

SEMANTIC DATA CUBES

FOR EO INDICATOR EXTRACTION FROM BIG EO DATA

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DGfG Arbeitskreis Fernerkundung | 05.10.2018

BIG EO DATA

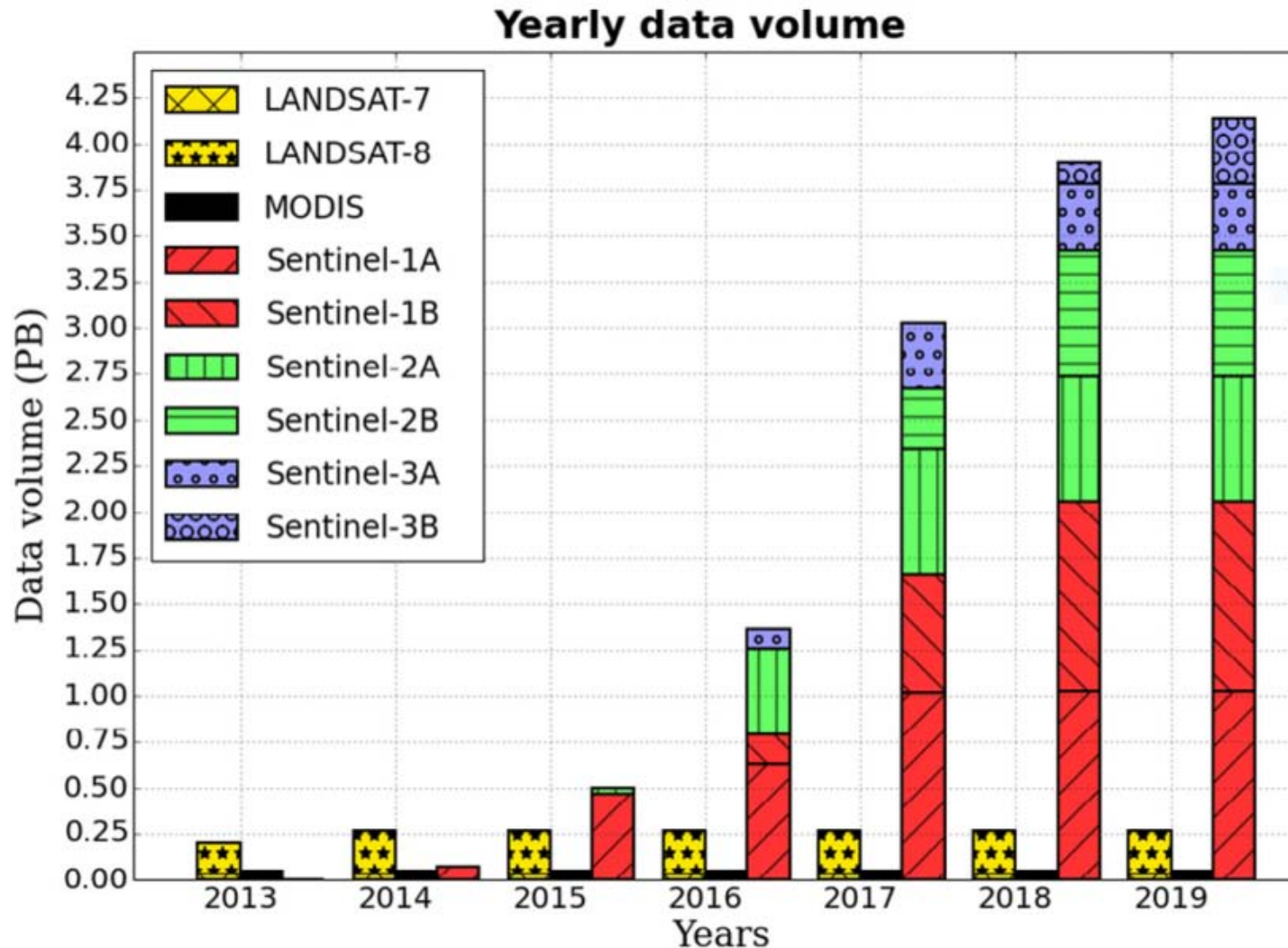


Figure 1: from Soille, P., et al. 2018. A versatile data-intensive computing platform for information retrieval from big geospatial data. *Futur. Gener. Comput. Syst.* 81, 30–40. doi:10.1016/j.future.2017.11.007

CHALLENGES

- efficient and intelligent analysis, storage and distribution
- low percentage ever downloaded (i.e. dark data)
- data is not (necessarily) information
- developing automated workflows

Bring the user to the data,
rather than data to the user.

WHAT IS A DATA CUBE?

A datacube is a massive multi-dimensional array, also called “raster data” or “gridded data”; “massive” entails that we talk about sizes significantly beyond the main memory resources of the server hardware. Data values, all of the same data type, sit at grid points as defined by the d-axes of the d-dimensional datacube. Coordinates along these axes allow addressing data values unambiguously.

