

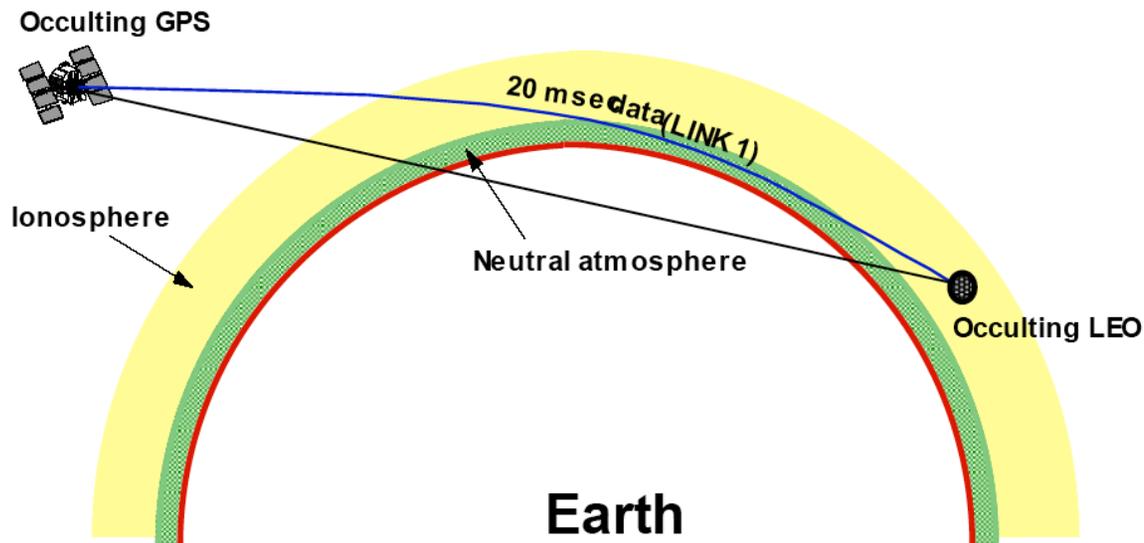
Applications of GPS Radio Occultation Data over the Antarctic

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UCAR

GPS Occultation

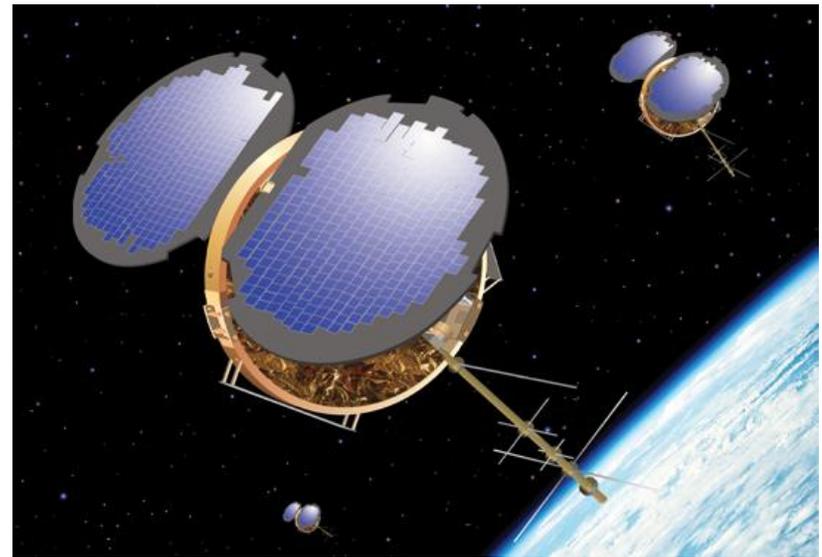
Basic measurement principle:

Deduce atmospheric properties based on precise measurement of phase delay and amplitude.

