GRUAN basics for new GRUAN ICM participants

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ICM-9 Helsinki

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Motivation for GRUAN

(GCOS Reference Upper Air Network)

IPCC AR5 long term trends

Lower troposphere (PW):

"Radiosonde, GPS and satellite observations of tropospheric water vapor indicate very likely increases at *near global scales* since the 1970s …."

Upper troposphere:

"… the abse
platforms pr om
these recor

Stratospher

"Because of
confidence in long-term stratospheric H_2O trends is low."

Alain Ratier (Dir. Eumetsat):

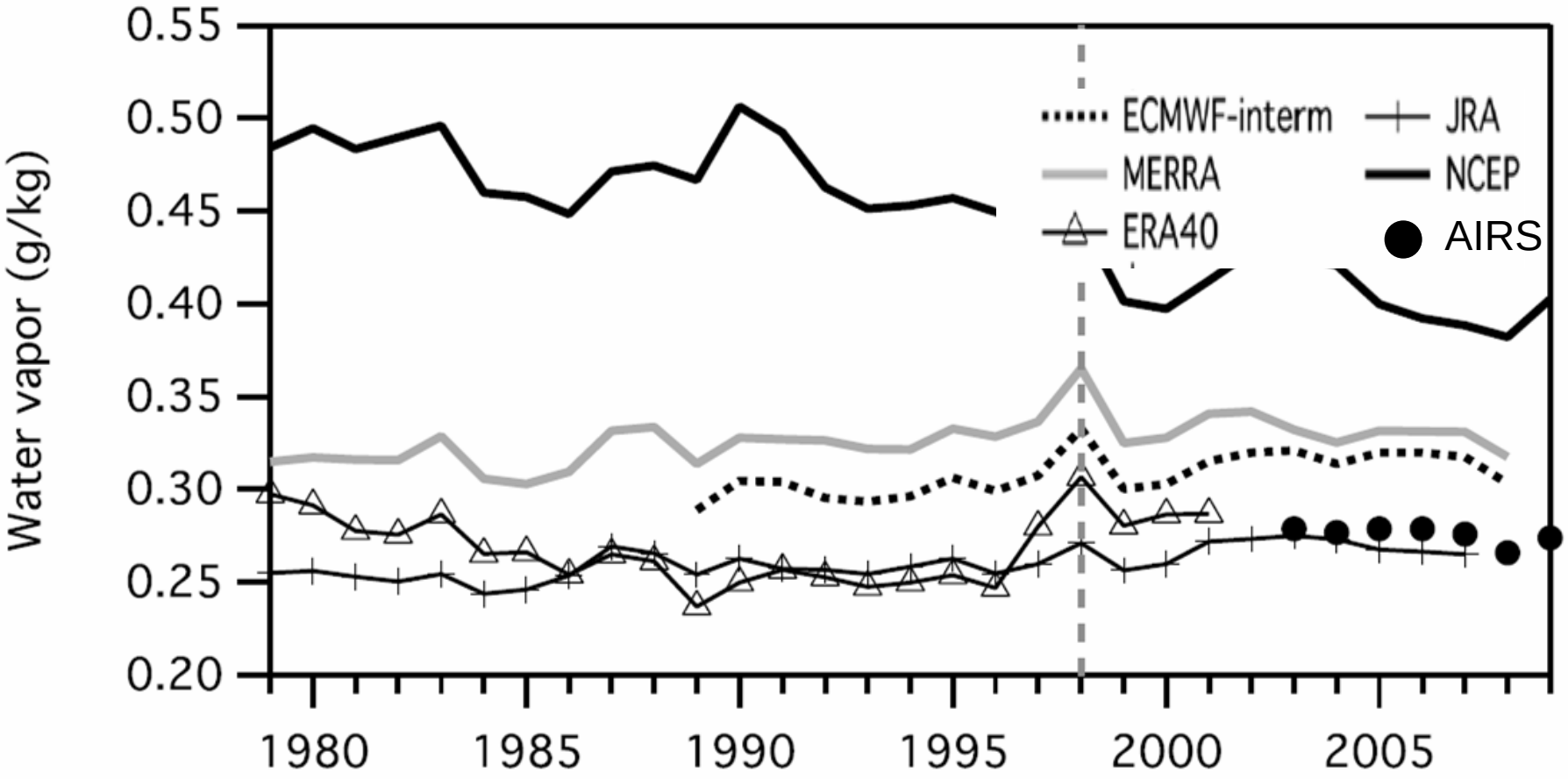
"[the satellite community] needs calibrated reference data."