- [The Datacube Manifesto](#), © 2017 Peter Baumann

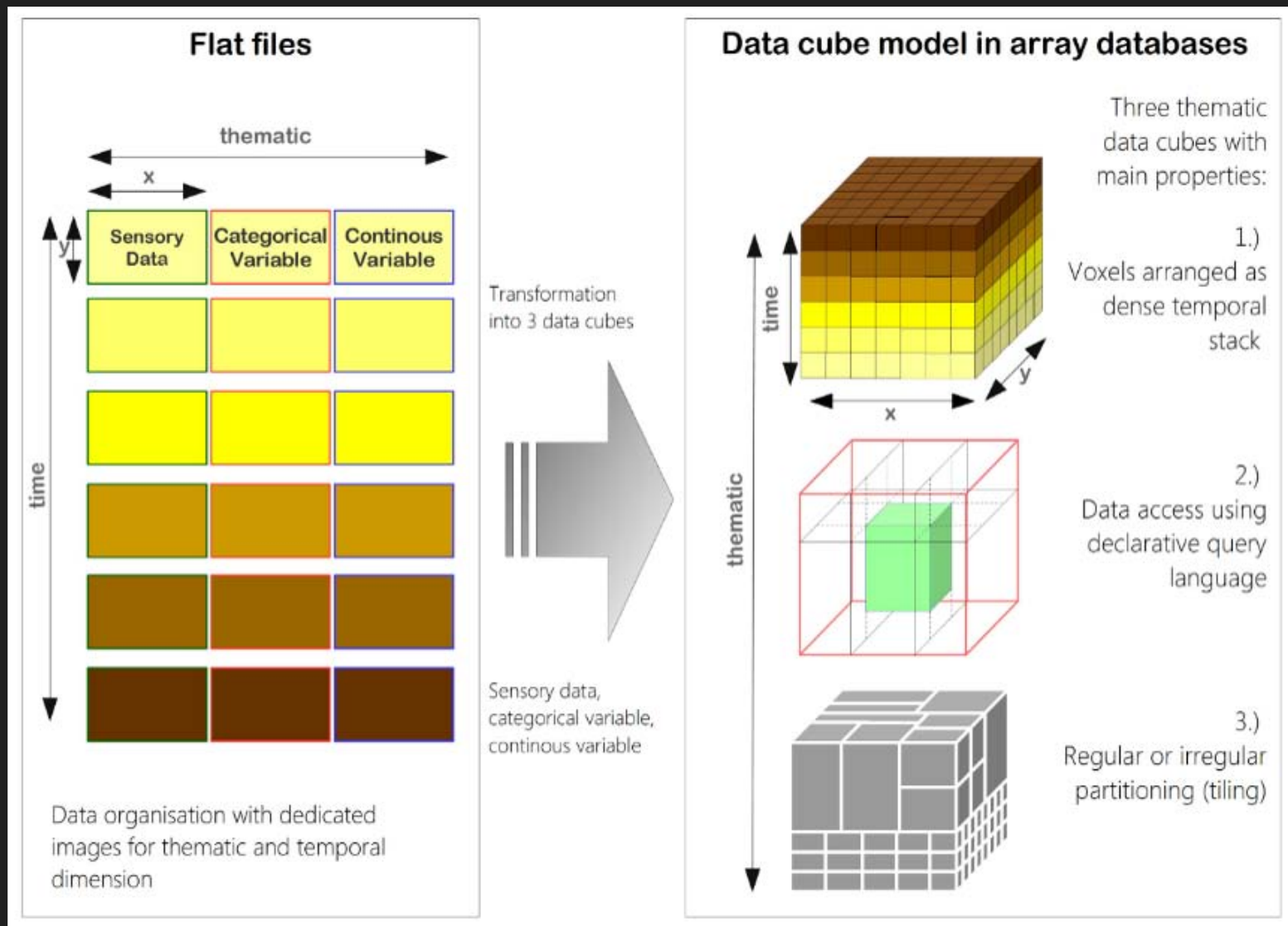


Figure 2: from Sudmanns, M., Tiede, D., Lang, S., Baraldi, A., 2018. Semantic and syntactic interoperability in online processing of big Earth observation data. *International Journal of Digital Earth* 11, 95–112. doi:10.1080/17538947.2017.1332112.

WHAT IS A SEMANTIC DATA CUBE?