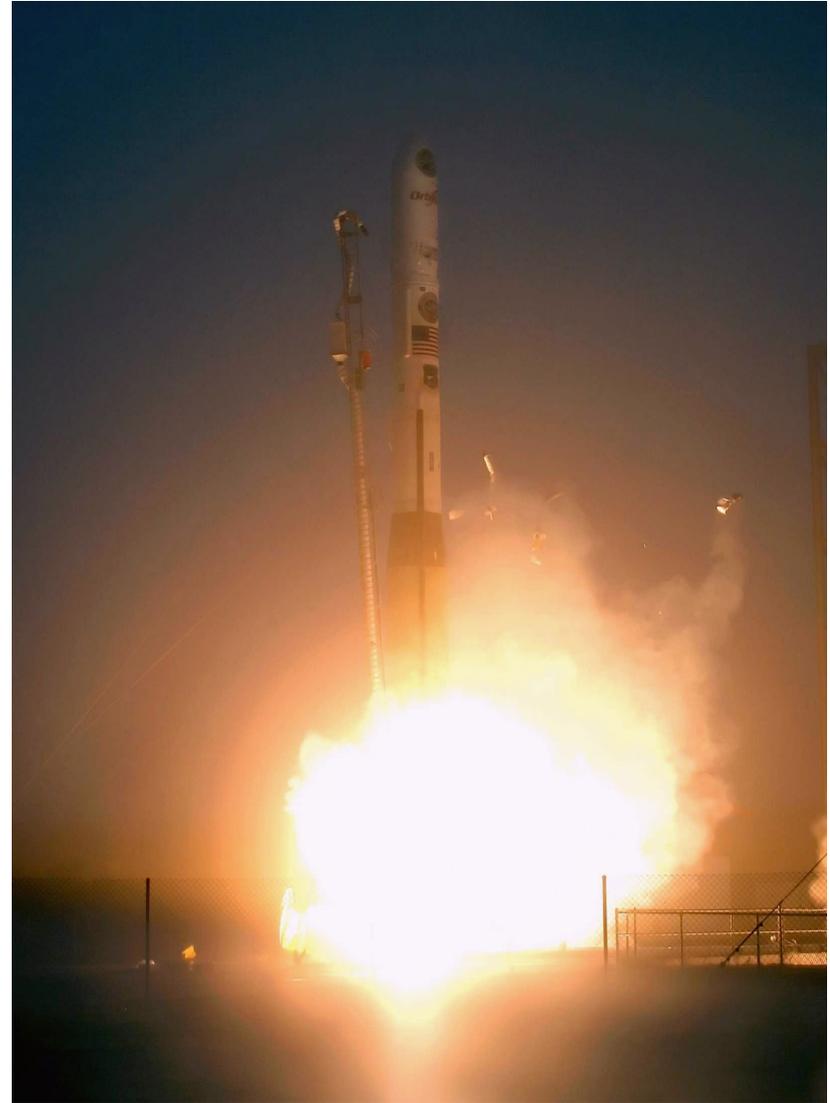


COSMIC: Constellation Observing System for Meteorology, Ionosphere and Climate

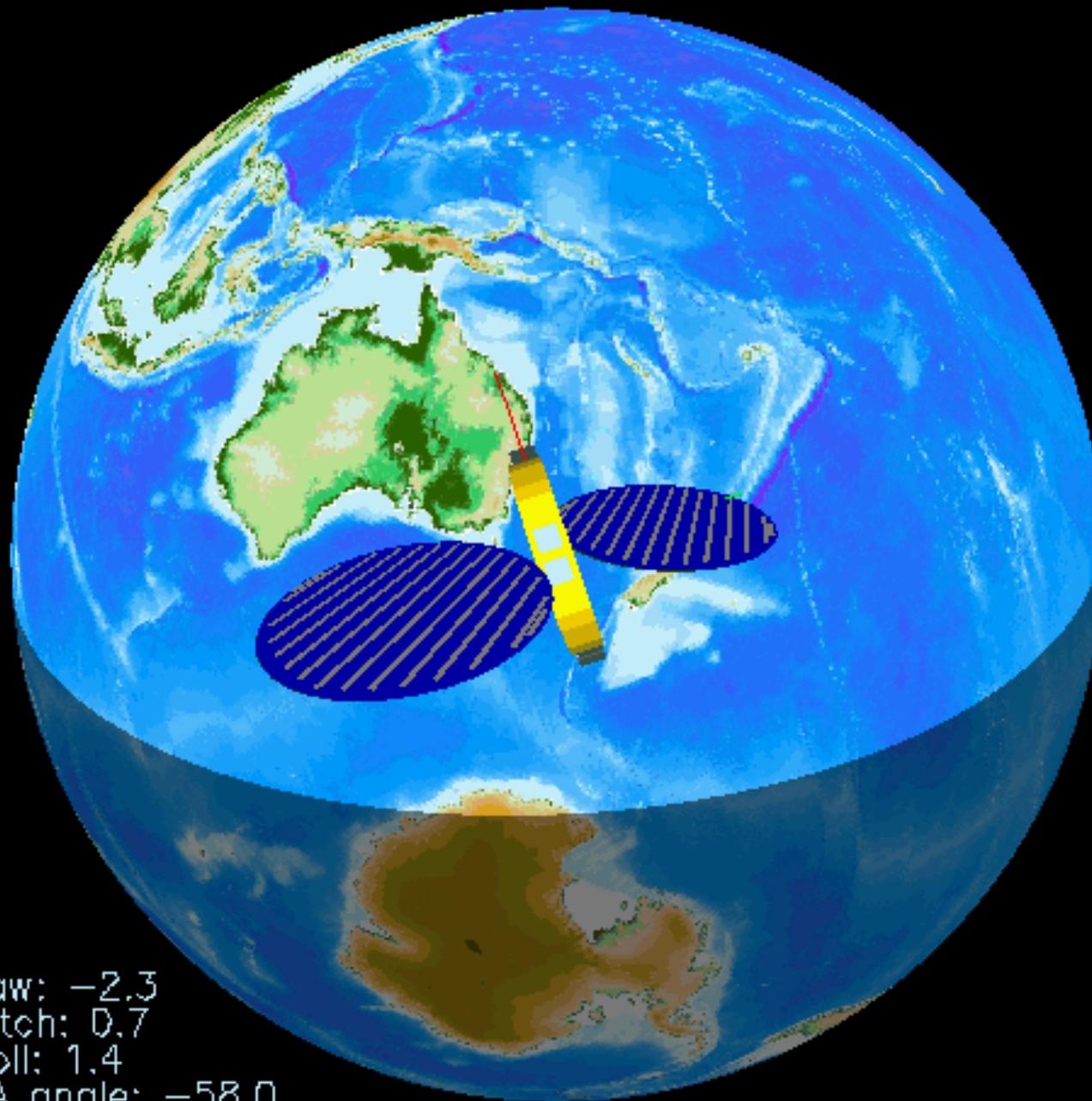
- 6 Satellites launched:
01:40 UTC 15 April 2006
- Three instruments:
GPS receiver, TIP, Tri-band beacon
- Weather + Space Weather data
- Global observations of:
 - Pressure, Temperature, Humidity
 - Refractivity
 - Ionospheric Electron Density
 - Ionospheric Scintillation
- Demonstrate quasi-operational GPS limb sounding with global coverage in near-real time
- Climate Monitoring



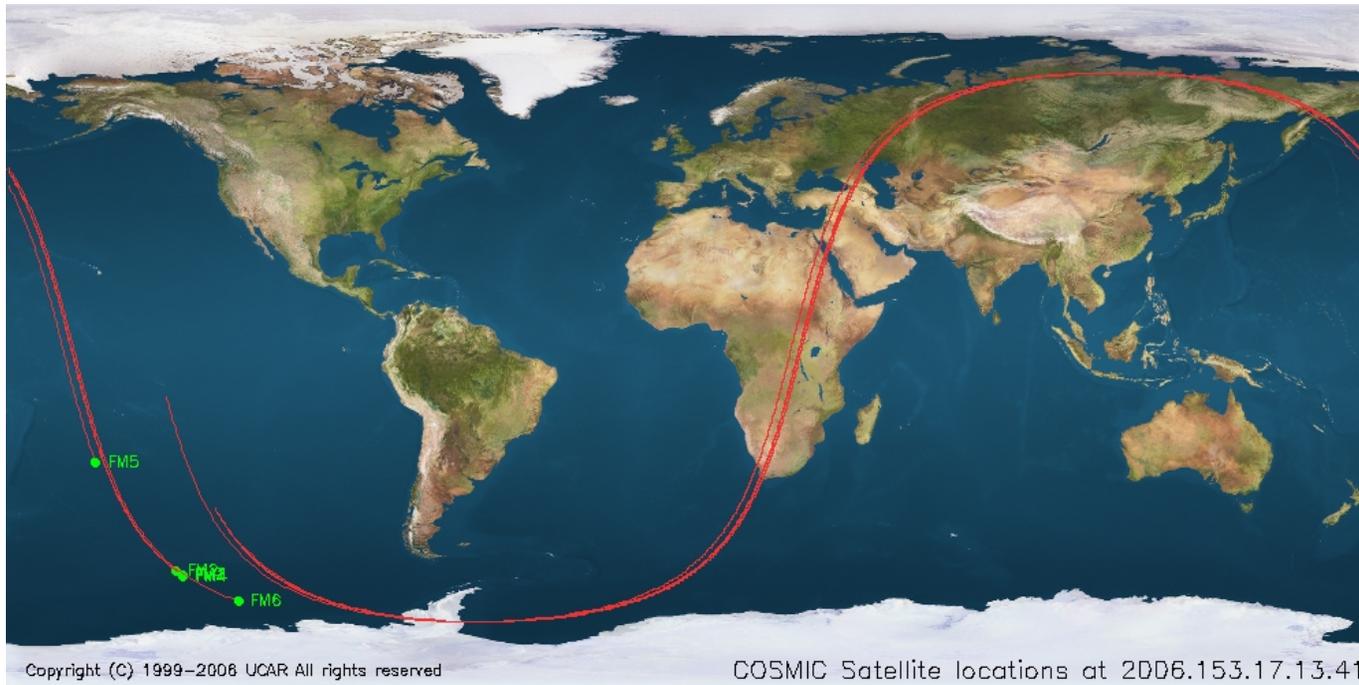
FORMOSAT-3/COSMIC launched at 01:40 UTC 15 April 2006



