Data Quality Issues Affecting Current GPS RO Retrievals and Implications for Future Receiver Development

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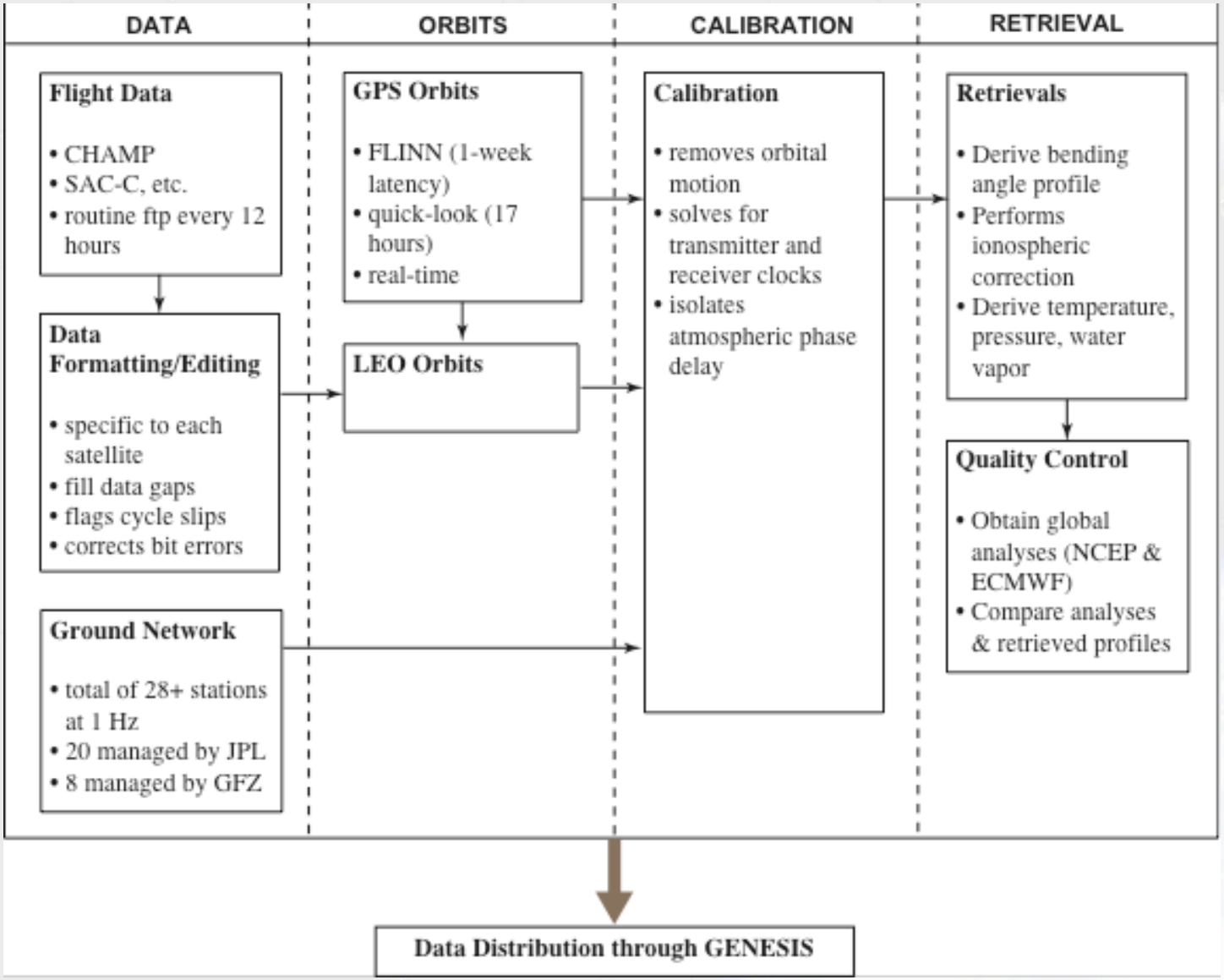
Overview

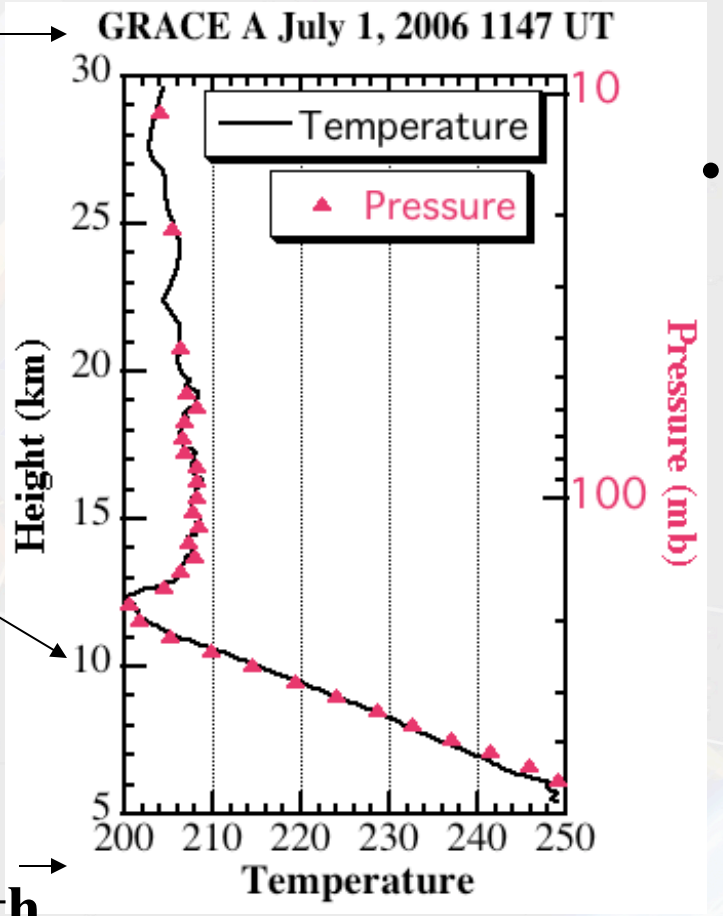
- Processing overview
- Summary of data quality issues and mitigations
- Data quality issues
- Summary

