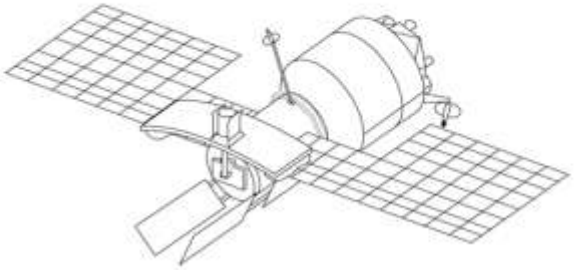
The BEYOND Center of Excellence for monitoring natural disasters from space



Ioannis Papoutsis

National Observatory of Athens

Institute for Astronomy, Astrophysics, Space Applications & Remote Sensing

MOWE-IT
16 September 2014
Thessaloniki, Greece

FP7-Regpot-2012-23-1

Outline

- What is BEYOND?
  - Earth Observation
  - Ground based infrastructure
- Overview of the services
- EO and transport
  - Forest wildfires monitoring
  - Flood risk modelling and flood extend
  - Smoke dispersion estimation
  - Geophysical hazards mapping
  - Construction activity monitoring

What is BEYOND?

Objective

BEYOND aims to maintain and expand the existing state-of-the-art and interdisciplinary research potential, by

Building a Centre of Excellence for Earth Observation based monitoring of Natural Disasters

AOI: The south-eastern Europe, with a prospect to increase its access range to the wider Mediterranean region through the integrated cooperation with more than 20 **twining organizations**

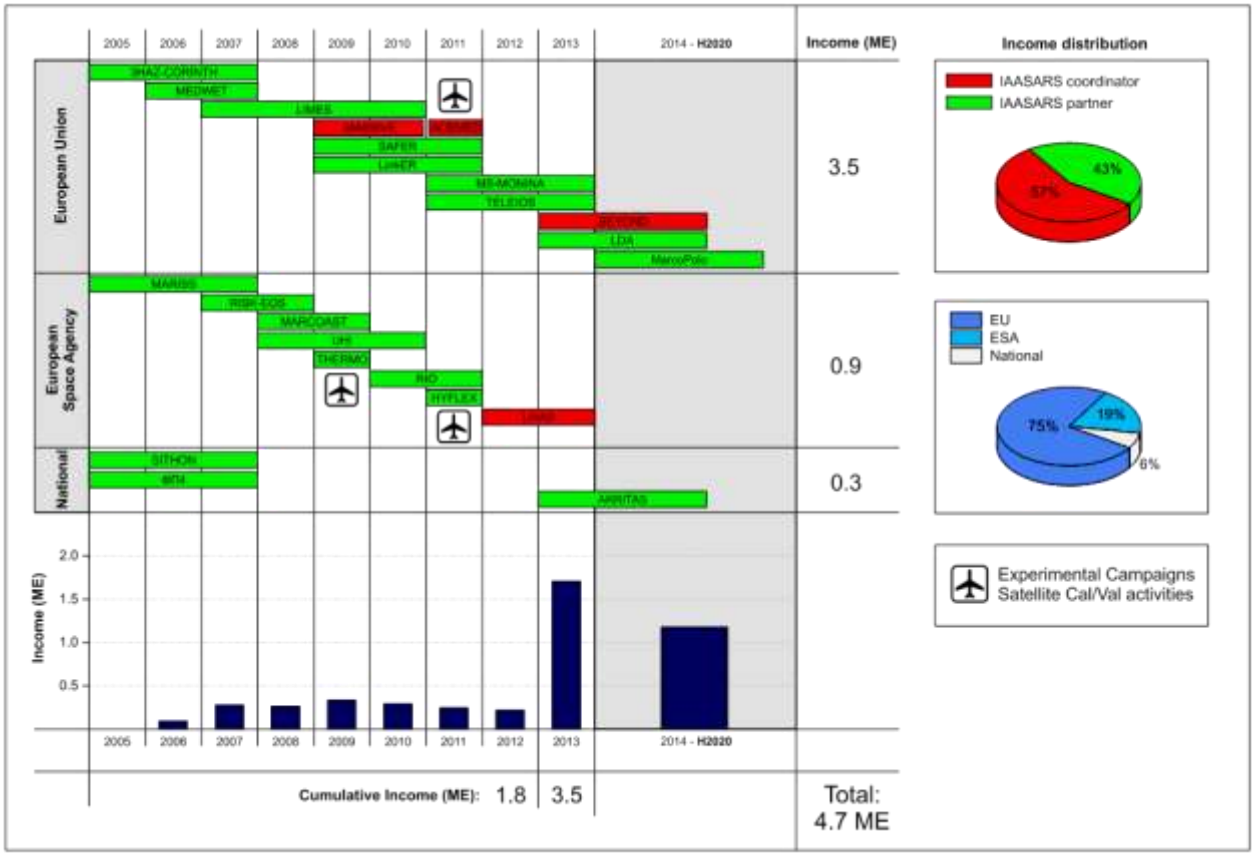
What is BEYOND?

Services development

LDA Large-scale demonstrators in support of GMES and GNSS based services in Athens, Greece, GMES/DG ENTR

MASSIVE: Mapping Seismic Vulnerability and Risk of Cities, European Commission - DG ENV A.3 – Civil Protection

TELEIOS—Virtual Observatory Infrastructure for Earth Observation Data, FP7-ICT-2009-5



LinkER - Supporting the implementation of an operational GMES service in the field of emergency management, Invitation to Tender No: ENTR/08/028

LIMES (Land and Sea Integrated Monitoring for European Security/GMES / EC DG Enterprise

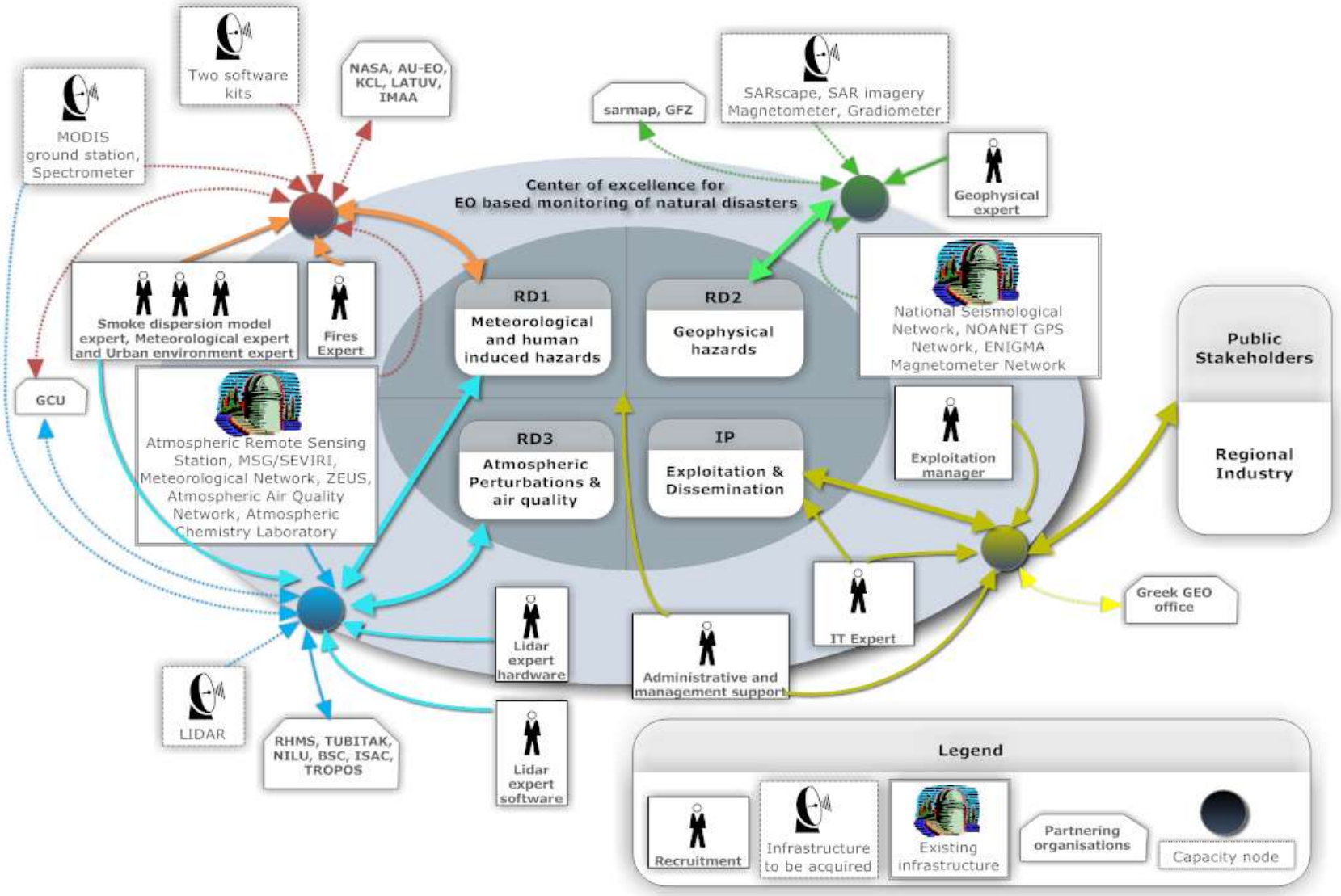
SAFER – EMERGENCY: Building Emergency Response Core Service, FP7-2007-SPACE-1/ GMES Collaborative Project

RISK-EOS Extension to Greece - Promotion of the GSE RISK-EOS fire services portfolio in Greece, EarthWatch GMES Services Elements, ESA/GSE

MARCOAST/ISSUE-OS - Integrated system for suspect vessels emergency tracking – OIL SPILLS

What is BEYOND?

Concept



What is BEYOND?
Infrastructure

Integrated satellite based observational solutions

- X-/L- band acquisition station for (EOS Aqua and Terra, NPP, JPSS, NOAA, Met Op, FengYun) (part of the DB network)
- MSG SEVIRI Acquisition station (part of EUMETSAT's network)
- Access to NOA's Collaborative Ground Segment (Mirror Site) dedicated to ESA Sentinel missions (Copernicus), allowing near real time acquisition of S-1, S-2, and future S3, S5P satellite missions
- Access to NOA's in-situ monitoring seismological, magnetometer, and GPS networks

IAASARS/NOA MSG SEVIRI Acquisition station

IAASARS/NOA X-/L-band Acquisition station

What is BEYOND?

