Determining and Reporting Uncertainty in Atmospheric Reference Network Measurements

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Background

Atmospheric reference networks have been established to provide long-term high quality data on key atmospheric measurands including essential climate variables.

The metrological challenge is how to determine the uncertainties in these data and report in a way that is accessible and usable for the wide range of potential applications and user groups for these data.

Application-driven uncertainties

A particular challenge in reporting atmospheric network measurement uncertainties is that the applications cover a wide breadth of timescales, from short term process studies through instrument intercomparison and satellite validation studies to long-term trend studies.

A methodology has been developed for assessing and reporting the traceability and uncertainty of atmospheric data products for different user communities, initially under EU Horizon2020 project GAIA-CLIM and refined within Copernicus Climate Change Service activities.

Uncertainty assessment process

In order to obtain the final uncertainty, a full process chain is developed that identifies each and every element in the process that affects the final results.

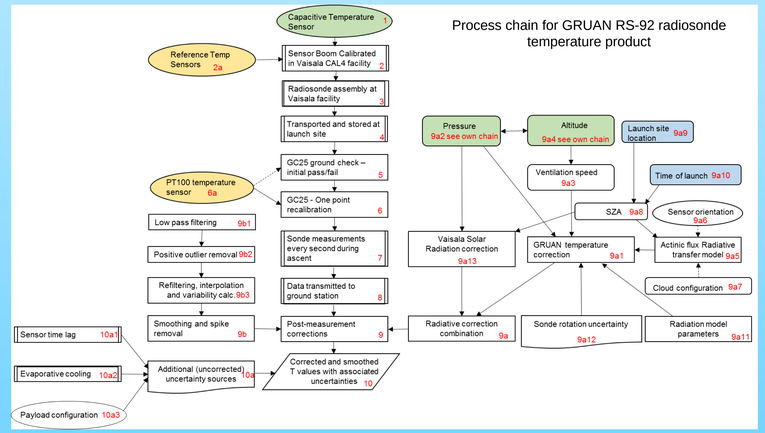
The uncertainty of each element in the chain is then assessed including consideration of how they behave over different timescales.

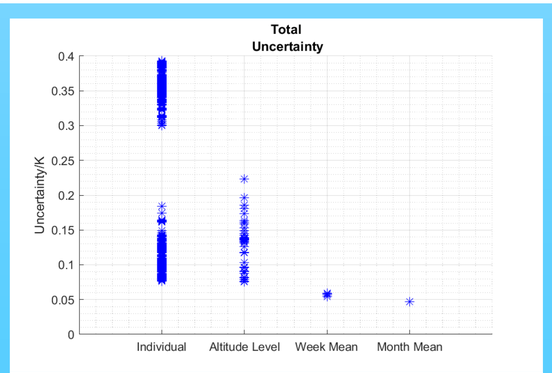
Individual uncertainty contributions are then propagated through the process chain to provide uncertainties over different timescales.

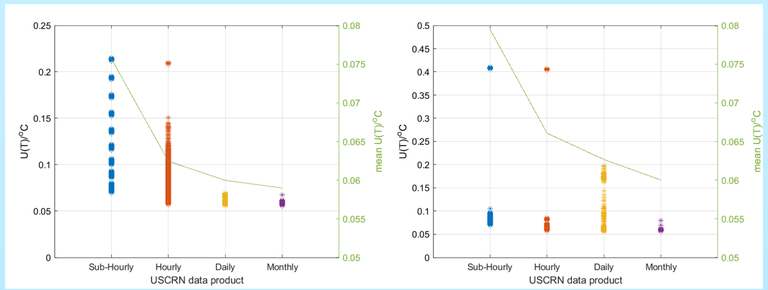
Case Studies – GRUAN and USCRN

Results from two case studies for temperature measurements are given from:

- the Global Climate Observing System (GCOS) Upper Air Reference Network (GRUAN) which provides reference quality data on priority upper atmospheric parameters (process chain and temporal uncertainty behaviour).
- NOAA's U.S. Climate Reference Network (USCRN) which provides future long-term homogeneous observations of key surface parameters relating to climate change (temporal uncertainty behaviour).







Possible and mean values of uncertainty for different data products from the OK-Goodwell 2 SE USCRN site including +ve and –ve systematic terms.

Conclusions

Methodology developed for reporting uncertainties in atmospheric reference networks and applied in two case studies which provides a summary of all potential uncertainty contributions (and gaps in this knowledge).

Reporting uncertainties on different timescale provides a simple way for different users to identify relevant uncertainty for their application.

In both case studies the availability of extensive metadata was critical in enabling the full uncertainty assessment.

Recommendations for next steps

- The wider dissemination of such metrological methods to atmospheric measurement providers supported by case studies of the impact and benefits of the improved knowledge of the relevant uncertainties.
- Further collaboration with atmospheric measurement users to define and deliver the uncertainty reporting requirements of the diverse user needs.

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