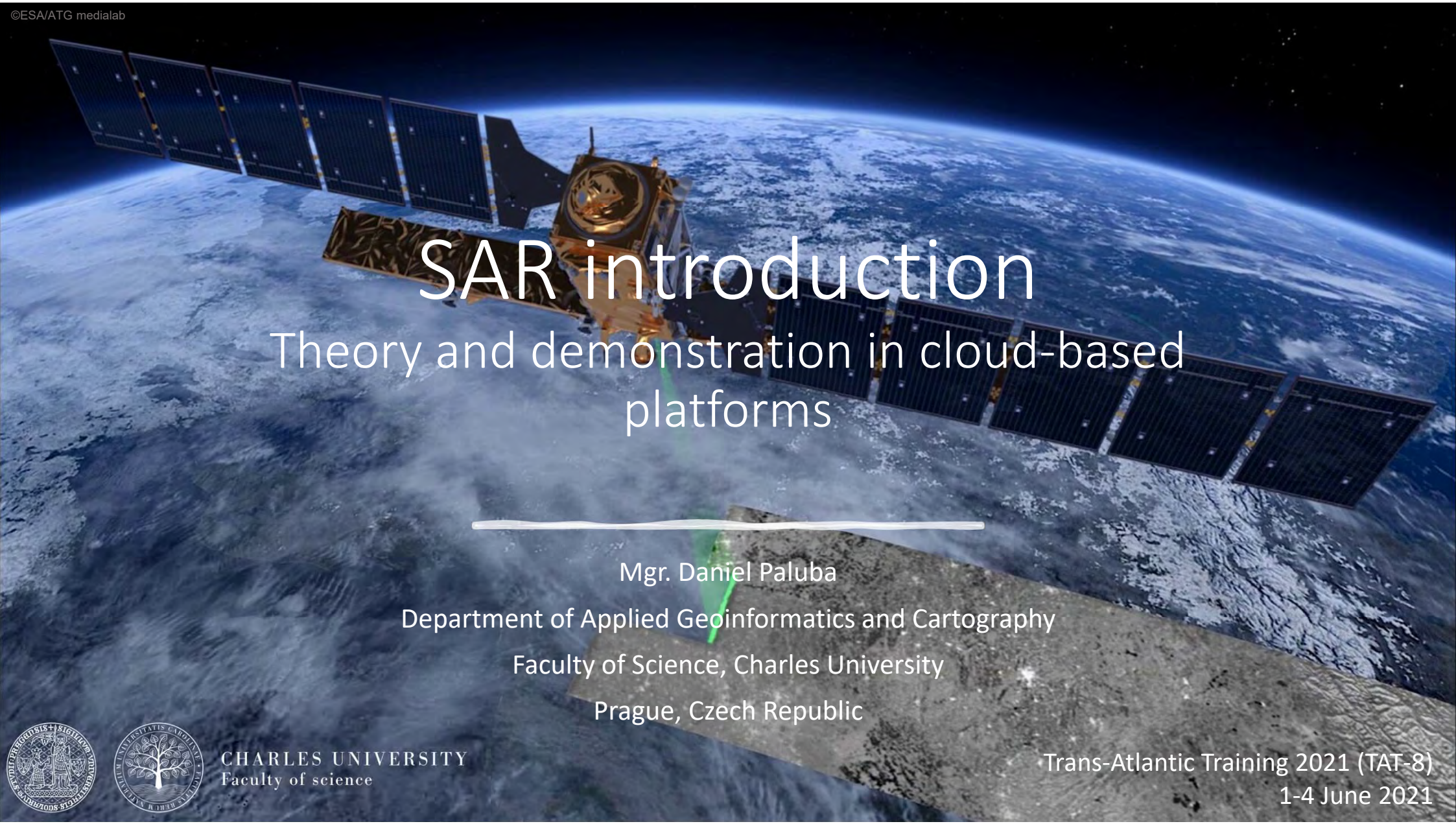

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# SAR introduction

## Theory and demonstration in cloud-based platforms

Mgr. Daniel Paluba

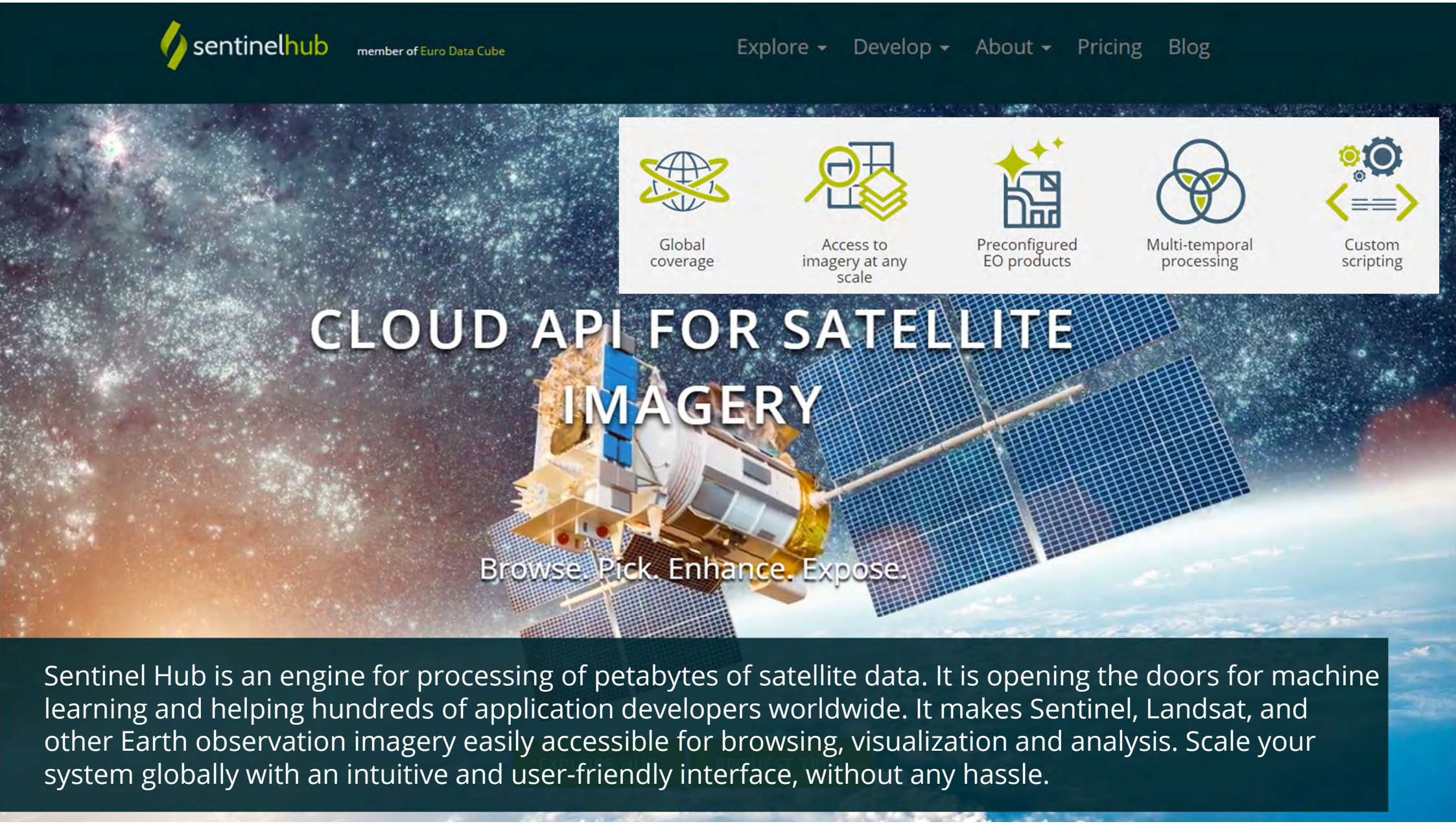
Department of Applied Geoinformatics and Cartography

Faculty of Science, Charles University

Prague, Czech Republic

CHARLES UNIVERSITY
Faculty of science

Trans-Atlantic Training 2021 (TAT-8)
1-4 June 2021




Sentinel Hub is an engine for processing of petabytes of satellite data. It is opening the doors for machine learning and helping hundreds of application developers worldwide. It makes