

# Framing the Question of GRUAN Launch Schedule

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# GRUAN sonde launch schedule should satisfy these objectives:

- Data homogeneity and continuity for unambiguous detection of long-term trends
  - > Fixed launch times
- Obtaining best calibration data for homogenizing satellite observations and data products
  - > Launches coordinated with overpass
- Profile information for climate process studies
  - > Sampling particular weather conditions, times of day, seasons, ...

# Questions & considerations:

- Are these objectives mutually exclusive or can they be harmonized?
- Is a 2008 decision permanent?
- Is there a literature basis for devising an intelligent schedule?
- What should be GRUAN's decision-making process?

# A little background:

- GRUAN represents a convergence of upper-air sounding cultures
  - Operational soundings at fixed synoptic times
  - Research launches to suit science needs
- GRUAN represents a convergence of ideas
  - Satellite Upper-Air Network proposal by T. Reale and P. Thorne
  - Recommendations of National Academy panel on temperature trends
- Issue raised, not resolved, in Seattle (5/06)

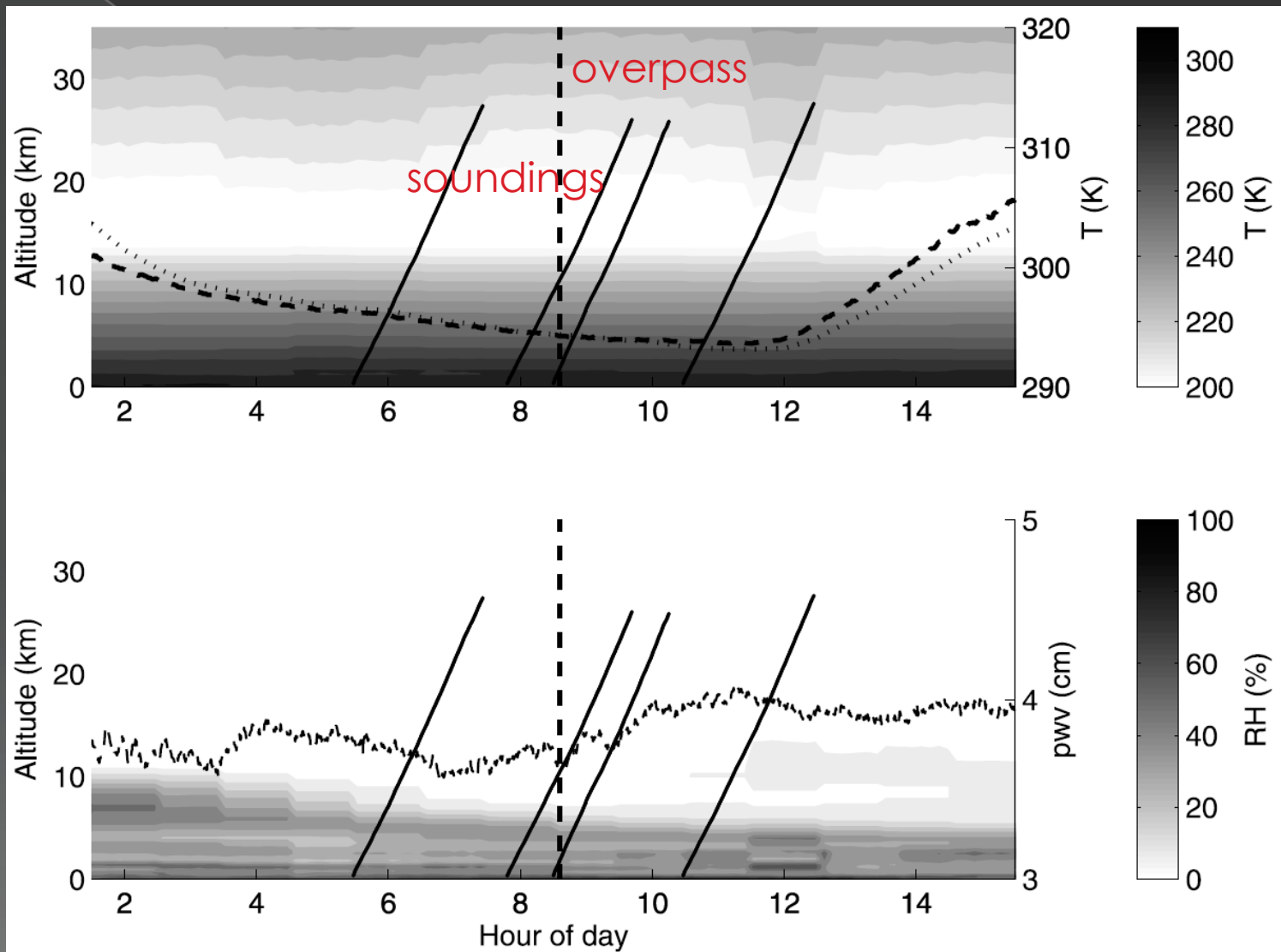
# Literature using sondes to calibrate satellite climate data