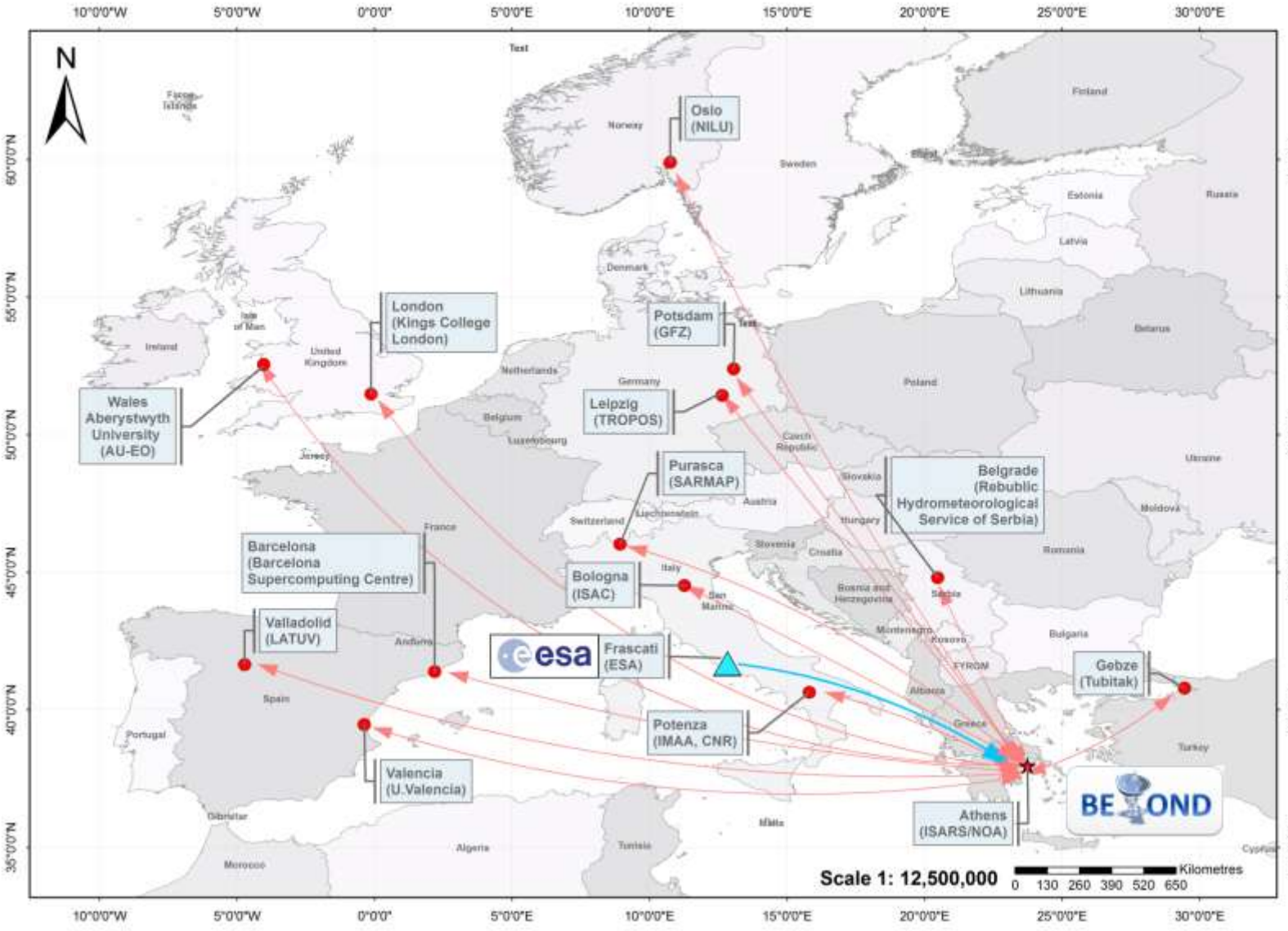
Infrastructure

Operation of the mobile lidar of ESA by IAASARS

Development of a state-of-the-art multi-wavelength lidar to be installed in Crete (FKL), in the framework of the BEYOND project, part of the EARLINET network

What is BEYOND?

Partnering organizations



Overview of the services
1/2

Service	Status	End Users	Scale
EMERGENCY RESPONSE/EMERGENCY SUPPORT-METEO RELATED HAZARDS			
Real Time Fire Monitoring	Operational GMES Standard	Fire Brigades, Civil Protection, Public, Private Sector	National Regional
Rapid Fire Mapping	Operational GMES Standard	Fire Brigades, Civil Protection, Forestry Services, Min of Env	Regional Local
Disaster Event Mapping & Damage Ass.	Operational GMES Standard	Forestry Services, Min of Env (DG for Nat. Vegetation/Forest Protection	Local
Seasonal/Diachronic Fire Mapping & Damage Ass.	Operational GMES Standard	Forestry Services, Min of Env (DG for Nat. Vegetation/Forest Protection, Cadastral Org, Fire Brigades	National
Wild Fire Smoke Dispersion	Research/ Preoperational	Fire Brigades, Civil Protection, Min of Env	Regional Local
Saharian Dust Episodes	Research/ Preoperational	Civil Protection, Min of Env, Public	National
Flood Risk	Research/ Preoperational	National Electric Power Org, Min of Development, Local Authorities, Civil Protection	Regional Local
Heat Waves Risk	Research/ Preoperational	Min of Public Health, Local Authorities, Medical Science	Local

Web service

Web service

Delivered

To be Delivered as V1.0 in 2014

To be Delivered as V1.0 in 2015-2016

Overview of the services
2/2

EMERGENCY RESPONSE/EMERGENCY SUPPORT- GEO- HAZARDS			
Earthquake related crustal deformation field	Operational GMES Standard	Anti-seismic Planning& Protection Org, EQ Scientists	Local
Volcano related surface velocity field	Operational GMES Standard	Anti-seismic Planning& Protection Org, Local Authorities, EQ Scientists	Local
Landslide related surface velocity field	Research	Anti-seismic Planning& Protection Org, Local Authorities, Enterpreneurs, Civ. Eng, Geologists	Local
ATMOSPHERIC DISTURBANCES - CLIMATOLOGY			
3D-Climatology	Operational GMES Standard	Cal/Val Industry, Global Atm Monitoring Networks	Global
Atmospheric Episodes	Research	Cal/Val Industry, Global Atm Monitoring Networks, Medical Science	Local
LULC CHANGE MONITORING – UAV / AIRBORNE / SATELLITE			
Urban Mapping	Operational GMES Standard	World Bank, EIB, Min of Env, Cadastral Org	Local
UAV Damage Recording	Research/ Preoperational	Anti-seismic Planning and Protection Organisation	Local
Ecosystem Monitoring and Mapping (Forests/Wetlands)	Operational	Min of Env, Hellenic Biotope & Wetlands Center, Cadastral Org	National Regional

Web service

Delivered

To be Delivered as V1.0 in 2014

To be Delivered as V1.0 in 2015-2016

EO & Transport
Research Domains

BEYOND

Centre of Excellence for

EO-based monitoring of Natural Disasters

- Fires & Floods
- Geophysical hazards
- Atmospheric disasters
- Weather-related disasters

