








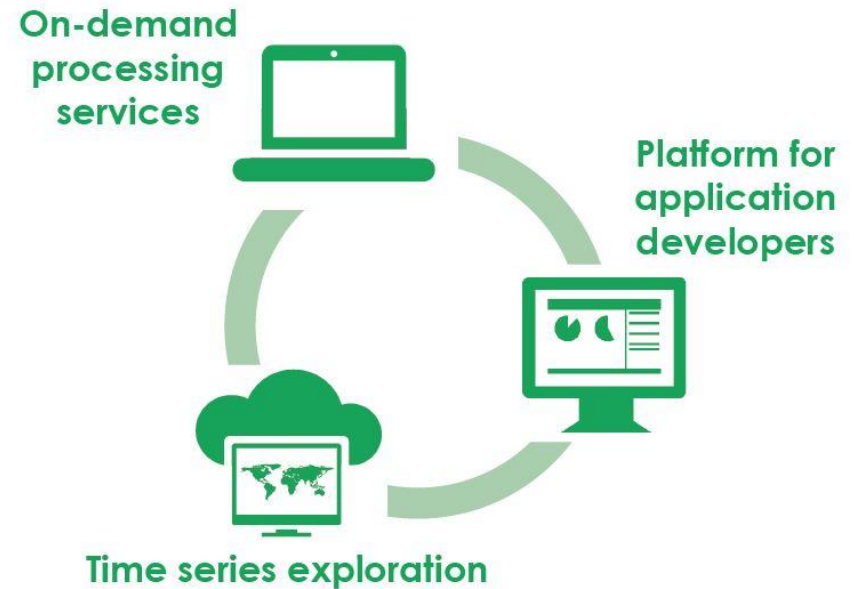
PROBA-V MISSION EXPLOITATION PLATFORM UPDATE NOV '16 → MAY '17

ERWIN GOOR, VITO

PROBA-V MEP OVERVIEW

<https://proba-v-mep.esa.int/>

-  **Geo Viewer**
-  **Time Series Viewer**
-  **N-daily Compositor**
-  **Request Virtual Machine**
-  **Jupyter Notebooks**



(*) only operations & EC funded - limited to viewers

(**) <http://viewer.globalland.vgt.vito.be/viewer/>
<http://viewer.globalland.vgt.vito.be/tsviewer/>

Copernicus Global Land (*) (**)

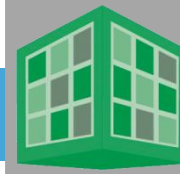
SPOT-VEGETATION

Proba-V

Update needed after reprocessing!



Notebooks record & distribute 'reproducible research'



SnowDetectionNotebook.html

```
In [6]: def parseTargets(statusmap, x, y):
dataset = gdal.Open(statusmap)
status = dataset.GetRasterBand(1)
ret = status.ReadAsArray(x[0], y[0], x[1], y[1])
del dataset
return np.array(ret).flatten(order='F').tolist()

def parseFeatures( radiometry, X, y ):
raster = gdal.Open(radiometry)
raster_bands = [ raster.GetRasterBand(i).ReadAsArray(x[0], y[0], x[1], y[1]) for i in xrange(1, raster.RasterCount + 1) ]
# 4 * Y * X

del raster
raster_bands = np.transpose(raster_bands)
# Y * 4 * X

raster_bands = raster_bands.reshape((len(raster_bands) * len(raster_bands[0]), len(raster_bands[0][0])))

# Y * X * 4
return raster_bands.tolist()

def parseChunk(chunk):
return zip(
    parseTargets(chunk['statusmap'], chunk['x'], chunk['y']),
    parseFeatures(chunk['radiometry'], chunk['x'], chunk['y'])
)

dataset = chunks.flatMap(parseChunk)
dataset.take(5)
```

```
Out[6]: [(244, [764, 804, 874, 305]),
(244, [767, 805, 876, 306]),
(244, [768, 809, 879, 306]),
(244, [775, 810, 880, 305]),
(244, [773, 814, 879, 305])]
```

Some pixels contain invalid data. In such cases, one of the Reflectance value will be equal to -1. Since those pixels contain incomplete data, we might as well filter them out.

```
In [7]: def is_valid(row):
for v in row[1]:
if v == -1:
return False
return True

dataset = dataset.filter(is_valid).repartition(100)
dataset.take(5)
```

```
Out[7]: [(123, [1418, 1482, 2055, 618]),
(123, [1376, 1434, 1998, 586]),
(251, [1331, 1395, 1403, 573]),
(251, [1307, 1351, 1405, 578]),
(251, [1318, 1355, 1406, 594])]
```

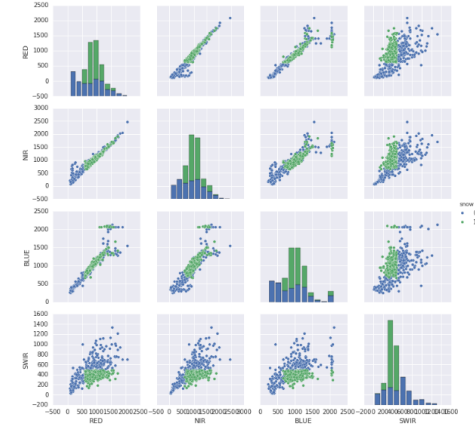
As mentioned earlier, the mask for Snow/Ice is 100. Since we are only interested in those, we can define a function to convert the complete bitmask into a single bit equal to 1 if the pixel is Snow/Ice and 0 otherwise.

```
In [8]: def is_snow(row):
return int((row[0] & 0b100 != 0), row[1])

dataset = dataset.map(is_snow).cache()
dataset.take(5)
```

```
Out[8]: [(1, [675, 695, 783, 304]),
(1, [674, 694, 773, 300]),
(1, [1456, 1593, 1490, 478]),
(1, [1392, 1540, 1485, 460]),
(1, [1392, 1540, 1485, 460])]
```

```
In [12]: sns.pairplot(df, hue='snow', vars_bands, hue_order=[0, 1])
Out[12]: <seaborn.axisgrid.PairGrid at 0x7f648cf9910>
```



```
In [17]: def is_snow_mask(mask):
return int((mask & 0b100 != 0))

def parseChunk(chunk):
statusmap = map(is_snow_mask, parseTargets(chunk['statusmap'], chunk['x_range'], chunk['y_range']))
features = parseFeatures(chunk['radiometry'], chunk['x_range'], chunk['y_range'])
return (chunk['chunk'], map(parseSample, zip(statusmap, features)))

all_data = chunks.map(parseChunk)
def average_snow(data):
return np.mean(map(lambda x: x.label, data))

averaged_by_chunk = all_data.map(lambda x: (x[0], average_snow(x[1]))).cache()
averaged_by_chunk.count()
```

