Update on Task Team 3 : Measurement Scheduling and Related Activities

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- Update on activities
- Review of temperature measurement literature
- Short-term sampling issues (study of example temperature dataset)
- Instrument qualification issues (Dave Whiteman)

TT3 Scheduling - Objectives

- to develop defensible, quantifiable, scientifically-sound guidance for GRUAN sites on measurement schedules and associated site requirements, in order to meet all GRUAN objectives including :
  - climate trend detection
  - satellite calibration/validation
  - studies of local meso-scale processes and events
- main information sources are from peer-reviewed literature, GRUAN documentation, and currently unpublished studies of which the group is aware. Some limited new analyses where critical gaps exist, using existing data sets.

Update on TT3 Activities

- Presentation at 9th International Temperature Symposium on ‘Sampling and Measurement Issues in Establishing a Climate Reference Upper Air Network‘. Paper to be published in ~one month.
- DW-lead proposal to NASA on ‘What measurements are required to detect 21st century trends in upper tropospheric and lower stratospheric water vapor ?‘ Still waiting for outcome – was due end Jan.
- Rigel Kivi has joined the TT as a representative from the sites.
- Draft review of temperature measurement requirements distributed for comment within TT – following from previous review of water vapour requirements.
- International NMI meeting on Low Carbon and Climate Science, including presentation by Adrian Simmonds

Review of Temperature Measurement Requirements

- TG and a colleague at NPL (Dave Butterfield) have tried to summarise the key papers in this area, and use them to come up with a series of referenced recommendations.
- This work is reported in two documents, currently under review, :
  - a bibliography, summarising the main contents of a series of 12 relevant papers;
  - a shorter recommendations document, which draws some general conclusions from the papers.
- General focus on sonde measurements and long-term trend detection, although a number of the conclusions will be more generally applicable.

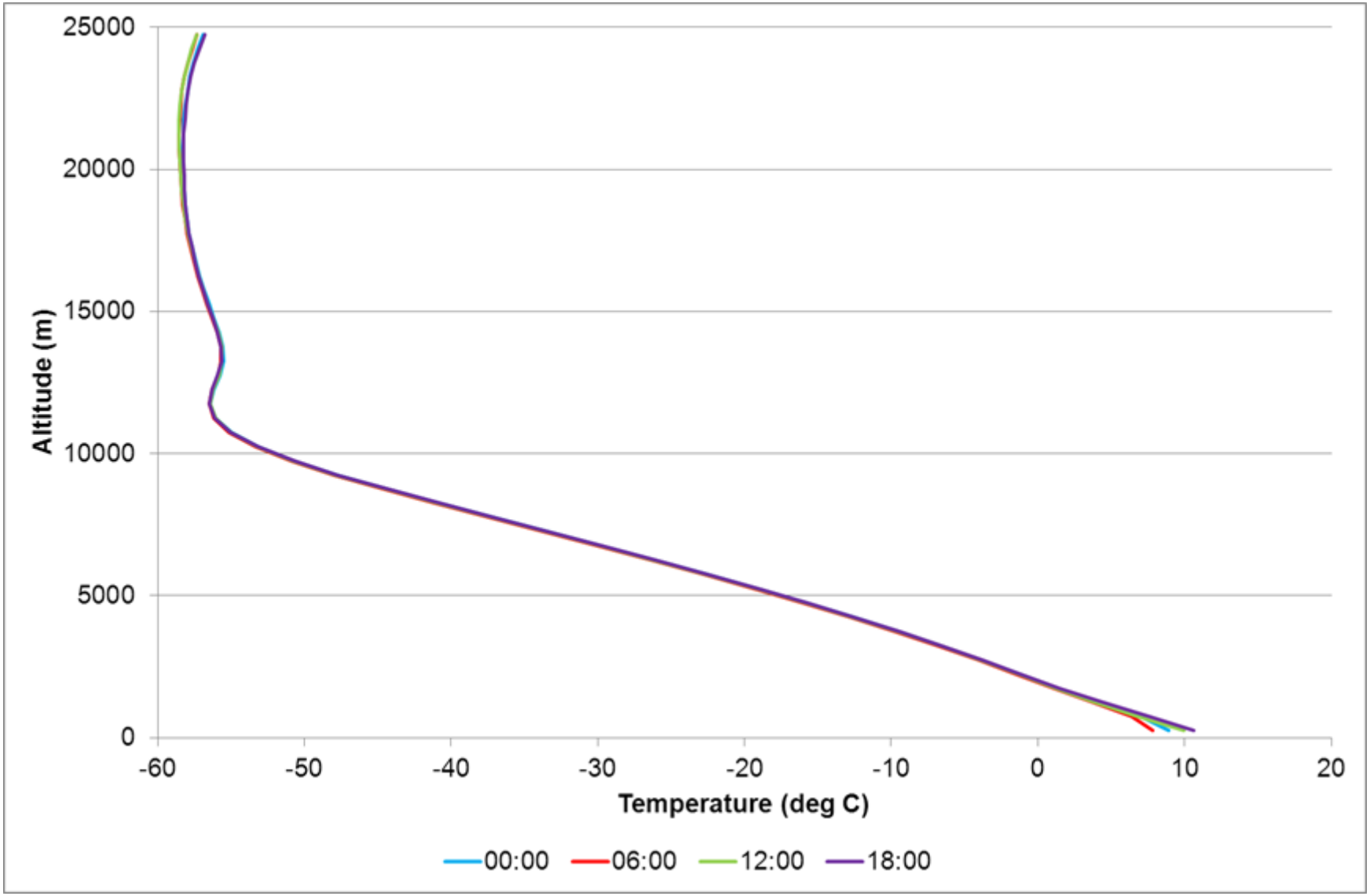
Review of Temperature Measurement Requirements

