Floods in BEYOND

Centre of Excellence for

EO-based monitoring of Natural Disasters

Fires & Floods

Urban heat waves

Geophysical hazards

Atmospheric & Weather related disasters

Floods in BEYOND

Plain and flash flood events are the world's most frequent natural disasters affecting a large number of people and assets.

Floods in BEYOND

Factors affecting floods

* 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;

* 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.

European Union Floods Directive 2007/60/EC

The EU Floods Directive "***on the assessment and management of flood risks***" aims to reduce and manage the risks that floods pose to human health, the environment, cultural heritage, economic activity and infrastructure.

Flood is defined as ***'a covering by water of land not normally covered by water'*****.** The Directive applies to inland waters as well as all coastal waters across the whole territory of the EU.

The Directive requires Member States to establish **flood risk management plans focused on prevention, protection and preparedness by 2015**. All assessments, maps and plans prepared shall be made available to the public.

Floods in BEYOND

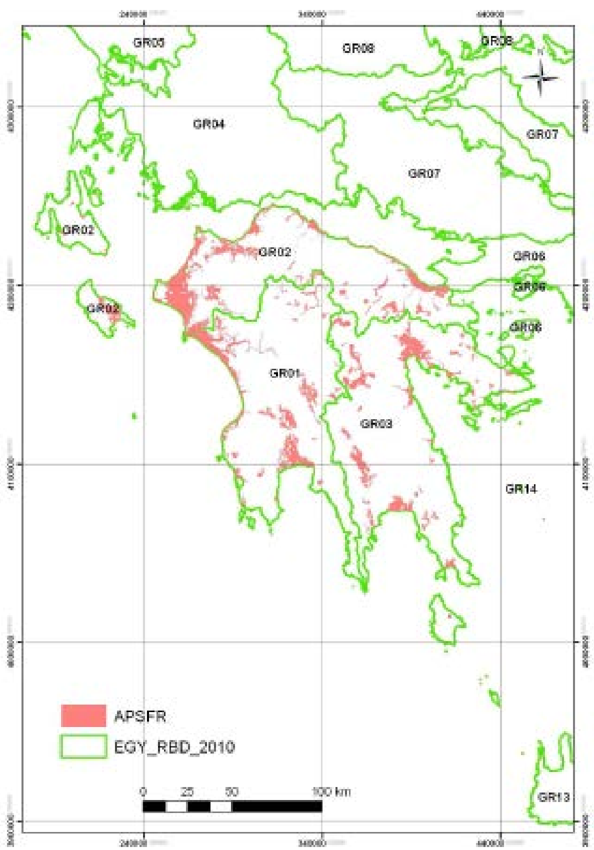
Greece & EU Floods Directive

The Directive has been incorporated into Greek law by the Joint Ministerial Decision H.P. 31822/1542/E103/2010 (GG B 1108/21.07.2010), where the concept of flooding includes flooding caused by disasters of large hydraulic works, such as dams and levees breaks, which are not mentioned in the Directive.

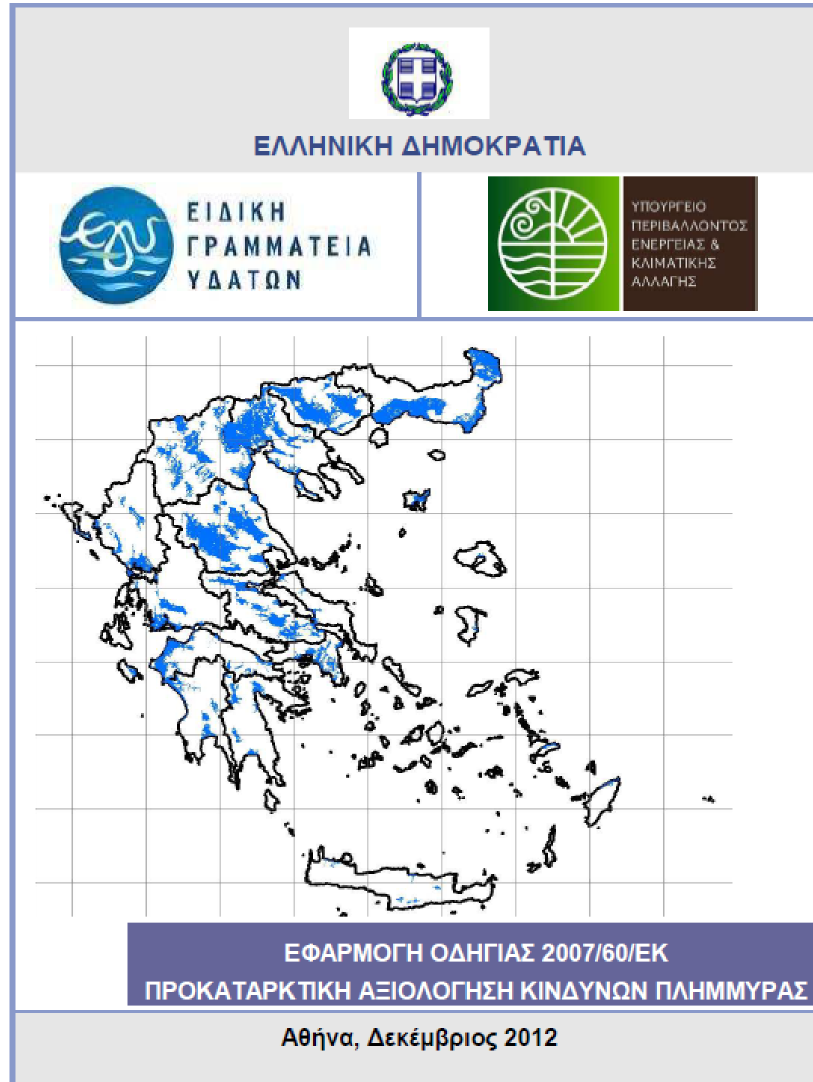
In December 2012 the Special Secretariat for Water of the Ministry of Environment, Energy and Climate Change published the preliminary flood risk assessment for the 14 water districts in Greece. It was based on 1627 floods events at 1076 sites all over Greece. It also provides the database for the registration of flood events, configured to meet the requirements of the Directive 2007/60/EC.

