Interreg Atlantic Area
European Regional Development Fund

EUROPEAN UNION

AGEO

TERRITORIAL RISKS

Platform for Atlantic Geohazard Risk Management

European spatial data infrastructures to improve risk management

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AGEO Final Conference – Lisbon – 19th April 2023

OUTLINE

- ✓ Introduction
- ✓ European Platforms - Infrastructures for geospatial information
  - EGDI | Copernicus
- ✓ Emergency platforms Copernicus EMSN, EMSR
  - Activations in the Atlantic Area
  - Uptake of the Copernicus Services in AGEO geohazards
  - citizen`s observatories
- ✓ Development of tools
  - EZ-InSAR
- ✓ Final notes

European Platforms - Infrastructures for geospatial information

EuroGeoSurveys

European Geological Data Infrastructure

https://www.europe-geology.eu/

EGDI

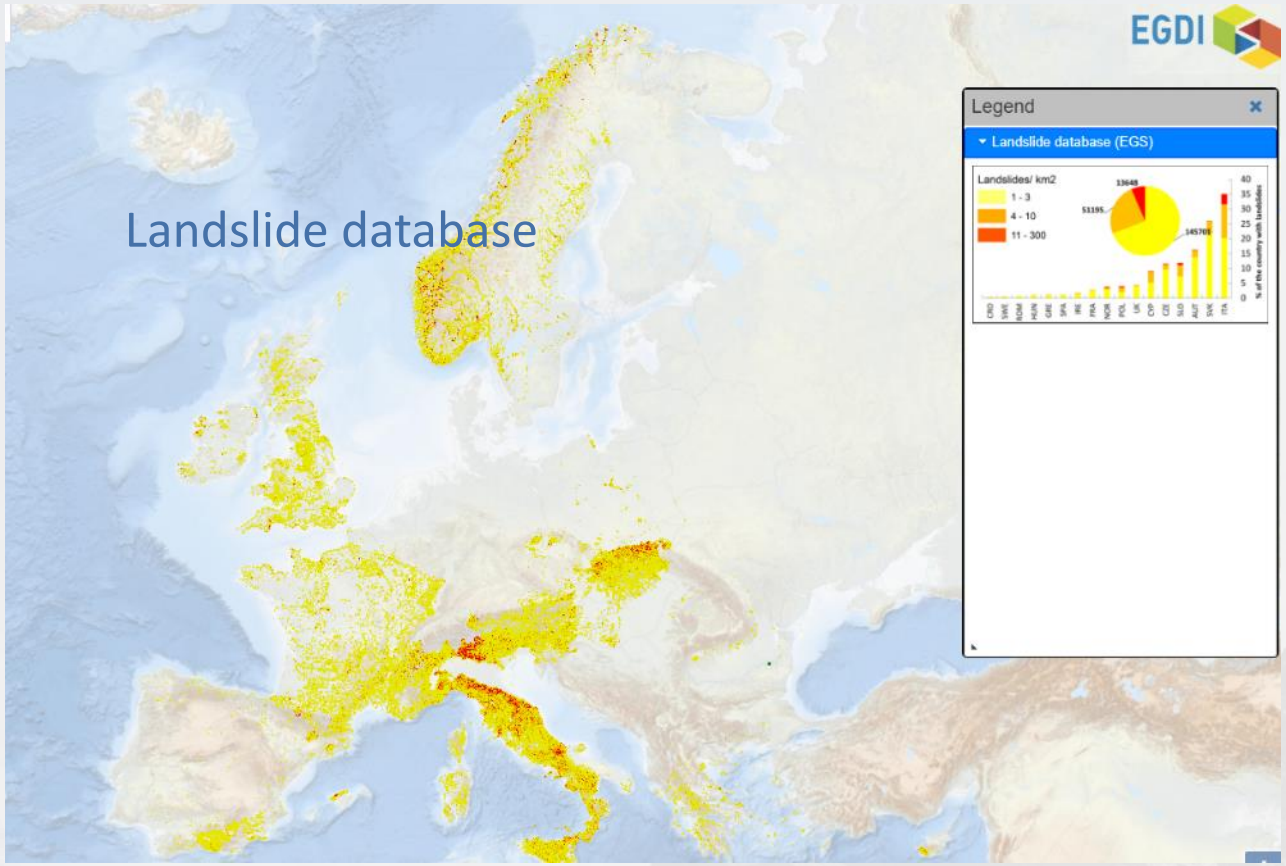
Data Tools | Scientific themes | About EGDI | English

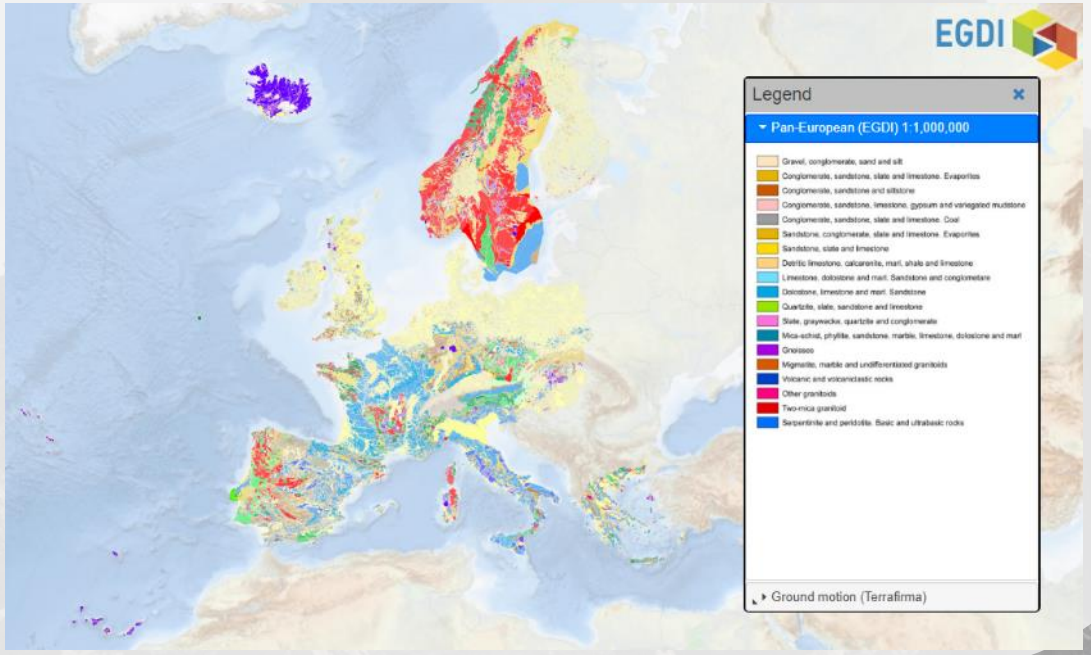
TOOLS FOR SEARCHING AND SHOWING DATA

- Map Viewer
- Data Search
- Document Repository
- Vocabularies
- Multilingual Keyword Thesaurus
- Metadata Catalog
- Map Services and Layers

SCIENTIFIC THEMES

- Basic Geology
- Marine Geology
- Mineral Resources
- GeoEnergy
- Water Resources
- Geochemistry
- Earth Observations and GeoHazard
- Urban Geology





European Platforms - Infrastructures for geospatial information

EuroGeoSurveys
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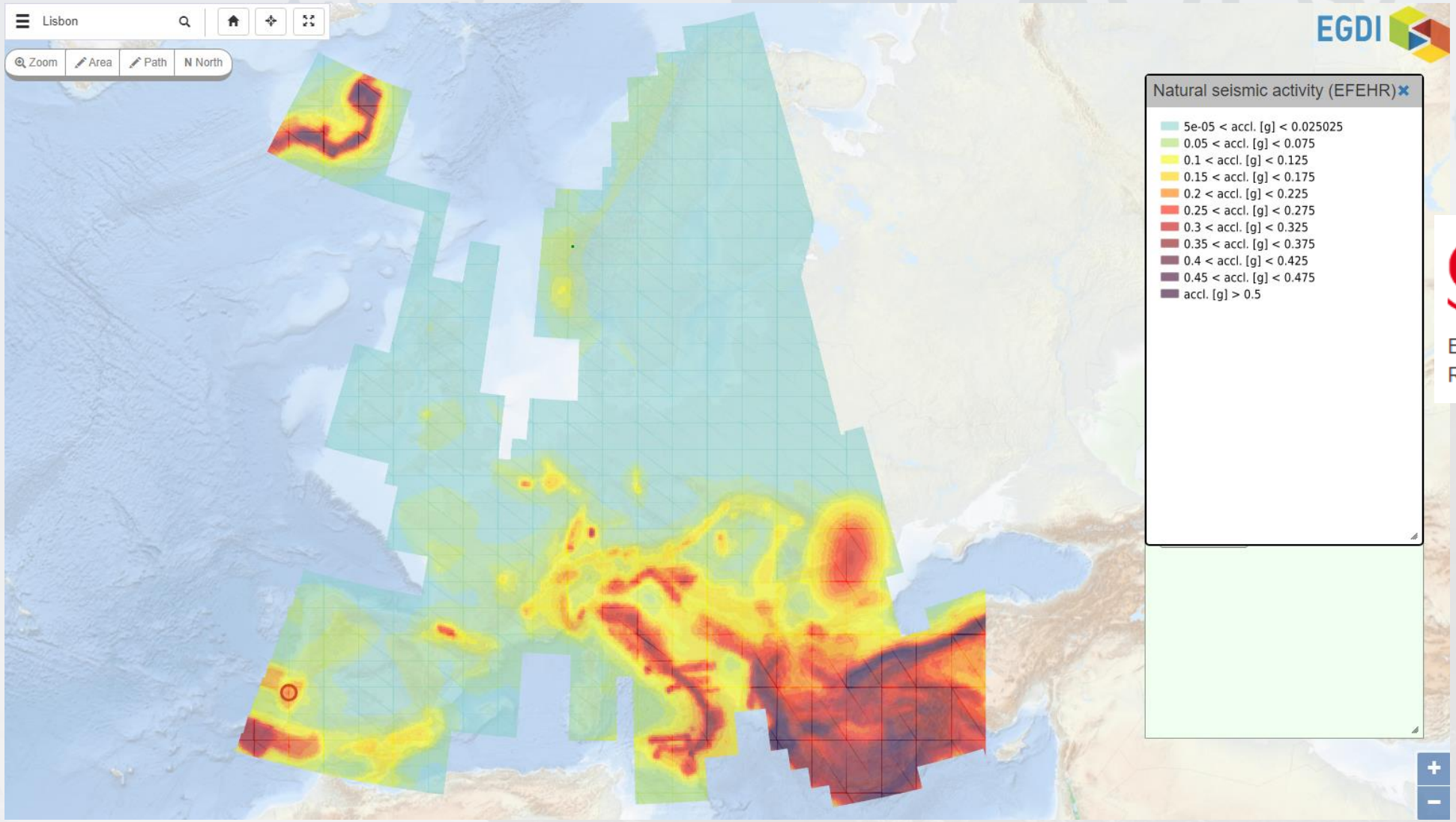


EFEHR EPOS EUROPEANPLATEOBSERVINGSYSTEM

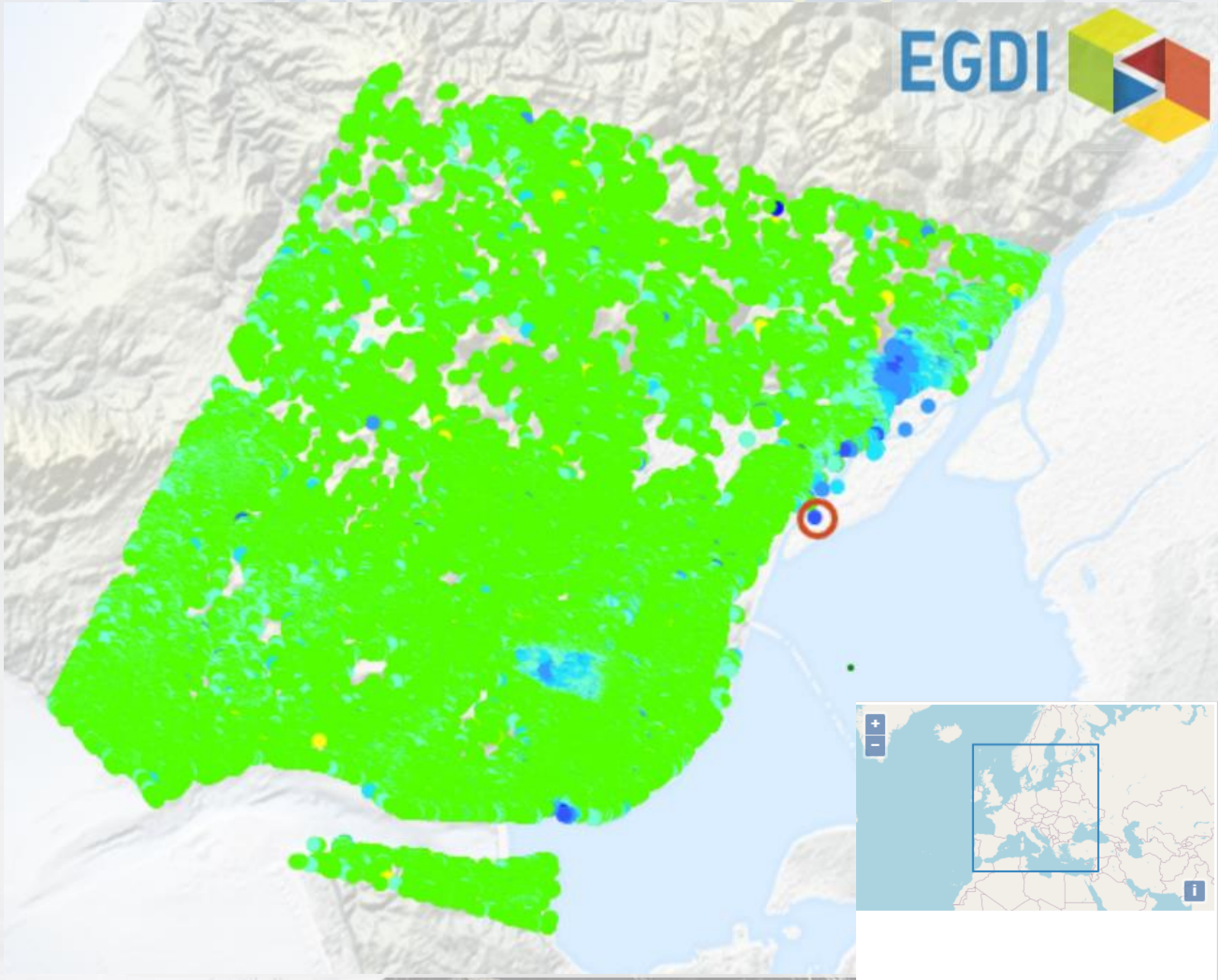
European Facilities for Earthquake Hazard and Risk.

