GABONX / AFRISAR-2:
Airborne SAR Campaign Over Tropical Forests in Gabon

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GABONX 2023

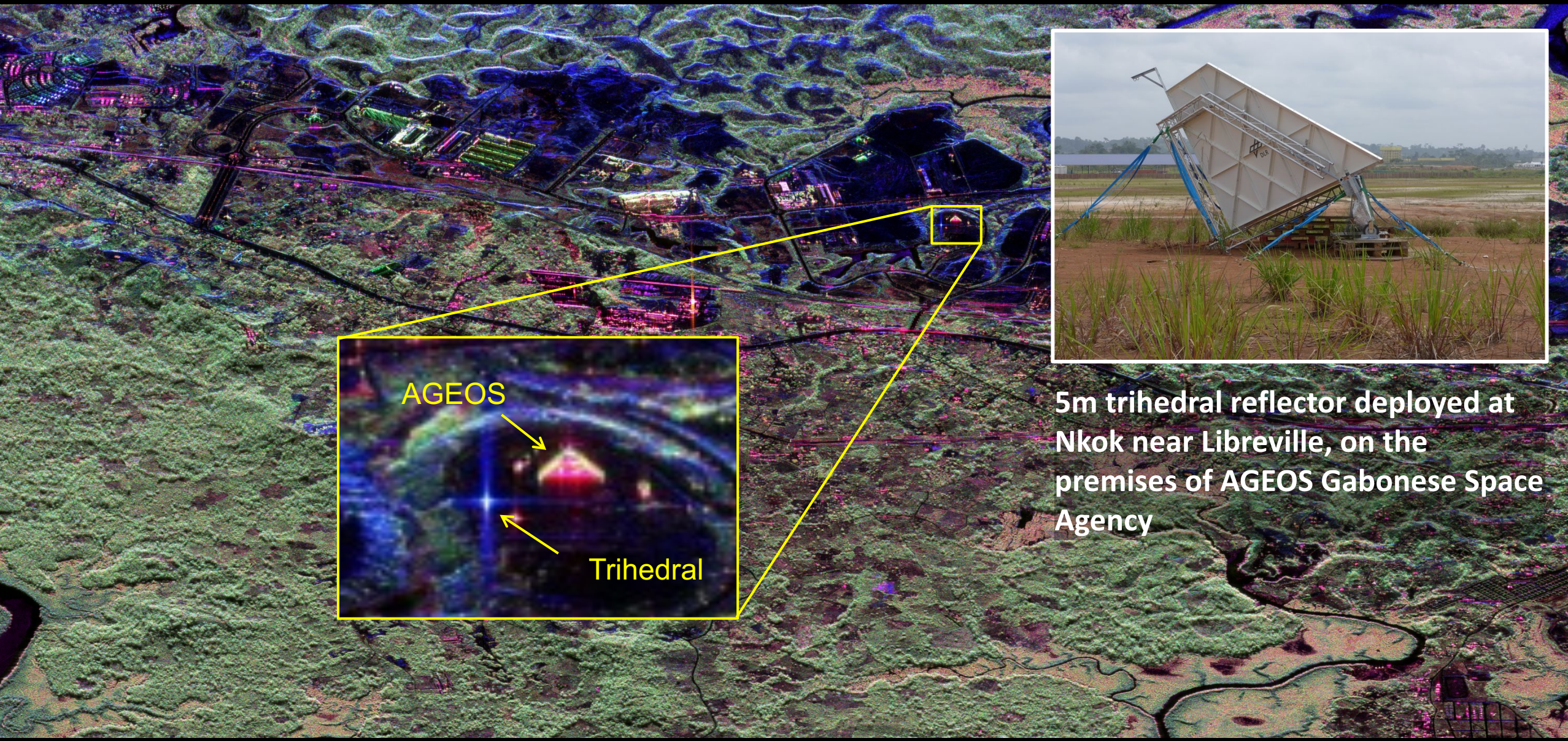
Science goals:

Measure **quantitatively changes** over tropical forest (7 years difference).

- Sensitivity of P-band **intensity, polarimetry and interferometry** signatures with respect to AFRISAR 2015/16.
- Document statistics on **temporal coherence** at L-/P-band for time intervals up to 6 days.
- Relate L-/P-band changes between AFRISAR-1 and AFRISAR-2 to **biophysical states** of the forest and land cover.
- Provide feedback on **forest biomass validation methods** and BIOMASS forest product validation concept (e.g. sampling, in-situ measurements, role of lidar).
- **Simulate ROSE-L Level 1 SAR products** for selected scenes.
- Document the **sensitivity** of L-band intensity, polarimetric and interferometric radar signatures to **forest conditions** (biomass, forest structure, terrain slope, deforestation, degradation)
- Develop a consolidated **multi-source tabular database** (MSTD) consisting of averaged radar signatures and correlative data including uncertainty estimates extracted over pre-defined regions of interest.

Testsite GABONX 2023

Nkok – Calibration Site in 2016 and 2023

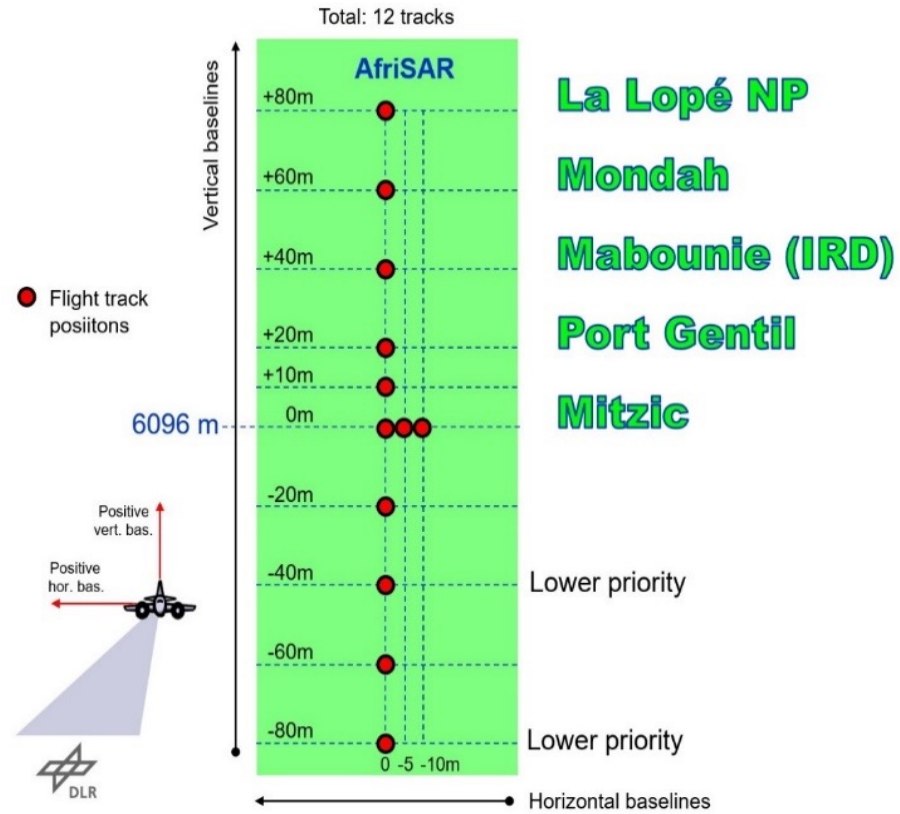


5m trihedral reflector deployed at Nkok near Libreville, on the premises of AGEOS Gabonese Space Agency

F-SAR L-Band, 100 MHz, Pauli (HH-VV,HV,HH+VV)

Flight configuration

- Observation with same flight configuration as in 2016 (focus on P-band)
- New: Baselines in 2023 adjusted to L-band
- New: 6 days repeat observations
- New: -40m and -80m lower prio flight lines
- New: Two test sites (Port Gentil / Mitzic)