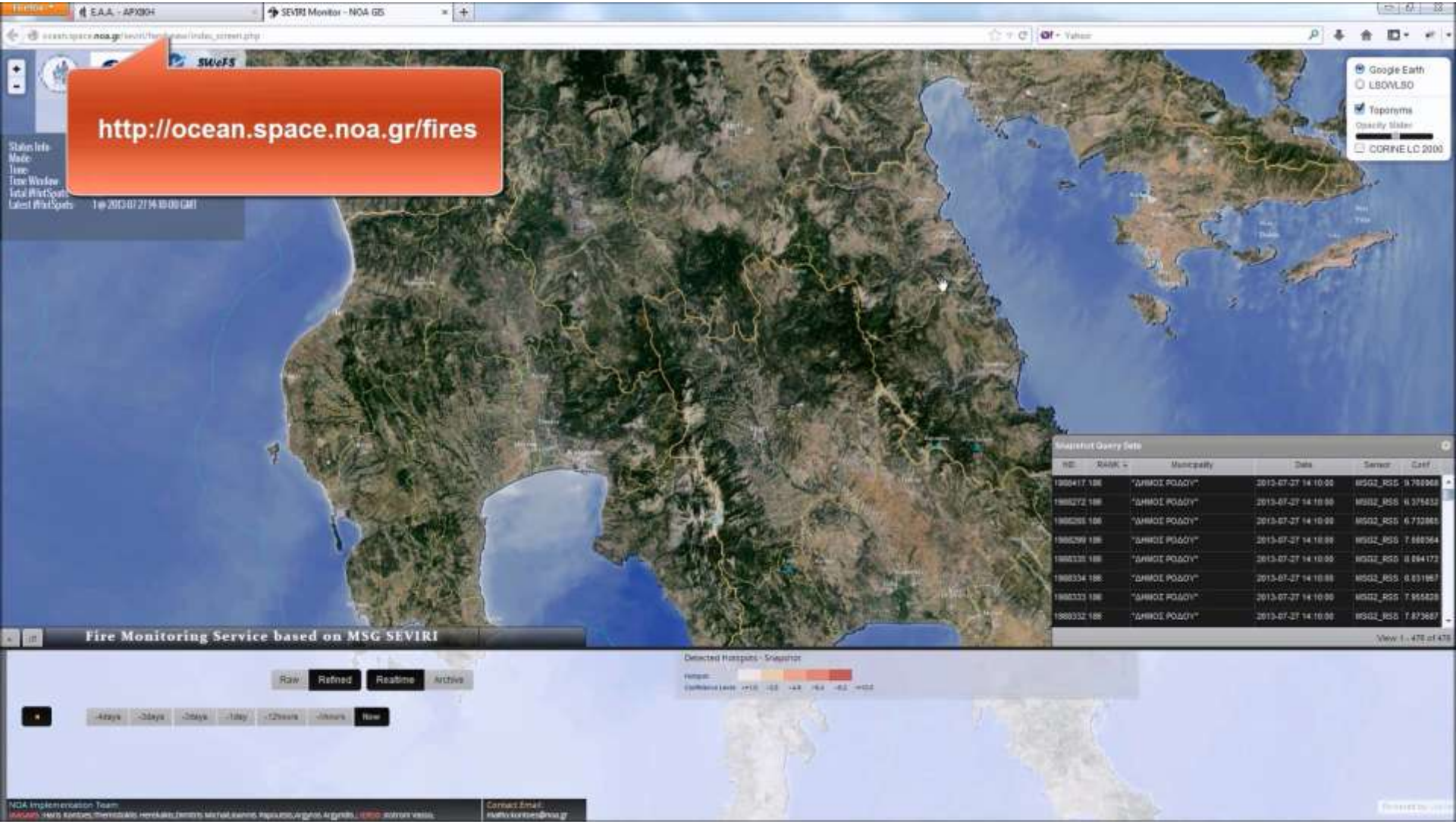
EO & Transport
Forest wildfires

BEYOND

Regional Real Time Fire Monitoring - NOA's MSG SEVIRI Station

EO & Transport

Forest wildfires: http://ocean.space.noa.gr/fires



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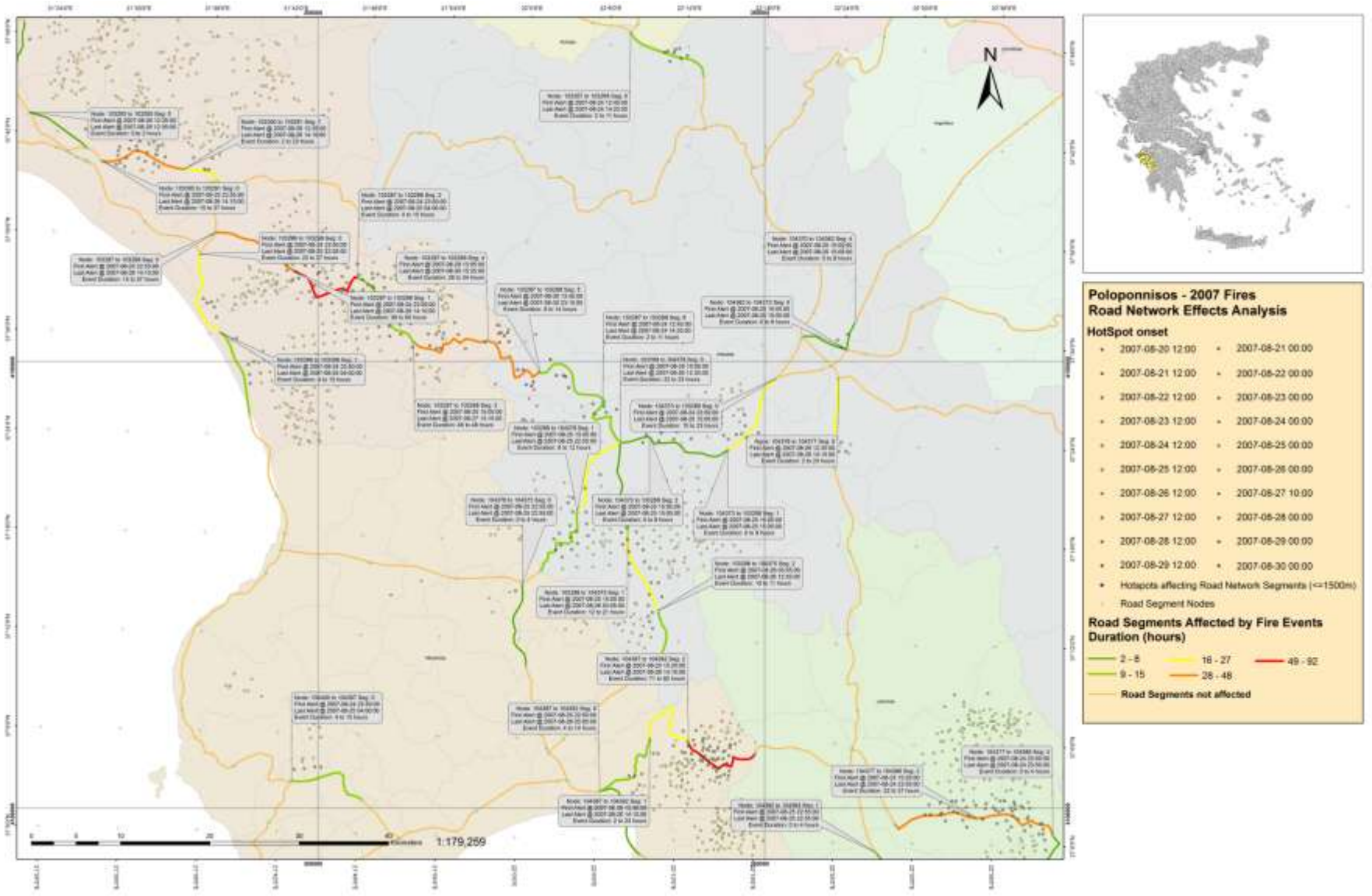
Forest wildfires: http://ocean.space.noa.gr/bsm

