2 jan 2017



13 feb 2017



8 may 2017



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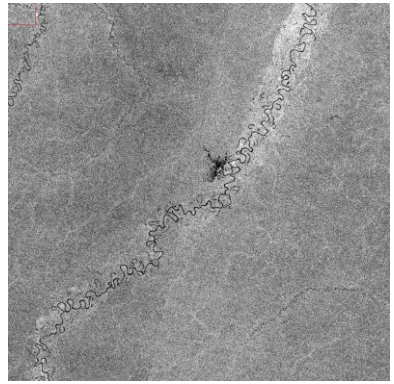
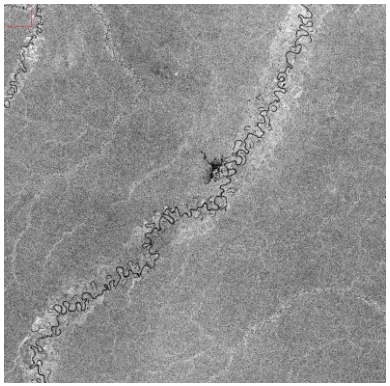


17 jul 2017



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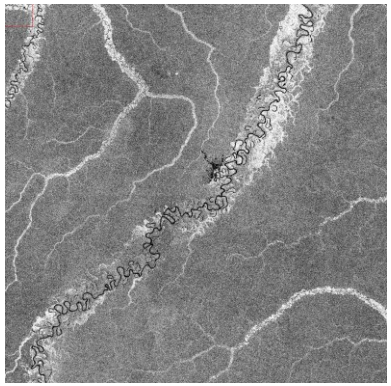
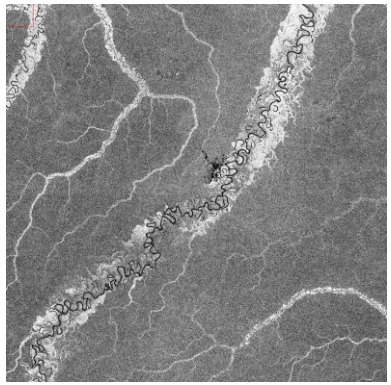


1 jan 2018



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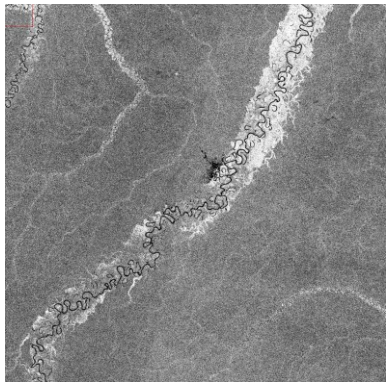
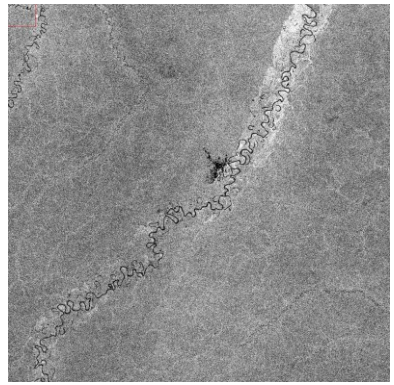
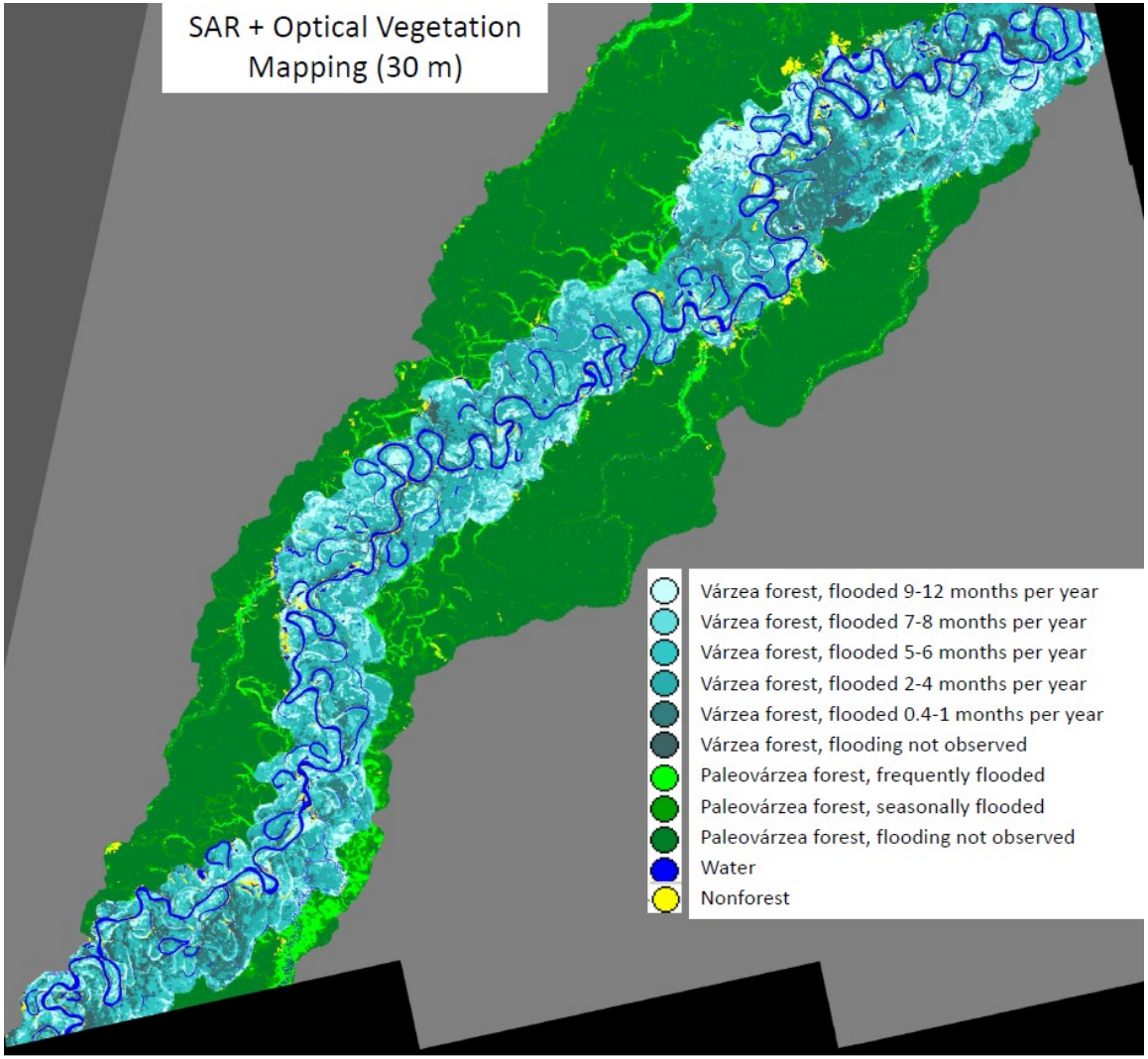