Floods in BEYOND

Greece & EU Floods Directive



Σχήμα 4.2 Περιοχές με Δυνητικά Σημαντικό Κίνδυνο Πλημμύρας (στα GR01, GR02, GR03)



ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ

ΕΙΔΙΚΗ ΓΡΑΜΜΑΤΕΙΑ ΥΔΑΤΩΝ

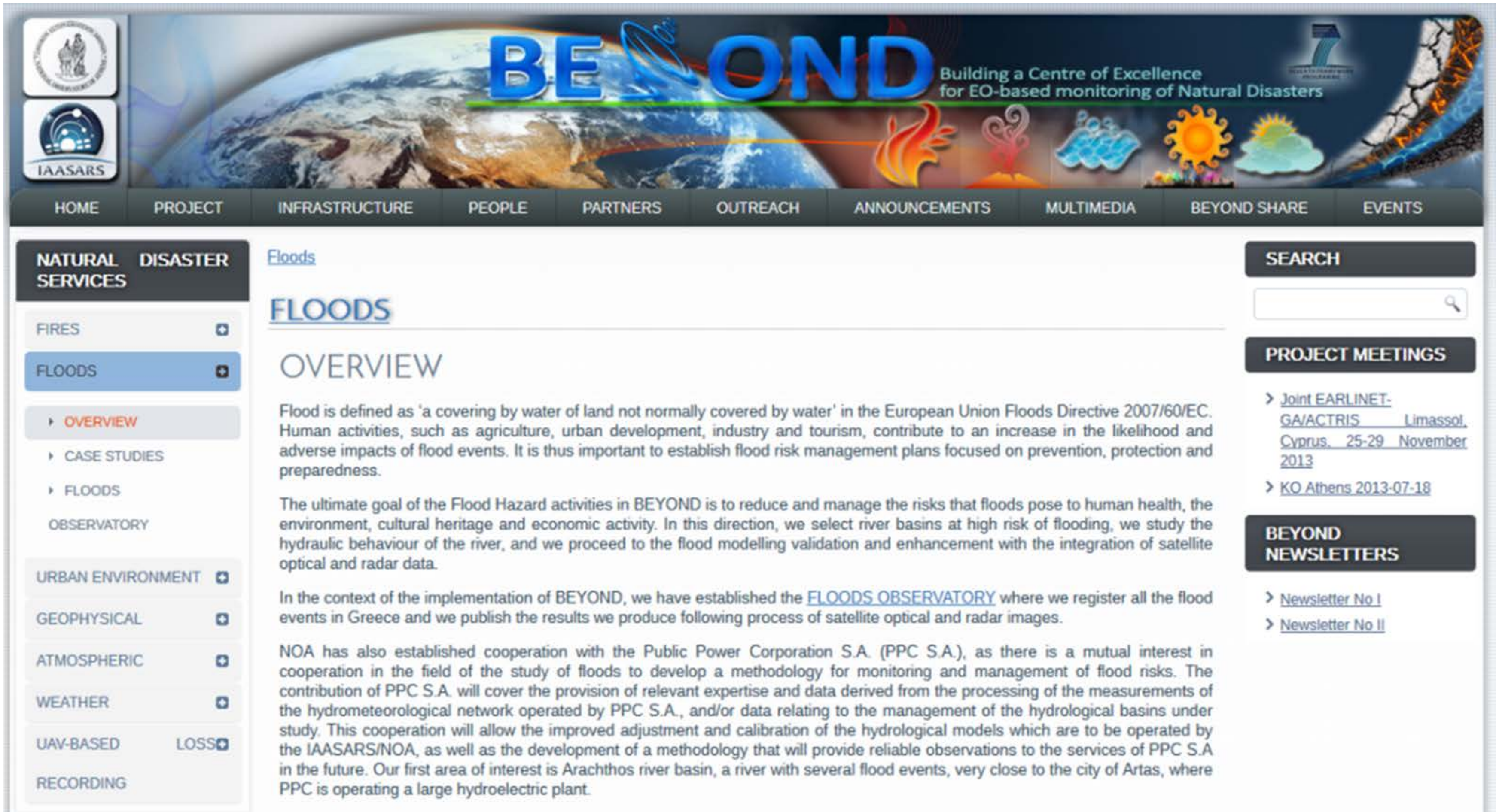
ΥΠΟΥΡΓΕΙΟ ΠΕΡΙΒΑΛΛΟΝΤΟΣ ΕΝΕΡΓΕΙΑΣ & ΚΛΙΜΑΤΙΚΗΣ ΑΛΛΑΓΗΣ

ΕΦΑΡΜΟΓΗ ΟΔΗΓΙΑΣ 2007/60/ΕΚ
ΠΡΟΚΑΤΑΡΚΤΙΚΗ ΑΞΙΟΛΟΓΗΣΗ ΚΙΝΔΥΝΩΝ ΠΛΗΜΜΥΡΑΣ

Αθήνα, Δεκέμβριος 2012

Floods in BEYOND

BEYOND for flood monitoring


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

IAASARS

HOME | PROJECT | INFRASTRUCTURE | PEOPLE | PARTNERS | OUTREACH | ANNOUNCEMENTS | MULTIMEDIA | BEYOND SHARE | EVENTS

NATURAL DISASTER SERVICES

- FIRES
- FLOODS
  - OVERVIEW
  - CASE STUDIES
  - FLOODS OBSERVATORY
- URBAN ENVIRONMENT
- GEOPHYSICAL
- ATMOSPHERIC
- WEATHER
- UAV-BASED LOSS RECORDING

Floods

FLOODS

OVERVIEW

Flood is defined as 'a covering by water of land not normally covered by water' in the European Union Floods Directive 2007/60/EC. Human activities, such as agriculture, urban development, industry and tourism, 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.

The ultimate goal of the Flood Hazard activities in BEYOND is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. In this direction, we select river basins at high risk of flooding, we study 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 the context of the implementation of BEYOND, we have established the FLOODS OBSERVATORY where we register all the flood events in Greece and we publish the results we produce following process of satellite optical and radar images.

NOA has also established cooperation with the Public Power Corporation S.A. (PPC S.A.), as there is a mutual interest in cooperation in the field of the study of floods to develop a methodology for monitoring and management of flood risks. The contribution of PPC S.A. will cover the provision of relevant expertise and data derived from the processing of the measurements of the hydrometeorological network operated by PPC S.A., and/or data relating to the management of the hydrological basins under study. This cooperation will allow the improved adjustment and calibration of the hydrological models which are to be operated by the IAASARS/NOA, as well as the development of a methodology that will provide reliable observations to the services of PPC S.A in the future. Our first area of interest is Arachthos river basin, a river with several flood events, very close to the city of Artas, where PPC is operating a large hydroelectric plant.

SEARCH

PROJECT MEETINGS

- Joint EARLINET-GA/ACTRIS Limassol, Cyprus, 25-29 November 2013
- KO Athens 2013-07-18

