



# EGU 2015 BEYOND Splinter Session

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## EGU dedicated session

### *The European Center of Excellence **BEYOND** for EO based monitoring of Natural Disasters*

Within the National Observatory of Athens it has been recently established a Centre of Excellence for Earth Observation based monitoring of Natural Disasters in south-eastern Europe, named **BEYOND** - <http://beyond-eocenter.eu/>. The Center aims primarily at setting up leading edge integrated observational solutions to operate space-borne and ground-based monitoring networks in a complementary, unified and coordinated manner. The research portfolio covers a broad spectrum of phenomena such as earthquakes, volcanoes, extreme weather events, fires, fire smoke and toxic gasses, emission concentrations, manmade hazards, dust storms, air quality and impacts to human health.

The focus of BEYOND is to assemble technological expertise, know-how and research capacity to seamlessly design innovative processing chains, generate added-value products and develop end-to-end services for disaster management, environmental monitoring and climate change analyses, to serve institutional stakeholders, the scientific community, end-users and the general public, for the benefit of the environment and the society.

This session will provide a thorough insight in the activities undertaken with BEYOND Center of Excellence, giving characteristic examples of applications and products that have been systematically delivered using remotely sensed data sets, on a pre-operational and operational basis. The three thematic pillars of BEYOND will be addressed, namely meteorological and human induced hazards, geo-hazards and atmospheric pollution and air quality.

Title	Presenter	Time
What is the BEYOND Center of Excellence?	<a href="#">Haris Kontoes</a>	15.30
Operational fires disaster management and Floods in the framework of BEYOND via Earth Observation	<a href="#">Haris Kontoes</a>	15.40
EO-based System for monitoring the Urban Thermal Environment	<a href="#">Panagiotis Sismanidis</a>	16.00
Monitoring geophysical activity from Space, in the framework of BEYOND Center of Excellence	<a href="#">Ioannis Papoutsis</a>	16.20
Atmospheric activities in the framework of BEYOND	<a href="#">Vassilis Amiridis</a>	16.40
Coffee		17.00

### Details:

Splinter Session:  
SPM1.4  
Room:R2 (36)  
Requested day:  
Thursday  
Time.. Block IV:  
15:30-17:00



## BEYOND Center of Excellence for EO-based monitoring of natural disasters

**BEYOND Center of Excellence for EO-based monitoring of natural disasters**  
 Charalampos Kontoes, Vassilis Amiridis, Iphigenia Keramitsoglou, Ioannis Papoutsis, Alexia Tsouni, Georgios Balasis and Eleni Christia

BEYOND project (2013-2016, 2.3M€) funded under the FP7-REGPOT scheme is an initiative which aims to build a Centre of Excellence for Earth Observation (EO) based monitoring of natural disasters in south-eastern Europe (<http://beyond-eocenter.eu/>), established at the National Observatory of Athens (NOA). The project focuses on capacity building on top of the existing infrastructure, aiming at unlocking the institute's potential through the systematic interaction with high-profile partners across Europe, and at consolidating state-of-the-art equipment and technological know-how that will allow sustainable cutting-edge interdisciplinary research to take place with an impact on the regional



and European socioeconomic welfare. The vision is to set up innovative integrated observational solutions to allow a multitude of space borne and ground-based monitoring networks to operate in a complementary and cooperative manner, create archives and databases of long series of observations and higher level products, and make these available for exploitation with the involvement of stakeholders.

BEYOND will focus on improving the interdisciplinary approach which is necessary for disaster management, crossing the boundaries between the traditional academic disciplines, technological expertise, and research methodologies.

Moreover, through BEYOND, the National Observatory of Athens will enhance its international collaborations, via twinning with high excellence partners at European level, drawing new creative perspectives in the Relevant Research Area, and allowing sustainable collaborative schemes to be formed and synergies to flourish.

The collaboration schemes foreseen in BEYOND, and the coordinated operation of monitoring infrastructures, will allow to up-scale our regional role for contribution to the ERA on disaster management, and together with the partnering organisations built in the appropriate capacity level for providing innovative solutions and information to the involved communities for sustaining the centre's operation in future.

The research portfolio of BEYOND Center of Excellence covers a broad spectrum of phenomena such as earthquakes, volcanoes, extreme weather events, fires, fire smoke and toxic gasses, emission concentrations, manmade hazards, dust storms, air quality and impacts to human health. This session is dedicated to providing characteristic examples of user-tailored, operational and pre-operational services that are currently or will be soon available in the framework of the BEYOND Center of Excellence.

<http://www.beyond-eocenter.eu/>

**BEYOND**







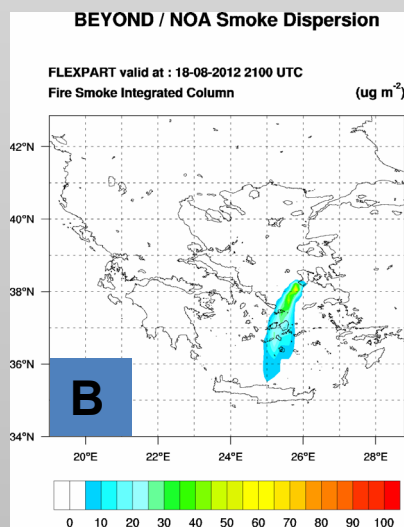
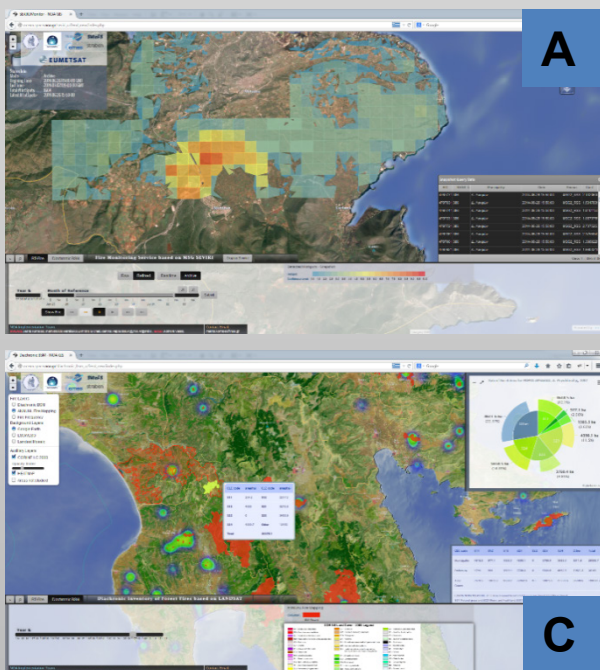
## Operational fires disaster management and Floods in the framework of BEYOND via Earth Observation

**The FireHub Tool: NOA EO-based Fire Related Services in the framework of BEYOND**  
 H. Kontoes, Th. Herekakis, V. Tsironis, I. Papoutsis, S. Solomos, E. Ieronymidi, and V. Amiridis

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Firehub is a novel, multidimensional, highly robust and efficient WebGIS platform that aims to provide the best support in the Disaster Risk Management (DRM) and Emergency Response (ER) disciplines regarding the wildfires phenomena. It is the result of a laborious and multiyear, research and development effort in the fields of remote sensing (RS), topography, forestry, meteorology, geographic information systems (GIS) and computer engineering that evolved during several projects in which National Observatory of Athens (NOA) and specifically the Institute of Astronomy, and Astrophysics Space Applications and Remote Sensing (ISAARS) was a counterpart. It was recently honored with the high award of the first prize of Best Challenge Service in the 2014 Copernicus Masters Awards competition and it is already recognized by the Greek Fire Brigades and Civil Protection authorities as an effective and stable wildfires DRM and ER platform, currently utilized by them to a large extent, especially during the challenging Summer season; a season (in Greece) that is highly vulnerable to wildfires which are causing devastating effects in both the biosphere and the economy.