- Let us know if anyone else wishes to see / review the documents at this stage.
- Also, please update us with any other recent papers / citable reports that would be relevant.
- Particularly interested in suitable material on shorter timescale measurement objectives rather than long-term trends (satellite validation, process studies, etc.)
- Recommendations currently extend beyond scheduling to cover other aspects of temperature measurement requirements – should we limit scope ?

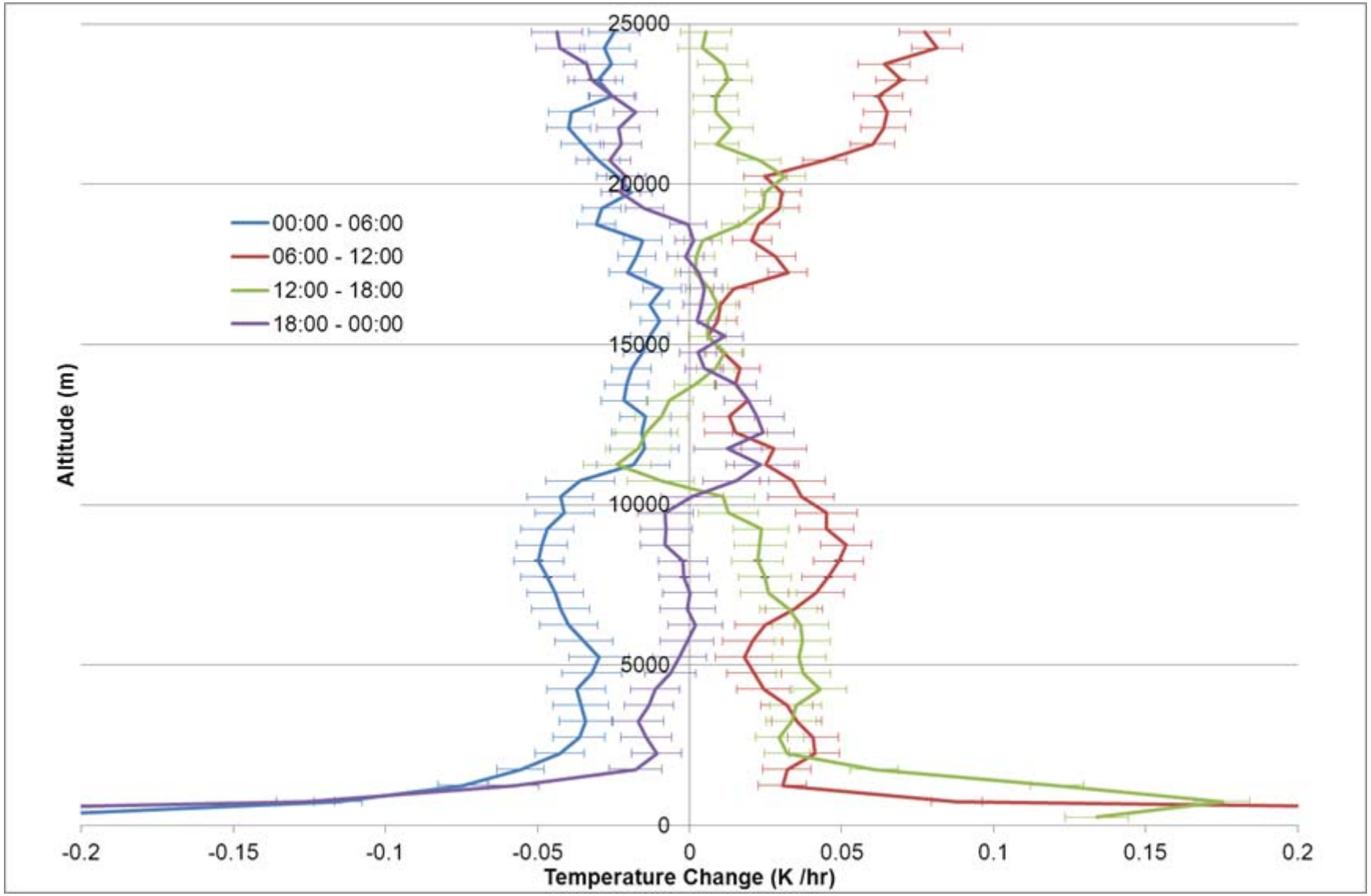
Short-timescale sampling issues

