RAINMAN D.T3.5.5 - FORECAST AND WARNING SYSTEM

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Forecast and Warning system

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1. Context and goals of this study

1.1. Project context

One of the main objectives of the RAINMAN Project is to develop risk reduction measures through warning, alarm and alert systems, test them, improve their reliability and make them applicable in practice. As part of this activity, information was collected about the existing forecasting system in the pilot areas and proposals are given for its improvement.

1.2. Goals

The measures that are implemented today are intervention measures, i.e. they are implemented once a flood event has already occurred. What is missing are preliminary, preparatory activities that start from a phase of defining the area with an increased flood risk depending on the extent of the flood event, preventive activities for the reduction of risks to an acceptable level, the implementation of operational measures during the event itself, and a phase after the event has ended, i.e. repair of possible damage. The purpose of the improvement of the forecast and warning system is to enable the competent authorities (local (self-)government units) to prepare appropriate plans and procedures to be in place when heavy rain is forecast.

2. Forecast and warning system in Croatia

Early warning is defined as "the provision of timely and effective information, through identified institutions, that allows individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response" (ISDR, 2004).

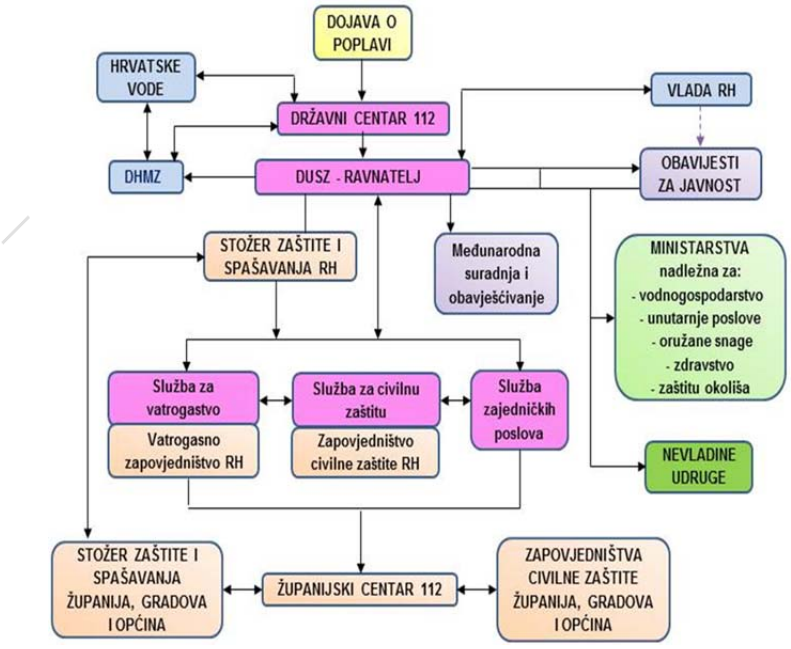
An early warning system necessarily comprises the following elements:

- Knowledge of the risks (information about potential hazards and assessment of the vulnerability of a community and people to a certain hazard);
- Constant monitoring and forecasting, and if needed communication or dissemination of warnings;
- Provision of timely, reliable and easy-to-understand warnings; and
- Planning, preparation and education aimed at reducing the possible consequences of natural hazards.

The early warning system must be based on clear plans, include cooperation between all the relevant institutions responsible for different components of the system, and enable cooperation at all levels. According to the Law on Tasks of Hydrological and Meteorological Service (OG 14/1978), the warnings about weather hazards issued by the Croatian Hydrological and Meteorological Service (DHMZ) are the only officially valid information in emergencies.

The basic document based on which all the essential preliminary actions and immediate activities in case of a flood event are planned is the National Flood Defence Plan. In addition to detailed organizational definition of activities and leaders of activities for the particular areas, the National Flood Defence Plan also details the measures of prevention, early warning, planing, development of studies, and water regime monitoring.

Pursuant to the National Flood Defence Plan, DHMZ is obliged to regularly monitor hydrological and meteorological events, measure high discharges during flood events, prepare reports about the volume and type of precipitation in the affected area, prepare weather forecasts, precipitation volume forecasts and forecasts about the size and time of arrival of a water wave. Based on the collected data, daily reports are prepared in the Main Flood Defence Centre of Hrvatske vode and are distributed to the services in charge of operational flood defence, and if needed to the competent services of the neighbouring countries and the public.



DOJAVA O POPLAVI – FLOOD WARNING	*VLADA RH – CROATIAN GOVERNMENT*
DRŽAVNI CENTAR 112 – NATIONAL CENTER 112	*OBAVIJESTI ZA JAVNOST – NOTICES TO THE PUBLIC*
DUSZ – RAVNATELJ – NATIONAL PROTECTION AND RESCUE DIRECTORATE (DUZS) - HEAD	*Međunarodna suradnja i obavješćivanje – International cooperation and communication*
STOŽER ZAŠTITE I SPAŠAVANJA RH – NATIONA PROTECTION AND RESCUE HQ	*MINISTARSTVA nadležna za… - MINISTRIES in charge of:* - *Water management* - *Interior* - *Armed forces* - *Health* *Environmental protection*
Služba za vatrogastvo – Firefighting Service	*Služba za civilnu zaštitu – Civil Protection Service*
Služba zajedničkih poslova – Common Affairs Service	*Vatrogasno zapovjedništvo RH – Firefighting Command*
Zapovjedništvo civilne zaštite – Civil Protection Command	*NEVLADINE UDRUGE – NGOs*
STOŽER ZAŠTITE I SPAŠAVANJA… - PROTECTION AND RESCUE HQs OF COUNTIES, TOWNS AND MUNICIPALITIES	*ŽUPANIJSKI CENTAR 112 – COUNTY CENTER 112*
ZAPOVJEDNIŠTVA CŽ… - CIVIL PROTECTION COMMANDS OF COUNTIES, TOWNS AND MUNICIPALITIES	

Since 1995, Croatia has been a member of the ALADIN Cooperation Programme (Aire Limitée Adaptation Dynamique Développement InterNational), and forecasts with the Croatian version of the model (ALADIN/HR) have been developed by the DHMZ since the year 2000.