GCOS science conference, Amsterdam, 02.03.2016

➢ Lack of good reference measurements for climate observations

Tropospheric water vapor trends

Specific humidity at 300 hPa

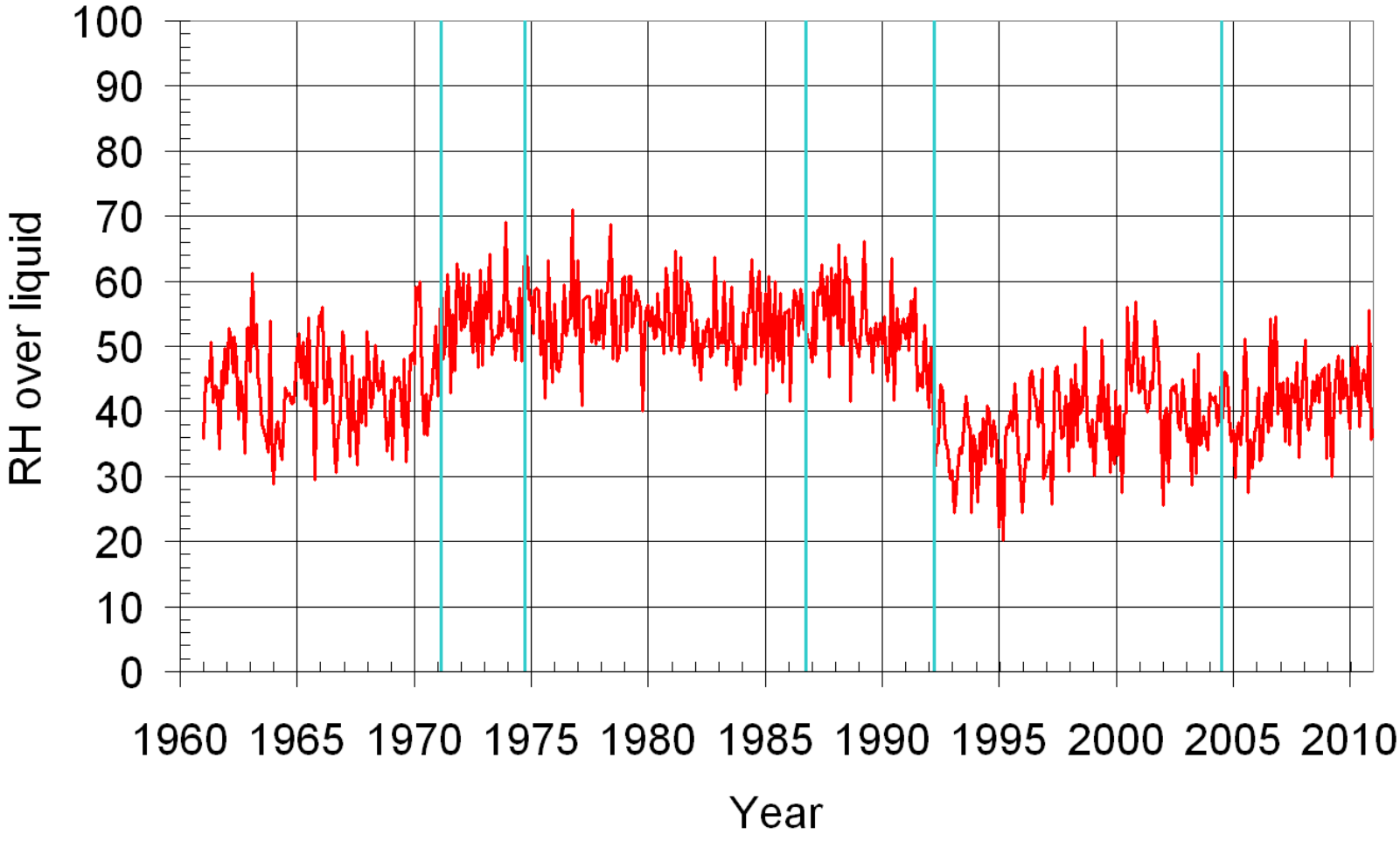


Dessler and Davis, JGR 2010

Water vapor trends in the troposphere?

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

e.g.: Lindenberg 8km (0:00 UT)



