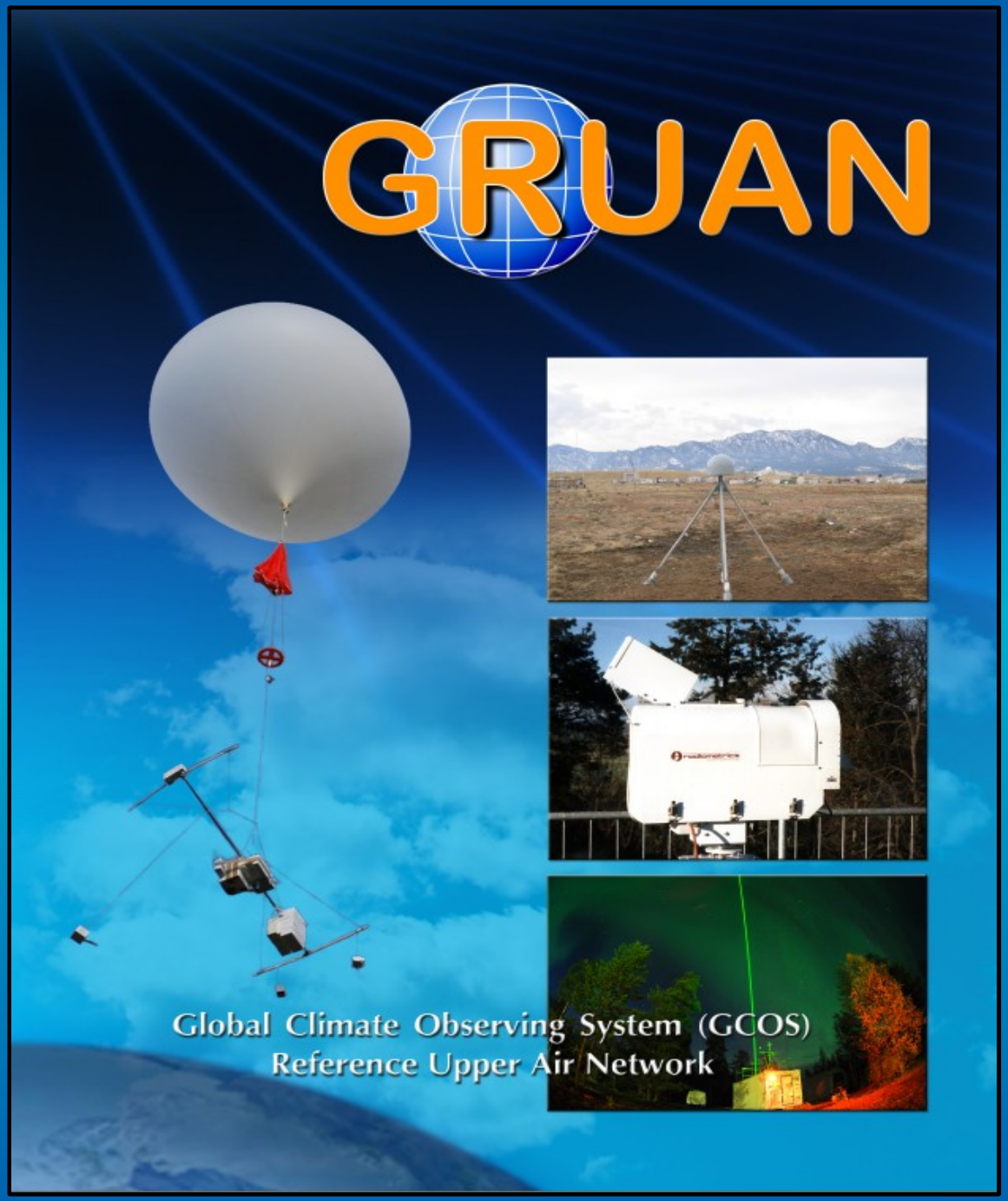


Greg Bodeker

Presented at NIES
8 March 2012

Acknowledging

Peter Thorne
NOAA NCDC, USA

Holger Vömel and other members of the GRUAN Lead Centre at the Meteorological Observatory Lindenberg DWD, Germany

What is GRUAN?

- Network for ground-based reference observations for climate in the free atmosphere in the frame of GCOS
- Initially 15 stations, envisaged to be a network of 30-40 sites across the globe when GRUAN becomes fully operational in 2013.

