# FoReS :: NoR for Sentinel-Hub

Utilization of Sentinel-Hub in purpose of EO satellite data processing – Sentinel-1 SAR, and MAXAR's collection VHR optical

Zlatomir Dimitrov, SRTI-BAS

# Why Sentinel-Hub© (SH) ?

▶ Extensive platform for processing EO satellite imagery data, from different providers

▶ Chosen based on the availability for processing VHR third party optical data (e.g. WorldView)

▶ Also, about the capability for native processing of ESA COPERNICUS – Sentinel-1 SAR data

▶ Extreme ease of use by a bit of coding, with interactive environment

▶ Whole-in-one platform

▶ Provided with a thorough video tutorials, uploaded in YouTube©, by Sinergise© Slovenia

▶ Availability of a customer's scripts portal - a strong base to further develop needed scripts

▶ Saved time and efforts of stand alone desktop processing

▶ Simplified the workflow for VHR optical data processing from WorldView (MAXAR)

▶ Saved time for downloading the whole time series archive data, from Sentinel-1 SAR

▶ Saved serious amount of storage for downloading the GRD archives of Sentinel-1 SAR

▶ Fast processing, without any computational interrupts, by a few bugs experienced

# ESA NoR application for SH access

- Sponsorship request: ID 222594

- Voucher amount requested: 2610 €

- Requested service: EDC Sentinel Hub - DPaaS

- Subscription plan: Basic-Yearly, 2 Subscription(s), 1 year

- Quota WorldView (MAXAR): 28 sqkm

- NoR application approved on: 03.03.2022

- Main project: The application aimed to support part of the activities of the Forest Disturbance Inventory using Remote Sensing (FoReS) project, which was funded by ESA PECS (4000134290/21/NL/CBi) and led by Space Research and Technology Institute – Bulgarian Academy of Sciences (SRTI-BAS)

- NoR application objectives: i) Sentinel-1 SAR data processing for forest disturbance detection and ii) validation of Post-fire regrowth (PFIR) product using VHR data

- Project Coordinator: Petar Dimitrov

- SH implementer: Zlatomir Dimitrov

- PFIR validation: Daniela Avetisyan

# Learning, Video Tutorials studied in YouTube, by Sinergise©

1. https://www.youtube.com/watch?v=eK0OMn5H-kY&t=4s

2. https://www.youtube.com/watch?v=4JviobxqTO8

3. https://www.youtube.com/watch?v=wkFQxzxpLAA

4. https://www.youtube.com/watch?v=kbw3OyYkbA4
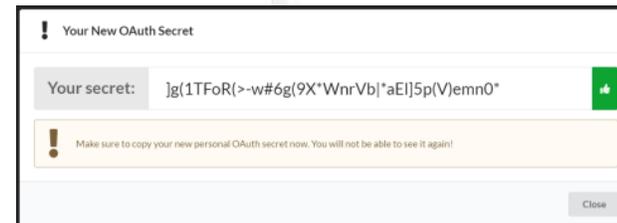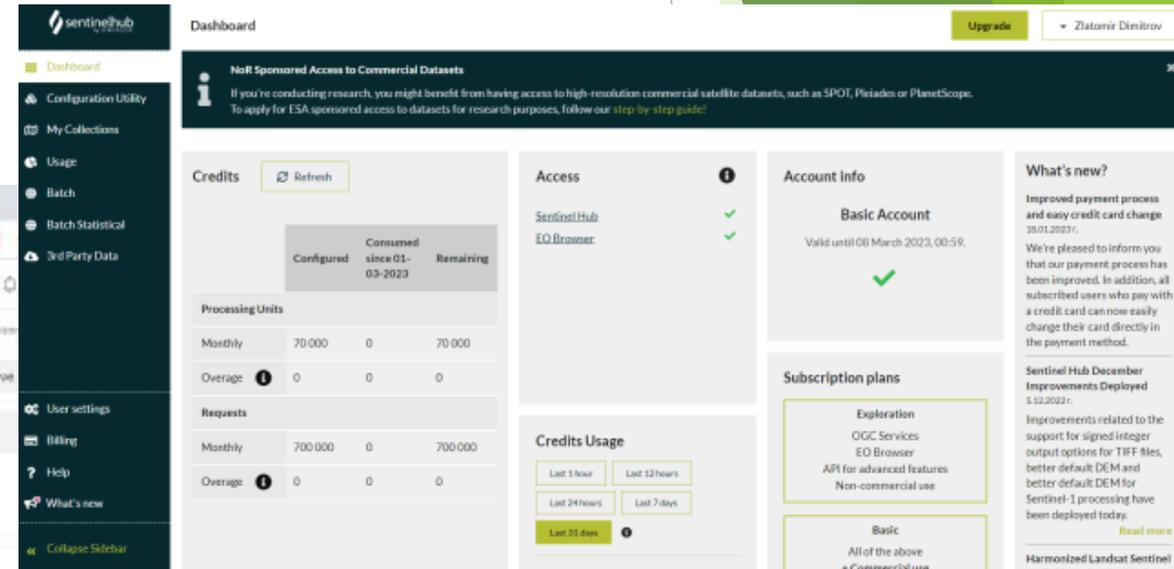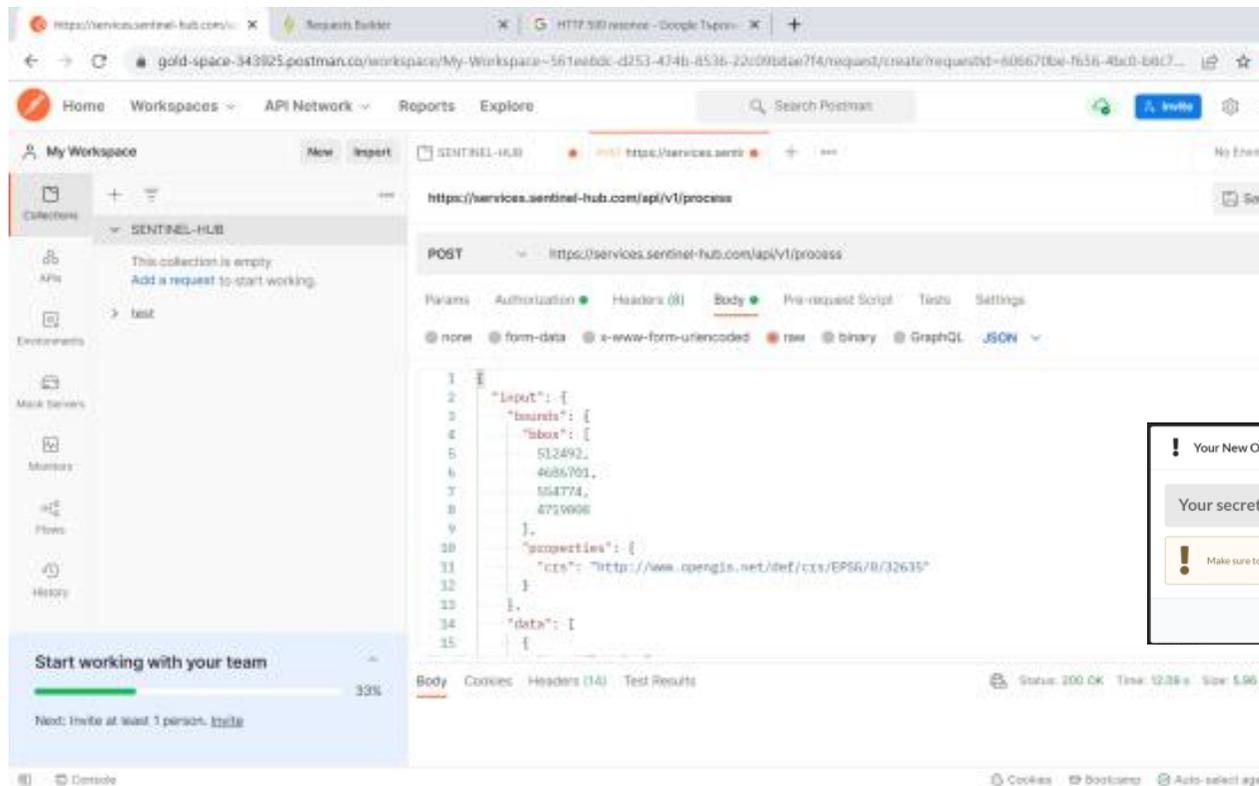
5. https://www.youtube.com/watch?v=sX3w3Wd3FBw

