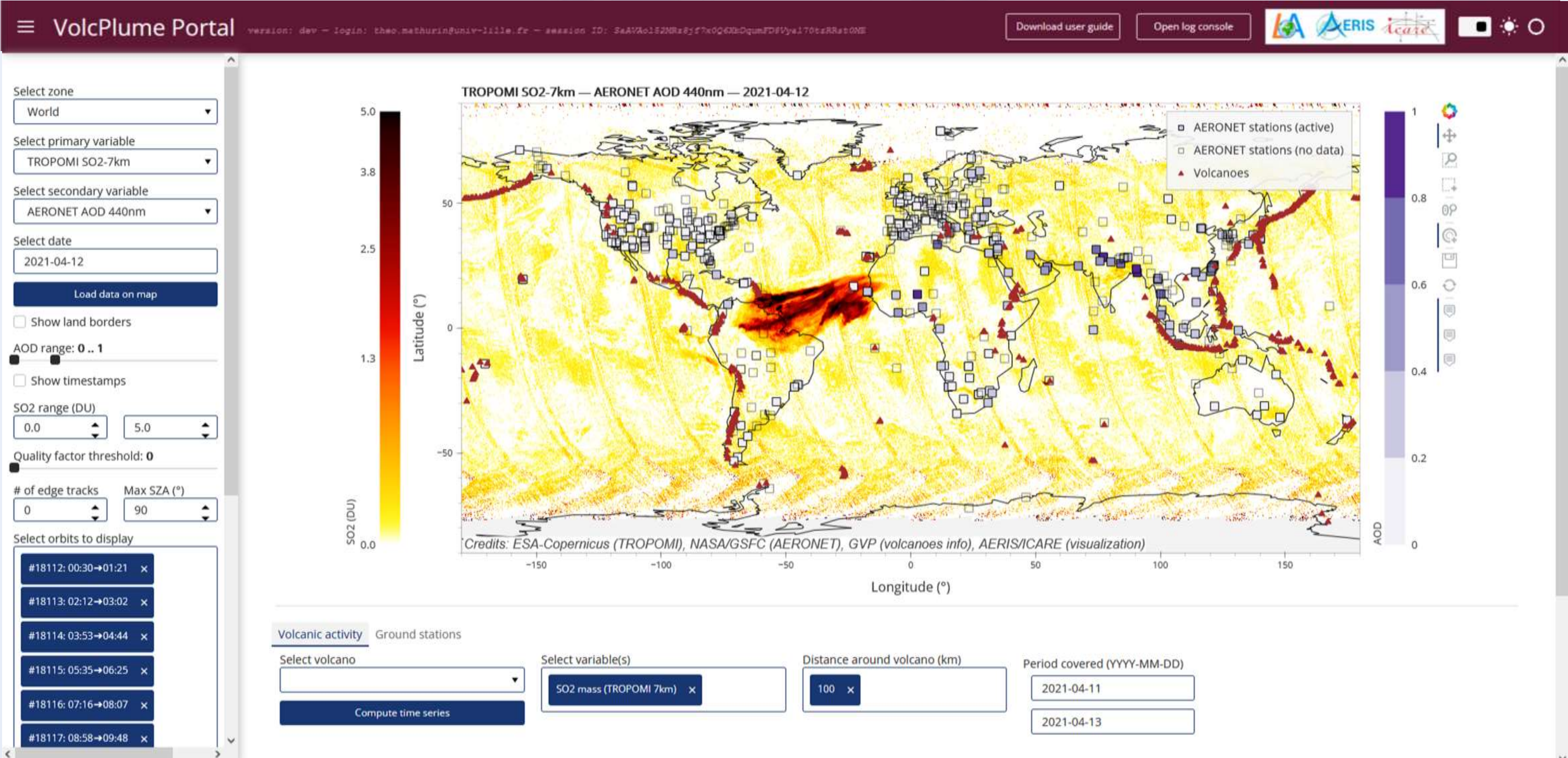


VOLCPLUME PORTAL USER GUIDE

Contact: theo.mathurin@univ-lille.fr – marie.boichu@univ-lille.fr

Overview

Integrated multiscale observation of volcanic emissions worldwide in a web application