Sentinel, Landsat, and other Earth observation imagery easily accessible for browsing, visualization and analysis. Scale your system globally with an intuitive and user-friendly interface, without any hassle.

Google Earth Engine combines a multi-petabyte catalog of satellite imagery and geospatial datasets with planetary-scale analysis capabilities and makes it available for scientists, researchers, and developers to detect changes, map trends, and quantify differences on the Earth's surface

https://youtu.be/gKGOeTFHnKY

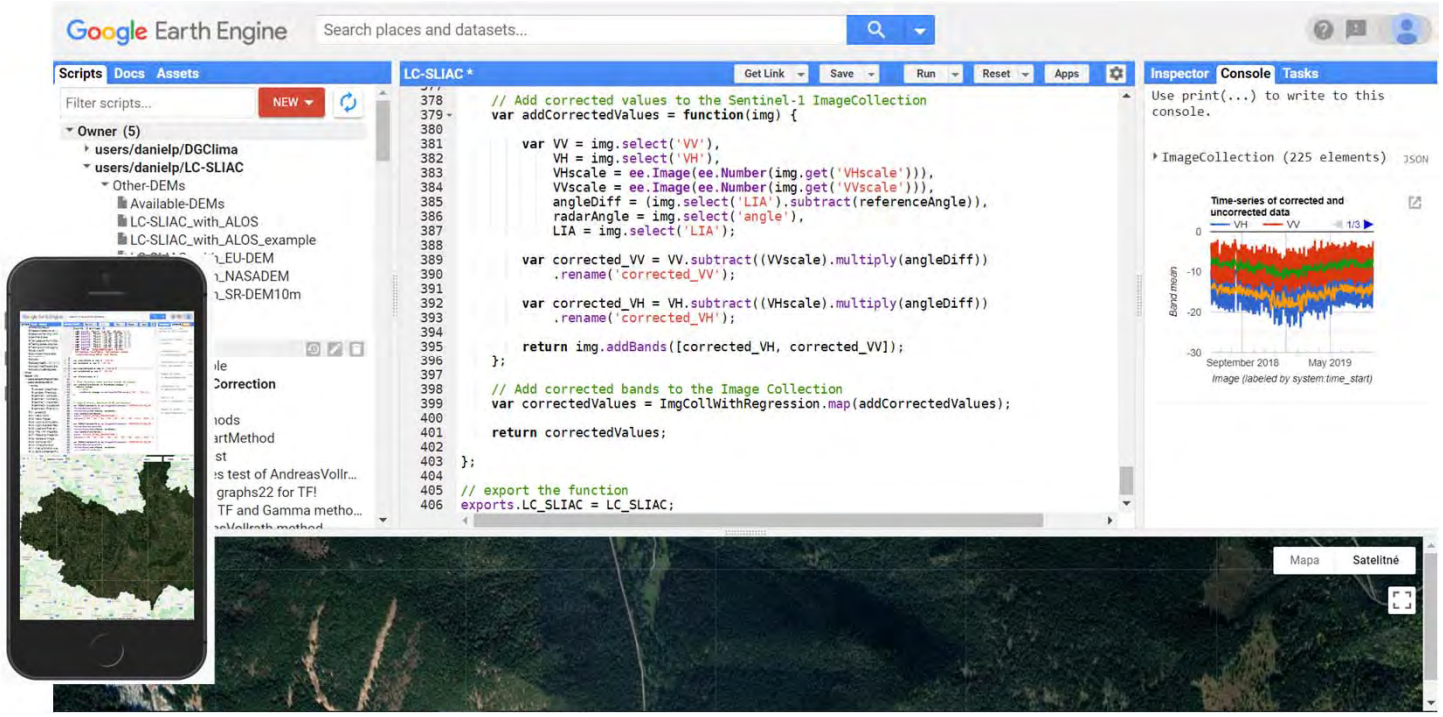
# Data and data processing on cloud-based platforms