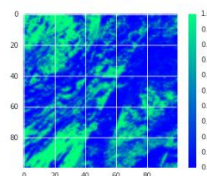
```
Out[17]: 10000
```

```
In [18]: img_flat = averaged_by_chunk.collect()
```

Here is how our original data looked like.

```
In [19]: img = np.array(img_flat[1:, 1]).reshape(100, 100, order='F').astype('float')
plt.imshow(img, cmap='winter')
plt.colorbar()
```

```
Out[19]: <matplotlib.colorbar.Colorbar at 0x7f648c46f400>
```

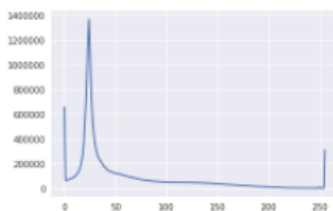


SAMPLE NOTEBOO

▾ Notebook sample gallery

Repository: <https://bitbucket.org/vitotap/notebooks>

Quick start sample

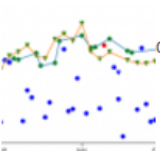


Finds PROBA-V products and computes a histogram using the processing cluster.

<https://nbviewer.jupyter.org/urls/bitbucket.org/vitotap/notebooks/raw/master/QuickstartExample.ipynb>

Keywords: catalog query, Spark, Python, histogram, matplotlib

Time series analysis (cal/val)



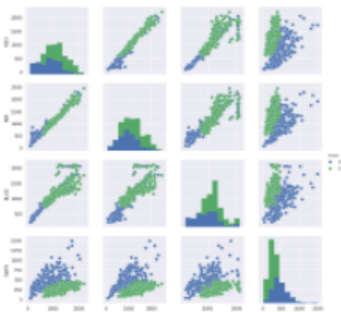
Uses MEP web services to retrieve time series from various products for a given point coordinate.

<https://nbviewer.jupyter.org/urls/bitbucket.org/vitotap/notebooks/raw/master/CalVal%20WCS%20Timeseries.ipynb>

<https://nbviewer.jupyter.org/urls/bitbucket.org/vitotap/notebooks/raw/master/AERONET%20CalVal%20TSViewer.ipynb>

Keywords: Time series, REST, WCS, calibration, validation

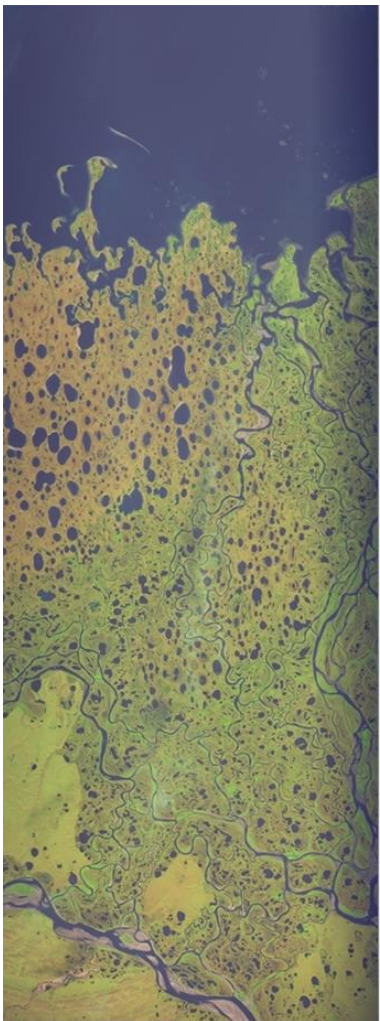
Snow classification



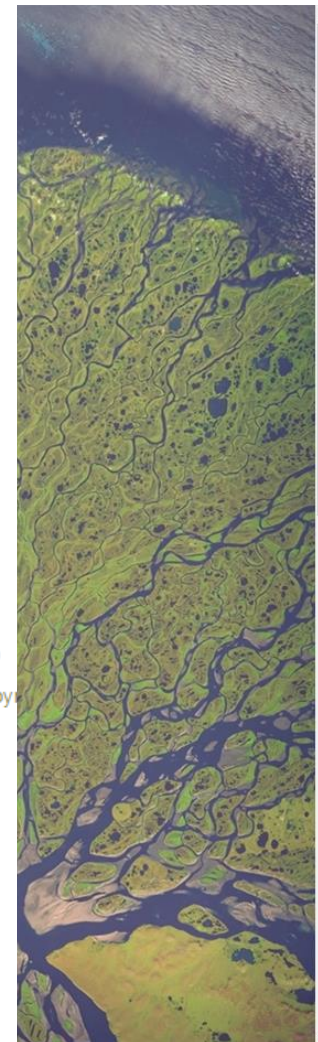
Trains a machine learning classifier to classify snow pixels based on PROBA-V radiometry.

