

Open Loop Processing of Rising Occultations from SAC-C

T. K. Meehan, G. A. Hajj, C. O. Ao, D. Dong, B. A. Iijima, A. J. Mannucci

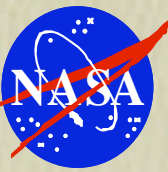
**Jet Propulsion Laboratory
California Institute of Technology**

Topics

- Some of the Limitations of GPSRO Remote Sensing Instrumentation
- The Atmospheric Model
- Instrument Time Stability Issues
- Process of Recovering a Rising Occultation
- SAC-C Rising Occultation Results
- Summary



Some of the Limitations of GPSRO Remote Sensing Instrumentation



- The Purpose of the Spacecraft Is to Provide Point of View and Ray “Motion” Through the Atmosphere
- The Purpose of the GPSRO Instrument Is to Record the Ray Motion (and Amplitude)

Some of the Options for GPSRO Remote Sensing Instrumentation

- **Very Wideband Digital Recording**

- No OL Model, Simple HW, but... ~800 GBytes/Day
- Intensive Ground Based Processing

- **Moderate Wideband Digital Recording**

- Needs Only Geometric Model, Special DSP HW, ~450 MBytes/Day

- **Narrowband Digital Recording (BlackJack)**

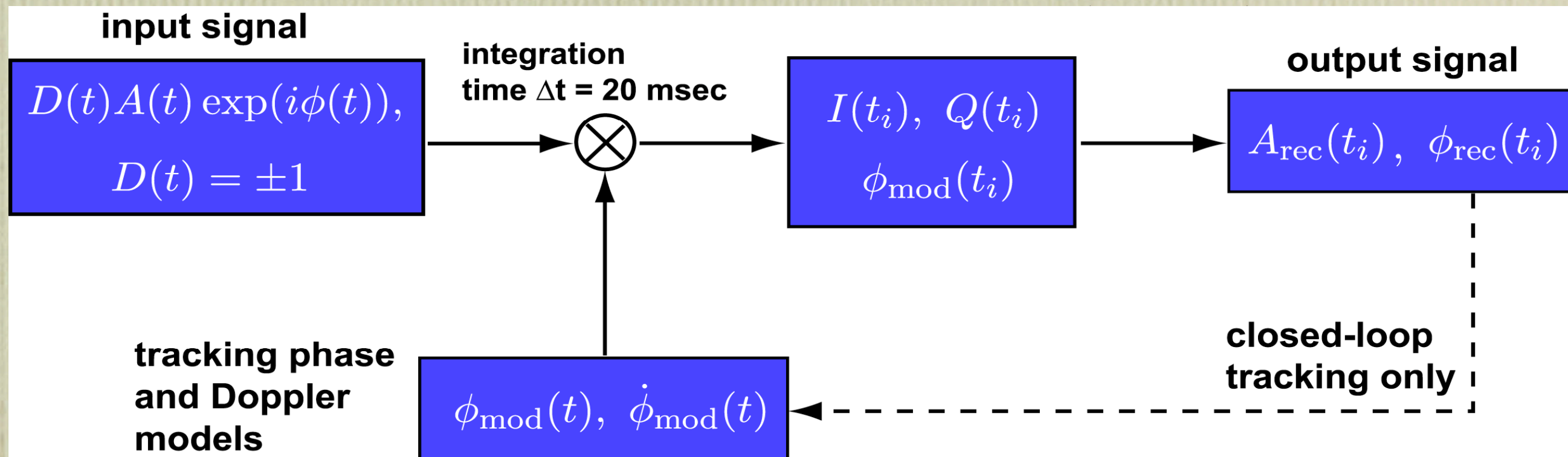
- Needs Accurate Model (± 10 Hz) but only ~50MBytes/Day

Some of the Limitations of GPSRO Remote Sensing Instrumentation (cont'd)

- SAC-C & COSMIC GPSRO Software & Hardware Are Nearly Identical
- In Spite of Its Limitations, the SAC-C BlackJack GPSRO Is the Empirical Standard for Evaluating COSMIC Rising Occultation Readiness

