Dynamic Water Surface Detection
Applied on PROBA-V Multispectral Data
The Copernicus Global Land Service Water Bodies product

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Proba-V

- **Belgian** mission
- Daily **GLOBAL** low and medium resolution monitoring of land surface, continuity of SPOT-VGT time series
- 1 km & 300 m (daily), **100 m** (5-daily)
- Spectral bands: Blue, Red, NIR and SWIR
- Launch: May 2013
- End data acquisition: May 2018

→ Almost 5 years of global data! 20 years with SPOT-VGT
Copernicus Global Land Service

Water Bodies product

- **Operational, NRT, every 10 days!**; Based on daily observations
- **Global at 300m and 1km**
- water bodies **detection** (binary) and **occurrence** (6 classes)
- **Validated, freely available**

**NEXT**

- **SPOT-VGT** → 20 years of water bodies at 1km
- **Sentinel-3**
Water Body Detection Algorithm (WBDA)

Input Data

- PROBA-V S1-TOC
- MC10 Status Map
- WB Potential (GLSDEM)
- Permanent Glaciers
- Volcanic Soils
- Max. Water Extent (GSW)

1. MEAN COMPOSITE
   - MC10 <dekad N>

2. COLOR TRANSFORM
   - Hue/Value <dekad N>

3. WB DETECTION
   - WBs history <dekad N-x - N>

4. WB OCCURRENCE
   - Water Bodies <dekad N>
   - Quality Layer <dekad N>

Ancillary Data Layers

- Water body potential mask
  → Based on GLSDEM
Ancillary Data Layers

- Permanent Glaciers
  → National Snow and Ice Data Centre
Ancillary Data Layers

- Volcanic Soils
  \(\rightarrow\) The Holocene Volcano List

Input Data

- PROBA-V
  - S1-TOC

- MC10
  - Status Map

- WB Potential
  - (GLSDEM)

- Permanent
  - Glaciers

- Volcanic
  - Soils

- Max. Water Extent
  - (GSW)
Ancillary Data Layers

- Maximum water extent mask
  → Global Surface Water (Pekel et al. 2016)

Maximum Water Extent - Part of the Niger, Sahel region
HSV transform

- **Hue** → Dominant Wavelength
- **Value** → Brightness Approximation
HSV transform
Dynamic Thresholding
Water Bodies Detection

- Lake Basaka
- Lake Koka
- Lake Ziway
- Lake Langano
- Lake Shala
- Lake Awasa
- Lake North of Denfo
- Lake Abijata
- Lake Bojo
- Lake Abaya
- Lake Chamo

Legend:
- Cloud
- Snow
- Glacier
- Volcanic
- Mountain
- Lowland
- Mountainous Vegetation
- Lowland Vegetation
- Water Body

1. Lake Wedeche
2. Lake K’oftu
3. Lake Chilotes
4. Lake Guda
5. Lake Chelekaleka
6. Lake Hora
7. Lake Bishoftu
Water Bodies Occurrence

- **WB frequency** = \( \frac{ntWBs}{ntObs} \)

- **mctWBs**: Maximum number of continuous temporal WB detections
Water Bodies Occurrence - Sahel

The diagram shows the number of pixels at different levels of water body occurrence in the Sahel region from 2012 to 2016. The horizontal axis represents the years from 2012 to 2016, while the vertical axis shows the number of pixels.

- **Permanent**: High number of pixels indicating constant water bodies.
- **Very High**: Medium number of pixels indicating significant water bodies.
- **High**: Low number of pixels indicating occasional water bodies.
- **Medium**: Very low number of pixels indicating rare water bodies.
- **Low**: Very low number of pixels indicating minimal water bodies.
- **Very Low**: No pixels indicating no water bodies.

The images labeled A to E correspond to different years and levels of water body occurrence as indicated by the legend.
Validation

- Validation was done against the GSW dataset (Pekel et al. 2016)
- At global scale: October 2013 to October 31st 2015 (73 dekads).
- OE: 47.5 to 1.5% for WSR of 0.1 to 0.95 ; CE: 3.7% for WSR of 0.1
Product Access


- **Proba-V Mission Exploitation Platform**: [https://proba-v-mep.esa.int](https://proba-v-mep.esa.int)
  - Virtual Machine
  - Python/R Notebooks
Product Access

1. Load packages

```
In [1]:
library(raster)
library(gdal)
library(gsubfiles)

Loading required package: sp
raster: version 2.2-10, SVN revision 7611
gdal: geospatial data abstraction library: extensions to R successfully loaded
loaded package: geotiff 2.1-1, released 2017-06-20
R path to GDAL shared files: /usr/shares/gdal
GDAL library built with GeoTIFF 7.4.1
GDAL configuration: "gdal-config --list-dirs | grep 'GDAL'" for path: /usr/shares/gdal
Path to GeoTIFF shared files: [not detected]
Linking to GDAL version: 2.2-4
```

2. Get paths

```
In [2]:
too <- list.files(path = '/path/to/directory', pattern = '.tif$', recursive = T)
too

['/path/to/directory/20170524T153016_14013导师_20170524T153016_14013导师.tif', '/path/to/directory/20170524T153016_14013导师_20170524T153016_14013导师.tif', ...
```

3. Make spatial vrt per band (combining all tiles)

```
In [3]:
gdalbuildvrt too, too, too, too, too, too, too, too, too
```

4. Make multiband vrt

```
In [4]:
gdalbuildvrt too, too, too, too, too, too, too, too, too, too, too, too, too, too, too
```

5. Plot

```
In [5]:
im <- stack(too)
plot(im, c(1, 2, 3, 4), c(1, 2, 3, 4), main = "Plot")
```
Questions?

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