<https://nbviewer.jupyter.org/urls/bitbucket.org/vitotap/notebooks/raw/master/SnowDetection.ipynb>

Keywords: Spark, Machine learning, Python, Seaborn, graphs, plotting



<https://proba-v-mep.esa.int/applications/notebooks>



SUPPORT FOR CAL/VAL USERS - SAMPLE NOTEBOOKS

- *Use WCS to retrieve time series for pixel, including bitmasks*
- *Use RESTfull service to retrieve time series (only Proba-V S10)*

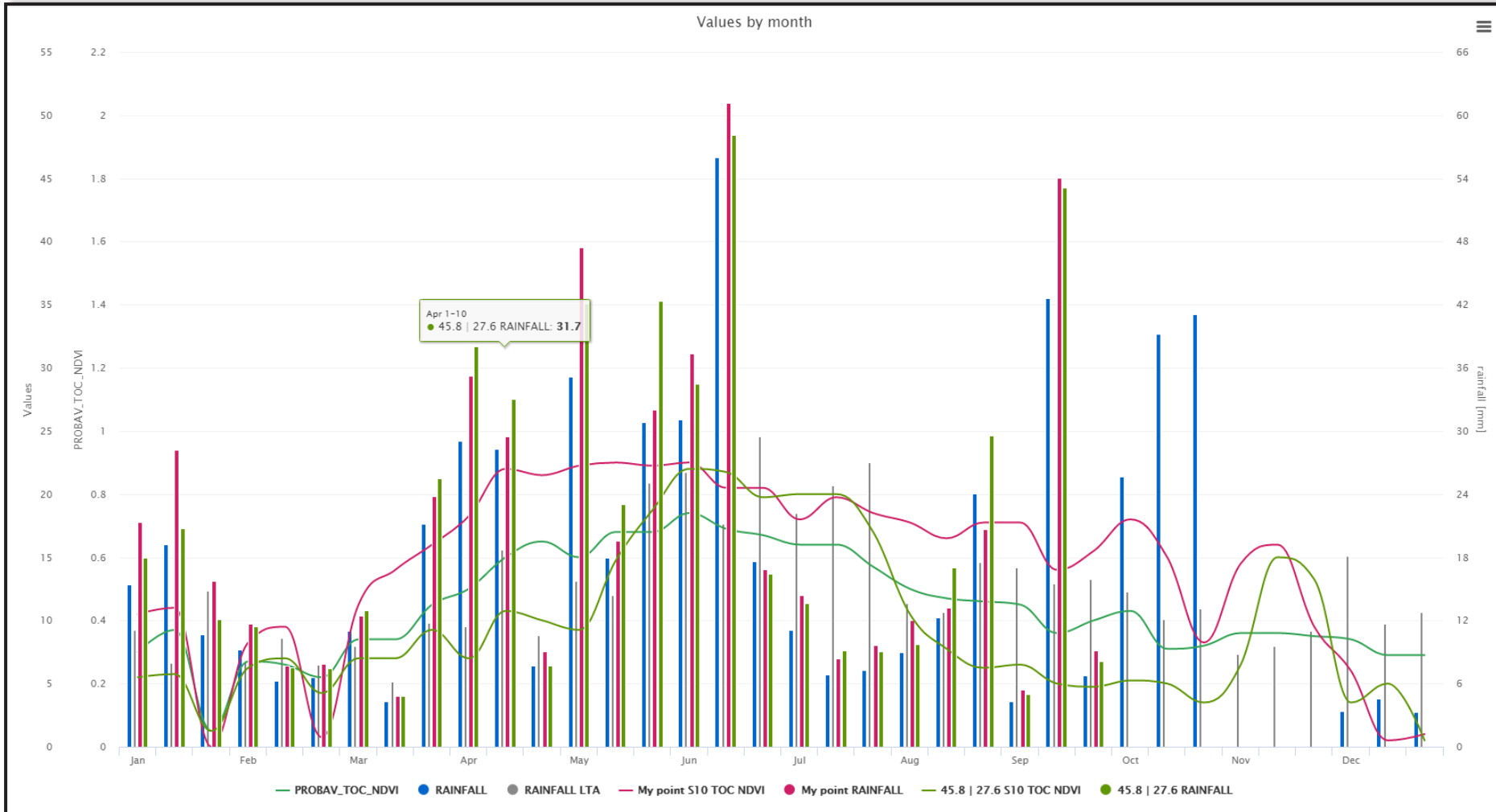
<https://nbviewer.jupyter.org/urls/bitbucket.org/vitotap/notebooks/raw/master/CalVal%20WCS%20Timeseries.ipynb>

- » Filter out pixels which are flagged as cloud/no data

<https://nbviewer.jupyter.org/urls/bitbucket.org/vitotap/notebooks/raw/master/AERONET%20CalVal%20TSViewer.ipynb>

