



Weather data for climate change

To understand climate change, scientists need detailed data on many different environmental parameters. Data on temperature, humidity and pressure – currently captured by weather stations for forecasting – could provide important additional data for climate monitoring. But to use this data reliably, climate scientists need confidence that measurements collected from different stations, which are managed and calibrated by several different networks, are comparable and can be robustly linked to the SI.

Europe's National Measurement Institutes working together

The European Metrology Research Programme (EMRP) brings together National Measurement Institutes in 23 countries to address key measurement challenges at a European level. It supports collaborative research to ensure that measurement science meets the future needs of industry and wider society.

Challenge

The World Meteorological Organisation (WMO), a specialised agency of the United Nations, oversees global monitoring of the Earth's weather. This includes maintaining networks of Automatic Weather Stations (AWS) which measure temperature, humidity and pressure around the world, data which is used to make short term local and national weather forecasts. This data could also be used by climate scientists as a way to monitor long term global climate change trends and assess the effect of mitigation initiatives.

Weather monitoring networks are run independently, by national or supra-national bodies. Each use their own instrumentation and measurement approaches and have their own calibration labs. This works well for local forecasting, but climate researchers need to be sure they are looking at a consistent set of global data between networks.

The WMO runs the Commission for Instruments and Methods of Observation (CI-MO) which is responsible for ensuring instrument accuracy across networks. Through this agency, it hopes to harmonise measurements across global networks, so all results are comparable and traceable to the same standard, and have links to the SI. To do so, it needed to develop methods to test the ability of calibration labs to perform reliable and consistent calibrations.

Solution

The EMRP Project *Metrology for Essential Climate Variables*, identified suitable existing instruments for reliably measuring temperature, humidity and pressure, and a protocol for using these to confirm calibrations.

The instruments were identified based on their robust links to the SI, stability over time, and suitability for transportation to different labs around the world without losing accuracy. The project developed a protocol for setting up and using these instruments, which enables the comparison of calibration lab performance using the same instruments as a reference. This allows different AWS networks to compare their calibrations against SI-linked instruments and demonstrate their proficiency.

Impact

Following the project, the WMO requested a comparison between national monitoring networks throughout Europe, using the newly developed project protocols. This was performed by the University of Ljubljana, which sent out instruments to European calibration labs and collated the results. The comparison exercise demonstrated that European labs did indeed have good results. Their calibration labs' approaches can now be shown to be consistent and traceable to the SI, allowing them to confirm harmonised results.

The project derived protocol is now included by the WMO in a new CI-MO instrument guide on meteorological instruments and methods of observation that will be rolled out to AWS networks around the world. This will bring all AWS calibration labs in line with each other, creating harmonisation between global temperature, humidity and pressure measurements. As a result, climate scientists will have the confidence they need to use AWS data to inform ongoing climate monitoring and trend predictions. Feeding this additional data into climate models will improve their accuracy and help governments make better informed decisions about the best ways to mitigate and adapt to climate change.

Improvements for climate change monitoring

The EMRP project *Metrology for Essential Climate Variables* investigated the performance of various climate-monitoring instruments under conditions likely to be encountered in their upper atmosphere, deep sea, or mountain operating environments. It developed a humidity calibration chamber for radiosonde instrumentation used to monitor water vapour in the upper atmosphere, and a high-pressure calibration facility for temperature sensors used deep under the ocean. Automatic weather station performance was also assessed, leading to an increased understanding of the effects of back reflected radiation from the ground or surroundings on sensor accuracy. The project derived protocol for confirming the equivalence of calibrations performed on temperature, pressure and humidity instrumentation used at weather stations has been adopted by the World Meteorological Organisation Commission for Instruments and Methods of Observation for use in large scale laboratory performance comparisons. These developments will increase weather monitoring data accuracy and increase its potential for use in climate change predictions.



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