- Not much, but maybe enough
- More studies using satellites to identify problems in sonde data, e.g.,
  - > Soden and Lanzante (J. Climate 1996)
  - > Parker et al. (GRL, 1997)
  - > Soden et al. (JGR, 2004)
  - > Christy and Norris (JAOT, 2007)
- Some relevant, extrapolatable studies
  - > Buehler et al. (JGR, 2004)
  - > Tobin et al. (JGR, 2006)
  - > Seidel and Free (J. Climate, 2006)
  - > Pougatchev et al. (in preparation)

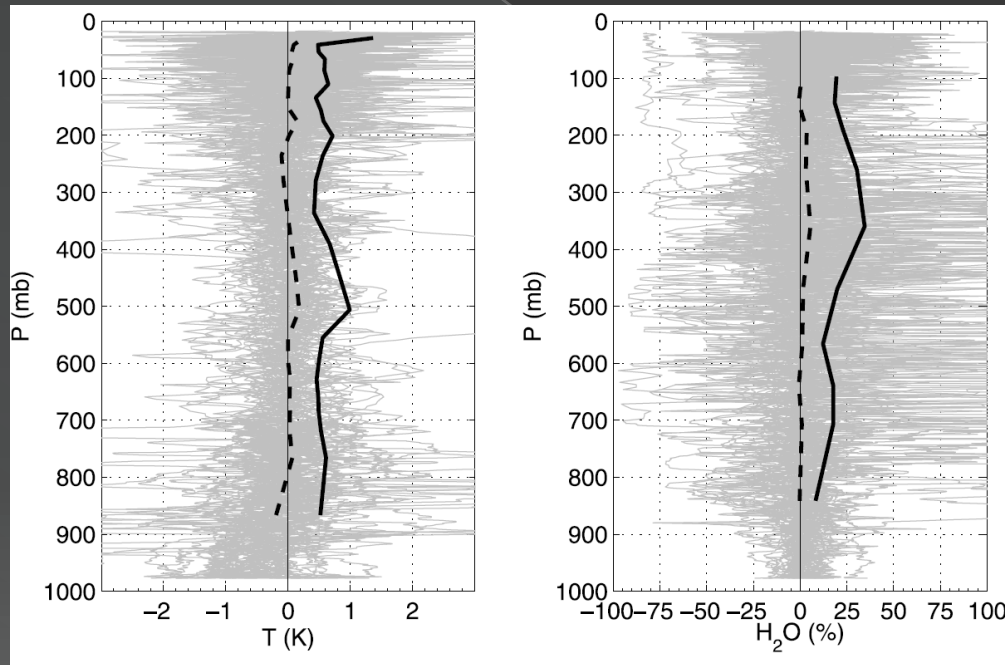
# Is “match-up” with satellite overpass possible?

- ◎ Synchronicity match-up?
  - > Overpass is nearly instantaneous
  - > Soundings take ~1 hr and so cannot avoid short-term atmospheric variability
- ◎ Co-location match-up?
  - > Sounding is a point measurement
  - > Larger satellite footprint includes small-scale variability of atmosphere
    - Nadir vs. off-nadir view angles
    - Limb-scanning sees a “noodle”

