Land validation over temperate and tropical forest

IDEAS-QA4EO, Cal/Val WS3, Frascati 2022-03-31

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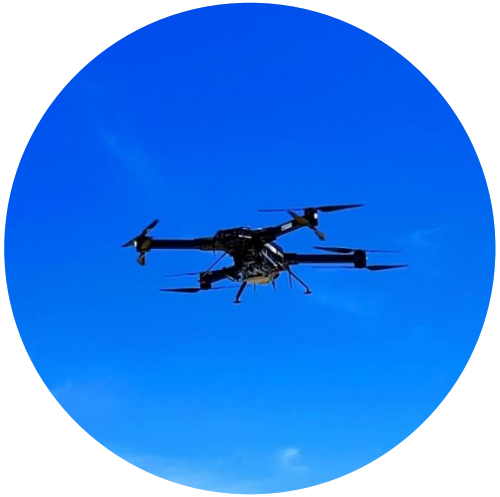

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Overview

1. Land Cal/Val: Forest Site (WP-2140) – tropical
2. Land Cal/Val: Forest Site (WP-2140) – temperate
3. Support BIOMASS Cal/Val (WP-2350) – Eifel
4. Support BIOMASS Cal/Val (WP-2350) – MAAP
5. UAV-based Surface Reflectance for Cal/Val (WP-2342) > Magdalena's presentation
6. Scientific outcomes
7. IDEAS-QA4EO @ GFZ

1. Land Cal/Val: Forest Site (WP-2140) – tropical

Forest AGB estimation

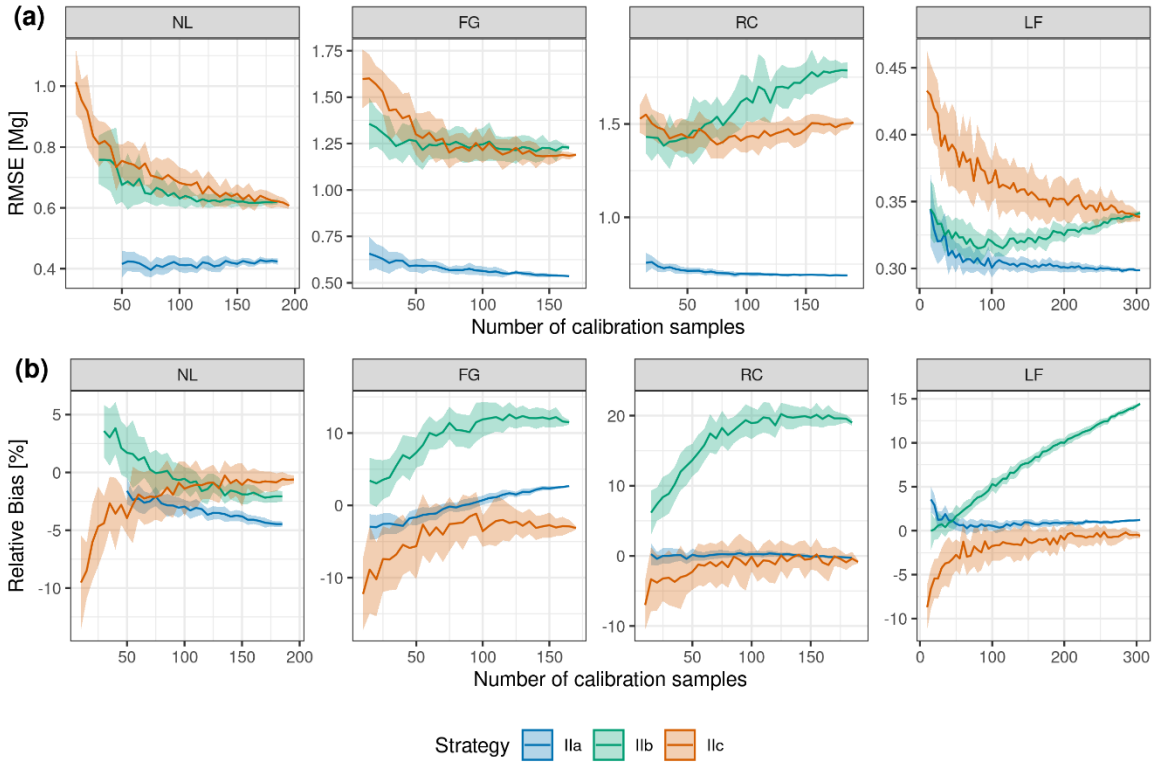
- 2019 UAV-LS & TLS campaign at Paracou research station (tropical)
- Included 3 additional sites:
  - Speulderbos (temperate, NL)
  - Robson Creek (tropical wet, Australia)
  - Litchfield (savannah, Australia)