4 jun 2018



2 jul 2018

Juruá site


SAR + Optical Vegetation Mapping (30 m)
Várzea forest, flooded 9-12 months per year
Várzea forest, flooded 7-8 months per year
Várzea forest, flooded 5-6 months per year
Várzea forest, flooded 2-4 months per year
Várzea forest, flooded 0.4-1 months per year
Várzea forest, flooding not observed
Paleovárzea forest, frequently flooded
Paleovárzea forest, seasonally flooded
Paleovárzea forest, flooding not observed
Water
Nonforest

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1. Land cover and inundation dynamics mapping

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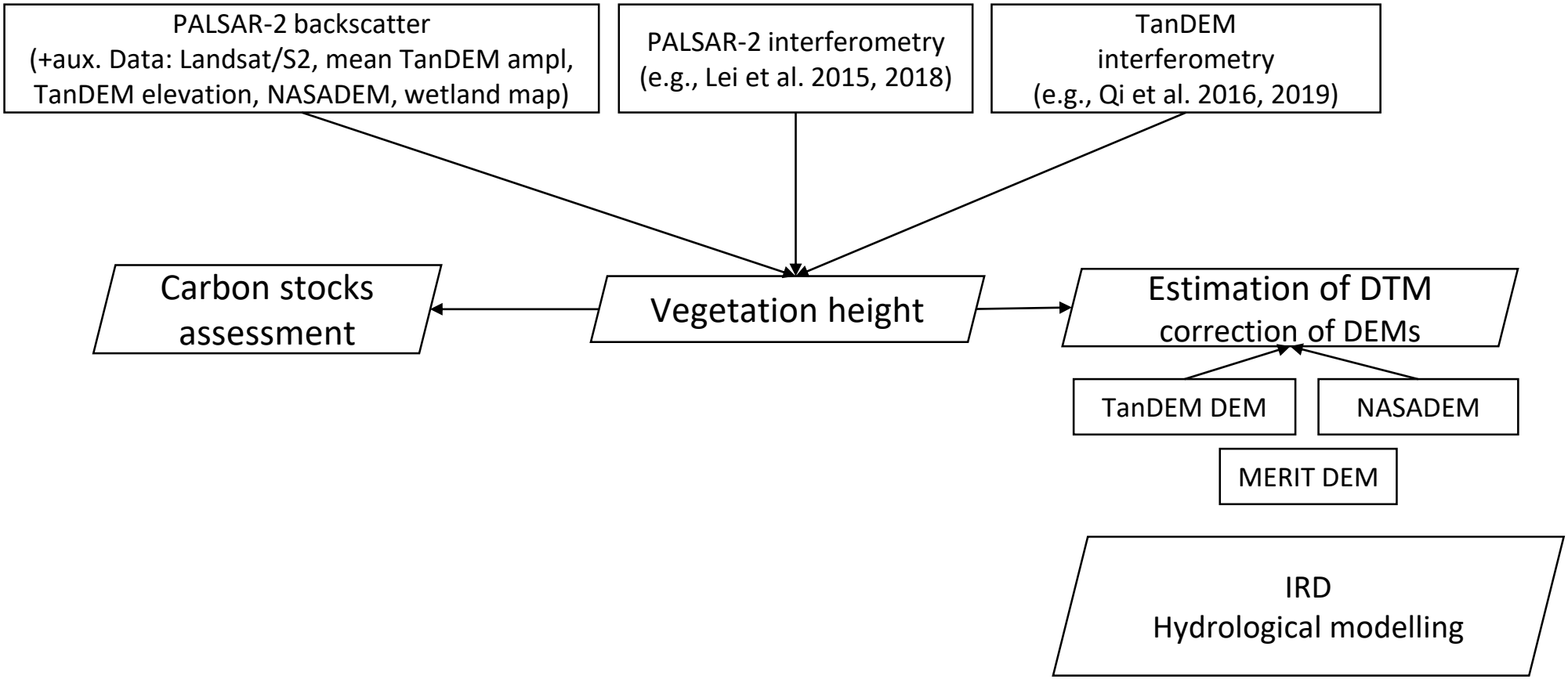
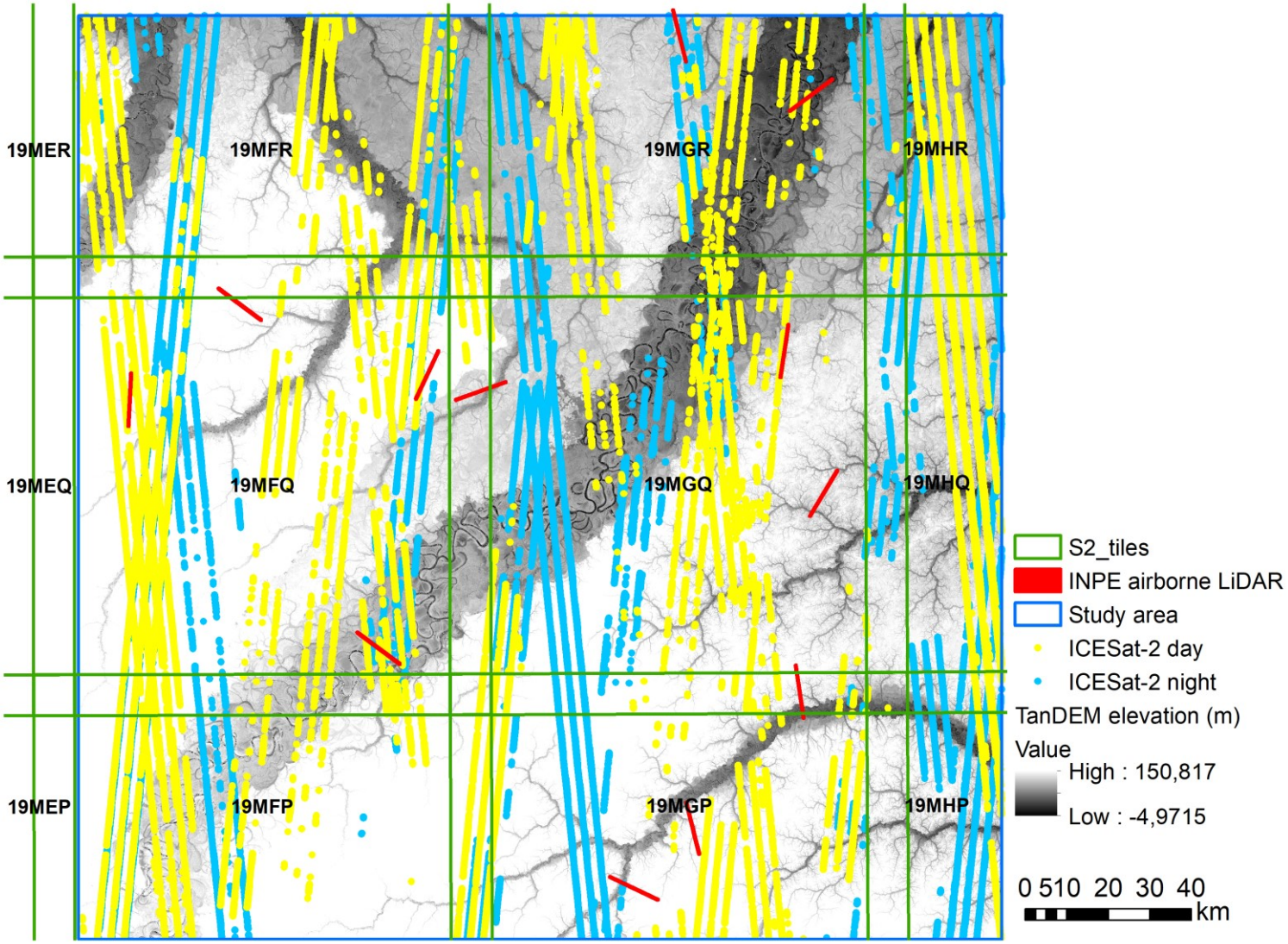
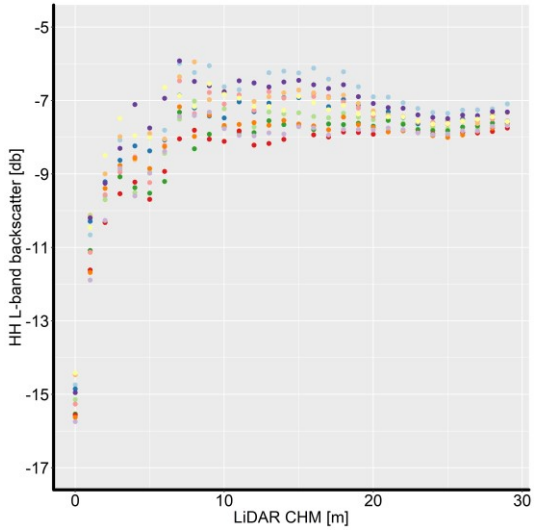