- Difficult / impossible to produce a fixed set of sampling guidelines given the wide potential range of short-timescale applications (for process studies and satellite validation).
- One option is to estimate the increased uncertainty due to non-simultaneous temperature measurements.
  - For example, what is the increased uncertainty in the temperature profile if a sonde result is used for a satellite overpass some time later ?
- This would enable an appropriate sampling strategy to be put in place for a given requirement / application.
- We have tried to produce an estimate of this from atmospheric data.

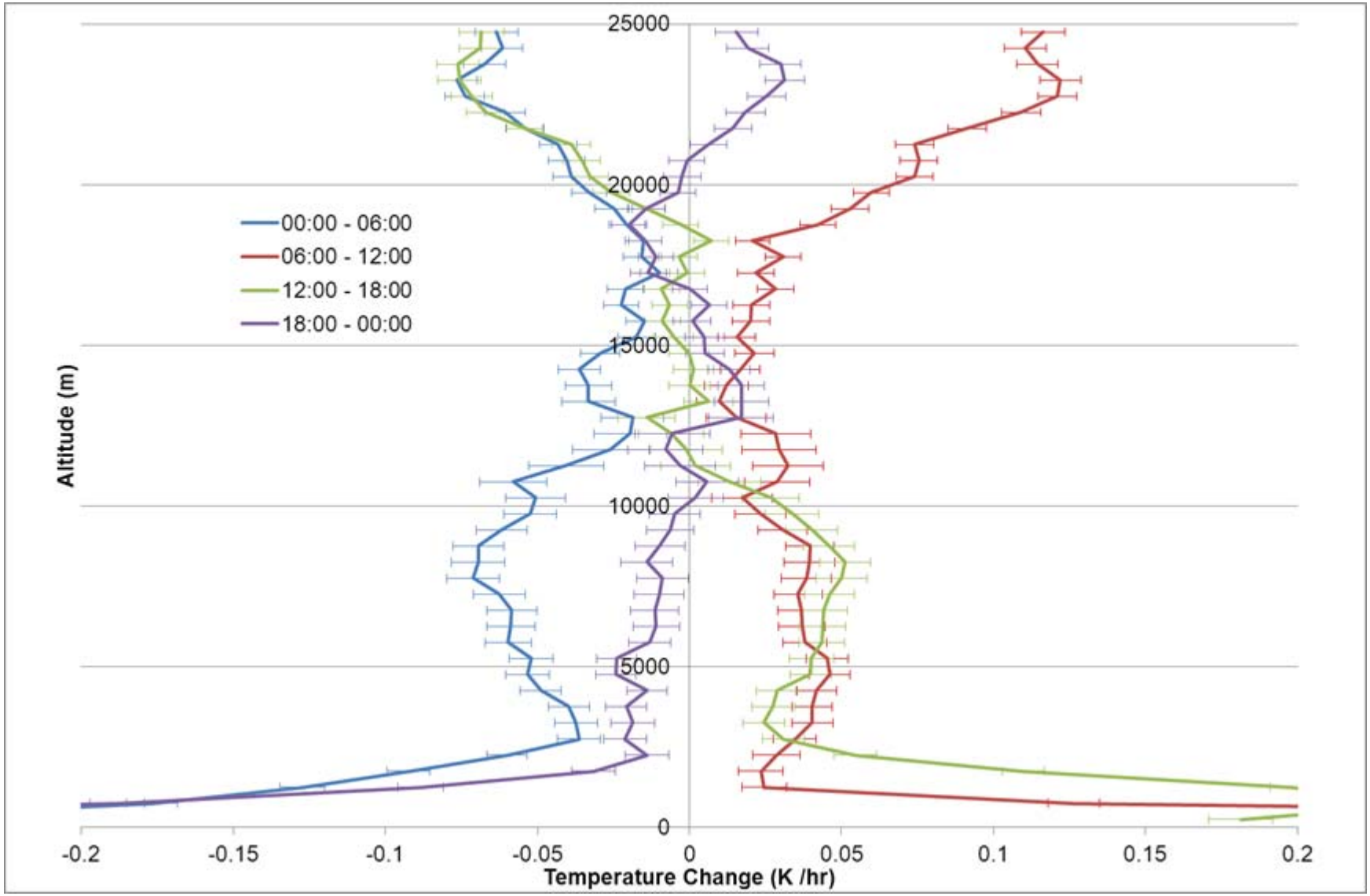
Lindenburg 6-hourly routine sonde dataset (1999-2008)