Brede et al., RSE, in review

1. Land Cal/Val: Forest Site (WP-2140) – tropical

- UAV-LS: high variance predictions compared to TLS/traditional
- UAV-LS + ML can estimate AGB with bias <5% for cohorts of >50 trees

>> towards pure lidar-based AGB across supersite

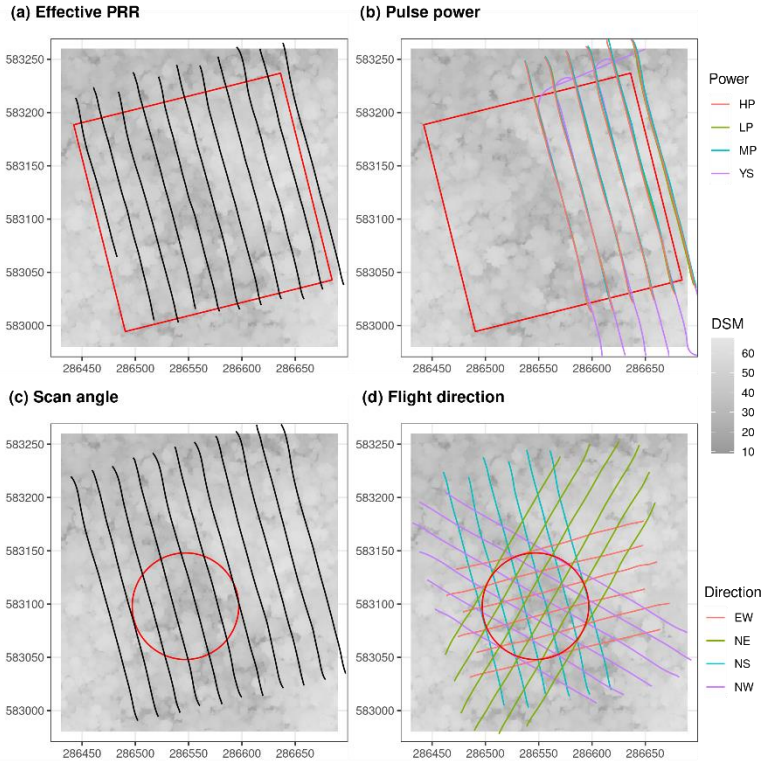


Brede et al., RSE, in review

1. Land Cal/Val: Forest Site (WP-2140) – tropical

Recommendations on scanner settings and flight planning for dense forests to reduce occlusion

- Pulse Repetition Rate (PRR)
- Laser power (range as proxy)
- Scan angle
- Flight directions



Brede et al., in preparation

1. Land Cal/Val: Forest Site (WP-2140) – tropical

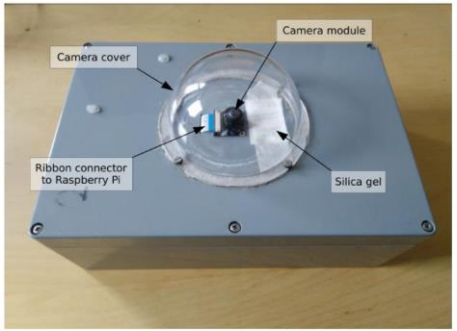
Recommendations on scanner settings and flight planning for dense forests to reduce sampling occlusion

- PRR ~150 kHz per 1 m s^{-1} flight speed @ 360° FOV
- Higher pulse power (~ laser range) leads to more canopy exploration
- Off-nadir scan angles of up to 20° (40° FOV) optimal:
  20 m flight line spacing at 120 m flight altitude @ 50% overlap
- At least 2 horizontal directions, but still random effects possible

>> towards best practice for UAV-LS

Brede et al., in preparation

2. Land Cal/Val: Forest Site (WP-2140) – temperate



PiLAI 1.0 (Vellekoop 2019)