- Earth Observation - Geohazards

- [ ] Landslide database (EGS)
- [ ] Ground motion (Terrafirma)
- [ ] Ground instability (Pangeo)
- [x] Natural seismic activity (EFEHR)

European Platforms - Infrastructures for geospatial information

EuroGeoSurveys
https://www.europe-geology.eu/



Ground motion (Terrafirma)

- Greater than 20 mm per year
- 10 to 20 mm per year
- 5 to 10 mm per year
- 3 to 5 mm per year
- 1.5 to 3 mm per year
- -1.5 to 1.5 mm per year
- -3 to -1.5 mm per year
- -5 to -3 mm per year
- -10 to -5 mm per year
- -20 to -10 mm per year
- Less than -20 mm per year

Basic / Full metadata

Terrafirma PSI legacy data service (OGC WxS)

Metadata language

Abstract

This web service provides access to Terrafirma legacy data as WMS and WFS.
Terrafirma is a project that originated within the GMES (Global Monitoring for Environment and Security) Service Element (GSE) programme of the European Space Agency, under the name Geohazard Land Motion (Terrafirma) Services.
MapServer software is used to provide these OGC WMS and WFS services.

Type service

Copernicus

https://www.copernicus.eu/en

Space (ESA)

Sentinels Missions S1-S2-S3-S5P….

+

Contributing missions

In situ

to produce, enrich and validate the services, improving their accuracy and reliability.

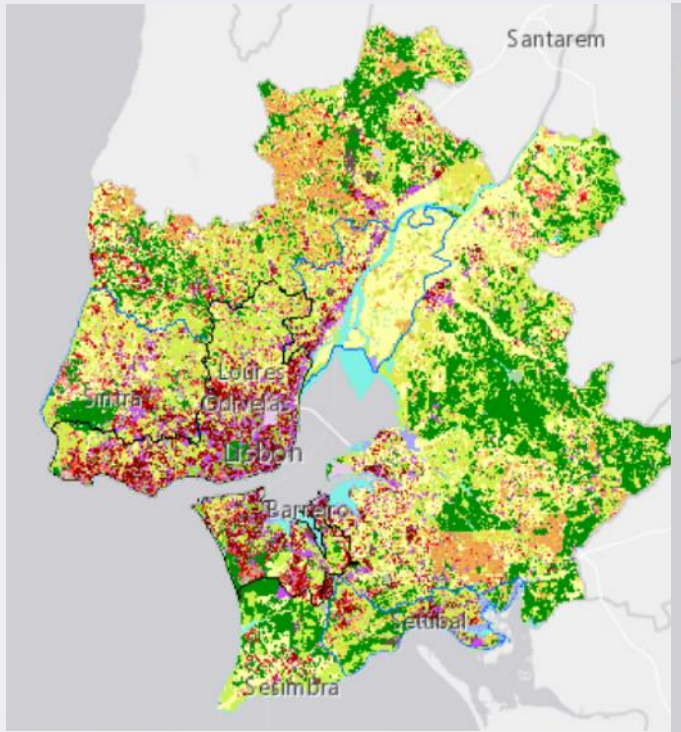
https://insitu.copernicus.eu/observations

- Land Monitoring
- Marine Environment Monitoring
- Atmosphere Monitoring
- Emergency Management
- Security
- Climate Change

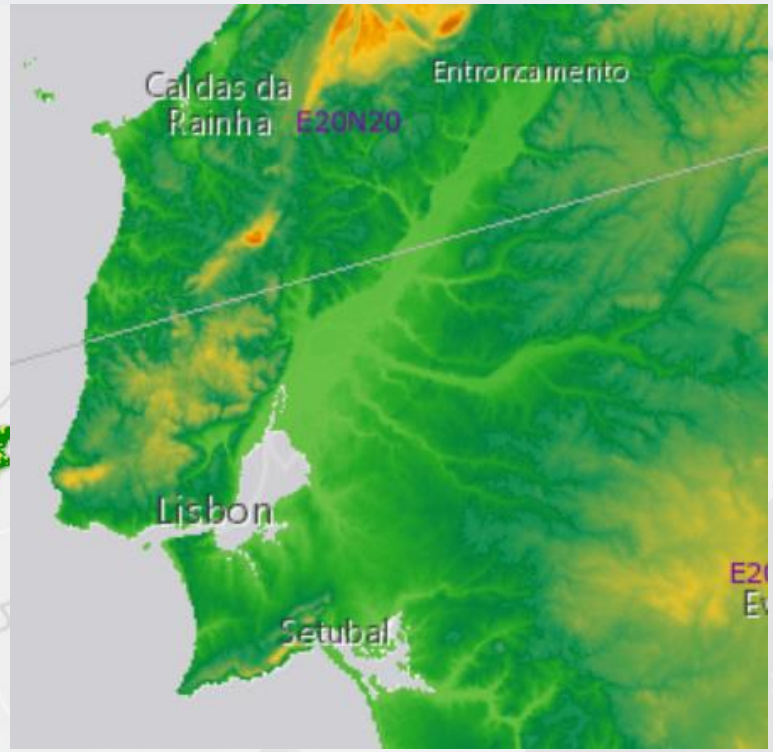
European Platforms - Infrastructures for geospatial information

