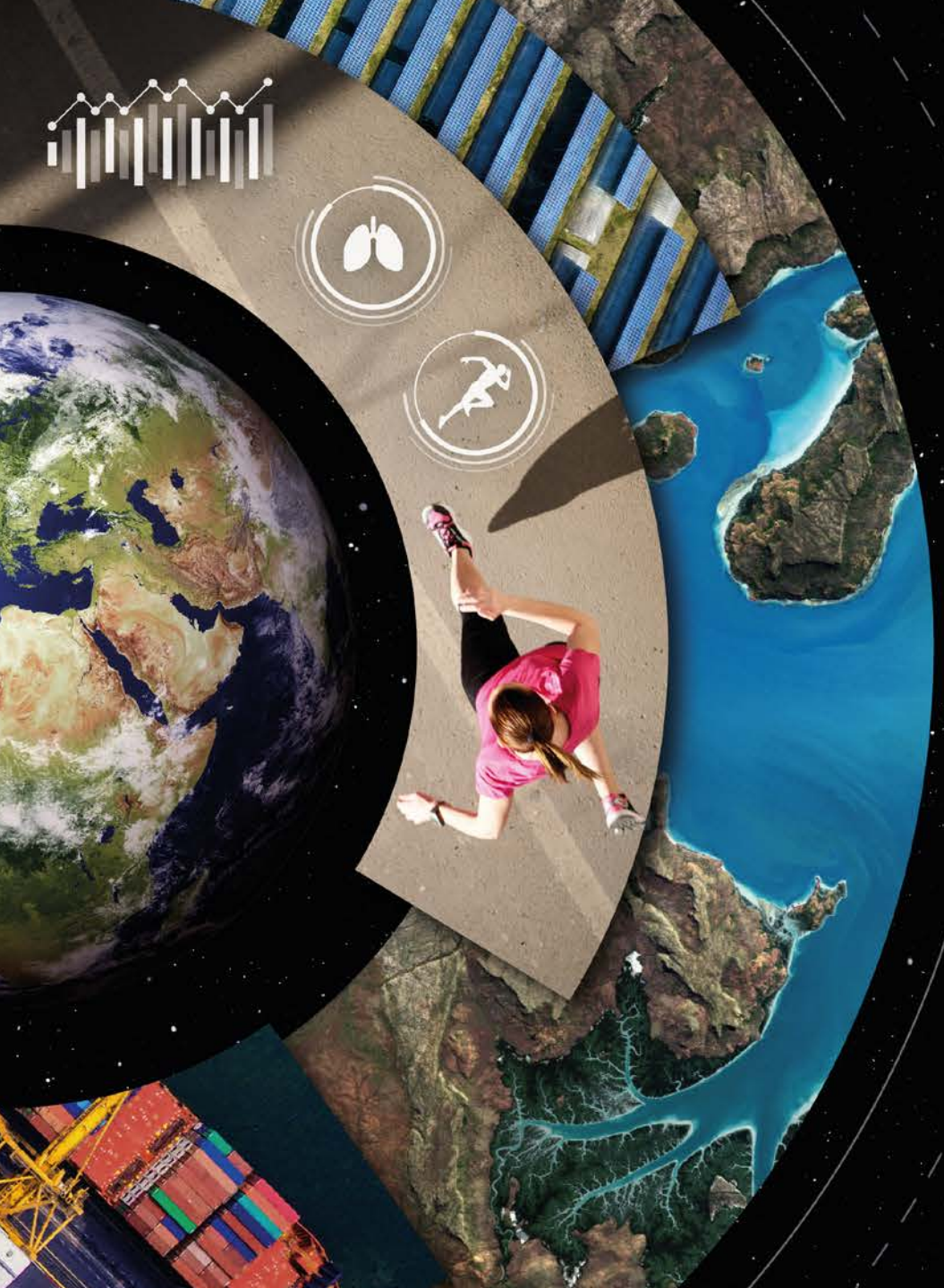

esa
business applications
SENTINEL Hub
by SINERGISE
European Space Agency

➔ Guidelines

- Guidelines how/when to interact during the WebEx session:
  - Due to the number of attendees, please keep always your webcam and microphone switched-off
  - You can use anytime the “chat to all” function to submit your questions that will be then addressed at the end of the Webinar



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→ YOUR BUSINESS POWERED BY SPACE

Roberto Cossu

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business.esa.int

European Space Agency


esa
business applications
→ THE EUROPEAN SECTOR
IS POWERED BY SPACE
Earth Observation
Satellite Navigation
Satellite Communication
Human Space Flights Technologies
European Space Agency

Who are we

→ A European funding programme

We have **€195m** available for funding

And we have invested...

€190m in over

500 European Businesses

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European Space Agency

What we offer

→ Support to propel your business with Space

- Zero-Equity Funding
- Technical & Commercial Guidance
- Access to Our Network & Partners
- Use of the ESA Brand for Credibility

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European Space Agency

Space for ...

→ YOUR BUSINESS

Satellite Navigation

- Global Positioning
- Navigation
- Timing

Satellite Communication

- Communication on the move
- Deployable connectivity
- Unprecedented speeds

Earth Observation

- Digital Mapping
- Global coverage
- Hi-res imagery
- Weather forecasting

European Space Agency

Space for ...

→ YOUR BUSINESS

Satellite Navigation

Satellite Communication

Earth Observation

- Digital Mapping
- Global coverage
- Hi-res imagery
- Weather forecasting

European Space Agency

Earth Observation

→ Land monitoring 1/2

Forestry: clear-cut and partial-cut detection, forest type classification, biomass estimation, mapping of forest fire …

Agriculture and precision farming: Monitoring of crop conditions, soil properties and mapping tillage activities ➔

- help to assess land use,
- predict harvests,
- monitor seasonal changes and
- assist in implementing policy for sustainable development.

Earth Observation

→ Land monitoring 2/2

Characterisation of Vegetation: extensive range of parameters characterising vegetation like NDVI, FaPAR

Snow and Ice monitoring: snow and ice classification, sea-ice and ice thickness monitoring

River and lakes: river and lake water levels, extensive range of parameters, e.g. chlorophyll

Earth Observation

→ Marine Monitoring

Ship Monitoring: detection and location of ships

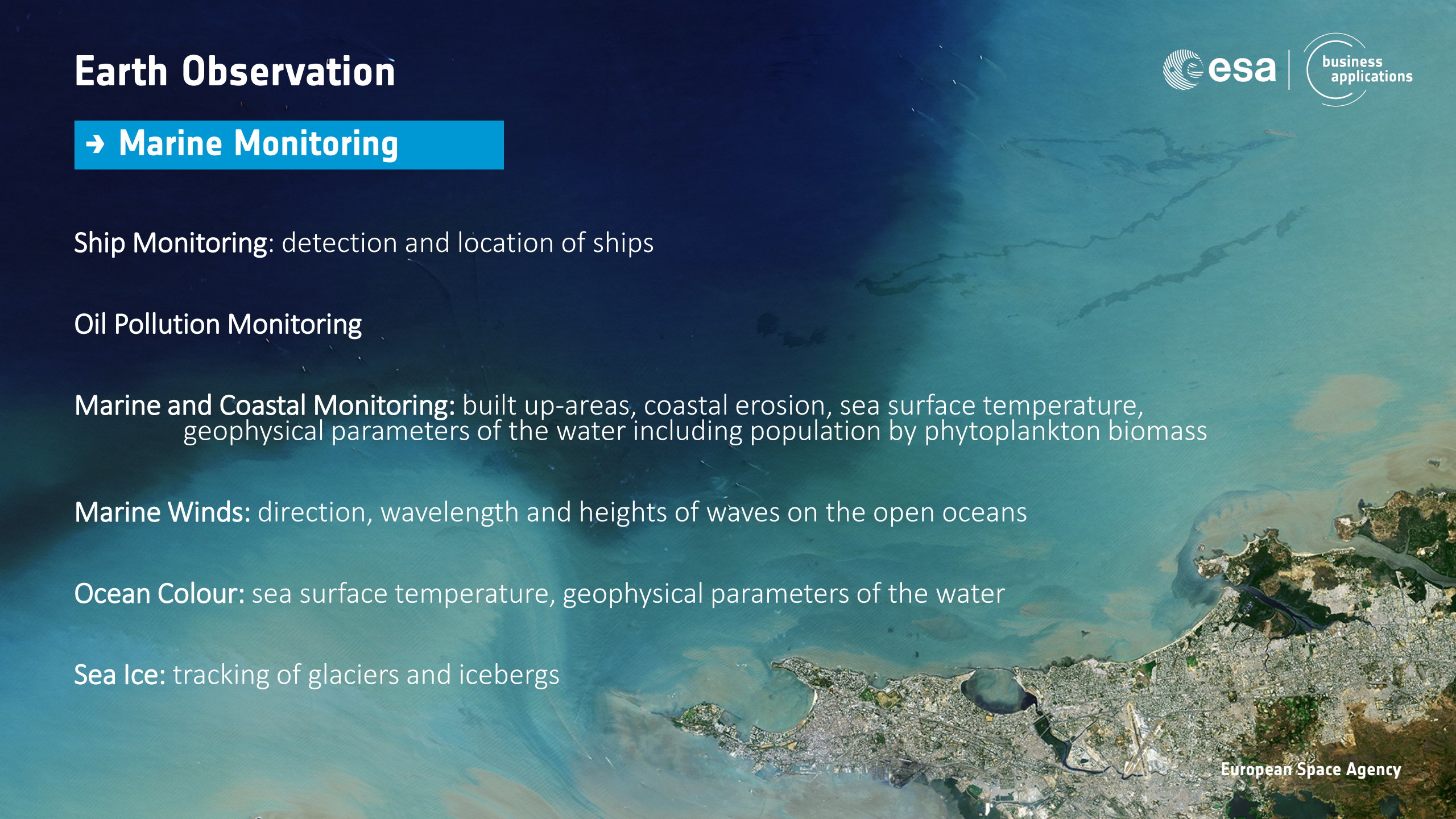
Oil Pollution Monitoring

Marine and Coastal Monitoring: built up-areas, coastal erosion, sea surface temperature, geophysical parameters of the water including population by phytoplankton biomass

Marine Winds: direction, wavelength and heights of waves on the open oceans

Ocean Colour: sea surface temperature, geophysical parameters of the water

Sea Ice: tracking of glaciers and icebergs



Earth Observation

→ Emergency Management

Flood monitoring: assessment of the extent of flooded areas and the impact on human, economic and environmental loss

Extreme weather events

Subsidence, landslides and volcano monitoring: monitor surface deformation to provide early warning of potential disasters and monitoring of critical infrastructure

Earthquakes: medium and high-resolution maps of earthquake deformations

Forest fires

Oil Spills

Earth Observation

➔ Security, Climate Change, Atmospheric monitoring

Security: Maritime Surveillance, border control

Climate Change: Land Monitoring, Marine Environmental Monitoring, Atmospheric Monitoring, Essential Climate Variables

Atmospheric monitoring: including Greenhouse Gases, Ozone and Solar UV Radiation, Aerosols

Earth Observation

→ Example

In the URGED project Rezatec Ltd has developed a suite of services for detecting, monitoring and predicting water infrastructure failures and pipeline leakage signals

EO data - Terrain Motion

EO data - Vegetation encroachment

Other data: use of historic burst, leak event data associated with corresponding pipeline attributes to model individual pipe segment failure probabilities.