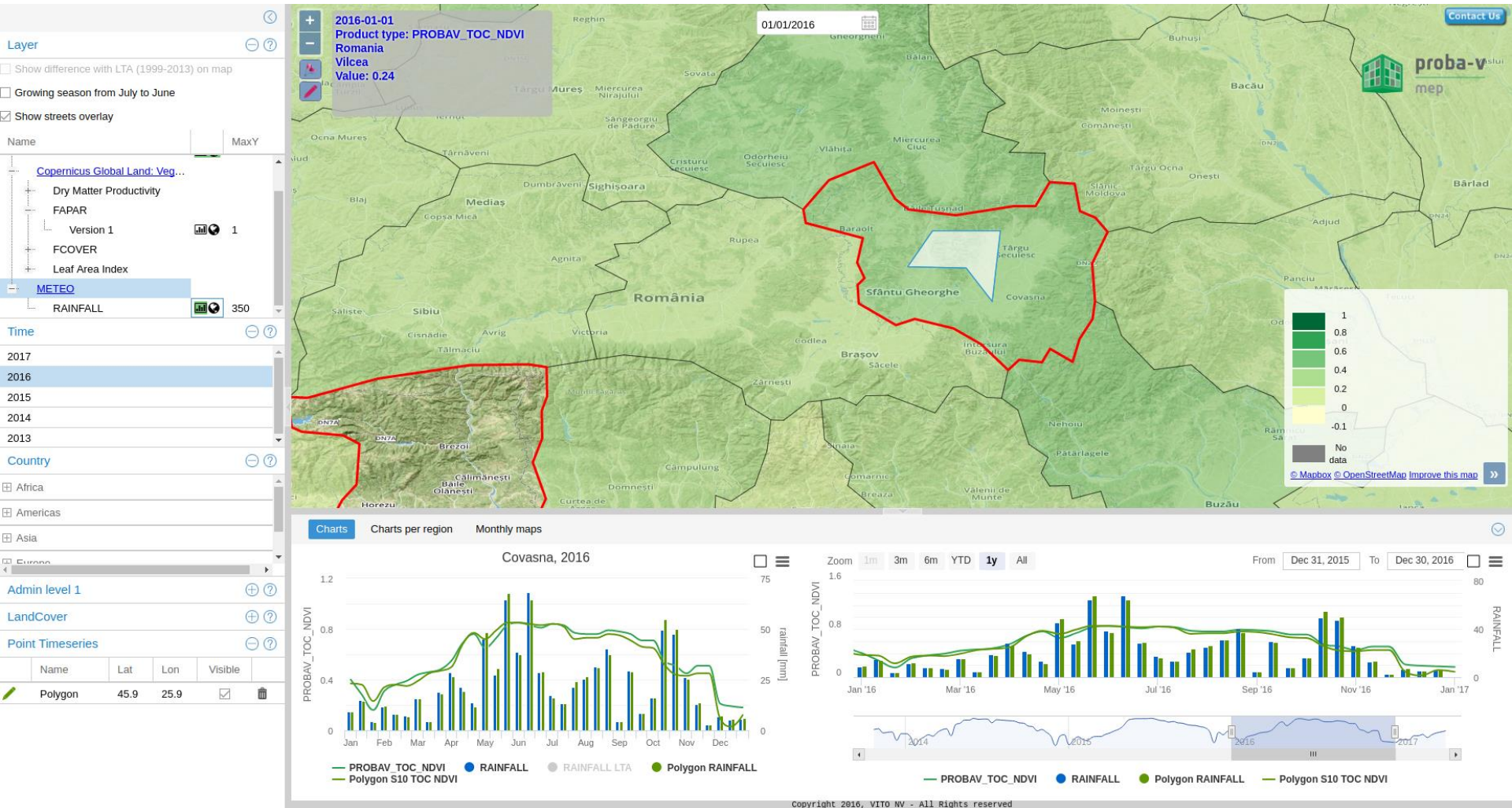
TIME SERIES VIEWER

- *Pixel support: released*
- *Polygon support: release on Web service, to be released on Web client*
- *SPOT-VEGETATION: to be released*



TIME SERIES VIEWER



Preview 'user-defined polygon' - not yet released!



N-DAILY COMPOSITOR

Proba-V 100 m supported

Please specify your input parameters


Area of interest ?


7.35502 45.45628 AOI 8.76127

44.41257

Simple composite Sliding window

Time of interest ?

Start Date: 01/03/2017 

End Date: 30/03/2017 

Composite unit (number of days in a composite) ?

7 (between 2 and 31 days)

Monthly (aligned to a calendar month)

Calculate composite ?

every 7 days (1...30 days)

Monthly (aligned to a calendar month)

Composite algorithm ? Maximum NDVI

File format ? geoTIFF


Spatial resolution ? 100 m

Bands ? Radiometric and NDVI

Product type ? TOC

Weekly composites for March 2017 on Proba-V 100 m

Launch processing



N-Daily Compositor

Launch job **Your jobs** User guide

All jobs

Job runs

Weekly composites for March 2017 on Proba-V 100 m - SUCCEEDED

Start date	2017-03-01
End date	2017-03-30
Minimum longitude	7.35502
Maximum longitude	8.76127
Minimum latitude	44.41257
Maximum latitude	45.45628
Spatial resolution	100 m
Composite span	7
Composite span unit	DAYS
Composite frequency	7
Composite frequency unit	DAYS
Product type	TOC
Composite algorithm	maximumNdvi
Bands	radiometricAndNdvi
File format	geotiff
Description	Weekly composites for March 2017 on Proba-V 100 m
Process	PROBA-V N-daily compositor
Start of processing	05/05/2017 15h39
End of processing	05/05/2017 16h48
Status	SUCCEEDED

Relaunch job

Jobrun 05/05/2017 15h39 - 'SUCCEEDED'

Start date 01/03/2017 - End date 28/03/2017

CalculateComposite: OK
Start time: 05/05/2017 15h39
End time: 05/05/2017 16h07

UploadResults: OK
Start time: 05/05/2017 16h07
End time: 05/05/2017 16h47

DistributeViaPDF: OK
Start time: 05/05/2017 16h47
End time: 05/05/2017 16h48

Cleanup: OK
Start time: 05/05/2017 16h48
End time: 05/05/2017 16h48

Results

Order ID	URL
D0164752	ftp://erwing@ftp.vito-eodata.be/D0164752/

JOB MONITORING ON HADOOP CLUSTER

Implementation nearly finished → already used internally

jobcontroltest.vgt.vito.be:8080/ops-dashboard/jobs/start

Apps PoD Hadoop PDF GIO MEP TAP OpenStack NextGEOSS VITO Outlook Bug #1311273 Processing Land GIT How-to: Prepare AITH Python ElasticSearch