DATA & INFORMATION

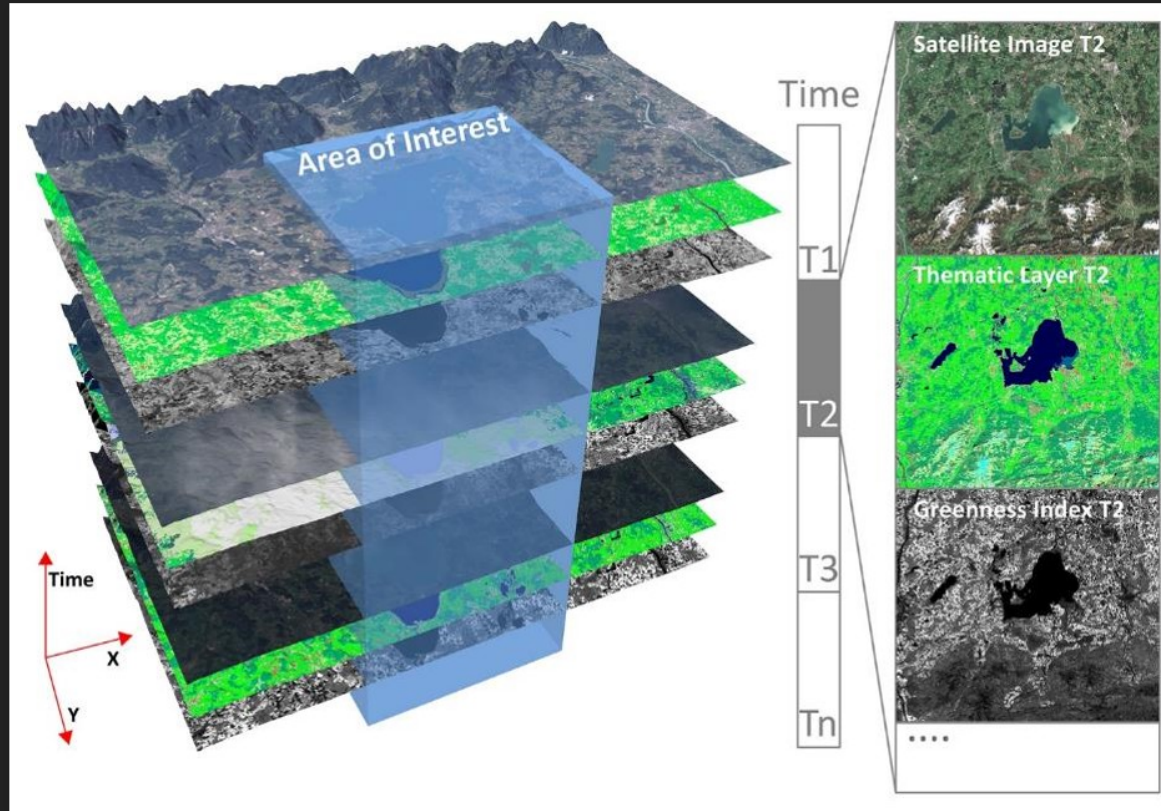


Figure 3: from Tiede, D., Baraldi, A., Sudmanns, M., Belgiu, M., Lang, S., 2017. Architecture and Prototypical Implementation of a Semantic Querying System for Big Earth Observation Image Bases. *Eur. J. Remote Sens.* 50, 452–463. doi:10.1080/22797254.2017.1357432

SEMANTIC ENRICHMENT

assigning meaning to (calibrated) pixel values

PRELIMINARY CLASSIFICATION WITH SIAM™

a priori knowledge-based

physical model-based

decision-tree

fully automatic

per-pixel spectral categorisation

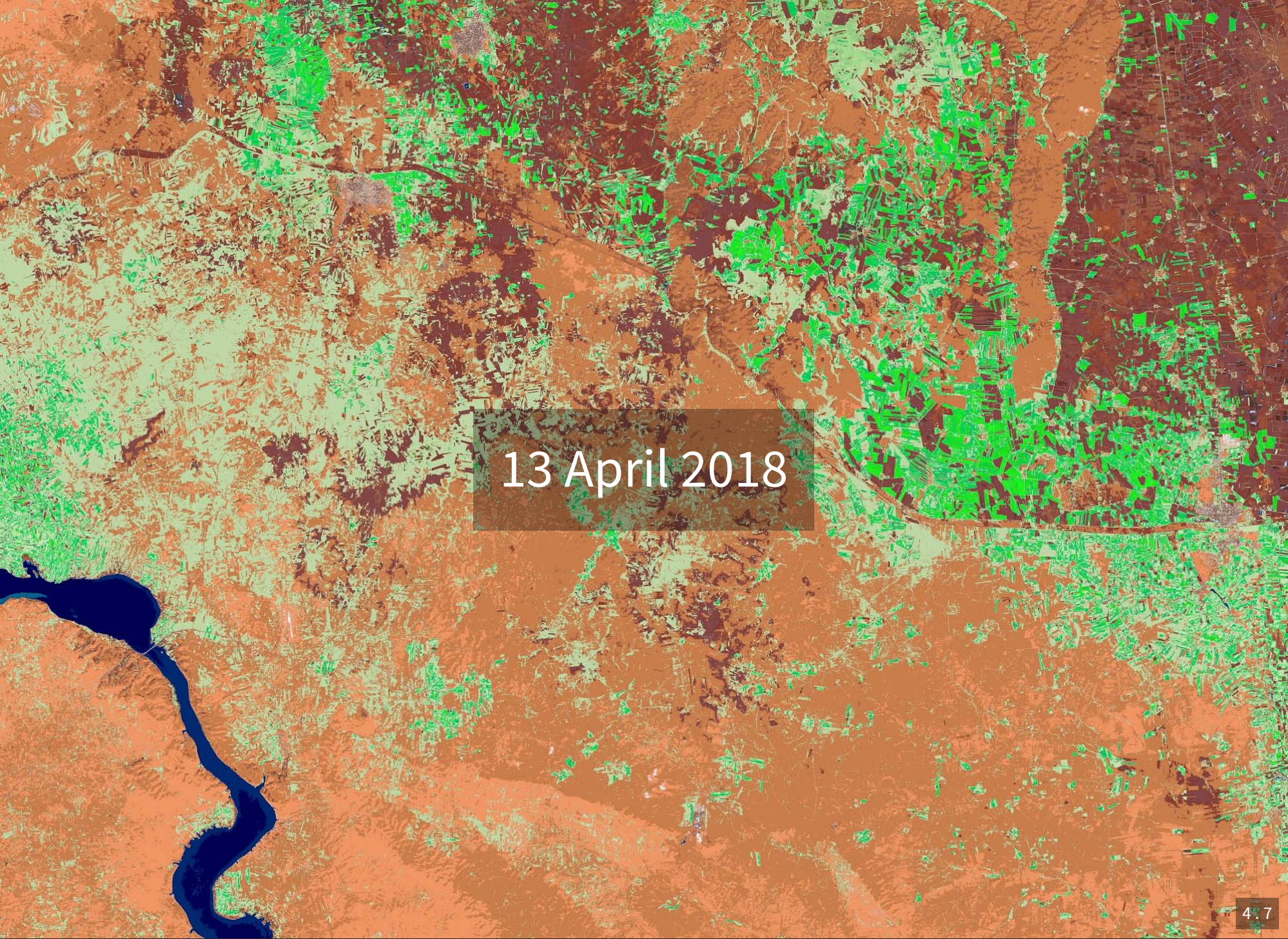
semi-concepts

EXAMPLE: 61 SEMI-CONCEPTS

[illegible]

A satellite image of a landscape, likely in a rural or agricultural area. The terrain is a mix of brown and tan colors, suggesting dry earth or sparse vegetation. A prominent, dark, winding river or water body is visible in the lower-left corner. The land is divided into numerous small, irregular patches, possibly representing different types of crops or land use. A semi-transparent dark rectangle is overlaid in the center of the image, containing the date "13 April 2018" in white text.