Firehub is characterized as a multidimensional platform due to the fact that it is comprised of three modules that provide valuable DRM and ER information regarding the wildfires in the Greek terrain, through different perspectives. The three modules are: **a) the Real-time Fire Monitoring** module which provides continuous information on active fires detected from the MeteoSat Second Generation (MSG) SEVIRI satellite with a 5-minutes fire spots monitoring frequency, **b) the Smoke Dispersion Forecast** which provides smoke dispersion assessments based on a Lagrangian model, and **c) the Burn Scar Mapping and Damage Assessment** module which is capable to depict the results of the diachronic burnt area mapping over Greece for the last 32 years (1984 to 2015) by implementing a fully automated processing chain for burnt area mapping, which is based on the exploitation and analysis of the full USGS archive of Landsat TM images, since the first satellite image was ever recorded over Greece.



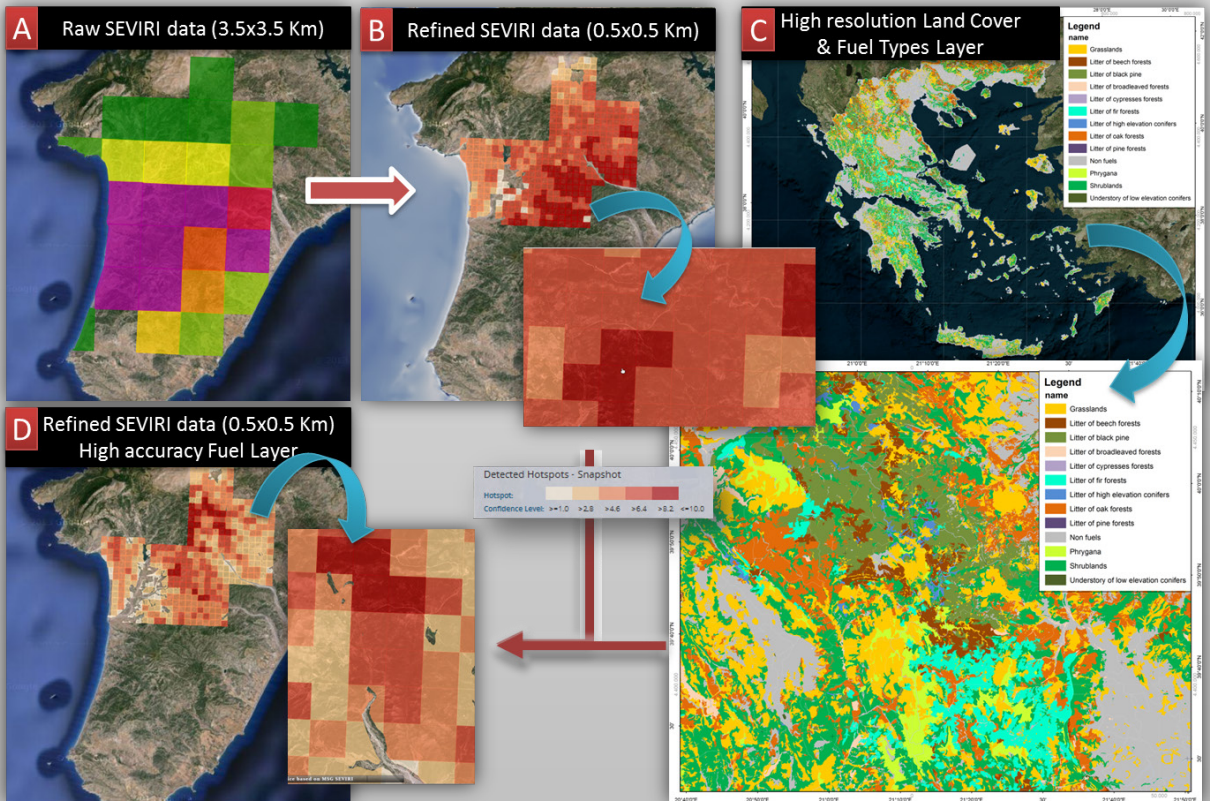
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## The FireHub Tool: NOA EO-based Fire Related Services in the framework of BEYOND

H. Kontoes, Th. Herekakis, V. Tsironis, I. Papoutsis, S. Solomos, E. Ieronymidi, and V. Amiridis

Here we describe the greatest novelty of Firehub which stems from its ability to accommodate both the needs for high space resolution data and monitoring frequency, with the least possible processing cost. It's been a long time since the scientific fire community is trying to address the wildfire phenomena using RS techniques and GIS to effectively support the decision-making process. Although, RS is a powerful tool for generating and visualizing situation awareness pictures in DRM, its limitations in performing complex near real time data analysis at fine spatial resolution scales, requires powerful downscaling methods, integration of multisource spatial data and robust web based dissemination. For example a fine grained and real-time fire monitoring system like the corresponding module in Firehub has to cope with a specific trade-off which is consisted from the following dilemma: either receive high resolution satellite images or receive more frequently but of a lower resolution satellite images for a specific Area of Interest (AOI). Such a system is bound to choose the frequency offered by low and medium resolution satellite sensors, and alleviate the resolution problem by applying a downscaling methodology, that is improving the spatial resolution or the raw satellite observation. Firehub achieves to provide real time fire monitoring, every five minutes, and in the same time to improve the spatial resolution of the MSG SEVIRI satellite images by about 50 times, namely returning fire occurrence information in cells of 500m x 500m wide, without compromising the system's response time (i.e. it provides a new observation every 5 minutes).



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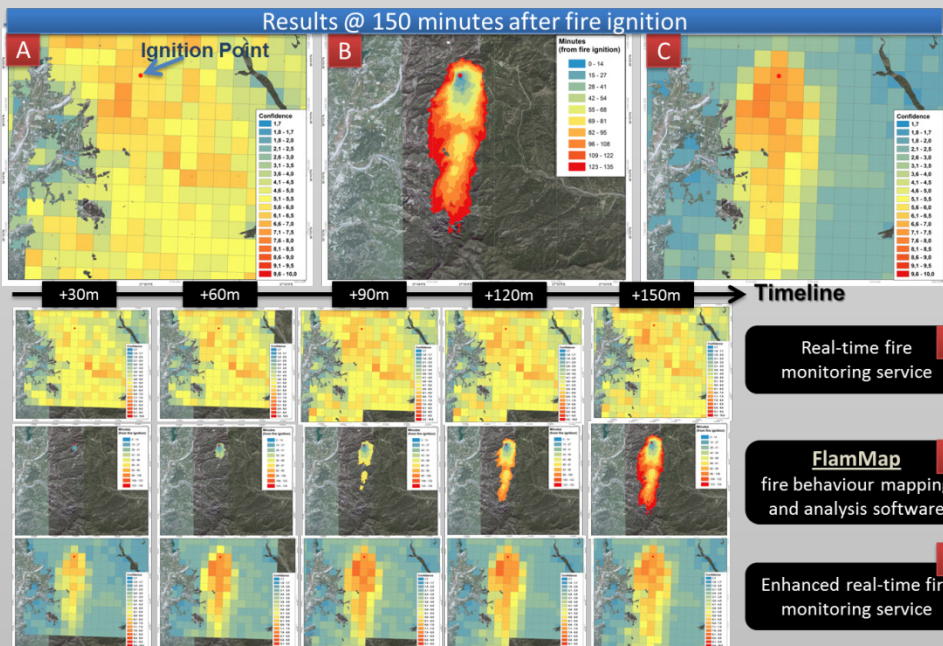
## The FireHub Tool: NOA EO-based Fire Related Services in the framework of BEYOND