EO & Transport

Forest wildfires



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Floods

EO & Transport

Geodetic measurements from Space

BE OND

National Seismological Network

NOANET

ENIGMA

Earth Observation - SAR Interferometry

Geodesy

Modeling

Hazard assessment

Distributed processing

Volcanoes

Tectonics

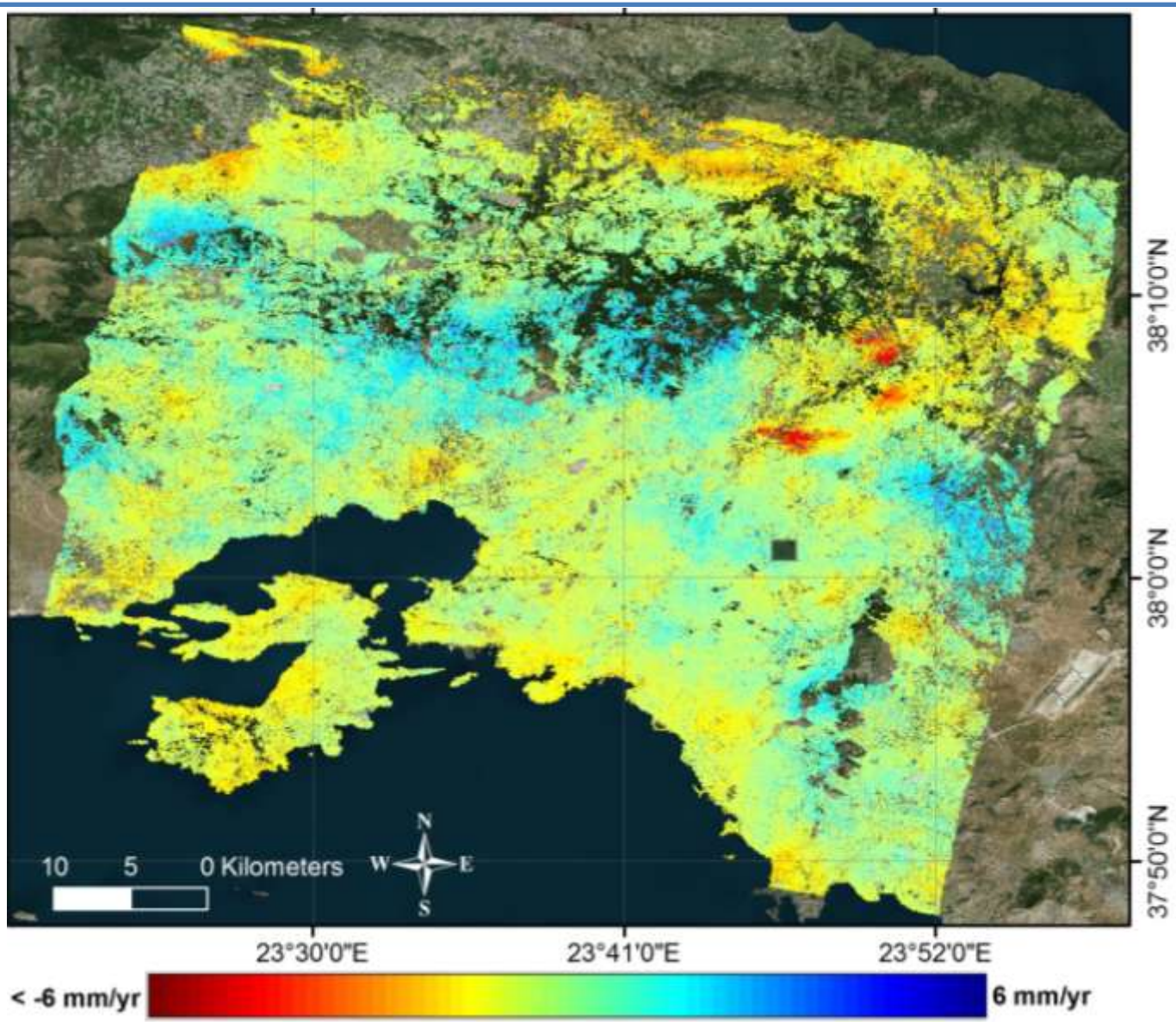
Landslides

Subsidence

Tsunami

EO & Transport

Construction activity monitoring



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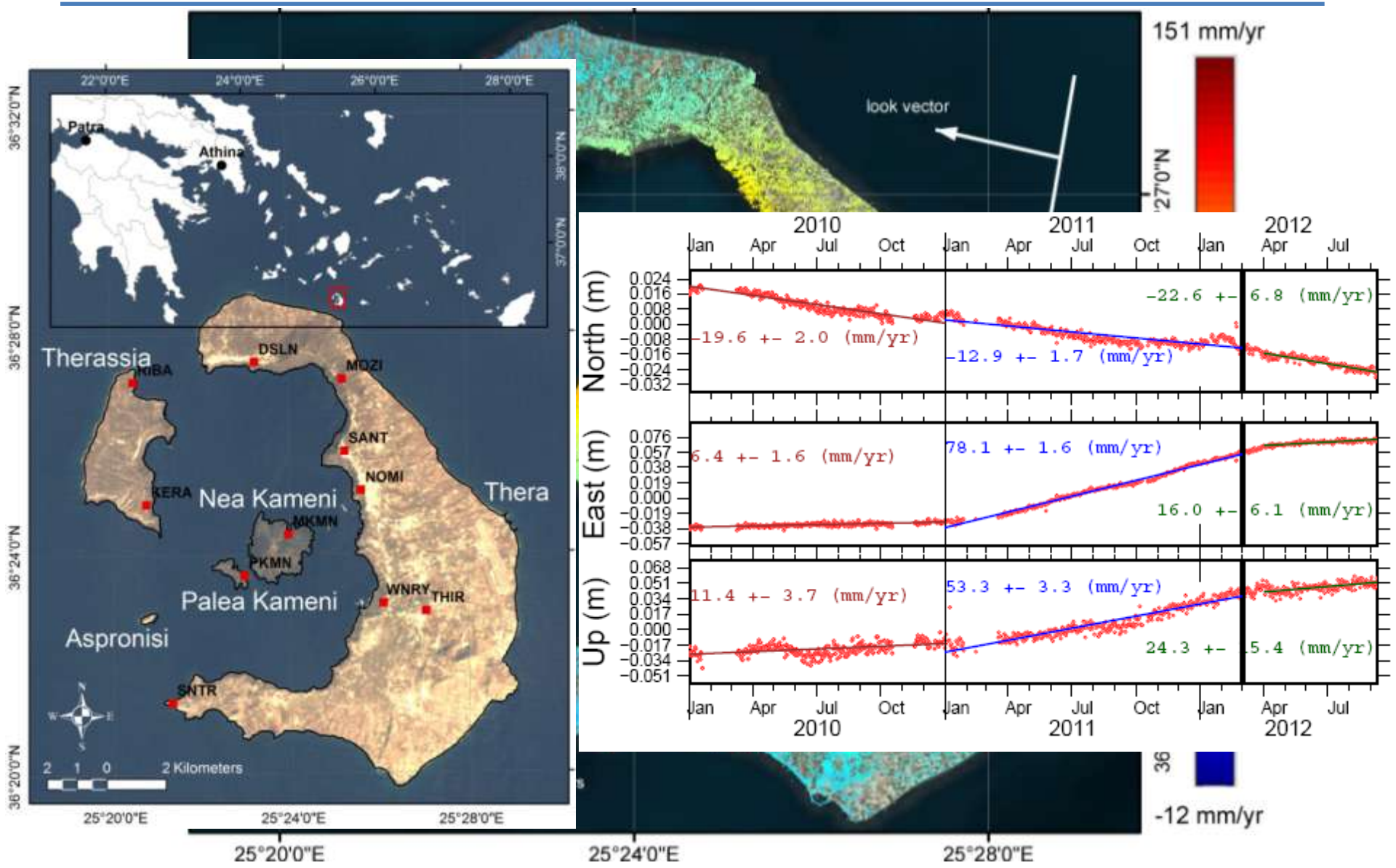
Geophysical hazards - Volcano



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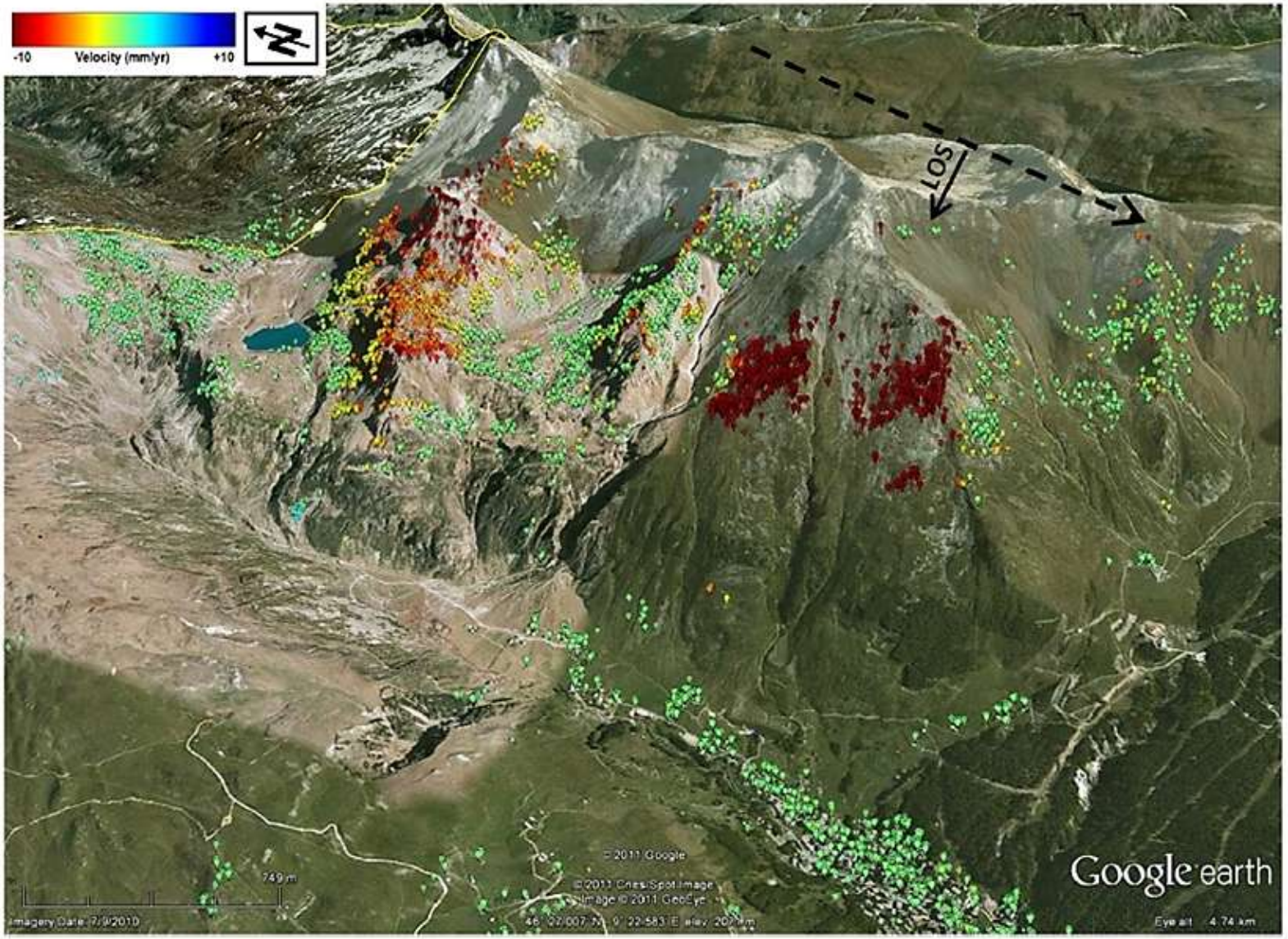
Geophysical hazards - Landslide



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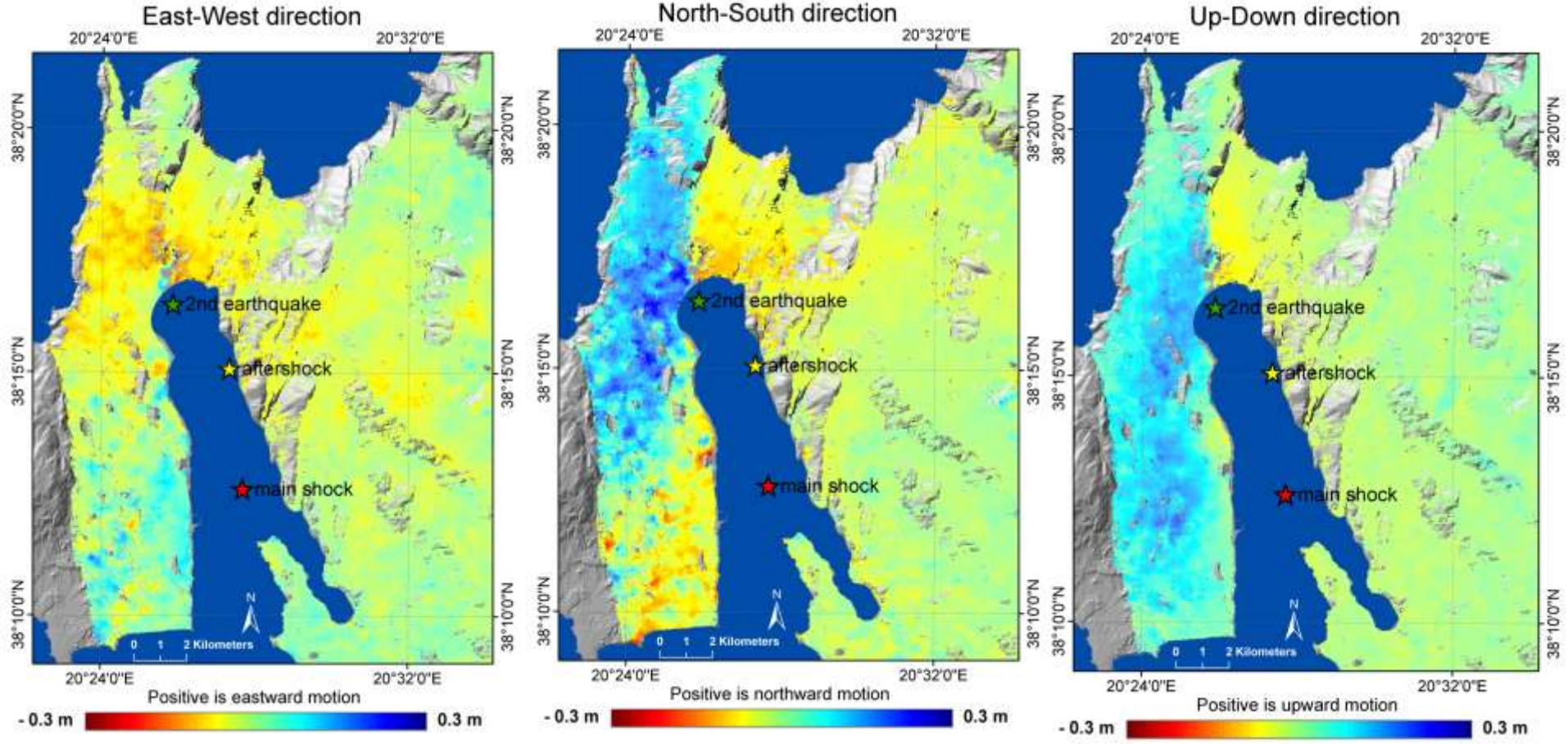
Geophysical hazards - Earthquake

3D crustal deformation from TerraSAR-X & COSMO-SkyMed data



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Geophysical hazards - Earthquake

