



Assessment of Open-Loop Tracking Occultation Data from COSMIC

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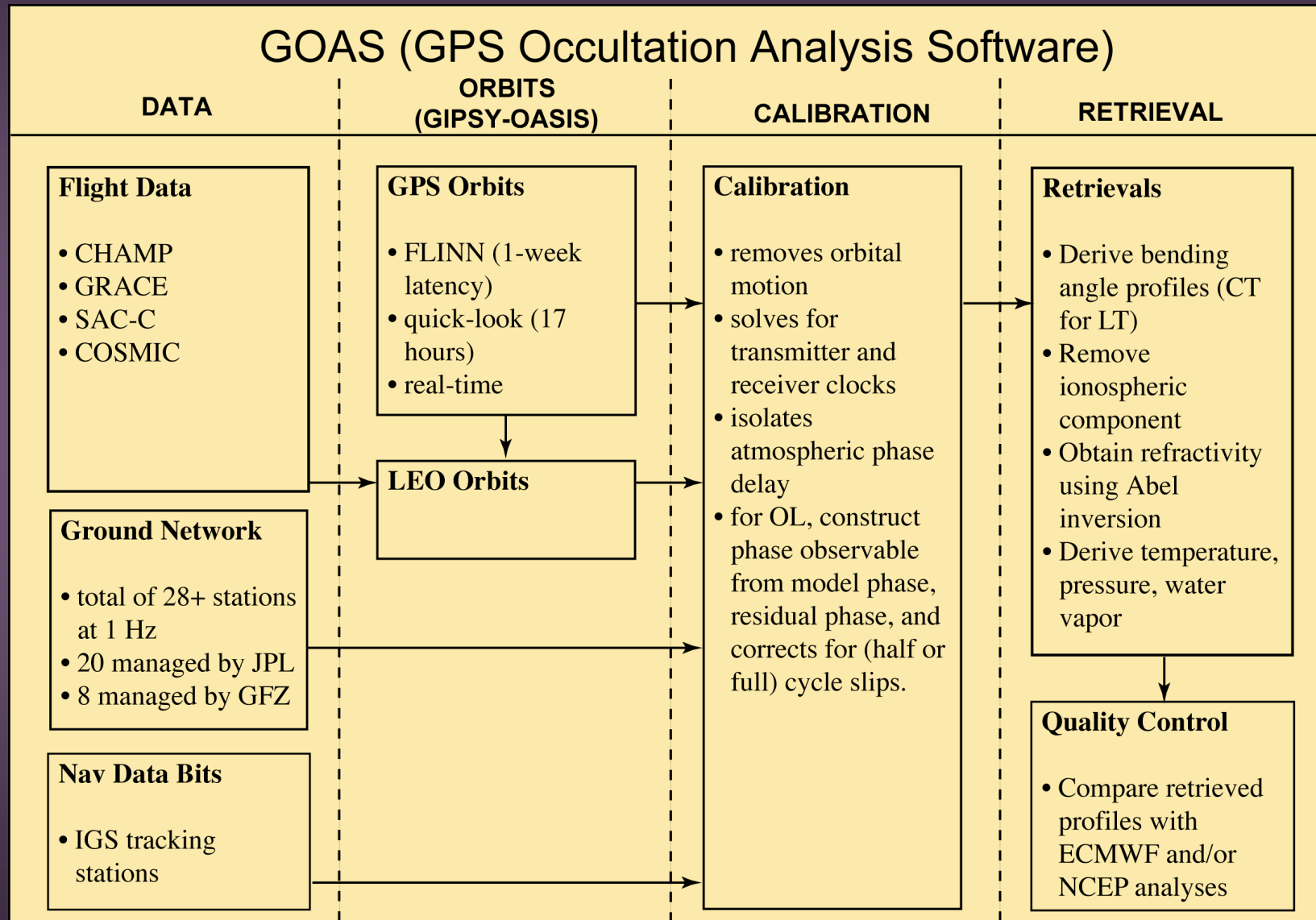
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With thanks to Da Kuang and Marc Pestana

- Open-loop (OL) tracking needed for lower troposphere.
- Narrowband (50 Hz) OL tracking requires:
 - *a priori* model for the *atmospheric Doppler*
 - *a priori* model for the *atmospheric range* (for rising)
- OL models developed and implemented at JPL (Hajj & Meehan). UCAR has given valuable feedback on evaluation of OL data.
- SAC-C has provided (and should continue to provide) a very effective in-flight test-bed.

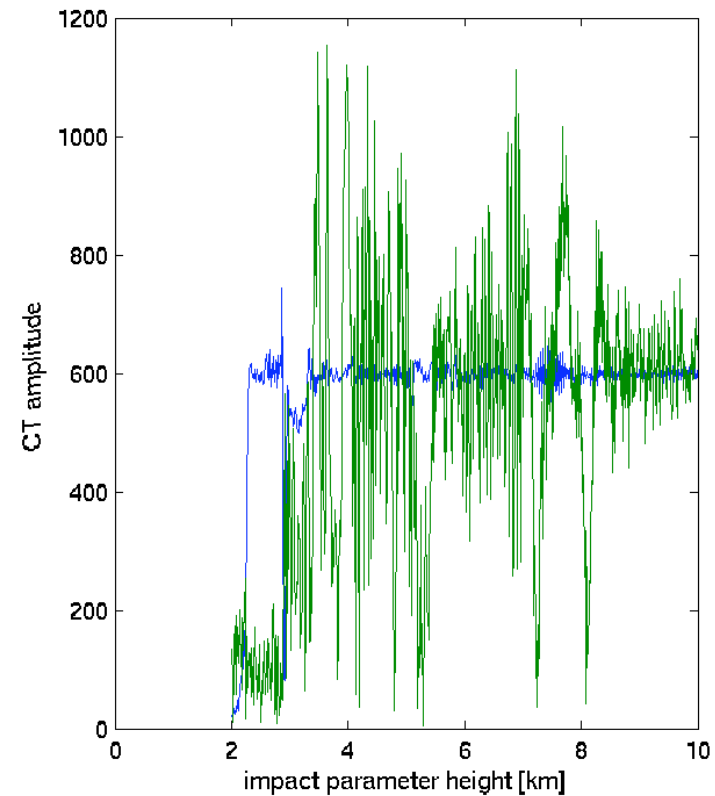
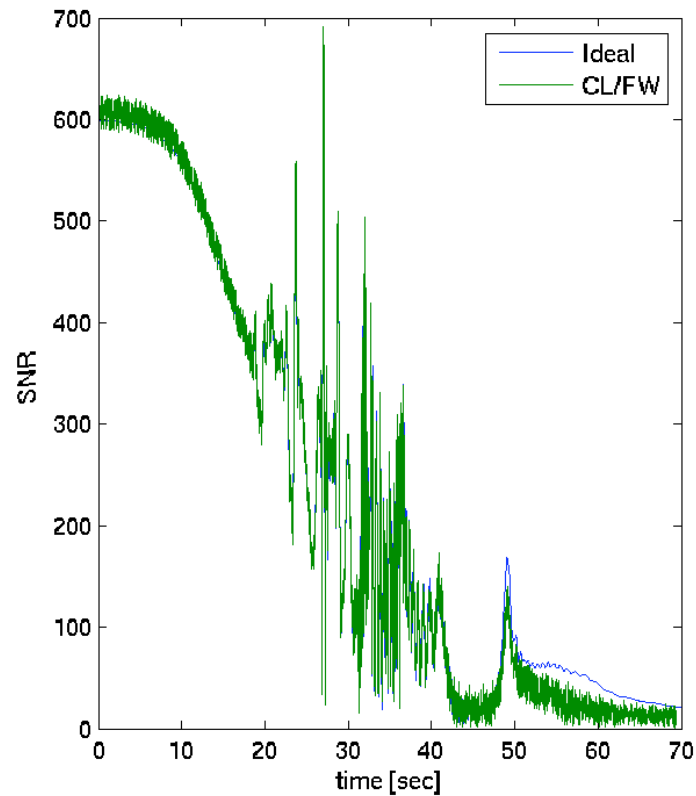
How well is OL working?

