EODATASERVICE.ORG

DIGITAL EARTH PLATFORM TO ENABLE MULTI-DISCIPLINARY GEOSPATIAL APPLICATIONS

Stefano Natali, Simone Mantovani
MEEO - Italy

THE MEEO-SISTEMA GROUP

FOUNDED IN 2004 IN FERRARA, ITALY, **MEEO** ACTIVITIES AIM AT **FACILITATING GEOSPATIAL DATA ACCESS** WITH MAIN FOCUS IN SATELLITE-BASED PRODUCTS. **SINCE 2006** MEEO IS A CONSOLIDATED PARTNER OF THE **EUROPEAN SPACE AGENCY** AND PROVIDES ITS SERVICES TO PUBLIC AND PRIVATE ENTITIES.

IN **2009 SISTEMA** GMBH WAS FUNDED IN VIENNA, AUSTRIA, IN ORDER TO ENFORCE THE **RESEARCH AND DEVELOPMENT ACTIVITIES**, AND TO **ENLARGE THE MARKET TO CENTRAL AND EASTERN EUROPE**.

MEEO DATA FACILITY (MEEO-DAF)

THE MEEO-DAF CONSISTS OF ABOUT **1 PBYTE OF ONLINE STORAGE**, 3.5PB OFF-LINE STORAGE, +1000CPUS, +4.5TB OF RAM CONNECTED TO THE HIGH-SPEED BACKBONE GARR NETWORK (1GBPS LINK).

SATELLITES FOR EARTH OBSERVATION

WE LAUNCH OBJECTS ON SPACE TO BETTER OBSERVE THE EARTH (NOT ONLY, BUT MAINLY)

FIRST SATELLITE FOR EARTH OBSERVATION IS DATED **1960**

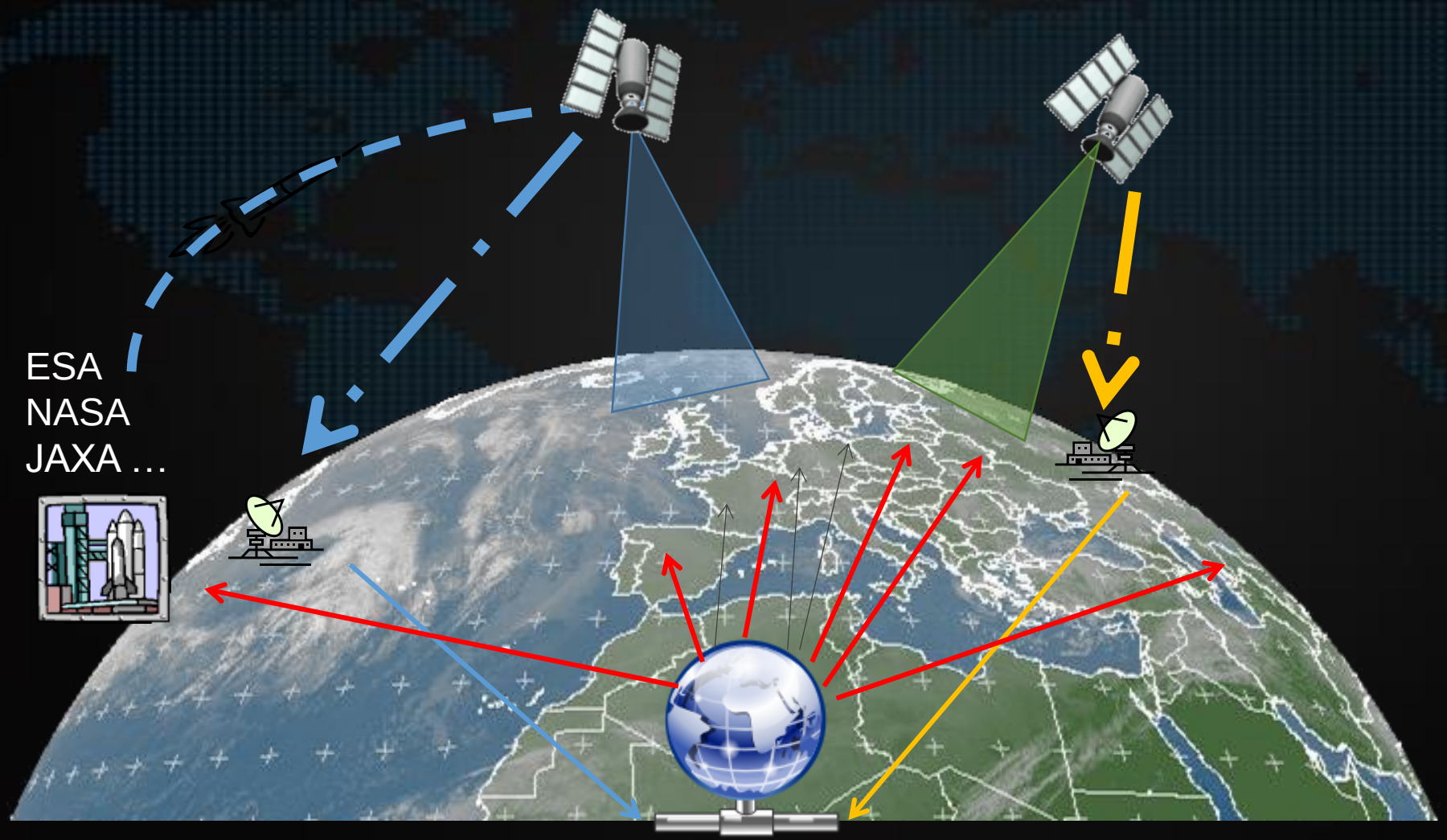
CURRENTLY ABOUT 1000 NON-MILITARY FLYING SATELLITES FOR EARTH OBSERVATION

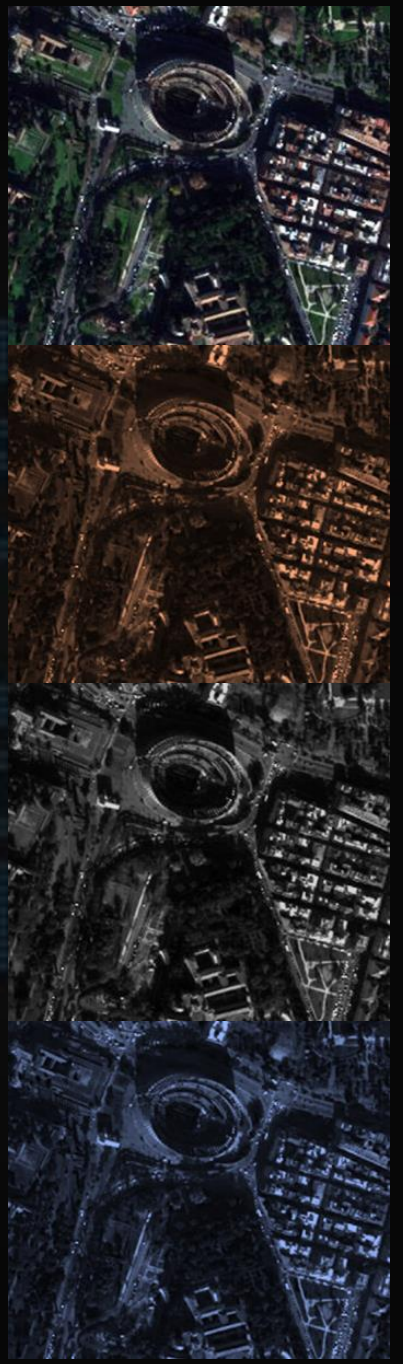
- ABOUT 200 FOR COMMERCIAL EARTH OBSERVATION
- ABOUT 500 METEOROLOGICAL, RESEARCH

27000 SATELLITES FOR EARTH OBSERVATION EXPECTED FOR 2025

ORBITS: GEOSTATIONARY (35.800 KM), LOW EARTH ORBIT (LEO) 400 – 800 KM

SATELLITES FOR EARTH OBSERVATION



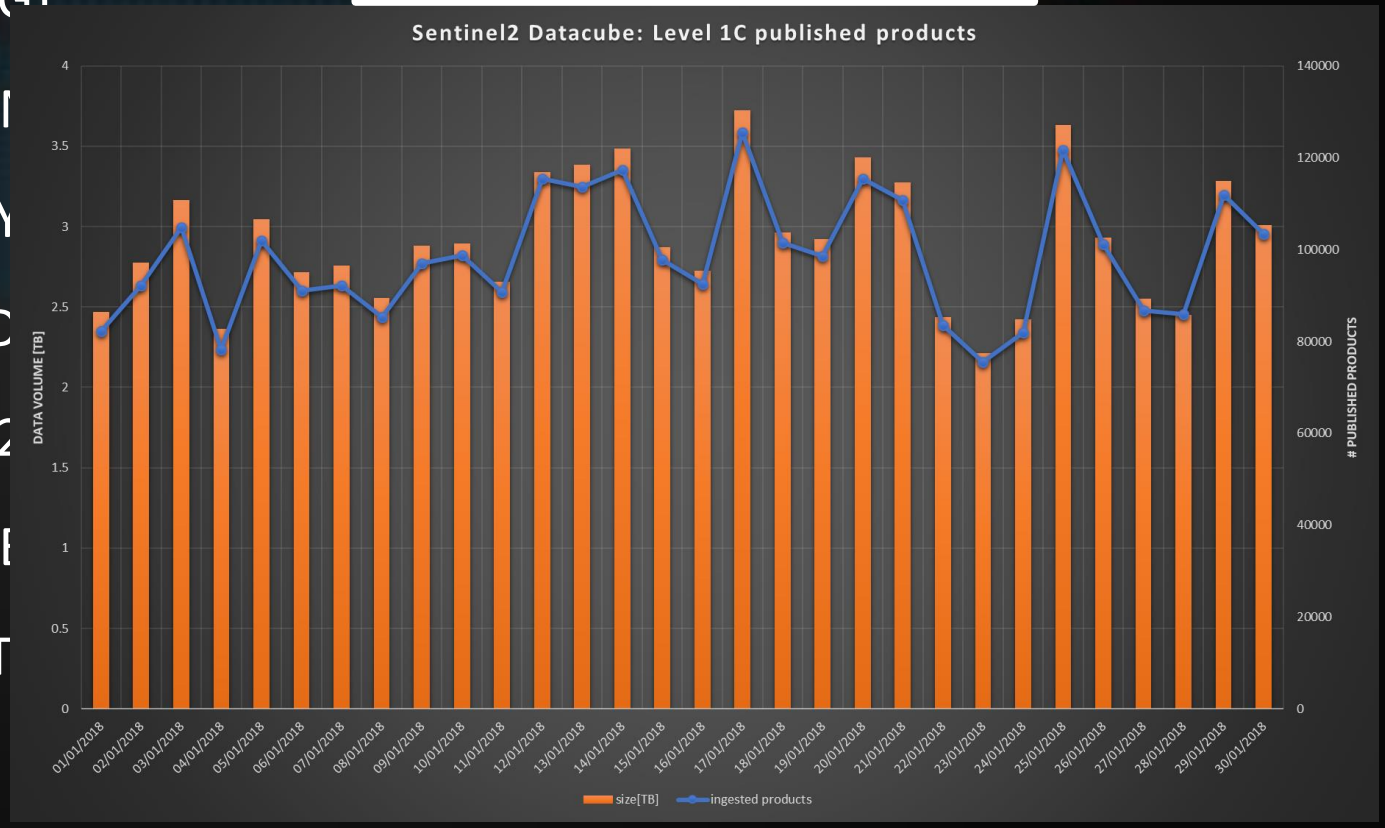


EARTH OBSERVATION DATA VOLUME

EXAMPLE: COPERNICUS SENTINELS CONSTELLATION:

- SENTINEL 1 (SAR) (4 SATS, 2 ALREADY FLYING)
- SENTINEL 2 (LAND) (4 SATS, 2 ALREADY FLYI
- SENTINEL 3 (OCEAN) (4 SATS, 1 ALREADY FL
- SENTINEL 5P (ATMOSPHERE) (1 SAT, ALREAD
- SENTINEL 5 (ATMOSPHERE) (4 SATS, FROM 2
- SENTINEL 4 (ATMOSPHERE) (4 SATS, PLANNE
- SENTINEL 6 (OCEAN) (2 SATS, FROM 2022 (T

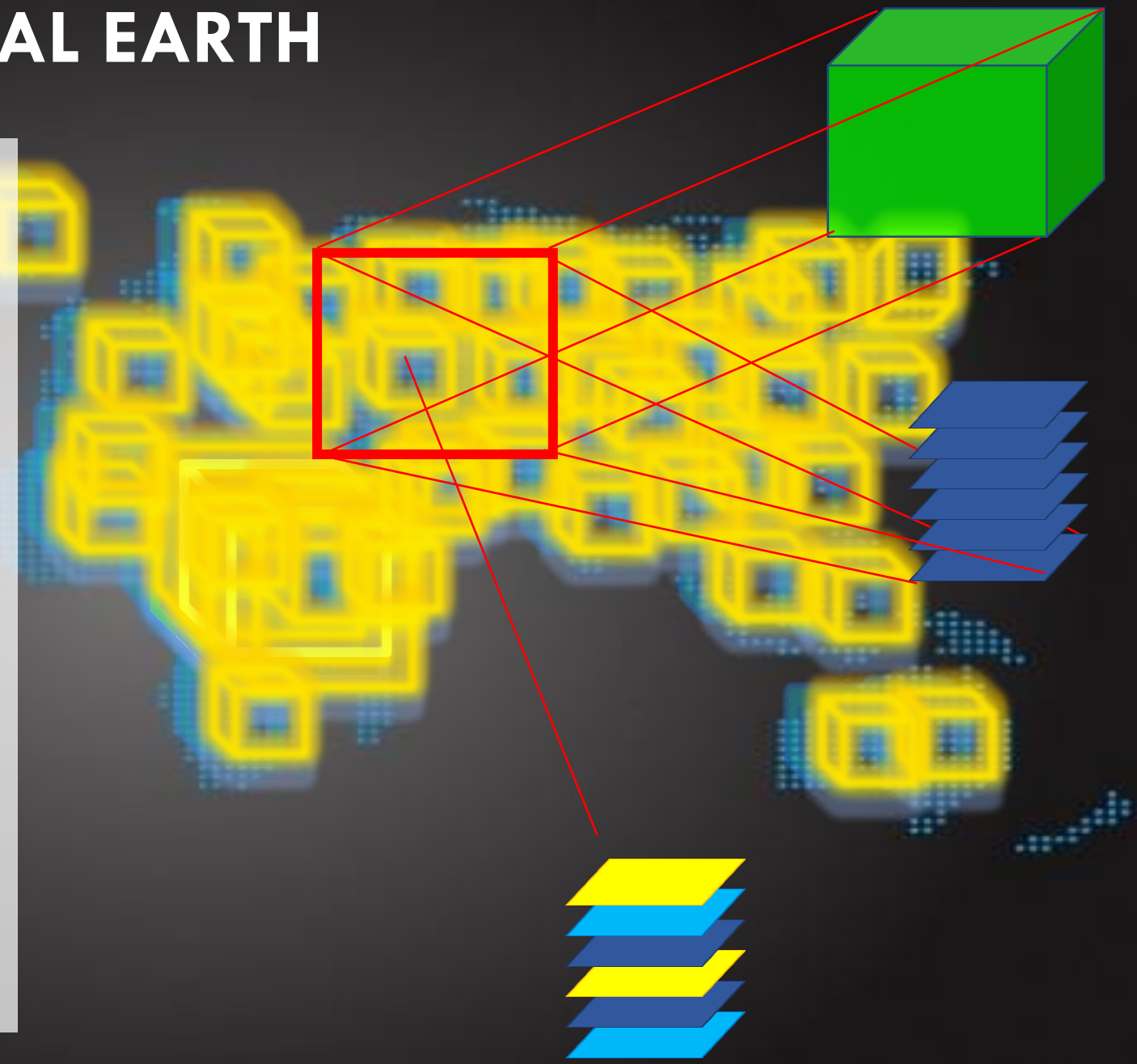
Sentinel 2A Level 1C daily figures
- Products: ~ 100.000 per day
- **Volume: ~ 3 TB/day**
- Coverage: global



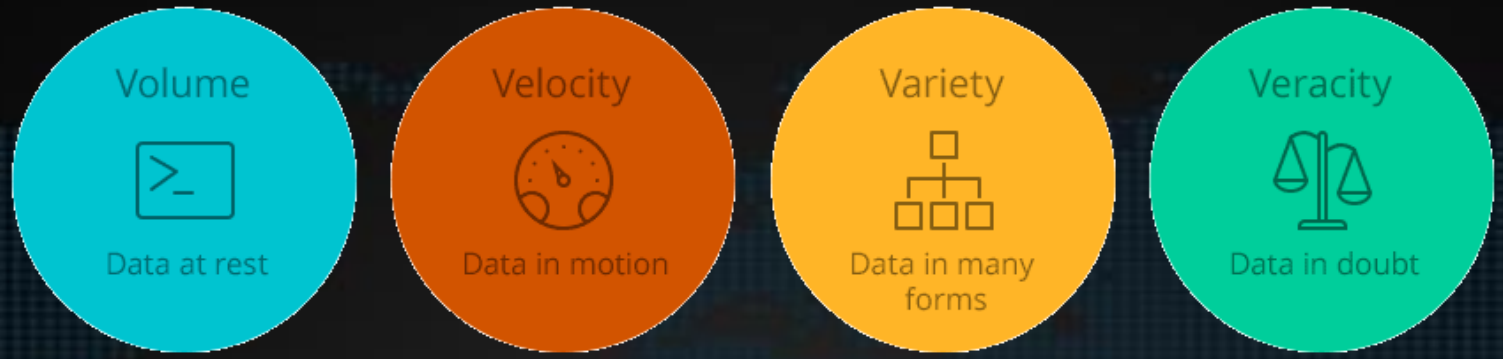
→ **OVERALL MORE THAN 1PB PER DAY GENERATED BY EO SATELLITES**