Copernicus

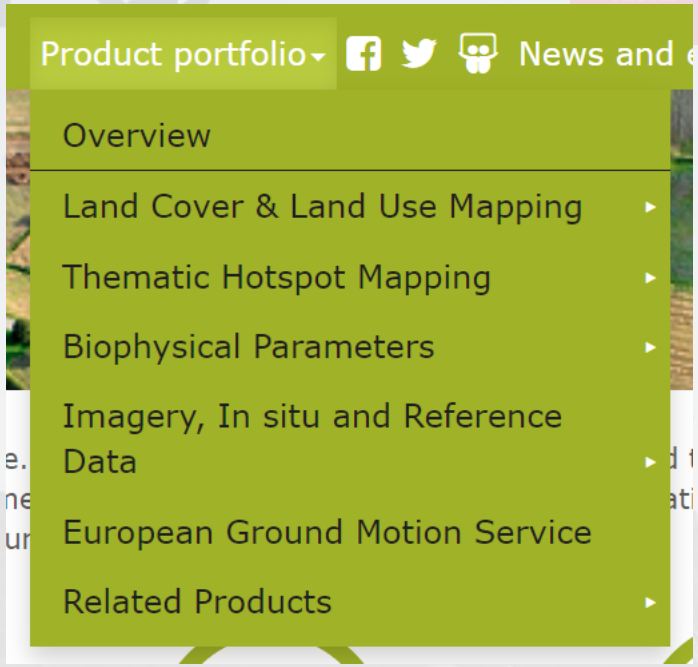
https://www.copernicus.eu/en



Urban Atlas

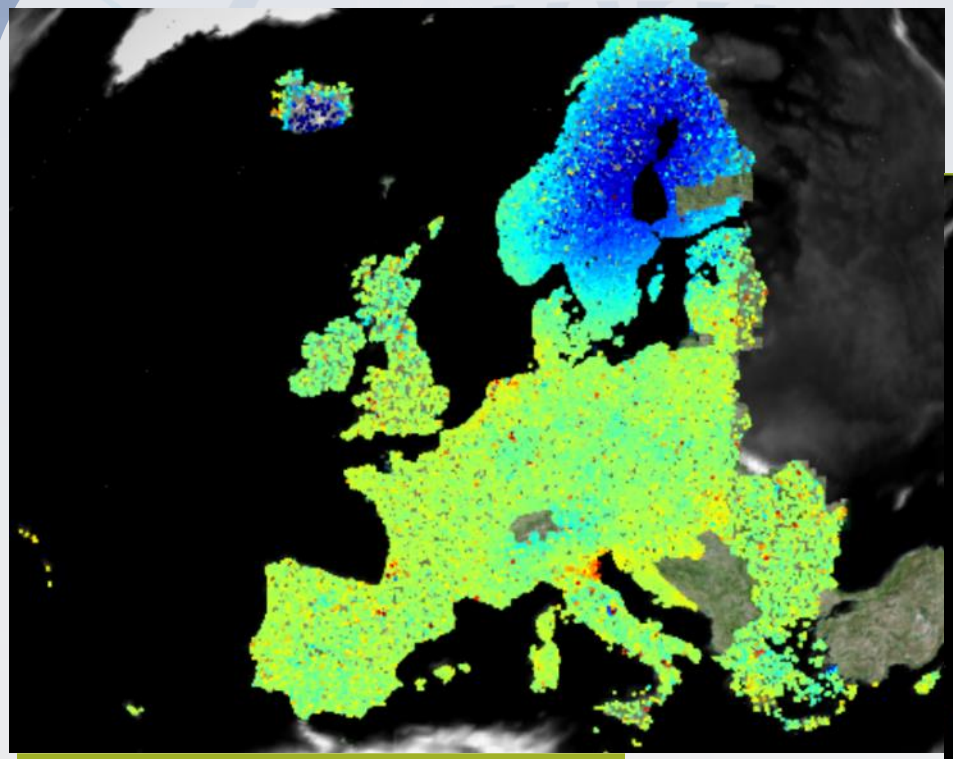


EU-DEM

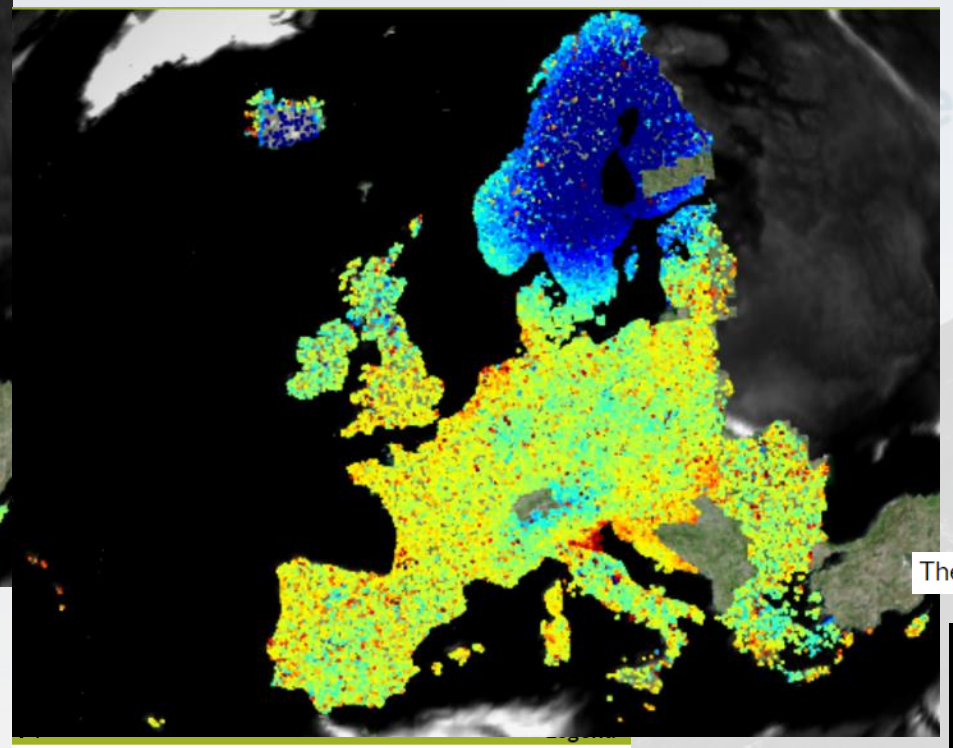


Providing base data and elements for exposure and vulnerability

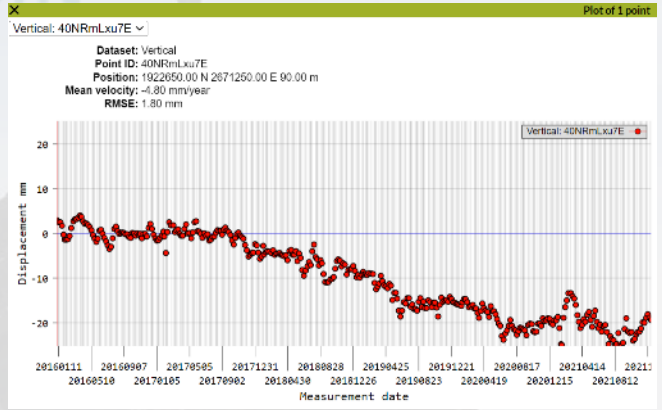
Urban Atlas 2018



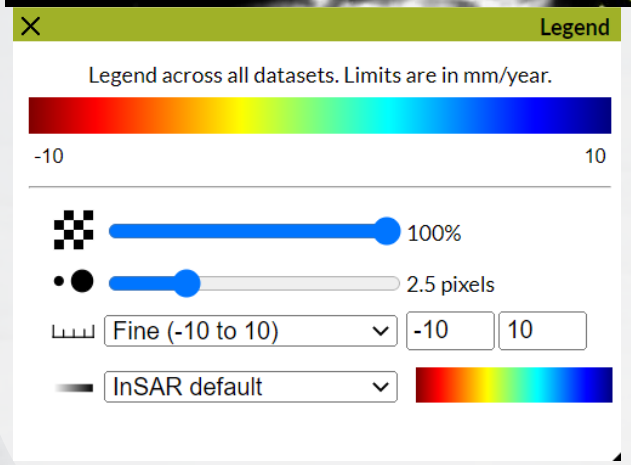
Sentinel 1 from
2015 -2021 and updates

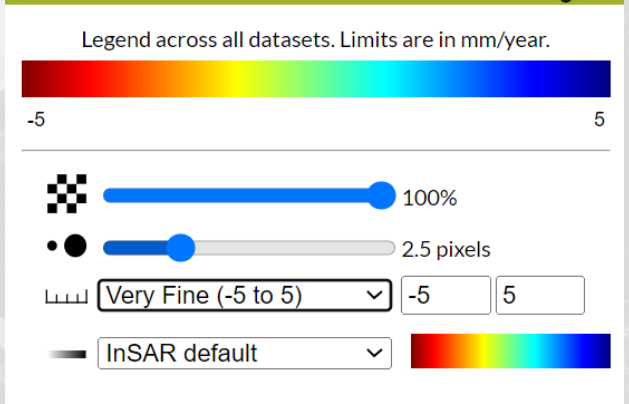


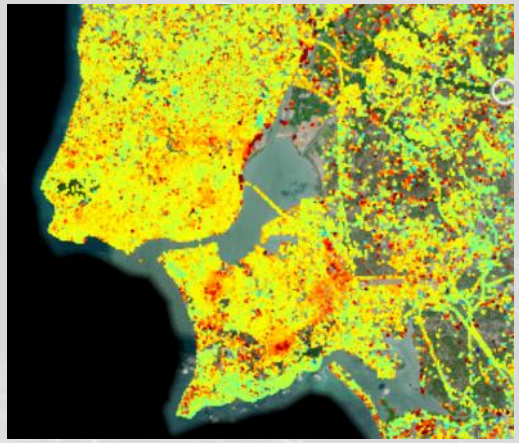
https://land.copernicus.eu/pan-european/european-ground-motion-service



The service contains modified Copernicus Sentinel data (202







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TERRITORIAL RISKS

Platform for Atlantic Geohazard Risk Management

Emergency platforms

Emergency platforms – Copernicus-EMS

On demand mapping

Copernicus EMS On Demand Mapping provides on-demand detailed information for selected emergency situations that arise from natural or man-made disasters anywhere in the world.

Rapid Mapping

Rapid Mapping provides geospatial information within hours or days of a service request in order to support emergency management activities in the immediate aftermath of a disaster.

Risk and Recovery Mapping

Risk & Recovery Mapping supplies geospatial information in support of Disaster Management activities including prevention, preparedness, risk reduction and recovery phases.

Exposure mapping

The Copernicus EMS exposure mapping component provides highly accurate and continuously updated information on the presence of human settlements and population with the Global Human Settlement Layer (GHSL).

Population grids

Population grids are effective datasets to assess the amount of resident population at fine spatial resolution. Population counts per grid cell quantify the amount of people exposed to hazards.

Built-up surface

Built-up surface grids are essential information to map human settlements and their characteristics (like land use and density). The amount of built-up surface per grid cell is useful to estimate settlement typologies and is used as covariate for population disaggregation.

Early Warning & Monitoring

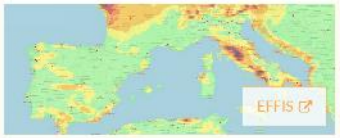
Copernicus EMS Early Warning and Monitoring offers critical geospatial information at European and global level through continuous observations and forecasts for floods, droughts and forest fires.

Floods

The **European Flood Awareness Systems (EFAS)** and **Global Flood Awareness Systems (GloFAS)** provide complementary flood forecast information to relevant stakeholders that support flood risk management at the national, regional and global level.

Fires

The **European Forest Fire Information System (EFFIS)** monitors forest fire activity in near-real time. EFFIS supports wildfire management at the national and regional level for EU member states and across the Middle East and North Africa.



Droughts

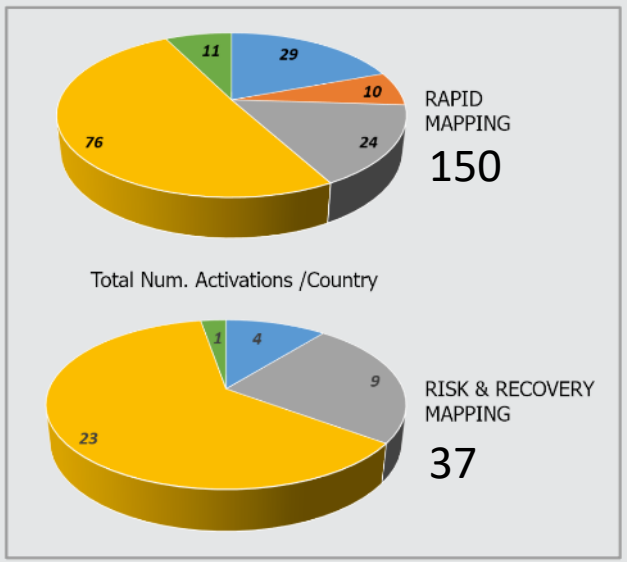
The **Drought Observatory (DO)** provides drought-relevant information and early-warnings for **Europe (EDO)** and **globally (GDO)**. The service publishes short analytical reports (Drought News) in anticipation of an imminent drought.

Copernicus
Europe's eyes on Earth

Emergency Management Service

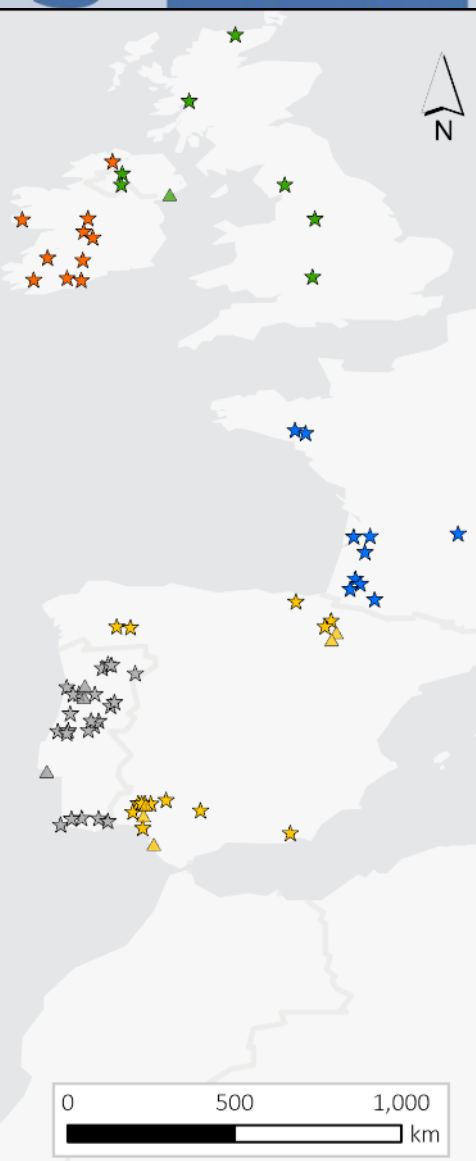
https://emergency.copernicus.eu/

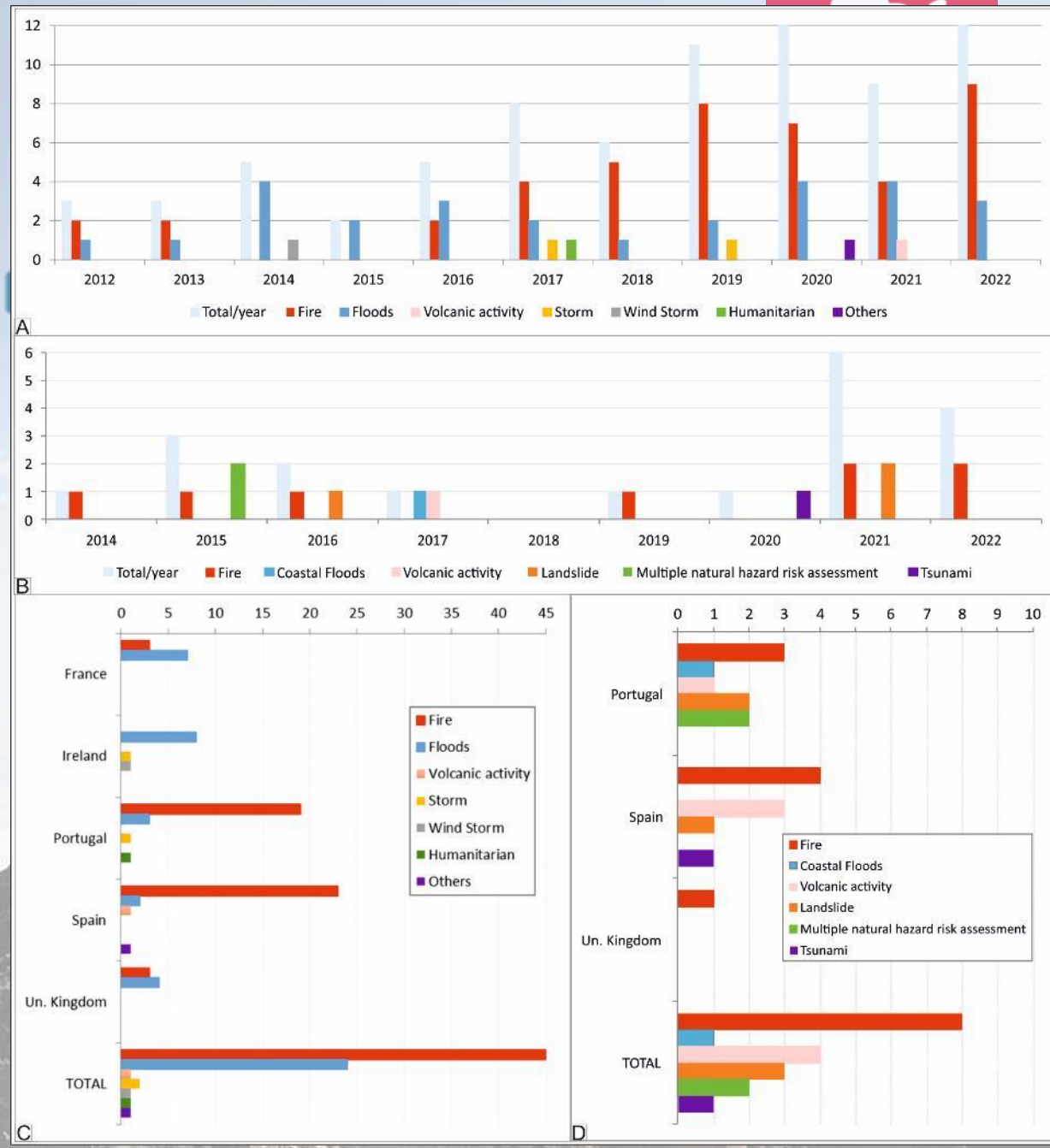
On Demand Mapping Services Activations



78 EMSR
19 EMSN

FRANCE
IRELAND
PORTUGAL
SPAIN
UNITED KINGDOM





Montoya et al., submitted 2023

Example of Copernicus use, through different services*, in each risk analysis stage for each specific hazard.

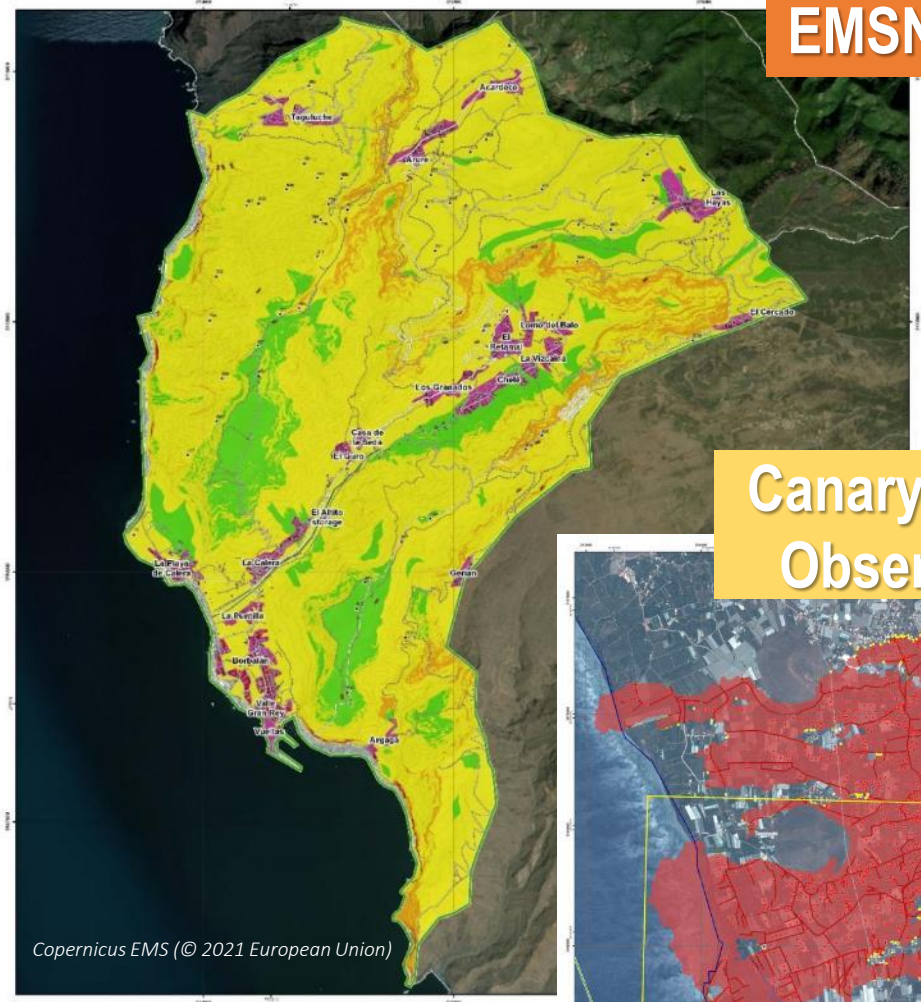
Geohazard	Pre-event stage	During-event stage	Post-event stage
Floods	Precipitation, vegetation, weather forecast, EFAS, digital elevation model (slope), elements throughout the sensitivity area, sea level, waves	Affected areas, elements for crisis management	Affected areas map with different levels of characterization, maps
Rockfalls	Precipitation, vegetation, new constructions (update landcover), fires burning (loss vegetation, temperature), land use, geomorphology, digital elevation model, deformation, settlements, landscape dynamics monitoring in coastal zones, soil moisture index, exposed elements	Precipitation	Affected area map
Coastal erosion	Exposed elements, settlements, landscape dynamics monitoring in coastal zones, Digital Elevation Model, water and wetness, land cover, riparian zones	Wave height, wind, sea level	Affected area map
Earthquakes	Area prone to deformation, tectonic plate movement	Tectonic plate movement, wave height, sea-level, affected areas, elements for crisis management, deformation	Affected area map (access for rescue teams)
Landslides	Area prone to deformation, precipitation, vegetation cover, weather forecast, new construction, land use, geomorphology, digital elevation model, settlements, soil moisture index, exposed elements	Precipitation, deformation, affected areas, elements for crisis management	Affected area map
Volcanic eruptions	Area prone to deformation, satellite images, digital elevation model, temperature, gas emissions, exposed elements	Deformation, wind, temperature, emissions, affected areas, elements for crisis management	Affected area map
Geotechnical risks	Area prone to deformation, tectonic plate movement, satellite images, precipitation, vegetation cover, weather forecast, new construction	Precipitation, deformation, affected areas, elements for crisis management	Affected area map