Attitude display for 2006.139.005.01, duration: 248 minutes

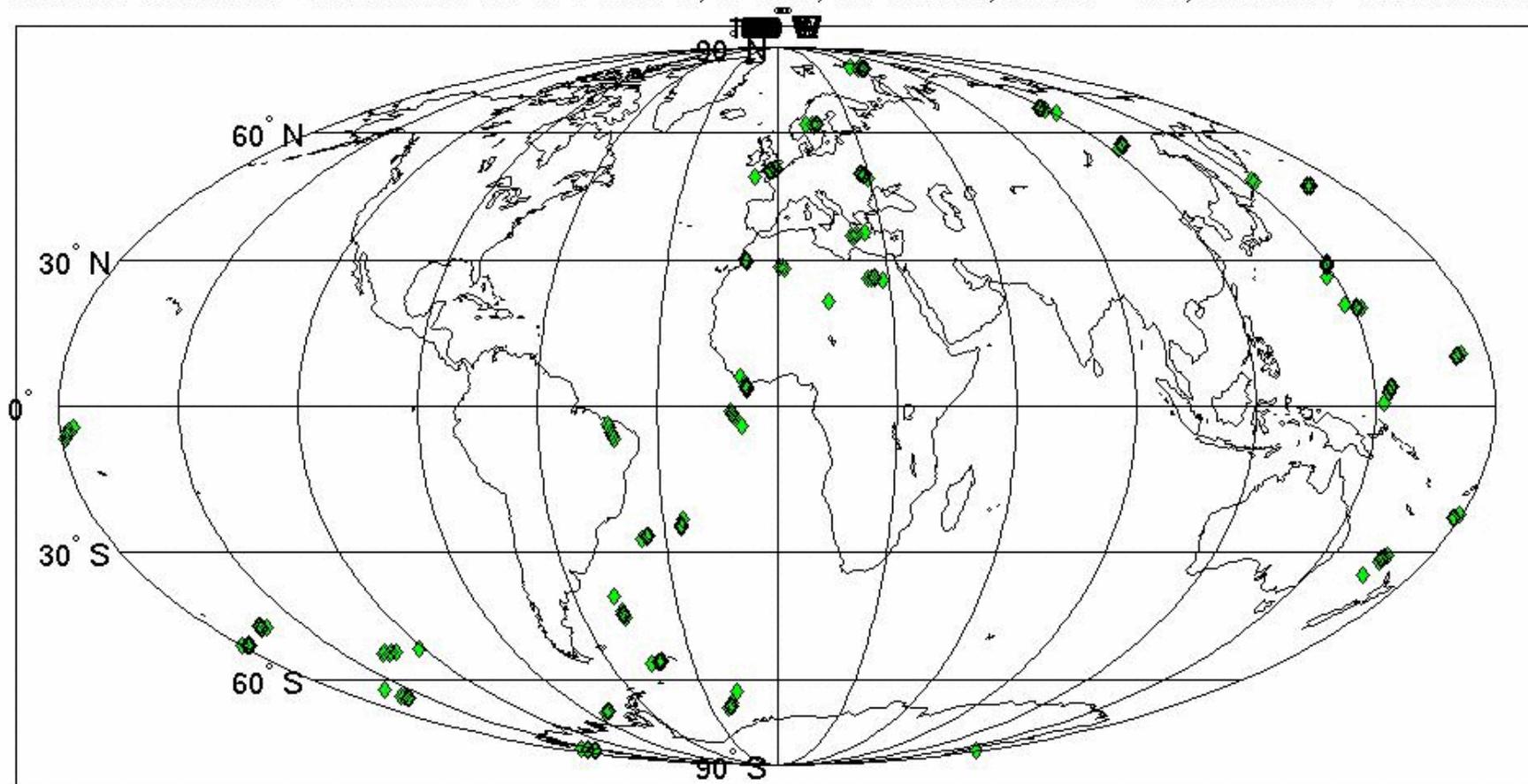


Yaw: -2.3
Pitch: 0.7
Roll: 1.4
SA angle: -58.0
2006.139.01.41.20

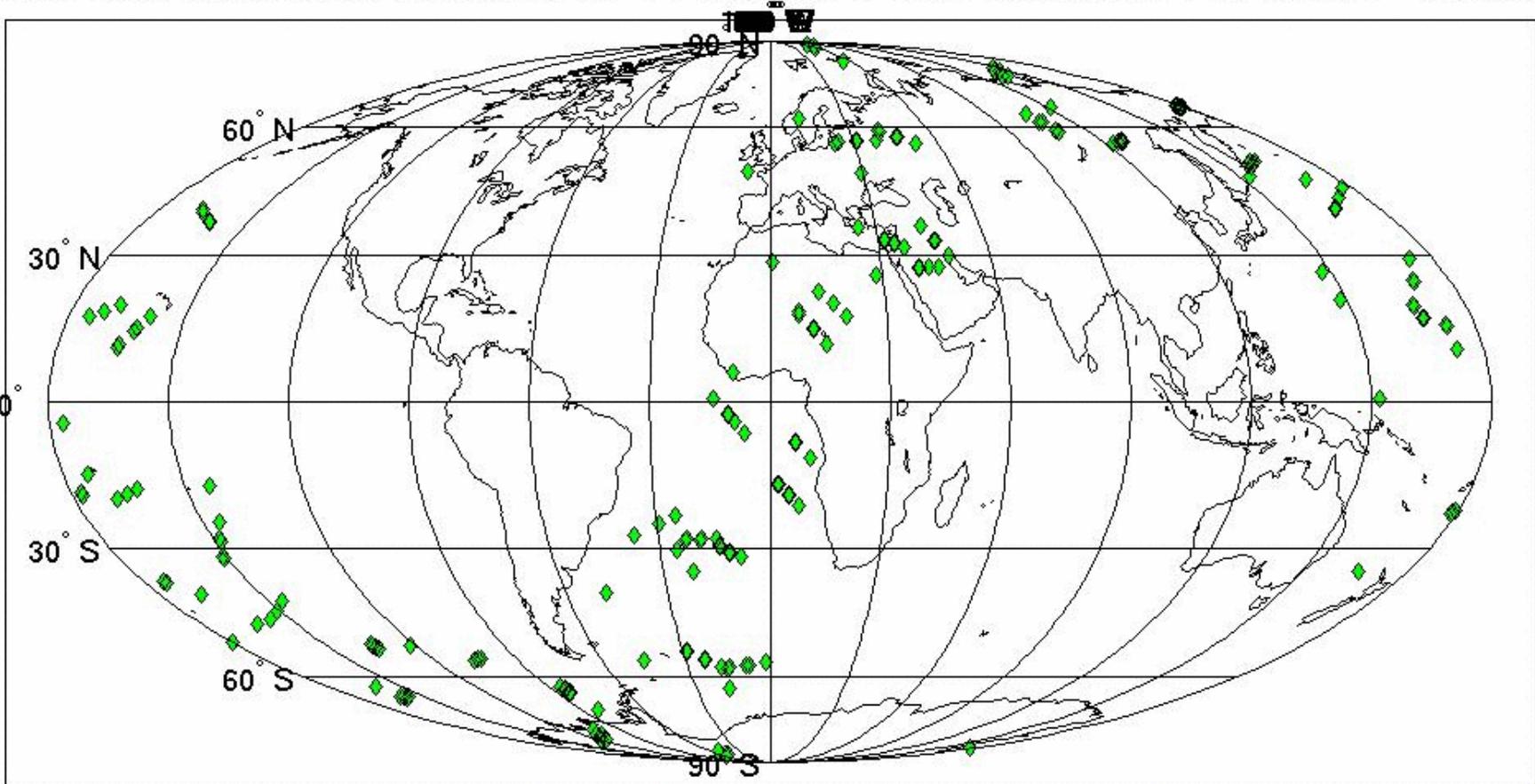


- COSMIC satellites are going through check out phase now:
 - All six satellites are healthy
 - All payload working as expected
 - Begin orbit raising for one satellite last week
- Mass production of GPS RO sounding is expected to begin in late June 2006.

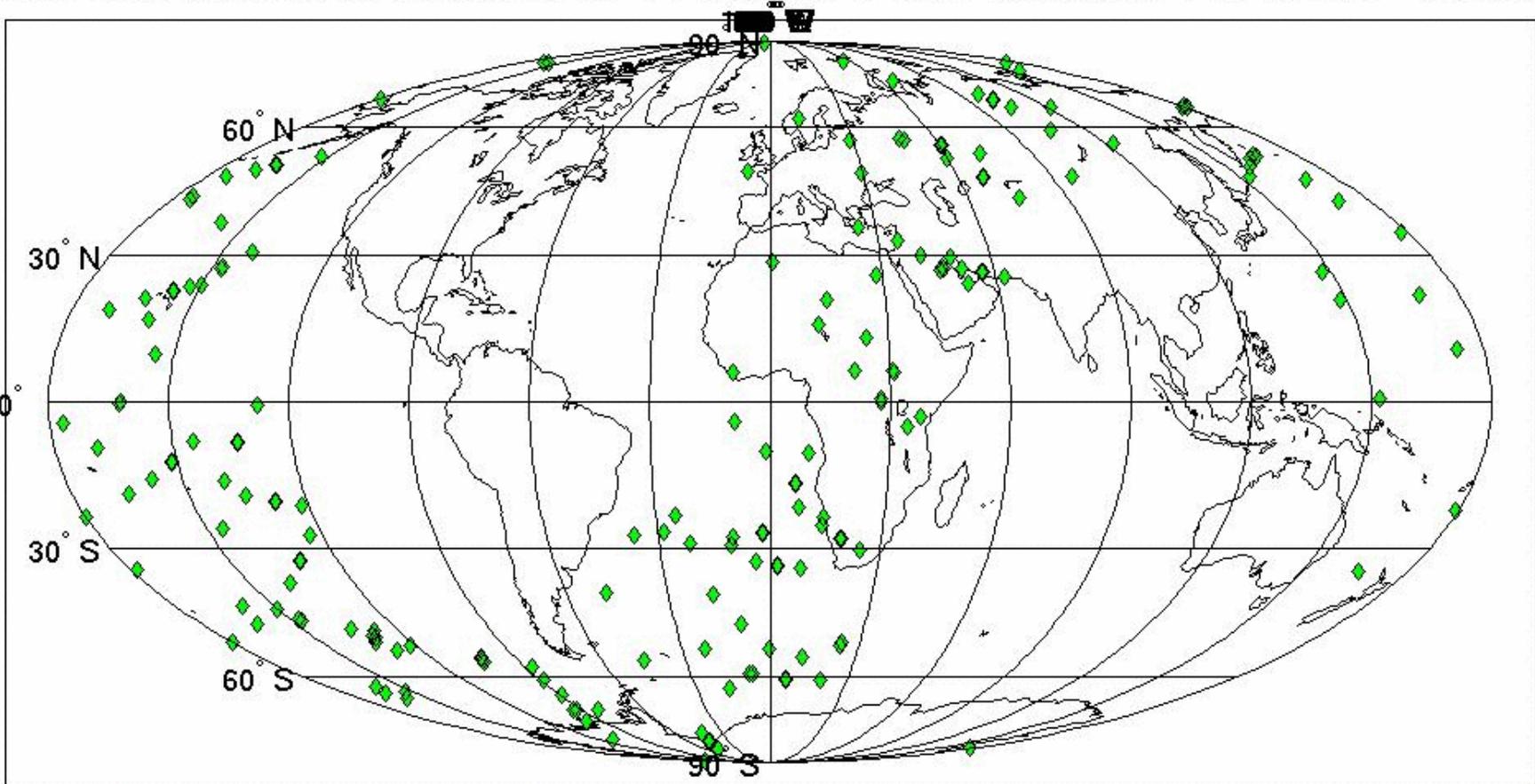
Earth-Fixed RO Locations for COSMIC, 6 S/C, 6 Planes, Orbit = 01, Launch+1.5months



