



geohazards
tep



 EO.Lab
Earth Observation
& Geospatial Applications Lab

TERRADUE
Advancing Earth Science

Geohazards Thematic Exploitation Platform | GEP

TAT | June 2021

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Fabrizio Pacini | Terradue s.r.l.

International Forum on Satellite EO and Geohazards

GEP designed in the context of:

- Geohazards Supersite initiative (GSNL)
- CEOS Disasters Working Group

User-driven model for partnership and community building:

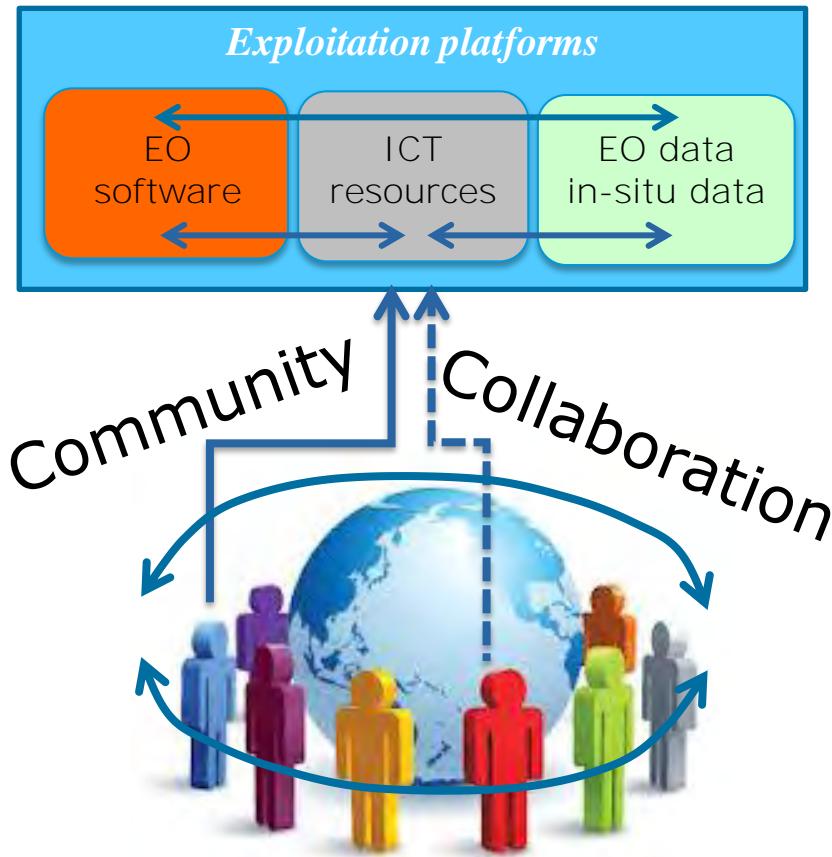
- Started from Int. Forum on Satellite EO and Geohazards organised by ESA and GEO in Santorini in 2012 (140+ participants)



ESA Thematic Exploitation Platforms | TEP

<https://tep.eo.esa.int>

“Move User activities to the Data”



Part of a set of R&D activities to create an ecosystem of interconnected Thematic Exploitation Platforms

Geohazards Exploitation Platform | GEP

<https://geohazards-tep.eu>



The Geohazards Exploitation Platform (GEP) is a cloud-based environment providing a set of EO processing services that allow mapping hazard prone land surfaces and monitoring terrain deformation.

tep
thematic exploitation platform
<https://tep.eo.esa.int>

 geohazards tep	 polar tep	 coastal tep
 hydrology tep	 urban tep	 forestry tep

GEP | Initial Consortium

<https://geohazards-tep.eu>

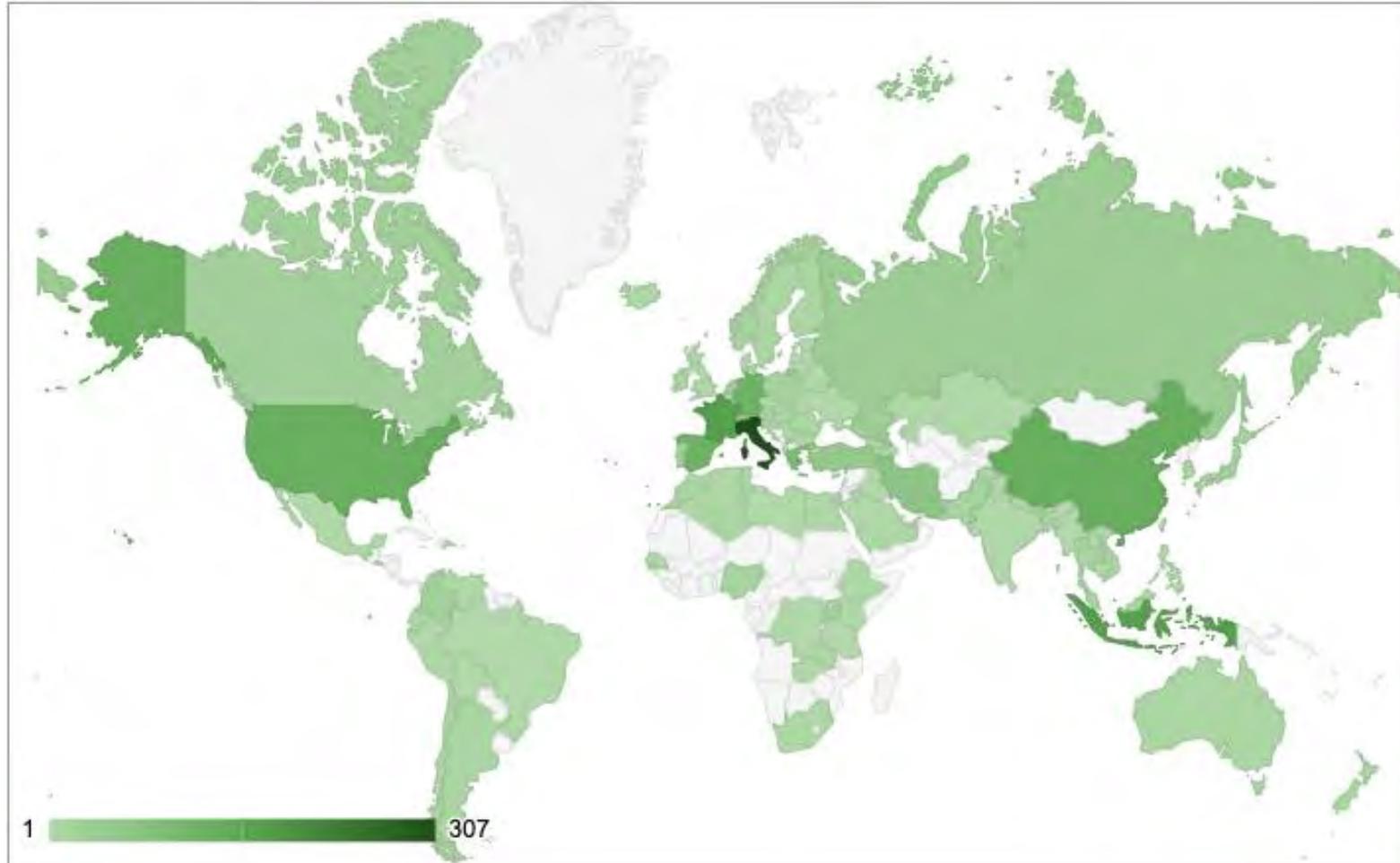


**Consortium: Terradue [lead] (IT), TRE ALTAMIRA (ES), CNR IREA (IT), DLR (DE),
EOST-CNRS (F), ENS-CNRS (F), INGV (IT)**

- Develop a Platform based on **virtualization & federation of satellite EO data and methods**
- Provide innovative responses to the **geohazards** community needs (services & support)
 - **On-demand processing** services to address AOI-specific analysis
 - **Systematic processing** services to address needs for “common information layers”
 - **Massive Cloud Compute** power, managing multi-tenant resources
 - **Access to Copernicus Sentinels-1/2/3 repositories**
 - **Access to 70+ TB of EO data archives (ERS and ENVISAT)**, and specific data collections from EO missions, such as JAXA’s ALOS-2, ASI’s Cosmo-Skymed and DLR’s TerraSAR-X, provided under special arrangements in the framework of the **CEOS WG Disaster** and the **GSNL**

GEP | Users Uptake (Geographic Locations)

Pre-Operations Reporting April 2021



#	Country	#users
1	Italy	307
2	France	169
3	Indonesia	167
4	United States	134
5	China	134
6	Spain	126
7	Germany	126
8	United Kingdom	101
9	India	94
10	Greece	94
11	Iran	94
12	Switzerland	94
13	Turkey	94
14	Russia	94
15	Canada	94
16	Colombia	94
17	Portugal	94
18	Poland	94
19	Netherlands	94
20	Austria	94
21	Japan	94
22	Uganda	94
23	Belgium	94
24	Philippines	94
25	Norway	94
26	Thailand	94
27	Pakistan	94
28	Nigeria	94
29	Morocco	94
30	Mexico	94
31	South Korea	94
32	Brazil	94
33	Chile	94
34	Argentina	94
35	United Arab Emirates	94
36	Taiwan	94
37	Romania	94
38	Singapore	94
39	Malaysia	94
40	Algeria	10
41	Tunisia	9
42	Sweden	9
43	Australia	9
44	Luxembourg	8
45	Ireland	8
46	Hungary	8
47	Finland	8
48	Vietnam	8
49	Slovenia	8
50	Peru'	8
51	New Zealand	8
52	Hong Kong	8
53	Egypt	8
54	Ecuador	8
55	Nepal	8
56	Czech Republic	8
57	Cyprus	8
58	Bangladesh	8
59	South Africa	8
60	Saudi Arabia	8
61	Rwanda	8
62	Perú	8
63	Lebanon	8
64	Kenya	8
65	Kazakhstan	8
66	Estonia	8
67	Denmark	8
68	Bulgaria	8
69	Venezuela	8
70	Ukraine	8
71	Tanzania	8
72	Sri Lanka	8
73	Slovakia	8
74	México	8
75	Lithuania	8
76	Israel	8
77	India	8
78	Iceland	2
79	Ethiopia	2
80	Dominica	2
81	Democratic Republic of the Congo	2
82	Czech Republik	2
83	Bolivia	2
84	Bhutan	2
85	Belarus	2
86	Zambia	1
87	Trinidad & Tobago	1
88	Swaziland	1
89	Serbia	1
90	Senegal	1
91	Republic of Kosovo	1
92	Qatar	1
93	Philippine	1
94	Peru	1
95	Malta	1
96	Lybia	1
97	Latvia	1
98	Laos	1
99	Kurdistan	1
100	Kenia	1
101	Guadalupe	1
102	Georgia	1
103	England	1
104	El Salvador	1
105	Dominican Republic	1
106	Danemark	1
107	Croatia	1
108	Cambodia	1
109	Brasil	1
110	Birmania	1
111	Bielorussia	1
112	Azerbaijan	1
113	Armenia	1
114	Albania	1
Grand Total		2298

The GEP has a total of **2298 registered users** from **114 countries** world wide

GEP | Advanced Users (Geographic Locations)

Pre-Operations Reporting April 2021



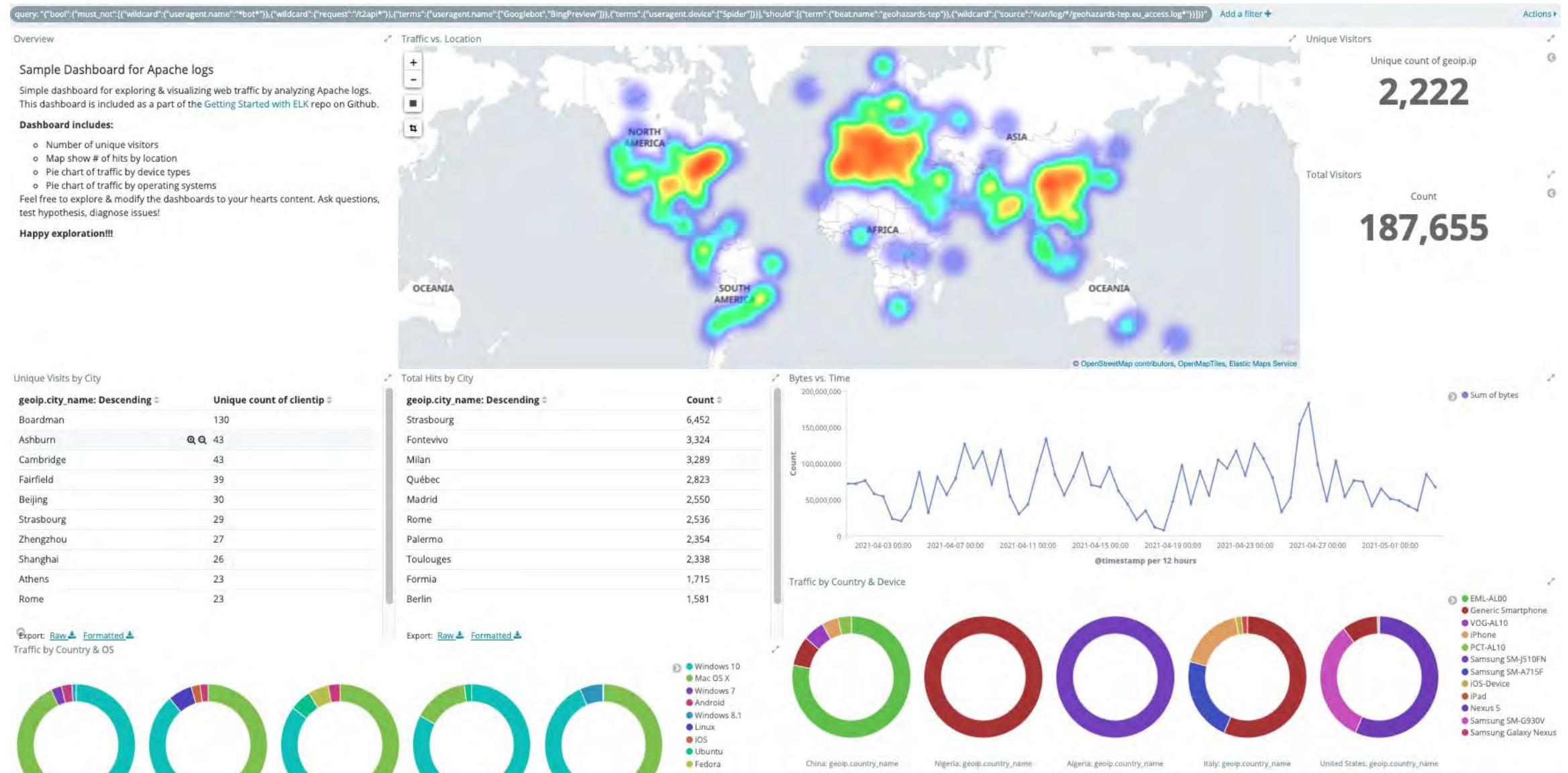
#	Countries	# of Users
1	Italy	55
2	France	40
3	Greece	39
4	Spain	34
5	United Kingdom	12
6	Uganda	11
7	Indonesia	11
8	Switzerland	10
9	United States	9
10	Germany	9
11	Turkey	6
12	South Korea	6
13	Thailand	5
14	Norway	4
15	India	4
16	Austria	4
17	Poland	3
18	China	3

The platform is also accessible via the **Network of Resources (NoR)** initiative

27	Sweden	35	Luxembourg	1
28	Singapore	36	Lithuania	1
29	Rwanda	37	Hungary	1
30	Portugal	38	Ethiopia	1
31	New Zealand	39	Ecuador	1
		40	Denmark	1
		41	Czech Republic	1
		42	Cyprus	1
		43	Chile	1
		44	Brazil	1
		45	Bhutan	1
		46	Argentina	1
			Grand Total	302

- 302 users (from 46 countries and 134 organisations) are carrying out projects on the platform with advanced access to GEP services

GEP Portal | Users visits and Geo-Distribution (Dec 2020)



GEP | Active Research Community

More than 8 papers based on GEP results publish in high level peer-reviewed journals during last semester



ARTICLE <https://doi.org/10.1038/s43247-020-0012-z> OPEN

Surface rupture and shallow fault reactivation during the 2019 Mw 4.9 Le Teil earthquake, France

Jean-François Ritz¹, Stéphane Baize², Matthieu Ferry³, Christophe Larroque³, Laurence Audin⁴, Bertrand Delouis³ & Emmanuel Matnot⁵

The Rhône River Valley in France, a densely populated area with many industrial facilities including several nuclear power plants, was shaken on November 11th 2019, by the Mw 4.9 Le Teil earthquake. Here, we report field, seismological and interferometric synthetic-aperture radar observations indicating that the earthquake occurred at a very shallow focal depth on a southeast-dipping reverse-fault. We show evidence of surface rupture and up to 15 cm uplift of the hanging wall along a northeast-southwest trending discontinuity with a length of about 5 km. Together, these lines of evidence suggest that the Oligocene La Rouvière fault was reactivated. Based on the absence of geomorphic evidence of cumulative compressional deformation along the fault, we suggest that it had not ruptured for several thousand or even tens of thousands of years. Our observations raise the question of whether displacement from surface rupture represents a hazard in regions with strong tectonic inheritance and very low strain rates.

scientific reports

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nature > scientific reports > articles > article

Article | Open Access | Published: 23 July 2020

Poorly known 2018 floods in Bosra UNESCO site and Sergiopolis in Syria unveiled from space using Sentinel-1/2 and COSMO-SkyMed

Deodato Tapete & Francesca Cigna

Scientific Reports 10, Article number: 12307 (2020) | Cite this article

881 Accesses | 2 Citations | 9 Altmetric | Metrics

Abstract

The instability situation affecting the Middle East poses threats to preservation of cultural



Volume 223, Issue 2
November 2020

< Previous Next >

Rupture kinematics of 2020 January 24 M_w 6.7
Doğanyol–Sivrice, Turkey earthquake on the East
Anatolian Fault Zone imaged by space geodesy

Diego Melgar, Athanassios Ganis, Tuncay Taymaz, Sotiris Valkaniotis,
Brendan W Crowell, Vasilis Kapetanidis, Varvara Tsironi, Seda Yolsal Çevikbilen,
Taylan Öcalan

Geophysical Journal International, Volume 223, Issue 2, November 2020, Pages 862–874,
<https://doi.org/10.1093/gji/ggaa345>

Published: 16 July 2020 Article history ▾

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nature > scientific reports > articles > article

Article | Open Access | Published: 04 June 2020

Sentinel optical and SAR data highlights multi-segment faulting during the 2018 Palu-Sulawesi earthquake (M_w 7.5)

Guillaume Bacques, Marçeló de Michele, Michael Foumelis, Daniel Raucoules, Anne Lemoine & Pierre Briole

Scientific Reports 10, Article number: 9103 (2020) | Cite this article

2215 Accesses | 3 Citations | 47 Altmetric | Metrics



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Using Growing-Season Time Series Coherence for Improved Peatland Mapping: Comparing the Contributions of Sentinel-1 and RADARSAT-2 Coherence in Full and Partial Time Series

Koenraad Millard¹, Patrick Kirby², Sashik Narinsath³, Amil Behramian², Sarah Banks² and Fabrizio Pacini⁴

¹ Department of Geography and Environmental Studies, Carleton University, Ottawa, ON K1S 5B6, Canada

² Landscape Science and Technology Division, Environment and Climate Change Canada, Ottawa, ON K1S 5B6, Canada

³ Space and ISR Applications Section, Defence Research and Development Canada, Ottawa, ON K2K 2Y7, Canada

⁴ TerraTide SL, 00165 Rome, Italy

Author to whom correspondence should be addressed

Remote Sens. 2020, 12(15), 2465; <https://doi.org/10.3390/rs12152465>

Received: 25 June 2020 | Revised: 27 July 2020 | Accepted: 29 July 2020 | Published: 31 July 2020

(This article belongs to the Collection Feature Papers for Session Environmental Remote Sensing)

GEP | Available EO missions

Copernicus Sentinel-1, Sentinel-2, Sentinel-3 and US Landsat-8 data available globally

Via the GEP Data Agency Catalogue, the Platform currently makes available for processing the **global coverage** of the following data collections:

- **Sentinel-1A/B:** (RAW, SLC, GRD and OCN) synchronized* with the Copernicus Open Access Hub
- **Sentinel-2:** (MSI L1C) synchronized* with the Copernicus Open Access Hub
- **Sentinel-3:** (OLCI, SLSTR) synchronized* with the Copernicus Pre-Operations Data Hub
- **Landsat-8:** (OLI and TIRS) synchronized* with the USGS EarthExplorer

GEP is primarily focusing on InSAR and Optical processing with Sentinel-1 and Sentinel-2

* *metadata*: complete catalogues published in NRT.

data: different solutions according to use case incl. co-located data & processing, on-demand data fetching, caching, etc.

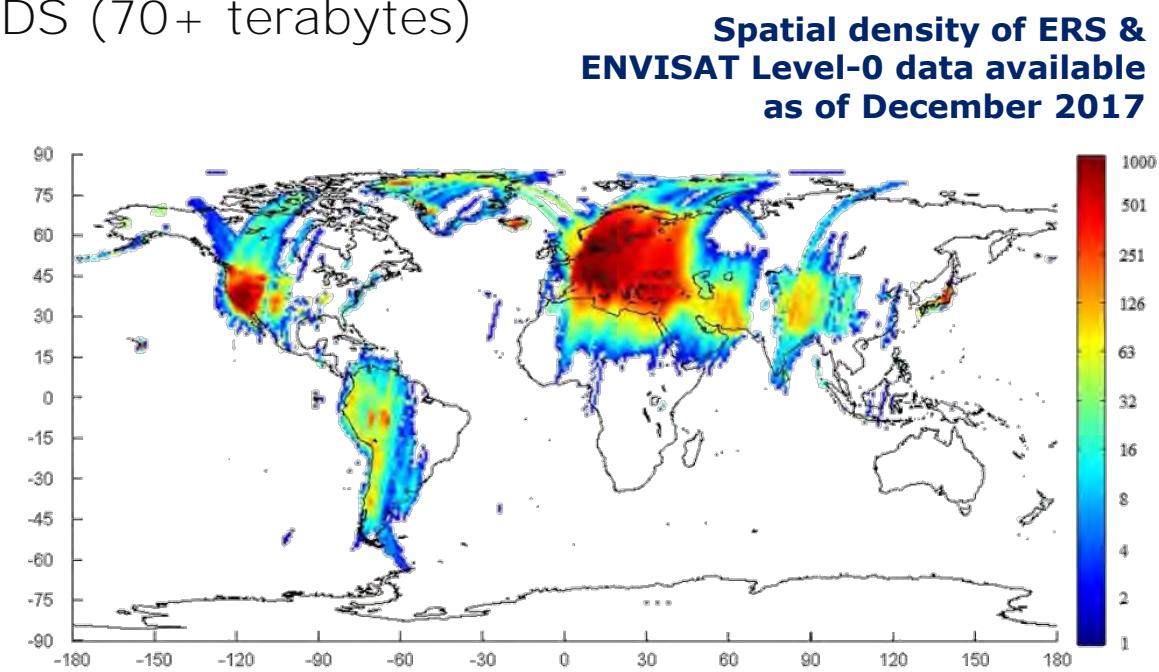
GEP | Other EO Resources

GEP has taken commitments about data access as per some recommendations associated to Fringe workshop

- The GEP provides on line access to ESA heritage EO missions data:
 - **ERS (SAR IM Level-0)**
 - **ENVISAT (ASAR IM Level-0)**
- Global coverage synchronized with the ESA OADS (70+ terabytes)

Through agreements with CEOS partners and project partners (CEOS Pilots and Geohazards Supersites), limited private collections of the following missions are made available for processing & download:

- **ALOS-2**
- **TerraSAR-X**
- **COSMO SkyMed**
- **RADARSAT-2**

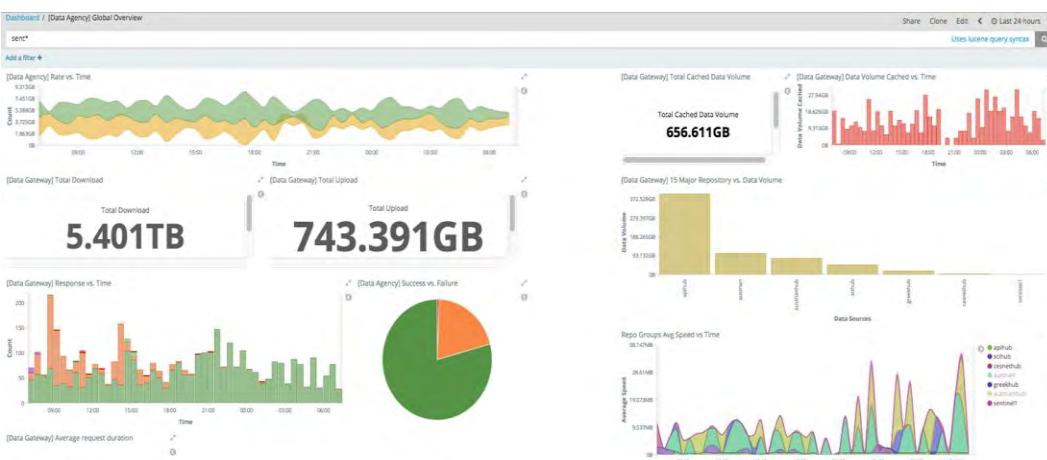


GEP | Cloud Platform - Data

Enhanced Data Gateway using OpenSearch

- Automatic multi-sourcing to optimise data access
- Programmable and systematic data caching
- Data usage accounting
- Personal cloud storage (repository)

Daily figures

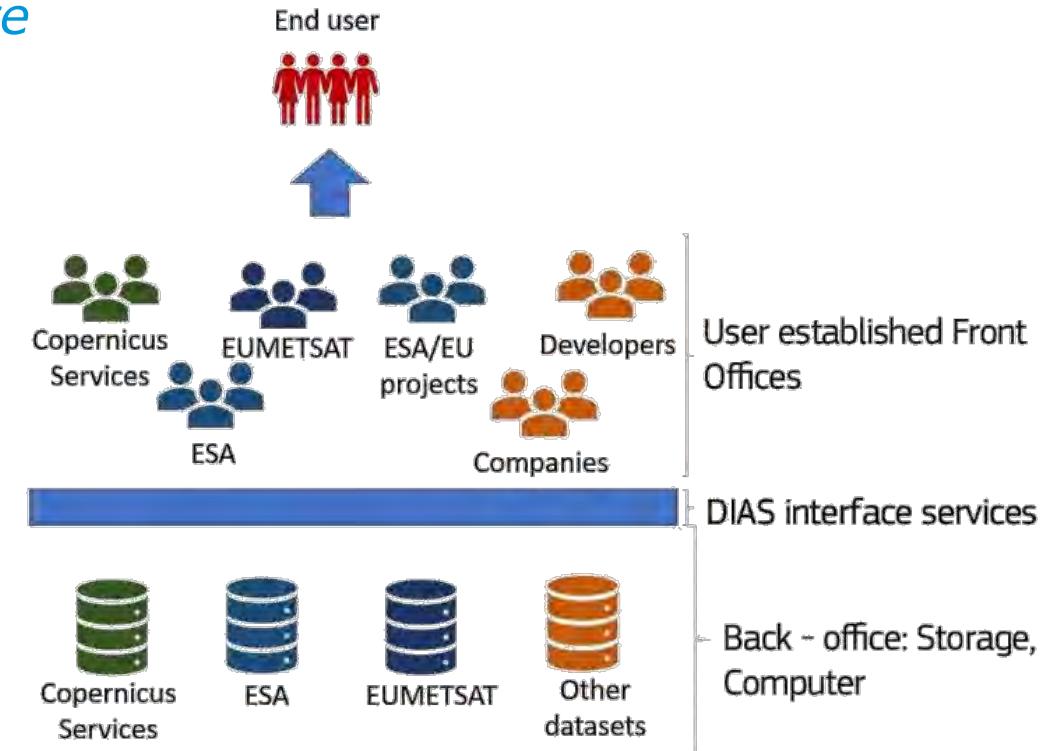


Copernicus Data and Information Access Services | DIAS

The European Commission (EC) has launched an initiative to develop Copernicus Data and Information Access Services (DIAS) that facilitate access to Copernicus data and information from the Copernicus services.