Open source/DIY monitoring

PiLAI 1.0 (Sam Vellekoop)

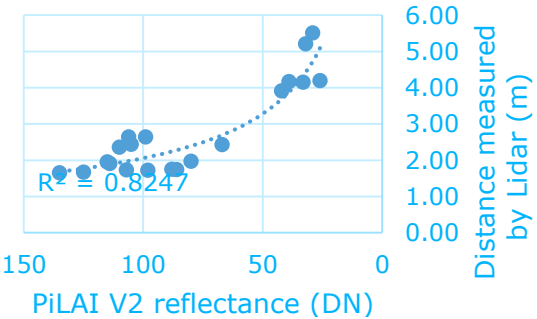
PiLAI 2.0 (Rinus Vijftigschild)

PiLAI FLASH (Jan-Jaap Stam)

PiLAI 2.0 (Vijftigschild 2020)

PiLAI FLASH (Jan-Jaap Stam 2020)

PiLAI FLASH night-image



LiDAR distance with PiLAI v2 at Dassenbos Location 1 (ash Leaves)

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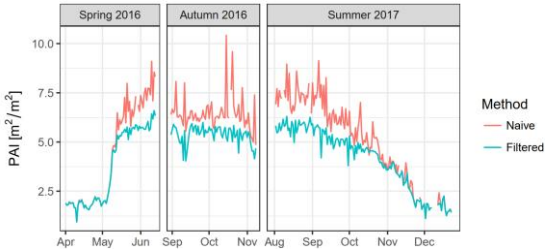
2. Land Cal/Val: Forest Site (WP-2140) – temperate

- Break down of monitoring sensors (PASTIS-57) without repair option



PASTIS57

- New systems in preparation (to be installed):
  - 2 LEAF (monitoring lidar)
    (1 paid by QA4EO material & travel budget)
  - 30 TreeTalker (multi-spectral canopy transmittance)
- Transition Speulderbos > Loobos (ICOS)

environmental SENSING SYSTEMS

LEAF MkI

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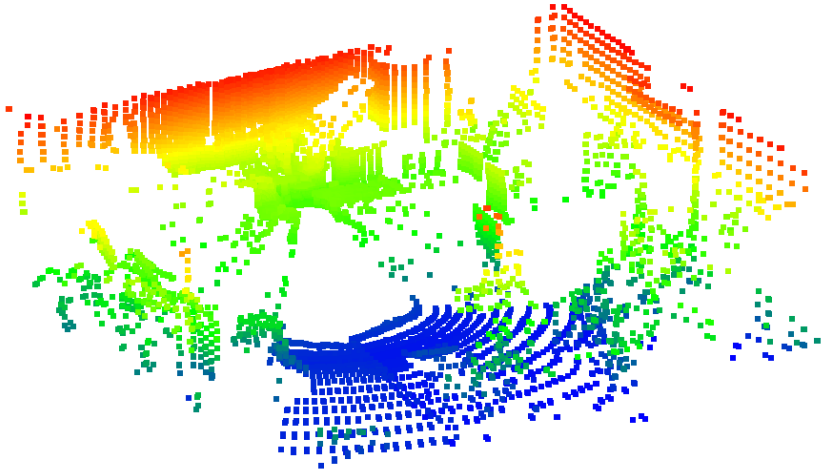
www.sensingsystems.com.au

2. Land Cal/Val: Forest Site (WP-2140) – temperate

- Purchase of LEAF MkI - In-Situ Monitoring LiDAR
- NIR-LiDAR (905 nm)