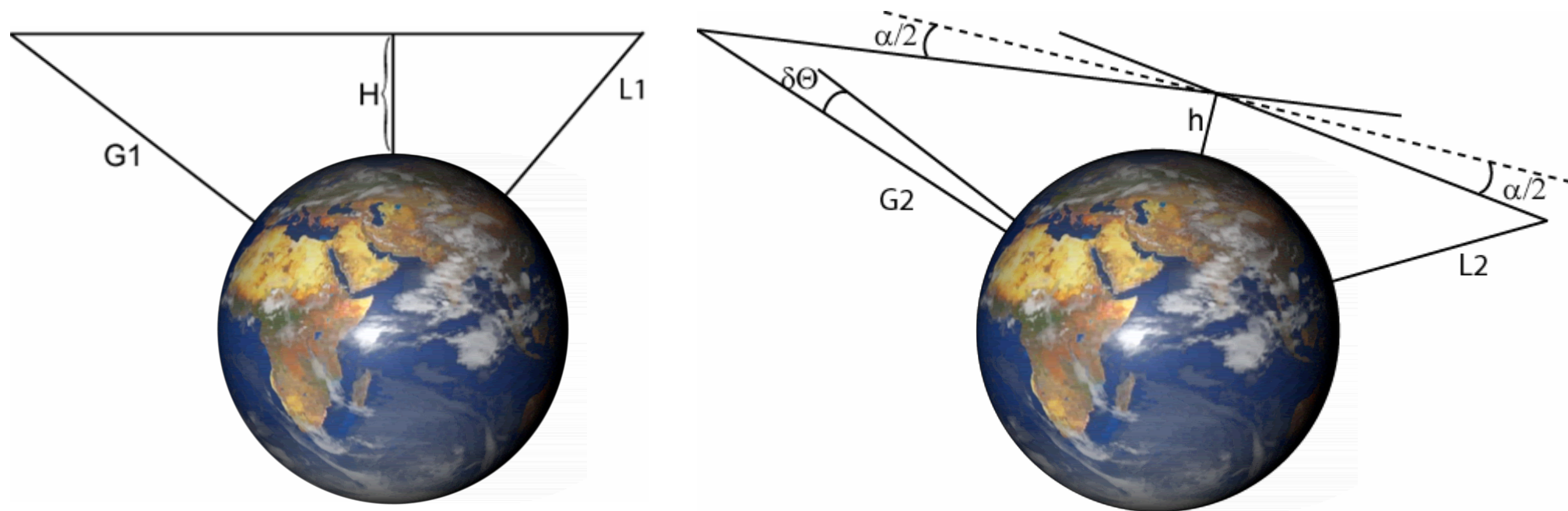
The SAC-C Real Time Atmospheric Model

Requirements for Open-loop Phase & Amplitude Extraction



The SAC-C Real-Time Atmospheric Model

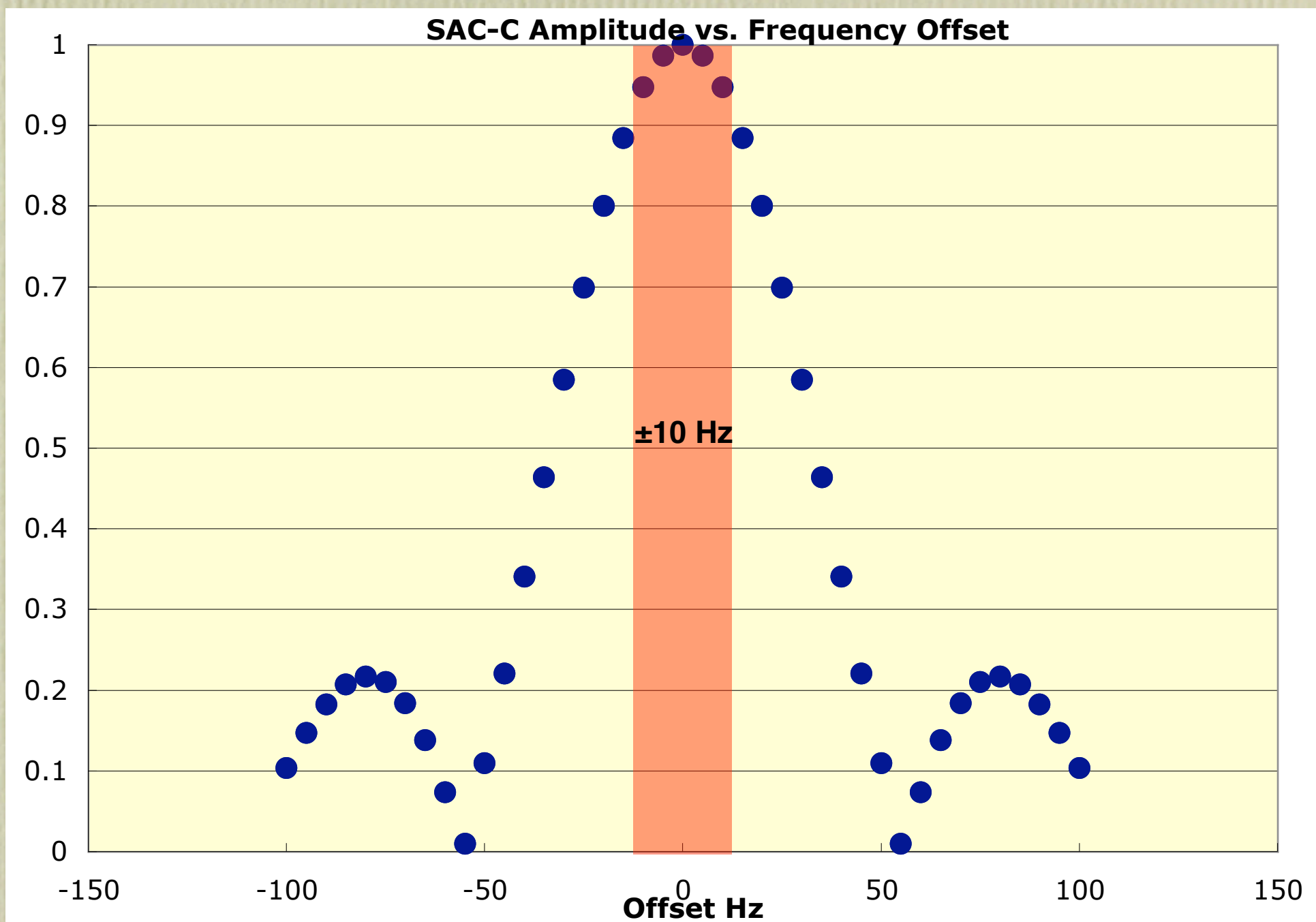
Geometric; Independent of Latitude, Season, Orbit



Real-Time Open Loop Check List

- Continuous Tracking of 6 to 9 Sats for RT-Nav Sol'n
- Clock Reference Sat Tracking and Scheduled
- Rising Occ Sat Ephemeris Available and Accurate
- Atmospheric+Geometric Model Accurate (**± 15 Hz; 100 m**)
- Receiver Oscillator Stable for Nav Estimate
- Successful L1 Closed Loop Transition
- Successful Acquisition and Tracking of L2 (± 3 Hz; 15 m)