By providing data and information access alongside processing resources, tools and other relevant data, this initiative is expected to boost user uptake, stimulate innovation and the creation of new business models based on Earth Observation data and information.



GEP | Cloud Platform - Computing

Continuous Integration and Deployment Environment with
automatic packaging & deployment in production environments

Improved Production Center, with
(auto)scalability allowing cost-effective
data processing on Cloud Computing

Deployment in multiple Cloud-based
processing environments with no
lock-in on a Cloud provider

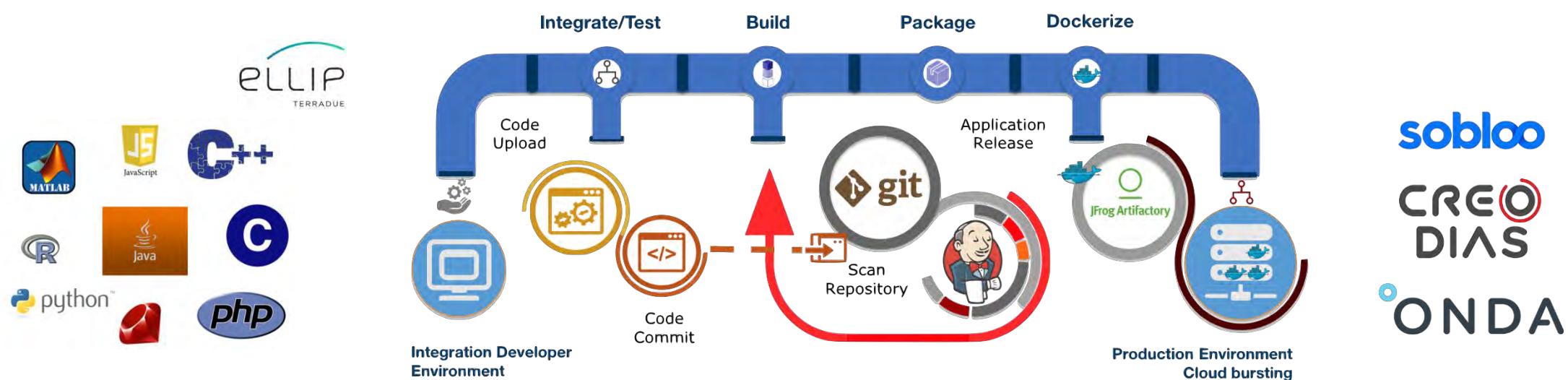


GEP | Application Integration

Applications developed in any programming language supported

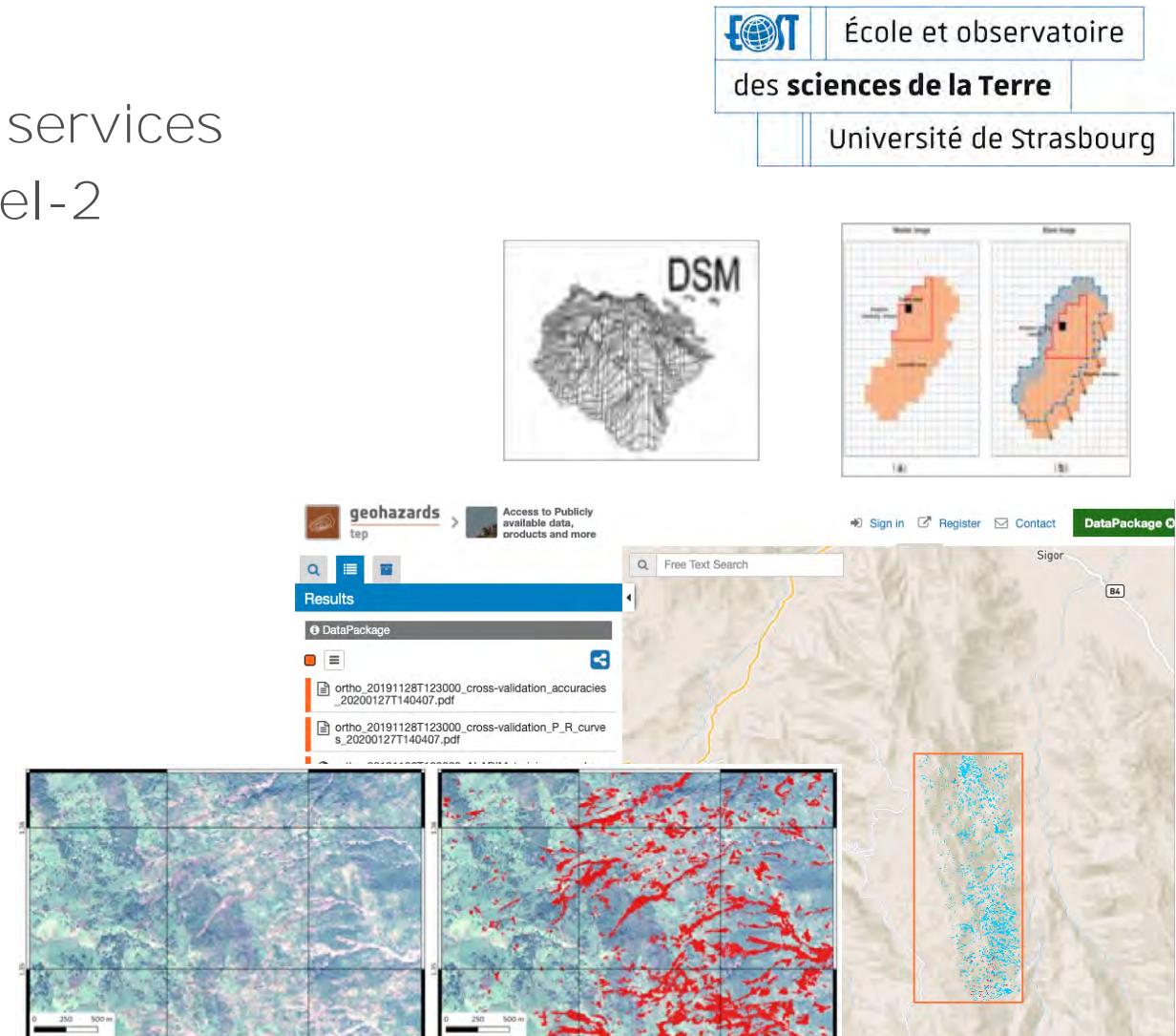
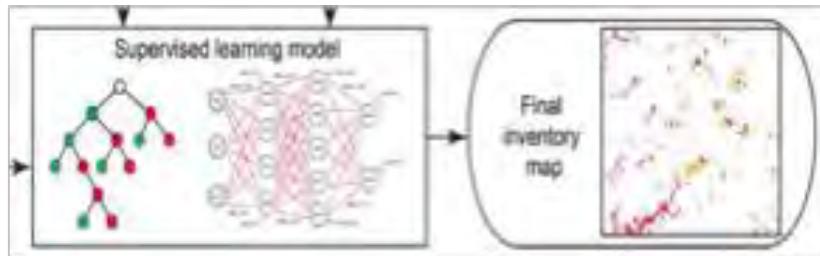
C/C++, Java, Python, Matlab and IDL

Continuous Integration and Deployment Environment with automatic packaging and deployment in production environments



GEP | Algorithm Hosting

- CNRS-EOST Strasbourg developed 3 services for landslide monitoring using Sentinel-2 and Pléiades data measuring:
 - Earth surface deformation
 - Digital surface Model
 - Automatic landslide detection based on Machine Learning



GEP | Data Exploitation: Target Reproducibility

- Exploring the Earth Observation Catalogues from a Jupyter Notebook accessing open APIs
- Analyse results as data structures
- Interactive processing and post-processing services enabling users to exploit and share the processing results

Define the catalogue endpoint to Sentinel-1:

```
In [14]: series = 'https://catalog.terradue.com/sentinel1/search'
```

Search for a post-event slave Sentinel-1 SLC product

```
In [15]: slave_search_stop_date = (dateutil.parser.parse(events.earthquakes[eq_index].date) + timedelta(days=6)).isoformat()
```

Define the end of the time of interest and look for a post event Sentinel-1 SLC slave between the earthquake event date and up to six days after:

```
In [16]: search_params = dict([('geom', aoi_wkt), ('start', events.earthquakes[eq_index].date), ('stop', slave_search_stop_date), ('pt', 'SLC'))]
```

Build and submit the catalog search:

```
In [17]: slave_search = ciop.search(end_point=series, params=search_params, output_fields='self,productType,track,enclosure,identifier,wkt,startdate', model='EOP')
```

Create a geodataframe with all candidate slaves plot them:

```
In [18]: aoi = loads(aoi_wkt)
```

The geodataframe can now be accessed:

```
In [20]: slaves
```

	aoi_intersec	contains	date	...
0	43.173406	False	2017-07-03T04:39:56.4681330Z	https://store.terradue.com/
1	100.000000	True	2017-07-03T04:39:31.6411240Z	https://store.terradue.com/
2	100.000000	True	2017-07-02T16:39:44.5117870Z	https://store.terradue.com/
3	82.375592	False	2017-07-02T04:47:15.0173420Z	https://store.terradue.com/
4	100.000000	True	2017-06-27T16:31:42.6303130Z	https://store.terradue.com/

By moving the slider, the slave on the map will be updated and clicking on it will show its information:

```
In [22]: interact(f, x=widgets.IntSlider(min=0,max=len(slaves)-1,step=1,value=0));
```

Visually the best slave is S1A_IW_SLC_1SDV_20161018T163206_20161018T163233_013547_015AEB_712A.

We can also query the geodataframe to get the slave the best covers the area of interest:

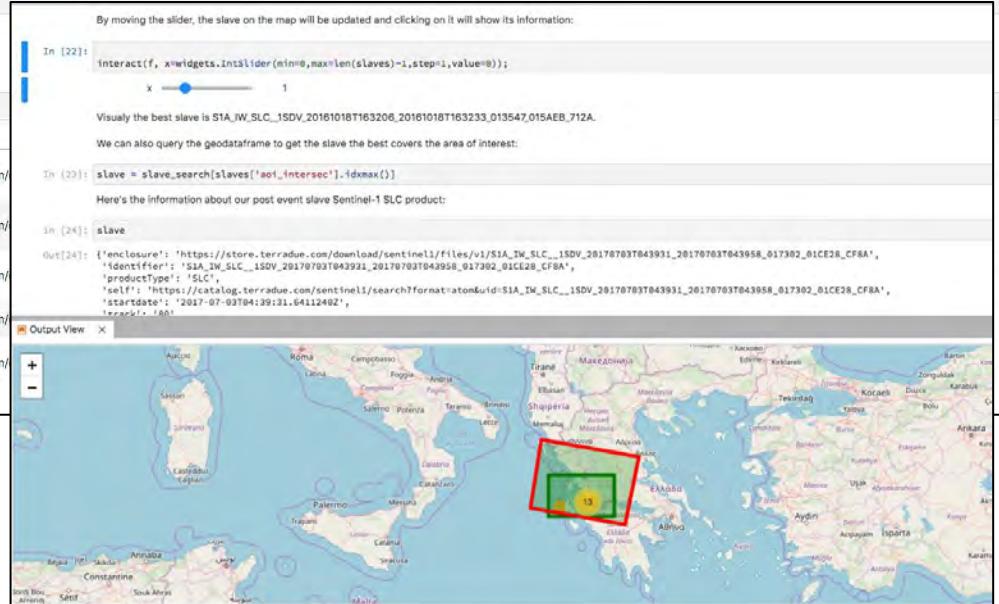
```
In [23]: slave = slave_search[slaves['aoi_intersec'].idxmax()]
```

Here's the information about our post event slave Sentinel-1 SLC product:

```
In [24]: slave
```

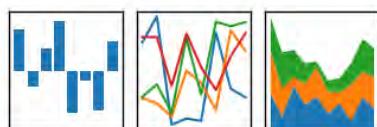
```
Out[24]: {'enclosure': 'https://store.terradue.com/download/sentinel1/files/v1/S1A_IW_SLC_1SDV_20170703T043931_20170703T043958_017302_01CE28_CF8A', 'identifier': 'S1A_IW_SLC_1SDV_20170703T043931_20170703T043958_017302_01CE28_CF8A', 'productType': 'SLC', 'self': 'https://catalog.terradue.com/sentinel1/search?format=json&uid=S1A_IW_SLC_1SDV_20170703T043931_20170703T043958_017302_01CE28_CF8A', 'startdate': '2017-07-03T04:39:31.6411240Z', 'track': 801}
```

Output View X



pandas

$$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$$



GEP | Data Exploitation: Access to EO Products

Notebooks
documenting how to
plot and analyse
Sentinel data

```
In [5]: import numpy as np
import matplotlib
import matplotlib.pyplot as plt
import matplotlib.colors as colors

%matplotlib inline

def plotBand(product, band, vmin, vmax):
    band = product.getBand(band)

    w = band.getRasterWidth()
    h = band.getRasterHeight()

    band_data = np.zeros(w * h, np.float32)
    band.readPixels(0, 0, w, h, band_data)

    band_data.shape = h, w

    width = 12
    height = 12
    plt.figure(figsize=(width, height))
    imgplot = plt.imshow(band_data, cmap=plt.cm.binary, vmin=vmin, vmax=vmax)

    return imgplot

plotBand(terrain, 'Sigma0_0' + polarization, 0, 0.3)

Out[5]: <matplotlib.image.AxesImage at 0x7f6e2370e90>
```



* Step 4: Plot an RGB image

```
In [6]: red_radiance = reproject.getBand('Oa08_radiance')
green_radiance = reproject.getBand('Oa05_radiance')
blue_radiance = reproject.getBand('Oa04_radiance')

w = red_radiance.getRasterWidth()
h = red_radiance.getRasterHeight()

red_radiance_data = np.zeros(w * h, np.float32)
red_radiance.readPixels(0, 0, w, h, red_radiance_data)
red_radiance_data.shape = h, w

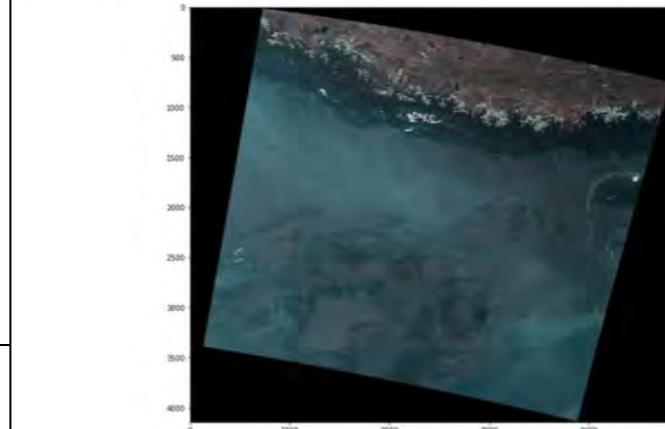
green_radiance_data = np.zeros(w * h, np.float32)
green_radiance.readPixels(0, 0, w, h, green_radiance_data)
green_radiance_data.shape = h, w

blue_radiance_data = np.zeros(w * h, np.float32)
blue_radiance.readPixels(0, 0, w, h, blue_radiance_data)
blue_radiance_data.shape = h, w

xmax=200
red = (red_radiance_data*256/(xmax-np.amin(red_radiance_data)))
green = (green_radiance_data*256/(xmax-np.amin(green_radiance_data)))
blue = (blue_radiance_data*256/(xmax-np.amin(blue_radiance_data)))

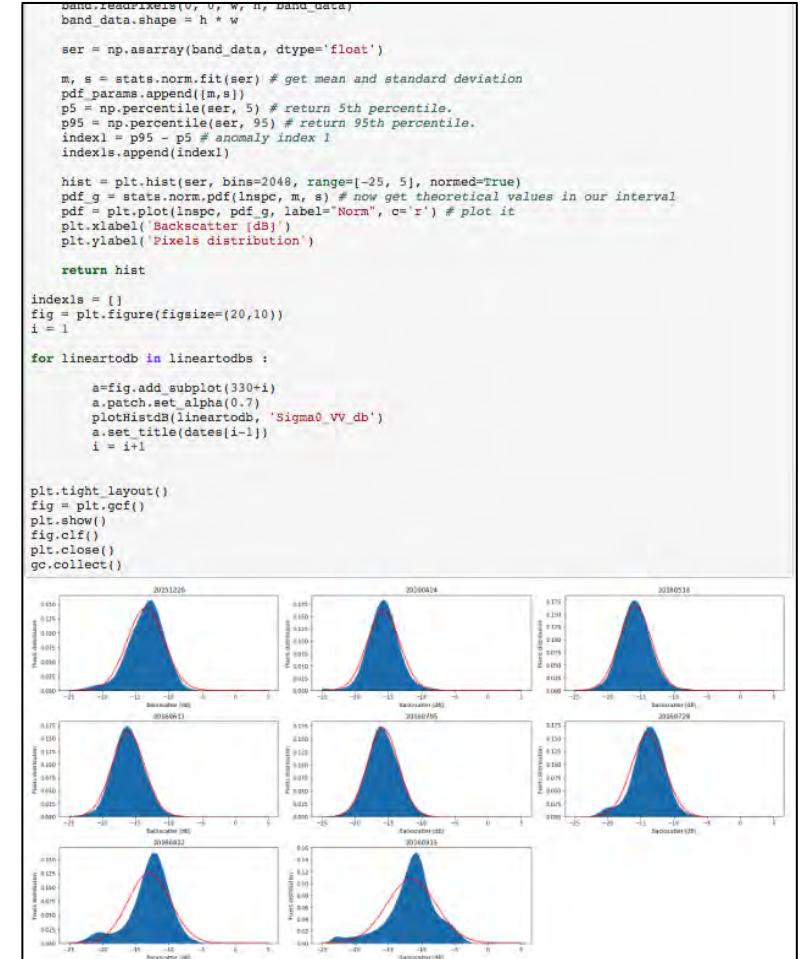
rgb_uint8 = np.dstack((red, green, blue)).astype(np.uint8)

width = 12
height = 12
plt.figure(figsize=(width, height))
img = Image.fromarray(rgb_uint8)
imgplot = plt.imshow(img)
```



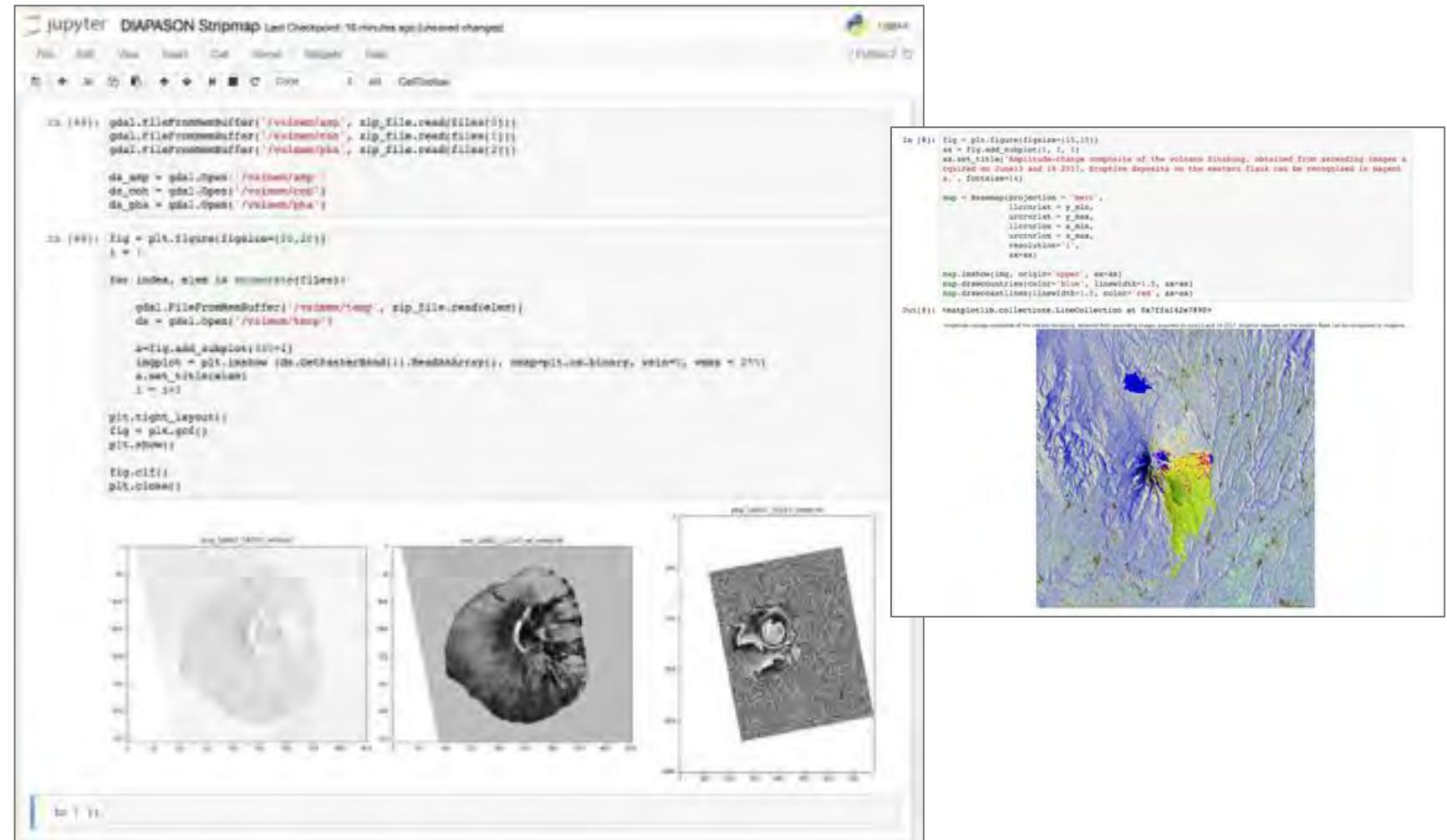
GEP | Data Exploitation: Time Series Analysis

- Notebook analysis of a stack of Sentinel-1 data
- Backscatter profiles for reference image used in flood analysis



GEP | Data Exploitation: Invoking Services

- Invoking GEP services from a notebook
- GEP Processing Service over active volcano (Fogo) through a OGC API



GEP | New Initiatives / Projects



Extend and diversify sources of funding through new stakeholders, by providing access to services in support of:



- The **International Charter**: Space and Major Disasters
- **EPOS**: Satellite Data Thematic Core Service
- **Alpine Region**: Landslide Geo-Information Services (EO4Alps)
- World Bank Landslide Hazard Inf. System for Disaster Risk Financing
- Indonesian government: capacity building on hazard & risk mapping (via ESA & Asian Development Bank collaboration agreement)
- Various training programmes organised with partner organisations such as IGME, INDRA, IGN, BRGM and AUTH; for training classes in Indonesia, Greece, Germany, UAE, **Spain**, **Switzerland**...

GEP | Services Offering

- Copernicus Sentinel EO missions complemented by commercial High Resolution Optical & Radar missions and geohazards community derived products
- The deployment of processing services relies on several Copernicus DIAS and Cloud providers, in a constant search of optimization of the overall costs
- Publicly available price-list
 - GEP Service packs onboarded on the NoR marketplace

<https://nor.cloudeo.group/geohazards-tep-gep-operational-algorithm-hosting>

GEP | Services Offering

- The hosted EO services on GEP are provided either on a pay per use basis or via subscription
 - These services encompass on-demand and systematic generation and delivery of Value Added products, as well as the ability for expert users to integrate customized EO services.
- The service production cost is based on tailored components including
 - Cost for EO data (when licensed, commercial data are used),
 - Cloud processing resources
 - Support from VA service owners (including license fees when relevant) and the cost for the Platform operations

GEP | Target Users

- Privileged channel for subscribers to the GEP Services to renew their subscriptions, or newcomers to engage with us
 - Geohazards analyst (i.e. principal investigator, researcher, scientific engineer, PhD student, trainee) interested in data processing
 - A service or data provider interested to connect resources for their use via the Platform,
 - An organization interested in receiving training in specific topics
- GEP is ready to help you in leveraging ESA and European Union initiatives for requesting sponsorship (vouchers) for your forthcoming GEP activities (<http://bit.ly/GEP-NoR>)

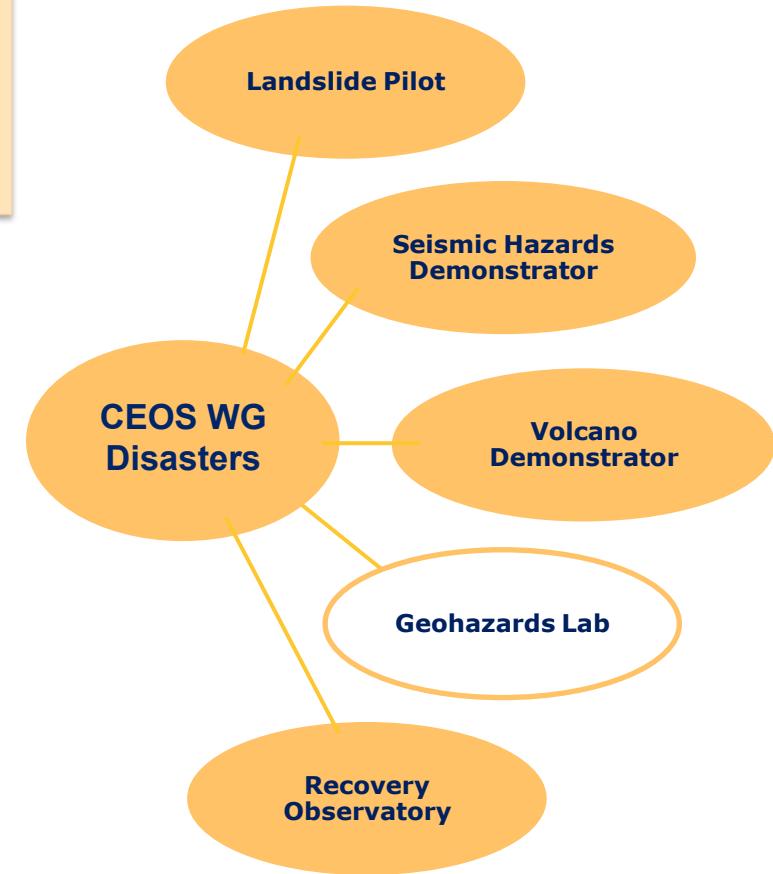
CEOS Working Group Disasters | Geohazards Lab

The **CEOS WG Disasters** aims to **increase and strengthen satellite Earth observation contributions to the various Disaster Risk Management (DRM) phases** and to **inform decision-makers and major stakeholders on the benefits of using satellite Earth Observations** in each of those phases.

