



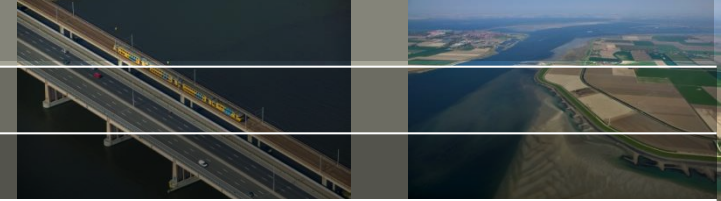
# Introduction to Google Earth Engine and Applications for Water Quality

Or: can we really teach you Earth Engine in 90 minutes?

15 november 2018

Arjen Haag

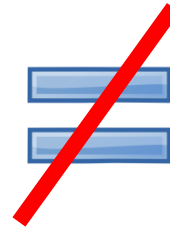
# Google Earth Engine (GEE)



**Google Earth**



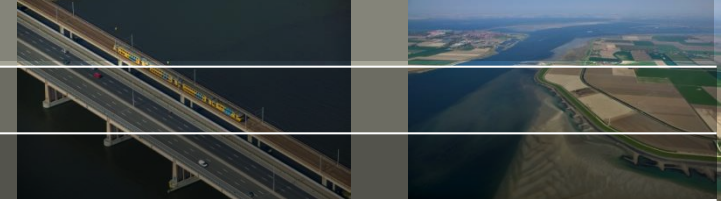
3-D Globe  
Visualization



**Earth Engine**



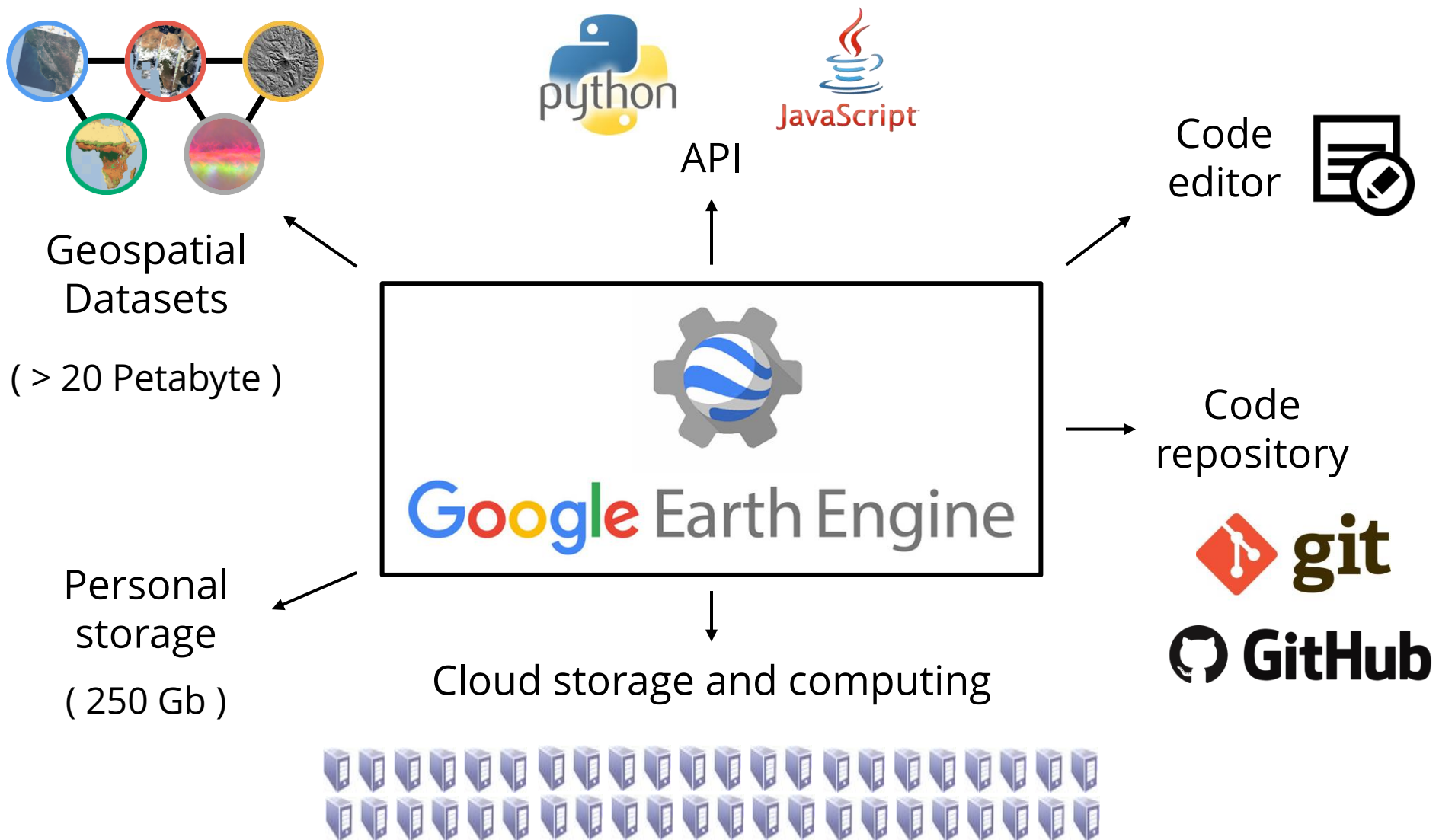
Geospatial  
Analysis

A large, detailed satellite map of the world serves as the background for the main title. The