UAVSAR Interferometric Processing Overview for the AfriSAR Campaign

The UAVSAR Processing Team
Jet Propulsion Laboratory, California Institute of Technology
AfriSAR Team Meeting, College Park, Maryland

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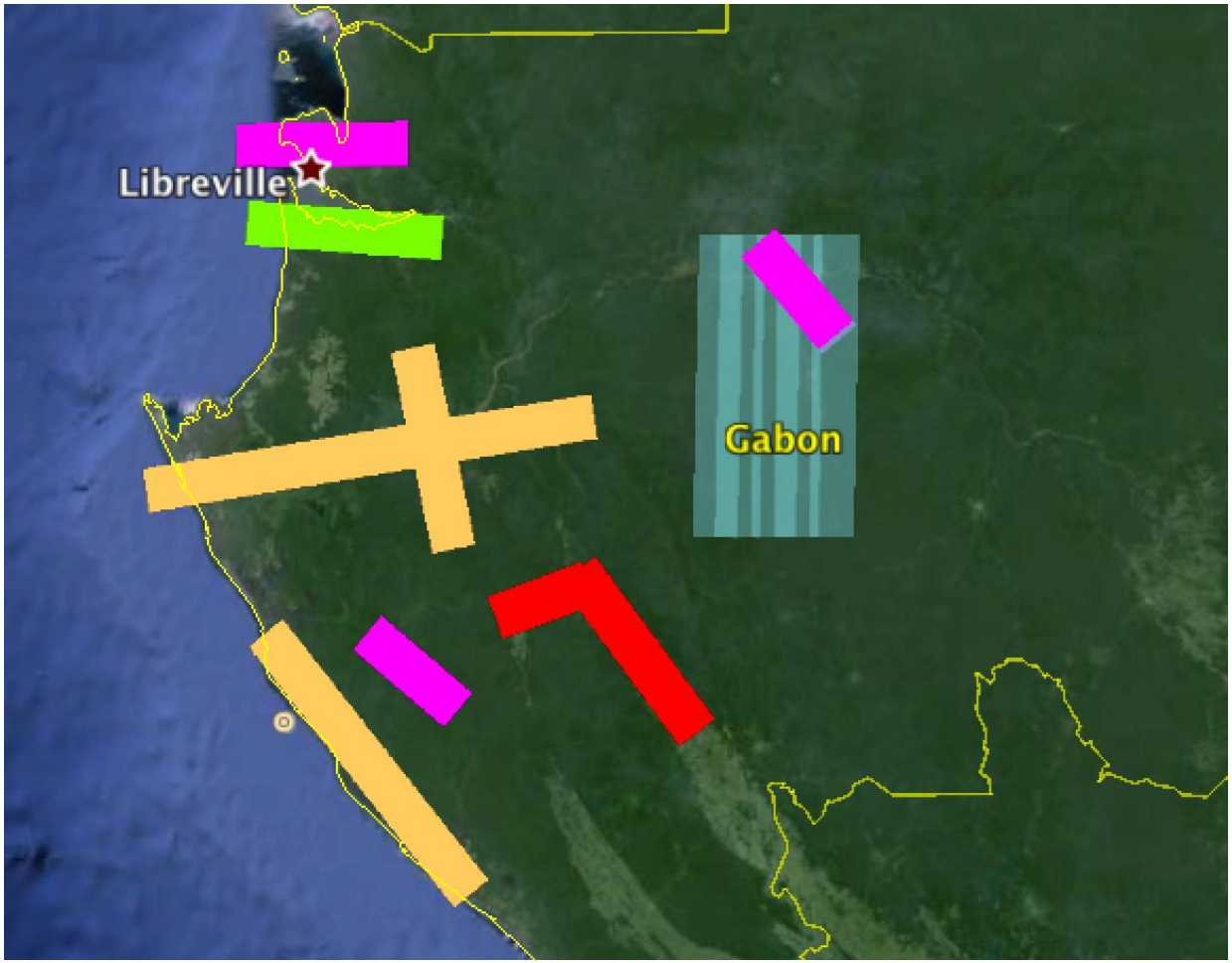


Proposed UAVSAR Imaged Areas

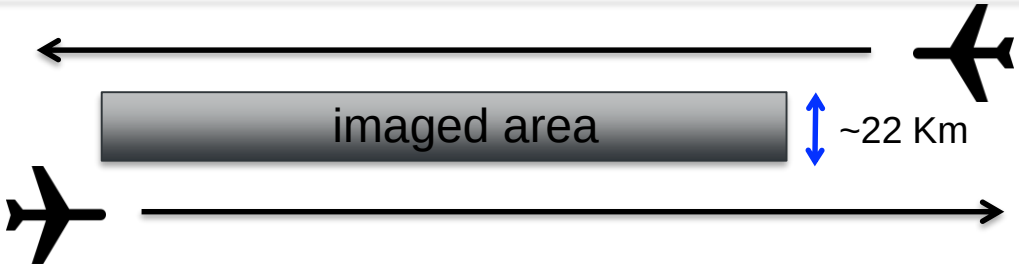
DLR/ESA Calibration and Validation Sites

Pongara Mangroves

Ogooue River Basin and Wetlands

Lope National Park mosaic

Mouilla Low Biomass



UAVSAR is a left-looking instrument.

Summary of UAVSAR Acquisitions

Gabon Deployment: 20 Feb. – 19 Mar., 2016

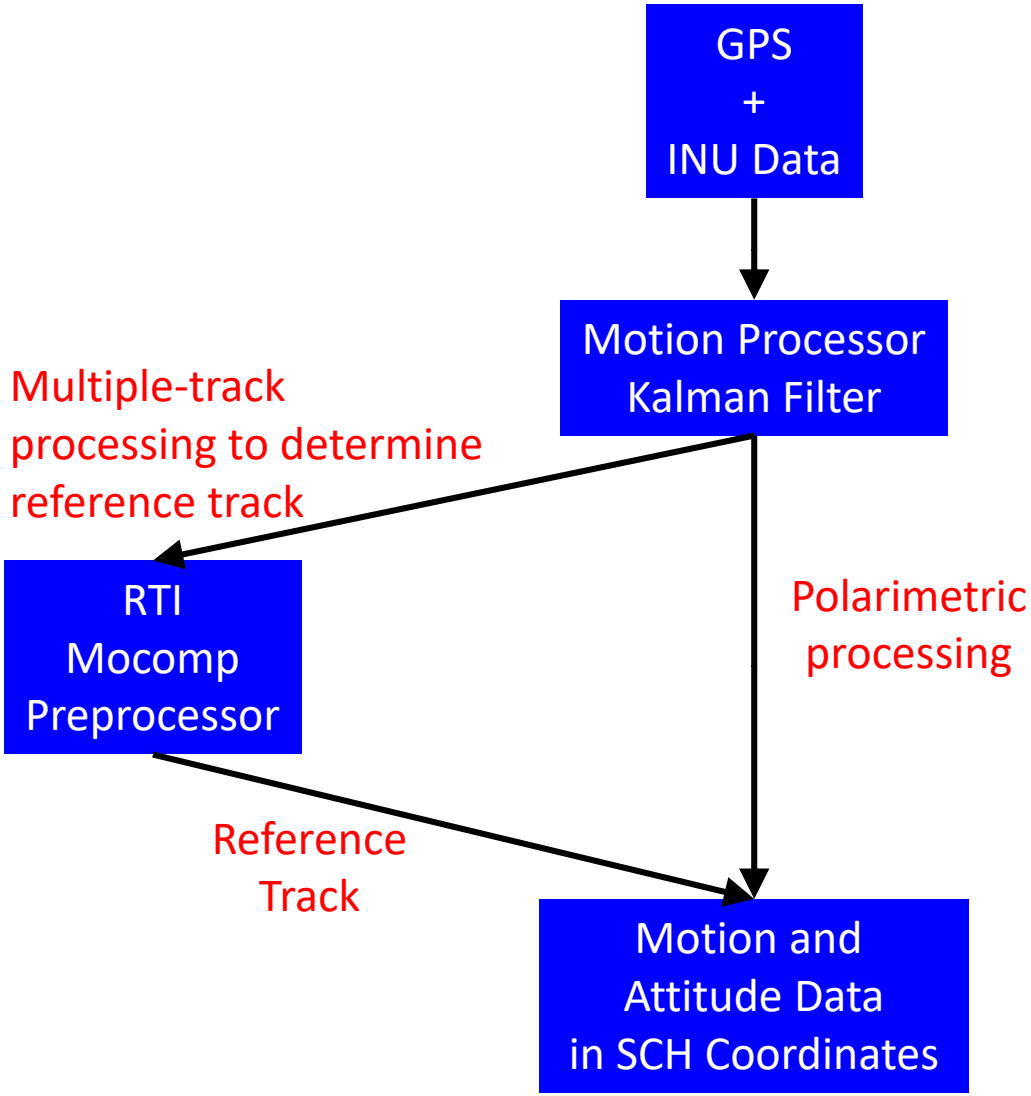
Site Name	Type	Supported mission	Supported Science Product	Flown
Mondah	Primary	ESA Cal/Val	Forest vertical structure	Flight 1: 10 Flight 2: 9
Mondah		ESA Cal/Val	Ancillary dataset showing temporal variability of SAR signal	7 1 line x 3 flights 2 lines x 2 flights
Rabi		ESA Cal/Val	Forest vertical structure	11
Lopé		ESA Cal/Val	Forest vertical structure	8
Lopé		ESA Cal/Val	12-day repeat	10
Pongara		NISAR	Carbon stocks in coastal ecosystems	5
Mouilla		NISAR	Carbon stocks in low biomass forest	3
Ogooue River		NISAR	Wetland delineation	3
Ogooue River	Secondary	NISAR	Wetland delineation secondary sites	3
Lopé National Park		-	Mosaic for Gabonese collaborators	5