CONCEPT: THE DIGITAL EARTH

*'**Digital Earth**' (Gore 1999)* ***multi-resolution three-dimensional*** *representation of the planet that would make it possible to* ***find***, ***visualise*** *and* ***make sense*** *of* ***vast amounts*** *of* ***geo-referenced information*** *on physical and social environments. Such a system would allow users to navigate through* ***space*** *and* ***time***, *accessing* ***historical data*** *as well as* ***future predictions*** *and would support its use by scientists, policy-makers and* ***children alike***



BACKGROUND: CHALLENGES



- Datasets to be managed are getting huge
  - GB, TB, PB, EB, ZT, YB
  - Sentinel2: PB with growing rate ~3TB/day)
  - CAMS: 100TB/day
- Users need fast and **FAIR**[1] discovery, access, processing an visualization services

- **Each product has its own**
  - **data specification (format, grid / tiling schema, resolution, …)**
  - **Users community and needs**
- **Veracity relies on**
  - **data owners (ESA, USGS, ECMWF, …)**
  - **service providers**

[1] Findable, Accessible, Interoperable, and Re-usable: https://www.force11.org/group/fairgroup/fairprinciples

EFFECTIVE DATA SUBSETTING

Full collection
(NDVI + P + SM) > 5 TB

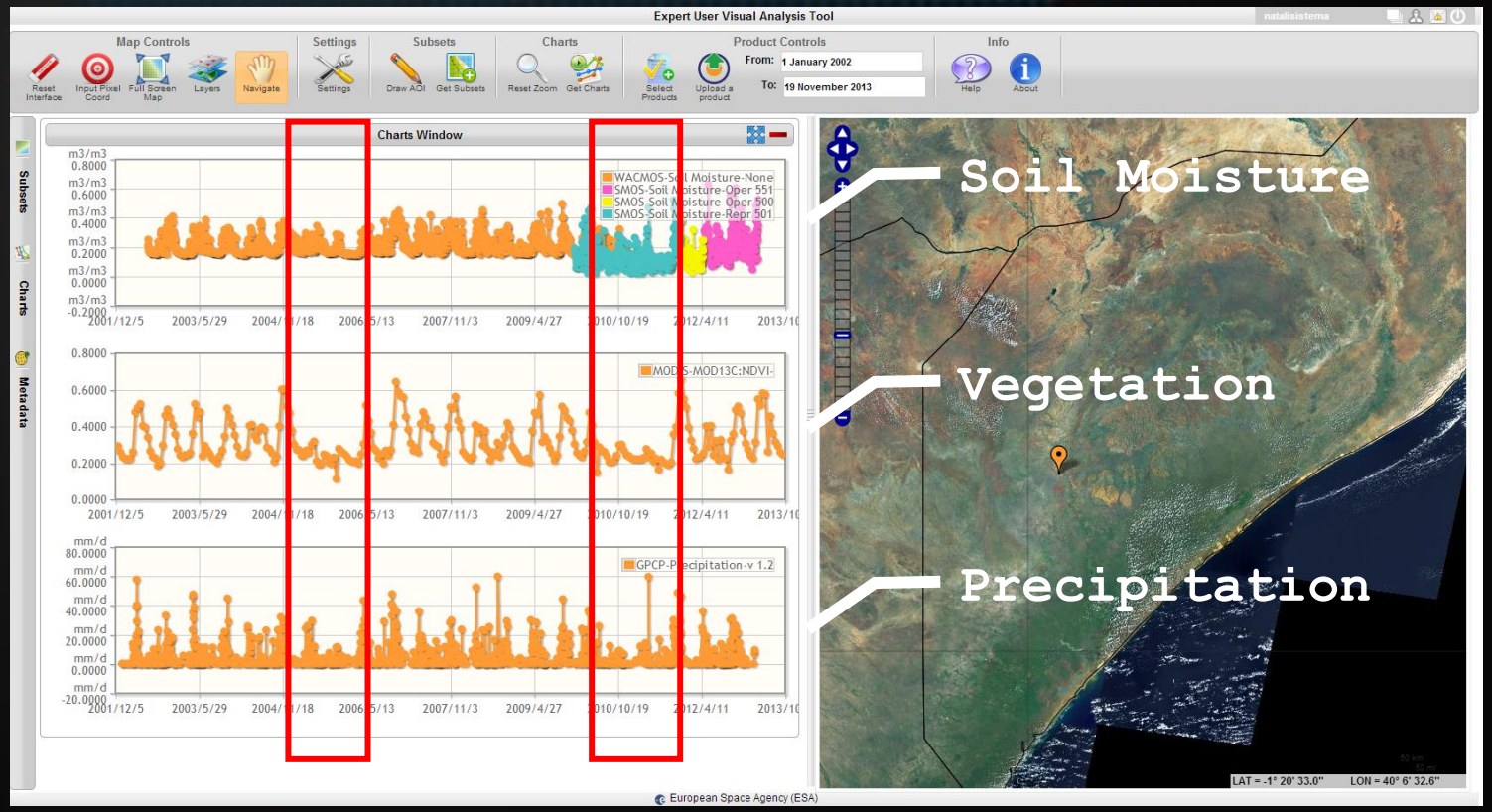
17 years, one point
(NDVI + P + SM) < 1MB

- Identification of anomalies
- Cross-fields correlation
- Identification of similar areas

In real time

Let's assume we want to study drought in Eastern Africa in the last 17 years.

We want to use time series of Vegetation Index (NDVI), Precipitation (P) and Soil Moisture (SM).

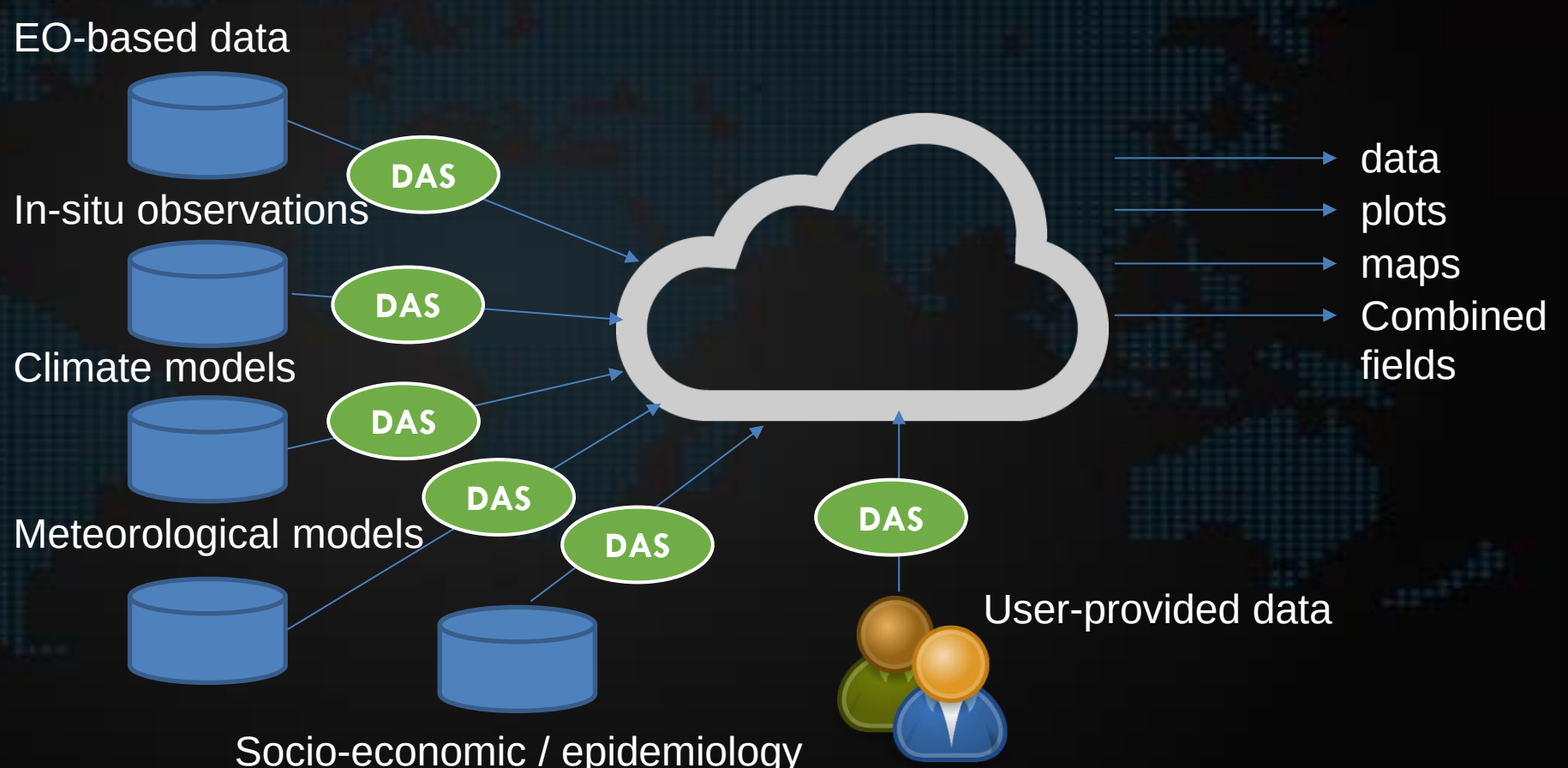


THE ENABLING TECHNOLOGY

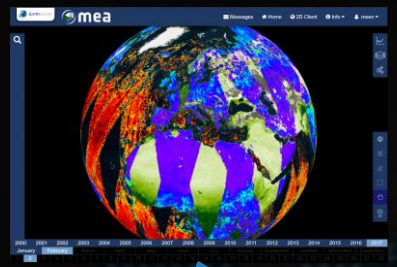
The technology shall allow managing a **large set of geospatial information** deploying a standardized Data Access System (**DAS**) in front of the data sources

It shall allow accessing, visualizing, **subsetting,** combining, processing, downloading **all data sources simultaneously**

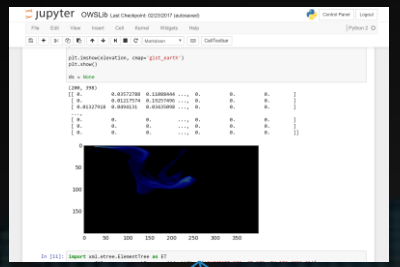
Only <u>one requirement</u>: each dataset shall feature **position and time tags**



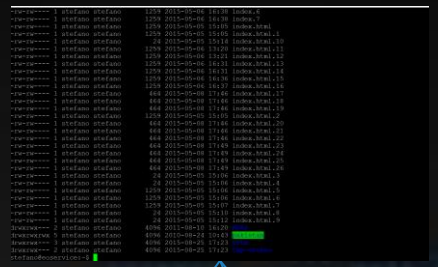
Web based GUI



Jupyter Notebook



Direct data access via CLI



Third-party applications (including GIS)

Standardised data access interfaces allow connecting a wide range of user interfaces

DIGITAL EARTH

DAS DAS DAS DAS DAS DAS DAS

SMOS Landsat ... Sentinel 1/2/3

Atmosphere Vegetation ...

Health data Population distribution ...

Mission-specific data

Thematic data

Other geospatial data

Data Access Systems (DAS) deployed in front of each data source enables OGC standardised interfaces (openSearch, WCS2.0)

Data remain at their own location (multiple data centers) with the original data format

CloudFerro ZAMG ECMWF NCI AWS

DATA AVAILABILITY

HIGH RESOLUTION OPTICAL SATELLITE DATA

SENTINEL 2 (10M, GLOBAL, SINCE 2015)

LANDSAT 8 (30M, GLOBAL, SINCE 2013)

LAND PRODUCTS

VEGETATION INDEXES (10M, 2000)

LAND SURFACE TEMPERATURE (1KM, 2000)

SOIL MOISTURE (10KM, 1978)

LAND COVER TYPE (1KM, 2000)

+ user provided data!

ATMOSPHERIC PRODUCTS

AIR TEMPERATURE (1KM, 1979)

PRECIPITATION (4.5KM, 1979)

AEROSOL OPTICAL THICKNESS (1KM, 2000)

OCEAN PRODUCTS

SEA SURFACE TEMPERATURE (5KM, 2017)

OCEAN SALINITY (10KM, 2010)

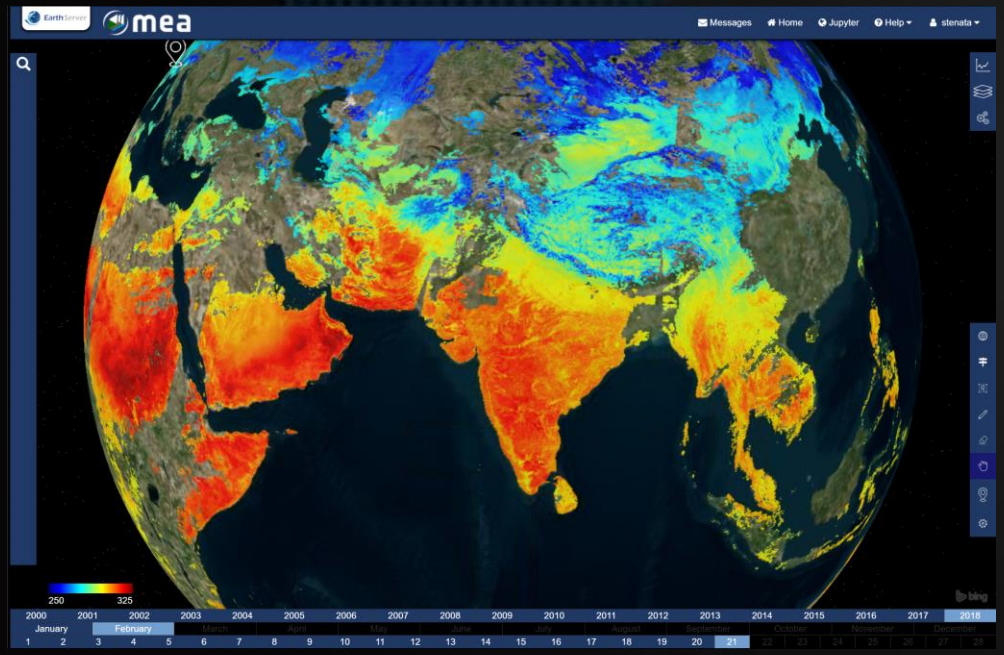
CHLOROPHYLL DATA (5KM, 2010 – 2013, EUROPE)

SEA SURFACE HEIGHT (12KM, 1993 – 2017, EUROPE)

SEA SURFACE VELOCITY (12KM, 1993 – 2017, EUROPE)

