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SENTINELS AND COPERNICUS IN SUPPORT OF GEOLOGICAL HAZARDS MONITORING AND EMERGENCY MANAGEMENT

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1 – Why are the Azores one of the geologically active regions of Europe prone to natural hazards?

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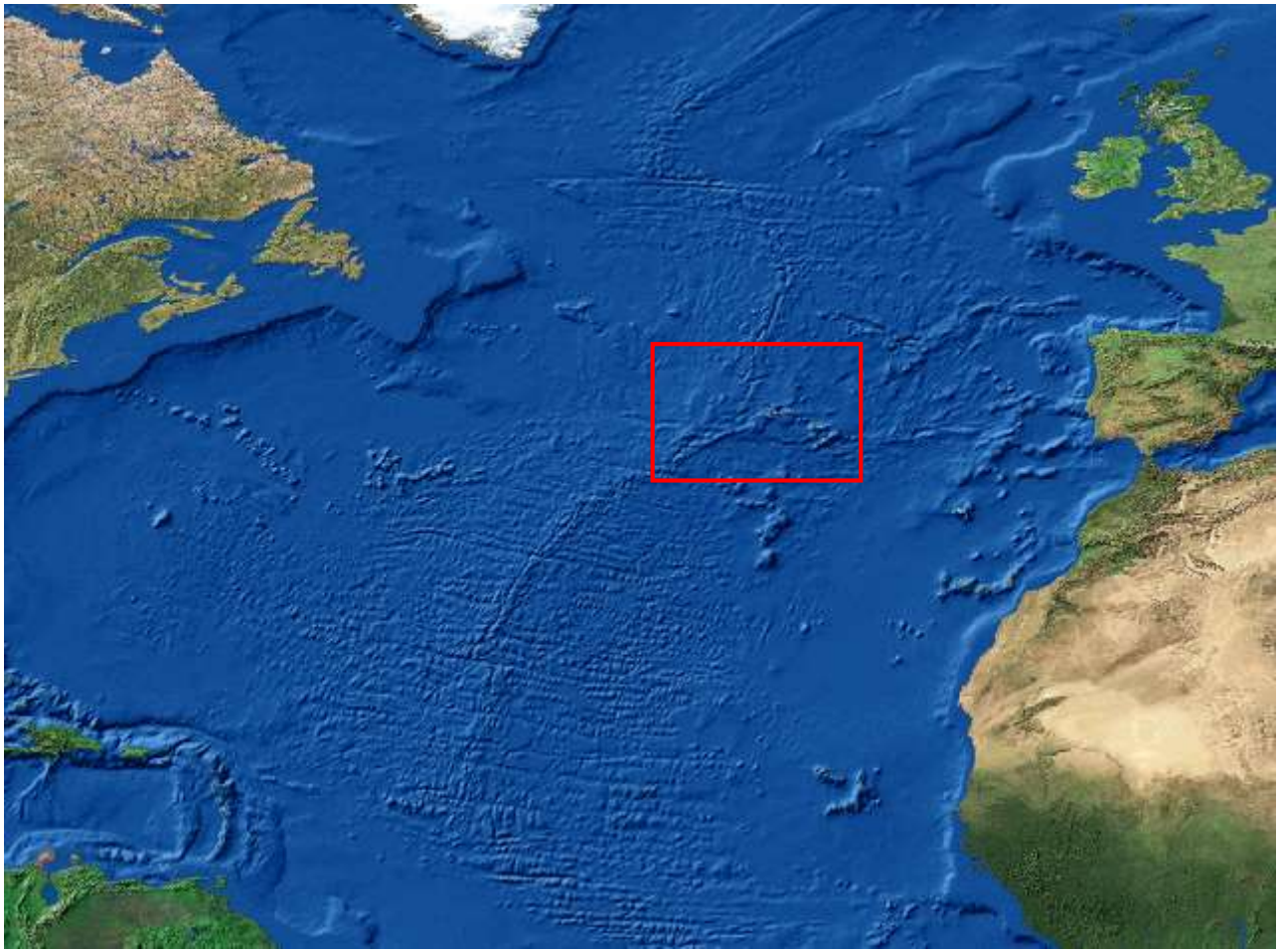
AZORES ARCHIPELAGO
Geographic and Geodynamic setting



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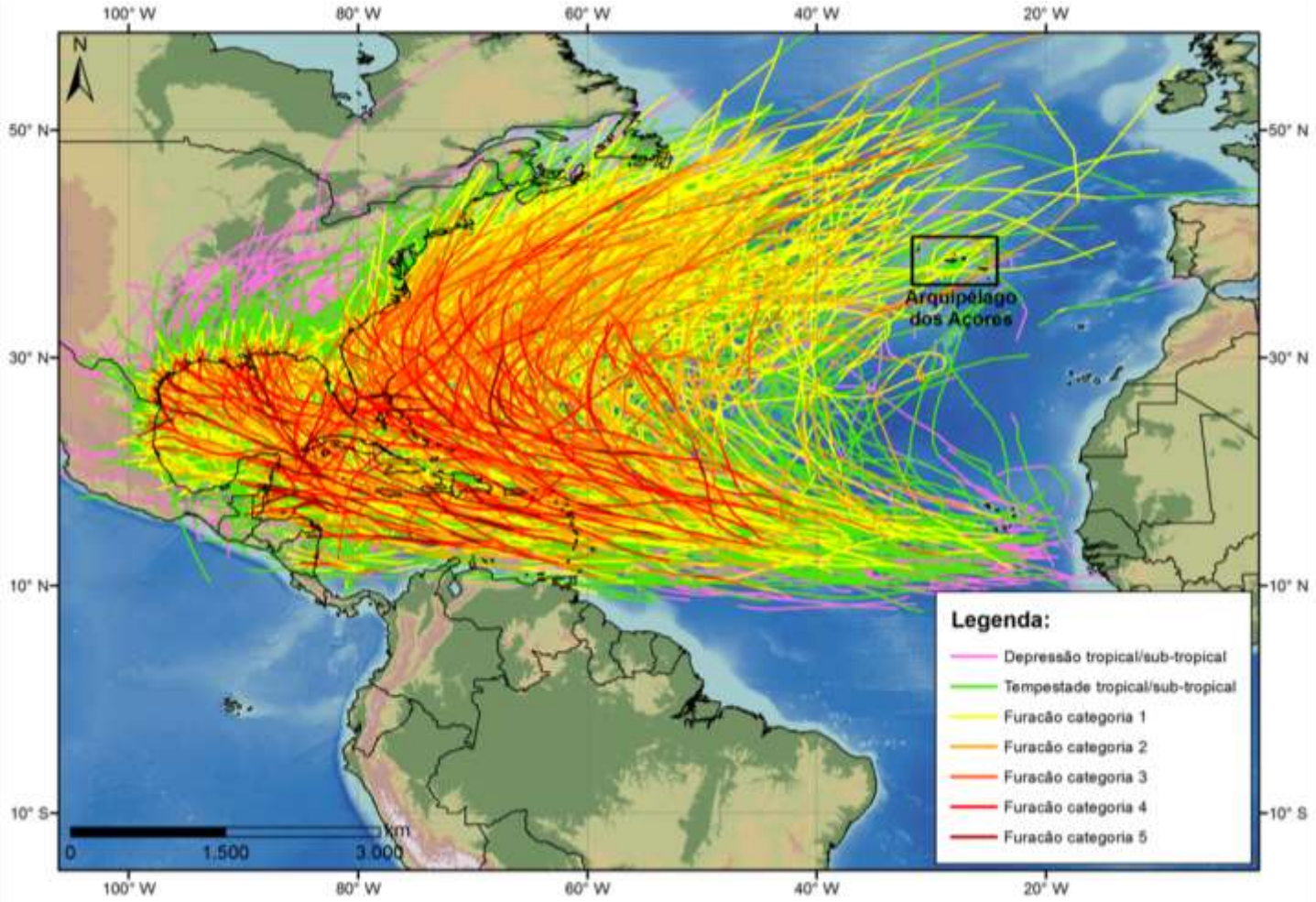