Gabon TomoSAR/PolInSAR Acquisitions

Site Name	Date	Num. of Flight Lines	Altitude Offset (m)
Mondah	6 March, 2016	9	0, 0, 0, 45, 45, 45, 60, 60, 60
Lopé	25 February, 2016	8	0, 20, 40, 60, 80, 100, 120, 0
Pongara	27 February, 2016	5	0, 20, 105, 0, 45
Rabi	28 February, 2016	11	0, 20, 40, 60, 80, 100, 120, 160, 180, 200, 0
Ogooue River	27 February, 2016	2	0, 70
Mouilla	1 March, 2016	2	0, 70

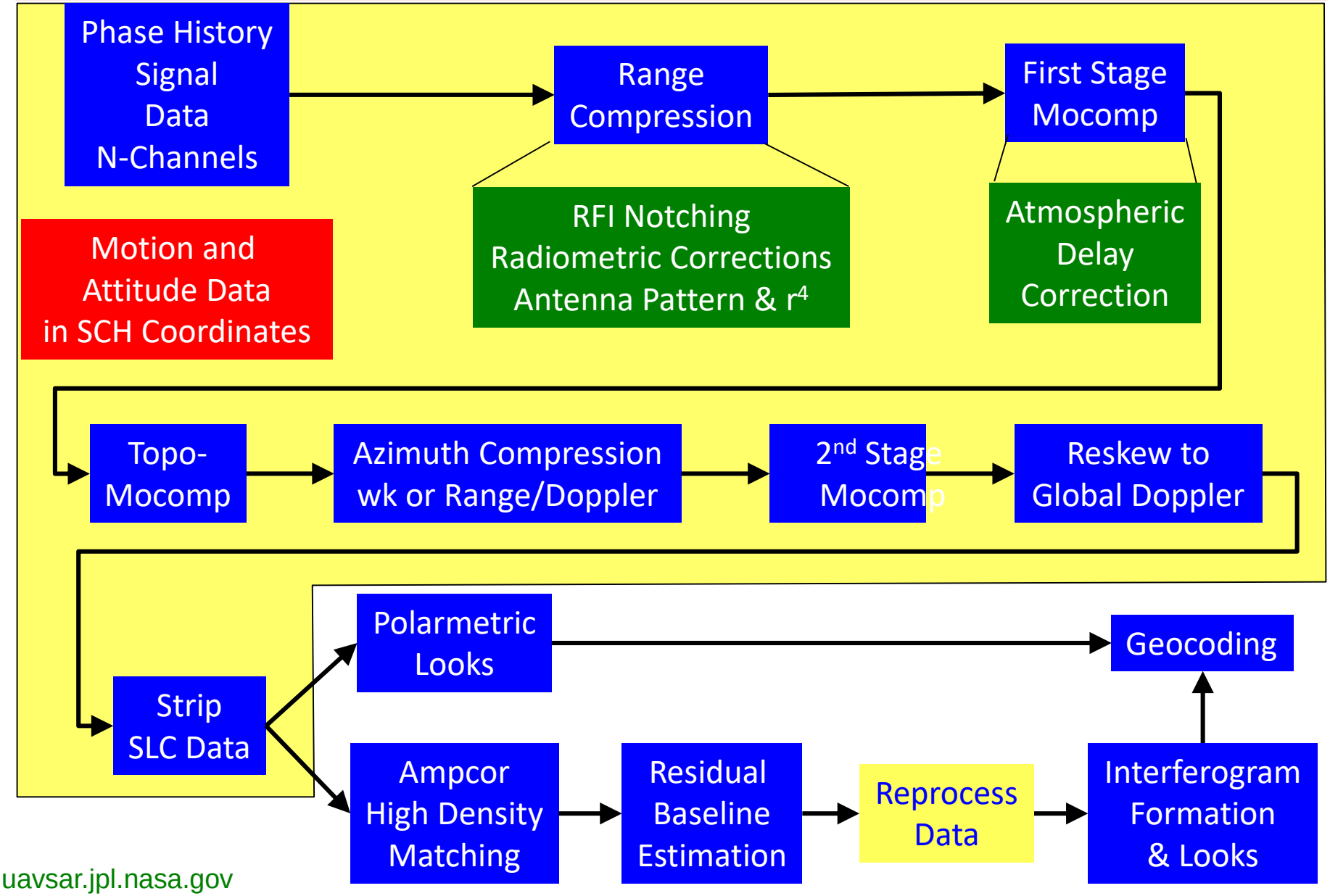
Which site is our study site for cross-comparison with Lidar and other radars?

