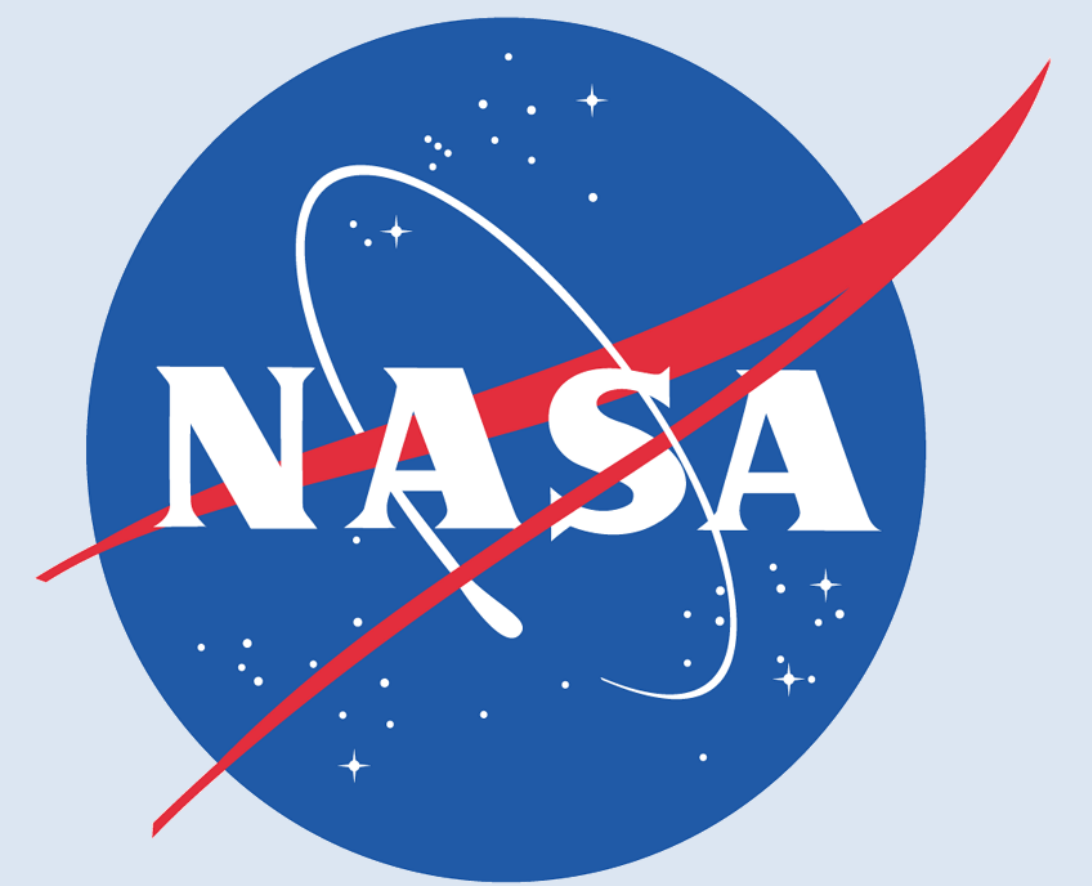
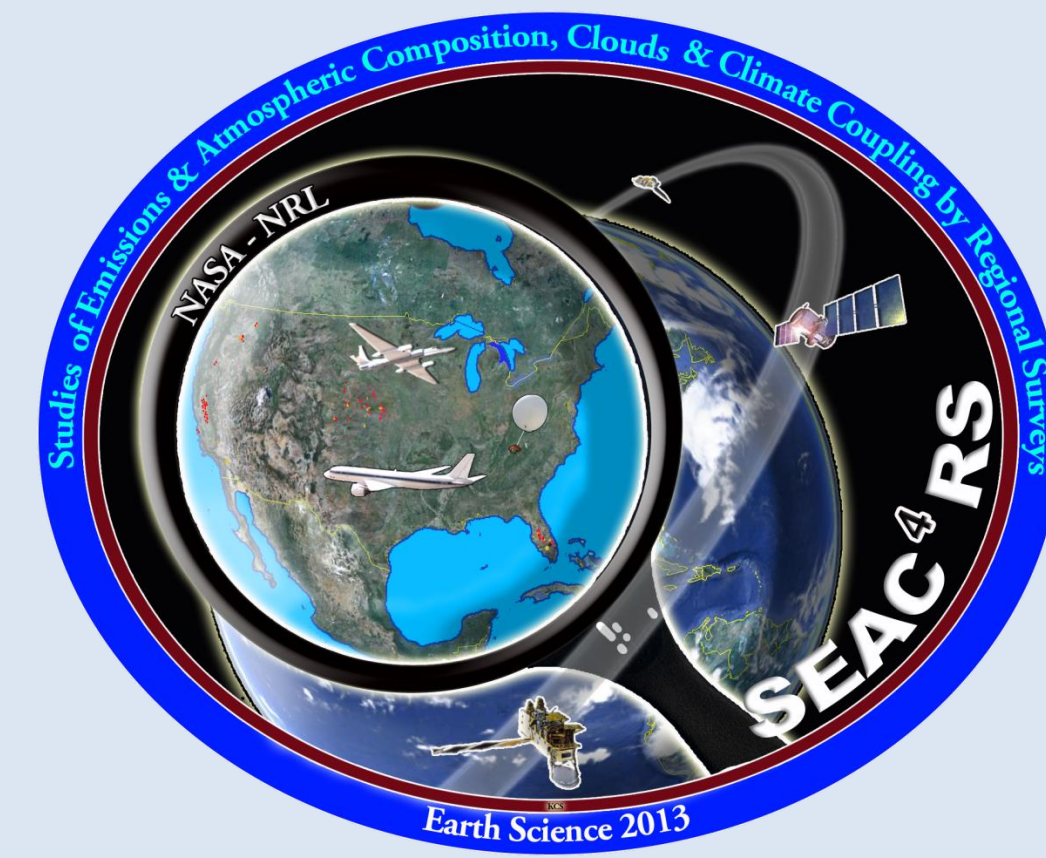