Radio Occultation Processing



Data Quality Issues

- Low SNR
- Abel extrapolation
- Ionospheric residual



- Higher gain: digital beam steering
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- Lose L2 signal
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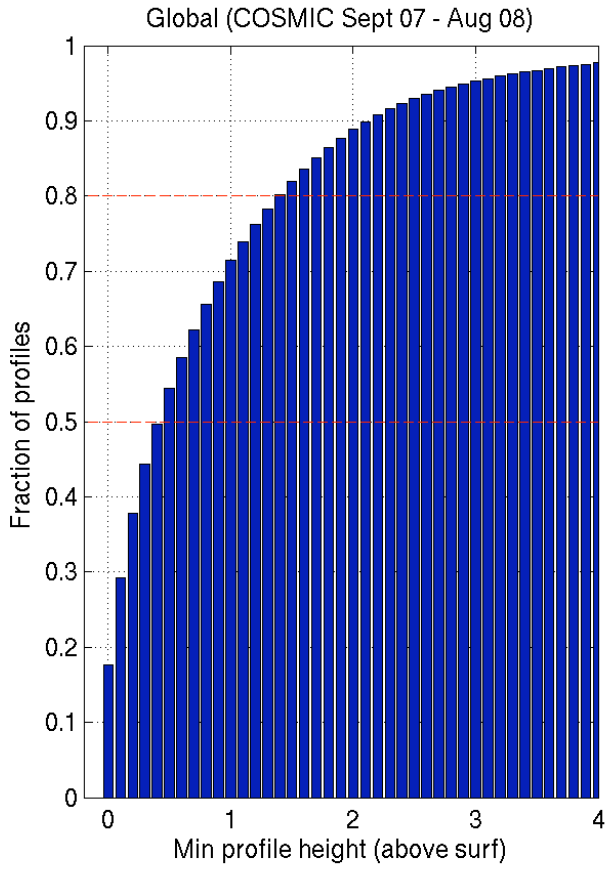
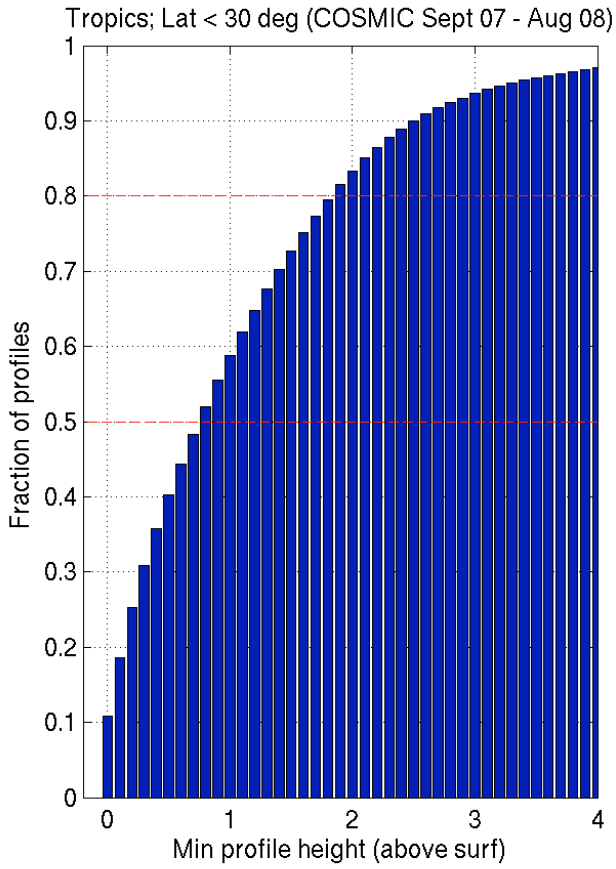
- Non-linear response

- Higher gain
- Wider bandwidth

Lower Troposphere Penetration

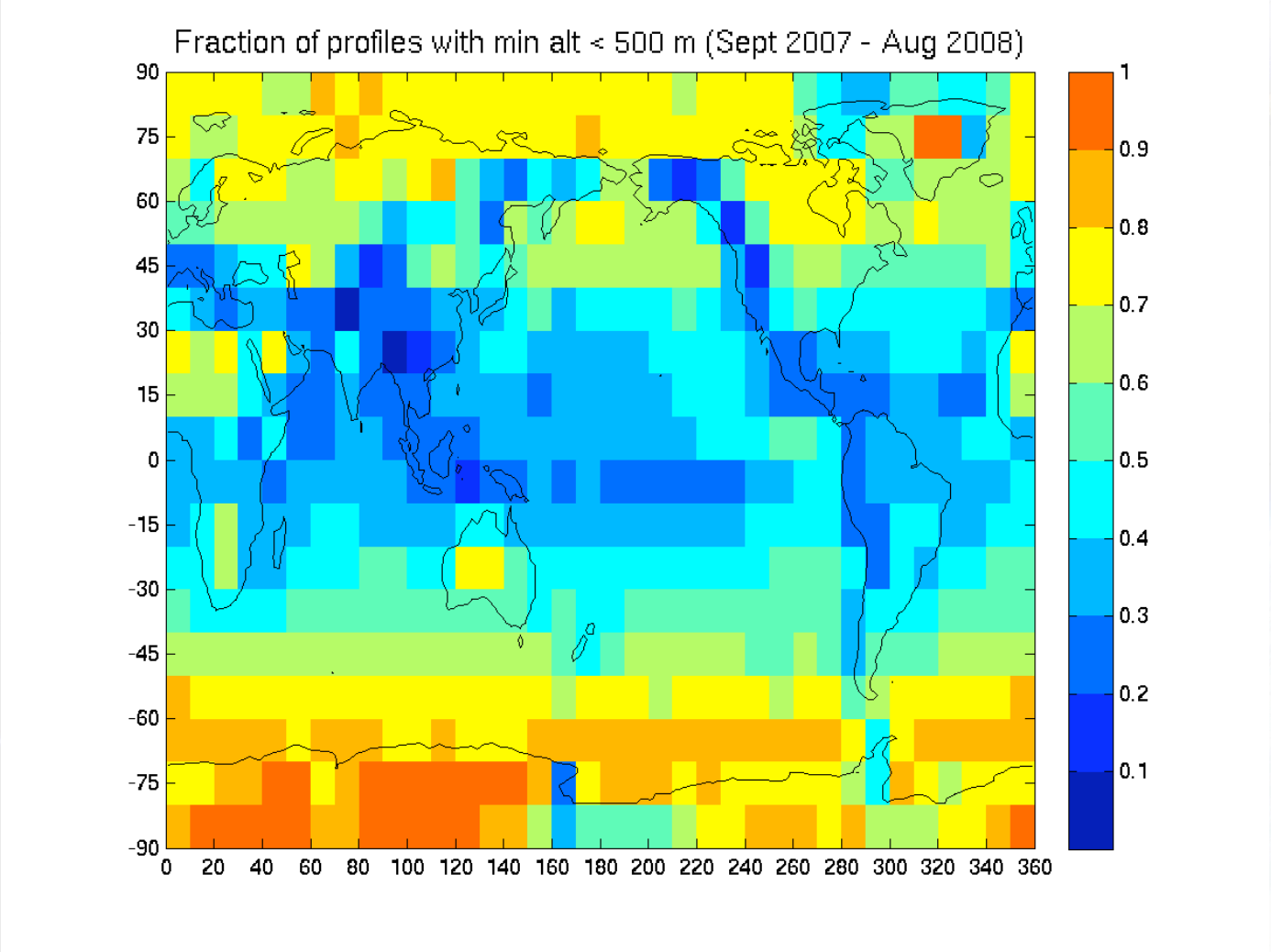
Distribution of minimum profile heights (only included profiles that reach 6 km or lower; setting & rising are similar)