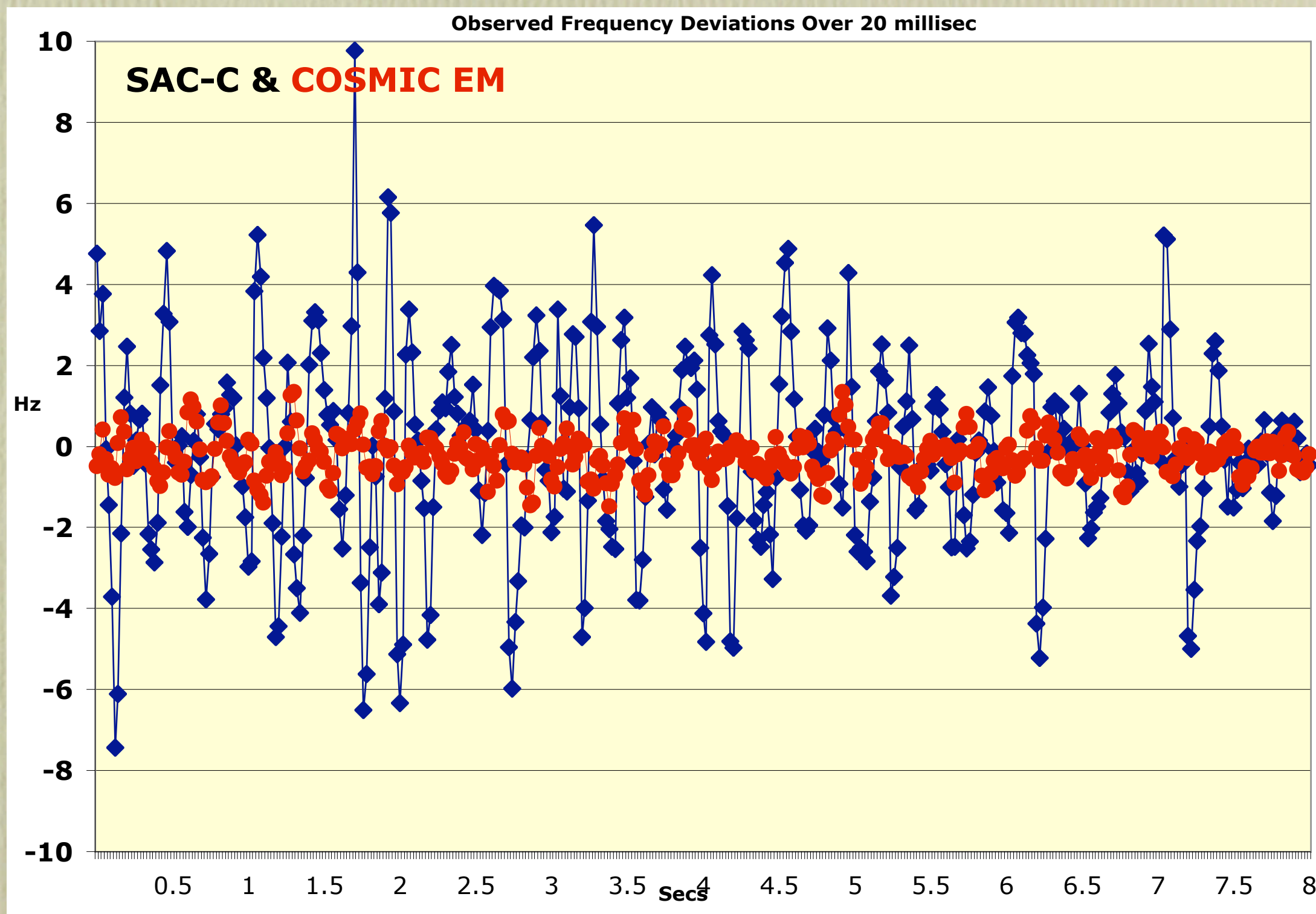
Importance of Model Frequency Accuracy



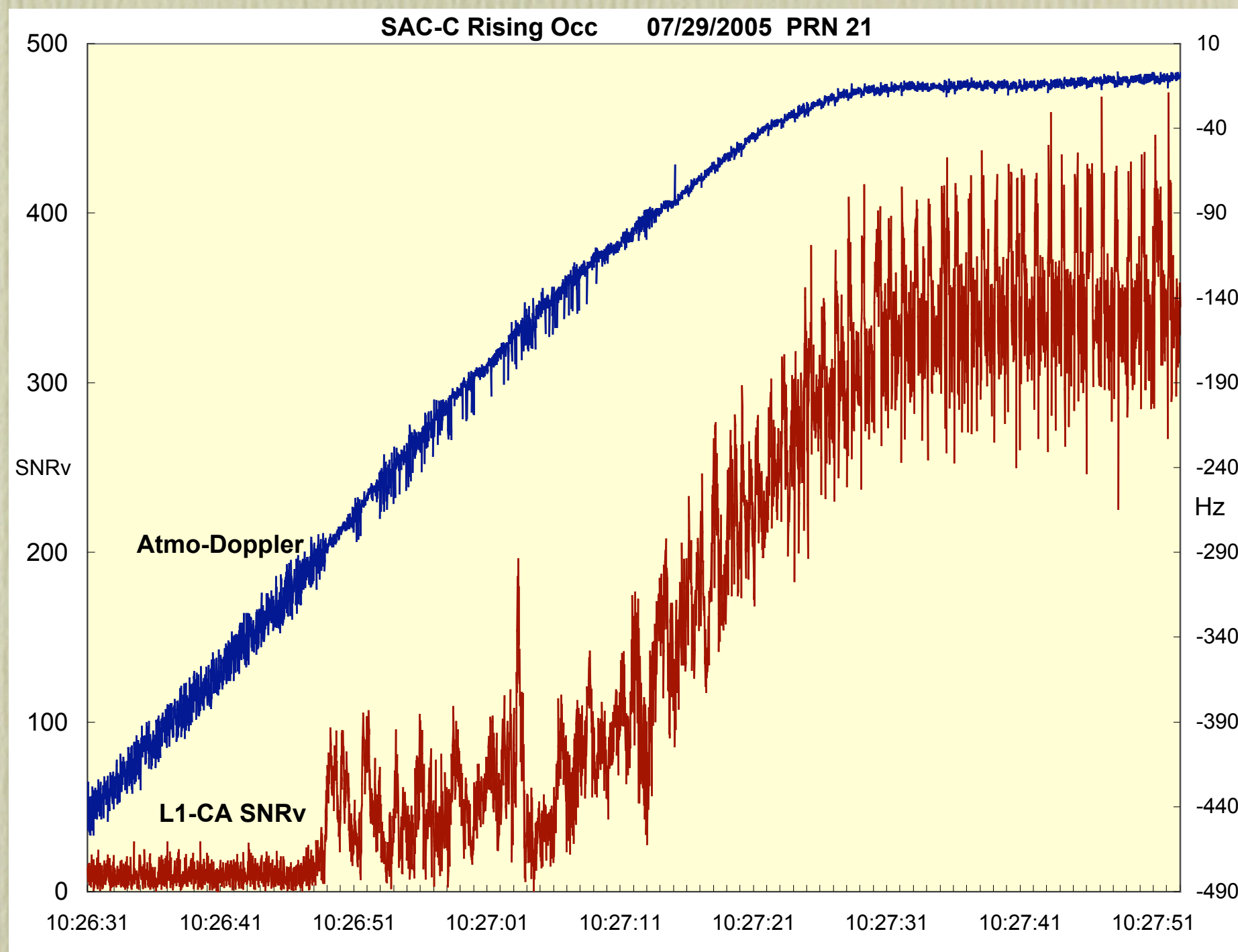
Real-Time Open Loop Check List

- Continuous Tracking of 6 to 9 Sats for RT-Nav Sol'n
- Clock Reference Sat Tracking and Scheduled
- Rising Occ Sat Ephemeris Available and Accurate
- Atmospheric+Geometric Model Accurate (± 15 Hz; 100 m)
- Receiver Oscillator **Stable** for Nav Estimate
- Successful L1 Closed Loop Transition
- Successful Acquisition and Tracking of L2 (± 3 Hz; 15 m)
- Continuous Tracking of 6 to 9 Sats for RT-Nav Sol'n