Processing Flow - I



All flight lines within the stack are motion compensated to one common reference track

Processing Flow - II



Inteferometric L1 Products

For each stack of multi-baseline flight lines, we produce the following:

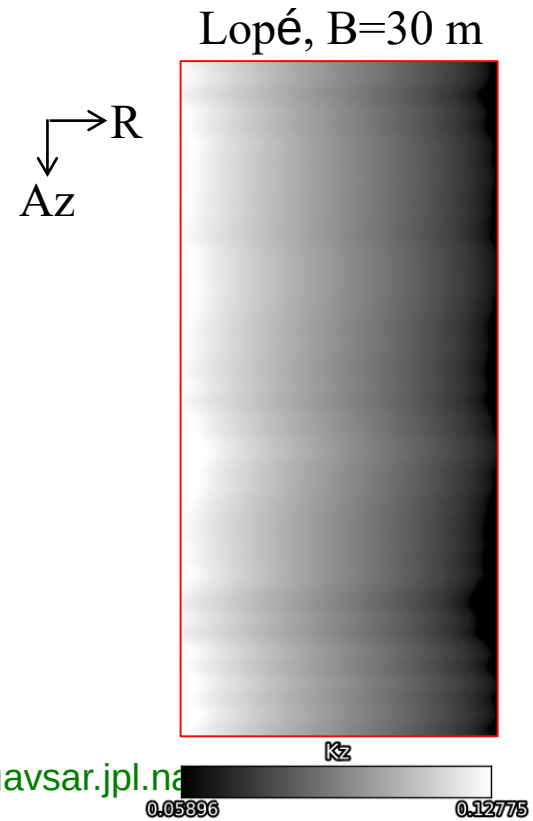
- Single Look Complex (SLC) image for each flight line
  - Resolution: 0.8 m (along track) x 1.8 m (range)
  - Range swath: ~ 22 km
- Lat/lon/height file for each pixel in the SLC image
- Vertical wavenumber (Kz) map for each flight line w.r.t. the reference track
- Line-of-sight vector for the reference track in double precision
- DEM fringe layer used in motion compensation
- Baseline vector for each flight line w.r.t. the reference track

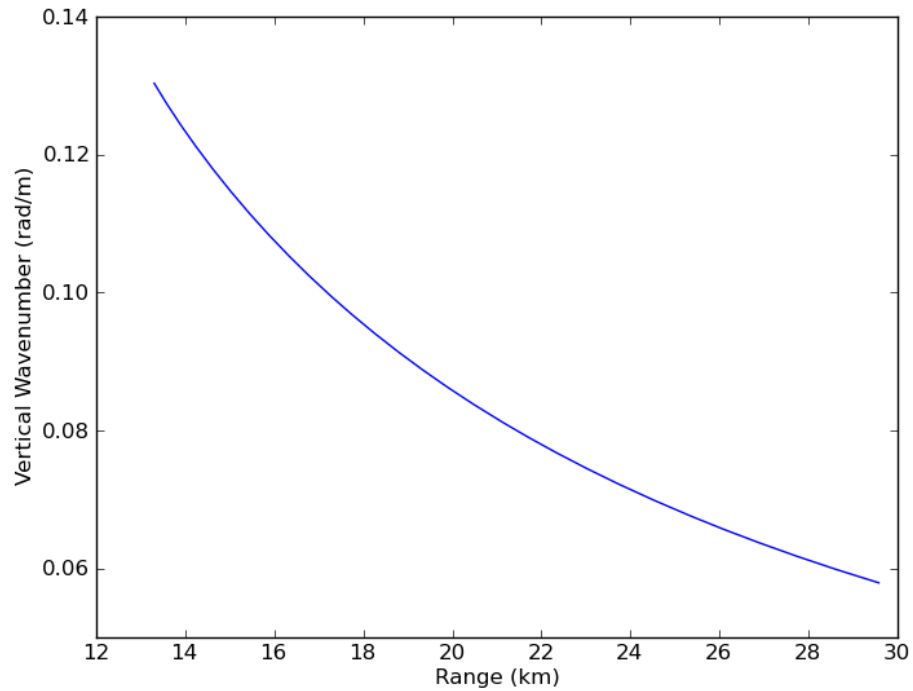
Vertical Wavenumber (Kz)

- Sensitivity of interferometric phase to topographic height.

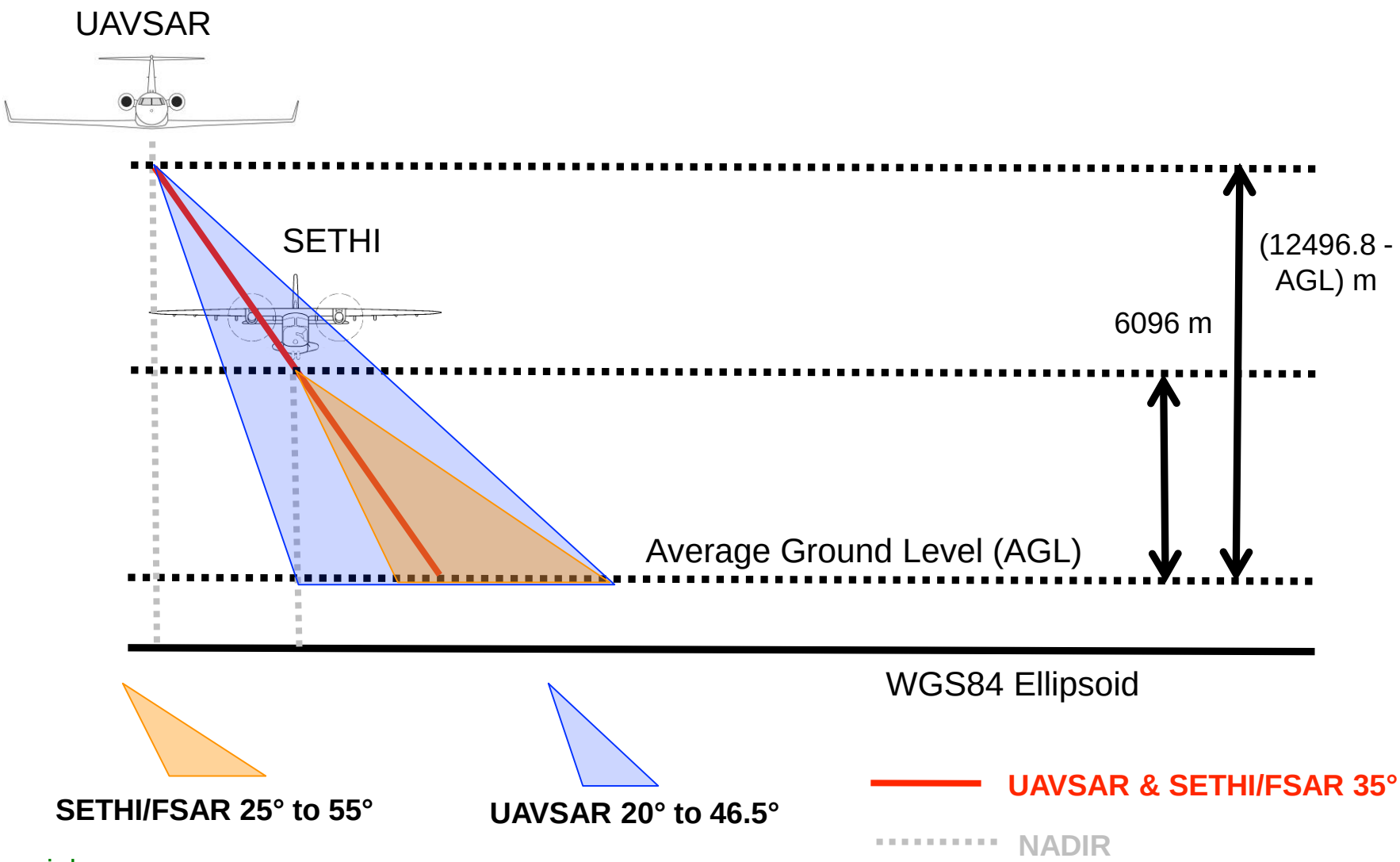
$$k_z = \frac{\partial \phi}{\partial h} \approx \frac{4\pi}{\lambda} \frac{B_\perp}{\rho \sin \theta_l}$$

- Implemented full vector equation.





