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

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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.

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.

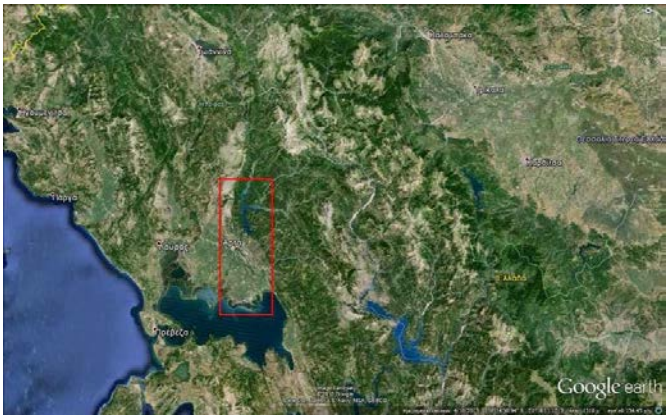


Figure 2 (up). Area of interest in the Arachthos river basin.

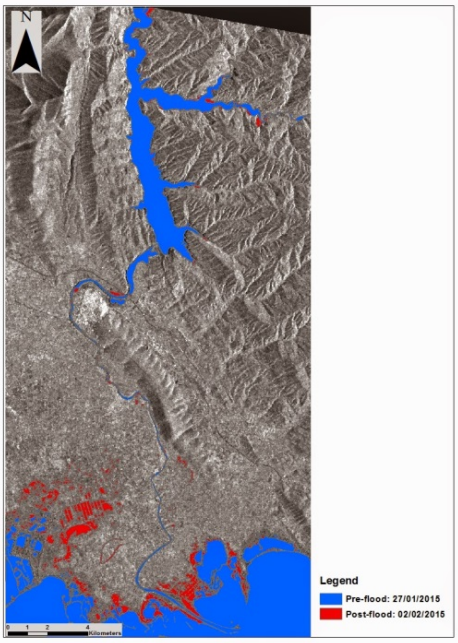
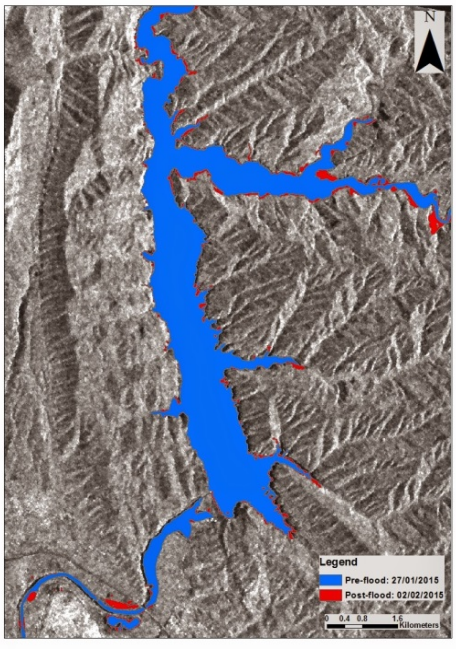
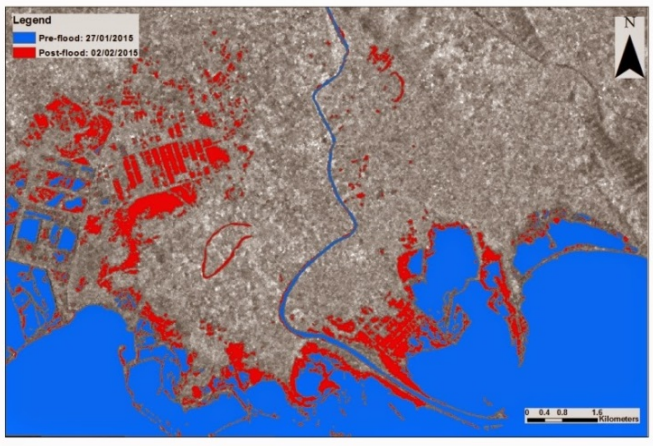


Figure 3 (up). Pre-flood water extent in blue, post-flood water extent in red. Background images: Sentinel-1 C-band SAR images (Interferometric Wide Swath mode) on 27/01/2015 (before the flood) and 02/02/2015 (after the flood).