UAV Flight Preparation

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Geophysical hazards - Earthquake

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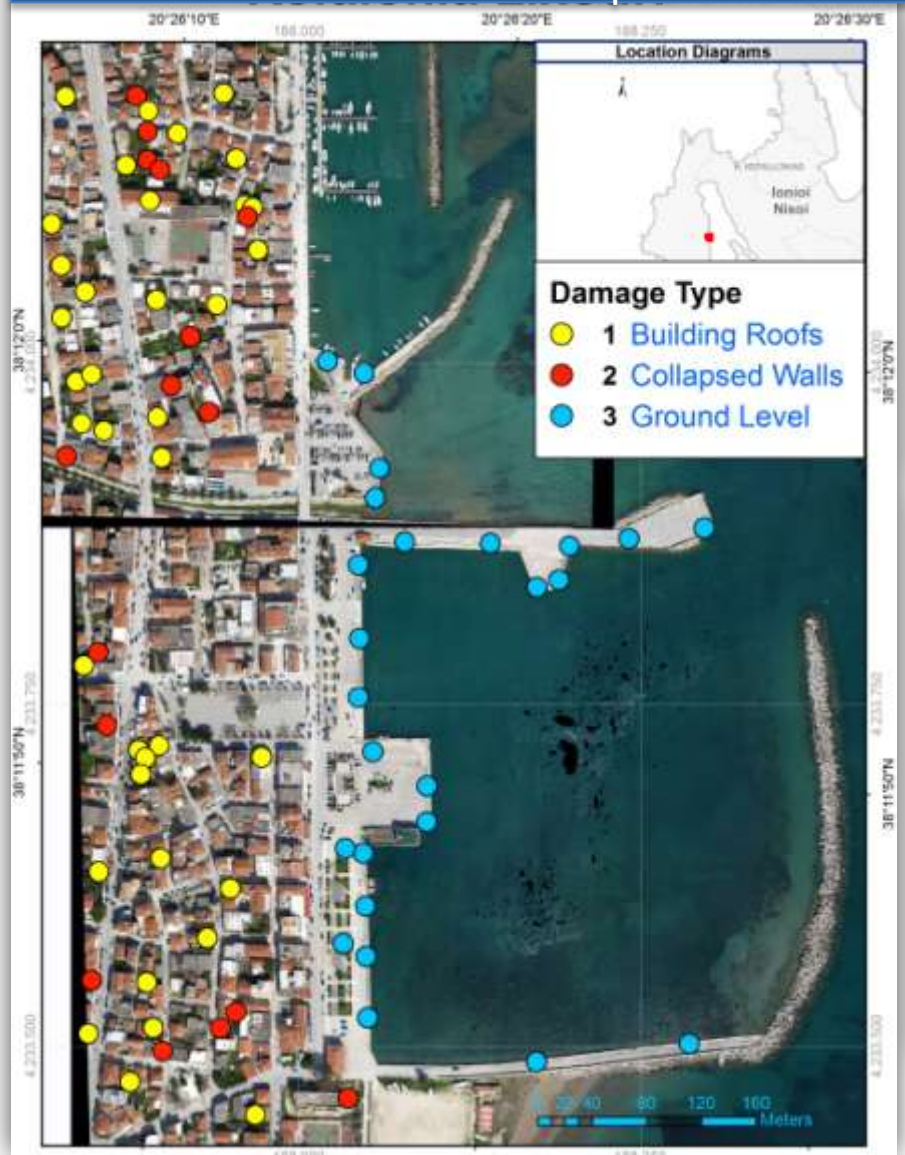
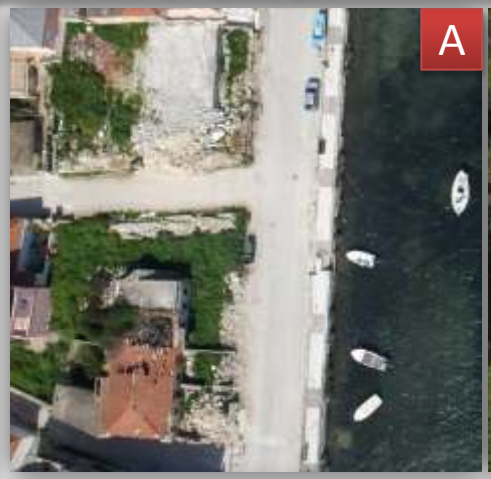
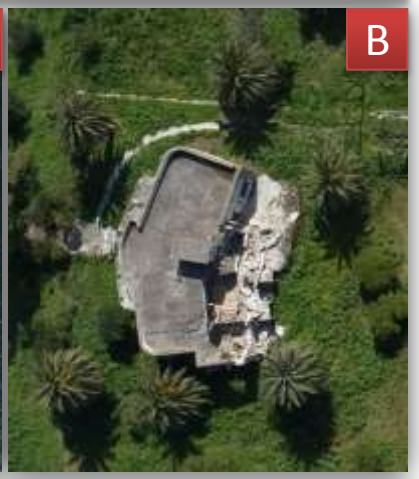
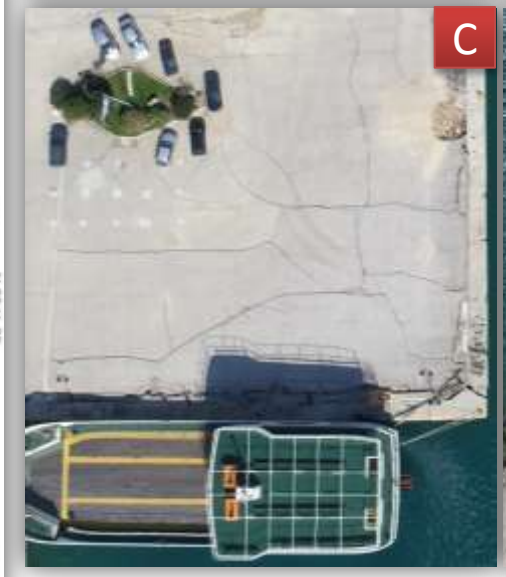
Geophysical hazards - Earthquake

Cephalonia Island – Town of Lixouri









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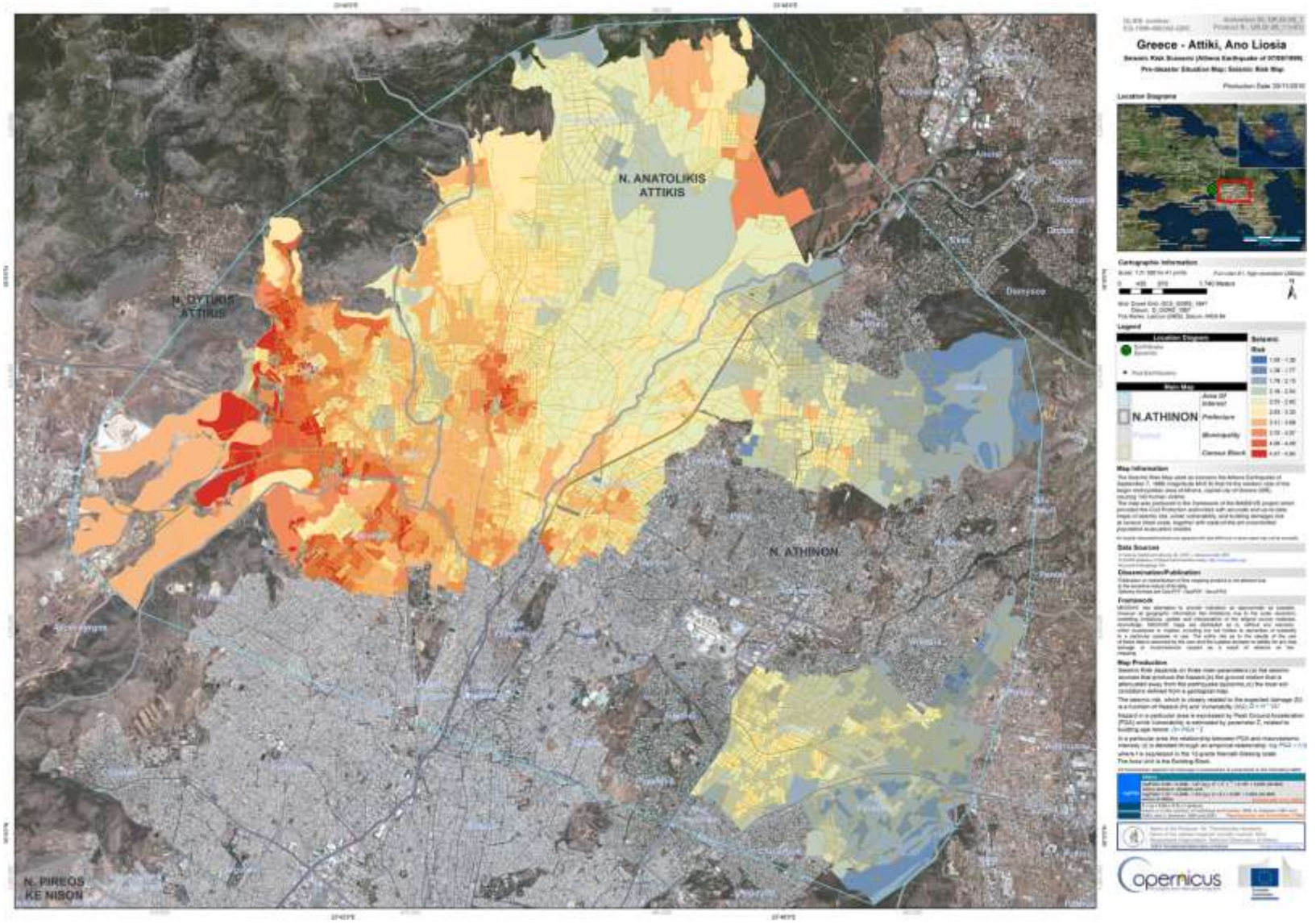
Geophysical hazards - Earthquake