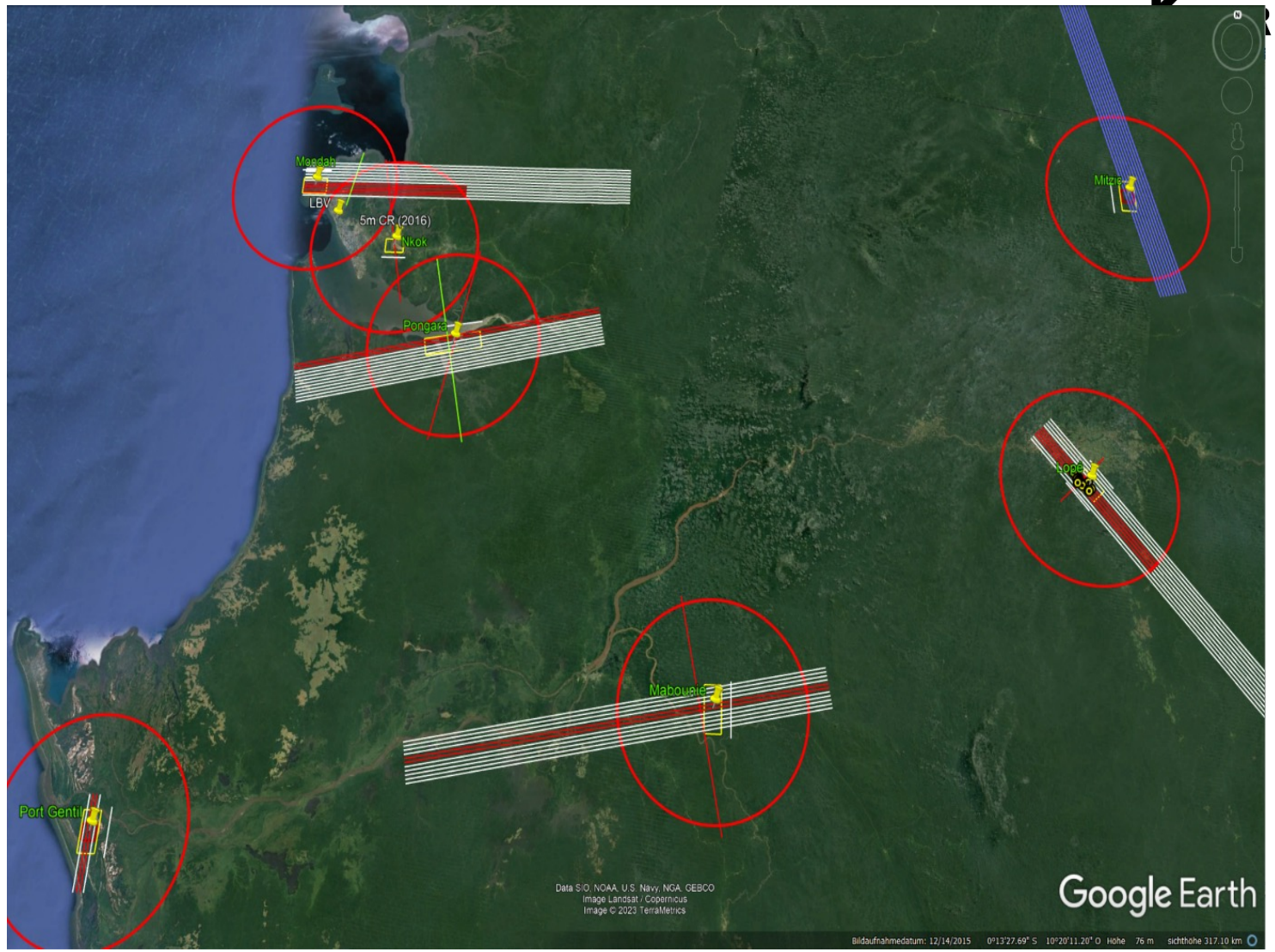


Test Site (2016/2023)	/BL: vertical (2016/2023)											BL: horizontal		
La Lopé NP (2FL)	-80	-60	-40		-20	0	10	20	40	60	80	0	5	10
Mondah(2FL)	-80	-60	-40	-30	-20	0	10	20	40	60	80	0	5	10
Mabounie (2FL)	-80	-60	-40		-20	0	10	20	40	60	80	0	5	10
Port Gentil (1FL)	-80	-60	-40		-20	0	10	20	40	60	80	0	5	10
Mitzic (1FL)	-80	-60	-40		-20	0	10	20	40	60	80			

Irena Hajnsek, PolinSAR Workshop, 19.06.-23.06.2023 – irena.hajnsek@dlr.de

GABONX 2023: NASA Airborne Lidar Data

- LVIS airbrone Lidar from NASA
- Measurement flights from May 19 to June 01
- Base station Sao Tome
- LVIS flight lines overlap F-SAR flight lines (coordinated campaign)



White lines LVIS tracks

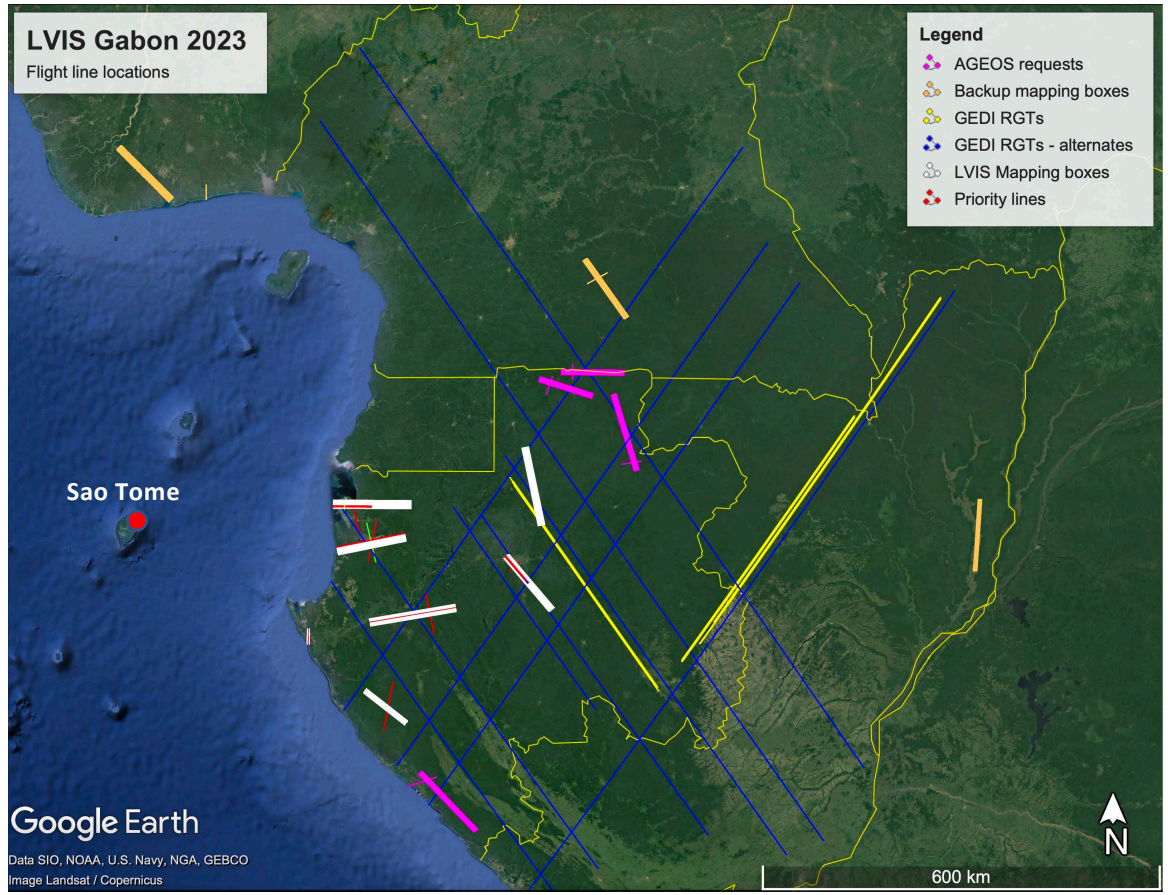
NASA-LVIS Gabon 2023 Mission Overview

- 50 flight hours using NASA LARC G-III aircraft, based out of Sao Tome and Principe:
  - 5/15/23 - 5/16/23 — Install at LARC and local test flight
  - 5/17/23 - 5/18/23 — Transit to Sao Tome and Principe
  - **5/19/23 - 6/1/23 — Science flights (15 days in country)**
  - 6/2/23 - 6/3/23 — Transit home and deinstall