There are several operational configurations of the ALADIN/HR model which primarily differ in terms of the model grid resoultion (from 8 km to 2 km), hourly availability (up to 72 hours in advance) and the time step (new forecast calculation each 3 or 6 h). Hrvatske vode receives from the DHMZ data about forecasted precipitation through the ALADINHR4 model. This concerns forecasted precipitation (rain, snow, total), temperature, moisture, wind and cloud cover in a 4x4 km grid, available for 72 hours in advance. The file format is ASCII. In addition, data from the global ECMWF model (the same parameters) is also received from the DHMZ.

Due to the character and occurrence of short-lasting heavy rain, unlike the flood protection measures on watercourses which are declared depending on the measured quantitative indicators (water level), warnings for the purpose of protection from floods due to heavy rain are - depending on the approach - issued depending on:

- the measured and forecasted quantitative indicators (cumulative measured rainfall in a given moment and forecasted rainfall in a given subsequent time frame) or
- forecasted quantitative indicators (cumulative rainfall in a given time frame), but also qualitative indicators (probability of occurrence).

Based on the forecasted and actual rainfall, in the next step it is possible to develop envelopes with a 4x4 km grid for the Zagreb and Umag pilot areas and follow the accuracy of the forecast. This can serve as a good indicator to define thresholds for individual degrees of warning and supporting action plans and operational procedures. Through systematic work on the model a significant number of data will be collected, by means of which the model will converge to higher accuracy, consequentially with a more appropriate response or risk reduction measures.

3. Proposal for improvement

3.1. Proposal for meteorological-hydrological improvement of the forecasting system

Concerning the model improvement in the domain of meteorological data, it is proposed to implement detailed regionalization of short-lasting rainfall throughout Croatia and to continuously collect data from the meteorological stations, as well as to compare forecasts with real events, based on which it will be possible to improve the forecasting models.

A correlation needs to be established between the measured meteorological indicators, topographic site conditions and the resulting flood events, with it serving as the basis for model calibration and risk analysis. Once established and verified, the model needs to be maintained, with each new project and the development and implementation of the spatial plans evaluated through the established model, in order to eventually ensure the provision of timely and spatially limited warnings. Based on the model established in such a way, Hrvatske vode can on its own or with the help of consultants give interpretation of forecast rainfall in terms of its repercussions on the field and prepare action plans accordingly. Continuous maintenance of such a database will enable better definition of thresholds and improvement of the overall forecasting system.

When working on the study, it was identified that the data collected by public firefighting brigades is of uneven quality, which is the consequence of non-existing standard operating procedure (SOP) which would ensure credibility and comparability of data. The establishment of a SOP ensures that all the included actors implement the same procedure in the same way, thus forming a basis for easier decision-making in terms of the implementation of certain measures, procurement of equipment, provision of human resources, education and control. It is therefore proposed that the SOP is adopted as soon as possible.

3.2. Proposal of activities immediately before and during a flood event

A specific feature of pluvial floods is that they last only a very short time, which is why the gradation of measures is related to the warning about rainfall, i.e. its intensity and duration. The forecasted rainfall joins the pre-defined threshold associated with the locations at an increased flood risk where people and material assets are at risk, depending on the combination of the depth and velocity of flow at priviledged flow directions.

Due to the proposed structure of the pluvial flood protection system, in which the basic territorial unit in the system is a local self-government unit (LSGU), according to the established threshold based on the forecasting model interpreted by Hrvatske vode, on the local level the organization and management of the process is taken over by an operating centre within the civil protection system (LSGU level). Once the head of the HQ declares a state of alert, the implementation of measures starts in accordance with the established (forecasted) threshold.

The remaining members of the operational team are called to the centre to lead the whole procedure, the locations potentially at risk are identified, and a procedure is launched to inform the remaining stakeholders who, in accordance with the pre-defined responsibilities, become involved based on event thresholds and by engagement locations.

The procedure is the following:

- Team leaders are informed about the locations where interventions can be expected and become familiar with the forecasted threshold;

- The team leaders organize the formation of a team to implement the measures and a supporting back-up team (depends on the possible changes in the forecasted values – thresholds);
- The teams implement preventive measures in accordance with the planning document regulating all the procedures (possible site visit, locally foreseen interventions, etc.);
- The teams prepare material and technical resources for a case if intervention activities have to be implemented (in accordance with the forecasted threshold) with a check of possibilities to use the other part of material and technical resources (depends on a potential deviation of a forecast against the baseline values);
- They implement active protection measures during a flood event (if shown necessary);
- They perform post-event restoration;
- The head of the HQ declares the end of the implementation of measures;
- Team leaders report on the event itself, the measures taken and other pertinent factors characterizing the event.

RAINMAN Key Facts

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