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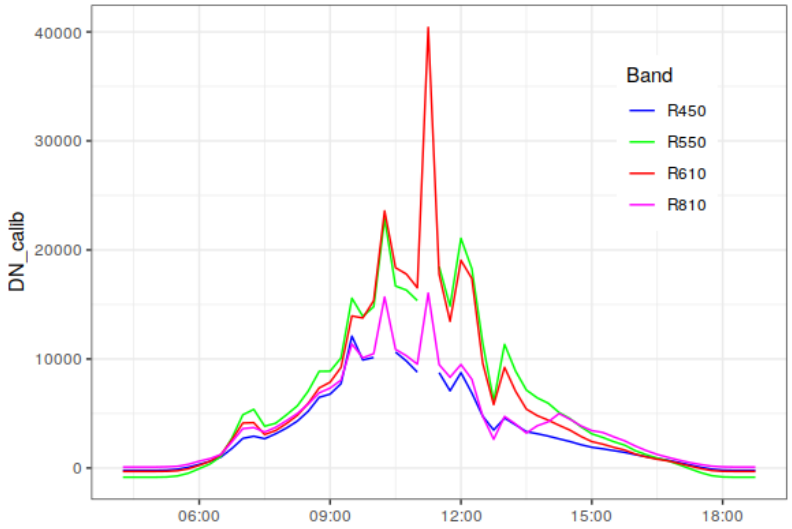
2. Land Cal/Val: Forest Site (WP-2140) – temperate

- TreeTalker (https://www.nature4.org)
  - IoT: live transfer of data to server
  - 12 band spectrometer VNIR between 450 – 860 nm



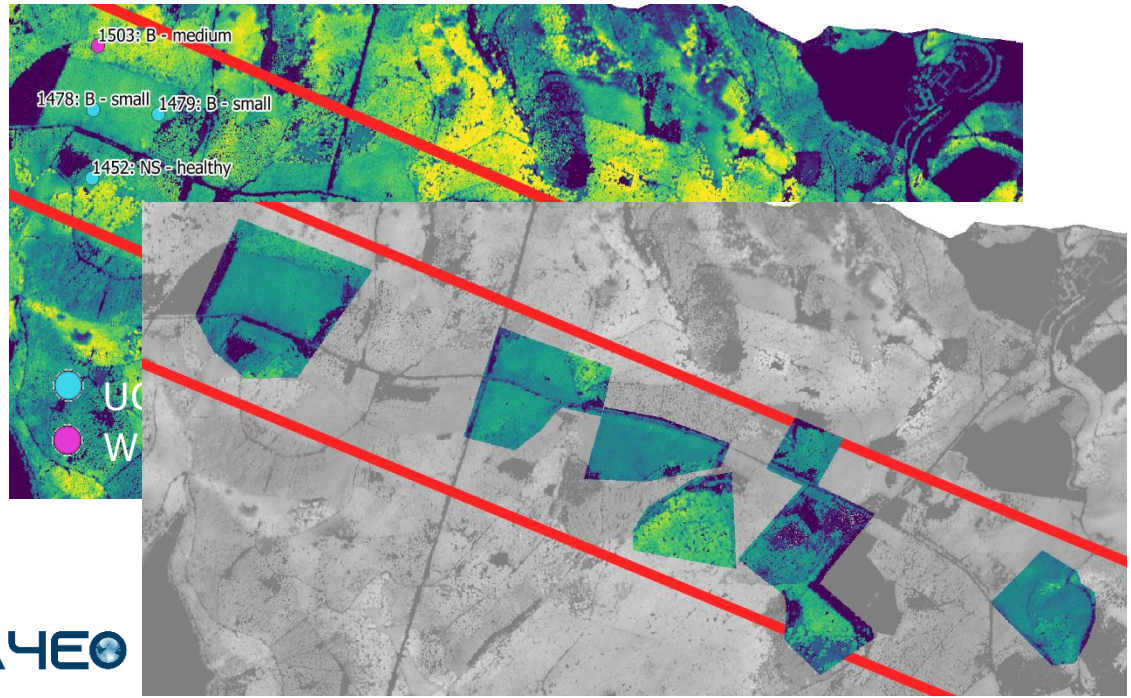
TT diurnal radiometer readings

3. Support BIOMASS Cal/Val (WP-2350) – Eifel

18-24 Sept 2021 (6 field days) overlapping with UCL

Support ESA TomoSense

- TLS, MLS, UAV-LS
- Coordinate with UCL to retrieve AGB based on TLS
- Next TomoSense workshop April 4, 2022