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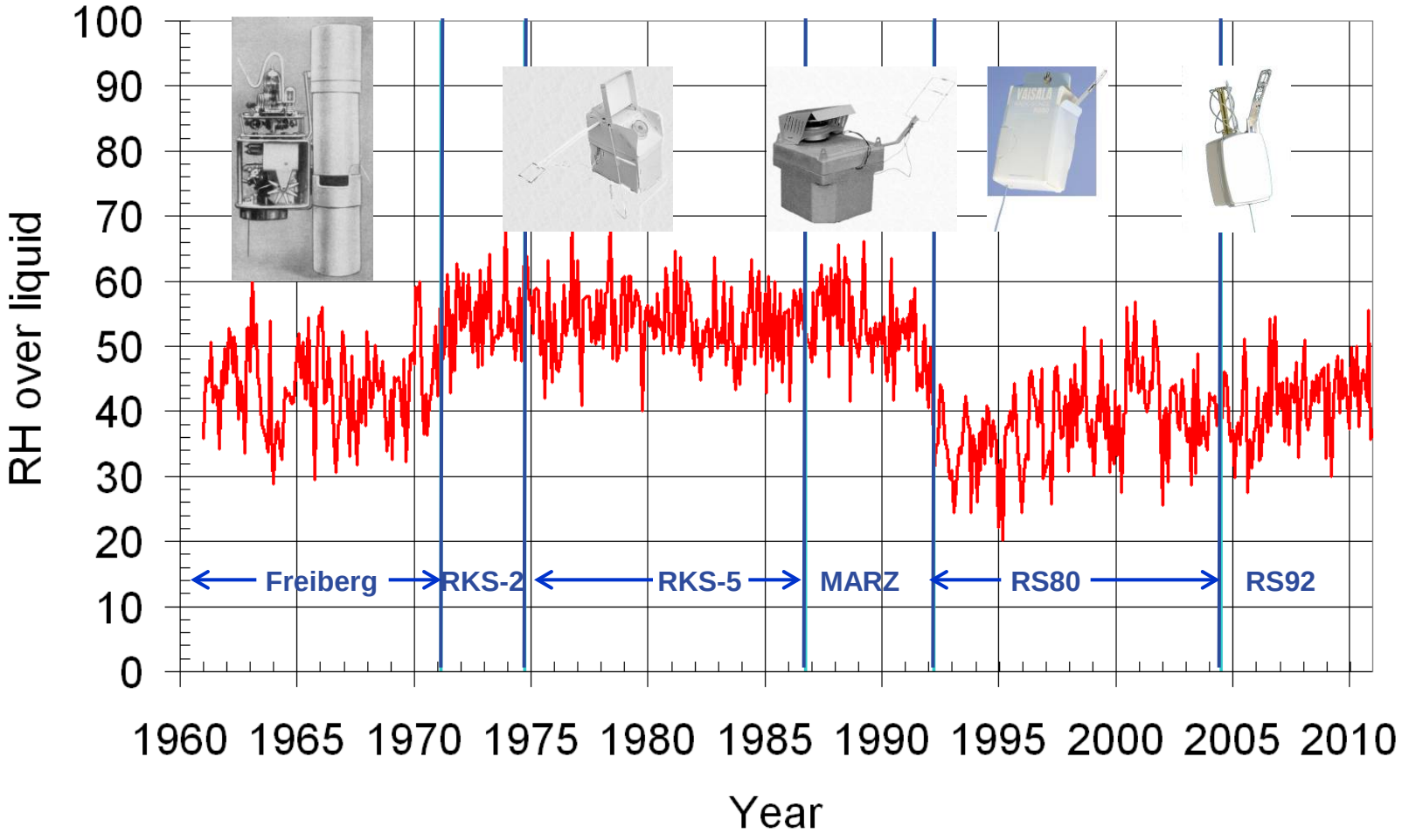
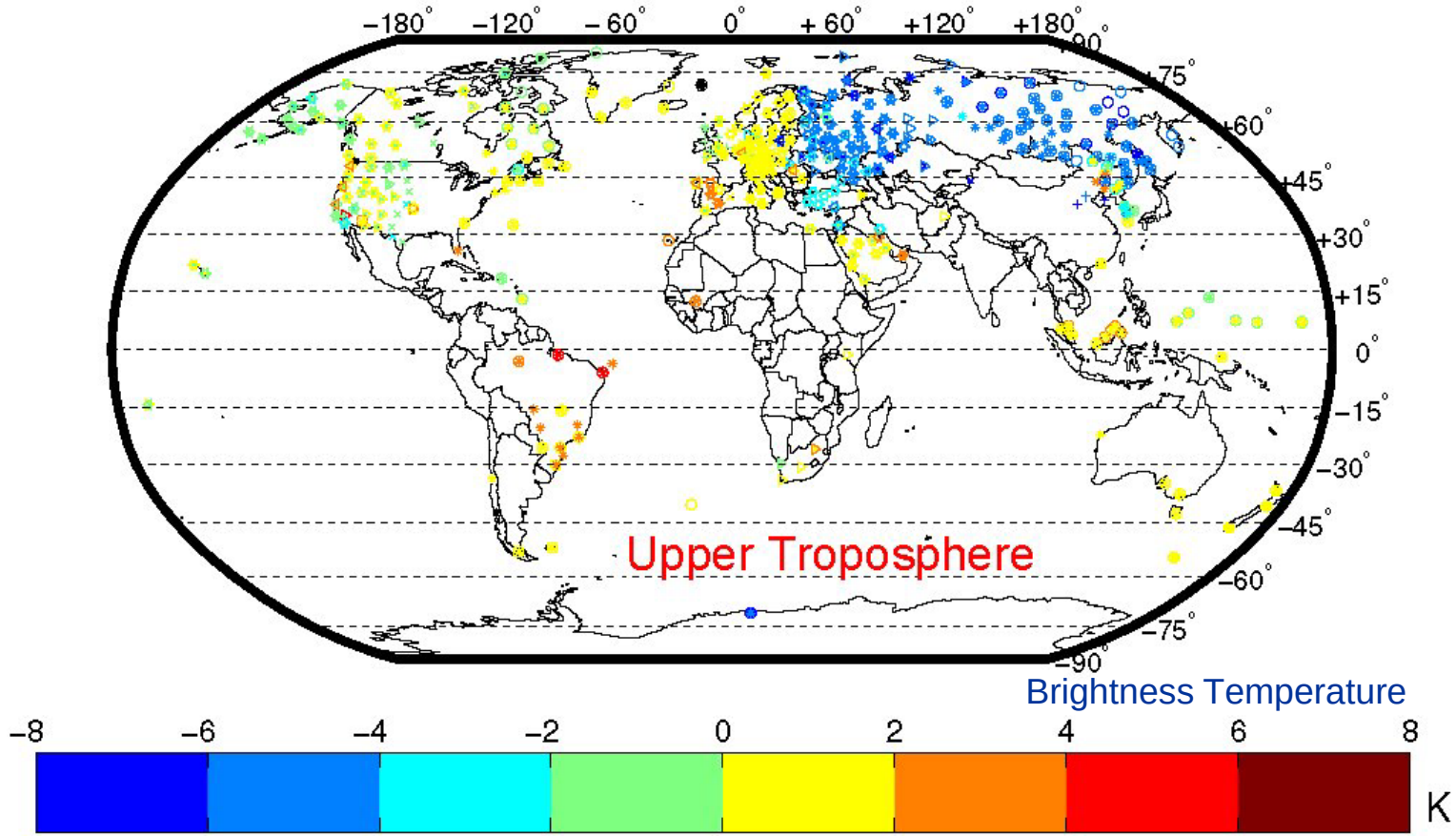