SENTINEL Hub by SINERGISE

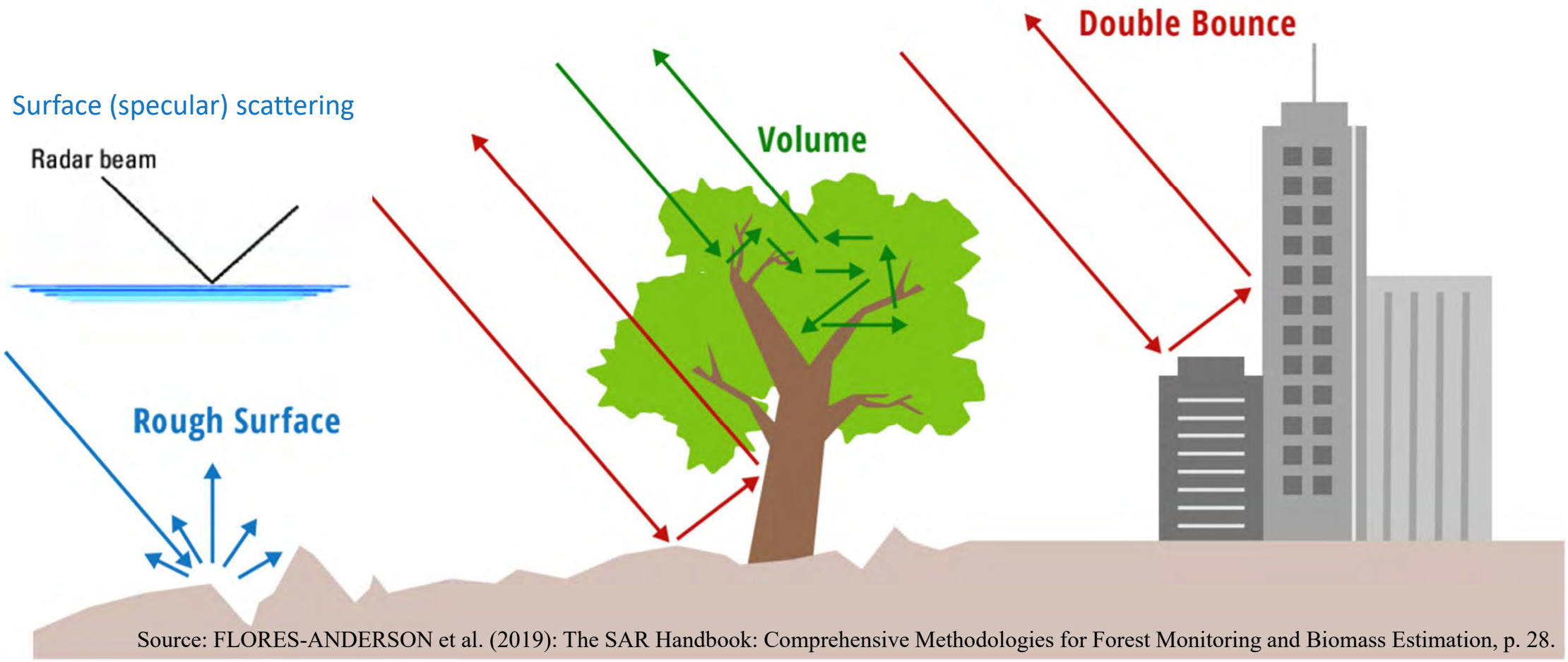
Google Earth Engine

+ Wide selection of data stored in the cloud - available from anywhere and from any device without the need to download
+ No storage required for data and software
+ All you need is an internet connection and a web browser
+ Speed

- Scripting knowledge required for more advanced analysis
- Some functions not available - need to import a function or create your own functions



# Scattering types considered for SAR data




Source: FLORES-ANDERSON et al. (2019): The SAR Handbook: Comprehensive Methodologies for Forest Monitoring and Biomass Estimation, p. 28.