* Copernicus (Marine Environment Monitoring Service-CMEMS, Land Monitoring Service-CLMS, Atmosphere Monitoring Service-CAMS, Emergency Management Service-EMS, service for Security, Climate Change Service-C3S)

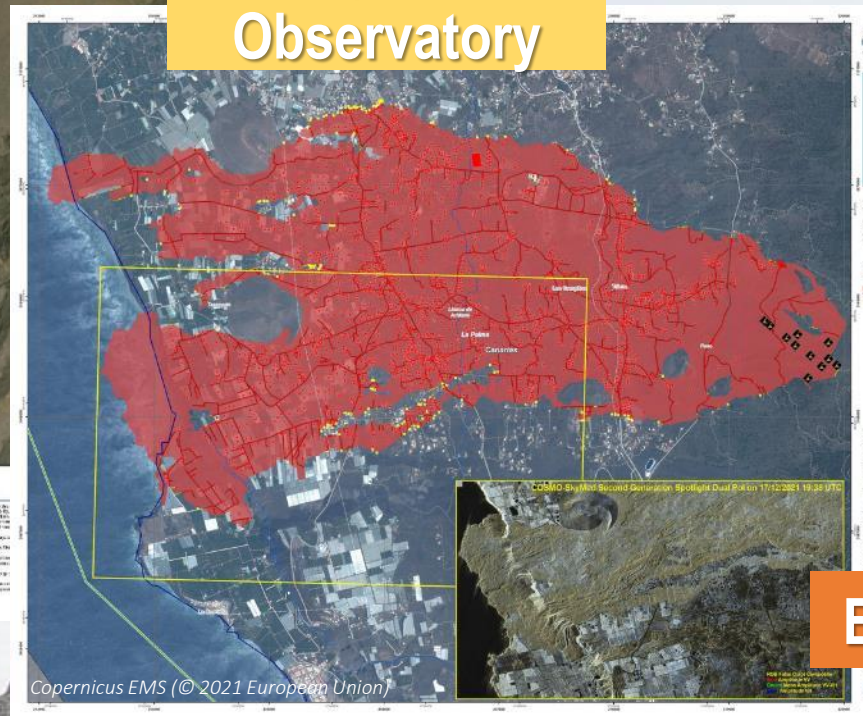
Montoya et al., submitted 2023

Copernicus EMS Activations requested from the AGEO pilots

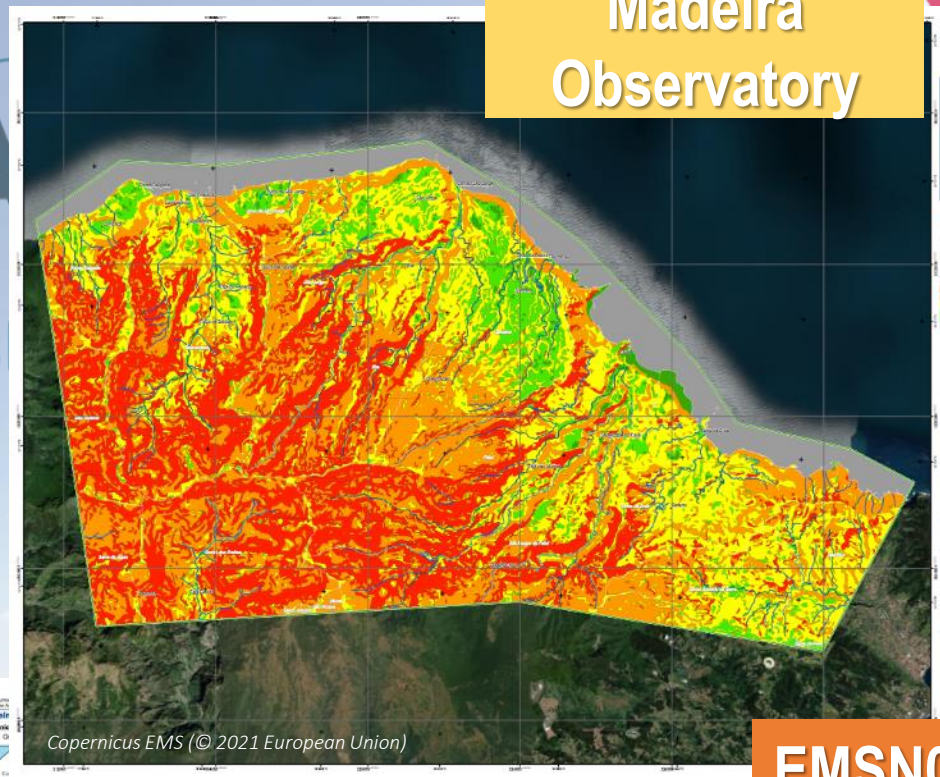
EMSN093



Canary Islands Observatory



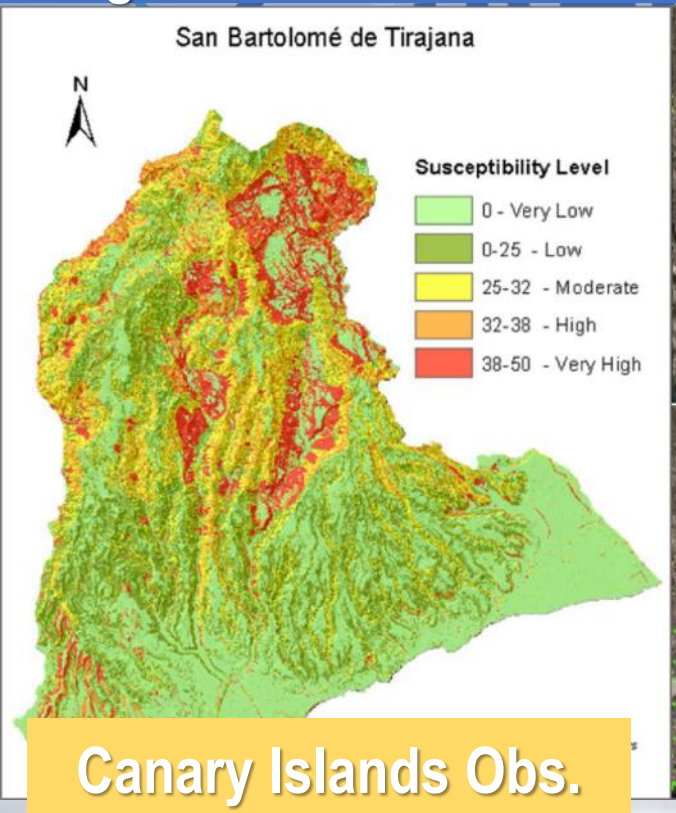
Madeira Observatory

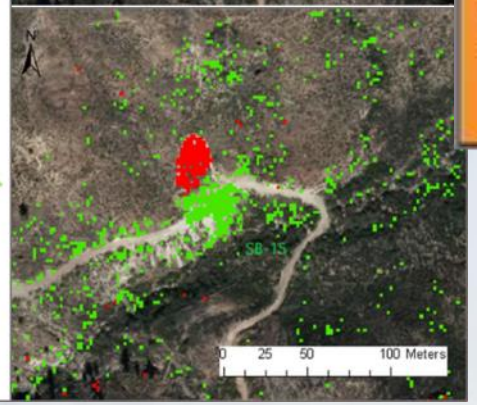


EMSN089

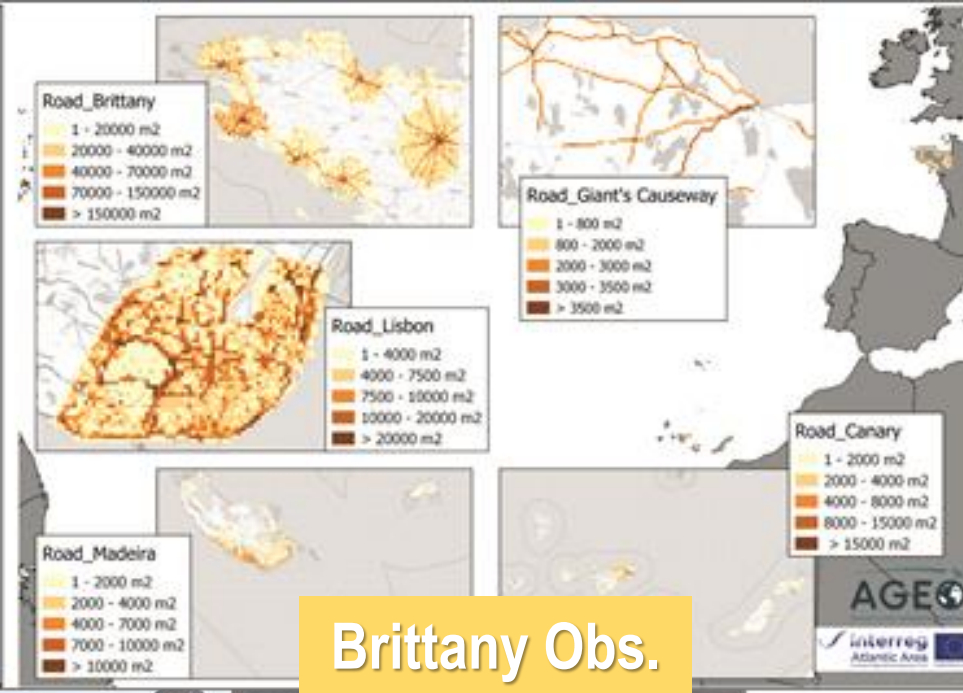
EMSR546, EMSN112/124 and EMSN119

Use of Copernicus services and products for geohazards



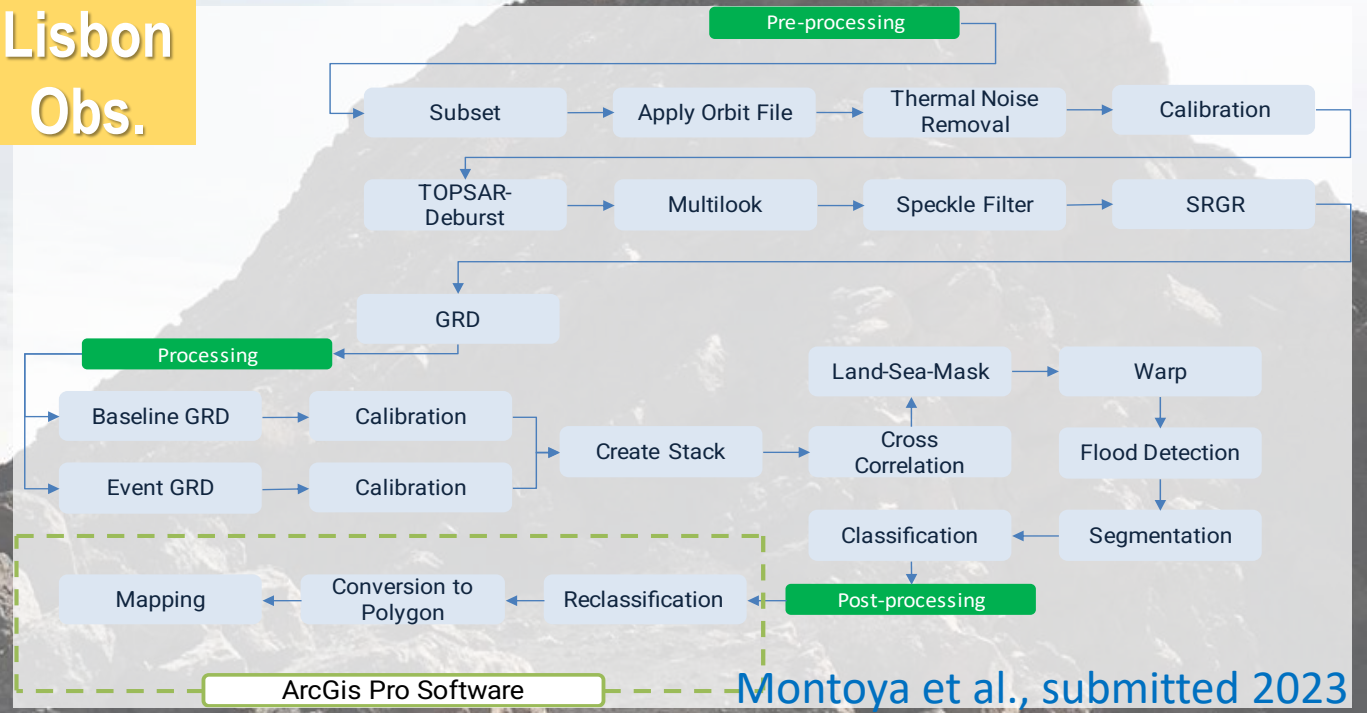


Canary Islands Obs.