➔ Pipeline Failure Risk

→ business.esa.int/projects/URGED

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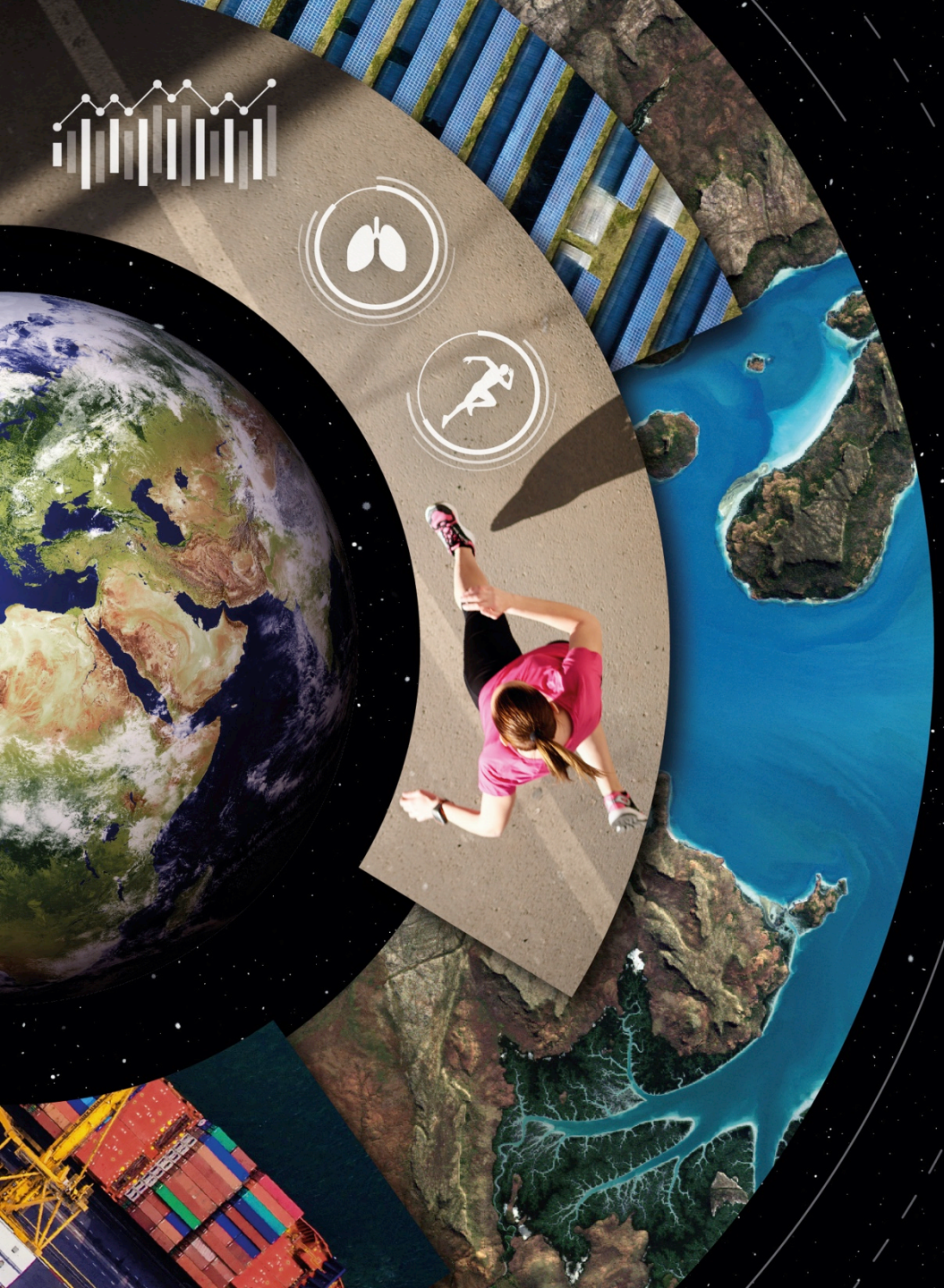

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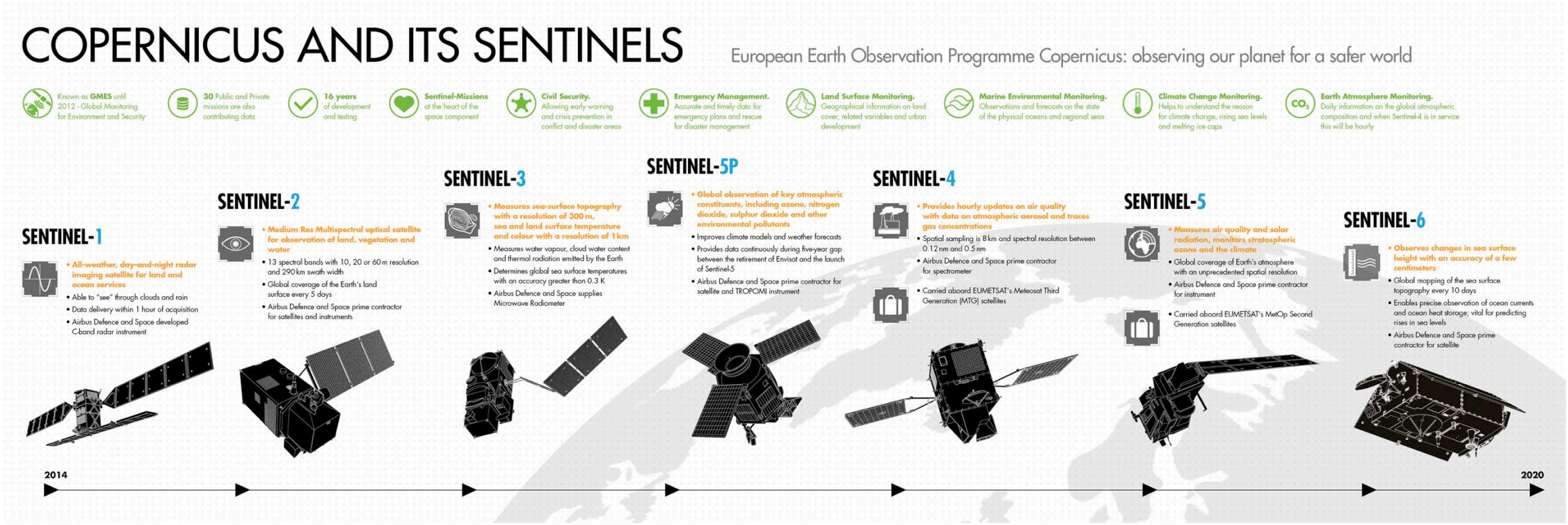
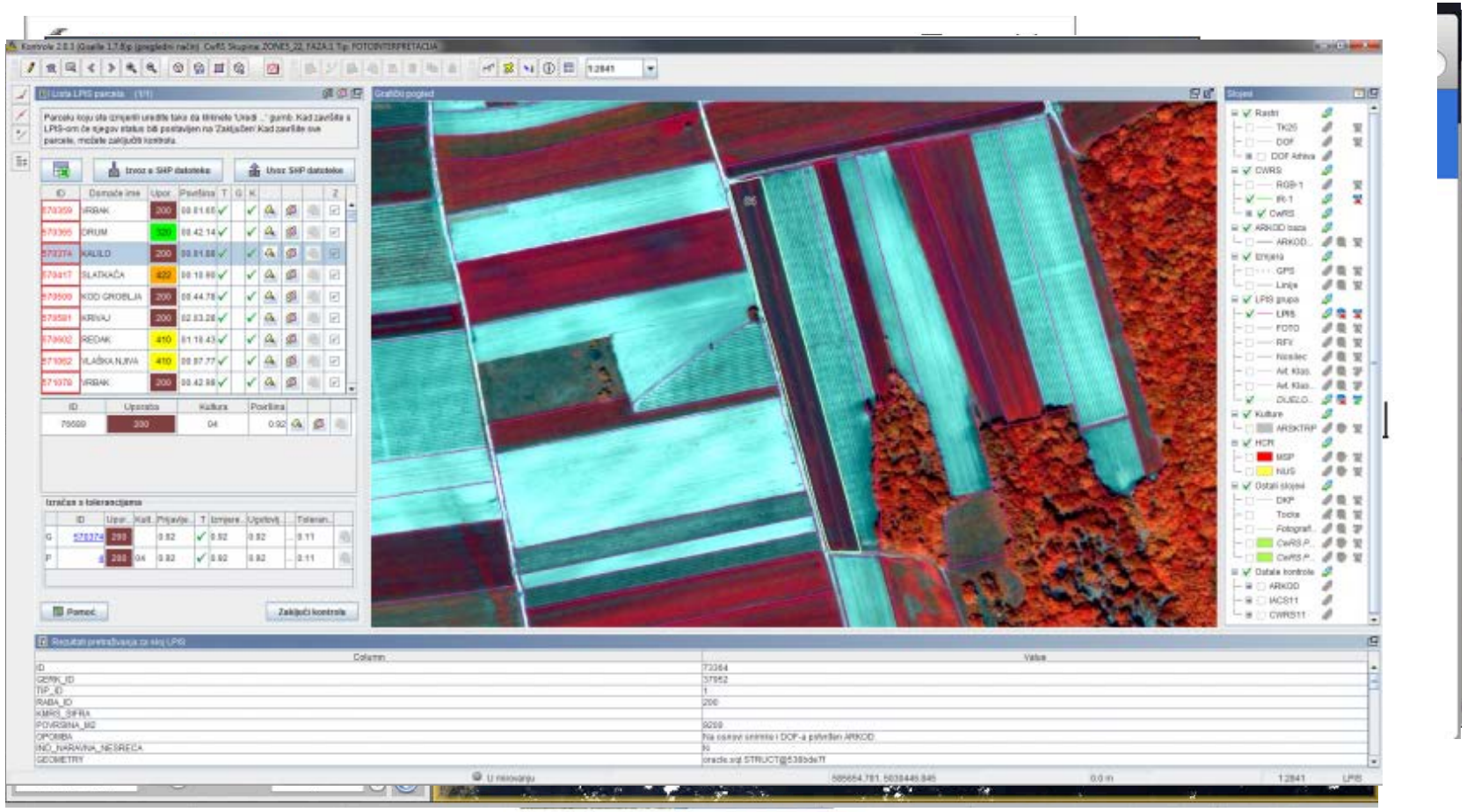
Sentinel Hub

Grega Milcinski, Sinergise

Enormous data availability

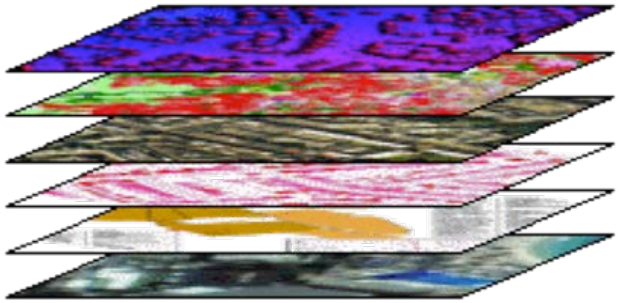


Manual processing no longer feasible

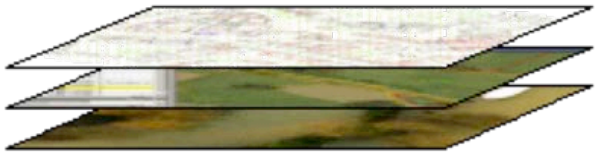


RGB Composite

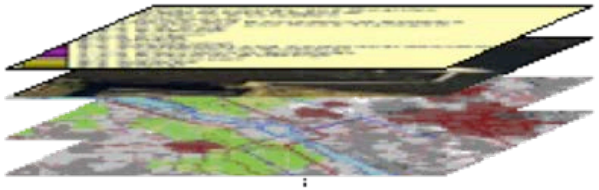
Open EO data - Sentinel-1, Sentinel-2, Landsat, etc.