- **How good is the Doppler model?**
- **How good is the range model (for rising)?**
- **How do the retrievals depend on the accuracy of these models?**

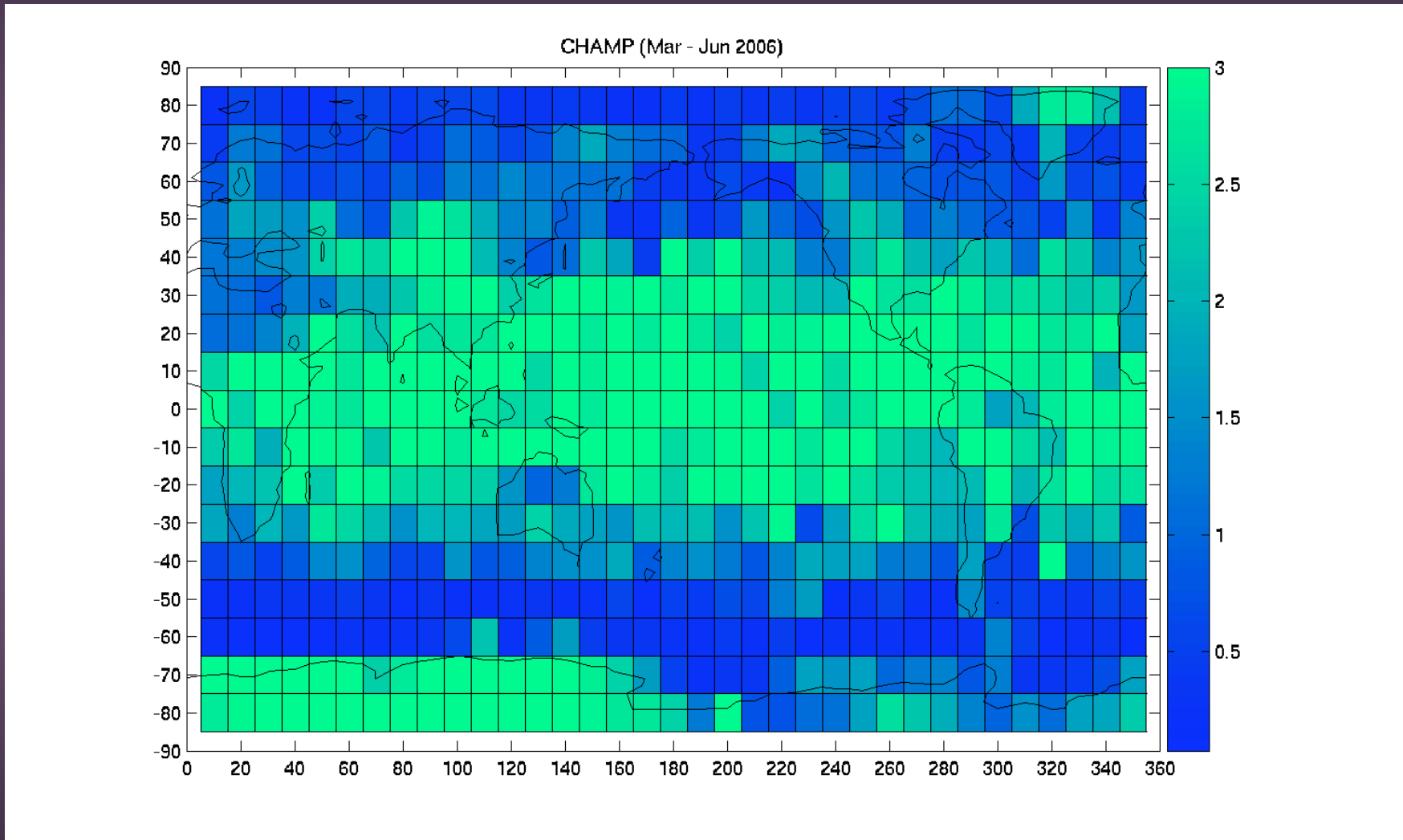


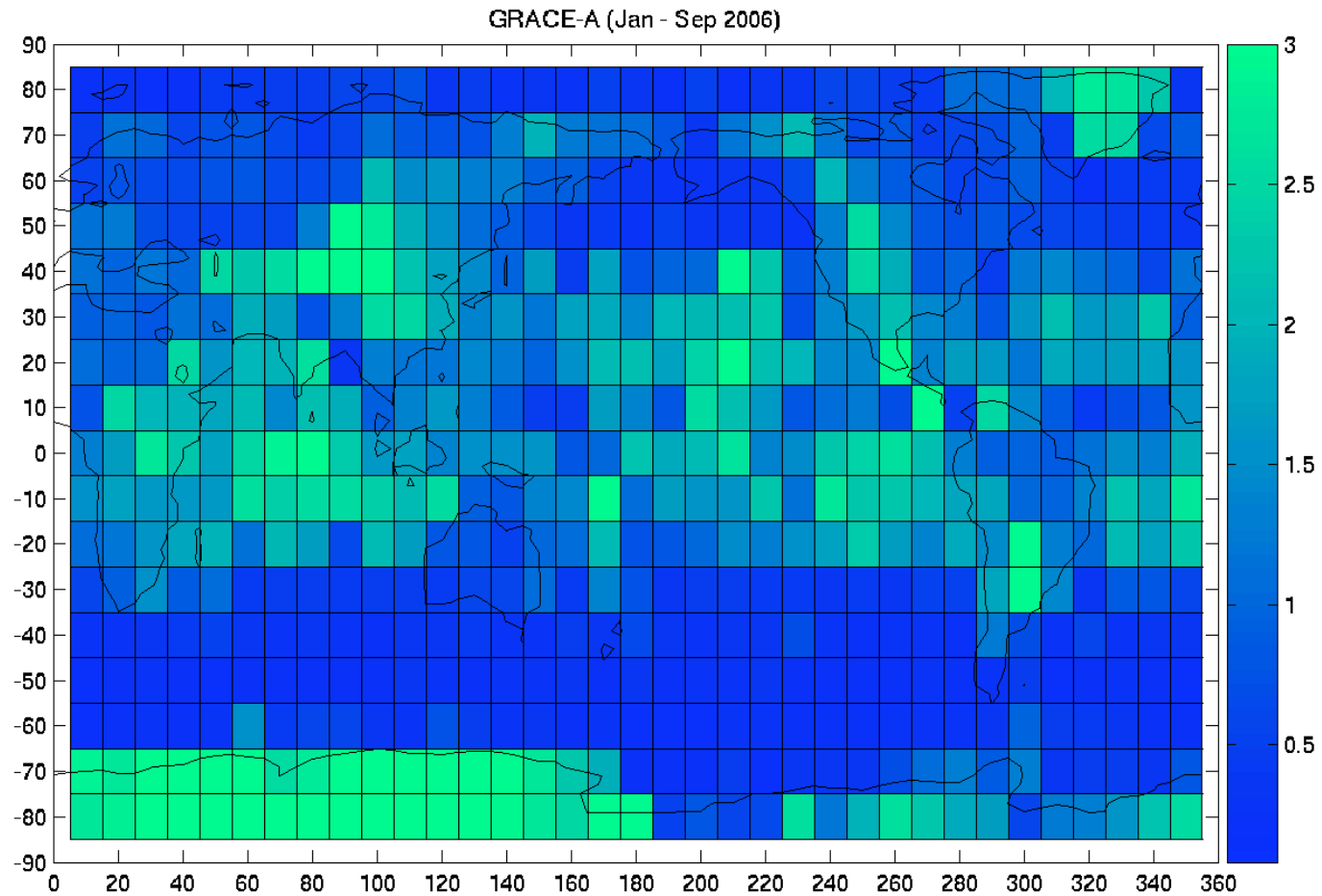
The minimum altitude is usually determined by examining the dropoff in CT (FSI) amplitude.

