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TITAN software for the quality control of in-situ observations and its application on amateur weather station data

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The data quality control has always been a crucial task in any operational chain aimed at providing reliable atmospheric observations for climatological, meteorological and hydrological application. The sharp increase in the number of in-situ observations, the pressure to provide real-time products at hourly -or sub-hourly- time rate and the diversification of the observing systems pose new challenges to the developer of quality control tools.

TITAN addresses quality control from the point of view of the operational daily routine within the Norwegian Meteorological Institute (MET) where the in-situ observations of essential climate variables are used not only to provide observational gridded datasets but also in the post-processing of the weather forecasts available to the general public on the widely used platform yr.no. The pillars on which TITAN has been designed are: (i) all the available observations need to be to quality controlled, from professional weather stations managed by expert staff at MET to amateur stations; (ii) the procedure must be quick and robust enough to serve real-time applications. By using all the available information we accept to use stations that may have a very short time-series available, such as some of the amateur stations, though being aware that an higher level of uncertainty must be associated to the quality of their observations. A viable solution is then to exploit the expected spatial consistency and continuity of the meteorological fields to detect suspect observations. In fact, spatial data quality control allows us to develop reliable routines that can be used in operational chains.

TITAN tests all the observations referring to the same observation time simultaneously and it has been tested for surface variables: air temperature, total precipitation and relative humidity, at daily and hourly time steps. Available checks are (applied sequentially as in this list, though the actual application and configuration of each test is variable-dependent): Plausibility check; Climatological check (predefined range for each month); Buddy-check; Isolated event test (STEVE) both over and under multiple thresholds; Check against a deterministic first-guess field, such as a numerical model output or remote sensing-derived gridded field; Check against an ensemble of first-guess fields; Spatial Consistency Test (SCT); Check elevations against digital elevation model; Detect isolated observations. The system is configured such that is possible to have observation black-list.

We will present the application of TITAN over significant case studies and by means of summary statistics on its performances. As an additional element of interest, a dense network of amateur weather stations undergo the TITAN quality controls.

TITAN is currently under development at MET and it is linked to several projects. The code is open-source and available online at https://github.com/metno/TITAN.