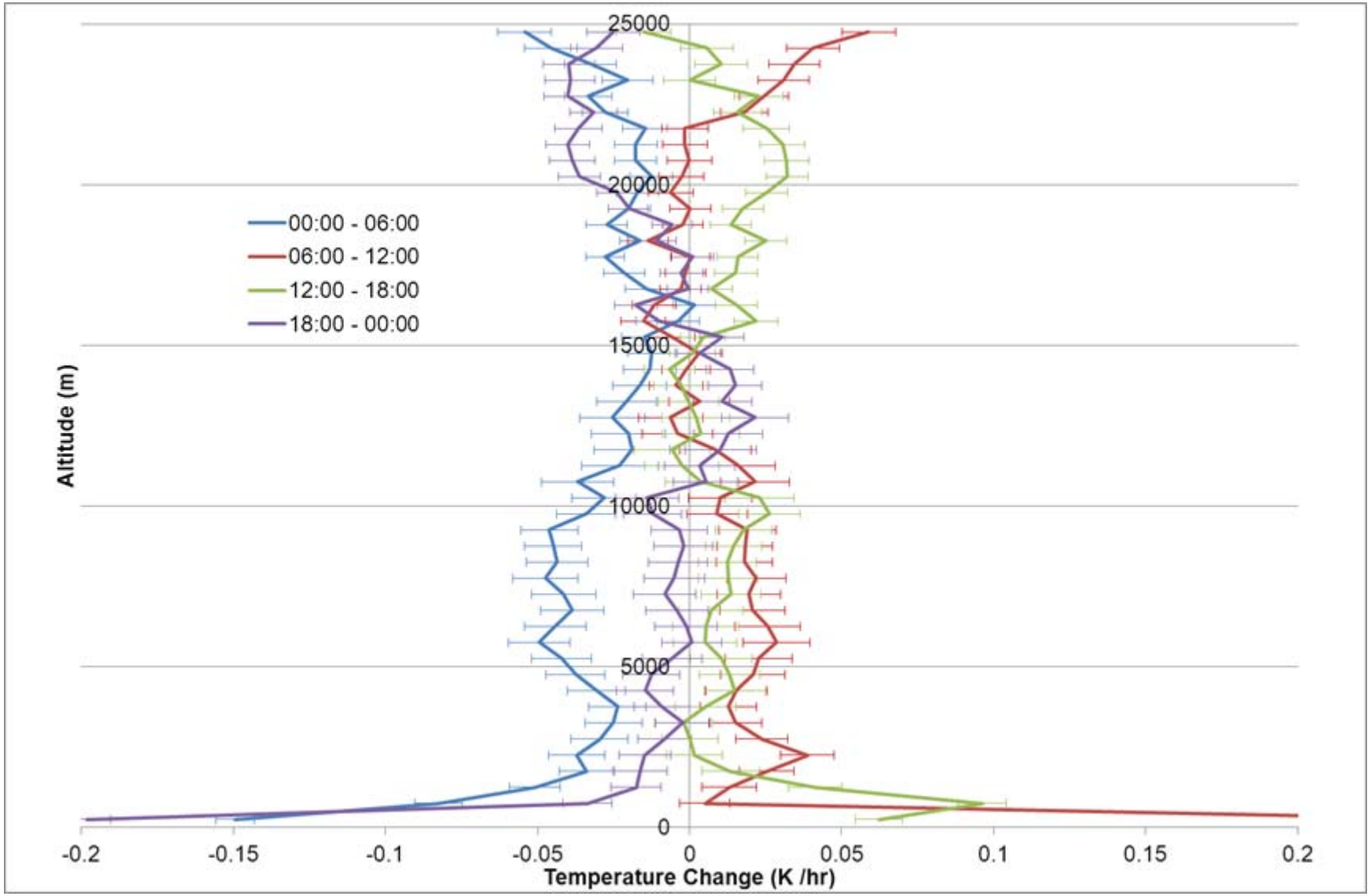
Temperature change profile : Spring



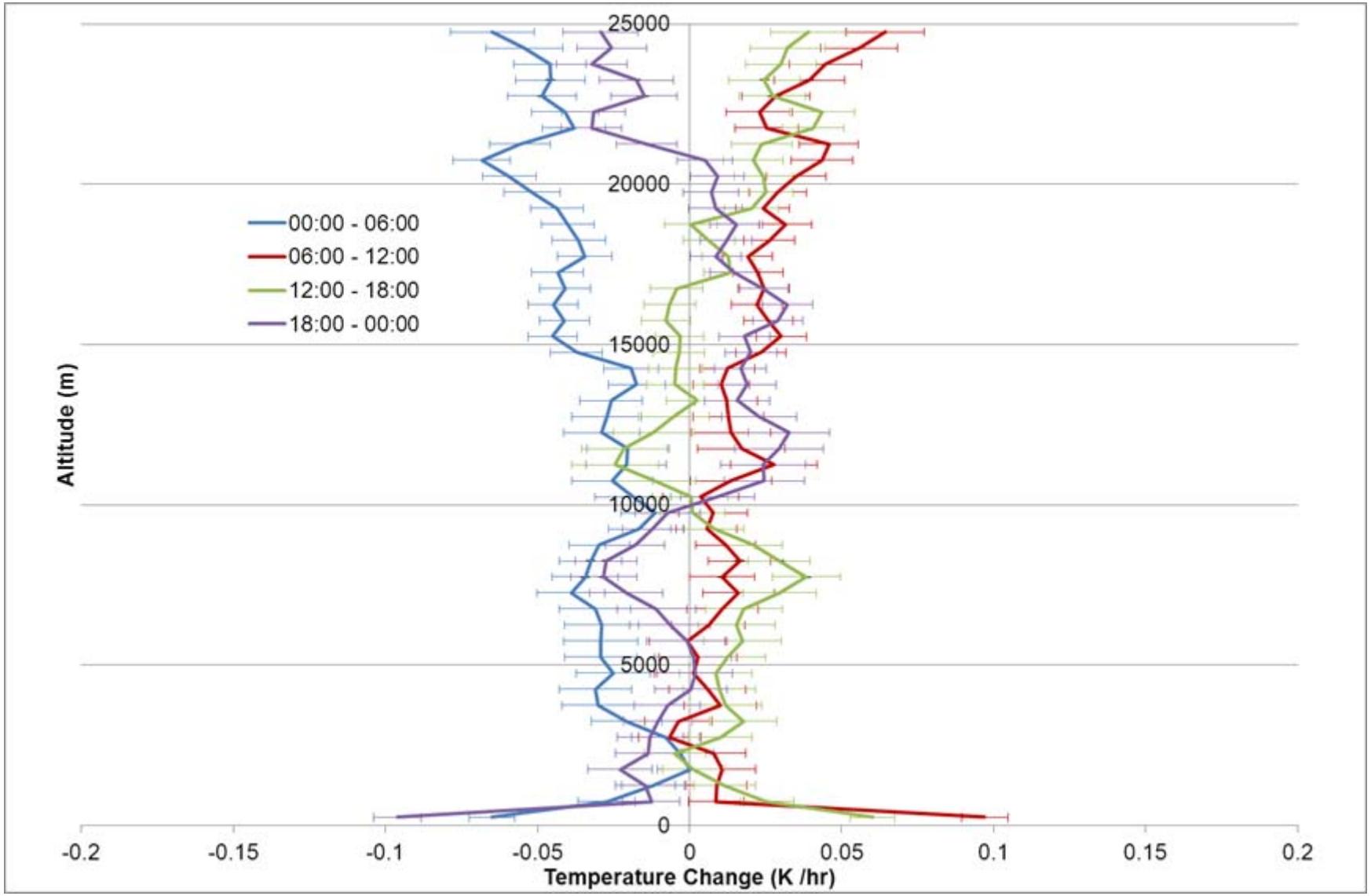
Temperature change profile : Summer



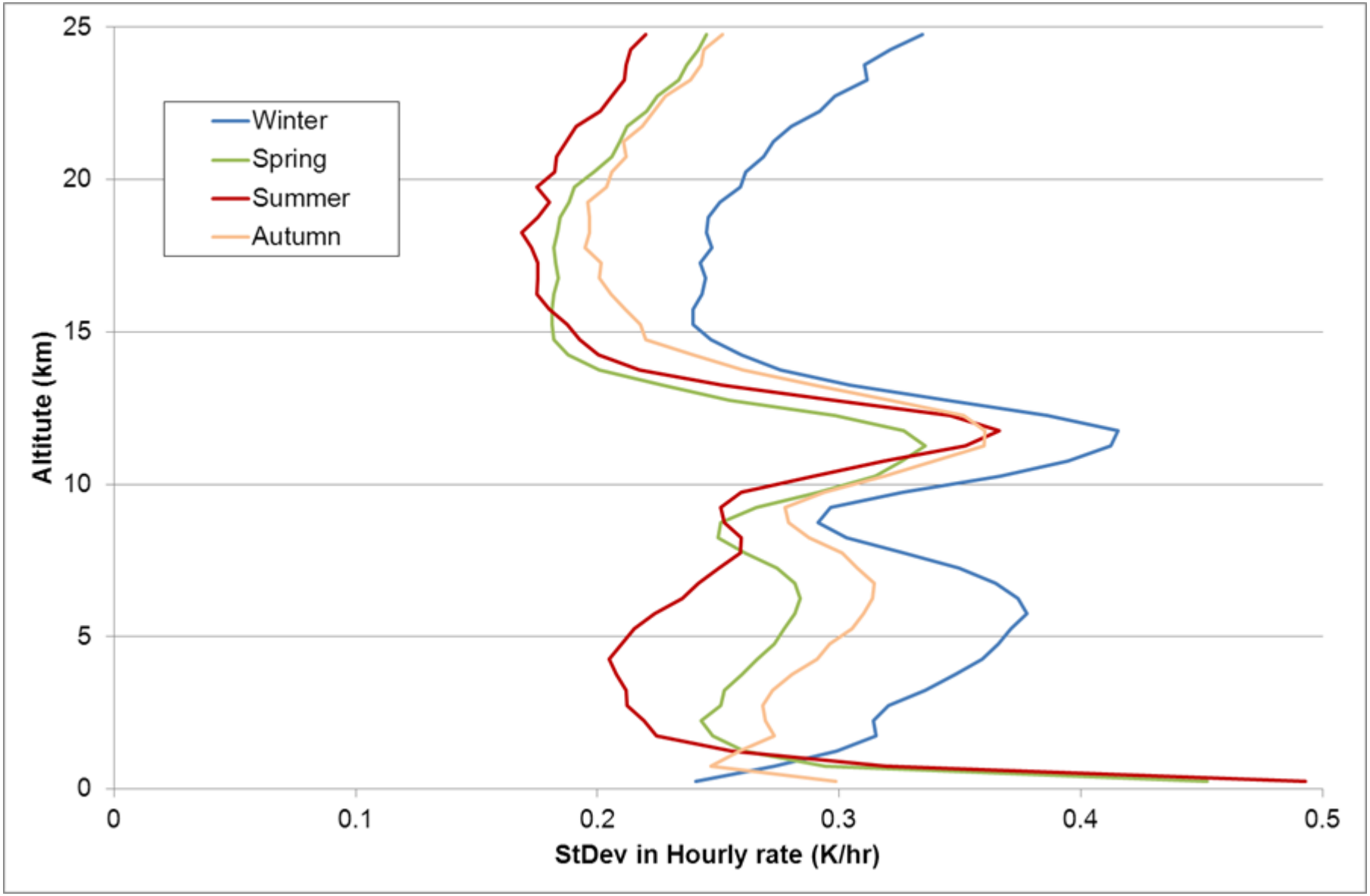
Temperature change profile : Autumn



Temperature change profile : Winter



Variability profiles



Temperature adjustment uncertainties

Rates of change (in K / hr) between 12:00 and 18:00

At Altitude of 5 km

	Spring	Summer	Autumn	Winter
Mean rate of change	0.036	0.040	0.010	0.013
Stdev (1 reading)	0.265	0.219	0.304	0.372
Stdev (10 readings)	0.084	0.069	0.096	0.118
Stdev (100 readings)	0.026	0.022	0.030	0.037

