- System of Hydrology -
A Hydrological Monitoring, Forecasting and Warning System for Poland

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ABSTRACT

In 1997 serious flooding has occurred on major rivers covering the total territory of the Republic of Poland causing tremendous, basin-wide material damages. The main challenges today are to protect the flood prone areas reducing flood risks and to provide sustainable data management and telecommunication capabilities. This will additionally support the development of a Hydrological Monitoring, Forecasting and Warning System, which is badly in need for River Basin Management in Poland. This will be one of the main issues of the Emergency Flood Recovery Project in Poland.

Within this framework, a concept has been thoroughly prepared, which encompasses the technical design of a Hydrological Monitoring, Forecasting and Warning System (referred as "System of Hydrology") to be implemented subsequently by the Institute of Meteorology and Water Management (IMGW) Headquarter in Warsaw, and at the corresponding eight Regional Branch Offices.

The System of Hydrology (SH), which is going to be implemented at IMGW, is aimed at development of a comprehensive and integrated hydrological monitoring, forecasting and warning system. The main tasks were to provide effective management of the hydrometeorological monitoring network; promote uniformity of access to all observation results; streamline and formalise the access to the information used for forecast preparation therefore enabling full access to the digital presentation of current meteorological conditions and digital forecasts.

In order to provide the requested services, such system has to fulfil the following requirements:

?? Provide effective management of the hydrometeorological monitoring network;

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?? Providing uniformity of access to all observation results used for hydrological management and forecasting;
?? Streamlining and formalising access to the information used for forecast preparation and throughout the management process;
?? Enabling full access to the digital presentation of current meteorological conditions and digital forecasts;
?? Being implemented based on an effective QA system for the information used in forecasting;
?? Supporting development of a multi-modelling platform required throughout the forecasting process;
?? Allow simplifying and streamlining procedures for user service and analyses preparation; and
?? Offering up-to-date and uniform processing procedures for historic hydrological information.

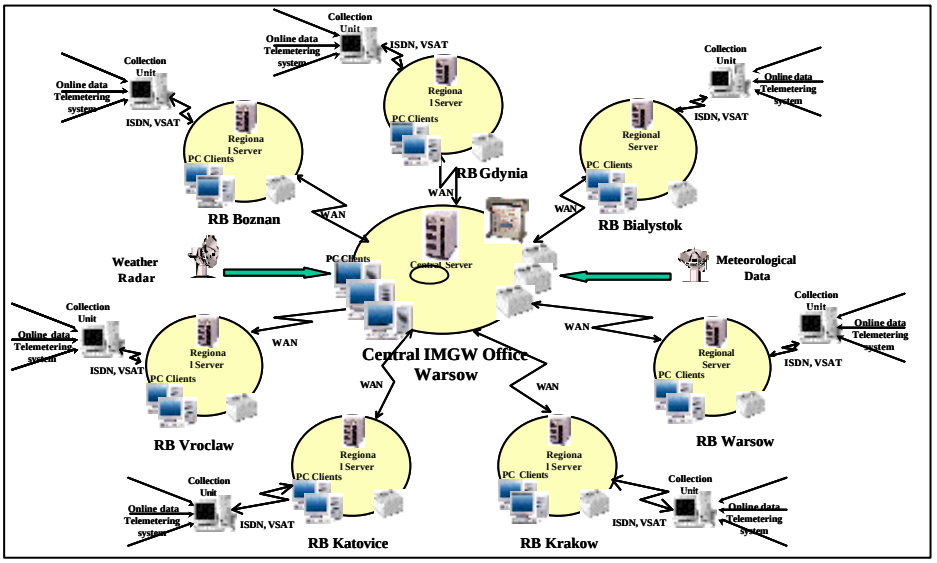

Fig. 1: Organisation of the IMGW data acquisition system and IT environment

A Telemetry System will be implemented within the frame of another project component and will be comprised of about 1000 monitoring stations. Up to approximately five parameters will be measured in each station every 15 min and have to be sent to the Data Collection Units within user defined transmission time intervals. Hydro-

meteorological data transfer within the system will be carried out through a sophisticated communication net according to Figure 1.
In order to accommodate the user requirements regarding the proposed Database System (here referred as SH-Database) to the requirements concerning data to be transferred from and control commands sent to the Telemetry System a detailed concept for the data transmission protocols has been made.

The wide scope of functions that have to be available within the proposed System of Hydrology provides a database for management and analysis of collected information. In order to make these tasks secure, efficient, and user friendly, the database will be equipped with a package of appropriate tools and applications for:

- ?? System management (Station, Parameter, Data Selection, User Privileges, etc.)
- ?? Manipulation of the data (searching, editing, deleting, inserting, etc.),
- ?? Data input and output (data exchange, reporting, etc.),
- ?? Data analyses (comparison, calculation, statistics, etc.),
- ?? Decision making (during flood forecasting, alarming, etc.),
- ?? Data security, backup, archiving, protocolling, etc.

Designing the future shape of SH, following information sources have to be taken into account:

- ?? On-line monitoring data
- ?? Off-line measured data,
- ?? Meteorological forecasts and remote sensing data,
- ?? Hydrological modelling scenarios,
- ?? Results of hydrological forecasting,
- ?? Images and maps from Geographical Information System (GIS),
- ?? Information describing measurement stations, etc.

In order to ensure an effective and user friendly handling of the data, SH will consist of following main components:

- ?? Data Manager,
- ?? Telemetry Manager,
- ?? Import/Export Modules,
- ?? Reporting,

?? Data Analyser,
?? SH Navigator,

The proposed multi-modelling system for operational hydrologic forecasting will be conceived as a sort of modelling platform allowing integration of various models, providing a variety of options for simulating precipitation runoff processes. This platform will be comprised of a graphical user interface (GUI), which provides the means for an object-oriented specification of the watershed model elements using GIS capabilities. Data storage will be performed in the central database (SH-Database) allowing for retrieval of model input data as well as other model specific parameters and basin related attributes. Through the proposed GUI, Model Objects (watershed elements whose runoff process can be described by a hydrological model) can be easily placed within the basin area and are configurable to a scheme using node objects as links to other model objects. This allows for effective analysis of the hydrological behaviour of the whole catchment. Prescriptions and rules stored in the central database enable integration of model components like the required input data, data processing information (algorithms for regionalisation and interpolation of data and other transformation procedures), model objects, modelling methods and their parameters, time related data and model output. Error correction modules use input data from downstream the model object and are processed in the so-called Node Objects (Linkages).
Several meteorological scenarios may be represented as historical time series standing for representative meteorological conditions and are stored in the SH-Database system. Hypothetical meteorological situations allow for modelling of extreme weather conditions in the river basin. These scenarios have to be adequately managed for easy retrieval and classification.
An effective QA system was proposed for the information used in forecasting, supporting development of a multi-modelling platform for all required hydrological models and procedures for user services, offering up-to-date and uniform data processing system for historical hydrologic information.
The presentation pinpoints the priority areas identified together with the IMGW for the System of Hydrology to attain the above-mentioned objectives. It describes the methods and applications in more detail.

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