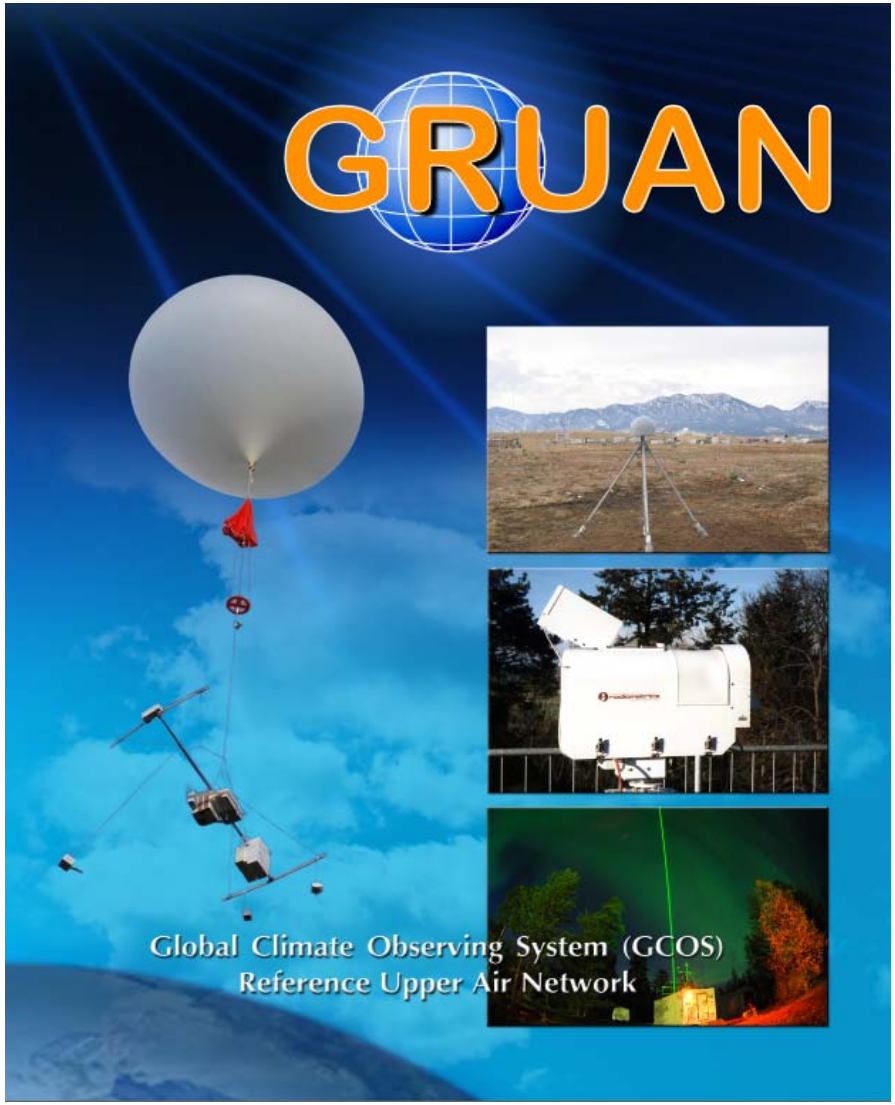

What is the GCOS Reference Upper Air Network (GRUAN)

and How Can It be Useful to Reanalysis Efforts?