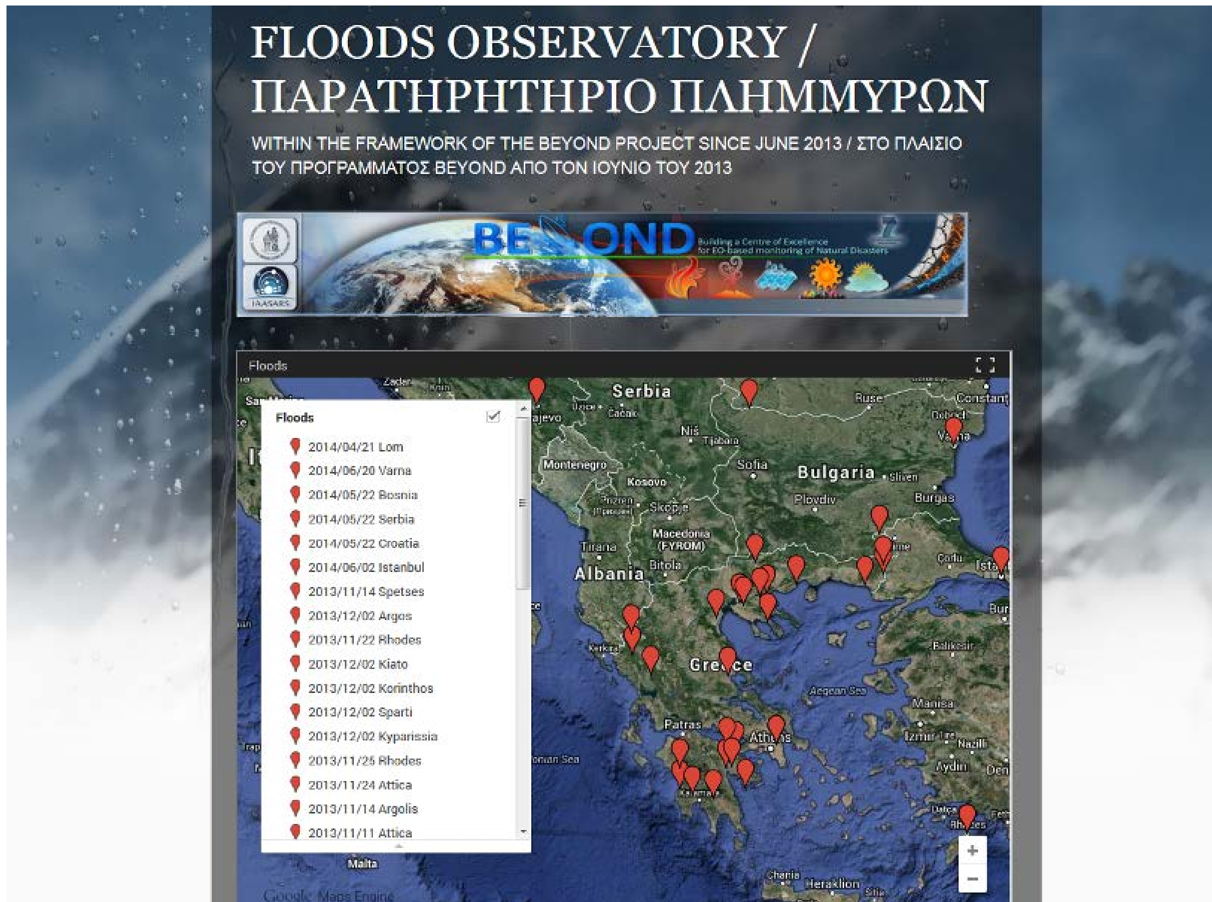
BEYOND NEWSLETTERS

- Newsletter No I
- Newsletter No II

Floods in BEYOND

BEYOND Floods Observatory

We have established the **BEYOND Floods Observatory** where we register and maintain information on the major flood events in Greece and south-eastern Europe.

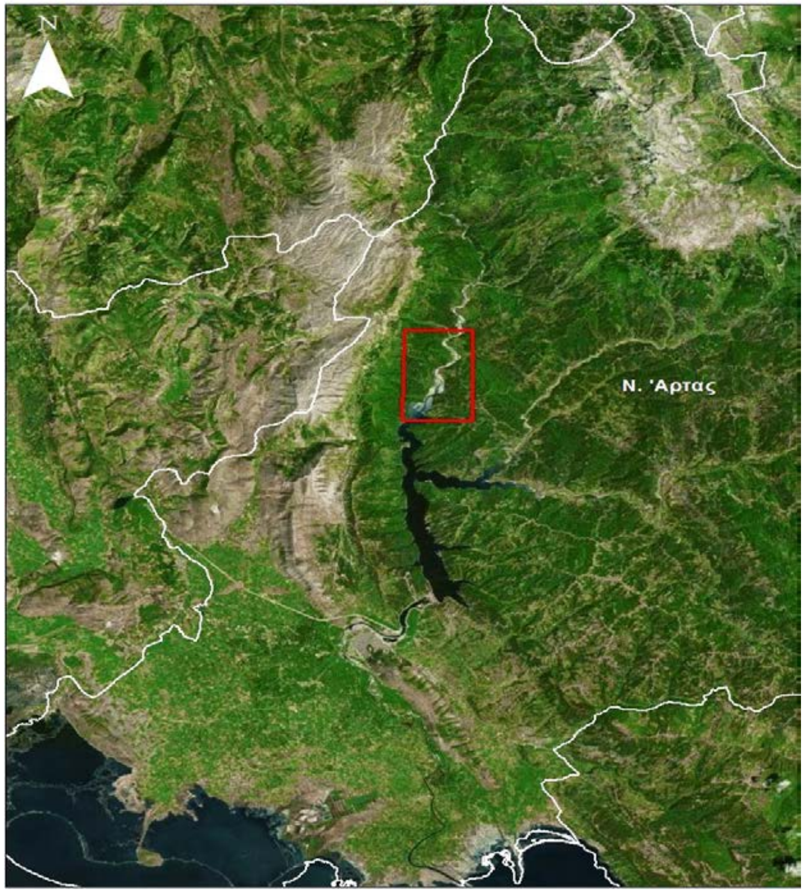


Floods in BEYOND

BEYOND Floods Observatory

Moreover, the **BEYOND Floods Observatory** publishes the flood mapping results produced through the process of satellite optical and radar images.

CASE STUDY:
The flood event of the Arachthos river on 24 October 2003, with one casualty. Arachthos river in western Greece, is the river where the Public Power Corporation S.A. operates two dams upstream of the city of Arta.