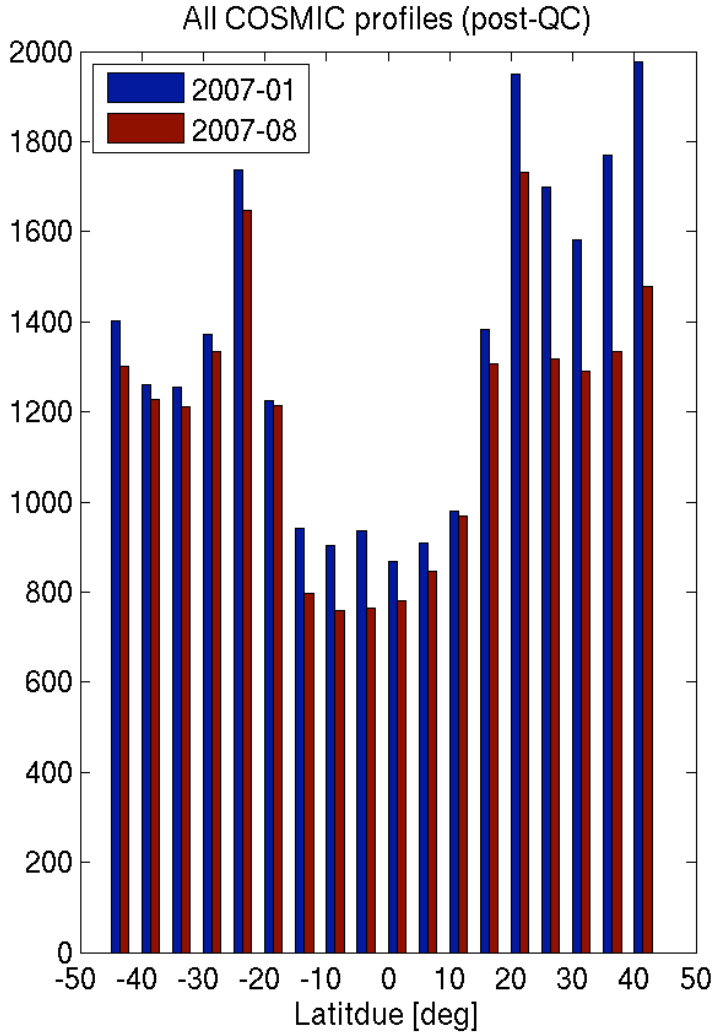
Geographic Distribution: Lowest 500 m

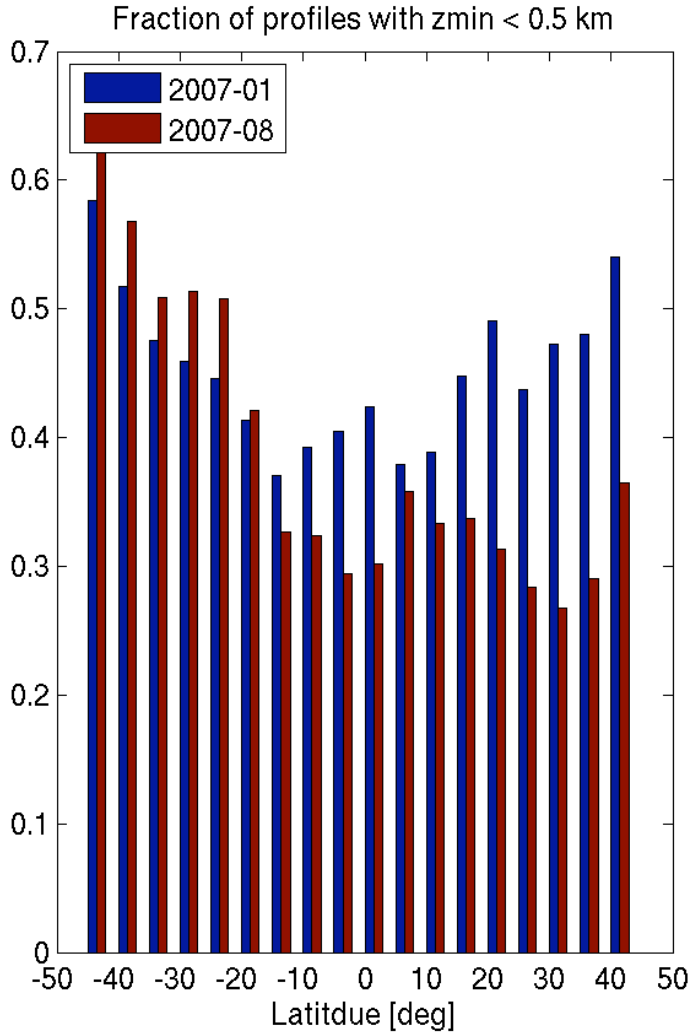
Depth penetration depends on location (altitudes are above the surface; possible effects of topography)



