AUTOMATIZATION OF METEOROLOGICAL MEASUREMENTS IN REPUBLIC OF MACEDONIA FOR THE NEEDS OF ENVIRONMENTAL SUSTAINABILITY

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INTRODUCTION

The intensive progress of science and technology during last decade enabled the beginning of a process of automatization of the conventional meteorological measurements in the Republic of Macedonia basic meteorological network. Automatic measuring systems (AMS) with various working programs, configurations of sensors and manufacturers have been installed at measuring sites in Skopje-Zajcev Rid, Kavadarci, Gostivar and Star Dojran. Goals that are expected to be achieved are: to standardize the different networks and their operation, to lower the maintenance and operating costs, as well as to better fulfil the requirements of the clients and researchers.

Basic reason for installation of the AMS in Star Dojran was the first phase of realization of the Research Project for Dojran Lake protection, approved and financed by UNESCO. Dojran lake is one of the three natural lakes in Macedonia, situated on the south border line with Greece and it is notable by its specific biodiversity and climate conditions. During the last period of prolonged dryness and intensive and uncontrolled anthropogenic influence the lake suffered enormous decrease of the water level. The UNESCO project comprised provision of the main meteorological parameters necessary for water balance estimation. The Project leader – Faculty for civil engineering, jointly with the Republic Hydrometeorological Institute committed themselves to carry out measurements and evaluation of meteorological parameters and creation of data base that will be used for further research.

The supplied AMS from a German manufacturer of meteorological and hydrological equipment was installed on a representative site, and starting form 1996 has registered a huge amount of meteorological data.

Dojran Lake is one of the three natural lakes in Macedonia, which is notable by its specific biodiversity and climate conditions. It is situated on the south border line of Republic of Macedonia and Greece, with a surface area of 41 km^2 (63% belongs to Macedonia and 37% to Greece). The lake has elliptic form with total accumulated water amount of 262 mil m^3 and average depth of 10 m. It is very popular tourist resort and fishery region, unique by the method of fishing with birds' assistance.

During the last period of prolonged dryness and intensive and uncontrolled antropogenic influence, the lake suffered enormous decrease of the water level. The Hydrological Department at the Republic Hydrometeorological Institute, responsible for operational monitoring of the hydrological parameters had been recording the oscillation of the water level since 1951.

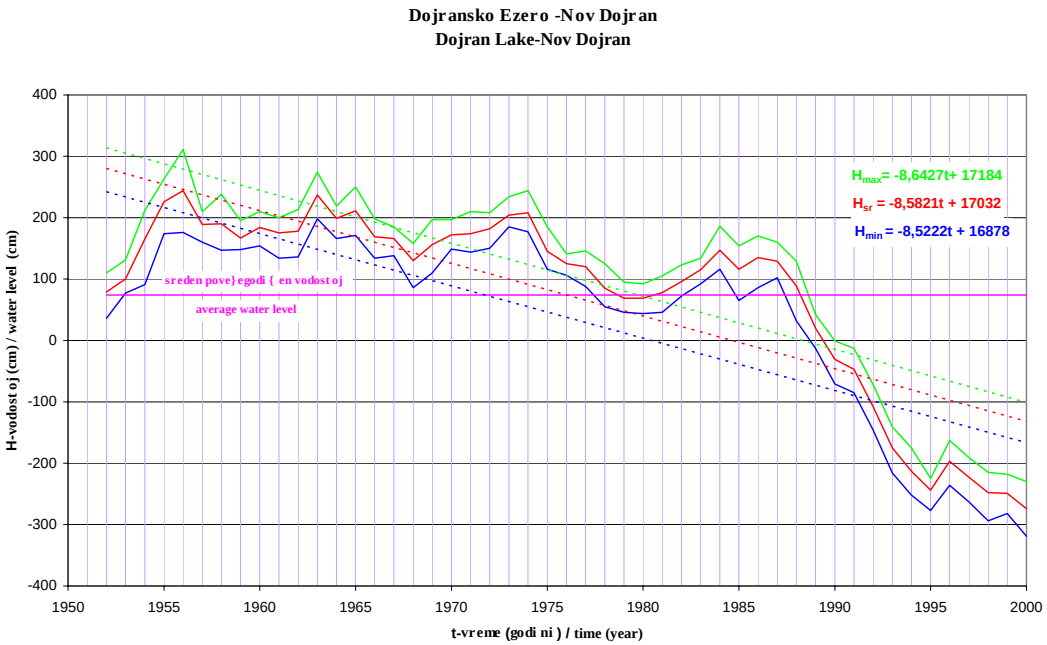

Fig.1 - Water level decrease started in 1987

CONFIGURATION AND AMS OPERATION

The entire automatic measuring system is design to provide simple, quality and exact measurements of the necessary meteorological data. The system is modern, universal and economical type of a meteorological equipment with a possibility for future upgrade in order to register the hydrological parameters, as well.

