

Objective

The main objective of the project is to offer the opportunity to IAASARS/NOA to enhance its capacities, drawing new creative perspectives in EO-based disaster management, rendering IAASARS/NOA into the leading south-eastern Europe/Balkan research centre of excellence, and allowing sustainable collaborative schemes to be formed.

Vision - Mission - Impact

Vision

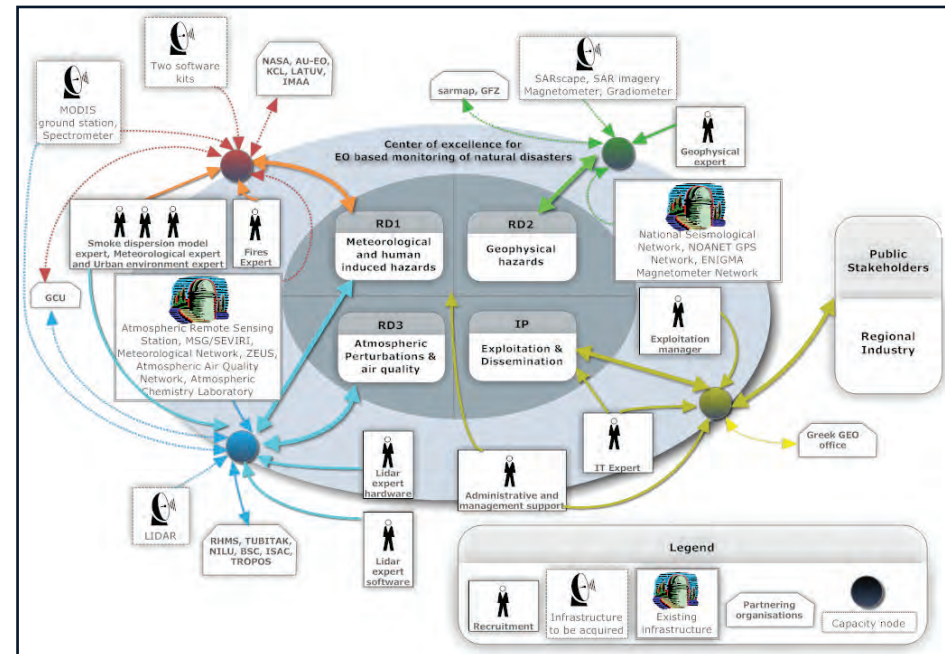
It is envisaged that BEYOND will substantially contribute to human, institutional and infrastructure capacity building, via the uptake of a crucial role on co-ordinating local and regional actions, at the same time creating multi-directional communication and co-operation channels with esteemed foreign organisations. Following a stepwise approach, emphasis will be first placed on upgrading RTD capacity, capability and quality of existing IAASARS/NOA potential, in human, institutional and infrastructure resources:

Mission

The mission of the project is not to build a new EO capacity from scratch, but seeks to coordinate and build upon existing efforts in south-eastern Europe, increasing the efficient use of limited resources. The current availability of observational capabilities in the regional research establishments are of isolated nature, therefore there is limited impact to sufficiently address an integrated environmental decision making approach. Based on the above, BEYOND will not be confined to national or local borders but rather requires a European approach.

Impact

The impacts after the project implementation to the national and regional economy and the society are expected to be significant. The setup and optimization of the modeling parts to the BEYOND system will be used in the future for the provision, at an operational basis, of real-time forecasts for a number of hazards (e.g. fires, fire progression, smoke and toxic pollutant dispersion, accurate weather forecasts, dust forecasts). Moreover, boosting of regional cooperation of research entities with industry and SMEs is anticipated, focusing on knowledge intensive sectors, with a strong exports-orientation, resulting in economic growth, improvement of the business environment and social cohesion.



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 in south-eastern Europe, with a prospect to increase its access range to the wider Mediterranean region through the integrated cooperation with twinning organizations in Europe**



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Activity: 4.1
Unlocking and developing the research potential of research entities established in the EU's Convergence regions and Outermost regions.
Call Identifier:
Integration of research entities from the EU's Convergence and Outermost regions in the ERA and enhancement of their innovation potential.
Project GA number: 316210
Duration: 3 years (2013-2016)

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BEYOND

Building a Centre of Excellence for EO-based monitoring of Natural Disasters



What is BEYOND ?