H. Kontoes, Th. Herekakis, V. Tsironis, I. Papoutsis, S. Solomos, E. Ieronymidi, and V. Amiridis

Firehub, in order to achieve the aforementioned downscaling, is using auxiliary thematic and GIS information with higher space resolution, which subsequently combines with the ingested raw images of MSG SEVIRI. Firehub integrates three geo-spatial layers:

- A novel fuel map which contains information about the type and density of any fuel type, generated through the combination of forest/ecosystem vegetation geo-spatial layers with expert knowledge on fuel modelling using fuel physical and chemical properties. To this end, specific fuel proneness to fires data, resulted from the long term analyses (more than 30 years of analyses) of fire regimes conducted by the IAASARS/NOA team are used.
- A topography layer created using Digital Elevation Map (DEM) data either from the ASTER Global DEM, and/or any other existing DEM available for use at national/regional level, extracting the necessary buffers of altitudinal zones, along with slope magnitude and slope direction (aspect) data for the forested zones affected and/or threatened by the occurring fires
- A meteorology layer ingesting to the system dynamic meteorological forecasts for the next hours of up to a couple of days relevant to wind speed and wind direction in the AOI, so as to escalate the resolution of the raw observations.

Exploiting these geo-spatial ancillary data in conjunction with the satellite observations through complex modelling the system succeeds in providing on a 5-minute basis, and with a time interval of less than 6 seconds after the satellite image acquisition, a first level classification of the fire / non-fire pixels, but also a much finer grained classification of fire occurrence in sub-pixels of 500mx500m wide, improving that way the raw MSG SEVIRI observation by about 50 times (to be noted that the raw spatial resolution of MSG/SEVIRI over SE Europe is approximately 3.5km).



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## The FireHub Tool: NOAA EO-based Fire Related Services in the framework of BEYOND

H. Kontoes, Th. Herekakis, V. Tsironis, I. Papoutsis, S. Solomos, E. Ieronymidi, and V. Amiridis

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To be noted that in the framework of BEYOND much attention has been also given to further evaluate and improve the effectiveness, and reliability of the Firehub tool. A large number of Earth Observation (EO) images of different spectral and spatial resolutions are systematically being processed to derive thematic products that cover a wide spectrum of fire management applications in the pre-, during- and post-fire crises, ranging from fire detection, fire monitoring and rapid mapping, up to damage assessment. The X-/L-band station recently acquired and operated by the BEYOND Center of Excellence receives medium and high resolution images from a multitude of satellite missions as MODIS, NPP, MetOp, NOAA/AVHRR, FY. At the same time the first mirror site (Collaborative Data Hub) of the Sentinel missions established at the premises of NOA allows direct access in near real time to all Sentinel data acquired over SE Europe, North Africa, and Middle East. With these new observational capacities and the relevant image products generated on a routine basis, new assimilation techniques, and validation mechanism for the Firehub tool have become available for a more credible fire spots detection and fire evolution assessments time during crisis.

The improvement of the Firehub platform and the ongoing development is expected to contribute substantially to judicial wildfires management. Countries with climate similar to that of Greece (e.g. Mediterranean countries) which suffer from wildfires phenomena, especially during the summer season, may benefit a lot from a system that is fully operational and can function autonomously, namely without further processing and with the minimum human intervention. The local and civil protection authorities will be able to design and apply finer disaster management plans and thus to minimize or even to eliminate the risk of human losses and its social impact, as well as to protect the economy and the environment. For example, by using the Burn Scar Mapping module of Firehub the local authorities are able to map each area's proneness to fire and thus to generate a more sophisticated contingency plan depending on each area's risk, but even better to preempt a disaster according to that plan. In the same way the responsible authorities may exploit the other modules of Firehub in order to refine their decision making process and provide qualitative services to the civilians.

**FireHub URL:** <http://ocean.space.noa.gr/FireHub>





## Flood mapping and modelling in the framework of BEYOND Center of Excellence

Alexia Tsouni, Emmanouela Ieronymidi, Charalambos Kontoes

### 1. INTRODUCTION

Flood events are the world's most frequent natural disasters affecting a large number of people and assets. The European Union Floods Directive 2007/60/EC [1] defines flood as 'the temporary covering by water of land not normally covered by water'. This includes floods from rivers, mountain torrents, Mediterranean ephemeral water courses, and floods from the sea in coastal areas, and may exclude floods from sewerage systems. Human activities, such as agriculture, urban development, industry and tourism, but also climate change, contribute to an increase in the likelihood and adverse impacts of flood events. It is thus important to establish flood risk management plans focused on prevention, protection and preparedness.

### 2. BEYOND CENTER OF EXCELLENCE FOR FLOOD MONITORING

The ultimate goal of the flood hazard activities in BEYOND Centre of Excellence [2], run by the National Observatory of Athens, is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. In this direction, we develop products and services, using both earth observation and in-situ data, as well as modelling, in a complementary and coordinated manner.

### 3. PRODUCTS AND SERVICES

#### 3.1. The Floods Observatory

In the context of the implementation of BEYOND, NOA has established the Floods Observatory (Figure 1) [3] where we register all the major flood events in Greece and south-eastern Europe, and we publish the flood mapping results produced following the process and photointerpretation of satellite optical and radar images.

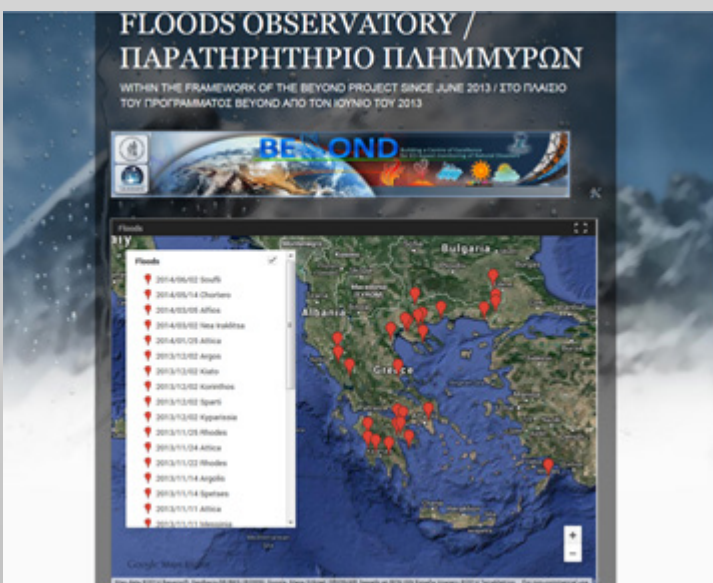


Figure 1: The Floods Observatory within the framework of the BEYOND project.