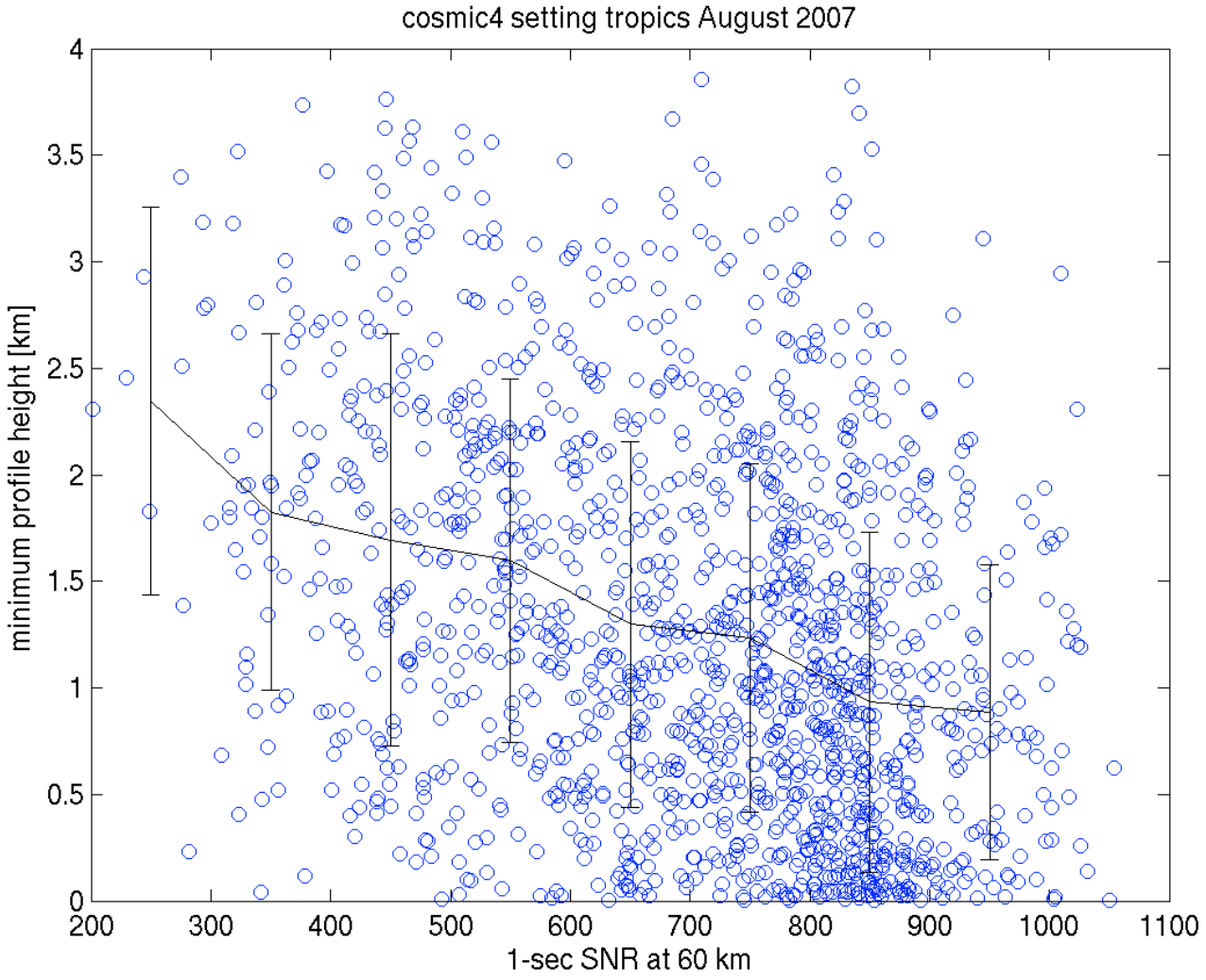
Penetration Depth: Seasonal Effect

Seasonal dependence (also note NH, SH asymmetry)