- Instrument suite:
  - **LVIS-C lidar – 20 m footprint, ~1.3 km wide swath (2016 AfriSAR configuration)**
  - LVIS-F lidar – 10 m footprint, ~1.3 km wide swath
  - 2 cameras (150 MPixel and 50 Mpixel)
  - @ flight altitude of 24,000' (i.e., same as 2016), 5 hour flight duration, 350 knots

- Mission priorities:
  - Repeat sections of 2016 AfriSAR data collection for change studies
  - Fly locations coincident with DLR's GabonX, and/or TanDEM-X acquisitions
    - DLR will be in Gabon May 2023; UAVSAR planning for Aug 2023
  - Collect GEDI cal/val-relevant data to inform geolocation and other questions
  - Widen data collection to new sites requested by AGEOS

- LVIS Data Products available at the DAAC within 4-6 months:
  - Products will be similar to those generated for AfriSAR:
  - LVIS Level1B products (geolocated laser waveforms)
  - LVIS Level2 data products (geolocated elevation, height and energy products)
  - Level4 data products (estimated above ground biomass) (UMD/Dubayah/Armston)
  - Where available, LVIS Camera Level1A imagery (geotagged with location and attitude)



Note: Not enough time in-country to do all the lines that are available

Michelle Hofton (mhofton@umd.edu)
Bryan Blair, Lola Fatoyinbo (NASA, GSFC)

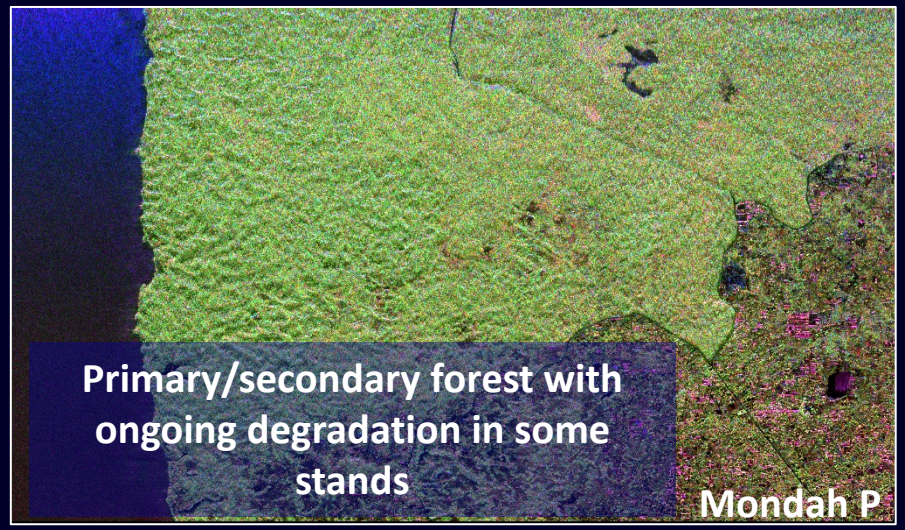
LVIS Performed Measurements

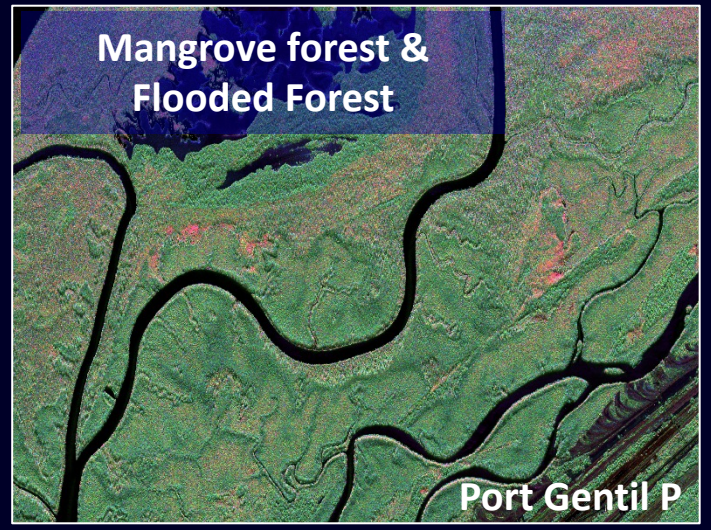
- Good flight conditions
- 2x flown over the test sites