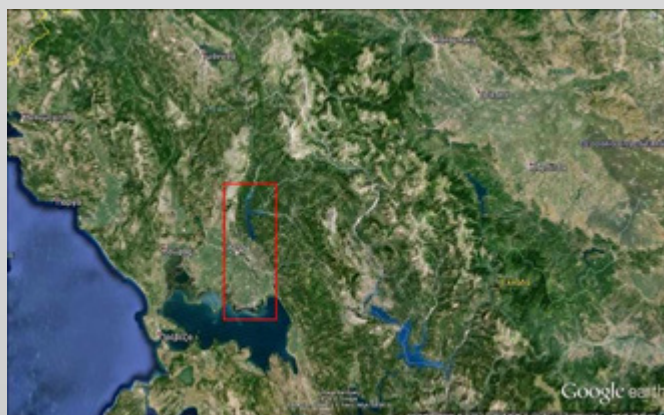
## Flood mapping and modelling in the framework of BEYOND Center of Excellence

Alexia Tsouni, Emmanouela Ieronymidi, Charalambos Kontoes

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.

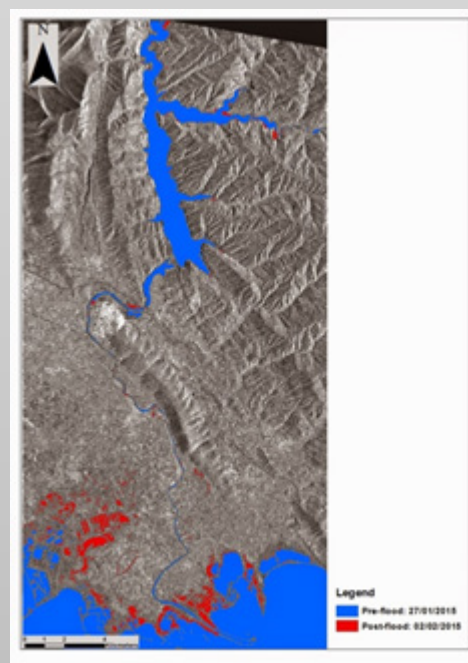
Mapping activities have been greatly improved recently with the exploitation of data from the Sentinel family of satellites, an ESA-Copernicus venture, after NOA signed an agreement with the European Space Agency to install a Mirror Site for the collection, management, processing and distribution of Sentinel data and products. This Mirror Site provides us with satellite images of high resolution and high frequency on a near real-time basis; therefore the mapping of the flood extent is more possible than ever before in our area of interest through elaborated algorithms and processing chains which are under development in BEYOND.

A case study presented here is the recent flood event of Arachthos river in western Greece on 1st February 2015. Our area of interest for studying the flood event of 01/02/2015 is depicted in red in Figure 2. Sentinel-1 C-band SAR images (Interferometric Wide Swath mode) were available before and after the flood, so the best suited pair of images was selected; one image acquired before the flood on 27/01/2015, and one after the flood on 02/02/2015. Following image processing and photointerpretation, we mapped the flood extent in Figure 3 and in detail in Figures 4 and 5.



**Figure 2:** Area of interest in the Arachthos river basin.

**Figure 3:** Pre-flood water extent in blue, post-flood water extent in red. Background images: Sentinel-1 C-band SAR images (Interferometric Wide Swath mode) on 27/01/2015 (before the flood) and 02/02/2015 (after the flood).

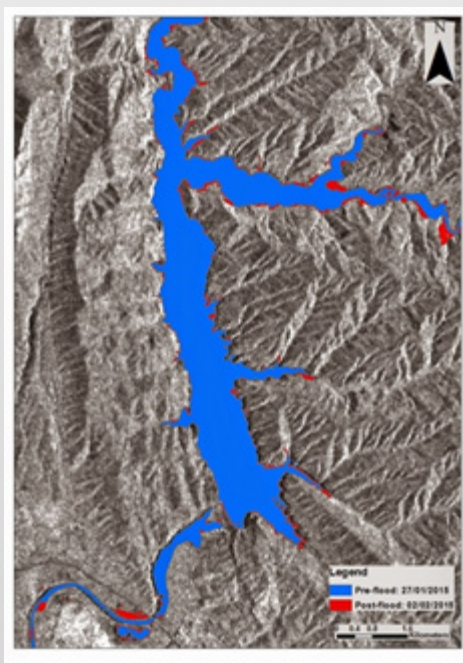


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## Flood mapping and modelling in the framework of BEYOND Center of Excellence

Alexia Tsouni, Emmanouela Ieronymidi, Charalambos Kontoes



**Figures 4(left) and 5 (up):**

Focus on two regions in detail. Pre-flood water extent in blue, post-flood water extent in red. Background images: Sentinel-1 C-band SAR images (Interferometric Wide Swath mode) on 27/01/2015 (before the flood) and 02/02/2015 (after the flood).

### 3.2 Floods Early Warning System

The main factors affecting floods are the following: rainfall intensity and duration; characteristics of the river and the basin (area, shape, slope, soil type and land use), antecedent conditions, extreme temperature, drainage systems and river (or generally water resources) management. In the framework of the BEYOND project, we select river basins at high risk of flooding, we study the hydrology and the hydraulic behaviour of the river, and we proceed to the flood modelling, validation and enhancement with the integration of satellite optical and radar data.

In this direction, NOA has established cooperation with the Public Power Corporation S.A. Hellas (PPC S.A.) [4], as there is a mutual interest in the field of studying floods and developing a methodology for monitoring and management of flood risks, ultimately by creating an early warning system for floods. 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. This cooperation allows the improved adjustment and calibration of the hydrologic and hydraulic models which are operated by NOA, as well as the development of a methodology that will provide reliable products and services to PPC S.A..

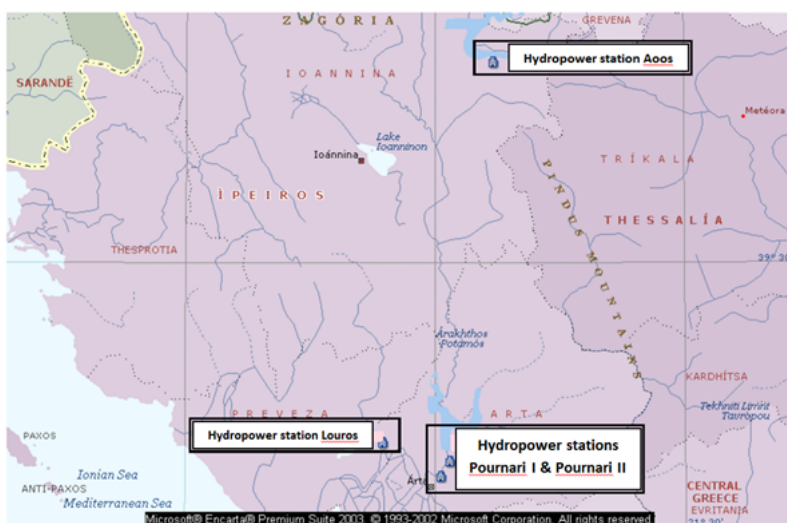
Our first area of interest is Arachthos river basin in western Greece (surface 1.850 km<sup>2</sup>), a river with several flood events, where PPC S.A. is operating two hydroelectric plants, just upstream of the city of Arta: a large one known as Pournari I (effective capacity of reservoir 303 million m<sup>3</sup>) and a smaller one known as Pournari II (effective capacity of reservoir 4 million m<sup>3</sup>) (Figure 6).