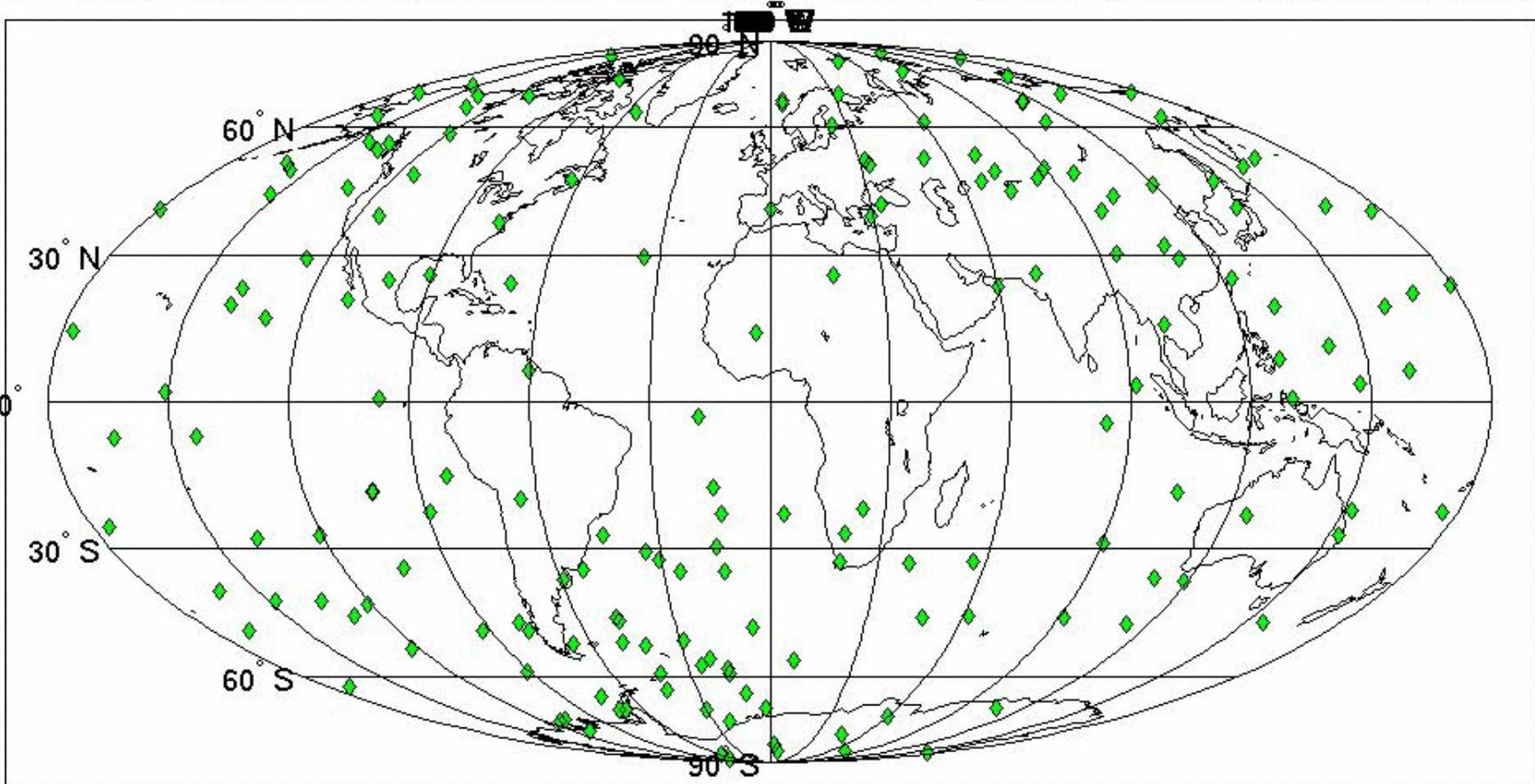
Earth-Fixed Occultation Locations for COSMIC, 6 S/C, 6 Planes, 24 Hrs, Launch+~3months



Earth-Fixed Occultation Locations for COSMIC, 6 S/C, 6 Planes, 24 Hrs, Launch+~6months