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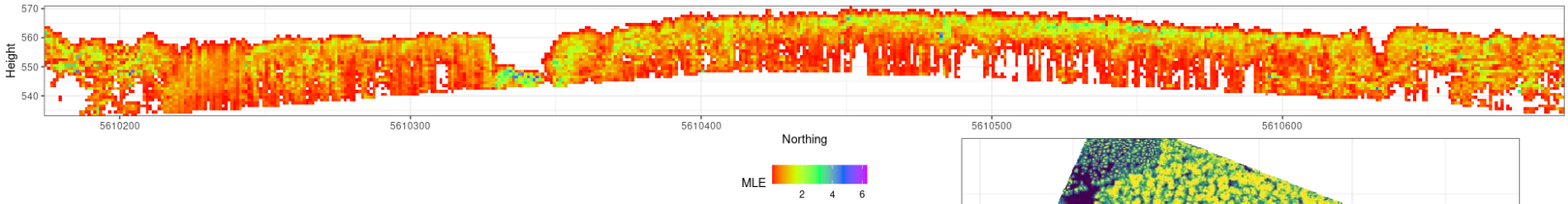
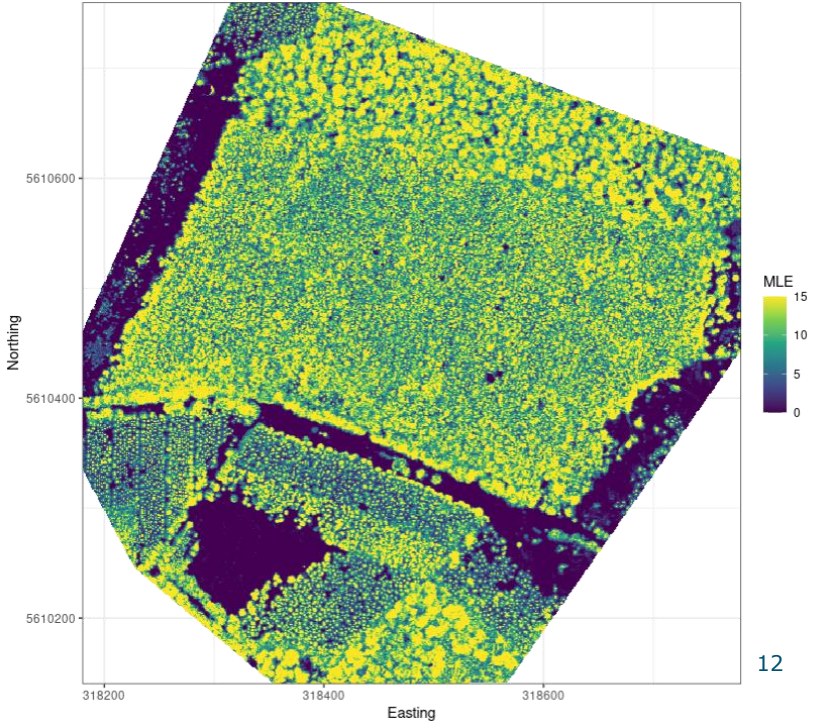
3. Support BIOMASS Cal/Val (WP-2350) – Eifel



- LAD estimation via MLE with UAV-LS: LAI in 3D
- Estimation of LAD with maximum-likelihood estimator (Pimont et al., 2018), incl. uncertainties
- Open: Intercomparison with TomoSAR



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3. Support BIOMASS Cal/Val (WP-2350) – MAAP

- Plot2Map in the MAAP

1. Implements the model-based uncertainty assessment framework for global AGB map assessments in Araza et al., 2022 (https://dx.doi.org/10.1016/j.rse.2022.112917)
2. Preliminaries include securing a MAAP account; Workspace creation; and "git clone": https://repo.ops.maap-project.org/arnanaraza/PlotToMap1
3. Plot2Map user requirement includes reference data (plot data or airborne LiDAR-based AGB); own forest mask is optional
4. A sample Jupyter Notebook for country implementation can be seen here: https://repo.ops.maap-project.org/lduncanson/biomass_harmonization/-/blob/master/plot2map_Mexico_demo.ipynb

