4.2 INSTRUMENTAL QUALITY CONTROL ON RAW DATA COLLECTED BY AUTOMATIC WEATHER STATIONS OF A NEW GROUND-BASED MEASUREMENT NETWORK IN SWITZERLAND

Y.-A. Roulet*, J. Rast, A. Heimo, B. Calpini
MeteoSwiss, Aerological Station, Payerne, Switzerland

1 INTRODUCTION

Among its duties, MeteoSwiss is responsible for the operation and maintenance of a meteorological and climatological network guaranteeing regular measurements on the entire Swiss territory. The ground-based network is currently being renewed by MeteoSwiss, under the project SwissMetNet (Heimo et al., 2005). With this project, MeteoSwiss will have a state-of-the art unified network, composed of 130 automatic weather stations, measuring ca. 20 meteorological parameters and 20 housekeeping values.

In order to ensure reliable output data, instrumental quality control is performed on the raw data (meteorological and housekeeping parameters) at two levels. The first level computes online plausibility tests (real-time control), and delivers instantaneous alarms. The second level is a quality control performed on an operational way each night over the entire network, using the measured raw data from the past 90 days. The aim of this control is to detect drifting values due to instrumental problems, which are not seen by the first level control, and hence to avoid "*a fortiori*" gaps in time series due to non-valid data. This paper focuses on the development and operational implementation of this second quality control on raw data within SwissMetNet.

2 SWISSMETNET PROJECT

2.1 General

The main goal of the SwissMetNet project is the renewal of all the automatic and conventional meteorological networks existing in Switzerland, operational under the direct responsibility of MeteoSwiss.

The SwissMetNet configuration is made up of the following station types:

- 51 climatic stations of type Westa B (full stations of highest quality)
- 49 complementary stations of type Westa S1 (identical to WESTA B with reduced instruments configuration)
- 35 complementary stations of type Westa S2 (simplified stations, reduced instrumentation)

2.2 Data transmission

The selected configuration has following characteristics (cf. Fig. 1):

- All the weather stations are connected to the blue network (the secured BV-NET).
- All service PCs are connected to the blue network.
- The central station CDAS/NIMDAS (Central Data Acquisition System/Network and Instrument Monitoring and Data Analyzing System) is connected to the blue network.
- The central station CDAS/NIMDAS is connected to the Message Handling System (MHS) located on the unsecured MeteoSwiss LAN. Bulletins are sent through the MHS to the Data WareHouse (DWH) of MeteoSwiss.
- All information concerning the network has to be stored on the DWH only. A special link allows for the backward transmission of the needed information (station configuration, instruments characteristics, etc.) to the CDAS/NIMDAS and the ADASs (Automatic Data Acquisition System).

* *Corresponding author address :* Yves-Alain Roulet, MeteoSwiss, Aerological Station, 1530 Payerne, Switzerland ; phone : +41 26 662 62 58 ; email : yves-alain.roulet@meteoswiss.ch

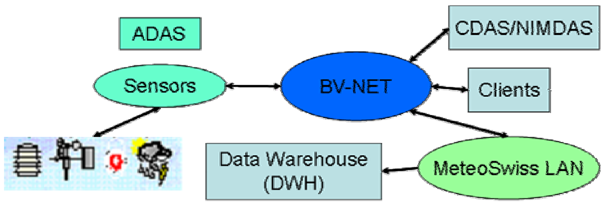

Figure 1: Schematic display of the configuration of the BV-NET transmission network.

3 QC OF THE NEW WEATHER STATIONS

3.1 MetConsole

MetConsole is the front end tool from where all the functionalities of the CDAS/NIMDAS tool can be accessed. MetConsole monitors the state of the whole system and handles all the communications between CDAS/NIMDAS servers and clients. It gives an overview of the state of all stations in a map display and all measured quantities are displayed numerically and graphically.

Three types of alarms can be distinguished:

- System alarms and alerts, e.g. when the communication to an ADAS fails, when a server is down, etc.
- Plausibility alarms, i.e. violation of an upper or lower limit, too high variability or dead band situation (no variability) of a house keeping or meteorological value measured by the ADAS
- Meteorological alarms, i.e. special alarms used for realtime warnings of high wind speed, precipitation, temperature extremes, pressure drops and radioactivity

The alarm list is constantly monitored by an operator. In the case of a malfunction of the system, a station or a sensor, the appropriate action will be taken.