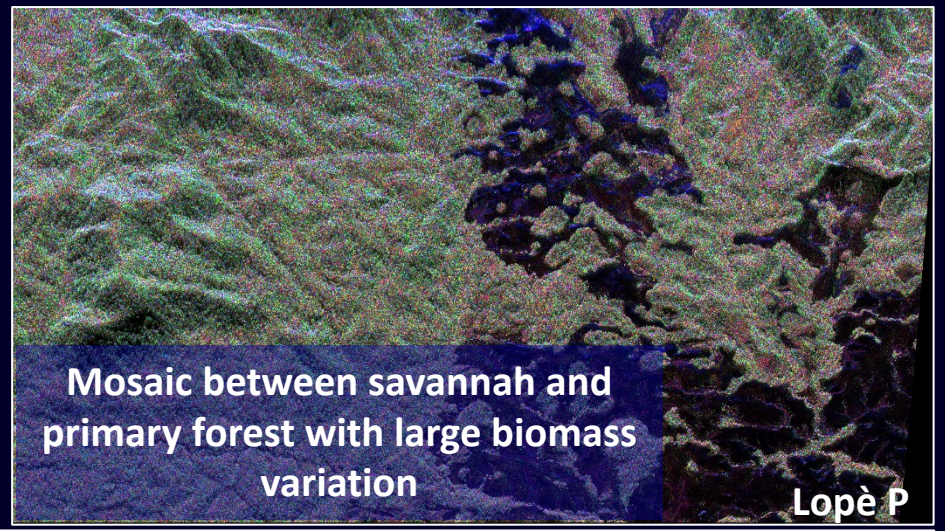
GABONX 2023

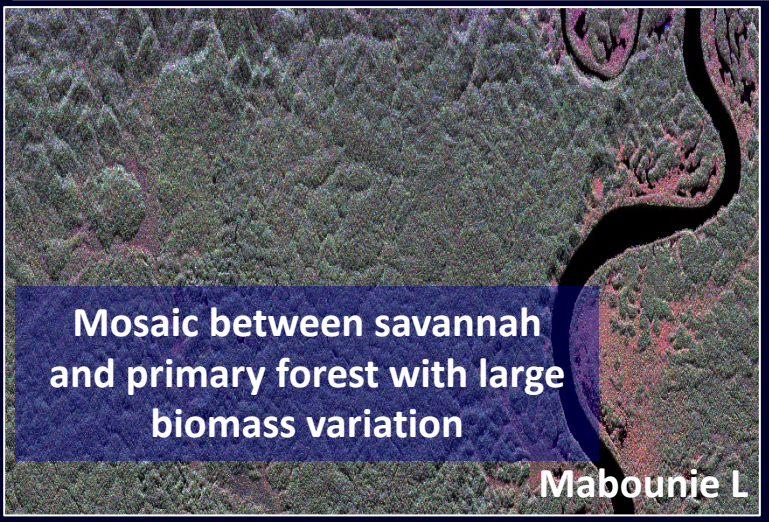
DLR

P: P-band L: Band





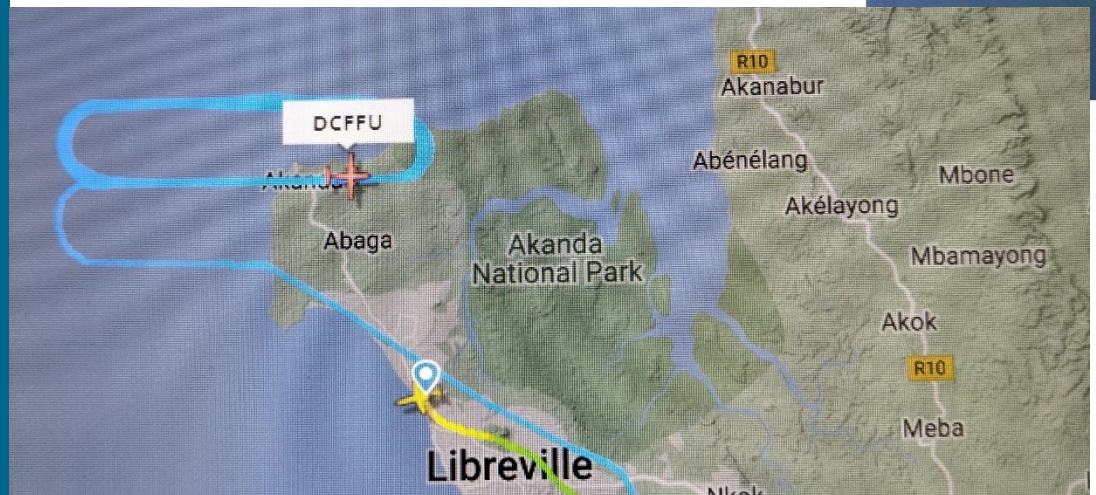




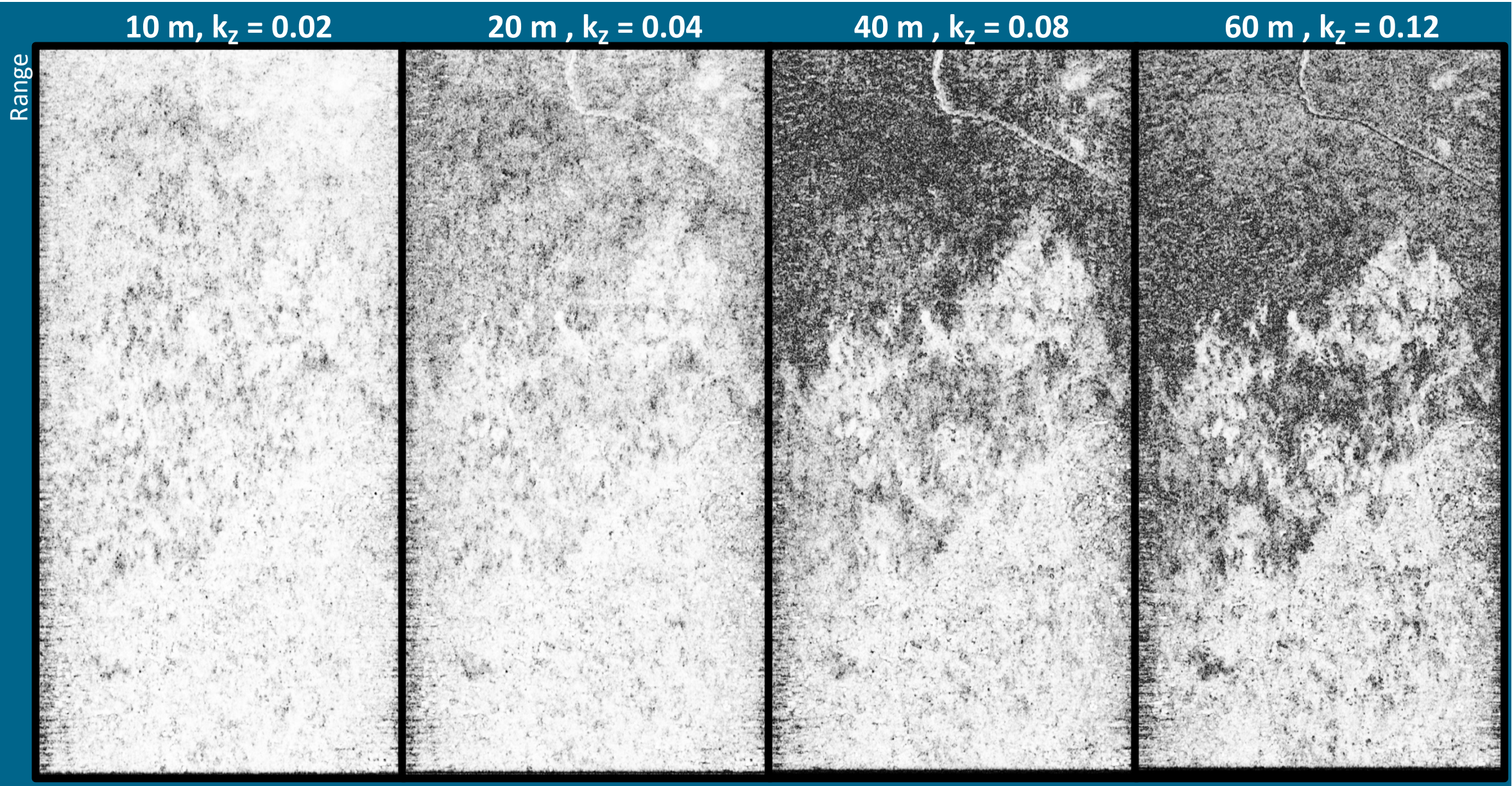
Pauli RGB : HH+VV HV HH-VV

Preliminary Data Assessment: Example Mondah

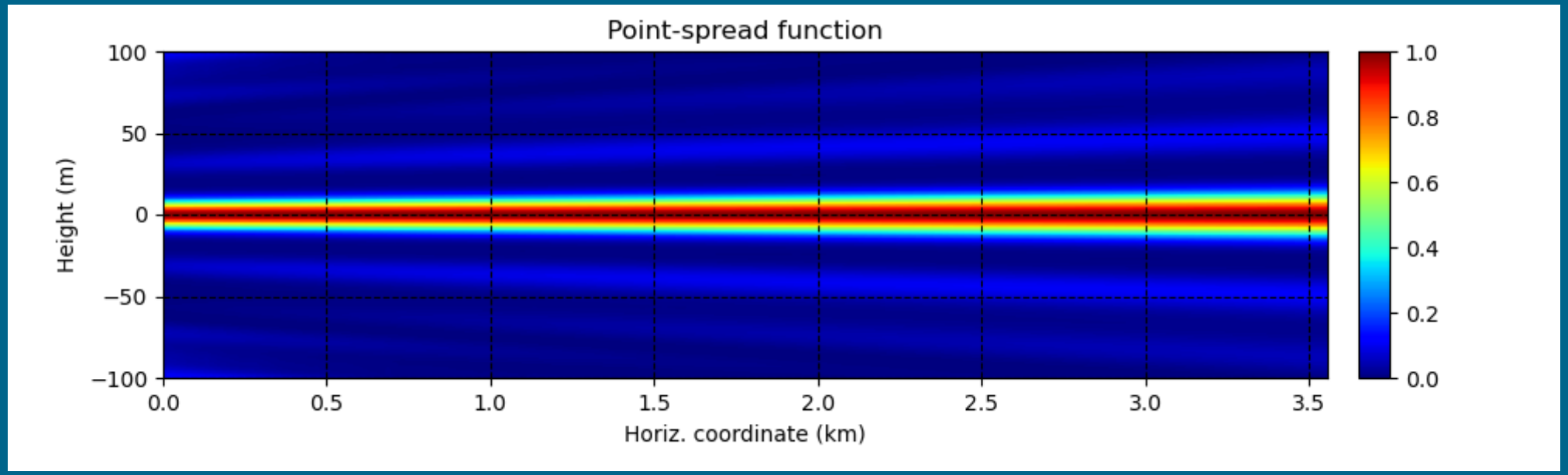
- Reduction of the image (in azimuth) of
- Fully polarimetric tomographic stack was processed for L- and P-band