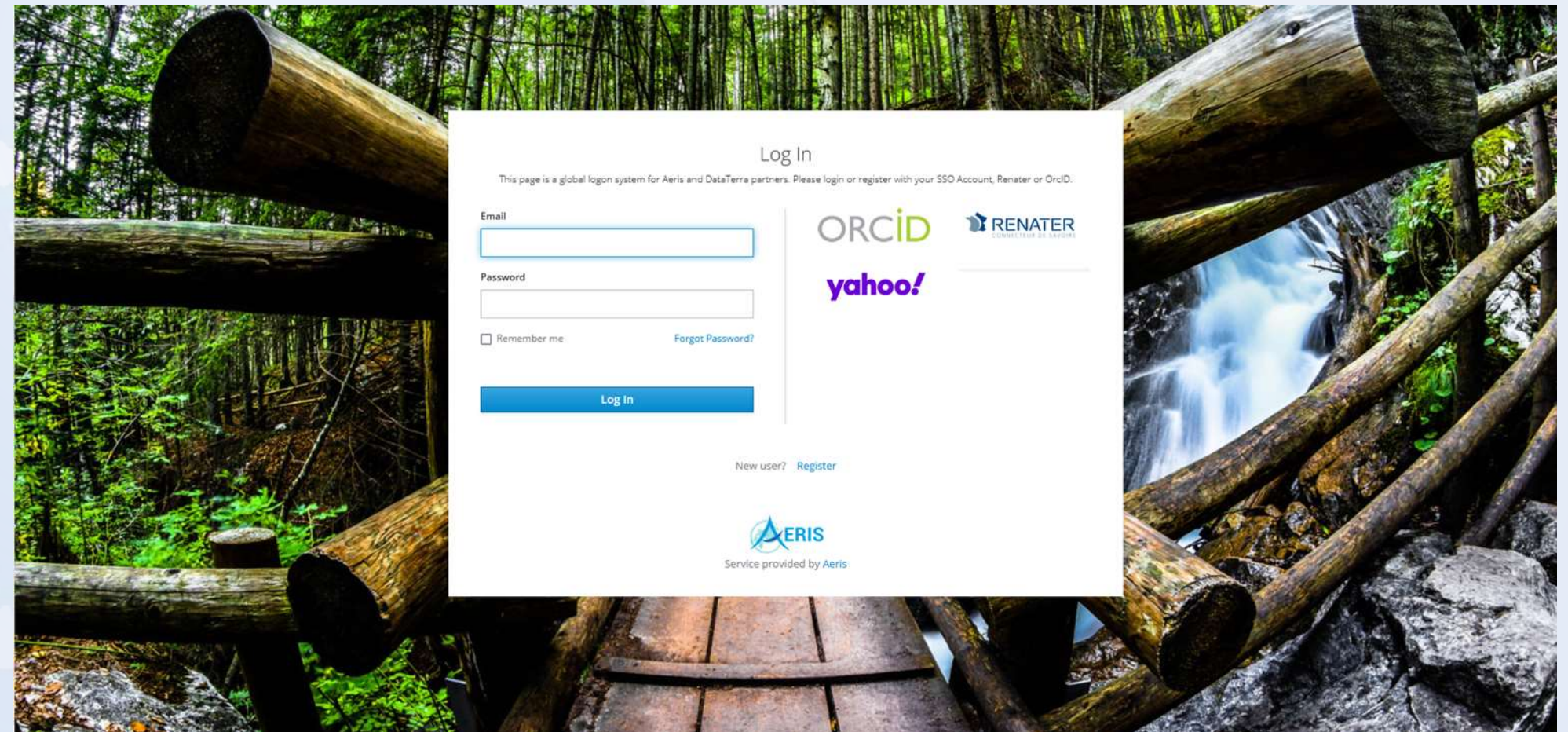


Access

URL: <https://dataviz.icare.univ-lille.fr/volcplume>

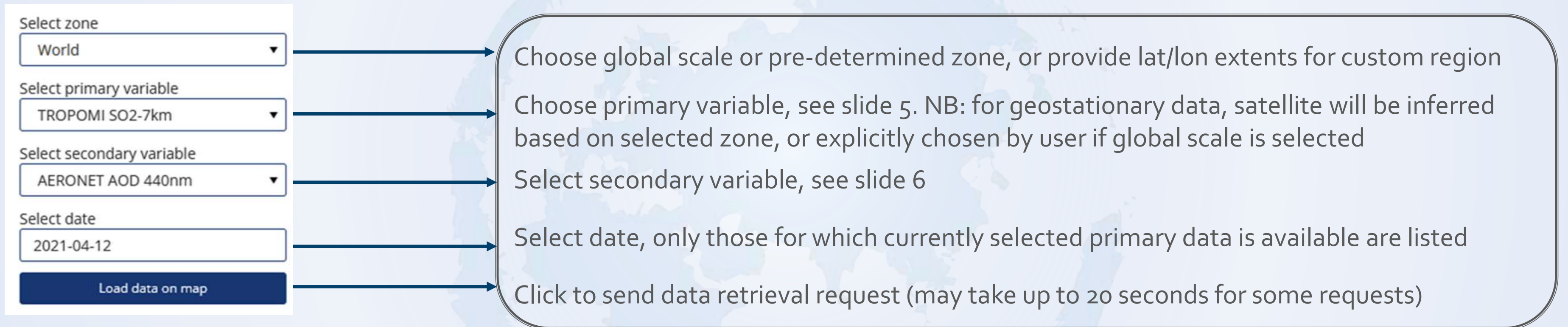
AERIS SSO authentication

- Use AERIS credentials
- Alternative log in possible with ORCID, RENATER
- Once logged in, authentication is no longer required for subsequent access



Select and load your data

Selection widgets



The screenshot shows a web interface for selecting data. It includes four dropdown menus: 'Select zone' (set to 'World'), 'Select primary variable' (set to 'TROPOMI SO2-7km'), 'Select secondary variable' (set to 'AERONET AOD 440nm'), and 'Select date' (set to '2021-04-12'). Below these is a 'Load data on map' button. Arrows point from each of these elements to a large rounded rectangle containing explanatory text.

Choose global scale or pre-determined zone, or provide lat/lon extents for custom region

Choose primary variable, see slide 5. NB: for geostationary data, satellite will be inferred based on selected zone, or explicitly chosen by user if global scale is selected

Select secondary variable, see slide 6

Select date, only those for which currently selected primary data is available are listed

Click to send data retrieval request (may take up to 20 seconds for some requests)

NB: a significant amount of computation is done by the browser, so that the processing power of your machine will affect your experience

Primary variable products (1/2)

Sentinel-5P/TROPOMI

- TROPOMI SO₂-{n}km: *sulfurdioxide_total_vertical_column_{n}km* dataset in [S5P L2 SO₂ product](#) (assumed altitude 1, 5 or 7km)
- TROPOMI Cloud Fraction: *cloud_fraction* dataset in [S5P L2 CLOUD product](#)
- TROPOMI Aerosol Index: *aerosol_index_340_380* dataset in [S5P L2 AER_AI product](#)
- TROPOMI Aerosol Layer Height: *aerosol_mid_height* dataset in [S5P L2 AER_LH product](#)

METOP/IASI

- IASI SO₂-{n}km: {n}km height data within *SO₂_all_altitudes* dataset in [Metop-B/Metop-C LATMOS L2 SO₂ product](#)
- IASI SO₂-interpolated: *SO₂_interpolated* dataset in [Metop-B/Metop-C LATMOS L2 SO₂ product](#)
- IASI SO₂-height: *SO₂_vertical_level* dataset in [Metop-B/Metop-C LATMOS L2 SO₂ product](#)

Aura/OMI

- OMI SO₂: *ColumnAmountSO₂_{PBL/TRL/TRM/STL}* datasets in [L2 OMSO₂ products](#), vertical slider to explore the different levels
- OMI Cloud Fraction: *CloudFraction* dataset in [L2 OMSO₂ products](#)
- OMI Aerosol Index: *UVAerosolIndex* dataset in [L2 OMSO₂ products](#)

Suomi-NPP/OMPS

- OMPS SO₂: *ColumnAmountSO₂_{PBL/TRL/TRM/TRU/STL}* datasets in [L2 OMPS NMSO₂ products](#) (PCA algorithm), vertical slider to explore the different levels
- OMPS Cloud Fraction: *CloudFraction* dataset in [L2 OMPS NMSO₂ products](#) (PCA algorithm)
- OMPS Aerosol Index: *UVAerosolIndex* dataset in [L2 OMPS NMSO₂ products](#) (PCA algorithm)

Primary variable products (2/2)

GEOSTATIONARY SATELLITES (GOES₁₆, GOES₁₇, HIMAWARI₈, MSG₂, MSG₄)