Figures 4 (up) and 5 (right). 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^2), 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^3) and a smaller one known as Pournari II (effective capacity of reservoir 4 million m^3) (Figure 6).

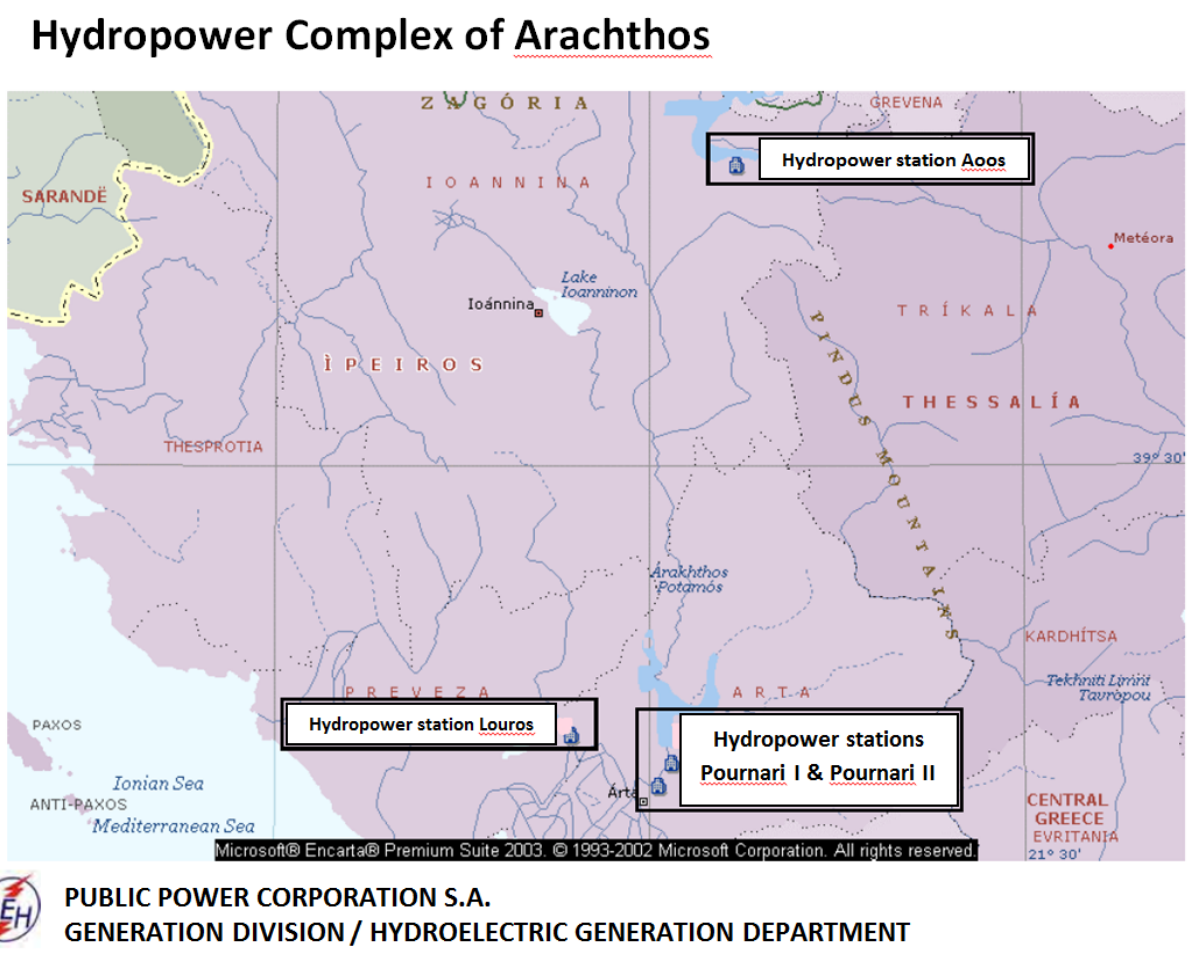


Figure 6. Map showing Arachthos river and the city of Arta in western Greece, as well as the location of the two hydroelectric plants of the Public Power Corporation S.A. Hellas: Pournari I and Pournari II.

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

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