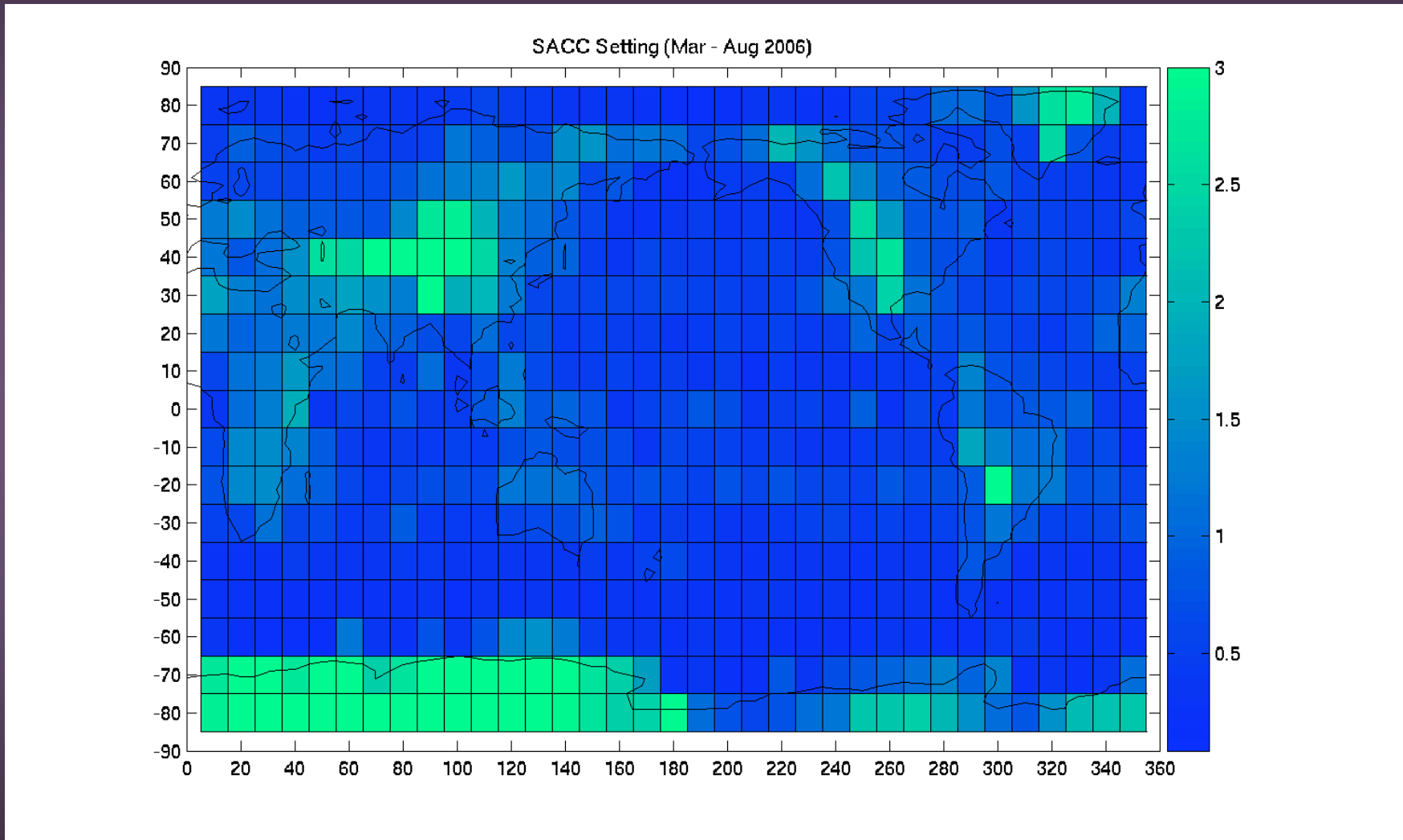
A simulation example:

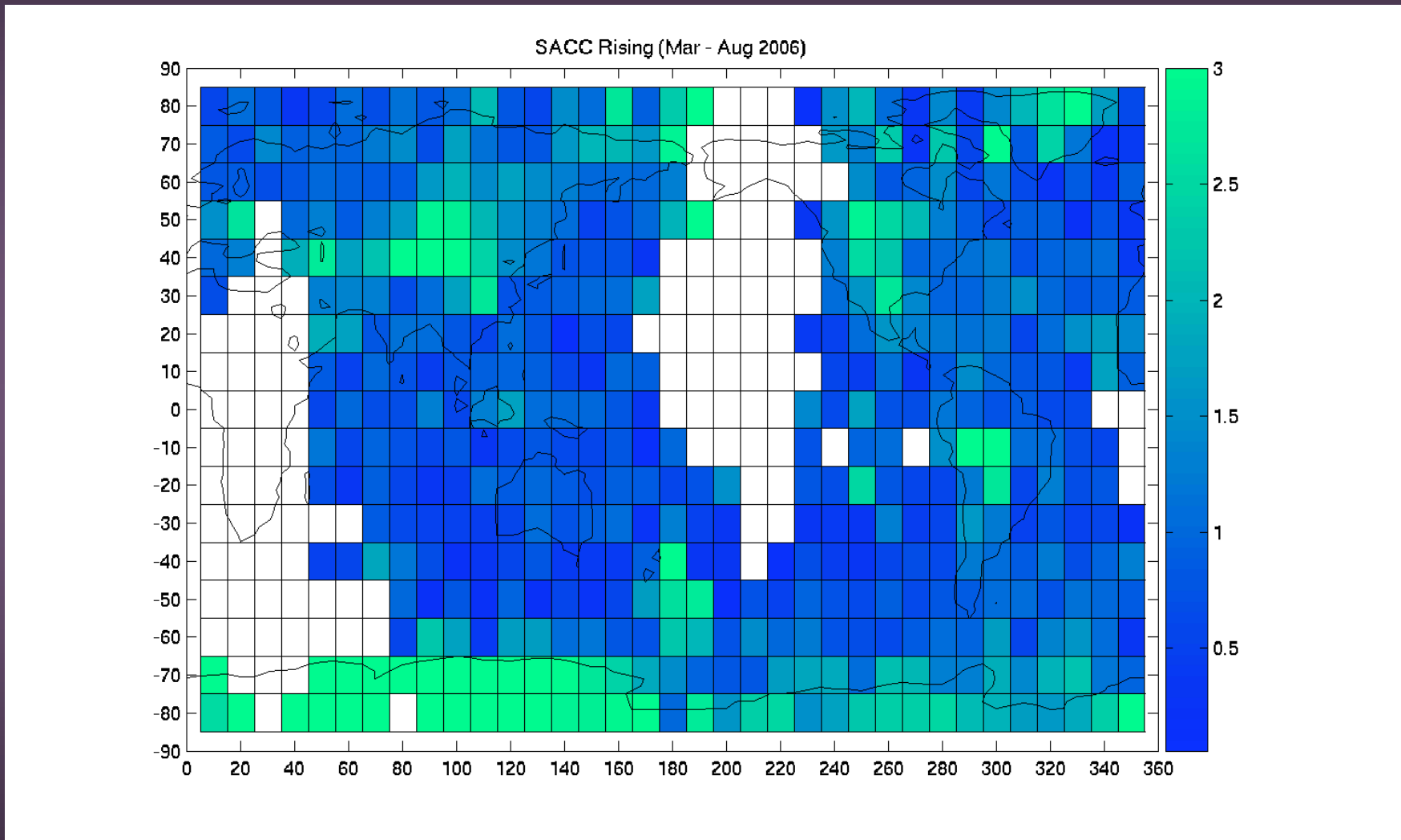


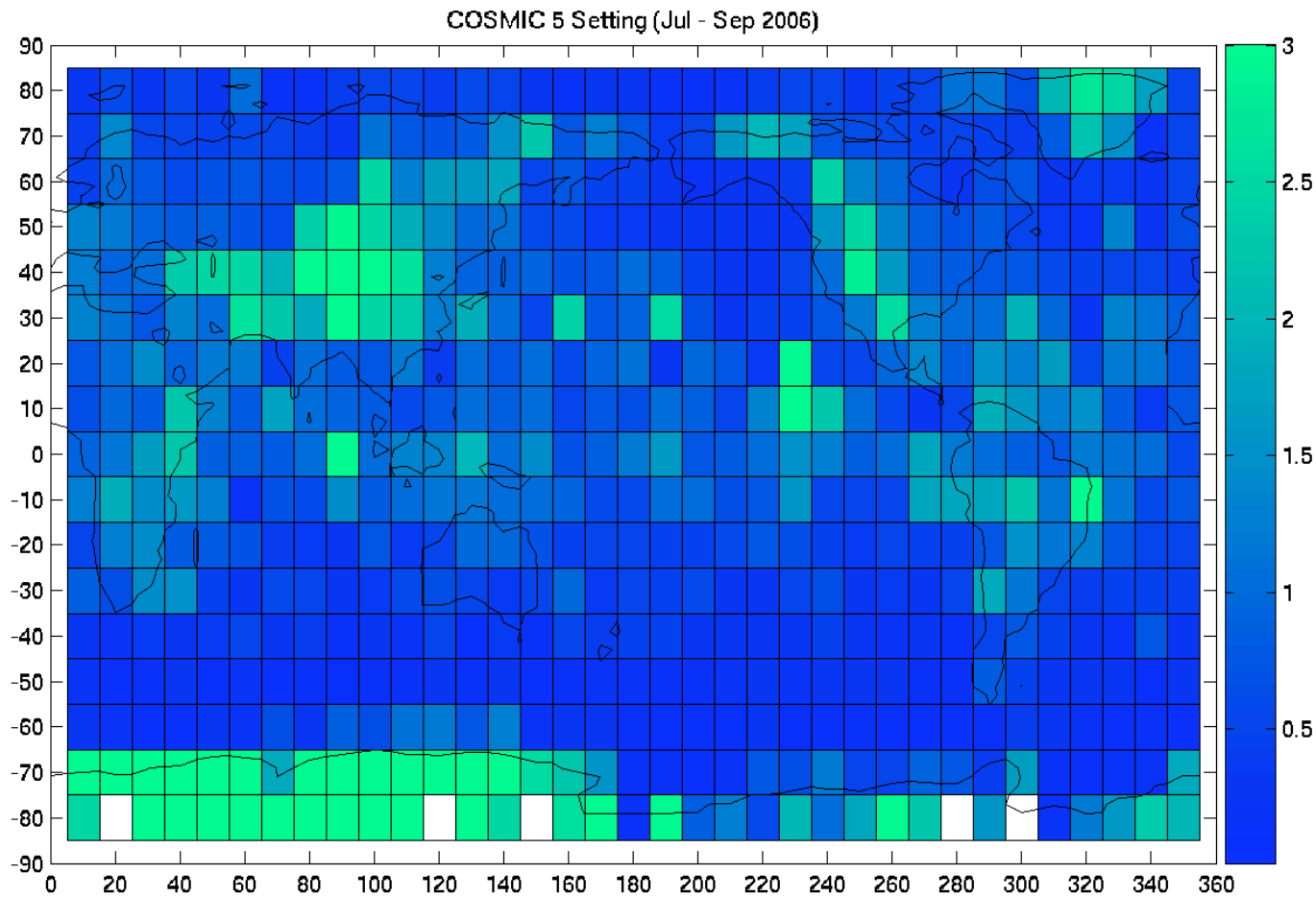
Minimum Altitude CL (CHAMP)