map shows the continents and oceans in realistic colors, with a focus on the Atlantic and Indian Oceans.

# Google Earth Engine:

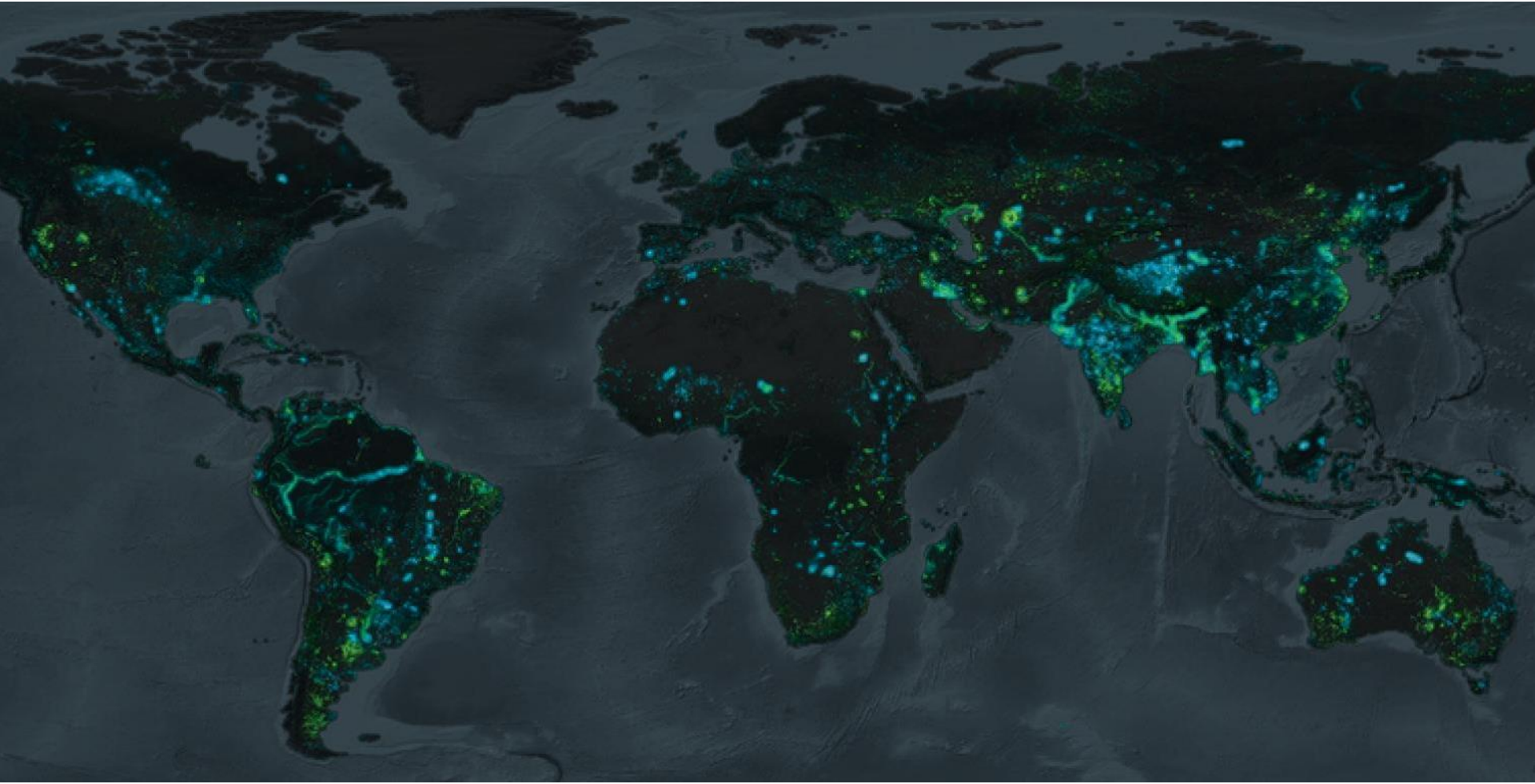
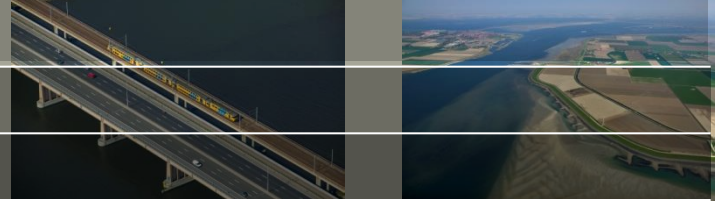
Google's Cloud Platform for  
Big Earth Data Analytics