Established in the framework of the FP7-REGPOT-2012-2013-1 Coordination and Support Actions - Theme Area "4.1 Unlocking and developing the research potential of research entities established in the EU's Convergence regions and Outermost regions", the **BEYOND** project (EC GA No 316210) aims at maintaining and expanding the existing state-of-the-art interdisciplinary research potential, by **Building a Centre of Excellence for Earth Observation based monitoring of Natural Disasters in South-Eastern Europe**. BEYOND foresees to increase its access range to the wider Mediterranean region through the integrated cooperation with twinning organizations in Europe and USA. BEYOND Center of Excellence is hosted at the National Observatory of Athens (NOA) - Institute of Astronomy, Astrophysics, Space Applications and Remote Sensing (IAASARS). The operations of BEYOND officially started in June 2013, and will last for the next three years. The approved EC budget contribution for BEYOND is 2.305.650 Euros.

BEYOND Center aspires to:

Incorporate multidisciplinary excellence from diverse sciences, such as Remote Sensing, Meteorology, Atmospheric Physics, Hazard Modelling, Geology, Geophysics, Seismology, Volcanology, and Hydrology.

Exchange know-how with more than 20 International Organisations (e.g. GEO, EC DGs, UNISDR), Universities in Europe and USA, and cooperate with Space Agencies such as ESA, NASA, and DLR.

Set up innovative integrated observational solutions of the Earth, allowing a multitude of monitoring networks (space borne and in-situ), owned by NOA and the collaborative Institutions and Space Agencies, to operate in a complementary, unified and coordinated manner.

Transform the observations to added value products ready for down-streaming to specific societal needs for disaster management.

Deliver online observations and higher level products to the stakeholders, scientists and institutional users.

BEYOND Research Portfolio:

The BEYOND Center research/product portfolio covers a broad spectrum of natural disaster phenomena such as earthquakes, volcanoes, extreme weather events, floods, fires, fire smoke and toxic gasses dispersion, emission concentrations, dust storms, air quality aspects and their impacts to human health.

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Fires

Big volumes of EO images are being processed on a systematic basis to derive thematic products needed for Emergency Response and Emergency Support during and after wildfire crises, as fire detection, fire monitoring and rapid mapping, fire smoke spread and ecosystem damage assessments in the inflicted areas. BEYOND fire services are delivered under the name FIREHUB: "A Space Based Fire Management Hub", a unique web tool that has been elected as the Best Challenge Service of the Copernicus Masters Awards Competition of 2014. For more information visit: <http://ocean.space.noa.gr/FireHub>



Products:



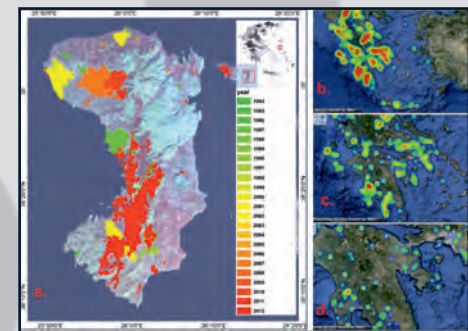
Real Time Fire Monitoring

Real-time Fire Monitoring System

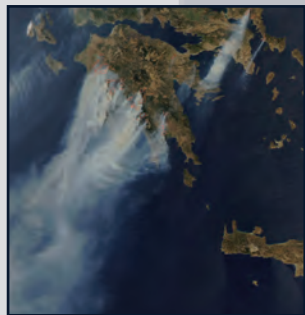
Through a complex modelling, the FIREHUB web service combines the METEOSAT satellite observations with additional evidences of fire occurrence, weather forecasts, fuel, and landscape data, in order to derive and disseminate on a 5 minute basis reliable pictures of the active fires with an enhanced spatial resolution of up to 500 meters on the ground, that is 50 times better than the spatial resolution of the raw satellite observations (note that the MSG SEVIRI sensor resolution is ~3.5km over the SE Europe). Full Link: http://ocean.space.noa.gr/seviri/fend_new/index.php

Diachronic/Rapid Mapping of Burned Areas over Greece (1984-2013)

FIREHUB Web service has been developed so as to depict the results of the rapid/seasonal, and/or diachronic mapping of burned areas over the years. For this, a fully automatic production chain for burned area mapping and damage assessment has been developed and validated. For the diachronic burned area product generation, FIREHUB has processed the full USGS archive of Landsat TM images since the first Landsat TM image ever captured over Greece (1984-2014). Full Link: http://ocean.space.noa.gr/diachronic_bsm/index.php



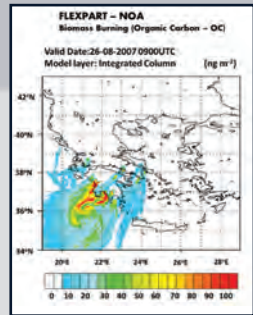
(a) Diachronic BSM over the Island of Chios from 1984 to 2012, (b, c and d) Heat mapping of burnt areas, at different zoom levels



Fire Smoke Dispersion

Detected by FIREHUB tool fires, are used as input to trigger in real time the process for generating hourly forecasts of fires' smoke dispersion and organic carbon concentrations. The process makes use of the Lagrangian dispersion model FLEXPART driven by the WRF-ARW meteorological output at a resolution of 4X4 km over Greece.