Imaging geometry at Cal/Val TomoSAR sites



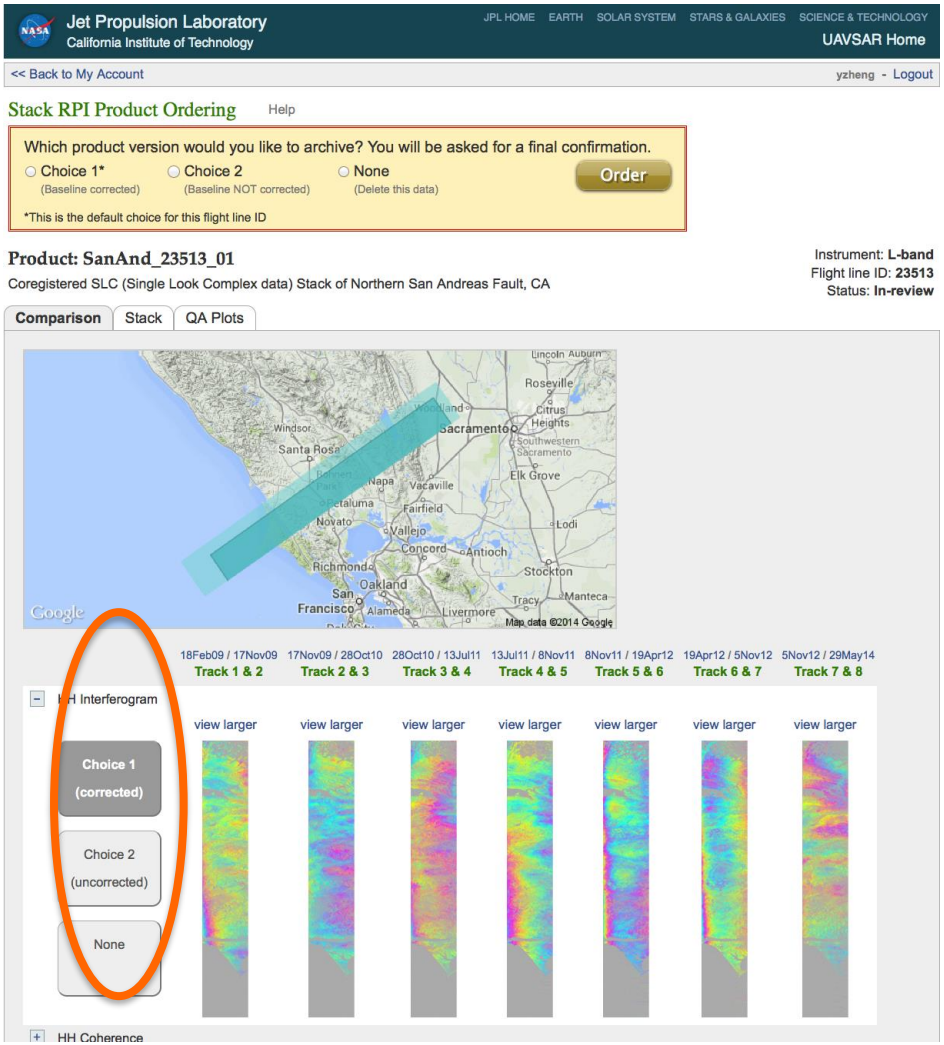
Interferometric L2 Products

- Canopy height map from PolInSAR pair of flight lines
  - Corresponding height uncertainty map
- Forest structure profile products
  - How many slices per TomoSAR stack?
  - Height profile (and uncertainty) per slice
- Biomass map from radar backscatter (and canopy structure?)

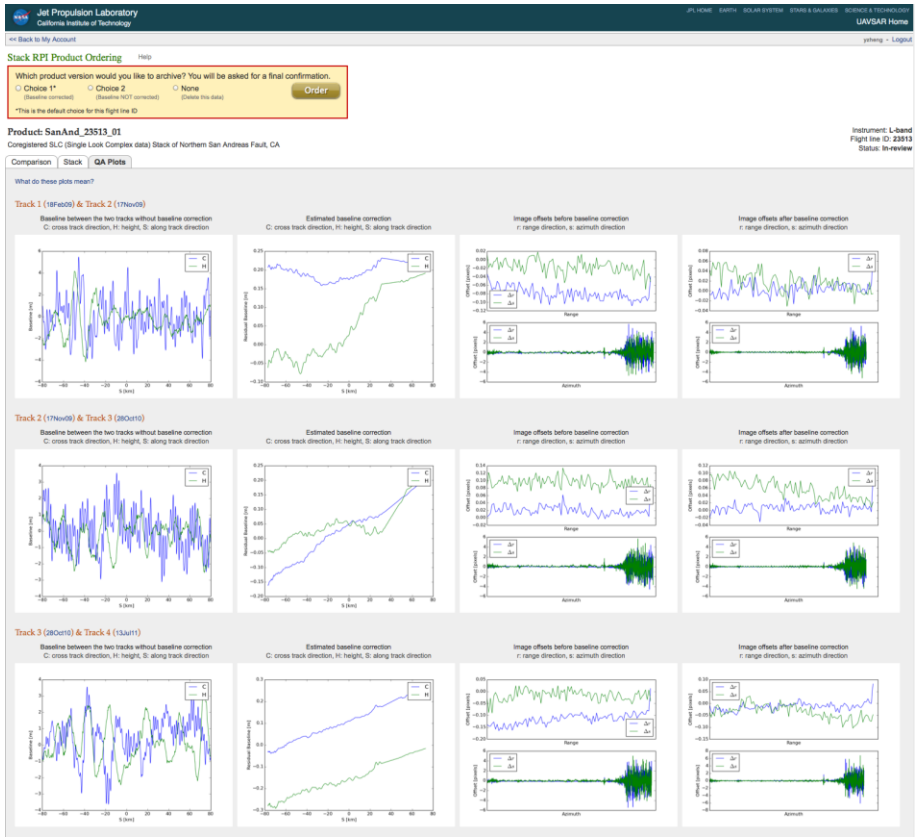
SLC Stack Review

Review page: *Sequential-Pair interferograms are shown, along with coherence and offset maps. PI does product QA using these thumbnail images and QA Plots.*