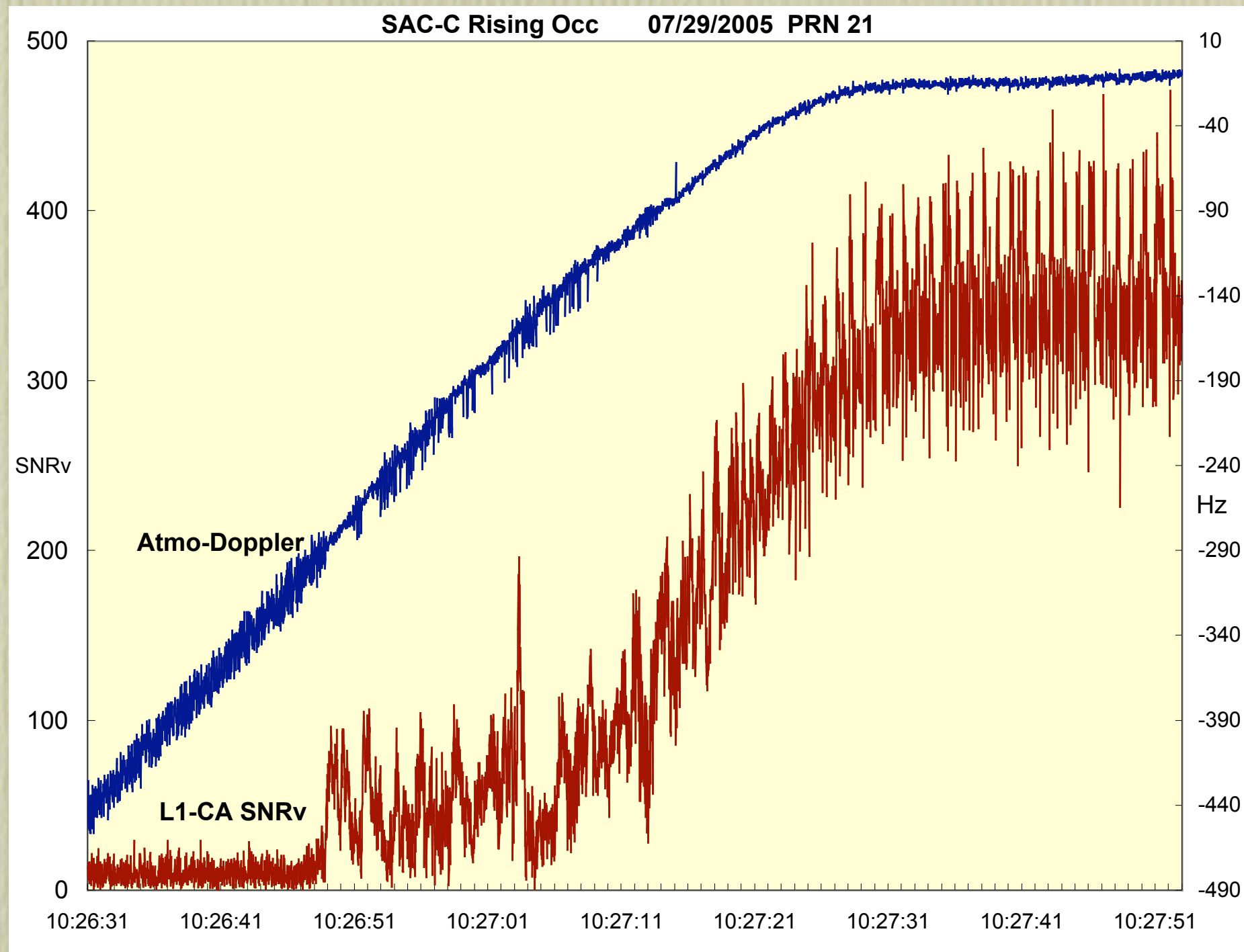
Rapid Un-modeled Oscillator Frequency Deviations