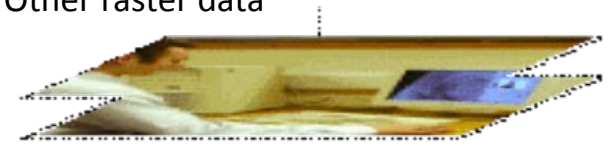
Commercial EO data – WorldWind, GeoEye,...



Aerial imagery (drone, plane)



Other raster data



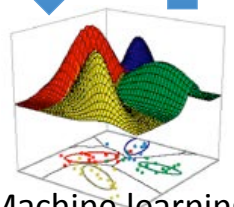
SENTINEL Hub

WMTS

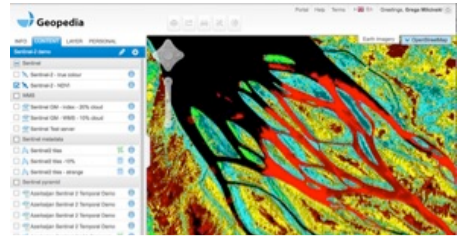
WMS

WCS

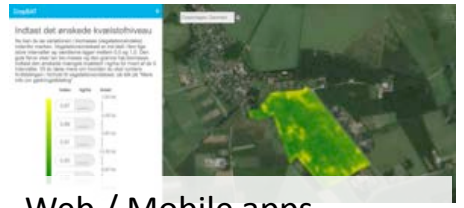
API



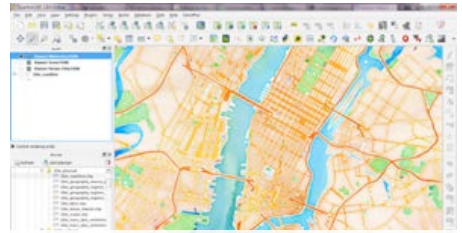
Machine learning



Cloud GIS



Web / Mobile apps



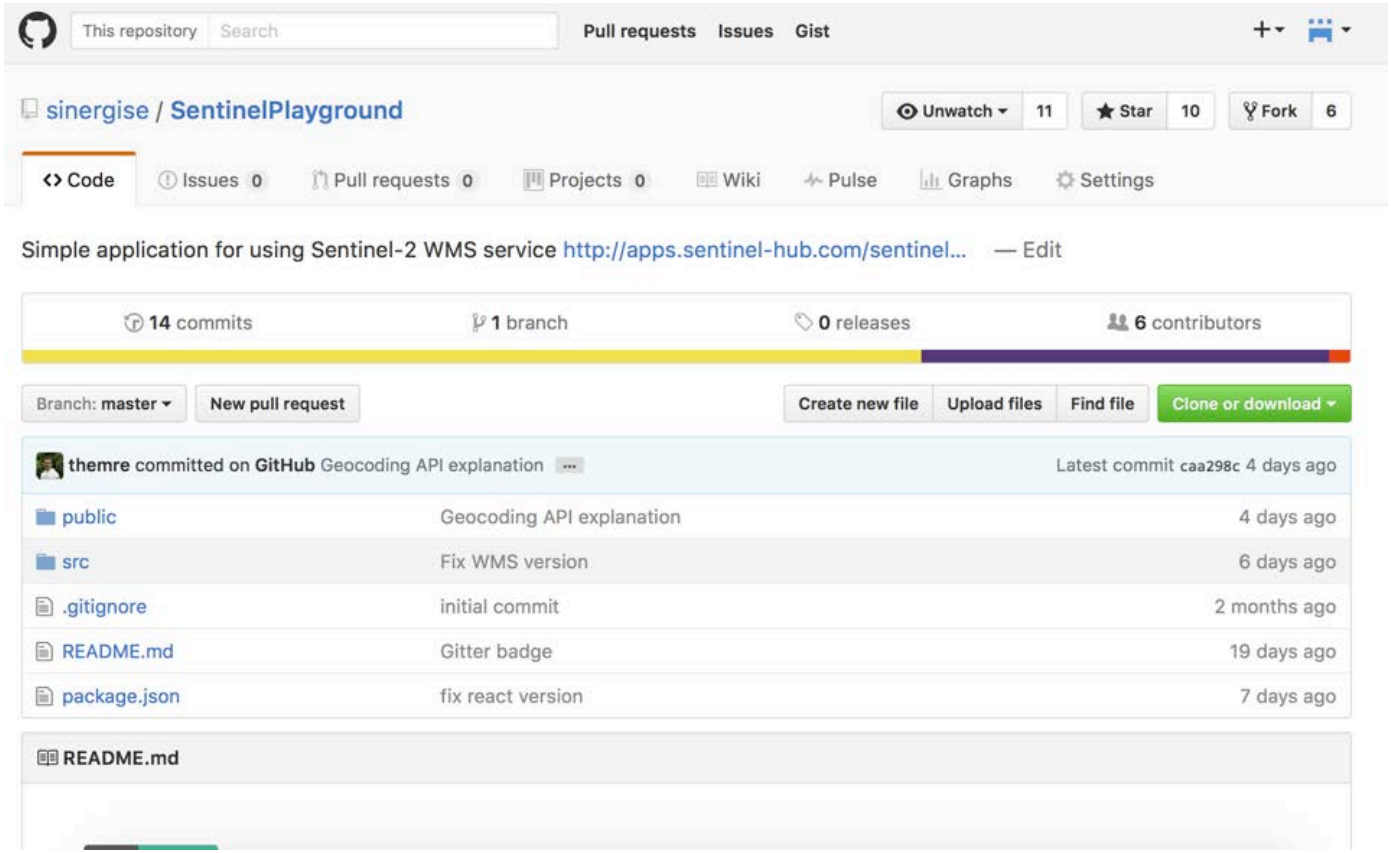
Desktop (QGIS,, ArcGIS…)

Scripting
(R, Python, ENVI…)

App example – Sentinel Playground

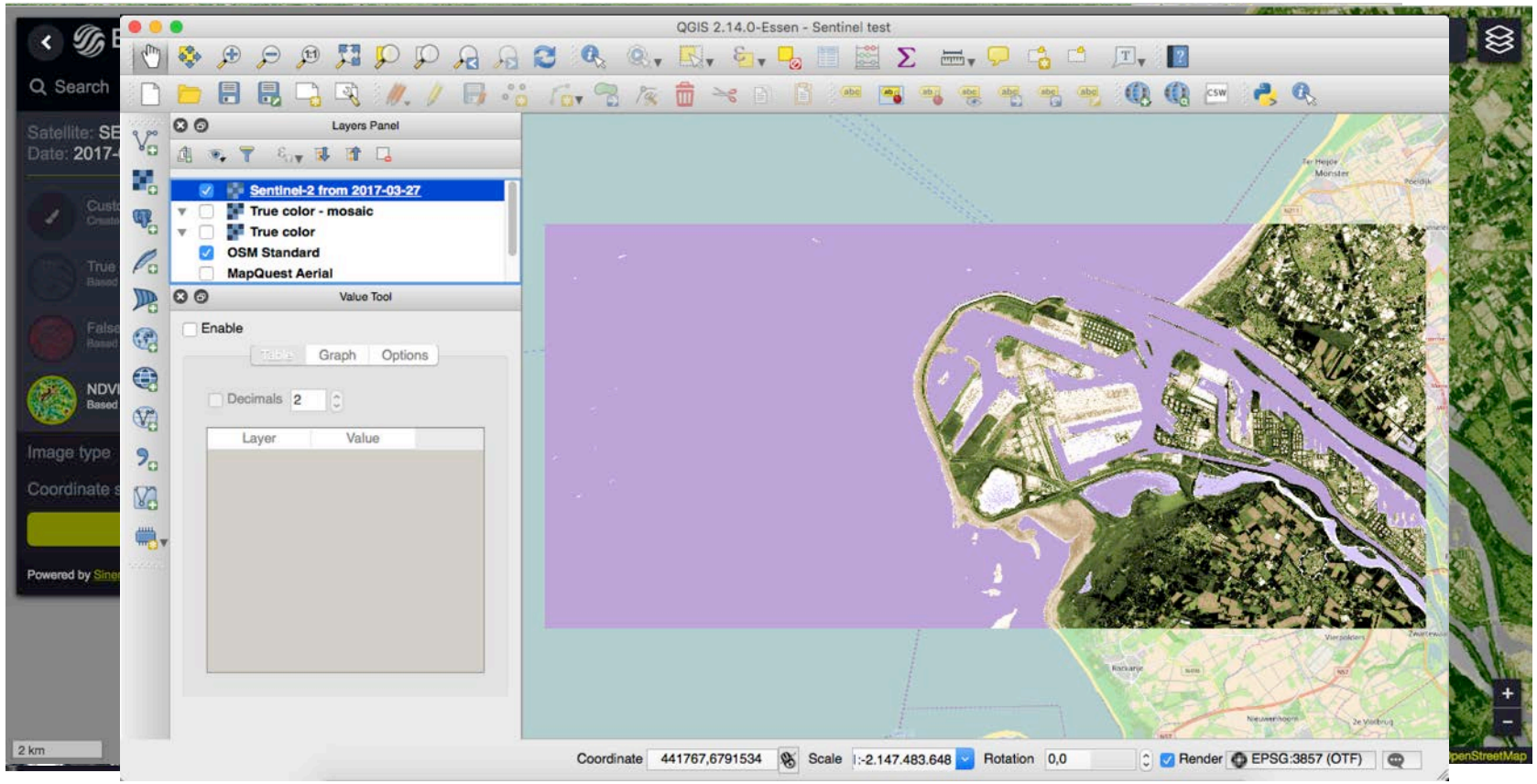
http://apps.sentinel-hub.com/sentinel-playground/