Floods in BEYOND

BEYOND Floods Observatory

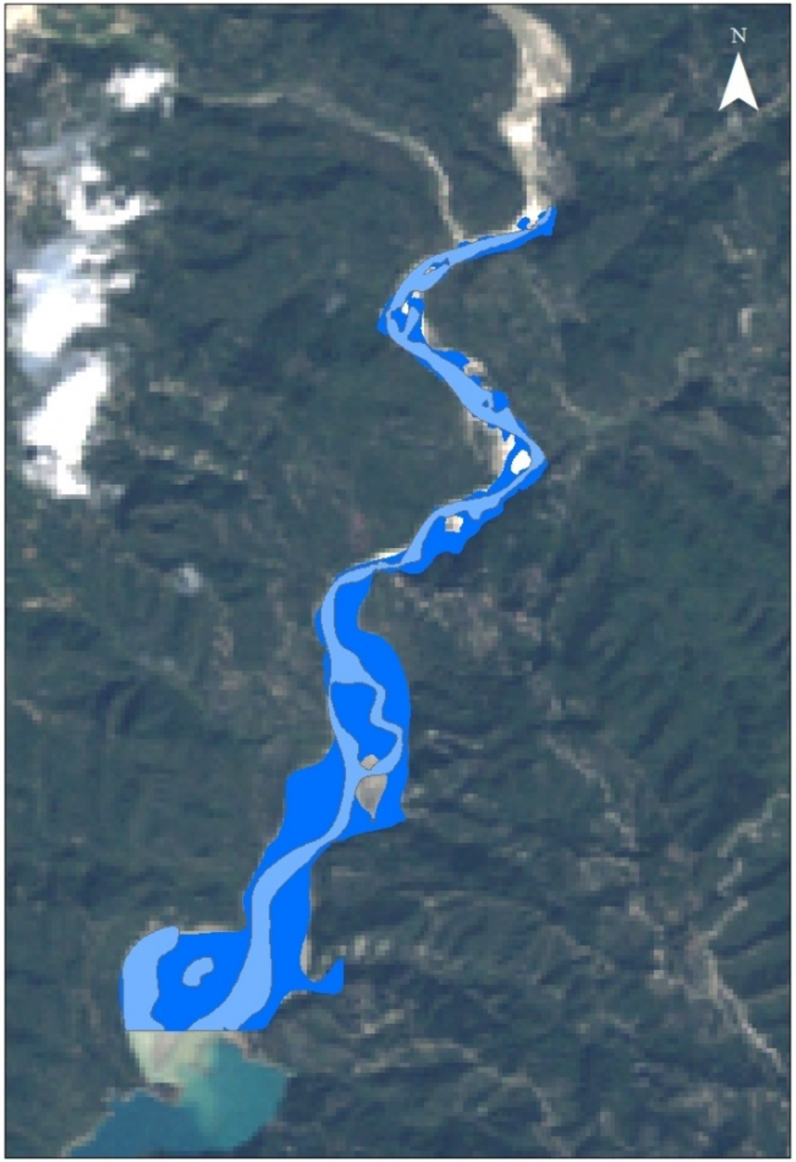
CASE STUDY:
LANDSAT-5 images were available before and after the flood, so the best suited pair of images has been selected:
one image acquired before the flood on 10/10/2003, and one after the flood on 26/10/2003.

Floods in BEYOND

BEYOND Floods Observatory

CASE STUDY:

Following image processing
and photointerpretation,
we estimated
the water surface
at 85 ha on 10/10/2003 (light blue),
and
at 202 ha on 26/10/2003 (dark blue).



Floods in BEYOND

BEYOND Floods Observatory

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. NOA has signed an agreement with the European Space Agency, to install, from autumn 2014 onwards, a mirror site for the collection, management, processing and distribution of Sentinel data and products.

BEYOND Floods Observatory
Active remote sensing

Any available SAR sensor time series can be used (Sentinel-1, ALOS/PALSAR, TerraSAR-X, COSMO-SkyMed, etc.) and several methods have been proposed in literature for delineation of flood extent.

Single image analysis:

This method is based on visual examination of post-flood image for areas of low backscatter, i.e. areas appearing in dark tones. Backscatter depends on surface roughness and flooded surfaces are normally associated with low backscatter when compared to sites that are not flooded. Therefore, using this methodology, the sites exhibiting low backscatter values are assumed to be inundated.

BEYOND Floods Observatory
Active remote sensing

<u>Two images analysis</u>:

* Topographic effect elimination for avoiding any shadowing, layover and foreshortening distortions that may appear in the SAR image.
* Flood change enhancement for interpretation purposes by forming a color composite image in RGB using the pre-flood, post-flood and the change detection images. The resulting image highlights permanent waters, submersed and emerged areas, thereby facilitating their interpretation.
* Extraction of changes with the use of supervised classification (pixel or segmentation based) on the aforementioned color composite image.
* Flood depth determination by combining SAR with other geospatial data such as DEMs or Lidar DTMs.

BEYOND Floods Observatory
Passive remote sensing

Different wavelengths have different responses to water in the landscape. The infrared wavelength performs well for separating water from land.

Sensors such as LANDSAT, SPOT-5, IKONOS, Quickbird, Worldview have high or very high spatial resolutions allowing for the detection of fine water bodies.

Sensors such as AVHRR and MODIS have coarser spatial resolution but higher temporal resolution, thereby offering a greater probability of obtaining cloud free imagery due to their frequent revisit time.

Several methods have been developed to delineate flooded areas.

BEYOND Floods Observatory
Passive remote sensing

1) The use of the **Normalised Difference Water Index** to classify flooded areas consists in analyzing NDWI values from two different dates (before & after the flood event). The difference among the NDWI values from the 2 dates is called Difference of NDWI. Ogashawara et al. showed that DNDWI got an accuracy of 85.68% for mapping flooded areas with LANDSAT-5.

2) By setting the appropriate **Digital Numbers** cut-off value it is possible to separate water from non-water features in a single band image. The choice of this value is a judgment made by the analyst based on the histogram, image characteristics or ground-truth data. Frazier and Page found that a simple density slice classification on LANDSAT TM Band 5 achieved an overall accuracy of 96.90% when compared to aerial photographic interpretation.

BEYOND Floods Observatory
Passive remote sensing

3) Flood water extent can be mapped through the object based image classification technique. This technique divides an image into contiguous and homogeneous objects and classifies these objects using their spectral, contextual and textural properties.

Photointerpretation is needed to correct possible errors, such as mapping some of the very high moisture areas as waters, where the waters physically may have receded leaving the soil still wet. The water extent from a pre-flood image is considered as the base of pre-flood normal water. By comparing this water extent with the one extracted from the peak flood image, the actual flood extent can be obtained. A change map can be produced this way, showing before & after floods in the extent of water bodies and revealing the most serious flooding in the area of interest.