MTP PERFORMANCE DURING THE SEAC⁴RS CAMPAIGN

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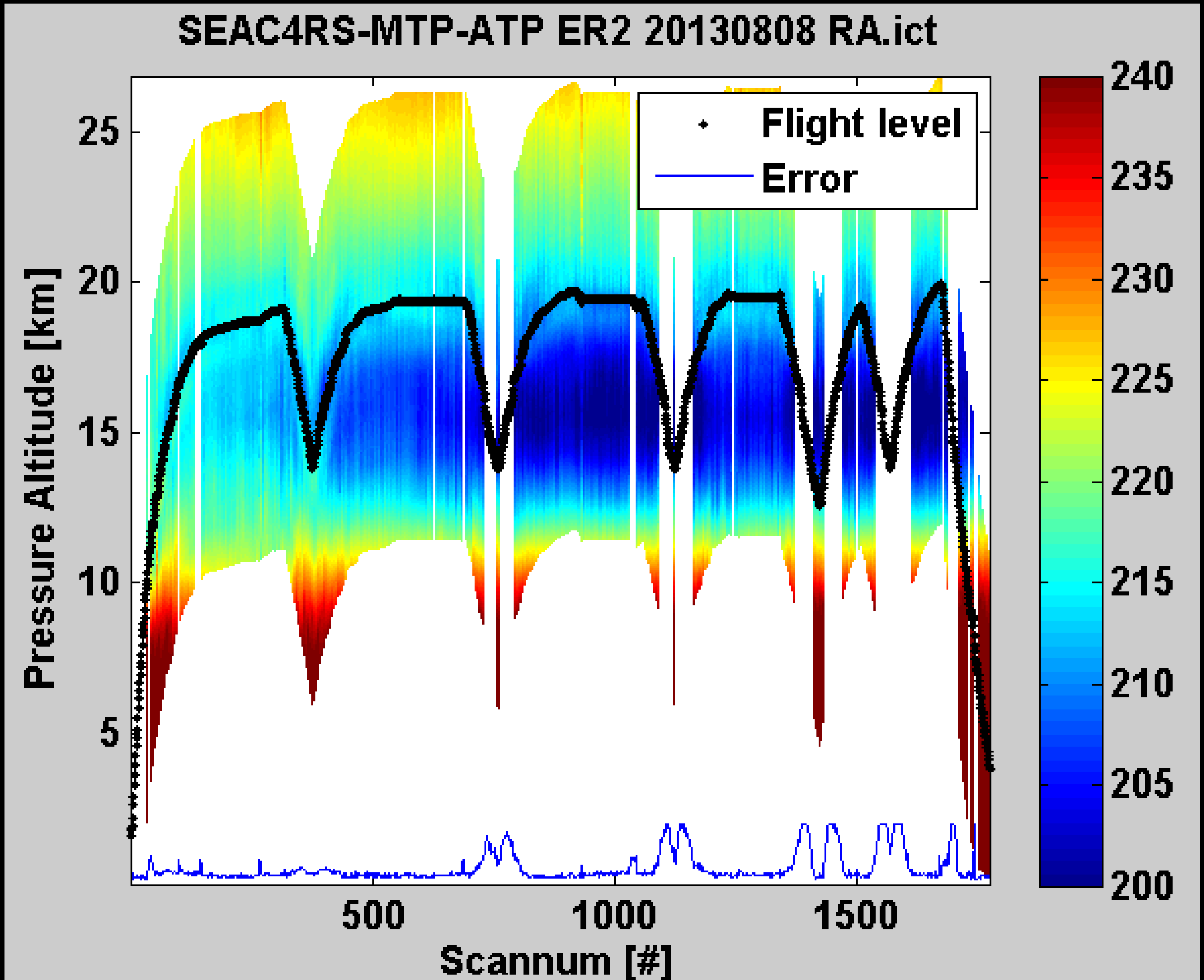