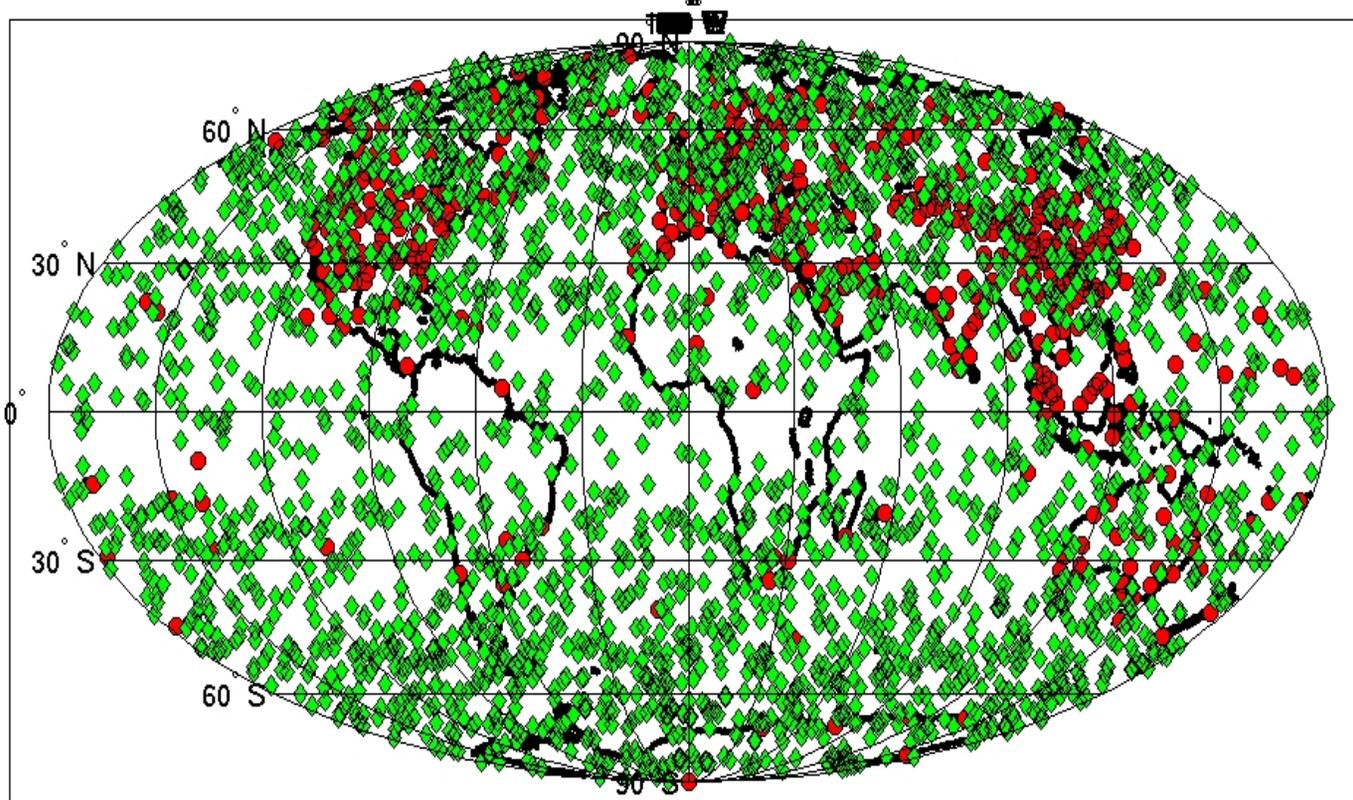


Earth-Fixed Occultation Locations for COSMIC, 6 S/C, 6 Planes, 24 Hrs, Operational Constell