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Outline: Q's and A's

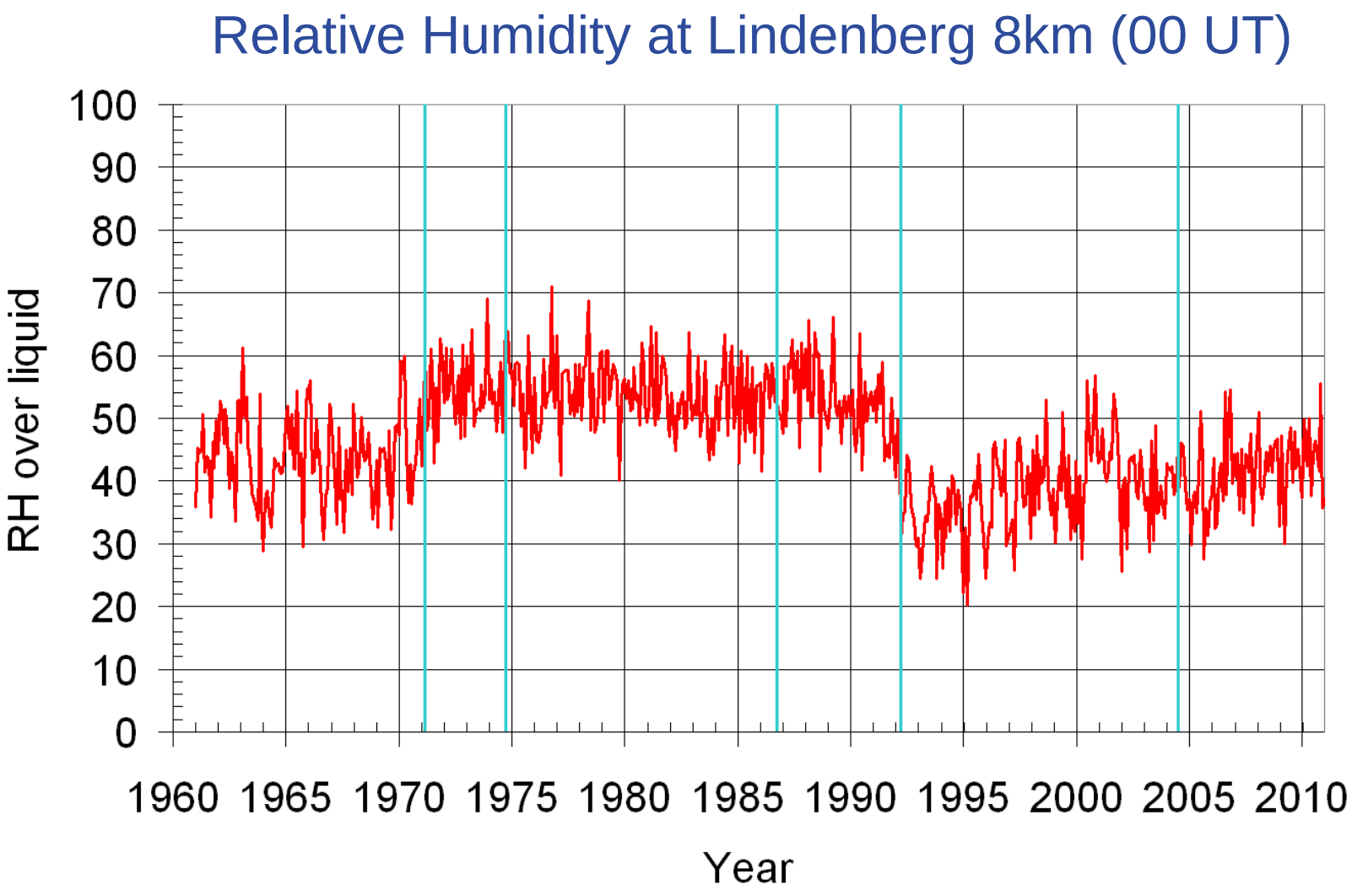
- Why do we need reference upper-air observations?
- What is GRUAN?
- How does, or might, GRUAN relate to reanalyses?
- How can the reanalysis community engage with GRUAN?

Main Message: We seek feedback on all aspects of GRUAN and look forward to growing interactions between the GRUAN and reanalysis communities.