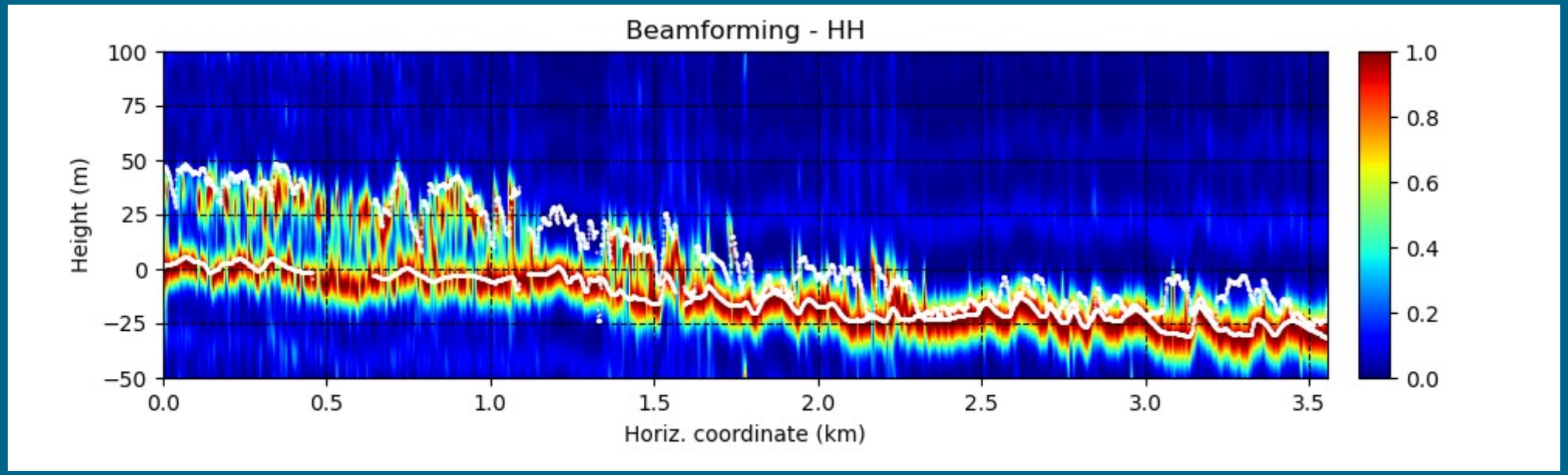


Mondah: Coherences HH, P-band – May 23, 2023



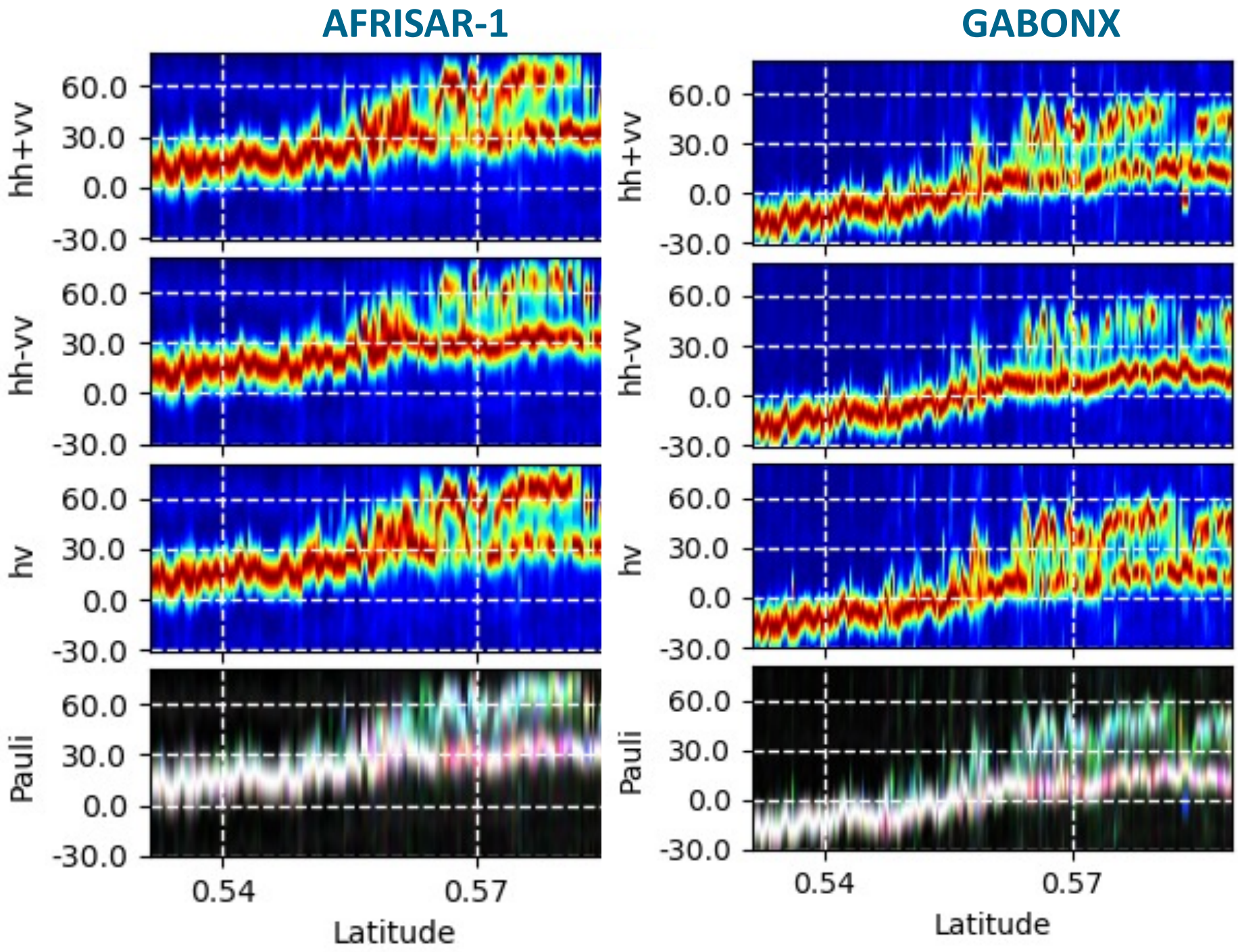
Mondah: P-band profile – May 23, 2023



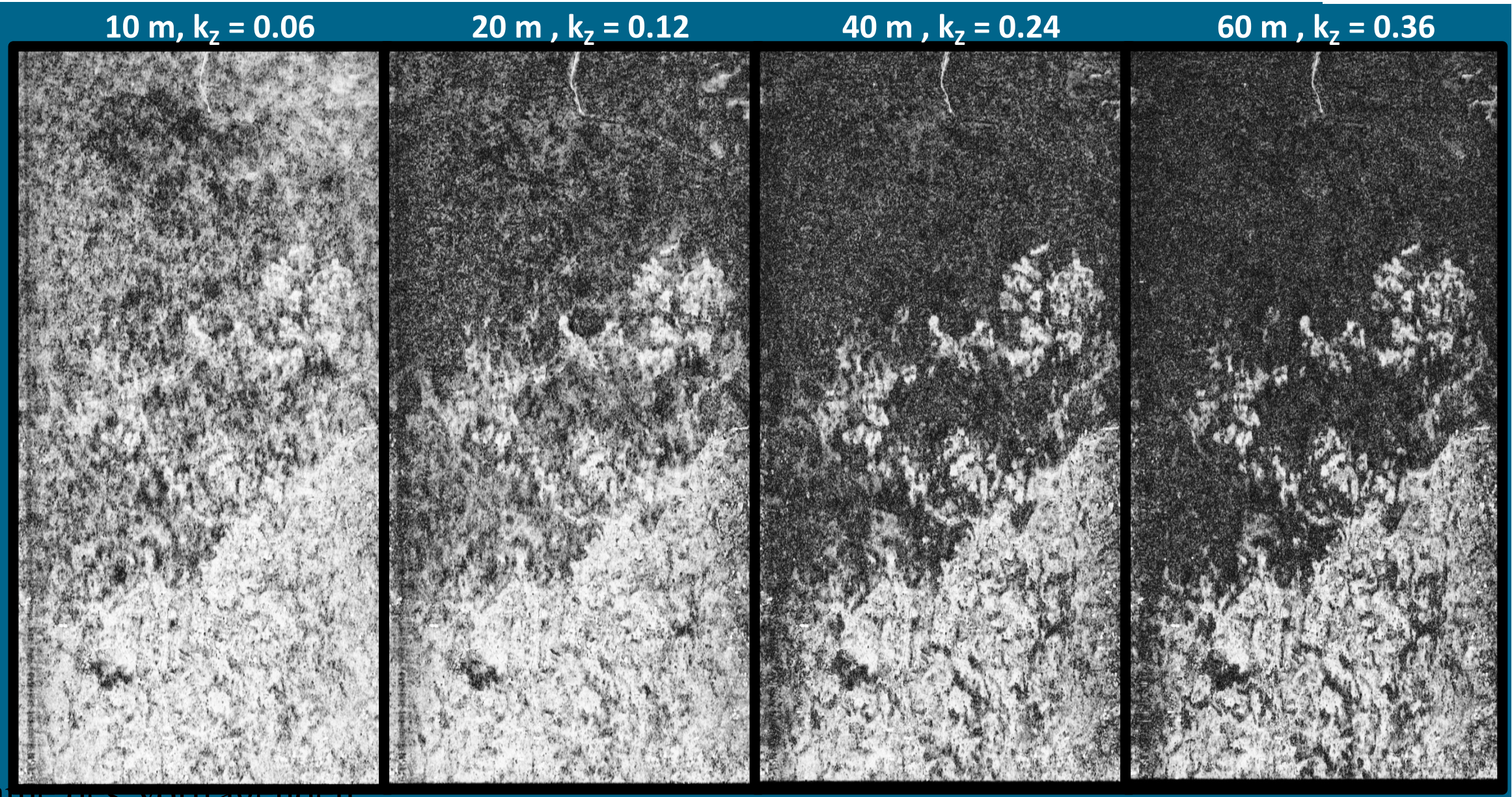


P-band Beamforming Profiles