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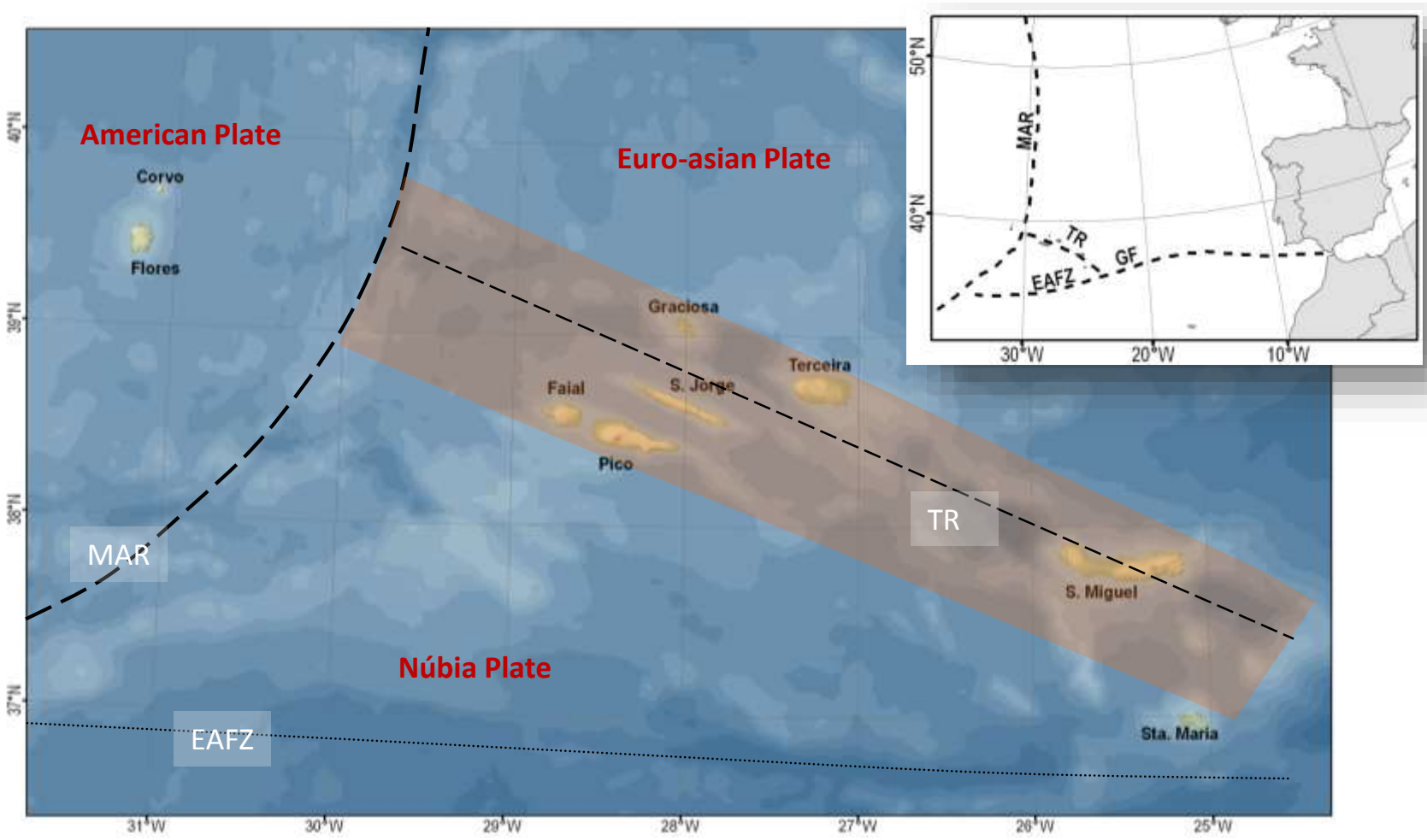