# The Myth of Synchronicity



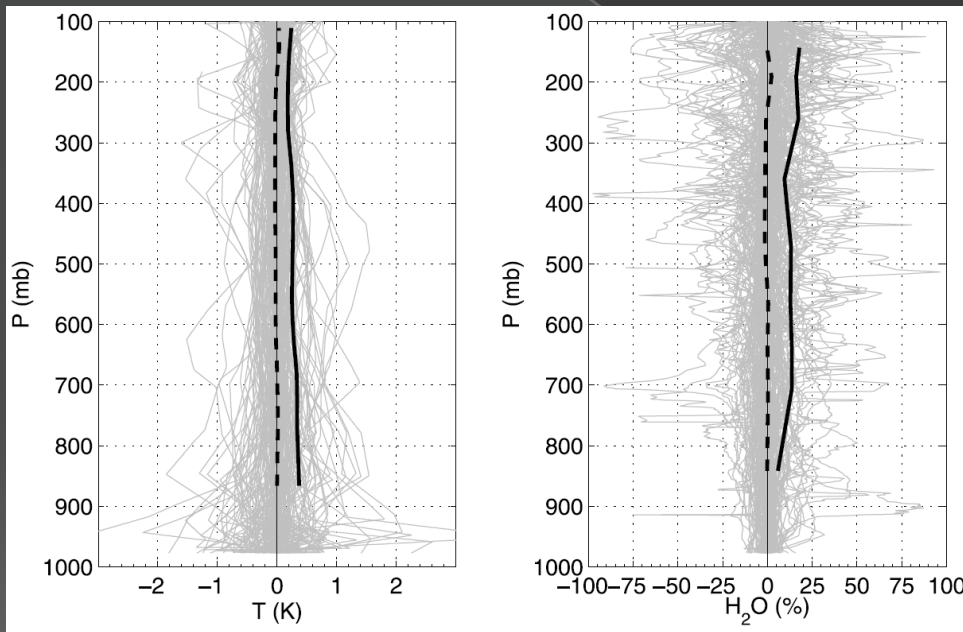
# Short-term variability cannot be fully estimated or removed



- Differences between paired soundings within 60 min of SGP ARM site overpass
  - > Actual difference
  - > RMS difference
  - > Mean difference
- Day and night are similar
- Tobin et al. (2006)