Geohazards Lab: An initiative within WG Disasters

A platform with federated resources to provide data access and an online processing and e-collaboration environment to exploit EO data to assess geohazards and their impact

- ✓ Supports and complements the **CEOS WG Disasters activities** (on-going pilots, follow-on activities and the RO), **GSDL**, **GEODARMA** and users from the broader geohazards community.
- ✓ Maximize use of EO techniques and cloud processing by the EO expert community
- ✓ Achieve acceptance of EO products by the non-EO scientific community and decision makers



Geohazards Lab - Take-home Messages

Benefit from **fast access to EO data, storage capacity and processing resources offered by platform-based solutions**

A hosted processing platform is a **partnership** that needs the support of scientist/developer to offer operational services providing value added information to the community

Platform **e-collaboration and reproducible knowledge** promote innovation and response capacity

Communities remain owners of their created assets, and decide how to share these on the platforms

Bertrand Delouis Retweeted
Stéphane Baize @stef92320
Thanks to an amzing work by InSAR guys (@emmanuelmathot @RaphaelGrandin @SotisValkan), we could trace the deformation zone & find out that a surface rupture actually occurred during the M4.9 11/11/19 Le Teil #earthquake. Tiny offset or fissuring, still there when InSAR suggests

ESA @esa Following
A 7.5-magnitude earthquake and tsunami hit #Indonesia on 28 September, destroying s. Geological ted displacement J #Sentinel2

Sotiris Valkaniotis @SotisValkan Follow
Shallow afterslip following M7.5 Palu #earthquake. 12-day interferogram (Oct4-Oct16) from ascending pair of #Sentinel1, w/DIAPASON at @esa_gep. Patches of afterslip follow the ruptured plane (hangingwall), small higher peaks found along the trace. Each fringe is ~2.8cm LOS.

Geohazards-Tep @esa_gep · Oct 17 New @ZENODO_ORG Geohazards Community entry from @SotisValkan:
Differential Interferogram of the September 16 2018 Mw 5.3 earthquake Lake Muir, Perth, Australia
DOI: doi.org/10.5281/zenodo... @OpenAIRE_eu
zenodo.org/record/146471...

Sotiris Valkaniotis @SotisValkan
Released dataset: Differential Interferograms of the Sep.16 2018 Mw 5.3 #earthquake Lake Muir, Perth, #Australia. Produced with SNAP/DIAPASON at @esa_gep doi.org/10.5281/zenodo...



GEP On-Demand and Systematic Services

TAT | June 2021

Michael Foumelis | Aristotle University of Thessaloniki (AUTH)

Fabrizio Pacini | Terradue s.r.l.

Geohazards Services Portfolio

- **25+ on-demand services** using Optical & SAR data grouped in Thematic Apps organized by Community Managers
- New basic services providing full resolution, band combinations and change detection imagery for rapid **online visualization**
- **Systematic and event-triggered** services delivering continuously updated information
- Service Portfolio to grow with new Initiatives and Projects
 - World Bank Landslide Hazard Inf. System for Disaster Risk Financing
 - EO4Alps Landslide Geo-Information Services for the Alps
 - Disasters Charter Processing Environment

GEP | Hosted Processing Services

The screenshot displays the GEP geohazards platform interface. On the left, a map of Europe shows various geological and hydrological hazards. A red dashed rectangle highlights a specific area, and several orange ladders are overlaid on the map, indicating active processing or monitoring. Below the map, a timeline shows data from June 15, 2014, to June 24, 2018. A legend indicates a 300 km scale bar. On the right, a "Processing Services" catalog lists numerous EO-based products and services, each represented by a colored box with a logo and a brief description. The services include RASTER, GMT5SAR Sentinel-1, COI, SNAC, SNAP InSAR, COIN, DIAPASON Sentinel-1, COMBI, STEMP L-8, STEMP S-2, eGEOS SAR Flood, SRTM x InSAR, ADORE DORIS, STAMPS PS, PSI Post-Proc, MineSAR, COREG, SBAS Stripmap, PF-ERS, GAMMA Level-0, and GAMMA DInSAR.

The platform is continuously expanding including a broad range of on-demand and systematic products and services, to support EO practitioners and end-users to better understand geohazards and their impact [10.1109/IGARSS.2019.8898304].

Examples of GEP Services | COIN (Alps region)

geohazards

Main area

Riedenau

Kempten

Hüllendorf

Kaufbeuren

Weingarten

Rosenheim

Traunreut

Baier Reith

Mülhouse

Singen

Schaffhausen

Wangen im Allgäu

Penzberg

Fischbachau

Oberammergau

Ettal

Reit im Winkl

Kitzbühel

Saalfelden

Innsbruck

Brixen

Bruneck

Mayrhöfen

Meran

Bolzano

Trento

Ampezzo

Terme

Arco

Conegliano

Vittorio Veneto

Portogruaro

Verbania

Lecco

Palazzolo

Luminozane

Arco

2005-01-01

2020-01-23

20 km

Terradue

Lon: 11.146 Lat: 45.652

Current search result

Discovery feed for local data

Total results: 7

Features Basket

Data Packages

No results found.

Total results: 0

set.all

inv.sel.

Remove all

Save

coh_sigmaAvg_IW_VV_06May2018_18May2018_Coh_Ampl

coh_coherence_IW_VV_06May2018_18May2018_coherence_IW_VV_06May2018_18May2018

Products

Store Upload

EO Data

EO-based products

Community

Private

Processing Services

COIN_Harmaliere

Job Info

Job Name: COIN_Harmaliere

Wps Job Id: 32a01cf7-d2fa-467c-a6a4-83eaf8eae2ea

Processing service: COIN – Coherence and Intensity change for Sentinel-1

Started at: Jun 19th 2018 13:45

Created by: Michael Foumelis

Status/Result Location:

Status: Success

Visibility: restricted

Share

Amplitude Change RGB Composite

Parameters

Name	Value
master	https://catalog.terradue.com/sentinel1/search? format=json&uid=S1A_IW_SLC_1SDV_20180506T171509_20180506T171536_021787_025996_90E8
slave	https://catalog.terradue.com/sentinel1/search? format=json&uid=S1A_IW_SLC_1SDV_20180518T171509_20180518T171536_021962_025F27_471B
polarisation	VV
orbittype	Sentinel Precise (Auto Download)
cohWinAz	10
cohWinRg	40
demtype	SRTM 3Sec

Examples of GEP Services | SNAC (Floods in Laos)

The screenshot displays a geospatial web application interface. At the top left, there's a navigation bar with icons for 'geohazards' and 'Main area'. On the right, there are buttons for 'Upload Data', 'Products', and dropdown menus for 'EO Data', 'EO-based products', 'Community', and 'Private'.

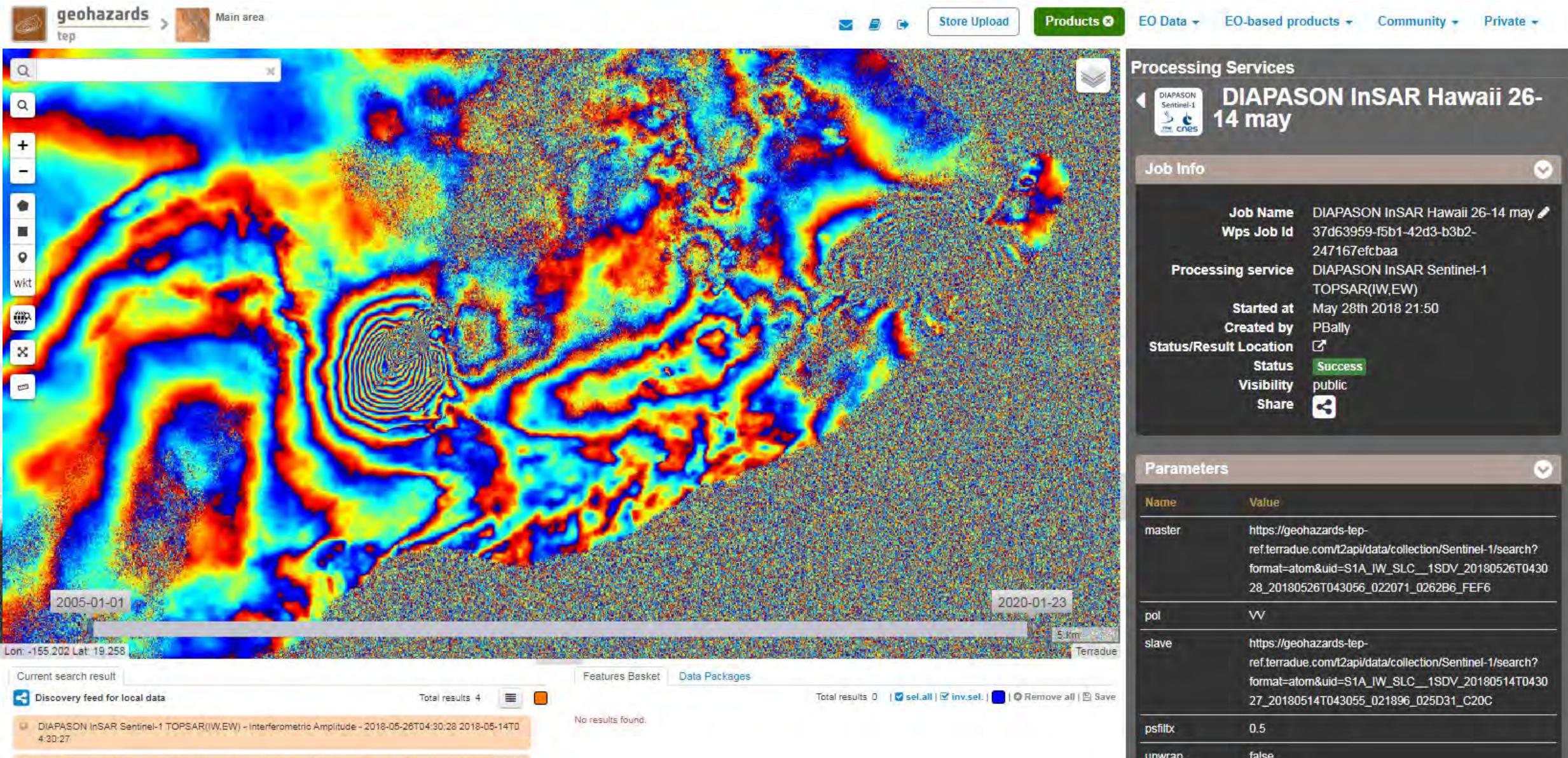
The main area features a satellite map of a river system in Laos. A large red polygon highlights a flooded area. A legend on the left indicates the date range from '2005-01-01' to '2020-01-23'. A scale bar shows '2 km'. Below the map is a 'Features Basket' section with a 'Discovery feed for local data' button. It lists three results:

- S1_GRD_VV_20180705_20180729_RGB_Amplitude_Change.tif
- S1A_IW_GRDH_1SDV_20180705T224418_20180705T224443_022665_0274AF_8B63_Orb_Cal_ML_TC_DB.tif
- S1A_IW_GRDH_1SDV_20180729T224419_20180729T224444_023015_027F8D_B944_Orb_Cal_ML_TC_DB.tif

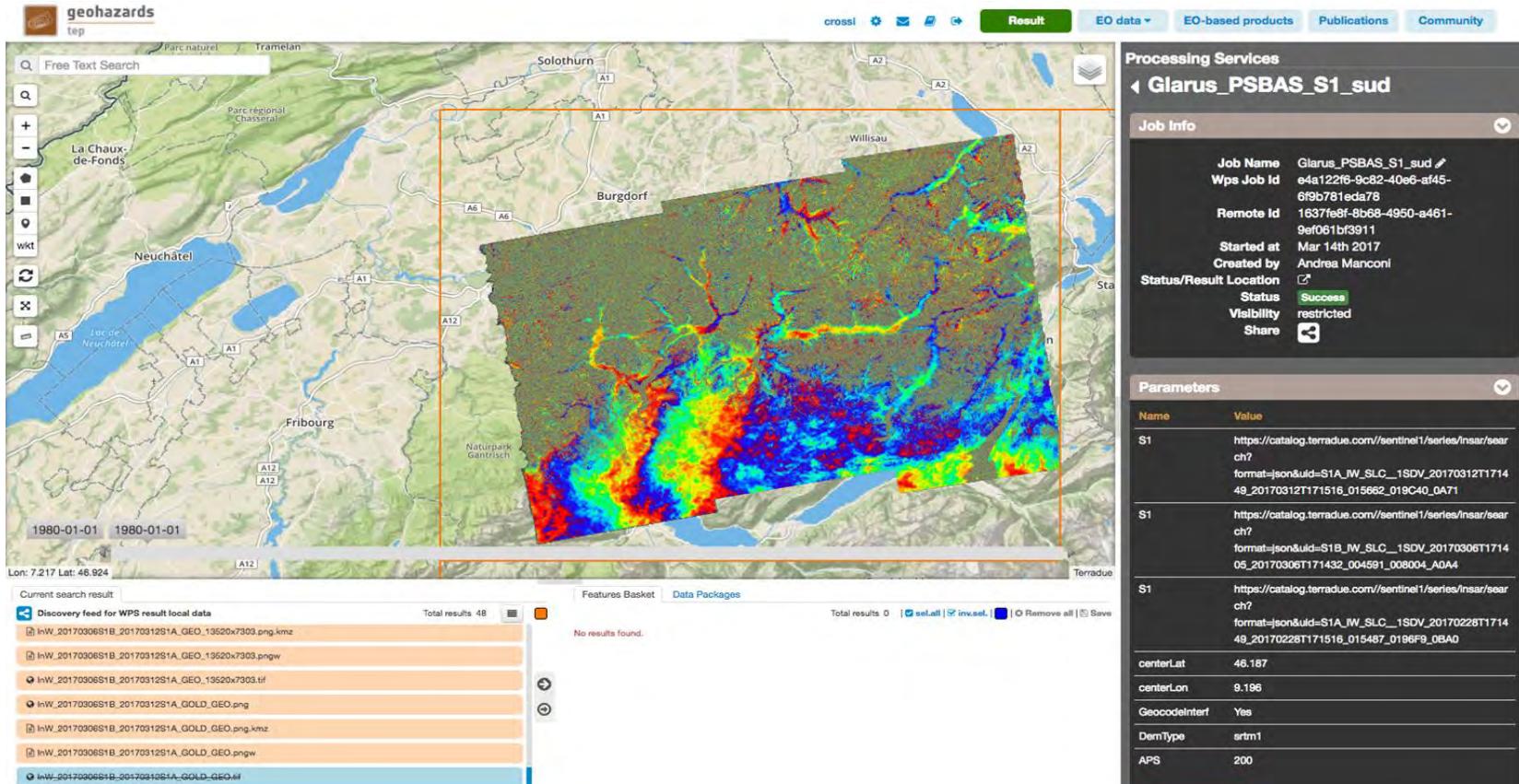
To the right of the map is a processing service interface titled 'SNAC - Flood in Laos July 2018'. It includes sections for 'Job Info' (with details like Name: SNAC - Flood in Laos July 2018, ID: 3cbdd96e-earf-494e-a672-cc1da220e706, Processing service: SNAC - SNAP S1 GRD Amplitude Change, Started at: Oct 19th 2018 10:51, Finished at: Oct 19th 2018 11:00, Created by: Mauro Arcorace, Status: Success, Visibility: public), 'Parameters' (with entries for master, slave, polarisation, SubsetBounding, Box, and pixelSpacingInM), and a 'Share' section.

Below the processing service interface is a color calibration chart titled 'SNAC Amplitude Change RGB Composite' with axes for 'Slave Backscatter σ⁰ [dB]' and 'Master Backscatter σ⁰ [dB]'. The color scale ranges from blue (-15 dB) to red (5 dB).

Examples of GEP Services | DIAPASON (Kilauea Eruption)



GEP | P-SBAS On-demand Processing Service



<https://geohazards-tep.eu>

Will be
supported by
BELNET-BEGRID (Belgium)

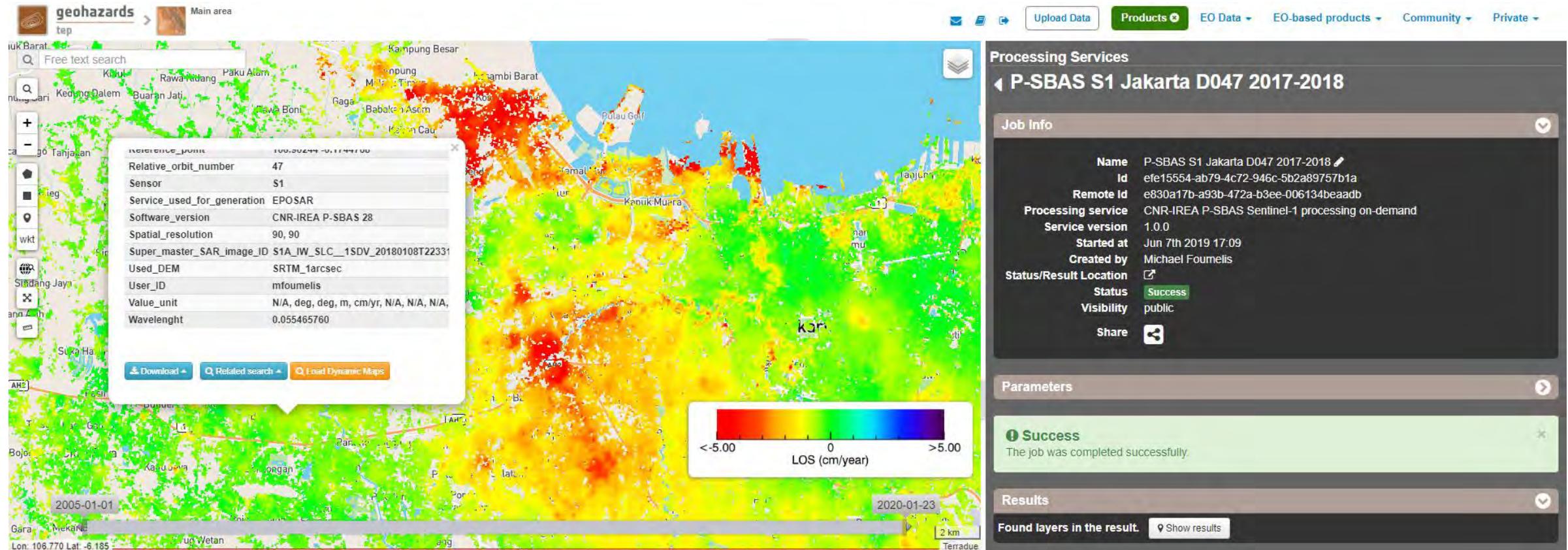


CNR-IREA P-SBAS Sentinel-1 processing on-demand

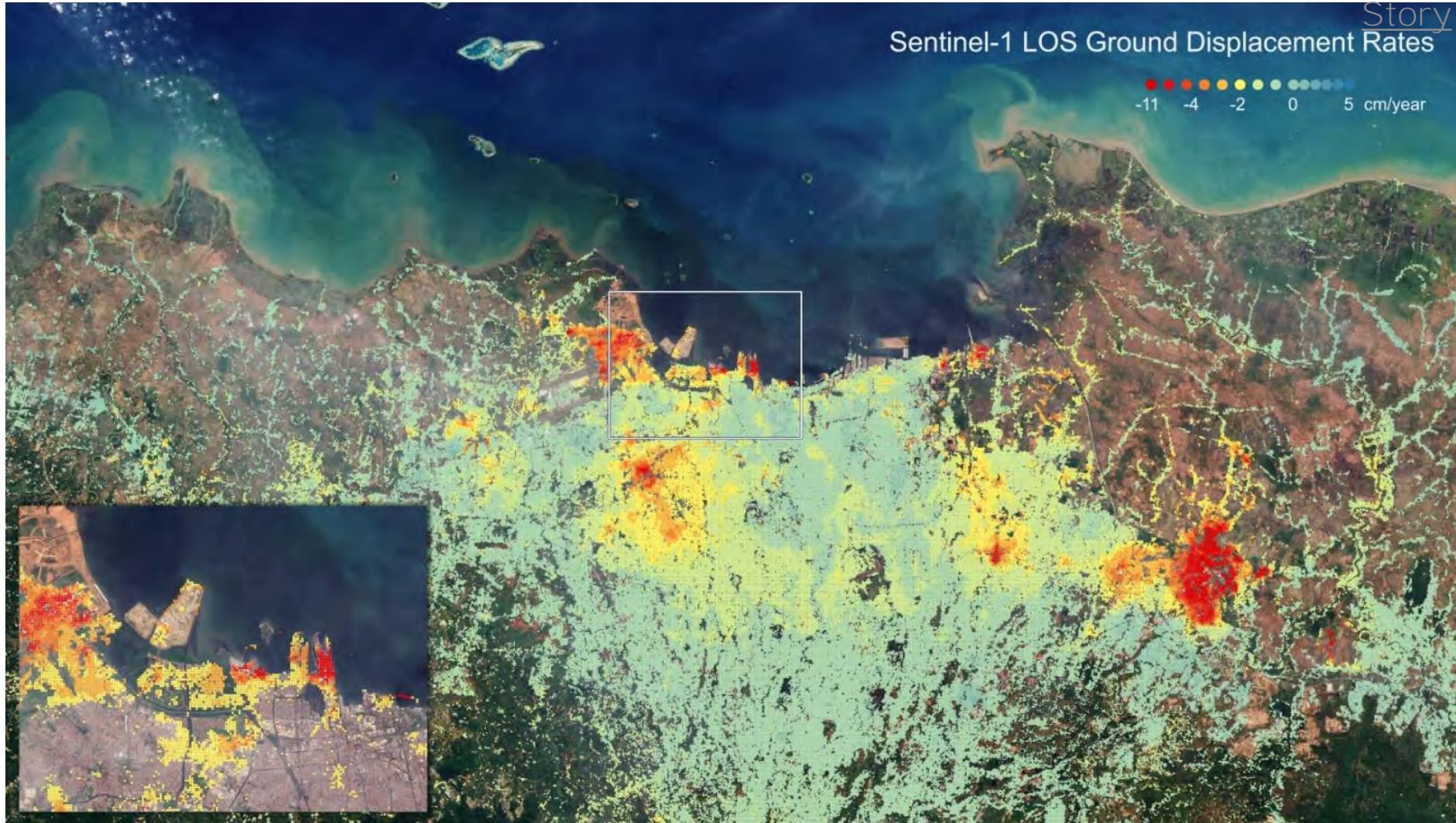
P-SBAS stands for Parallel Small BAseline Subset and it is a DInSAR processing chain for the generation of Earth deformation time series and mean velocity maps. Input: SLC (Level-1) Sentinel-1 data.



