SET UP OF THE NEW AUTOMATIC HYDROMETEOROLOGICAL NETWORK IN HUNGARY

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ABSTRACT. – Set up of the new automatic hydrometeorological network in Hungary. The Hungarian Meteorological Service (OMSZ) and General Directorate of Water Management (OVF) in Hungary run conventional precipitation measurement networks consisting of at least 1000 stations. OMSZ automated its synoptic and climatological network in 90's and now more than 100 automatic stations give data every 1-10 minutes via GPRS channel. In 2007 the experts from both institutions determined the requirements of a common network. The predecessor in title of OVF is general Directorate for Water and Environment gave a project proposal in 2008 for establishment of a new hydrometeorological network based on common aims for meteorology and hydrology. The new hydrometeorological network was set up in 2012 financed by KEOP project. This network has got 141 weighing precipitation gauges, 118 temperature - humidity sensors and 25 soil moisture and soil temperature instruments. Near by Tisza-Lake two wind sensors have been installed. The network is operated by OMSZ and OVF together. OVF and its institutions maintain the stations itself and support the electricity. OMSZ operates data collection and transmission, maintaines and calibrates the sensors. Using precipitation data of enhanced network the radar precipitation field quality may be more precise, which are input of run-off model. Thereby the time allowance may be increased in flood-control events. Based on soil moisture and temperature water balance in soil may be modelled and forecast can be produced in different conditions. It is very important task in drought and inland water conditions. Considering OMSZ investment project in which new Doppler dual polarisation radar and 14 disdrometers will be installed, the precipitation estimation may be improved since 2015.

Keywords: hydrometeorological network, precipitation, soil parameters, models, flood forecasting.

1. INTRODUCTION

In Hungary more institutions operate meteorological network. Each organization has special task, for example Road Maintenance Authority interested in road surface condition and they collect weather information along the roads. Two organisations have the biggest meteorological networks with long period data series. One of them is the Water Management Institutions (hereinafter called OVF). They started their meteorological measurement activities since 70's. The stations

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are located generally near by rivers or lakes. They measure most frequently the precipitation. Some sites measure also temperature, humidity, evaporation and soil temperature. In their network more than 600 traditional precipitation stations work. The number of stations equipped with automatic weather station (AWS) is less than 60 and they have very different types of sensors. The Hungarian Meteorological Service (hereinafter called OMSZ) represents Hungary in WMO, and includes all activities of meteorology area. Its observation network has almost 600 precipitation stations and more than 100 AWSs based on Vaisala instruments. There are three Doppler radars, two windprofilers, lightning detection systems and two radiosonde stations.

In 2006 the Hungarian Government set up a governmental committee with dedicated task to reform governmental organisations. In the field of meteorology they should like to harmonise and integrate meteorological activity on common platform under OMSZ direction. The first action of this was set up joint commissions from OMSZ and OVF experts. They investigated the advantages and disadvantages of both network and build up the aims and idea of such observation network, which will achive all requirements of both organisations using all available observation data. The feasibility study was completed by the end of 2007. The most important aims beside to enhance efficiency are to stop parallel activities, to decrease the infrastructure cost, to determine at least 3-hour precipitation field with 2x2 km spatial resolution for flood-prevention. The requirement of data availability is at least 95%.

2. AUTOMATIC PRECIPITATION NETWORK

During 2008 the Water Management gave a project proposal for establishing of a new hydrometeorological network based on common aims for meteorology and hydrology. Their proposal was accepted by KEOP program which is supported by EU Cohesion and Structure Foundation. The title of project was KEOP 2.2.2.- 2008-0001 The automation of hydrometeorological network. The first tender called in 2009 was terminated unsuccessfully because of some financial reason. The second one was succesfull and the installation work started early 2012 and finished in September of 2012.

The installation regime was very tightened but everything have been achived on time. The network consists of 141 stations located mainly at the area of water management. Each station is equipped with weighing precipitation gauge, type of PLUVIO^2. Rotronic HygroClip HC2-S3 temperature and humidity sensors have been installed at 118 stations. At 25 sites Decagon EC-5 soil moisture sensor and UNITEK Soil Temperature sensor are used. Wind sensors located at 2 stations and all data-logger are also developed by UNITEK. The communication is based on GPRS technology, Sierra Xtend modem is used. Every 10 minutes the central computer hosted in OMSZ collects data and transfers them into the central database. After validation data OMSZ sends them to the OVF database. During the first half year the data availability is more than 99%.

This network is operated by OMSZ and OVF together. Water management maintaines the field of instrument and supports the electricity. OMSZ's task is to operate central database, control data flow, validate the data, maintain the instruments and calibrate the sensors according to its ISO certification.

The location of all station of both network can be found in Figure 1. AWS station operated by OMSZ is marked with red triangle and blue circle means automatic hydrometeorological station of OVF. The brown line is border of county.