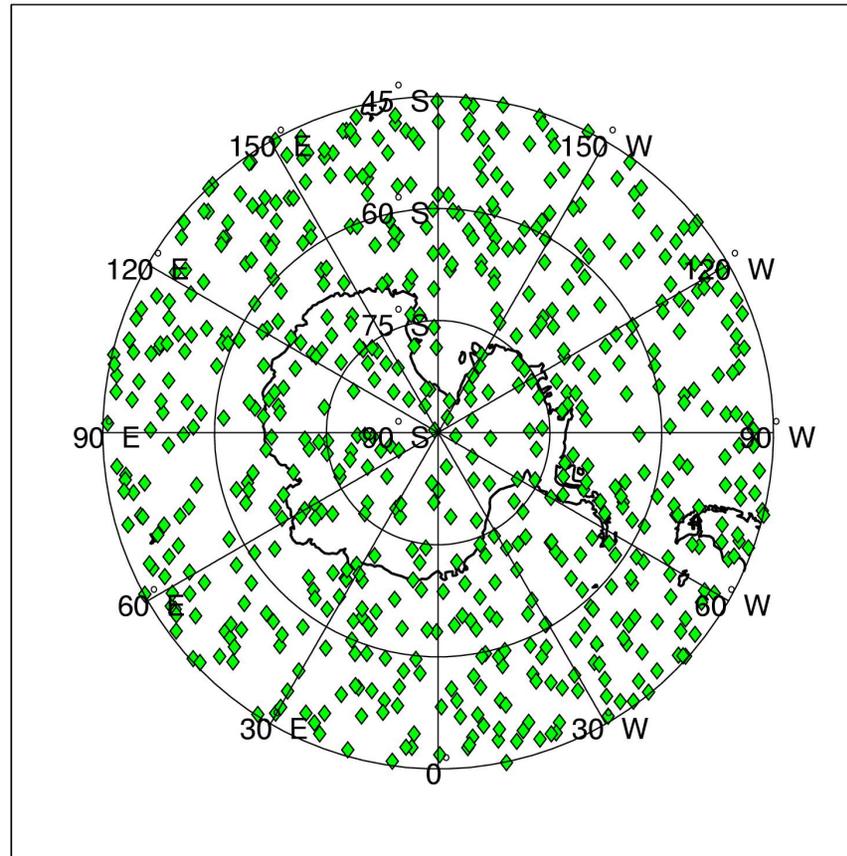
COSMIC sounding distribution in a day

Occultation Locations for COSMIC, 6 S/C, 6 Planes, 24 Hrs

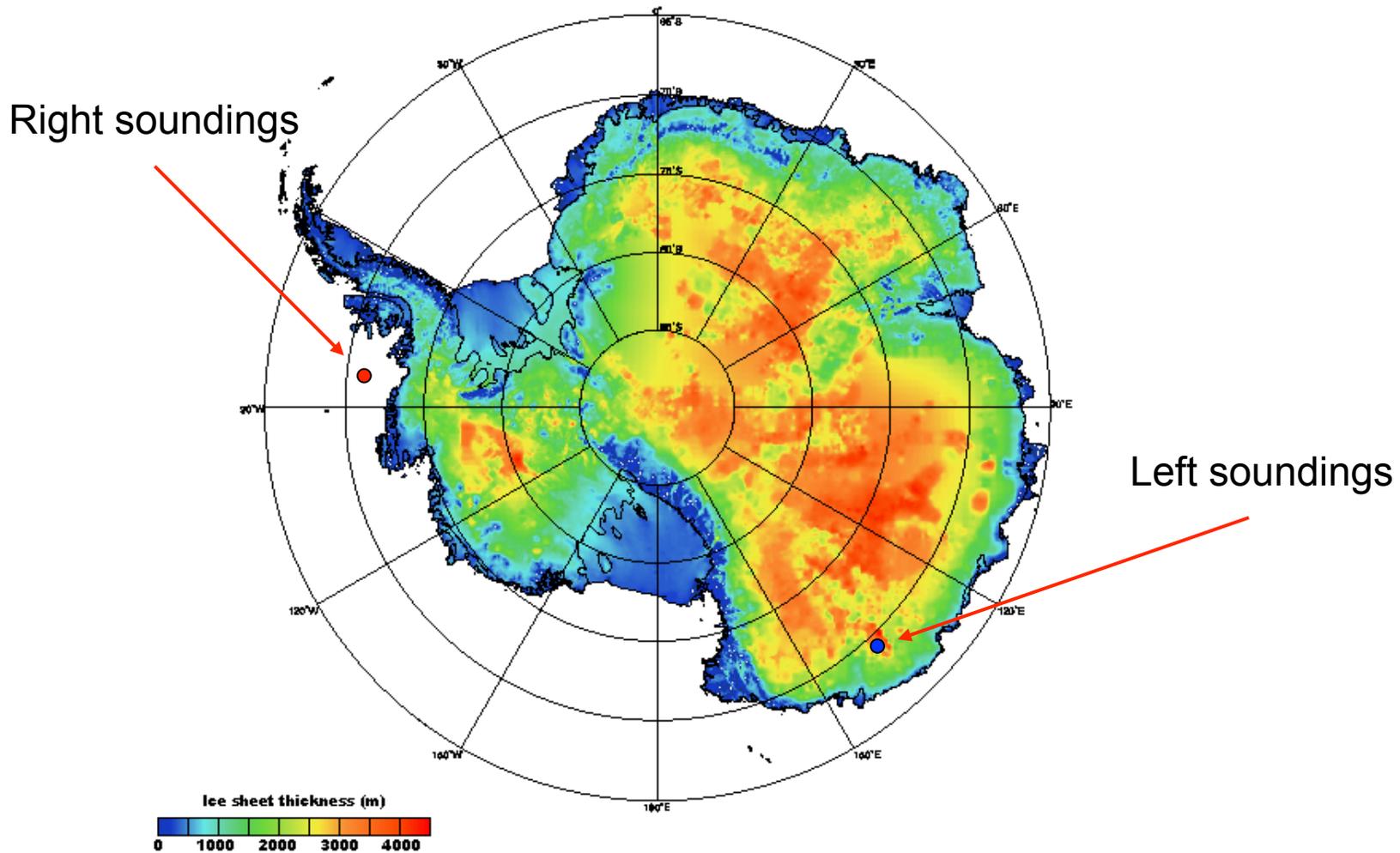


COSMIC GPS RO Soundings in a Day after it is deployed to final orbits

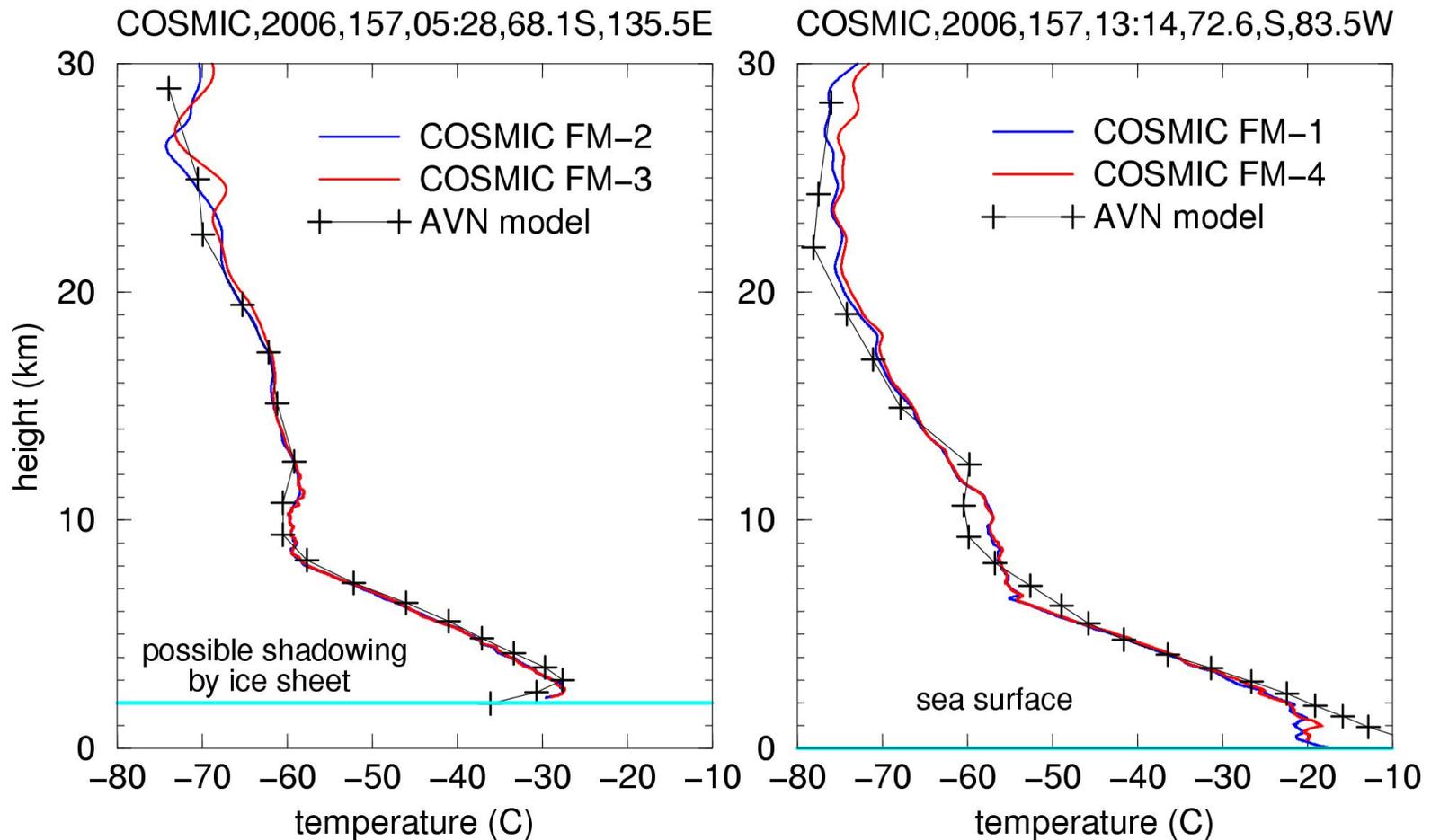
Occultation Locations for COSMIC, 6 S/C, 6 Planes, 24 Hrs



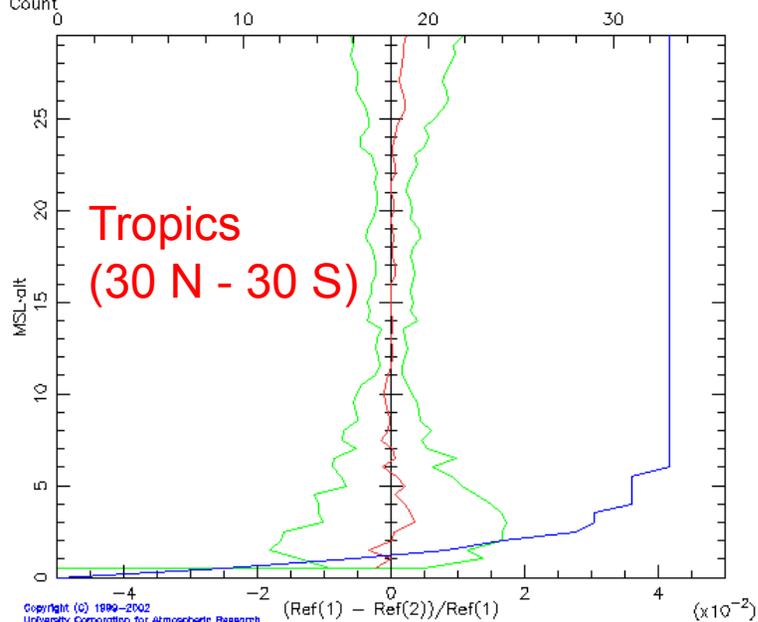
Locations of the two pairs of COSMIC soundings



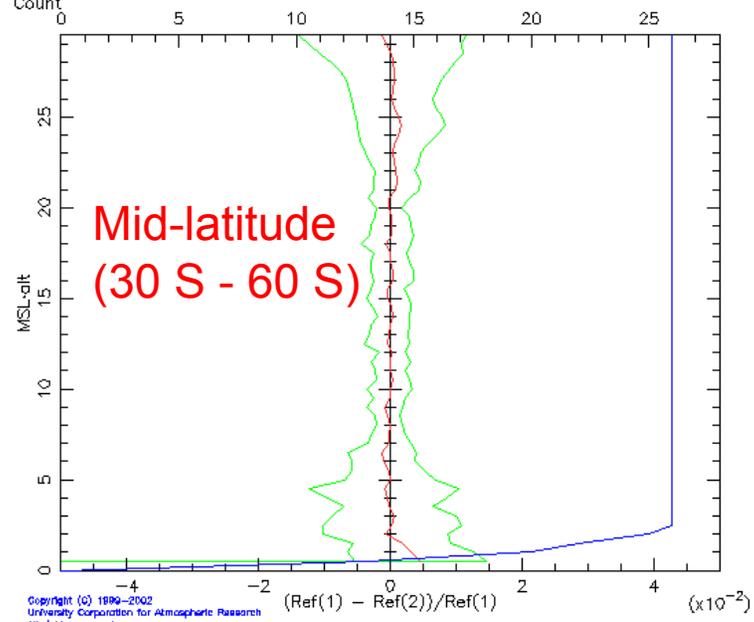
Two pairs of COSMIC Soundings (10~20 km apart)



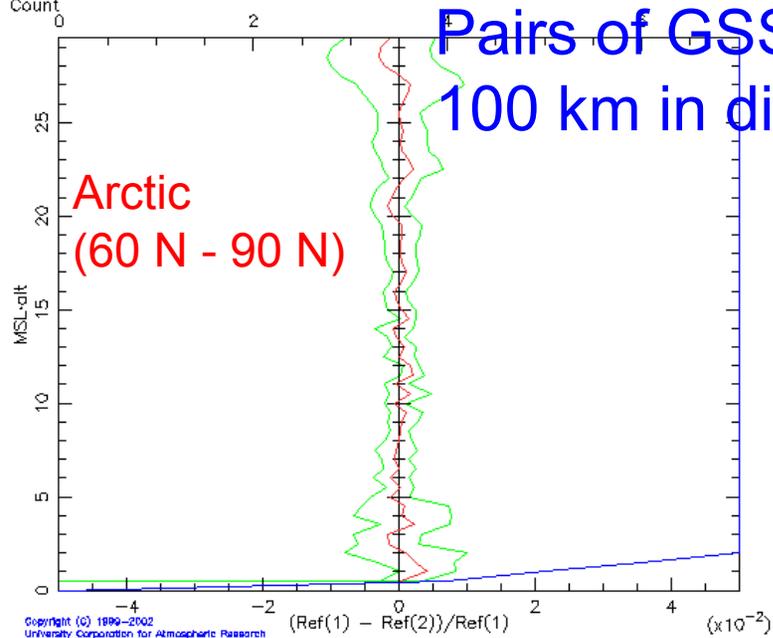
COSMIC Colocations: Refrac., 2006.151-164, -30<LAT<30, DIS<100km