GEP | P-SBAS Subsidence in Jakarta

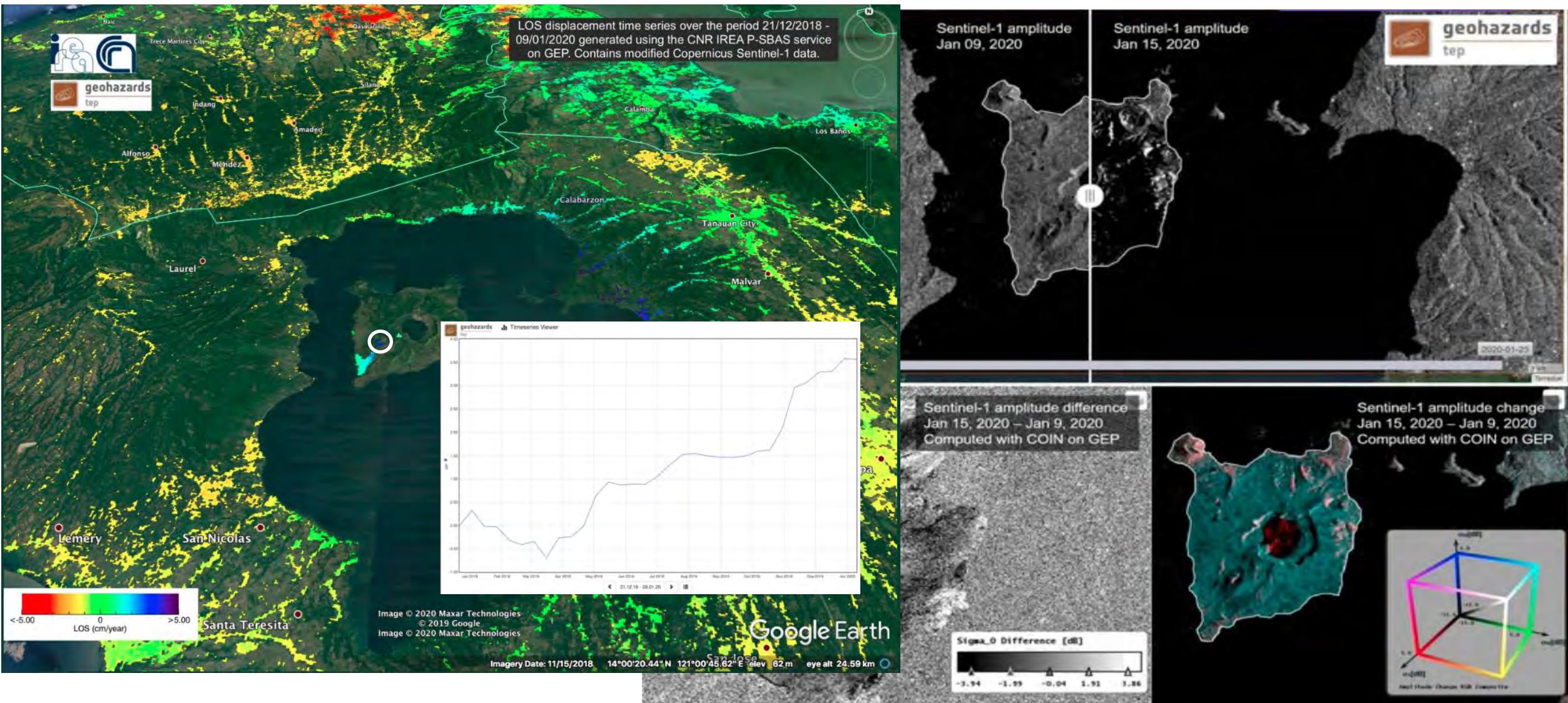


Using Satellite Information to Help Rebuild After a Disaster



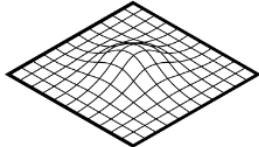
Contains modified Copernicus
Sentinel-1 data (2015-2020),
processed by BRGM via GEP

GEP | P-SBAS Taal Volcano (Philippines)



SNAPPING | Surface motion mAPPING service

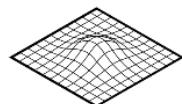
by AUTH, MJaen & TerraDue



SNAPPING
SURFACE MOTION MAPPING

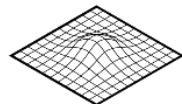
A multi-temporal interferometric service that produces measurements of surface displacements based on ESA SNAP and StaMPS software packages

A two step process:



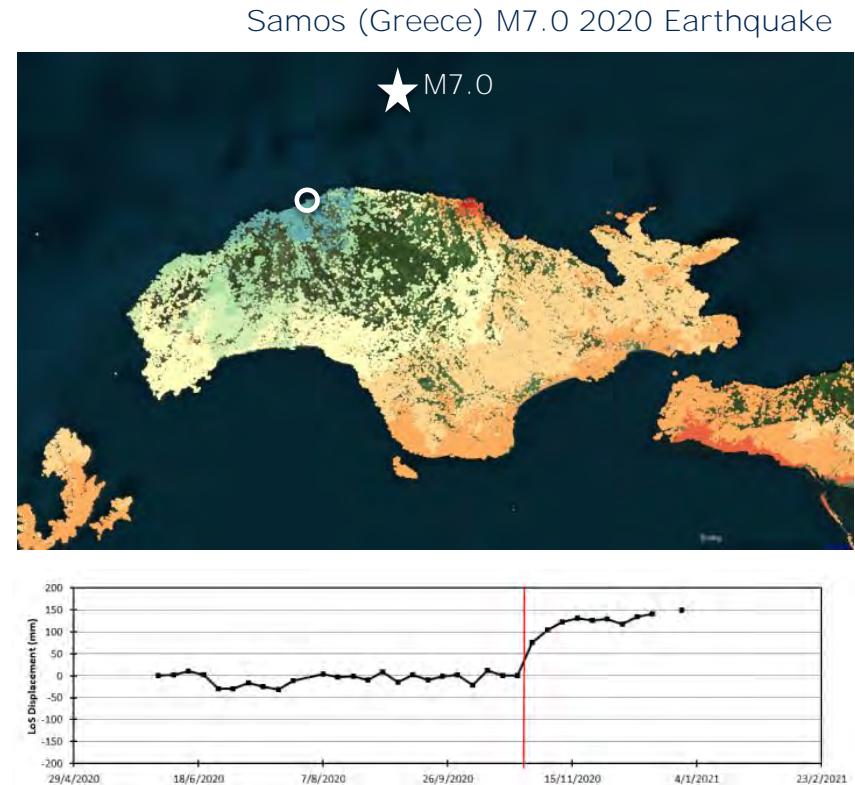
**SNAPPING
IFG**

The first consists in setting-up **SNAPPING IFG** processing pipeline to generate the interferogram stack:



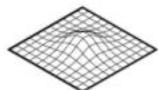
**SNAPPING
PSI**

In the second step the interferogram stack is channeled to the **SNAPPING PSI** pipeline for time series analysis



SNAPPING Visualizer | Rome (Italy)

Tailored visualization as (off-line) standalone HTML file accessible to end-users with limited internet access and without the need for ingestion into any geospatial database for inspection of measurements.



SNAPPING
SURFACE MOTION MAPPING

SNAPPING Visualizer

SNAPPING PSI Displacements rates processed on GEP | Observation period 01/2018-12/2020 (92 images) from Relative Orbit 117



© Contains modified Copernicus Sentinel-1 data [2018-2020]



geohazards
tep

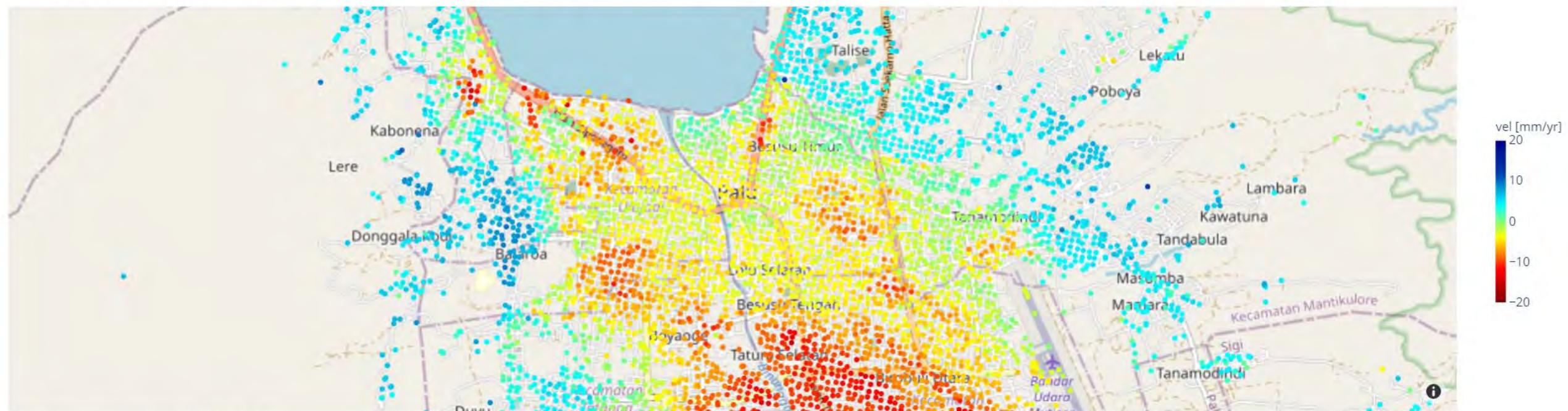
GEP Community Training

SNAPPING Visualizer | Palu (Indonesia)



SNAPPING Visualizer

SNAPPING PSI Displacements rates processed on GEP | Observation period 10/2018-12/2020 (115 images) from Relative Orbit 134



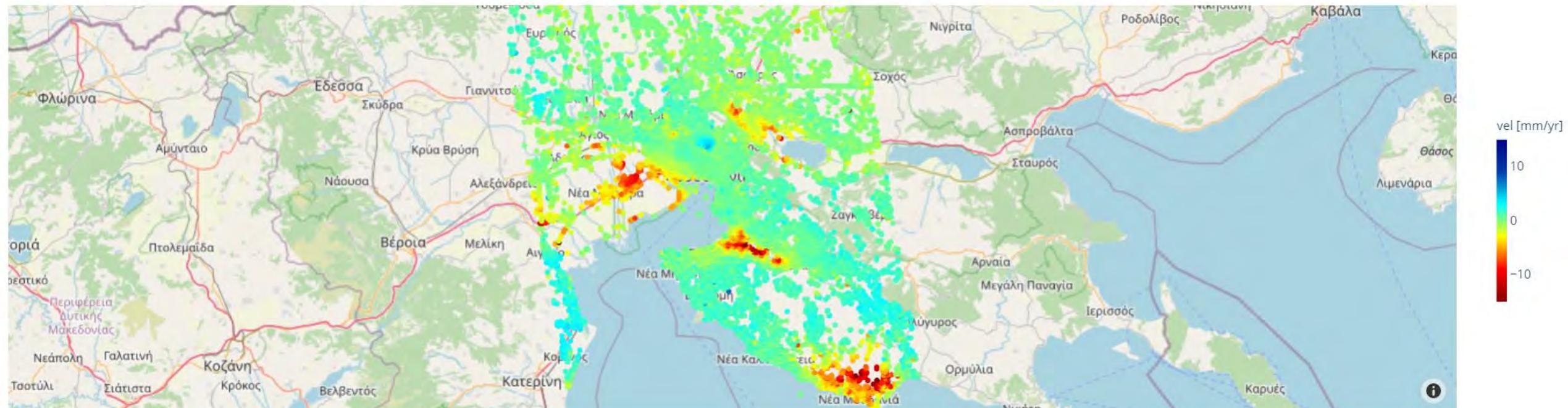
© Contains modified Copernicus Sentinel-1 data [2018-2020]

SNAPPING Visualizer | Thessaloniki (Greece)

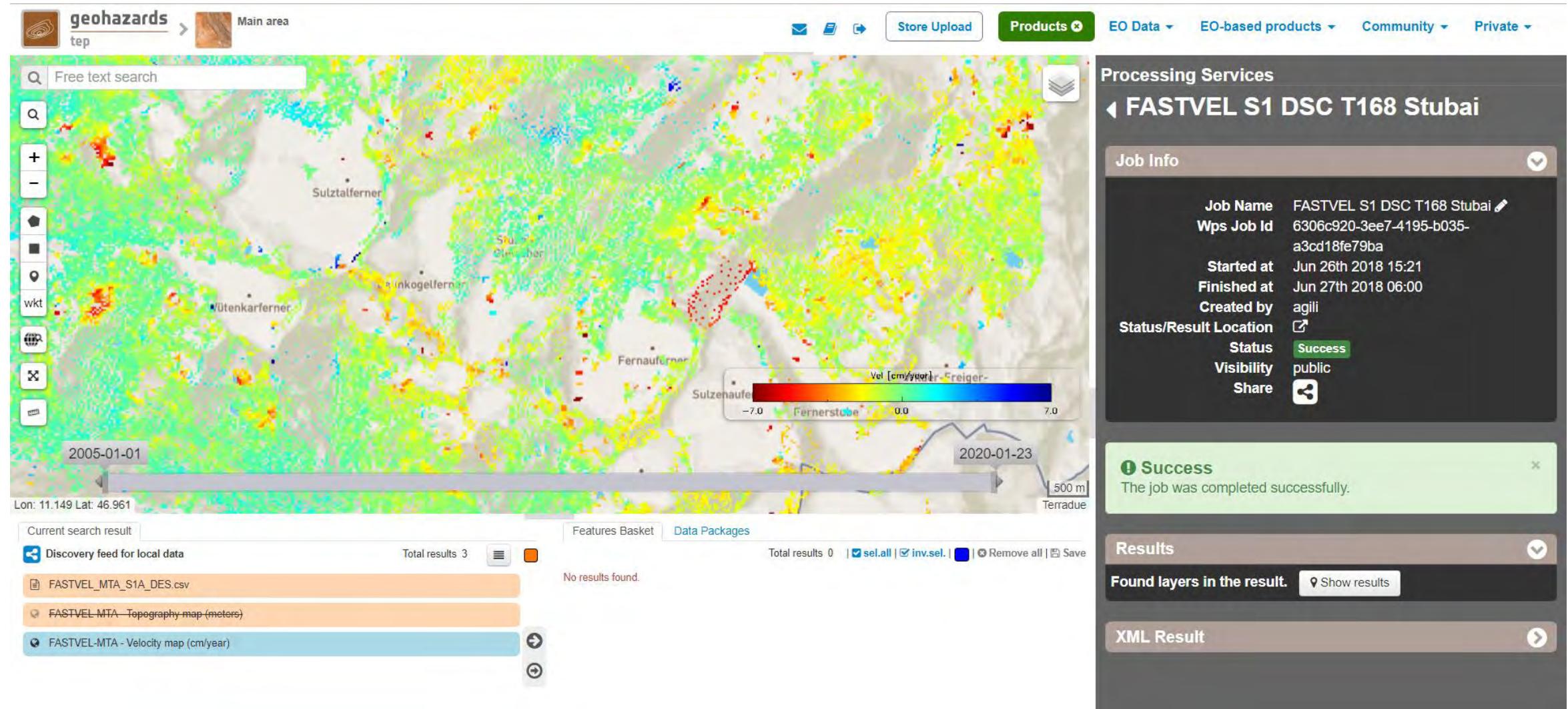


SNAPPING Visualizer

SNAPPING PSI Displacements rates processed on GEP | Observation period 04/2015-12/2020 (138 images) from Relative Orbit 102



GEP | FASTVEL Landslides over French Alps

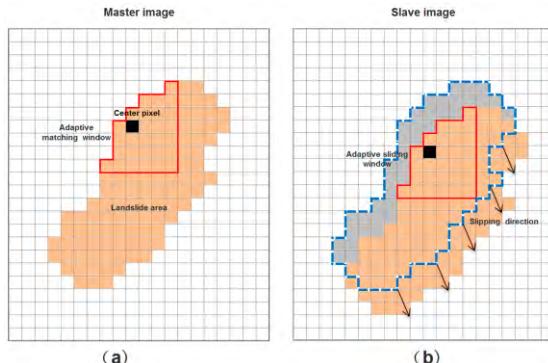


GEP | Landslide app¹

3 main services developed by CNRS-EOST Strasbourg

Developed for [landslide monitoring](#) **but** can be applied to other objects (e.g. Earthquake, volcano, glacier, etc.)

Pixel-offset tracking



Measurement: [Ground displacement](#)

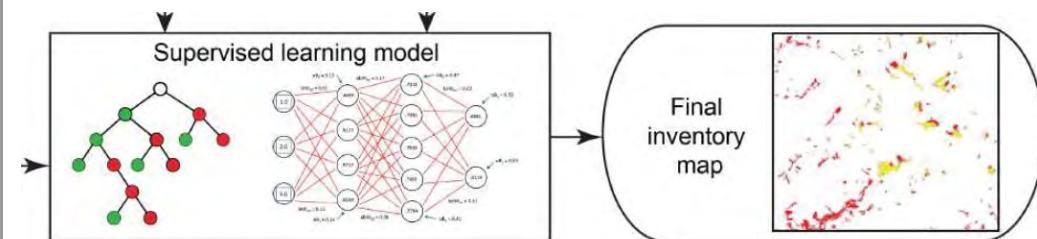
Application: local to regional scale
Satellites: Sentinel-2, Pléiades and VHR satellites (coming)



Digital surface Model



Automatic landslide detection based on Machine Learning (Random Forest)



Measurement: [landslide areas \(polygon\)](#)

Application: regional scale
Satellites: Sentinel-2, Pléiades and VHR satellites (coming)

Measurement: [surface elevation](#)

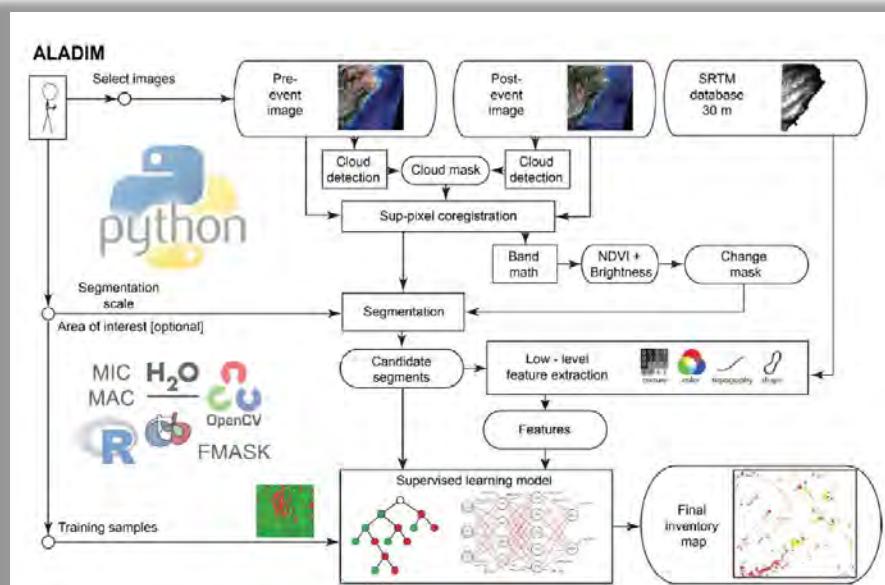
Application: local to regional scale
Satellites: Pléiades and other tri-stereo VHR satellites (coming)

Automatic Landslide Detection and Inventory Mapping

Now available on GEP for Sentinel-2

Earthquakes or typhoons can trigger numerous landslides (> 1000)

- **6.7-magnitude earthquake, 2018**, northern Japanese island of Hokkaido



ALADIM provides landslide maps automatically with:

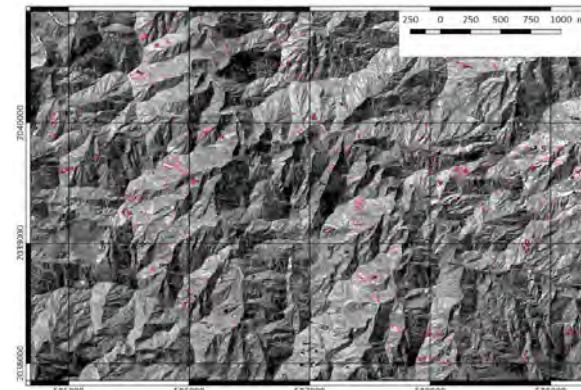
- Reduce human working time (only to build the training set)
- Estimation of the detection accuracy

→ Rapid-mapping for emergency response

- **Landslides detected** over Macaya National Park (Haiti) after Cyclone Matthew in 2016, from Spot-6 and -7



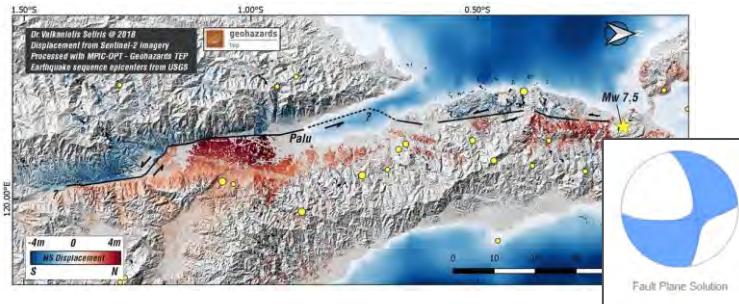
- **Landslides detected** over Taiwan after Tropical Cyclone Komen in 2015, from Sentinel-2 data



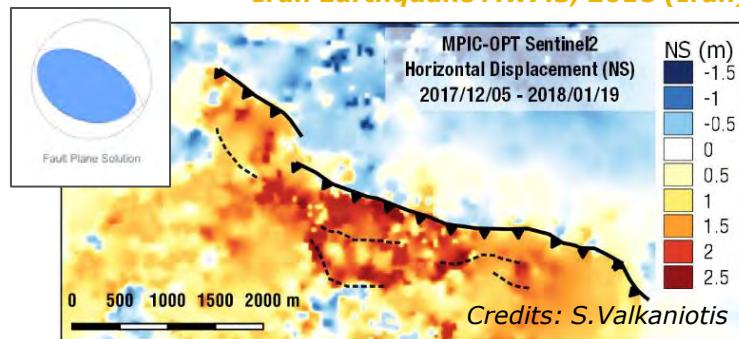
Multiple-Pairwise Image Correlation for the monitoring of surface deformation from optical image time-series

Example of application 1: *Diachronic displacement*

- **Palu Earthquake Mw7.5, 2018 (Indonesia)**

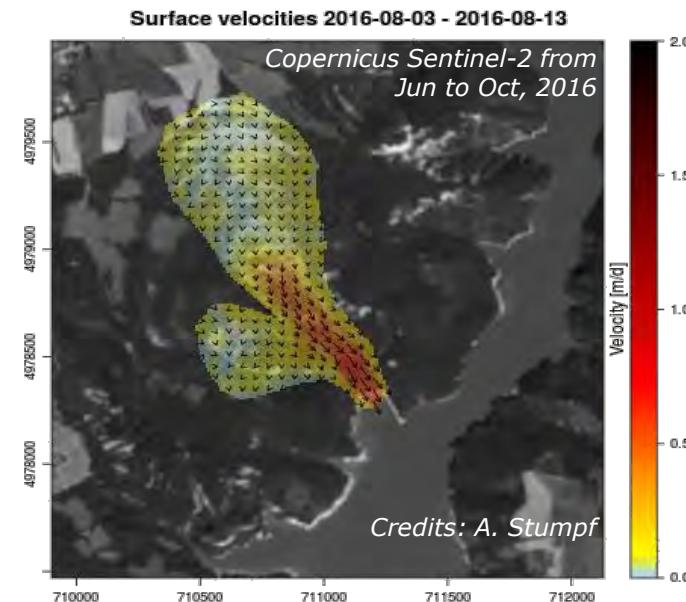


- **Iran Earthquake Mw7.5, 2018 (Iran)**



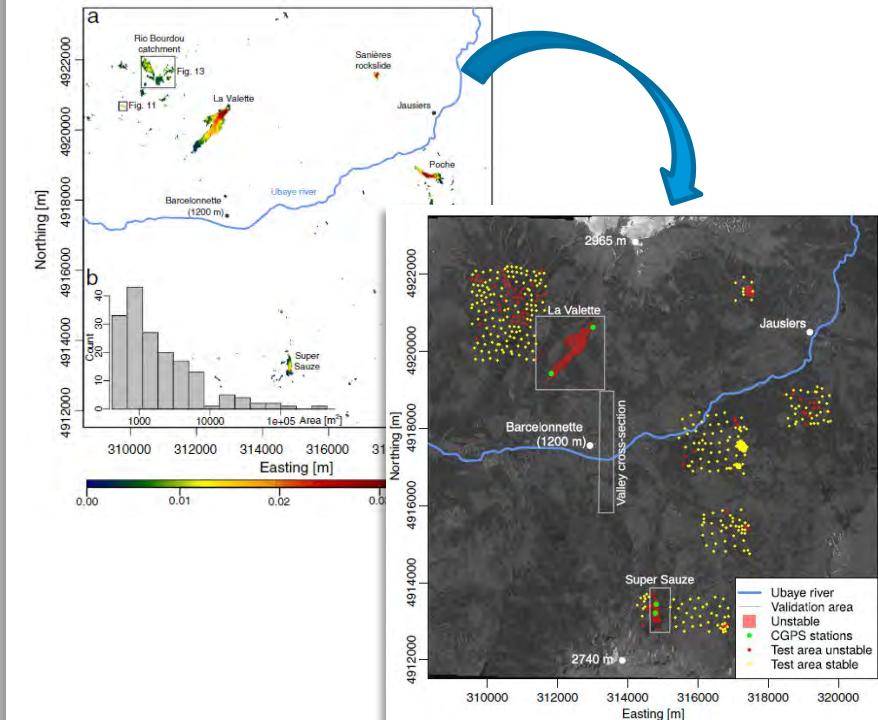
Example of application 2: *Displacement time series*

- **Harmalière landslide (French Alps)**



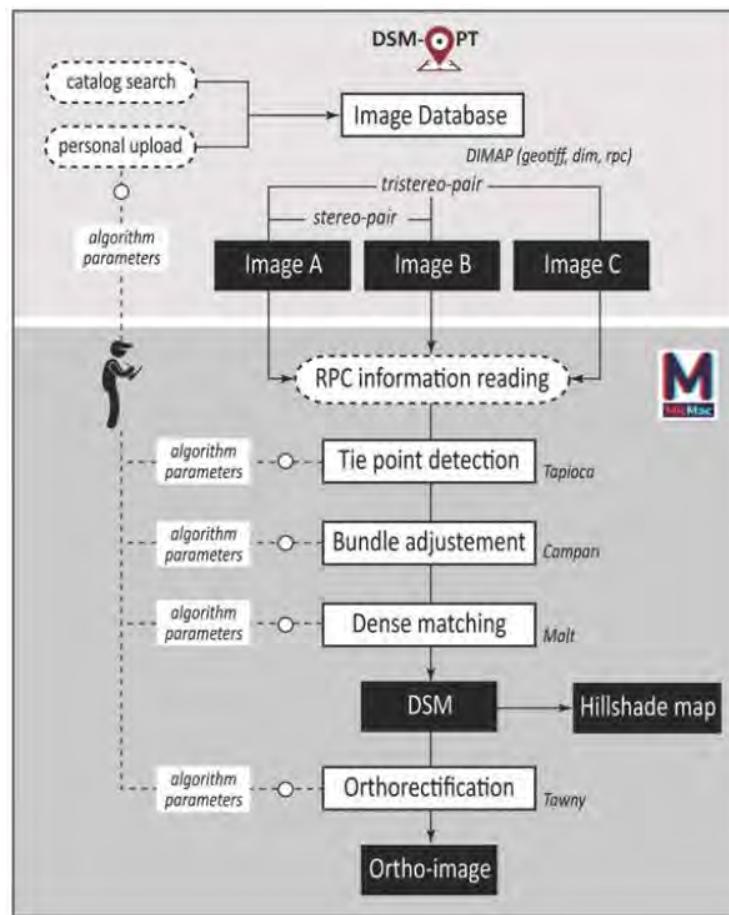
Example of application 3: *Detection of Persistent motion*

- **Ubaye Valley (French Alps)**

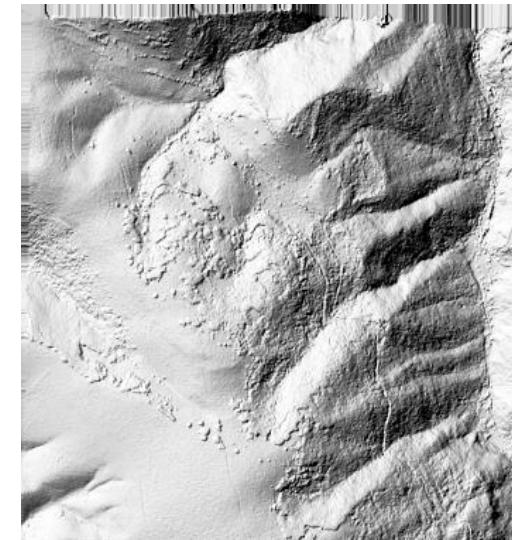


GEP | DSM-OPT service

Digital Surface Models (DSM) and ortho-images from stereo- and tri-stereo satellite images acquired by the VHR Pléiades satellite constellation



Hillshade from DSM ,
Pléiade image 2016, Italy



DSM, Pléiade image 2016
Strasbourg city (France)