- Accounts used:
  - U1: zlatomir.d.dimitrov@gmail.com
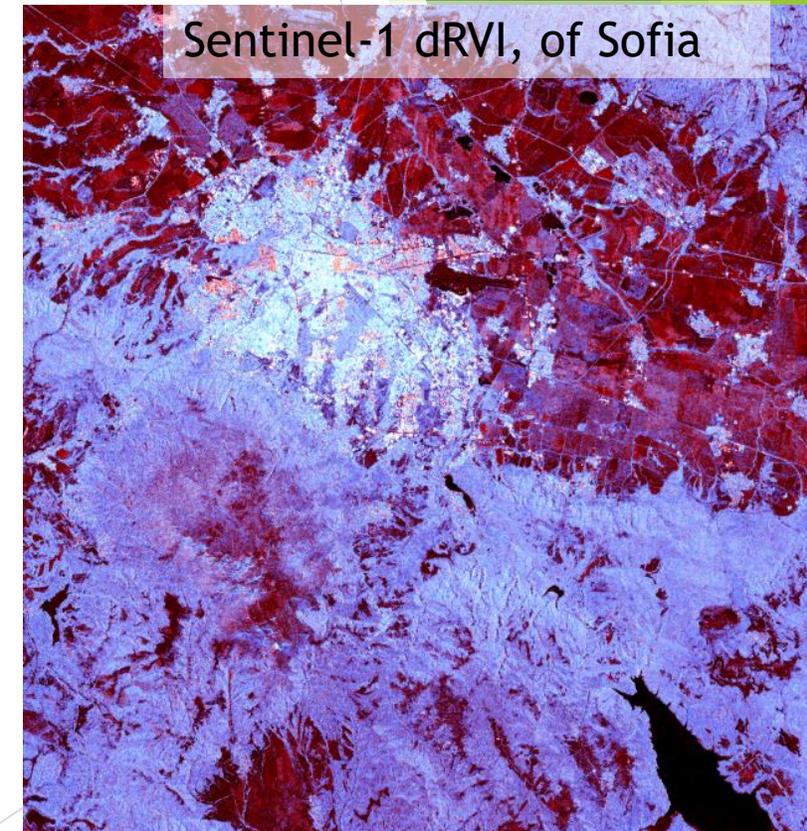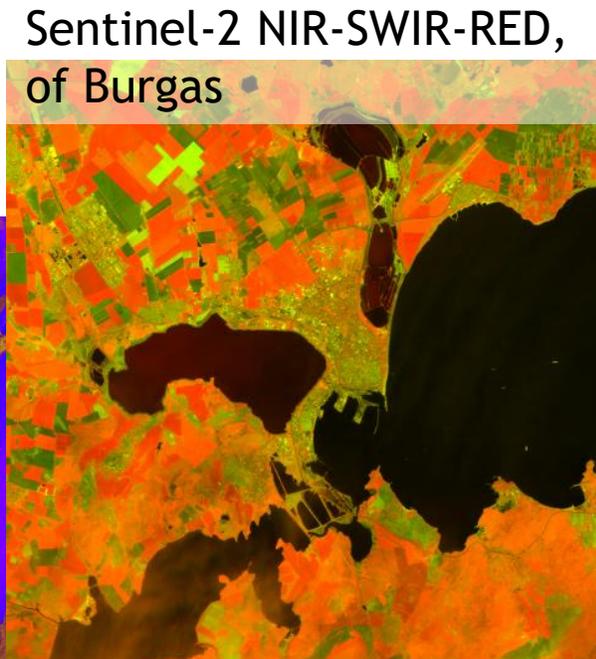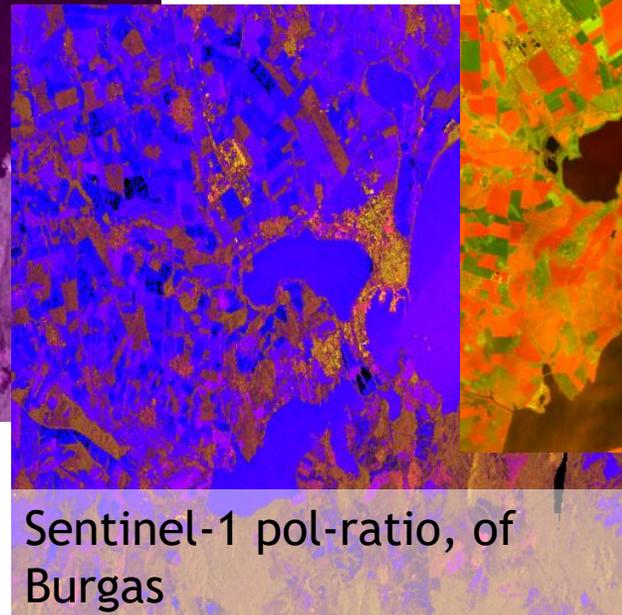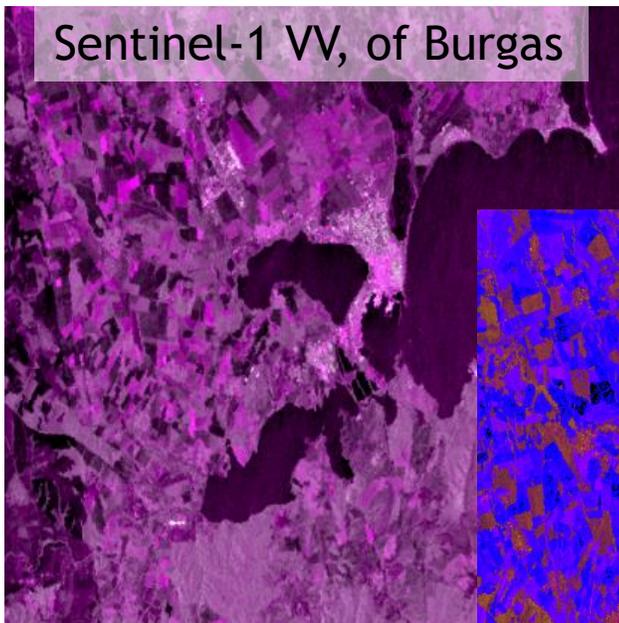  - U2: petar.dimitrov@mail.space.bas.bg