Comparison Images



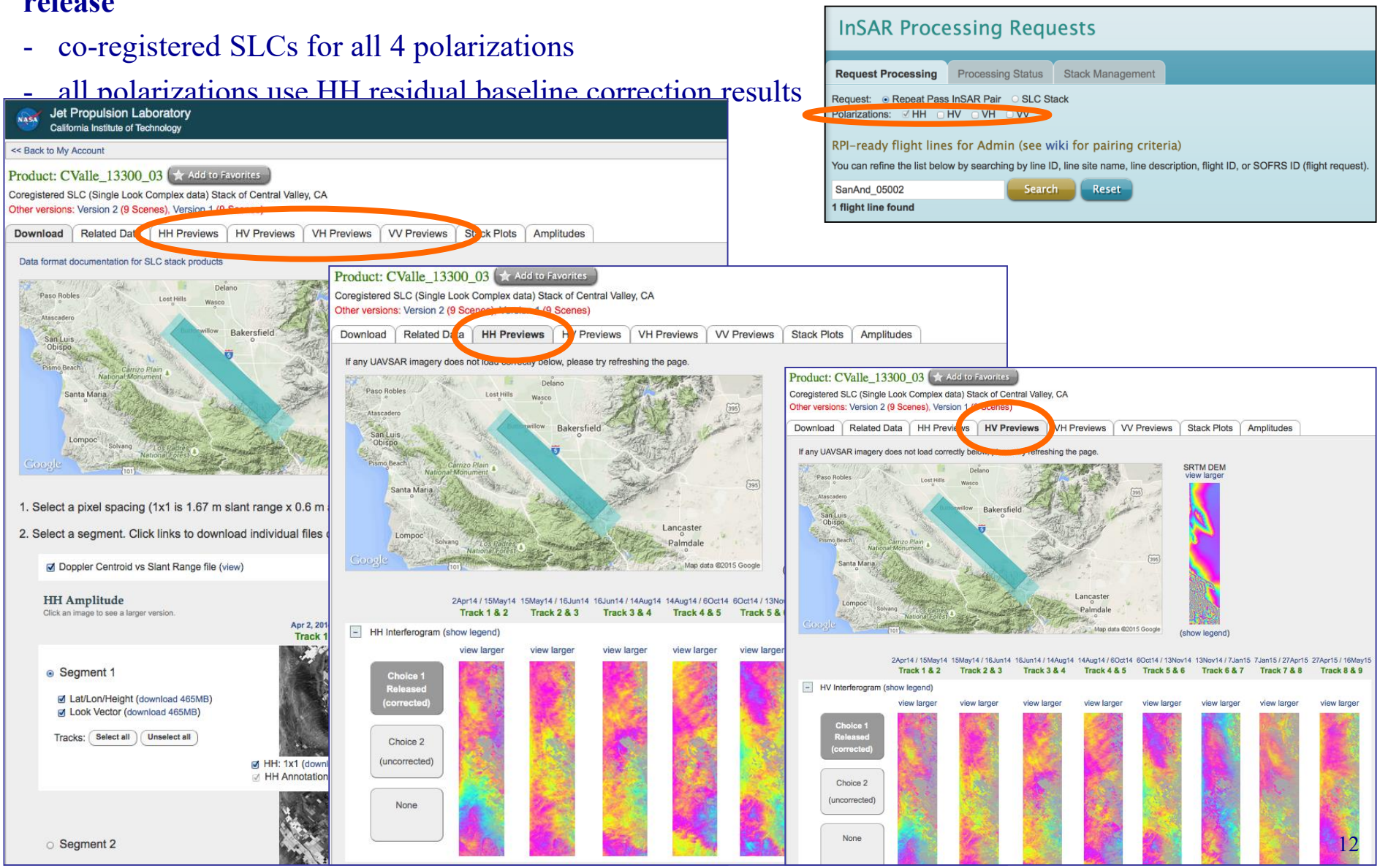
QA Plots



Polarimetric Interferometric Processing

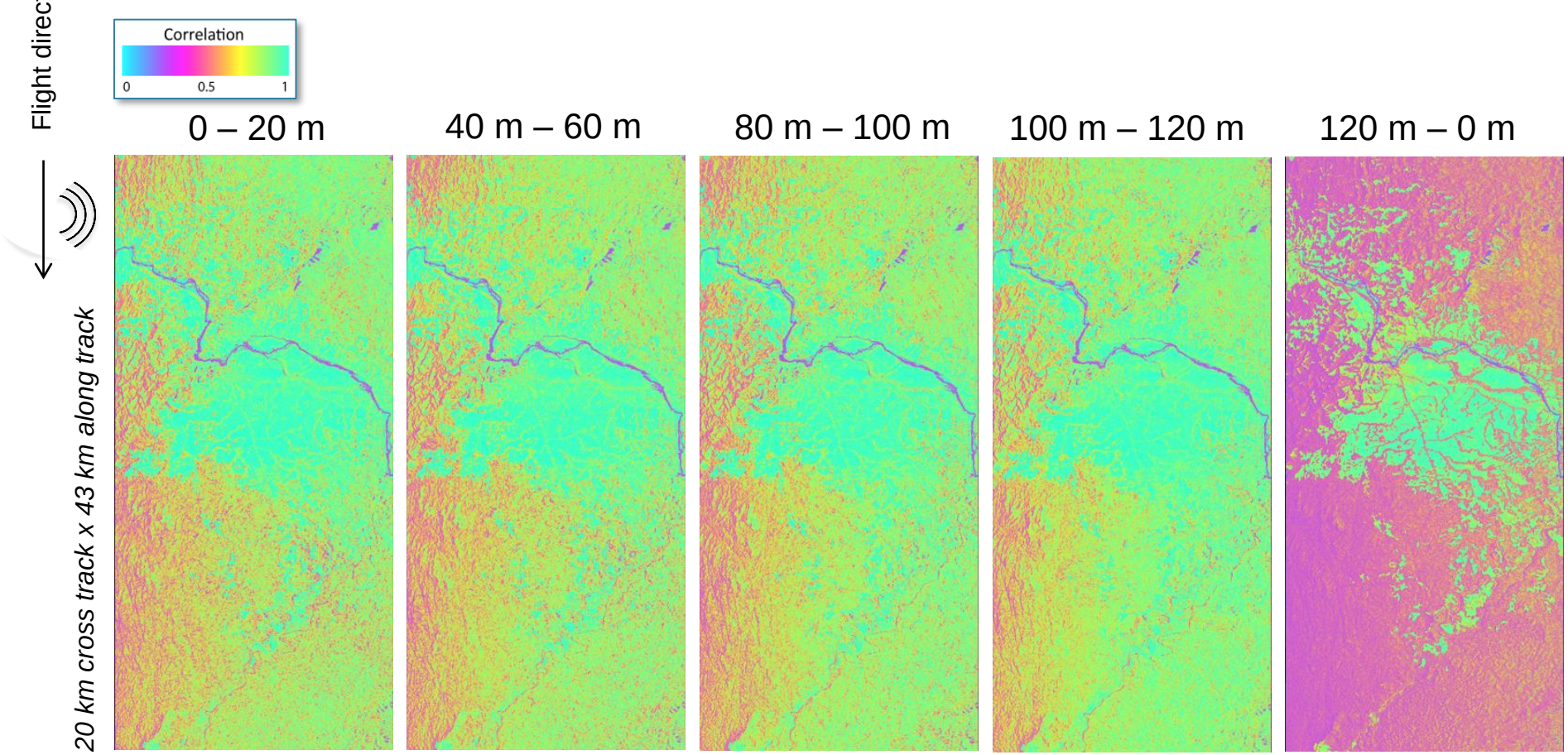
Quad-pol Interferometric processing (including InSAR Pairs and SLC Stacks) is ready for public release

- co-registered SLCs for all 4 polarizations
- all polarizations use HH residual baseline correction results