ABSTRACT

The Microwave Temperature Profiler (MTP) provides temperatures above and below the aircraft flight level to provide meteorological context for the companions instruments. During SEAC⁴RS it was installed on the ER-2 with a suite of 14 other instruments.

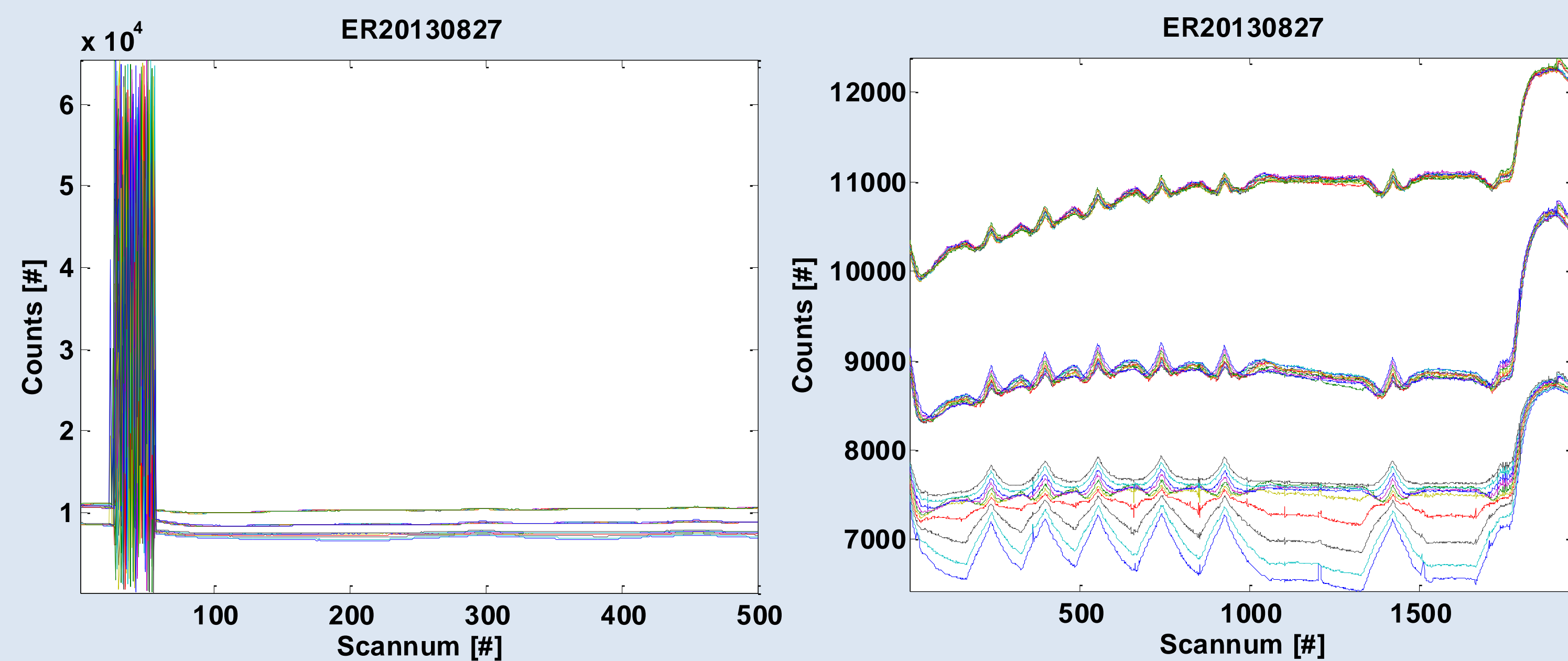
Data was collected during all 22 flights, which included test and transit flights. 9 of the flights had suspected RFI issues that obscured measurements for short periods of time during takeoff only. Temperature profile retrieval performance of the instrument was degraded in the mission during the 'dip' maneuvers performed. The rapid change in aircraft pitch and altitude causes insufficient sampling time for the instrument to complete a full scan. For the worst case flights, this currently results in a >15% loss of data.