# Meet the SH

► API key inizialisation is performed, based on video tutorials

► First attempts were made via PostMan

► The Dashboard

# Meet the Request Builder (RB)

- First attempts were based on sample scripts, by also used the custom scripts repository
- Played with Sentinel-1 and Sentinel-2 examples, over capital of Bulgaria and city at the Black Sea coast.
- Load tested, processing units vs requests



Sentinel-1 VV, of Burgas

Sentinel-1 pol-ratio, of Burgas

Sentinel-2 NIR-SWIR-RED, of Burgas

Sentinel-1 dRVI, of Sofia

# Meet the Request Builder (RB)

▶ Setup, import/export test site's geometry via GeoJSON; set CRS (4326, 32634)

▶ Initial coding included sample **curl** requests, using Sentinel-1 over test site

▶ Sample Javascript functions coding, based on the custom-scripts repo

# Spatial coverage and set-up

- Several geometries of desired test sites, as a GeoJSON were imported

- Main CRS was set to – EPSG:3857

- The provided output from the SH-RB was set to be as a TAR archive

- Raster Output as a geo-coded GeoTIFF files

A) Icethrow SAR test areas selection
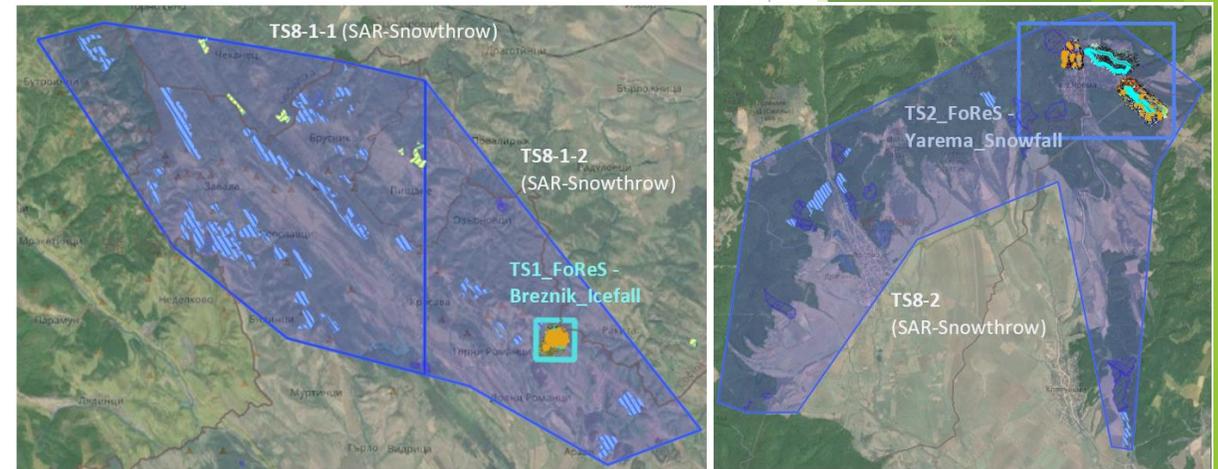


B) Snowthrow SAR test areas selection
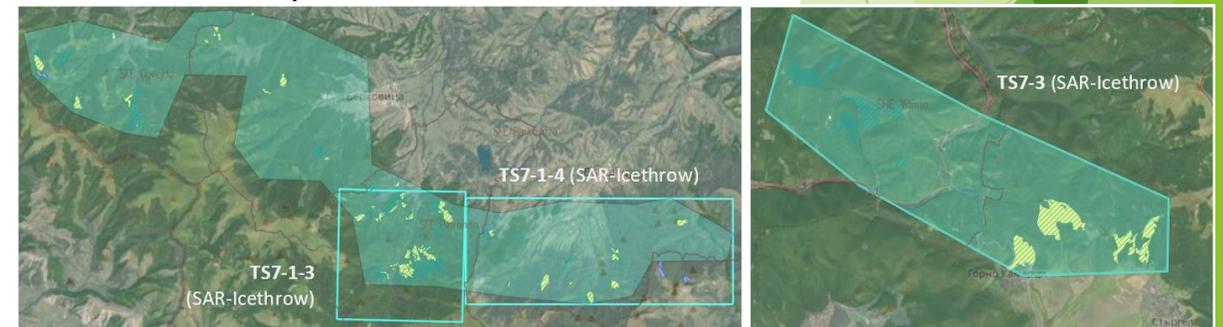
# Utilize Processing API for Sentinel-1 Time series calculation

▶ Developed custom scripts, which to calculate mean values from time series data, of cross-/co-pols (VH and VV), and SAR indices – dRVI, DoP, for a two time series periods, in particular:

  ▶ Period 1: from 2020-06-30 to 2020-08-30

  ▶ Period 2: from 2021-06-30 to 2021-08-30

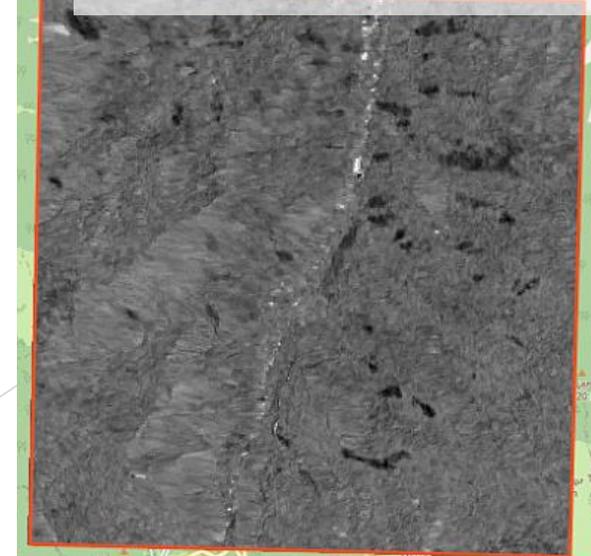▶ Considering both orbits – ASCENDING and DESCENDING
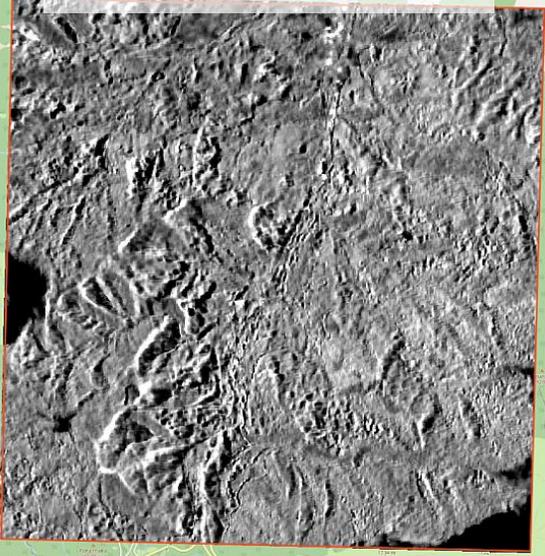


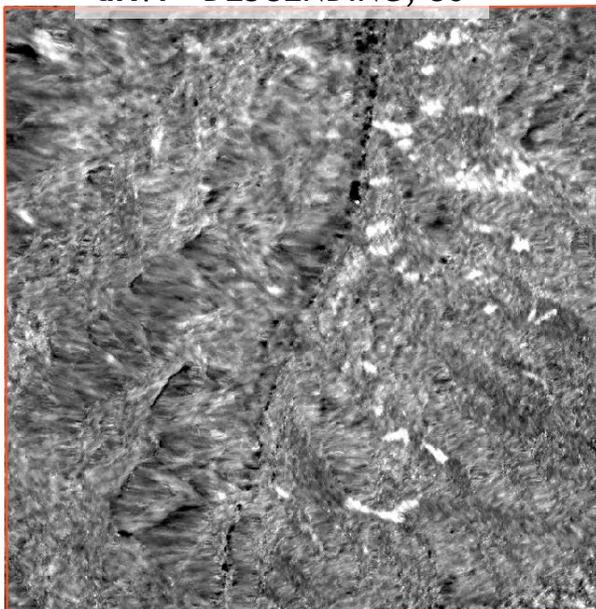TS7-1-3: Mean-VH / DESC   TS7-1-3: Mean-VV / DESC   TS7-1-3: Mean-VV dRVI / DESC   TS7-1-3: Mean-VV DoP / DESC
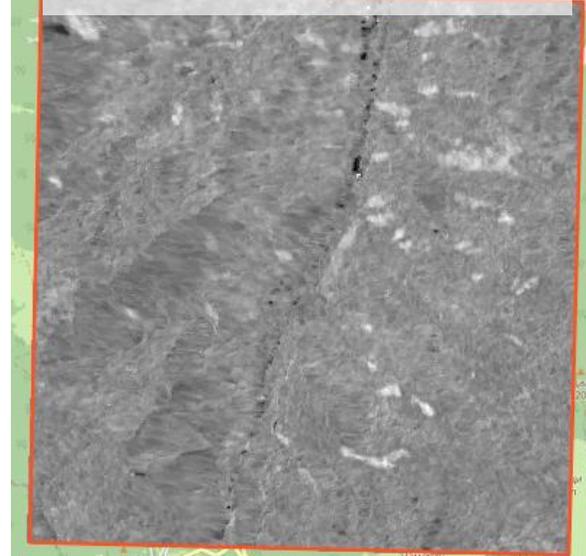
# Utilize Processing API for Sentinel-1 Time series calculation

- Comparrison analysis of mean values:
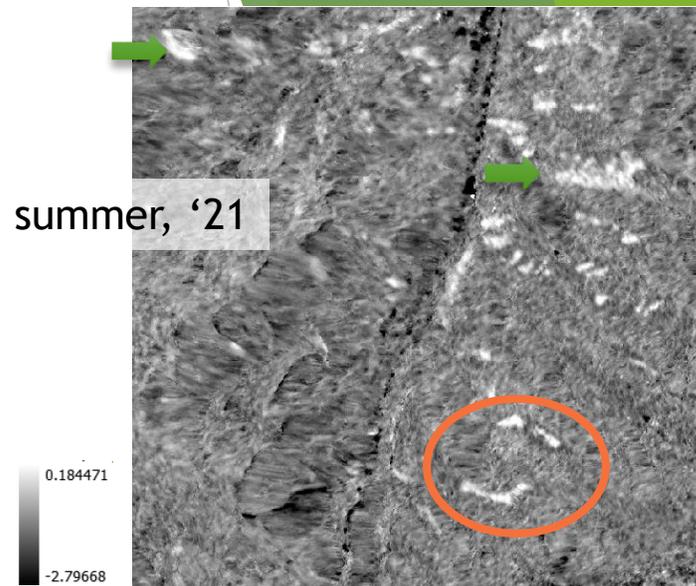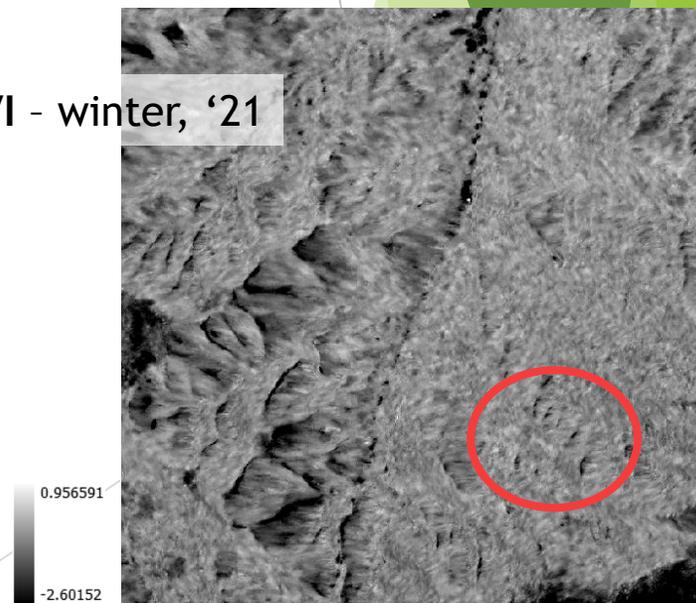  - winter / summer time periods
  - DESCENDING vs ASCENDING