See www.gruan.org for more detail

The goals of GRUAN

The purpose of GRUAN is to:

- Provide long-term high quality climate records;
- Constrain and calibrate data from more spatially-comprehensive global observing systems (including satellites and current radiosonde networks); and
- Fully characterize the properties of the atmospheric column.

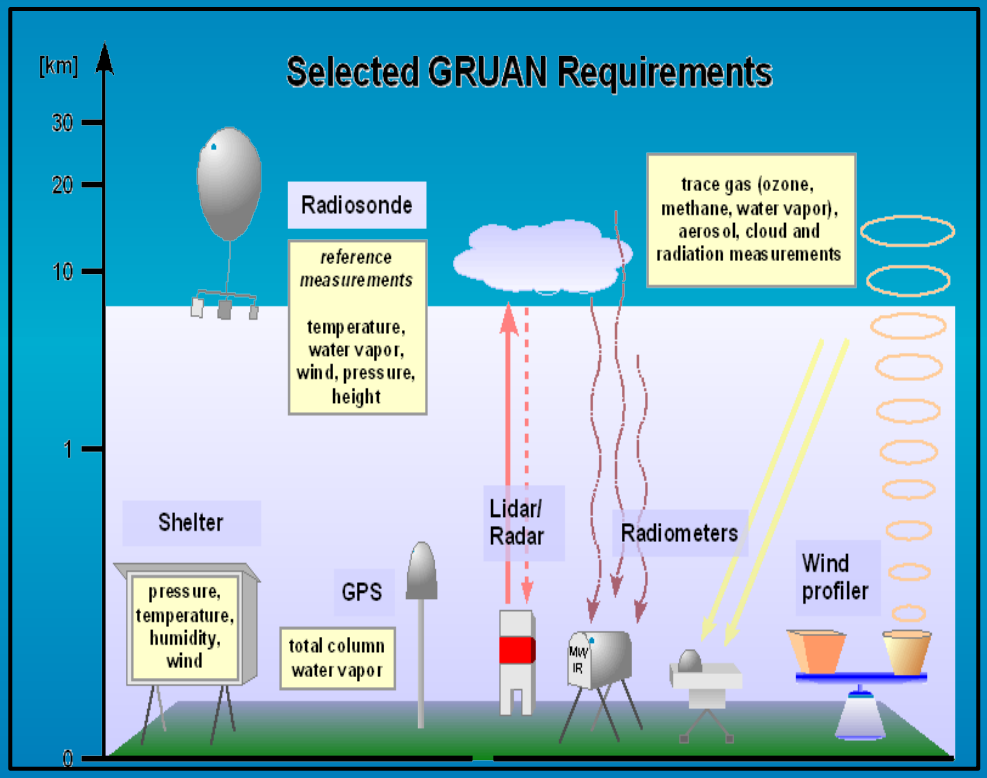
Four key user groups of GRUAN data products are identified:

- The climate detection and attribution community.
- The satellite community.
- The atmospheric process studies community.
- The numerical weather prediction (NWP) community.