Ops Dashboard Applications Jobs Logout daemsd

Select job to Start <

N_daily_compositor

startDate
2016-05-01

endDate
2016-05-02

lonMin
-10

lonMax
10

latMin
-10

latMax
10

Algorithm
algorithm

productType
TOC_1KM

outputBands
ndvi

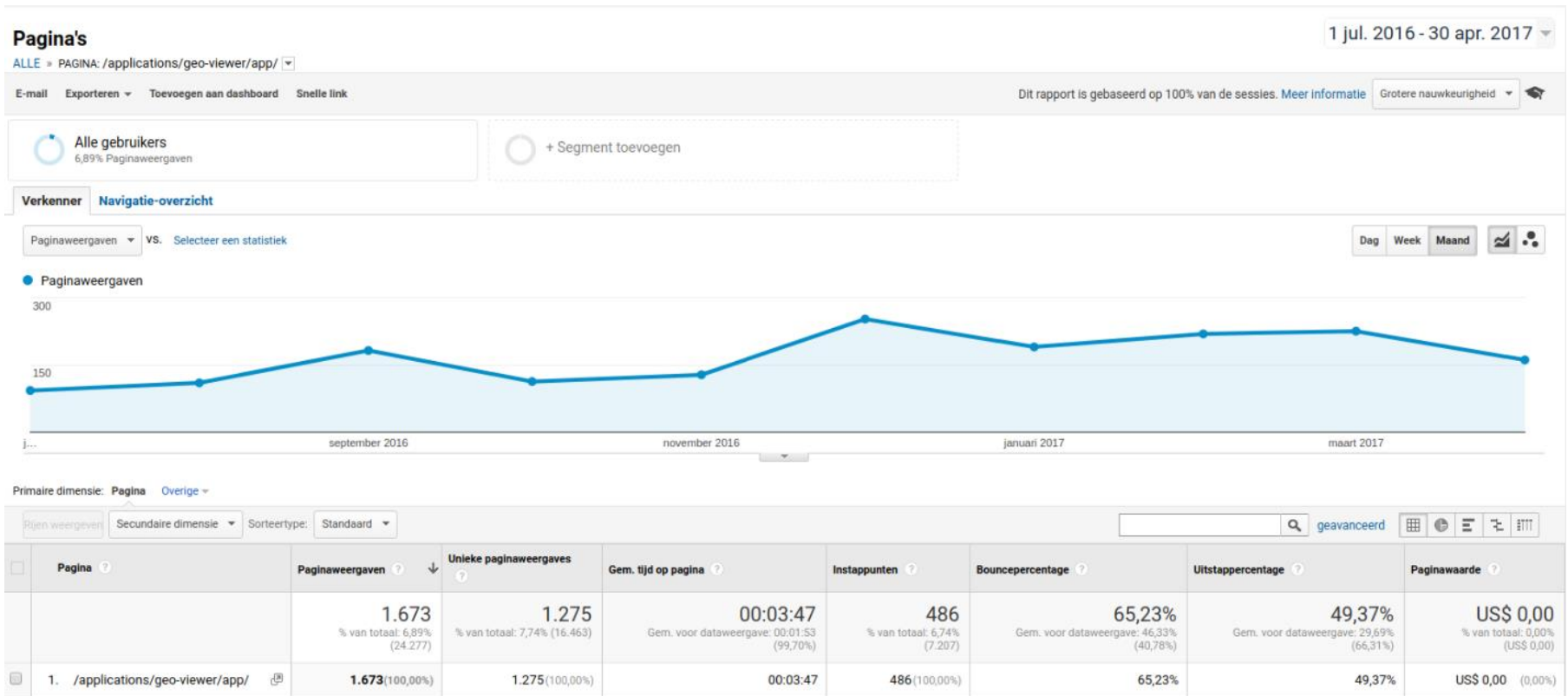
catalogueType
PDF

outputDir
hdfs://hacluster/user/daemsd

Execute

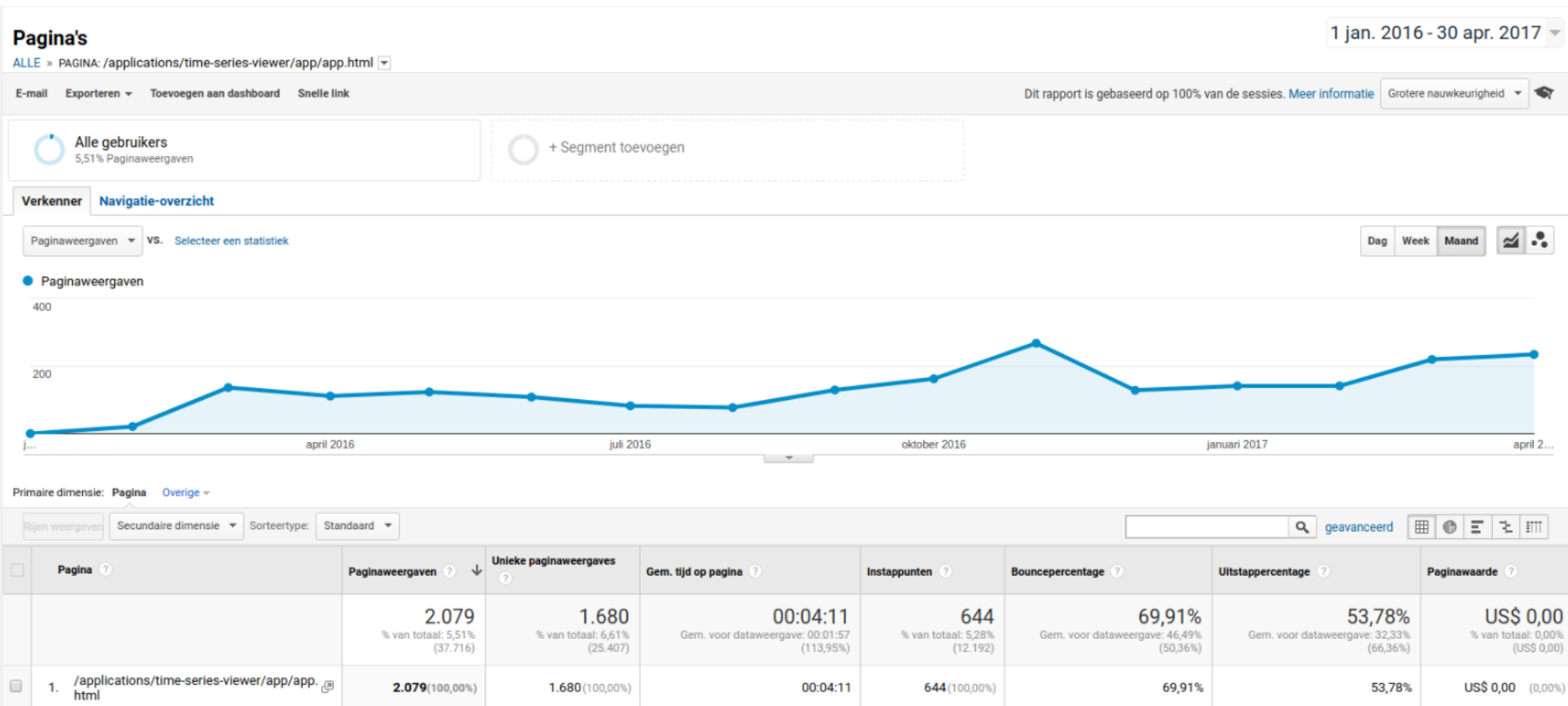
UPTAKE OF PROBA-V MEP APPLICATIONS - GEO VIEWER