Sentinel Playground on GitHub



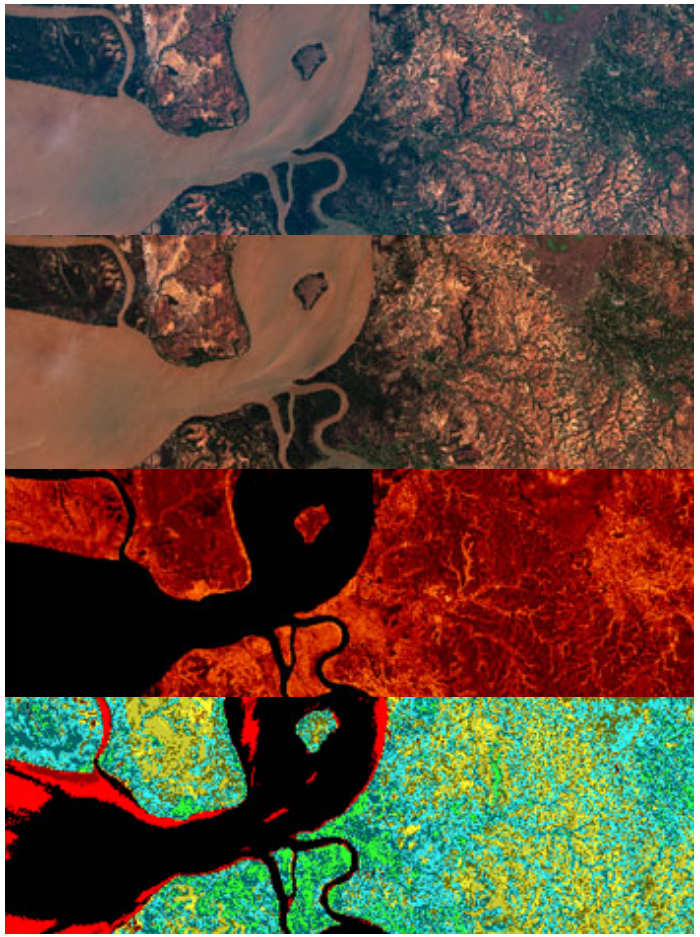
https://github.com/sinergise/SentinelPlayground

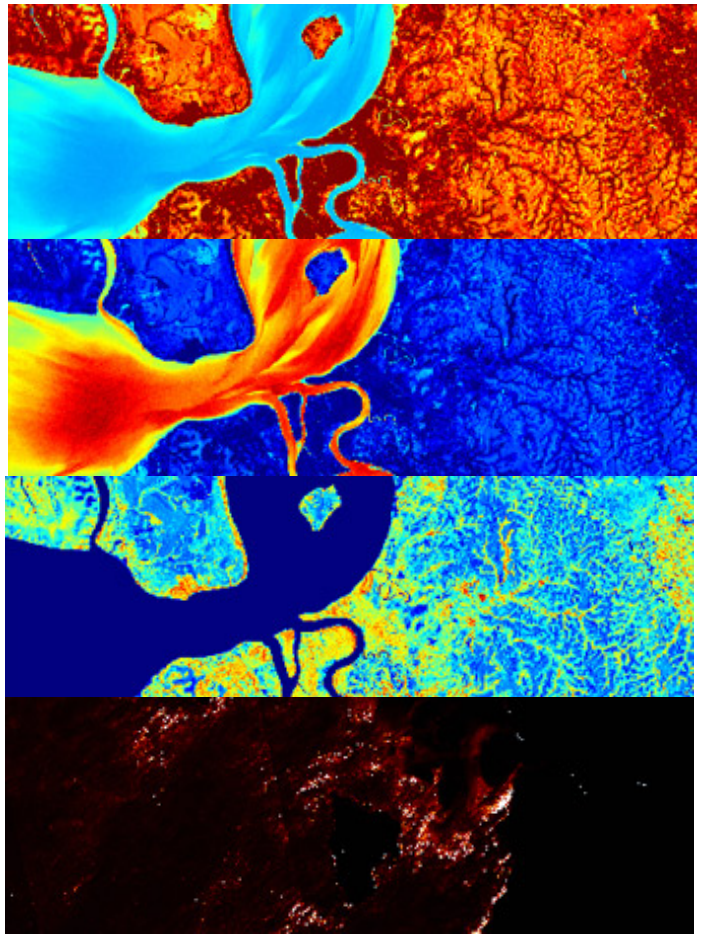
App example – EO Browser



http://apps.sentinel-hub.com/eo-browser/

EO Product Templates

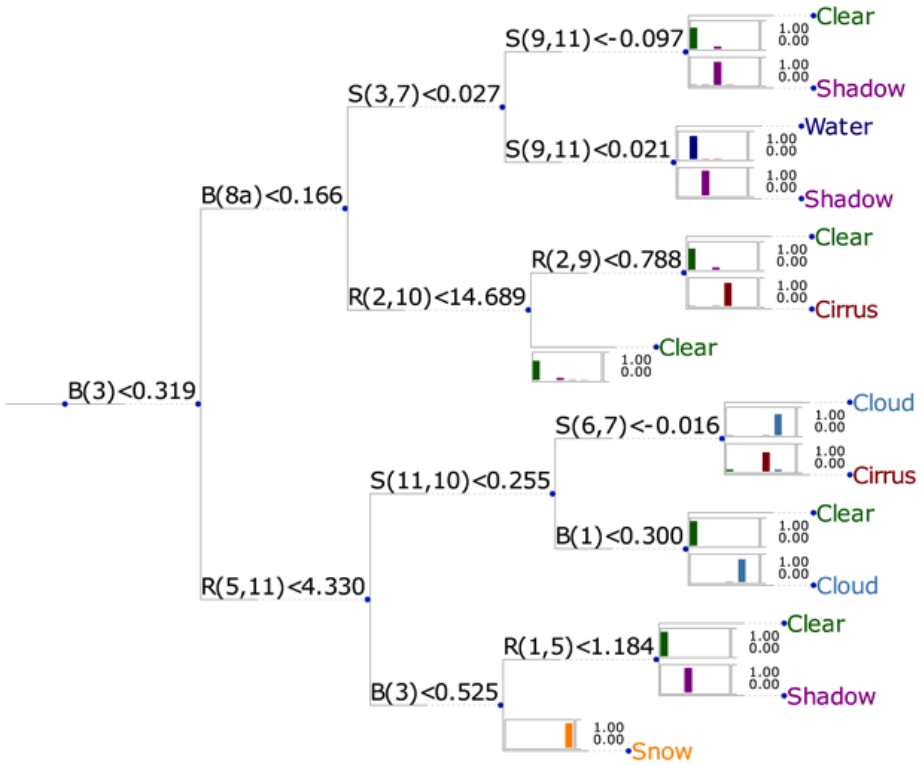




Custom scripting

Hollstein et. al: *Ready-to-Use Methods for the Detection of Clouds, Cirrus, Snow, Shadow, Water and Clear Sky Pixels in Sentinel-2 MSI Images*