(Left) Dispersion of fire smoke on August 26, 2007, depicted on a MODIS scene acquired at 09:30 UTC, and (Right) the forecasted smoke dispersion using the FLEXPART model at 09:00 UTC.

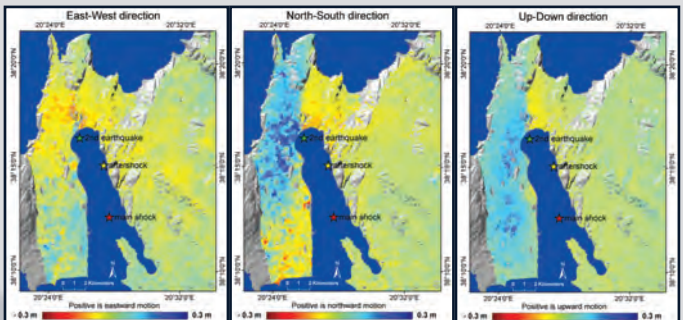


Geophysical

Earthquakes

Radar interferometry has highlighted the value of remote geodetic measurements for estimating ground displacement patterns with an unprecedented spatial coverage and accuracy.

Exploiting sensor diversity of high resolution COSMO-SkyMed and TanDEM-X satellites we were able to reconstruct the 3D surface deformation field associated with the Cephalonia, 3 February 2014 Mw 5.9 event.



3D deformation field for Cephalonia earthquake, derived from radar interferometry



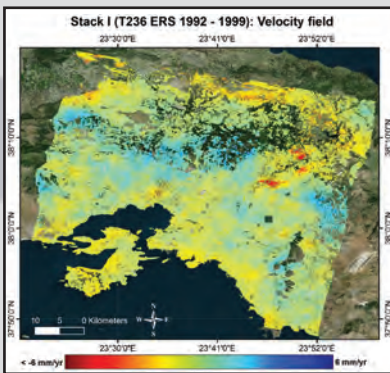
Damage assessment

We rely on UAV technology to map the damages of the catastrophic events and assess the Mercalli Intensity of the earthquake. BEYOND, in collaboration with Geotech LTD flew a mission over the urban area of Lixouri, five semi-urban areas and two rural areas in Cephalonia, in an attempt to detect and classify earthquake related damages.

UAV-based damage assessment for Cephalonia earthquake

Volcanoes

Time-series of Synthetic Aperture Radar data are exploited to monitor slowly evolving phenomena, like volcanic unrest episodes. State-of-the-art Persistent Scatterer Interferometry techniques are applied on multi-temporal, multi-resolution, multi-frequency satellite data. In addition, BEYOND has been developing an early warning system, for volcanic ash dispersion. This system is based on WRF / FLEXPART and modeling and simulations.



Ground displacement in Athens for the period 1992-1999 using ERS-1, 2 data

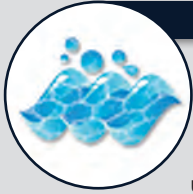
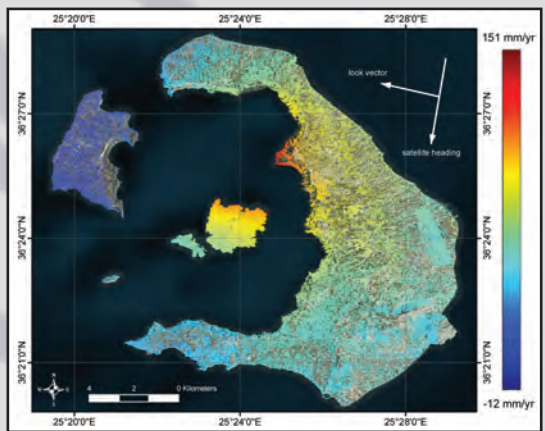
Urban subsidence

Similar time-series algorithms on top of SAR data are used for the diachronic mapping of ground motion in urban environments. Such maps constitute a benchmark for geological, geotechnical and engineering studies.

Landslides

Earth Observation can provide crucial information for landslide monitoring at regional and local level. In BEYOND we combine radar and optical imagery with geotechnical modeling for the production of landslide susceptibility maps and estimation of corresponding hazard.

Santorini inflation episode, 2011-2012, captured from space



Floods

We have established the BEYOND Floods Observatory where we register and maintain information on the major flood events in Greece and south-eastern Europe. Moreover, we publish the flood mapping results produced through the process of satellite optical and radar images and photo-interpretation.