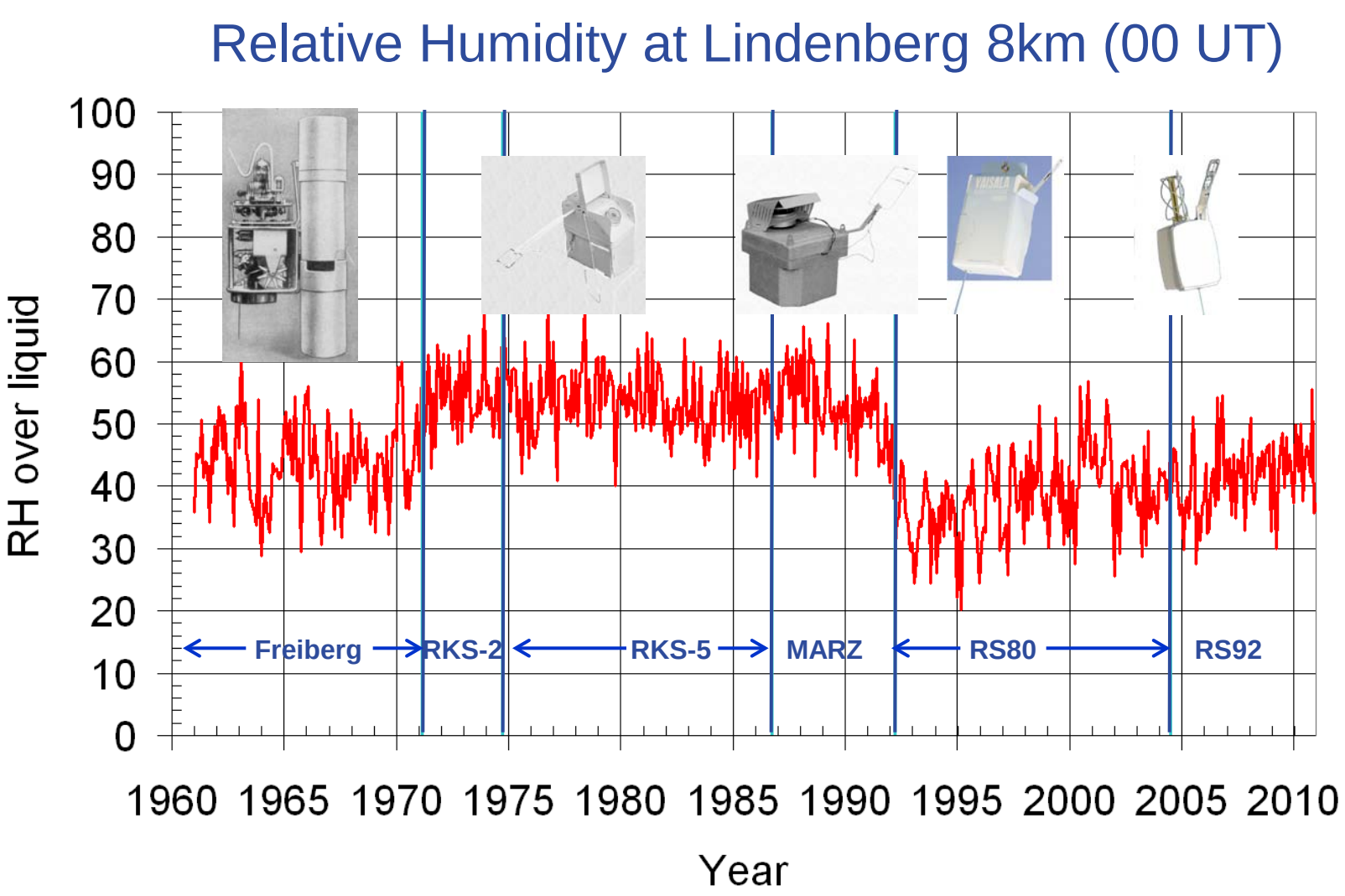
Why do we need reference upper-air observations?

- Non-reference observations (in situ and satellite) have time-varying biases
- Reanalyses do not remove the biases
- Most homogenizations are not assimilatable