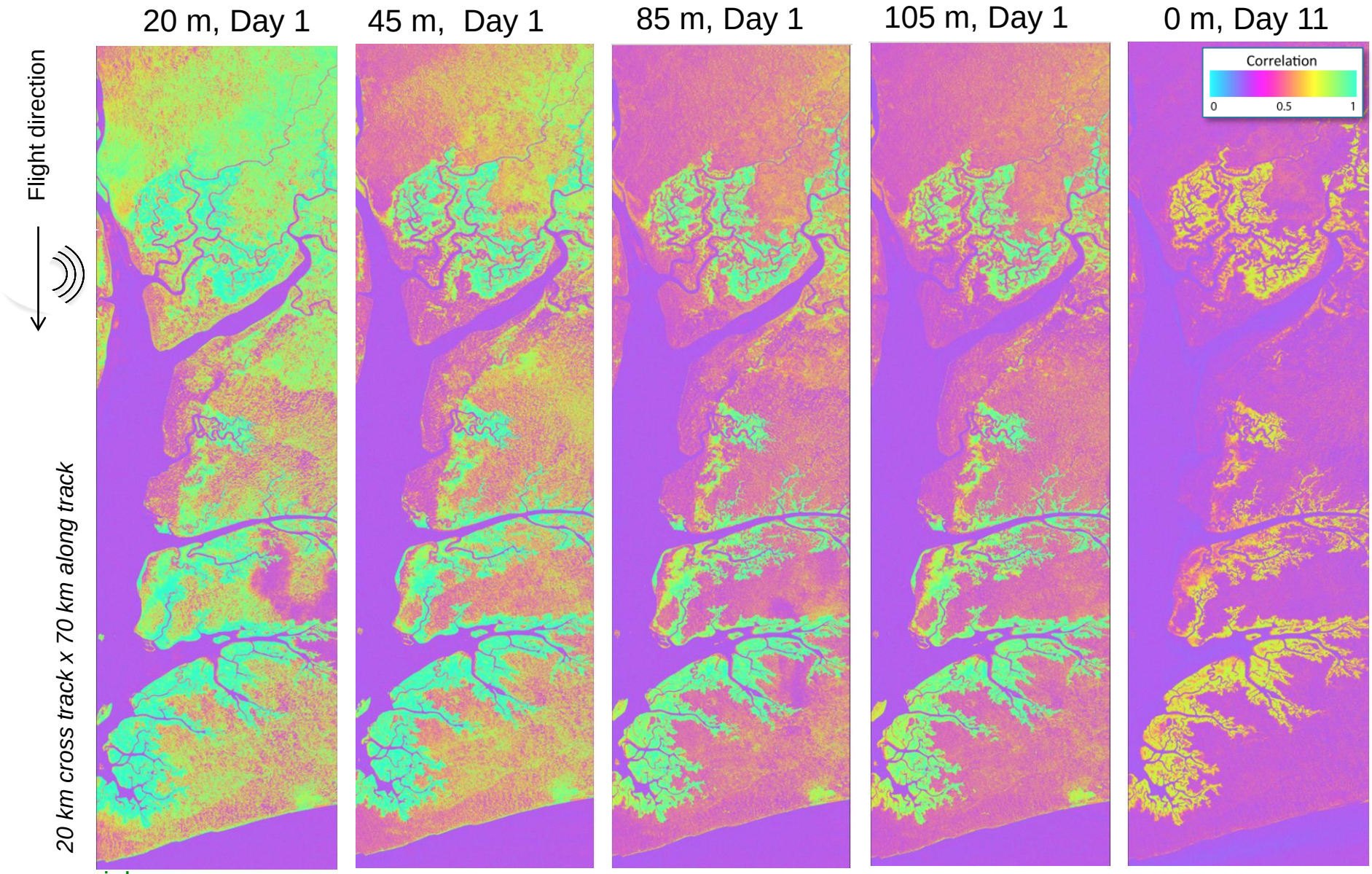
UAVSAR HH Polarization Coherence at Lopé NP as a Function of Altitude Separation

A stack of 8 data takes were acquired over Lopé National Park at slightly offset altitudes to form the following baselines: 0, 20m, 40m, 60m, 80m, 100m, 120m



UAVSAR data acquired at slightly offset altitudes on 25 February, 2016

UAVSAR HV Polarization Coherence at Pongara, Gabon as a Function of Altitude Separation



UAVSAR data acquired at slightly offset altitudes as well as on different days. Day 1: February 27 / Day 11: March 8, 2016