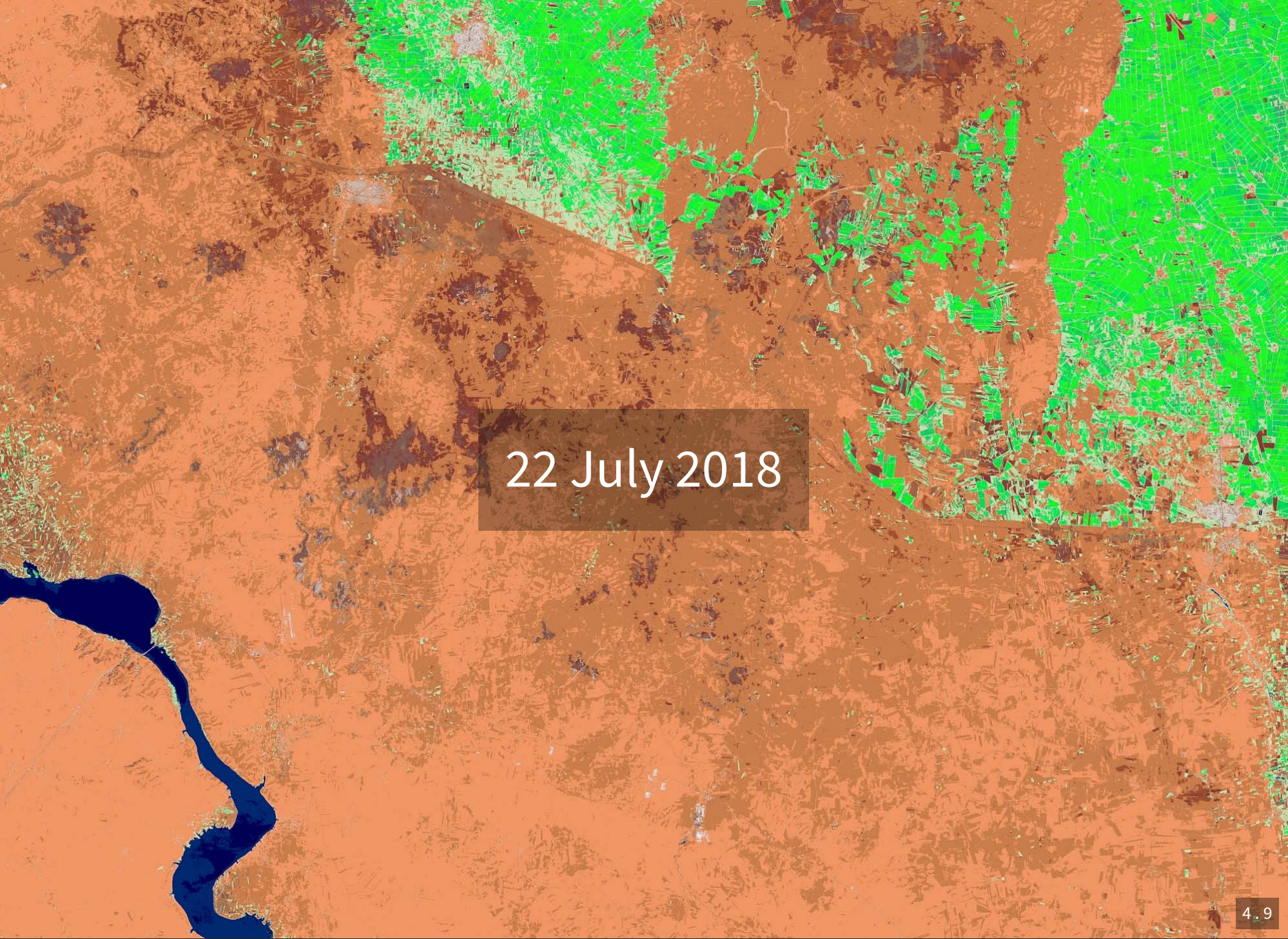
13 April 2018

An aerial photograph of a landscape. A dark, winding river flows through the lower-left portion of the frame. The surrounding land is a mix of brown and tan colors, with numerous small, bright green patches scattered throughout, possibly indicating vegetation or specific land use. A semi-transparent dark rectangle is centered in the image, containing the date "13 April 2018" in white text.

13 April 2018

A satellite image of a landscape. The foreground is dominated by a large, irregularly shaped body of water, likely a reservoir or a large river bend, with a dark, almost black surface. The surrounding land is a mix of brown and tan hues, suggesting dry vegetation or bare soil. In the upper right, there are patches of darker, more textured areas that could be forests or dense vegetation. The overall image has a grainy, high-resolution appearance typical of satellite photography.

22 July 2018



22 July 2018

PROOF-OF-CONCEPT IMPLEMENTATIONS

SOMALIA

rasdaman
raster data manager



- 78 Landsat 8 temporal images
- 2013 until September 2016
- in-house developed Web-based GUI

Example: indicate flood-prone areas over time

▼

▼

coverage using the drop-down menu

Some coverages might be protected

you have a password. In this case,

ss. In the query panel you can

and add content-based filter or

pre-defined one in the toolbox. Run

▼

d.

et!