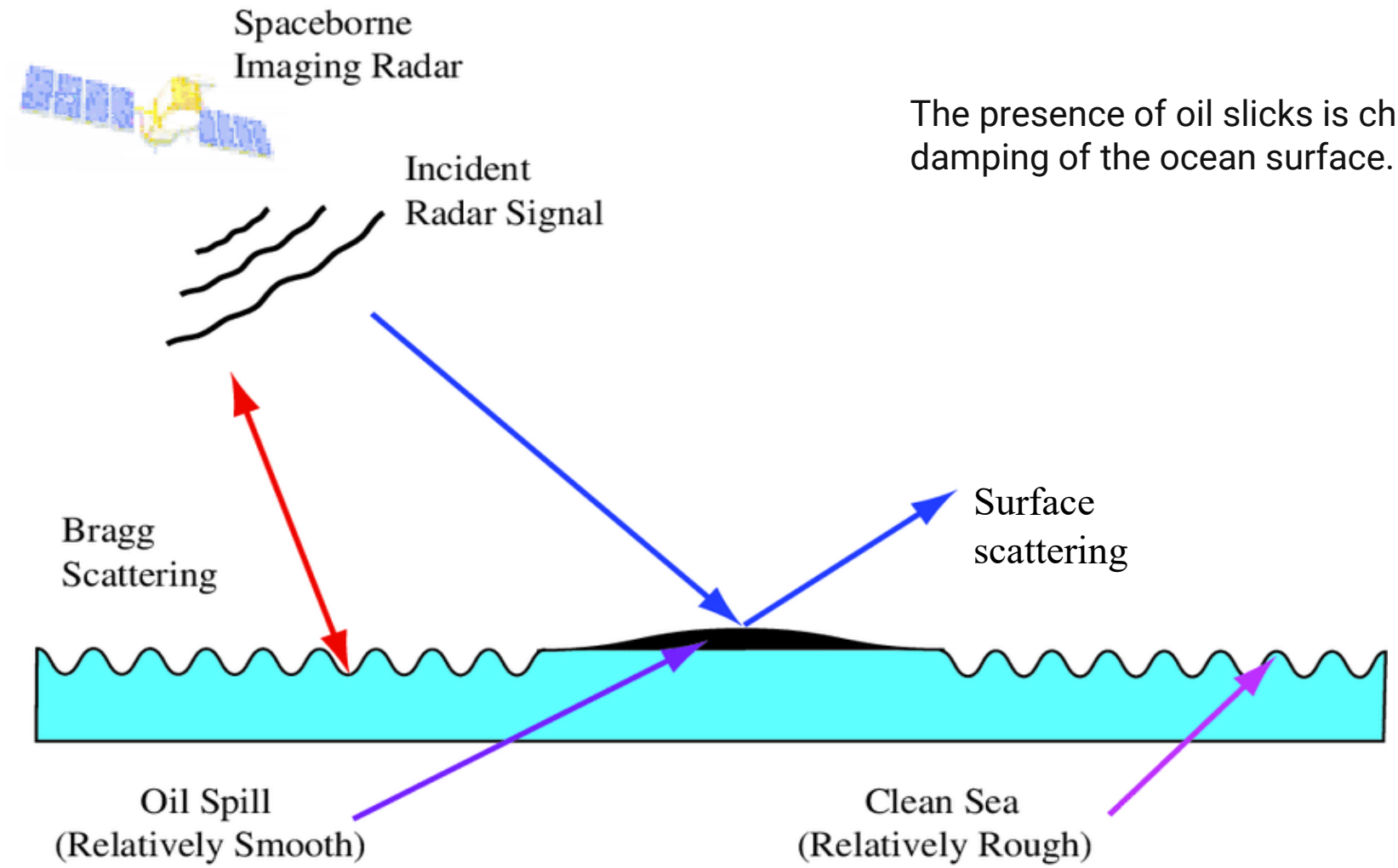
# Sentinel-Hub demonstration links

- Flooding in Australia, Sentinel-1: https://sentinelshare.page.link/CiJ4
  Sentinel-2: https://sentinelshare.page.link/Umq1

- Deforestation in Madagascar: https://apps.sentinel-hub.com/eo-browser/?sharedPinsListId=114680ca-ec35-49dc-9a1e-93a44bb209c3

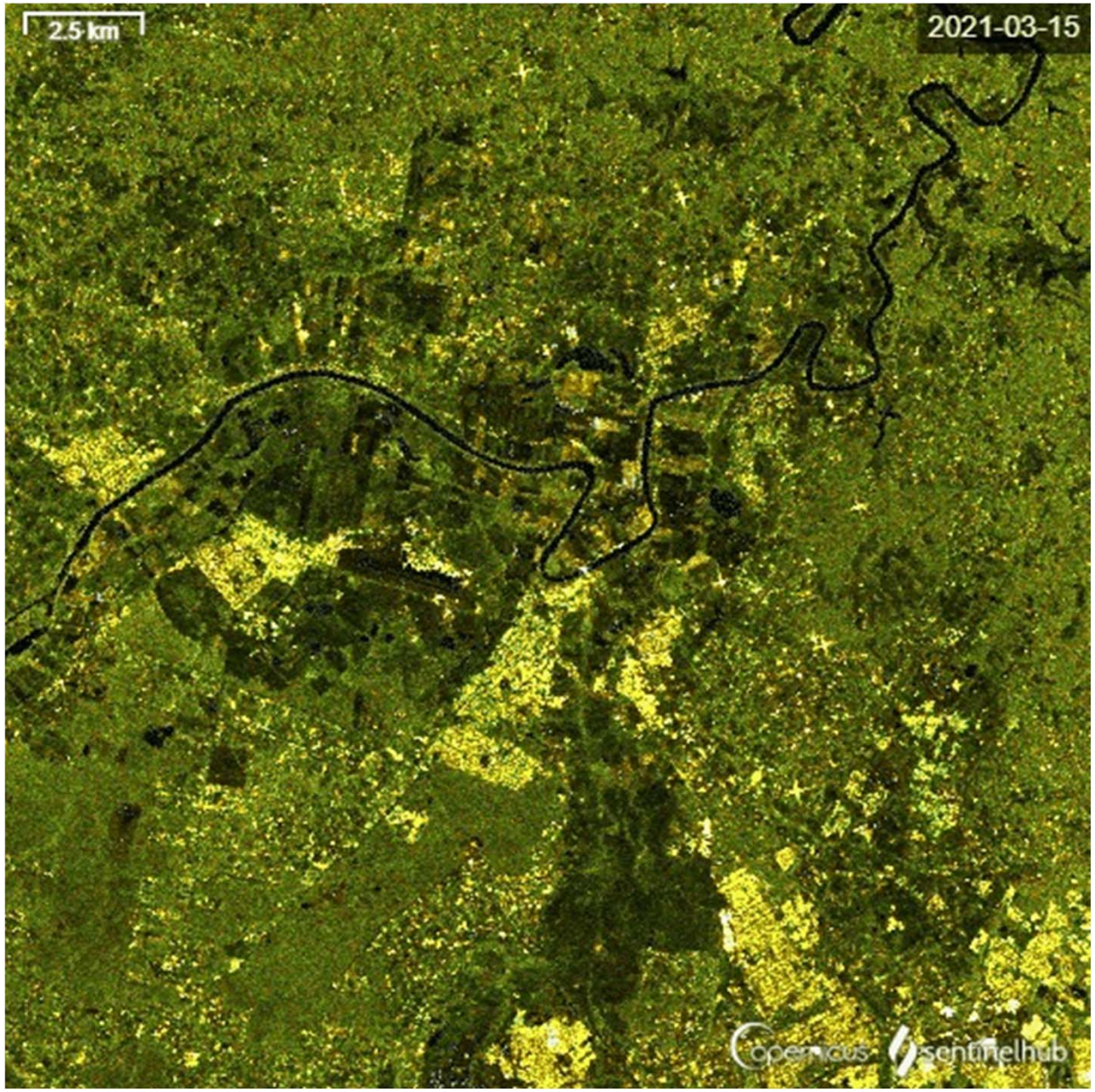
- Oil spill on the Red sea: https://sentinelshare.page.link/y1tV