Integration of Services | SNAP COSMO-SkyMED DInSAR



Expansion of SNAP services on GEP to support
TPM interferometric processing

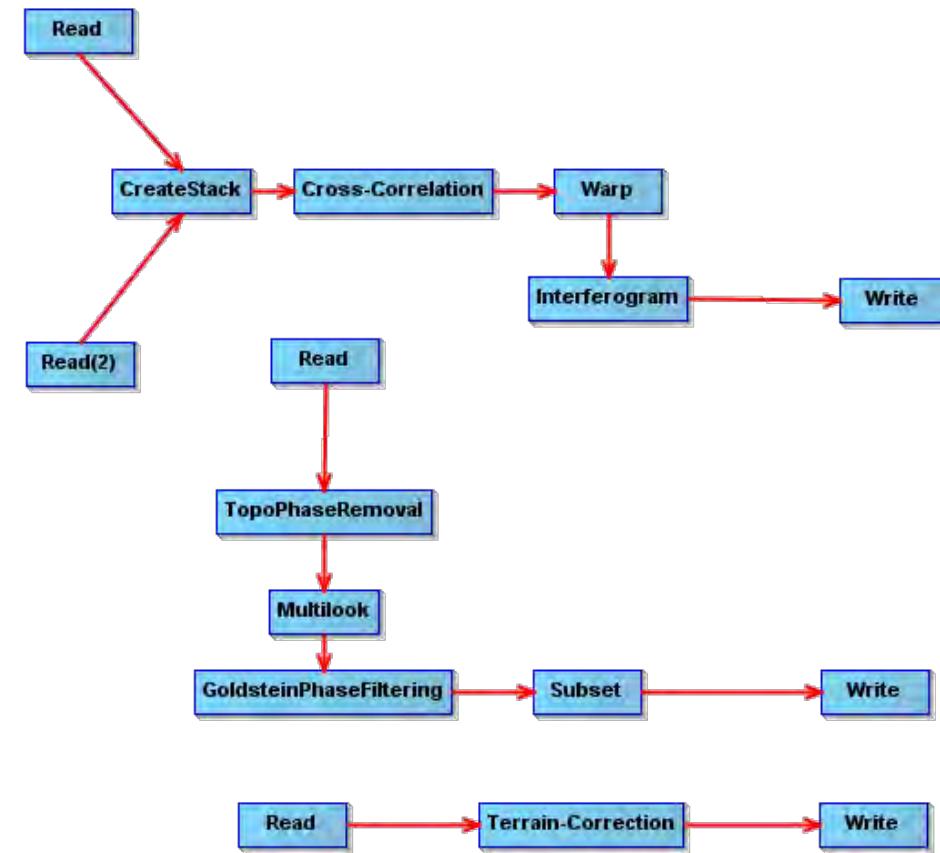
CSK_Stack_CrossCor_Wrap_Ifg.xml

CSK_TopoRem_ML_Flt_Sub.xml

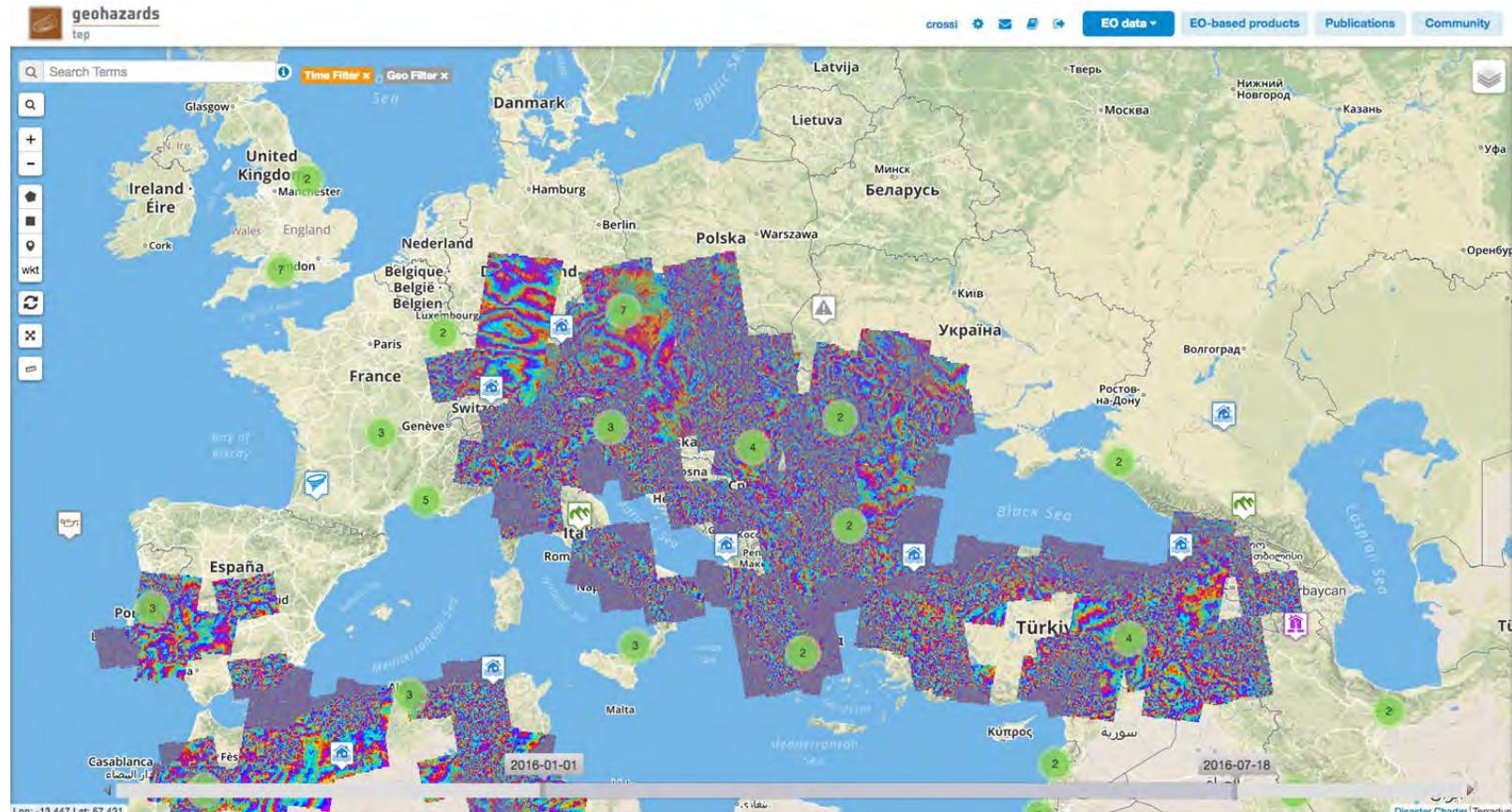
CSK_TC.xml

The screenshot shows the GEP interface with a map of Kathmandu. A specific dataset is highlighted with an orange bounding box. The processing service window for 'SNAP CSK DinSAR' displays the following details:

- Job Info:**
 - Name: SNAP CSK DinSAR / 1b1527d-54b-4096-9957-40f1870149cd
 - ID: 1b1527d-54b-4096-9957-40f1870149cd
 - Processing service: SNAP CSK DinSAR
 - Service version: 1.0
 - Started at: Mar 8th 2019 15:14
 - Created by: Rafa
 - Status/Result Location: Status: running, Result: restricted, Share: off
- Parameters:**
 - 1 - source: CSK32_BCS_B_HH_15_HH_RA_SF_20150813001856_20150813001856
 - 2 - source: CSK32_BCS_B_HH_15_HH_RA_SF_20150730001862_20150730001862
 - af: 94.666271729.84.84.37.476
 - fr_size: 30
 - min_dx: 3
 - post_spacing: 10



GEP | Systematic - Data Driven Scheduled Processing



<https://geohazards-tep.eu>

Supported by
BELNET-BEGRID (Belgium)



CREODIAS



DLR InSAR Browse Medium Resolution Service

It's a data driven systematic processing. The service has followed a ramp-up process starting from Dec 2016 until Aug 2017:

- EU Tectonic area
- World tectonic area (25%)
- World tectonic area (40%)

It currently processes 150+ Sentinel-1 SLC pairs per day.

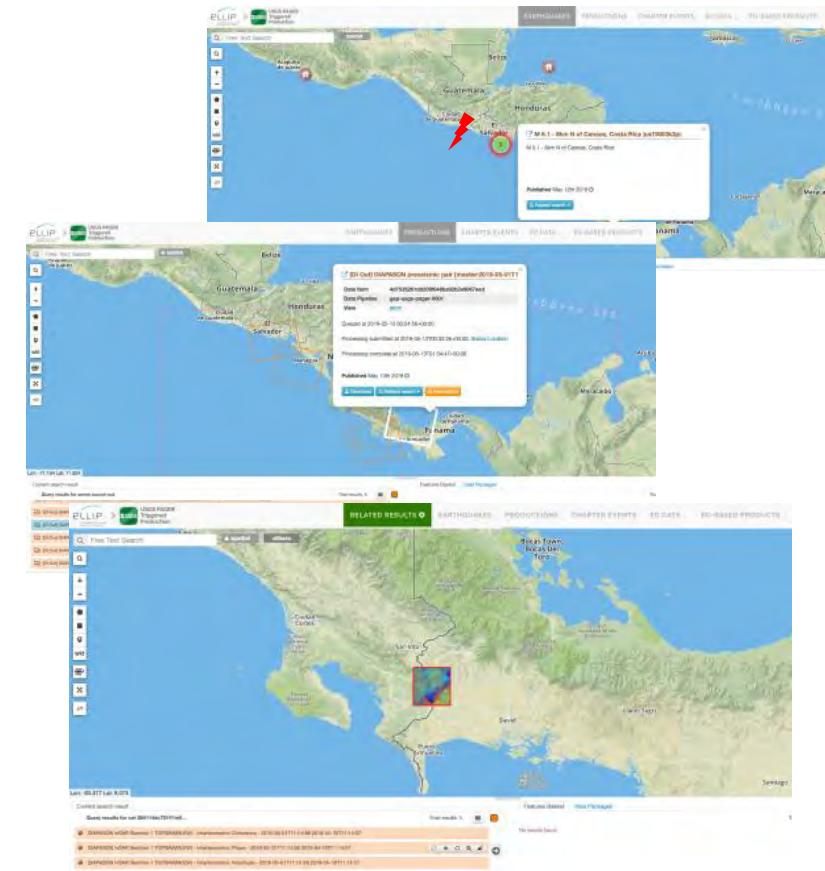


GEP | Automatic Alerting System

New GEP functionality under implementation:

Triggering services based on seismic events polled from external systems

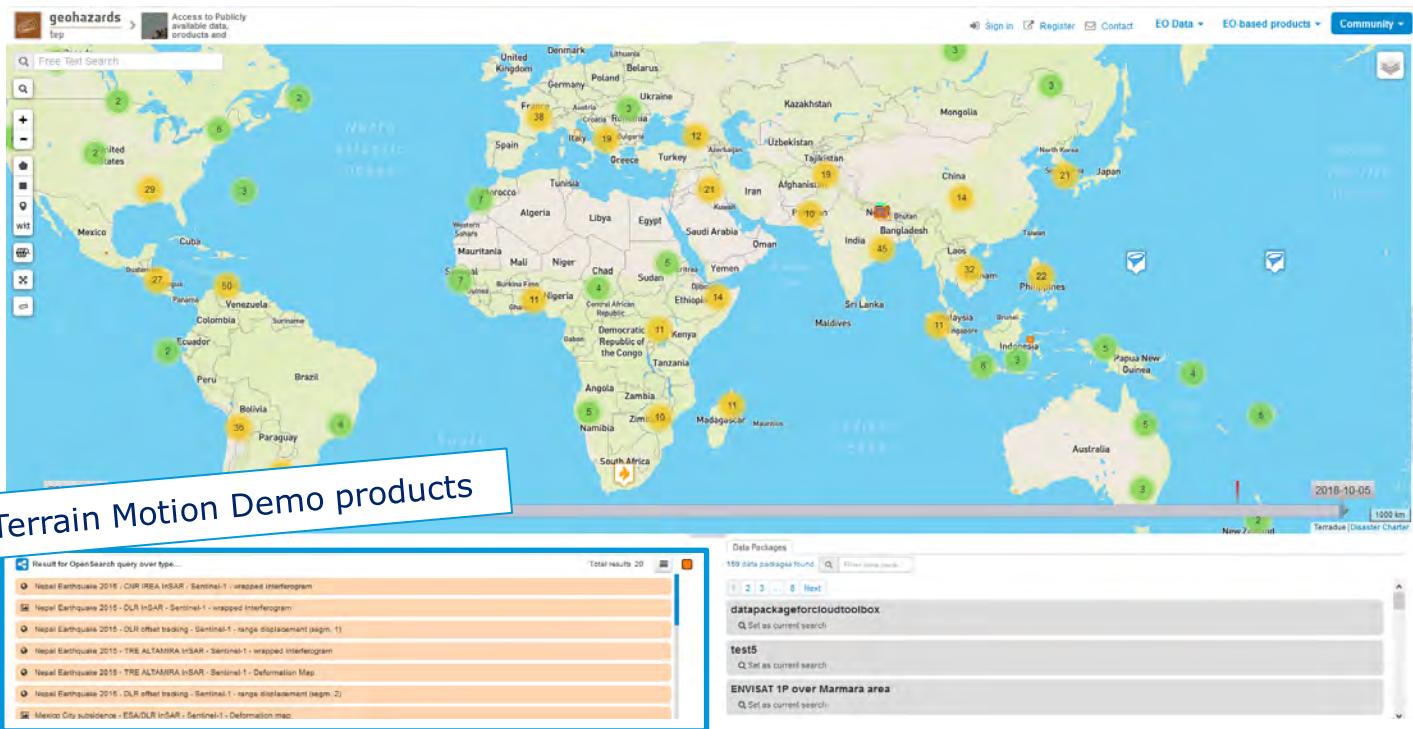
- **Automatic production of deformation maps** with different GEP processing services
 - **Actuators** are event-based components able to start specific data discovery, ingestion, caching and processing workflows (**USGS pager**, **@INGVterremoti** twitter feed based on the earthquake magnitude, **Copernicus EMS** rapid mapping and risk & recovery feeds and **UNOSAT/GDACS** disaster feed)
 - Services shall be triggered for each earthquake with a magnitude $> X$, based on the actuators feed
- **Publication** of generated maps in a specific index in the GEP catalogue linked to the originating event



GEP | Terrain Motion Demo

Promote use of EO for Geohazard applications

Demonstration of Ground Motion Services' products on different sites based on different terrain motion techniques using Optical and Radar data and publication on GEP.



DISCUSS

Log In



Providers of the EO sector are sharing their products on GEP in the framework of the Geohazards Lab initiative: visit the Terrain Motion Demo in the Community area

gep-blog

fnacini Terrae staff

6 2d

May 8

1 / 1

May 9

2d ago

In a CEOS initiative to promote and harmonize EO techniques for geohazards, service providers such as PLANETEK, TRE ALTAMIRA, GEOMATIC VENTURES, GAMMA REMOTE SENSING, CNRS-EOST and BRGM are providing access to terrain motion products on the GEP. Earth Observation techniques to monitor Terrain Motion provide key information to better understand hazards such as for instance earthquakes, volcanoes, landslides and ground subsidence. To raise interest and promote the use of these techniques the Terrain Motion Demo is a new exercise designed in the framework of the Geohazards Lab initiative of the CEOS Working Group Disasters. The Geohazards Lab aims to establish an inclusive and comprehensive process to optimise the use of EO techniques with a primary focus on Cloud based hosted tools and services. This includes publishing and providing persistent access to Third Party products via the GEP that is ESA's contribution to CEOS. The Terrain Motion Demo provides measurements based on different terrain motion techniques using Optical and Radar data from various missions (e.g. Sentinel-2, Pléiades and Sentinel-1). Some of the products presented were processed using GEP hosted services, while others were processed externally and then uploaded on the platform. Interested EO service providers are invited to contact the GEP to contribute to the Demo.

You can now start navigate and have a look at the different products via the Public Area on the GEP.



Geohazards-Tep
@esa_gep

Follow

On the blog: Providers of EO sector sharing their Terrain Motion demo products on GEP - @CEOSdotORG Geohazards Lab initiative



Providers of the EO sector are sharing their products on G...

In a CEOS initiative to promote and harmonize EO techniques for geohazards, service providers such as PLANETEK, TRE ALTAMIRA, GEOMATIC VENTURES, GAMMA REMOTE SENSI...

discuss.terradue.com

10:49 AM - 8 May 2019



GEP | Terrain Motion Demo

Geohazards

Earthquakes, Volcanoes,
Ground subsidence &
landslides

EO satellites

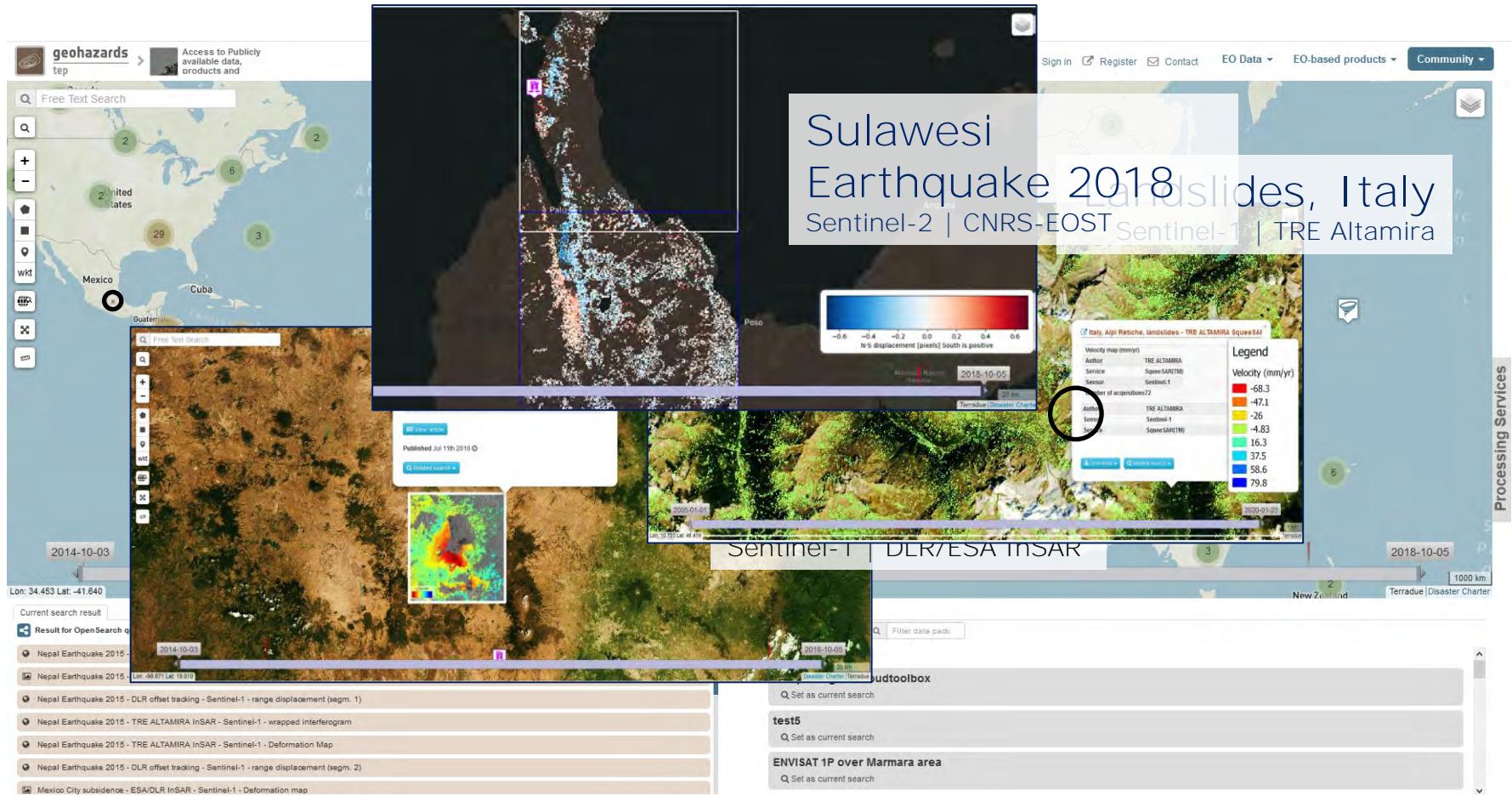
Sentinel-1 & 2, ERS-1&2,
Envisat, TSX, CSM,
Pléiades...

Providers

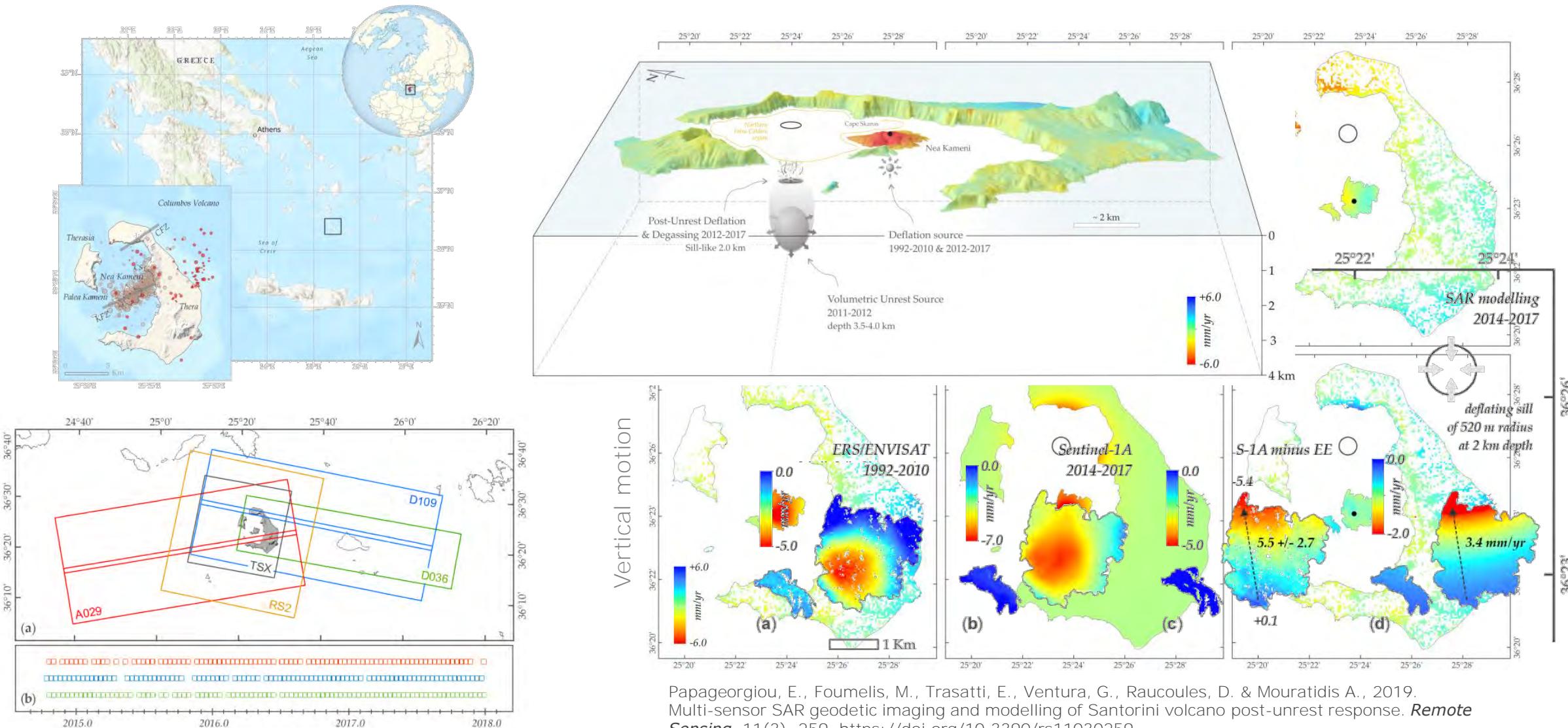
DLR, INGV, EOST , TRE-
ALTAMIRA, GAMMA, CNR-
IREA, Planetek, BRGM,
AUTh...