Brittany Obs.

Lisbon Obs.



Montoya et al., submitted 2023

Madeira Obs.

InSAR for monitoring slow mass movements

Causeway Coast Obs.

-InSAR to assess and monitor landslide instability and subsidence
-Copernicus database to improve characterization pilot site

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Platform for Atlantic Geohazard Risk Management

Development of tools

EZ-InSAR: a Matlab-based toolbox for processing satellite radar images to map ground motion

UCD DUBLIN

Overview of current InSAR processing tools

- **Commercial software**

MTI: Multi-temporal InSAR

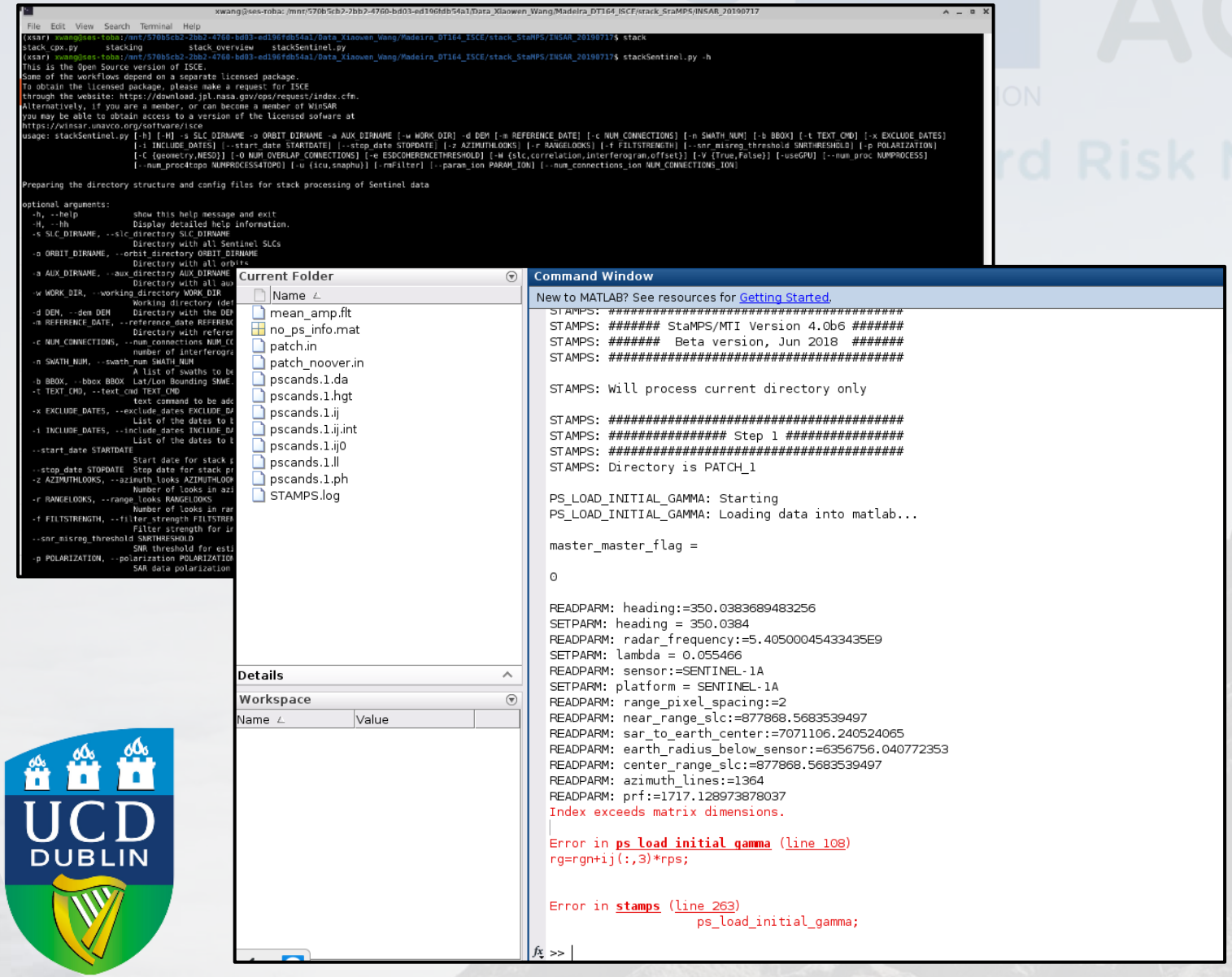
Y: YES
N: NO

	Platform	Language	GUI	InSAR	MTI-PS	MTI-SBAS
GAMMA	Unix	C/C++ /Shell/Python	N	Y	Y	Y
ENVI SARscape	Win/Unix	IDL	Y	Y	Y	Y
SARproz	Win	MATLAB	Y	Y	Y	Y

- **Free/Open-source software (most popular)**

	Platform	Language	GUI	InSAR	MTI-PS	MTI-SBAS
SNAP	Win/Unix	Python	Y	Y	N	N
ISCE2	Unix	C/C++/Python	N	Y	N	Y
GMTSAR	Unix	C/C++/Shell	N	Y	N	Y
MintPy	Unix	Python	N	N	N	Y
StaMPS	Unix	Matlab	N	N	Y	Y
New toolbox: EZ-InSAR			**Y**	**Y**	**Y**	**Y**

Pain points of running InSAR on current open-source software



- ***Command line*** running (needs a professional understanding of the software)
- ***Non-intuitive*** way of parameter setting
- ***Difficult to compare*** **the results retrieved from different methods**
- ***Switching between software packages*** needed to access different processing tools from SAR interferometry to displacement time series analysis

Developing of new toolbox: EZ-InSAR (Easy-to-use InSAR)

Aim: Developing a toolbox with easy-use GUI and open-source for SAR data processing from RAW level to multi-temporal displacement analysis in one flowchart.

Three-in-one

Interferometric synthetic aperture radar Scientific Computing Environment (ISCE)

- NASA's Jet Propulsion Laboratory (JPL)
- Processing data from the **RAW level**
- Processing for nearly all SAR sensors

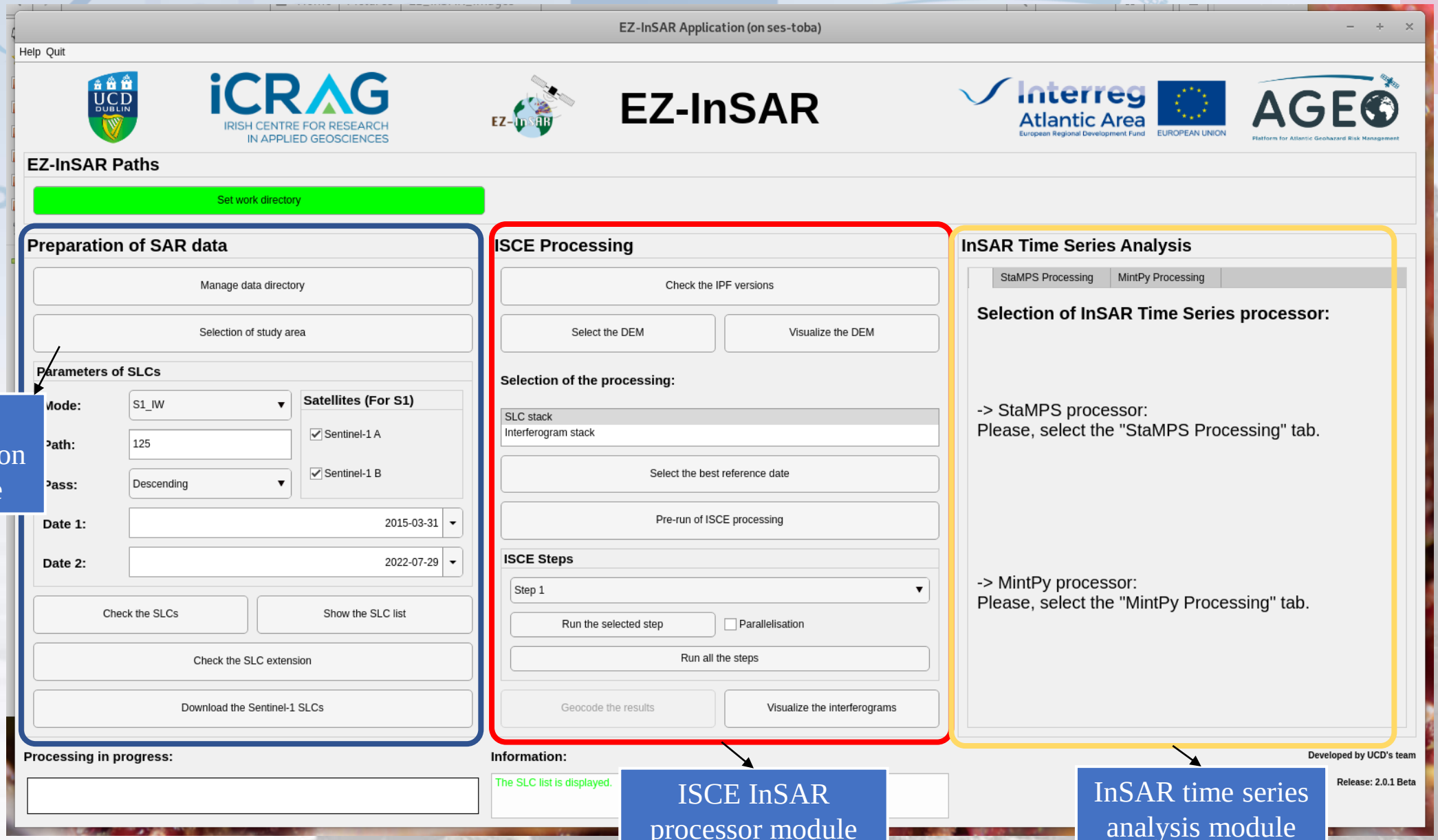
Stanford Method for Persistent Scatterers (StaMPS)

- Selecting pixels with rigorous statistical analysis
- PSI/SBAS processing with 3D phase unwrapping
- Combined (PS+SBAS) processing

Miami INsar Time-series software in PYthon (MintPy)

- 4 type of SBAS processing algorithms
- Various tools for error correction (unwrapping error, solid earth tides correction, & tropospheric error)

EZ-InSAR (Easy-to-use InSAR)