PALSAR-2 backscatter
(+aux. Data: Landsat/S2, mean TanDEM ampl, TanDEM elevation, NASADEM, wetland map)
PALSAR-2 interferometry
(e.g., Lei et al. 2015, 2018)
TanDEM interferometry
(e.g., Qi et al. 2016, 2019)
Carbon stocks assessment
Vegetation height
Estimation of DTM correction of DEMs
TanDEM DEM
NASADEM
MERIT DEM
IRD
Hydrological modelling

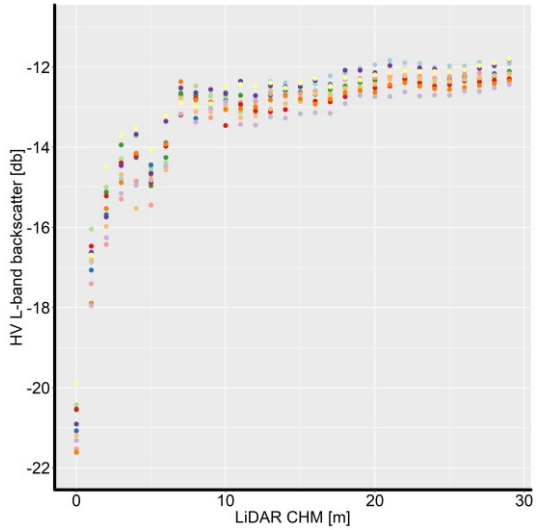
Juruá site


19MER
19MFR
19MGR
19MHR
19MEQ
19MFQ
19MGQ
19MHQ
19MEP
19MFP
19MGP
19MHP
S2_tiles
INPE airborne LiDAR
Study area
ICESat-2 day
ICESat-2 night
TanDEM elevation (m)
Value
High : 150,817
Low : -4,9715
0 5 10 20 30 40
km

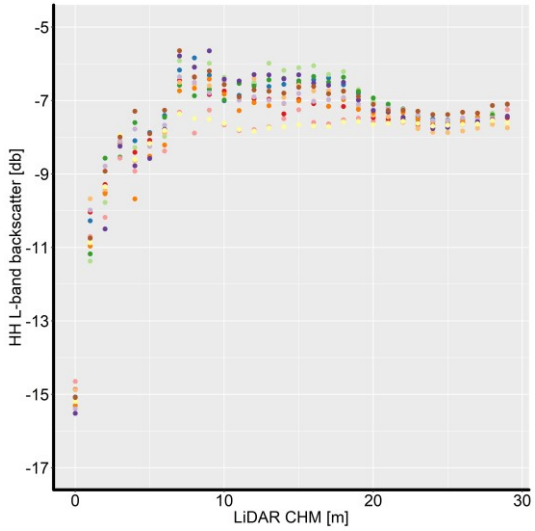
PALSAR-2 backscatter vs. airborne LiDAR CHM