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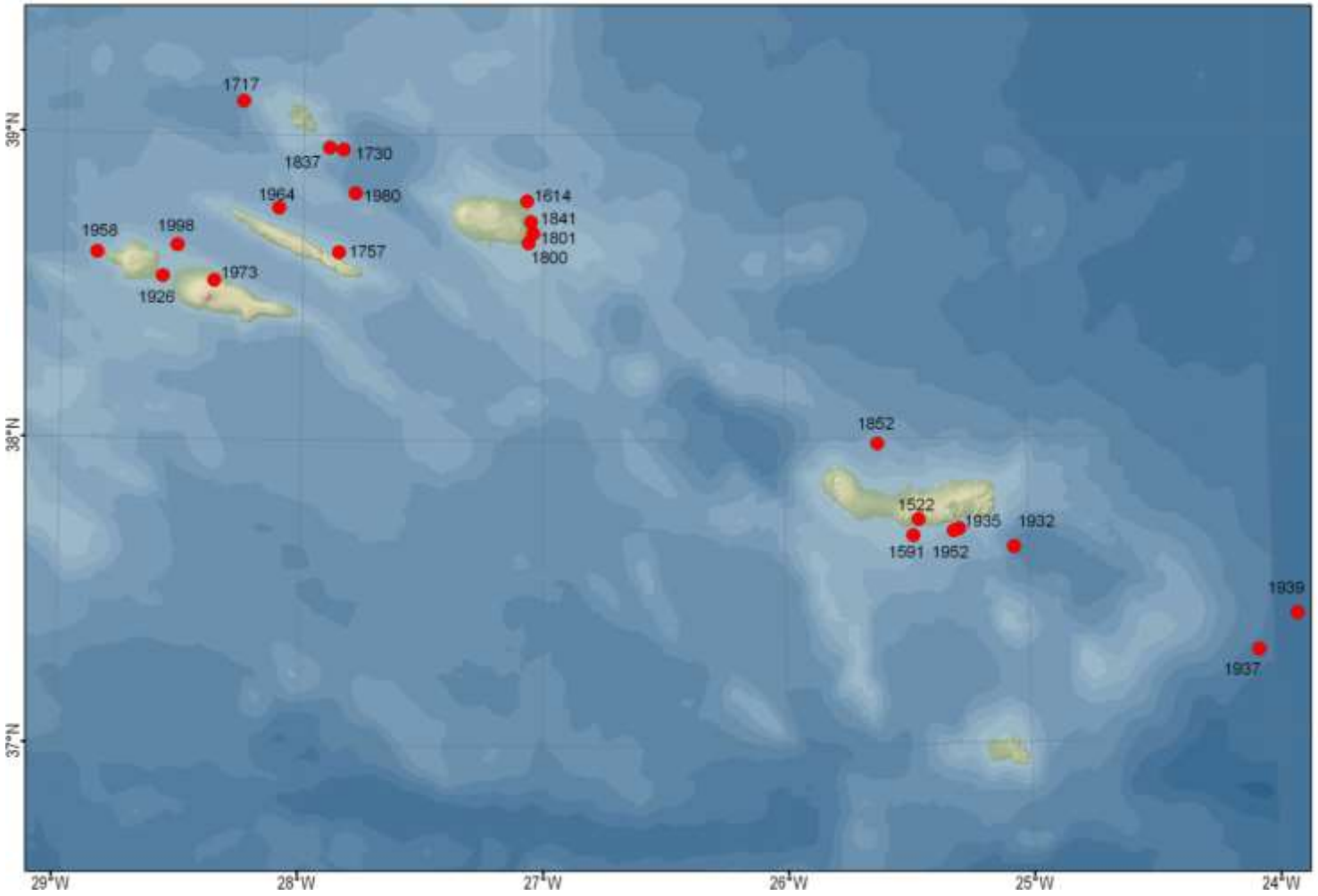
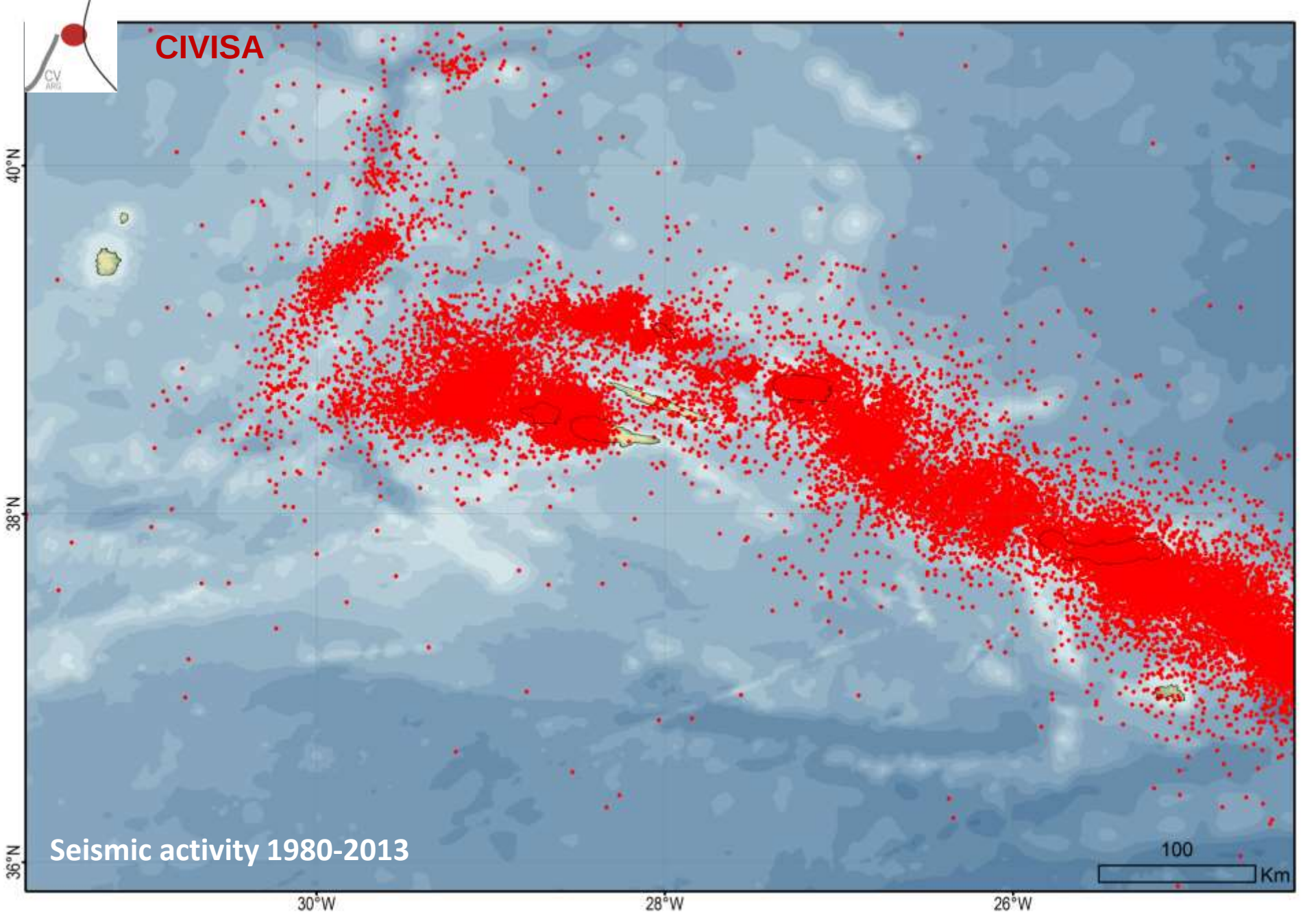
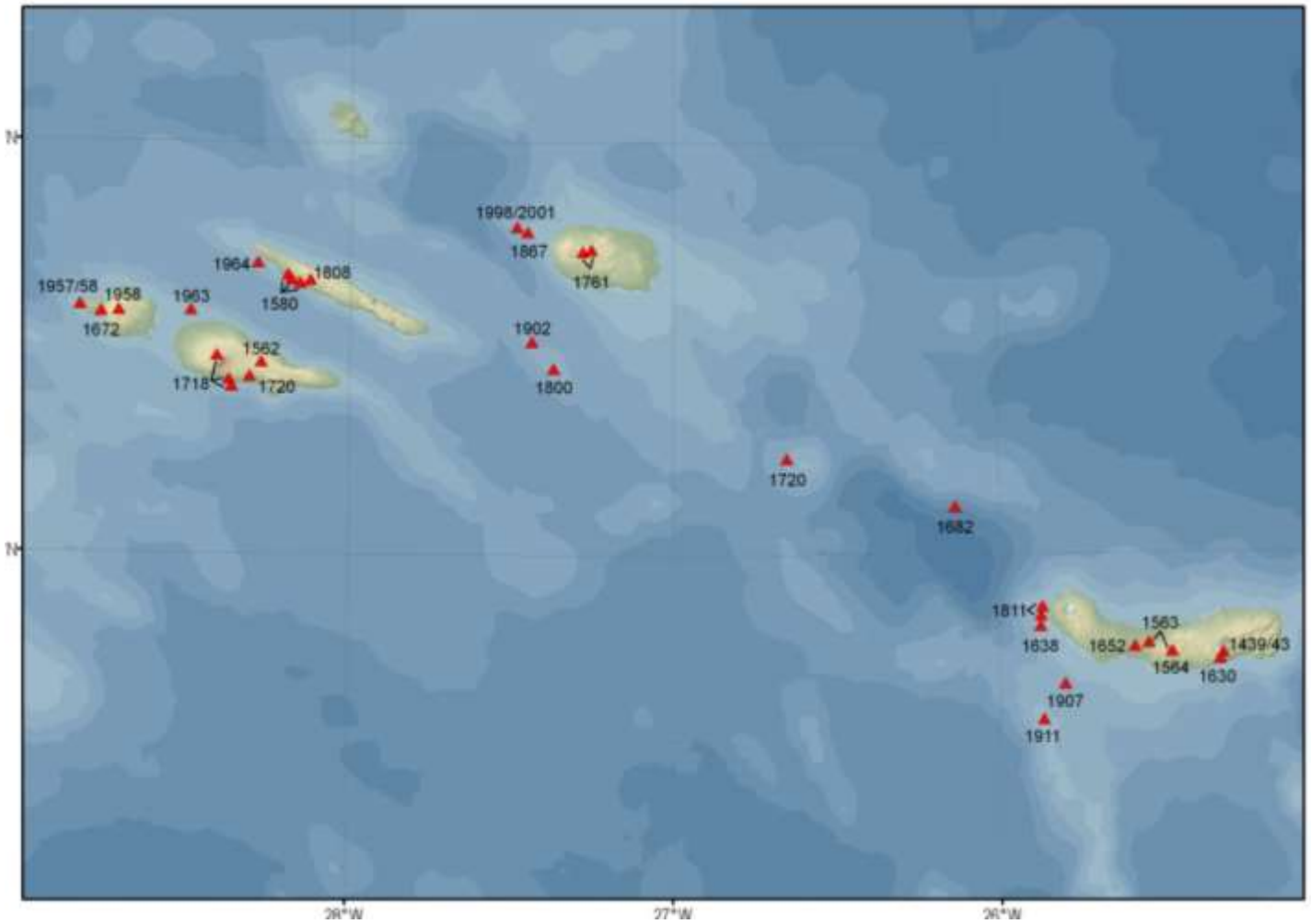
Major destructive earthquakes in historical time