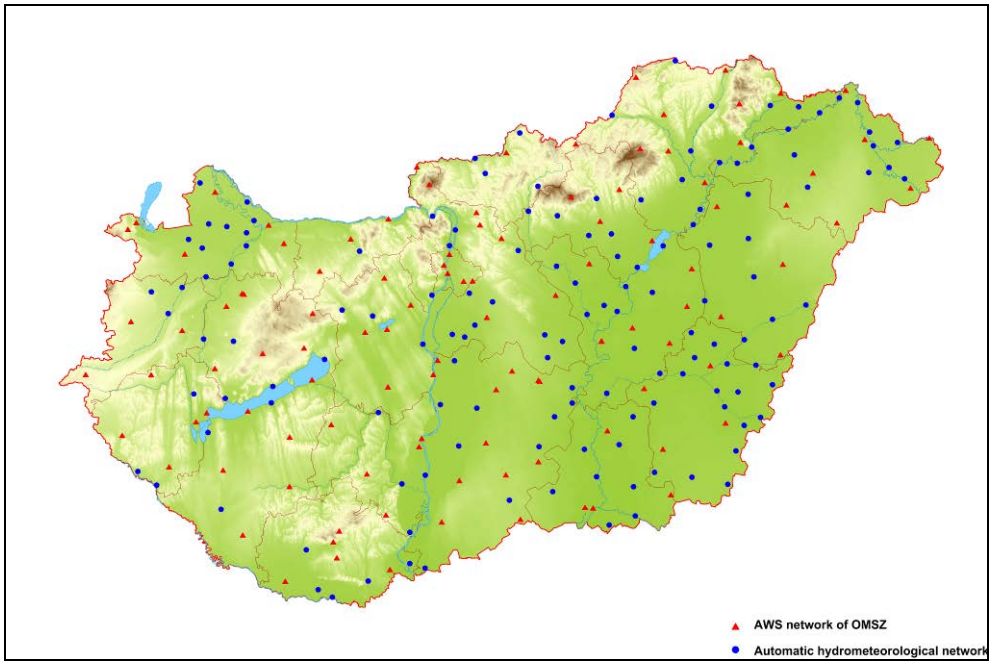

Fig.1. ***The location of all AWS station of OMSZ and OVF network***

3. DATA PROCESSING AND POSSIBILITIES

With setting up this new hydrometeorological network the number of precipitation and temperature AWSs has doubled. From 10 minutes measured data several products are calculated in central database, for example hourly, daily, monthly and annual sums, averages, extrems. We have got more information about several weather phenomena and our knowledge may be enhanced. It is obvious, the surface measurements have to be used with other data, among others remote sensing data. Some potential application areas are mentioned later on.

OMSZ's Doppler, dual-polarisation radars give volumetric data about precipitation echoes. Several products are calculated from elementary data. The most important information is a maximum reflectivity calculated every 5 minutes.

Several – 1, 3, 6, 12 and 24 – hourly precipitation fields are originated from reflectivities. This precipitation fields are adjusted by using AWS precipitation data at the OMSZ. This is the most important information for Water Management. The corrected database is input of run-off model.

The model developments joining with hydrometeorological monitoring help rainfall-runoff process, analysis and decision makings. The main element is DIWA (Distributed Watershed) model developed in Hungary.

This is designed to model the following: rainfall-runoff process, flood events analysis, regional land-use-change scenario analysis, real-time hydrological forecasting and control. The model-input is based on spatially distributed meteorological data, computed portion of rain and snow, evapotranspiration and rain interception.

The purpose of this model is supported by water monitoring system's automatic elements (water-level, discharge and underground water-level) partly founded by KEOP.

The main designated aims are flash-flood forecasting of smaller rivers up to 3 hours, rescue of people and assets during 3-6 hours and starting of protection activity when the time advantage is more than 6 hours.

Recently OMSZ operates the web-site as deputy of Ministry of Rural Development from where registered person can get information about drought, frost, flood and storm. Using data of hydrometeorological network and water balance output coming from above-mentioned model part of rain and soil the drought and inland waters may be determinated more precisely.

4. ONGOING DEVELOPMENTS

The above-mentioned model developments are going on continuously and new results are available for a public and decision-makers. Furthermore the big investment project at the OMSZ in process can be mentioned. A new Doppler dual-polarisation radar will be installed near to Szentes, South-Est area of Hungary and 14 disdrometers around the country. This project is also supported by KEOP. The installation work will be finished next year and enhanced national radar images will be available from 2015. The radar reflectivity may be adjusted by using disdrometer drop-size distribution data and enhanced radar data support the meteorological and hydrological forecast.

5. CONCLUSIONS

With cooperation of two governmental organisations, Hungarian Meteorological Service and General Directorate of Water Management the Hungarian hydrometeorological observation network has been enlarged. There is a possibility to detect more precisely the extreme weather phenomena and to make new product using Distributed Watershed rainfall-runoff model. At the flood

events depending on time advantage the decision-maker can organise suitable prevention task to save lives and protect the assets. This aim will be supported by new project going on in Hungary. Hopefully we can give information on our result in 2-3 years.

Acknoledgements: We acknowledge and express our gratitude to National Development Agency and European Union who supported the project. This article has benefited greatly from comments by my colleague, namely Róbert Tóth.

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