USER INTERFACES

WEB GRAPHIC INTERFACE

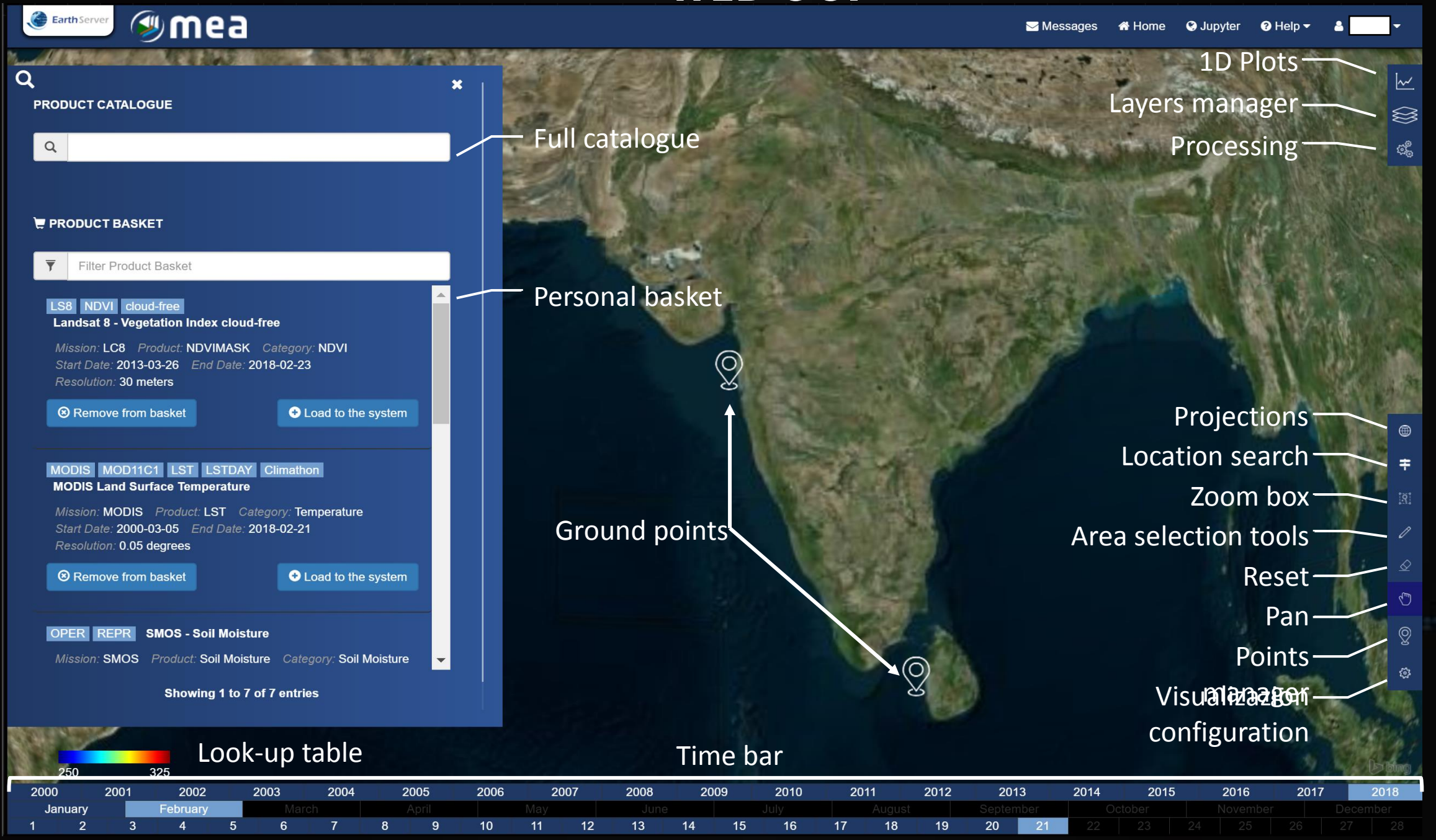


JUPYTER NOTEBOOK

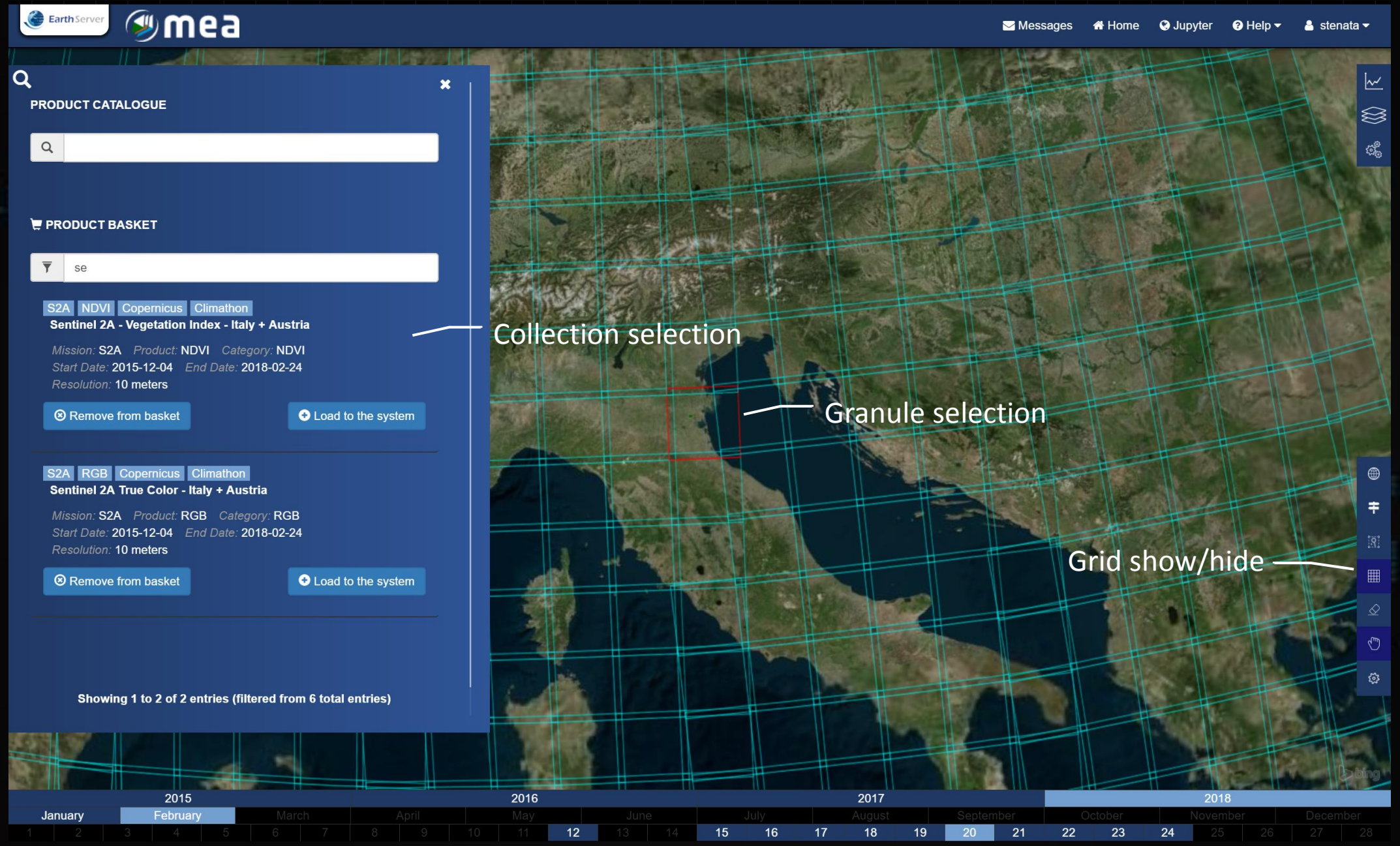
CLI / REST CALL

```
-rw-rw---- 1 stefano stefano      1259 2015-05-06 16:38 index.6
-rw-rw---- 1 stefano stefano      1259 2015-05-06 16:38 index.7
-rw-rw---- 1 stefano stefano      1259 2015-05-05 15:05 index.html
-rw-rw---- 1 stefano stefano      1259 2015-05-05 15:05 index.html.1
-rw-rw---- 1 stefano stefano        24 2015-05-05 15:14 index.html.10
-rw-rw---- 1 stefano stefano      1259 2015-05-06 13:20 index.html.11
-rw-rw---- 1 stefano stefano      1259 2015-05-06 13:21 index.html.12
-rw-rw---- 1 stefano stefano      1259 2015-05-06 16:31 index.html.13
-rw-rw---- 1 stefano stefano      1259 2015-05-06 16:31 index.html.14
-rw-rw---- 1 stefano stefano      1259 2015-05-06 16:36 index.html.15
-rw-rw---- 1 stefano stefano      1259 2015-05-06 16:37 index.html.16
-rw-rw---- 1 stefano stefano       464 2015-05-08 17:46 index.html.17
-rw-rw---- 1 stefano stefano       464 2015-05-08 17:46 index.html.18
-rw-rw---- 1 stefano stefano       464 2015-05-08 17:46 index.html.19
-rw-rw---- 1 stefano stefano      1259 2015-05-05 15:05 index.html.2
-rw-rw---- 1 stefano stefano       464 2015-05-08 17:46 index.html.20
-rw-rw---- 1 stefano stefano       464 2015-05-08 17:46 index.html.21
-rw-rw---- 1 stefano stefano       464 2015-05-08 17:46 index.html.22
-rw-rw---- 1 stefano stefano       464 2015-05-08 17:49 index.html.23
-rw-rw---- 1 stefano stefano       464 2015-05-08 17:49 index.html.24
-rw-rw---- 1 stefano stefano       464 2015-05-08 17:49 index.html.25
-rw-rw---- 1 stefano stefano       464 2015-05-08 17:49 index.html.26
-rw-rw---- 1 stefano stefano        24 2015-05-05 15:06 index.html.3
-rw-rw---- 1 stefano stefano        24 2015-05-05 15:06 index.html.4
-rw-rw---- 1 stefano stefano      1259 2015-05-05 15:06 index.html.5
-rw-rw---- 1 stefano stefano      1259 2015-05-05 15:06 index.html.6
-rw-rw---- 1 stefano stefano      1259 2015-05-05 15:07 index.html.7
-rw-rw---- 1 stefano stefano        24 2015-05-05 15:10 index.html.8
-rw-rw---- 1 stefano stefano        24 2015-05-05 15:12 index.html.9
drwxrwx--- 2 stefano stefano      4096 2011-08-10 16:20 KDA2
drwxrwxrwx 5 stefano stefano      4096 2010-08-24 10:43 pakistan
drwxrwx--- 3 stefano stefano      4096 2015-08-25 17:23 srtm
drwxrwx--- 2 stefano stefano      4096 2015-08-25 17:23 tmp-srokeo
stefano@eoservice:~$
```

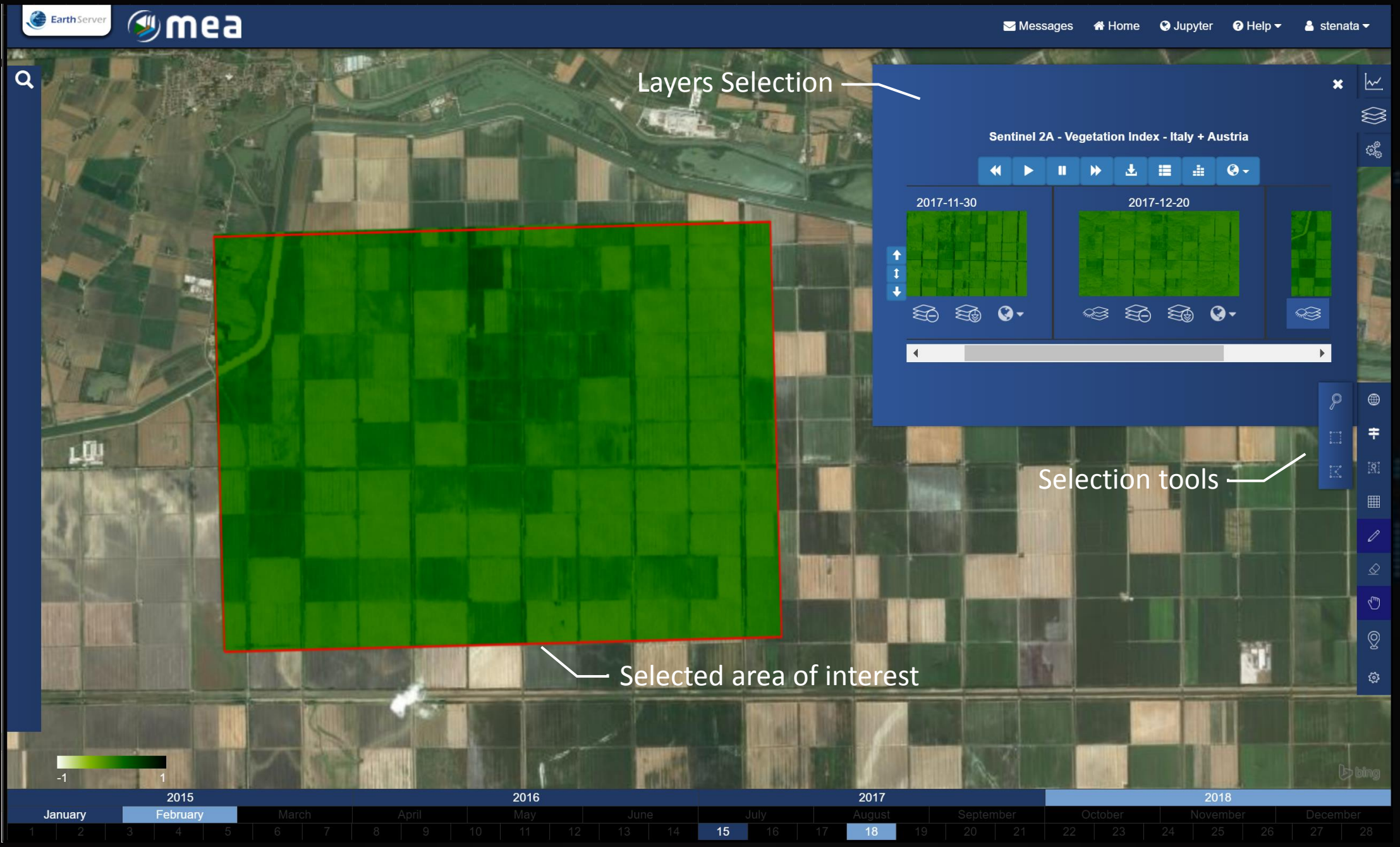
WEB GUI


EarthServer
mea
Messages
Home
Jupyter
Help
PRODUCT CATALOGUE
PRODUCT BASKET
Filter Product Basket
LS8 NDVI cloud-free
Landsat 8 - Vegetation Index cloud-free
Mission: LC8 Product: NDVIMASK Category: NDVI
Start Date: 2013-03-26 End Date: 2018-02-23
Resolution: 30 meters
Remove from basket
Load to the system
MODIS MOD11C1 LST LSTDAY Climathon
MODIS Land Surface Temperature
Mission: MODIS Product: LST Category: Temperature
Start Date: 2000-03-05 End Date: 2018-02-21
Resolution: 0.05 degrees
Remove from basket
Load to the system
OPER REPR SMOS - Soil Moisture
Mission: SMOS Product: Soil Moisture Category: Soil Moisture
Showing 1 to 7 of 7 entries
250
325
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
January February March April May June July August September October November December
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
1D Plots
Layers manager
Processing
Full catalogue
Personal basket
Ground points
Projections
Location search
Zoom box
Area selection tools
Reset
Pan
Points
Visualization configuration manager
Look-up table
Time bar

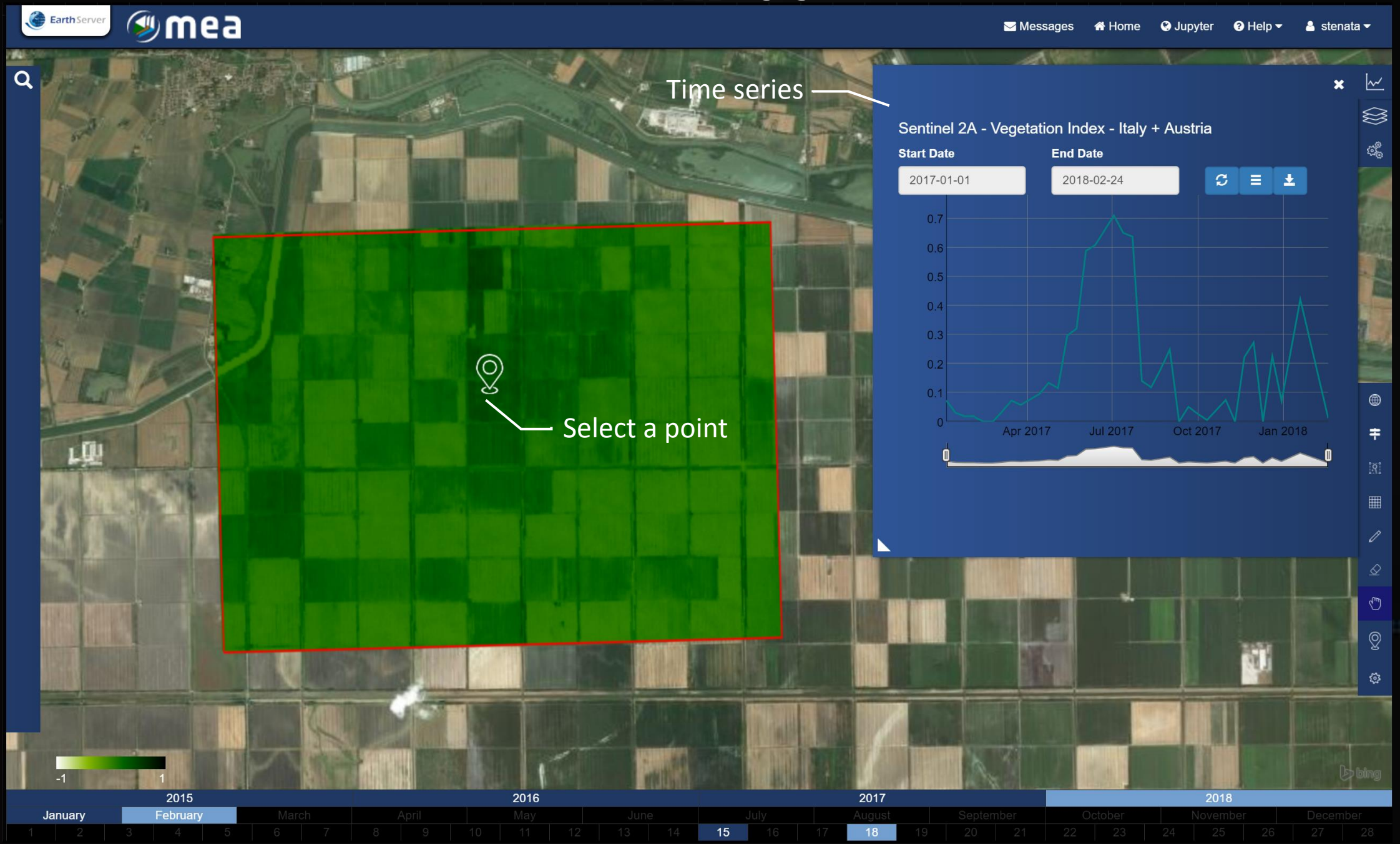
WEB GUI


EarthServer
mea
Messages
Home
Jupyter
Help
stenata
PRODUCT CATALOGUE
PRODUCT BASKET
se
S2A NDVI Copernicus Climathon
Sentinel 2A - Vegetation Index - Italy + Austria
Mission: S2A Product: NDVI Category: NDVI
Start Date: 2015-12-04 End Date: 2018-02-24
Resolution: 10 meters
Remove from basket
Load to the system
S2A RGB Copernicus Climathon
Sentinel 2A True Color - Italy + Austria
Mission: S2A Product: RGB Category: RGB
Start Date: 2015-12-04 End Date: 2018-02-24
Resolution: 10 meters
Remove from basket
Load to the system
Showing 1 to 2 of 2 entries (filtered from 6 total entries)
Collection selection
Granule selection
Grid show/hide
2015
2016
2017
2018
January
February
March
April
May
June
July
August
September
October
November
December