More about goals of GRUAN

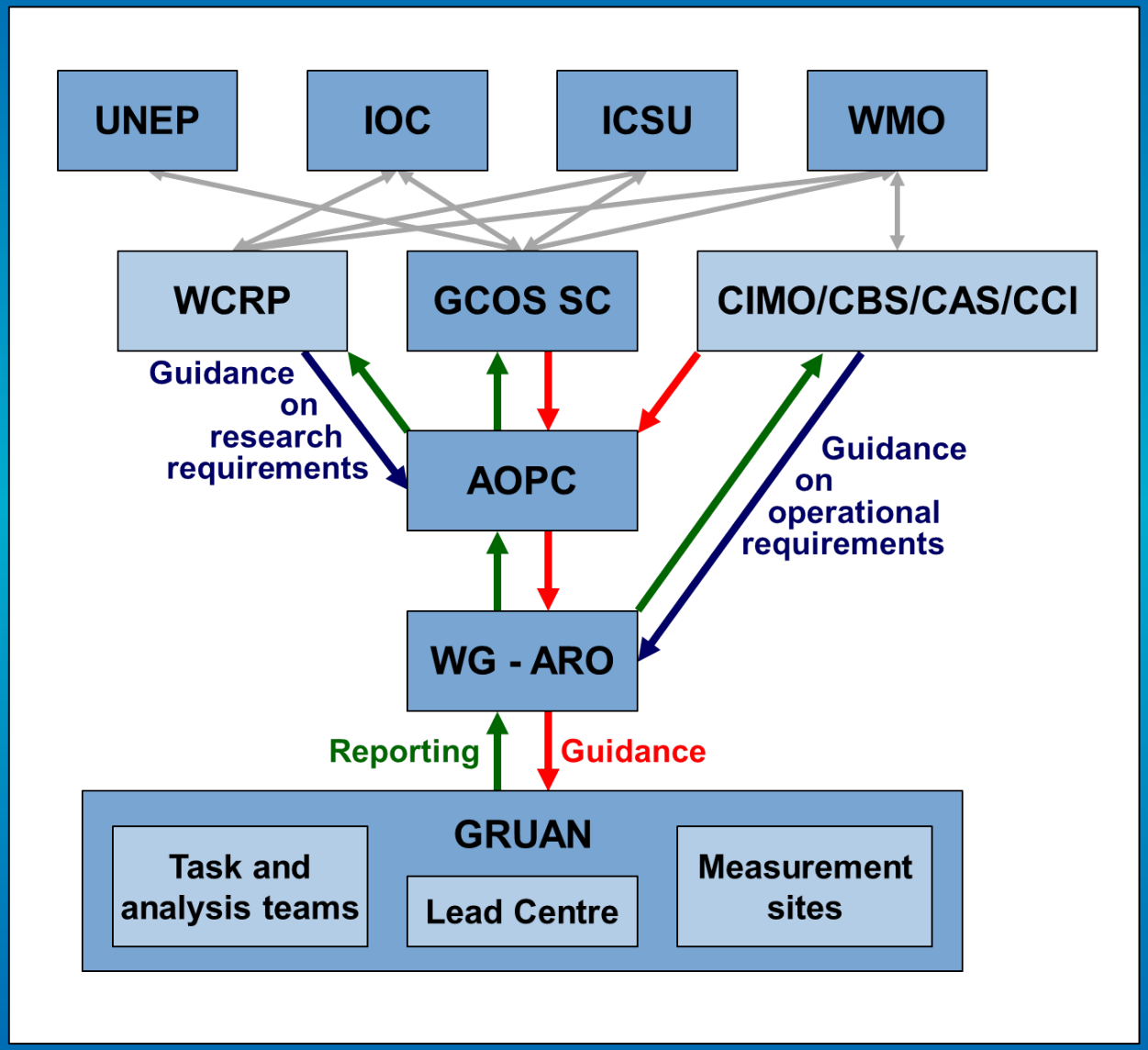
- Maintain observations over several decades for accurately estimating climate variability and change
- Focus on characterizing observational biases, including complete estimates of measurement uncertainty
- Ensure traceability of measurements by comprehensive meta-data collection, documentation, and traceability
- Ensure long-term stability by managing instrumental changes
- Tie measurements to SI units or internationally accepted standards

Priority 1: Temperature, pressure, water vapour
Priority 2: Ozone, methane …



- Measure a large suite of co-related climate variables with deliberate measurement redundancy