Ground Motion Processing

Diapason, SNAP, MicMac,
P-SBAS, MPIC-OPT,
GAMMA, PSInSAR®,
SqueeSAR®



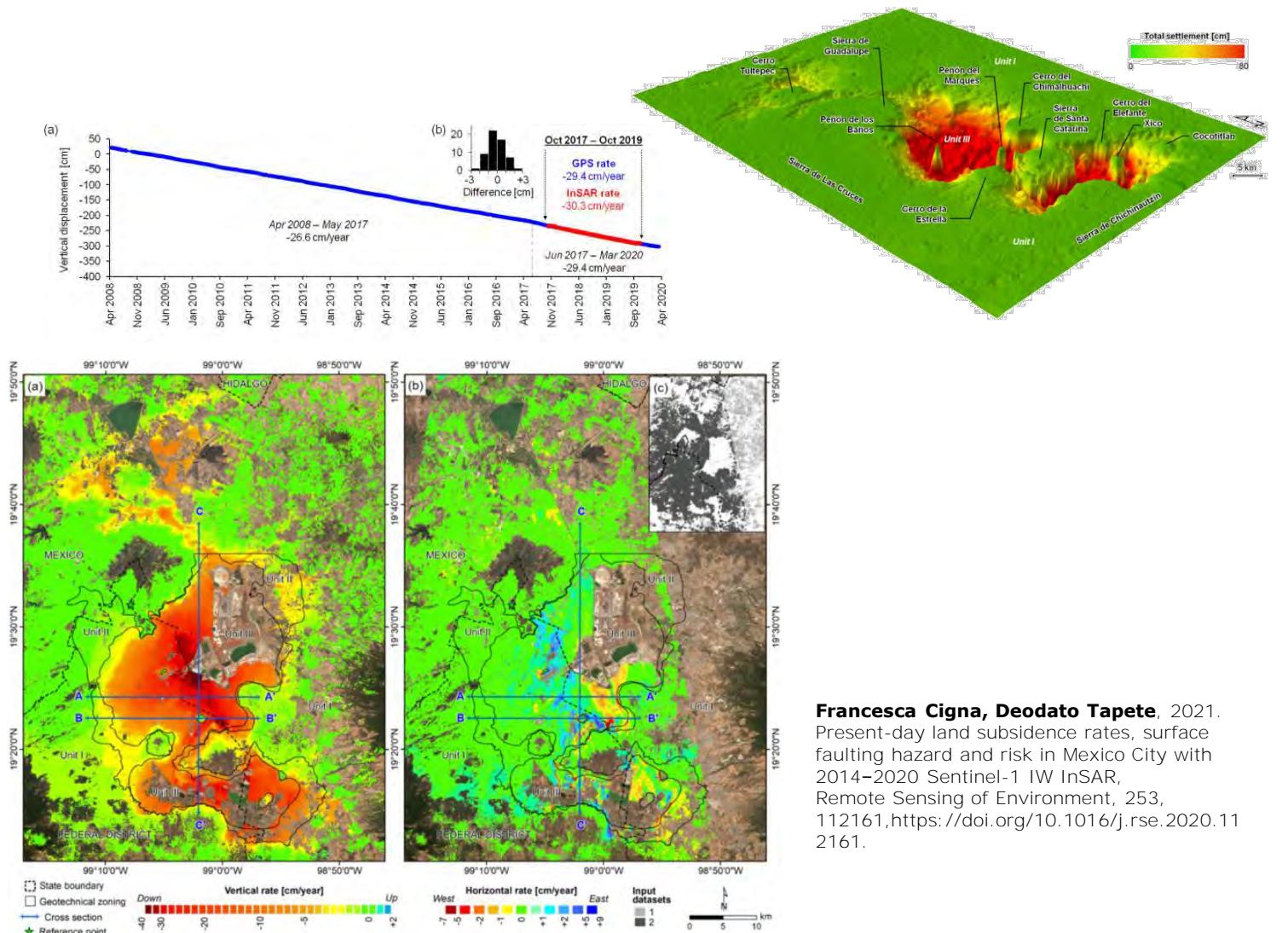
Scientific Publications | Santorini Volcano Post-Unrest



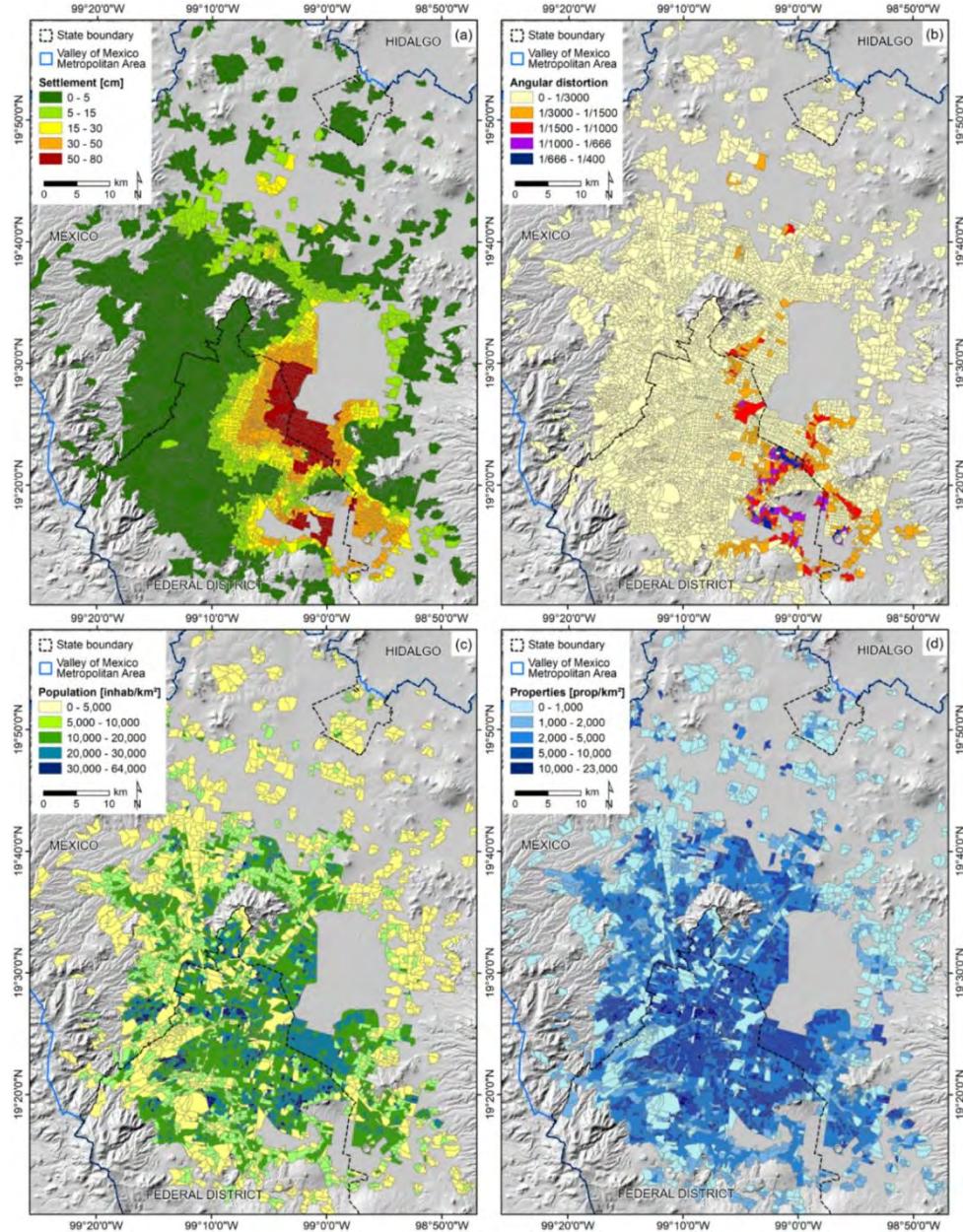
Contains modified Copernicus Sentinel data (2018)

Scientific Publications |

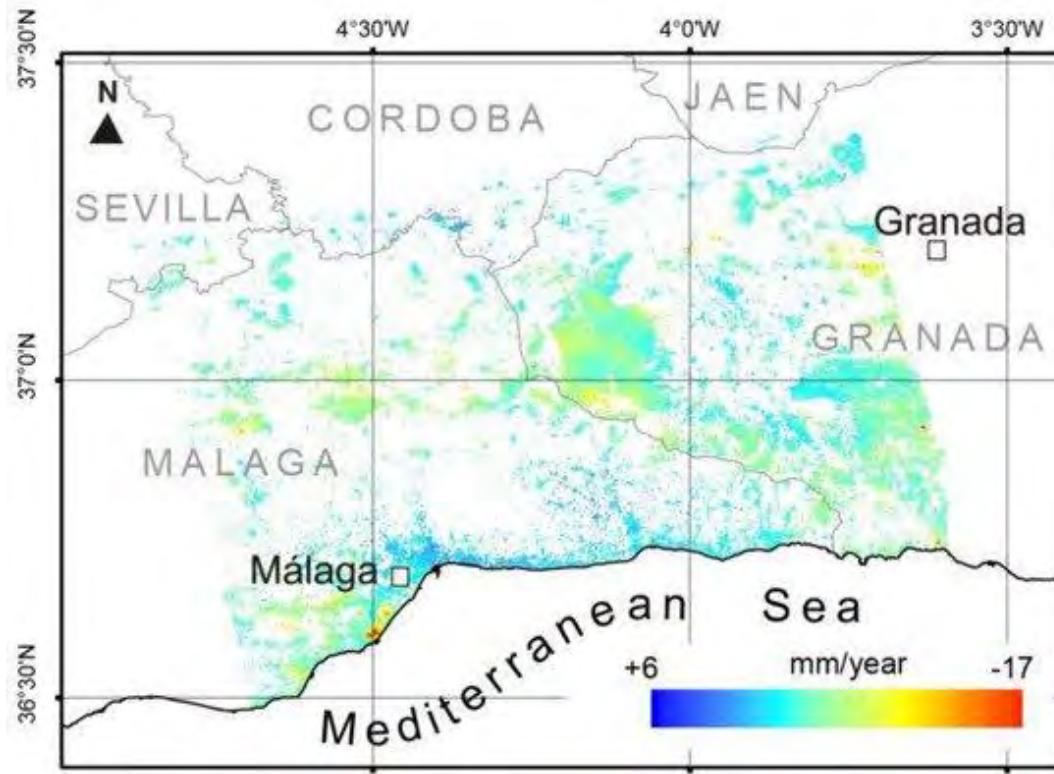
Mexico City Subsidence & Risk



Francesca Cigna, Deodato Tapete, 2021.
Present-day land subsidence rates, surface faulting hazard and risk in Mexico City with 2014–2020 Sentinel-1 IW InSAR,
Remote Sensing of Environment, 253,
112161, <https://doi.org/10.1016/j.rse.2020.112161>.

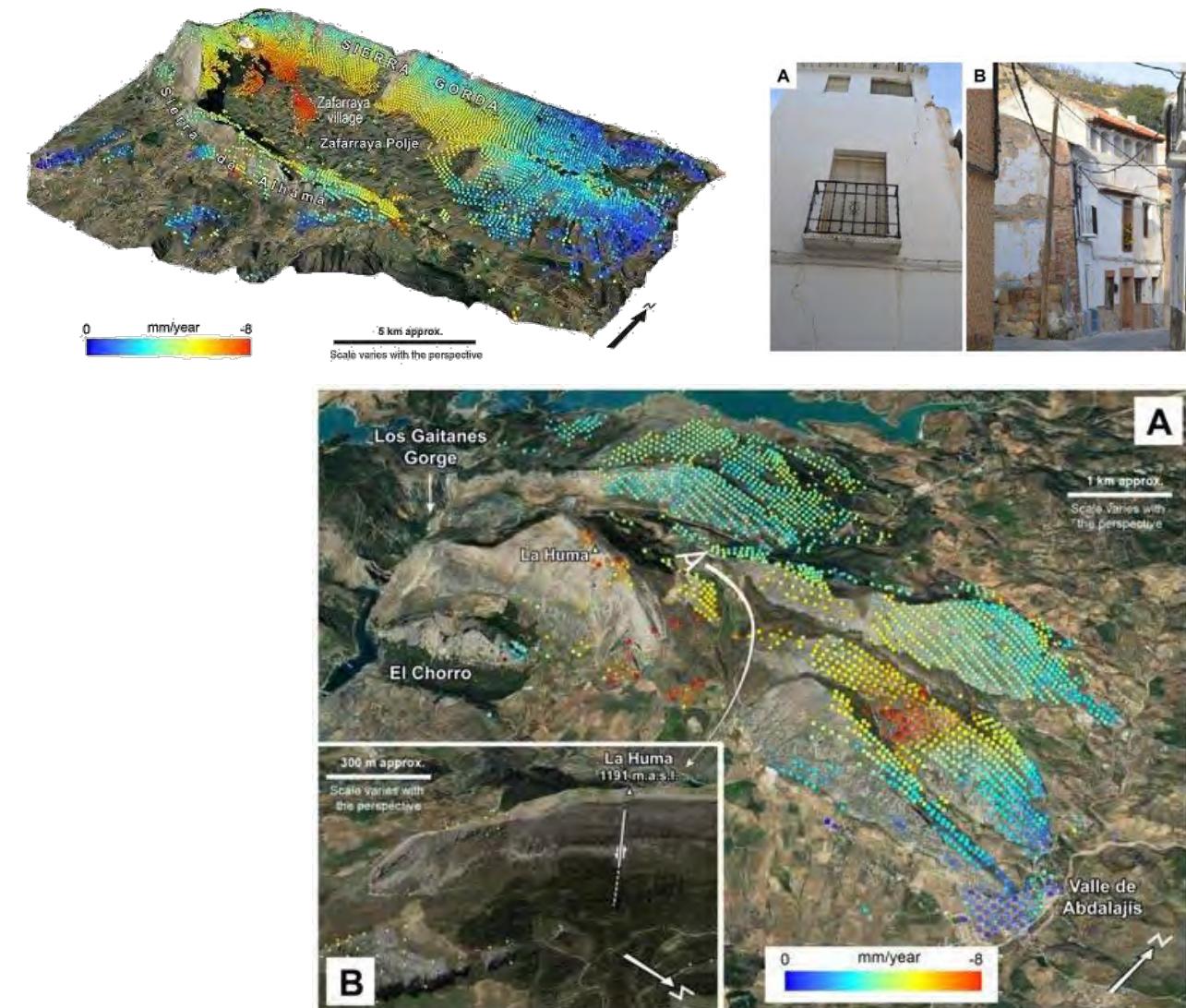


Scientific Publications | Human-induced Subsidence & Hazard Identification



Galve, J.P.; Pérez-Peña, J.V.; Azañón, J.M.; Closson, D.; Caló, F.; Reyes-Carmona, C.; Jabaloy, A.; Ruano, P.; Mateos, R.M.; Notti, D.; Herrera, G.; Béjar-Pizarro, M.; Monserrat, O.; Bally, P.

Evaluation of the SBAS InSAR Service of the European Space Agency's Geohazard Exploitation Platform (GEP). *Remote Sens.* 2017, 9, 1291.



Animate & Communicate GEP Scientific Results

EUROPEAN SPACE AGENCY ABOUT US OUR ACTIVITIES CAREERS AT ESA FOR MEDIA FOR EDUCATORS FOR KIDS

sentinel-2

esa observing the earth copernicus sentinel-2

Colour vision
Introducing Sentinel-2

SENTINEL-2 MAPS INDONESIA EARTHQUAKE

5 October 2018 A 7.5-magnitude earthquake and tsunami hit Indonesia on 28 September, destroying homes and hundreds of lives. As the death toll continues to rise, the effects of this natural disaster are far-reaching, with hundreds of thousands of people seeking access food, water and shelter in the aftermath of this tragedy.

The European Union activated its Emergency Copernicus satellite mapping service a couple of hours after the earthquake to assist authorities. Copernicus has also produced grading maps showing the impact of the damage covering ten areas of interest. The tailor-made service continues to closely monitor the situation and provide assistance in the aftermath of the disaster.

Fault line land movement

Operations and data
Data flow
Data products
Essential groundwater

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BRGM @BRGM_fr · Oct 12
#PaluEarthquake Mw 7.5. #Sentinel1 from @CopernicusEU allowed the #BRGM scientists to produce a second map of the displacement field generated by the #earthquake in #Palu (#Indonesia, 2018-09-28) within the frame of the #Geohazard Office with @ESA and @CNES

BRGM experts have generated displacement maps using Copernicus Sentinel-2 acquisitions from 17 September and 2 October.

Thematic experts from the Corinth Rift Laboratory in Greece have generated similar results using the Cloud processing platform GEP, which has been designed to rapidly provide automated measurements.

As shown in the images, the earthquake triggered deformations of several metres and a tsunami. Around 1400 people are thought to have lost their lives, hundreds have been hospitalised and many more thousands are thought to have been displaced. It has been estimated that up to 1.5 million people will be affected by these events.

The Vice-President of the country, Jusuf Kalla, has said that the final death toll could reach the thousands. The International Charter Space and Major Disasters was triggered by the Asian Disaster Reduction Centre on 29 September for this event. International collaboration is in place to organise Earth observation-based disaster response activities.

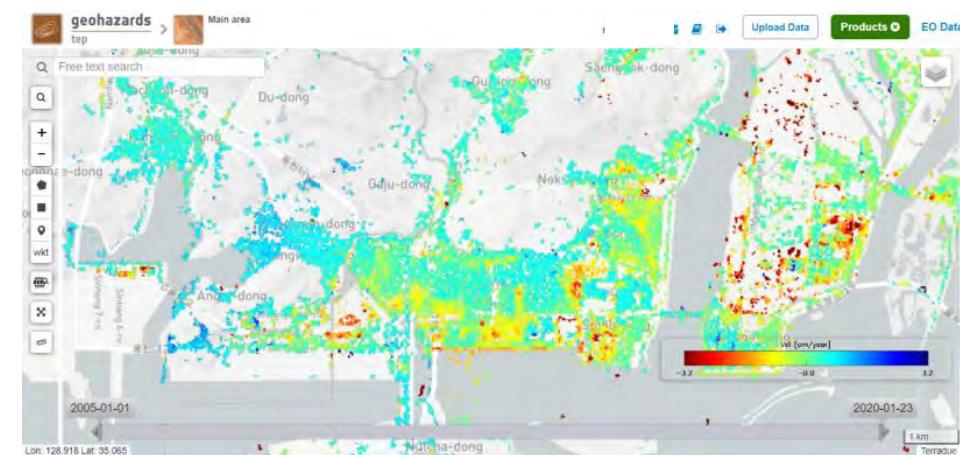
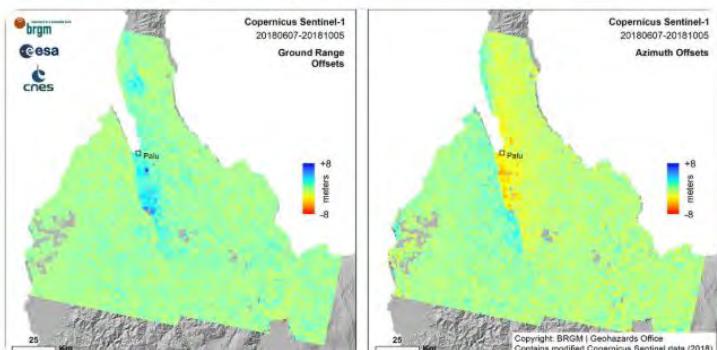
Scientific products such as the map created by BRGM are helping us to better understand hazards. Beyond this example it is foreseen that Earth

geohazards
tep

Sulawesi Earthquake (Indonesia)



BRGM @BRGM_fr · Oct 12
#PaluEarthquake Mw 7.5. #Sentinel1 from @CopernicusEU allowed the #BRGM scientists to produce a second map of the displacement field generated by the #earthquake in #Palu (#Indonesia, 2018-09-28) within the frame of the #Geohazard Office with @ESA and @CNES



Animate & Communicate GEP Scientific Results

South Korea fires

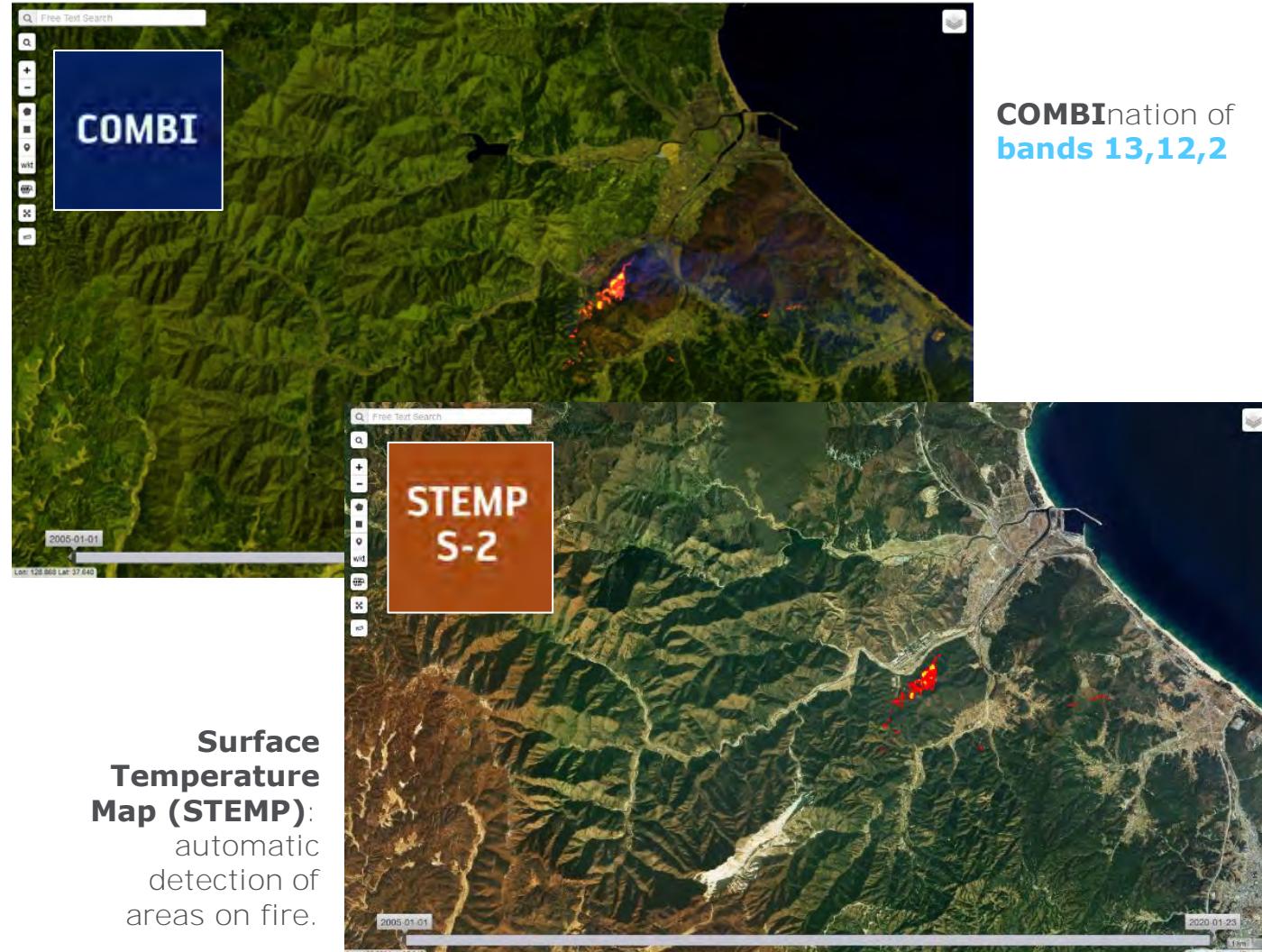
April 5th, 2019:

Strong wind fans fire in the north of South-Korea
About 400 homes and 500 hectares of land were destroyed
4000 people moved

Declared as **National Disaster** by South-Korean authorities on the 5th.



Sentinel-2 acquisition on the 5th!



GEP | Knowledge Hub Resources

GitHub, Zenodo,
Twitter, Forums,
Notebooks ...

twitter BOT 1:14 AM ★
<https://twitter.com/emmanuelmathot/status/7696>

Emmanuel Mathot @emmanuelmathot
#Insar #ItalyEarthquake #sentinel1 A&B with DInSAR @CopernicusEU <https://geohazards-tep.eo.esa.int/>
url=https%3A%2F%2FgeoHazards-tep.eo.esa.int%2F2api%2Fjob%2Fwps%2Fsearch%2Fa86d-048a419f9ebd https://pbs.twimg.com/media/Cq5umyXXYAAc8

Twitter Aug 28th at 1:14 AM (226KB) ▶

February 27, 2017 Dataset Open Access

Chernobyl's nature: Prypjat and Dnepr rivers amazing path Bauman, Andreas Bruno Graziano;

If someone hears about Chernobyl, then he will most probably think of the April 26th 1986 disaster in the nuclear power plant. But Sentinel-1 and Sentinel-2 caught a different eye on it. The rivers Prypjat, who passes by at the previous power plant, and Dnepr have a beautiful meandering watercourse!

Uploaded on February 27, 2017

January 29, 2017 Presentation Open Access

SBAS-DInSAR processing on the ESA Geohazards Exploitation Platform Casu, Francesco; De Luca, Claudio; Zinno, Ivana; Manconi, Andrea;

This organization Search

Rome, Italy <https://geohazards-tep.eo.esa.int>

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Search repositories... Type: All Language: All Customize pinned repositories New

dcs-landslide-sentinel2 Private Python Updated 21 hours ago

dcs-vegan Private The VEGAN services will be used to assess the impact of the volcanic eruption on the agriculture and vegetation ★ 1 Updated 4 days ago

dcs-LAND-Stat Forked from msurossi/dcs-LAND-Stat land-stat GEP implementation

Top languages Shell Python R C++ IDL

People 36 >

In [22]: interact(f, xxwidglets.IntSlider(min=0,max=len(slaves)-1,step=1,value=0));
Visually the best slave is S1A_IW_SLC_1SDV_20161018T163206_20161018T183233_013547_015AEB_712A.
We can also query the geodataframe to get the slave the best covers the area of interest:
slave = slave_search(slaves["aoi_Intersec"],idmax())
Here's the information about our post event slave S1A_IW_SLC_1SDV_20170703T043958_0173B2_01CE28_CFB8*.
In [23]: slave
Out[23]: {
'enclosure': 'https://store.terradue.com/download/sentinel1/files/v1/S1A_IW_SLC_1SDV_20170703T043951_20170703T043958_0173B2_01CE28_CFB8*',
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Output View



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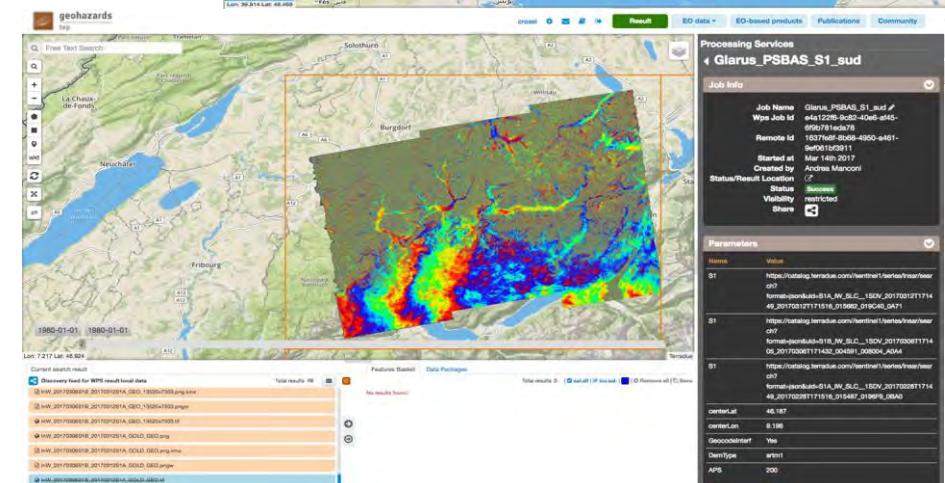
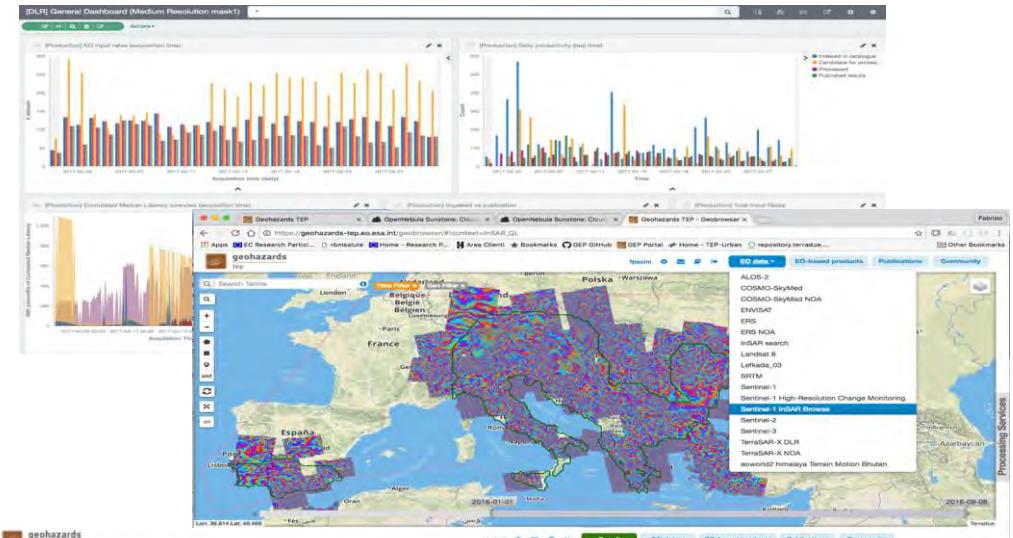
TERRADUE
Advancing Earth Science

GEP Hosted Processing Demonstration

TAT | June 2021

Michael Foumelis | Aristotle University of Thessaloniki (AUTH)

Fabrizio Pacini | Terradue s.r.l.