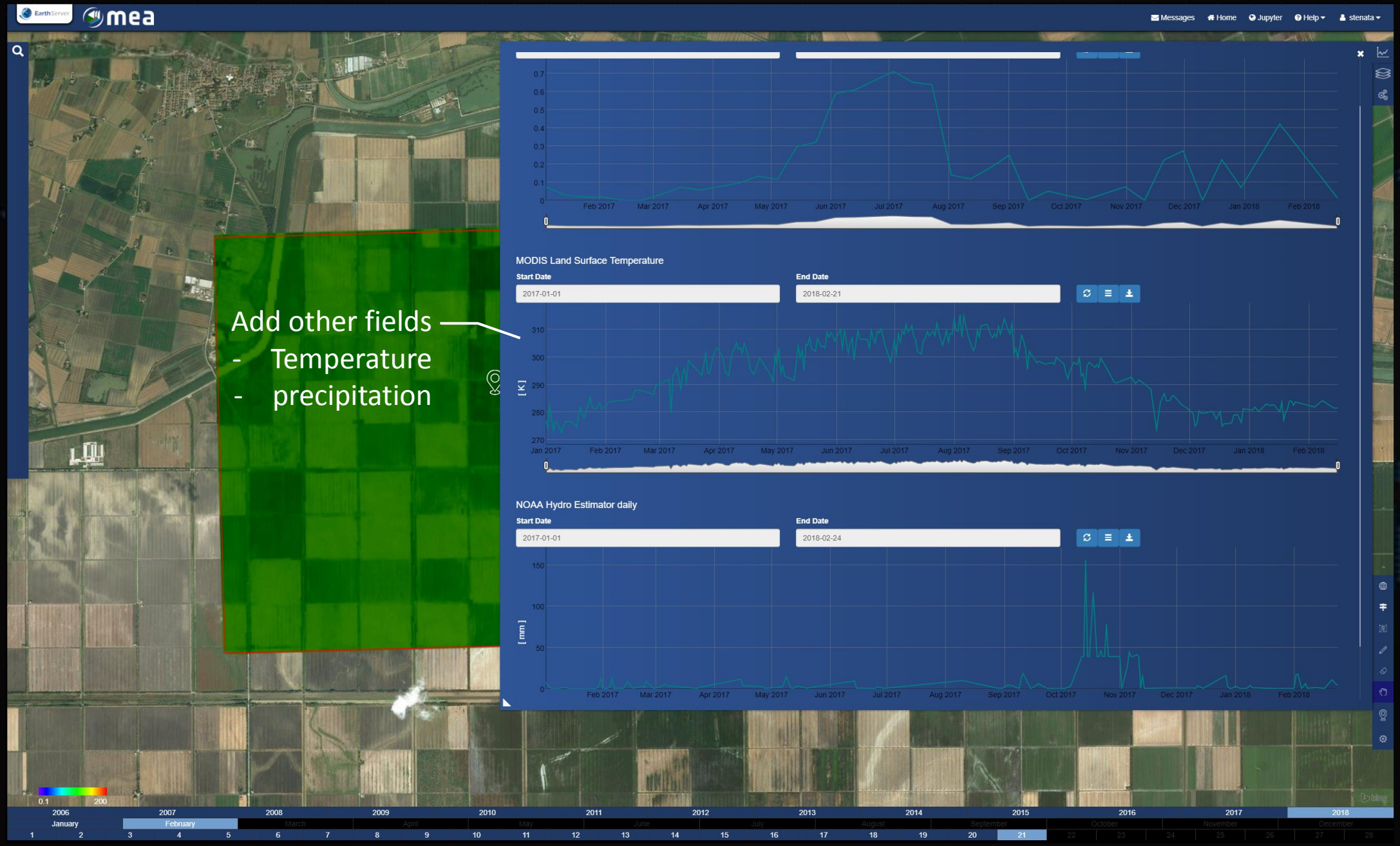
WEB GUI


EarthServer
mea
Messages
Home
Jupyter
Help
stenata
Layers Selection
Sentinel 2A - Vegetation Index - Italy + Austria
2017-11-30
2017-12-20
Selection tools
Selected area of interest
-1
1
2015
2016
2017
2018
January
February
March
April
May
June
July
August
September
October
November
December

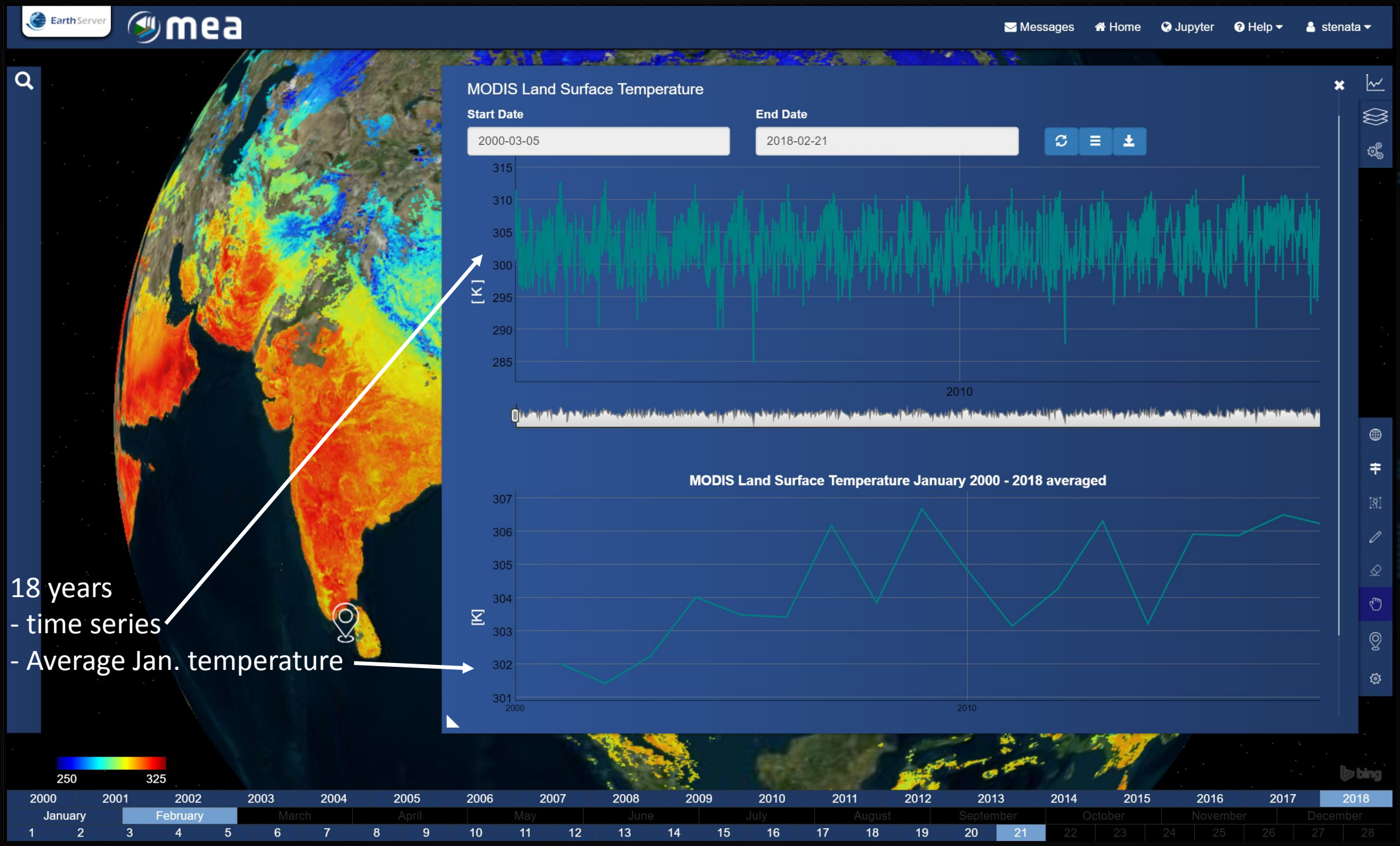
WEB GUI


EarthServer
mea
Messages
Home
Jupyter
Help
stenata
Time series
Sentinel 2A - Vegetation Index - Italy + Austria
Start Date
End Date
2017-01-01
2018-02-24
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Apr 2017
Jul 2017
Oct 2017
Jan 2018
Select a point
-1
1
2015
2016
2017
2018
January
February
March
April
May
June
July
August
September
October
November
December

WEB GUI

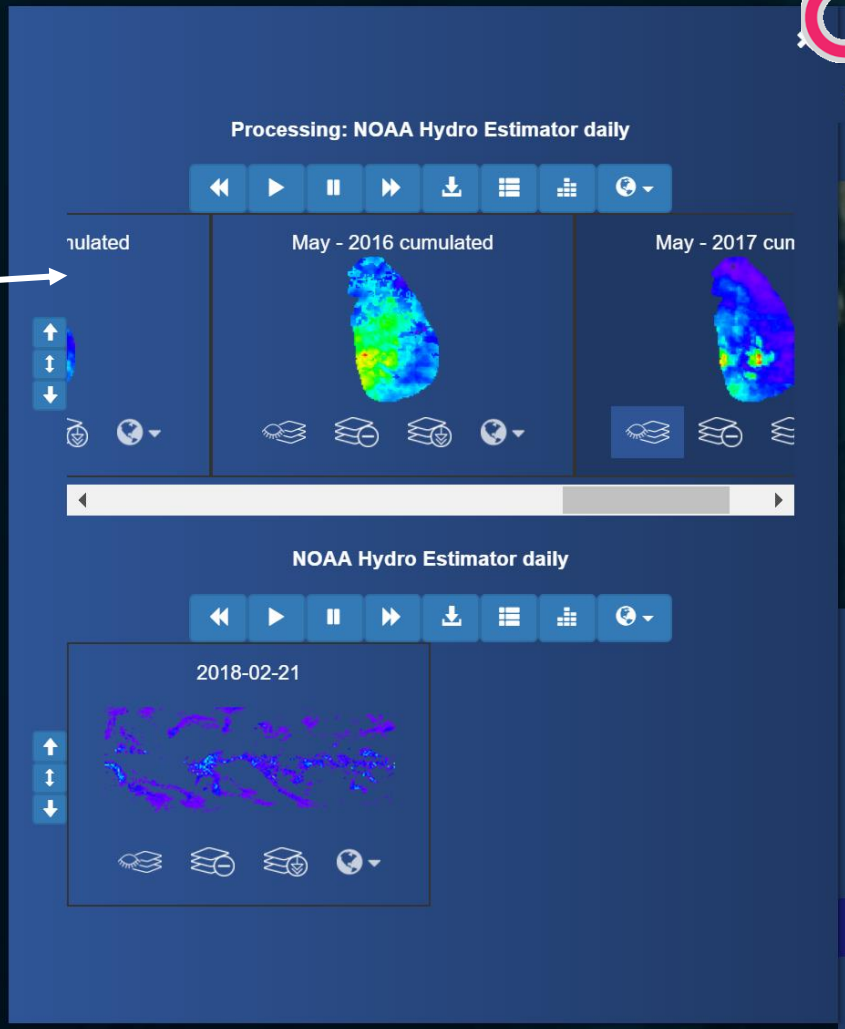

Messages
Home
Jupyter
Help
stenata
MODIS Land Surface Temperature
Start Date
2017-01-01
End Date
2018-02-21
[K]
NOAA Hydro Estimator daily
Start Date
2017-01-01
End Date
2018-02-24
[mm]
Add other fields
- Temperature
- precipitation

WEB GUI


EarthServer
mea
Messages
Home
Jupyter
Help
stenata
MODIS Land Surface Temperature
Start Date
2000-03-05
End Date
2018-02-21
315
310
305
300
295
290
285
[K]
2010
MODIS Land Surface Temperature January 2000 - 2018 averaged
307
306
305
304
303
302
301
[K]
2000
2010
18 years
- time series
- Average Jan. temperature
250
325
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
January February March April May June July August September October November December
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

WEB GUI

Accumulated precipitation over Sri lanka during the month of May from 2010 to 2017



0.1 200

2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

January February March April May June July August September October November December

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

DIRECT OGC INTERFACES: DISCOVERY

http://<endpoint>/opensearch?

&service=CSW

&version=2.0.2

&request=GetRecords

&elementsetname=full

&typenames=csw:Record

&resulttype=results

&q=<ID>

&bbox=<*UL,LR*>

&time=<t_1,t_2>

OpenSearch

OGC-standardised catalogue service

DIRECT OGC INTERFACES: ACCESS

http://<*endpoint*>/wcs2?

service=WCS&Request=**GetCapabilities**

&version=2.0.0

WCS

List of available datasets with some basic information

http://<*endpoint*>/wcs2?

service=WCS&Request=**DescribeCoverage**

&version=2.0.0

&CoverageID=<*ID*>

WCS

Detailed information for a specific collection (dimensions and ranges, supported output data formats, …)

http://<*endpoint*>/wcs2?
service=WCS&Request=**GetCoverage**
&version=2.0.0
&CoverageID=<*ID*>
&SubsetX=x(x_1, x_2)
&SubsetY=y(y_1,x_2)
&SubsetT=t(t_1, t_2)
&format=<#####>
&colortable=<ID>
&scale=<nn>
&size=<output raster size>

WCS

Data (raster, xml)

DIRECT OGC INTERFACES

GETCAPABILITIES OPERATION
HTTPS://EODATASERVICE.ORG/TEST/WCS?SERVICE=WCS&REQUEST=GETCAPABILITIES&VERSION=2.0.0

DESCRIBECOVERAGE OPERATION
HTTPS://EODATASERVICE.ORG/TEST/WCS?SERVICE=WCS&REQUEST=DESCRIBECOVERAGE&VERSION=2.0.0&COVERAGEID=MOD11C1_LSTDAY_4326_005

GETCOVERAGE: TIME SERIES OF LST OVER TOKYO FROM 2017-01-01 00:00:00 TO 2017-12-06T00:00:00 IN XML FORMAT (TIMES PROVIDED IN UNIX TIME
HTTPS://EODATASERVICE.ORG/TEST/WCS?SERVICE=WCS&REQUEST=GETCOVERAGE&VERSION=2.0.0&COVERAGEID=MOD11C1_LSTDAY_4326_005&FORMAT=APPLICATION/XML&SUBSET=LONG(139.5104,139.5104)&SUBSET=LAT(35.6900,35.6900)&SUBSET=T(1483228800,201512518400)

GETCOVERAGE: SAME AS ABOVE, BUT TIMES PROVIDED IN ANSI FORMAT
HTTPS://EODATASERVICE.ORG/TEST/WCS?SERVICE=WCS&REQUEST=GETCOVERAGE&VERSION=2.0.0&COVERAGEID=MOD11C1_LSTDAY_4326_005&FORMAT=APPLICATION/XML&SUBSET=LONG(139.5104,139.5104)&SUBSET=LAT(35.6900,35.6900)&SUBSET=UNIX(2017-01-01T00:00:00,2017-12-06T00:00:00)

DIRECT OGC INTERFACES

GETCOVERAGE: GLOBAL SEA SURFACE SALINITY IMAGE FOR THE DAY 2017-06-01 IN PNG FORMAT, COLORED FULL SIZE
HTTPS://EODATASERVICE.ORG/TEST/WCS?SERVICE=WCS&REQUEST=GETCOVERAGE&VERSION=2.0.0&COVERAGEID=OCEANSALINITY_4326_01&SUBSET=T(1496275200,%201496361599)&FORMAT=%20IMAGE/PNG&COLORTABLE=NCV_RAINBOW2

GETCOVERAGE: SAME AS ABOVE BUT SCALED (SMALL 300PX THUMBNAIL)
HTTPS://EODATASERVICE.ORG/TEST/WCS?SERVICE=WCS&REQUEST=GETCOVERAGE&VERSION=2.0.0&COVERAGEID=OCEANSALINITY_4326_01&SUBSET=T(1496275200,%201496361599)&FORMAT=%20IMAGE/PNG&COLORTABLE=NCV_RAINBOW2&SIZE=300

GETCOVERAGE: LANDSAT NDVI SUBSET FOR THE DAY 2017-12-04 09:58:54 IN GEOTIFF FORMAT
HTTPS://EODATASERVICE.ORG/TEST/WCS?SERVICE=WCS&REQUEST=GETCOVERAGE&VERSION=2.0.0&COVERAGEID=LC8_NDVI_32632_30&SUBSET=N(4900000,4910000)&SUBSET=E(600000,610000)&SUBSET=T(1512381534,1512381534)&FORMAT=IMAGE/TIFF

GETCOVERAGE: SENTINEL 2A WITH ANSI TIME AND SCALE FACTOR=0.1 – FULL IMAGE
HTTP://185.52.194.236/WCS?SERVICE=WCS&REQUEST=GETCOVERAGE&VERSION=2.0.0&SUBSET=UNIX(2018-01-29T00:00:00,2018-01-29T23:00:00)&MGRS_TILE=T30TVK&FORMAT=IMAGE/PNG&SCALE=0.1&COVERAGEID=S2A_MSIL1C_VRGB

EODATASERVICE

https://eodataservice.org

*eodataservice is a **interdisciplinary / cross domain** platform*

climate health

land cover

pollution

ocean

High Resolution optical satellite data

Sentinel-2

Landsat

Land Products

Vegetation Indexes (from 10m, NRT)

Land Surface Temperature (NRT)

Soil Moisture (1978, present)

Land Cover type (MODIS)

Atmospheric products

Airt Temperature (NRT)

Precipitation (NOAA Hydro Estimator) NRT

Aerosol Optical Thickness @ 1Deg NRT, 10Km, 1Km

Ocean products

Sea Surface Salinity NRT

Chlorophyll data

Sea Surface Height

Sea Surface Velocity

...