The internal memory capacity (ring memory) is 128 to 512 kB, which respond to 60 000 - 250 000 registered values. Each channel (possible 16 channels) has an option for time-interval set up from 1 second up to 1 month. The standard program at S.Dojran AMS records and stores hourly average and extreme values, so the needed storage per sensor per day is 600 bytes.

Depending of the measurement time and values there are various modes of measurements and the system has a possibility for automatic sensor calibration, as well.

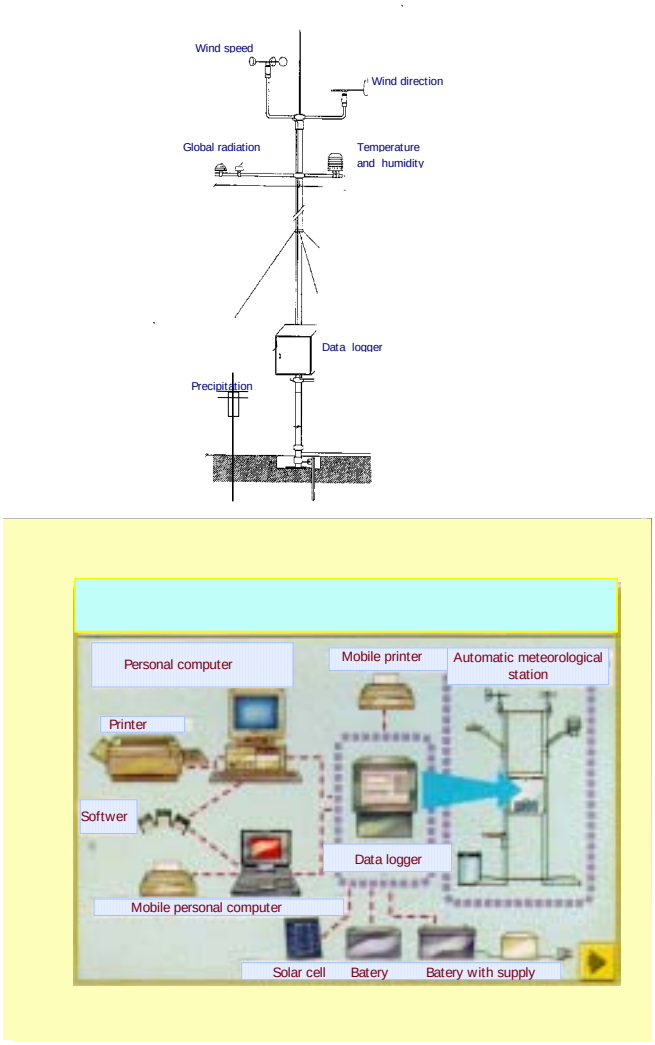

Fig. 2,3 - Installed sensors and the system for automatic meteorological measurements

There are several options for configuration of measurement parameters and transfer of the already recorded values from the central data-logging unit. The settings of sensors and readings of the data can be done with a mobile personal computer (laptop) or with replaceable memory cards. The stored data later are transferred with a reading unit and evaluated with a PC software. A remote communication using a modem is planned for near future, together with the upgrade of the AMS with a transmission system.

The present AMS is consisted of: data logging unit, sensors (air pressure, temperature, humidity, wind speed and direction, precipitation and radiation), operation software and software for multy parameter valorization, reading unit and memory cards.

Registrations from the installed sensors are memorized in a way and time intervals set up from the central unit with the operative software. In the beginning reading of the stored data was carried out once in 40-50 days with a mobile computer, and recently the registrations are stored on a memory card, which are later evaluated at the Republic Hydrometeorological Institute.