At Altitude of 10 km

	Spring	Summer	Autumn	Winter
Mean rate of change	0.011	0.027	0.023	0.000
Stdev (1 reading)	0.305	0.280	0.337	0.368
Stdev (10 readings)	0.097	0.088	0.107	0.116
Stdev (100 readings)	0.031	0.028	0.034	0.037

At Altitude of 15 km

	Spring	Summer	Autumn	Winter
Mean rate of change	0.006	-0.005	0.004	-0.003
Stdev (1 reading)	0.182	0.191	0.215	0.235
Stdev (10 readings)	0.058	0.060	0.068	0.074
Stdev (100 readings)	0.018	0.019	0.021	0.023

At Altitude of 20 km

	Spring	Summer	Autumn	Winter
Mean rate of change	0.031	-0.033	0.032	0.024
Stdev (1 reading)	0.199	0.175	0.202	0.270
Stdev (10 readings)	0.063	0.055	0.064	0.085
Stdev (100 readings)	0.020	0.017	0.020	0.027

Questions / next steps

- Aim is to provide tool / recommendation of short-term scheduling decisions.
- Is this a useful assessment ? If so, how best to disseminate the results ?
- What other datasets are available that could be analysed (Lamont SGP) ?
- Data distribution show signs of non-normal behaviour, so further analysis may be needed here for more rigorous uncertainties.
- Have also started to look at cluster analysis of results to identify correlation patterns in data.

SLIDES FROM DAVE WHITEMAN

Should GRUAN qualify instruments for each measurement objective separately?