To start, select data in the top corner

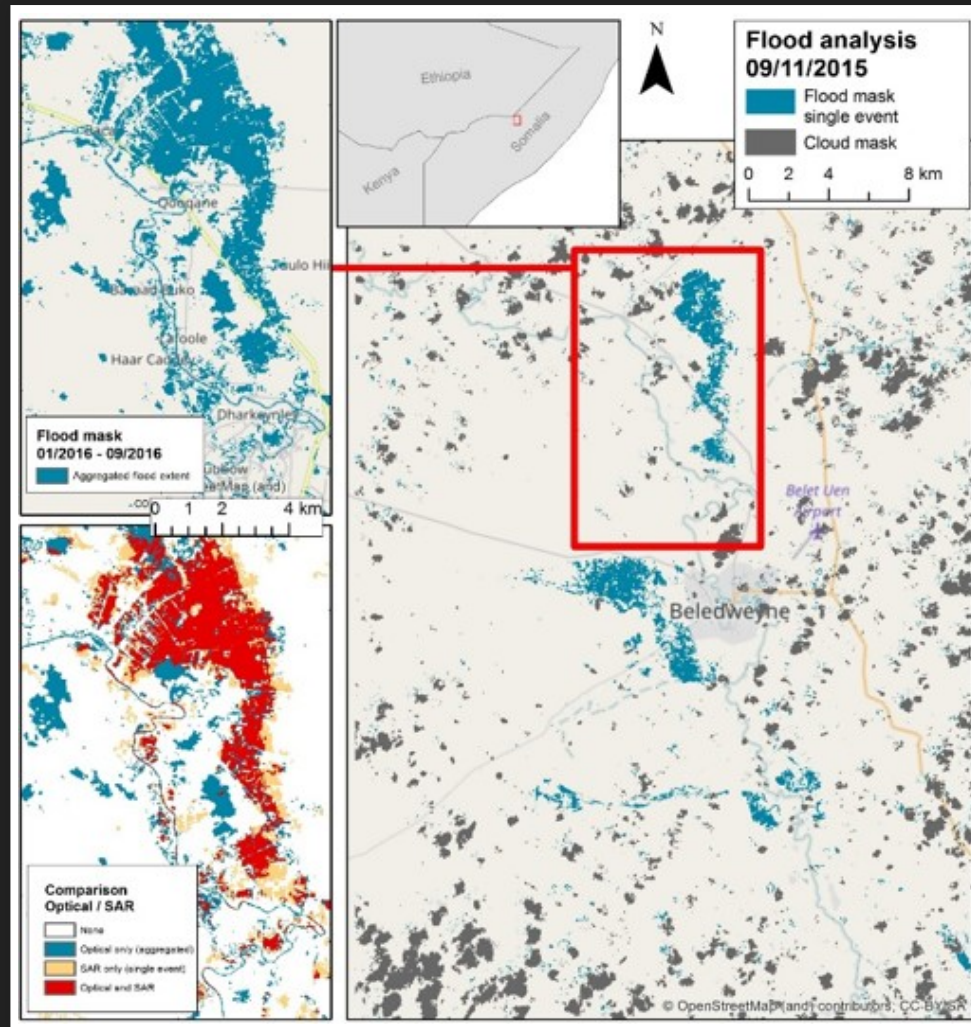


Figure 4: from Sudmanns, M., Tiede, D., Wendt, L., & Baraldi, A. 2017. Automatic ex-post flood assessment using long time series of optical Earth observation images. In *GI-Forum, Journal for Geographic Information Science* (Vol. 1, pp. 217-227). doi:10.1553/giscience2017_01_s217

SYRIA



- 
- A satellite image of a river delta, likely the Amazon, showing a complex network of channels and floodplains. The land is a mix of brown and green, indicating different vegetation and soil types. The river itself is a dark blue line winding through the landscape.
- 3 Sentinel-2 granules
 - June 28, 2015 - October 4, 2018
 - ~680 scenes (~430GB)
 - automated integration of newly acquired scenes
 - Jupyter notebook interface access