GRUAN governance



Notes

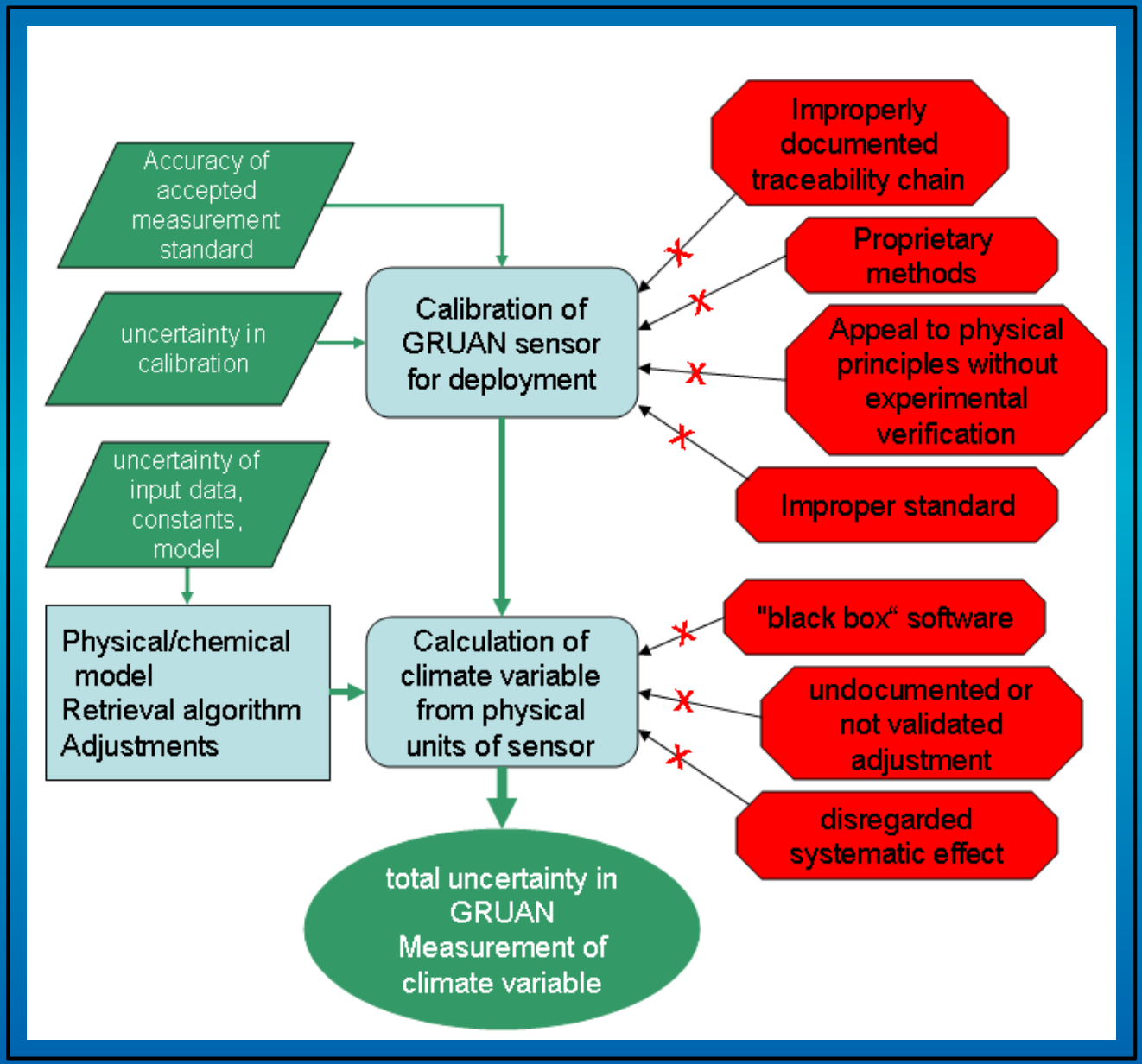
1. WCRP identifies scientific and research requirements for GRUAN. WMO identifies operational requirements.
2. Composition of WG-ARO determined in short term by Chair of AOPC in consultation with WMO. Includes representative from each of CIMO, CBS, CAS and CCI. These representatives will be responsible for reporting back to their respective Technical Commission.
3. WG-ARO reports to AOPC
4. GRUAN measurement sites are contributed by member countries of WMO.

GRUAN focuses on reference observations

A GRUAN reference observation:

- ✓ Is traceable to an SI unit or an accepted standard
- ✓ Provides a comprehensive uncertainty analysis
- ✓ Is documented in accessible literature
- ✓ Is validated (*e.g.* by intercomparison or redundant observations)
- ✓ Includes complete meta-data description

Establishing reference quality



Uncertainty, redundancy and consistency

Understand the uncertainties:

- Analyze sources - identify, which sources of measurement uncertainty are systematic (calibration, radiation errors), and which are random (noise, production variability …). Document this.

Synthesize best uncertainty estimate:

- Uncertainties for every data point, i.e. vertically resolved

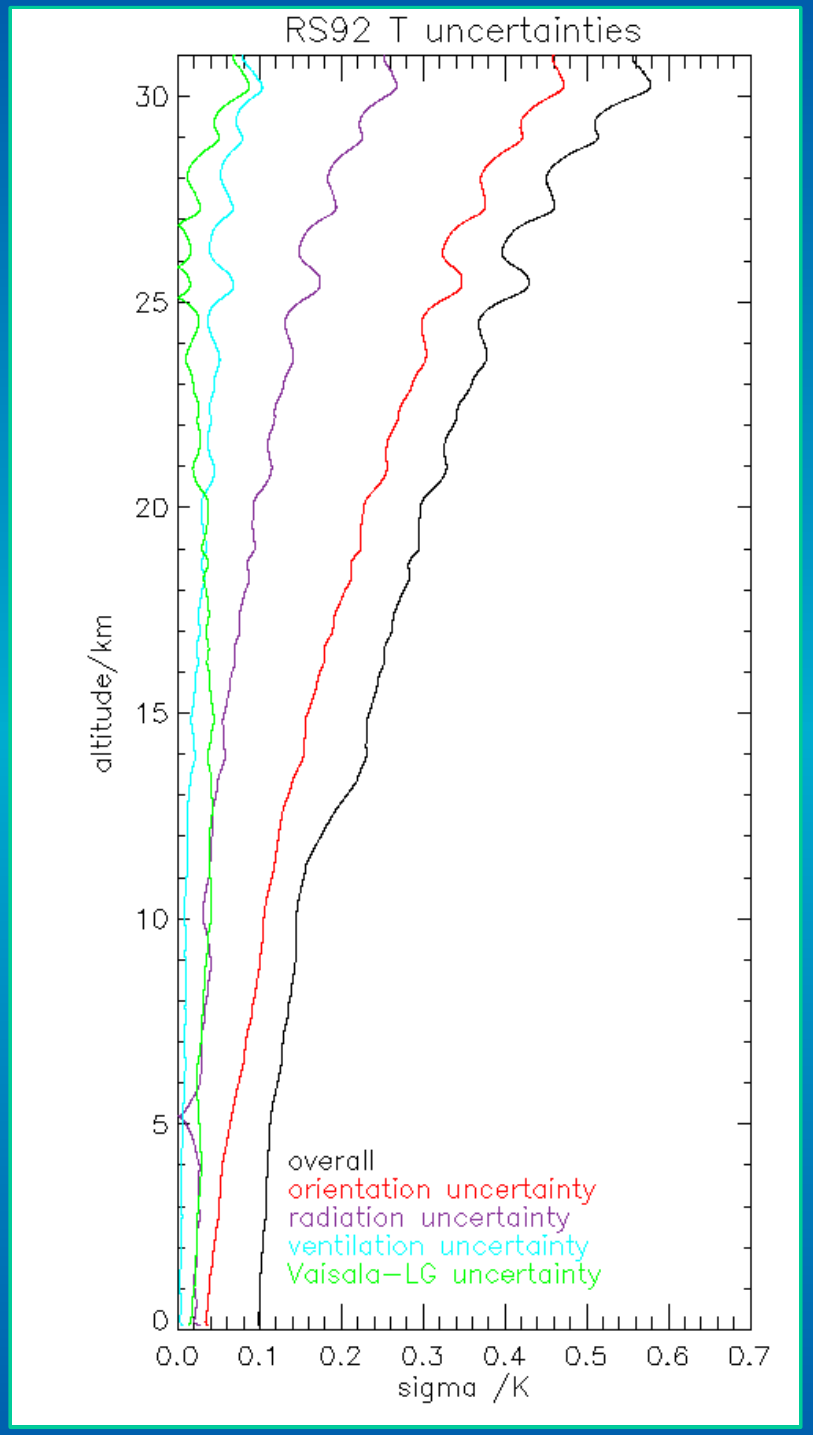
Use redundant observations:

- to manage change
- to maintain homogeneity of observations across network
- to continuously identify deficiencies

Uncertainty example: Daytime temperature Vaisala RS92

Sources of measurement uncertainty (in order of importance):

- Sensor orientation
- Radiative heating of sensor
- Unknown radiation field
- Ventilation
- Ground check
- Calibration
- Time lag



Things that are coming up

- GRUAN network design workshop: 13-15 June 2012 in Germany. Go to www.gruan.org for more details.
- There are many different ways you can become involved in GRUAN. We have a number of exciting projects underway and interesting scientific questions that need to be tackled. Please have fruitful discussions with the ICM-4 attendees, share what you are doing and find ways to become engaged in GRUAN. We need you.

Conclusions

- GRUAN is a new approach to long-term observations of upper air essential climate variables
- Focus on priority 1 variables to start: temperature, pressure and water vapour
- Focus on *reference* observation:
  - ✓ quantified uncertainties
  - ✓ traceable
  - ✓ well documented
- Understand the uncertainties:
  - ✓ analyze sources
  - ✓ synthesize best estimate
  - ✓ verify in redundant observations
- There are many ways to become involved in GRUAN activities at this very exciting stage in GRUAN development.