dRVI – summer, '21

0.184471

-2.79668

**dRVI – DESCENDING, 80**



0.635872

0.298052

**dRVI – ASCENDING, 29**



0.634593

0.319667

dRVI – winter, '21



0.956591

-2.60152

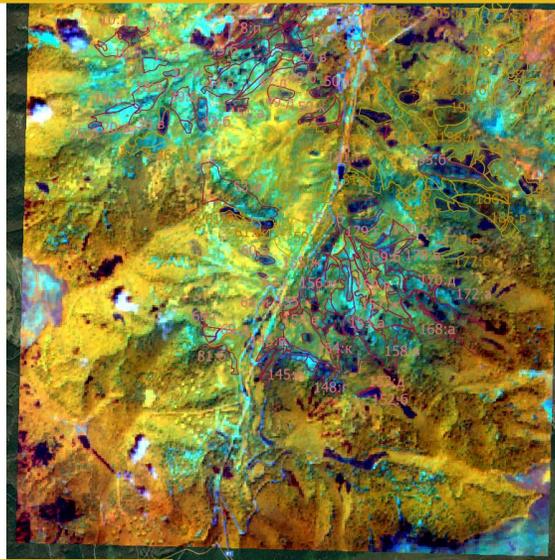# Utilize Processing API for Sentinel-2 reference optical data

▶ Play with sample scripts for RGB (NIR-SWIR-REDEdge) elaboration, from S2-L2 data

▶ Implement EVI2 calculation, based on custom-scripts repo

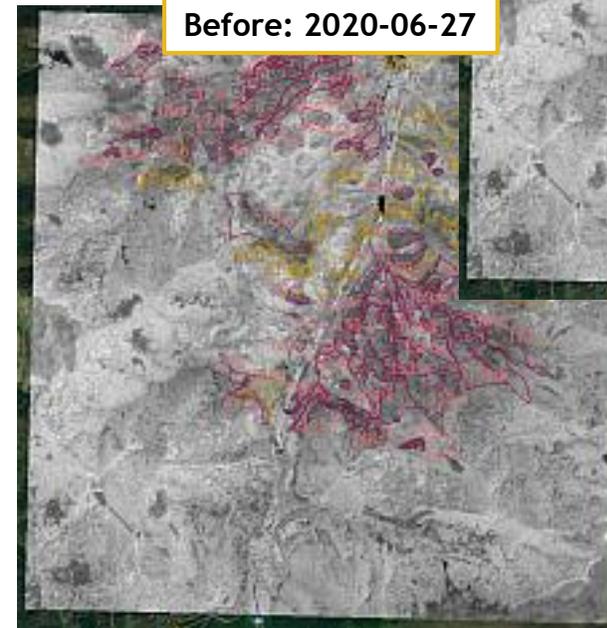▶ Results showed forest disturbances in test area



After: 2021-06-22

Sentinel-2: EVI2

Before: 2020-06-27

Before Icethrow disaster: 2020-06-27
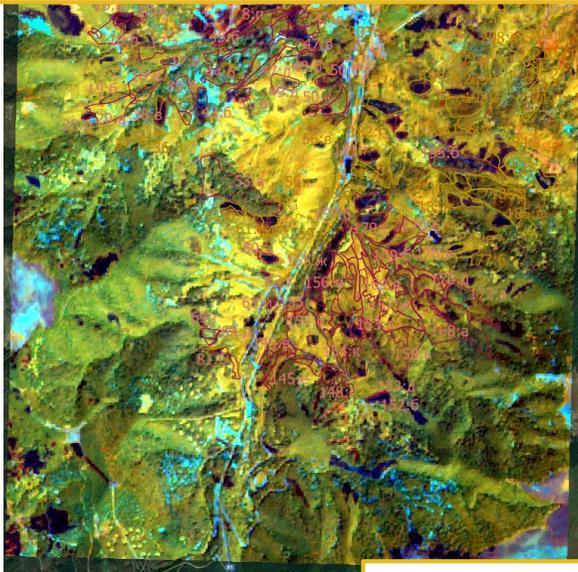
After Icethrow disaster: 2021-06-22

Sentinel-2: Nir/Swir/RedEdge
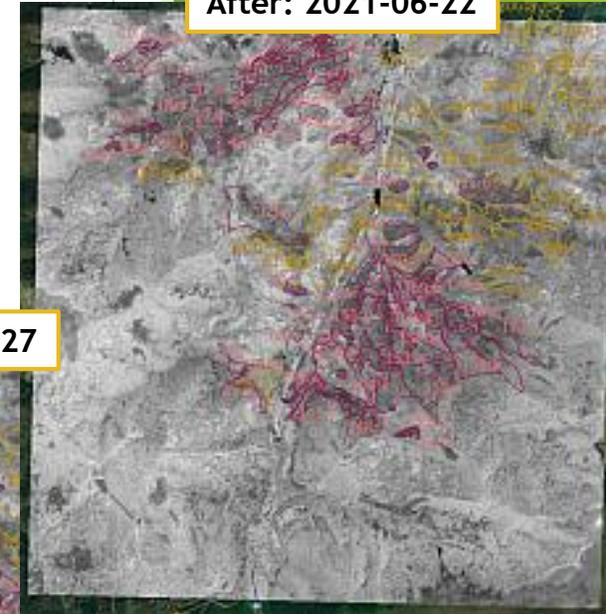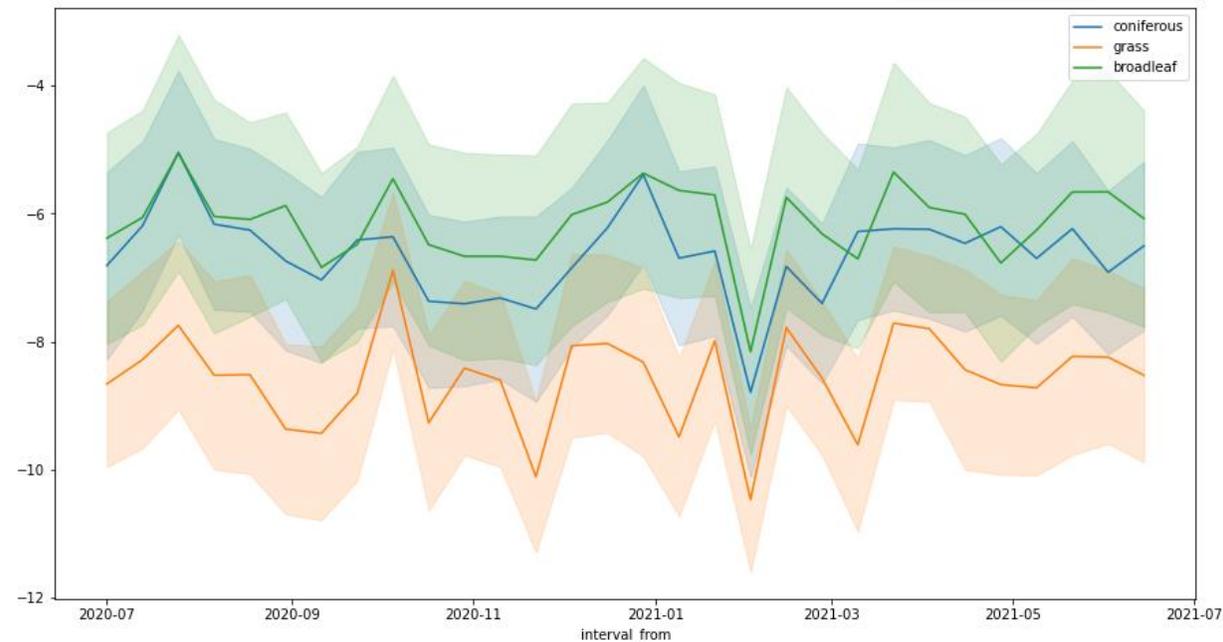
# Utilize Statistial API