- GRUAN identifies 4 key users for its data products
  - Climate detection community
  - Satellite community
  - Atmospheric process studies community
  - Numerical weather prediction community
- But the measurement requirements for meeting the needs of each of these GRUAN user groups can change dramatically for each community
  - Material in GRUAN guide illustrates this for water vapor. Material under development addressing this for temperature.
- Some instruments are currently capable of meeting the measurement requirements for some of these communities but not for others.
  - It would therefore seem useful to consider qualifying instruments on a need-by-need basis

Incorporating existing instruments into GRUAN

- A hallmark of GRUAN is the traceability of the calibration to international standards or references.
- But is this really needed for tropospheric process studies and for numerical weather prediction where time scales of interest range from hours to days?
- If existing measurements from an instrument are sufficient to enable useful scientific studies to be performed without traceability of uncertainty, why not consider qualifying that instrument and its current data stream for those particular scientific studies?

Example - The DOE/ARM Raman lidar measurements of water vapor (SGP and Darwin)

- These are 24/7 automated instruments supported by DOE with a sophisticated quality control and data processing infrastructure. The CART Raman lidar at the SGP site in Oklahoma has a >15 year record of participating usefully in field campaigns for atmospheric process studies resulting in numerous publications and is unique in the world in this respect.
- In terms of whether the data from the ARM lidars are good enough for process studies, this record would seem to indicate that they are good enough.
- It would seem wise to establish procedures that would ease the incorporation of such systems into GRUAN as tier 2 instruments for the purposes of atmospheric process studies.
- Establishing a protocol where instruments could qualify for GRUAN on a need-by-need basis could permit the easy incorporation of the ARM Raman lidars, in their current configuration and with their current data streams, for atmospheric process studies while the suitability of the ARM lidars for trend studies, for example, is still under investigation.