Discovery

Exploration

Visualization

Processing

agriculture

weather

esa

European Commission

NASA

APPLICATIONS

DATA ACCESS / DISTRIBUTION (EODATASERVICE, EODATACUBE, INSARITALY)

EARTH OBSERVATION F
HEALTH RISK IN AFRICA

ATMOSPHERIC SCIENCE

MARINE SCIENCE VRE

ILLEGAL IRRIGATION

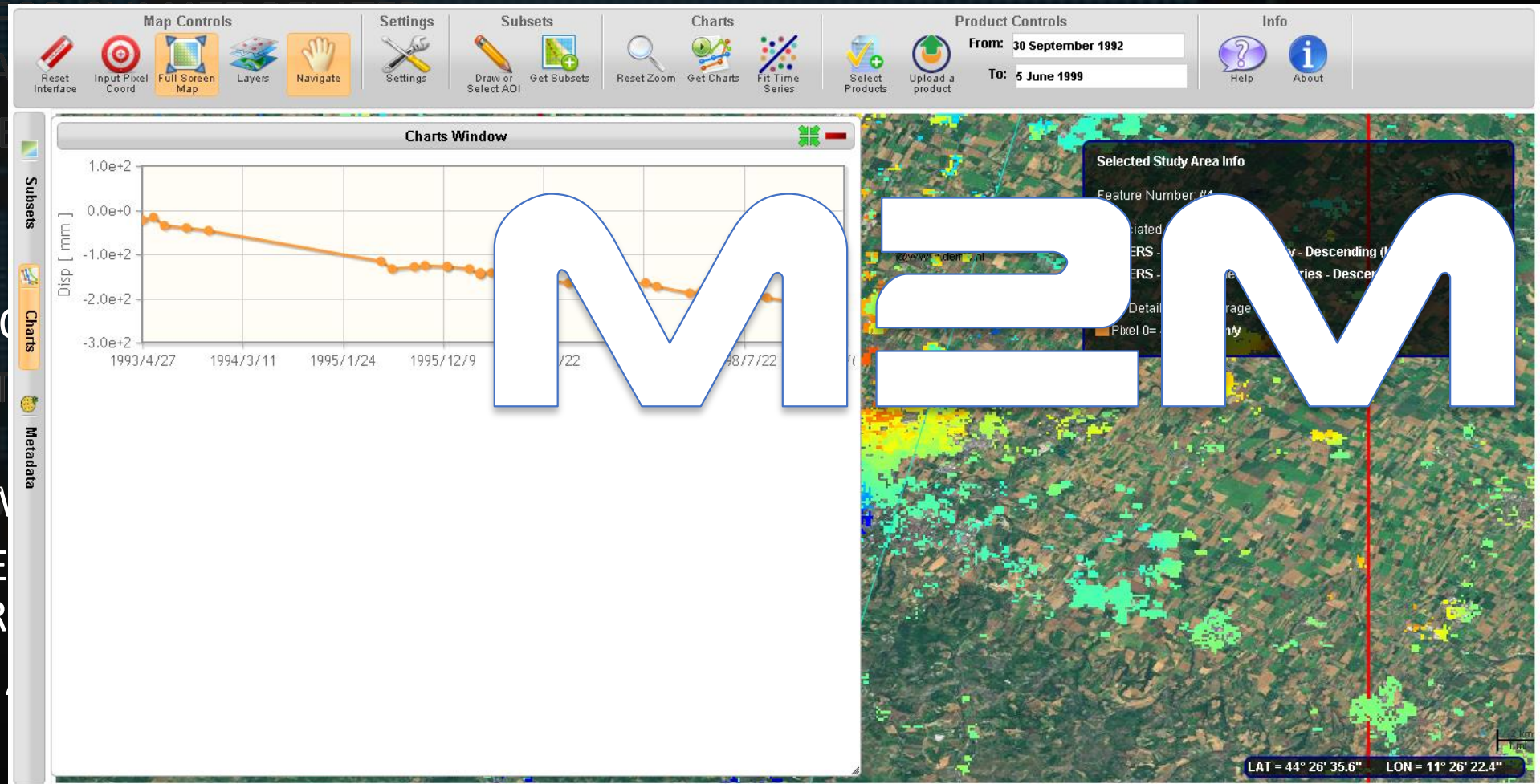
(RE-)INSURANCE SUPPO

URBAN ENVIRONMENT
(URBMOBI)

RENEWABLE ENERGY (W

SUPPORT HERITAGE RE
CLIMATE EVENTS (HER

MACHINE LEARNING / A



ADVANTAGES

Optimised data collection and preparation

save work time

Reduced storage and computation investments

Save $

Human / artificial intelligence

Multiplication of Value added (more time, more heads)

Improved quality and reliability **with less / same investment**

CONCLUSIONS

OUR “INDUSTRY” VIEW IS RATHER SIMPLE: WE WANT TO FACILITATE THE ACCESS TO GEOSPATIAL ENVIRONMENTAL DATA (MAINLY EO DATA) REMOVING DATA ACCESS BARRIERS

→ TRIGGER INFORMATION EXTRACTION (BASED ON SMART DATA ACCESS)
→ MAKE GEOSPATIAL DATA AS A COMMODITY
→ IMPLEMENT A **NEW TECHNOLOGY TRANSFER MODEL**

FROM DATA AVAILABILITY TO DATA USABILITY!

WE ARE OPEN FOR COOPERATIONS

CONTACTUS@EODATASERVICE.ORG
NATALI@MEEO.IT

Viale Volano, 195/A Int. 2
I-44123 Ferrara, Italy
Tel.: +39 0532 1861501
Fax: +39 0532 1861637
info@meeo.it
http://www.meeo.it

Tiefer Graben 19/2
A-1010 Wien, Austria
Tel: +43 (0)1 8908 788
Fax: +43 (0)1 2533033 7427
info@sistema.at
http://www.sistema.at

APPLICATION EXAMPLES

- INFRASTRUCTURES MONITORING
- CLIMATE CHANGE MONITORING (SUPPORT TO MITIGATION / ADAPTATION ACTIVITIES)
- AGRICULTURAL FIELDS MONITORING

INFRASTRUCTURES MONITORING

NEW ISTANBUL AIRPORT BUILDING WORKS

01/2016
04/2016
05/2016
07/2016
08/2016
10/2016
11/2016
01/2017
03/2017
04/2017
05/2017
06/2017
07/2017
08/2017
09/2017
10/2017
11/2017
12/2017
01/2018

CLIMATE CHANGE MONITORING AND ADAPTATION

EARTH OBSERVATION FOR CLIMATE-RELATED HEALTH RISK IN AFRICA (EOCHA)

Scope: to provide an effective web based platform to **collect meteorological and climate parameters** from heterogeneous data sources (satellite, in-situ, model) to support **geostatistical study of the relationship between climatic conditions and the diffusion of disease vectors** (e.g. Anophele mosquitoes)

Key factor: Users, scientists, and data experts together to build the tool

EOCHA PROJECT

Area of interest:

Eastern Sub-Saharan Africa (Kenia, Etiopia, Uganda, Tanzania, Somalia)

→**Restricted to Kenia, Tanzania, Somalia for higher data availability**

Diseases of interest:

Malaria, RFV, Chikungunya, Meningitis

→ **Restricted to malaria** for epidemiological data availability (Plasmodium falciparum – pf - parasite rate in population)

EOCHA PROJECT

Climate indicators from Temperature

Product	Description	Type
Current temperature	Either individual stations and/or krigged interpolated surfaces	Map
Temperature anomalies	Departure from climatology for decadal and monthly time periods. Allowing a user to click a ROI and obtain a graph showing values would be very useful	Map & Graph
Optimal vector thresholds	Maps highlighting those areas where the temperature is between 22 and 30 °C for current and past decades/months	Map
Optimal malaria thresholds	Maps highlighting those areas where the temperature is between 27 and 30 °C for current and past decades/months	Map

- Different resolutions
- Avalaible from MEA data portal at given resolution or regionalized
- **Climate indicators computed** for all selected variables

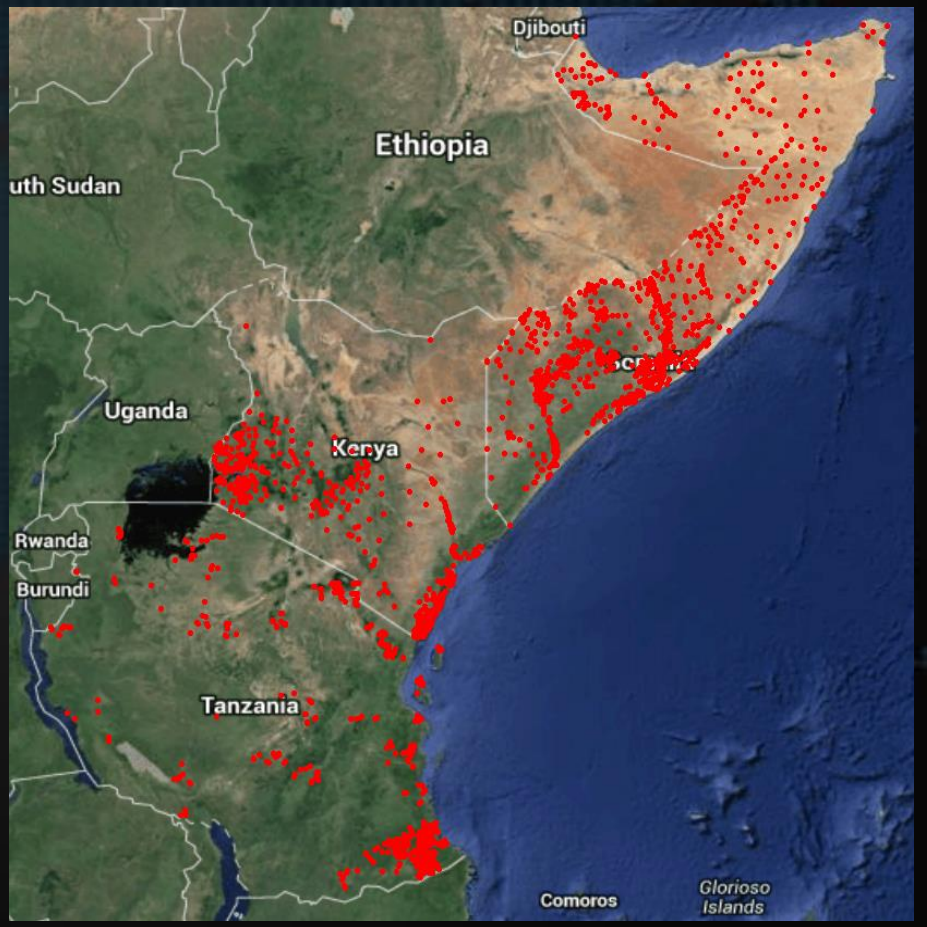
EOCHA PROJECT

- **Collected / used socio-economic datasets**

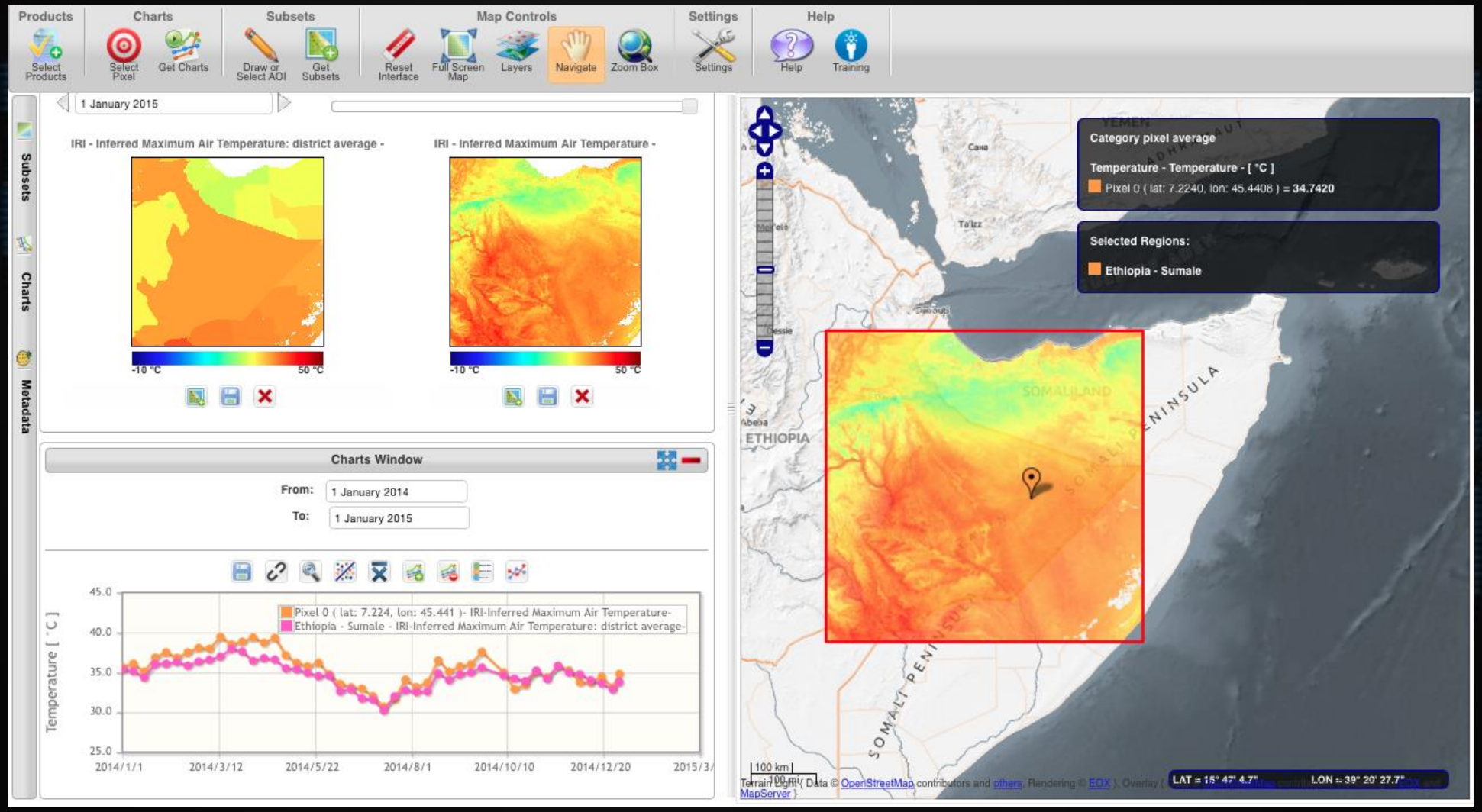
	Kenia	Tanzania	Somalia
Time period			
2000-2005	211	364	214
2006-2011	766	412	1275
Upper age sampled			
<=5	55	398	0
6-10	43	0	0
11-15	475	329	0
16-20	404	49	0
>20	0*	0~	1489§
Sample size			
20-50	232	437	843
51-100	275	164	516
101-500	464	169	122
>500	6	6	8
Total records	977	776	1489