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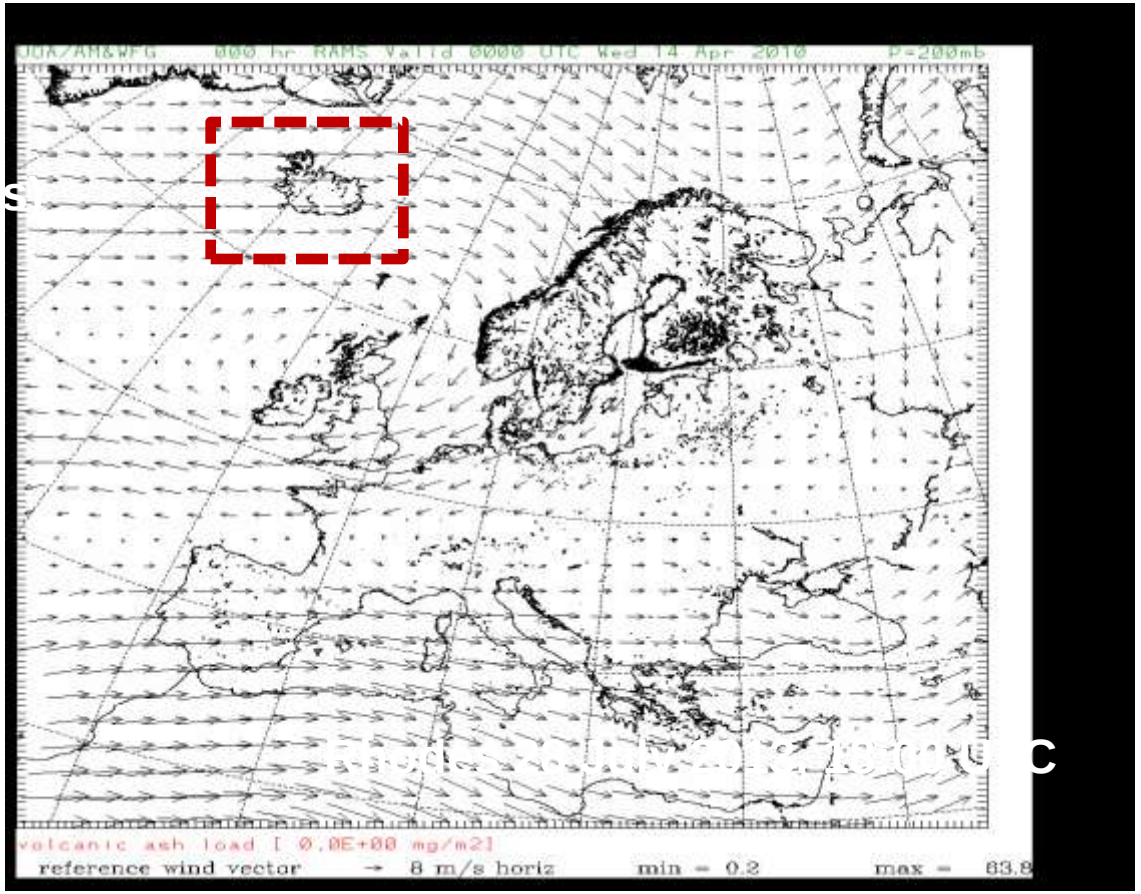
Geophysical hazards - Earthquake

EO & Transport

Modeling dispersion of volcanic ash

Dispersion of particles from volcanic eruptions has significant implications for:

- Health
- Weather and climate
- Aviation Safety



RAMS simulation of volcanic ash dispersion from Eyjafjallajökull - Iceland, 14-20 April 2010

Solomos et al., (Air Quality conf. Athens 2012)

EO & Transport

Modeling dispersion of volcanic ash

Examples of recorded aviation incidents related to volcanic ash

KLM Flight 867, 15 December 1989

British Airways Boeing 747-200, 24 June 1982

EO & Transport

Modeling dispersion of volcanic ash

Dispersion of volcanic ash is controlled by:

1.Particle size distribution

2.Injection height

3.Weather pattern

Satellite image of volcanic ash from Etna , July 24, 2001. (NASA SeaWiFs)

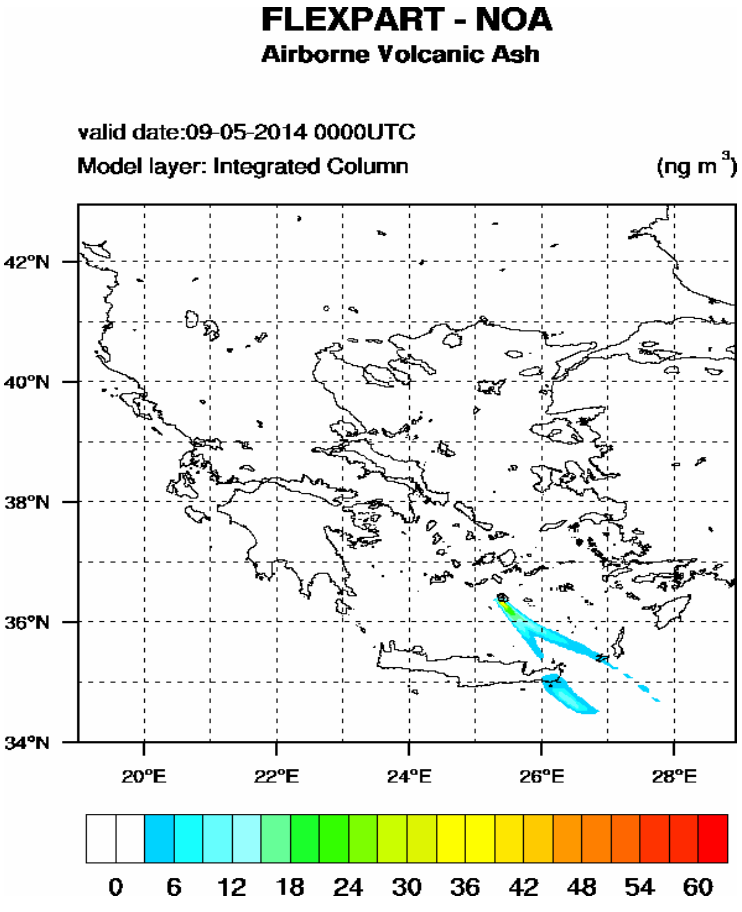
- Mapping of active volcanoes and their potential for ash cloud emissions for the development of an early warning system

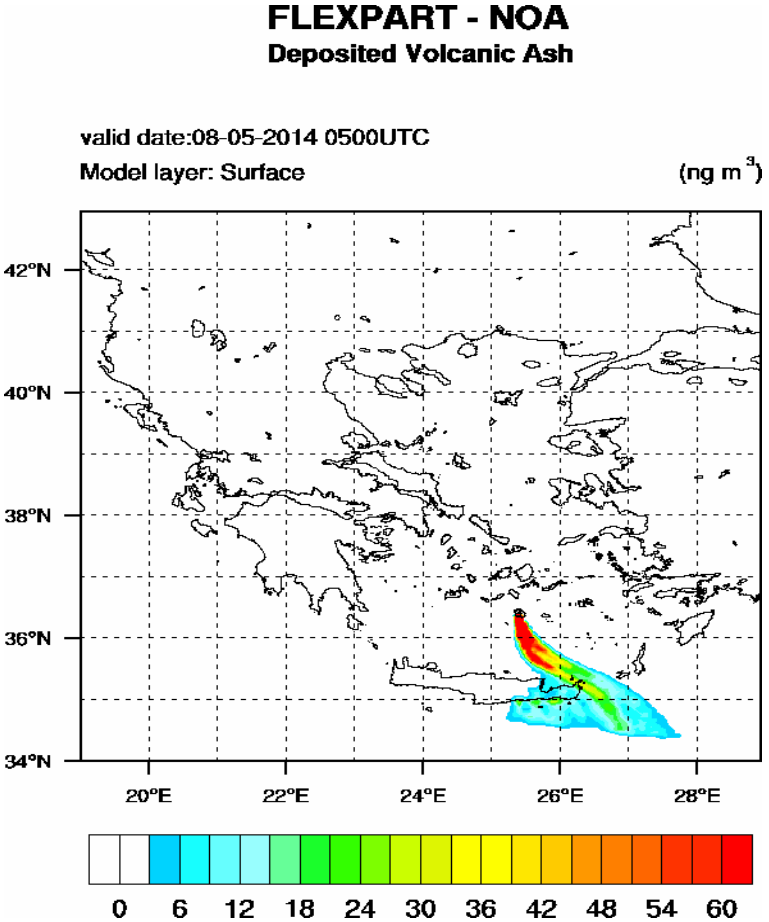
- The system is based on WRF / FLEXPART simulations

EO & Transport

Modeling dispersion of volcanic ash

- Preliminary results from the early warning system developed in the framework of BEYOND
- The specific hypothesis assumes 60 hours of continuous emissions at 1.5 km height column
- More work is underway for the identification of Santorini potential emission characteristics





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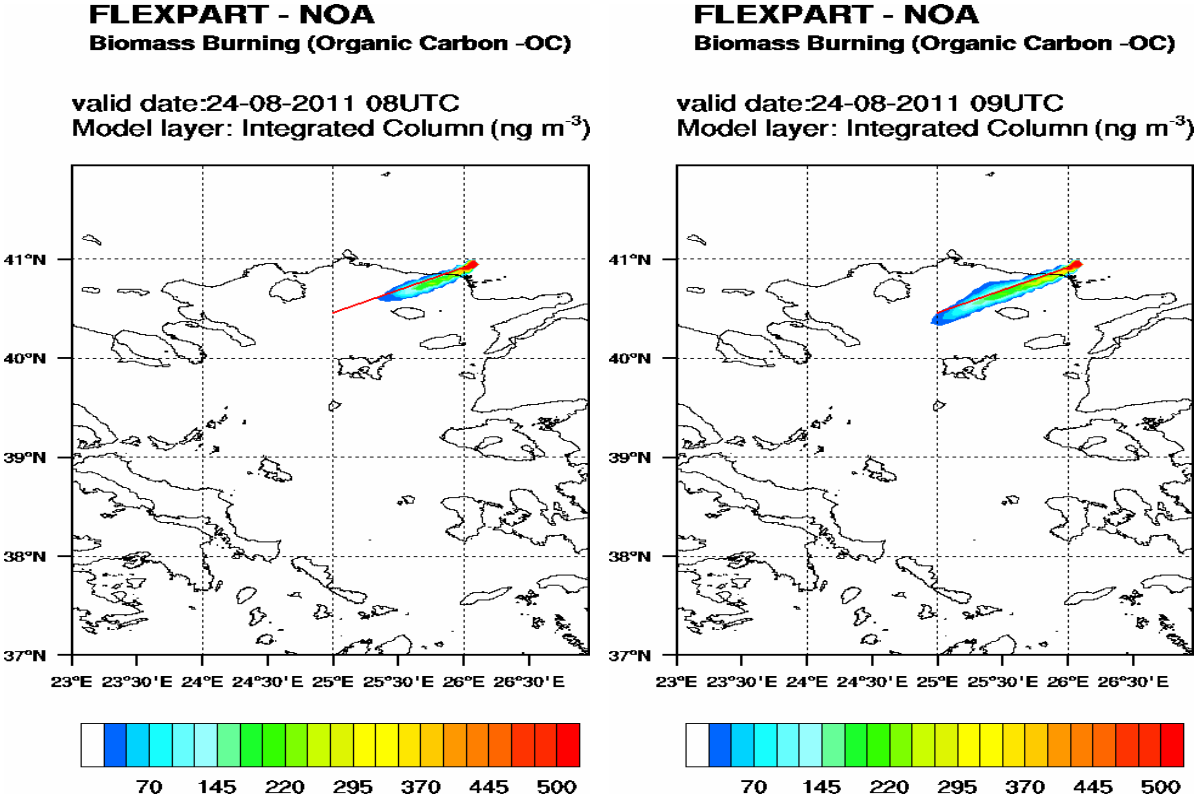
Fire smoke dispersion