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## Flood mapping and modelling in the framework of BEYOND Center of Excellence

Alexia Tsouni, Emmanouela Ieronymidi, Charalambos Kontoes

### Hydropower Complex of Arachthos



PUBLIC POWER CORPORATION S.A.  
GENERATION DIVISION / HYDROELECTRIC GENERATION DEPARTMENT

**Figure 6:**

Map showing Arachthos river and the city of Arta in western Greece, as well as the location of the two hydroelectric plants of the Public Power Corporation S.A. Hellas: Pournari I and Pournari II.

#### 4. CONCLUSIONS

Flood monitoring and forecasting is crucial to flood risk management, especially in reducing the impact of floods. The European Floods Awareness System [5] is an early flood warning system on European level, but it can only be complimentary to national and regional systems. Flood warning is a Member State responsibility, and, anyway, Member States are committed by the Floods Directive 2007/60/EC. Flood mapping and modelling are essential on national and regional basis, and earth observation offers increasing possibilities. BEYOND develops high quality products and services of added value for mapping and modelling floods, based on the use of satellite optical and radar data in combination with in-situ hydrometeorological measurements, efficient earth observation technologies and hydrological & hydraulic models, as well as long-term expertise in the field.

#### References:

1. Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks. Official Journal L 288, 06/11/2007, P. 27–34. Available at: [http://ec.europa.eu/environment/water/flood\\_risk](http://ec.europa.eu/environment/water/flood_risk).
2. Building a Centre of Excellence for Earth Observation based monitoring of Natural Disasters (BEYOND). Available at: <http://beyond-eocenter.eu>.
3. Floods Observatory. Available at: <http://ocean.space.noa.gr/BEYONDsite/index.php/floods/floods-observatory>.
4. Public Power Corporation S.A. Hellas. Available at: <https://www.dei.gr/en>.
5. European Floods Awareness System. Available at: <http://floods.jrc.ec.europa.eu/home.html>.



## EO-based System for monitoring the Urban Thermal Environment

Iphigenia Keramitsoglou, Panagiotis Sismanidis, and Chris T. Kiranoudis

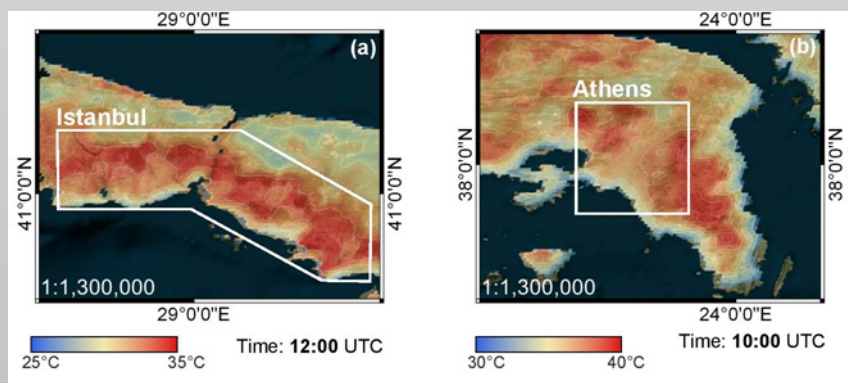
In recent years the urban thermal environment has adversely changed due to the processes of urbanization and industrialization. One of the most profound effects induced is the urban heat island (UHI) phenomenon, which refers to the increased temperature of the urban areas with respect to their suburban/rural surroundings. UHI has received significant attention in recent years, since it affects more than 50% of the world's population and increases the duration and magnitude of heat waves. However, many research efforts have been limited or hampered by the lack of the appropriate high spatiotemporal urban temperature data. In the framework of BEYOND project, the Institute of Astronomy, Astrophysics, Space Applications, and Remote Sensing of the National Observatory of Athens has developed a EO-based service that spatially enhances Land Surface Temperature (LST) data retrieved from the geostationary MSG-SEVIRI EUMETCast station in real-time. The system utilizes a large number of datasets, such as the Digital Terrain Model, CORINE land cover, MODIS vegetation indices and emissivity maps among others. The system has been designed specifically to facilitate urban climate studies, by producing LST datasets that combine high spatial and temporal resolution.

This activity is developed towards attaining the objective to derive urban biophysical parameters for characterizing urban land surface-atmosphere, as defined by the Group on Earth Observations, Task SB-04 Initiative. The system offers four significant advantages:

- a) it exploits the high temporal resolution of SEVIRI imagery,
- b) it enhances the spatial resolution of the retrieved LST data down to 1 km (the overall goal is 100 m),
- c) it covers a large number of cities around the world, and
- d) the derived LST data are available in real time and online.

Currently, no Earth Observation system provides data with adequate spatial and temporal resolution for studying and monitoring the surface UHI phenomenon. The wealth of information revealed can be useful to a range of applications, most notably heat-wave risk assessment. Furthermore, the optimized exploitation of the data could be tailored for different purposes, with several different end-users such as urban climate modelers, health responders and energy demand suppliers.