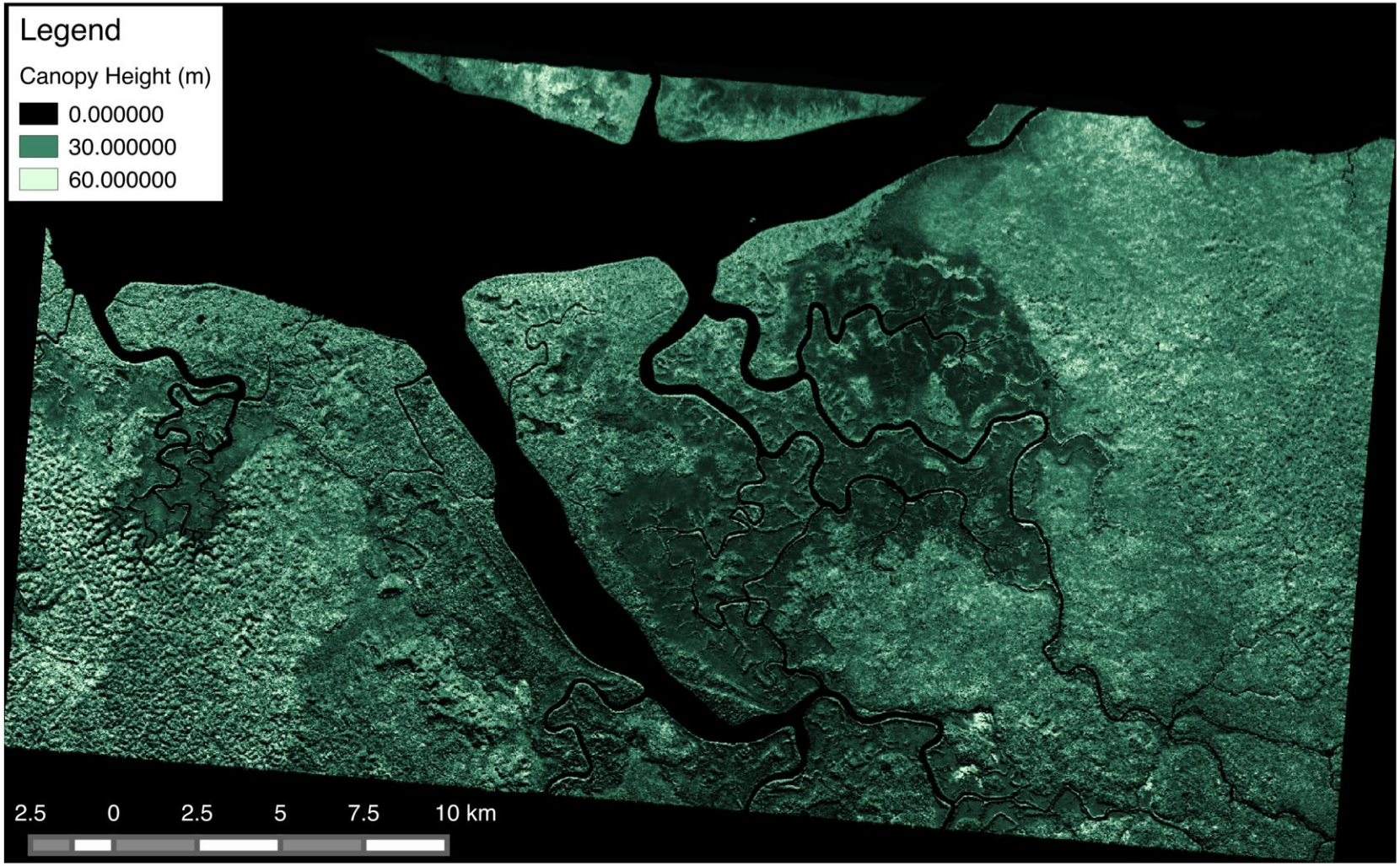
Pongara PolInSAR

Marc Simard / Michael Denbina

~20m Baseline

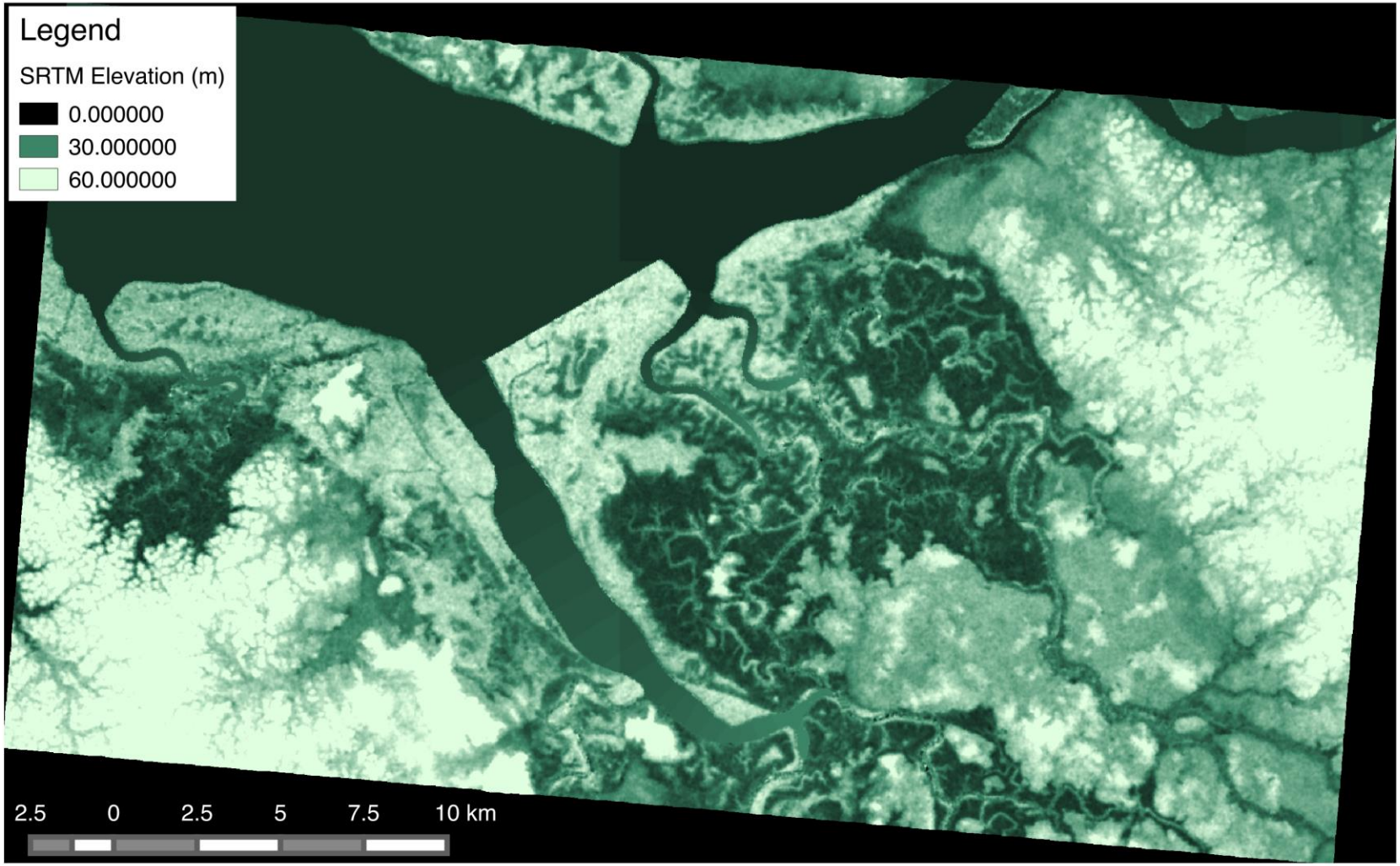
(Lines 27500—27501)

Preliminary Results from UAVSAR compared to SRTM

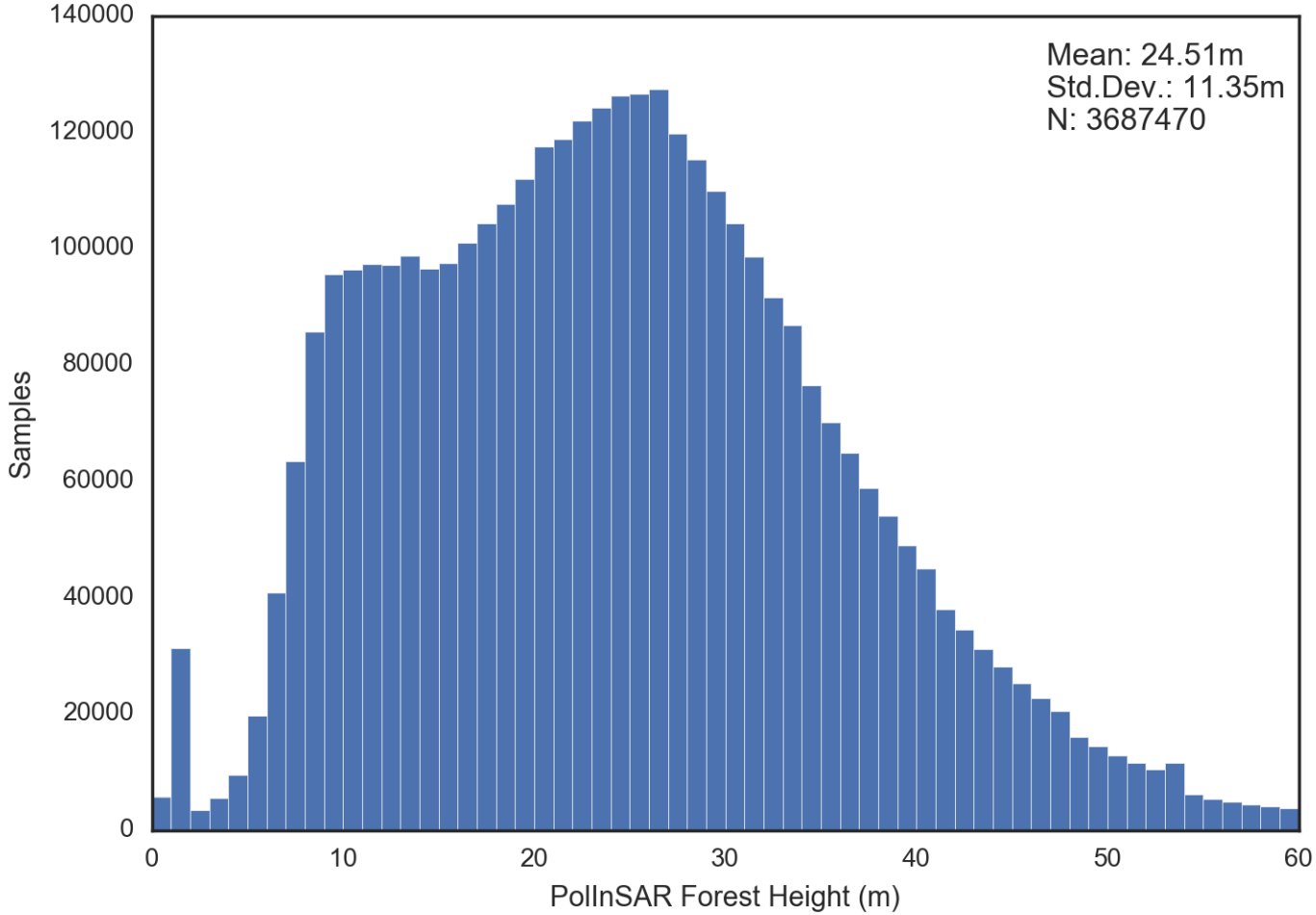


UAVSAR PolInSAR Forest Height Estimated from Single-Baseline RVoG Model
Fixed Extinction: 0.5 dB/m