GEP Hosted Processing Services

EO Data	Seismic	Volcanoes	Landslides	Subsidence	Floods	Fire
 OND ONDA/DIAS products order	 SNAP InSAR  SNAP CSK DiInSAR	 SNAP InSAR  SNAP CSK DiInSAR				
 DIAS product order Europe ONDA/DIAS products order	 DIAPASON Sentinel-1  DIAPASON Stripmap  DIAPASON InSAR-Stripmap	 DIAPASON Sentinel-1  DIAPASON Stripmap  DIAPASON InSAR-Stripmap				
 DIAS product order Asia and Oceania ONDA/DIAS products order	 GMTSSAR Sentinel-1  GMTSSAR Stripmap	 GMTSSAR Sentinel-1  GMTSSAR Stripmap				
 DIAS product order Middle East and Africa ONDA/DIAS products order	 Sentinel-1  MPIC-OPT ETQ	 Sentinel-1  SNAPPING SURFACE MOTION SNAPPING				
 DIAS product order North and South America ONDA/DIAS products order			 MPIC-OPT SLIDE	 ALADIM-S2 ALADIM-S2/Automatic LA...	 FASTVEL EOSC TRE ALTAMIRA A Collaborative Project	 RASTER Full Resolution Rasterization
 Data Publication	 DLR S-1 InSAR Browse	 COMBI Band combination  RGB RGB Composites with Sen...	 STEMP S-2 STEMP-S2/PDU  RGB RGB Composites with Sen...	 PSI Post-Proc TRE ALTAMIRA A Collaborative Project	 SNAPPING SURFACE MOTION SNAPPING	 COMBI Band combination  RGB RGB Composites with Sen...
		 DSM-OPT Digital surface...	 ALADIM-VHR ALADIM-VHR/Automati...	 DSM-OPT Digital surface...	 HAS Hazard-SAR based fo...	 S-2 Burned Area Analysis  S-3 Active Fire Detection
		 RGB RGB Composites with Sen...	 MPIC-OPT SLIDE			



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GEP Demo

Public Processing Jobs

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Seismic Events

Co-Seismic Ground Displacement

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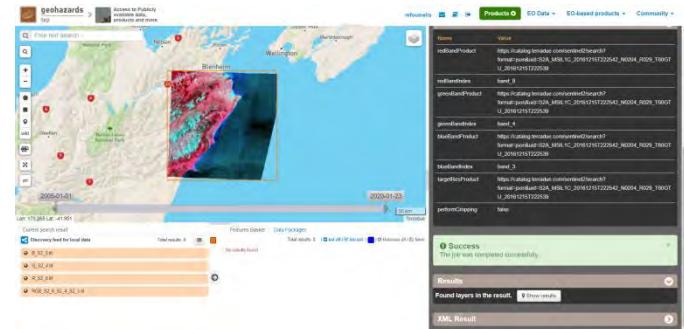
Michael Foumelis | Aristotle University of Thessaloniki (AUTH)

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GEP Service Jobs | Kaikoura Earthquake

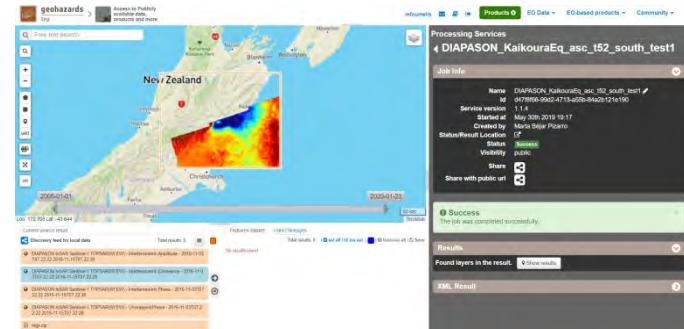
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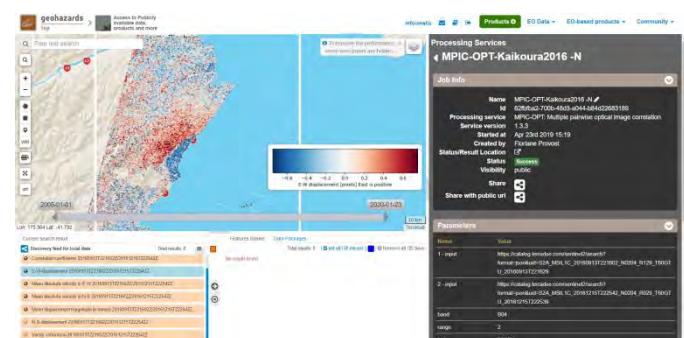
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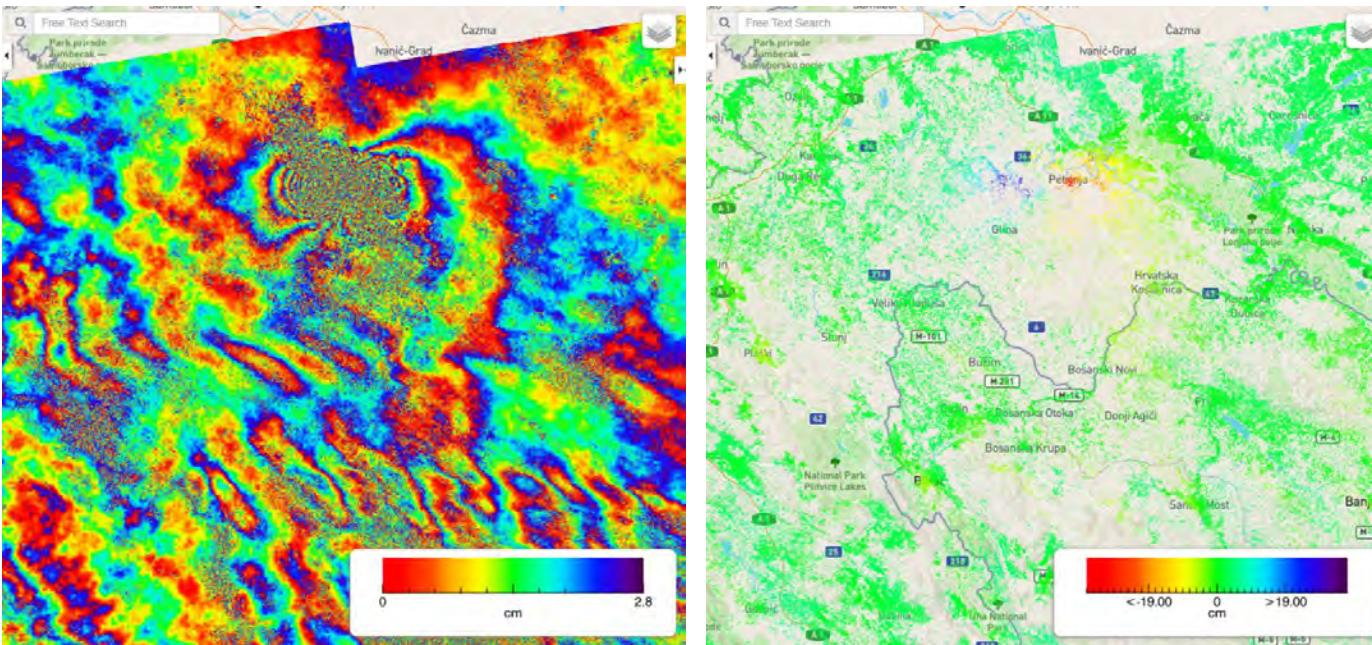
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GEP Service Jobs | Croatia 2020 Earthquake

■ Job ID | P-SBAS IFG:

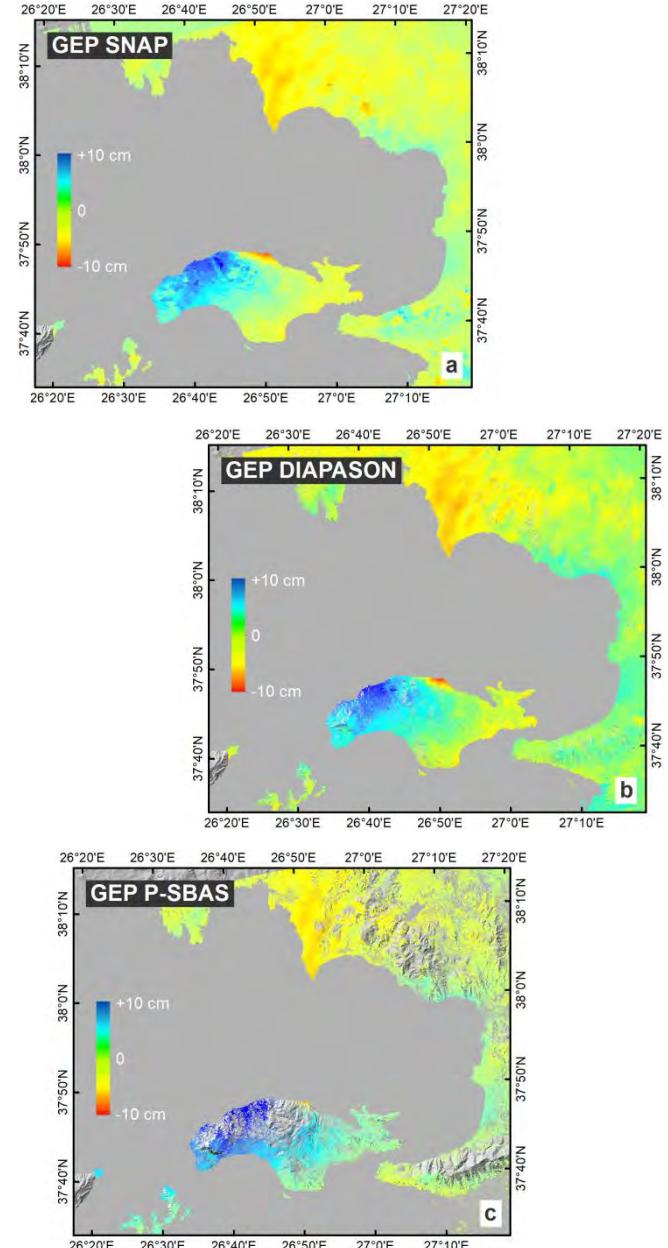
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GEP Service Jobs | Samos 2020 Earthquake

■ Job ID | SNAP DInSAR:

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■ Job ID | DIAPASON DInSAR:

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Ascending Track 131

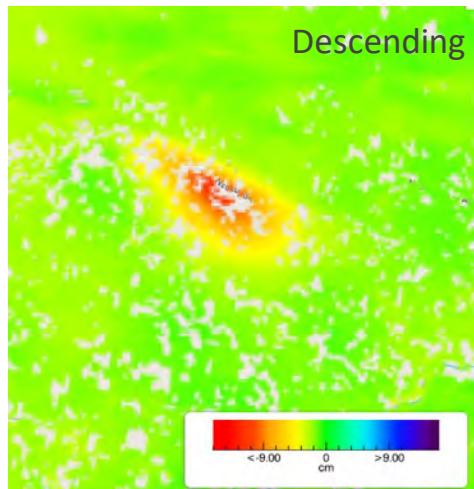
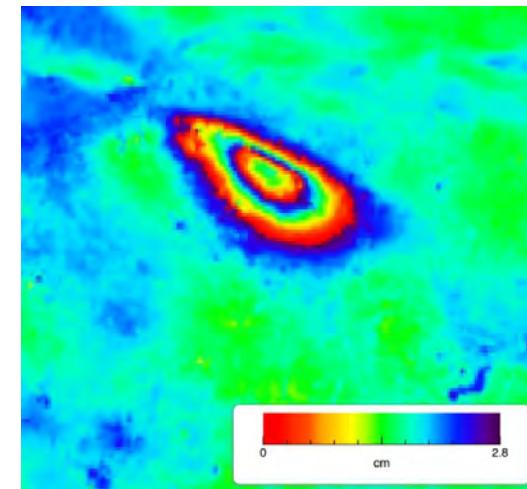
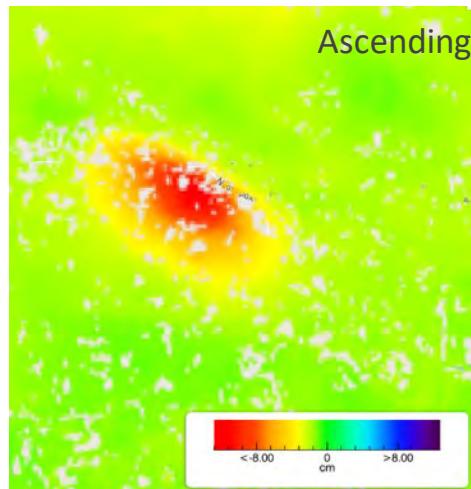
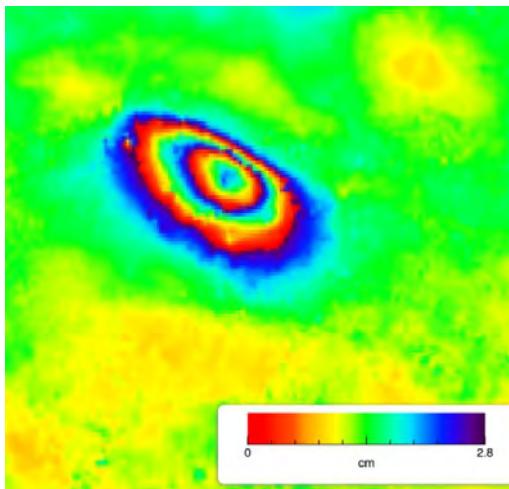
GEP Service Jobs | Thiva (Greece) 2020 M4.4 Earthquake

■ Job ID | P-SBAS IFG Ascending:

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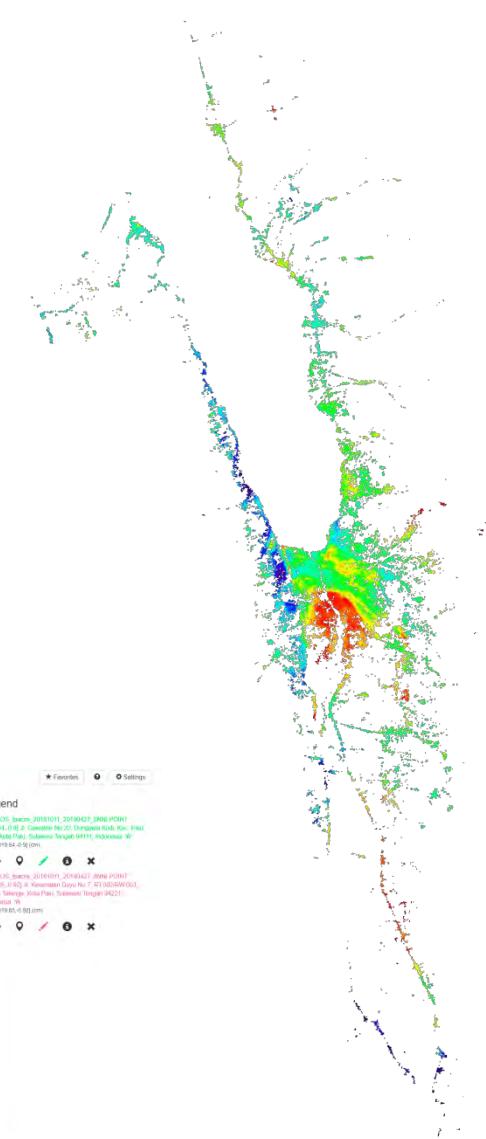
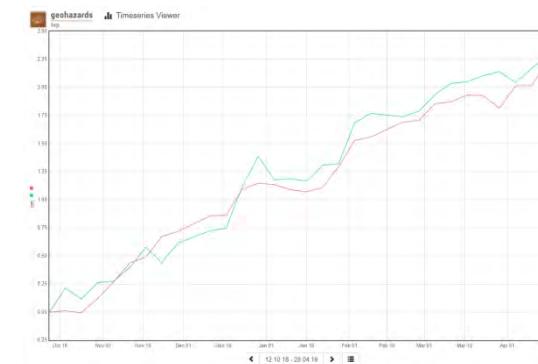
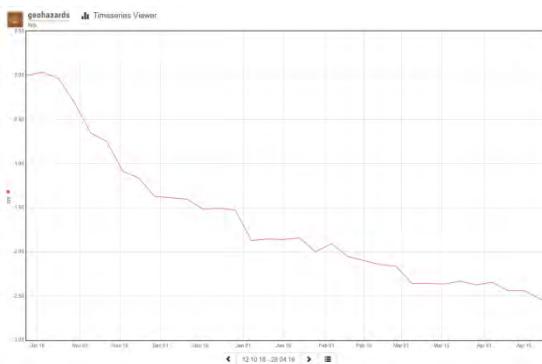


GEP Service Jobs | P-SBAS Sulawesi 2018 Earthquake

■ Job ID | P-SBAS:

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■ Search by Location: Sulawesi (Indonesia)



GEP Service Jobs | Sulawesi 2018 Earthquake

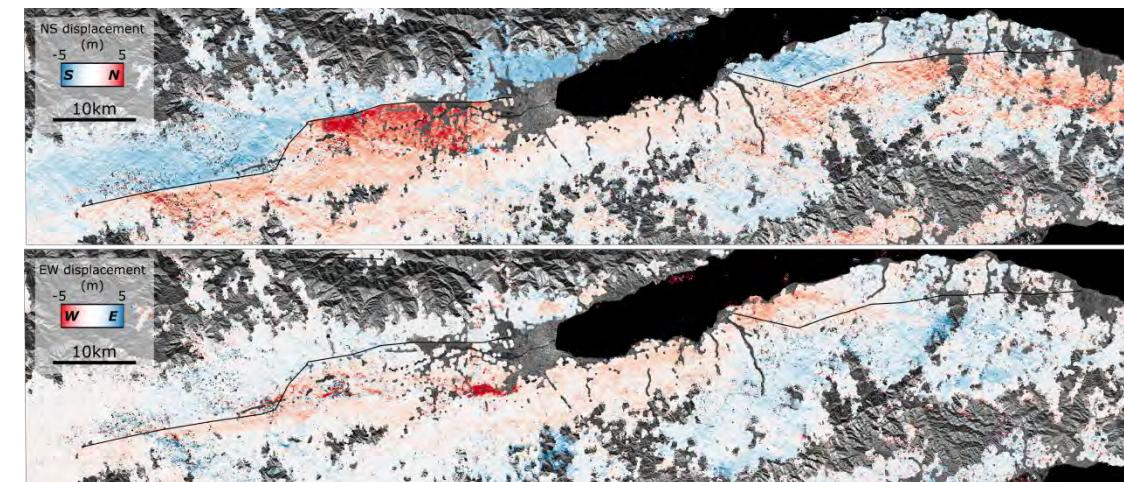
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Volcanic Eruptions

TAT | June 2021

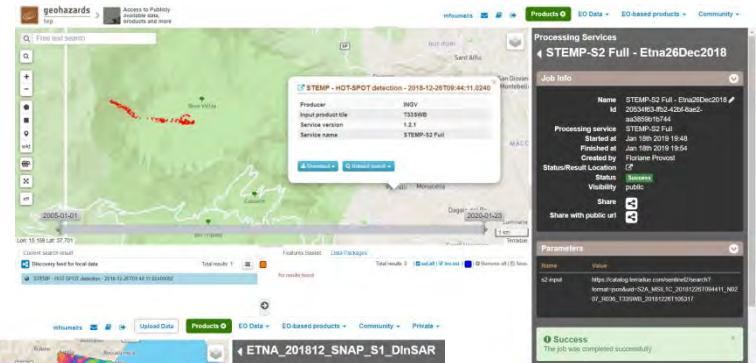
Michael Foumelis | Aristotle University of Thessaloniki (AUTH)

Fabrizio Pacini | Terradue s.r.l.

GEP Service Jobs | STEMP-S2 Etna Volcano Eruption

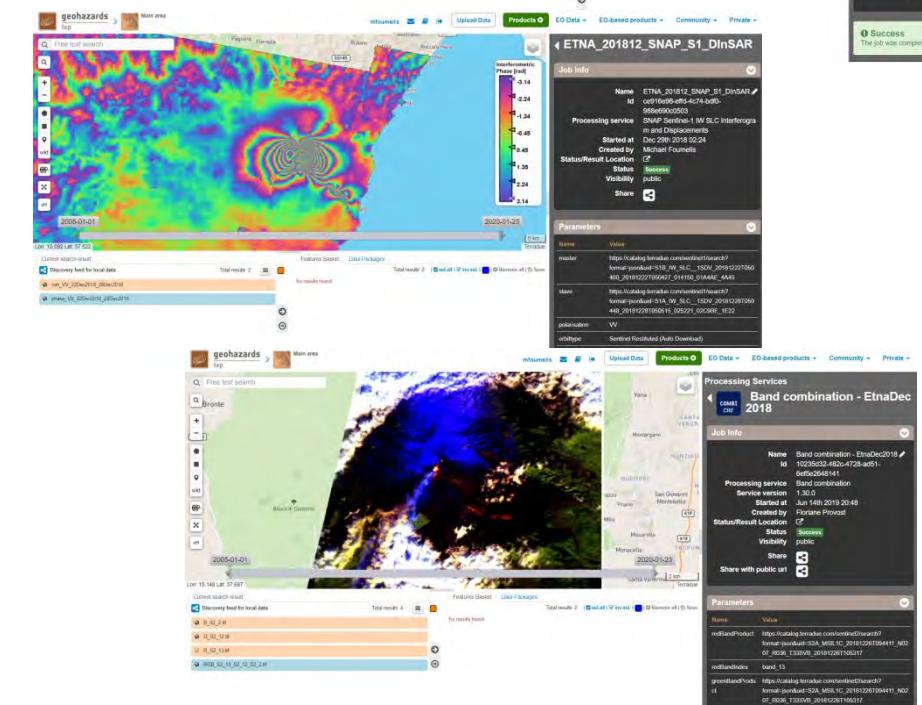
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■ Job ID | SNAP DInSAR:

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■ Job ID | S2 Band Combination:

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GEP Service Jobs | Kilauea Volcano (Hawaii)

■ Job ID | SNAC - SNAP S1 GRD Amplitude Change:

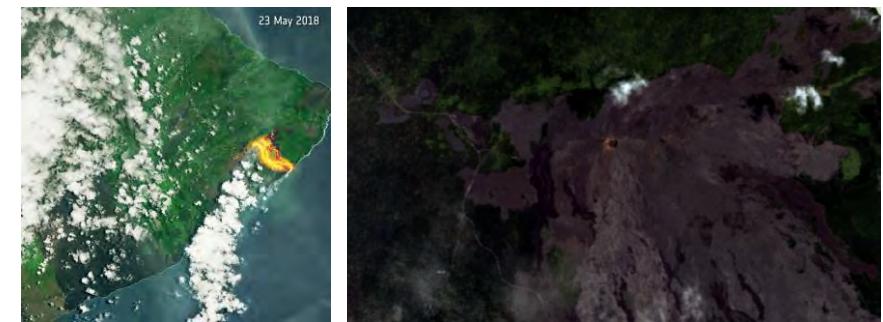
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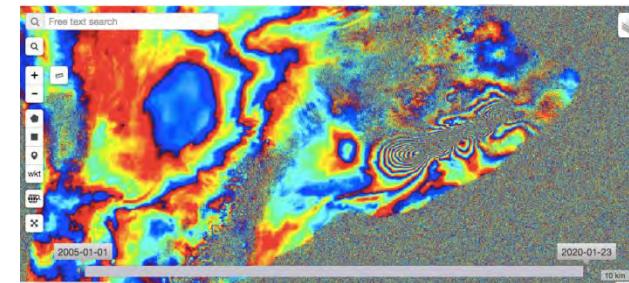
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■ Job ID | DIAPASON DInSAR:

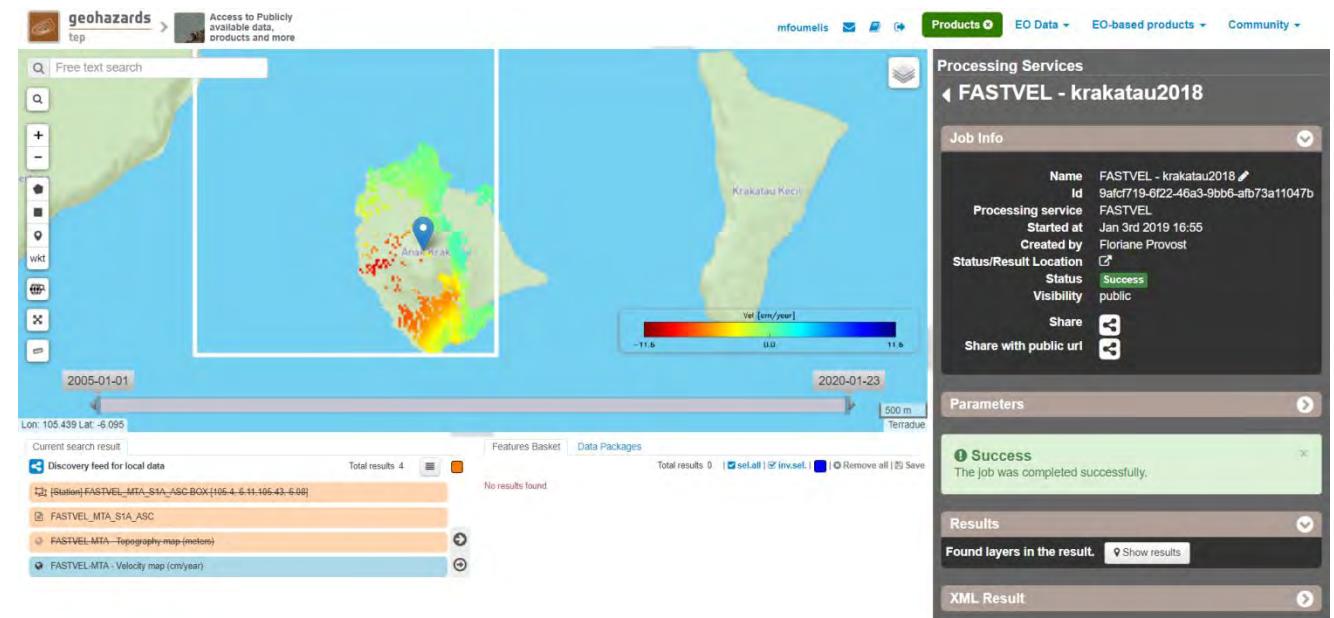
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GEP Service Jobs | FASTVEL Krakatau Precursory Motion