Forecasting Vertical structure of smoke plume Cross section of Organic Carbon concentration (ng m-3)

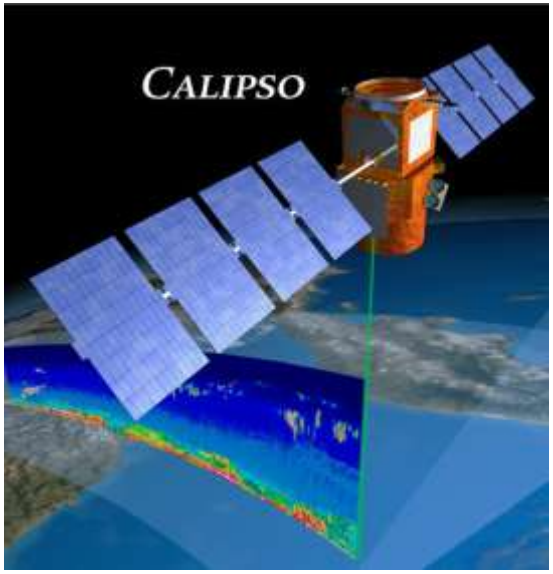
MISR satellite image
24 August 2011, 08:00 UTC

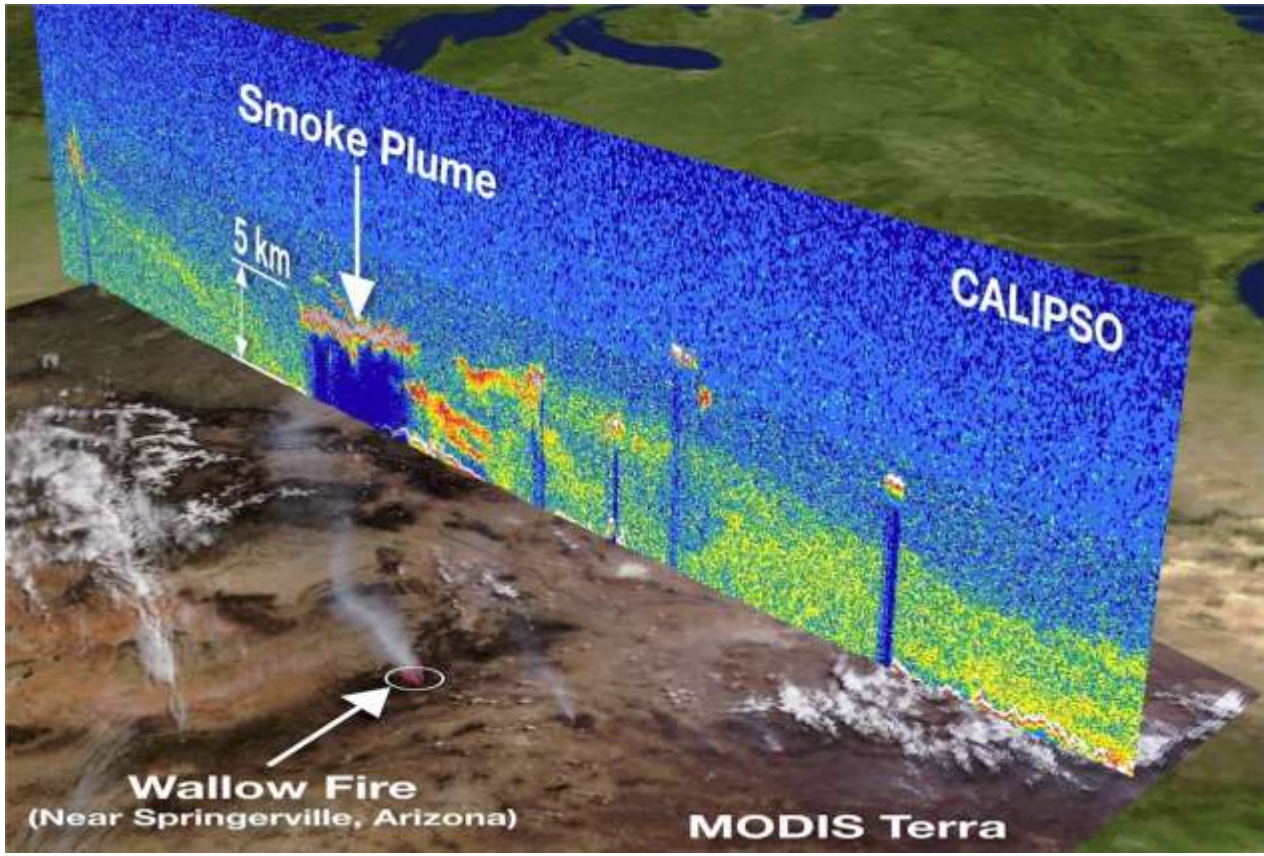


Simulated concentration of Organic Carbon (ng m^{-3}) 24 August 2011, 08:00 (left) and 09:00 (right) UTC

EO & Transport
3D climatology

Global 3D climatology of aerosols and clouds based on 4-year CALIPSO observations





Global AOD at VIS (532 nm) from LIVAS 4-year averages of CALIPSO observations

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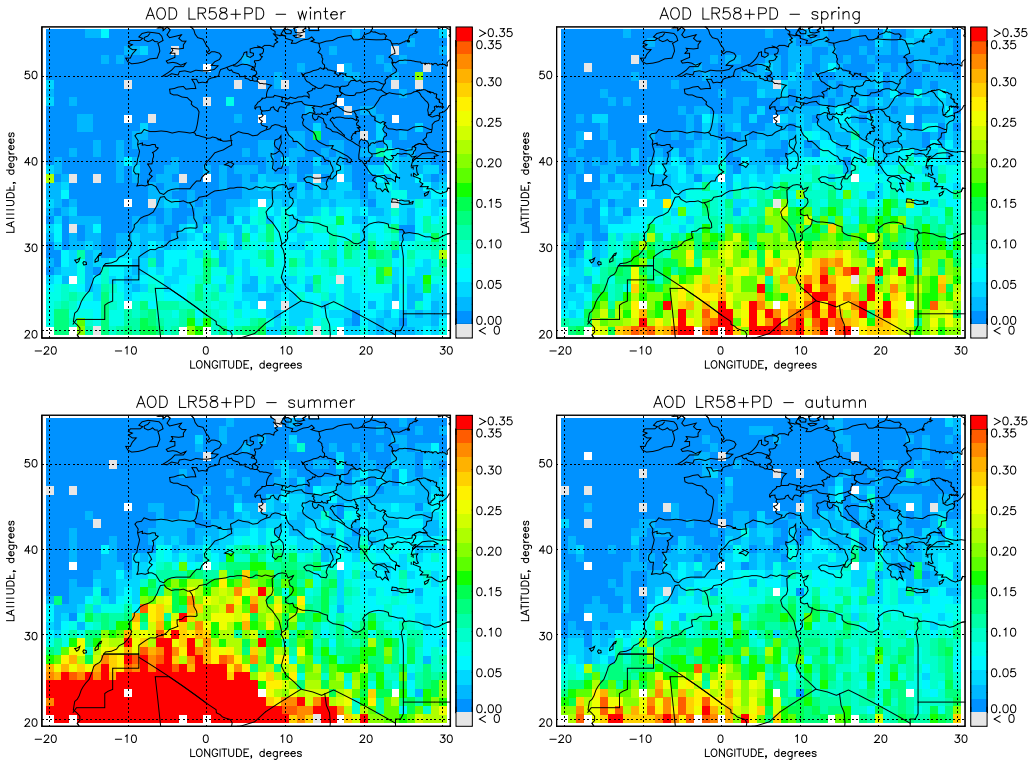
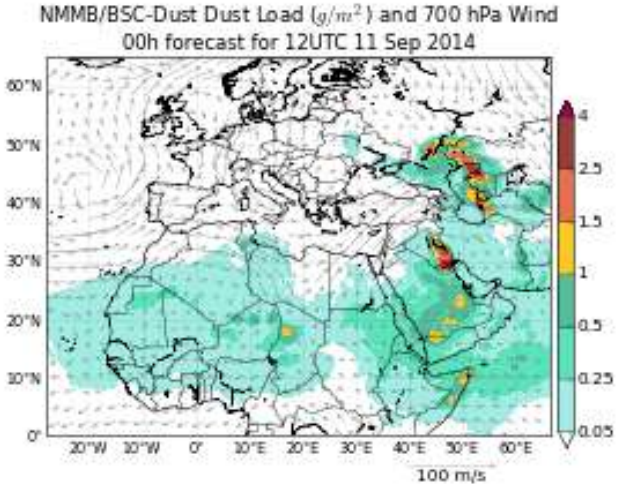
Dust monitoring

BEYOND dust product based on CALIPSO



Seasonal geographical distribution of pure Saharan dust particles over Europe and North Africa