Floods in BEYOND

BEYOND Floods Early Warning System

We select river basins at high risk of flooding, we study 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.

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, 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.

Floods in BEYOND

BEYOND Floods Early Warning System

This cooperation allows the improved adjustment and calibration of the hydrologic and hydraulic models which are operated by the IAASARS/NOA, as well as the development of a methodology that will provide reliable observations to the services of PPC S.A.

CASE STUDY:
The first case study is the river basin of Arachthos, a river with several flood events, upstream of the city of Arta, where PPC S.A. is operating two hydroelectric plants:
1) a large one known as Pournari I (effective capacity of reservoir 303 million m^3)
2) a smaller one known as Pournari II (effective capacity of reservoir 4 million m^3).

Floods in BEYOND

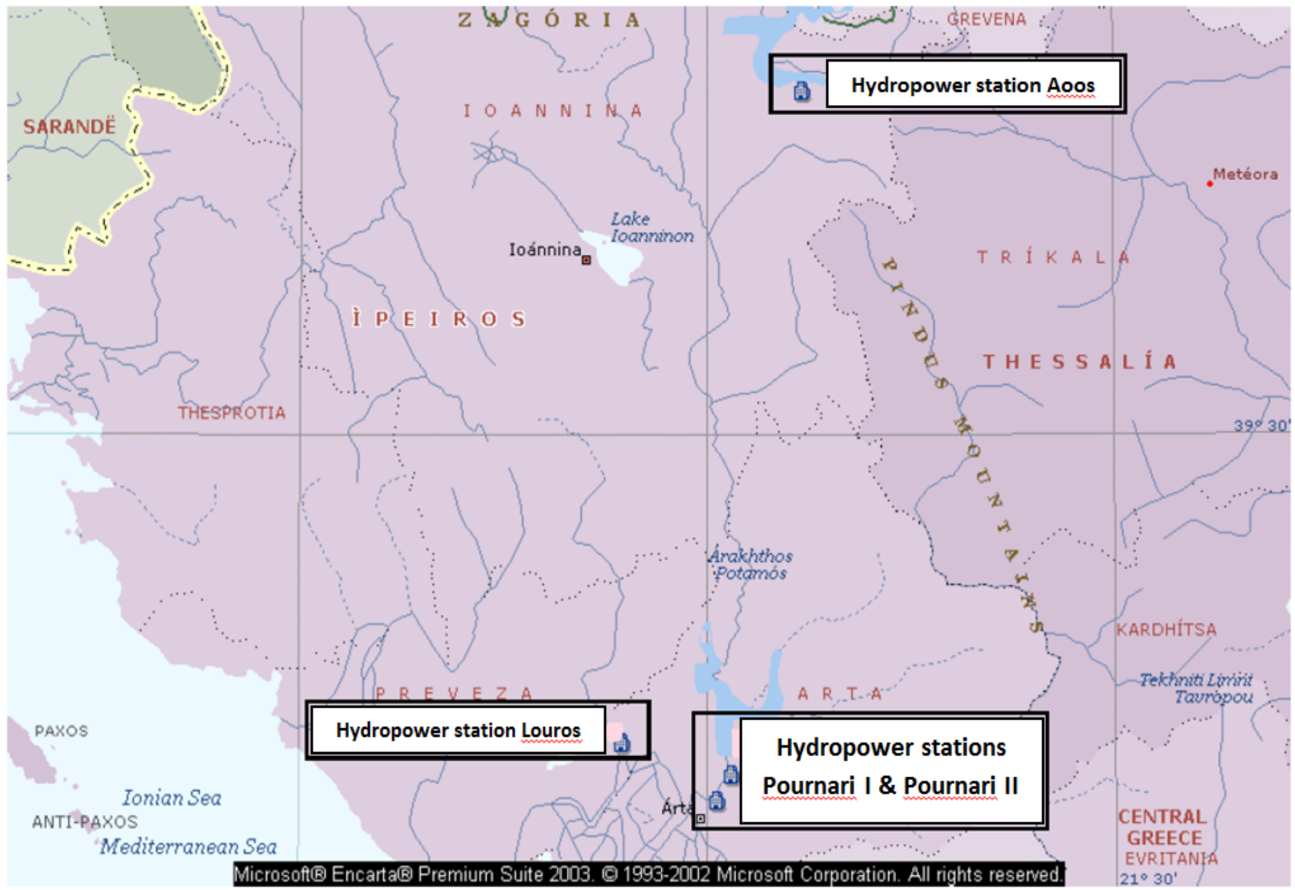
BEYOND Floods Early Warning System

CASE STUDY

Arachthos river basin

1.850 km^2

Hydropower Complex of Arachthos



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

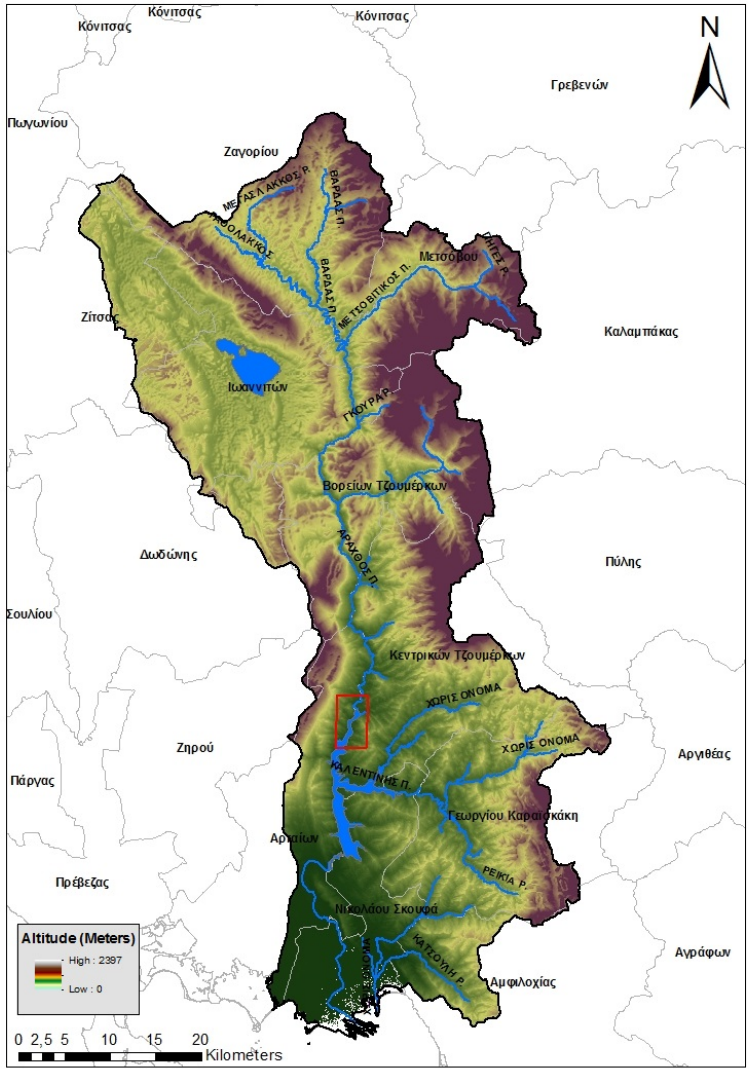
Floods in BEYOND

BEYOND Floods Early Warning System

CASE STUDY

Arachthos river basin

1.850 km^2



Available data from ground stations of PPC S.A.

Tsimovo

Kipina/Matsouki

Pistiana

Pramanta

Skoulikaria

Mikro Peristeri

Floods in BEYOND

BEYOND Floods Early Warning System

Hydrological & hydraulic software