Retrieved profiles have minimum error at the flight level (<0.2K) and this increases to >1K at the edges of the vertical swath. Recommendations for software and hardware upgrades are made. Specifically, for the software processing, we will be integrating model outputs (NCEP, MERRA) to improve data quality and extend the profiles provided to the surface.



NOISE ISSUES

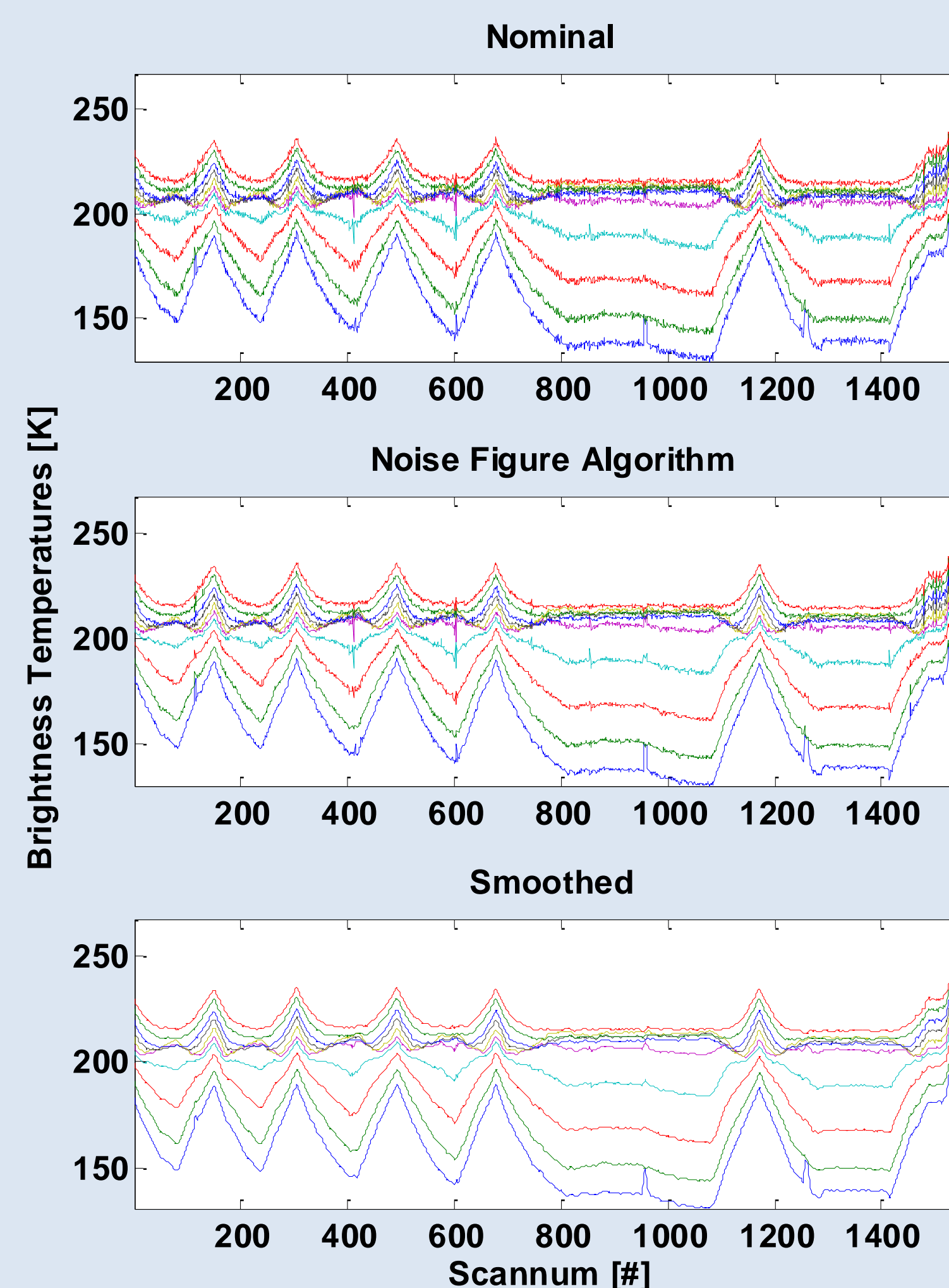
- Counts from 9 flights beyond the expected range of the instrument
- Initially suspected RFI, however, counts also deflected low
- Noise from aircraft possible, but unlikely due to varying duration at takeoff (and not present at all flights)
- High humidity at Ellington a possible issue however noise not always present during first power on
- Data nominal after takeoff at flight level
- Recommendations: 1. Perform warm up with heaters prior to take off 2. Replace older electronics on backend (underway)