3.2 MetConsole+

The second QC level, MetConsole+, is performed automatically off-line every night, using raw data of the past 90 days stored in a local DataMart. All measured parameters (meteorological and housekeeping data) are tested. The objective of MetConsole+ is to detect anormal trends in a time serie, e.g. caused by a drifting sensor, or instrumentation disfunctions. For that purpose several types of tests are processed:

- Statistical values must stay within a pre-defined plausiblity range, e.g. floating average over a certain period of time (cf. chapter 4).
- Time series are tested against redundant measurements at the same station (when available, e.g. temperature at 2m a.g.l.).
- Time series are tested gainst correlated values at the same station (e.g. shortwave incoming radiation and luminance).
- Time series are tested against the same parameter measured at a neighbour station (e.g. air pressure).

A list of alarms is automatically produced after each control cycle.

The criterias to determine plausibility range of each parameter in MetConsole+ are defined using following techniques or information:

- Laboratory tests on sensors, in order to increase know-how on their behaviour
- Analysis of past sensors breakdowns
- Specifications of the sensor given by the supplier

4 EXAMPLES

4.1 Anemometer

An anemometer breakdown at the Aigle station (cf. Fig. 2) was detected on-site by a technician on June 18th 2004. It is a typical case resulting from the wear of a bearing of an anemometer SCHASTA. This malfunction is very difficult to detect directly because the measured values remain in the tolerances until the sensor is completely out of order.

Figure 2: Location in Switzerland of the Aigle station (blue) and the Fey station (magenta) used for comparison.

The most powerful indicator for this type of defect (slow seizing of the bearing of the winch) is the running mean of calm number (vectorial wind set to zero after 10 minutes) observed during a period of time, i.e. 5 days (cf. Fig. 3). Analysing the history of this indicator in the last months preceding the breakdown detection, and comparing it with the same value for a neighbour station (FEY), showed that posing a threshold of 6 for the running mean would have allowed the problem to be automatically detected by end of April, that is to say two months before its effective detection.

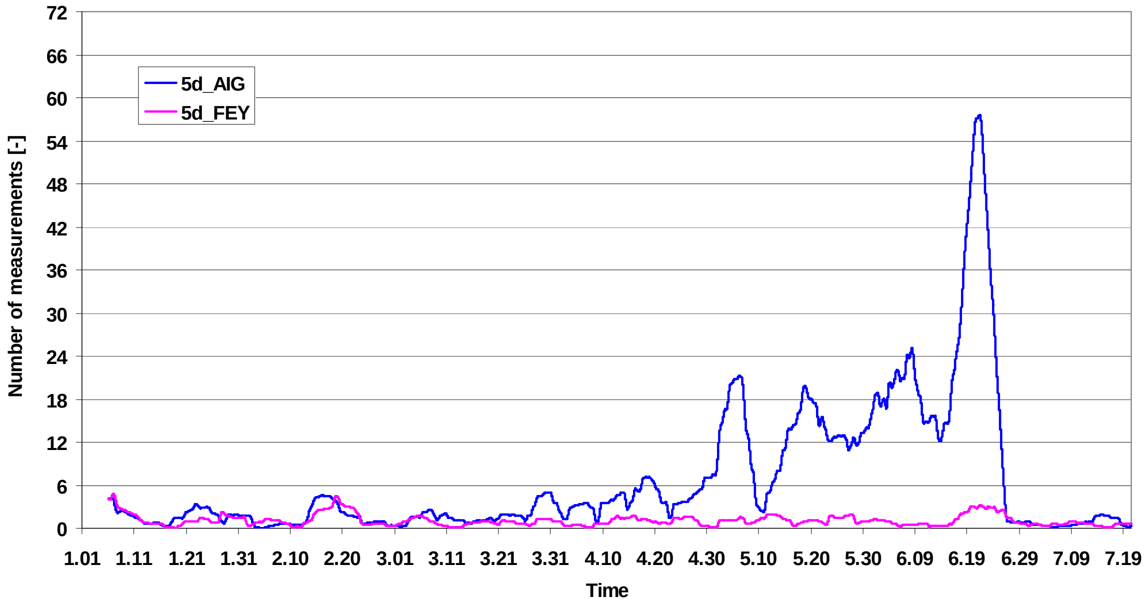

Figure 3: Running mean over 5 days of the number of measurements (10 min average with a sample time of 1 sec) with zero wind velocity at AIG and FEY stations from 01.01.04 to 20.07.04.

5 CONCLUSION

The development on MetConsole+ in an operational tool is a must for guaranting quality in time series of measurements from the new SMN weather stations. Following the implementation of the SMN network, MetConsole+ will be developed and implemented during 2006.

LITTERATURE

Heimo A., Konzelmann T., Calpini B., Rast J., Tschichold N., Grüter E., 2005: SwissMetNet: Renewal of the Swiss Meteorological Networks, *WMO-TECO-2005*, Bucharest, Romania, 4-7 May 2005.