MULTIDISCIPLINARY APPROACH TO FLOOD FORECASTING ON THE BASE OF EARTH OBSERVATION DATA AND HYDROLOGICAL MODELLING

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In this paper a new approach to creation the short-term forecasting systems of river floods is introduced. The proposed approach extends the traditional separate methods based on satellite monitoring or modeling of river physical processes, by integration of different models and technologies such as satellite image and hydrological data joint processing, digital maps of a relief and river terrain, crowdsourcing, hydrological models and geo-simulation, inundation visualization, and duly warning of stakeholders.

The real-time flood monitoring and forecasting system which was created within the described approach is shown on the fig.1.

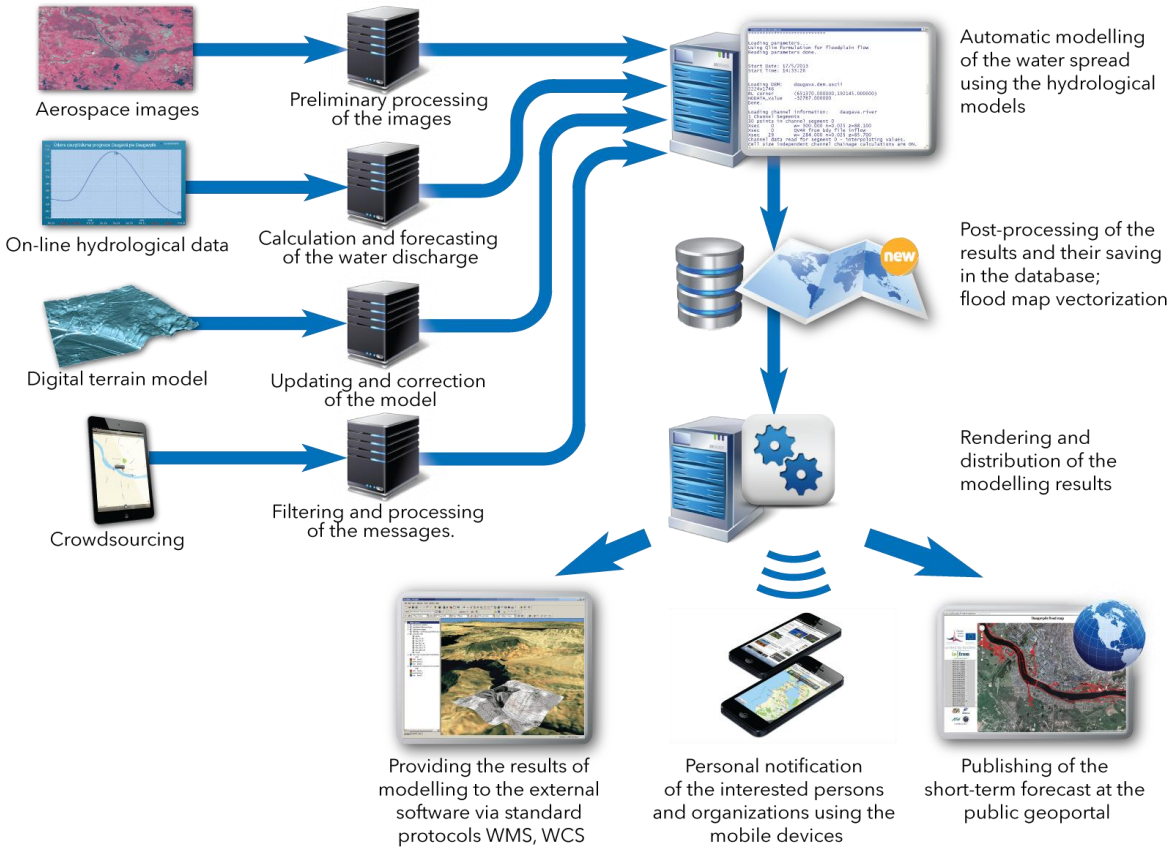

Fig. 1. Floods short-term forecasting system

Forecasting of flood areas and depths is performed on a time interval of 12 to 48 hours to be able to perform the necessary steps to alert and evacuate the population. Forecast results are available as Web-services.

A choice of software architecture type for the practical implementation of the multidisciplinary approach is one of the most fundamental issues. To solve this problem an Open Source Code and Service Oriented Architecture were used and that allowed to integrate different models and technologies into a single software complex. A key element of the proposed architecture is an intelligent interface for adaptation and selection of the model to forecast in each specific situation.

Using of remote sensing data in the flood forecasting allows to compensate the lack of ground-based data and to perform additional adaptation of the models. There are the following areas of remote sensing data application in short-term forecasting system constructing:

1). Actualization of cartographic information on modern infrastructure in river valleys.

2). Obtaining information on the river valleys relief.

3). Calibration and verification of hydrodynamic models on the base of the information on the flooding areas outlines obtained by satellite images.

It should be noted that the most reliable modeling results can be achieved only by a joint, integrated processing of various data received both in-situ and space measurements.

The developed system has been successfully tested in forecasting of floods on the river Northern Dvina (Russia) and on the river Daugava (Latvia) during the implementation of project ESTLATRUS/2.1/ELRI-184/2011/14 “Integrated Intelligent Platform for Monitoring the Cross-border Natural-Technological Systems”

In particular, a LISFLOOD hydrological model was adapted to simulate water flows in the Daugava river bed and within the channel network by integrating the digital map of the relief of the specified area and obtained hydrological characteristics of the river. The calibration of the model has been performed in two steps: by using the images received from the satellite RadarSat to precise the current state of the river channel and by using crowdsourcing technology.

Flood forecasting results were automatically published at the Geo-Portal for prior notification about emergency situation. The web service provides possibilities of viewing layers with flood contours from the beginning of the modelling process up to 12-hour forecast.

It should be noted the designed system after installation does not require any interaction with the operator. System automatically requests data from hydrological stations, processes them and sends the results to the database server. This operation is done once an hour, and the user receives updated flood forecast each hour by web service.

It is necessary to mention that the inundation areas were evaluated by the model with the real accounting to the features of water movement, not by simply raising the water level as it is done usually in well-known geoapplications. So the good accuracy was achieved. The performed real-time experiments allowed achieving about 90-95% confidence in floods forecasts regarding significant objects which were actually inundated later on.

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