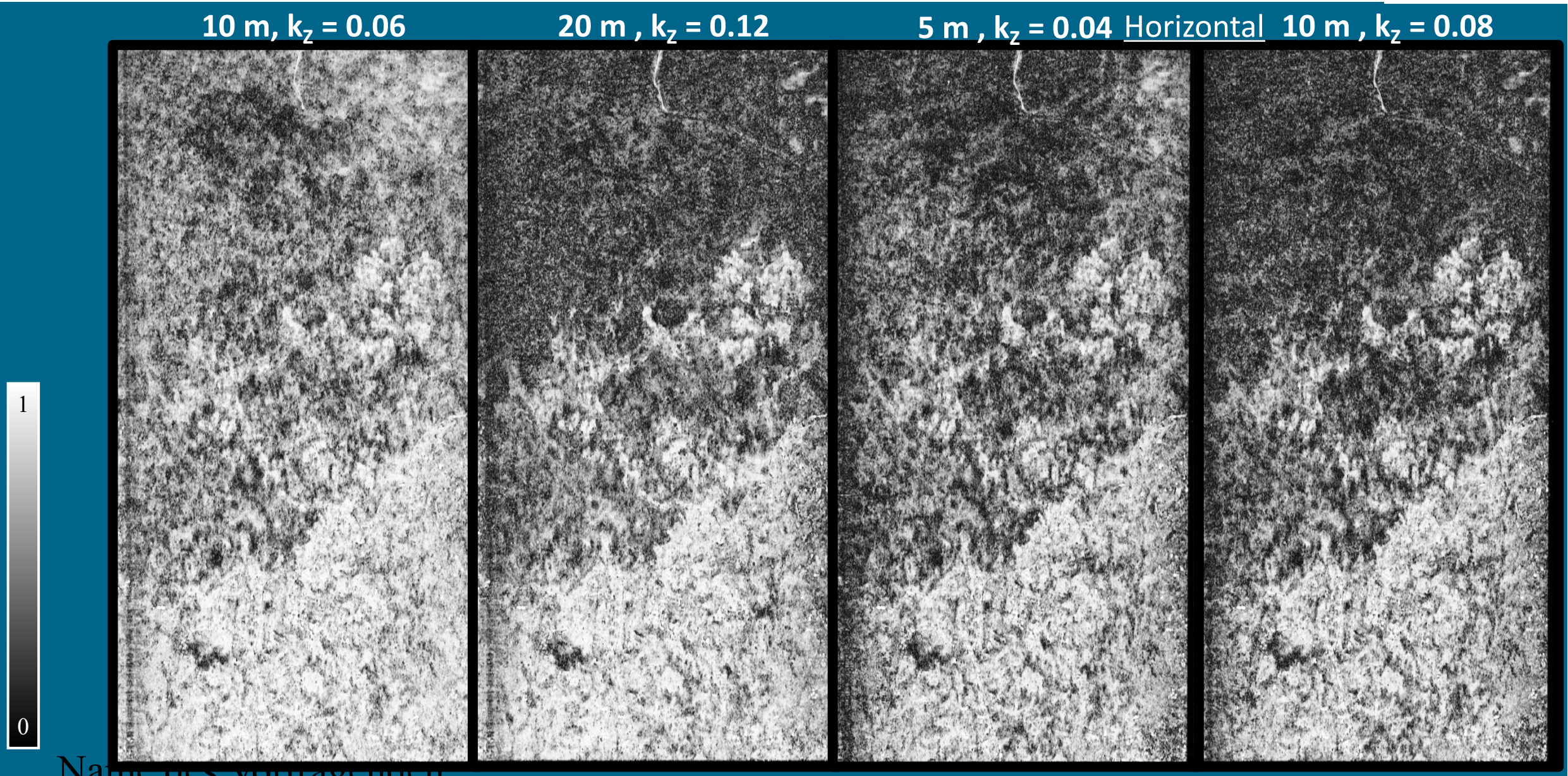
- 12 flight tracks
- Comparison between AFRISAR-1 and GABONX data with good consitency
- Polarisation diversity in TomoSAR
- Note: shift in height due to preliminary processing