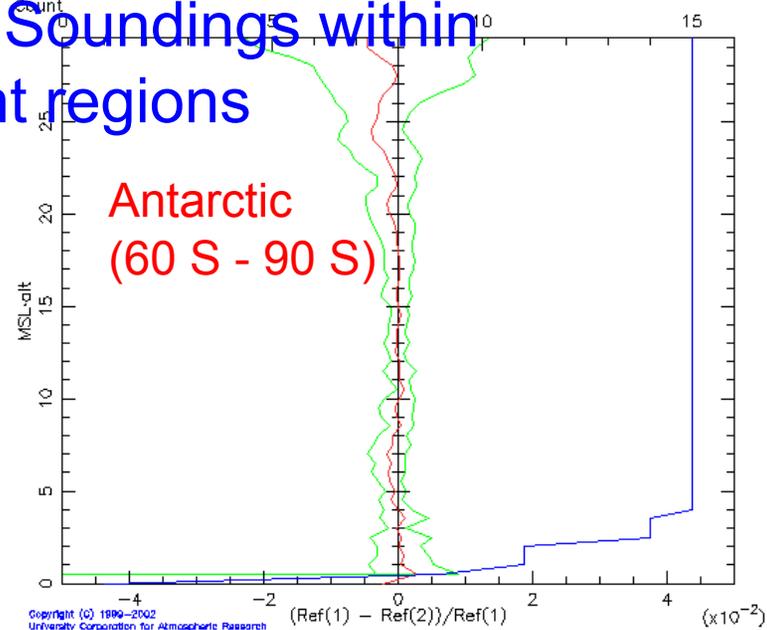
COSMIC Colocations: Refrac., 2006.151-164, -60<LAT<-30, DIS<100km



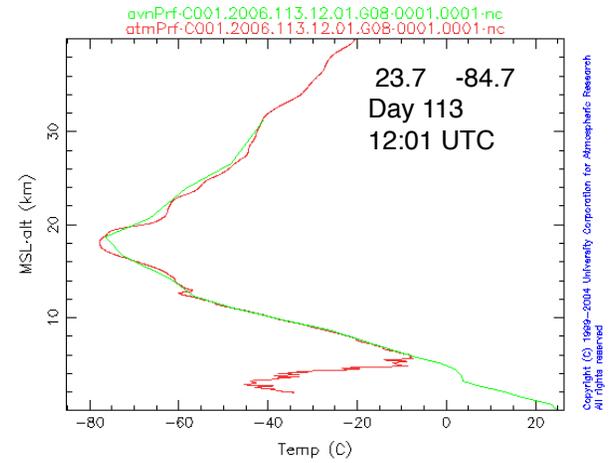
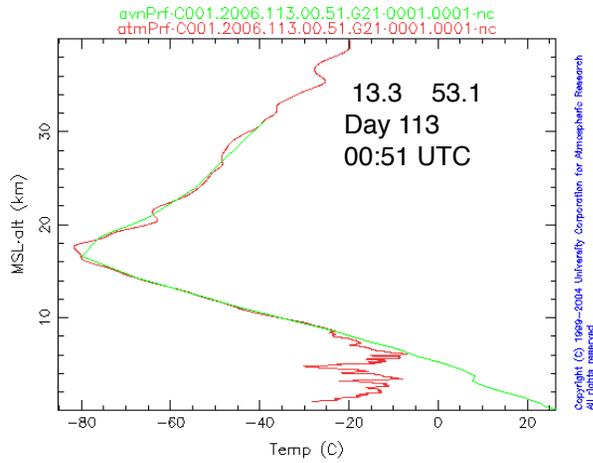
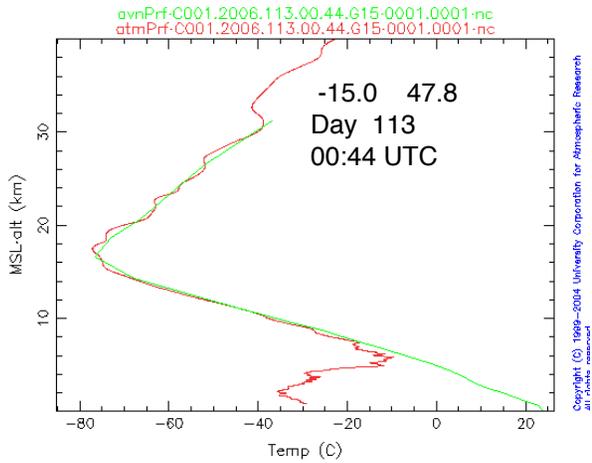
COSMIC Colocations: Refrac., 2006.151-164, 60<LAT<90, DIS<100km



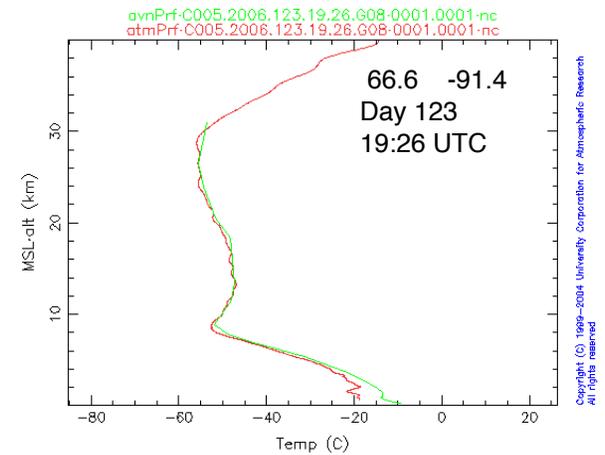
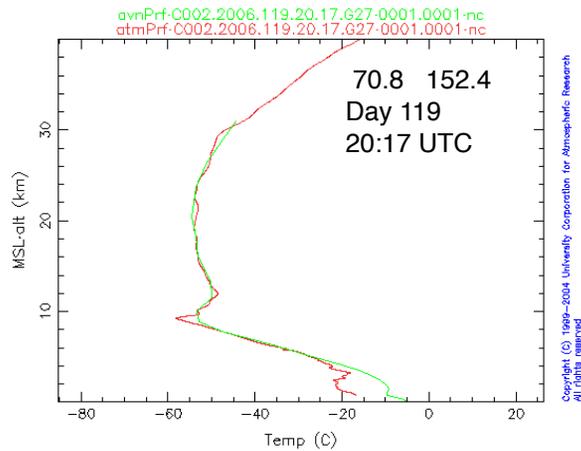
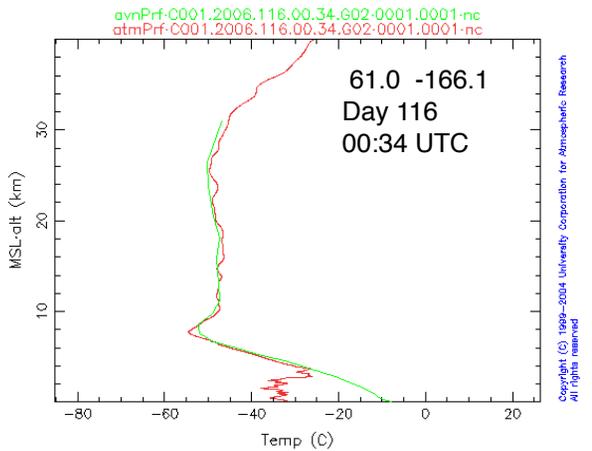
COSMIC Colocations: Refrac., 2006.151-164, -90<LAT<-60, DIS<100km