# Scattering properties of the oil spill

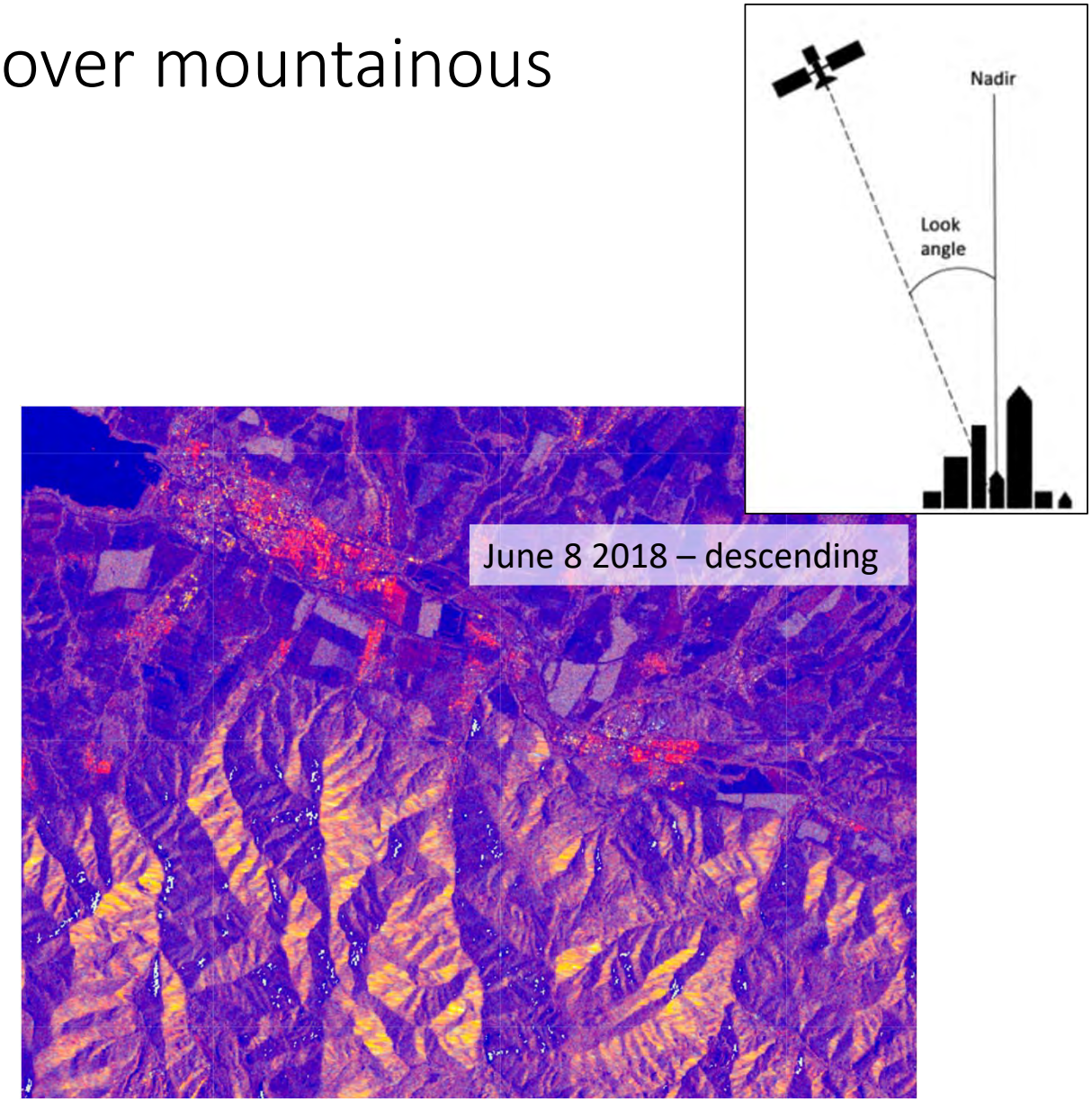



The presence of oil slicks is characterized by strong damping of the ocean surface.

Flooding timelapse animation
Richmond, Australia

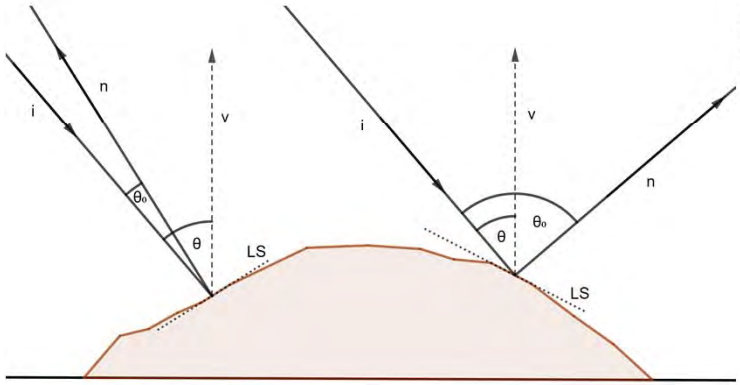


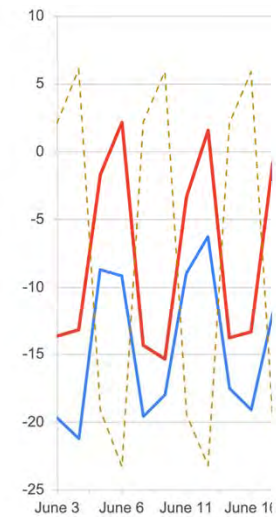
# Effect of terrain on SAR data over mountainous areas