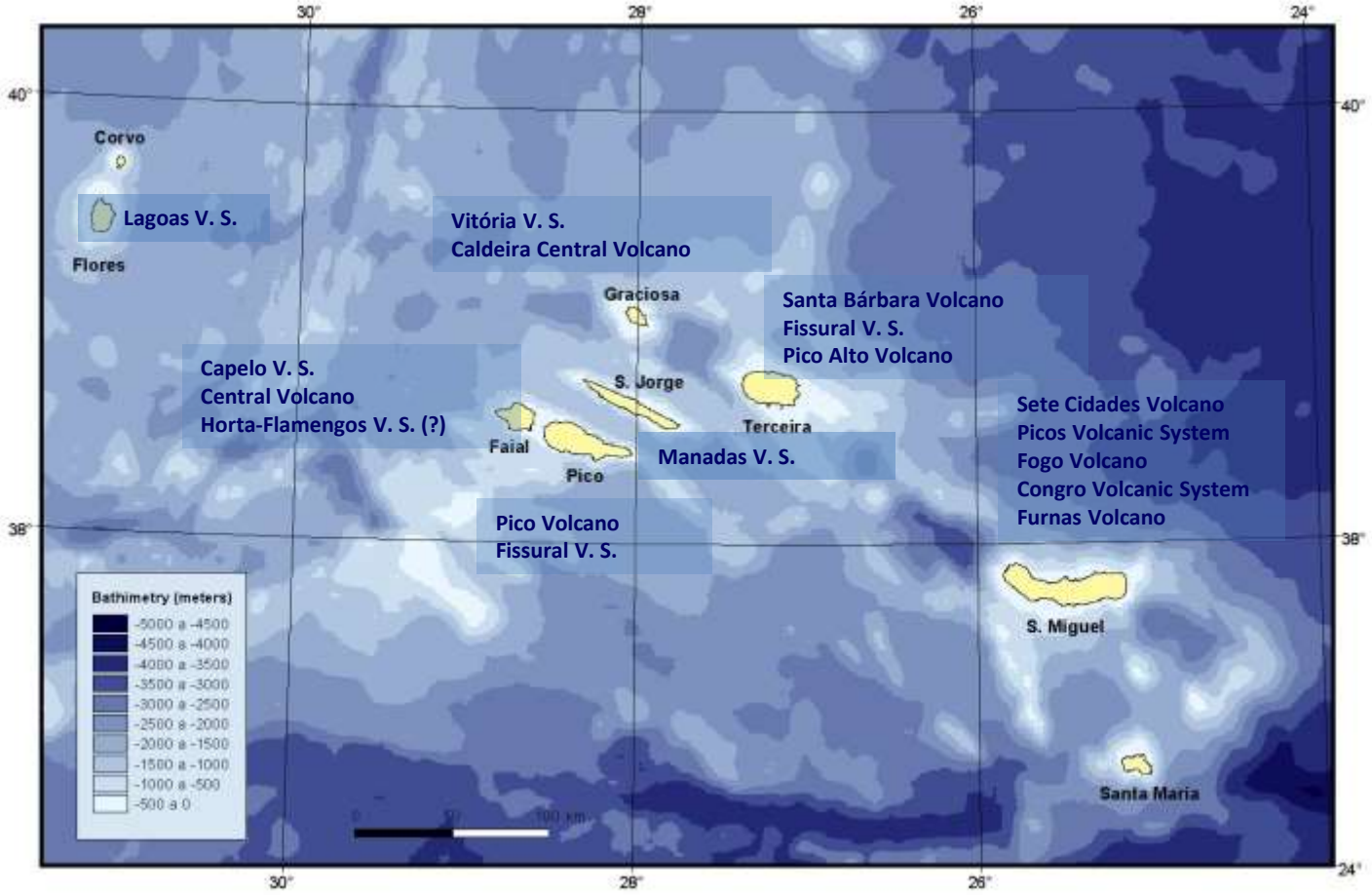



CIVISA
40°N
38°N
36°N
30°W
28°W
26°W
Seismic activity 1980-2013
100
Km

Historical Eruptions



Active Volcanic Systems



Some Recent Geological Events

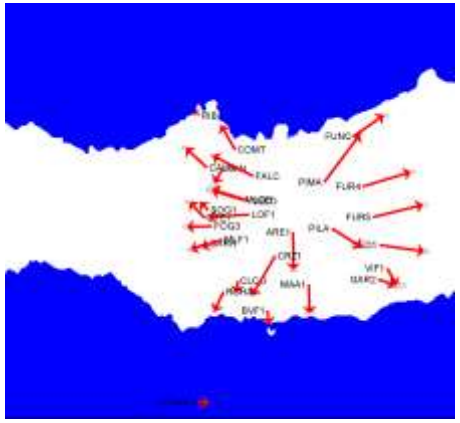
S. Miguel – Landslides - Ribeira Quente, 1997

Flores – Mudflows - Fajãzinha, 2010

Faial – Earthquake and lanslides, 1998

Faial – Capelinhos eruption, 1957-58

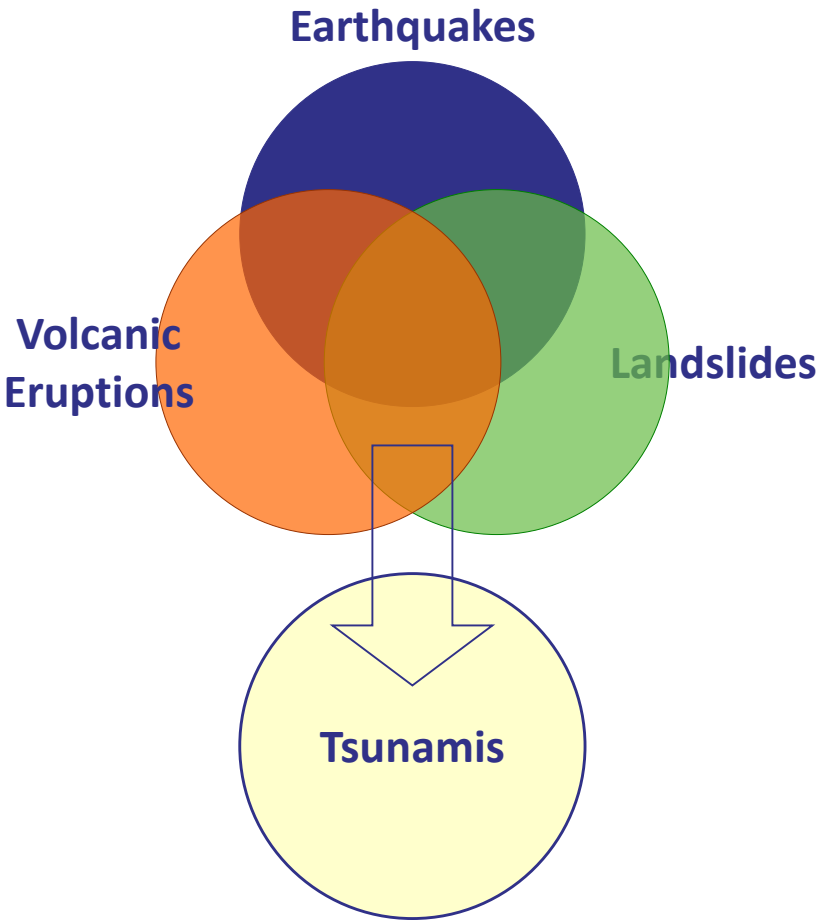
NW Terceira – Serreta eruption 1998-2001