- GEO ASH/Natural False Colour: SEVIRI-Like RGB compositions ([user guide](#), [recipes](#)) from L1_B products
- GEO Brightness Temperature: IR channels (10.3, 10.4, 10.8, 11.2, 12.0 μm depending on instrument) from L1_B products
- GEO SO₂ (GOESNG and HIMAWARI only): NOAA SO₂ RGB composition ([reference](#))
- GEO Cloud Top Altitude: *ctth_alti* dataset in [NWC SAF GEO CLOUD products](#)
- GEO Cloud Top Pressure: *ctth_pres* dataset in [NWC SAF GEO CLOUD products](#)
- GEO Cloud Top Temperature: *ctth_tempe* dataset in [NWC SAF GEO CLOUD products](#)

ECMWF/ERA₅

- ERA5 Wind: *u*, *v* wind components datasets from [ERA5 pressure-level reanalysis, analysis or forecast products](#), vertical slider to explore the different levels

Aqua/MODIS

- AOD 550 nm (Aerosol Optical Depth): *AOD_550_Dark_Target_Deep_Blue_Combined* dataset in gridded version of [MYDo4 L2 products](#)

Parasol/POLDER

- AOD 443 nm: *AOD₄₄₃*, *FineAOD₄₄₃* and *CoarseAOD₄₄₃* datasets in gridded version of L2 products ([GRASP algorithm](#))
- AE 670-875 nm (Angstrom exponent): *AExp* dataset in gridded version of L2 products ([GRASP algorithm](#))
- SSA (Single Scattering Albedo): *SSA₄₄₃* dataset in gridded version of L2 products ([GRASP algorithm](#))
- Refractive Index: *RealRefIndSpect₄₄₃* and *ImagRefIndSpect₄₄₃* datasets in gridded version of L2 products ([GRASP algorithm](#))

Secondary variable products

AERONET network

- AERONET AOD 440nm (Aerosol Optical Depth): *AOD_440* series average per station from [AERONET V1.5 AOD data](#)
- AERONET AE 440-870nm : *440-870_Angstrom_Exponent* series average per station from [AERONET V1.5 AOD data](#)

GEOD'AIR network

- GEOD'AIR SO₂: *valeur* series average per station from [GEOD'AIR SO₂ data](#)

Ground station LIDARs

- LIDAR Profile 532nm: quicklooks for RCS and depolarisation ratio from L1B products (ACTRIS & Meteo France LIDAR networks)

CALIOP

- CALIOP Profile 532nm: ground tracks and corresponding RCS quicklooks from L1B products ([Standard](#), [Validated Stage](#) or [Expedited](#))

Interactive map plot: customisation widgets

Once data is loaded on the map, additional widgets pop up in the sidebar to allow further customisation (depending on selected data: orbit filters, quality filters, subchoice of dataset, colour map bounds, display borders...)