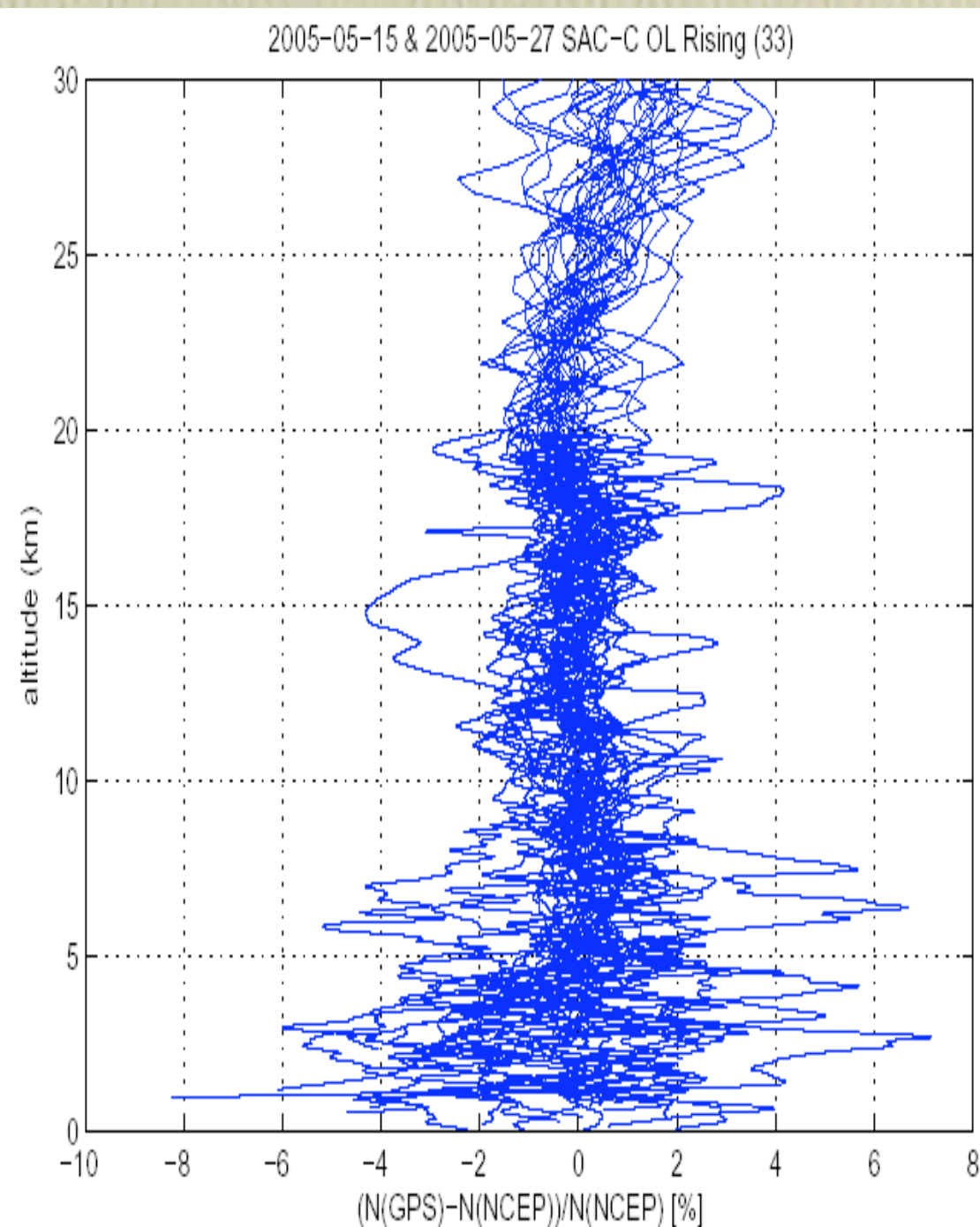
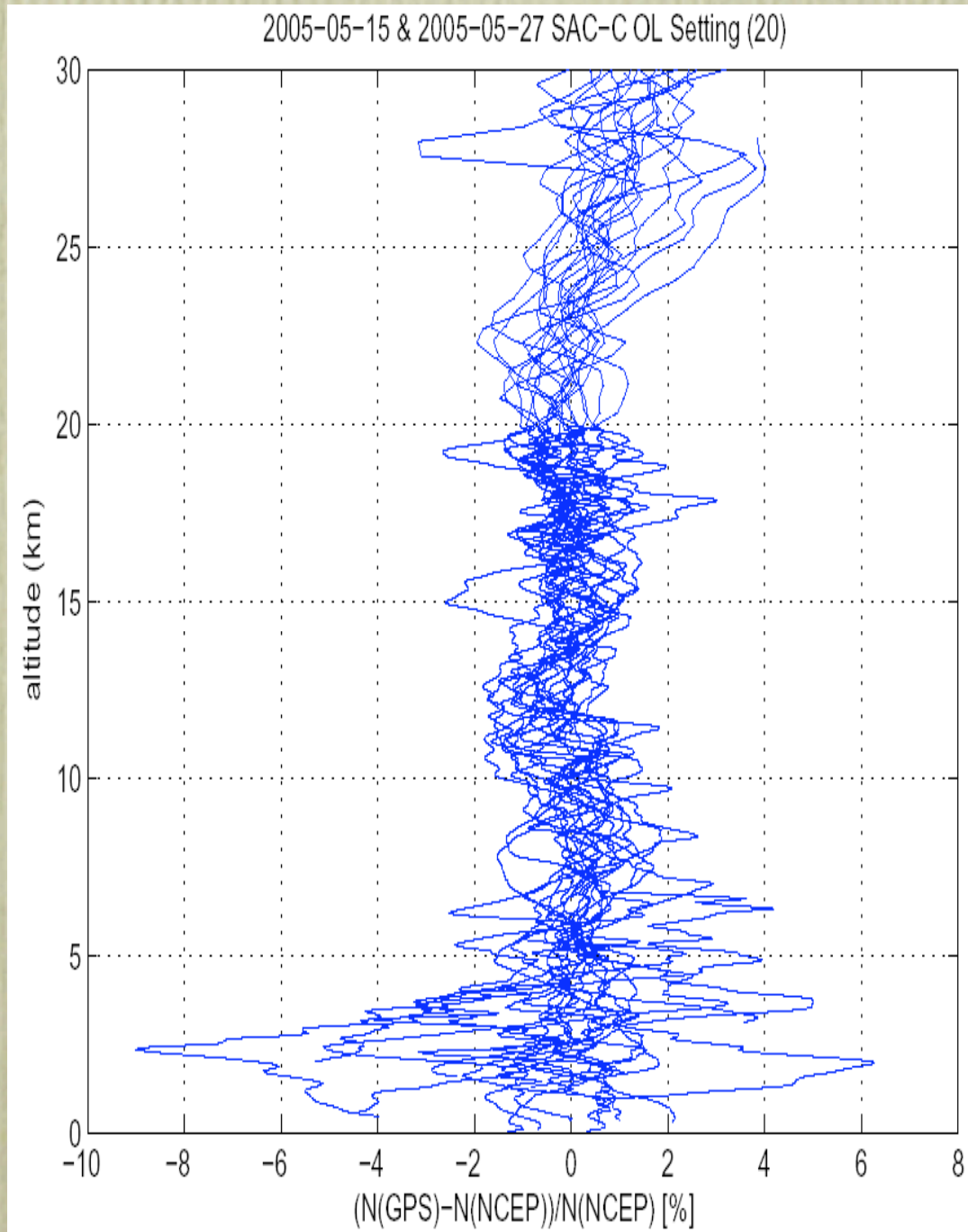
When the List is All 'Checked-Off'



Open Loop to Closed Loop Transition with Model + I,Q Sums



SAC-C Open Loop Comparisons With NCEP



Summary

- Despite Challenging Hardware and Software Issues Rising Occultations Are Consistently Being Retrieved by SAC-C BlackJack
- Geometric Atmospheric Model Appears Accurate Enough But Orbit Range Should Be Verified
- Oscillator Stability Does Not Appear to Be As Much of An Issue on COSMIC HW as SAC-C
- Further Work (with/without improvements) Remains But COSMIC Flight Build of SW Should Do the Job

Thank You



T. K. Meehan, G. A. Hajj, C. O. Ao, D. Dong, B. A. Iijima, A. J. Mannucci

**Jet Propulsion Laboratory
California Institute of Technology**