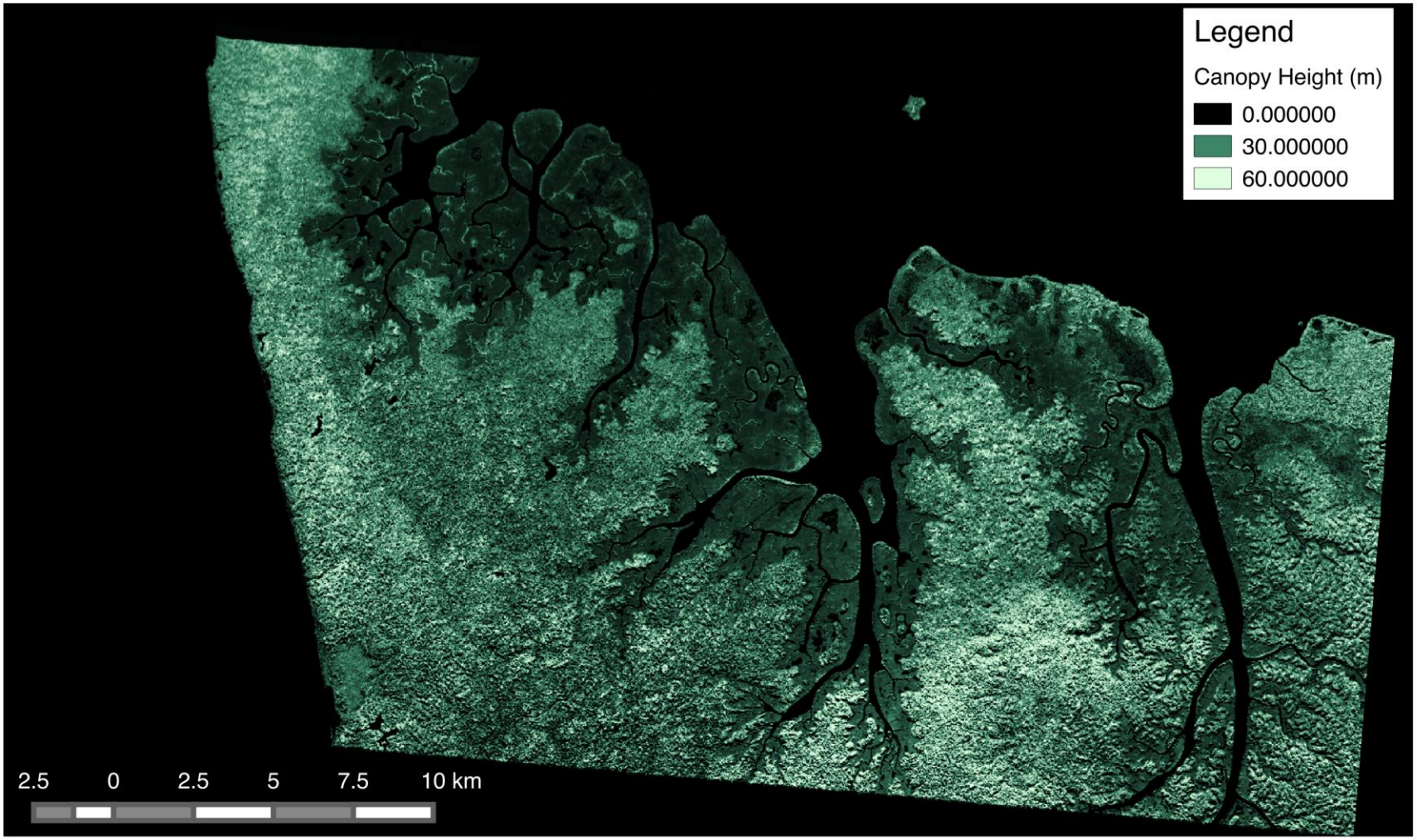
Preliminary Results from UAVSAR compared to SRTM



SRTM Digital Elevation Model


Mean: 24.51m
Std.Dev.: 11.35m
N: 3687470
Samples
PolInSAR Forest Height (m)
0
20000
40000
60000
80000
100000
120000
140000
0
10
20
30
40
50
60

Preliminary Results from UAVSAR compared to SRTM



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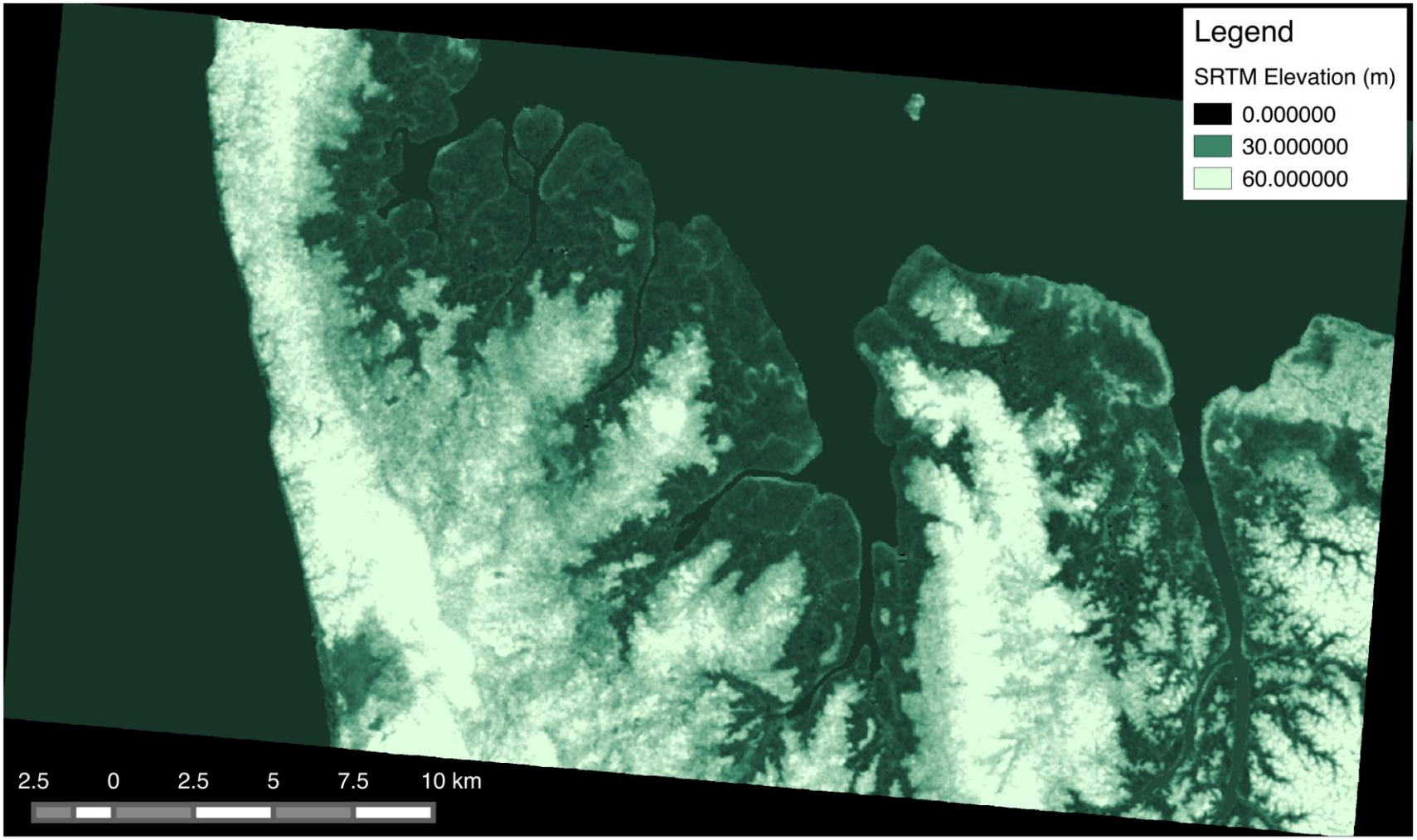

SRTM Digital Elevation Model