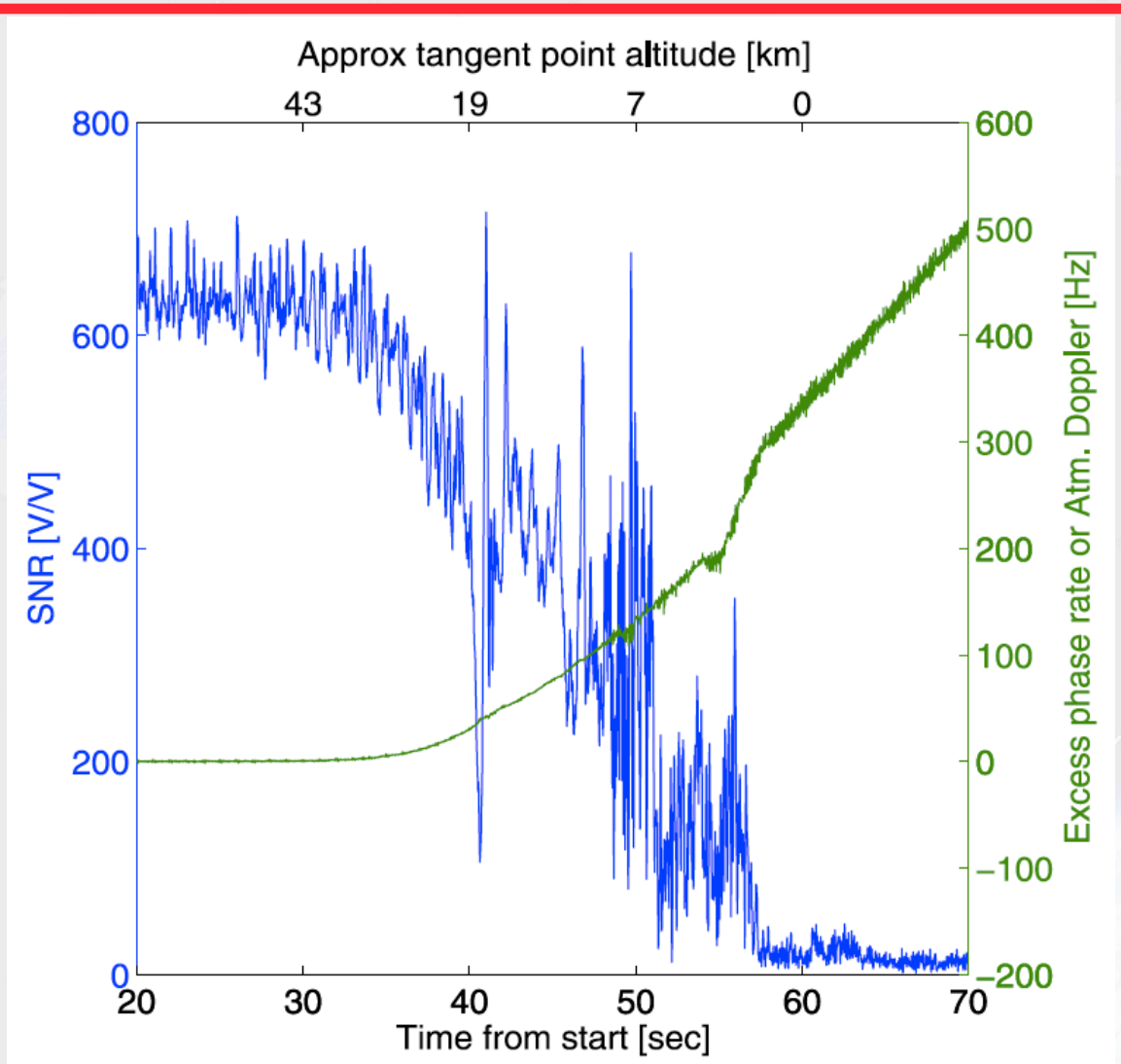




Dependence On Signal To Noise Ratio



Tracking Behind The Earth



Ao, C. O., G. A. Hajj, T. K. Meehan, D. Dong, B. A. Iijima, A. J. Mannucci, and E. R. Kursinski (2009), Rising and setting GPS occultations by use of open-loop tracking, J. Geophys. Res., 114, D04101, doi:10.1029/2008JD010483.

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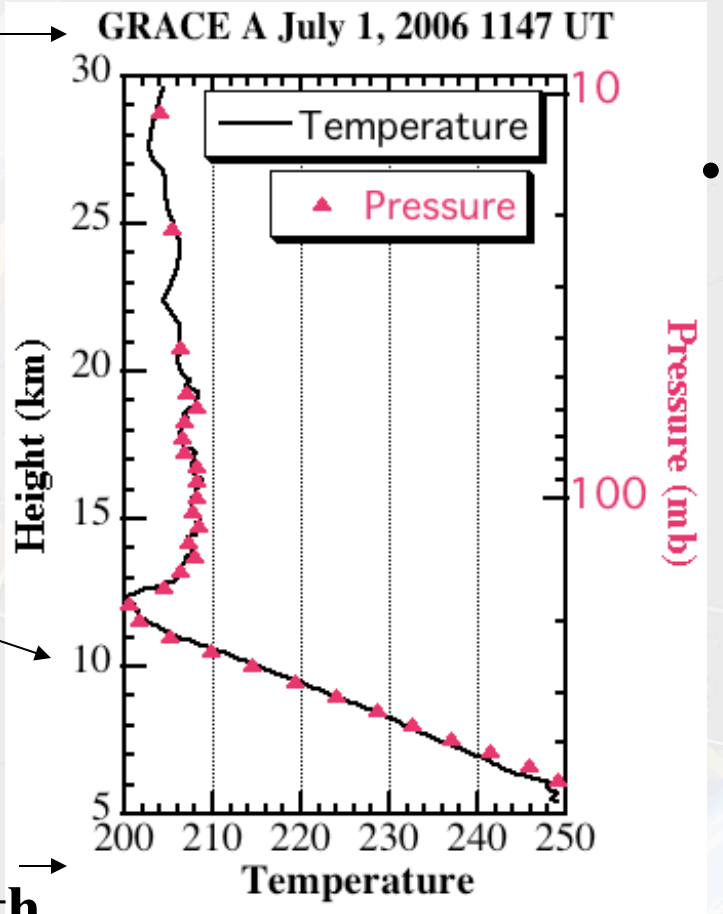