* Max upper age for Kenia is 19
~ Max upper age for Tanzania is 19
§ Min upper age for Somalia is 30, max is 99, median=99, mean=88.91

Available locations under selection criteria

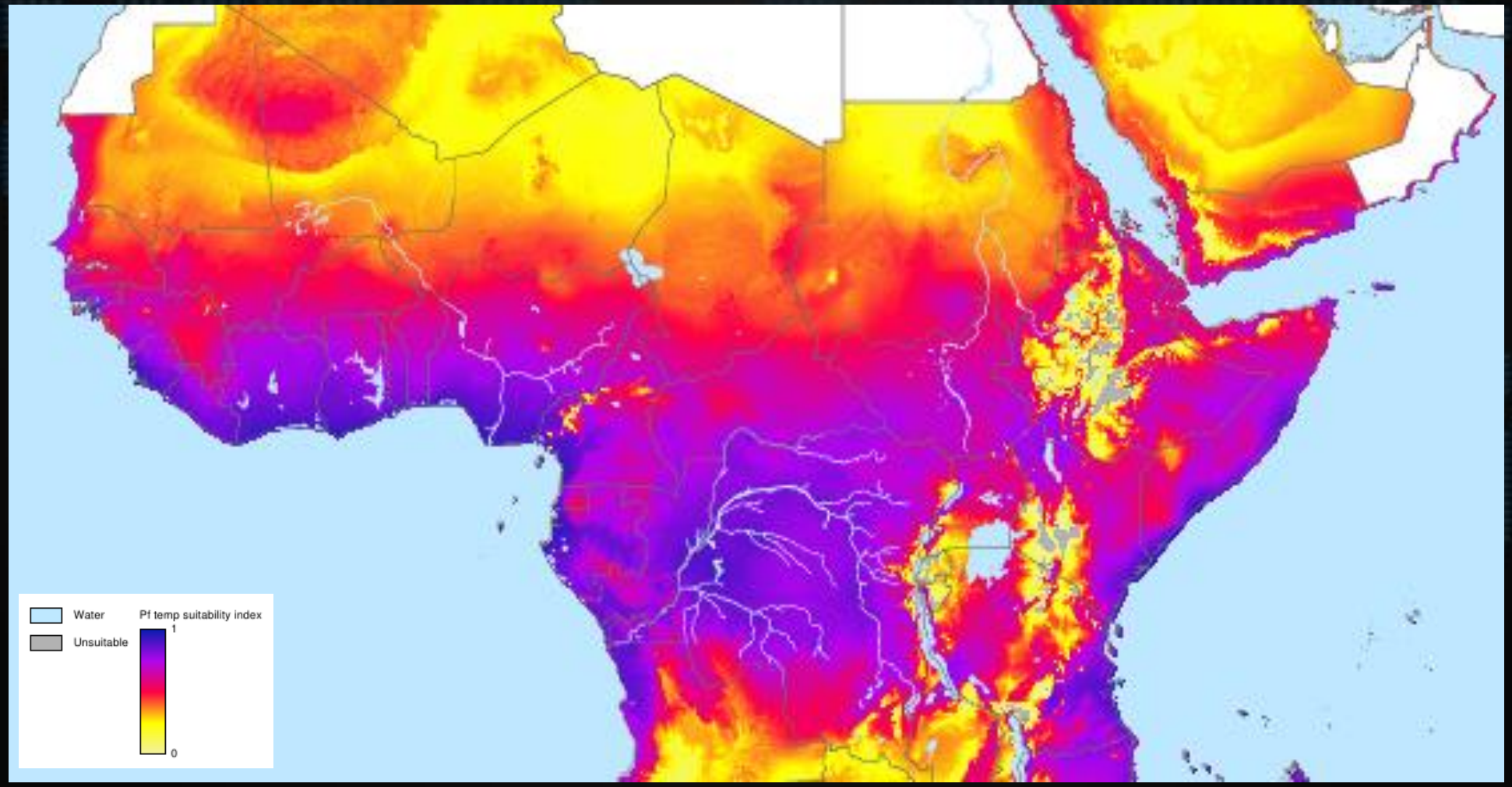


EOCHA PROJECT

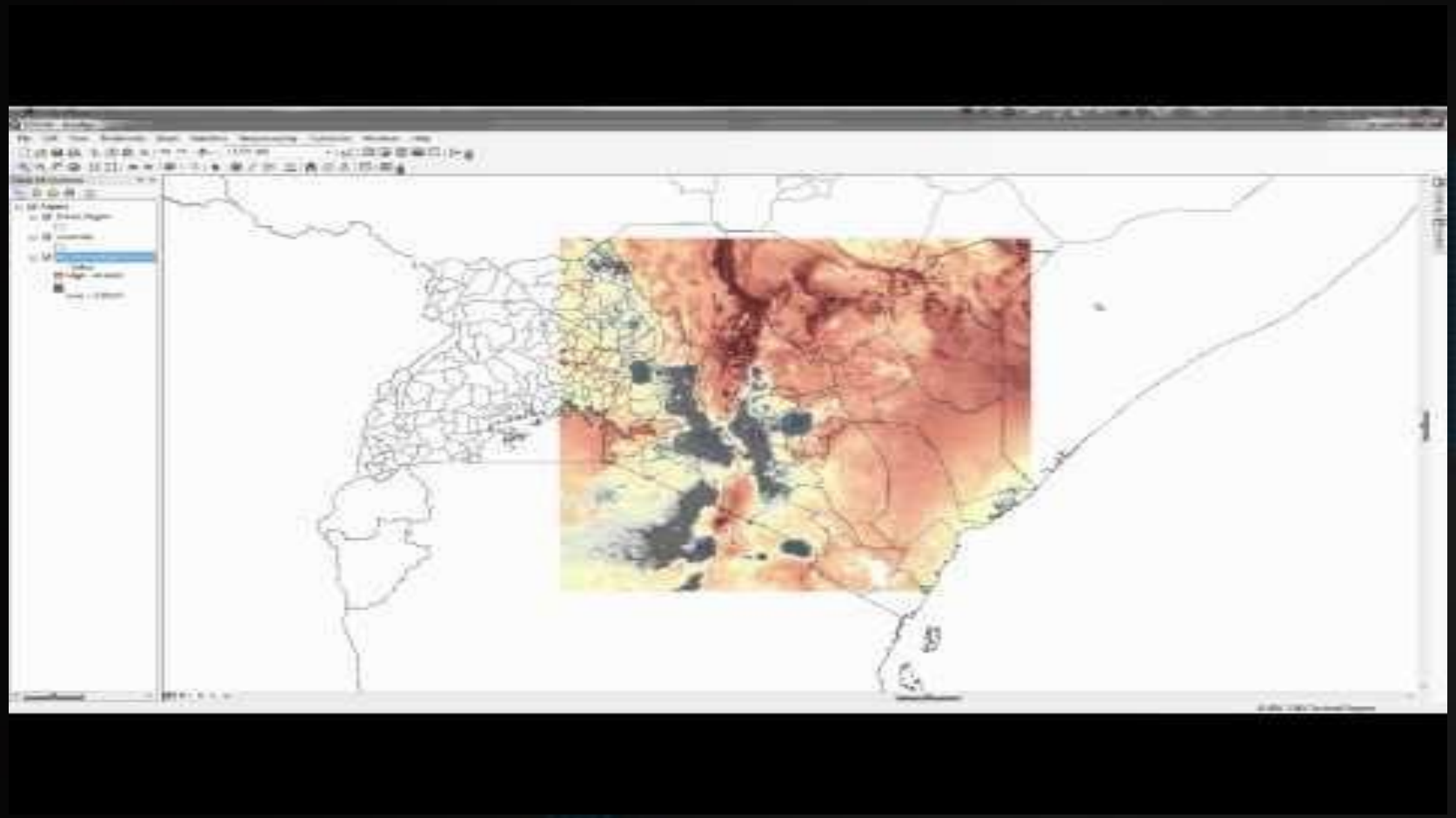


EOCHA PROJECT

pf temperature sustainability index map



EOCHA PROJECT



"…so I totally endorse this system and I think that **once people** in the medical community those you do research as well in to the effect of the climate and climate change on disease **are aware of this system that it will become a one stop shop for those people who need that data for their existing models and to develop new models in the future.**"

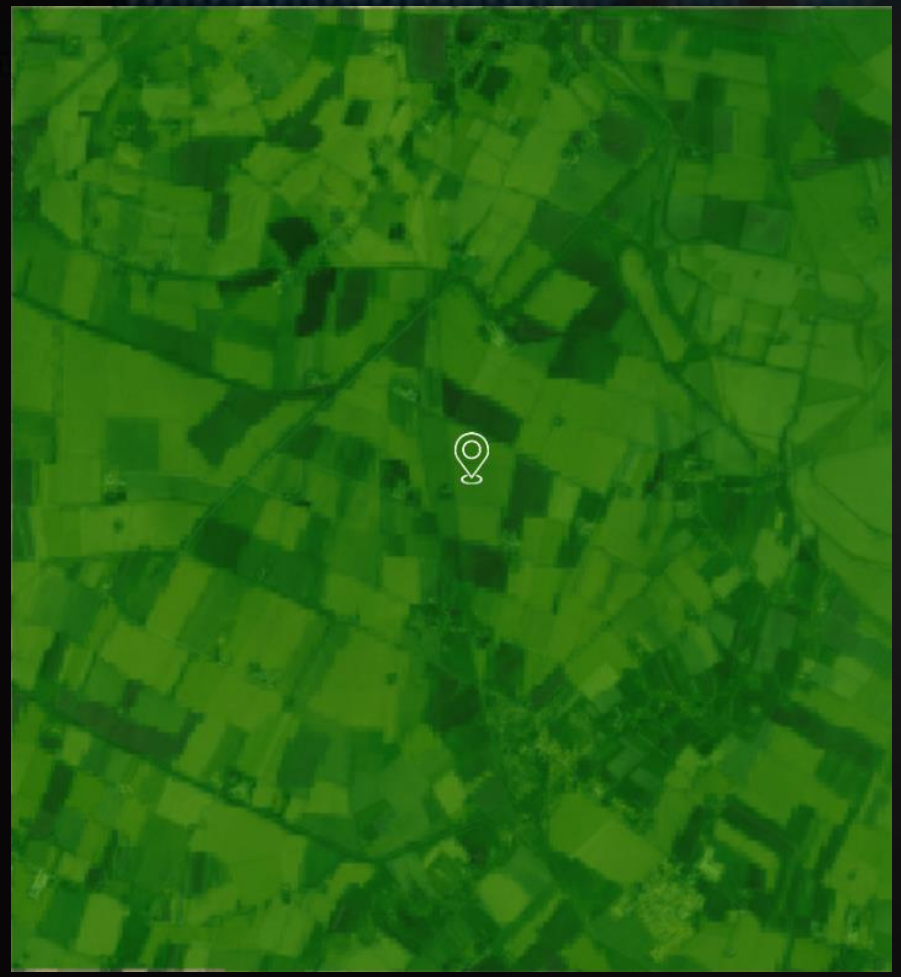
Mark Cresswell, Manchester University, UK

AGRICULTURE APPLICATIONS

SINGLE FIELD MONITORING

SATELLITE-BASED DAYTIME LAND SURFACE TEMPERATURE AND AIR TEMPERATURE (JAN-FEB 2012)

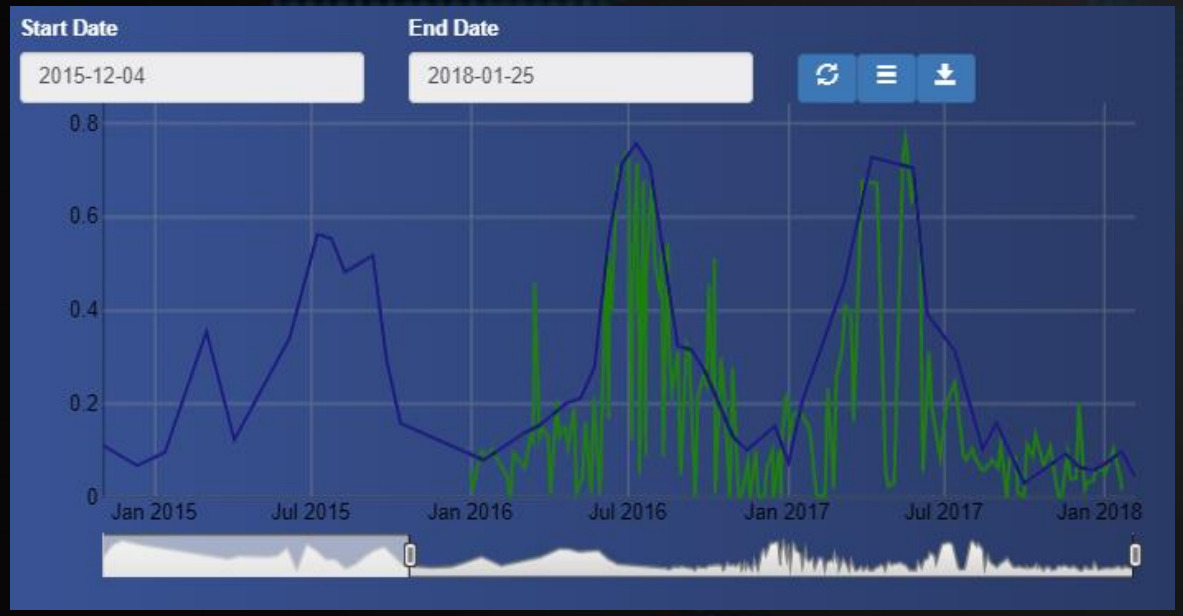
- 1 FIELD IN NORTHERN ITALY (BLUE: AIR TEMPERATURE, GREEN: LAND SURFACE TEMPERATURE)