Any available earth observation data can be used to extract flood extent information. Selection of a particular data source depends mainly upon the timely coverage, its availability, spatial, spectral and temporal resolution and finally the cost. The most important factor for mapping the extent of this flood is the acquisition time of the image, which needs to be very close to the peak flooding in the areas of interest. Mapping activities will be greatly improved with the exploitation of data from the Sentinels family of satellites, an ESA-Copernicus venture.



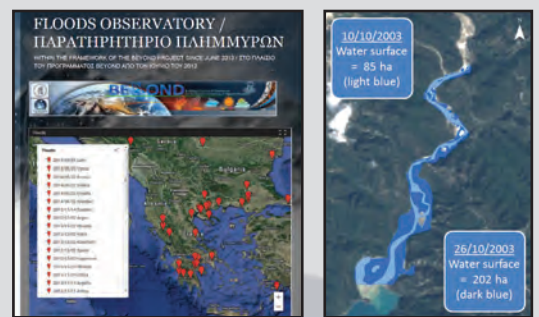
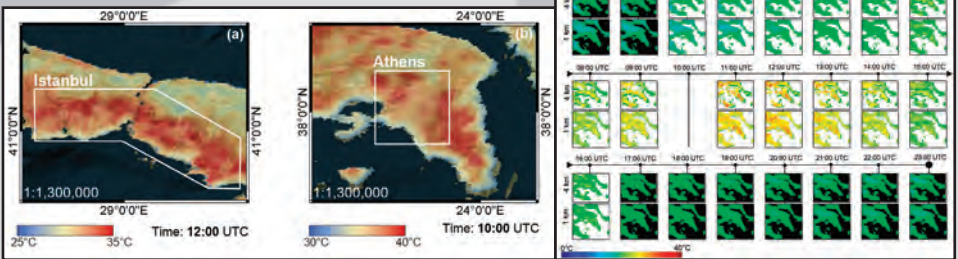
Flooded area in the DEWETRA platform

In this direction we have established cooperation with the Public Power Corporation S.A. (PPC S.A.), as there is a mutual interest in the field of studying floods and developing a methodology for the assessment of flood risks with the integration of earth observation data, especially in the river basins at high risk of flooding where PPC S.A. operates its hydroelectric power stations. The contribution of PPC S.A. covers the provision of relevant expertise and information derived from the processing of the in-situ collected data of the hydrometeorological network operated by PPC S.A., and/or data relating to the management of the hydrological basins under study.



Urban Environment

IAASARS/NOA has developed a system for real-time monitoring of the urban thermal environment by sharpening geostationary thermal remote sensing image data. The system has been specifically designed to facilitate urban heat island studies and to produce time-series of surface temperature maps that combine high spatial (1 km) and temporal resolution (15 min). In principle, the system has the potential to cover



BEYOND Floods Observatory platform

Case study: Mapping of flood event in Arachthos river on 24 Oct 2003 with LANDSAT-5 images of 10 and 26 Oct 2003



Atmospheric Hazards

Understanding the Earth system, its weather, climate, atmosphere, and natural/human-induced hazards is crucial to protecting the global environment, reducing disaster losses, and achieving sustainable development. Observations of the Earth system and its atmosphere from ground and space constitute the most critical input for advancing this understanding. The ground-sector lidar developments foreseen in BEYOND will enforce ground-based monitoring activities in the Mediterranean, a geographical area of great importance in terms of aerosol and cloud properties.



3D LIVAS global aerosol/cloud climatology

We provide a global 3-dimensional aerosol and cloud optical climatology and a collection of case studies focused on atmospheric episodes related to specific aerosol/cloud types (extended atmospheric scenes, i.e. Saharan dust events, volcanic eruption events, polar-stratospheric clouds etc). The service are continuously updated in the frame of BEYOND and is free under the following link: <http://lidar.space.noa.gr:BOBO/livas/>

UV effects on human health

Solar UV radiation exposure on humans can have harmful but also beneficial effects on human health. The solar UV Index provides the expected risk of overexposure to UV radiation from the sun. UV index is connected with the erythemal UV dose. UV can normally penetrate the skin only about 0.6mm deep and affects mostly epidermal cells causing melanoma. UVB radiation is also responsible for DNA damage. Finally, UV of wavelengths less than 310nm also stimulates the synthesis of biologically active vitamin D3 from provitamin by photoconversion.

CHARADMexp Campaign

The CHARADMexp campaign aims to derive optical, microphysical and chemical properties of marine component and its mixture with dust, employing sophisticated instrumentation installed on an appropriate site. Specifically, aerosol characterization will be established by ground-based active/passive remote sensing techniques, surface in-situ measurements and airborne UAV observations. The campaign is supported by BEYOND and twinning organizations (e.g. TROPOS, BSC) and funded by the European Space Agency (ESA).