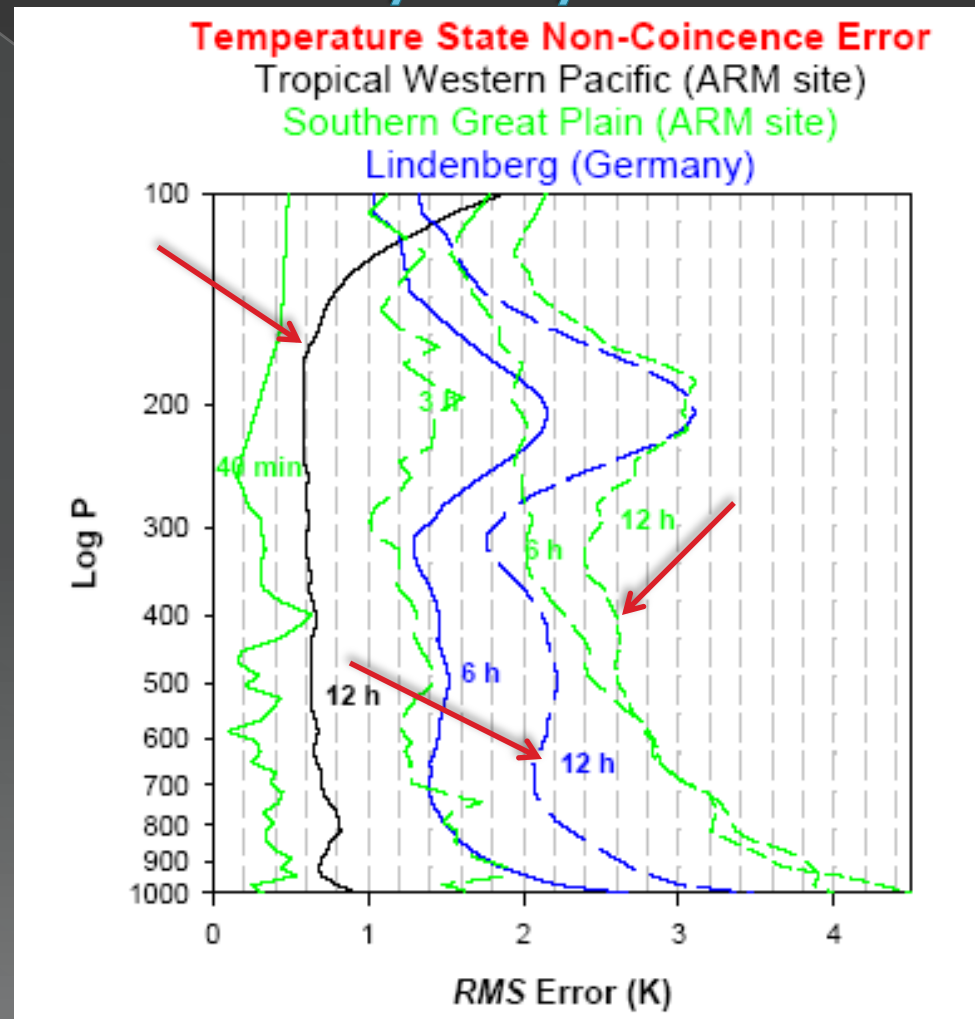


# Spatial variability cannot be fully estimated or removed



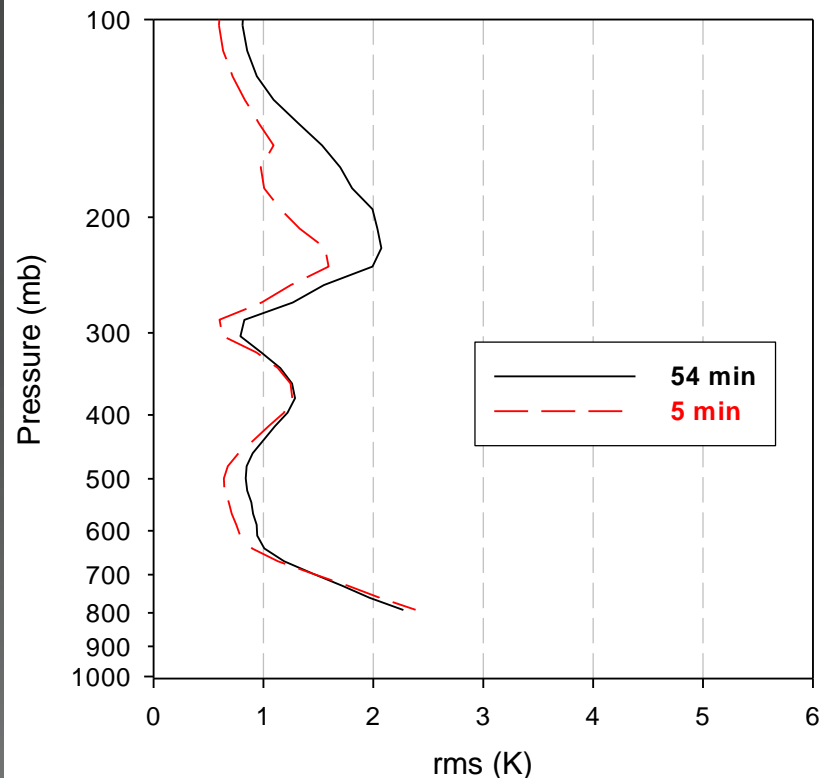
- ⦿ Differences between paired soundings within AMSU footprint (50-150 km), with one adjusted to match
- ⦿ Tobin et al. (2006)

# Atmospheric variability statistics vary by location



# Little difference in errors for launches within 1 hr

Lindenberg sondes and IASI retrievals comparison for 5 min and 54 min launch time differences