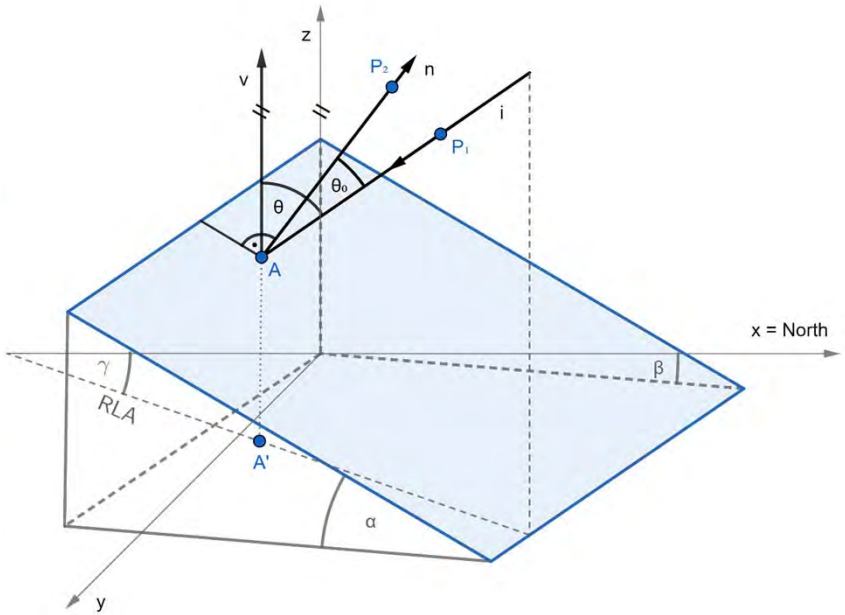


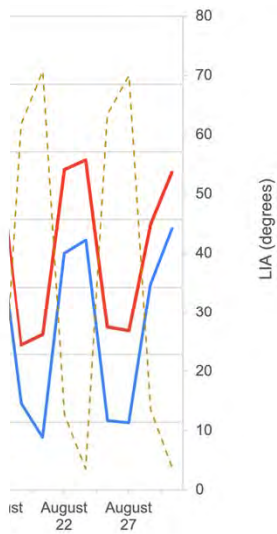
# Effect of terrain on SAR data over mountainous areas

- Local incidence angle



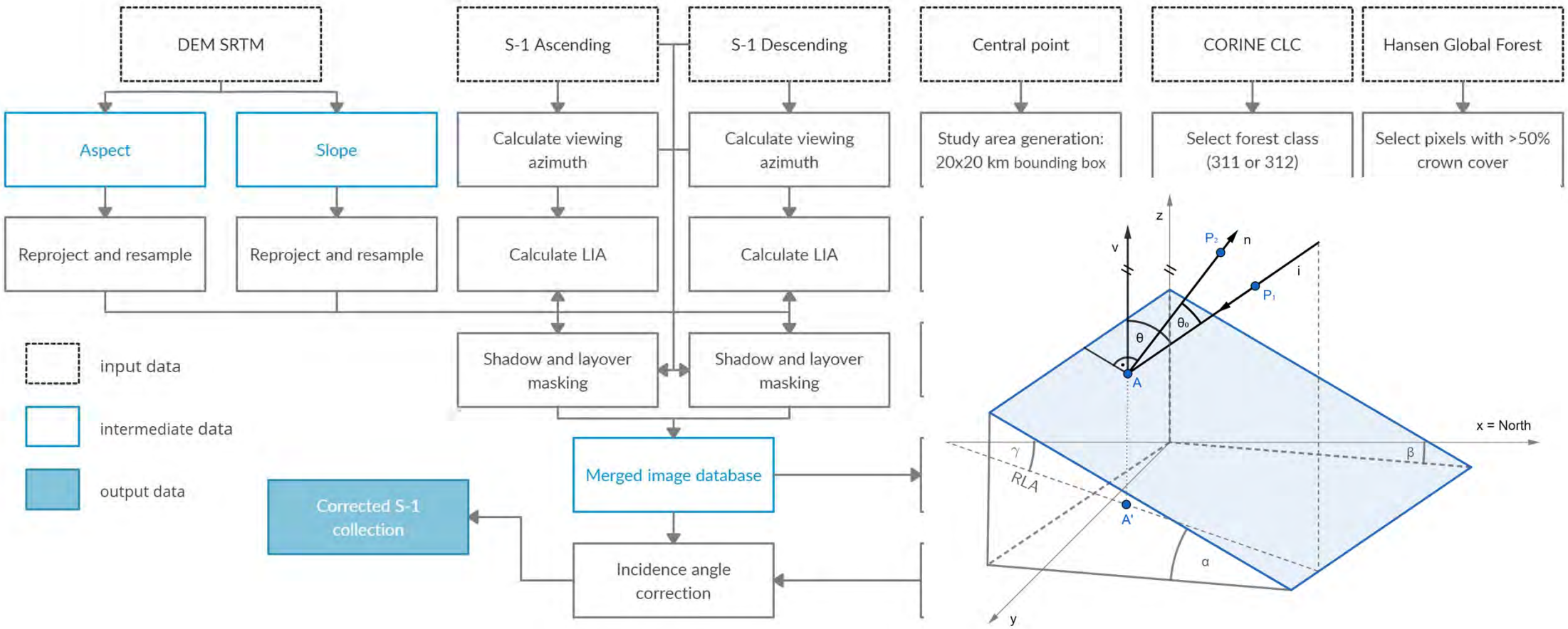




- Method for correction/normalization – Radiometric Terrain Correction/Flattening by D. Small (2011) → not available in GEE
- Linear relationship between LIA and backscatter (Dostálová et al., 2016 and 2018; Nguyen et al., 2015; Gauthier et al., 1998)
- Different land cover types have a different backscatter–LIA relationship (Hinse et al. 1988; Widhalm et al. 2018; Mougin et al. 1995; Frison et Mougin 1996)