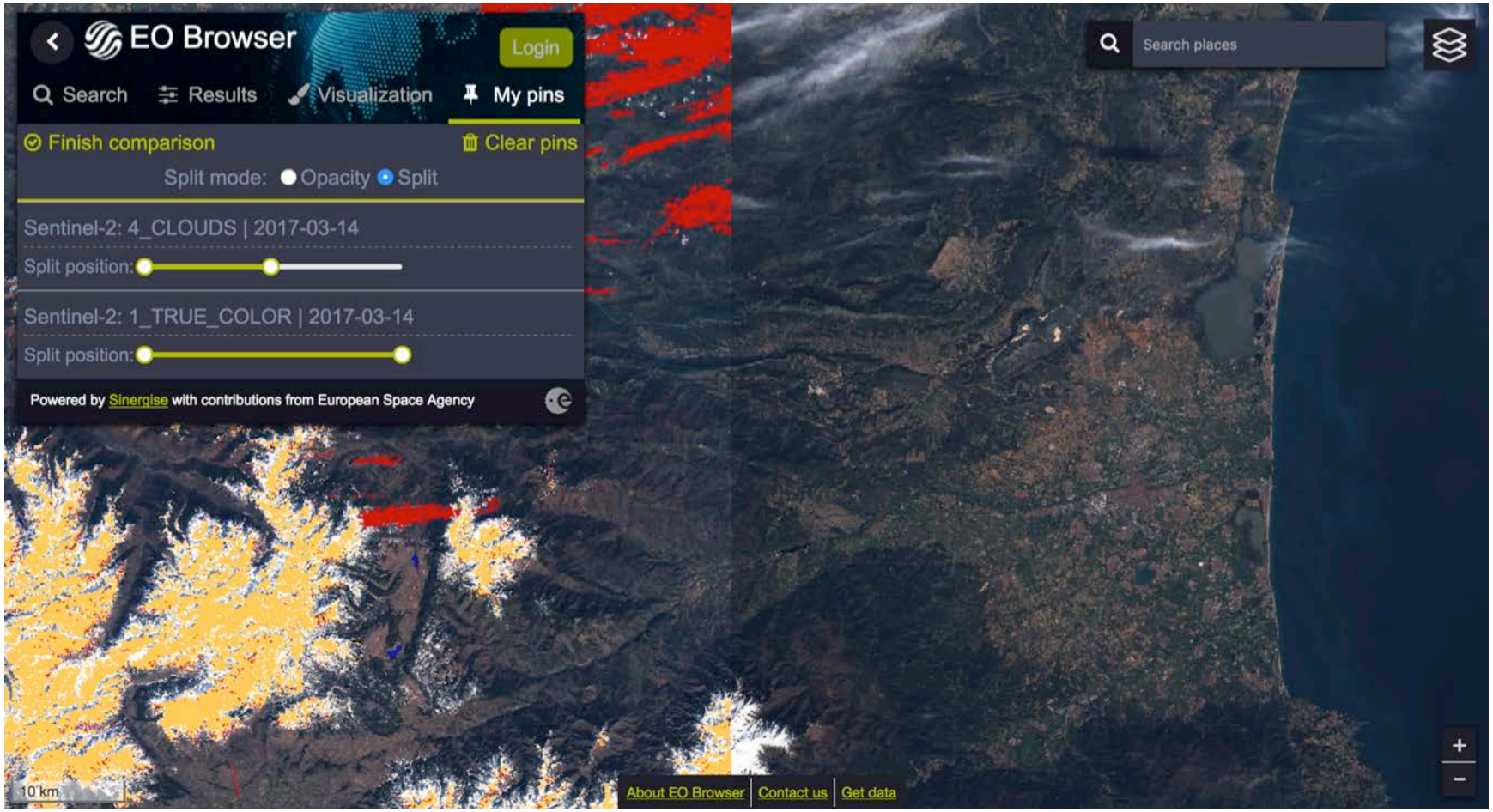
http://www.mdpi.com/2072-4292/8/8/666



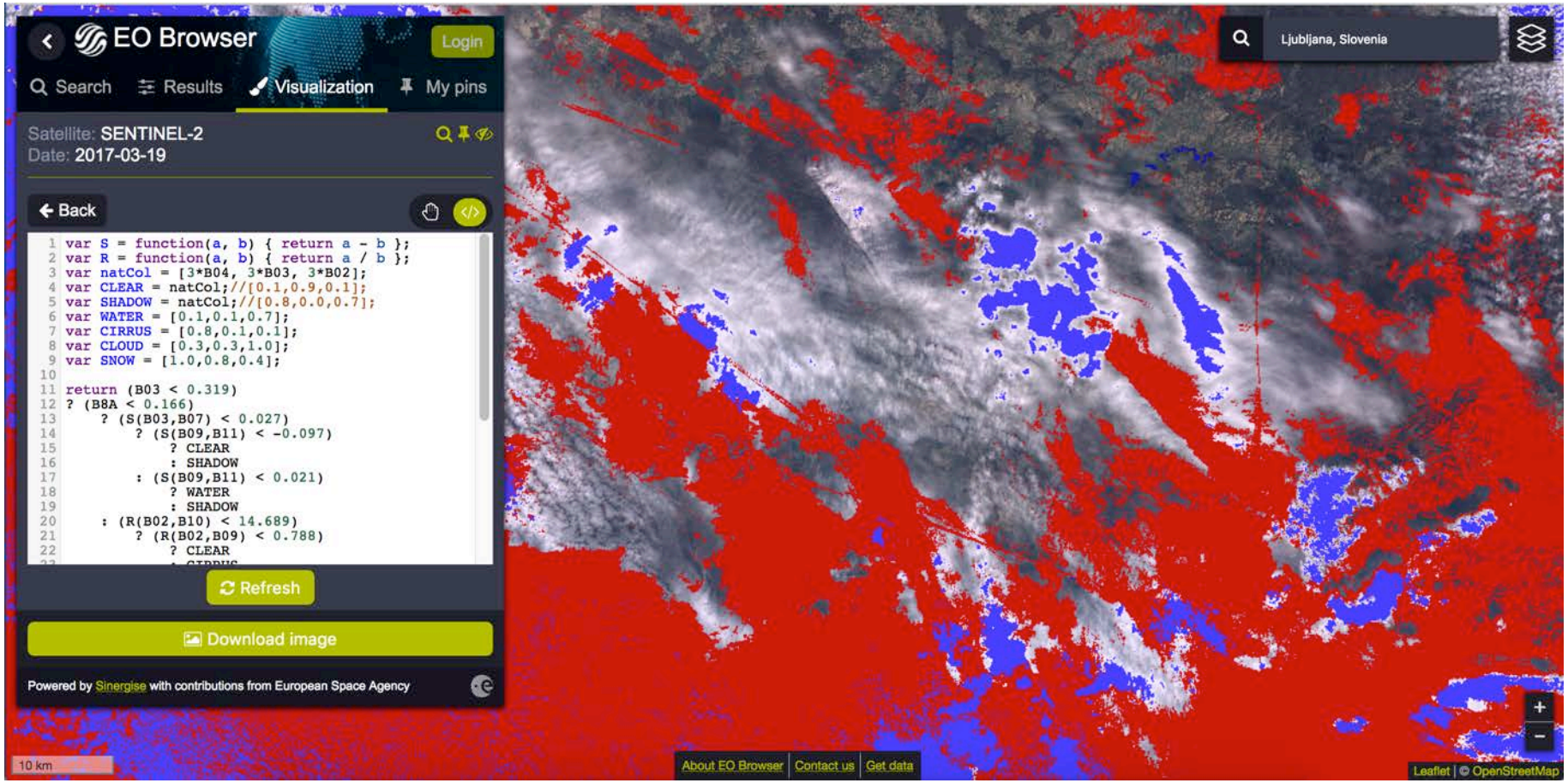

```javascript
var S = function(a, b) { return a - b };
var R = function(a, b) { return a / b };
var natCol = [3*B04, 3*B03, 3*B02];
var CLEAR  = natCol;//[0.1,0.9,0.1];
var SHADOW = natCol;//[0.8,0.0,0.7];
var WATER  = [0.1,0.1,0.7];
var CIRRUS = [0.8,0.1,0.1];
var CLOUD  = [0.3,0.3,1.0];
var SNOW   = [1.0,0.8,0.4];

return (B03 < 0.319)
? (B8A < 0.166)
    ? (S(B03,B07) < 0.027)
        ? (S(B09,B11) < -0.097)
            ? CLEAR
            : SHADOW
        : (S(B09,B11) < 0.021)
            ? WATER
            : SHADOW
    : (R(B02,B10) < 14.689)
        ? (R(B02,B09) < 0.788)
            ? CLEAR
            : CIRRUS
        : CLEAR
: (R(B05,B11) < 4.33)
    ? (S(B11, B10) < 0.255)
        ? (S(B06, B07) < -0.016)
            ? CLOUD
            : CIRRUS
        : (B01 < 0.3)
            ? CLEAR
            : CLOUD
    : (B03 < 0.525)
        ? (R(B01, B05) < 1.184)
            ? CLEAR
            : SHADOW
        : SNOW;
```