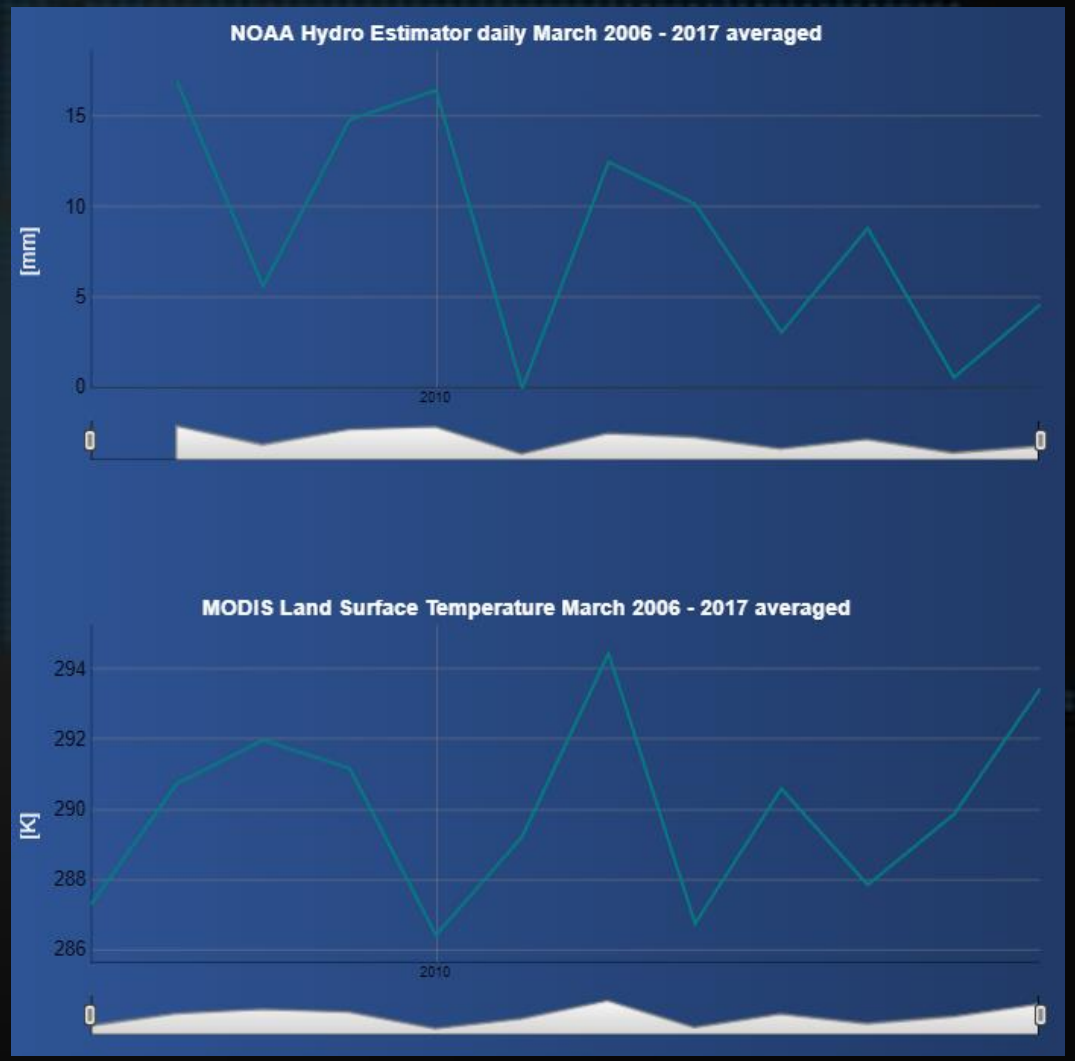
SINGLE FIELD MONITORING

VEGETATION INDEX TIME EVOLUTION

2 SATELLITES COMBINED



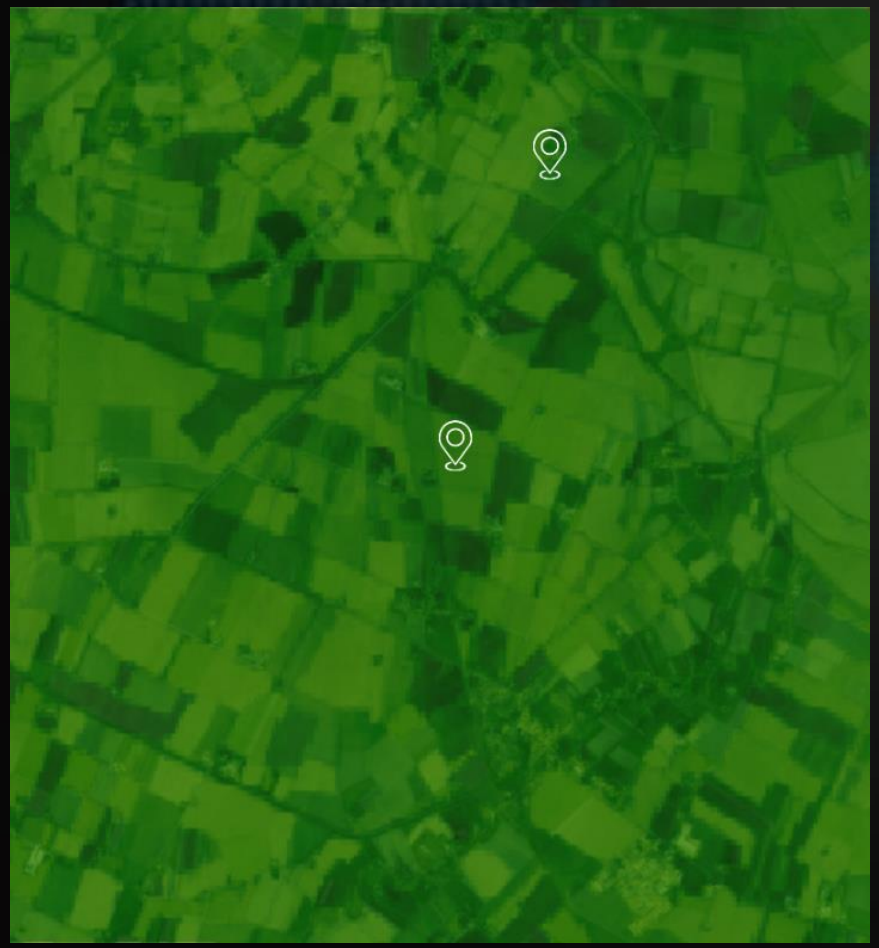
METEO-CLIMATE TRENDS



MULTIPLE FIELDS MONITORING

2 FIELDS, NORTHERN ITALY

- DAYTIME LAND SURFACE TEMPERATURE (2010 – 2018)
- VEGETATION INDEX EVOLUTION (2015 – 2018)



METEO-CLIMATE INFORMATION

SATELLITE-BASED DAYTIME LAND SURFACE TEMPERATURE:

DAYS IN WHICH THE AIR TEMPERATURE DROPS BELOW O°C BETWEEN JAN 1 – FEB. 28 2017

NUMBER OF TIMES THE SURFACE TEMPERATURE HAS BEEN BELOW O°C DURING FEBRUARY (FROM 2000 TO 2018)

PERIODS IN WHICH THE AVERAGE SURFACE TEMPERATURE HAS BEEN BELOW O°C FOR AT LEAST 3 CONSECUTIVE DAYS DURING 2010

Processing Output

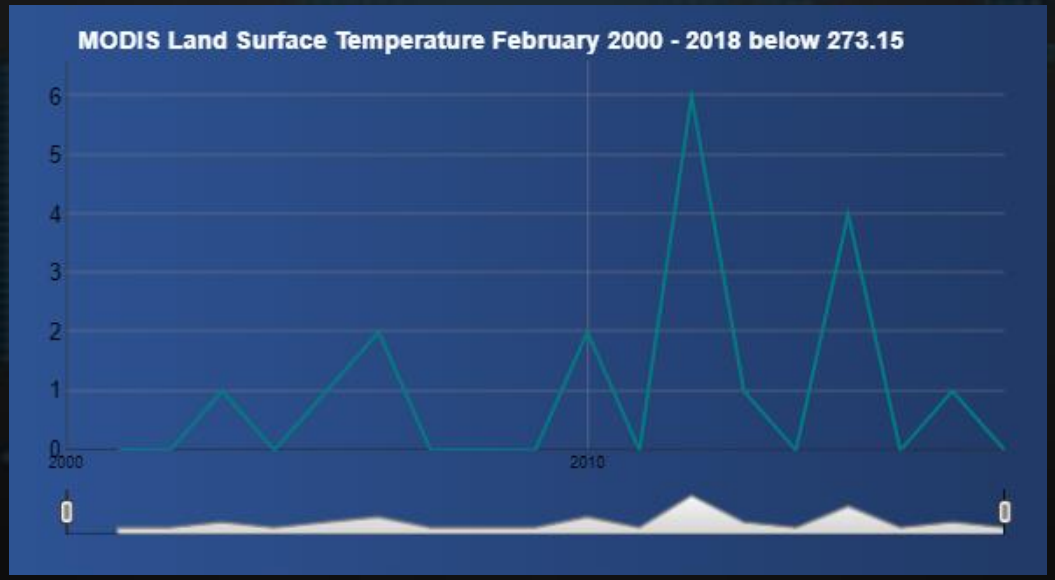
Skin temperature 2017-01-01 - 2017-02-28 below 273.15

Processing Results:

Villanova d'Arda 2: This event has occurred 22 times

Period	Value
2017-01-01	272.430
2017-01-03	272.180
2017-01-	272.710

Close | Export as .csv



Processing Output

MODIS Land Surface Temperature 2010-01-01 - 2010-12-31 averaged below 273.15 window: 5 days

Processing Results:

Villanova d'Arda 2: This event has occurred 16 times

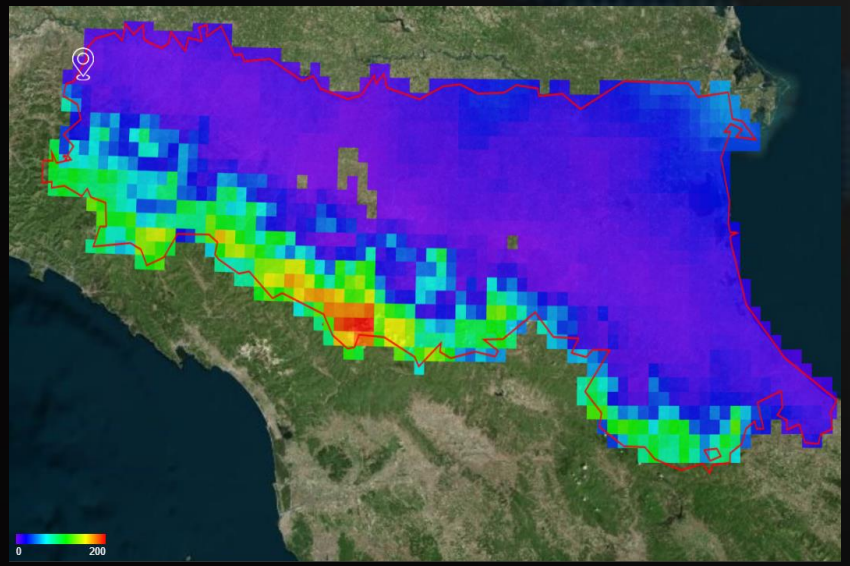
Period	Value
2010-01-03 - 2010-01-07	271.130
2010-01-04 - 2010-01-08	271.130
2010-01-05 - 2010-01-	271.130

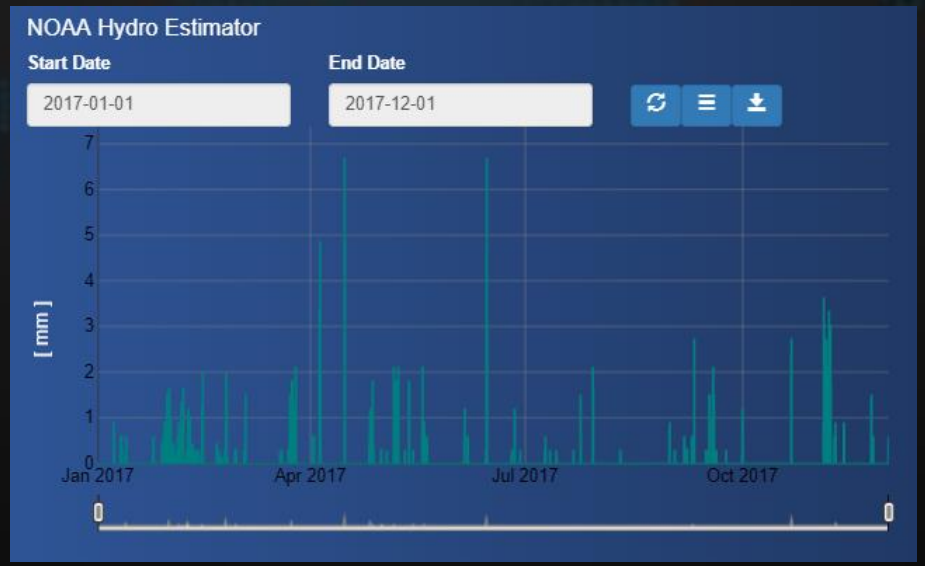
Close | Export as .csv

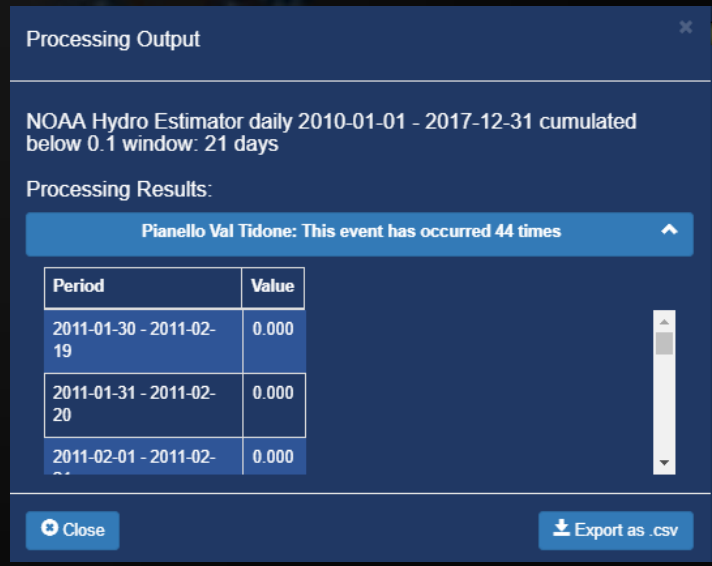
METEO-CLIMATE INFORMATION

SATELLITE-BASED HOURLY PRECIPITATION:

- ACCUMULATED PRECIPITATION IN THE EMILIA ROMAGNA REGION FOR SUMMER 2017
- TIME SERIES (2017) OVER PIANELLO VAL TIDONE (PIACENZA, ITALY) WITH THE POSSIBILITY TO IDENTIFY HEAVY RAIN EVENTS (HOURLY DATA)
- IDENTIFICATION OF PERIODS IN WHICH, FOR 21 CONSECUTIVE DAYS, THERE HAS BEEN NO PRECIPITATION (DAILY DATA, 2010 - 2017)