!! Excluding the WMTS requests



UPTAKE OF PROBA-V MEP APPLICATIONS - TIME SERIES VIEWER

!! Excluding the Web services (only Web client)



UPTAKE OF PROBA-V MEP APPLICATIONS - VIRTUAL MACHINES

<https://confluence.vgt.vito.be/pages/viewpage.action?spaceKey=EP&title=userVM+reporting>



proba-v
mep

Live Training Session MEP: Bring the User Closer to The Data

Dear,

Since November 2016, the PROBA-V Mission Exploitation Platform (MEP) is fully operational.

As a loyal user of PROBA-V, we invite you to one of our Webinars which we will organise in April – May and June 2017.

Learn from our experts about:

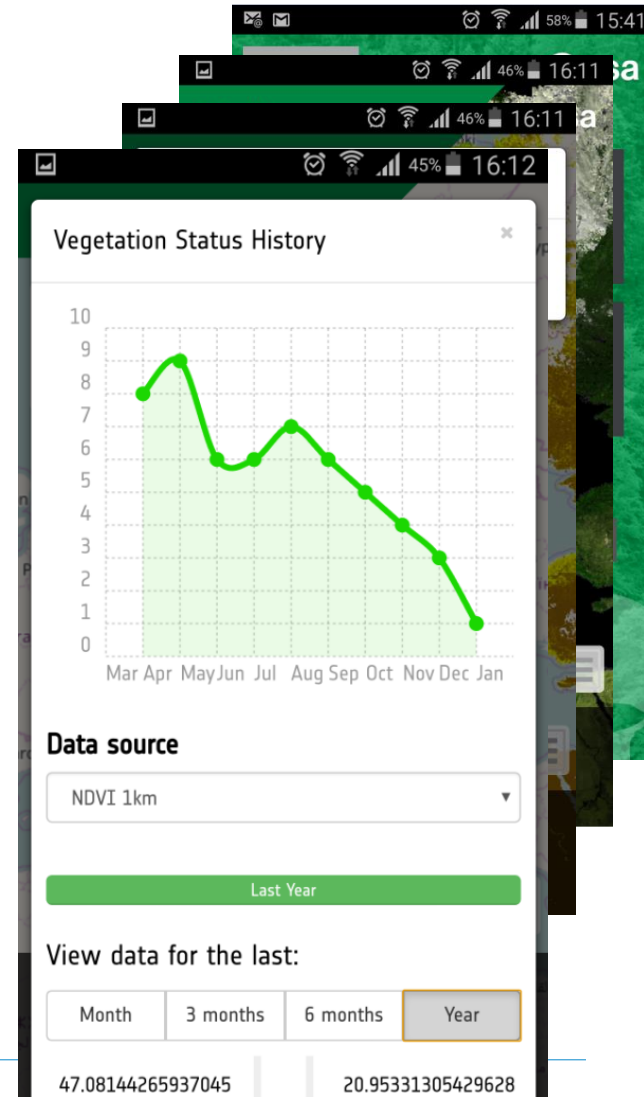
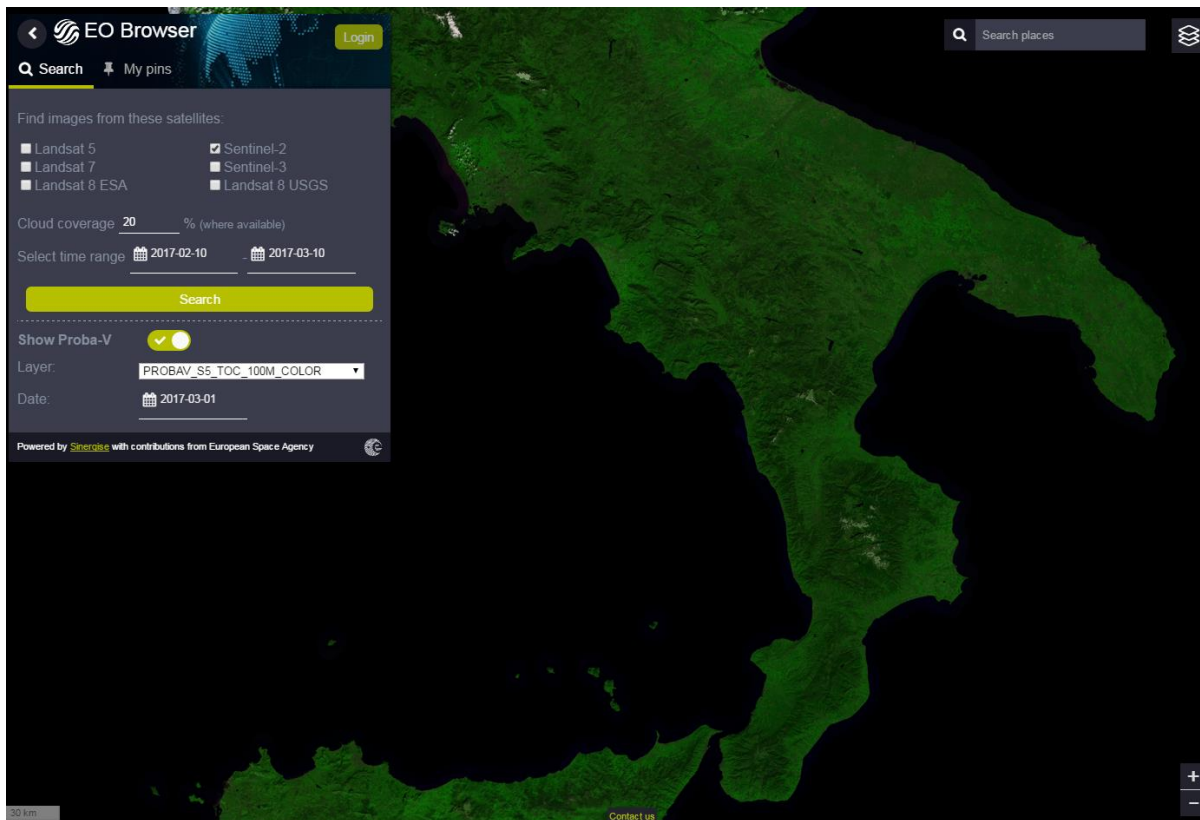
- Virtual Research Environment: working with PROBA-V data without downloading any data;
- Powerful Hadoop/Spark cluster for scalable EO-processing workflows;
- Data analytics: extract time series in real-time for any pixel or polygon;
- Interactive analytics with Notebooks technology.