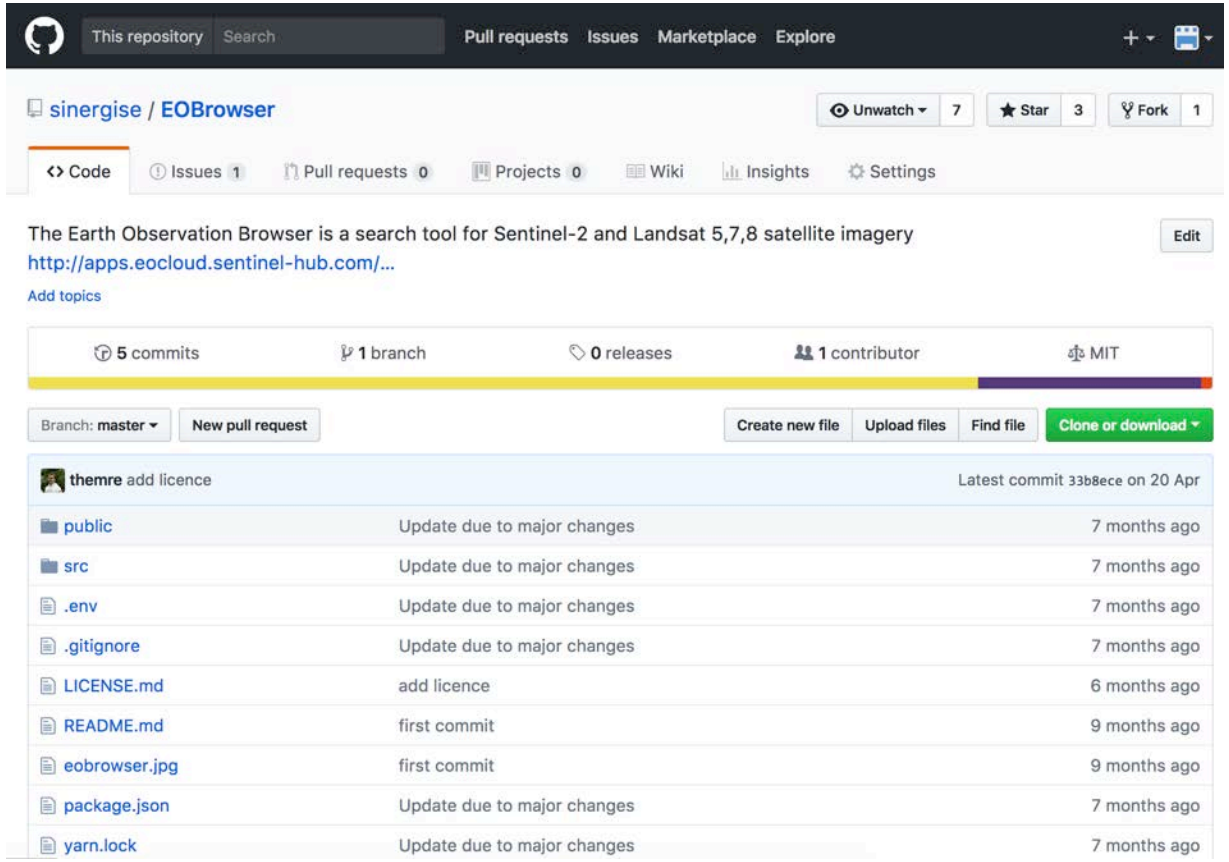
Custom scripting



Algorithm evaluation

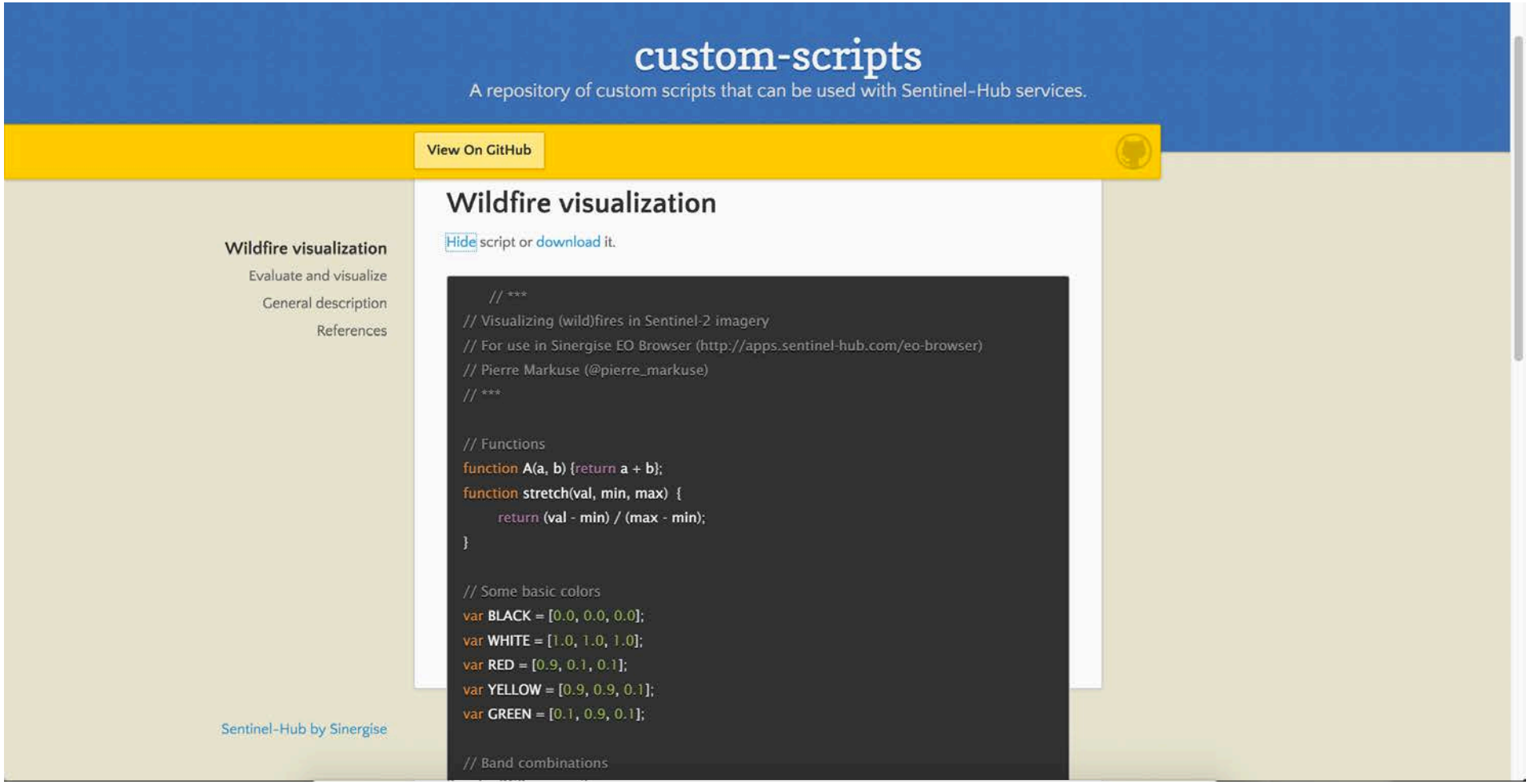


EO Browser on GitHub



https://github.com/sinergise/EOBrowser

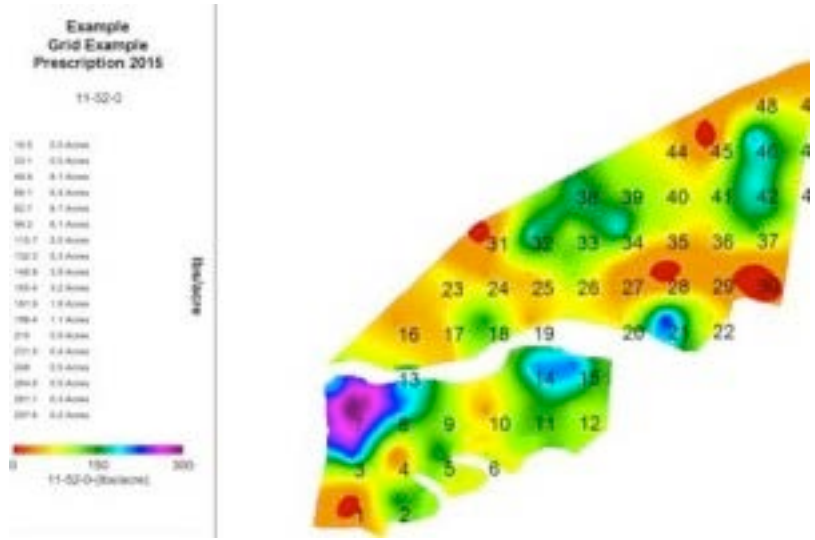
Custom Scripts on GitHub



http://custom-scripts.sentinel-hub.com

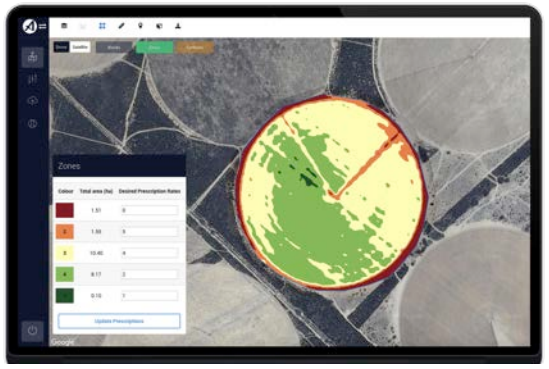
App example – Agriculture

cropsat.dk (.sk, .no)

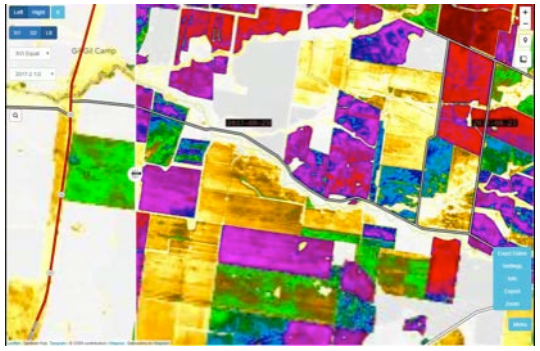


cropwatch.co.za

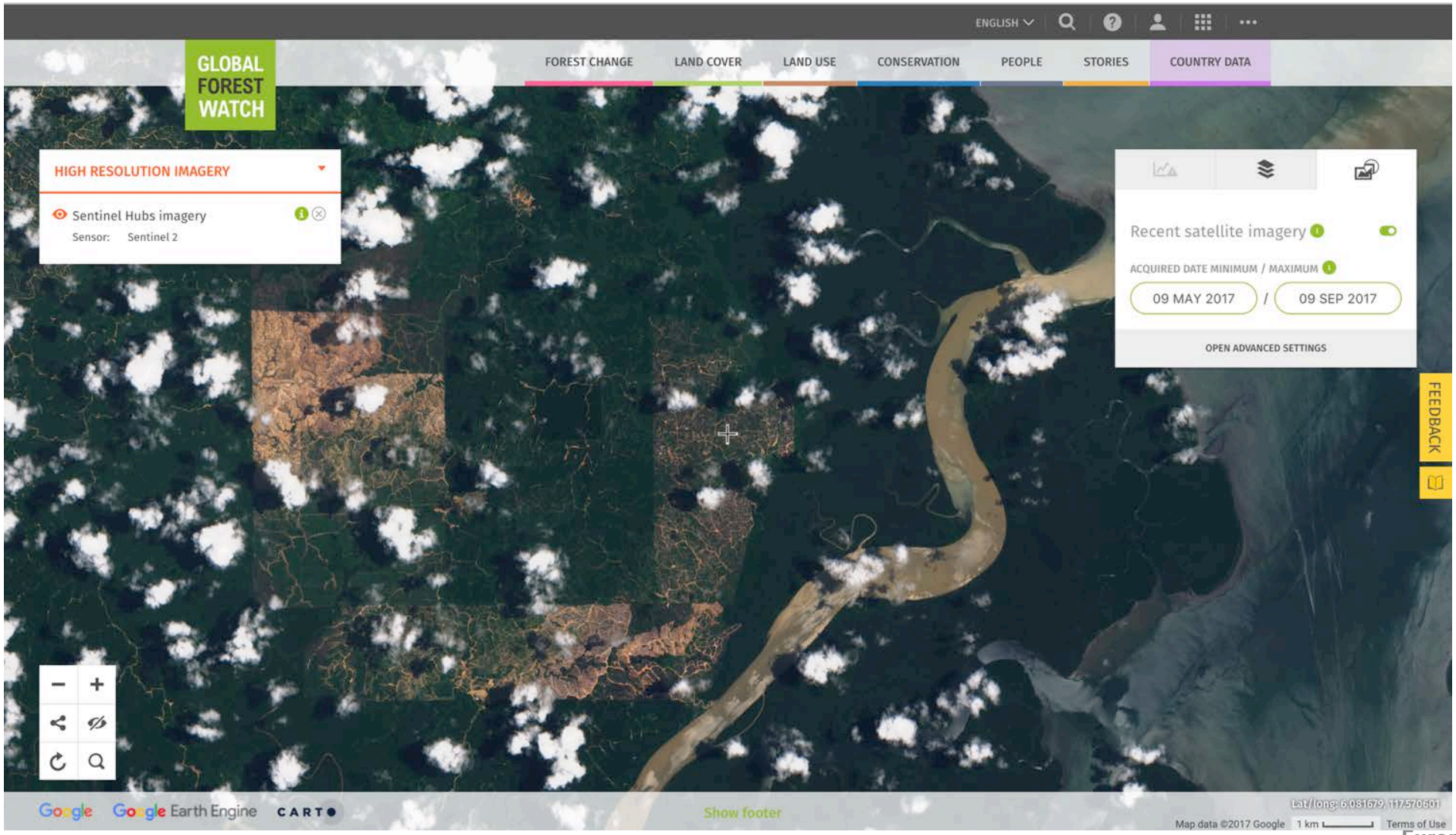
AeroView, aerobotics.co.za



satamaps.co.au

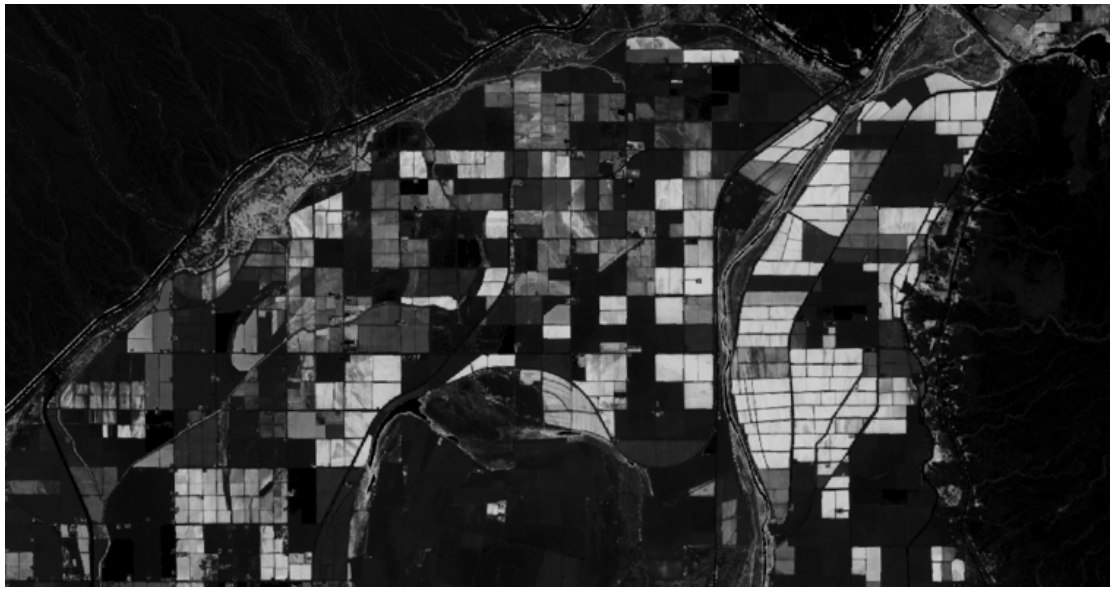


App example - Forestry



Web Coverage Service

- post-processing of data
- GeoTiff, JP2
- full resolution
- reflectance/composites