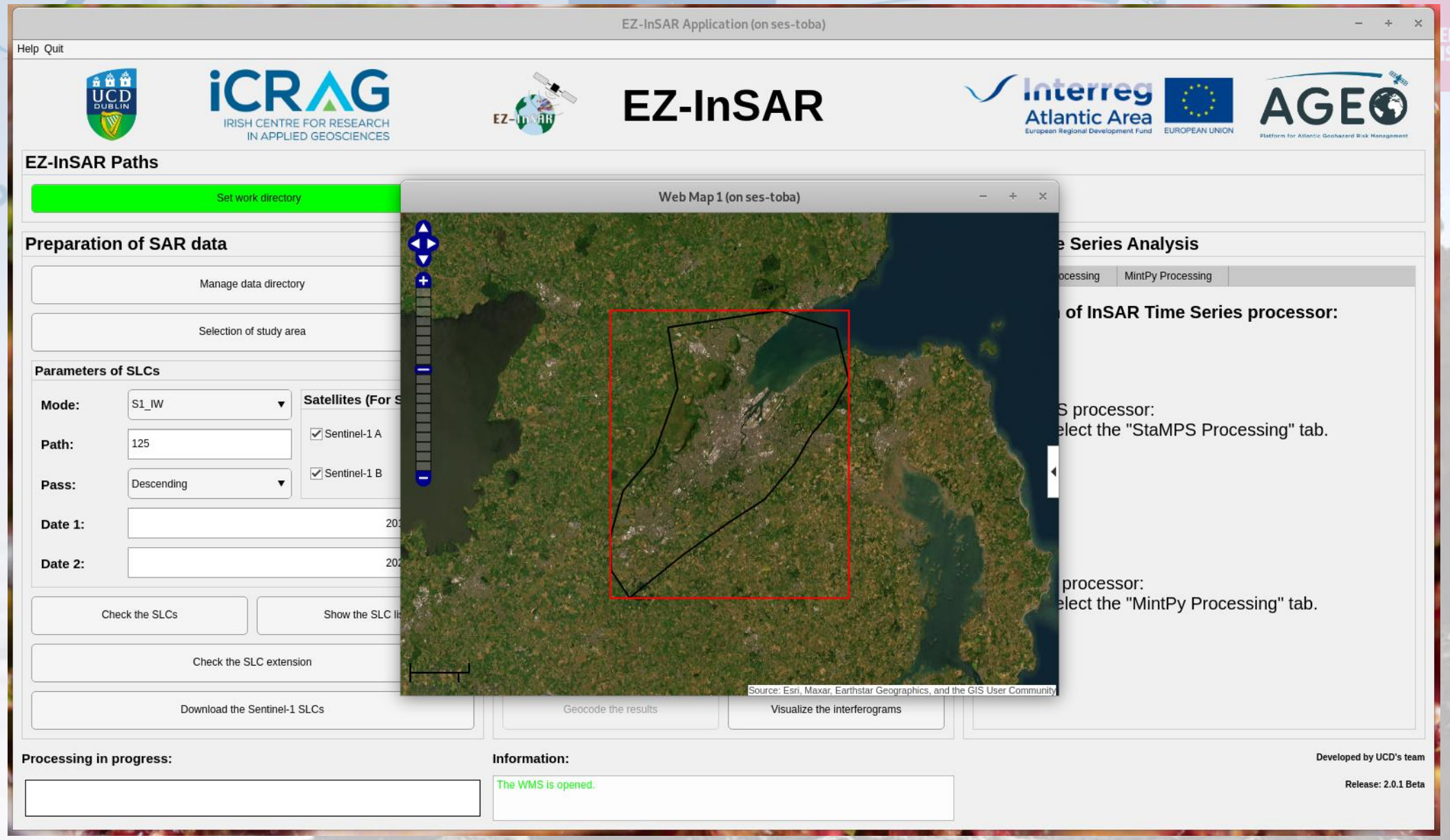
Data preparation module

ISCE InSAR processor module

InSAR time series analysis module

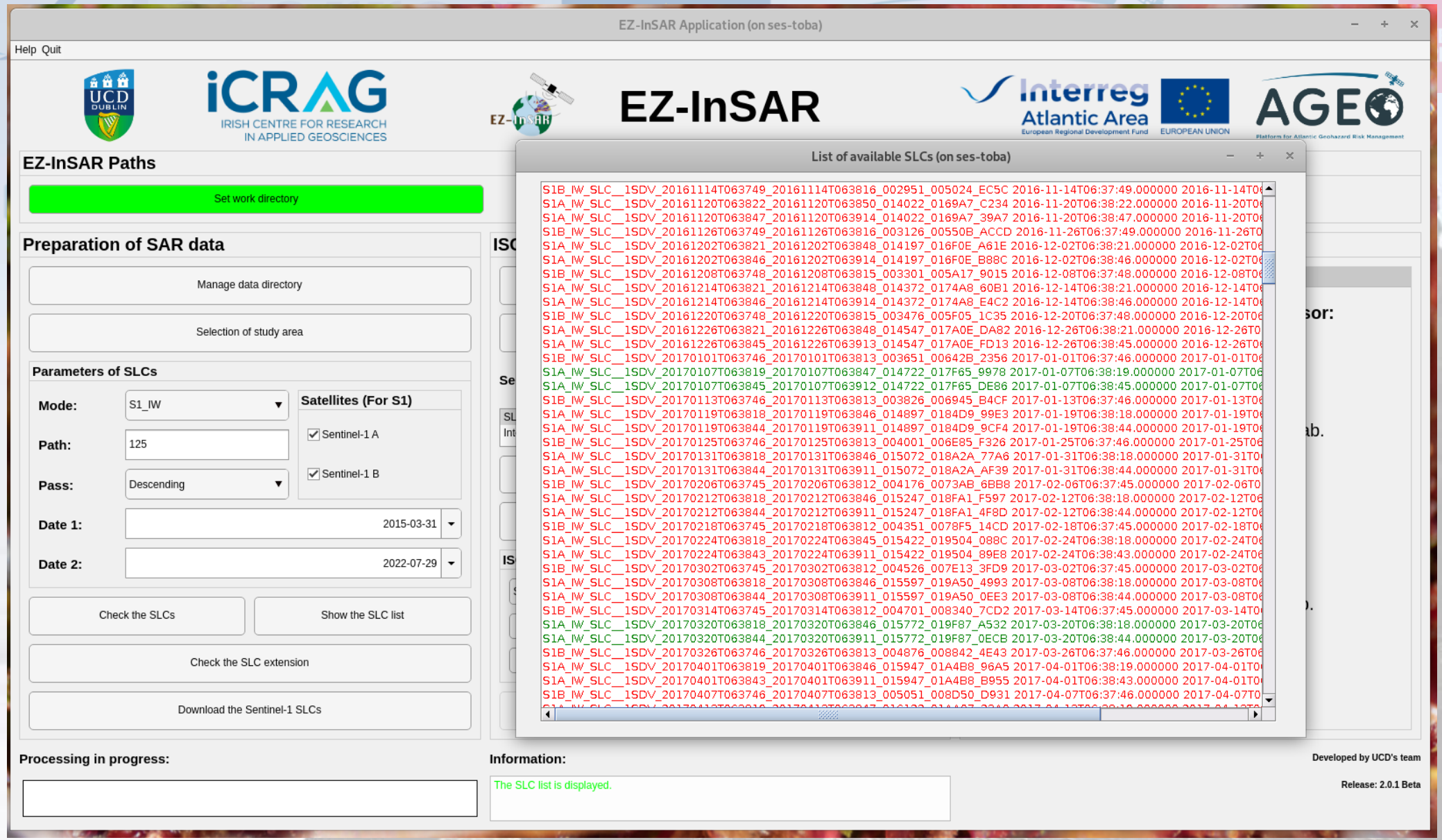
EZ-InSAR (Easy-to-use InSAR)

Selection of the study area: Belfast



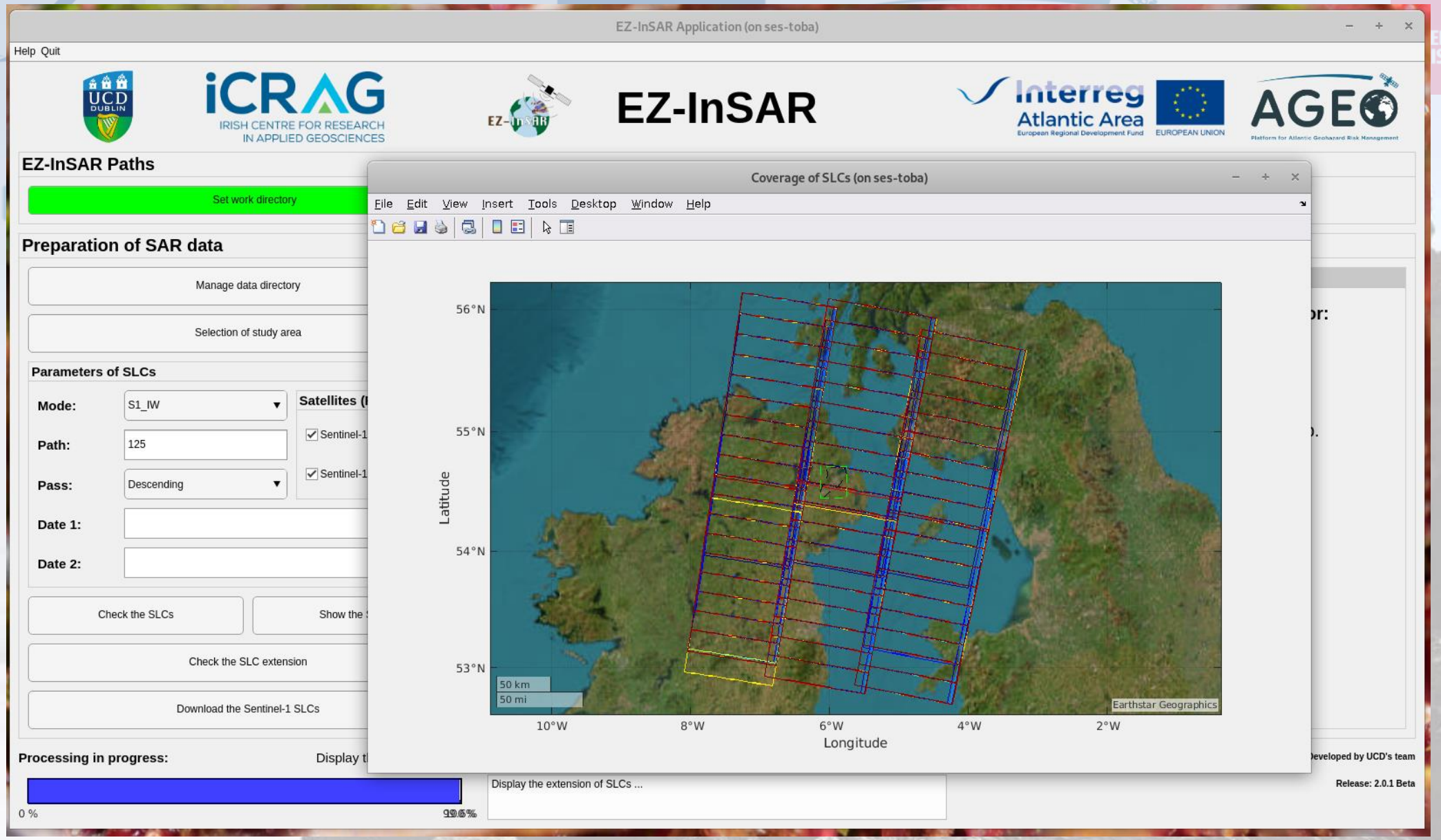
EZ-InSAR (Easy-to-use InSAR)

List of available SLCs (green: already downloaded)



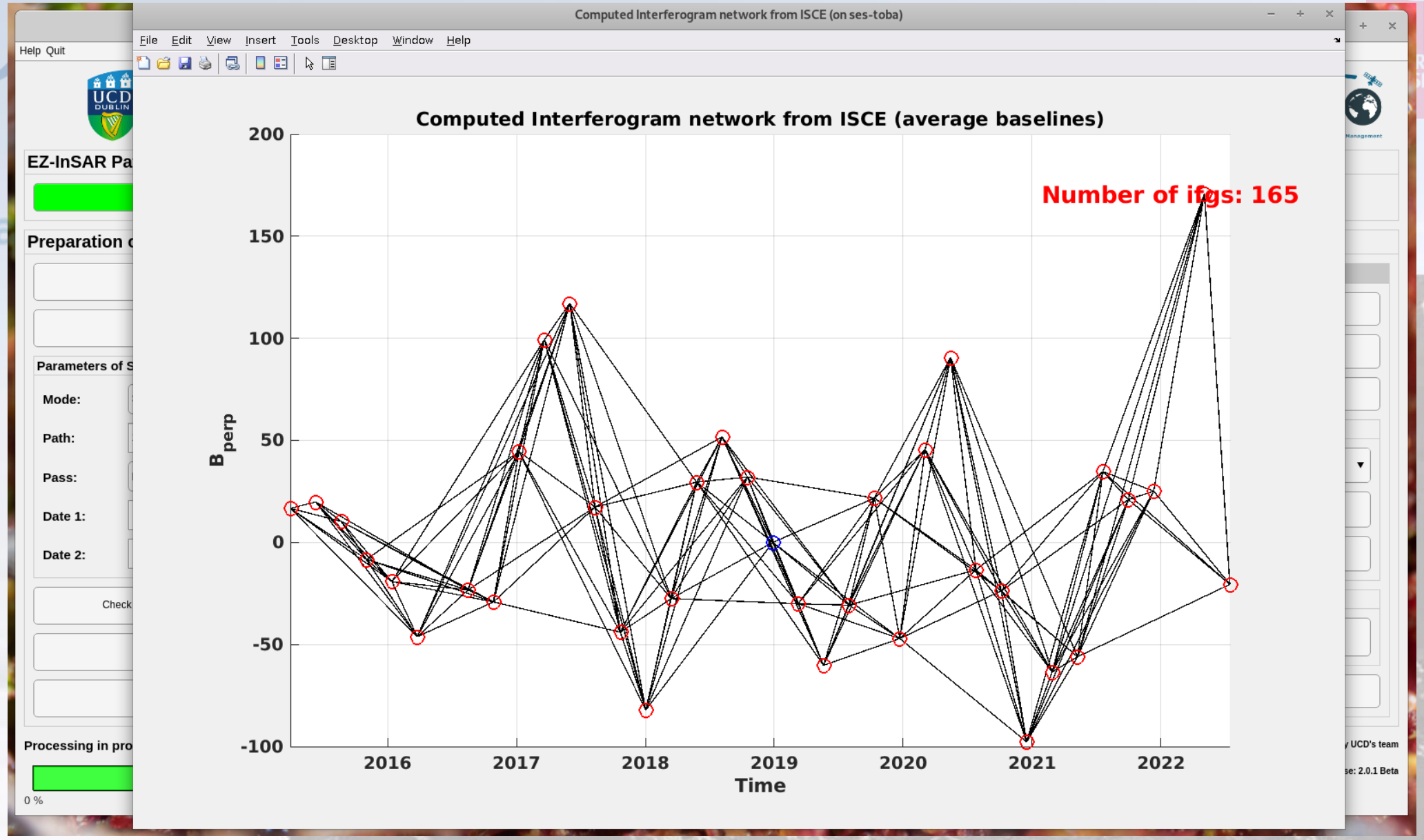
EZ-InSAR (Easy-to-use InSAR)