(Left) Noise dominating measurements (Right) Nominal flight data

NEW CALIBRATION

- Adopt best practices from similar radiometric instruments
- Calibration methodology from High Altitude MMIC Sounding Radiometer (HAMSR)
- Relies on the stability of the system noise figure
- Significantly reduces the system noise by a factor of ~2
- Boxcar averaging can reduce the noise further
- However, care must be taken to determine the appropriate averaging to ensure features are not washed out
- Ongoing work to characterize the averaging thresholds and additional error corrections



T_B calibration comparison

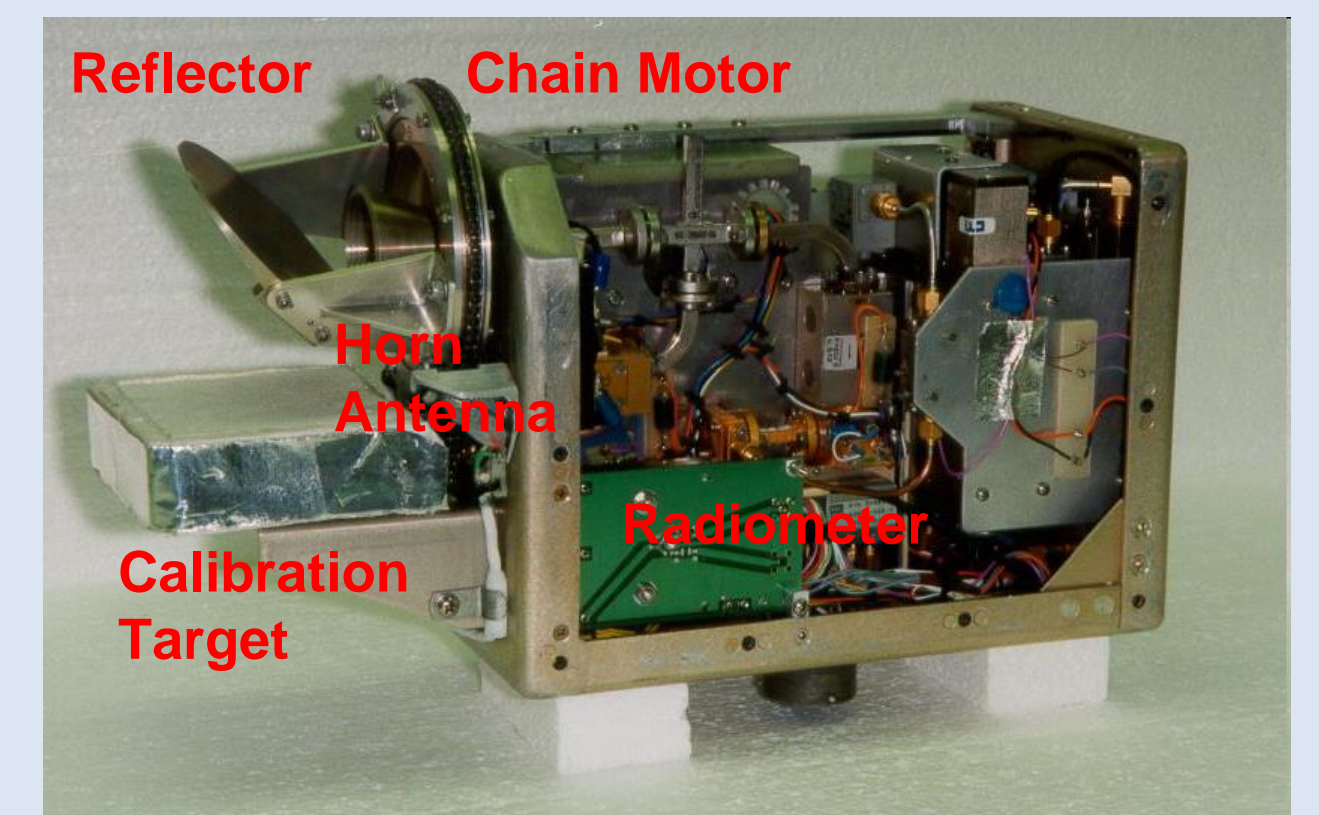
ACKNOWLEDGEMENTS

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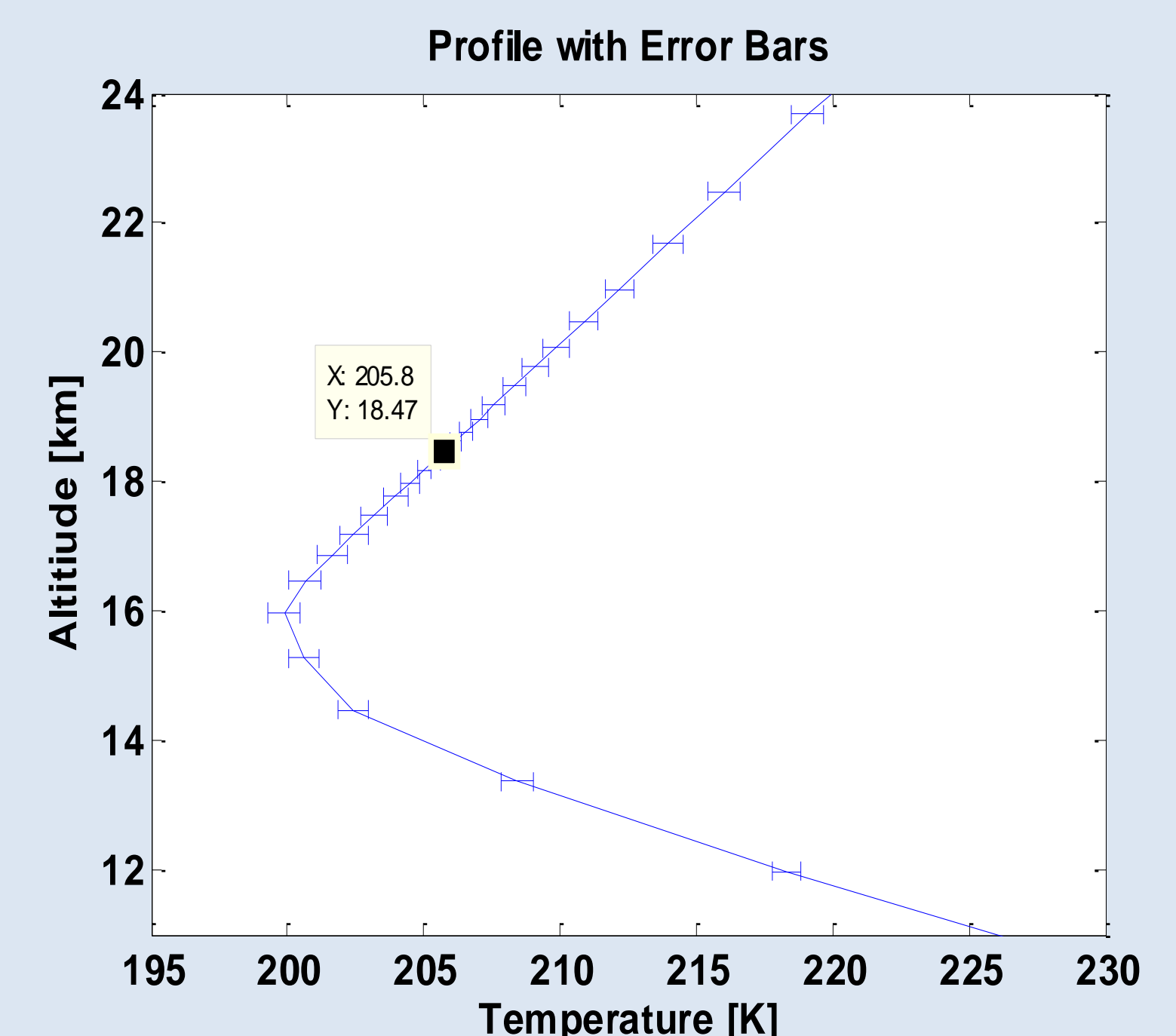
'DIP' MANEUVERS