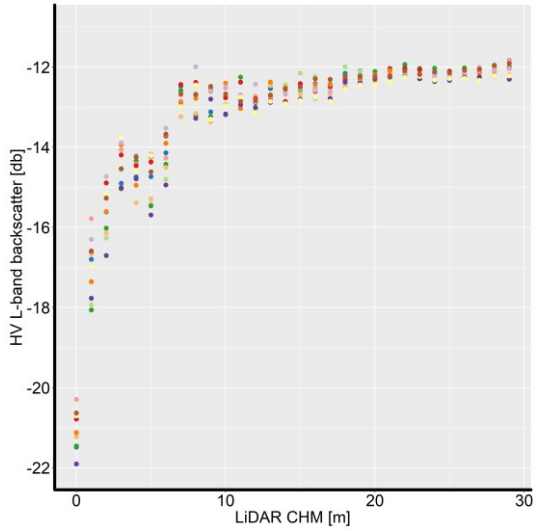
Dry season





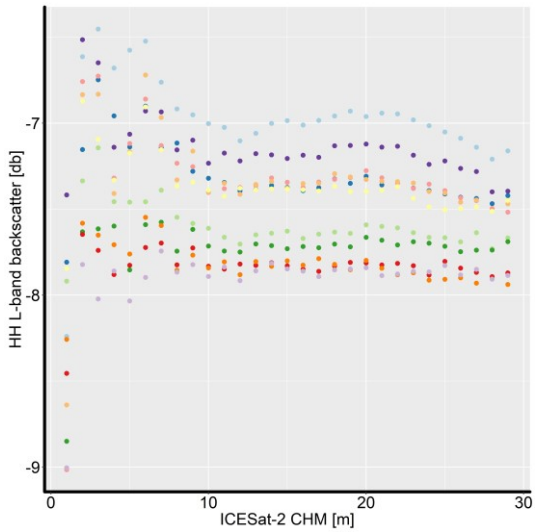
Wet season

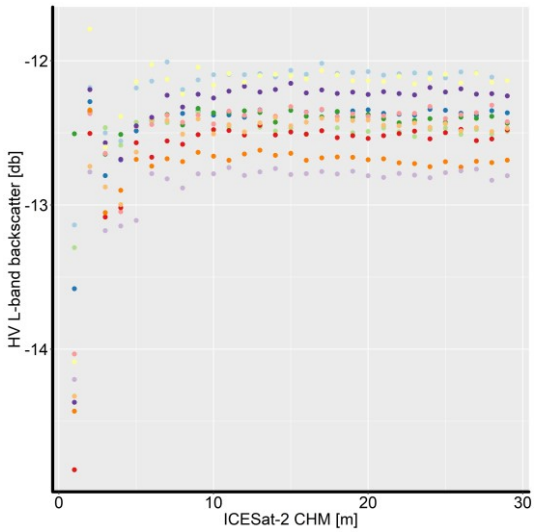




PALSAR-2 backscatter vs. ICESat-2 ATLAS CHM

Dry season





ATL08 Known Issues -- Release 002 (October 28, 2019)

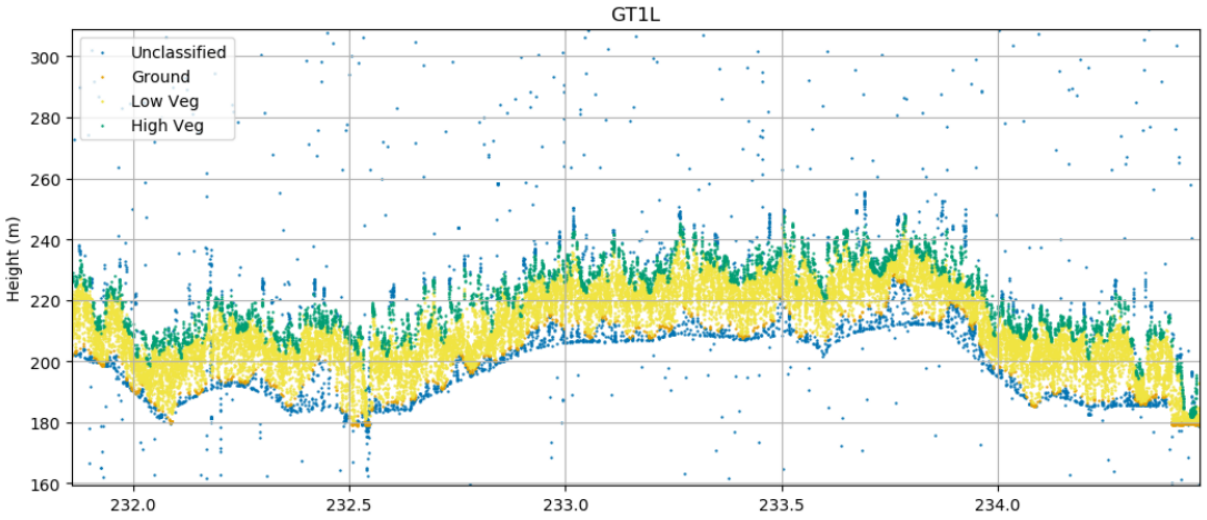
Prepared by Amy Neuenschwander and Ben Jelley