SAR data (SLC) coverage on Belfast



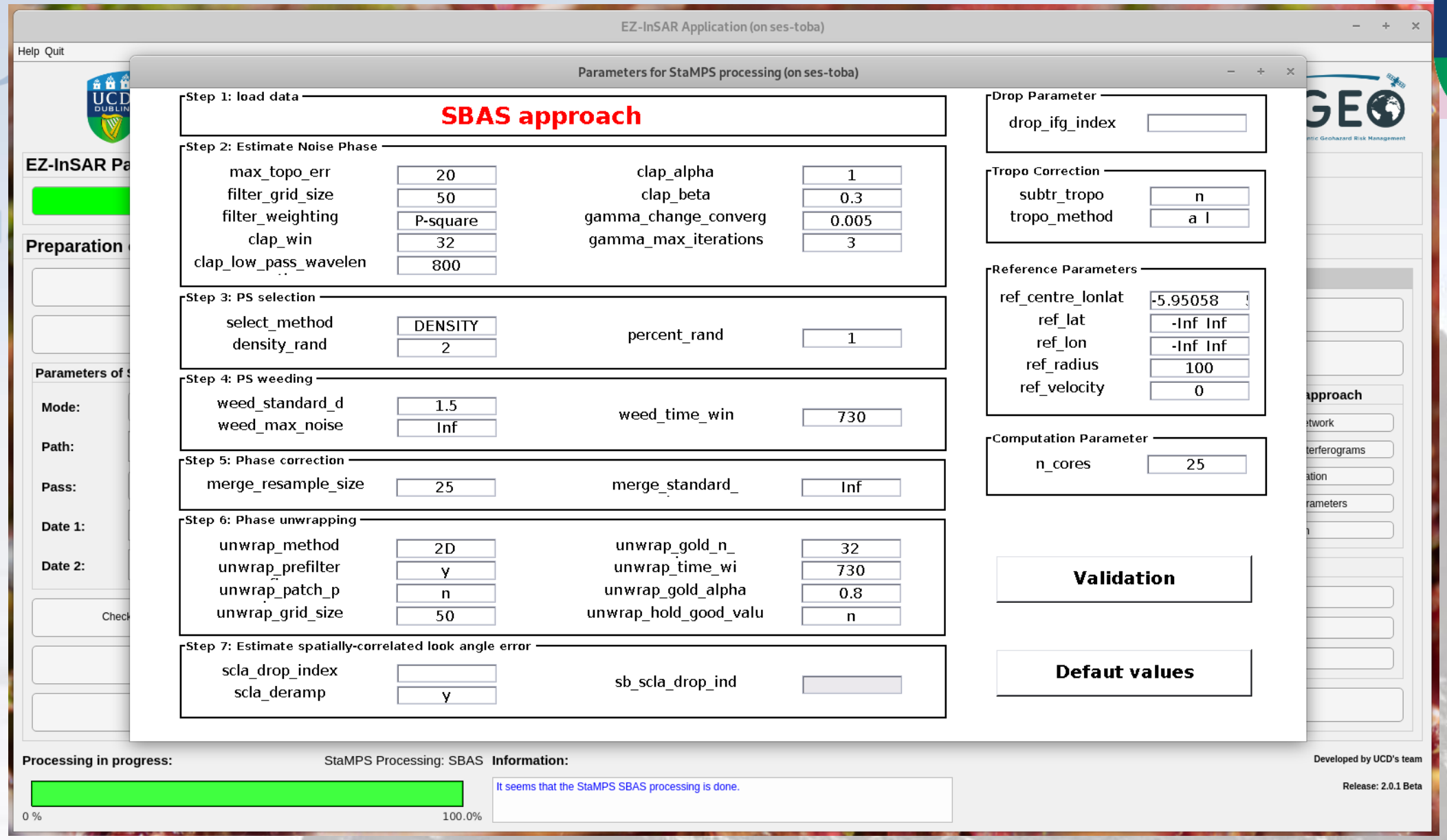
EZ-InSAR (Easy-to-use InSAR)

StaMPS: interferogram network



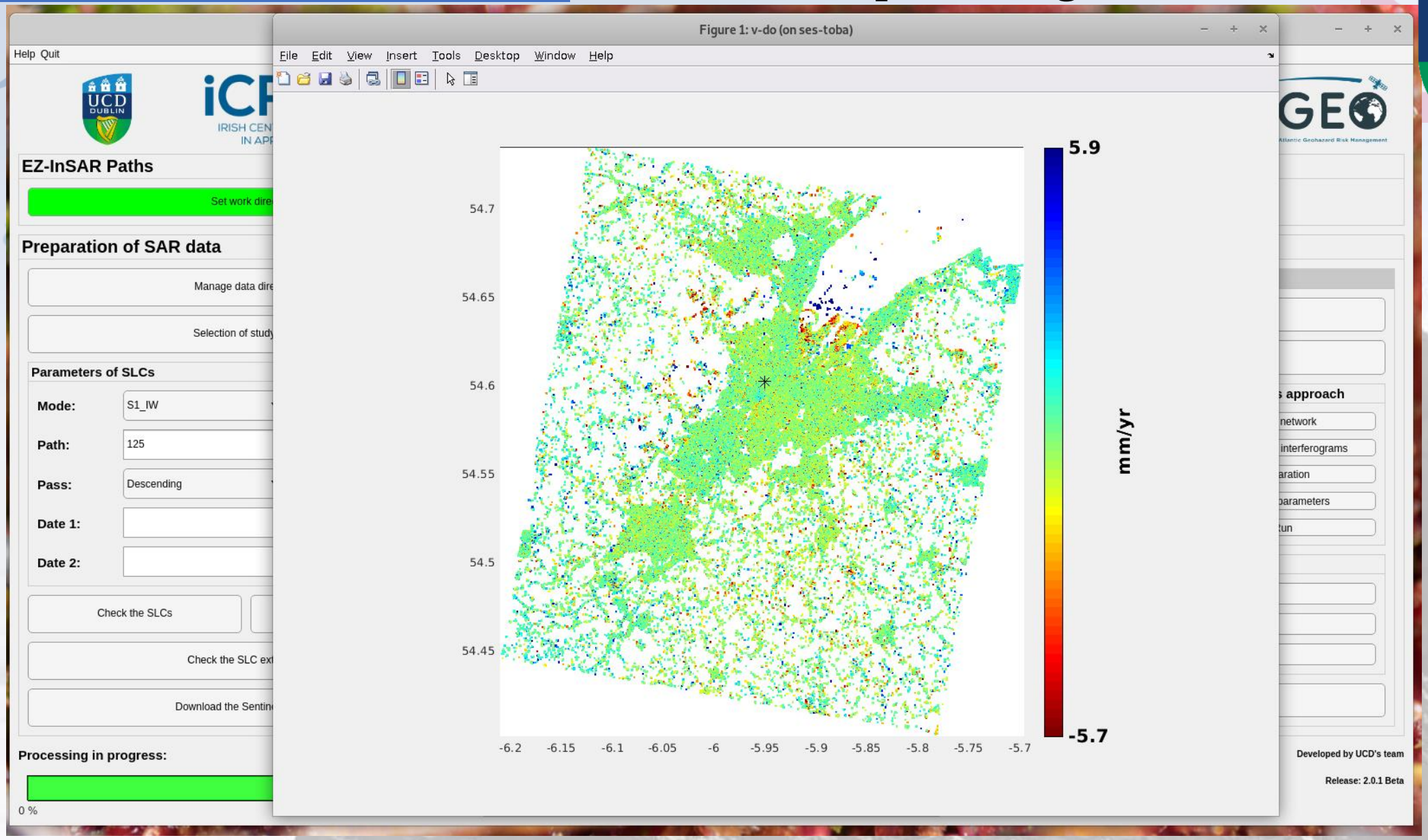
EZ-InSAR (Easy-to-use InSAR)

StaMPS processing: parameters



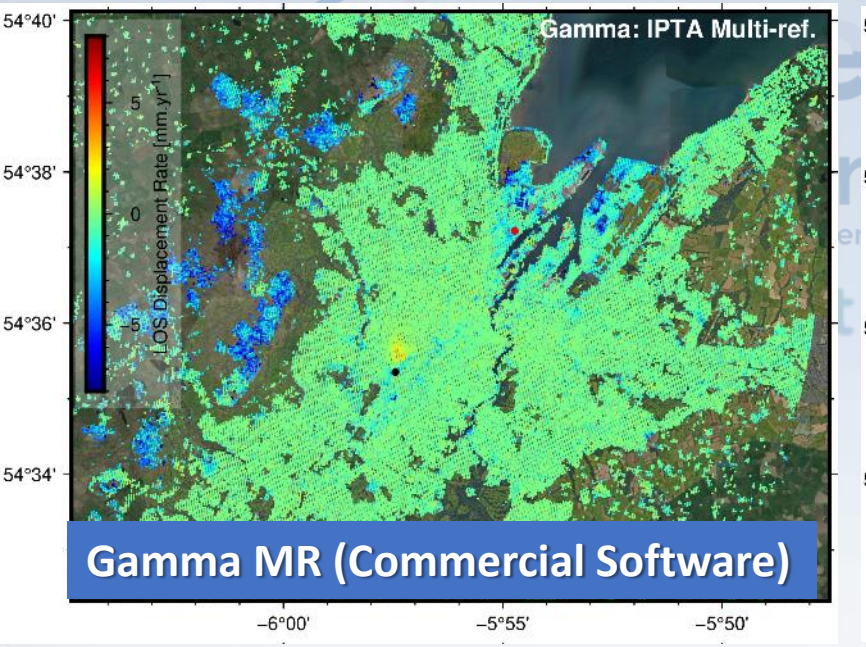
EZ-InSAR (Easy-to-use InSAR)

StaMPS processing: results

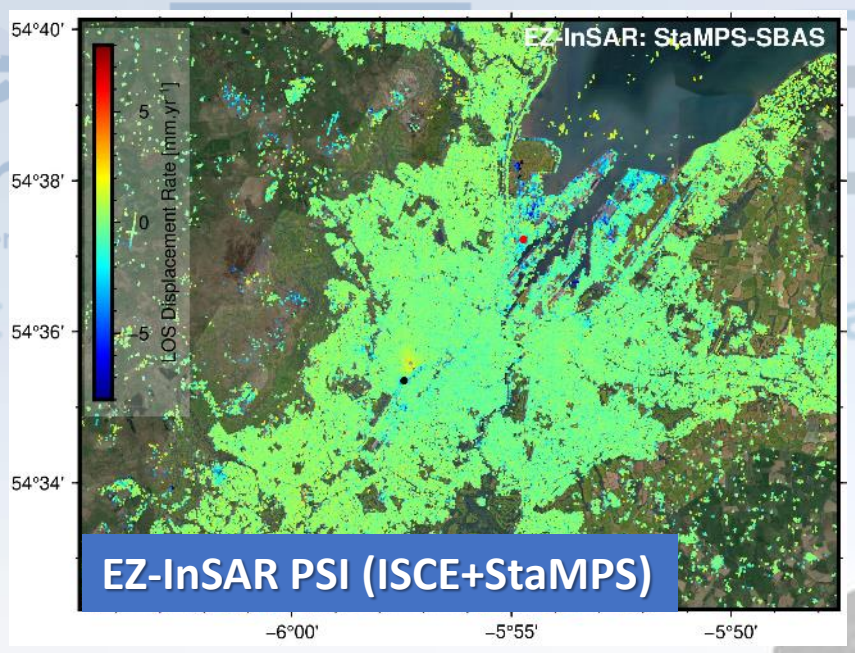


EZ-InSAR (Easy-to-use InSAR)

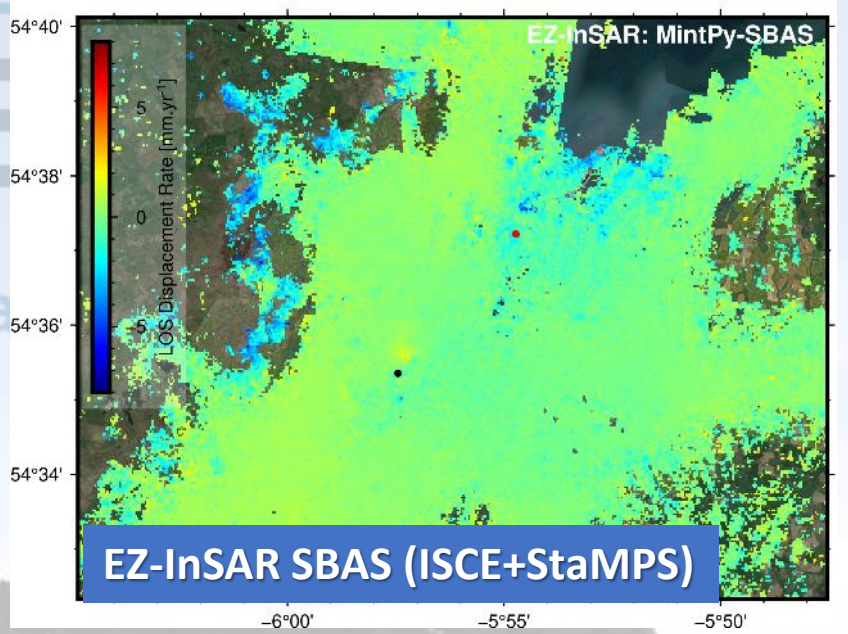
Results on Belfast



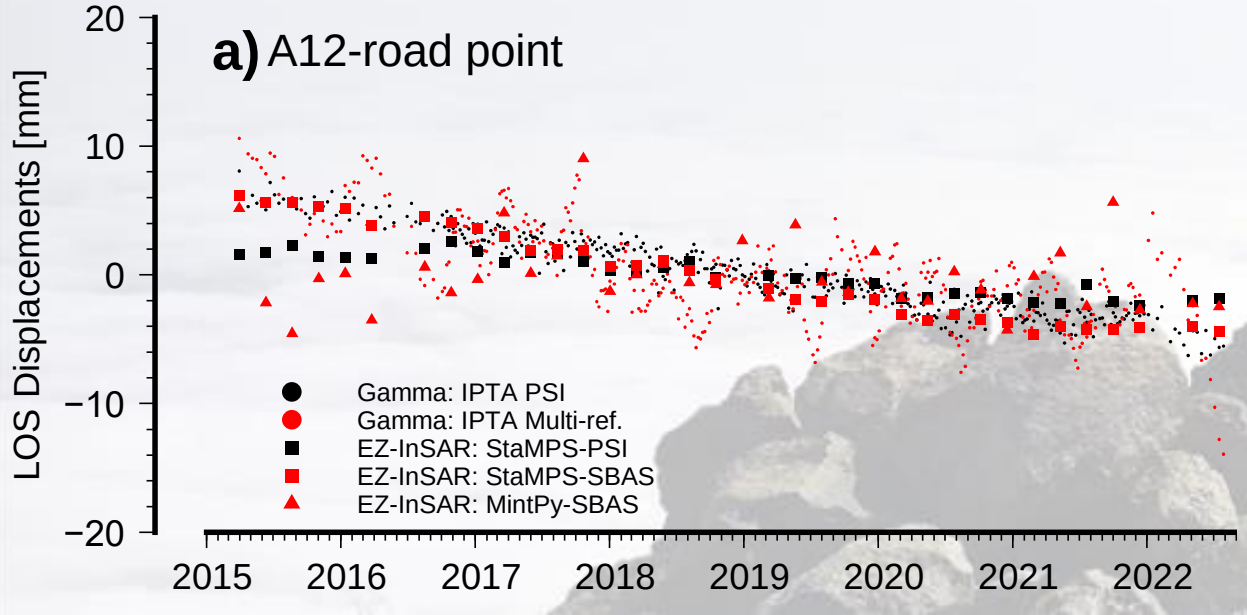
Gamma MR (Commercial Software)

