



A watchful eye

By developing existing regional capacities, the BEYOND project is playing a key role in progressing knowledge about monitoring and managing natural disasters, significantly advancing the development of a Centre of Excellence in disaster monitoring

Impact Objectives

- Enhance research capacity by establishing sustainable strategic partnerships
- Boost innovative cutting-edge research in the natural hazards monitoring field
- Set up a Centre of Excellence with high quality space-based and in situ observational capacities and networks

At the heart of the efforts to regionalise the south-eastern European knowledge on how natural disasters can be better predicted, how these impact on communities and infrastructure, and, ultimately, how resultant risks can be reduced is BEYOND (Building a Centre of Excellence for Earth Observation based monitoring of Natural Disasters) led by the Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing of the National Observatory Athens (IAASARS/NOA). It is hoped that BEYOND, which revolves around space-based monitoring, will deliver new solutions to coordinating networks of space-borne and ground-based monitoring of environmental and natural disasters in a complementary and unified manner.

BEYOND Research Director Dr Charalabos Kontoes, who is based at IAASARS/NOA, explains that BEYOND's portfolio of services relates to a variety of natural disaster phenomena, which they have conceptually divided into three main categories: disasters related to extreme weather conditions, such as forest wildfires, severe floods and heatwave extremities over the urban environment; disasters related to the disturbed quality of the atmospheric environment; and geophysical hazardous phenomena such as earthquakes, volcanoes and landslides. The approach to removing barriers to the exploitation of observation

databases on these wide-ranging natural disaster phenomena is three-pronged, and involves capacity building across all levels, fostering of high-profile relationships, and consolidating some of the most up-to-date technical equipment available. This is all about understanding what technology already exists for predicting and managing natural disasters and building on these to make them even more effective.

There are a number of goals being pursued by the BEYOND team, including strengthening human capacity, upgrading infrastructure, improving visibility of the project on a regional scale, and improving the capacity for research in the natural disaster field. One of the strengths of BEYOND is that there are key stakeholders and partners supporting the proposal who are not connected with IAASARS/NOA but are leading institutions, particularly with R&D capabilities, and governmental end users as well as the World Meteorological Organization, all of which have robust international connections. These organisations are able to offer guidance and expertise in a range of fields, such as meteorological and manmade hazards, geophysical hazards, atmospheric perturbations and air quality. Kontoes has previously commented that it is important to continue the achievements

and the long-term operations of BEYOND into the future: 'The major efforts in our Centre of Excellence today lie in research for developing new services that are useful for society, and the citizens and the institutional authorities, not only in Greece, but also over Europe.'

HUMAN RESOURCE AND TECHNOLOGICAL CAPABILITIES

By bringing on board experienced researchers who are able to transfer knowledge and build relationships across the European scientific community, and by supporting these researchers to explore study themes that are of particular interest to them, it is hoped that IAASARS/NOA will become a Centre of Excellence in Earth observation-based monitoring systems and technologies. These researchers are focused on a number of key scientific areas including meteorology, atmospheric pollution and air quality, geophysical hazards and human-induced hazards, with a number of staff experienced in using new remote monitoring technologies. For example, a smoke dispersion model expert and LIDAR experts were identified for new positions at the project setup. Achieving this goal will mean that the other objectives can be reached, in particular expansion of the visibility of the team to stakeholders, other research institutions, and government

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departments with an interest in natural disaster management.

Supporting access to advanced hardware and software infrastructure for the scientists is a critical component of the BEYOND project. For such a regional collaborative approach new, cutting-edge hardware and software was recognised as essential. Technologies such as SARscape, SAR imagery, LIDAR, Magnetometer and MODIS were identified early for acquisition. In addition to accessing some of the most high-tech software and hardware available, the project has also supported the training of researchers. A particular focus has been to foster key collaborative linkages through training sessions and staff exchanges which have been achieved through building strong partnerships with other research institutions in the European Research Area.

PROTECTING INTELLECTUAL PROPERTY RIGHTS

A challenge for the team has been protecting the intellectual property (IP) rights for assets that have been developed

in the framework of BEYOND, and ensuring that the researchers have access to legal and technical information on IP issues related to the project. Of importance to this has been the implementation of an IP plan which has guided how the knowledge outcomes and any technology developments, algorithms, services and products are protected. A key part of activating the IP plan has been the way in which the stakeholders were involved in the initiative and how growth across the whole region was to be supported.

Exploitation and dissemination has also been an important component of BEYOND since the project's outset. The driver for this has been to ensure the national, regional and European stakeholders are all aware of the work that is being done and feel empowered to support the project. An exploitation manager was recruited who has been working closely with the project's IT and management staff to disseminate information and activities to regional industry and public stakeholders. One of the main BEYOND dissemination events took place Frascati in October 2015, where

institutional stakeholders, scientists, policy makers and end users were given access to the pre-operational and operational services that BEYOND provides.