▶ Followed up the video tutorial, custom scripts based on Sentinel-1 SAR data was ealborated, to study the time backscatter responce, from both polarizations and dRVI

▶ Developed also a Python code, according the tutorial

▶ Different time periods was tested
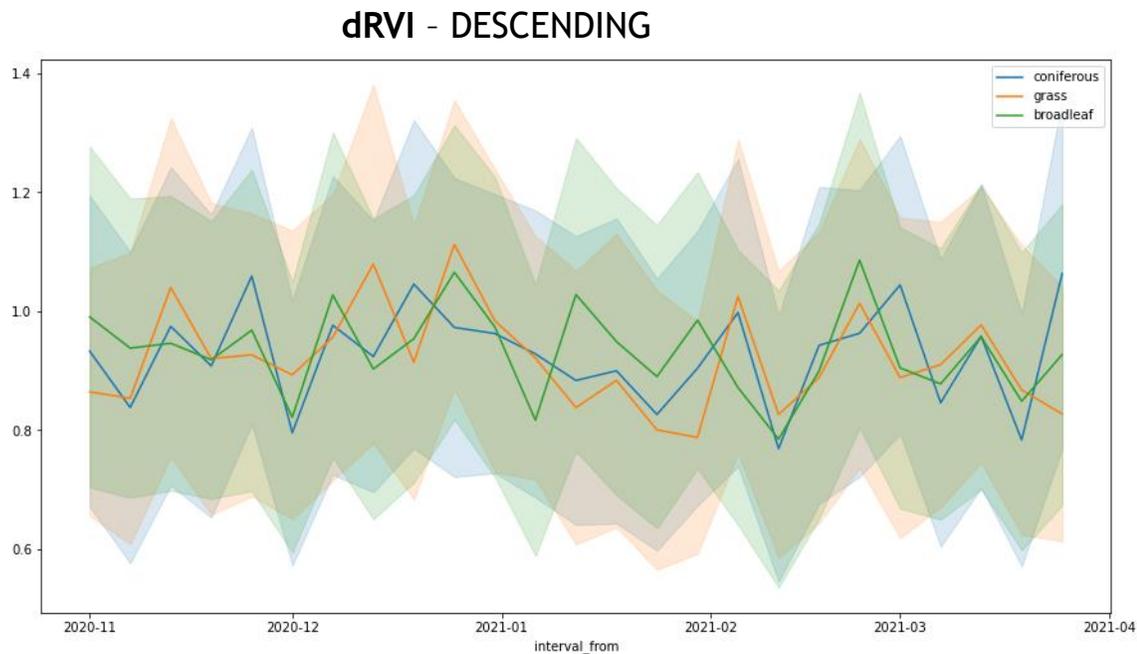
**VV** – DESCENDING

**dRVI** – DESCENDING

# Utilize Third Party API

▶ To process VHR optical data from MAXAR collection – WorldView and GeoEYE

▶ Maximum quota: 28 sq.km

▶ Three mountainous test sites

▶ Following orders were made:

    ▶ 5054cd6c-9bf0-4a3d-882c-6b27698ad47c - WV02 / 1030050015F97800

    ▶ 4e8067a1-313d-4ce8-9c10-9e763cf5a938 - WV02 / 103005007BF97C00

    ▶ 7e5d59b5-5fc8-4c0e-b8a4-4c0fec867ec8 - WV03 / 104001006CB10D00

    ▶ a864a053-7aa0-4922-bb7b-419416022d35 - WV03 / 1040050043DC7D00

    ▶ a4771857-c2ac-46c6-a423-28939ed28689 - GE01 / 10504100024E8C00
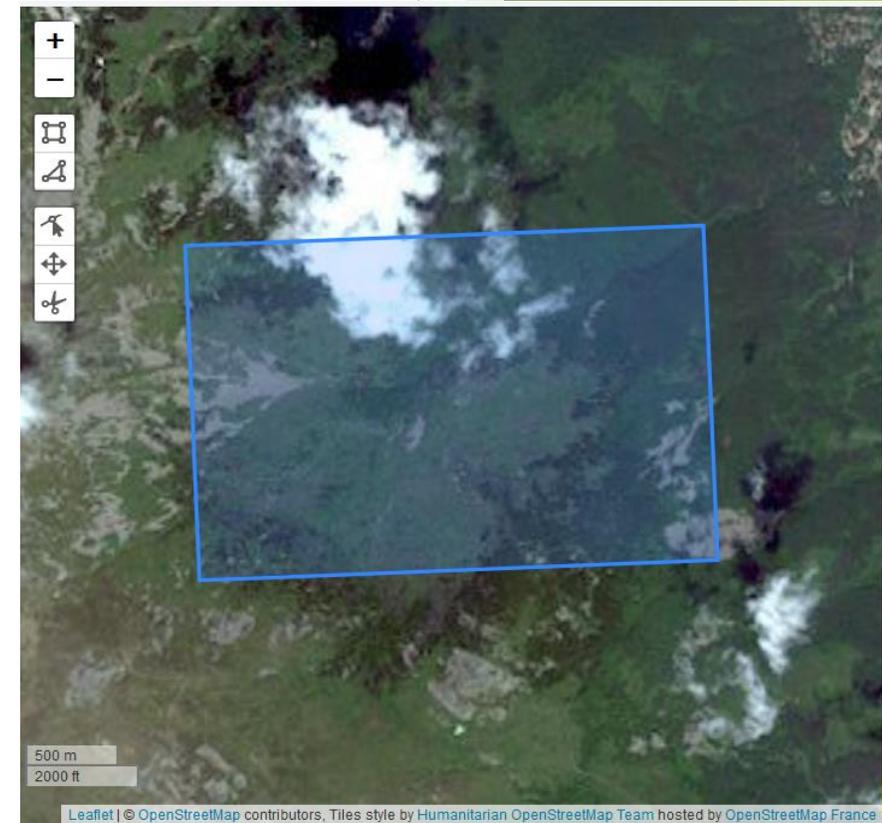
# Utilize Third Party API