S. Miguel – Volcanic unrest episode, 2005

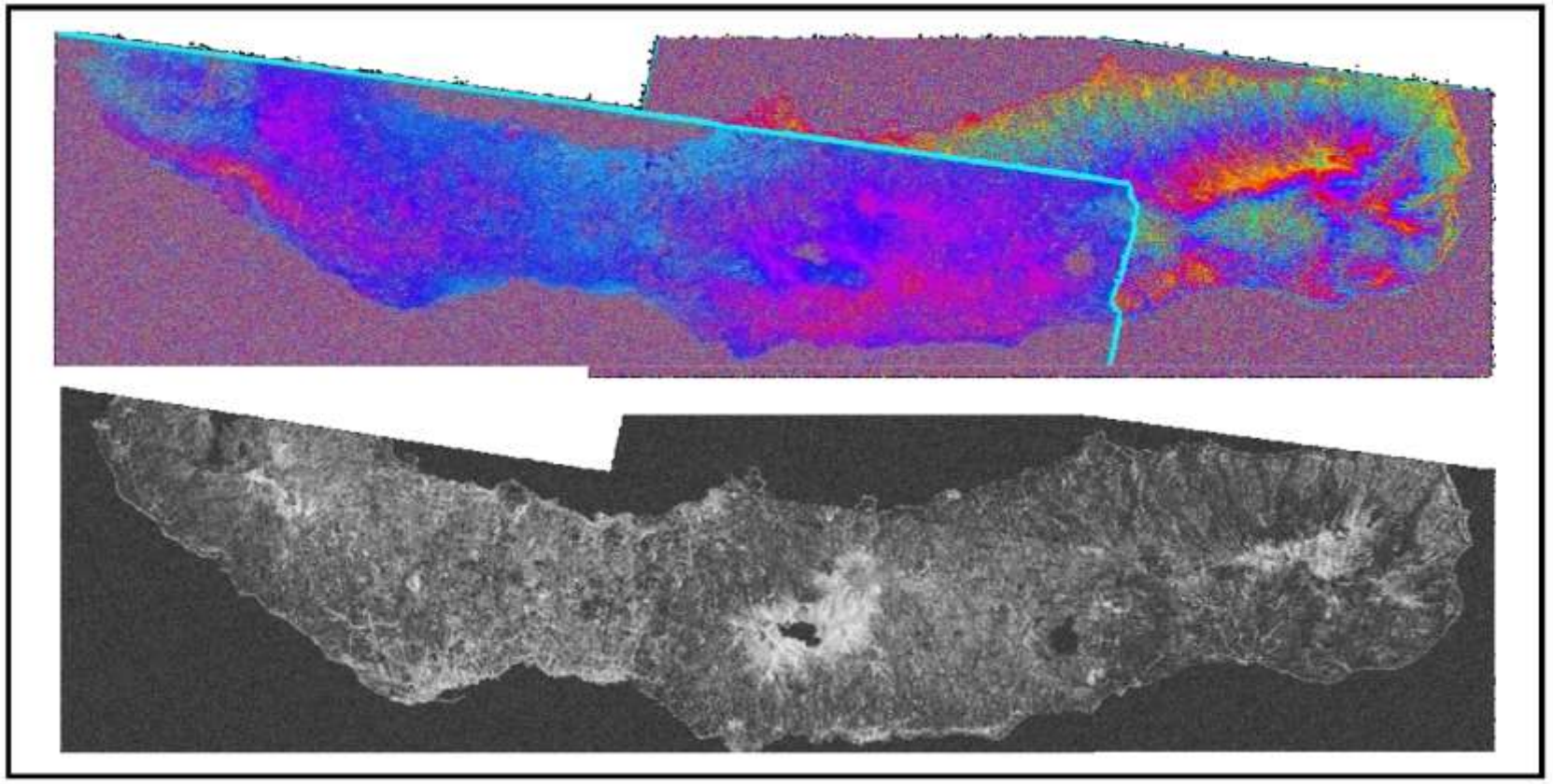
Geological Hazards in the Azores

- Azorean population is exposed to more than one natural hazard;
- Earthquakes, volcanic eruptions, landslides and tsunamis can occur as coupled events;
- The combined action of these events should always be considered when modelling scenarios for emergency planning;



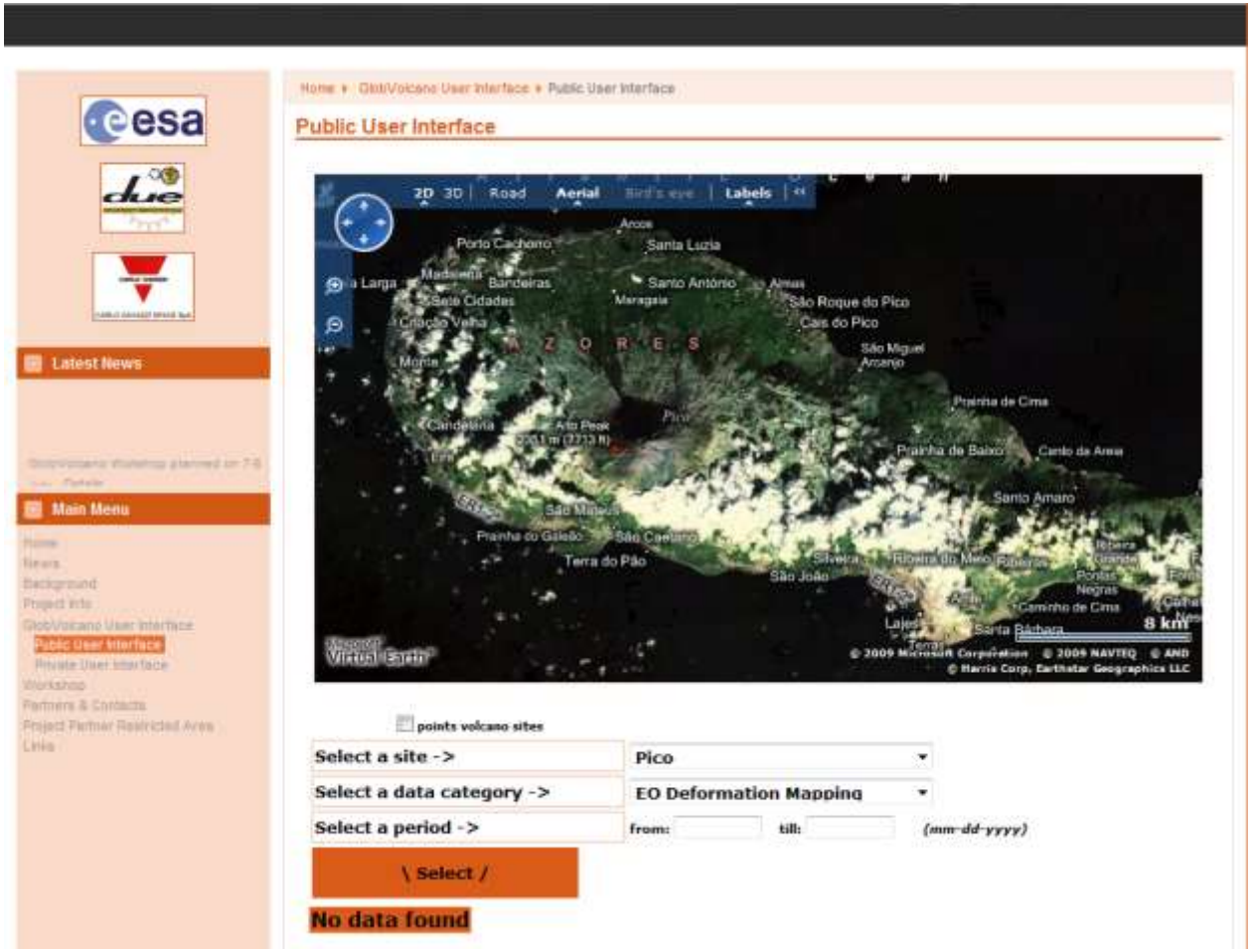
2 – PREVIOUS PROJECTS INVOLVING SPACE TECHNOLOGIES