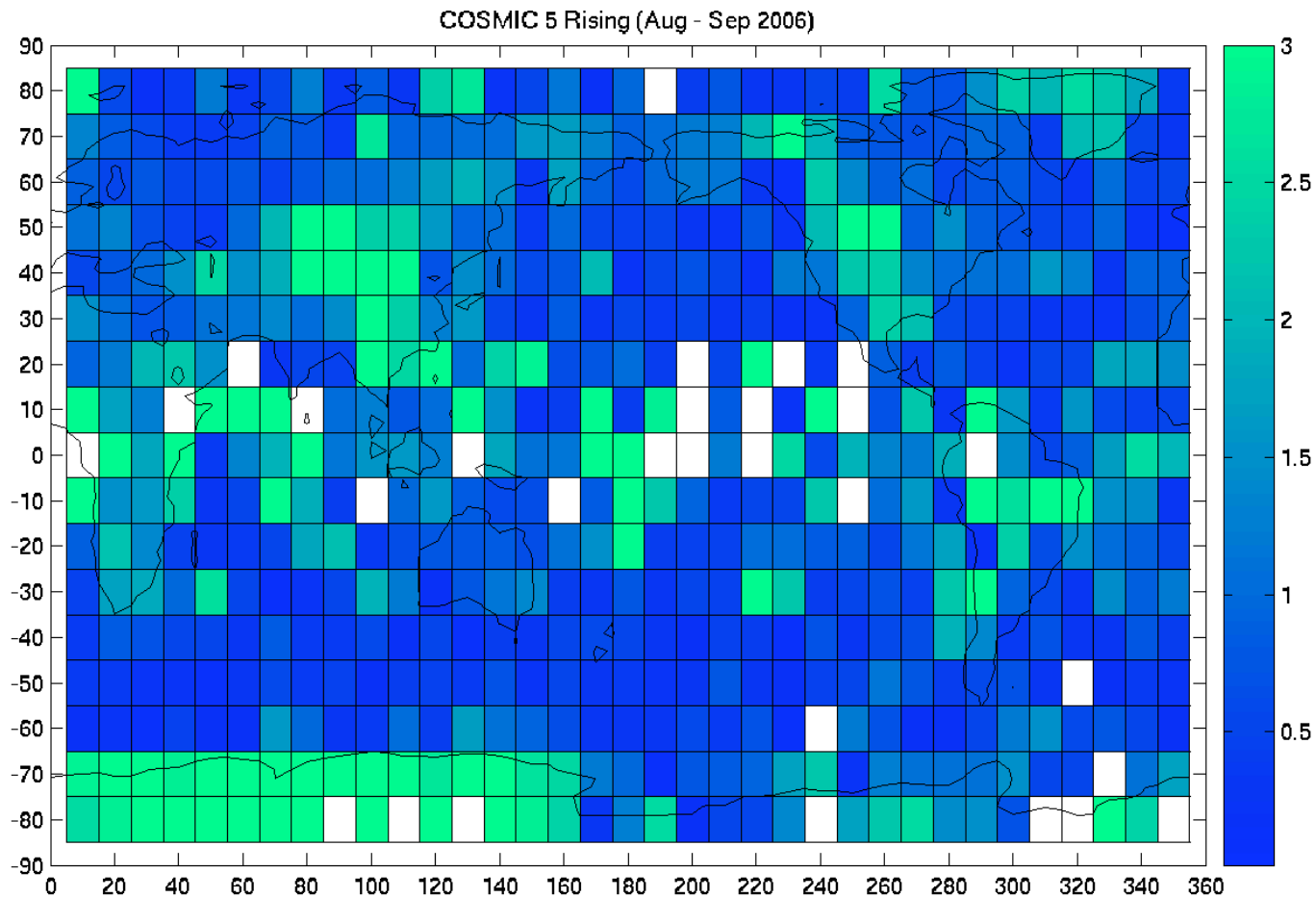


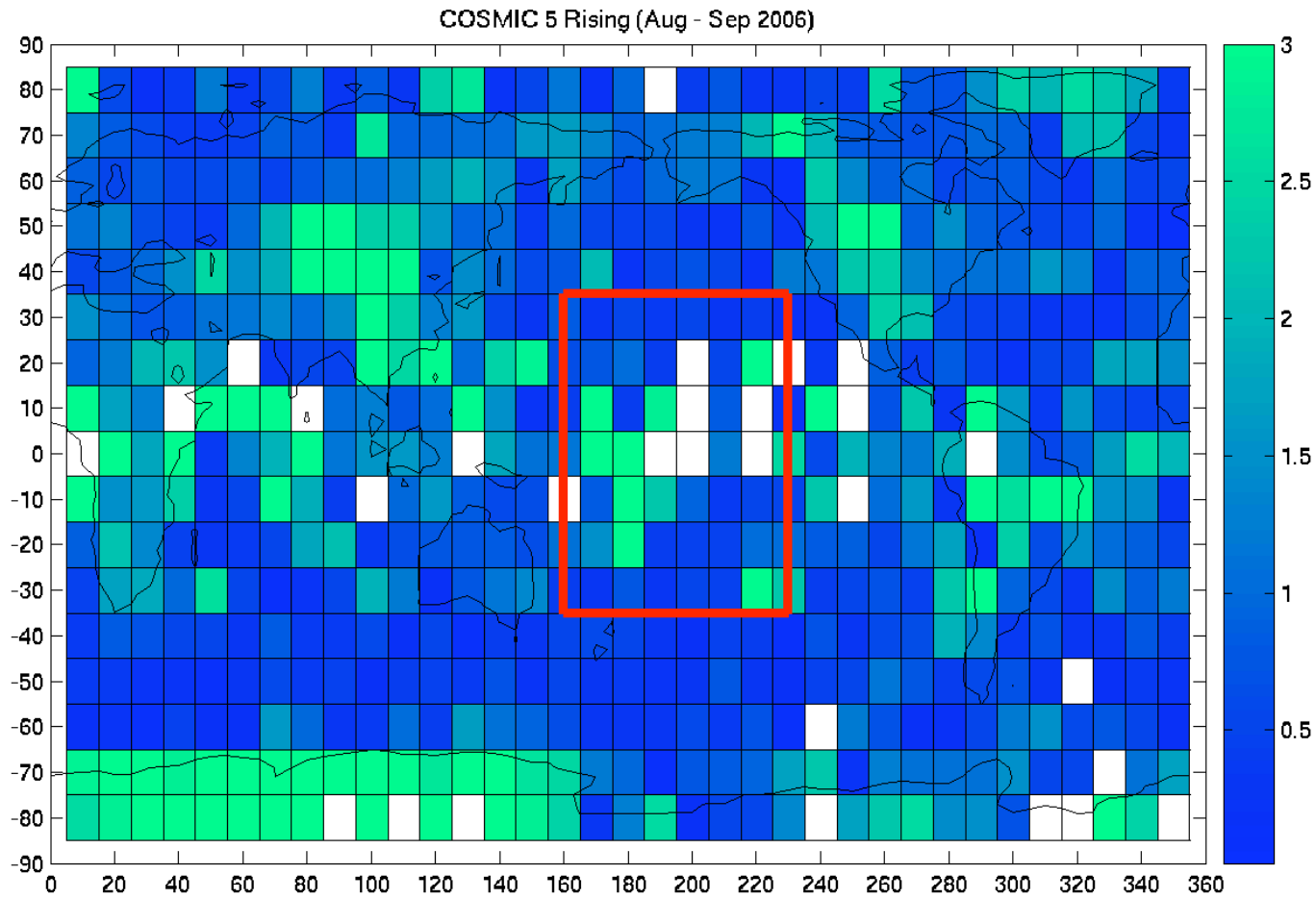




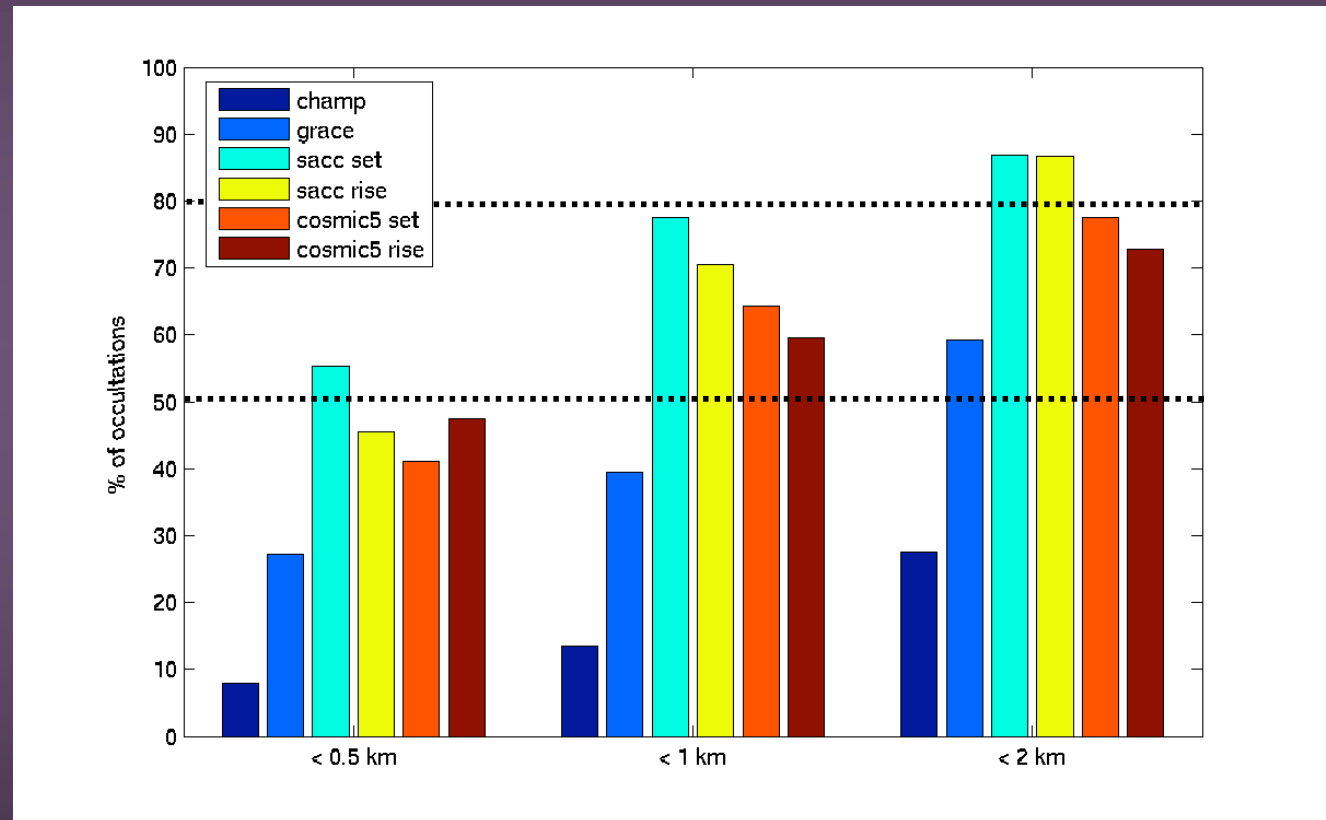








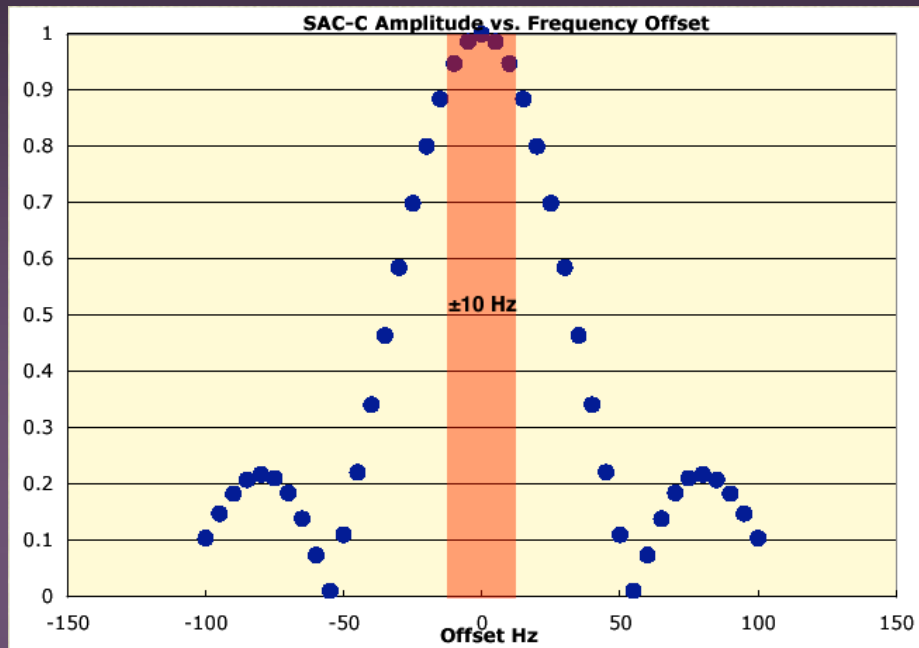
	Total
CHAMP	1377
GRACE	1351
SAC-C (Setting)	1910
SAC-C (Rising)	112
COSMIC 5 (Setting)	583
COSMIC 5 (Rising)	158



Why don't all OL profiles reach the surface?