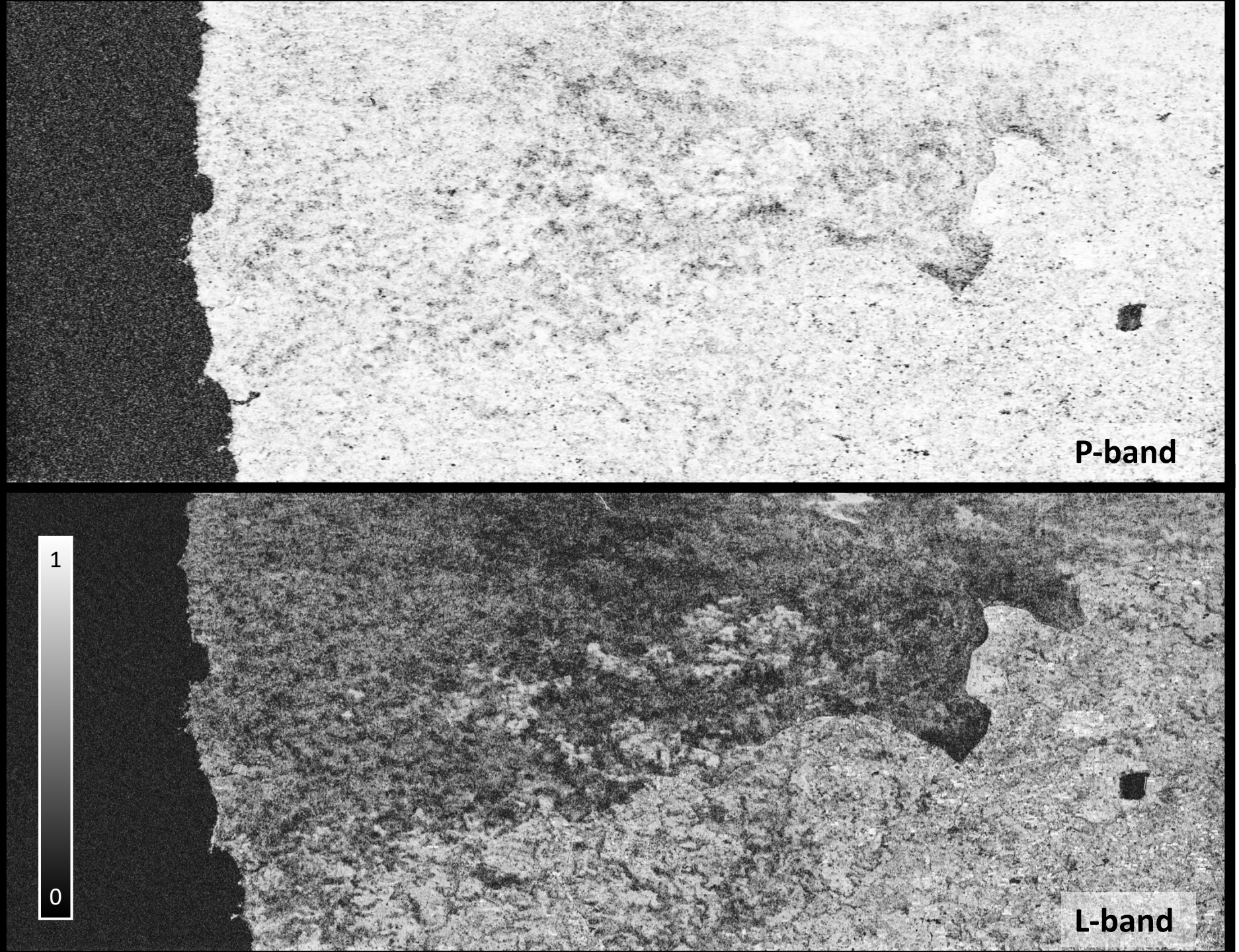


Mondah: Coherences HH, L-band – May 23, 2023



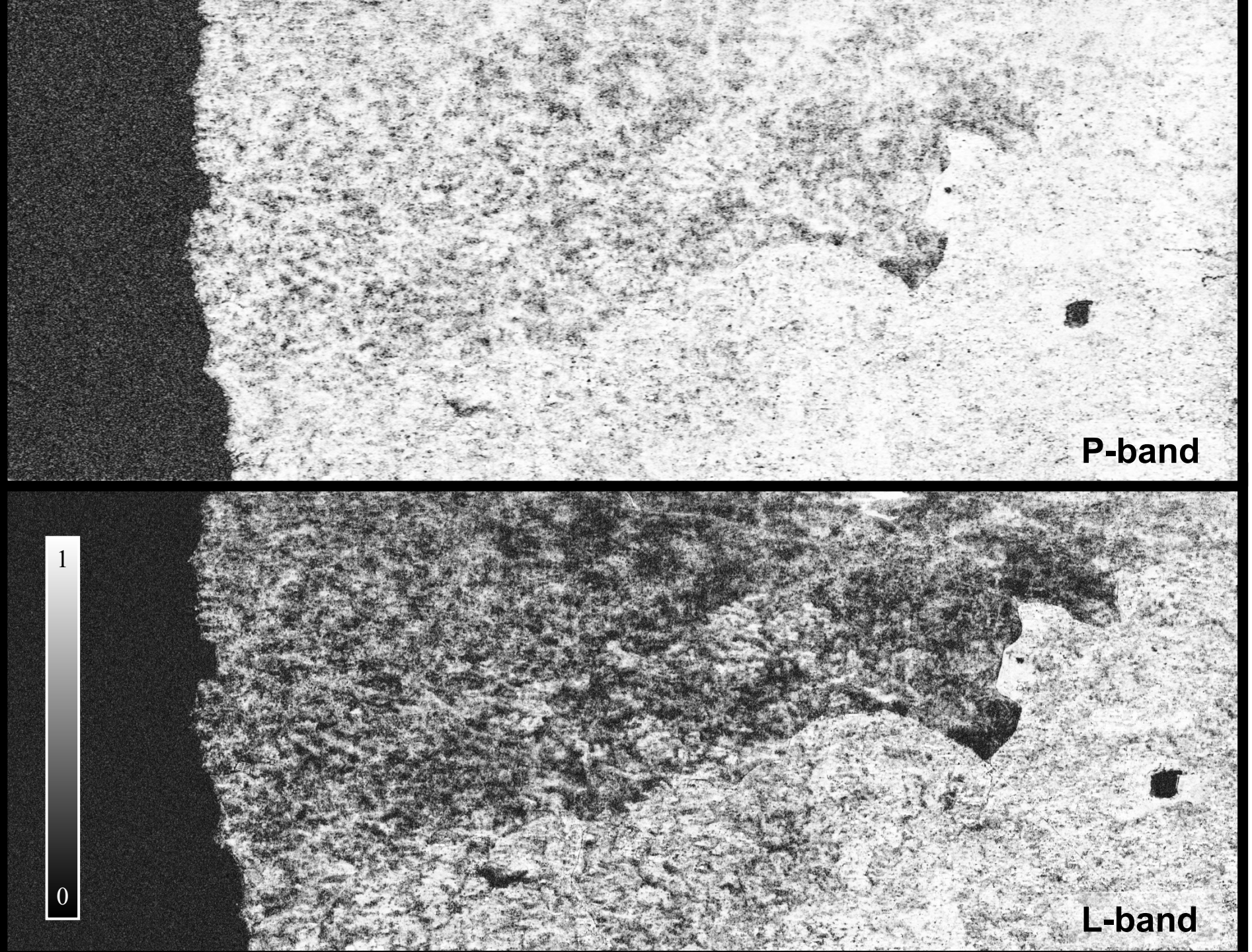
Mondah: Coherences HH, L-band – May 23, 2023





Mondah

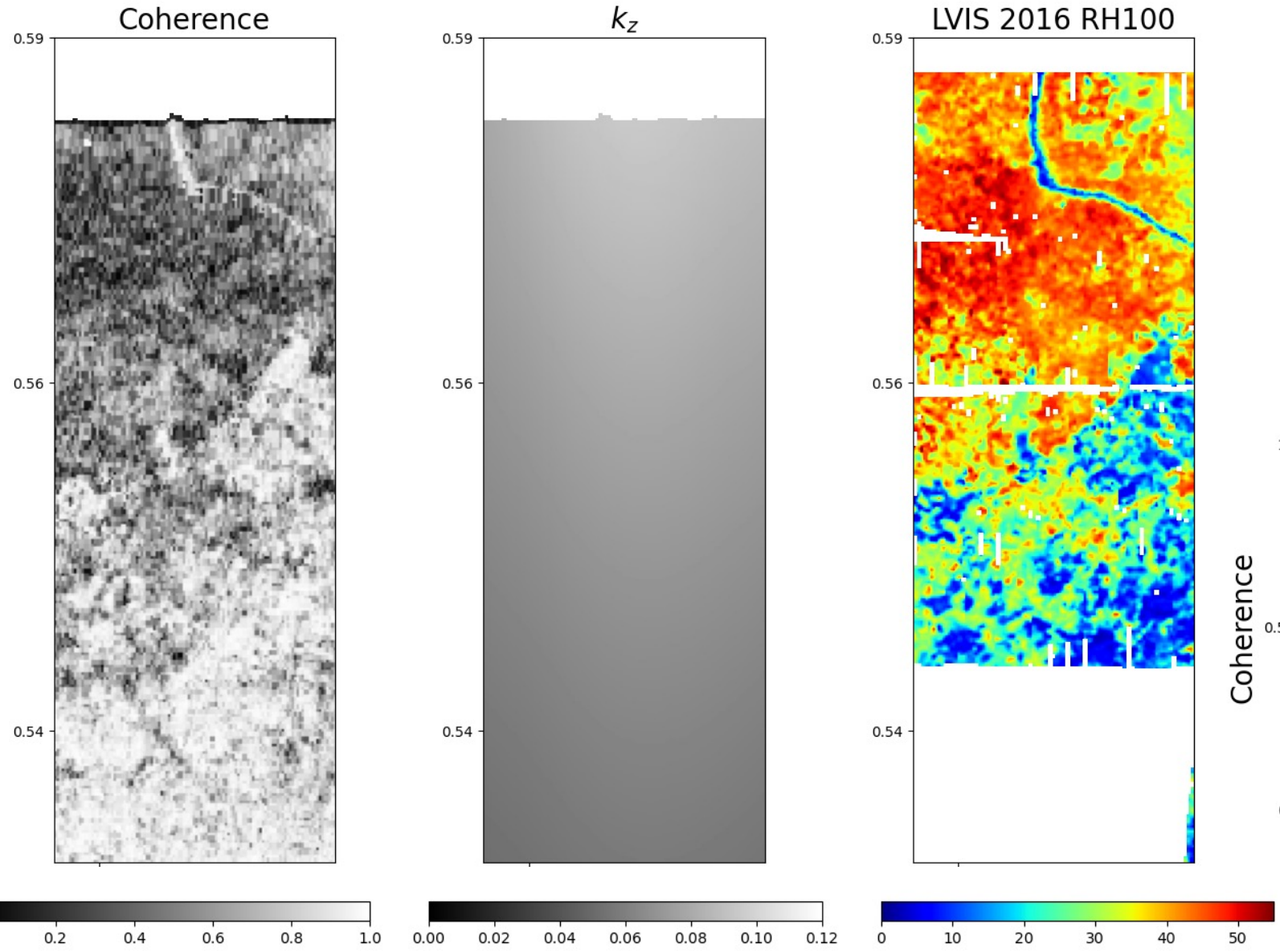
- **Coherence: 3 day** May 23 - May 26, 2023
- Zero-baseline coherence