Ground deformation InSAR



Differential PALSAR L-band interferograms
Cong, X. et al (2008) - Ground deformation measurement with radar interferometry in Exupéry Project

GlobVolcano Information Service



Ground deformation using images for DINSAR and ALOS PALSAR

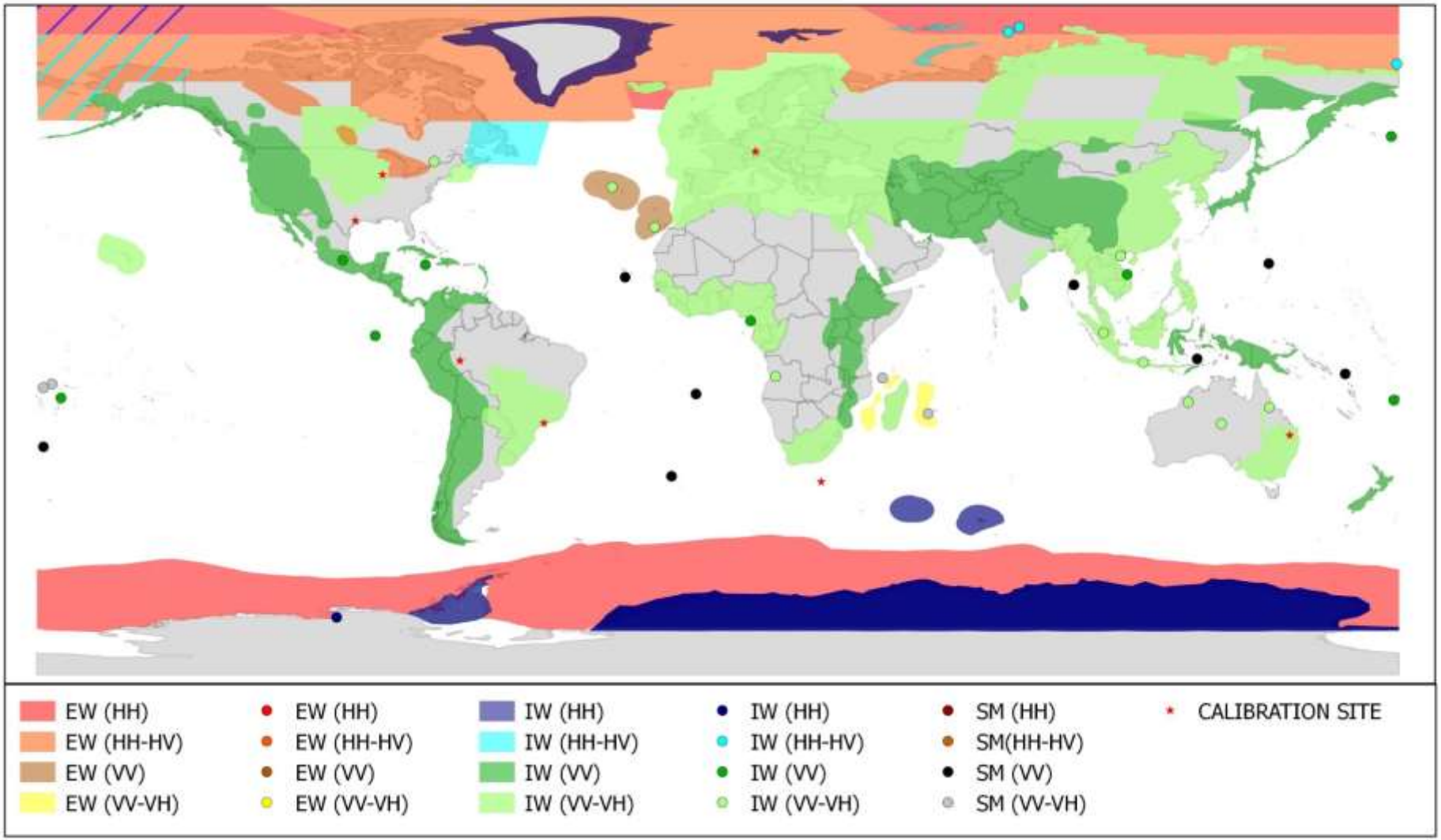
Main problems for EO monitoring

- Reduced number of pair images for SAR interferometry
- Slow strain rates
- Dense vegetation coverage
- Very poor time series

Poor coherence for images

3 – How can the Sentinels contribute for the geological hazards monitoring of the Azores Archipelago?

SENTINEL-1A - OBSERVATION SCENARIO 30.09.2015 - 12.10.2015 (CYCLE 60)



https://sentinel.esa.int/web/sentinel/missions/sentinel-1/observation-scenario

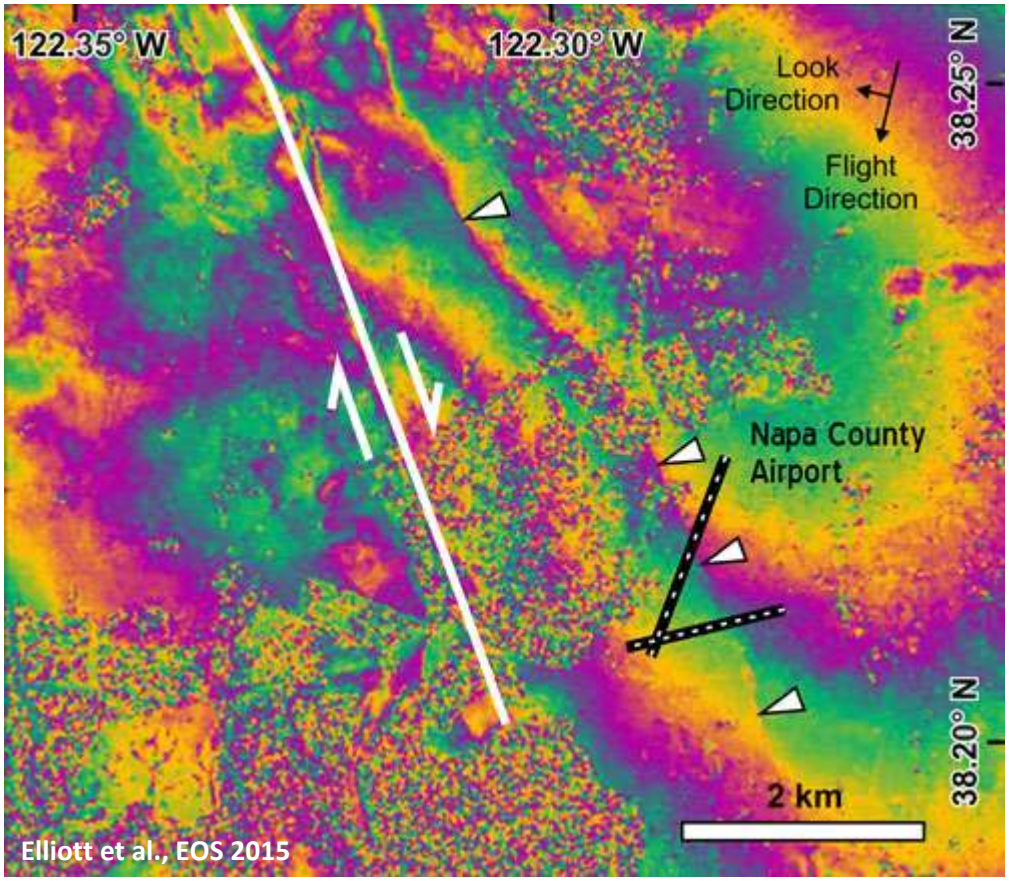
What changes with Sentinel-1?