Upper Tropospheric Humidity: Difference Radiosonde – Satellite (2013)

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Moradi et al. JGR 2013

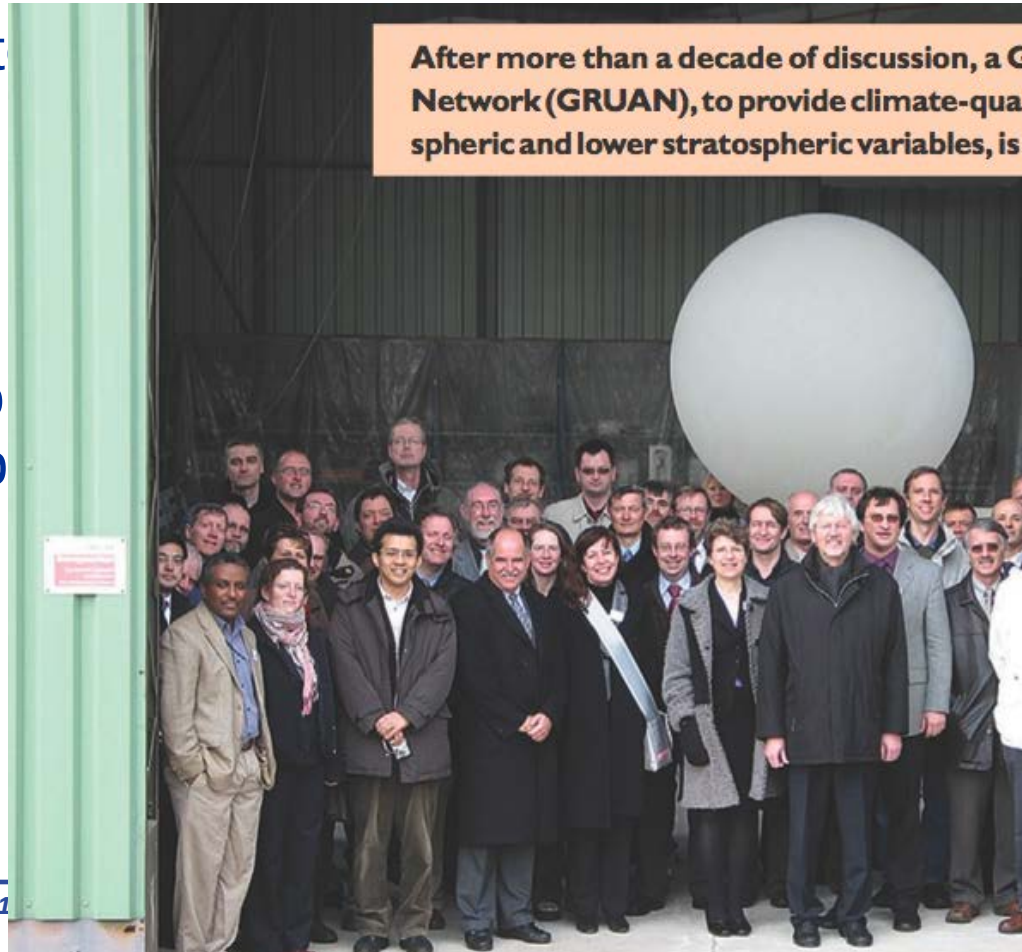
What is GRUAN?