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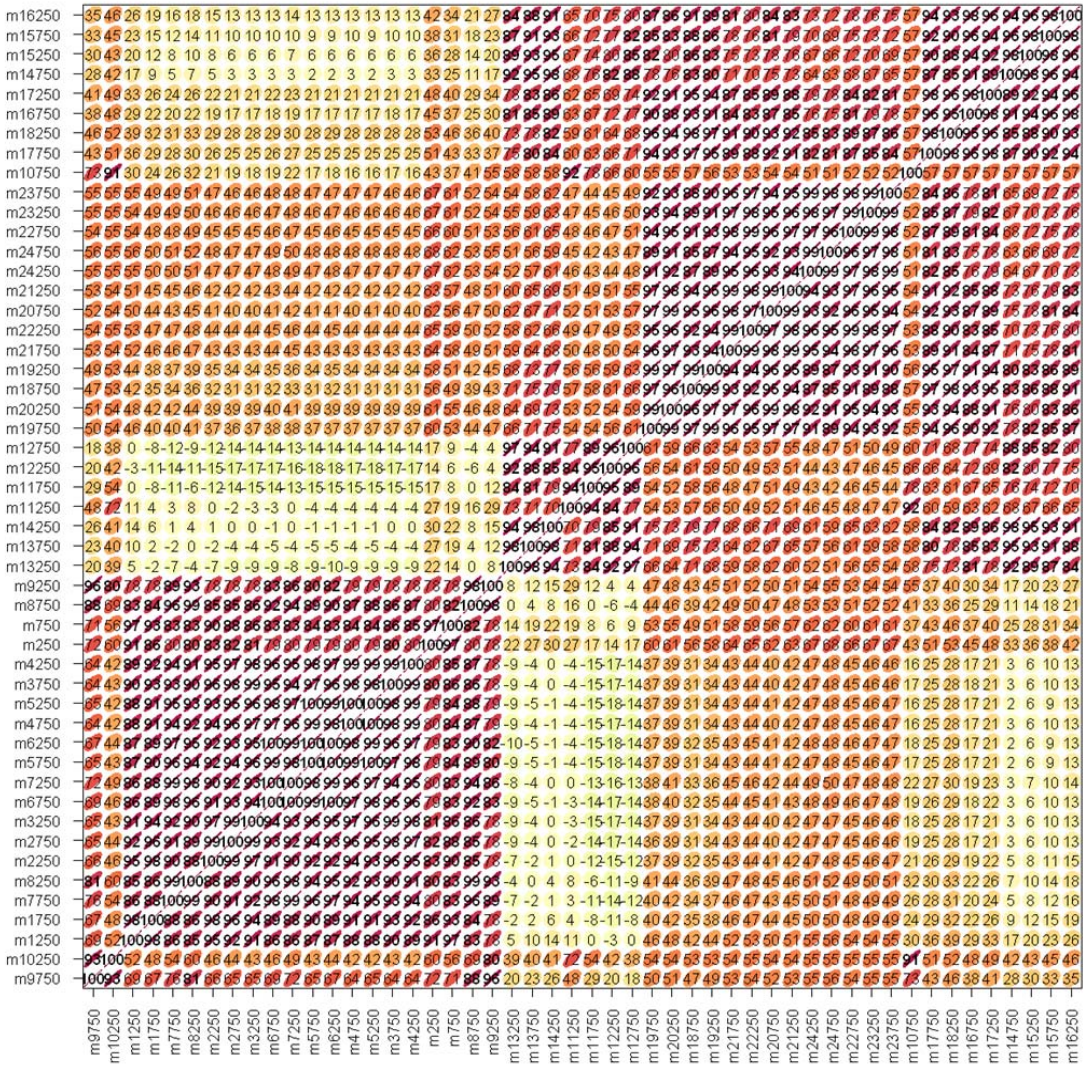
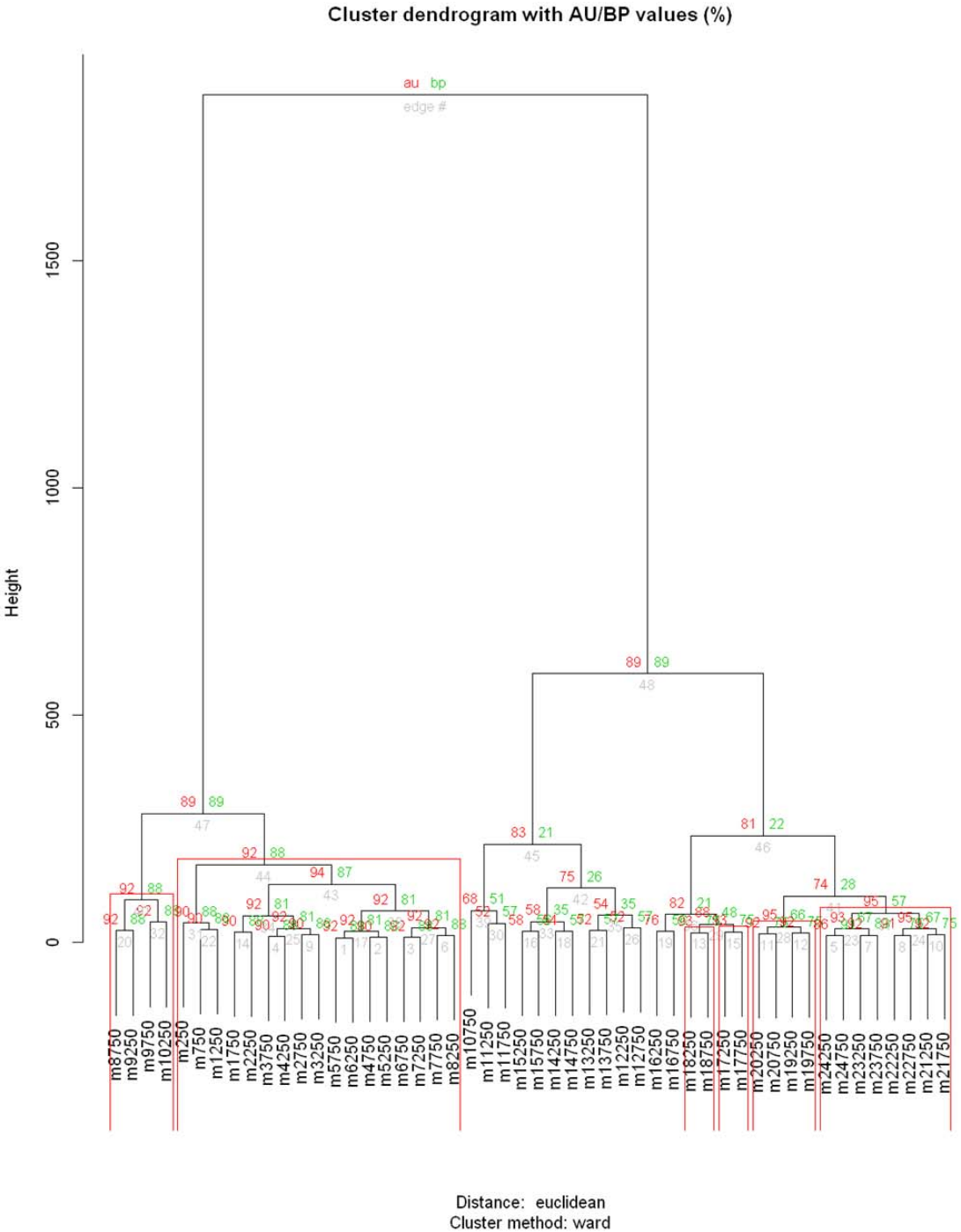
Cluster analysis - correlation plot of all launches, 1999 to 2008





- Red boxes with a correlation of 0.9
- To reduce analyse load can group into correlated altitude clusters