Select zone
World

Select primary variable
TROPOMI SO2-7km

Select secondary variable
AERONET AOD 440nm

Select date
2021-04-12

Load data on map

☐ Show land borders

AOD range: 0 .. 1

☐ Show timestamps

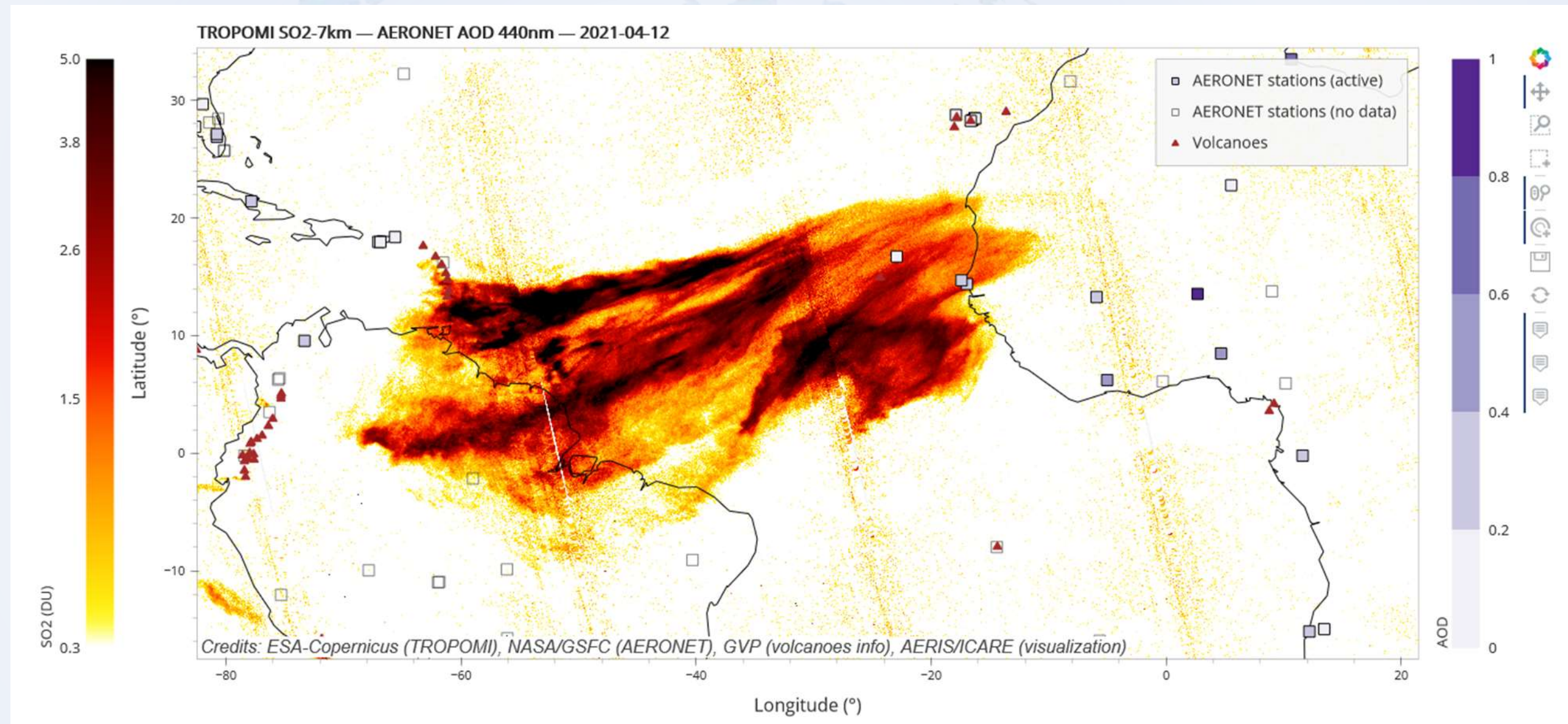
SO2 range (DU)
0.3 5.0

Quality factor threshold: 0

of edge tracks 0 Max SZA (°) 90

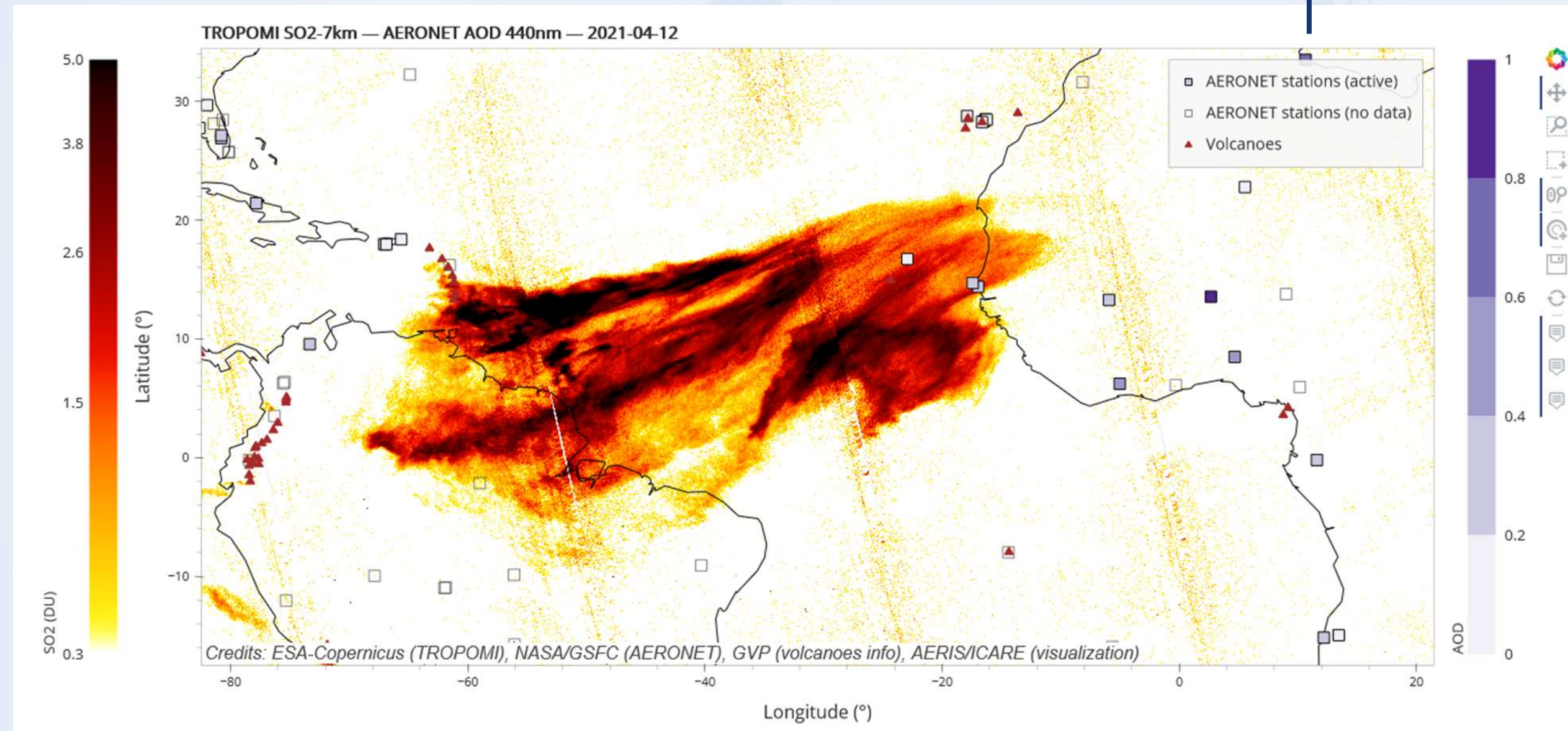
Select orbits to display

- #18112: 00:30→01:21 x
- #18113: 02:12→03:02 x
- #18114: 03:53→04:44 x
- #18115: 05:35→06:25 x
- #18116: 07:16→08:07 x



Interactive map plot: plot tools

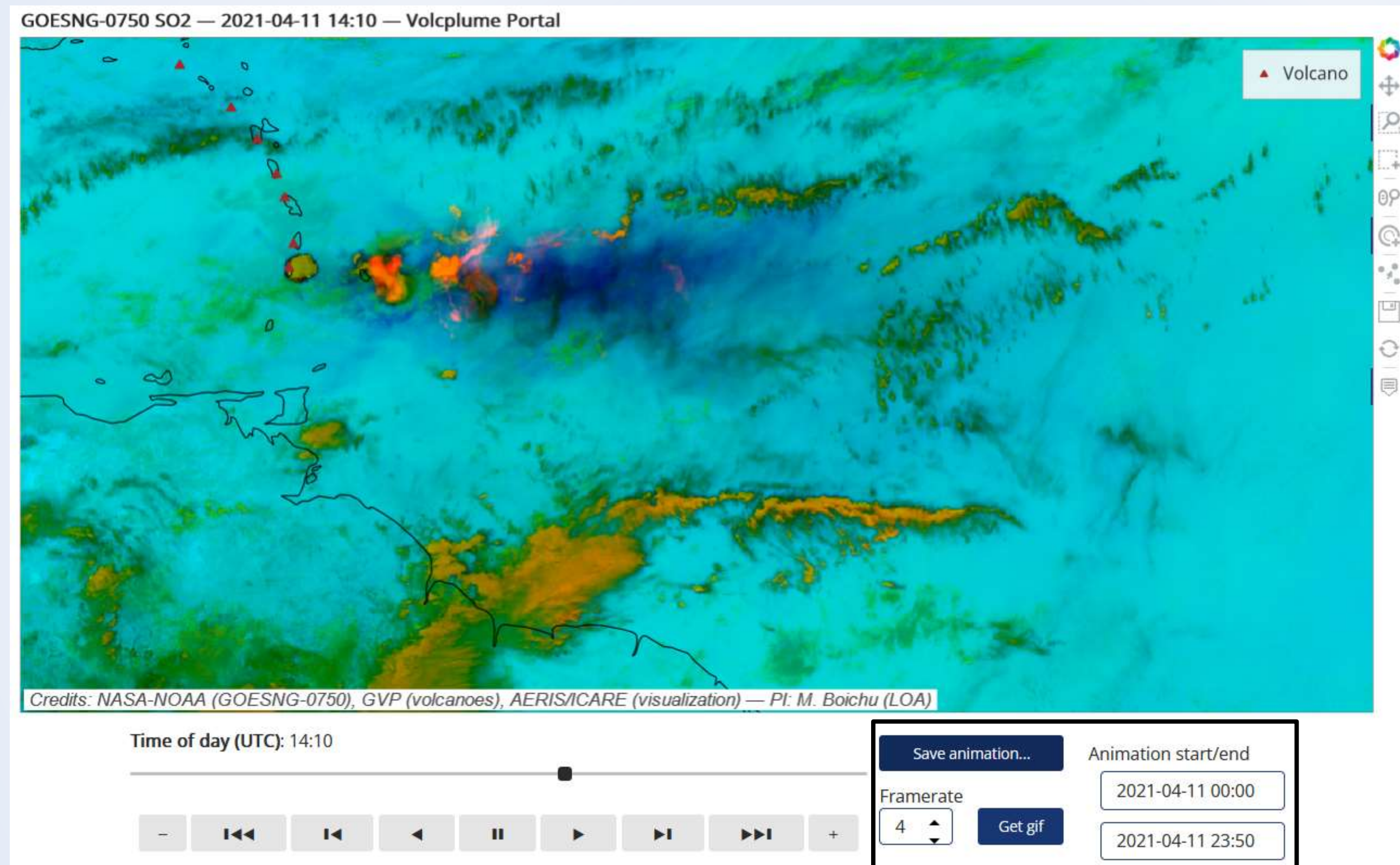
Click on legend item to hide/display elements