▶ Functional scripts are developed, based on custom-scripts repo

▶ Calculated the following set of imagery:

   ▶ Pansharp (RED, RED-Edge, NIR, SWIR) with pixel size of 0.5 m / GeoTIFF, floating point

   ▶ Multispectral (RED, RED-Edge, NIR)

   ▶ NDVI, with pixel size of 2 m / GeoTIFF, floating point
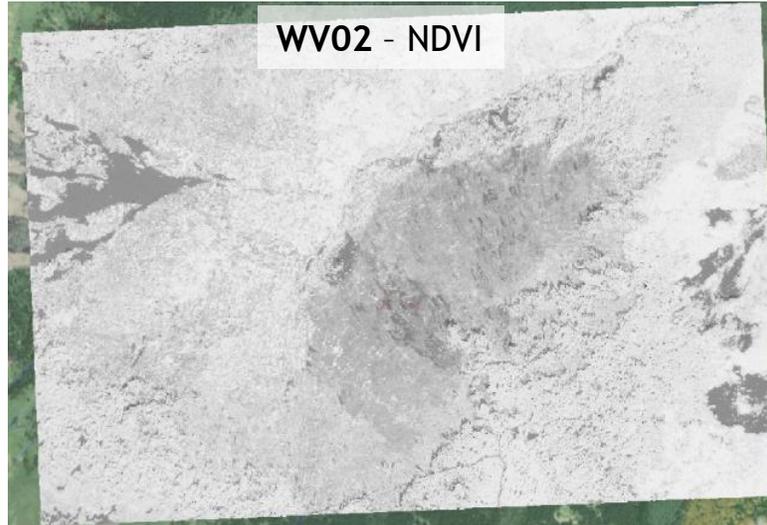
   ▶ NDVI RGB, with pixel size of 2 m / PNG



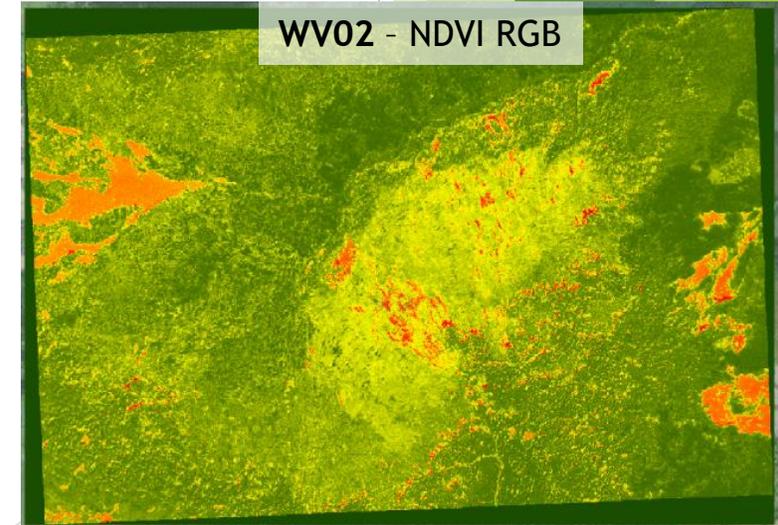**WV02** – Pansharp (Natural colors)
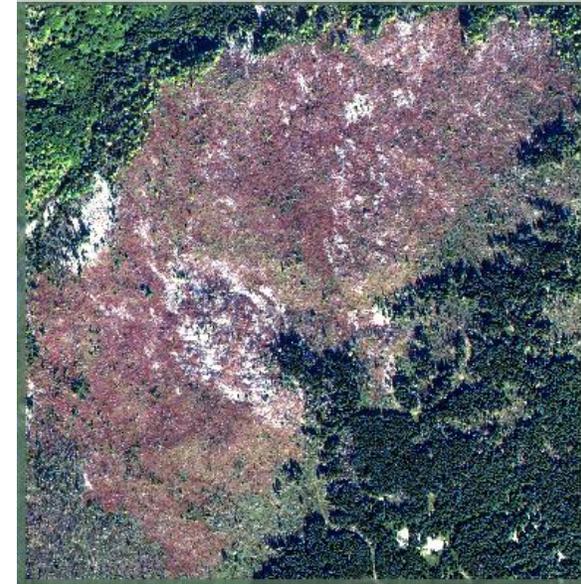