After this interactive session, we will support you further in your first activities on the platform, where you can **get free resources** to start experimenting.

Let us know whether you are interested to attend the Webinar (~1 hour) and we will contact you to provide you with the necessary information.

April 2017

UPTAKE OF PROBA-V MEP APPLICATIONS - AS A NODE WITHIN A FEDERATION



NEXT GEOSS
Contributing to the Vision of GEO

DataBio



food security
tep

017



UPTAKE OF PROBA-V MEP - USER FEEDBACK AT WORLD COVER 2017

- *Copernicus Global Land (VITO) - The dynamic Global Land Cover layer at 100 m resolution*



MEP platform

- Mission Exploitation Platform (MEP) PROBA-V is a virtual research environment
 - Backbone of your automated processing chain
 - Example: metrics extraction needs **5588** CPU-hours for whole Africa
→ MEP platform allows use to use 2 TB memory and 460 executers
→ processing time cut to 41 hours = **99.2 % time saving**
- *WUR - Large area land cover monitoring using satellite image time series*

Objective

- Case studies for land cover monitoring
 - Semi-arid Sahel region
 - Land cover
 - Forest cover
 - Boreal region
 - Land cover fraction
- Big EO data challenge ~ **Cloud-based processing platforms**
 - ESA Cloud Toolbox
 - Proba-Mission Exploitation Platform (MEP)

» **Iteration 2**

- » FAT (excl. Data Mgr) - 30 June 2017
- » AR (excl. Data Mgr) - 2 October 2017
- » ORR (excl. Data Mgr) - 31 October 2017

- » PDR (Data Mgr - Spacebel) - 30 June 2017
- » FAT (Data Mgr - Spacebel) - 31 October 2017
- » AR (Data Mgr - Spacebel) - 22 December 2017
- » ORR (Data Mgr - Spacebel) - 30 March 2018

» **Iteration 3 → limited new developments!**

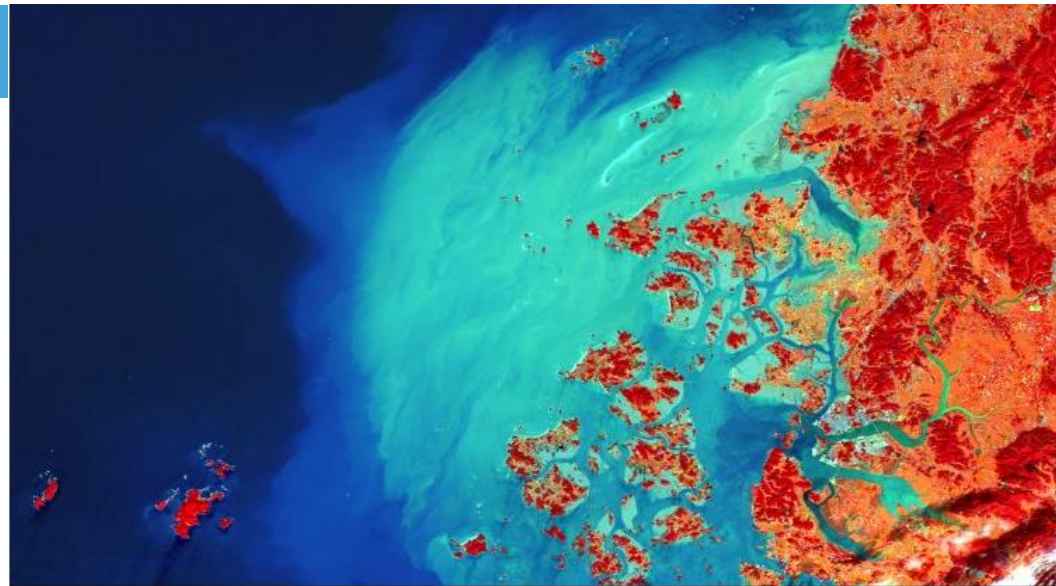
- » KO - September 2017

» **Operations** will be extended (CCN needed) till end of 2019

PROMOTION ACTIVITIES

PROBA-V WEEKLY MAILING

[Link to the Image of the Week in geoviewer](#)



ESA-BELSP0 2017, produced by VITO

Mokpo, South Korea

Mokpo is a mid-size city (~250,000 inhabitants) in the southwest of South Korea and is part of the South Jeolla Province. It is a main gate to the country's largest granary at the Honam Plain and has been a naval base during the Choson Dynasty (1392 – 1910). Further, it was the hometown of late South Korean president and Nobel Peace Prize 2000 recipient Kim Dae-Jung.

The city is surrounded outside the coast by more than 1,400 islands, which provide fishing grounds and also protect the area from large typhoon and tsunami impacts.