- The Azores are one target area for Sentinels;
- Sentinel-1 is an imaging radar mission providing continuous all-weather, day-and-night imagery at C-band.
- Sentinel-1 was specifically designed to monitor ground deformation; new scanning mode TOPS;
- Sentinel-1A revisits any point on Earth surface every 12 days
- The Sentinel-1 constellation will reduce revisit cycles to 6 days
- Systematic image acquisition every 6/12 days or more, allowing high coherence
- Long term programme for InSAR (20 years) → long time series
- Free and open data access

USA, Napa Earthquake

M_w = 6.0 South Napa earthquake, 24 August 2014

First geophysical event caught by Sentinel-1A. Interferogram generated with scans from 7 August 2014 and 31 August 2014

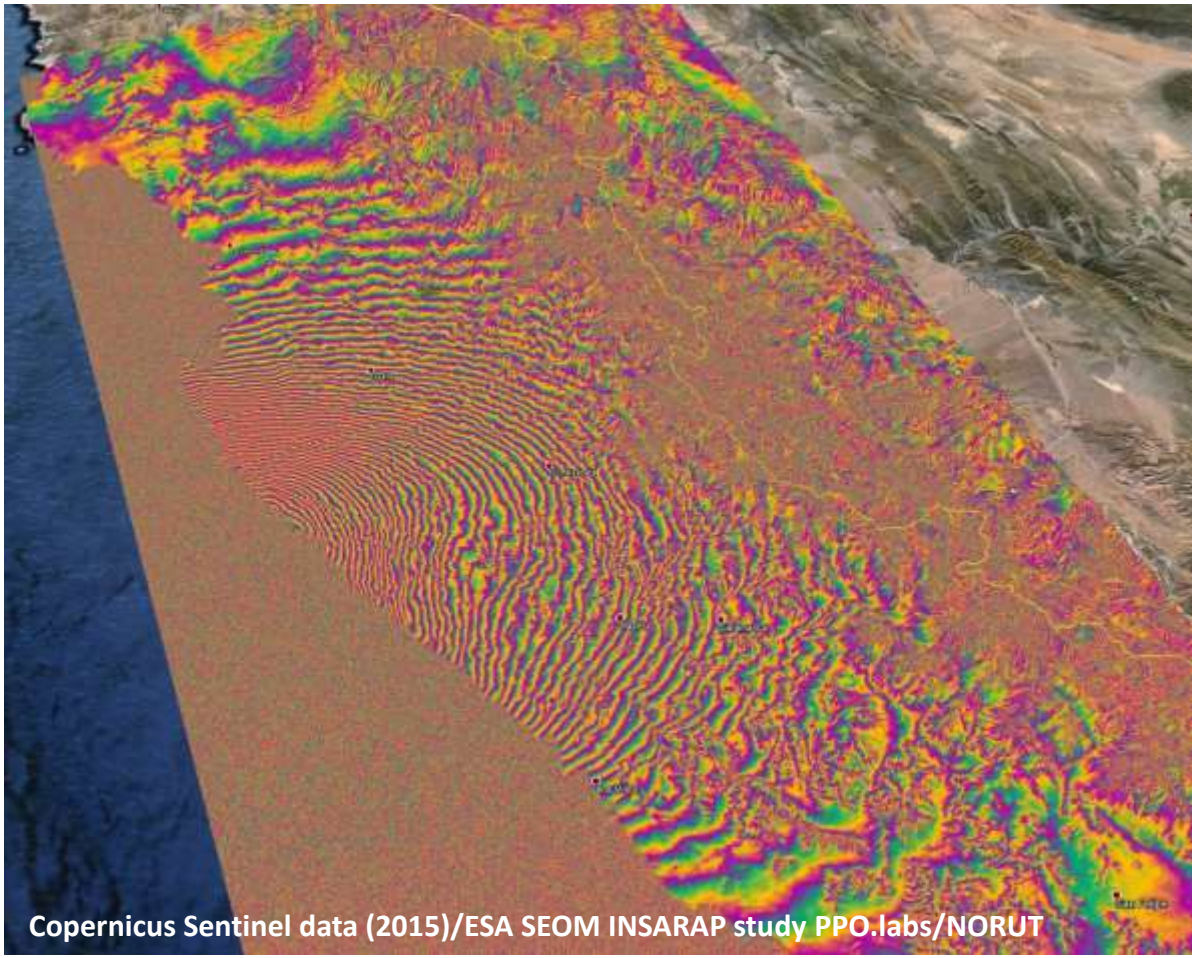


“Chile earthquake on the radar”