HYDROGNOMON, a free software application for the analysis and processing of hydrological data, mainly in the form of time series.

(ITIA – National Technical University of Athens)

HYDROGEIOS, an integrated simulation scheme, implementing a conjunctive (i.e. surface and groundwater) hydrological model that represents the soil and aquifer processes, combined with a system-oriented management scheme, which estimates the flows along the physical (i.e. hydrographic) and artificial (i.e. conveyance works) network and the actual abstractions through the hydrosystem, accounting for the properties and constraints of the hydraulic structures for the exploitation of the water resources.

(ITIA - National Technical University of Athens)

Floods in BEYOND

BEYOND Floods Early Warning System

Hydrological & hydraulic software

LISFLOOD, a GIS-based hydrological rainfall-runoff-routing model that is capable of simulating the hydrological processes that occur in a catchment. A tool that can be used in large and transnational catchments for a variety of applications, including flood forecasting, and assessing the effects of river regulation measures, land-use change and climate change. Special options exist to simulate the effect of reservoirs and polders. If detailed river cross-section data are available, it is possible to use dynamic wave river routing. If only the downstream part of a catchment is simulated, one can represent the upstream parts using (measured) inflow hydrographs.

(Institute for Environment and Sustainability – Directorate-General Joint Research Centre – European Commission)