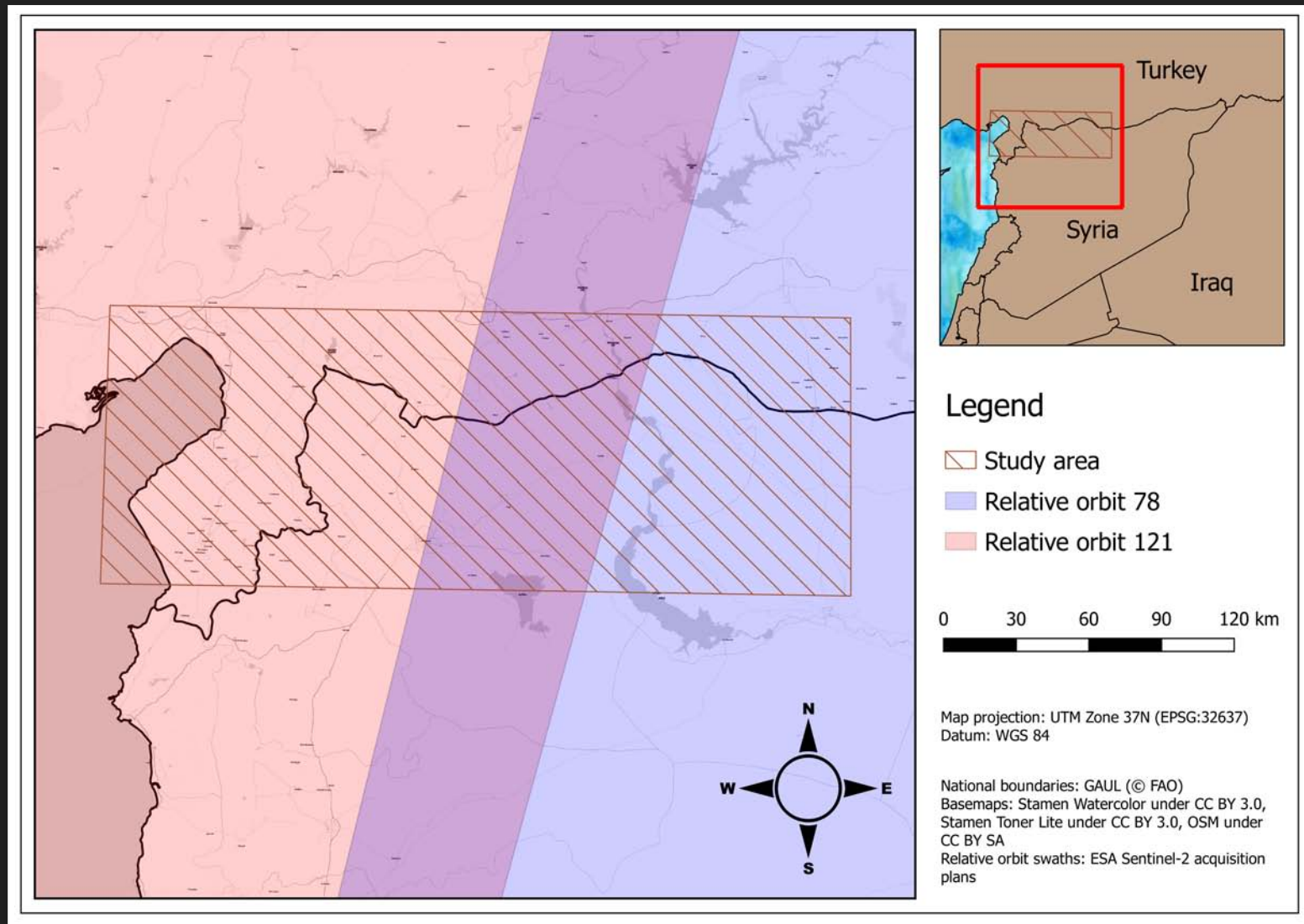


Figure 5: study area with overlapping relative orbits (Source: [H. Augustin](#)).

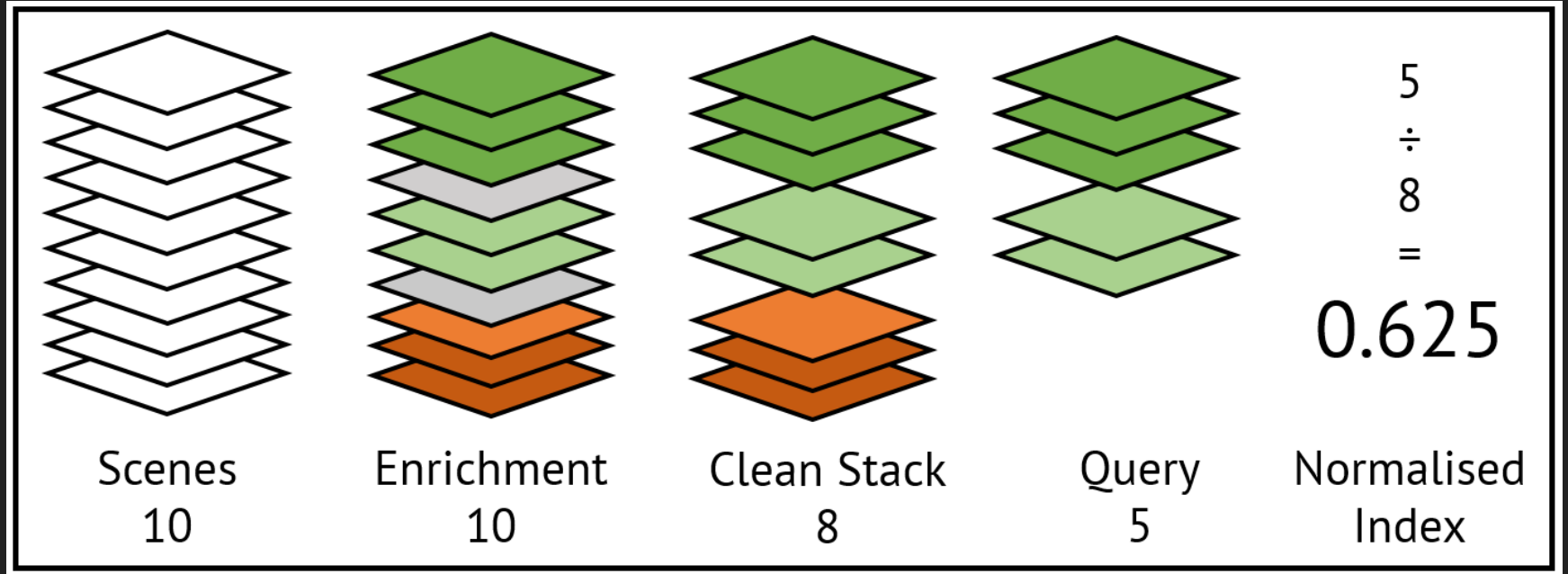
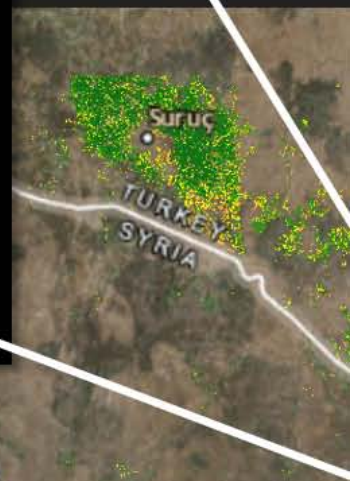
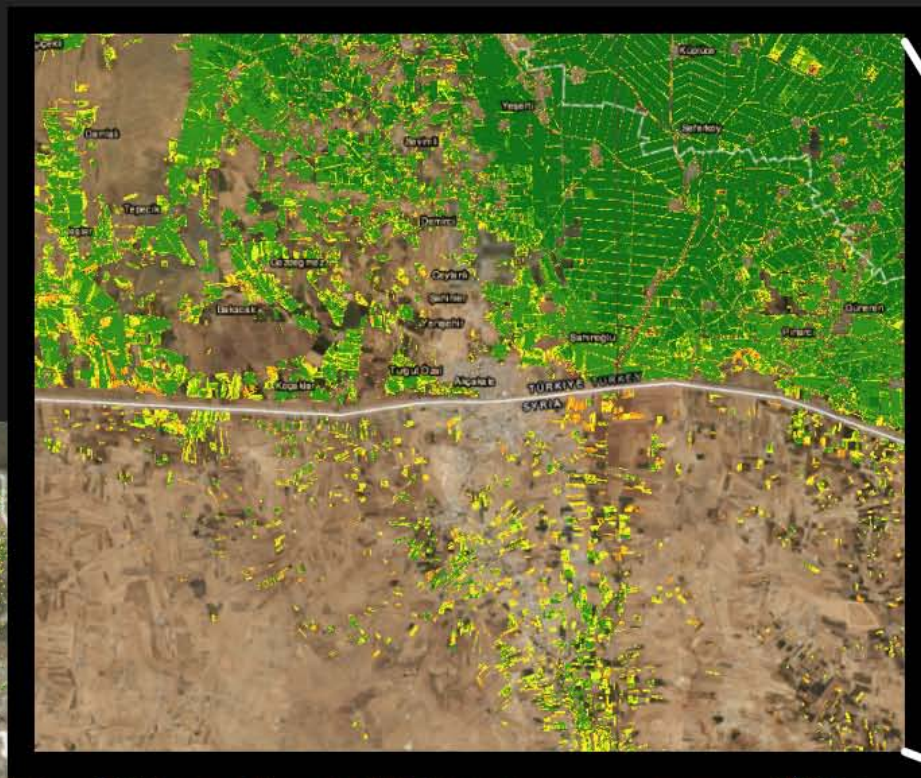