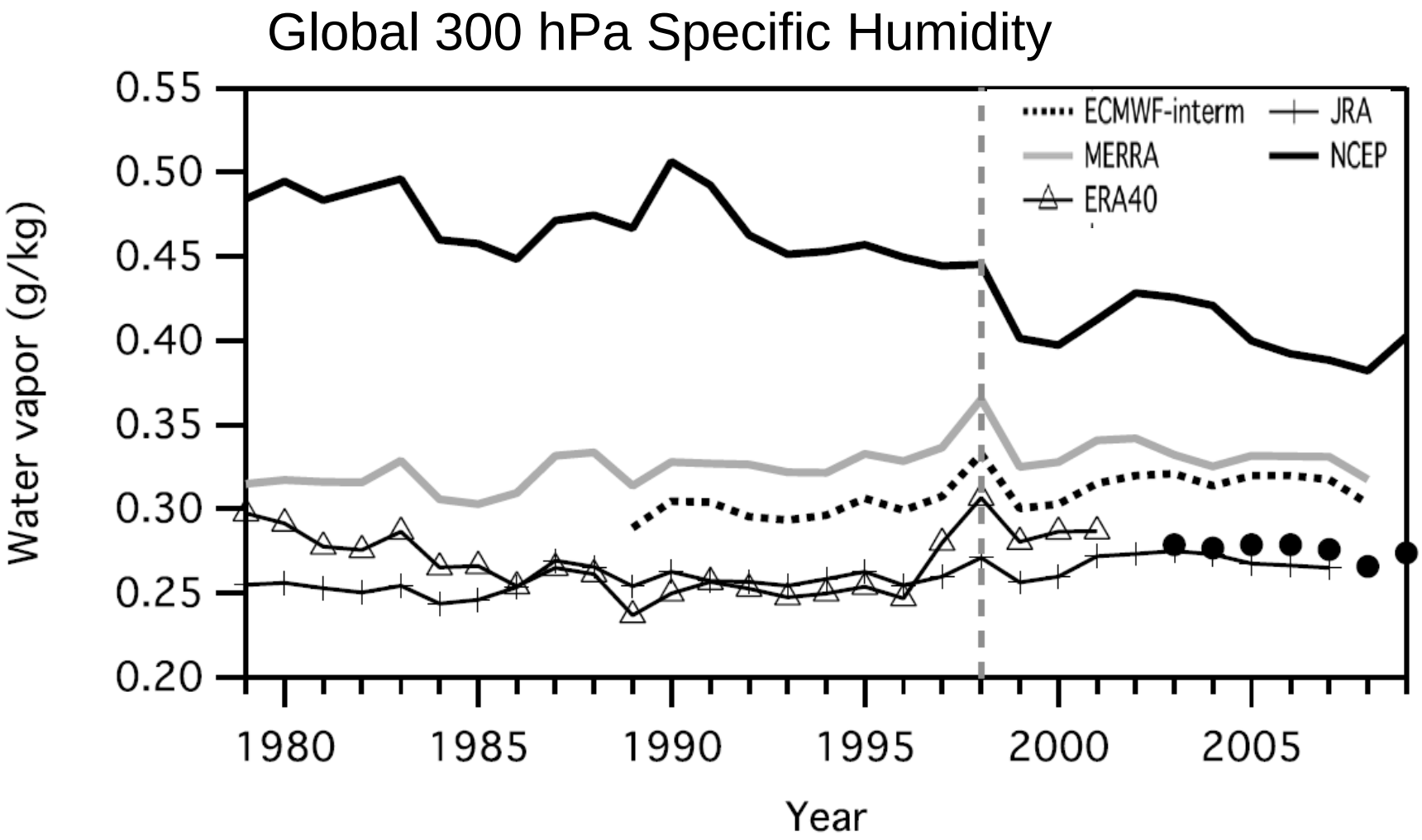
Example: Upper Tropospheric Humidity



Example: Upper Tropospheric Humidity

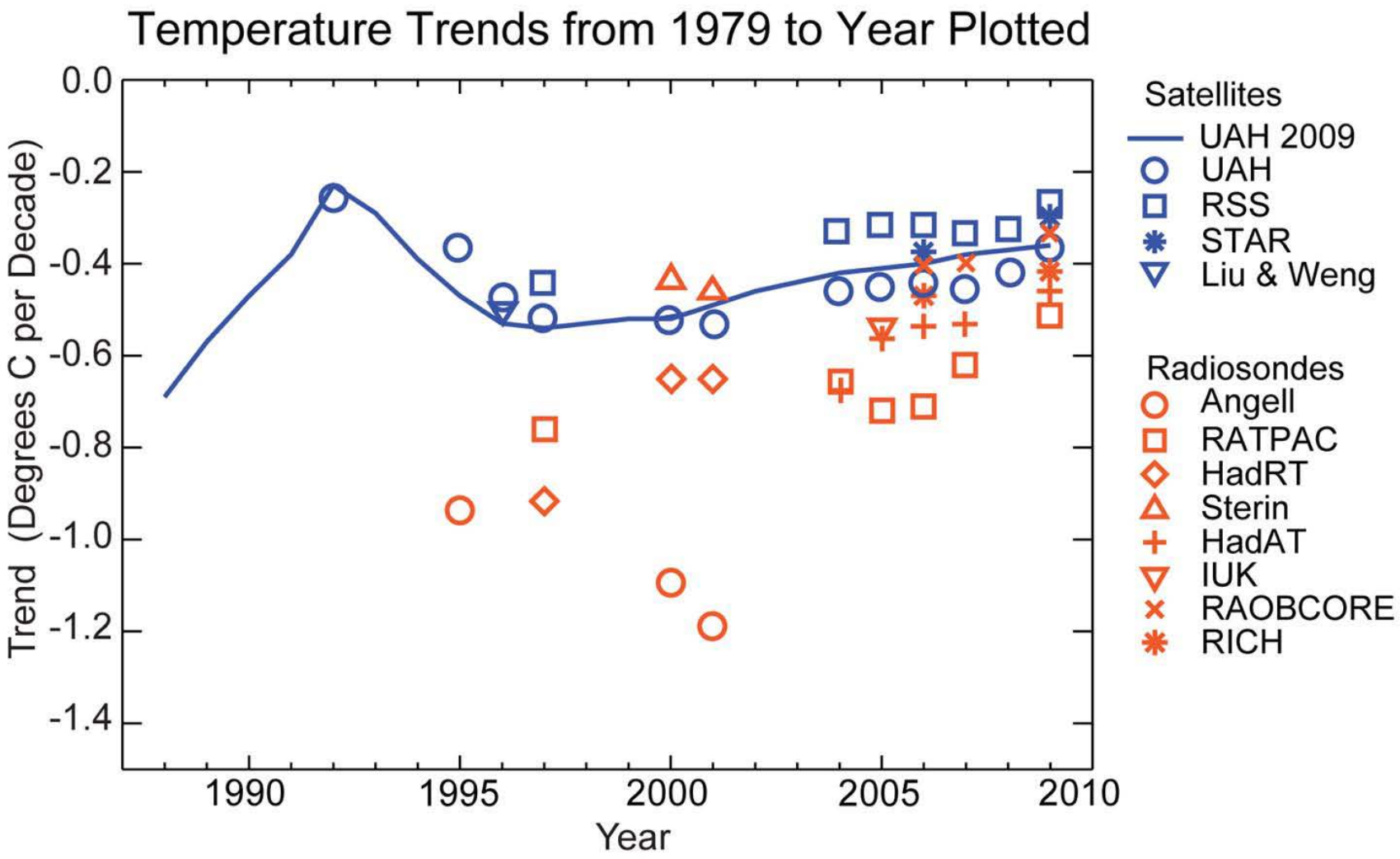


Example: Upper Tropospheric Humidity



Dessler and Davis, JGR 2010

Example: Lower Stratospheric Temperature



Seidel et al., WIREs Climate Change, 2011

Lessons Learned

- Past operational observations are inadequate for climate. So are analyses and reanalyses. Uncertainties have been exposed but not resolved.
- One “climate data record” from one type of observation is not sufficient. Redundant, independent approaches better constrain structural uncertainties.
- Observations with complete characterization of uncertainty would allow confident detection of climate trends.