Archives and databases of long series of observations have been created which can be accessed by a stakeholders and scientists for their own projects. An example of how BEYOND has been able to enhance the technological capability of its partners and stakeholders is the first version of the BEYOND Collaborative Ground Segment Data Site. This is a web-based technology which enables users to view, search through and download a range of catalogued Earth observation data gathered from satellites. This was released and made publicly available in January 2016. The results speak for themselves. With new skills being integrated through the recruitment of experts and organisations being brought on board as partners, BEYOND has been able to enhance the technological capability of these institutions and support Europe's growing Earth observation monitoring network.

Impact case studies

Through profiling some of the different projects that BEYOND is supporting, we highlight the important role this dynamic project is playing in progressing knowledge about monitoring and managing natural disasters



HOT WORK

The operational monitoring and management of forest wildfires is supported by a BEYOND program called FireHub. This service enables the early detection and real-time monitoring of the active forest fires all over the world. FireHub utilises a cluster of three satellites operated by the European Organisation for the Exploitation of Meteorological Satellites. These satellites send information from all over the planet every five minutes. As Kontoes explains, 'Collecting an image and deriving such information every five minutes returns a situation awareness picture and the evolution of the catastrophic phenomenon over the affected areas in real time.' The FireHub service has delivered a number of products which are supporting managers and researchers all over Europe, including a real-time fire monitoring system, diachronic burnt scar mapping, and fuel maps.



WATER WORLD

'Floods are the most frequent natural disasters worldwide and have an impact on a lot of people and also on the environment, artificial and natural', observes Alexia Tsouni, BEYOND team member. The focus of the BEYOND Floods Observatory is to study the hydraulic behaviour of river basins at high risk of flooding; validate flood modelling; and integrate satellite optical and radar data. All flood events in Greece are now registered at the Floods Observatory, with the information available to users. The Floods Observatory is working closely with partner organisations and stakeholders to support the management of flood-prone areas.



CITY HEAT

The BEYOND team have been helping to advance knowledge about the thermal heat environments resulting from urban areas, specifically surface urban heat islands and heat wave mapping. Their work improves the technologies available to gather land surface temperature measurements in real time so that databases can be more easily accessed by researchers wanting to understand trends in heating of urban environments. An important part of this service area is sharing the knowledge gathered so more people have access to the information.



ROCK SOLID

The generation of new information for ground deformation monitoring events resulting from earthquakes and tectonic and land-sliding activity has enabled better understanding of geophysical hazards. Dr Ionannis Papoutsis, BEYOND Assistant Researcher, says a characteristic example of their work on the Greek island of Santorini, where they observed an increase in micro-seismicity starting from January 2011 onwards. 'Straight away we ordered satellite images from the European Space Agency, a time series of Envisat data covering the 2011–2012 period. We analysed these data and found that Santorini was rising up to 15 centimetres per year in well-known tourist destinations such as the Imerovigli and Fira villages. A second-stage geophysical interpretation answered why we observed such deformation rates.'



OUT OF THIN AIR

Understanding atmospheric composition perturbations and air quality degradation is an essential part of reducing natural disaster risk. The BEYOND team are preparing an improved version of a space-based aerosols assessment service at global level, producing ozone and NO₂ satellite observations and Solar Ultraviolet irradiance. In addition, they have been progressing with a Saharan dust estimation service. Dr Vassilis Amiridis, BEYOND Researcher, says their main objective is the development of an integrated system for monitoring and forecasting Saharan dust outbreaks towards the European continent. 'In the framework of BEYOND, IAASARS/NOA has developed a sophisticated LIDAR system for ground-operation.'



FLYING FREE

The evolution of the unmanned aerial vehicles (UAVs) has allowed researchers to rapidly assess damage from natural hazards across a large area. Following the earthquakes on the Greek island of Kefalonia, the BEYOND team worked closely with a local partner to complete flyovers of a number of urban and rural areas across Kefalonia. Orthorectified images were prepared, which were then organised into a database to enable the detection and classification of damage. The BEYOND researchers are now working on software that automatically generates orthoimages from UAV images, all of which will help support the rapid evaluation of earthquake damage and a faster response for communities.

Project Insights

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PROJECT LEADER BIO

Charlalabos Kontoes, BEYOND Research Director, is based at the Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing of the National Observatory Athens (IAASARS/NOA). After gaining his PhD in Remote Sensing of the Environment, Kontoes has been heavily involved in a number of European Commission and European Space Agency projects focused on using advanced image processing tools to exploit high spatial resolution satellite data. This expertise has seen him participate in a range of important committees and boards for key remote sensing projects, including as National Delegate of the Space Committee of the Framework Programme 7 of the European Commission.