Figure 6: vegetation occurrence calculation (aggregated over time) (Source: [H. Augustin](#)).

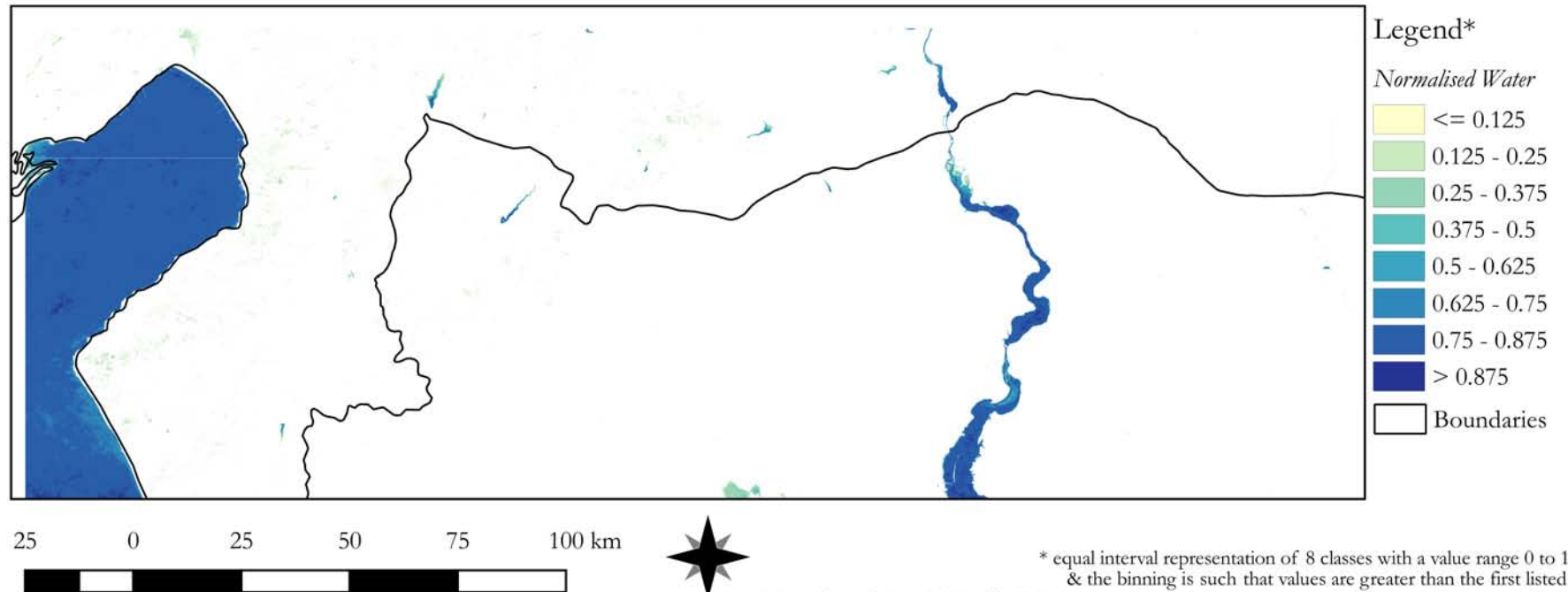
Over 30,000 km²
5-11 temporal images

- August 15 - September 15 2017
- <20 minutes, vegetation occurred





Normalised Occurrence of Water-like Observations in the Entire Study Area: 2015-06-28 until 2018-06-22



* equal interval representation of 8 classes with a value range 0 to 1
& the binning is such that values are greater than the first listed
National boundaries: GAUL (© FAO) | Projection: UTM Zone 37N (EPSG:32637) | Datum: WGS 84

Figure 7: water-like query of clean pixels (Source: [H. Augustin](#)).

Normalised Occurrence of Vegetation- and Water-like Observations: 2015-06-28 until 2018-06-22