Statistical API – time series


```
{
  "NDVI": [
    {
      "date": "2015-08-30",
      "basicStats": {
        "min": -0.5478424429893494,
        "max": 0.7815912365913391,
        "mean": 0.147320137875888,
        "stDev": 0.35443419609590726
      }
    },
    {
      "date": "2015-07-11",
      "basicStats": {
        "min": -0.5127978920936584,
        "max": 0.8115044236183167,
        "mean": 0.20168528533031557,
        "stDev": 0.31436594348376923
      }
    }
  ]
}
```



```
{
  "NDVI": [
    {
      "date": "2015-08-30",
      "basicStats": {
        "min": -0.5478424429893494,
        "max": 0.7815912365913391,
        "mean": 0.147320137875888,
        "stDev": 0.35443419609590726
      },
      "histogram": {
        "bins": [
          {
            "value": -0.23164855383139124,
            "count": 14377.0
          },
          {
            "value": 0.08134964140017291,
            "count": 1844.0
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            "value": 0.23792375711536012,
            "count": 4692.0
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          {
            "value": 0.37365802377462387,
            "count": 4.0
          },
          {
```
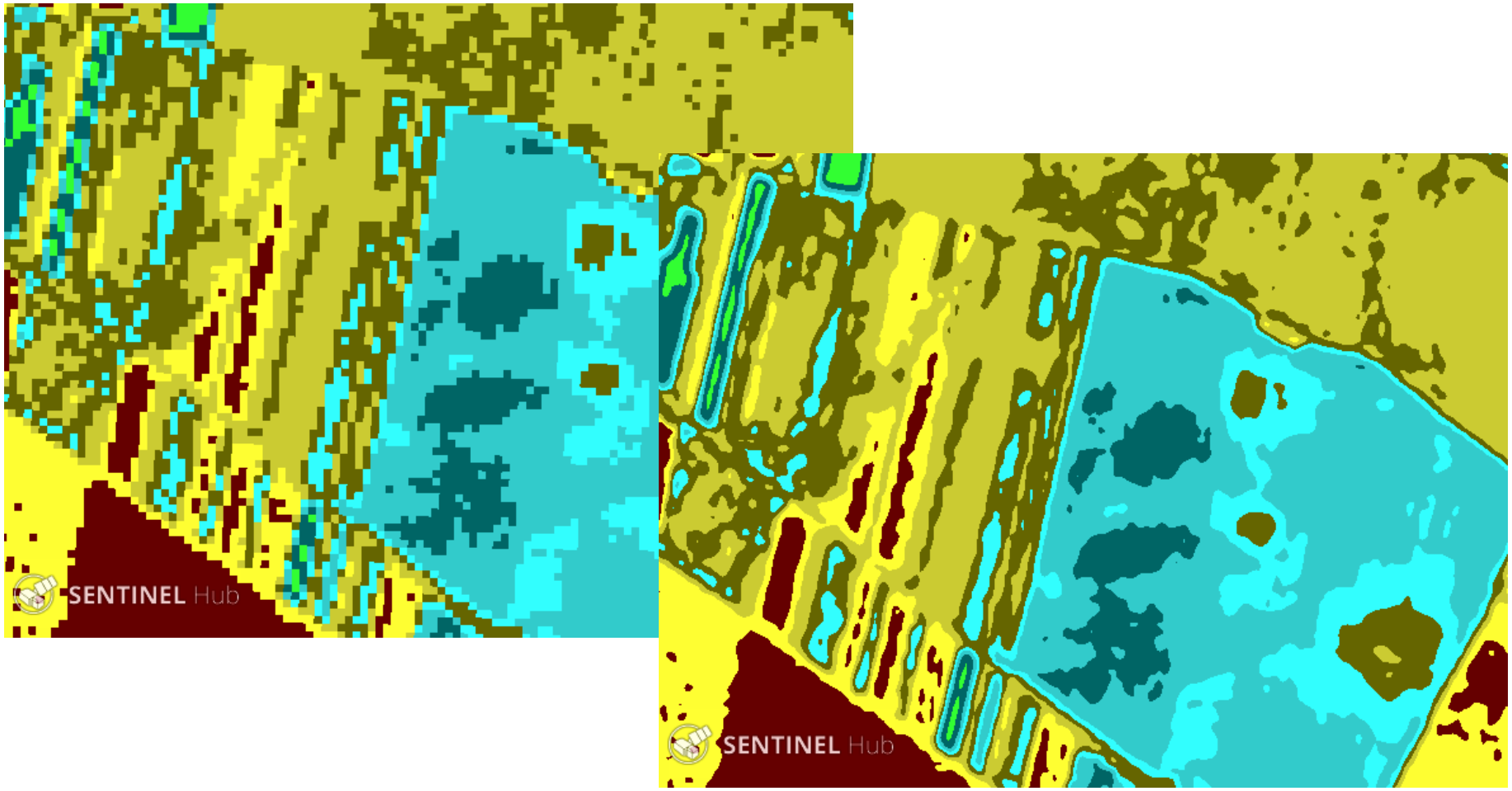
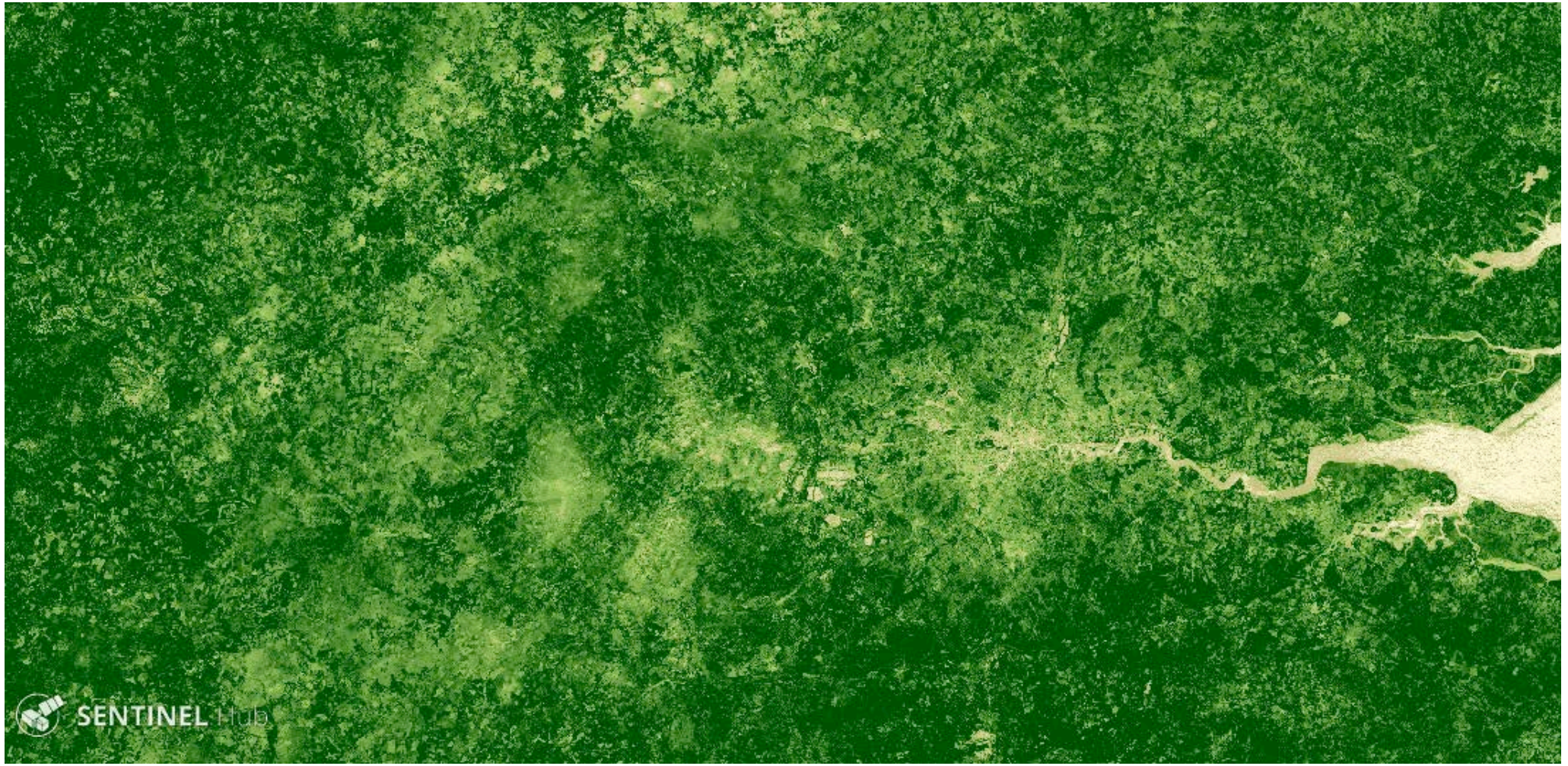
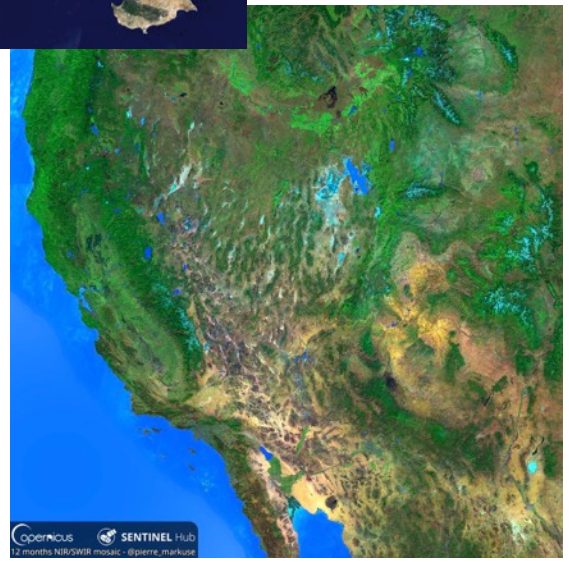