GCOS Reference Upper Air Network

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

- GRUAN is response to the need of WMO and the Global Climate Observing System for highest accuracy data possible
- Ground based network for reference upper air observations for climate under GCOS and integrated into WIGOS
- Currently 26 sites, with aim t worldwide
- Started in 2008

➔ Inception: NOAA/GCOS Wo
Requirements for Upper-Air Ob



GCOS Reference Upper Air Network

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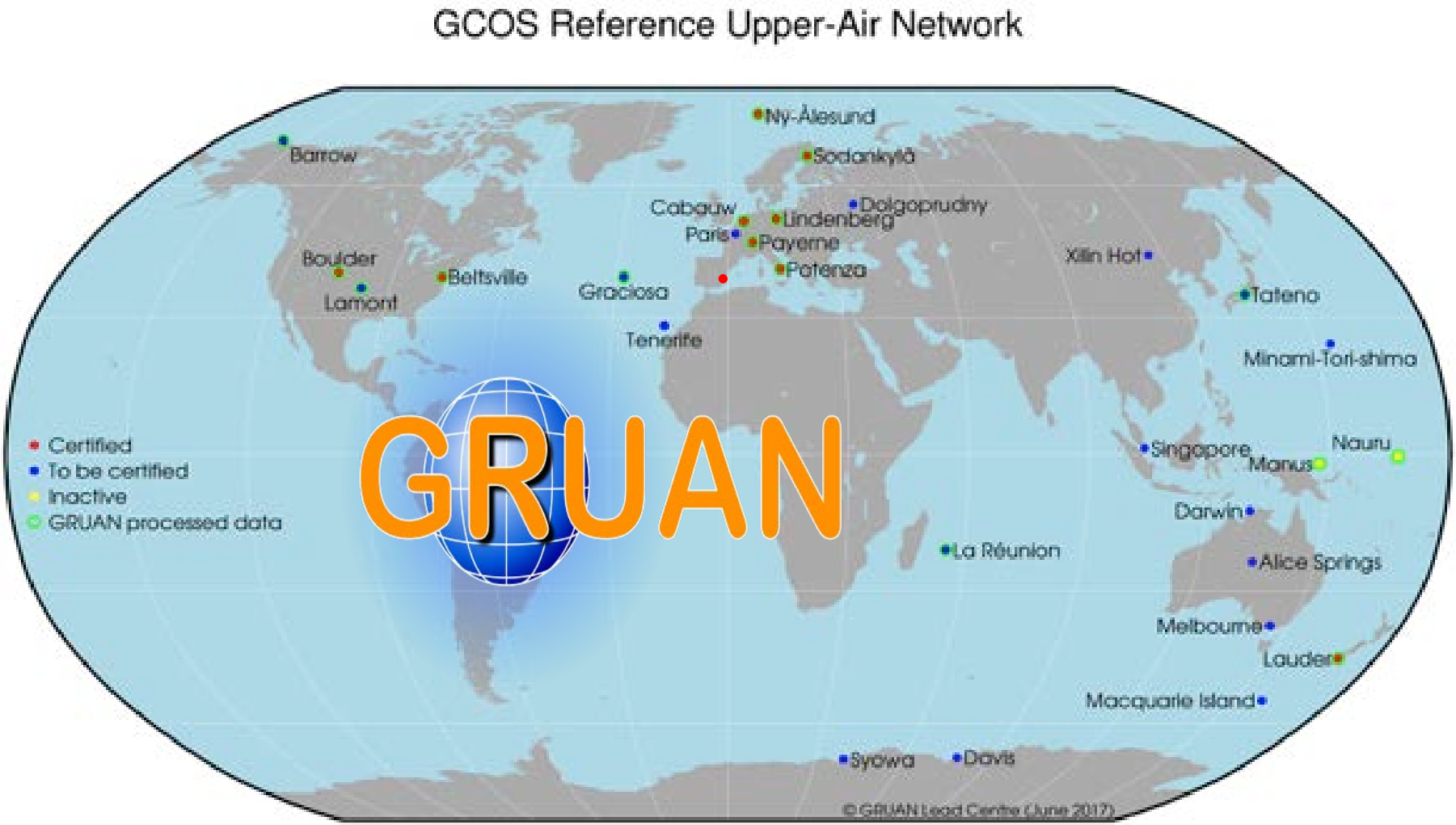
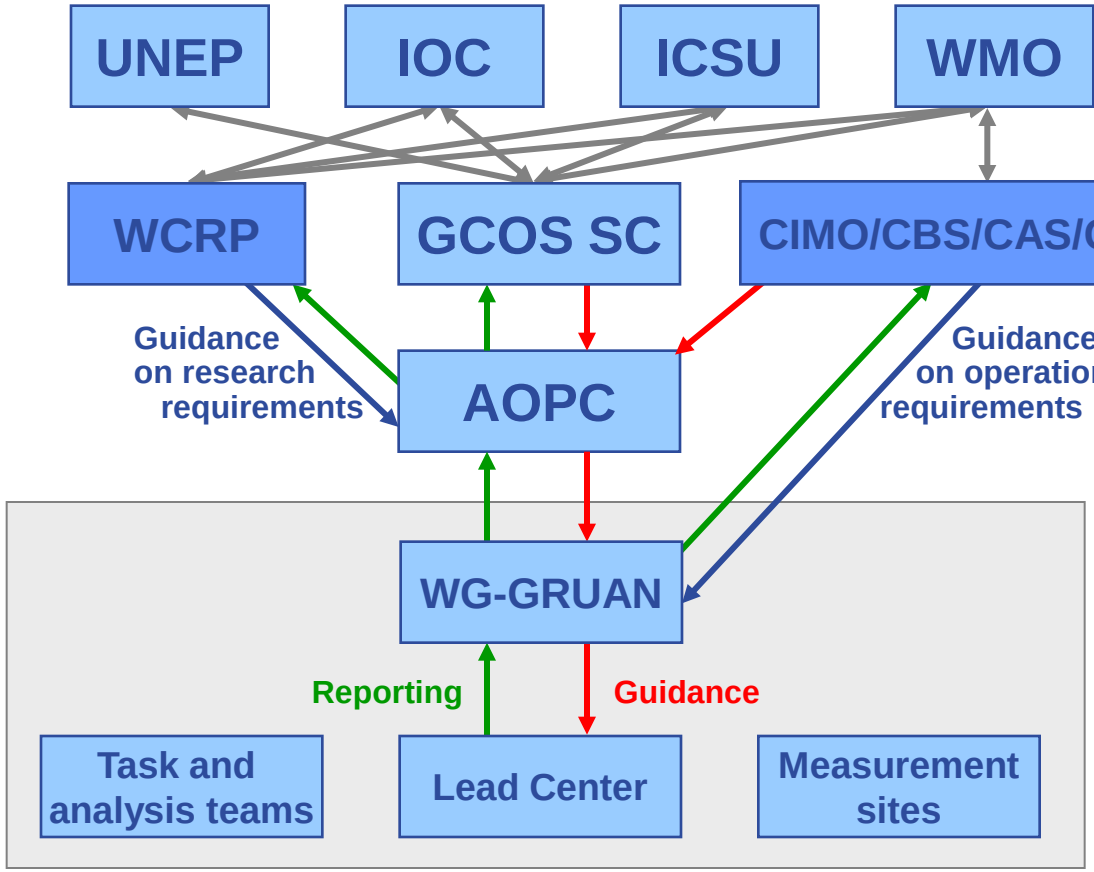