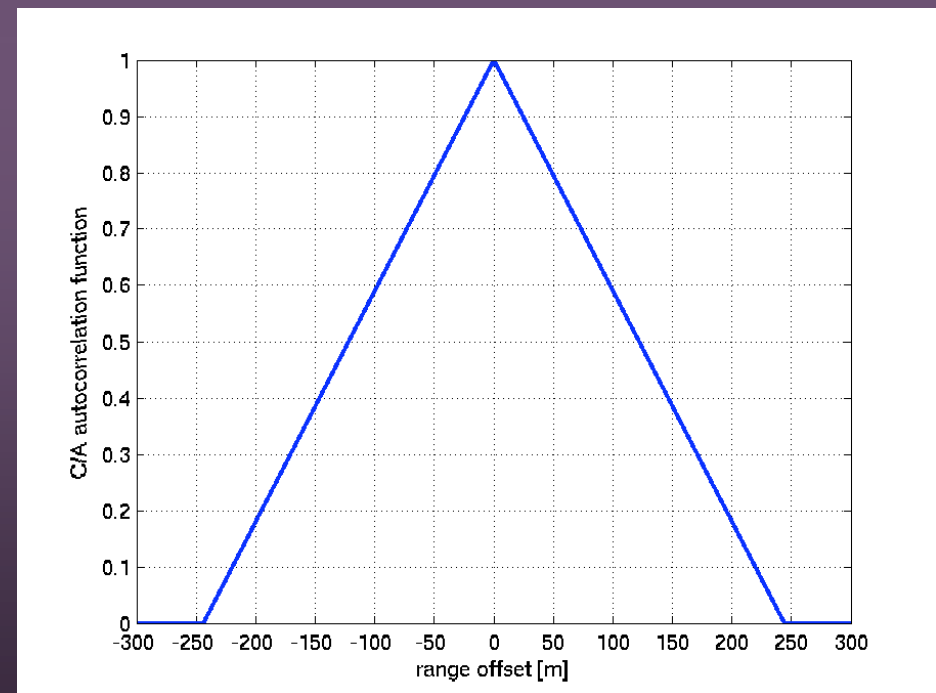
- Difference between rising and setting?
- Difference between COSMIC and SAC-C?

- Inaccuracy of frequency model?
- Inaccuracy of range model?
- Implementation problems?
 - Bad real-time navigation solution, etc.
- Retrieval/processing problems?
 - Is CT/FSI amplitude dropoff a good indicator?



Large frequency model offset causes amplitude reduction and cycle slips.

Large range model offset causes amplitude reduction (but not cycle slips).



Frequency model is accurate to within 10 Hz
[Hajj et al., 2002]