# GEE Quick Overview





# GEE example applications (1)



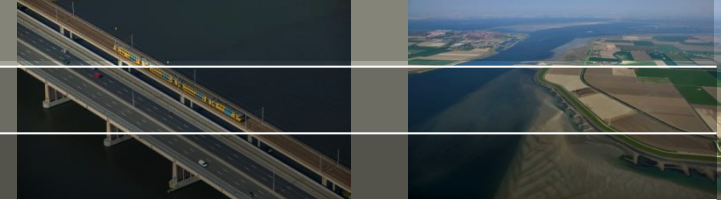
<http://aqua-monitor.deltares.nl/>

<https://www.deltares.nl/en/software/aqua-monitor/>

15 november 2018

**Deltares**

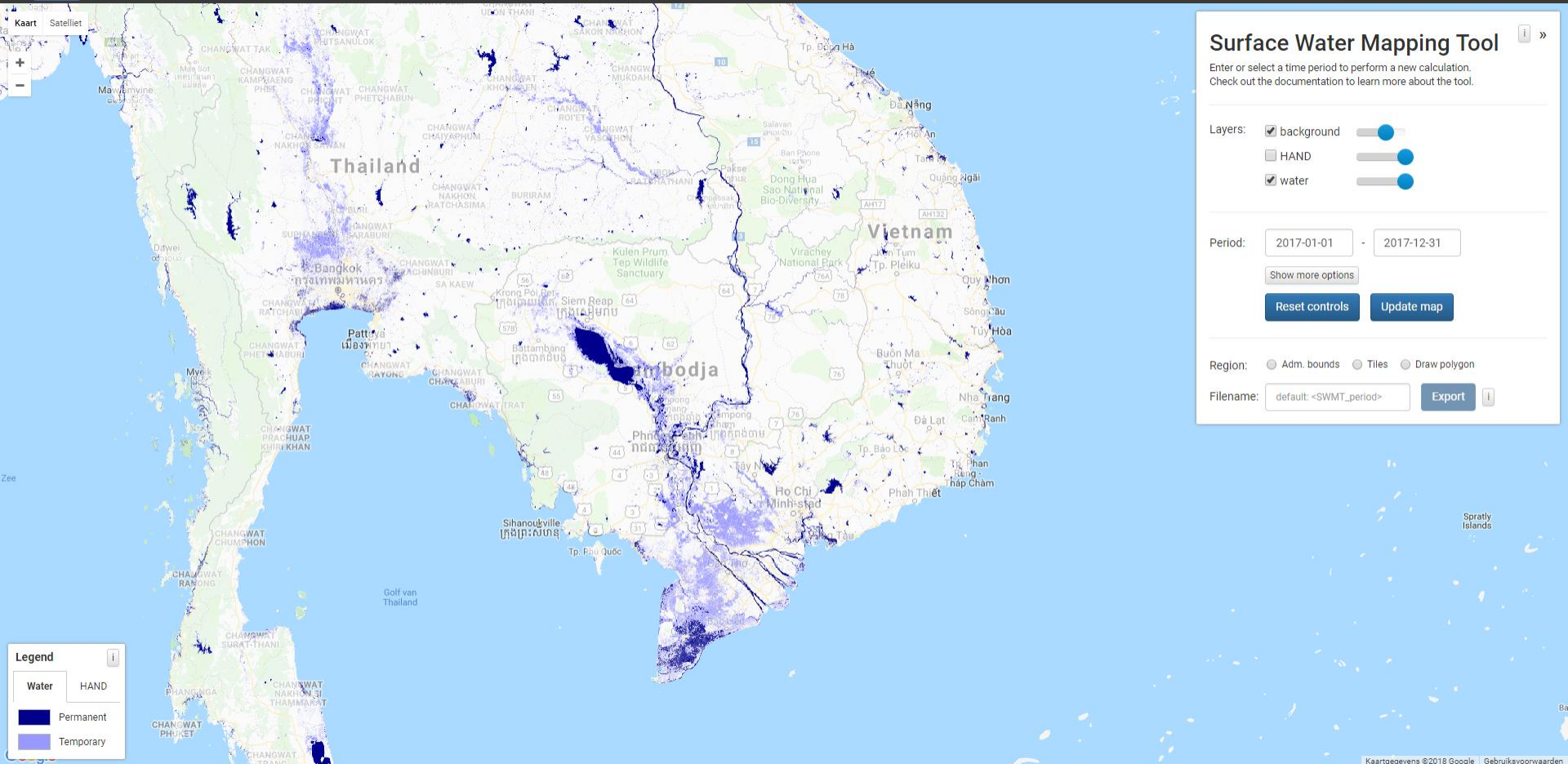
# GEE example applications (2)