TION DETECTION

TI ON, SOIL MOISTURE

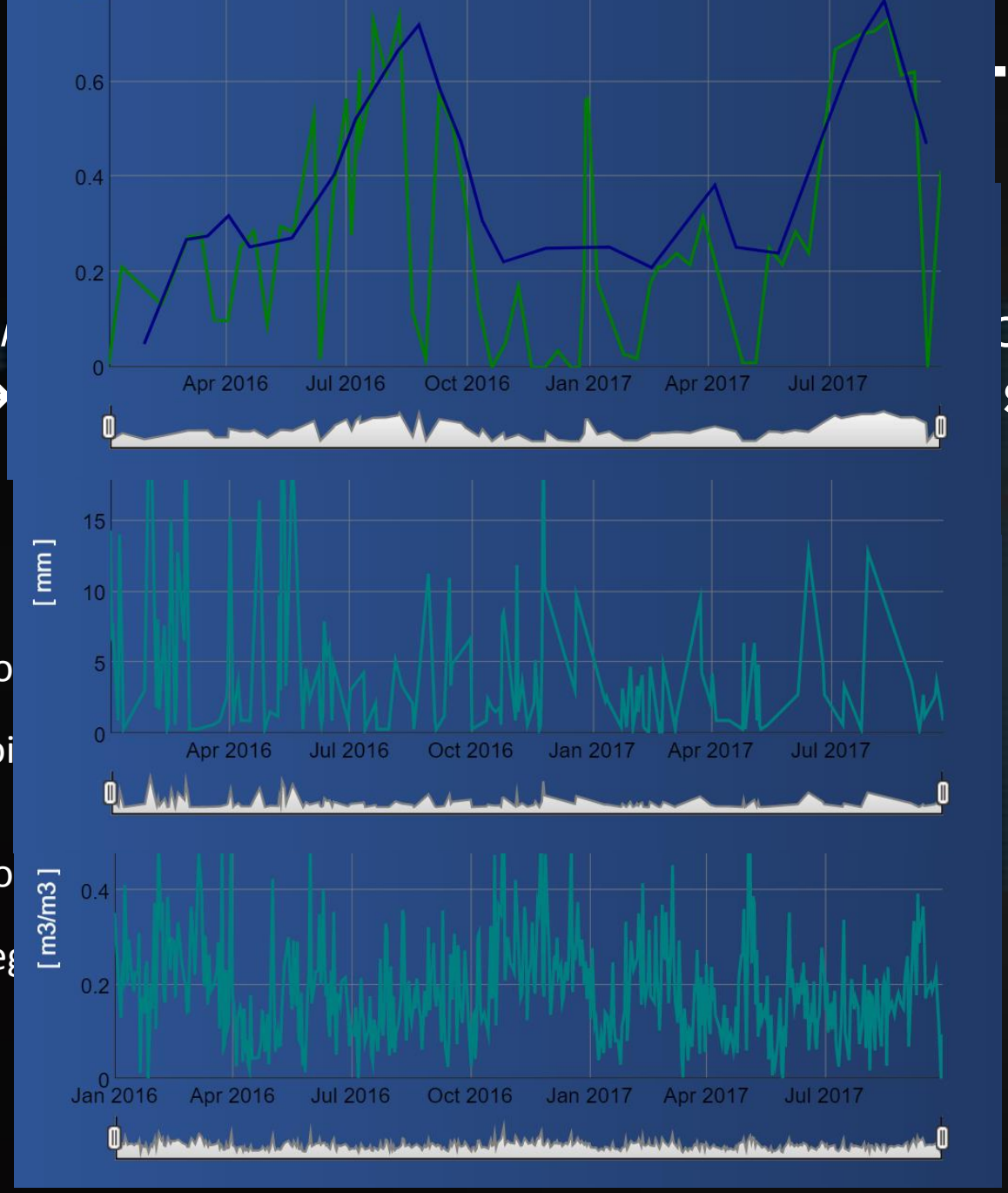
→ s

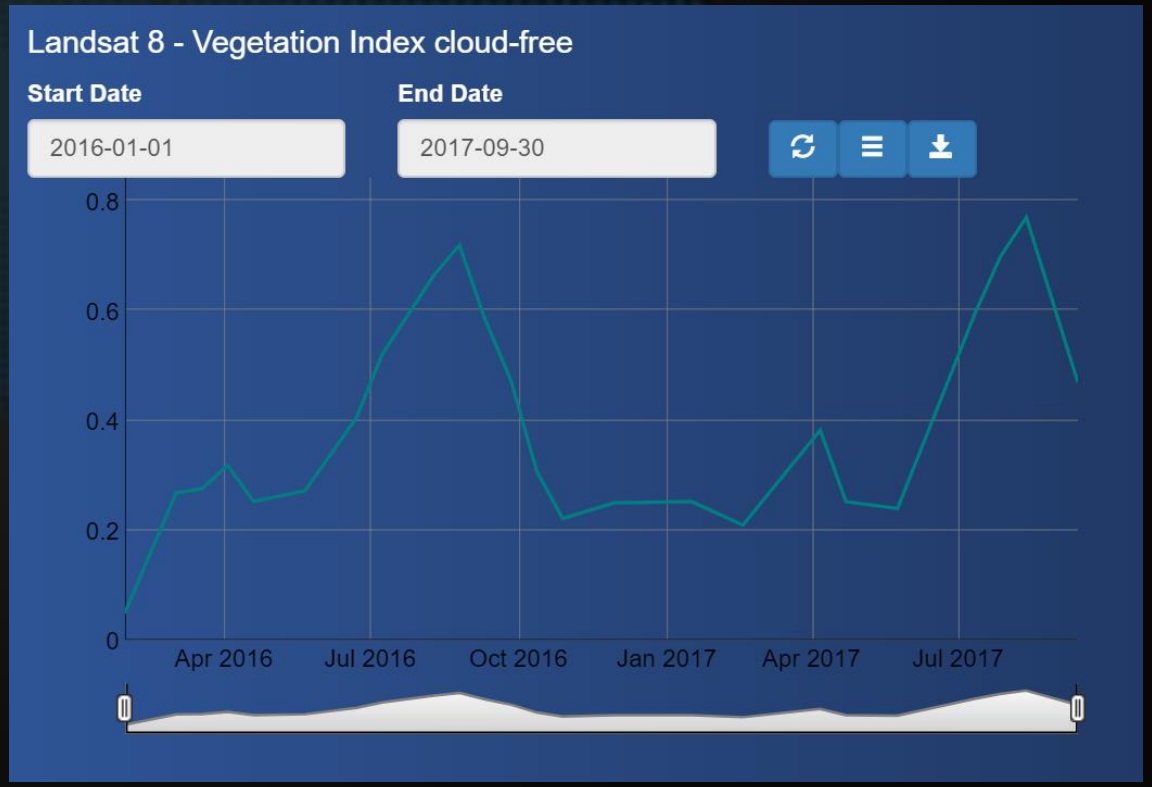
No

Soi

No

Veg





TIM

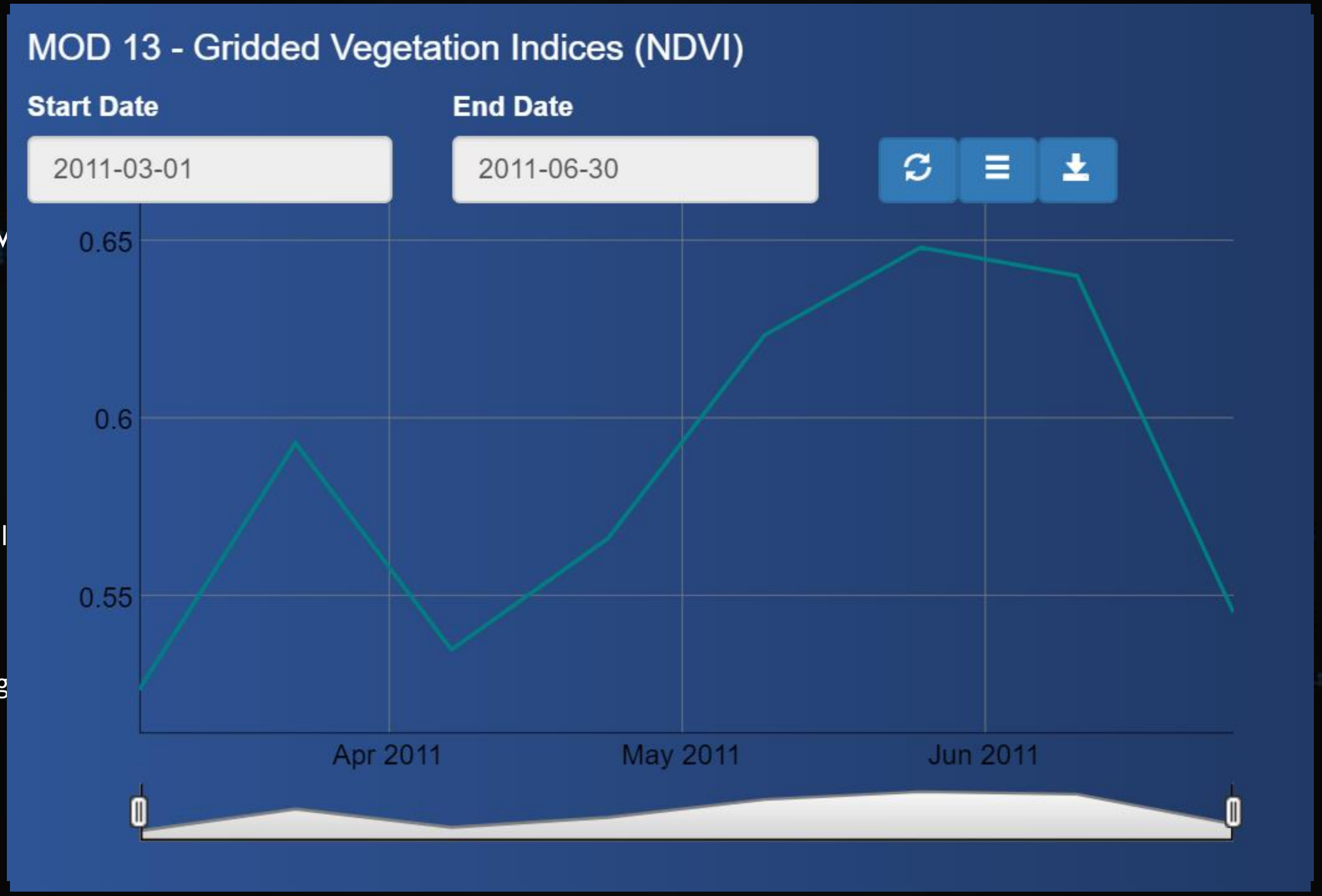
→

No

Soil

No

Veg



BACKUP

SCREENING OF CLOUDINESS IMAGES

Time gaps

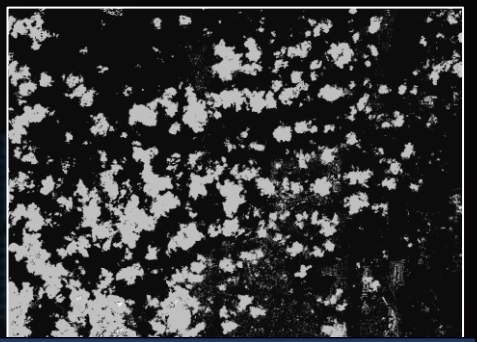
- February to March 2016
- June 2016
- September 2016
- December 2016
- February 2017

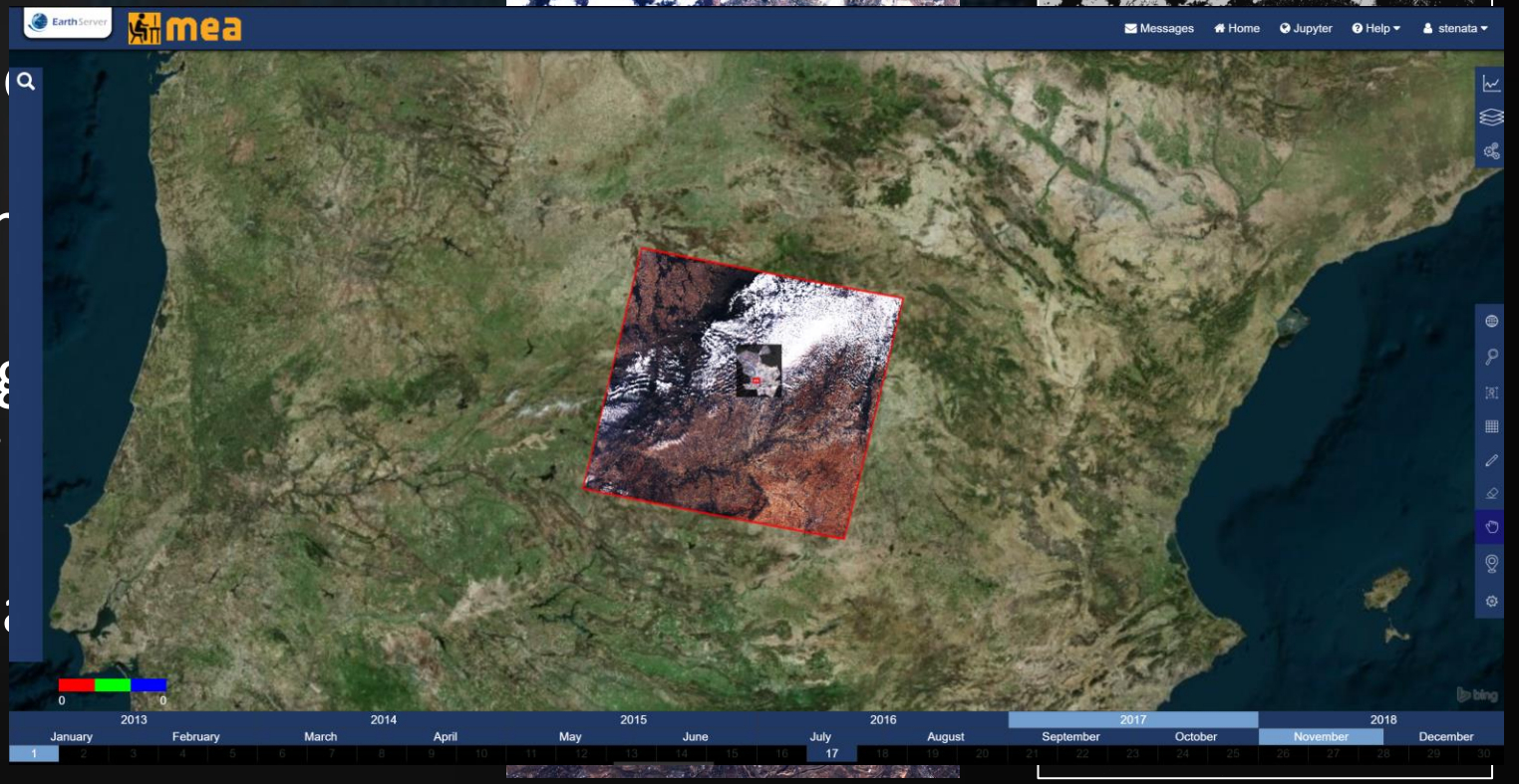
Precipitation time series

AUTOMATIC PROCESSING

Automatic e.g. change detection

- AOI selection (subsetting on the fly)
- Cloud masking application for
- Change detection computation
- Post processing operations (e.g
  visualization, download, warni
- Looping once new images are





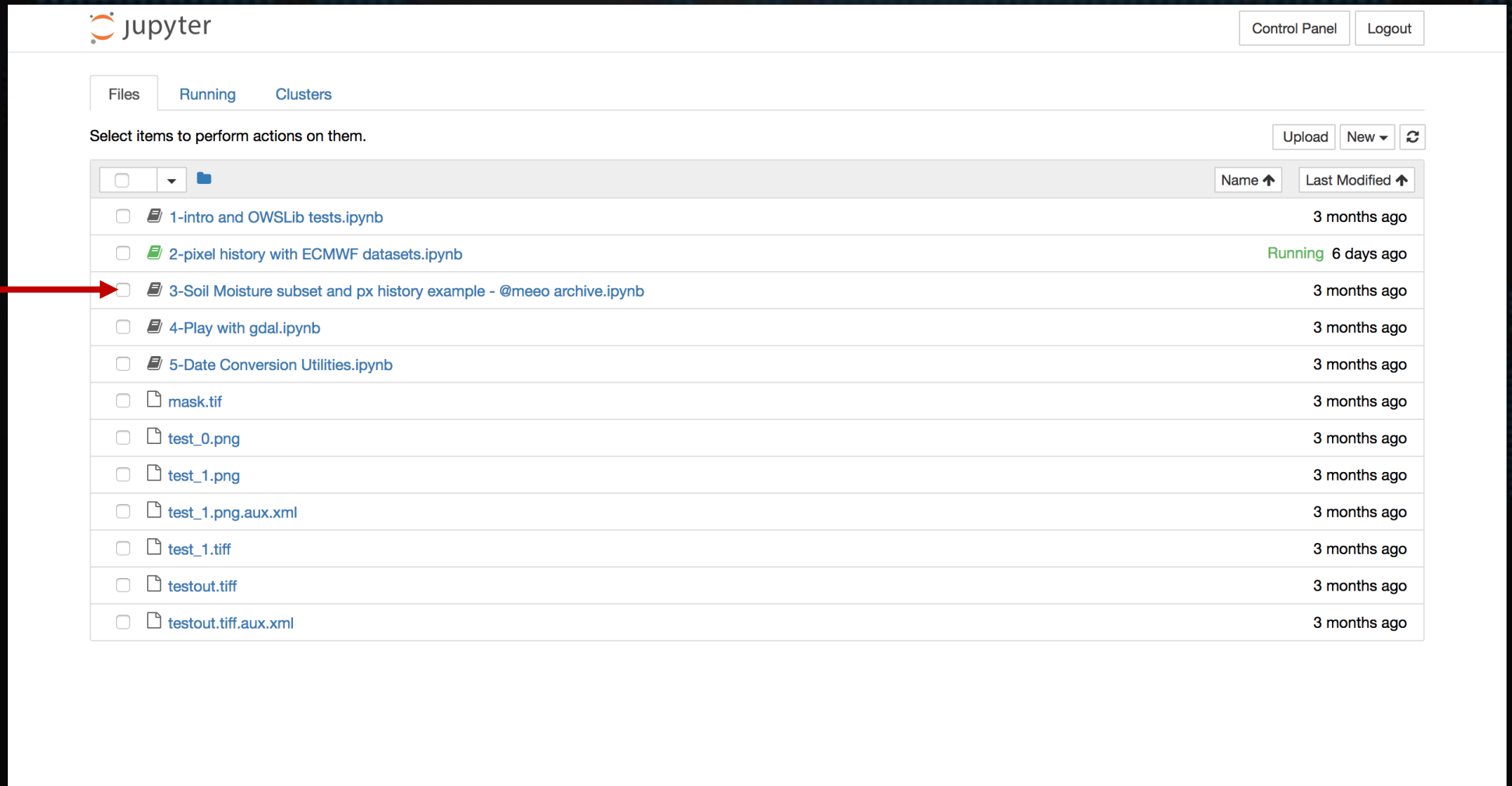
JUPYTER NOTEBOOK

JUPYTER NOTEBOOK

- INTERACTIVE DATA SCIENCE AND SCIENTIFIC ENVIRONMENT
- SUPPORT SEVERAL PROGRAMMING LANGUAGES (E.G. PYTHON, R, …)
- SCALABLE (I.E. THE PROCESSING CAPACITY OF THE RESOURCES MADE AVAILABLE TO A USER CAN BE EXTENDED)

JUPYTER NOTEBOOK

- Provide a set of e-learning examples (e.g. ***data discovery***, ***data access***, ***data processing***, ***data visualization***, …

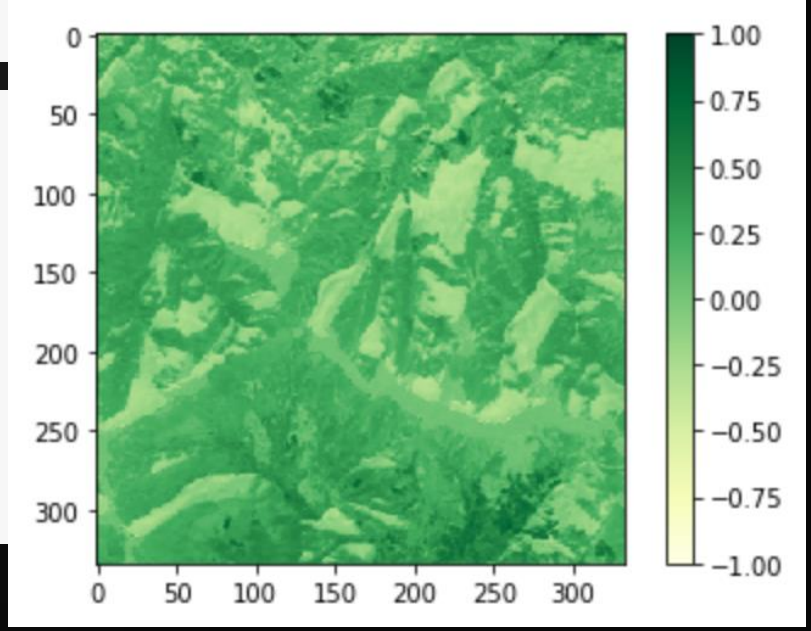


JUPYTER NOTEBOOK

- Data access, subset, download

```
#example using eodataservice endpoint - time expressed in UNIX time and temporal resolution is Second
#init WCS object
from owslib.wcs import WebCoverageService
import time

start = time.time()
my_wcs = WebCoverageService('https://eodataservice.org/dar05?', version='2.0.0')
print ( "time for GetCapabilities: %s s" %( time.time() - start ) )

for coverage_name in my_wcs.contents.keys():
    if coverage_name.startswith( "OceanSalinity" ):
        print ( coverage_name )
```

```
filename = "test_L8NDVI.tiff"

coverage_file = my_wcs.getCoverage(
    identifier=['LC8_NDVI_32632_30'],
    format='image/tiff',
    subsets=[('N',4900000,4910000), ('E',600000,610000),('t',"1512381534","1512381534")]
)

with open( filename, 'wb') as outfile:
    outfile.write(coverage_file.read())
print ("Done!")
```



JUPYTER NOTEBOOK

- Add your running code