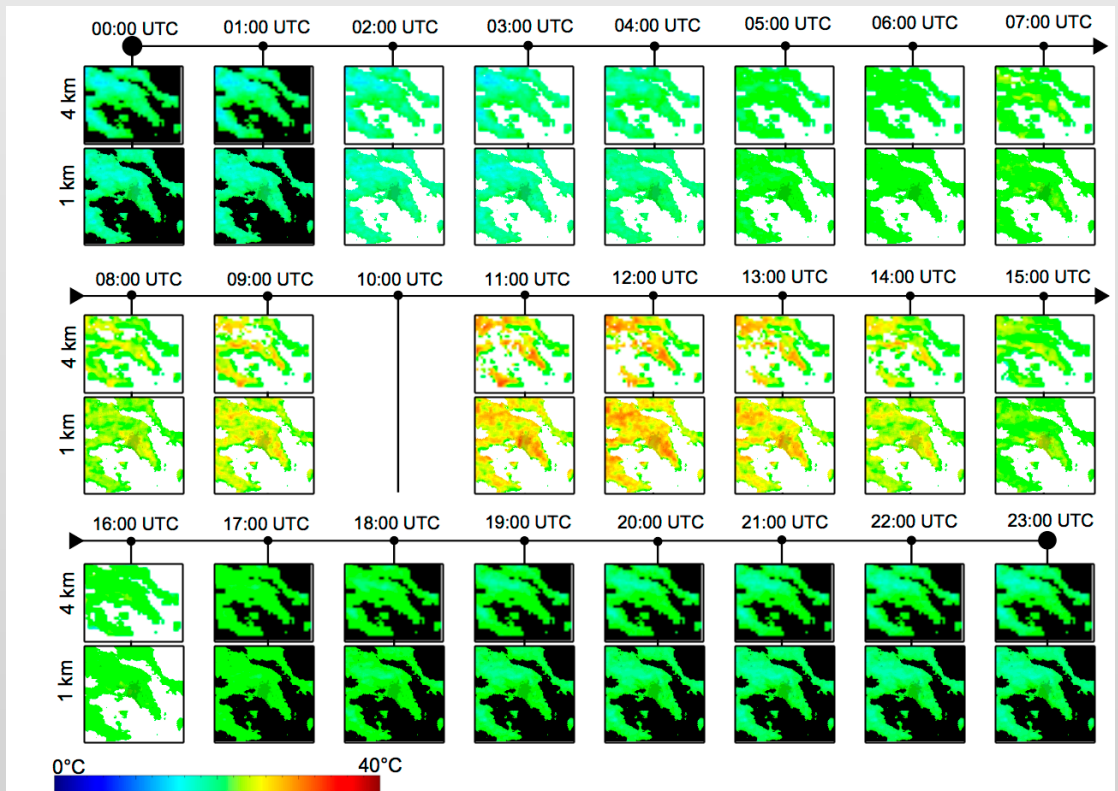
### Figures



**Figure 1:** The SUHI spatial patterns as observed by NOA/IAASARS system for Athens, Greece, and Istanbul, Turkey

## EO-based System for monitoring the Urban Thermal Environment

Iphigenia Keramitsoglou, Panagiotis Sismanidis, and Chris T. Kiranoudis



**Figure 2:** An example of the hourly LST evolution for the city of Athens on as resulted from the NOA/IAASARS system. The LST data are presented at a spatial resolution of  $\sim 4$  km, which corresponds to the MSG-SEVIRI raw geometry, and at a spatial resolution of 1 km as derived after the application of the system's downscaling algorithm. The local coordinated universal time (UTC) is UTC+2.





**Monitoring geophysical activity from Space,  
in the framework of BEYOND Center of Excellence**  
**Ioannis Papoutsis<sup>1</sup>, Christina Psychogyiou<sup>1</sup>, Nikos Svigkas<sup>1</sup>, Maria Kaskara<sup>1</sup>, Charalampos Kontoes<sup>1</sup>,  
Athanasios Ganas<sup>2</sup>, Vassilis Karastathis<sup>2</sup>, George Balasis<sup>1</sup>, Aggeliki Barberopoulou<sup>1</sup>**

- 1. Institute of Astronomy, Astrophysics, Space Applications & Remote Sensing, National Observatory of Athens
- 2. Institute of Geodynamics, National Observatory of Athens

A major objective of BEYOND Centre of Excellence is the operational monitoring of geohazards in Southeastern Europe. BEYOND primarily builds upon state-of-the-art optical remote sensing technologies and differential interferometry techniques. The resulting products are integrated with in-situ observations from the National Seismological Network, and the NOANET GPS network established at the National Observatory of Athens, to monitor the geodetic activity in Greece and beyond, interpret geophysical phenomena, assess and map damages after catastrophic events. Additionally, the ENIGMA magnetometer network is used in an attempt to address the issue of earthquake predictability by studying electromagnetic signals attributed to the coupled lithosphere-atmosphere-ionosphere system as one of the most promising potential pre-seismic transients.

Characteristic examples of services offered in the framework of BEYOND will be highlighted, to address different phenomena and processes in Greece. Three thematic pillar services are offered on a systematic basis, namely ground deformation estimation following catastrophic earthquakes, time-series analysis for mapping ground velocity patterns and signals in large scale and damage assessment using UAV technology for prompt response during or immediately after a crisis.

Persistent scatterer techniques are employed for a number of test sites. Firstly we discuss the 2011-2012 volcanic unrest in Santorini volcano. Using Envisat data, up to 15 cm/yr line-of-sight uplift was observed in the highly touristic villages of Fira and Imerovigli. Since February 2012, when the rapid episode ceased, the latest InSAR and GPS data show a significant decline in the observed displacements, signaling a new phase of relative stability for the island complex. At the moment, TerraSAR-X and COSMO-SkyMed data are being used to ensure the seamless monitoring of Santorini.

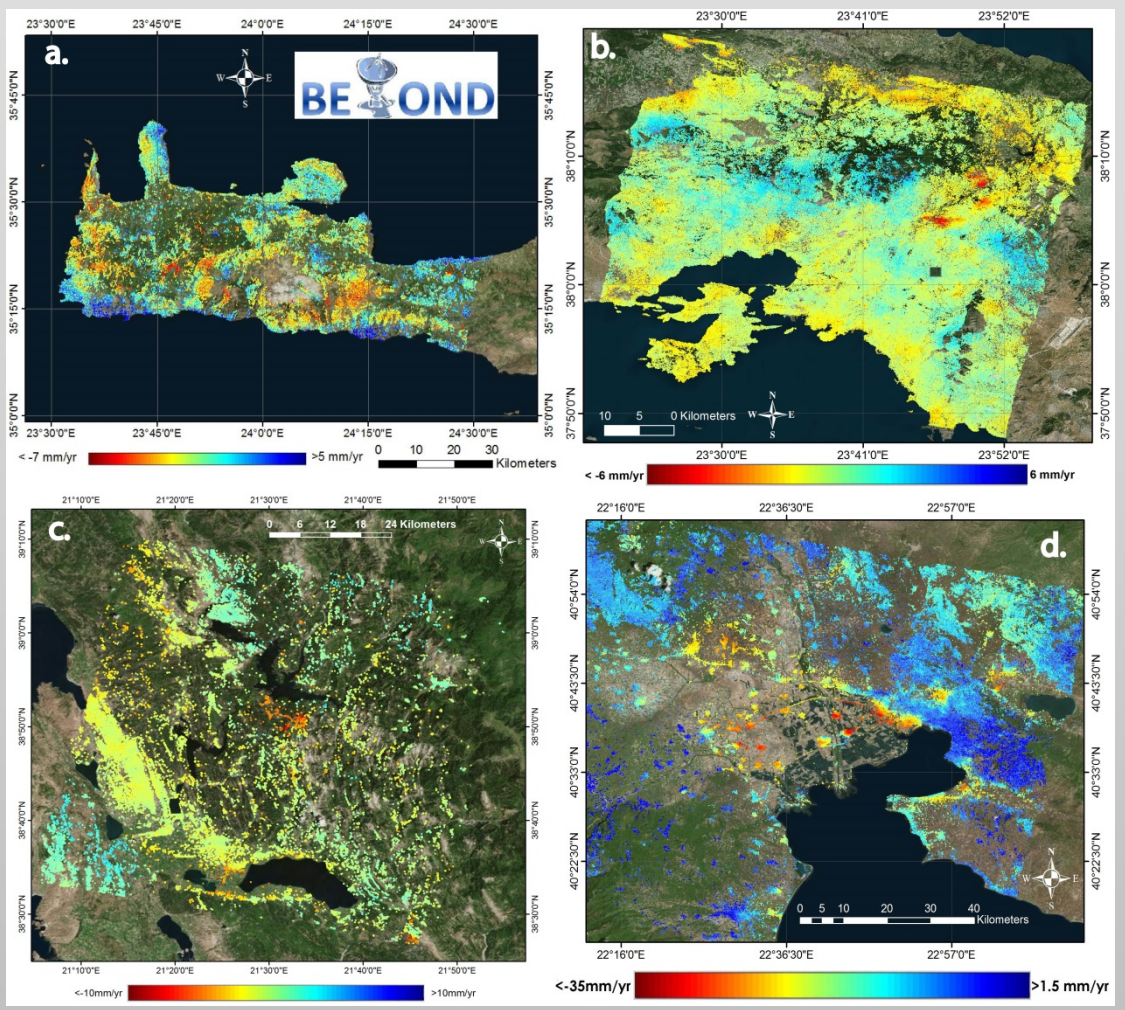
Several Greek cities are analyzed by mapping diachronic surface displacements and showcasing the significance of accurate and consistent monitoring of subsidence in an urban environment. The displacement rate field for the wider Athens metropolitan area is estimated for the 1992-2010 period using ERS and Envisat data with two adjacent and overlapping descending tracks and one ascending track. The extended spatial coverage of the ground velocity maps provide valuable information for the local displacement patterns, a benchmark for surface deformation studies in the region. Decomposition to vertical and horizontal components reveals zones of horizontal motion with opposite direction near the Athens 1999 earthquake epicenter (Mw 5.9), relating to strain accumulation. This motion pattern is not seen during the 2002-2010 period. In Thessaloniki, situated in a tectonically active environment, mainly characterized by normal faulting with a roughly E-W striking, we process ESA imagery for the 1992-2010 period. Results indicate deforming areas such as Kalochori at the western part of the city, suffering from extensive land subsidence phenomena (over 15 mm/yr), and Athemountas basin at the eastern part, where the "Macedonia Airport" lies, delimited by potentially active and active tectonic structures. Observed surface deformation in Athemountas follows known fault networks, providing new information for the geohazard characteristics of the area. Finally, Volos city in Central Greece is investigated to examine the seasonal deformation patterns close to irrigated lands.