The 100 m image of 6 October 2016 shows Mokpo in the lower-right image part as a blue-grey area located at the Yeonsang River estuary. Furthermore, the image shows the scattered smaller and larger islands outside the coast, while an extensive area with large sediment concentrations extends further into the Yellow Sea in a bow shape.



[Launch Geoviewer](#)

PROBA-V products comprise segment data (Level 1C and Level 2A) and daily and 10-daily synthesis files (S1 and S10), including NDVI data. More information on the PROBA-V product suite is available at the [Product Distribution Portal](#) and the [Product User Manual](#).

SPECIFIC PROBA-V MEP MAILINGS



» <http://www.flexmail.eu/m-f303452c581b6919c7b9113182a667abb4d05073d690e445>

The screenshot shows the ESA Earth Online website. At the top left is the ESA logo and 'Earth Online'. To the right are links for 'Login My Earthnet', 'Register', and a 'Google Custom Search' box. Below this is a navigation bar with 'Missions', 'Earth Topics', 'Data Access', and 'PI Community' menus, and an 'Explore more...' dropdown. A breadcrumb trail reads 'You are here Home > Missions > ESA EO Missions > Proba-V'. Social media icons for Twitter, Facebook, LinkedIn, and YouTube are visible. The main content area is titled '- Proba-V News' and features an article: 'Proba-V MEP - Enhanced TSV and Notebooks applications' dated 03 May 2017. The article text states: 'The Proba-V Mission Exploitation Platform (MEP), announced earlier this year, complements the Proba-V user segment by building an operational Exploitation Platform on the data and derived products to 'bring users closer to the data'. The Mission Exploitation Platform offers multiple online applications. Some useful information on two of them which were recently enhanced - the 'Time Series Viewer' (TSV) and 'Notebooks' - can be found below.' The article is divided into sections: 'Time Series Viewer' (describing the viewer's capabilities for rainfall and NDVI data) and 'Notebooks' (describing the interactive programming environment). A right-hand sidebar titled 'Missions' contains a list of mission links: 'Missions Home', 'ESA EO Missions', 'Sentinel-3', 'Sentinel-2', 'Sentinel-1', 'Swarm', 'Proba-V', 'FAQs', 'Image of the Week', 'CryoSat', 'SMOS', 'GOCE', 'Envisat', 'Proba-1', and 'ERS'. Below this list are links for 'ESA Future Missions', '3rd Party Missions', 'ESA Earth Observation Campaigns Data', 'ESA/EUMETSAT', 'ESA Mission Continuity', 'ESA Mission News', 'ESA User Services News', and 'NASA EO Missions'. At the bottom of the page, there is a dark blue bar with the text '- Key Resources' and a link for 'Proba-V dissemination portal'.

<https://blog.vito.be/remotesensing>

PROBA-V MEP BRINGS YOU CLOSER

PROBA-V's **Mission Exploitation Platform** user segment by building an operator derived products to bring the users closer to online applications. One of these is the PROBA-V Time Series for spectral indices and rainfall.

A story about Land use, Agriculture, Image Processing, PROBA-V, MEP

PIXEL AND POLYGON SUPPORT IN THE TIME SERIES VIEWER

Since March 2017, the Time Series Viewer has been updated to support the Time Series Viewer for PROBA-V 300 m TOC NDVI and Chirps rainfall. This service now shows you the exact information you need, not just for the whole region, but also for sub-regions. The next step? Supporting user-defined regions.

The pixel and polygon support can be used via the Time Series Viewer Web service. This service now supports both, point and polygon queries, into your applications. In the future more data from the Copernicus Global Land Service.

PROBA-V MEP TAKES IT ONE STEP FURTHER WITH THE NOTEBOOKS

Have you ever read a paper showing nice graphs, without giving a clear explanation on how they were produced? Or do you want to share your code and results with your colleagues easily? And are you frustrated when it takes days to rerun your code? Then we are happy to introduce the new **Notebooks** web application of PROBA-V MEP.

It offers a solution for all these problems, because it combines a **browser based interactive programming environment** with the power of our Hadoop processing cluster, connected to the full PROBA-V data archive.

A story about Image Distribution, Image Processing, PROBA-V, MEP by Jeroen Dries 10.04.2017

A NOTEBOOK APPLICATION TAILORED FOR REMOTE SENSING USERS

The PROBA-V MEP (Mission Exploitation Platform) Notebooks web application lets you **create and share documents that contain live code, equations, visualizations and explanatory text**. It is based on the Open Source Jupyter notebooks application, and tailored to the needs of remote sensing users.

For programming, you can choose between the Python and R programming languages. We also include an **ever growing list of software libraries** such as GDAL, rasterio, pandas, numpy, matplotlib and seaborn so you can start immediately. It is even possible to install and upload your own packages and files. Check out some **examples** to get a better idea of what you can achieve.

PROBA-V MEP LEAFLET FOR DEVELOPERS

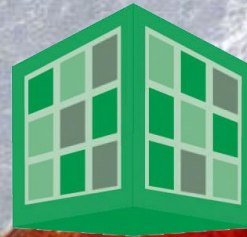
Being developed ...

PRESENTATIONS & DEMO'S AT VARIOUS EVENTS

- » BEGEO day 2017, Brussels (March) - demonstrations
- » ESA WorldCover 2017 (March), ESRIN - presentation
- » EGU 2017, Vienna (April) - poster
- » EODC forum 2017 (May), Vienna - presentation & demonstrations
- » Multitemp (June), Bruges - demonstrations
- » BIDS conference 2017 (November), Toulouse - Abstract submitted
- » **Datacube conference 2017 (October), ESRIN - ???**

MEP evolutions / R&D to be discussed with ESA - EC - Belspo ... after DIAS consortia are granted

!! DIAS is a clear opportunity for MEP as “Support for 3rd-party services integration”
→ fusion Proba-V with Sentinel-2, ...



proba-v

mep

Thank you ...

Erwin Goor – VITO - Belgium
erwin.goor@vito.be