SERVIR MEKONG

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Search for a location



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Google Earth Engine



<https://servir.adpc.net/tools/surface-water-mapping-tool>


<http://surface-water-servir.adpc.net/>

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# GEE example applications (3)



The screenshot shows the Global Forest Watch 2.0 website. At the top, there is a navigation bar with links: HOME, COUNTRIES, STORIES, MAP, BLOG, DATA, ABOUT, and a language selector set to ENGLISH. Below the navigation bar, a large green banner contains the text "Find out what is happening in forests right now". To the right of this text, two statistics are displayed: "44,479 ALERTS IN THE PAST YEAR" and "3 NEW FOREST STORIES". Below the banner is a world map with green overlays indicating forest cover. At the bottom, there are three icons with corresponding text: "Join the community" (with a speech bubble icon), "Analysis tool" (with a magnifying glass and pulse line icon), and "Stay updated" (with a tree and exclamation mark icon).

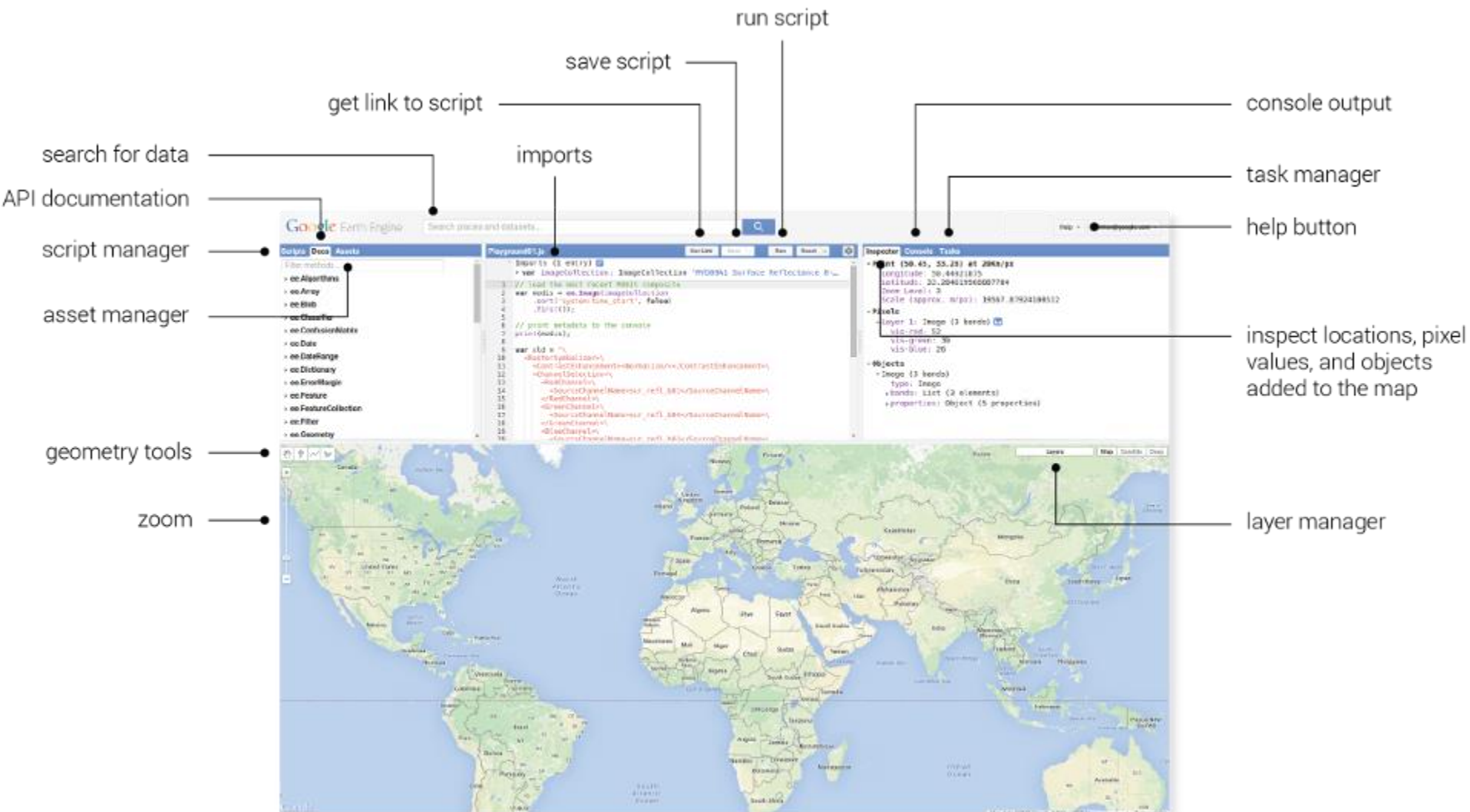
<https://www.globalforestwatch.org/>

[https://earthengine.google.com/case\\_studies/](https://earthengine.google.com/case_studies/)

