About KNMI

The Royal Netherlands Meteorological Institute (KNMI) is the Dutch national weather service. Primary tasks of KNMI are weather forecasting, and monitoring of weather, climate, air quality and seismic activity. KNMI is also the national research and information centre for meteorology, climate, air quality, and seismology.

The Netherlands is a densely-populated, highly-technical community in a delta area. In the event of disasters, the chance of human loss and economic damage is high, which is why safety, as well as habitability and accessibility, have been high on the political and social agenda for many years. Among other things, this includes the consequences of extreme weather conditions, climate change, sea level rise, earthquakes, air quality, volcanic ash and solar storms.

KNMI focuses on monitoring and warning for risks with an atmospheric or seismic origin. In addition, KNMI offers advice and strategy prospects for both acute and future dangers. In order to improve future advice and therefore reach risk reduction, we actively seek to learn from past events. We do this together with our environment: the general public, authorities and (weather) businesses. We continuously innovate our service and thereby create (sustainable) economic opportunities for business, while we contribute to keeping the Netherlands safe, accessible and habitable.

KNMI provides interns with a stimulating and diverse environment. More specific information (in Dutch only) about the possibilities and incentives can be found at

https://www.werkenvoornederland.nl/starters/stages-afstuderen

Data Validation at KNMI

The KNMI is constantly optimizing its measuring network. Including new sources of data, e.g. from crowd sourcing, requires new and innovative data validation methods to ensure the high quality KNMI is known for. The following projects are aimed to be stepping stones towards an automatic validation of these data (see next pages).
Advanced methods for Automated Quality Control for an extensive Observa-
tional Network.

The European Climate Assessment & Dataset (ECA&D, http://www.ecad.eu) is a dataset with over 10500 stations covering Europe and the Middle East providing daily values of the Essential Climate Variables (like maximum, minimum and averaged temperature and precipitation). These observations are sourced from the National Meteorological and Hydrological Services (NMHSs) in Europe. When these data are inserted in the ECA&D dataset, a simple quality control is applied. One aspect of the quality control is the detection of outliers by comparing each value against a fixed threshold, which is independent of location and elevation and independent of season.

In this research proposal, a new and more advanced method for quality control will be developed which should be applicable to Europe with its wide range of climates and areas with complex topography. Part of the research will be to thoroughly test the new approach and implement it in the operational structure. Extreme value statistics (Coles, 2001) are used as the basis of this method and similar approaches are developed and implemented at the Finnish Meteorological Institute (Hasu and Aaltosen, 2011). Particular attention will be given to the differences between results of a quality check method that considers values of neighbouring stations and an “absolute” approach, aiming at determining the best procedure for detecting ECA&D data issues. The difficulty with automated outlier checks is that the extremes in temperature are usually what the scientific community (and the general public) are interested in, making the reliability of the method important.

Initially, automated range checks for temperature (daily maximum and minimum) will be looked into. When time permits, outlier checks on precipitation will be developed as well.

The research is done at KNMI, de Bilt, and supervised by Antonello Squintu and Gerard van der Schrier. Contact Gerard (schrier@knmi.nl) for further details.

References:


Slippery roads

The temperature of the Dutch highways is measured by the “gladheidsmeldsysteem”. The system, from Rijkswaterstaat, is currently used for warnings of slipperiness. The total of 330 stations measure the road temperature, air temperature and dew-point temperature since 2009. The current validation method flags measurements with a large deviation from the average as suspect. The goal of the project is to improve the real time validation method using both spatial and temporal aspects.

Station description:

Each station consists of up to 12 read temperature sensors, one air temperature sensor, one sensor below the road and up to 12 conductivity sensors (measured in micro Siemens). This last sensor provides an indication if the road is dry (below 4 micro Siemens), wet or wet with salt. The sensors measures every 5 minutes. Ideally the different sensors are combined for the validation.

Types of error that can occur include:

- A sensor measures the same temperature for the entire day, this is highly unlikely.
- A sensor measures extreme high temperatures (for example 70 degrees).
- Systematically the sensor measures a couple of degrees lower than the other sensors.

Using the different sensors at a single station and time series at this location it is expected that most of the errors can be found. However, most stations have less than 12 sensors. Problems with the validation can occur when from the few sensors measuring more than 1 has problems. Ideally stations close to one another are smartly combined.

The research is done at KNMI, de Bilt, and supervised by Lotte de Vos and Marieke Dirksen. Contact Marieke (dirksen@knmi.nl) for further details.
How to clean up drifting air pollution?

In many Dutch cities air pollution is a serious problem. Air pollution, however, is hard to measure. The official monitoring network contains about 50 stations scattered over the country. This is not enough to resolve the street-to-street variability found in cities. New low-cost sensor technology has the potential to create a dense urban monitoring network which can fill in the blind spots. However, the current generation of sensors suffers from cross-sensitivities, meteorological dependencies, and signal drift.

Last summer a pilot project (Urban AirQ) was organized in Amsterdam, in which 16 experimental air quality sensors were distributed among volunteers living close to roads with high traffic volume. A preceding calibration period at a reference station shows that for accurate measurements of air pollution a regression analysis including temperature and humidity is essential. When the sensors are brought back to the calibration site after the two-month campaign, each reveals a significant – and apparently unpredictable – drift.

Goal of this project is to better understand how these experimental air quality sensors drift. How can we detect and describe this drift from the Urban AirQ data set? It will improve the applicability of low-cost devices, and a further step towards monitoring the air we breathe in our street.

More information:

- waag.org/en/project/urban-airq
- www.luchtmeetnet.nl
- www.snuffle.org
- www.samenmetenaanluchtkwaliteit.nl

The research is done at KNMI, de Bilt, and supervised by Bas Mijling. Contact Bas (mijling@knmi.nl) for further details.
Development of online monitoring of calibrations

KNMI operates an extensive network of instruments to collect data about the state of the atmosphere. Variables that are measured on an operational basis are temperature, relative humidity, pressure, precipitation, solar radiation, visibility, wind speed and –direction. All operational measurement instruments at KNMI are calibrated at regular intervals to ensure traceability, correct functioning of the sensors, and to limit uncertainty due to sensor drift.

These calibrations are executed in the KNMI calibration lab, and the results are collected in a database. The procedure is as follows: immediately when an instrument is taken from the field, a calibration is performed to check what has been the drift over its period in the field. Then the sensor receives maintenance and is stored in the cabinet, ready to be used again. Just before it is placed back in the field, another calibration is done. During the calibrations, the instrument is accepted or rejected based on whether a threshold value is exceeded.

Most probably the initial variable to be investigated is humidity, which is calibrated in a high-tech climatic chamber. These sensors have a tendency to drift and given issues with the uncertainty of humidity sensors, the claimed uncertainty by the manufacturer should be validated. The goal of the project is to evaluate the statistics on the available data, and develop online and automated monitoring.

Some applications are:

- Investigating whether the calibration period could be extended and its impact on the measurement uncertainty.
- Monitoring degradation of the sensor pool by statistical analysis to predict higher rejection rates, and foresee the need for replacement of the instruments.
- Identifying deviations in trends and investigate the cause for this, which could lead to better understanding of the instrument, and its impact on the measurement uncertainty.

The research is done at KNMI, de Bilt, and supervised by Tiemo Mathijssen. Contact Tiemo (mathijss@knmi.nl) for further details.