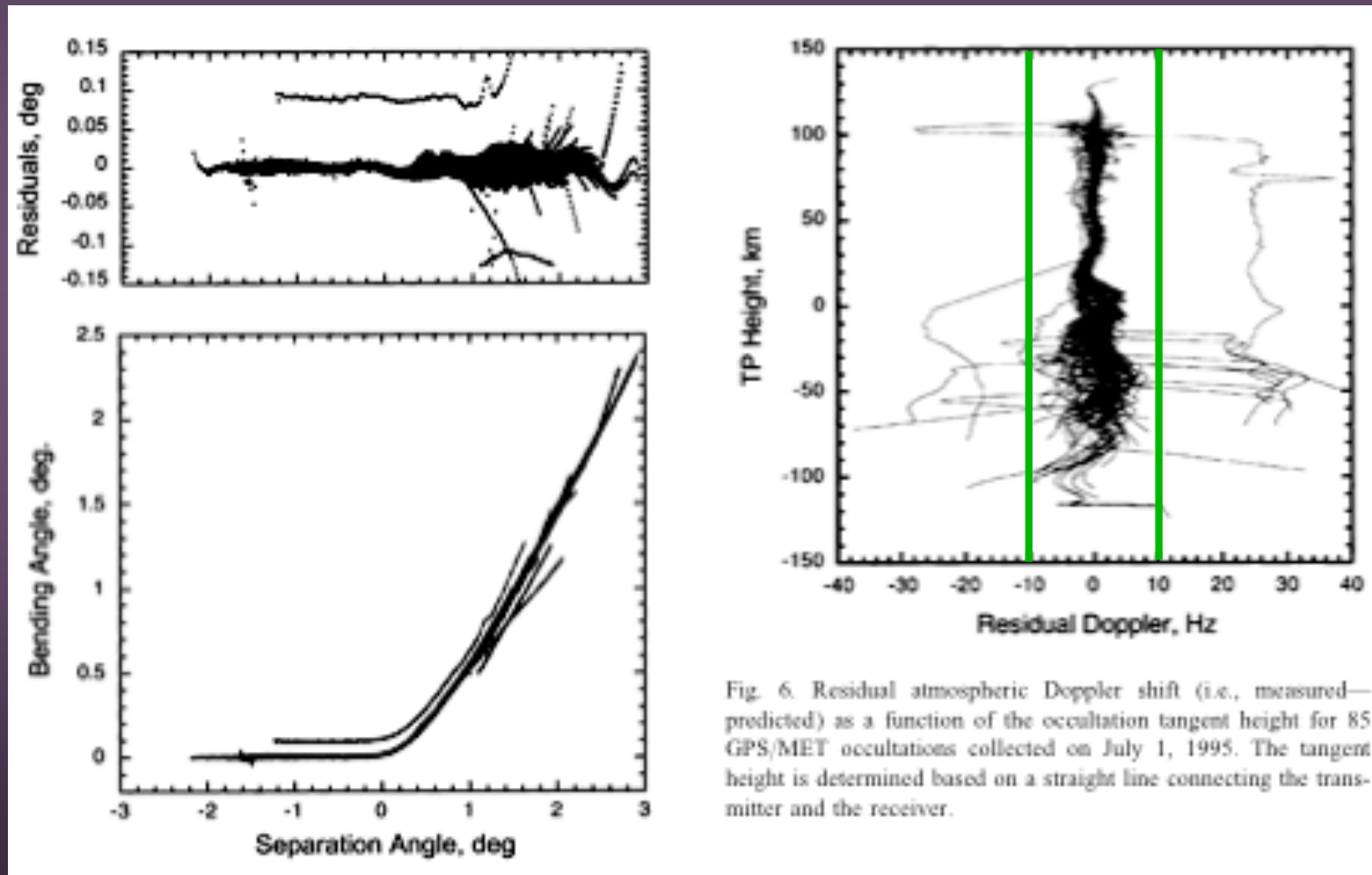
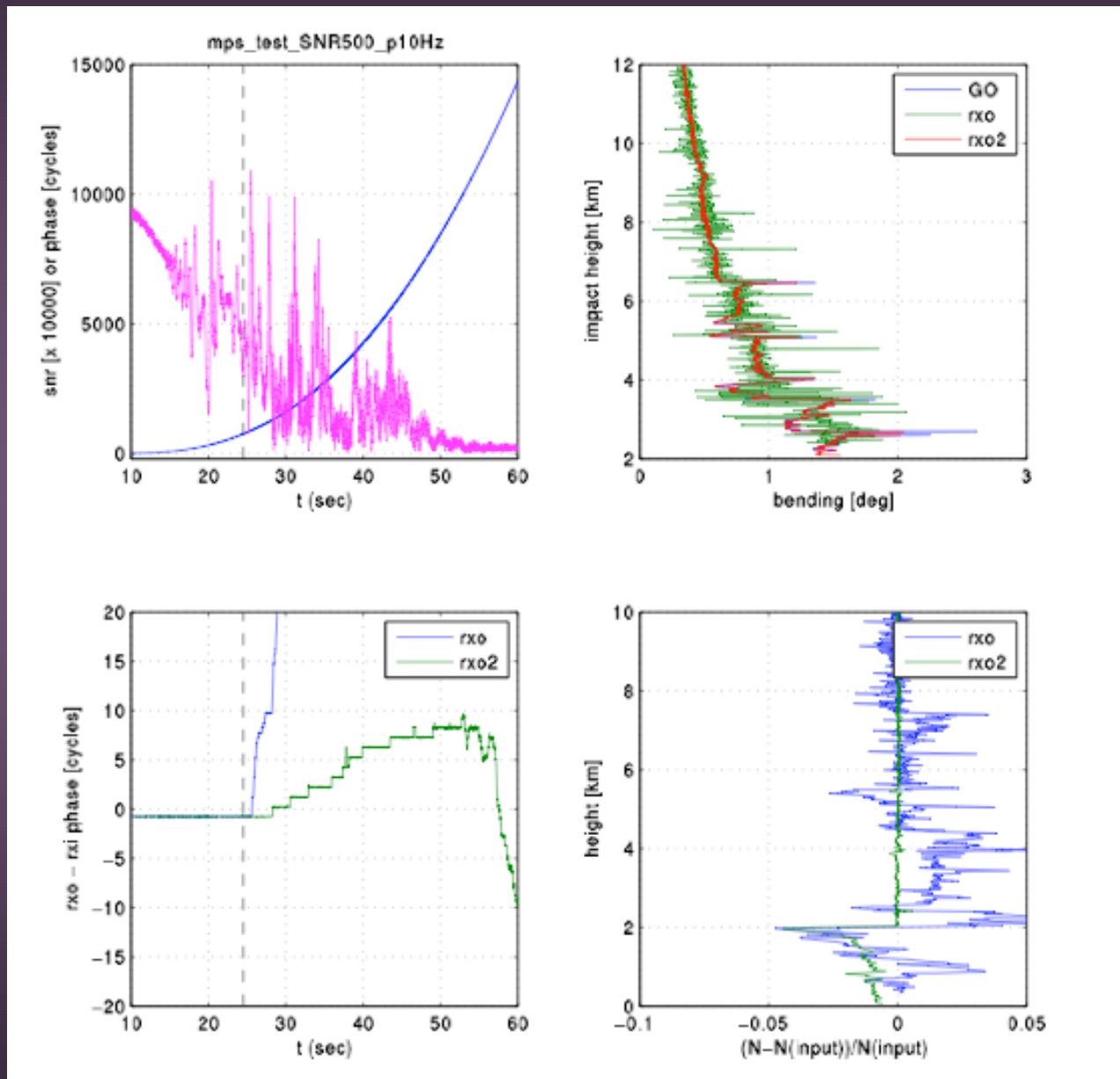
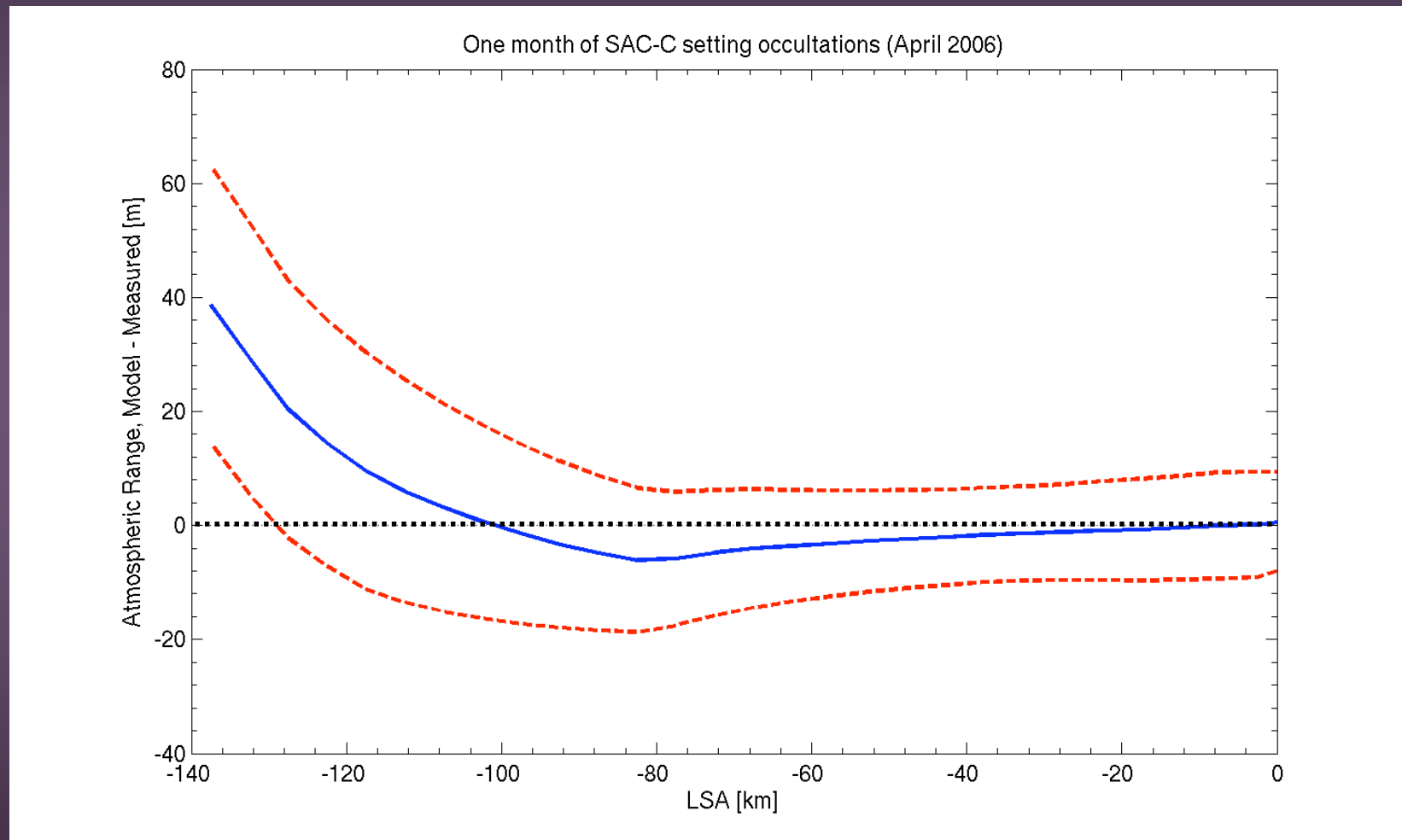


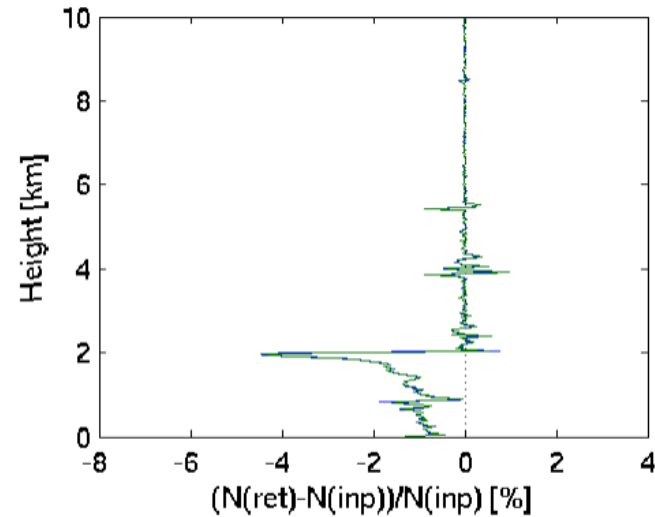
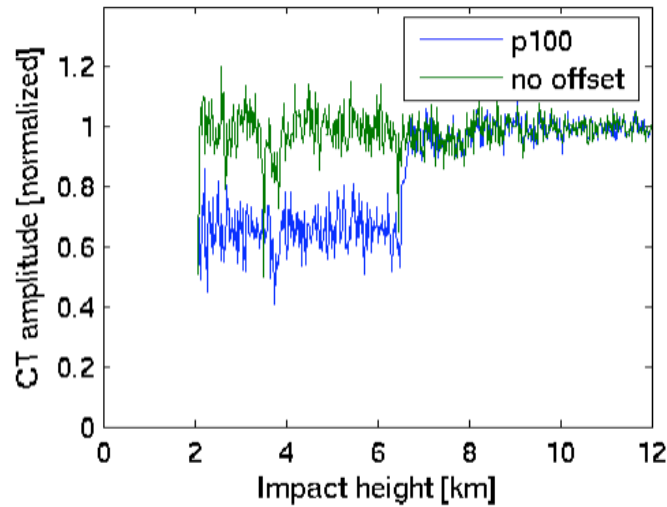
Fig. 6. Residual atmospheric Doppler shift (i.e., measured—predicted) as a function of the occultation tangent height for 85 GPS/MET occultations collected on July 1, 1995. The tangent height is determined based on a straight line connecting the transmitter and the receiver.