See **www.gruan.org**

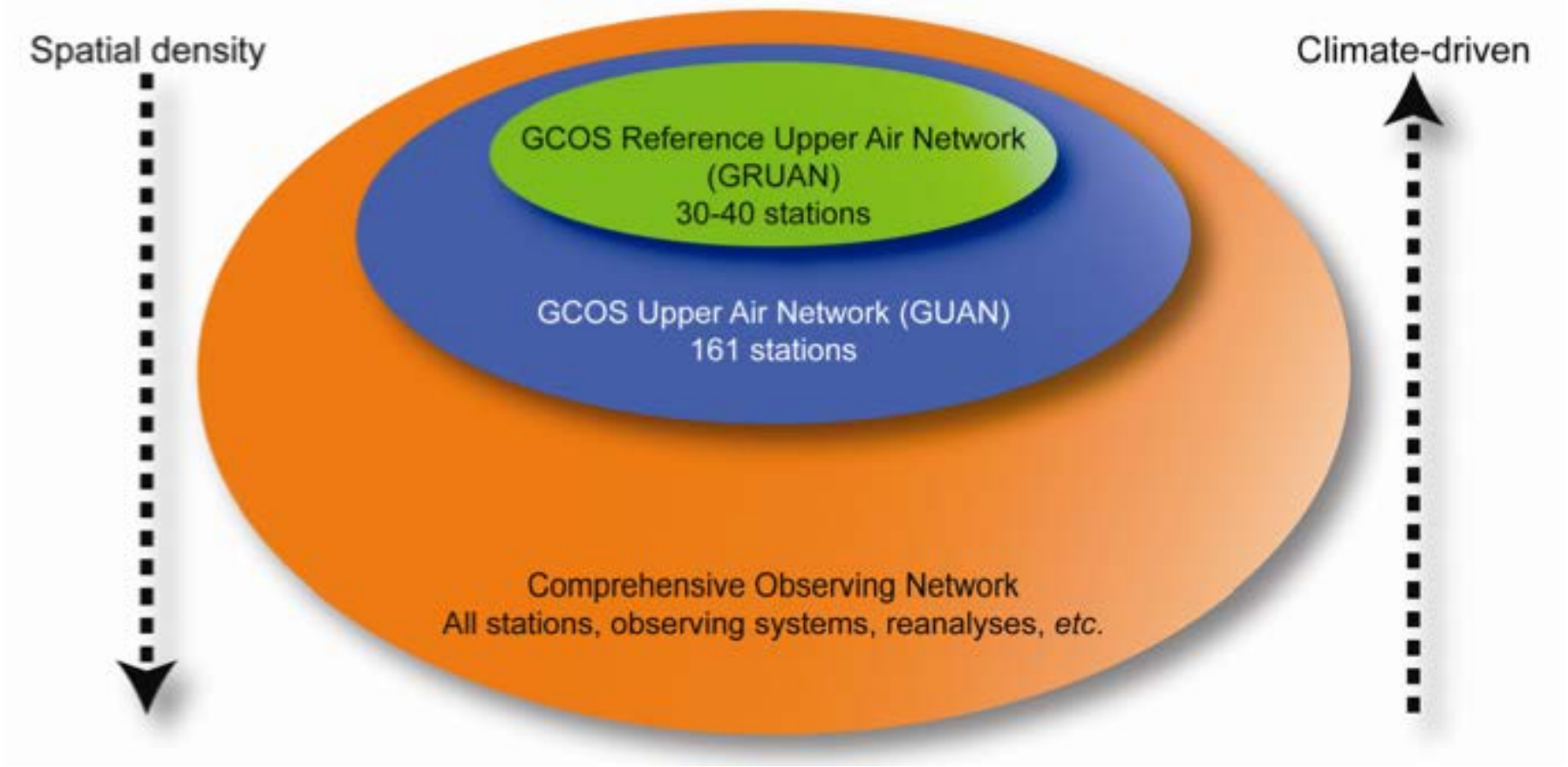
GCOS Reference Upper Air Network



AOPC: Atmospheric Observation panel for climate

- Lead Centre: day-to-day management of the network
  Coordination among stations
  Archival and dissemination of GRUAN data

GRUAN's relationship to existing observational networks

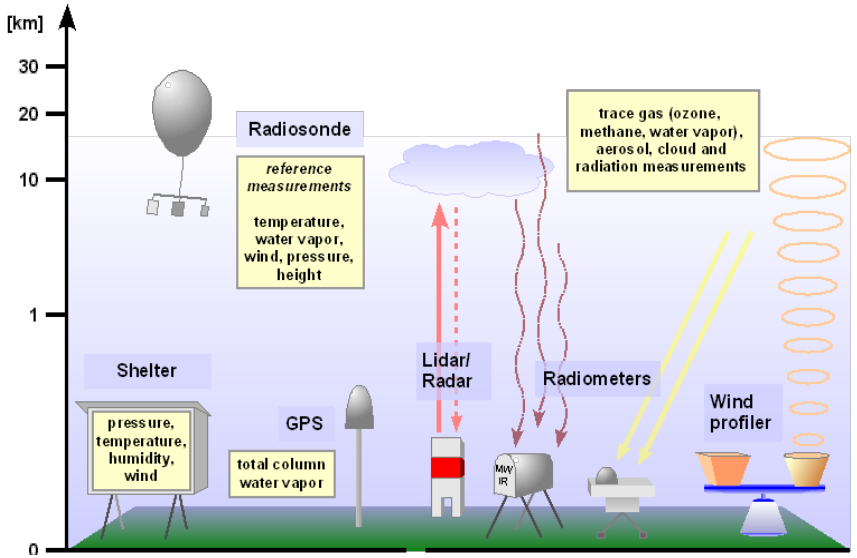


Seidel et al., 2009

What are GRUAN's goals?

GRUAN goals

- Maintain consistent observations over decades
- Validation of satellite systems
- Understanding of atmospheric processes
- Numerical weather prediction
- Deliberate measurement redundancy
- Standardization and traceability
- Quality management and managed change



Priority 1: Water vapor, temperature, (pressure and wind)

