Modernisation of the National Meteorological Measurements Network in Croatia

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Abstract

Demands for the real-time weather data are growing in all fields of meteorology but especially in operational NWP, forecasting and alerting tasks. Currently, the operational measurements network consists of 478 surface stations, the 104 climatological and 334 rain-gauge stations are manned and the data are collected on paper and transferred by post after the end of each month. The Meteorological and Hydrological Service of Croatia (DHMZ) is about to start the project of Modernisation of Croatian Meteorological Measurements Network (METMONIC) funded by the European Regional Development Fund with 35 mil. EUR (without taxes). The project consists of automation of 437 surface stations (34 main, 139 climatological and 264 rain-gauge), introduction of new vertical profile measurements using a wind profiler and microwave radiometer at one location and a lidar at another location. The remote sensing network is going to be improved with replacement of three weather radars at current locations in continental Croatia, and introduction of three new radars along the Adriatic coast. New radars will cover areas that are currently not covered by any radar. Installation of five marine and meteorological data buoys will introduce oceanographic measurements and enhance the meteorological network.
All measurements on the surface meteorological network currently made by humans will be done by automatic weather station (AWS). This enhancement of the measurement network will hugely increase the flow of data coming to the DHMZ servers on daily basis, so the databases for data storage and processing should be improved. New sensors and new measurements of meteorological elements will require the introduction of new methods of data management and quality control. The new data should be merged with the old measurement data series. We plant to have sufficient metadata and parallel measurements for producing the climate data series of the highest quality. Requirements for the Data acquisition systems are to collect information from the weather sensors with 1Hz frequency, and compute 10 minutes (mean, min, max) values. All measured data will be open to the public.

Improvement of the Surface Network

Whole meteorological infrastructure (power supply, lighting protection, fences, foundations and musts, communications cables, etc., not buildings) will be renewed on all stations. Most of main stations currently have problems with electrical infrastructure and suffer damages from lighting.
Automatisation of the surface network is planned on the 437 locations, where the measurements are currently performed in the following way:

- 34- M-Main (professional) meteorological station with DHMZ employee (hourly) +old AWS,
- 139- C-Climatologically stations (measurements 3x per day),
- 264- R-Raingauge stations (24 hrs precipitation 06-06UTC).

It is planned to keep current locations for main and climatological station wherever possible. Most of the current climatological stations are placed on the private property and new AWS will be installed on public land owned by local or state government at locations nearby. Several main stations will be relocated as the current positions are not representative any more due to urbanisation. To facilitate the climatological series homogenisation, current human served stations will remain operational for as long as needed.

Raingauge stations will be running in parallel with the new system for a minimum of two years.

Numbers of locations planned for improvement and associated meteorological parameters:

- 173-Wind speed and direction (all M&C)
- 236-Air temperature and relative humidity (all M&C+63R)
- 9-Air temp at 50, 100 and 150 cm above ground (8M+1C)

- 173-Air temperature at 5 cm above ground (all M&C)
- 62-Soil temperature (27M+35C) & 27-Soil wetness (27 M)
- 186-Pressure (all M&C+13R)
- 437-Precipitation (all M&C&R)
- 34-Present weather and visibility (all M)
- 107-Precipitation type (98C+9R)
- 296-Precipitation detection (41C+255R)
- 187- Snow height (30M+89C+68R)
- 11-Snow characteristics (10M & 1C)
- 19-Evapotranspiration (18M +7C)
- 51-Sunshine duration (32M+19C)
- 20-UV-B radiation (17M+3C)
- 19-Total Solar radiation (18M+1C)
- 10-Diffusive Solar radiation (9M+1C)
- 2-Solar radiation components (2M)
- 3-Cloud base height-ceilometers (3M)
- 20-Sea surface temperature (13M+7C)