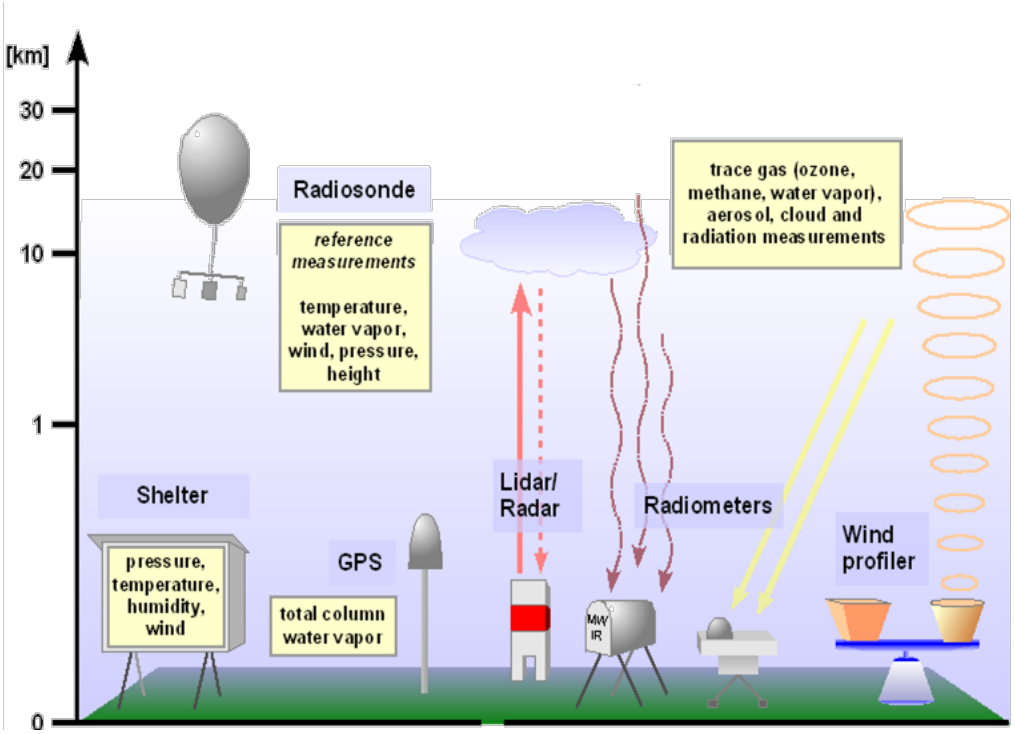
What is GRUAN?

- WMO and GCOS reference network, established 2005
- Reference measurements
  - Are traceable to standards at every step
  - Have known error sources removed
  - Have all uncertainties quantified for every datum
- Purposes:
  - Provide long-term high-quality upper-air climate records
  - Constrain and calibrate data from more spatially-comprehensive global observing systems (including satellites and current radiosonde networks)
  - Fully characterize the properties of the atmospheric column

What is GRUAN?

Measurements from GRUAN

- Priority 1: Water vapor, temperature, (pressure and wind)
- Priority 2: Ozone, clouds, …
- Deliberate measurement redundancy
- Careful management of change
- Coordination with other observing networks



How does, or might, GRUAN relate to reanalyses?

Some ideas:

- Use GRUAN uncertainty budgets in assimilation of GRUAN data
- Use GRUAN observations to better constrain uncertainties in conventional upper-air observations
- Use GRUAN time series to evaluate temporal homogeneity of reanalysis products (later)
- Use reanalyses in quality assurance of GRUAN data products

How does, or might, GRUAN relate to reanalyses?

Some questions:

- What is the primary value of GRUAN observations in reanalysis efforts? As part of the overall ingest of observational data or as independent validation?
- As GRUAN expands, what locations would be most valuable to reanalyses?
- Which Priority 2 GRUAN variables would be most valuable to reanalyses?
- Are reanalysis uncertainties sufficiently well characterized for use in validating GRUAN observations?

How can the reanalysis community engage with GRUAN?

- Let's talk today!
- Contact GRUAN leadership later (gruan.lc@dwd.de)
- Include GRUAN in ongoing reanalysis plans
- Participate in the GRUAN Workshop to Develop Network Design and Expansion Criteria (13-15 June 2012, Furstenwalde, Germany)

Main Message: We seek feedback on all aspects of GRUAN and look forward to growing interactions between the GRUAN and reanalysis communities.

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