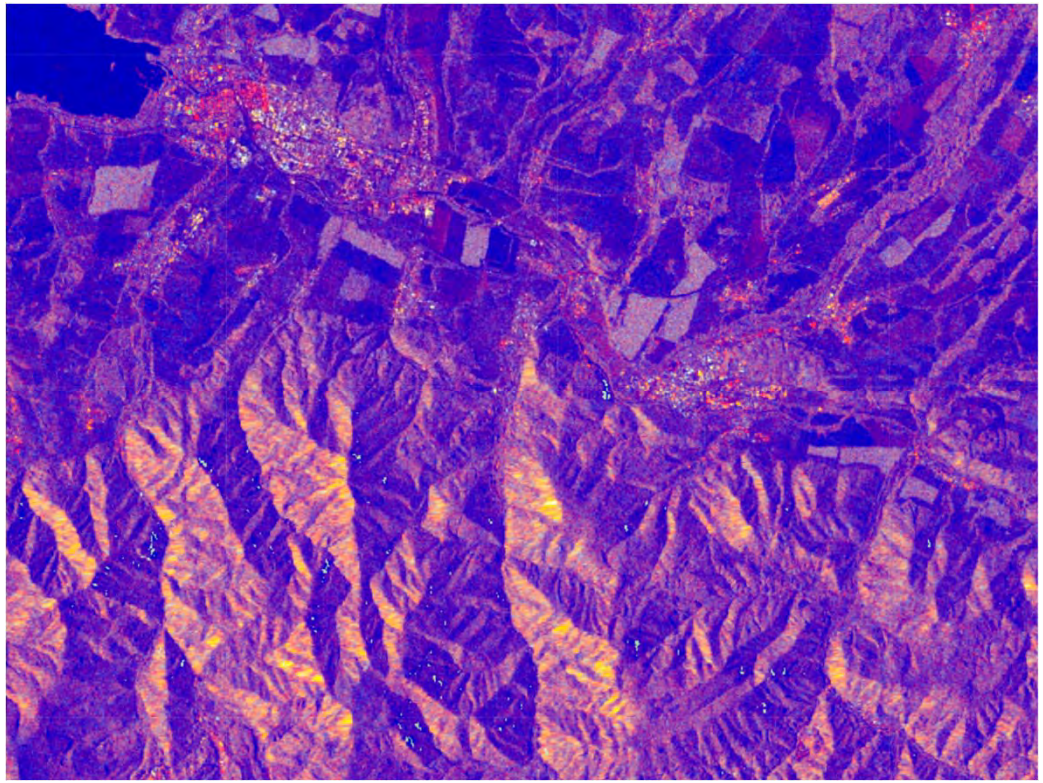
# Land cover-specific local incidence angle correction (LC-SLIAC)



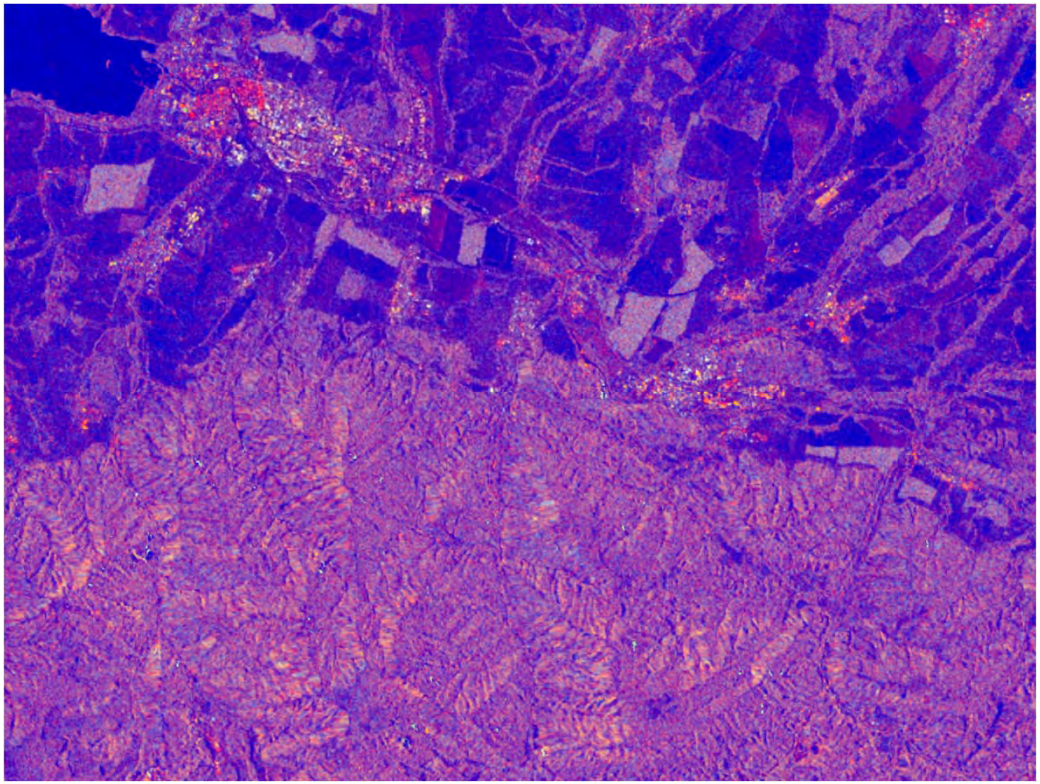

$$\sigma^0_{ref} = \sigma^0_0 - b\,(\theta_0 - \theta_{ref})$$

$$\cos\theta_0 = \cos\theta\cos\alpha - \sin\alpha\,\sin\theta\,\cos\,(\gamma - \beta)$$

