The data quality control chain for automatic surface observation data at MeteoSwiss

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Technical survey – detecting of sensor troubles

The technical test chain for automatic surface observation data at MeteoSwiss is designed for detecting instrument failures and sensor troubles based on housekeeping quantities combined with climatological parameters. The technical part of quality control allows the monitoring of ground-based stations and has no effect to the data series. Onsite instantaneous alarms

Each meteorological station has a local Automatic Data Acquisition System (ADAS) which among others delivers instantaneous alarms (e.g. windalarms or alarms for surface freezing) directly to the clients.

Real-time control (plausibility tests online)

In the Central Data Acquisition System (CDAS) real-time controls are performed, using an integrated quality control with threshold values and dead band criterias to detect instrument failures. These online plausibility tests deliver instantaneous alarms and warnings to a network surveying center.

Climatological survey – flagging of suspicious data / removal or correction of faulty and missing data

The tests for climatological survey are classified into four main categories (according the recommendations of WMO). Their goal is the cleaning and enhancing of climatological time series.

- Limit tests. Most variables are compared to physical hard (e.g. 0 and 360 deg for wind direction) and climatological soft (limit) values.
- Variability tests. There are different types of variability tests: one which tests the maximally allowed variability during a specified time interval and one which tests the minimal required variability during a certain period (dead band range).
- Inter-parameter consistency tests. Values measured at the same time and at the same place may not be inconsistent to each other (e.g. 8 octas of total cloud cover with bright sunshine).
- Spatial consistency tests. Values of the same parameter measured at the same time at nearby stations may not differ too much.

Inter-parameter integrity

At MeteoSwiss the inter-parameter integrity is checked at high temporal resolution (10 min). The chain is divided into two deferred modules, C&C and PuM.

In order to assure that both modules use the same set of tests and constants, the control data is implemented as the core of the QC system. All about 220 inter-parameter integrity tests are in operation. The modules use a unified testing procedure consisting of the ‘plausibility information’ (a bitmap indicating the test violations) and a ‘treatment information’ (indicating the correction if one was applied). The web based application for submission of visual observations is also linked to this system. The system returns quality check information directly to the observer white transmission.

PuM Module: Plausibility and mutation

This process starts automatically once a day and is split into a part of automatically treatment and a second part which allows an interactive checking and manual mutation of data for stations with a high climatological importance.

In a first step, the data are tested in a similar way as in the C&C Module but including tests for temporal variability. In a next step PuM automatically generate replacement values, if there are short gaps in the data (5% at maximum) with mean rational spline method (Fig. 4). Interpolation cases, which can not be handled automatically, as well as suspicious values which violated any integrity test, are handed over to the interactive process.

Spatial integrity

The spatial integrity tests use spatial-temporal information to find suspicious data and to provide objective interpolation values. At MeteoSwiss two different methods are in use for spatial quality checks.

VERA QC

Based on the SYMAP gridding algorithm for precipitation (Frei and Schär, 1998) an objective method to detect suspicious daily sums is implemented. One of the main challenges is the spatial interpolation in complex terrain of the Alpine region. The spatial precipitation QC method helps to objectify treatment of precipitation data and to reduce the workload for the data editors (incl. splitting of several days measurements). They can concentrate on editing outliers instead of finding them.

VERA QC Module was developed at the Department of Meteorology and Geophysics at the University of Vienna (Steinacker et al., 2000). The VERA spatial interpolation algorithm is used to generate a virtual comparative measurement (hourly values for temperature, humidity, pressure and wind components). This virtual parameter can be easily integrated in the existing PuM infrastructure and can be used for plausibility tests as well as for improvement of the automatic interpolation (Fig. 4). In near future VERA QC will be integrated into the operational QC chain.

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References


Frei, C. and Schär, C., 1996: A precipitation climatology of the Alps from high-resolution radiosonde observations. Int. J. Climatol. 16, 873-891

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Fig. 1: SwissMetNet – the new automatic meteorological ground-based network of Switzerland

quality control in time (QCT) daily

C&C Module every 10 min

PuM Module Spatial precipitation QC VERA QC daily

Homogenisation every few years

level 1

level 2

level 3

level 4

level 5

Data Warehouse

Fig. 4: GUI for interactive checking and mutation (e.g. soft limit violation)

The tool for interactive processing has a graphical interface which presents the data on a spreadsheet and as time series plots (Fig. 2).

At any stage the operator can test the corrections and confirmations. If there are no more tests violated, the case is considered as being solved.

Fig. 6: Comparison between different interpolation methods (gap 6h and 12h)