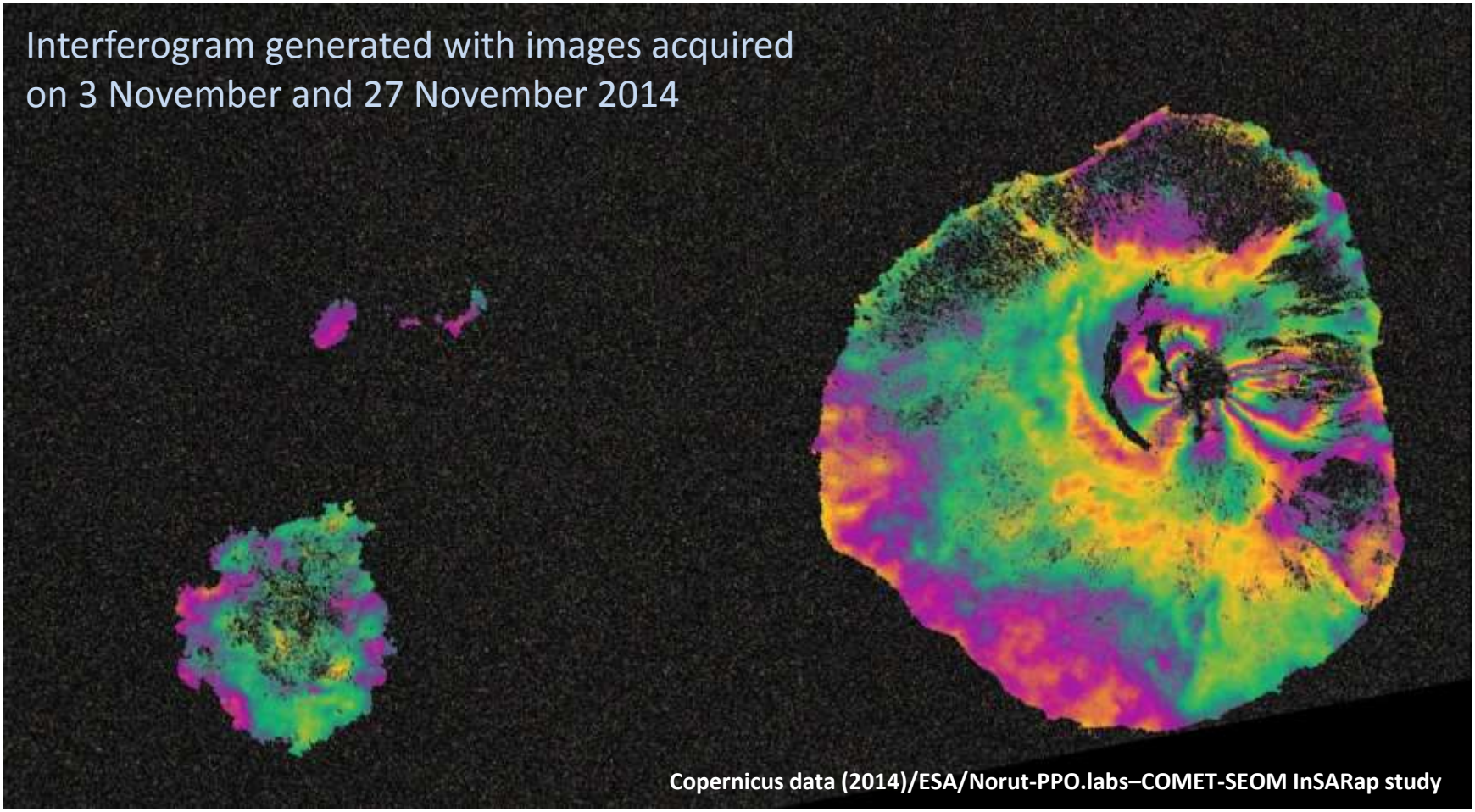
M_w = 8.3 near the coast of central Chile, 16 September 2015

Interferogram generated with Sentinel-1A radar scans from 24 August and 17 September

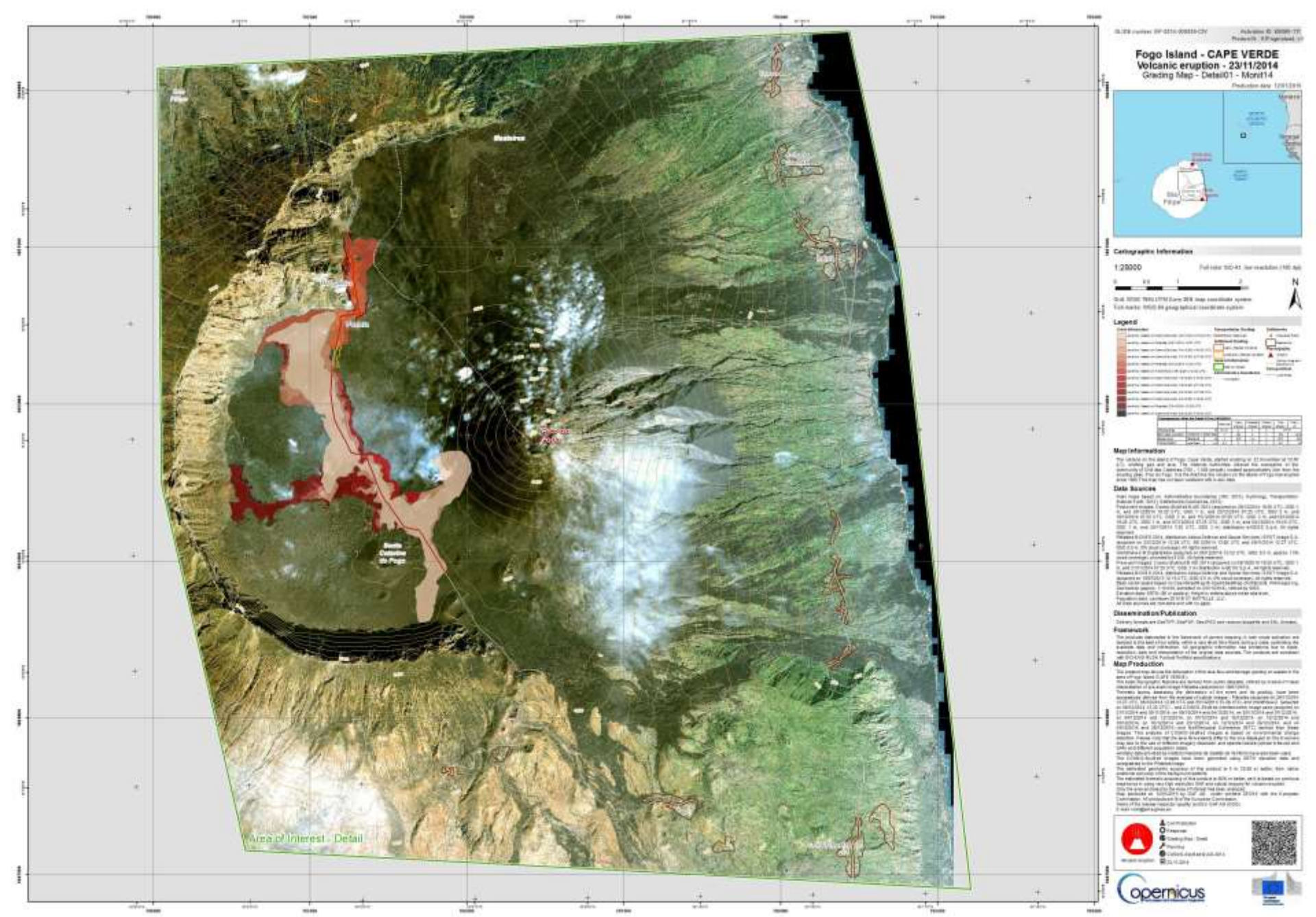
Released 21/09/2015
http://linkis.com/OvRHh



Cape Verde, Fogo island eruption



4 – Copernicus and emergency managment


Fogo Island - CAPE VERDE
Volcanic eruption - 23/11/2014
Grading Map - Detail01 - Mont14
Cartographic Information
1:28000
Legend
Map Information
Data Sources
Dissemination/Publication
Framework
Map Production
Area of Interest - Detail
Bordeira
Chã das Caldeiras
Pico
Bocca Cratera do Fogo
Copernicus

Copernicus emergency service

As stated by ESA:

- The Copernicus emergency service (Copernicus EMS) is targeted to provide information that facilitates the mitigation of and response to many types of disasters or crises including:
  - natural disasters (floods, fires, landslides, storms, earthquakes, etc.)
  - technological accidents
  - humanitarian crises (for instance after a period of severe drought), famine etc.)
  - civil crises.
- The SENTINEL missions support emergency management providing timely, continuous and independent data on a near-real-time basis.
- SENTINEL-1 - produces high resolution, co-seismic maps of earthquake deformations.
- SENTINEL-2 - supports rapid mapping for the GMES/Copernicus Emergency Response Support Service (ERSS). Rapid mapping is dedicated to the response management of civil protection and rescue services
- The service is provided in two modules: Rapid Mapping and Risk & Recovery Mapping.

Copernicus

For the first time a long-term frame for continuous monitoring of the environment

Sentinel-1 (Credits: ESA)