## Monitoring geophysical activity from Space, in the framework of BEYOND Center of Excellence

**Ioannis Papoutsis<sup>1</sup>, Christina Psychogyiou<sup>1</sup>, Nikos Svigkas<sup>1</sup>, Maria Kaskara<sup>1</sup>, Charalampos Kontoes<sup>1</sup>,  
Athanasios Ganas<sup>2</sup>, Vassilis Karastathis<sup>2</sup>, George Balasis<sup>1</sup>, Aggeliki Barberopoulou<sup>1</sup>**

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The Southern part of mountain range Pindus, the “backbone” of Greece’s mainland, is also investigated to detect slow moving landslides and to update landslide susceptibility maps towards hazard estimation. Due to the mountainous and vegetated setting of the area of interest, PSI processing is demanding. The integrated geo-information, namely PSI velocity rate maps and time-series displacements with in-situ observations, reveal areas prone to landslides, their activity and intensity state, movement type, as well as their cause and frequency of occurrence. A fully updated landslide inventory map is developed for two regional units, Evrytania and Aetolia-Acarnania, (4000km<sup>2</sup>) located in Central and Western Greece respectively.



**Figure 1:** Ground motion maps using PSI for several case studies in Greece: a. Crete, b. wider Athens, c. South Pindus, and d. wider Thessaloniki



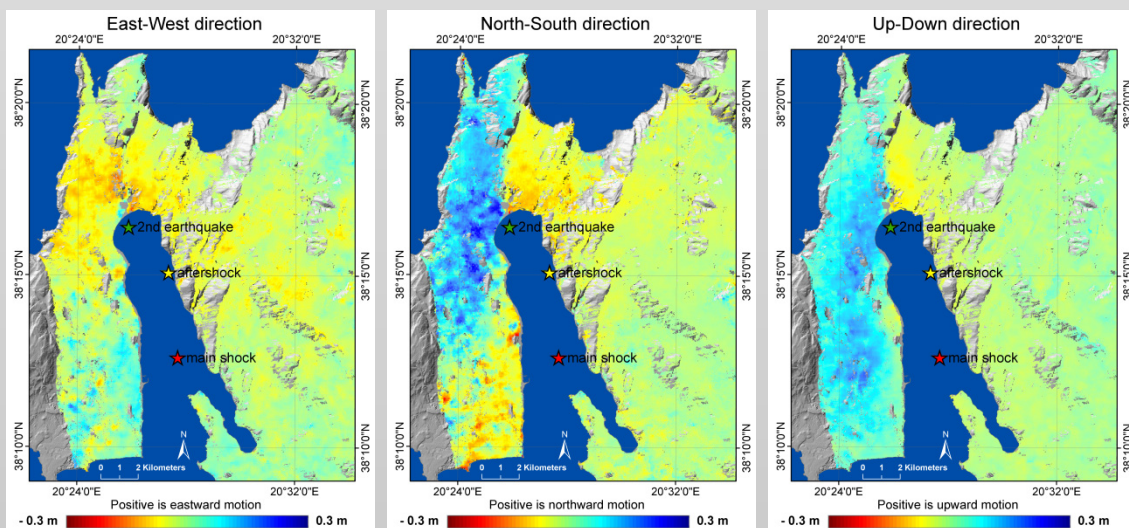
## Monitoring geophysical activity from Space, in the framework of BEYOND Center of Excellence

**Ioannis Papoutsis<sup>1</sup>, Christina Psychogyiou<sup>1</sup>, Nikos Svigkas<sup>1</sup>, Maria Kaskara<sup>1</sup>, Charalampos Kontoes<sup>1</sup>,  
Athanasios Ganas<sup>2</sup>, Vassilis Karastathis<sup>2</sup>, George Balasis<sup>1</sup>, Aggeliki Barberopoulou<sup>1</sup>**

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The boundary between the Eurasian plate and the African plate is widely referred to as the Hellenic Arc. It is an arcuate tectonic feature of the Eastern Mediterranean Sea related to the subduction. Crete is part of the non-volcanic arc characterized by high seismicity (highest in Europe), and capable of producing M8+ earthquakes. We process ERS and Envisat imagery to derive the ground velocity regime in the island of Crete. Uplift associated with the plates convergence is observed in the south and southwest of the island. The geodynamic implications of this process are further discussed.

Another example service is the derivation of the 3D surface deformation field associated with the Mw 5.9 Feb. 3, 2014 earthquake that struck the island of Cephalonia, Greece, based on the application of three independent measurement techniques to SAR acquisitions from the COSMO-SkyMed satellites and the TanDEM-X satellite. Exploiting sensor diversity we were able to reconstruct the 3D surface deformation field associated with the Cephalonia and to characterize the seismogenic sources of this region.



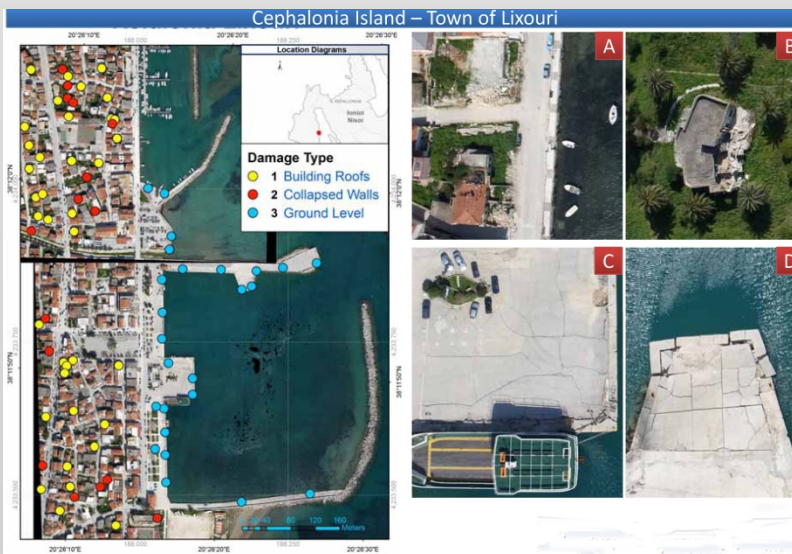
**Figure 2: Cephalonia 3D deformation after the 3/2/2014 earthquake**

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Last, a key service is the fast and accurate post-earthquake damage assessment using a UAV. BEYOND flew in Cephalonia a mission over of the urban area of Lixouri, five semi-urban areas and two rural areas. Orthorectified imagery was imported to a GIS and earthquake related damages were detected and classified. Three types of damages were monitored via simple ortho-interpretation: damages a) on ground level such as damages on roads, harbor infrastructure, cemeteries etc. and also small landslides, b) on walls and c) on roof-tops.