Floods in BEYOND

BEYOND Floods Early Warning System

CASE STUDY

Penios river basin
6.300 km^2

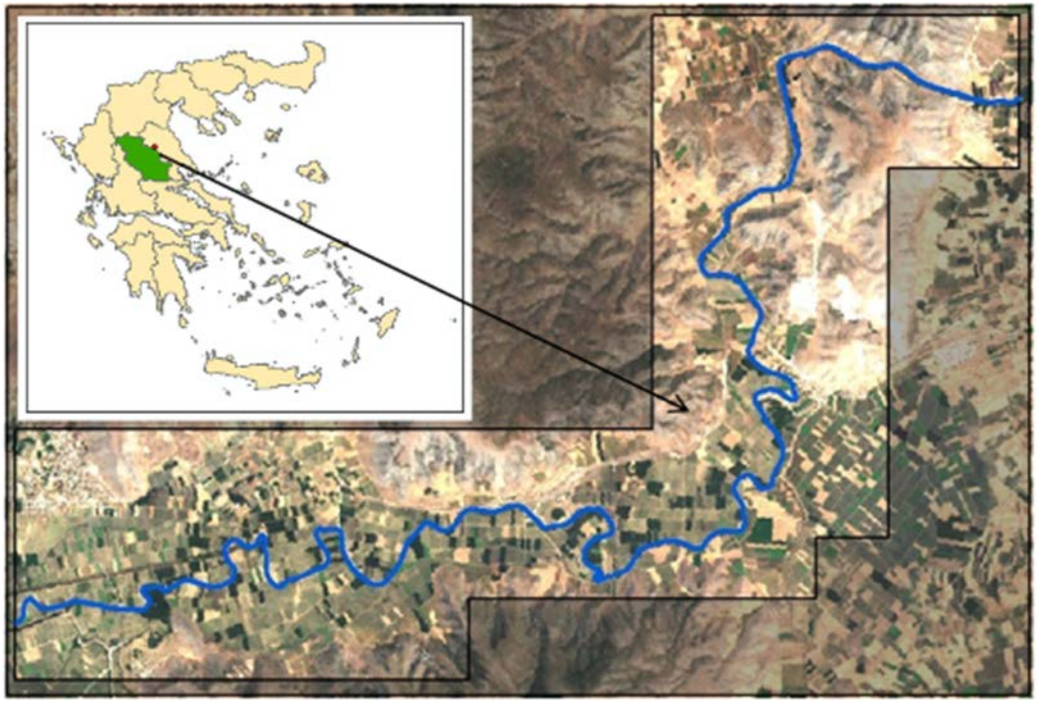


Figure 1: study area

Flood event

21-28 Jan 2003

Athanasios Oikonomou[1], Panayiotis Dimitriadis[1], Antonis Koukouvinos[1], Aristoteles Tegos[1,2], Vasiliki Pagana[1], Panayiotis-Dionisios Panagopoulos[2], Nikolaos Mamassis[1], and Demetris Koutsoyiannis[1]

[1] National Technical University of Athens, Civil Engineering, Water Resources and Environmental Engineering, Greece

[2] ECOS Consulting S.A.

Floods in BEYOND

BEYOND Floods Early Warning System

CASE STUDY

Penios river basin

6.300 km^2

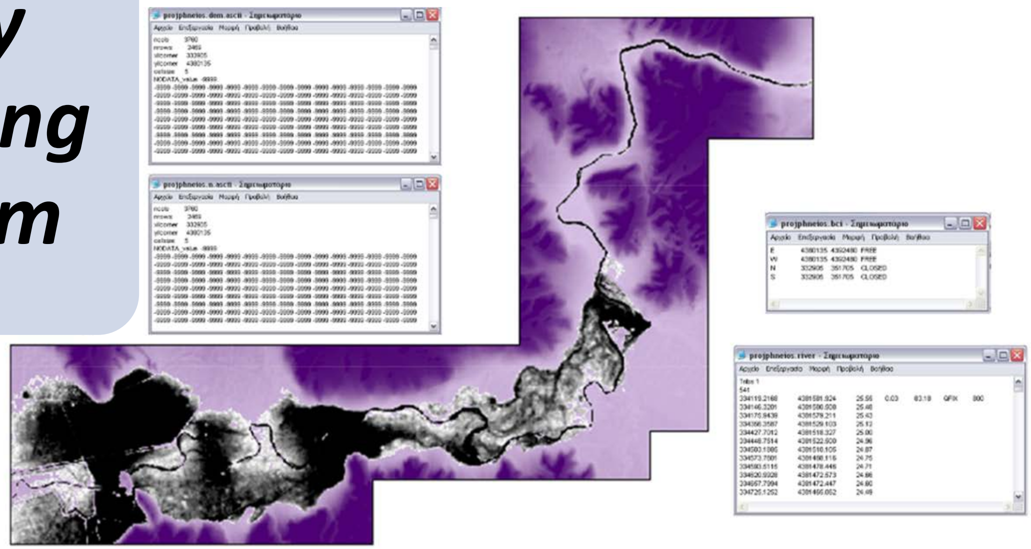


Figure 5: LISFLOOD-FP hydraulic model

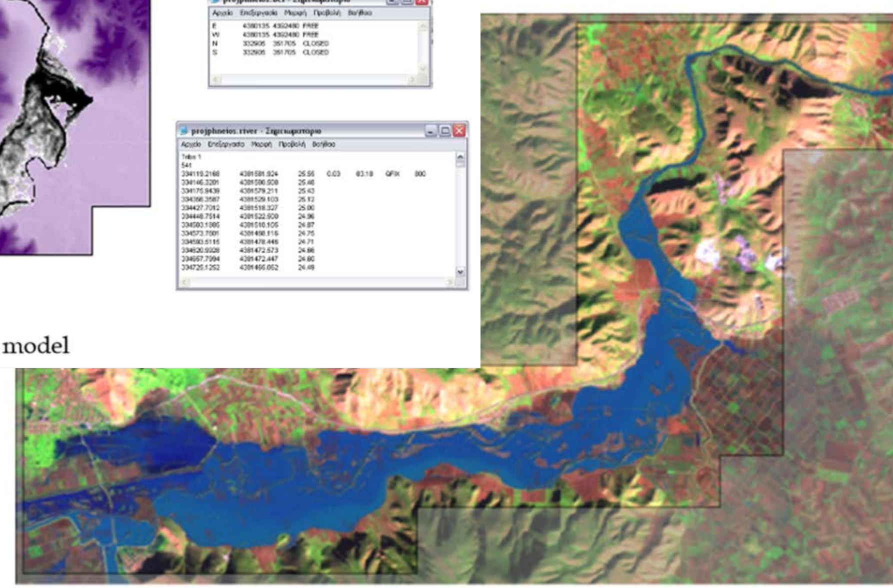


Figure 3: Landsat-7 satellite image (flooded area)

Floods in BEYOND