Pan
Group selection (stations)
Wheel zoom
Tap (volcano/station)
Save to image
Reset
Hover Tools

Click on tool to
activate/deactivate

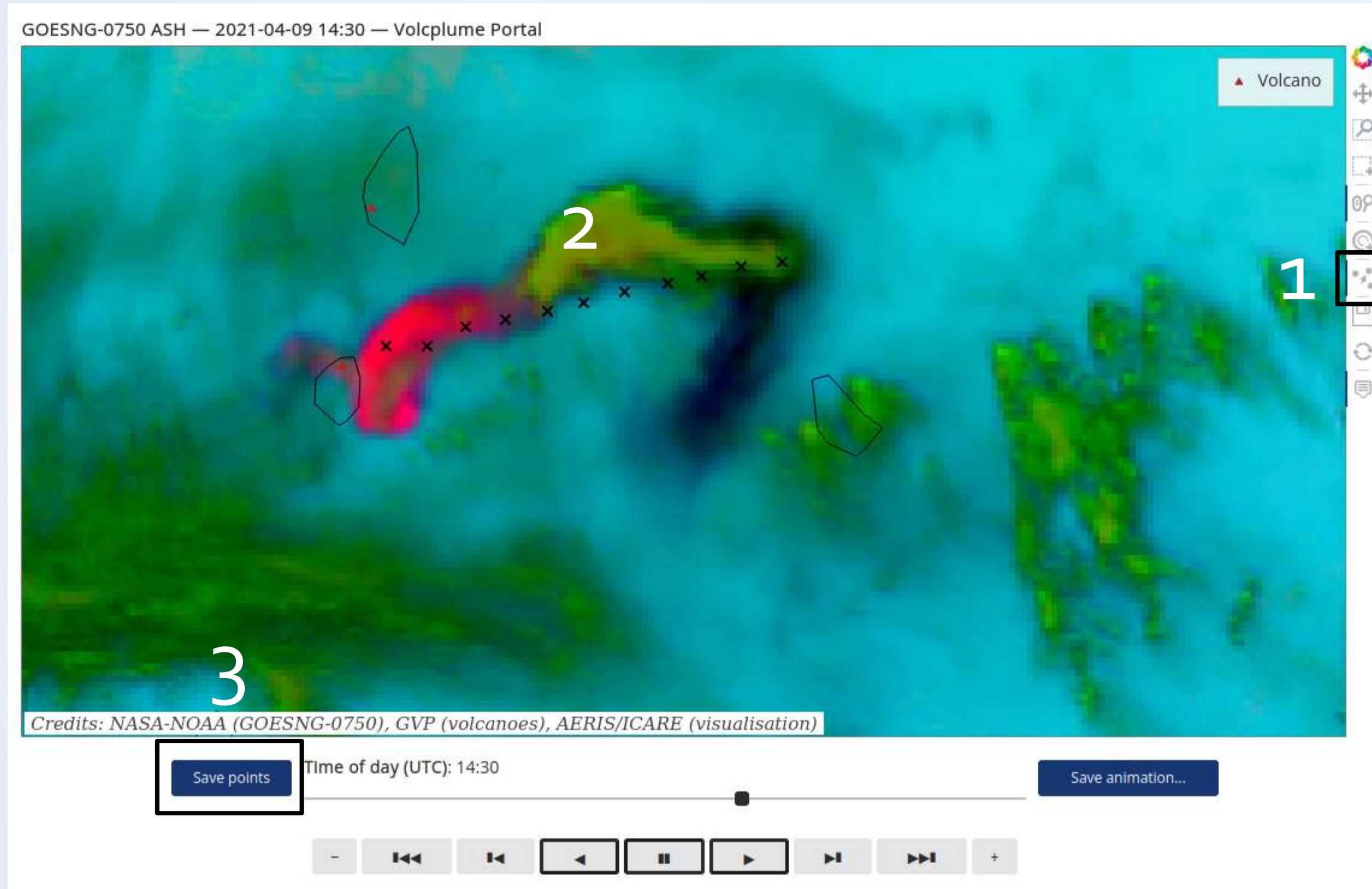
Geostationary data: explore and save animation



Temporal resolution
between 10' and 30'

Download animation:
Click on "Save
animation" button to
display more widgets
allowing to save an
animation (GIF
format), with editable
animation bounds and
framerate (fps)