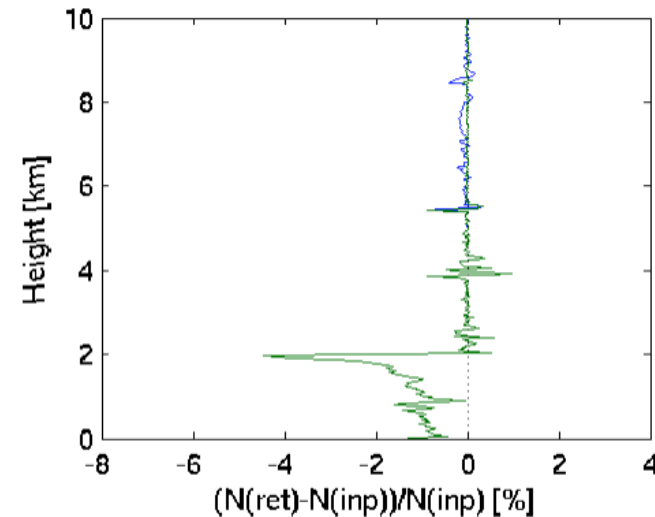
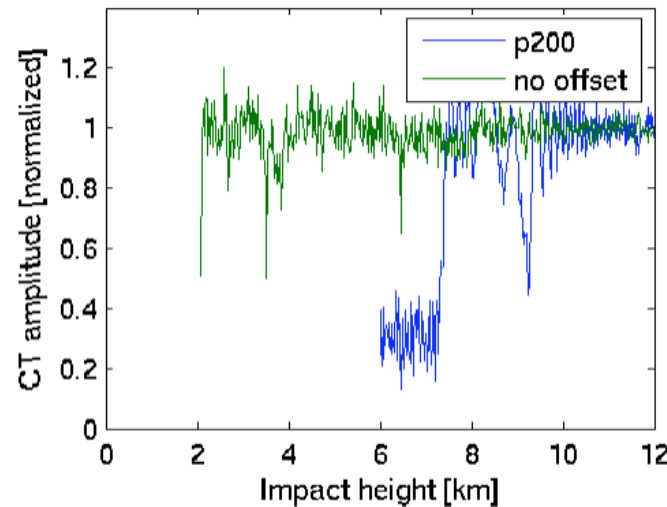


Simulations - Range Offset

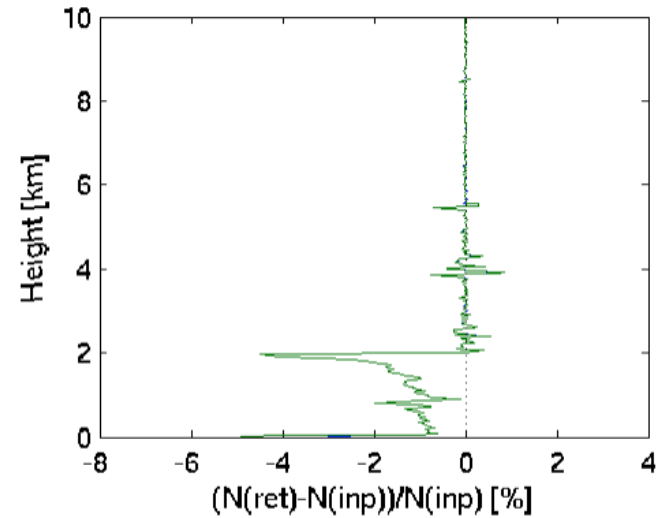
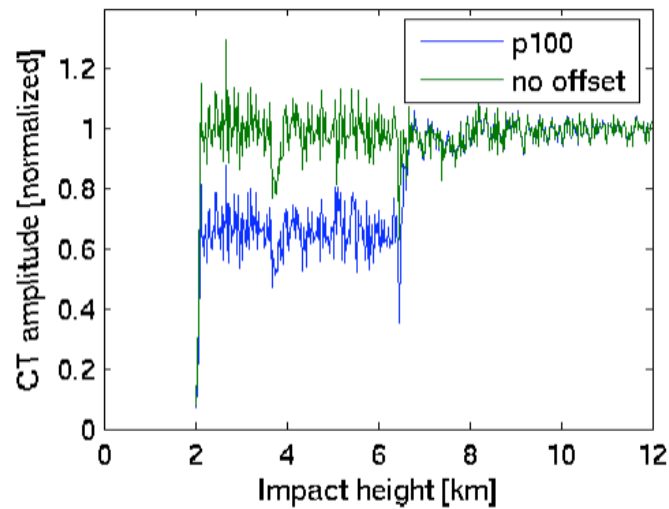
100 m offset



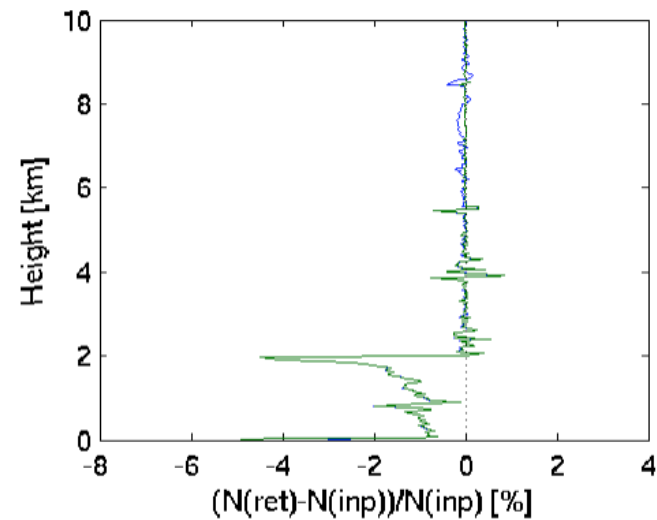
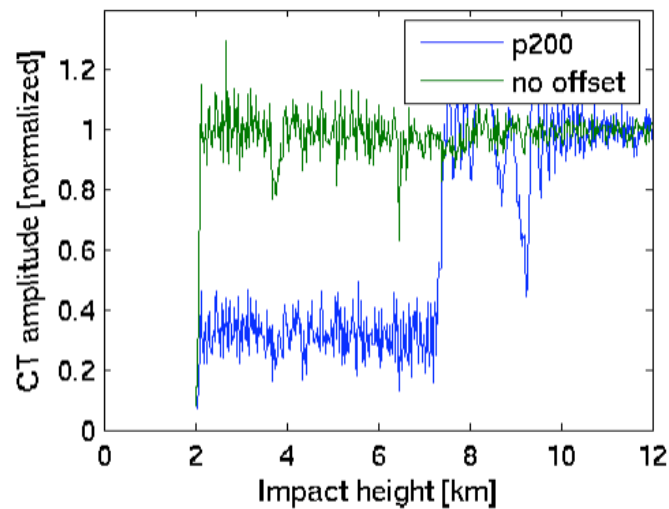
200 m offset



100 m offset



200 m offset



- **OL tracking allows RO profiles to reach much deeper in the lower troposphere.**
- **Analysis of COSMIC and SAC-C data shows that ~ 80% (50%) of the profiles reach below 2 km (0.5 km) over the Pacific.**
- **SSS (small sampling size) caveat applies...**
 - **SAC-C seems slightly better than COSMIC**
 - **Setting seems slightly better than rising**
 - **Simulations with frequency and range offsets show that the retrievals with full-cycle correction are not very sensitive to model errors.**