# Sentinel-1 data after LC-SLIAC



Original S-1 data in GEE



S-1 data after LC-SLIAC

TAT 2021 example code:
https://code.earthengine.google.com/8dd9a2a54edfa115cfb8d2088252624c

remote sensing

MDPI

https://doi.org/10.3390/rs13091743

Article

# Land Cover-Specific Local Incidence Angle Correction: A Method for Time-Series Analysis of Forest Ecosystems

Daniel Paluba [1], Josef Laštovička [1], Antonios Mouratidis [1,2] and Přemysl Štych [1,*]

[1] EO4Landscape Research Team, Department of Applied Geoinformatics and Cartography, Faculty of Science, Charles University, 128 43 Prague, Czech Republic; daniel.paluba@natur.cuni.cz (D.P.); josef.lastovicka@natur.cuni.cz (J.L.); amourati@auth.gr (A.M.)

[2] Department of Physical and Environmental Geography, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

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The developed algorithm can be used in GEE after a requirement call: *require ('users/danielp/LC-SLIAC:LC-SLIAC')*, similarly as demonstrated in the example code here: https://code.earthengine.google.com/56c6a3091534a3a231b67cd5f74c3af4.
The code of the algorithm and the demonstration are also available from the GitHub: https://github.com/palubad/LC-SLIAC.

After requests from the GEE community, a new version of the code was added, which can be used globally, not only for countries in the European Union. See the details here.
You can use this global method using the requirement call: require('users/danielp/LC-SLIAC:LC-SLIAC_global'), as demonstrated in the example code at the following link: https://code.earthengine.google.com/c110f906fc0551a47678409fd54401c8 (test site in Vietnam).

SENTINEL Hub by SINERGISE

VS

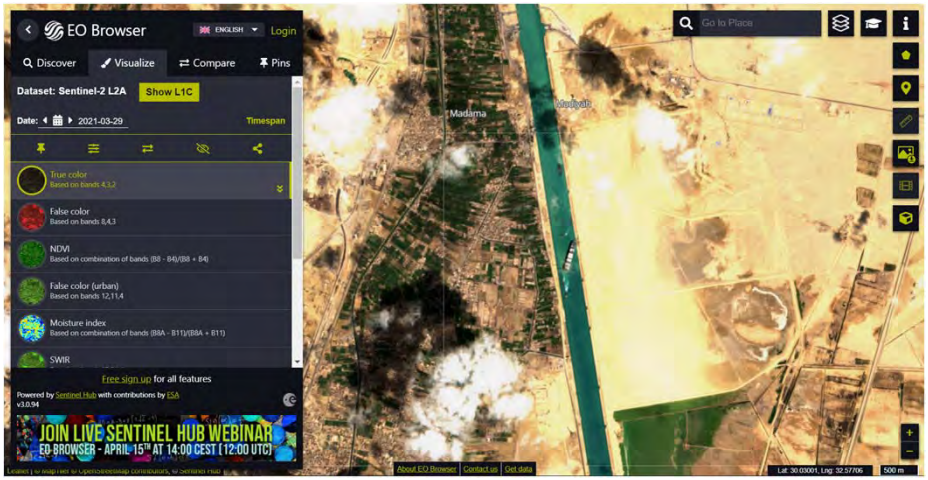
Google Earth Engine

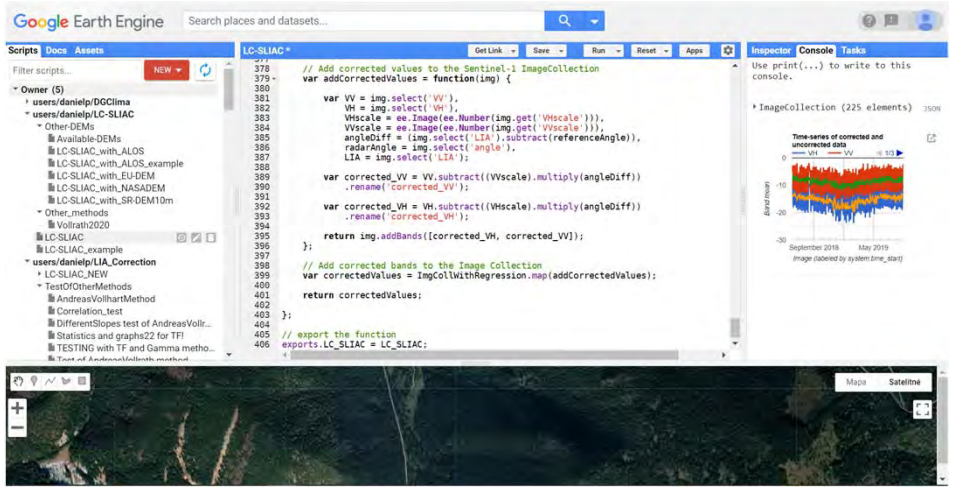
+ Very simple "user-friendly" interface - even without programming knowledge
+ Also suitable for teaching at high schools and elementary schools

- Advanced options - free only for the first 30 days, then the paid version
- Documentation on data and codes is often insufficient
- "Closed software", built-in functions are not open-source

+ Free for non-commercial use
+ More predefined functions
+ Much wider selection of data
+ Huge user community
+ Possibility to create your own applications

- Need knowledge of programming in JS or Python
- Closed software; features may change over time - need to folllow updates




Find out more here: Gomes et al. (2020): **An Overview of Platforms for Big Earth Observation Data Management and Analysis.** https://doi.org/10.3390/rs12081253

# Thank you for your attention!

Daniel Paluba

palubad@natur.cuni.cz

# Literature used in the presentation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