- MTP requires 15 seconds to complete a scan cycle
- During a dip (or climb) the scan becomes smeared resulting in larger than nominal error bars
- Current processing algorithms are unable to deal with this flight profile
- Recommendations: 1. Develop new algorithms (underway) 2. Upgrade hardware to minimize scan duration, targeting 2 second cycles (see below)



TYPICAL RETRIEVAL ERRORS

- MTP retrieval errors are smallest at flight level and progressively increase away from that level
- Typical error magnitudes at flight level are <0.2K
- Within ±2km this increases to the 0.5K level
- At full retrieval extent, the errors are >1K
- Radiometric sampling is more frequent closer to the flight level



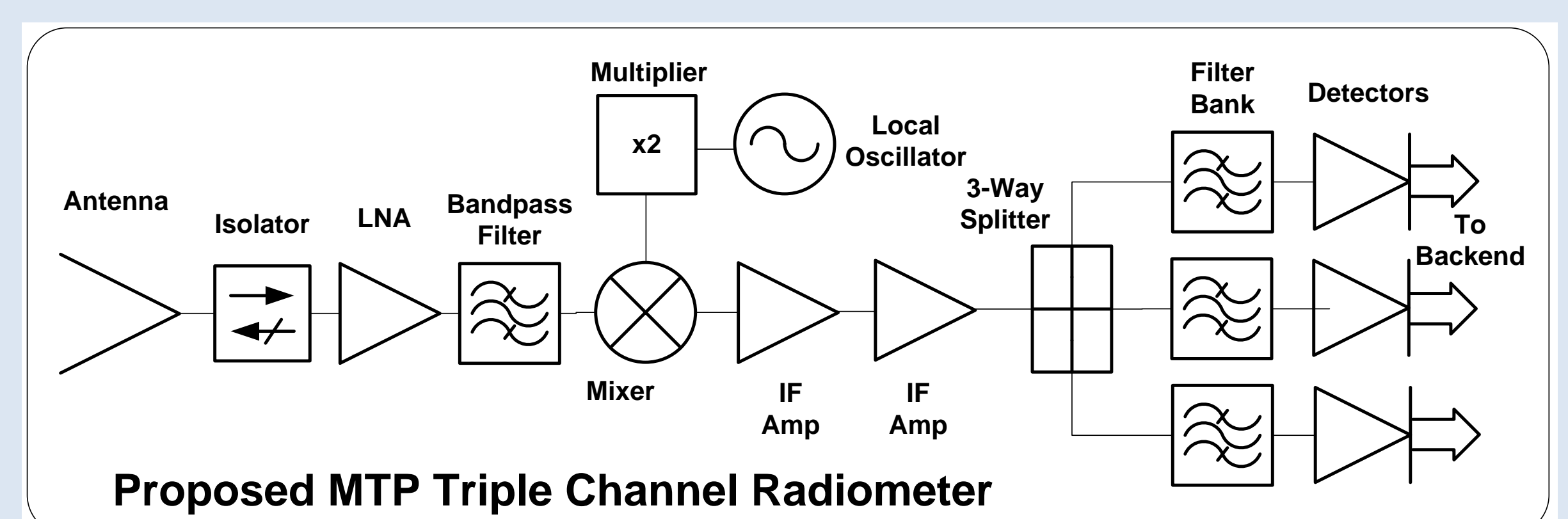
Typical profile retrieval errors

PROFILE EXTENSION

- Users have requested the extension of the profiles from the flight level all the way to the surface
- Currently retrieval levels extend to a maximum of ±8km from flight level, the extent of measurement sensitivity
- Secondary product to be developed to extend the profile by filling in the gap using both radiosonde and model data inputs (ongoing)

PROPOSED HARDWARE UPGRADES

- Communications unit and data unit to be combined into a single processing box utilizing current technology
- RF system to be upgraded with LNA front end and parallel IF outputs to allow for reduced scanning time
- These upgrades will increase the MTP system reliability and improve performance during rapid descents and ascents



Proposed upgrades to the MTP RF section to allow for faster scanning period