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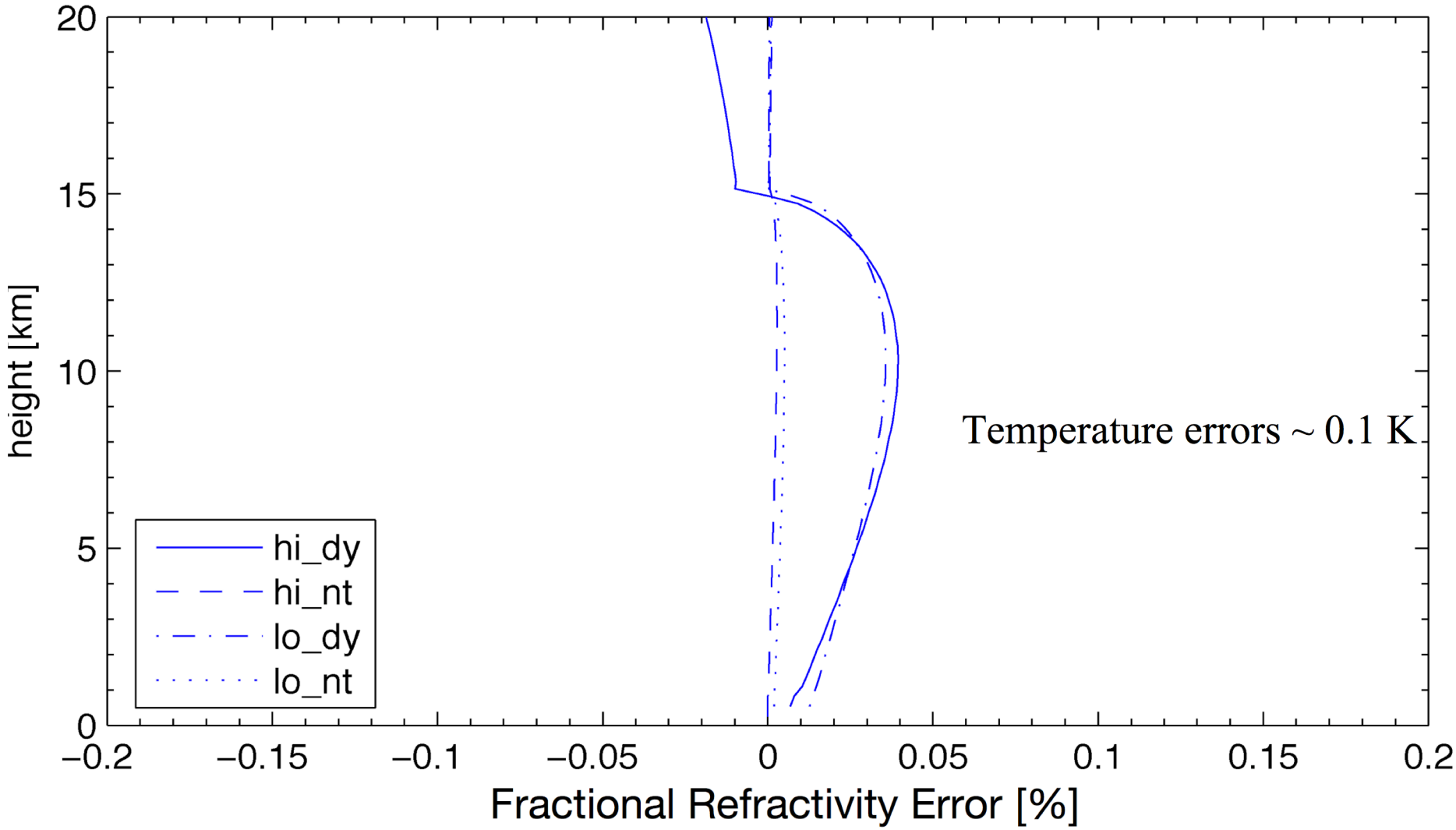
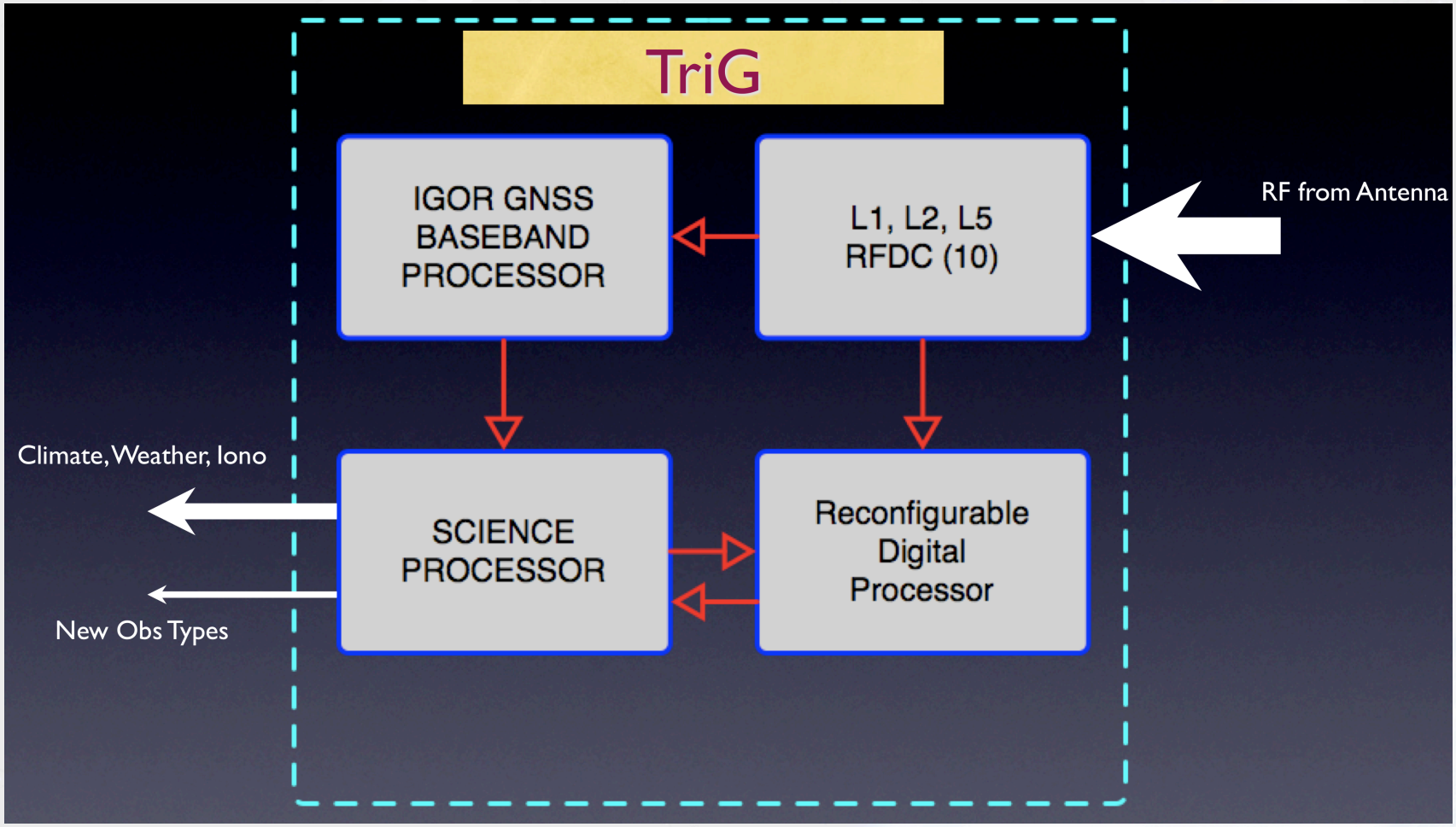
Impact of L2 Loss: Simulation Study



L2 drops out at ~8-12 km altitude

Science Processor

Will off-line science processing improve closed loop to open loop transition?