EXAMPLES OF MEASUREMENTS AND OPTIONS FOR DISPLAY

The data of the air temperature and humidity are set to be memorized in every full hour, wind speed and direction in an interval of 10 minutes, and the sensor for the precipitation registration records every 0.1 mm rain. The measurements have begun in June 1996 and until now a solid data base has been created.

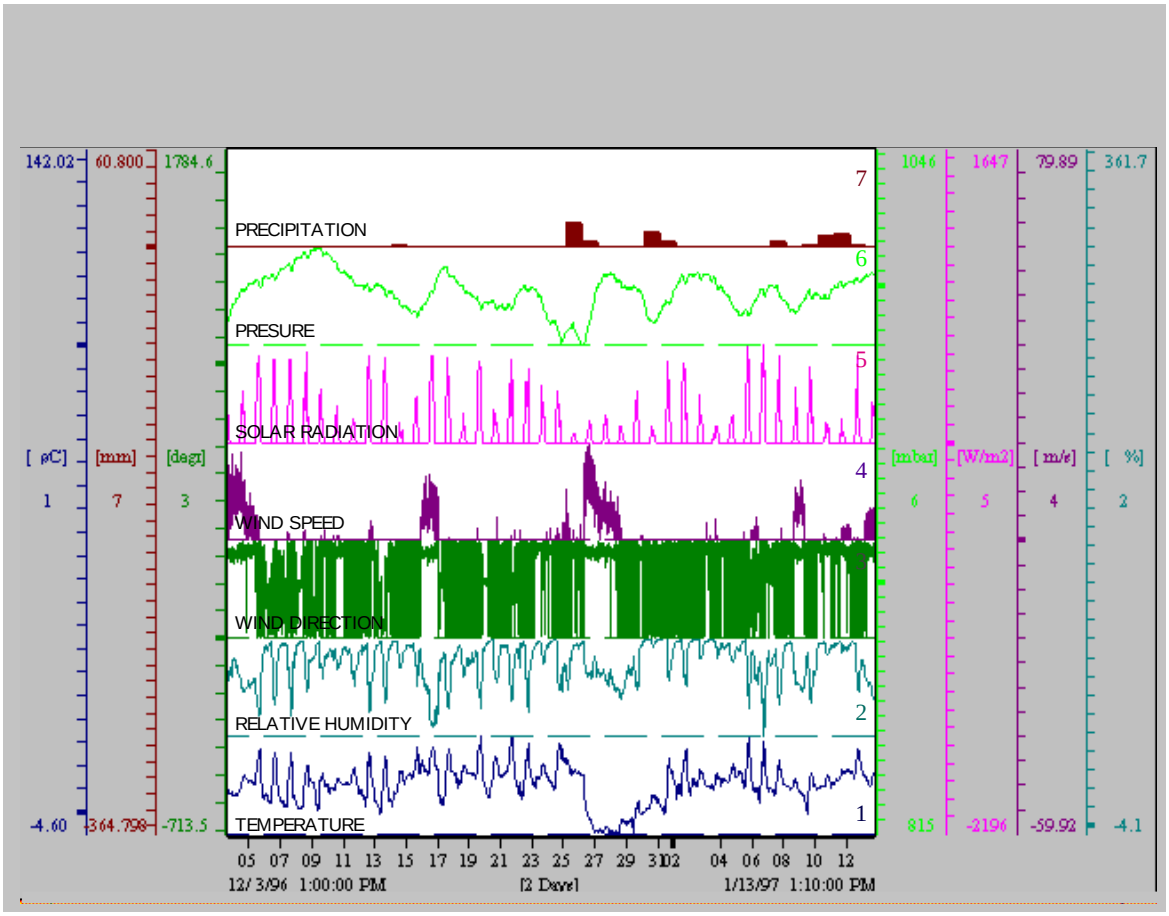

Fig.4 - Graphical display of registration of all sensors

The validation of the stored data is carried out with the multy parameter software package, which provide many options for tabular and graphic presentation of the measured values.