Upsampling/downsampling



Multi-temporal processing

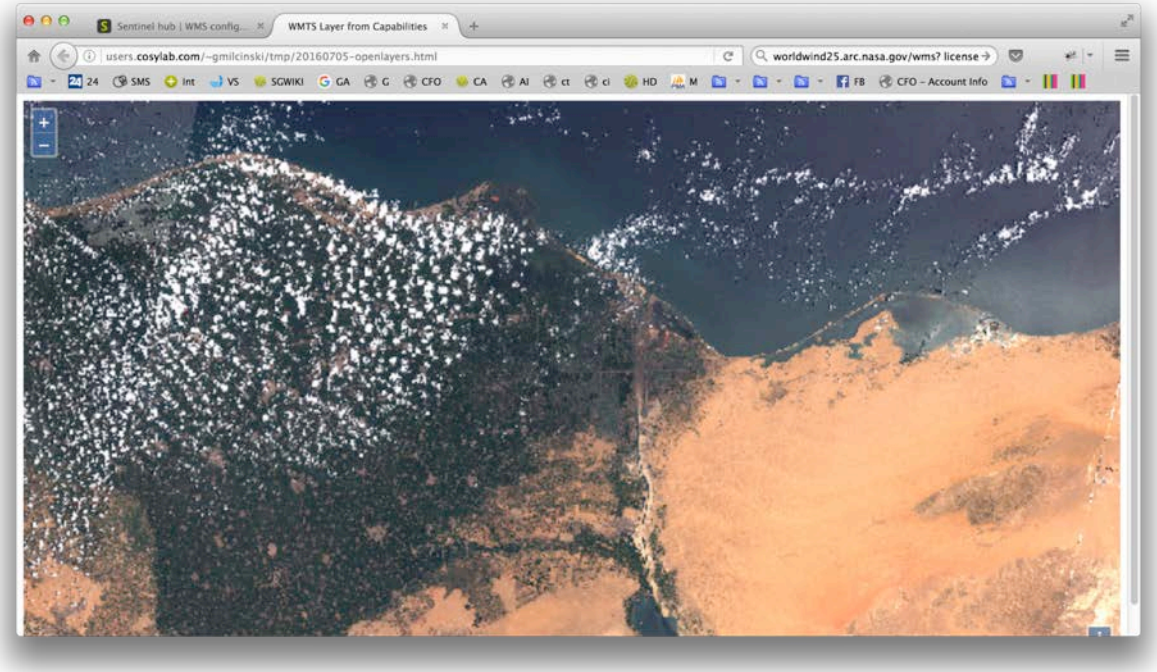


Multi-temporal processing

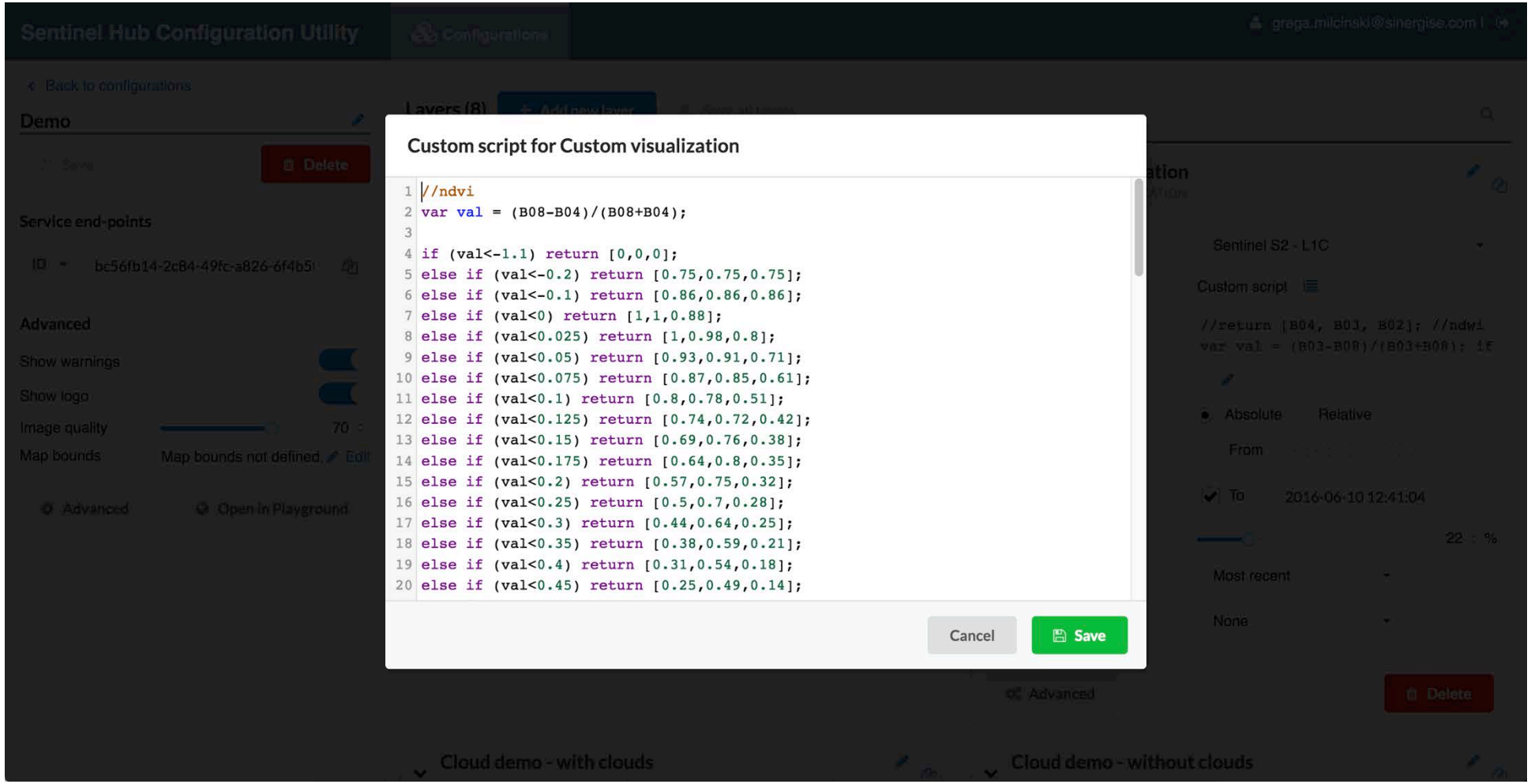


Why OGC services

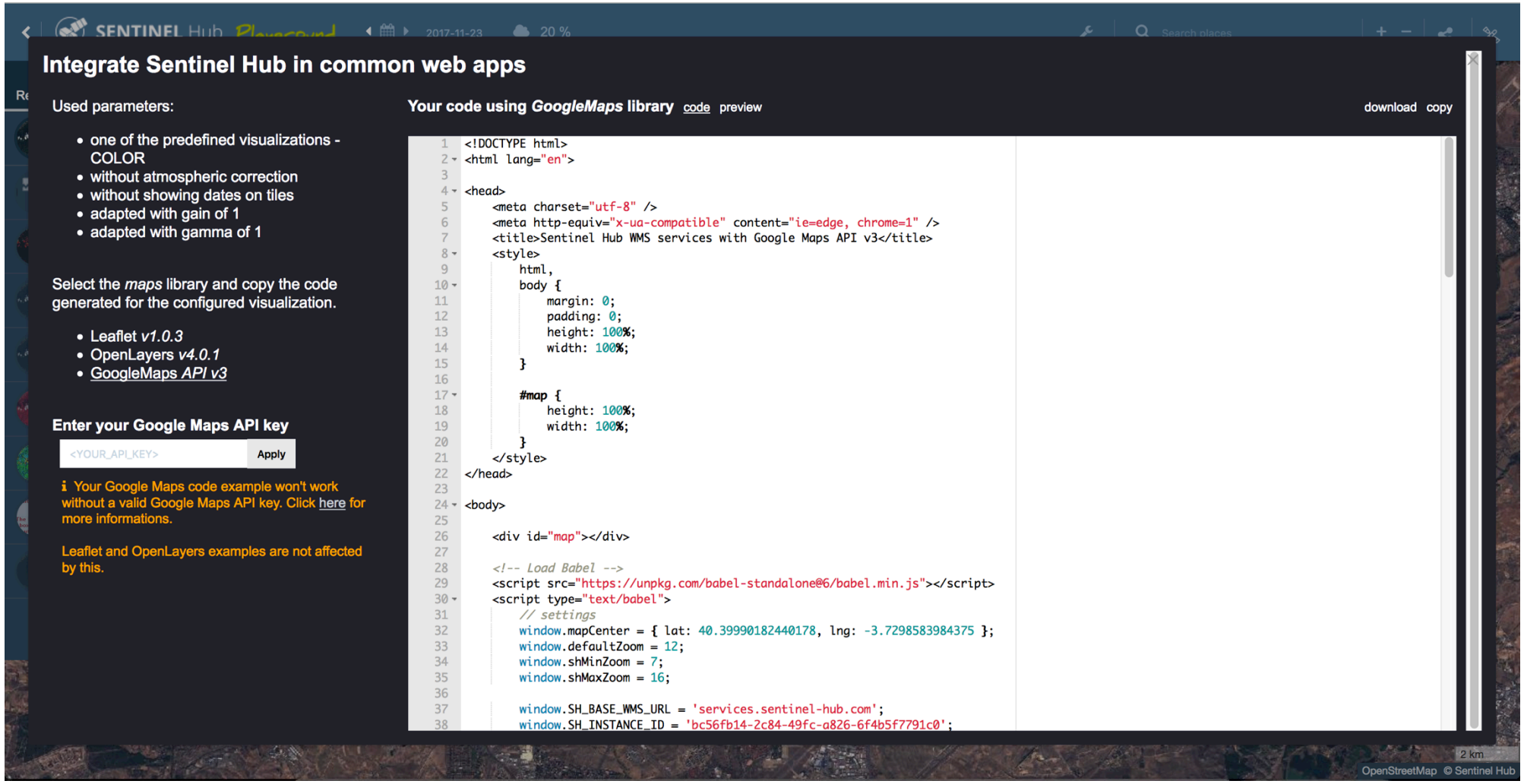
```
fetch('http://services.sentinel-hub.com/v1/wmts/INSTANCE_ID?REQUEST=GetCapabilities').then(function(response) {
  return response.text();
}).then(function(text) {
  var result = parser.read(text);
  var options = ol.source.WMTS.optionsFromCapabilities(result,
      {layer: 'TRUE_COLOR', matrixSet: 'PopularWebMercator512'});
```



Configuration Utility

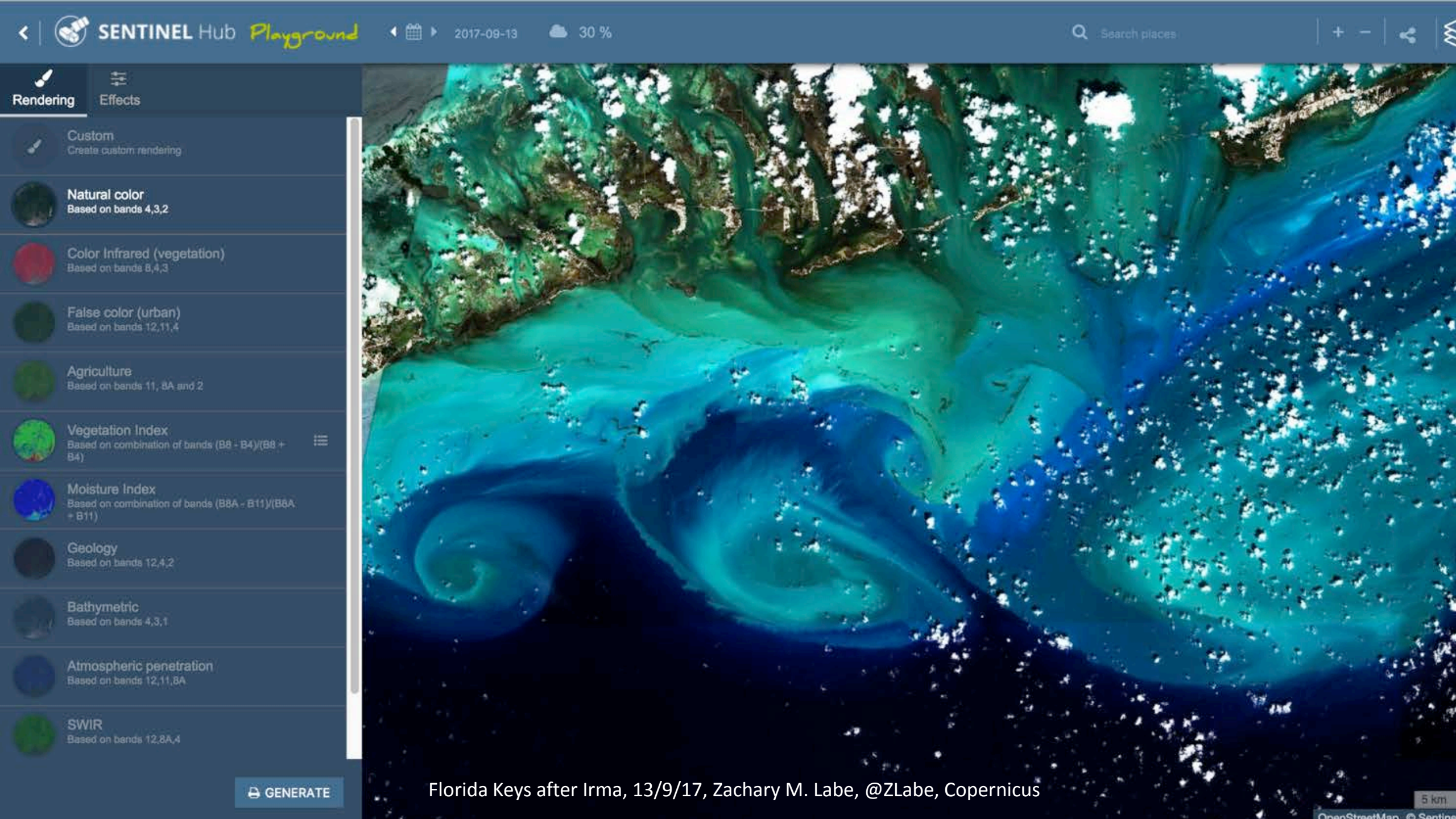


Integration tools



Data sources

- Currently available
  - Sentinel-1 GRD
  - Sentinel-2 (full global archive)
  - Sentinel-3 (full global archive)
  - Landsat-8 USGS (global archive)
  - Landsat-5, 7, 8 (ESA Archive)
  - Envisat MERIS (full global archive)
  - MODIS Terra and Aqua
  - DEM – SRTM30
- Up to date!



Florida Keys after Irma, 13/9/17, Zachary M. Labe, @ZLabe, Copernicus