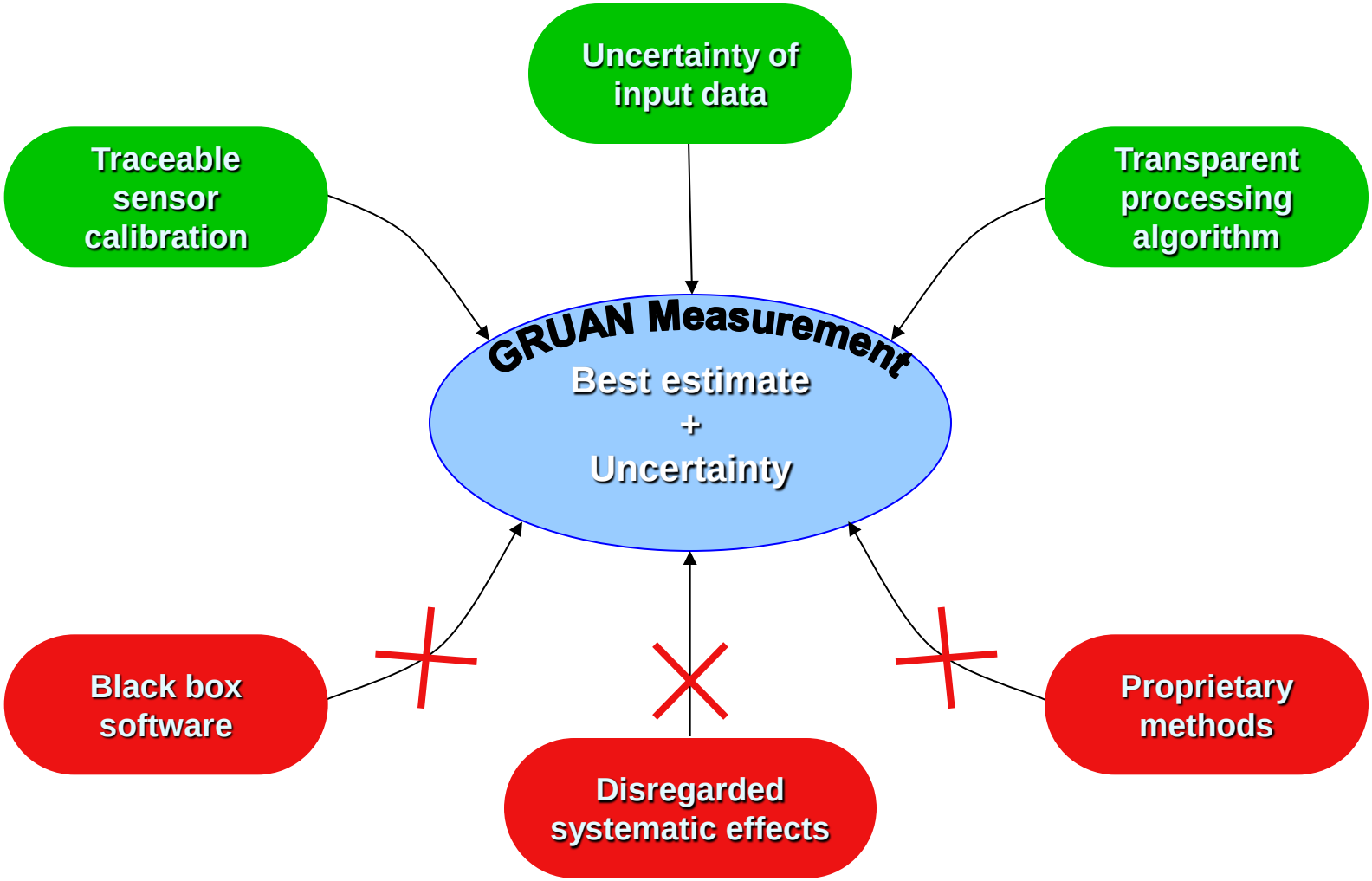
Priority 2: Ozone, …

Definition of “Reference Observation”

A GRUAN reference observation:

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

Establishing reference quality



Management of Change

- Change management is mandatory
- A new system, software, or procedure must be evaluated prior to implementation
- Systematic and random errors must be quantified for the new system
- Redundant observations verify the new system (overlap)
- Use transfer functions on old data where required

Summary

- GRUAN has a long term view to observations of upper air essential climate variables
- Focus on priority 1 variables to start: Water vapor and temperature (starting to bring in other variables)
- *Reference* observation means:
  - ✓ quantified uncertainties
  - ✓ traceable
  - ✓ well documented
  - ✓ verify in redundant observations
- Management of change utilizes measurement uncertainty

GRUAN certified sites

Assessment of measurement program

- Assessment of the site's measurement program
  - (e.g. continuity, operational procedures, change management)
- GRUAN-approved measurement quality


CAB
LIN
PAY
GRUAN
Certified Site
Sodankylä
Finland
Operated by FMI
GRUAN Lead Centre
Lindenberg, Germany
GCOS
GLOBAL CLIMATE OBSERVING SYSTEM

GRUAN achievements

- GRUAN Dataproduct for Radiosondes: Vaisala RS92, Meteolabor SRS C-34, Meisei RS11-G
- Other radiosondes under development (Modem M10, Frostpoint-Hygrometer)
- Other products & data:
  - GNSS total water vapor column
  - Lidar (T, U)
  - Microwave-Radiometer (T, U)
- Archive of ~60.000 Radiosonde-profiles
- > 30 GRUAN-related publications

GRUAN is about…

- Providing long-term reference observations of upper air essential climate variables
  - Quantified uncertainties
  - Well documented
  - Verify in redundant observations
  - Change management
  - Traceable
- Being a network
  - Gaining & sharing knowledge (task teams, lab-facilities)
  - Interaction with user community (annual meeting)

Questions