# Estimated non-coincidence errors for 3 locations

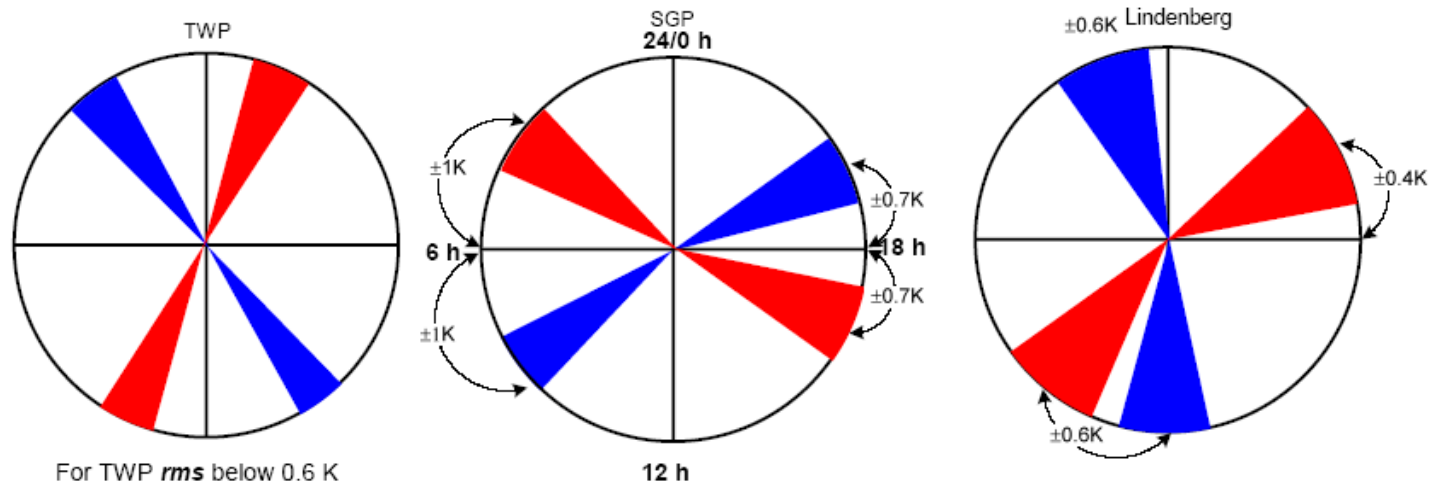


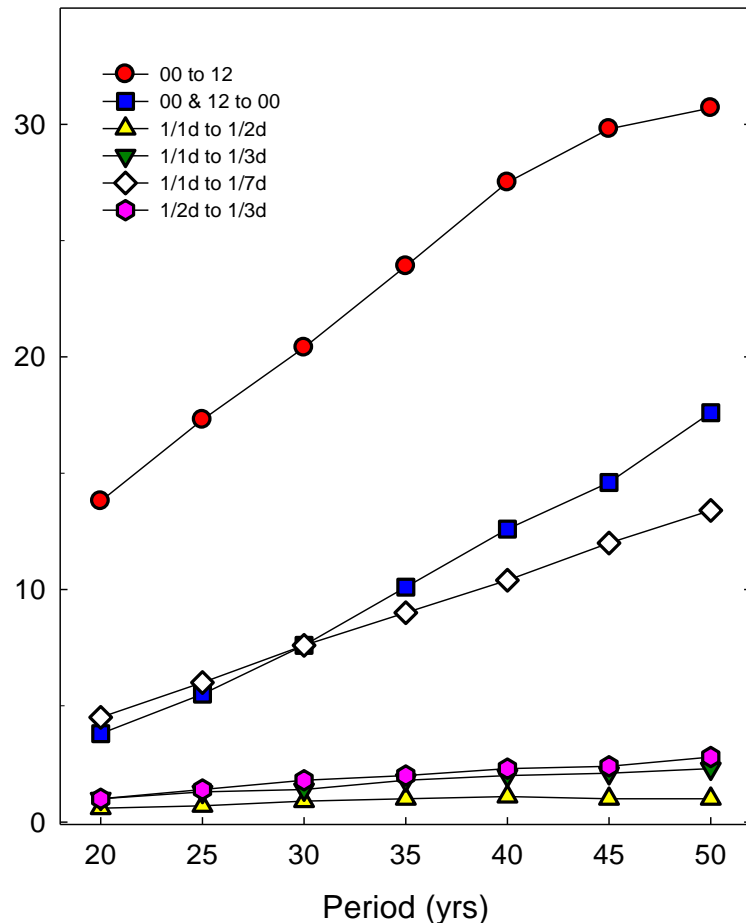
Fig. 6. Validation *rms* non-coincidence error for AIRS and IASI overpasses at three launch sites. Black crosshair lines corresponds to standard launch times, colored sectors shows the time intervals of overpasses: blue is for AIRS and red is for IASI.

# Issues for humidity soundings

- Buehler et al. (2004) used wind field to “displace” humidity sounding for better match-up with satellite overpass
- NOAA 15 vs 16 AMSU radiance differences identified using sonde-derived radiances
- Small-scale spatial variations in humidity and radiosonde (Vaisala RS80) biases limited ability to clearly identify source of discrepancy

# Effect of inconsistent launch time on T trend detection

Trend Error Rate (%) Due to Changing Observing Schedule



- Changing obs time of day has greater impact than changing sampling frequency
- Suggests making obs at fixed time, but not necessarily every day, to monitor trends.
- Seidel and Free (2006) based on sampling reanalysis data

# Summary Points

- Exact coincidence/co-location is neither needed nor possible
- Non-coincidence error can be quantified in a comprehensive error model
  - > Increases with increasing separation
  - > Varies geographically
  - > Larger for humidity than temperature
- Trend monitoring more efficient with fixed schedule but does not require daily obs.
- Monitoring and calibration goals might be met with a well-conceived schedule.