North Africa-Middle East-Europe



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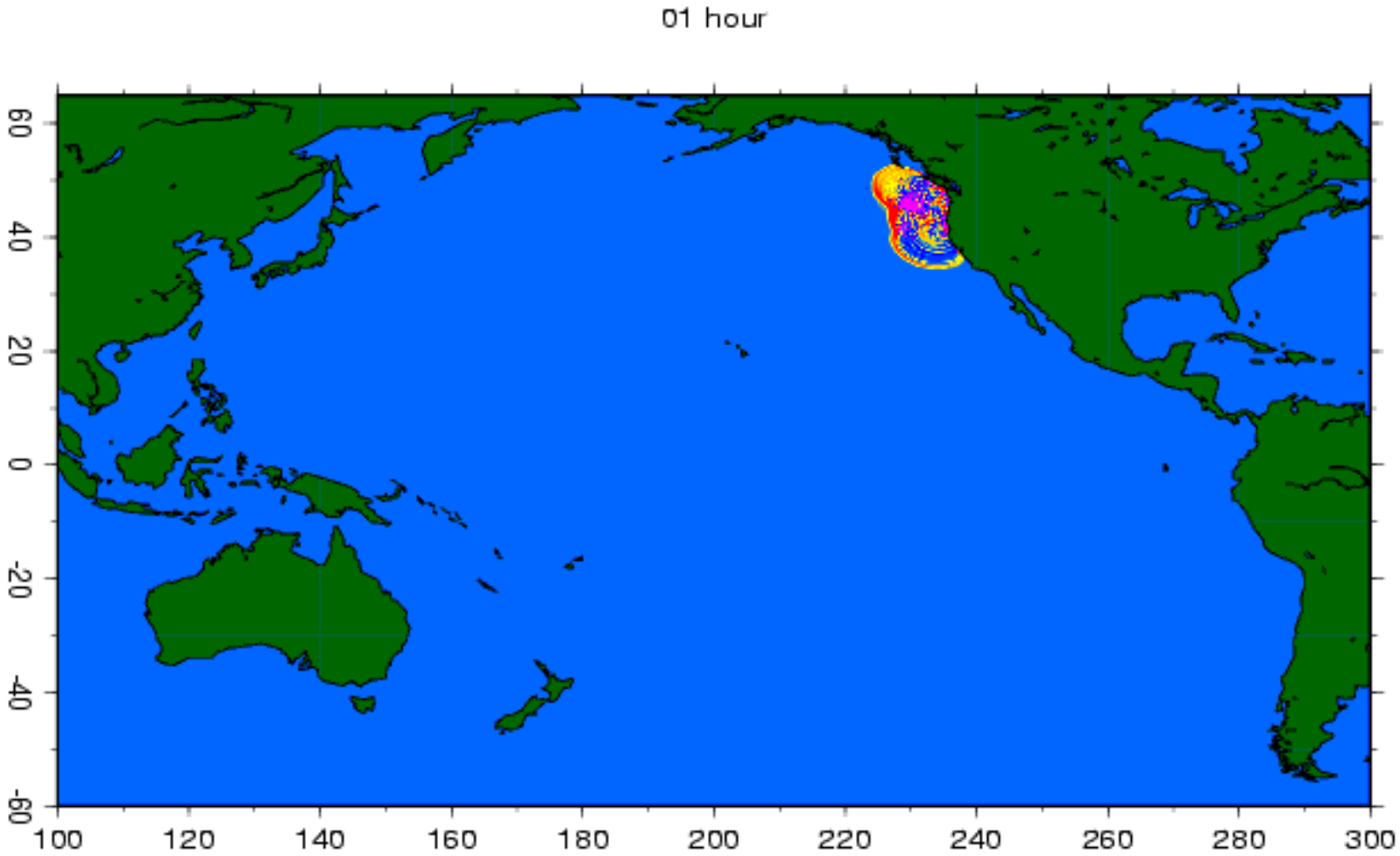
Wind storm

EO & Transport

Tsunami



Conclusions & remarks

- ✓ BEYOND Center of Excellence is a key player for monitoring natural disasters from space

- ❖ Integration of air-, ground- and space instrumentation

- ❖ Key activities include:
  - Pre-disaster situation maps (hazard mapping, risk analysis, evacuation modeling, etc.)
  - Emergency Response/Support products and services
  - Post-disaster monitoring (detailed damage assessment, reconstruction/rehabilitation mapping, vulnerability assessment etc.)

- ❖ Several products can be used to increase resilience to natural disasters, affecting the Transport System

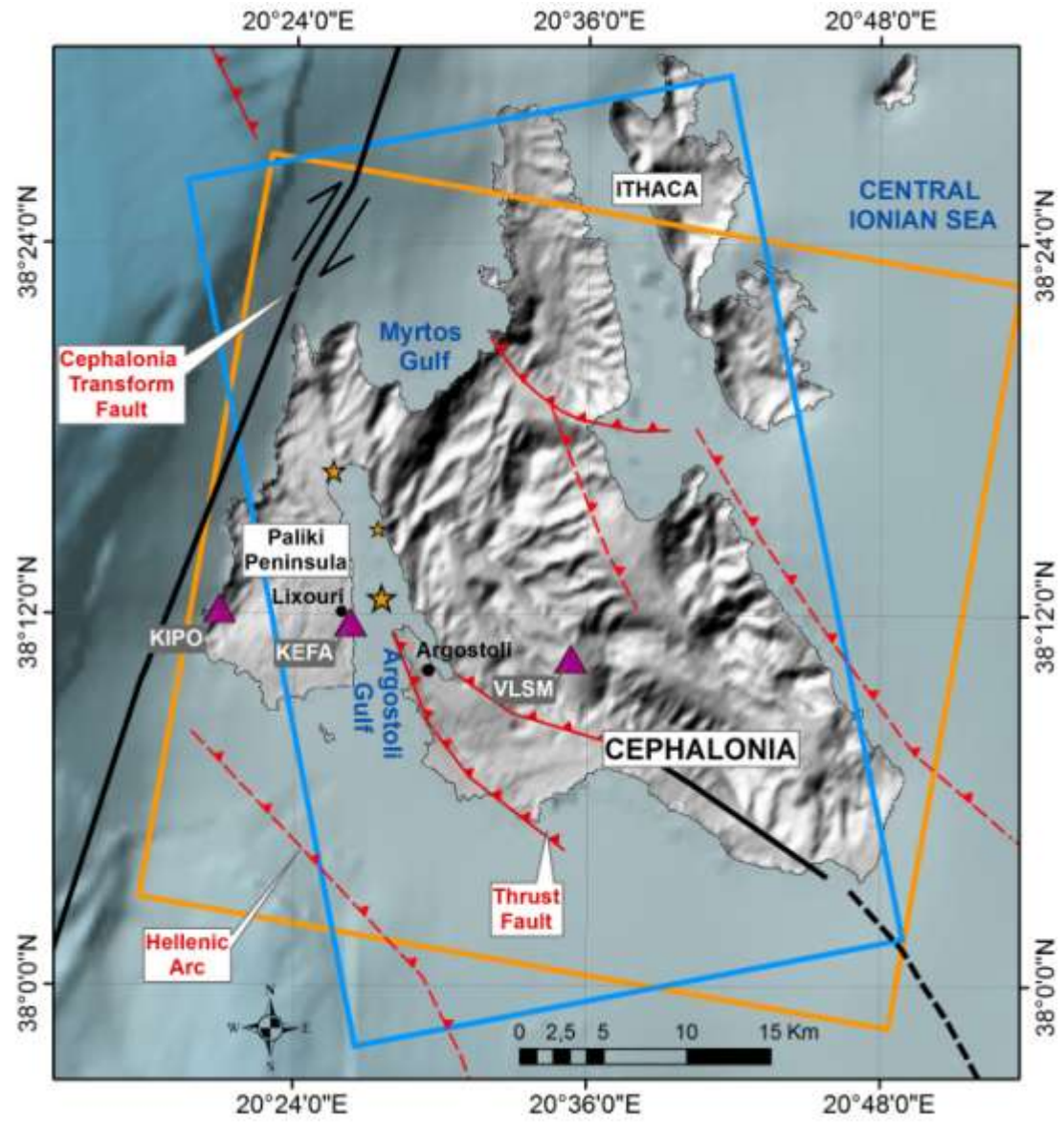
Questions?

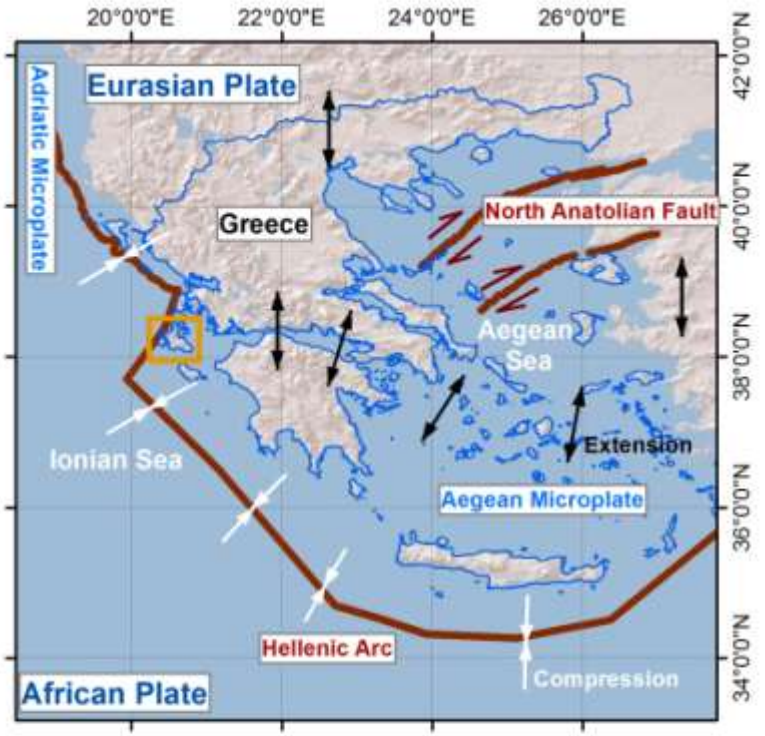
Thank you!

ipapoutsis@noa.gr

http://beyond-eocenter.eu

Cephalonia earthquakes





Mapped faults

- Strike-slip inferred
- Strike-slip
- Reverse inferred
- Reverse

Main earthqauke events

- 26/1/2014 ML 5,1
- 3/2/2014 ML 5,7
- 26/1/2-14 ML 5,9

GPS stations

- cGPS

SARframes

- COSMO-SkyMED
- TerraSAR-X