**Figure 3:** Mapping damages in Cephalonia, using UAV technologies

**References:**

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## Atmospheric activities in the framework of BEYOND

V. Amiridis, S. Solomos, H. Kontoes, E. Marinou, A. Tsekeri, T. Herekakis, S. Nickovic

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The research portfolio of BEYOND includes a cluster of activities related to the atmosphere. Ranging from the development of high quality ground-based remote sensing infrastructure for cal/val purposes to the assimilation of space-borne observations on atmospheric models, the activities focus on the development of high-quality services related to atmospheric hazards.

In this presentation, the following components of the atmospheric BEYOND cluster will be presented and discussed:

- a) The LIVAS aerosol and cloud climatological archive developed and optimized based on 3D CALIPSO observations. The climatology covers a wide spectral range from UV to NIR, at 355 nm, 532 nm, 1064 nm, 1.57  $\mu\text{m}$  and 2.05  $\mu\text{m}$ . The optical properties at the different wavelengths are calculated from CALIPSO measurements at 532 nm and aerosol-type-dependent spectral conversion factors for backscatter and extinction derived from EARLINET ground-based measurements for the UV and scattering calculations for the IR wavelengths, using a combination of input data from AERONET, suitable aerosol models and recent literature. The LIVAS climatology is freely available under the BEYOND url: <http://ocean.space.noa.gr/BEYONDsite/index.php/atmospheric/3d-livas>, where the database is stored and exposed (Figure 1). The webpage provides the complete information on the methodological approaches and instructions on portal's usage. The data are provided in ASCII and netcdf formats, while brief statistics and quick-view charts are projected online.



**Figure 1:** The LIVAS web-portal.

- b) The development of a sophisticated ground-based PollyXT lidar system and its operation on a 24/7 basis. The system will be installed in the station of Finokalia in Crete, aiming to monitor advection of air pollutants from remote sources (e.g. Sahara desert, forest fires and volcanic eruptions). This installation provides unique opportunities for effective aerosol characterization in the Eastern Mediterranean and cal/val activities related to European Sentinel and Earth Explorer missions.
- c) Development of fire smoke and volcanic ash atmospheric dispersion models based on space-borne observations. The first version of wild fire smoke forecast service is installed in BEYOND and is operational since July 2014. Smoke dispersion is included in the integrated FireHub processing chain. Detailed ignition, duration and locations of the fire spots are obtained in five (5) minutes intervals from the MSG SEVIRI instrument. Smoke dispersion is computed with the Lagrangian dispersion model FLEXPART driven by WRF-ARW meteorological fields at a resolution of 4x4 km over Greece. Hourly updated forecasts are available online: <http://ocean.space.noa.gr/BEYONDsite/index.php/fires/fire-smoke-dispersion>.

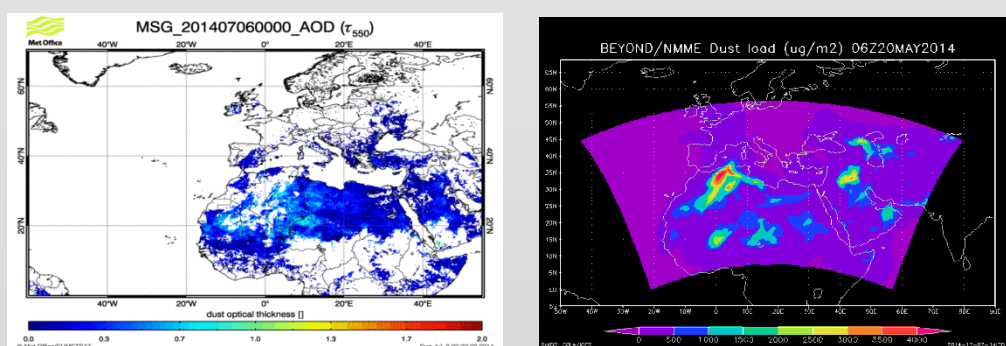
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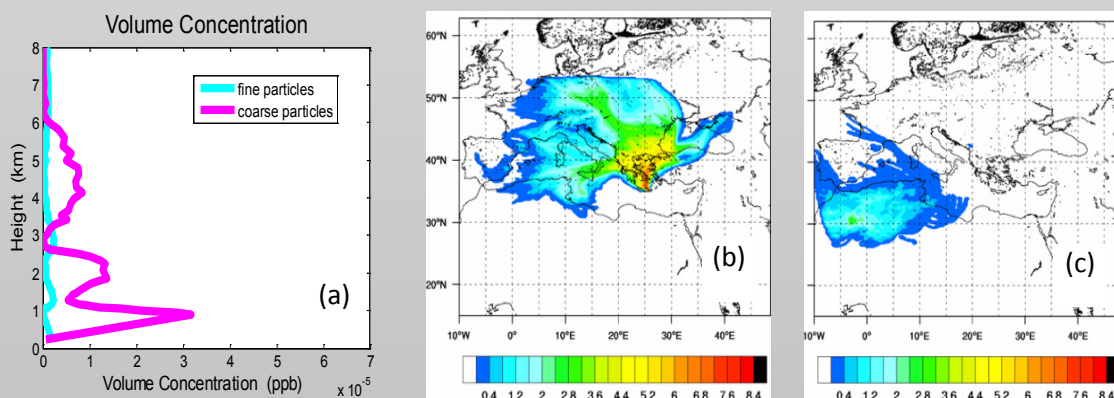
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- d) Development of a dust model coupled with real-time MSG-SEVIRI dust retrievals through advanced assimilation techniques. In this approach we attempt to derive dust fields from SEVIRI instrument (Figure 2a) and use it as initial conditions for the NMME dust forecasts (Figure 2b). This service is still under development and first results are evaluated towards the CHARADMEp campaign dust measurements in Crete, Greece. Dust model with and without assimilation of MSG-SEVIRI dust retrievals is used for the description of dust transportation towards Crete and the possible benefits of assimilation techniques are discussed based on lidar ground-truth data.



**Figure 2:** a) Example of dust optical thickness as provided by U.K. Met Office dust product on 6 July 2014. b) Example of BEYOND/NMME dust load forecast.

Finally, we present some synergistic applications incorporating several atmospheric BEYOND components. As seen in Figure 3, characterization of the observed aerosols during the CHARADMEp experimental campaign is provided from advanced lidar inversion algorithms and the origin of the particles is determined from detailed source-receptor analysis using WRF and FLEXPART models.



**Figure 3:** Aerosol particle characterization during the CHARADMEp campaign: (left) -Concentration profiles for fine and coarse particles derived with advanced lidar inversion algorithms and (right) – Origin of the particles in the profile for the layers 0-1 km and 3-6 km, respectively), derived with source receptor analysis modelling.





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# BEYOND

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

# BE OND

## EGU 2015 BEYOND Splinter Session

**BEYOND** aims to maintain and expand 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, with a prospect to increase its access range to the wider Mediterranean region through the integrated cooperation with twinning organizations .



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