15 november 2018

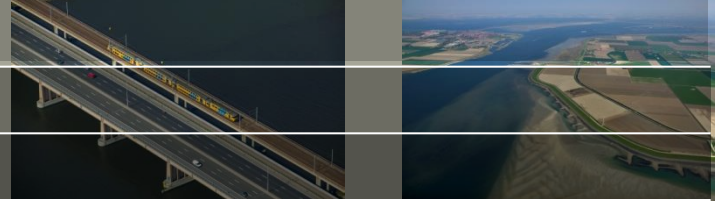
**Deltares**

# GEE Code Editor



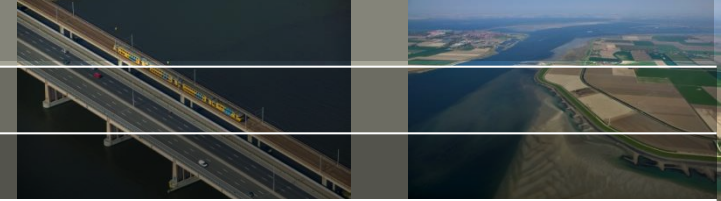


# GEE objects

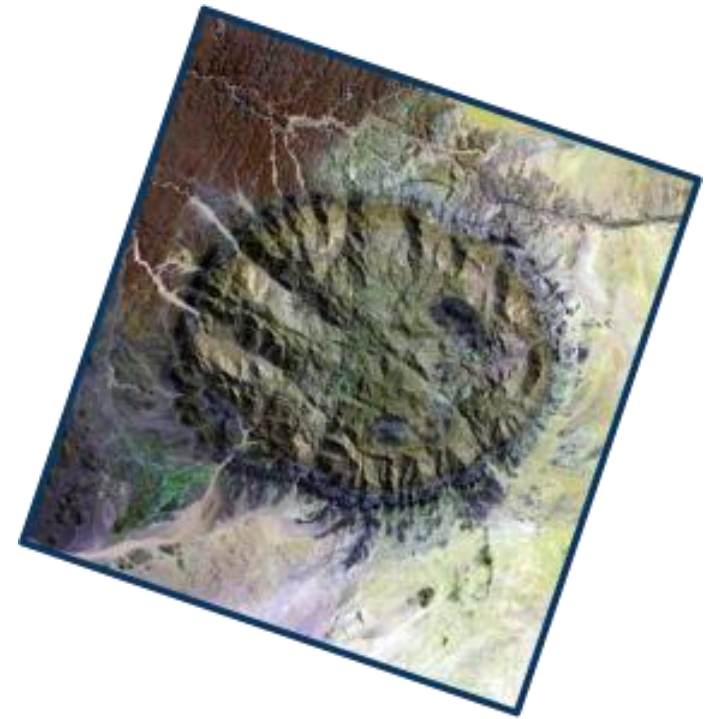


Most important GEE objects:

- Image: a raster object with a certain timestamp and spatial extent
- ImageCollection: a collection of Images with different timestamps and/or spatial extents
- Feature: a vector object with multiple geometries and properties
- FeatureCollection: a collection of Features (“shapefile”)
- List: a list containing any number of different GEE objects
- Array: a list containing numbers only (multiple dimensions possible)
- ...

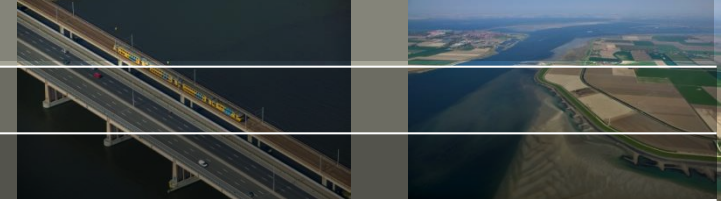


## Get a single Image



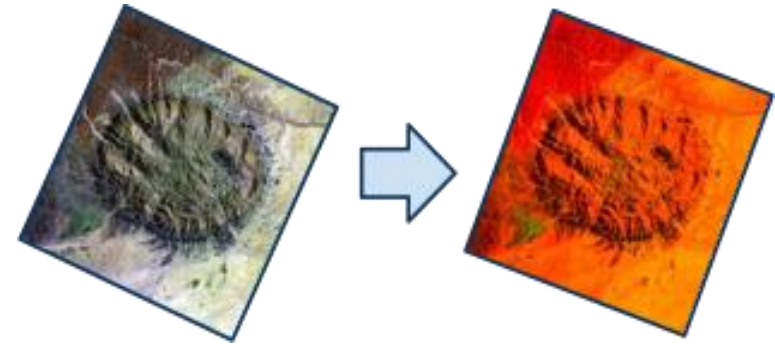
Each image has its own native projection and resolution. An image can contain multiple bands (single band: 2D raster, multiple bands: 3D raster).

# GEE processing



Get a single Image

Apply an algorithm to an image

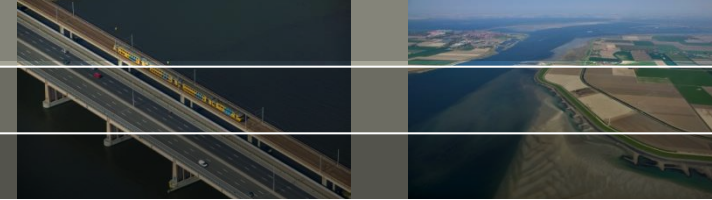


Use available library functions or write your own. Can be applied on a single band or multiple bands at once.

[https://developers.google.com/earth-engine/image\\_overview](https://developers.google.com/earth-engine/image_overview)