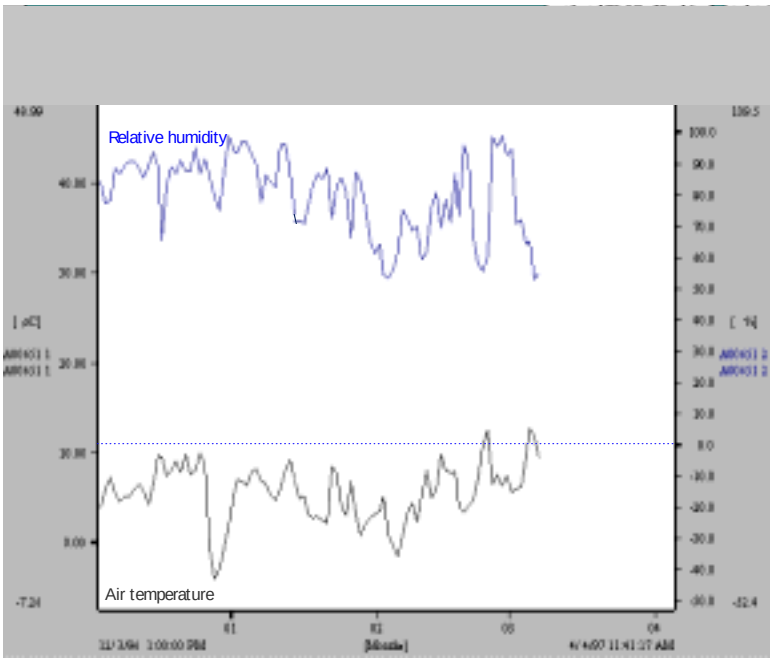

Fig. 5 - Graphical display of the air temperature and humidity for a three month period

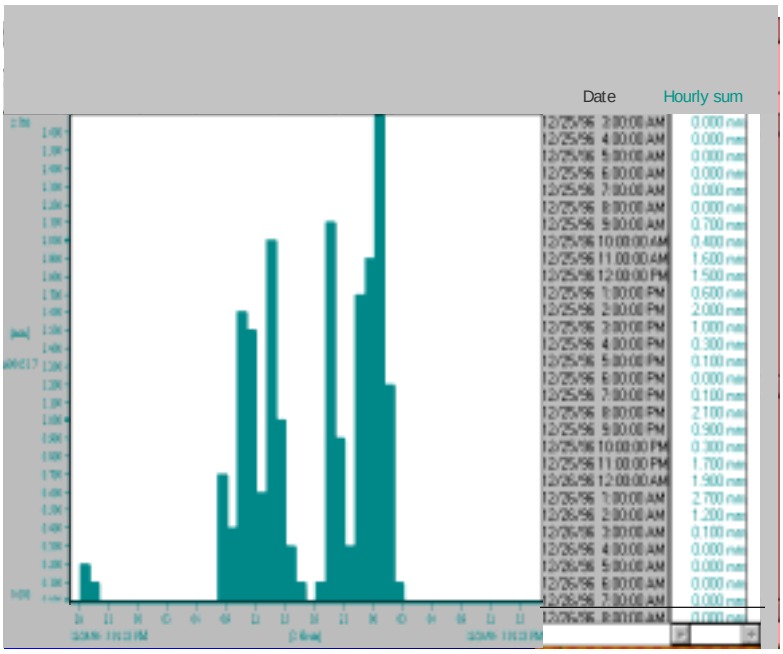

Fig. 6 - Graphical and tabular display of the hourly measurements of the precipitation sum

Beside the tabular and graphic presentation of all data, the analyze of each meteorological parameter can be done individually as well. There is also a possibility for complex analyze of two or more meteorological parameters. Also, the evaluation period can be enhanced from minute intervals to daily, monthly or annual period.

CONCLUSION

The automatic measuring system installed in Star Dojran with its five years of operation has created the necessary data base of relevant meteorological data for water balance components research, primary of the surface water evaporation estimation using complex empirical methods (Penman or other).

The installed system has a possibility for simple and economical upgrade, not only regarding the installation of additional sensors for automatic measurements of water level and temperature, but the improvement of the communication method and establishment of a real-time meteorological monitoring, as well.

Also, comparison of the AMS measurements with the classic method of meteorological measurement from the existing conventional meteorological instrumentarium on the nearby site will provide contribution toward the research of the compatibility of different methods of observation in the Macedonian meteorological network.

We look forward that the activities in the future period (including establishment of additional pluviometric sites along the coast line of the Dojran Lake, improvement and continuance of the AMS operation, etc.) will provide valuable information for time and space distribution of the meteorological parameters relevant for Dojran Lake ecological problem solution.