Geostationary data: track objects and save trajectories

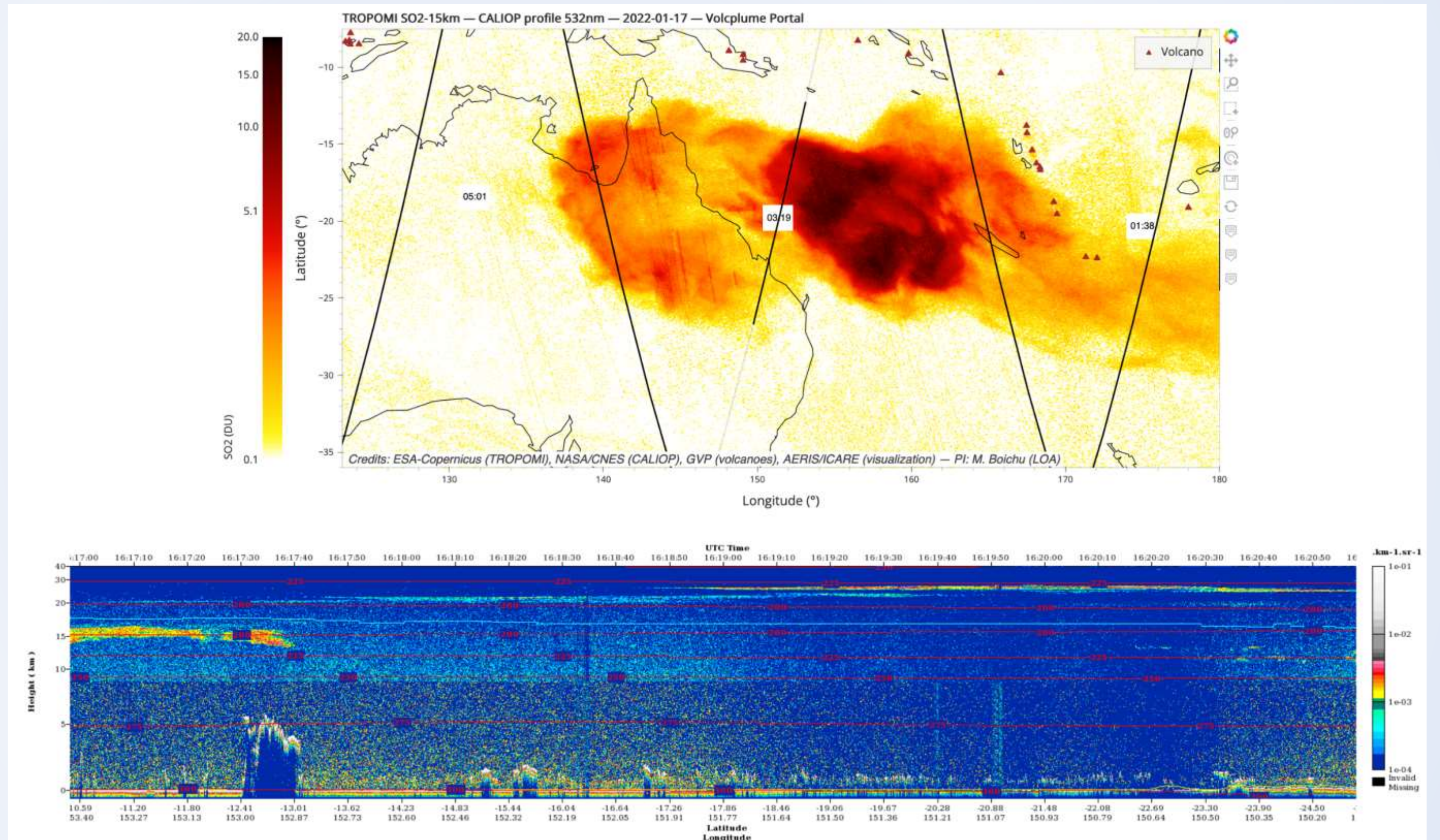


1. Activate "Point Draw" tool
2. Click on the map to add points (typically one per timestep to track an object)
3. Click on "Save points" to retrieve the points locations (csv file)

CALIOP tracks

Satellite ground tracks
appear on the map

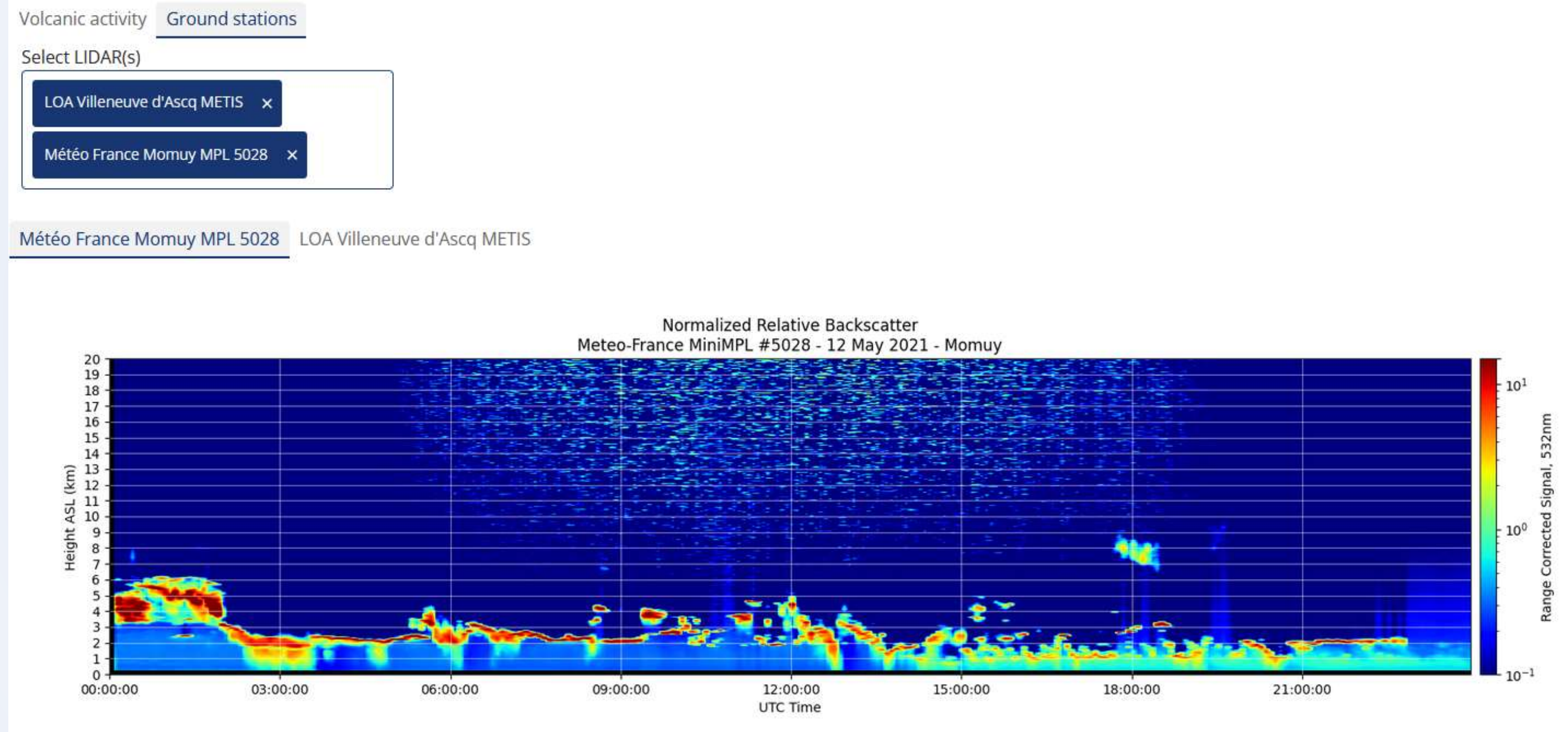
Click on a track to
display a quicklook
strip that corresponds
to the selected portion