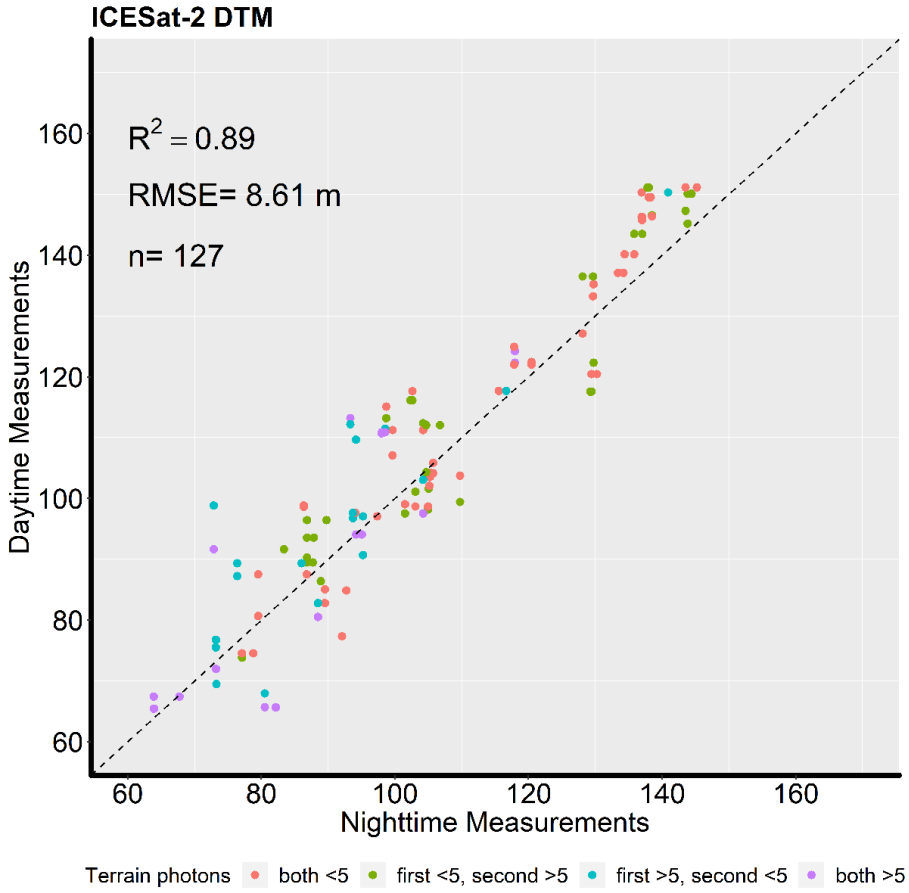
Known Issues

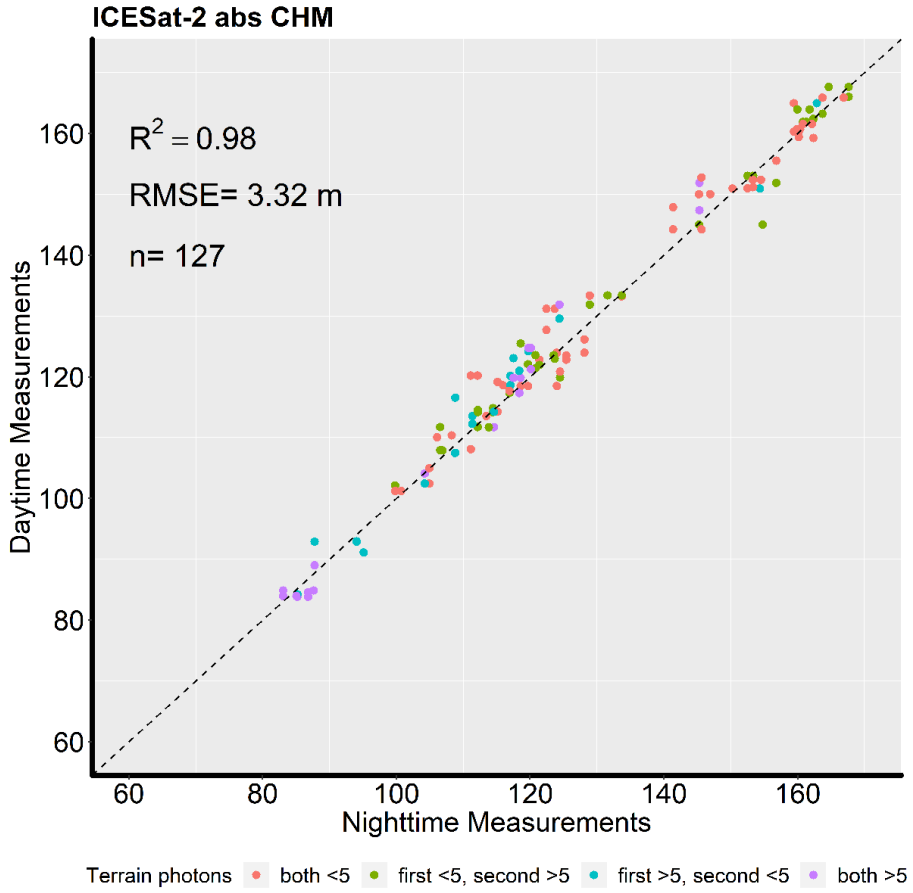
The second release (Release 002) of ICESat-2 data is now available from NSIDC.

1. Tropical Forest under-estimating height

A known issue with the production of the ATL08 data product concerns tropical forest. Due to the large amount of vegetation, the ATL08 algorithm will need to be adjusted to correctly identify the ground surface beneath the vegetation. This example, shown from Tropical forest in Brazil, highlights canopy photons misclassified as ground. The actual ground photons are labeled incorrectly as noise (blue dots). In this example, the ground height would be reported incorrectly by approximately 3-5 m, and the relative canopy height would be