

Reference observations of upper air climate variables: The path to climate trends in the upper troposphere and lower stratosphere

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Climate trends of water vapor, temperature and other atmospheric parameters in the upper troposphere and lower stratosphere are still highly uncertain. To address this problem, the climate community has undertaken large efforts to instigate a reference quality network to ensure the future record. These efforts have been taking shape as the GCOS Reference Upper Air Network (GRUAN).

GRUAN places a strong emphasis on what defines a reference observation of an upper air essential climate variable (ECV). Upper air observations of ECVs by in situ techniques, in particular the observations of temperature and water vapor, often suffer from poorly characterized biases and random variations, which may impact the ability to detect long term changes in these parameters. The measurement strategy of GRUAN takes these weaknesses into account and tries to improve instrumental errors and random effects through a better characterization of the instruments in use, a better quantification of systematic and random errors, and a better verification of these derived instrumental parameters.

Key aspects of a GRUAN measurement revolve around traceability of the measurements to recognized standards, documented uncertainty estimates, measurement technology redundancy, extensive metadata collection, and archiving of raw data in addition to processed data. Establishing long term climate series also requires that the measurement program accommodates a strategy to manage changes in instrumentation. A detailed understanding of the instrumentation and the associated processing algorithms provide the tools to manage instrumental change in a consistent manner. Proper change management will be the key assure a long term consistent record of upper air reference observations.