Ground-based LIDARs

Click on a station or
enter its name in the
“Select LIDAR(s)”
widget

RCS/depolarisation
quicklooks appear in
the stations panel



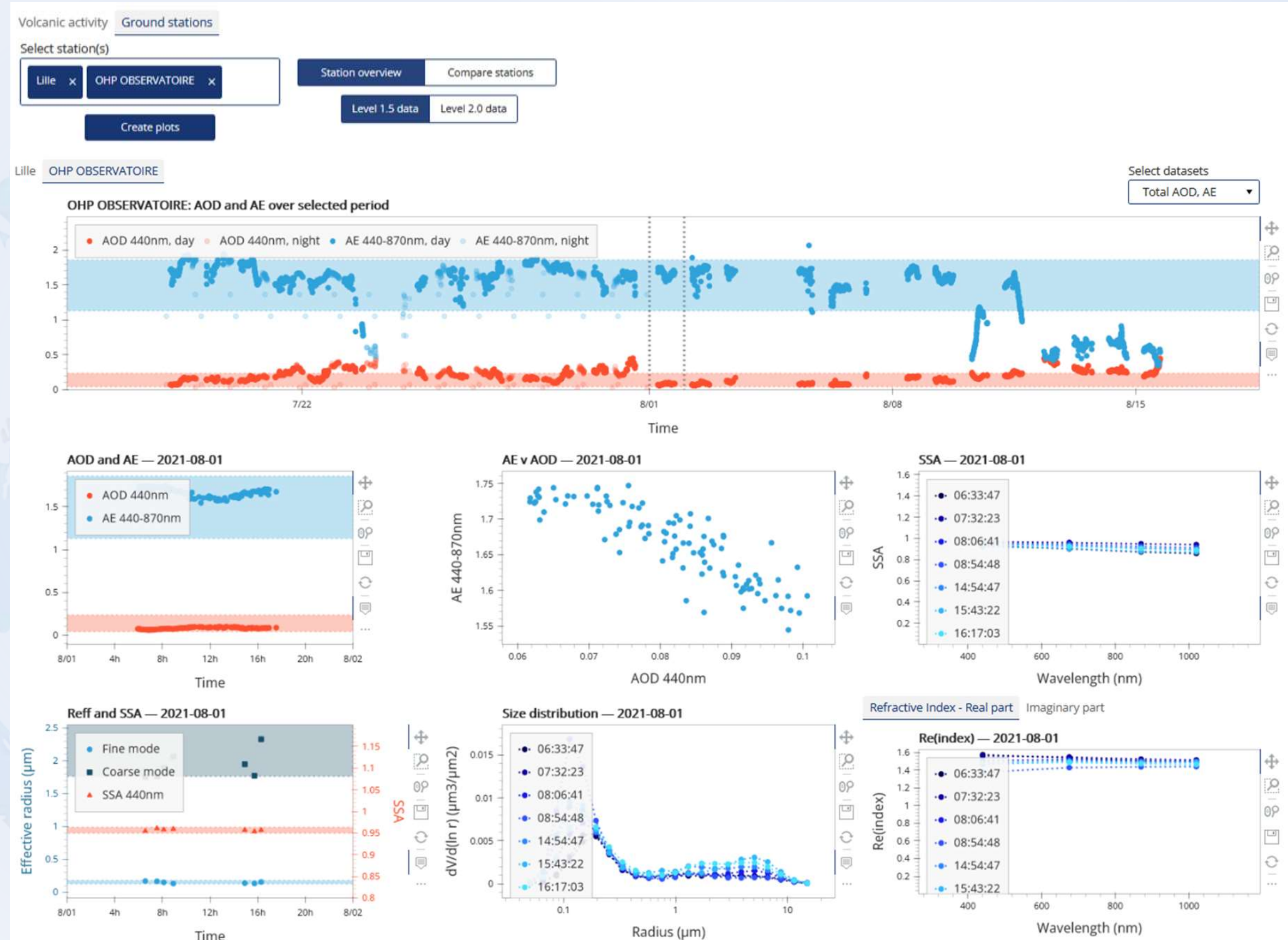
"Ground stations" panel: "Station overview" mode

With "Station overview" selected, select station(s) on map or with selection widget (typing name of station is supported)

One tab per station will be created with:

- Day and night AOD, AE, SDA fine/coarse and inversion variables (effective radius in coarse/fine mode, single scattering albedo @440nm) time series showing historical monthly range (mean +/- std)
- AE v AOD scatter plot
- Size distribution for each timestamp
- SSA and complex refractive index as a function of wavelength for each time stamp

NB: SDA and inversion data are not always available



"Ground stations" panel: "Compare stations" mode

With *Compare stations* selected, select station(s) on map or with selection widget (typing name of station is supported) and a set of variable of interest

One plot per variable will be created with time series allowing a multi-station data analysis. Time series can be downloaded as csv files.

Resulting panel with GEOD'AIR is similar



"Volcanic source" panel (1/3)