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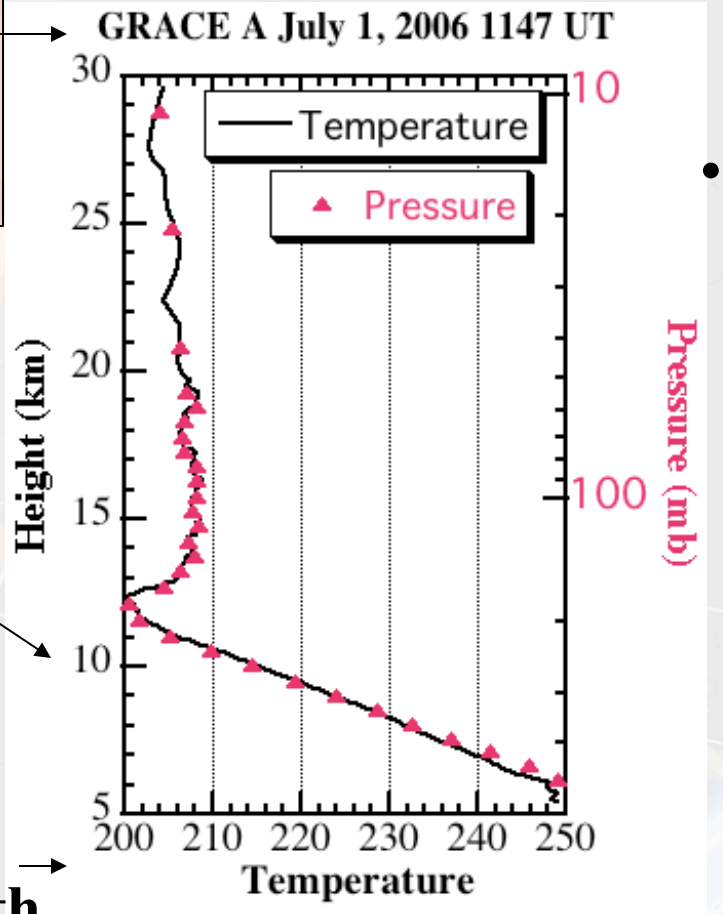

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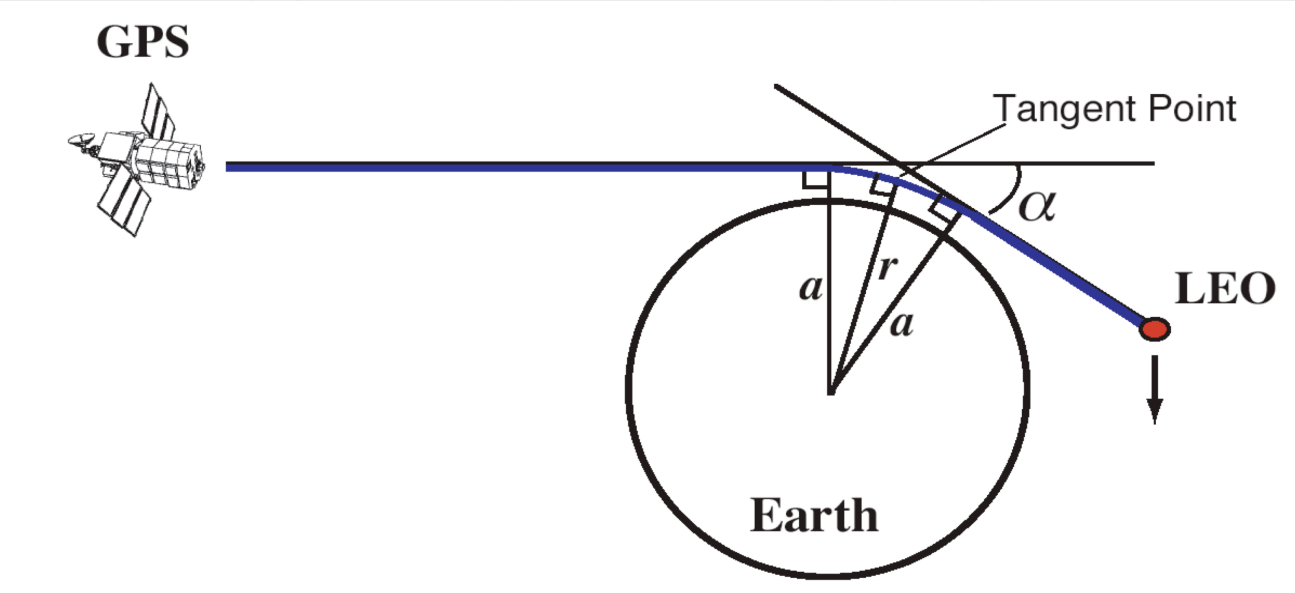
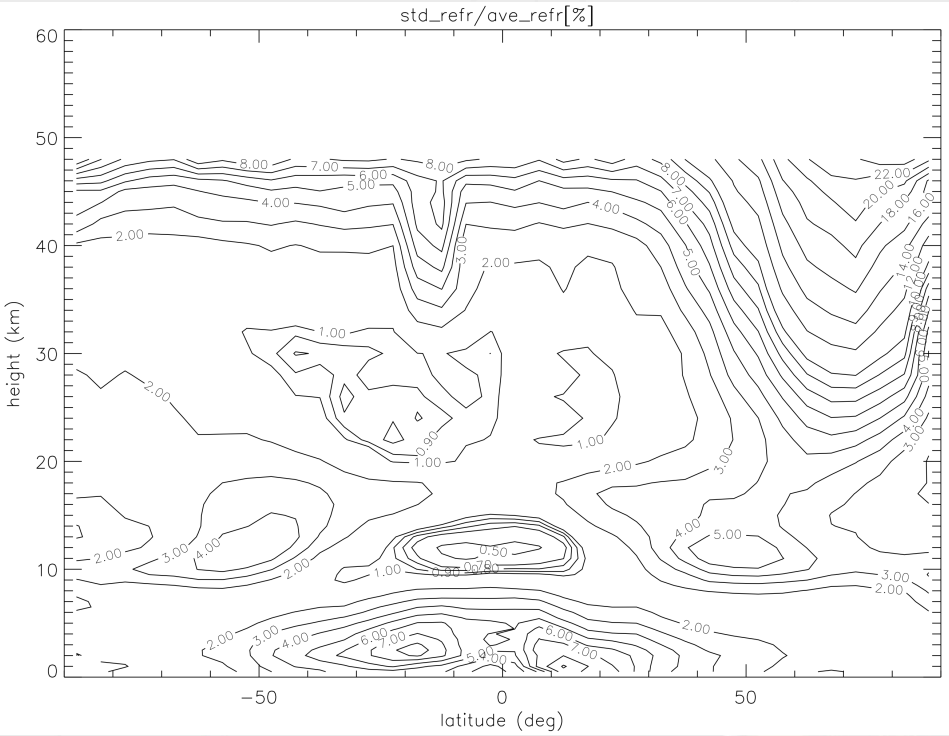
Upper Altitude Extrapolation