under-estimated by that same amount. Also, in this example, the top of emergent trees are not being correctly labeled as canopy photons. The expectation is that the ATL08 algorithm will be modified so this issue is resolved in upcoming data releases.




ICESat-2 DTM
$R^2 = 0.89$
RMSE= 8.61 m
n= 127
Daytime Measurements
Nighttime Measurements
60
80
100
120
140
160
Terrain photons
both <5
first <5, second >5
first >5, second <5
both >5


ICESat-2 abs CHM
$R^2 = 0.98$
RMSE= 3.32 m
n= 127
Daytime Measurements
Nighttime Measurements
60
80
100
120
140
160
Terrain photons
both <5
first <5, second >5
first >5, second <5
both >5

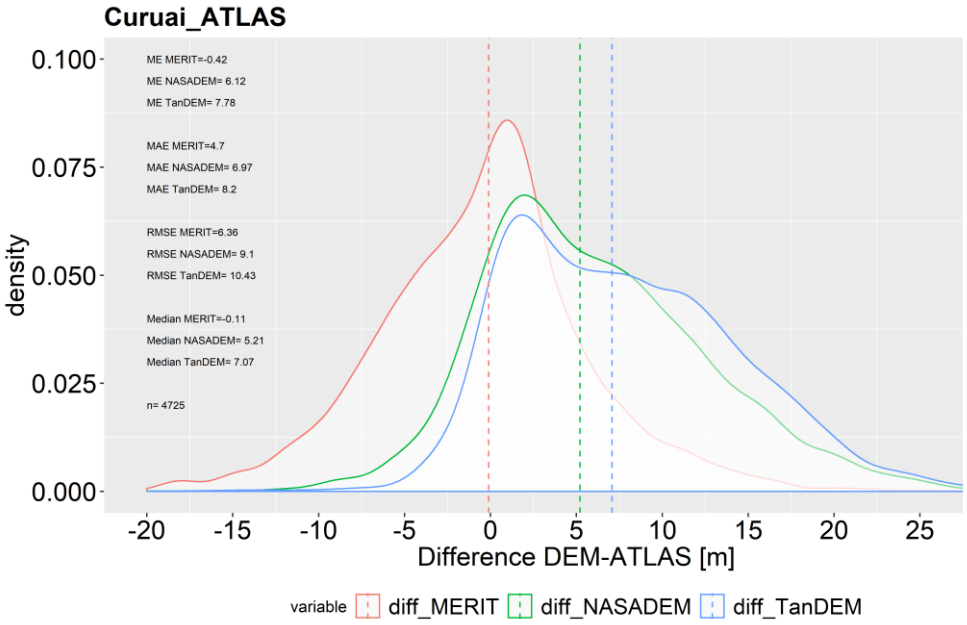
$$ME = \frac{1}{n}\sum_{i=1}^{n} h_{i,GDEM} - h_{i,ref} = \frac{1}{n}\sum_{i=1}^{n} \Delta h_{i,ref}$$