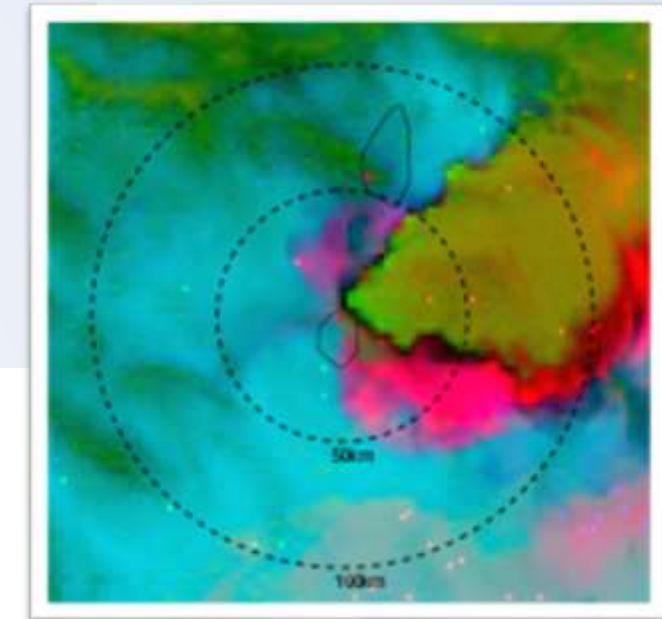
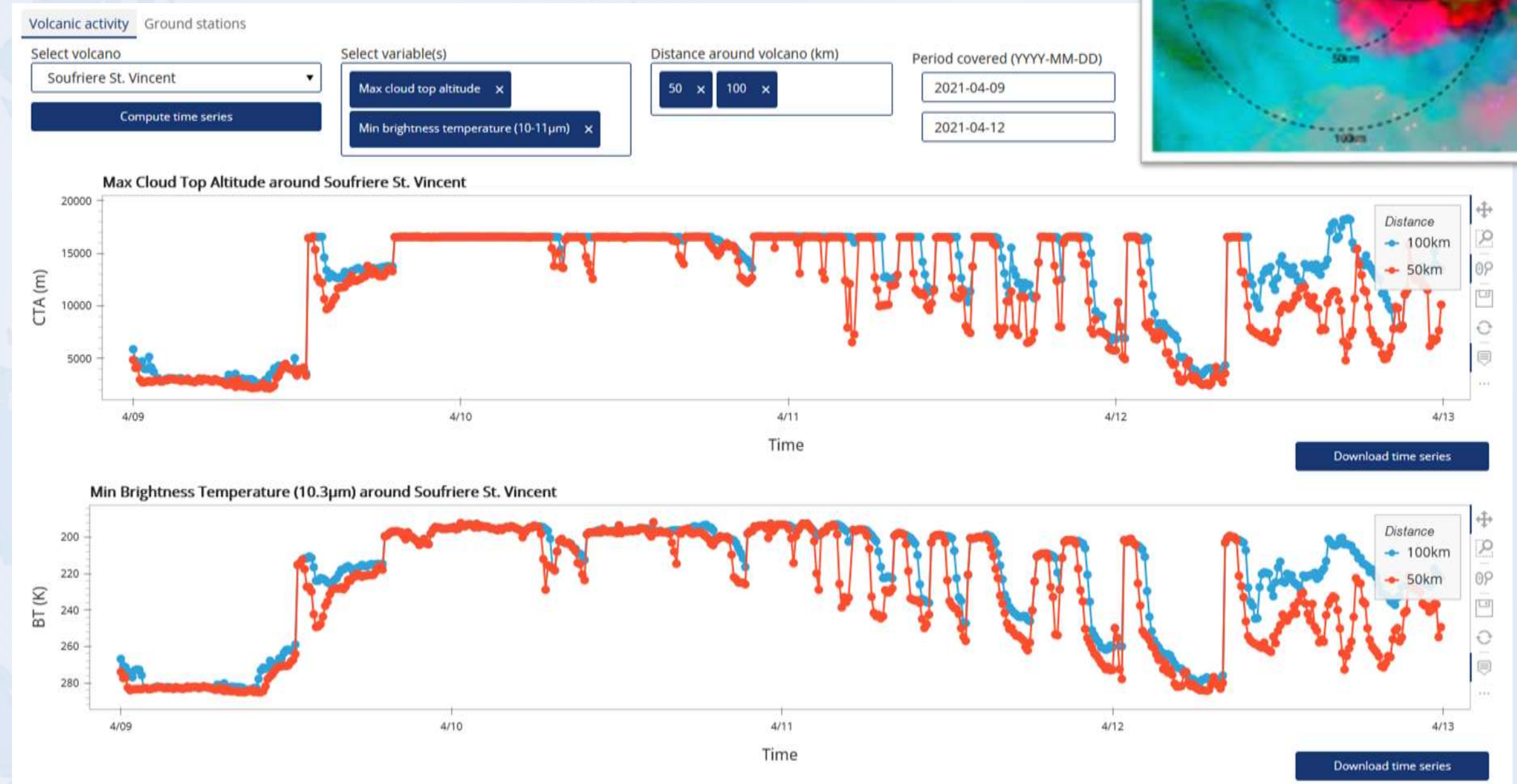
Compute time series of emission parameters around selected volcano

Select:

- Volcano (click on map or using selection widget)
- One or several distance(s)
- (will display corresponding circular area(s) around volcano)
- One or several variables of interest
- Period of interest

Click *Compute time series* to launch computation, log console will open for monitoring purposes

Time series can be downloaded as csv files



"Volcanic source" panel (2/3)

Time series of minimum brightness temperature around volcano

Information on brightness temperature (BT) is available from geostationary satellite observations at several channels sensitive to ash particles. For a given channel, the portal returns the minimum of brightness temperature values over a disk area centred at the volcano. The radius of the disk can be interactively chosen by the user. Minimum BT is a proxy of the altitude of the top part of the aerosol-rich plume.

Time series of plume-top altitude around volcano

NWC SAF CTTH products from geostationary satellite observations are used here to evaluate the altitude (and associated pressure and temperature conditions) reached by the top part of the ash-rich plume over the volcanic source with time.

Pixels corresponding to ash particles are isolated by applying a filter removing high semi-transparent cirrus clouds and keeping only opaque and high thick cloud pixels (*i.e.* keeping bits 2 to 4 and 9 to 12 of the CTTH_method parameter, see [reference](#)). The portal returns the maximum value of the altitude of these selected ash-rich pixels over a disk area centred at the volcano. The radius of the disk can be interactively chosen by the user. Note that this product is not suitable for altitude retrieval of stratospheric plumes.

"Volcanic source" panel (3/3)

Time series of daily SO₂ mass / mean cloud fraction (TROPOMI)

The computation returns daily SO₂ mass from TROPOMI observations (assumed altitude 1, 5 or 7km) by integration over a disk area centred at the volcano after a prior linear interpolation on a 0.05° regular grid. Integration over a circular domain allows for compensating cross-plume diffusion, without requiring prior knowledge of the direction of plume transport. The radius of the disk can be interactively chosen by the user.

Data points will be discarded for high SZA (default: 70°), low quality factor (default: 0). Interpolated SO₂ column amounts lower than a threshold value are ignored (default 0.5 DU). The fraction of points belonging to noisy edge tracks (default: 30 first and 30 last swath tracks) is also returned. Default values for these filters can be overridden by manually selecting widget values if TROPOMI data are previously loaded in the map panel.

The mean cloud fraction over the same disk area can also be computed as an auxiliary product. This information can be used to assess the quality of the daily SO₂ mass product as the presence of meteorological clouds can bias the in-plume SO₂ column amount retrieval. In the literature, a threshold of 30 % cloud fraction is commonly reported as a criterion for selecting reliable pixels.