■ Job ID | FASTVEL:

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■ Search by Location: Krakatau



GEP Service Jobs | Taal Volcano Eruption 1/2

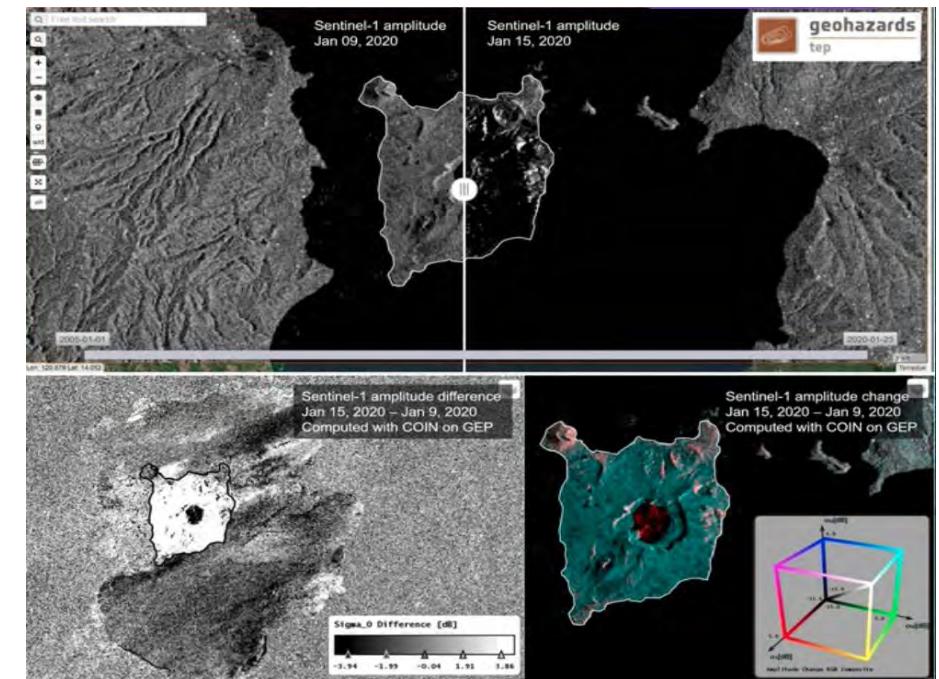
■ Job ID | SNAC - Amplitude Change - Taal Volcano:

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■ Job ID | COIN – Taal volcano Jan2020:

<https://geohazards-tep.eu/t2api/share?url=https%3A%2F%2Fgeohazards-tep.eu%2Ft2api%2Fjob%2Fwps%2Fsearch%3Fid%3Da7b6ca20-1dc8-47b3-8b68-18f3b45ffa29%26key%3Dd27ee21e-f1dd-463e-ac31-e43ddc3bcdcc4>

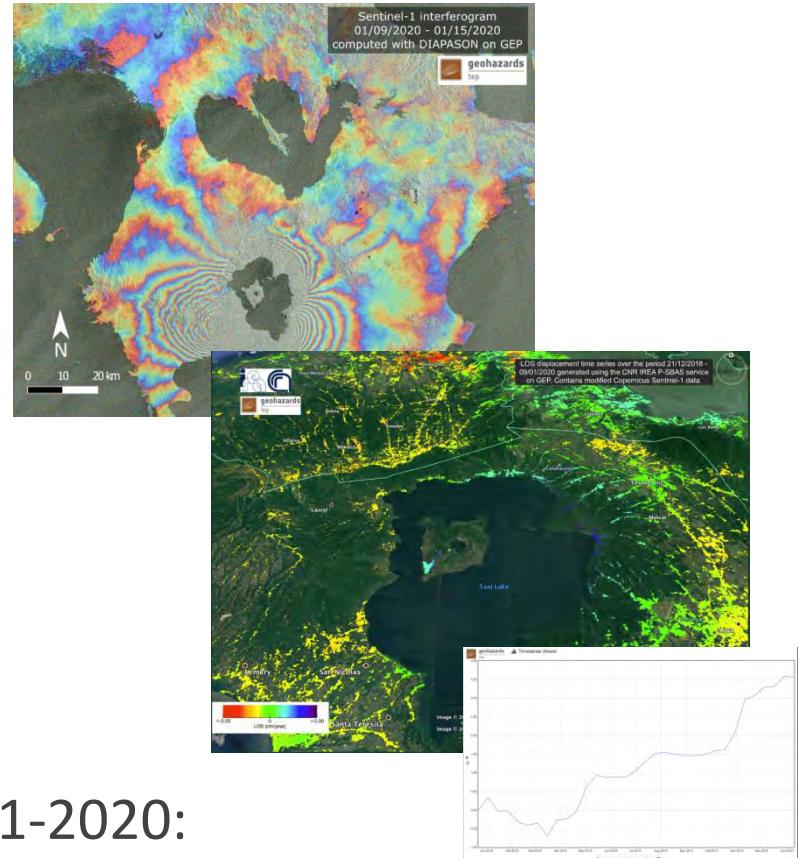
■ Search by Location: Taal



GEP Service Jobs | Taal Volcano Eruption 2/2

■ Job ID | DIAPASON - Taal 20200115-20200109:

<https://geohazards-tep.eu/t2api/share?url=https%3A%2F%2Fgeohazards-tep.eu%2Ft2api%2Fjob%2Fwps%2Fsearch%3Fid%3D6de3a5ba-1288-439b-bfdf-78e865b3656f%26key%3De1b62aaf-ae95-4baf-927a-3d5fb3d3cbd5>



■ Job ID | SNAP S1 Taal Volc Desc:

<https://geohazards-tep.eu/t2api/share?url=https%3A%2F%2Fgeohazards-tep.eu%2Ft2api%2Fjob%2Fwps%2Fsearch%3Fid%3Db1d65c70-a028-4225-8427-2b3628edf006%26key%3D5f2d2091-8fc9-46e1-8a88-19821029dbd0>

■ Job ID | P-SBAS Sentinel-1 Taal volcano 21-12-2018 to 09-01-2020:

<https://geohazards-tep.eu/t2api/share?url=https%3A%2F%2Fgeohazards-tep.eu%2Ft2api%2Fjob%2Fwps%2Fsearch%3Fid%3D3b4b4ab0-d412-4962-bc5f-9b02fd54a8e2%26key%3D5fdf221-c409-43a3-a288-e902f0f3832e>



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Landslides

TAT | June 2021

Michael Foumelis | Aristotle University of Thessaloniki (AUTH)

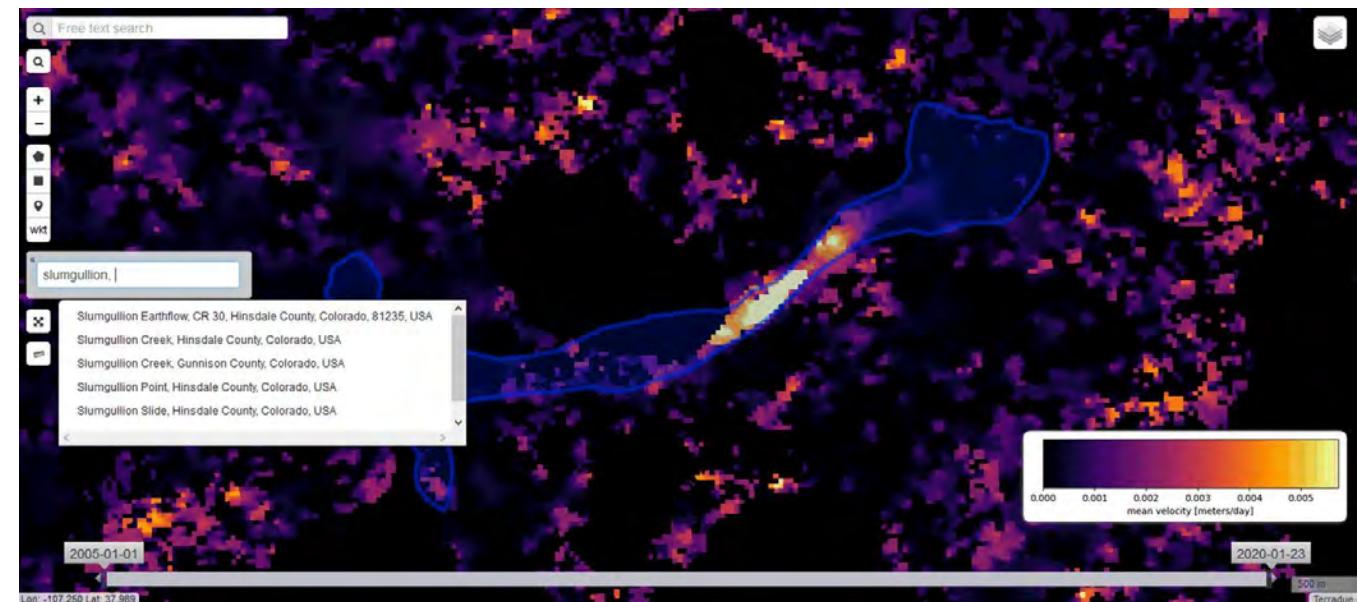
Fabrizio Pacini | Terradue s.r.l.

GEP Service Jobs | MPIC-OPT Colorado (USA) Landslide

■ Job ID | MPIC-OPT:

<https://geohazards-tep.eu/t2api/share?url=https%3A%2F%2Fgeohazards-tep.eu%2Ft2api%2Fjob%2Fwps%2Fsearch%3Fid%3D3fc4fb23-716c-4401-afee-090af6e85704%26key%3D847e07eb-14d9-4f6f-8dc8-73931ee6f2a4>

■ Search by Location: Slumgullion





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Flood Events Inundation Mapping

TAT | June 2021

Michael Foumelis | Aristotle University of Thessaloniki (AUTH)

Fabrizio Pacini | Terradue s.r.l.

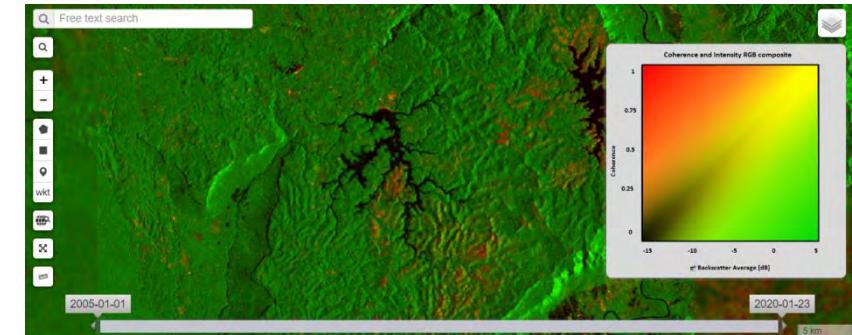
GEP Service Jobs | Floods in Laos

■ Job ID | COIN S1 Coherence Intensity Time Series:

<https://geohazards-tep.eu/t2api/share?url=https%3A%2F%2Fgeohazards-tep.eu%2Ft2api%2Fjob%2Fwps%2Fsearch%3Fid%3De16c69f9-30b7-49ea-b431-445fe5cea916%26key%3Df5bf8a57-31ef-461e-a65d-979febee90d5>

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■ Job ID | S-1 Band Combination Time Series:

<https://geohazards-tep.eu/t2api/share?url=https%3A%2F%2Fgeohazards-tep.eu%2Ft2api%2Fjob%2Fwps%2Fsearch%3Fid%3Ded83f73d-3c7f-4968-b260-17ea8c8cd33e%26key%3Dec379324-61ef-4836-98e4-eaab016b9f5e>

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Fires

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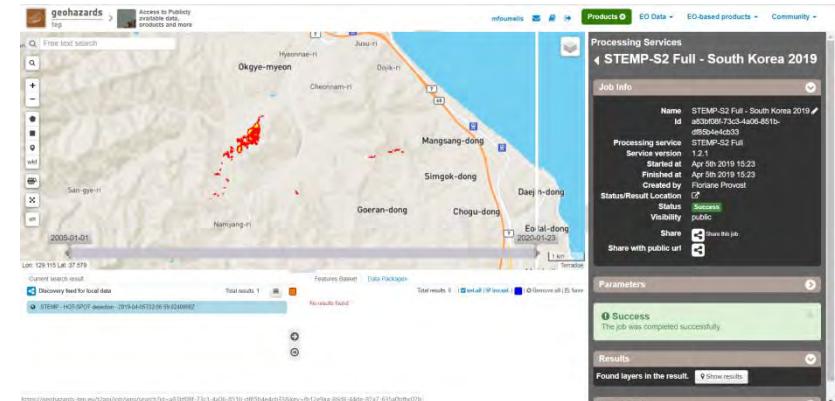
Michael Foumelis | Aristotle University of Thessaloniki (AUTH)

Fabrizio Pacini | Terradue s.r.l.

GEP Service Jobs | Fires in South Korea

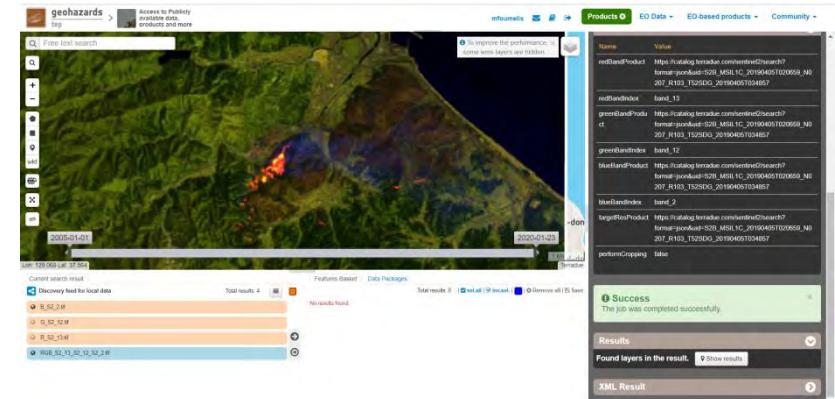
■ Job ID | STEMP S2:

<https://geohazards-tep.eu/t2api/share?url=https%3A%2F%2Fgeohazards-tep.eu%2Ft2api%2Fjob%2Fwps%2Fsearch%3Fid%3Da83bf08f-73c3-4a06-851b-df85b4e4cb33%26key%3Dfb12e9aa-86d8-44de-87a7-635a0bfbc07b>



■ Job ID | S2 Band Combination:

<https://geohazards-tep.eu/t2api/share?url=https%3A%2F%2Fgeohazards-tep.eu%2Ft2api%2Fjob%2Fwps%2Fsearch%3Fid%3D1fa75424-9bf3-4f5b-8a88-40b8f1ce9884%26key%3De56c713d-4e23-4c56-89a5-68ef97c37fa>





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Land Subsidence Terrain Motion

TAT | June 2021

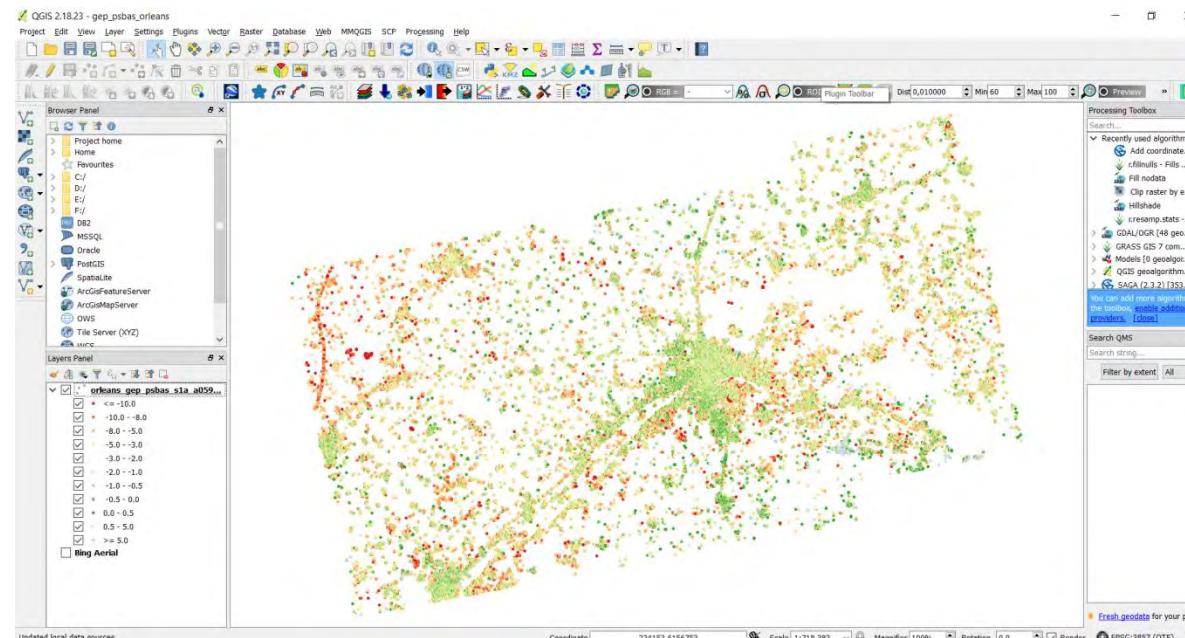
Michael Foumelis | Aristotle University of Thessaloniki (AUTH)

Fabrizio Pacini | Terradue s.r.l.

GEP Service Jobs | Subsidence in Orleans

■ Job ID | P-SBAS Sentinel-1:

<https://geohazards-tep.eu/t2api/share?url=https%3A%2F%2Fgeohazards-tep.eu%2Ft2api%2Fjob%2Fwps%2Fsearch%3Fid%3D59f5d57a-41fb-423f-8129-25ab14535938%26key%3D2777af75-b0f1-470b-8894-083d5ebb885f&id=esaapp>

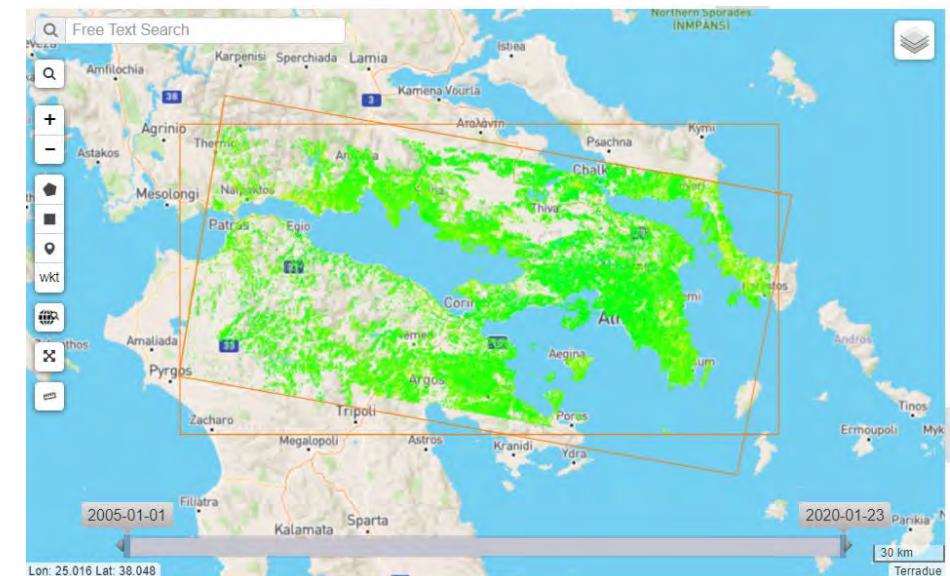


GEP Service Jobs | Ground Displacement Corinth Gulf

■ Job ID | P-SBAS S1A Athens D007 201504-201812 - NEW:

<https://geohazards-tep.eu/t2api/share?url=https%3A%2F%2Fgeohazards-tep.eu%2Ft2api%2Fjob%2Fwps%2Fsearch%3Fid%3Dbbee35d7-6a3f-4f9c-ab1c-3abb76f9aa9f%26key%3D4eff828f-48b4-4489-8008-421da2004b49>

Observation period 201504-201812 (S1A 185 scenes)

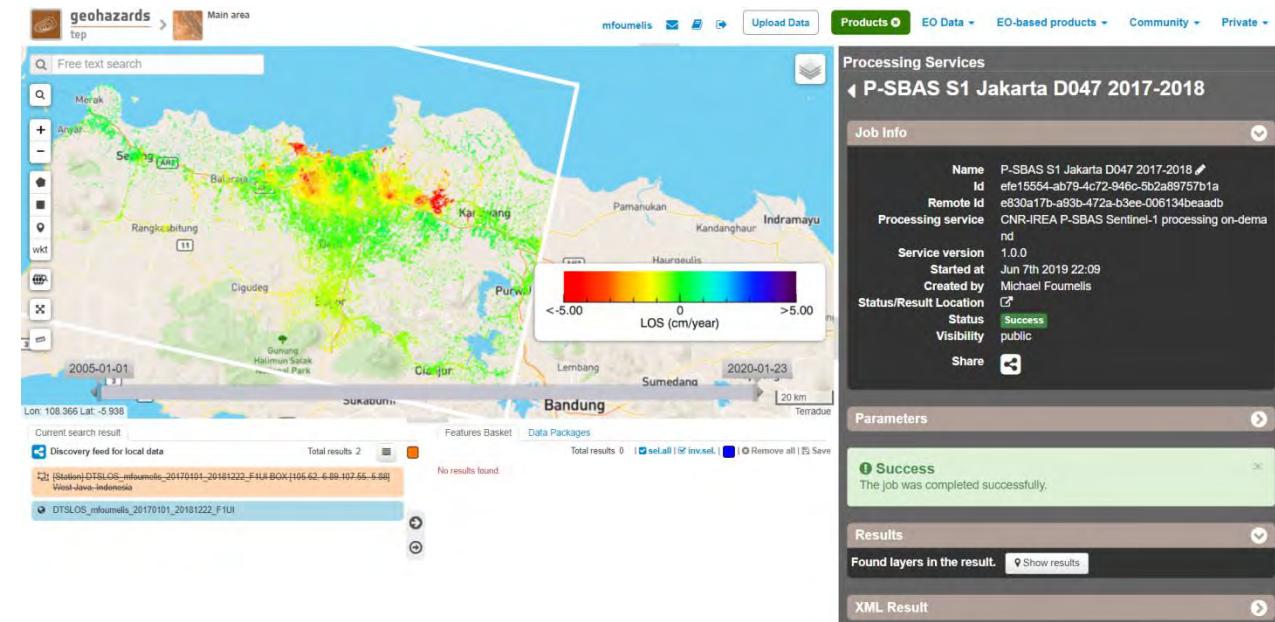


GEP Service Jobs | Subsidence in Jakarta

■ Job ID | P-SBAS Sentinel-1:

<https://geohazards-tep.eu/t2api/share?url=https%3A%2F%2Fgeohazards-tep.eu%2Ft2api%2Fjob%2Fwps%2Fsearch%3Fid%3Dfe15554-ab79-4c72-946c-5b2a89757b1a%26key%3D345c03ad-4603-4b22-8896-3465d903267d>

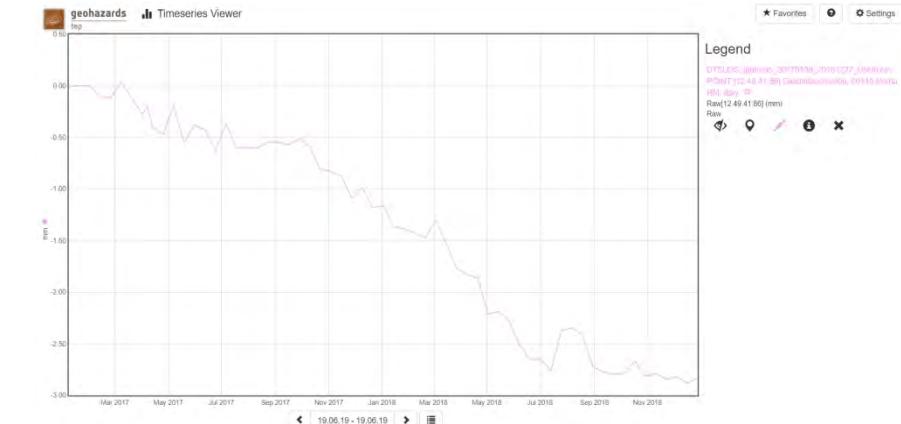
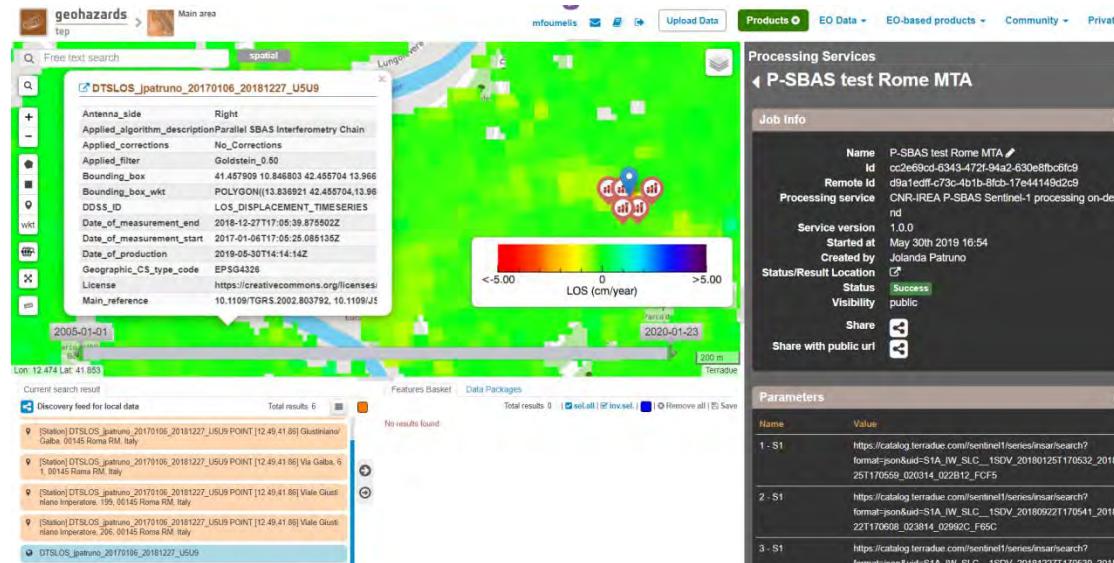
■ Search by Location: Jakarta



GEP Service Jobs | Subsidence in Rome

■ Job ID | P-SBAS Sentinel-1:

<https://geohazards-tep.eu/t2api/share?url=https%3A%2F%2Fgeohazards-tep.eu%2Ft2api%2Fjob%2Fwps%2Fsearch%3Fid%3Dcc2e69cd-6343-472f-94a2-630e8fc6fc9%26key%3D5c128370-e4a8-45a3-9fa3-c9eff6471183>



THANKS

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