3. Support BIOMASS Cal/Val (WP-2350) – MAAP

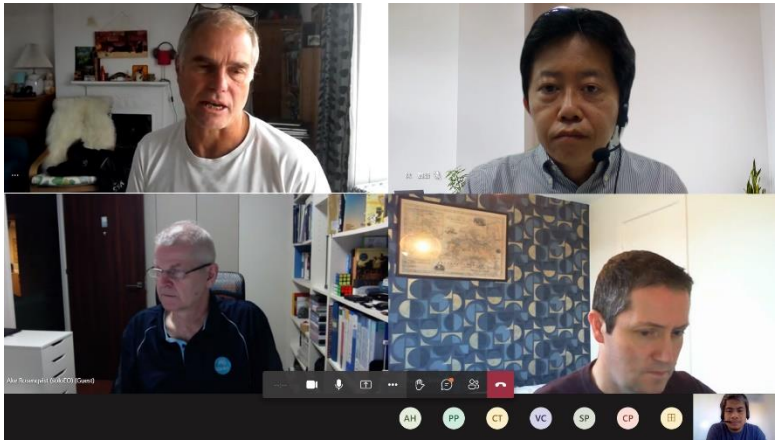
Assessment of global AGB maps

- Independent map validation using own data
- Compiled open-source data also usable: s3://wur-agb-reference-database/validationData_WUR_Open_v3.csv

Country cases

- Mexico and Philippines data for testing
- Wales and Japan cases using own NFIs and country forest mask

Can be useful for BRIX-2 also



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6. Scientific outcomes

- Terryn, L., Calders, K., Bartholomeus, H., Bartolo, R. E., Brede, B., D'hont, B., Disney, M., Herold, M., Lau, A., Shenkin, A., Whiteside, T. G., Wilkes, P., & Verbeeck, H. (2022). Quantifying tropical forest structure through terrestrial and UAV laser scanning fusion in Australian rainforests. *Remote Sensing of Environment*, *271*, 112912. https://doi.org/10.1016/j.rse.2022.112912
- Araza, A., de Bruin, S., Herold, M., Quegan, S., Labriere, N., Rodriguez-Veiga, P., Avitabile, V., Santoro, M., Mitchard, E. T. A., Ryan, C. M., Phillips, O. L., Willcock, S., Verbeeck, H., Carreiras, J., Hein, L., Schelhaas, M.-J., Pacheco-Pascagaza, A. M., da Conceição Bispo, P., Laurin, G. V., … Lucas, R. (2022). A comprehensive framework for assessing the accuracy and uncertainty of global above-ground biomass maps. *Remote Sensing of Environment*, *272*, 112917. https://doi.org/10.1016/j.rse.2022.112917
- Benjamin Brede, Louise Terryn, Nicolas Barbier, Harm M. Bartholomeus, Renee Bartoloe, Kim Calders, Geraldine Derroire, Sruthi M. Krishna Moorthy, Alvaro Lau, Shaun R. Levick, Pasi Raumonen, Hans Verbeeck, Di Wang, Tim Whiteside, Jens van der Zee, Martin Herold (2022). Non-destructive estimation of individual tree biomass: allometric models, terrestrial and UAV laser scanning. *Remote Sensing of Environment* (in review).
- Contributions to CEOS LPV AGB best practice protocol
- 2 sessions @ IGARSS 2021, Brussels
- 4 sessions @ ESA Living Planet 2022, Bonn

7. IDEAS-QA4EO @ GFZ

StrucChangeNet

- Infrastructure:
  - UAV lidar, TLS, LEAF, TreeTalker

- Vegetation monitoring sites
  - 10 (global) sites with initial focus on Europe
  - Implement strategies tested at Speulderbos
  - Dynamic vs homogenous sites
  - Target variables: LAI, AGB, (FAPAR), (Chl)

RIEGL VZ-120

CEOS LPV proposed supersites as candidates

SRIX4VEG participation (best efforts basis)

7. IDEAS-QA4EO @ GFZ

Further relevant GFZ cal/val activites

- Hyperspectral EO validation with airborne (Max Brell, Sabine Chabrillat)
- EnMAP validation (Sabine Chabrillat)
  >>> launch scheduled for tomorrow!
- ESA Mission Advisory Group CHIME & CHIME E2E simulator
  (Sabine Chabrillat, Karl Segel)
- Hypernets (Daniel Spengler, Mohammadmehdi Saberioon)
- TERENO: Terrestrial Environmenal Observatories by Helmholtz Research Centers
  (Sibylle Itzerott, Daniel Spengler)

POTSDAM 2022

22-24 June 2022 in Potsdam, Germany

SCAN ME

GFZ Helmholtz Centre Potsdam

http://is.earsel.org/workshop/12-IS-Potsdam2022/

Acknowledgements

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Take off! at Paracou, French Guiana

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