$$MAE = \frac{1}{n}\sum_{i=1}^{n} |h_{i,GDEM} - h_{i,ref}| = \frac{1}{n}\sum_{i=1}^{n} |\Delta h_{i,ref}|$$

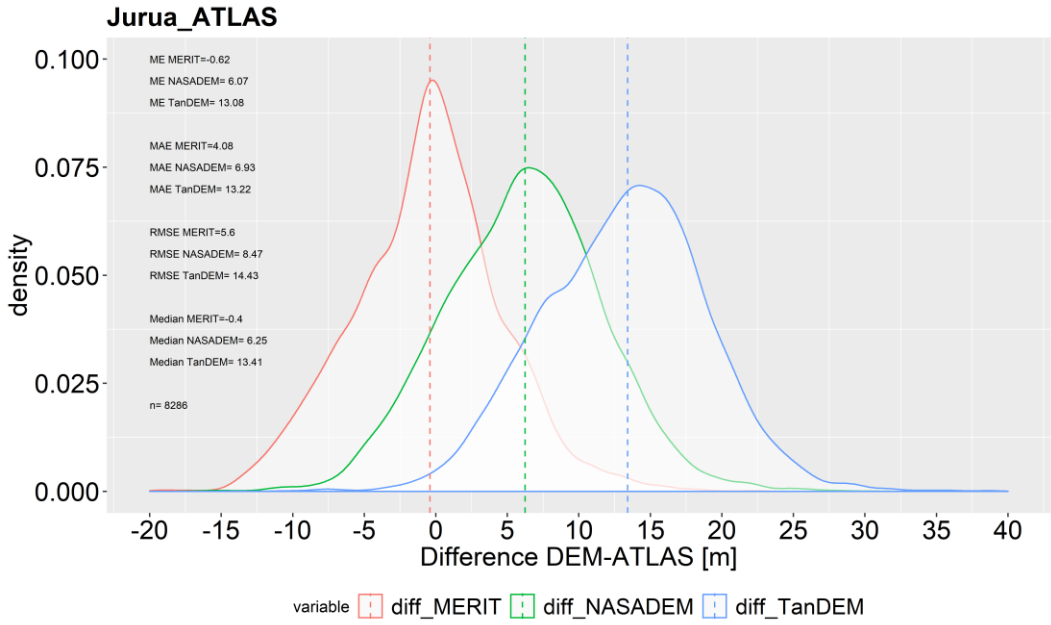
$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n} \Delta h_{i_{ref}}^{2}}$$

Histogram of $\Delta h_i = h_{i,GDEM} - h_{i,ref}$

flooded grassland



flooded forest



Deliverables and other output

Describe planned output of your project.

- Project deliverables
  - Vegetation height maps
  - Inundation maps
  - Landcover maps

For four study sites (Curuai, Janauacá, Juruá and Leticia)

- Peer-reviewed publications

Planned few peer-reviewed publications on estimation of vegetation height and terrain elevation; inundation and landcover mapping

- Non-peer-reviewed publications (conference papers, reports etc.)
  - ForestSAT2020
- Other results

PALSAR/PALSAR-2 data access

Please list the PALSAR/PALSAR-2 data you have

(1) requested and (2) obtained.

All scenes requested (23) were obtained

Scene ID
ALOS2130567080-161023
ALOS2244417080-181202
ALOS2254767080-190210
ALOS2097447080-160313
ALOS2174037080-170813
ALOS2107797080-160522
ALOS2192667080-171217
ALOS2151267080-170312
ALOS2066397080-150816
ALOS2203757070-180302
ALOS2203757060-180302
ALOS2209227090-180408
ALOS2209227080-180408
ALOS2207897060-180330
ALOS2205827080-180316
ALOS2205827070-180316
ALOS2180987060-170929
ALOS2180987070-170929
ALOS2180247090-170924
ALOS2180247080-170924
ALOS2178917060-170915
ALOS2123027080-160902
ALOS2123027070-160902

PALSAR/PALSAR-2 data access

Have you had sufficient data to complete your research (according to your K&C agreement)?

If not, which key data sets are missing?

New PALSAR-2 acquisitions are required to extend backscatter time-series