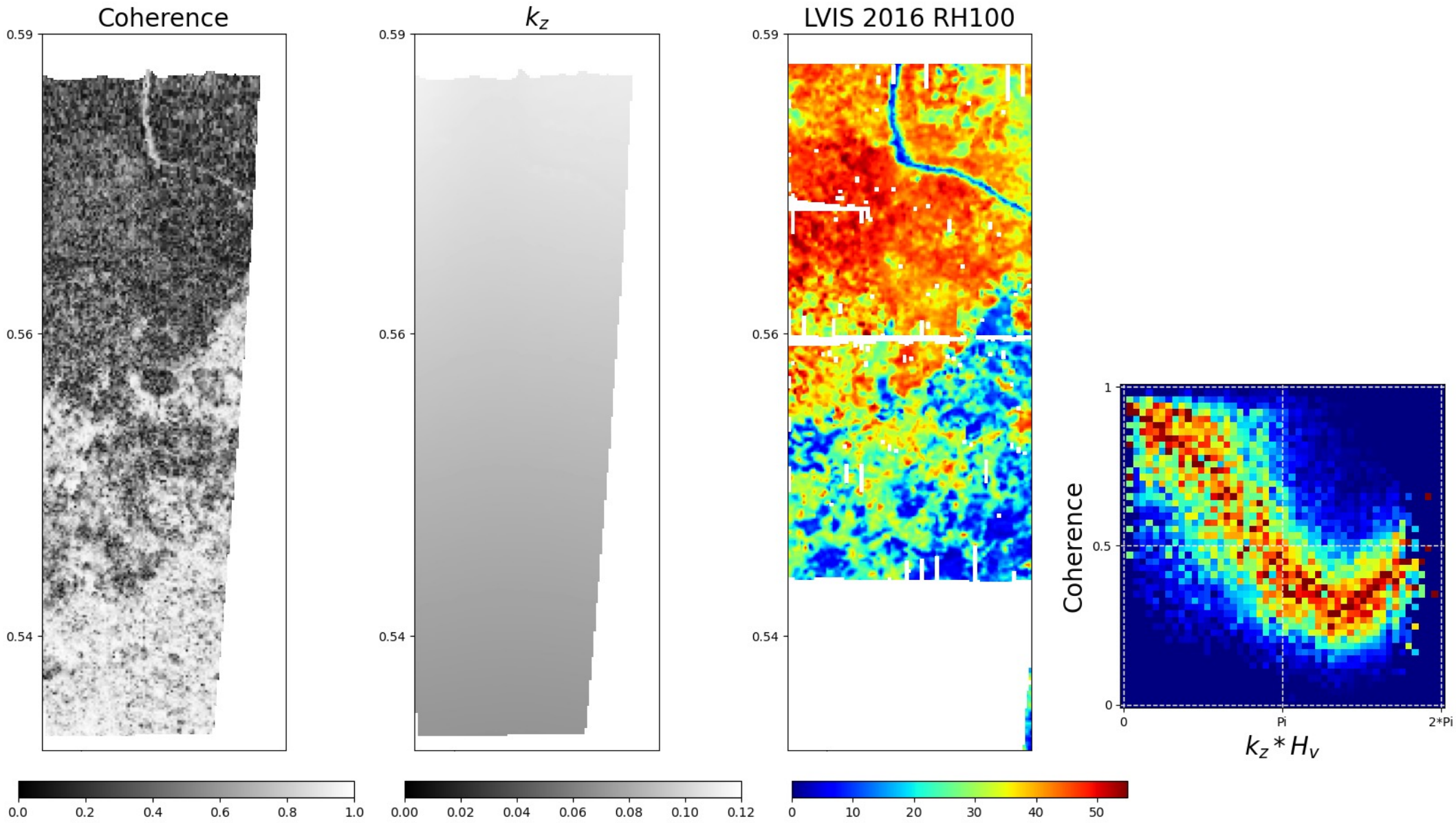
Mondah

- **Coherence: 3.5 hr time difference**
  June 1, 2023
- Zero-baseline coherence

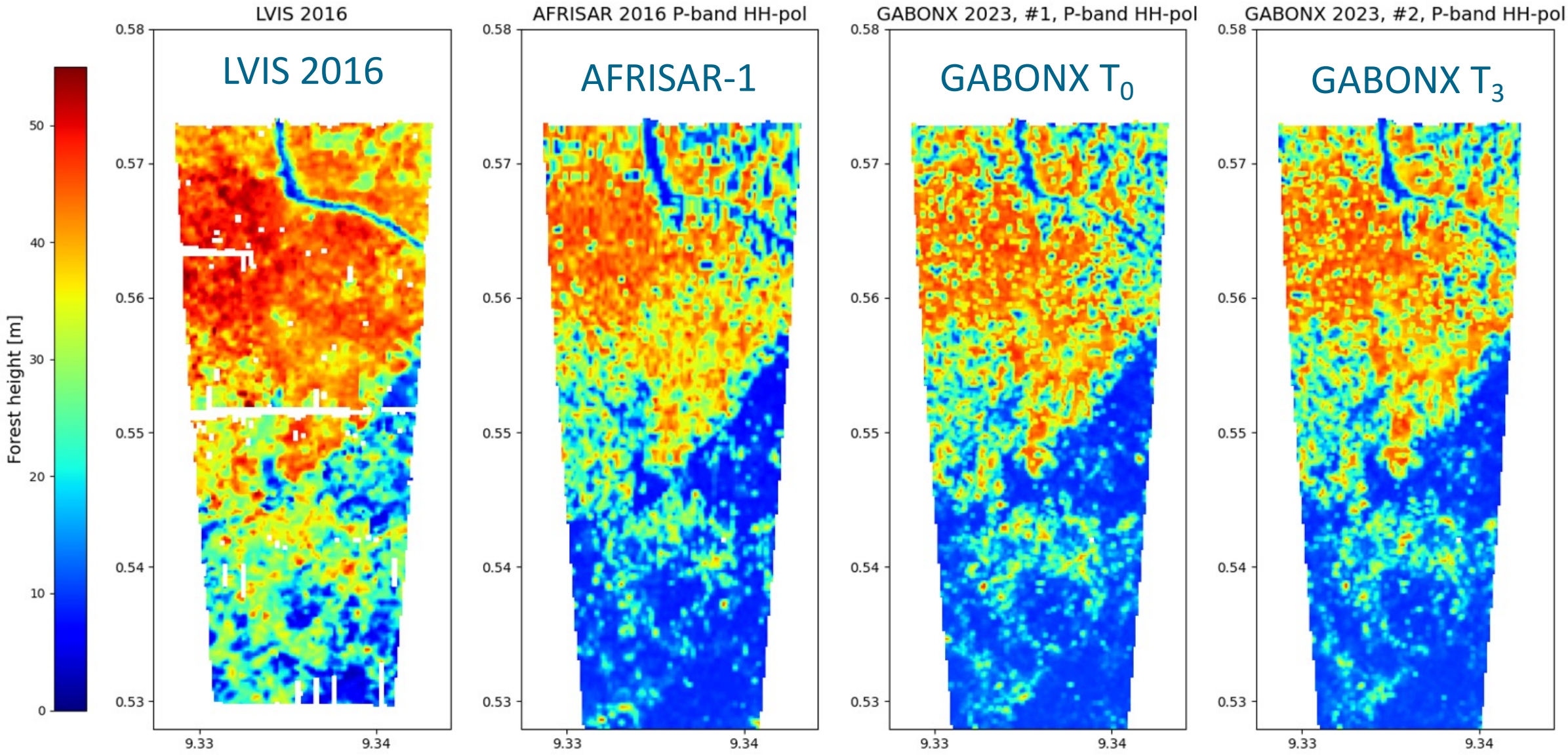
Coherence Profiles: P-band, AFRISAR 2016



Coherence Profiles: P-band, GABONX 2023



Forest Height Comparison with 3 Days Separation



DLR‘s GABONX Team with the DO228

Mondah seen from the Do228