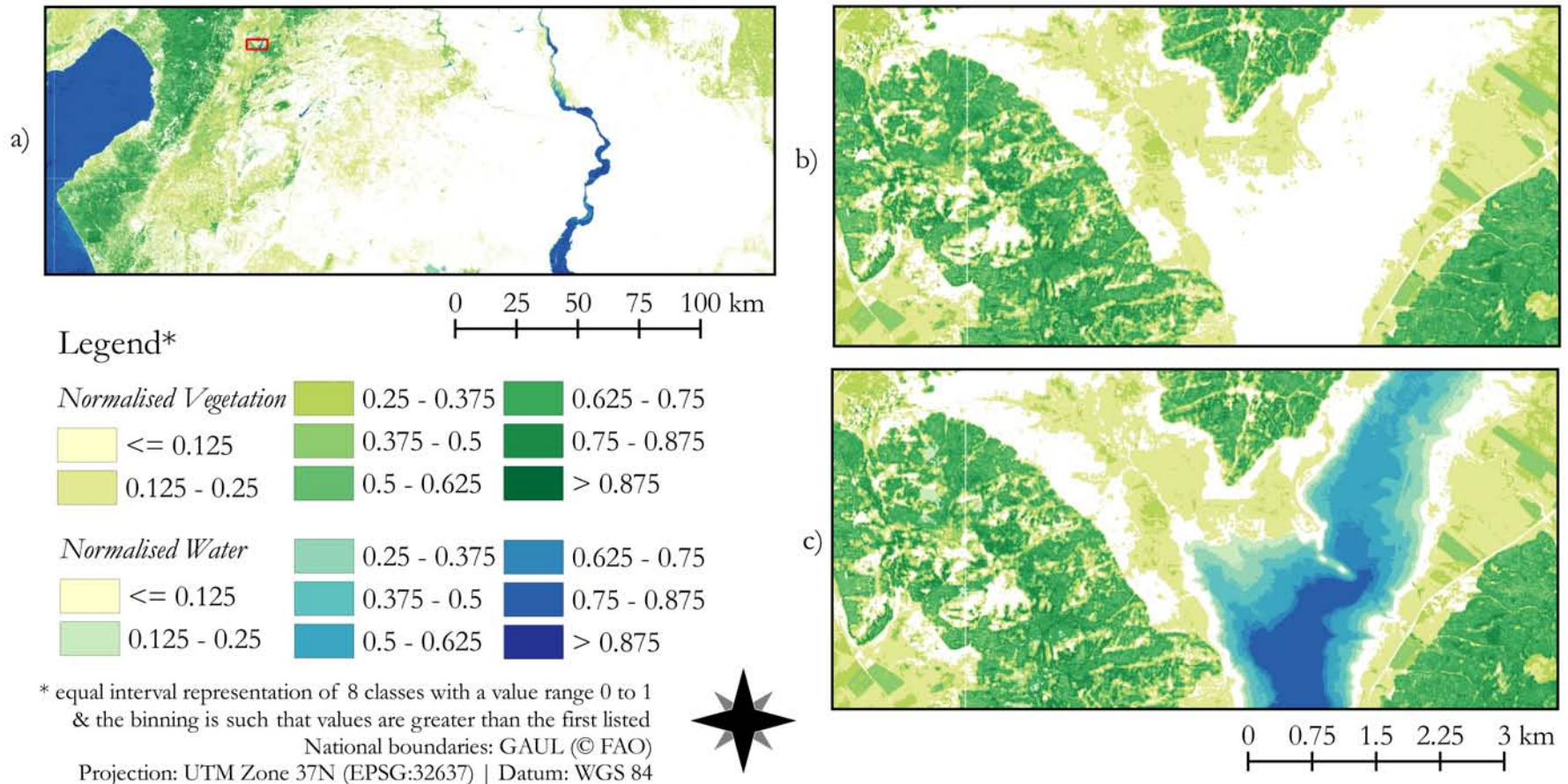
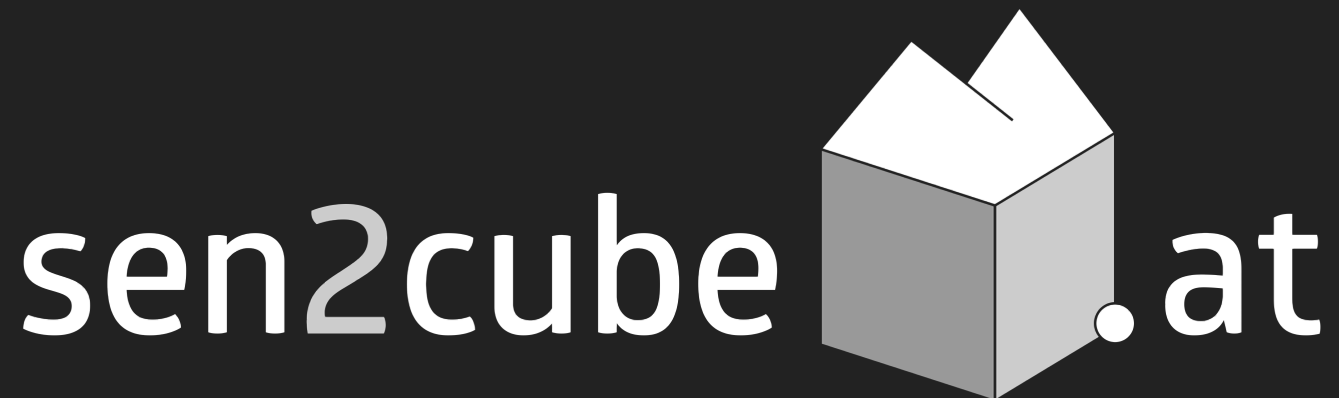


Figure 8: water-like and vegetation-like query of clean pixels (Source: [H. Augustin](#)).

CURRENT RESEARCH



Duration: 2018-2020

<http://sen2cube.at>

AUSTRIAN DATA AND INFORMATION CUBE

Sen2Cube.at is a project funded under the Austrian Space Applications Programme (ASAP) of the Austrian Research Promotion Agency (FFG; project no.: 866016).



PROJECT PARTNERS



OUTLOOK

- integrate >4000 Sentinel-2 scenes
- semantic content-based image retrieval
- generation of cloud-free mosaics/composites
- location-based queries through time
- polygon-based/object-based land cover change analysis through time

A satellite image of a river valley, likely the Danube River, showing a winding river through a brown, hilly landscape. The river is dark blue, and the surrounding land is a mix of brown and tan colors, indicating dry vegetation or bare earth. The terrain is rugged with many small hills and valleys.

THANK YOU FOR YOUR ATTENTION!

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GitHub: [@augustinh22](#)

Slides: <http://slides.hannahaugustin.at/DGfG/2018/>



DIGITAL | EARTH | OBSERVATION

01-04 JULY 2019 IN SALZBURG / AUSTRIA

www.zgis.at/earsel2019