# GEE processing

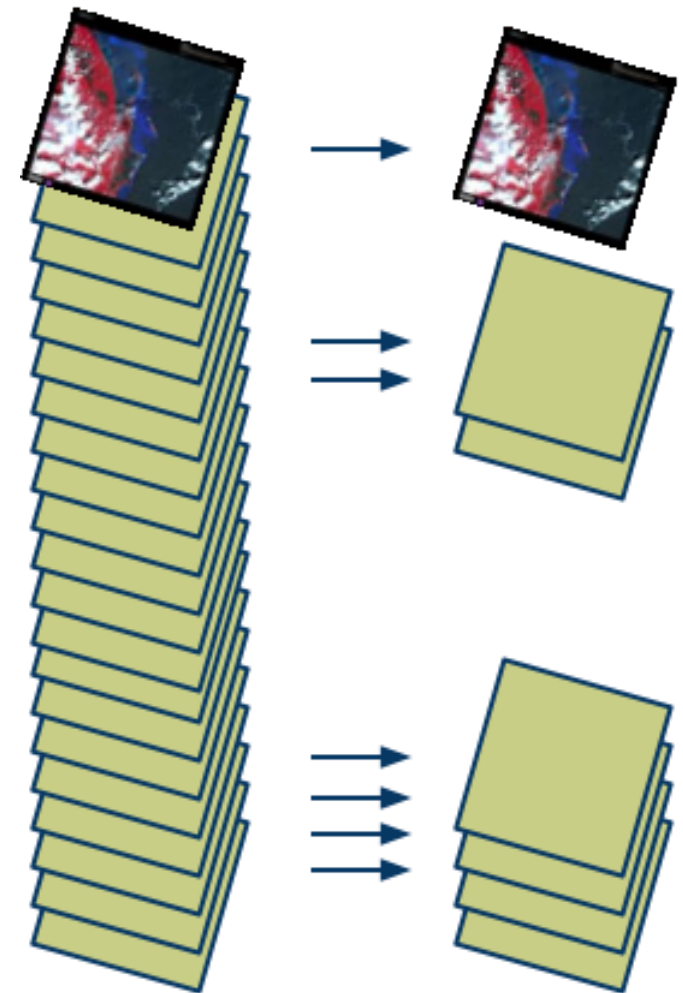


Get a single Image

Apply an algorithm to an image

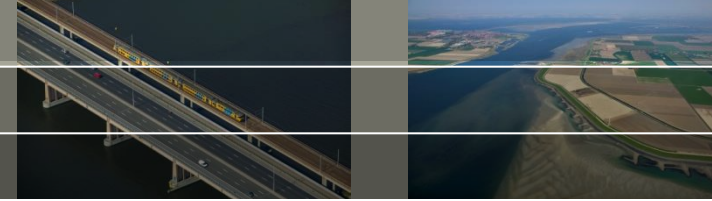
Filter a collection

Filter on time, space, metadata, etc.



[https://developers.google.com/earth-engine/ic\\_filtering](https://developers.google.com/earth-engine/ic_filtering)

# GEE processing

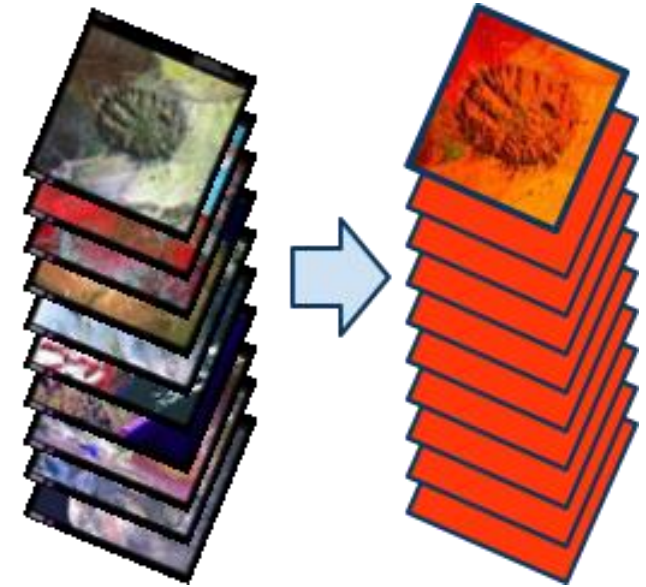


Get a single Image

Apply an algorithm to an image

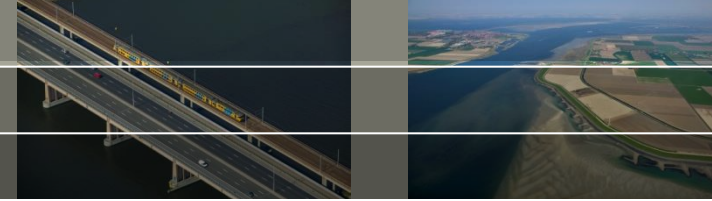
Filter a collection

Map an algorithm over a collection



Apply a function/algorithm on each image within a collection ( $N \rightarrow N$ )