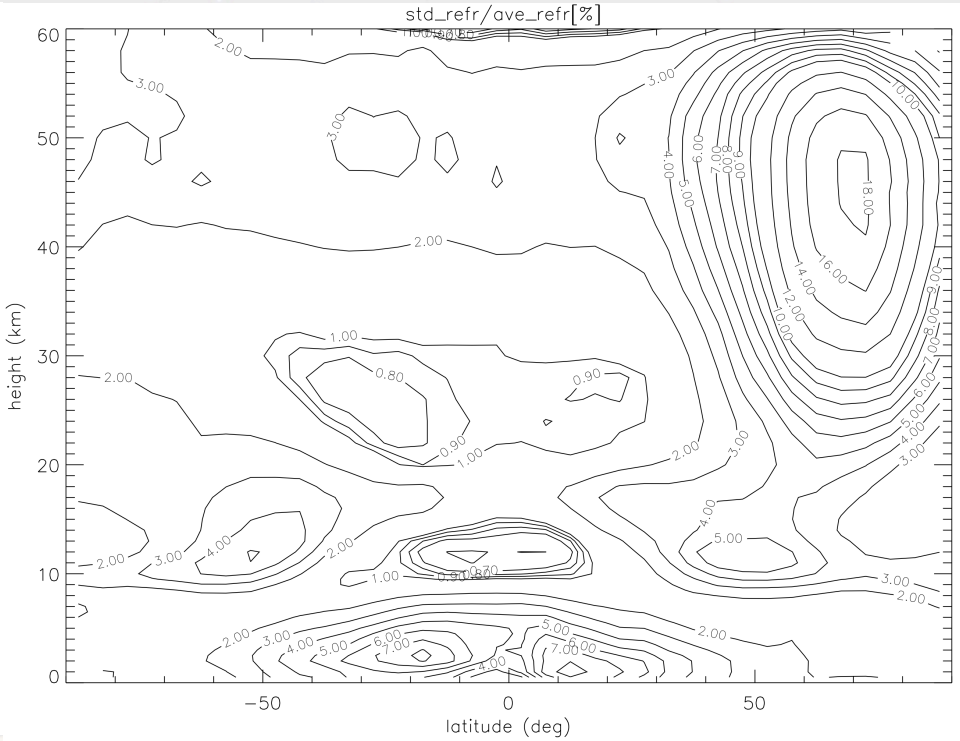


$$\ln(n(a)) = \frac{1}{\pi}\int_{a}^{\infty} \frac{\alpha(a')}{\sqrt{a'^2 - a^2}}\,da'$$

Abel transform
α – bending angle
a – impact parameter

Fractional Refractivity Variance



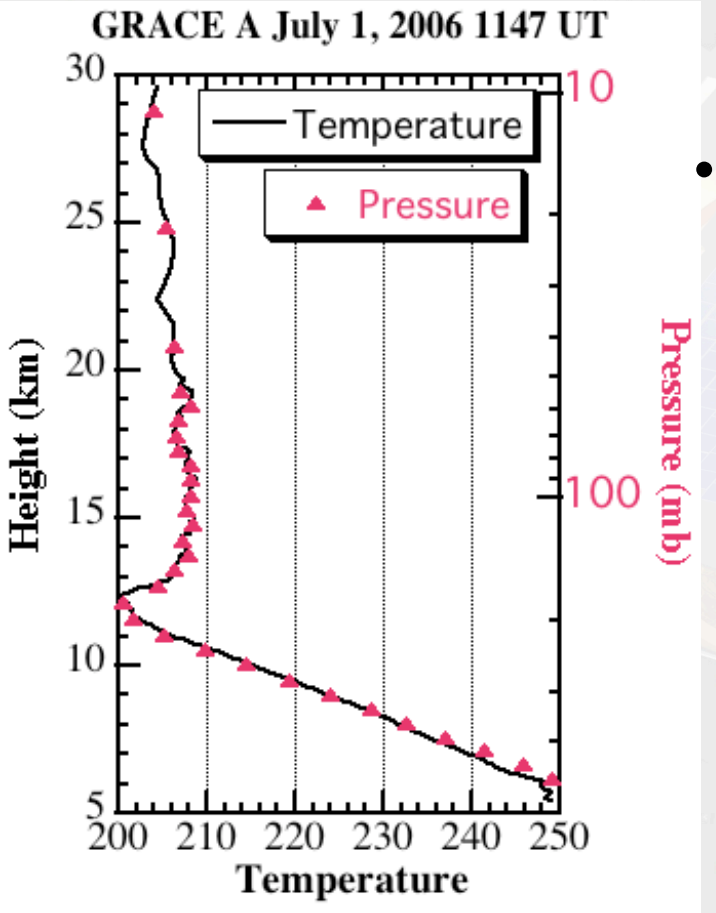


Differences found above 30 km in two approaches (JPL & UCAR)
Higher SNR could provide more flexibility as to approach

The following reference suggests that GPS retrievals show less variance compared to SABER measurements above 35 km.

Wang, L., and M. J. Alexander (2009), Gravity wave activity during stratospheric sudden warmings in the 2007–2008 Northern Hemisphere winter, J. Geophys. Res., 114, D18108, doi:10.1029/2009JD011867.

Summary



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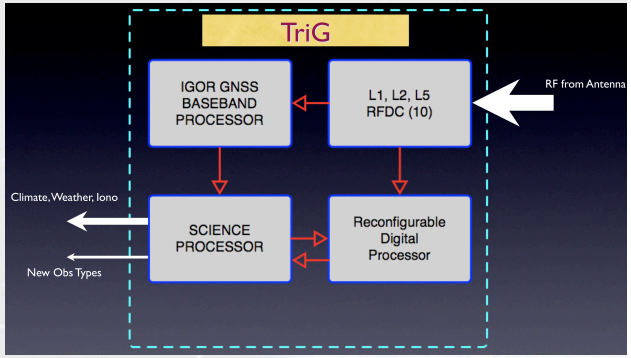
New technology!



- **Cases where open loop model is 1-sec behind and we get a poor result**