Upgrade and new developments of the automatic weather stations network in Austria

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Abstract:

The Central Institute for Meteorology and Geodynamics of Austria (ZAMG) has launched the project for the renewal of its presently operational meteorological networks consisting of AWS's (148 stations), and classical customary stations (120 stations). As in many other places and countries AWS should not only become the primary but finally the only source of surface observations. They are in use in synoptically, climatologically, environmental and hydrological applications. The realization phase starts in this year and we are sure that the new generation will again meet the needs of all parts of meteorology to help ensure that uncertainties associated with weather and climate data are minimized.

1. Introduction and history

In our country the beginning of automation of meteorological parameters was at the end of the 1970ies with the development of algorithms for data processing and recording. 1981 the first AWS was put into operation which was working autonomously, only with local storing on data tapes. Ten years later was the beginning of the network of AWS were the data are collected nearly real time and every 10 minutes is sent via leased telephone line to regional centres [1]. The network grew continuously and it comprises today 148 stations. But at the same time this means that the oldest station in our network reaches today an operational period of more than 23 years. For various reasons such as the difficulties in guaranteeing the renewal of the spare parts, a increasing old technology (field stations and central data acquisition station), a wear of the material, the lack of flexibility, an aging system of transmission of the data, etc, but also on the undisputable advantages of using AWS'S systems instead of customary stations like

- Increasing temporary coverage
- Providing data from data sparse areas where human observations are not practical
- Providing data continuously at frequent intervals and for any observation time
- Eliminating the subjectivity in manual observations
- Reflecting the requirements of all users of near real time synoptic data
- Supporting the trends to reducing model grid scale and the need for more observations to be available in shorter timescales

- Make-believe to reduce costs

Because of the topography of the Austrian territory and supporting the trends to reduce the grid scale and increase the time resolution of meteorological models an increase of the density of AWS in Austria is required. At the other side a significant reduction of the overall costs of operation of measurement network is necessary. Therefore the following decisions were made:

- Shut down of all manually operated classical climatic stations
- Increase of the network of AWS up to 200 - 220 stations
- Substitution of the present AWS with a new generation of AWS
- Improvement of the sensor equipment of AWS

This project has to be completed within 2007.

2. Present system of AWS

The configuration of a standard AWS is shown in Fig. 1. The system consists of a Central Unit for power supply and data processing and a limited number of sensors connected directly to the Central Unit. The real time data telegrams are requested by the regional center every 10 minutes. For data transmission a special secure transfer protocol with subcarrier transmission on analog telephone lines is used. Because of the sensor specific design of the Central Unit the operation of new sensor types at this system is impossible. The hardware and software of the Central Unit are state of the early 1980ies. The source code of the system is not available, therefore also known bugs of the system can not by repaired. Even spare parts for this stations are available very difficulty.

One of the weak points of the present system is the direct connection between sensors and Central Unit via long cable lines (up to several 100m). This causes problems with electromagnetic interferences on the measurement increases the probability of faults.

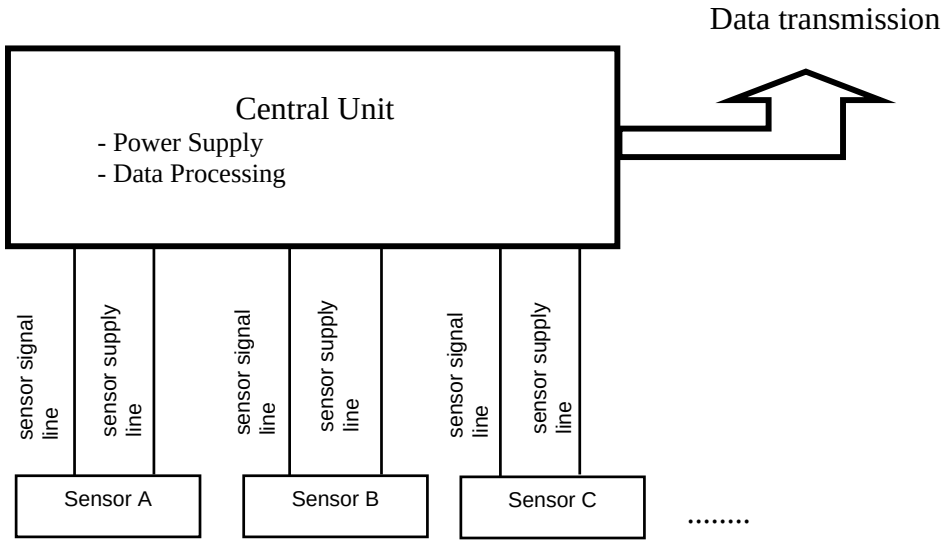

Fig. 1: Configuration of a standard AWS

3. New system of AWS

For the extended network of AWS in a new designed AWS has to be developed. In order to ensure a maximum of flexibility and reliability at one hand and reducing the cost of operation at the other hand the system has to fulfill the following requirements[2,4]:

- Installation of a bus system for power supply and data transmission
- All sensors are connected to the bus with appropriates interfaces
- Application of fiberoptic or short distant radio transmission for data transmission in the bus system.
- With universal interfaces between sensor and bus system the AWS can operate arbitrarily sensor systems with different signal output (digital, analog or digital telegram)
- The extension of the system for special sensors (present weather sensor, visibility sensors, ceilometer etc.) is possible without modifications on the basic system.
- The modular design of the AWS ensures more reliability an reduced fault rate.
- As a second way of transmission and for remote configuration of the AWS a standard GSM link is installed. In order to ensure a reliable data transmission also in case of public emergency, the same data transmission system as in the present system (secure transfer protocol with subcarrier transmission on analog telephone lines) is employed.

The supplier of system shown in Fig. 2 has to be determined in an international advertisement released in January 2005.

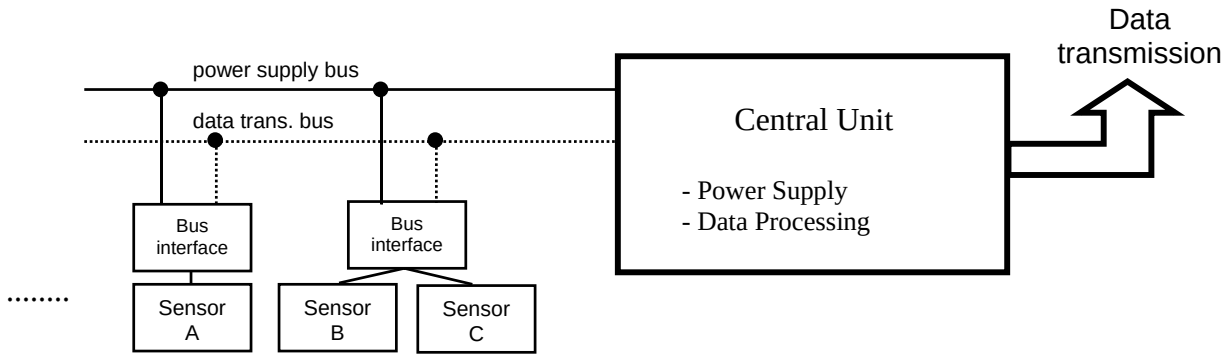

Fig. 2: Configuration of the new AWS

4. Improvement of the sensor system

In the last decade many new sensor systems for various meteorological parameters were developed and tested in national and international comparisons (e.g. WMO and EUMETNET[3,6,]). The

general trend is to replace sensors with moving mechanical parts with static systems. This sensor systems ensure a noticeable reduction of cost of operation and an increase of reliability even under severe conditions. Several sensor types in operation in the present system of AWS are no longer available and need to be replaced by others, whereas several other sensors of the present system with excellent characteristics are employed also in the new system.

In Tab. 1 the sensor configuration of the present and the future AWS is shown.

Parameter	Sensor Type	
	Present AWS	Future AWS
Air temperature	NTC	NTC
Soil temperature	NTC	NTC
Relative humidity	Hair hygrometer	Hair hygrometer
Amount of precipitation	Tipping bucket or weighing gauge	Tipping bucket or weighing gauge
Precipitation detector	Resistive sensor	Optical sensor
Wind speed and direction	Cup Anemometer	Ultrasonic Anemometer
Sunshine detector	Rotating Shutter	Static detector
Global radiation	BW pyranometer	BW pyranometer
Pressure	Electronic aneroid barometer	Electronic aneroid barometer

Tab. 1: Sensor systems in AWS network

5. Conclusion

With the upgrade of the automatic weather stations network in Austria a quantitative and a qualitative improvement of the measurement of meteorological parameters in Austria is ensured. With the network of 200 AWS a station should be representative for approximately 400 km² (20x20km). The increase of the temporal resolution of the measurement data in real time is required by different users of meteorological data [5] and especially for inputs in local area numerical models (e.g. ALADIN). The standardization of the network would make it possible to optimize the operational aspects by decreasing the costs of operation.

6. References

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