# GEE processing



Get a single Image

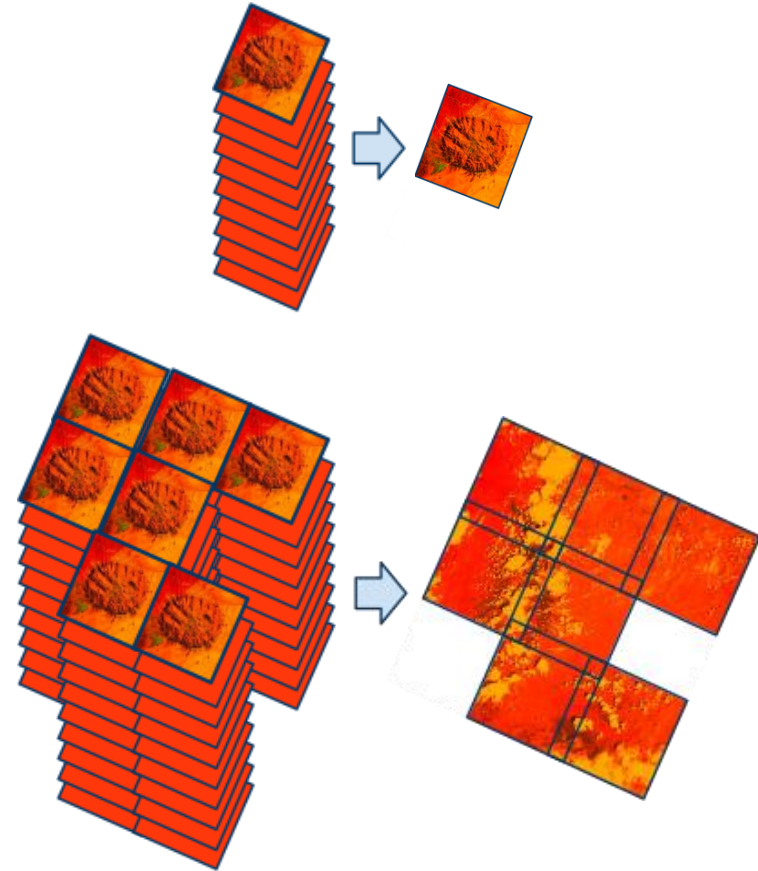
Apply an algorithm to an image

Filter a collection

Map an algorithm over a collection

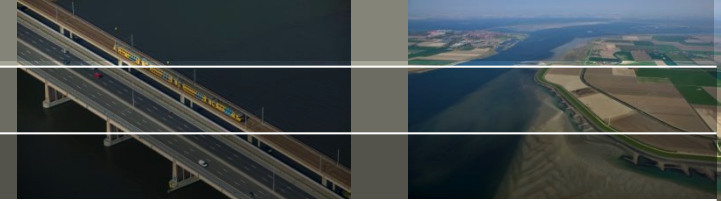
Reduce a collection

Use a function to reduce a collection of images to a single value per pixel ( $N \rightarrow 1$ , for the same spatial extent, or  $N \rightarrow M$ , for different spatial extents)





# Wrap-up



**Google Earth Engine** is a cloud-based platform for performing spatial analyses on large datasets, hosting available open data, allowing users to easily share code and applications and which is free to use for research purposes.

## Websites overview:

- General website: <https://earthengine.google.com/>
- Documentation: <https://developers.google.com/earth-engine/>
- Data Catalog: <https://developers.google.com/earth-engine/datasets/>
- Code Editor: <https://code.earthengine.google.com/>
- Developers Forum: <https://groups.google.com/forum/#!forum/google-earth-engine-developers>

## Additional tips & tricks:

- Lazy evaluation ([https://en.wikipedia.org/wiki/Lazy\\_evaluation](https://en.wikipedia.org/wiki/Lazy_evaluation))
- Client vs. Server ([https://developers.google.com/earth-engine/client\\_server](https://developers.google.com/earth-engine/client_server))
  - Do NOT use regular 'for-loops' !
  - Be careful with regular 'if-statements' !
- More Earth Engine concepts: [https://developers.google.com/earth-engine/concepts\\_overview](https://developers.google.com/earth-engine/concepts_overview)

## Questions?

# Extra: multispectral satellite data