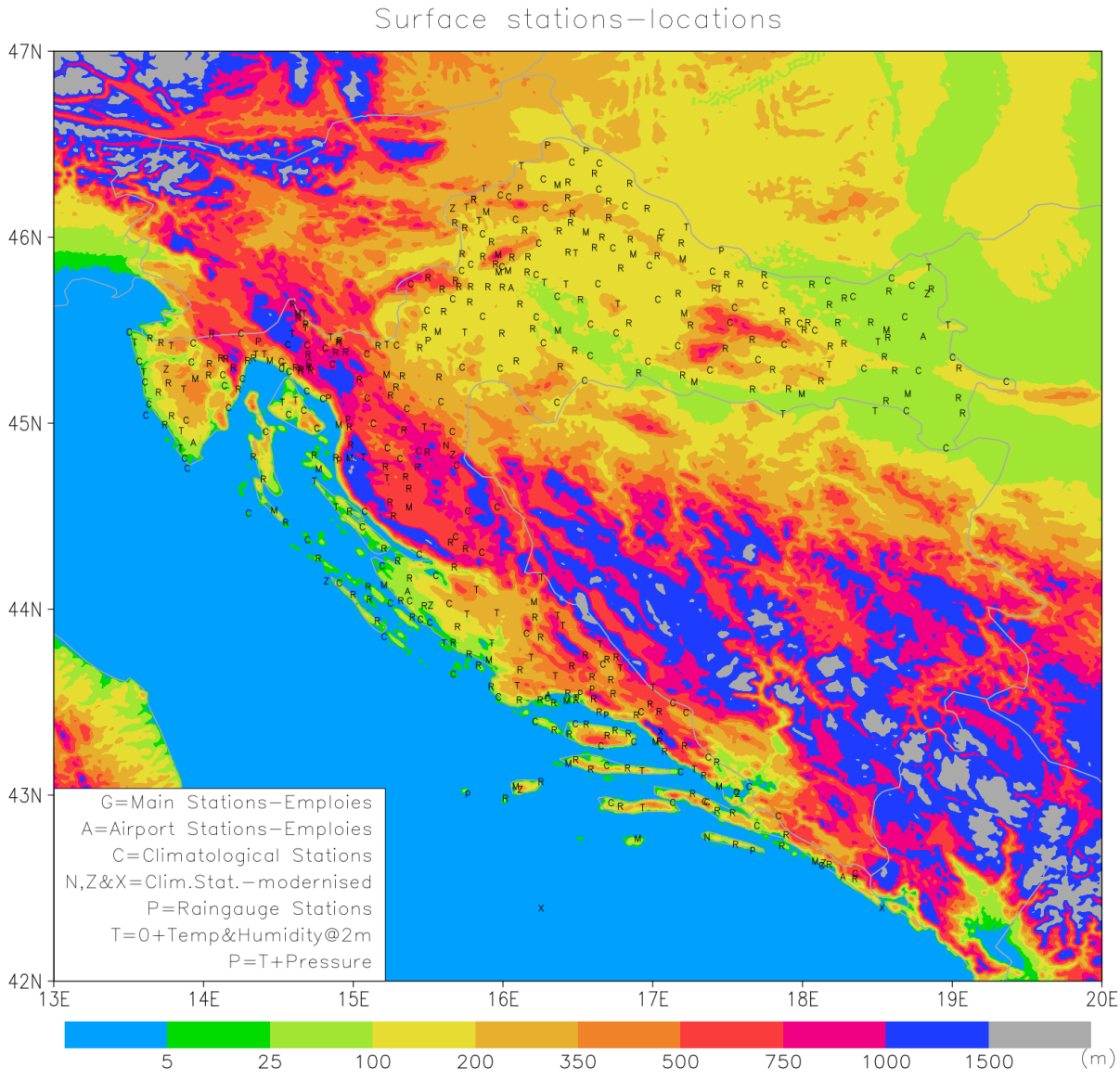


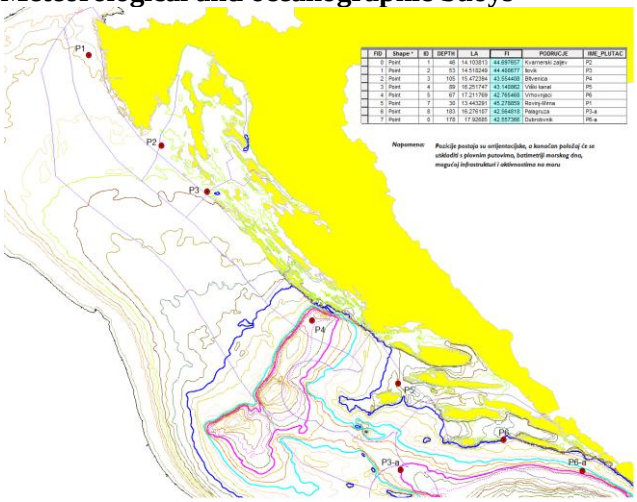
Figure 1. Planned surface meteorological network after the project finishes.

Upper-air and remote measurements

Figure 2. Upper-air and remote sensing network after the project.

Currently, there are two vertical sounding measurements, on locations Zagreb and Zadar, twice per day, at 00 and 12 UTC. New types of measurements will be introduced: continuous measurement of wind, temperature and humidity profile on a wind profiler and microwave radiometer on one location and a lidar at another. The remote sensing network: existing S-Band weather radars are going to be replaced with new C-Band weather radars (circles for range 120 km) in continental Croatia and three new radars are going to be placed along the Adriatic coast.

Meteorological and oceanographic buoys



Currently, there are no continuous measurements of meteorological parameters over the open sea surface. Project proposal is to have 5 buoys on the eastern Adriatic away from the islands. The data from these buoys will be used mostly for the early warnings.

Figure 3. Positions of possible locations of meteorological-oceanographic buoys, 5 out of 8 locations will be used in the project.

Upgrade of the calibration laboratory

Current DHMZ calibration capacity could not handle all the new equipment planned to be delivered and installed in the project. It is proposed to upgrade the laboratory with a wind tunnel for wind speed calibration, and upgrade the equipment for calibration of sensors for temperature, humidity, pressure and precipitation.

Upgrade of the data handling system

The upgrade of the measurement network during the project will increase the data volume and type transferred to the DHMZ servers on hourly basis. Therefore, the acquisition procedure must be reliable, quality control must be automated, and human intervention should be minimised. The databases for data storage and processing will be improved. New methods of data management and quality control will be introduce to handle the data from new sensors and meteorological elements previously not measured in DHMZ. The challenge of merging the data series from the old network with the new one will be handled by parallel measurements and metadata. This is expected to produce a homogeneous

climate data series of the highest quality. The data acquisition system should handle measured data with one second interval and produce 10 minute average, minimum and maximum values.

Data availability

All measured data will be open to the public and available to download for free. User friendly custom made platform will be developed during the project for the usage of professionals and public.

Conclusion

Main goal of the project is to provide accurate and reliable meteorological data on time to be used for climate monitoring, early warning system, NWP, forecasting for state and local government, private companies and the general public.