**WV02** – Multispectral



**WV02** – NDVI



**WV02** – NDVI RGB

TS5-Bistrishko Branishte, Vitosha mountain, SOFIA
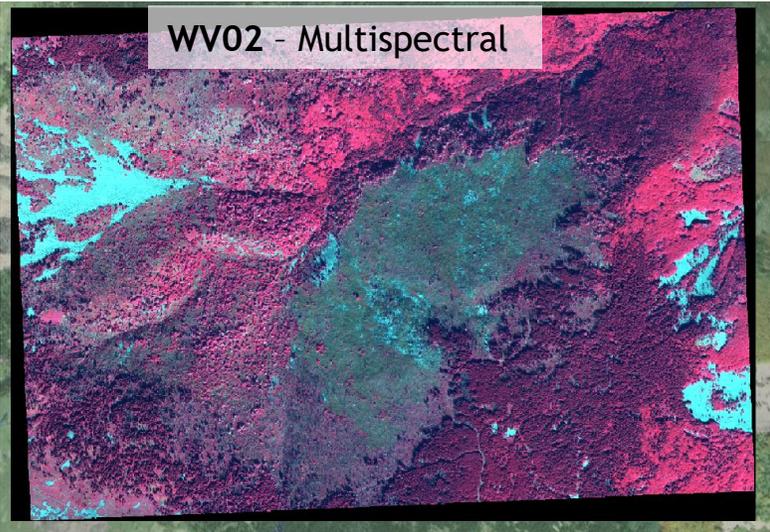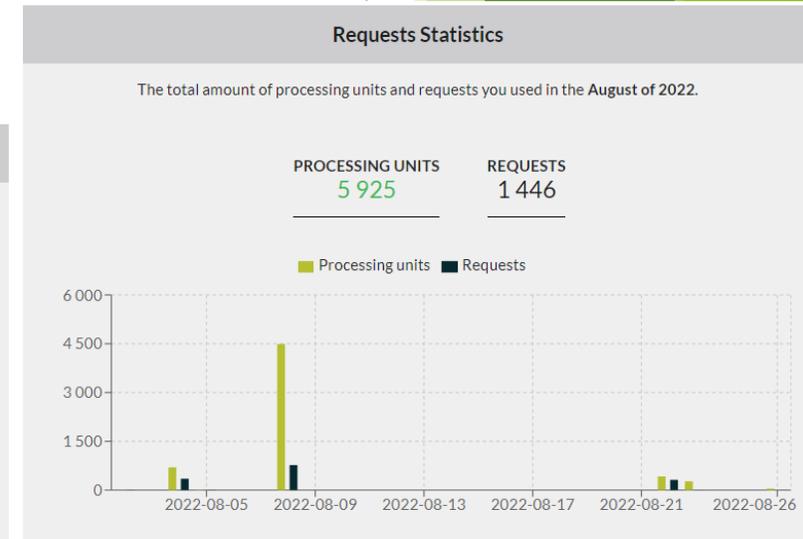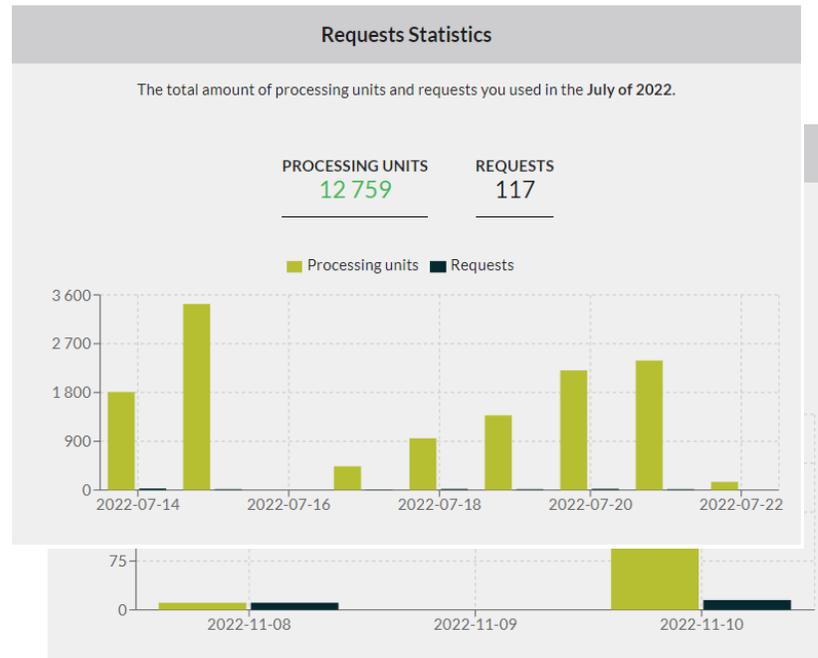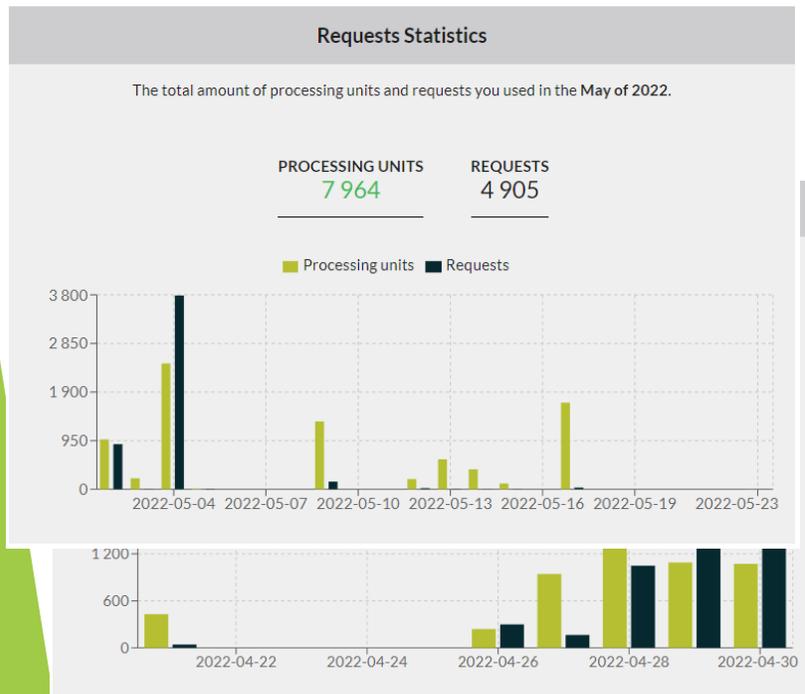
# Workload

▶ General computation activities took place in Summer of 2022

▶ The maximum workload was through the account of: zlatomir.d.dimitrov@gmail.com, where processing of Sentinel-1 GRD SAR data was held, comprises wide areas, speckle filtering and spatial resolution of 10 m.

▶ This increased dramatically the processing units, and limits was reached in some days

# Bugs met

- A few bugs met, where:

  - RB stops accept requests, whilst the system accounts for a request sent. This rate limits was rached inappropriately

  - Issue with the boundary of the test area, inappropriate differences from KML to GeoJSON

  - Bugs reported to Mr. Grega Milcinski (Sinergise), and two topics opened at the SH-Forum

# Conclusion

▶ The Sentinel-Hub by Sinergise© is an extensive wonderful platform, which extremely supported our work about the „FoReS" ESA's project at SRTI-BAS.

▶ The ease of use of the RB, really facilitates the EO satellite data processing

▶ Absolutely sophisticated platform, which boosts up scientific work by means of the **Processing API**, allowing vast processing of ESA COPERNICUS Sentinel-1 SAR and Sentinel-2 optical satellite imagery

▶ The availability of Custom-Scripts repository is a big plus, which facilitates functional scripts (i.e. Javascript) elaboration

▶ The **Third Party API** offers fast and suitable processing of VHR optical data (e.g. WorldView)

▶ The **Statistical API** also shows potentital, whilst some Python code still needed in order to fulfil processing

▶ Integration with EO – browser is really fantastic, very useful option!

▶ Also good option is implementation of OGC based WMS services, in purpose for QGIS

# Sincere Thanks to ESA and NoR for approving our proposal!

Zlatomir Dimitrov, SRTI-BAS, department „RS and GIS".

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Elaborated in purpose of ESA NoR!

„FoReS" ESA Project.

Sofia, 7.3.2023