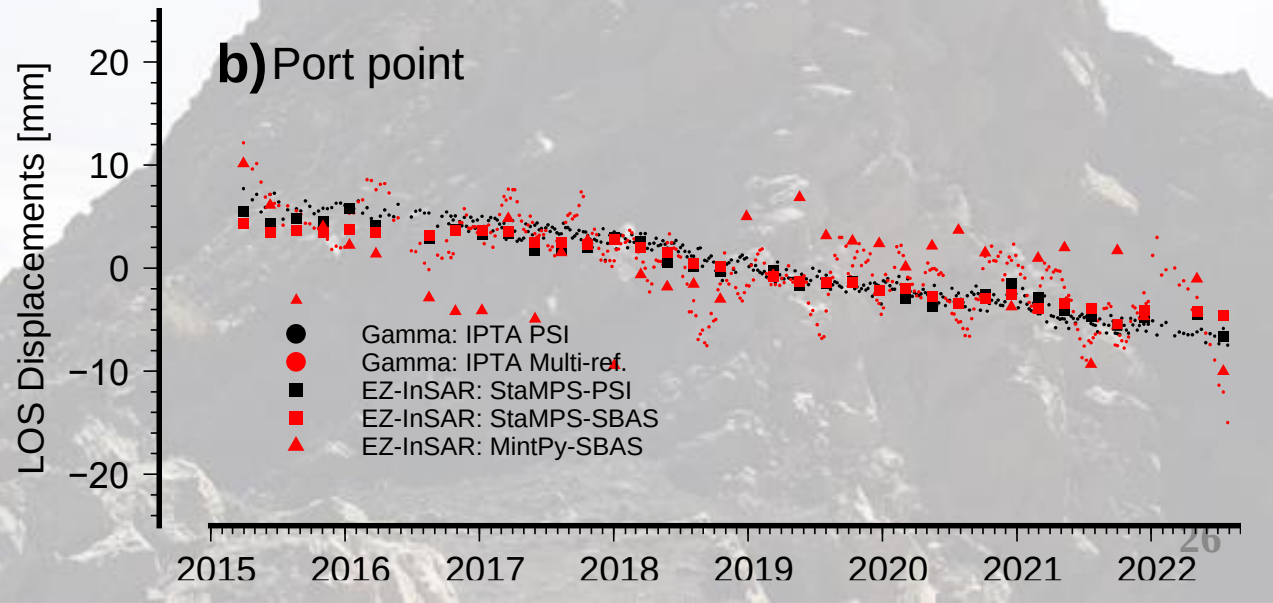


EZ-InSAR PSI (ISCE+StaMPS)



EZ-InSAR SBAS (ISCE+StaMPS)





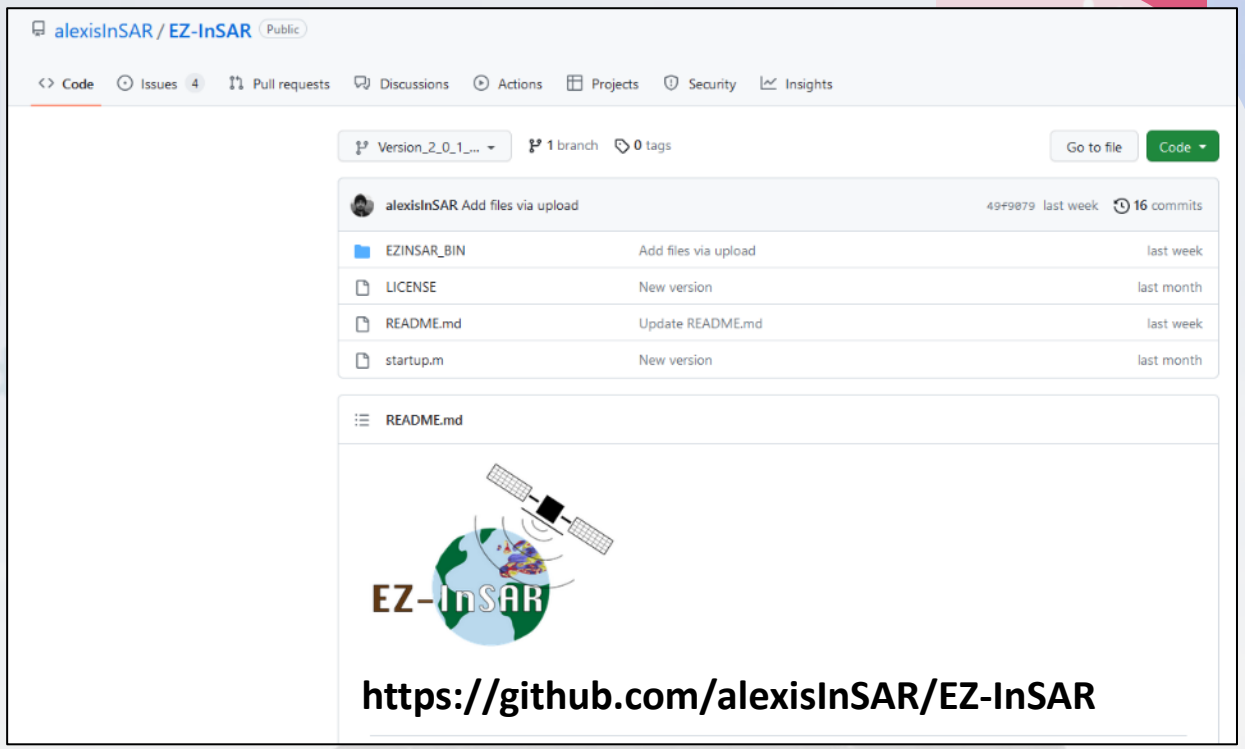
Why use EZ-InSAR?

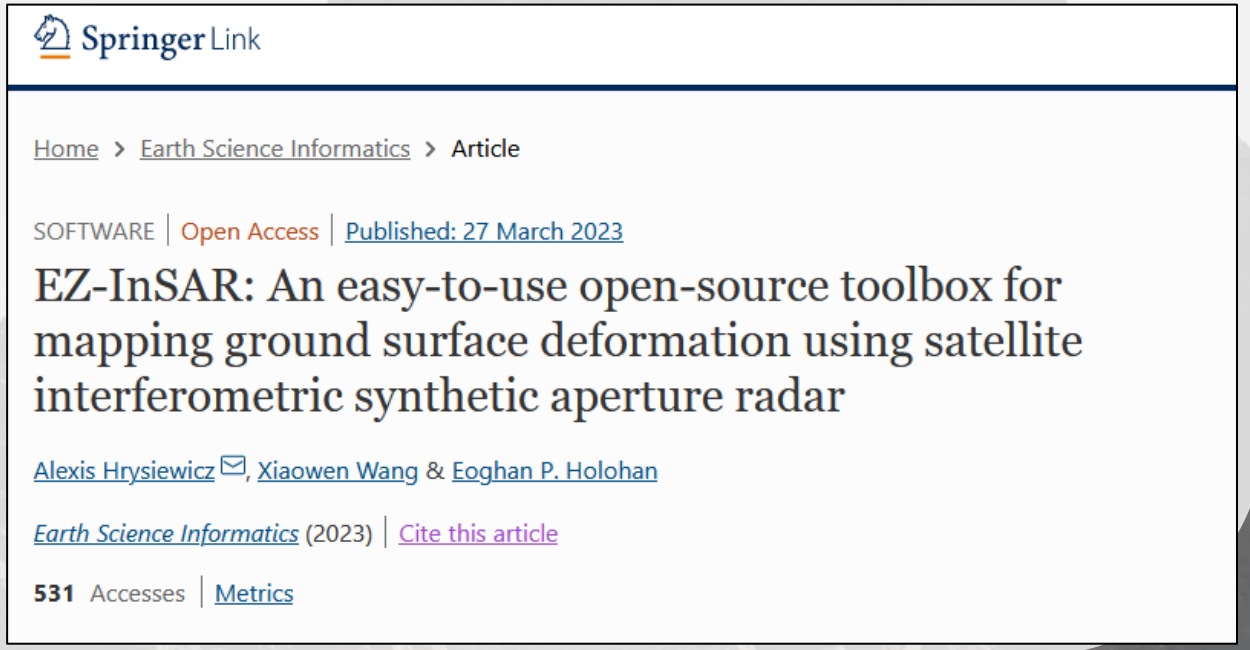
Complementary to European Ground Motion Service:

- ***Bespoke processing*** for your area of interest
- ***Higher spatial resolution*** (potentially) → EGMS at 100m resolution
- ***More up-to-date time series*** →EGMS updated only annually – data are 18 months out of date already)

Compared to Commercial or Open-source Software:

- ***It is FREE!*** *(Matlab license needed currently to run it, but development to Python is our ambition)*
- ***It is easy to use!***





Final notes

- ✓ ***European Open Data platforms*** → advance geohazards knowledge based on charaterisation and time series
- ✓ ***Copernicus EMS*** → many components & possibilities to improve risk management.
- ✓ ***EZ-InSAR***, ***AGEO App*** & ***AGEO Citizen Observatory Platform*** → new tools developed in AGEO for user tailored geohazard monitoring
- ✓ ***Citizens Observatories*** → can take advantage of many freely available spatial data infrastructures for geohazard monitoring

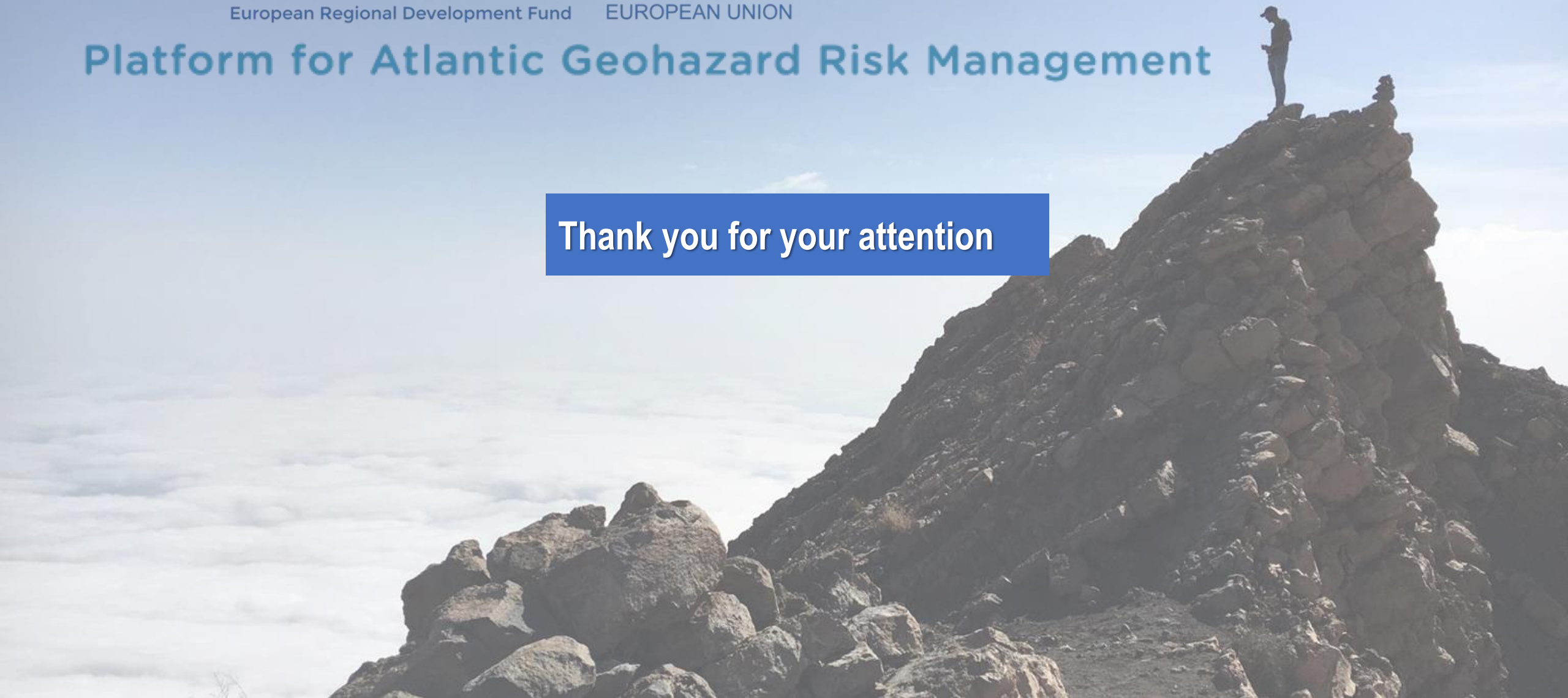
Interreg Atlantic Area
European Regional Development Fund

EUROPEAN UNION

AGEO

TERRITORIAL RISKS

Platform for Atlantic Geohazard Risk Management



Thank you for your attention