**Pairs of GSS RO Soundings within
100 km in different regions**



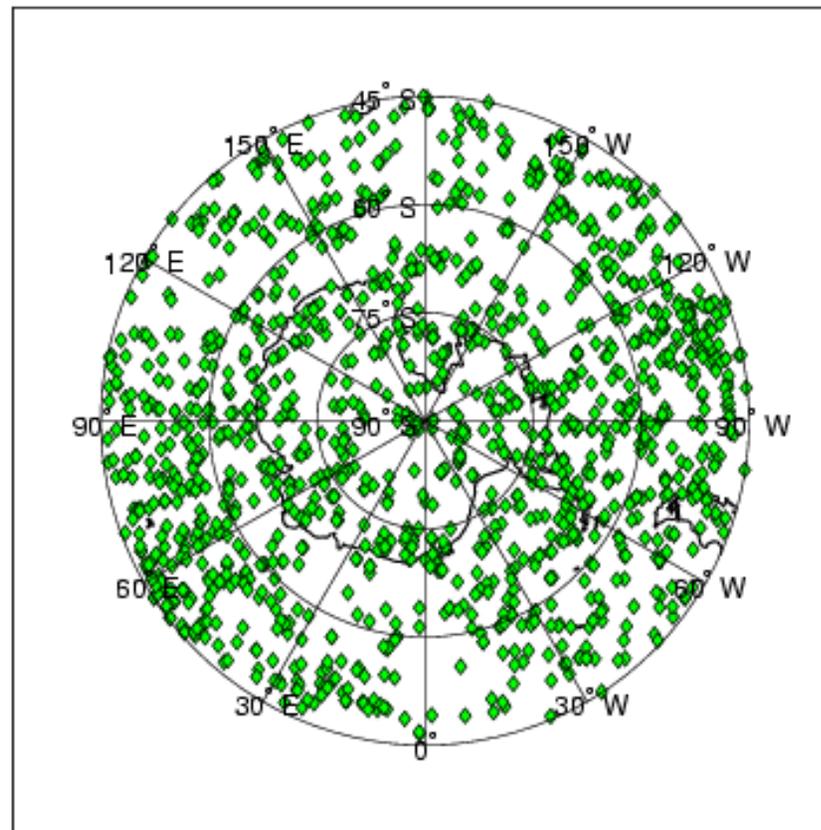
Three Tropical Soundings



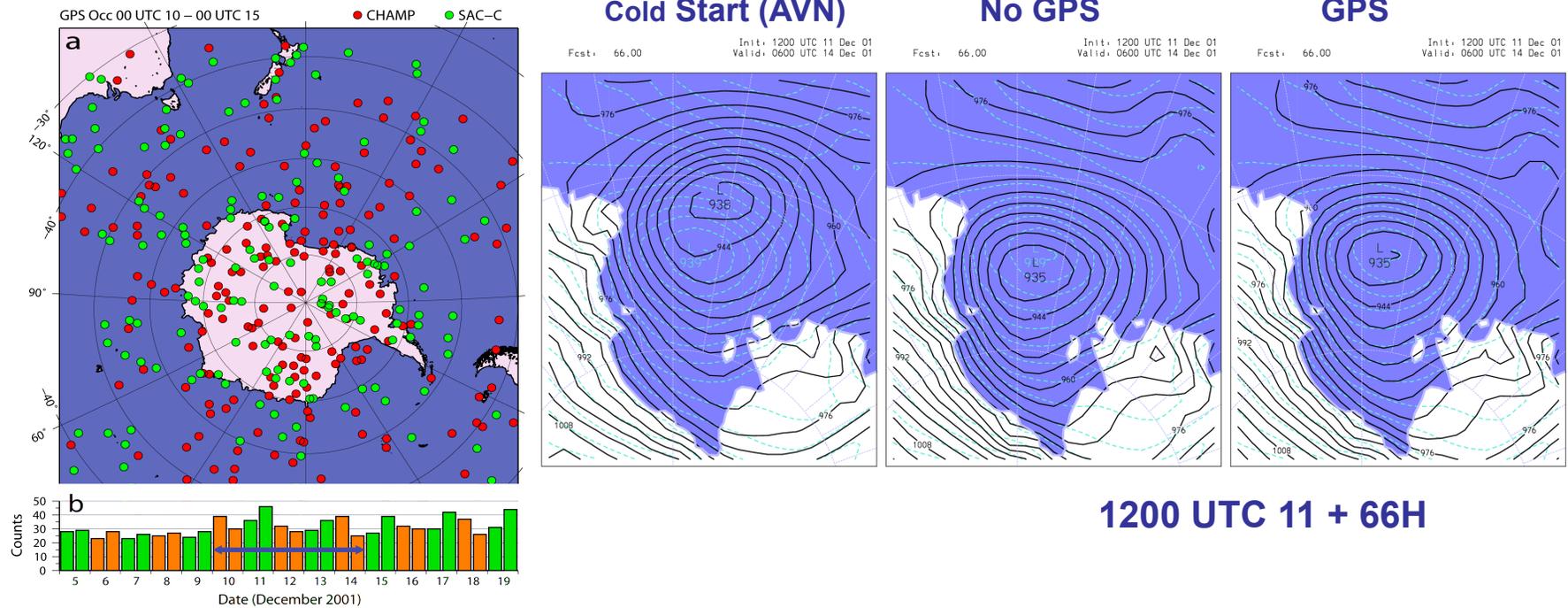
Three Polar Soundings

COSMIC GPS RO Sounding Over the Antarctic since launch

Occultation Locations from COSMIC, 2006.111-163



MM5 4D-Var Assimilation of GPS RO data



Wee et al. (2006) assimilated 50+ GPS RO soundings from CHAMP and SAC-C over the Antarctic over a two-day period and demonstrated positive impact on the prediction of an intense Antarctic cyclone out to 3 days. The GPS RO soundings account for ~3% of the data used.

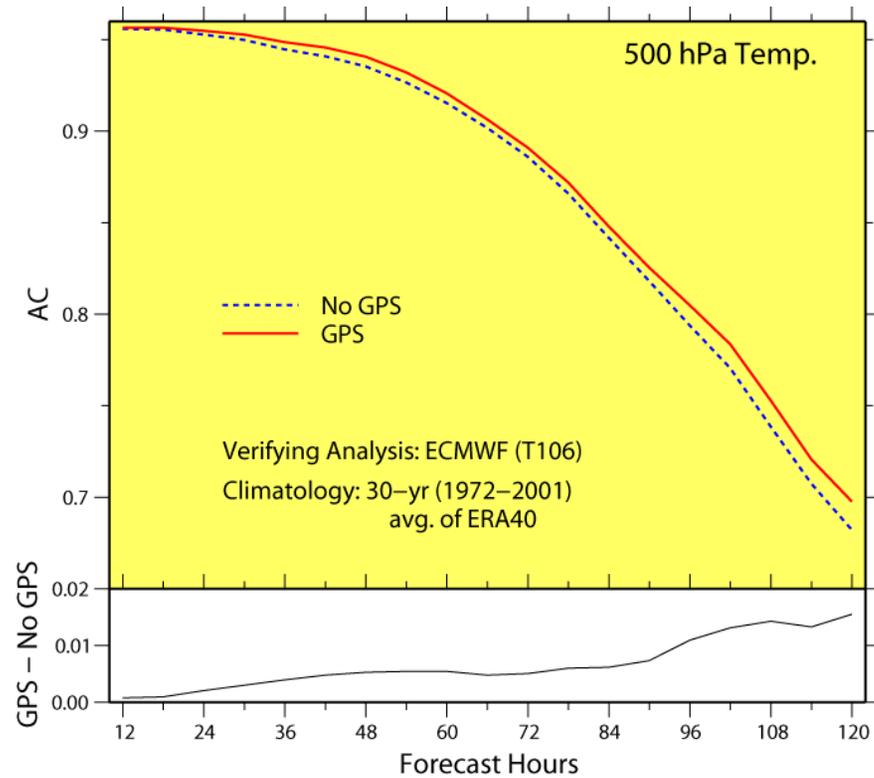
Solid contour: Predicted Sea Level Pressure by MM5 using different initial conditions. Dashed lines are verifying ECMWF analysis.

Observations

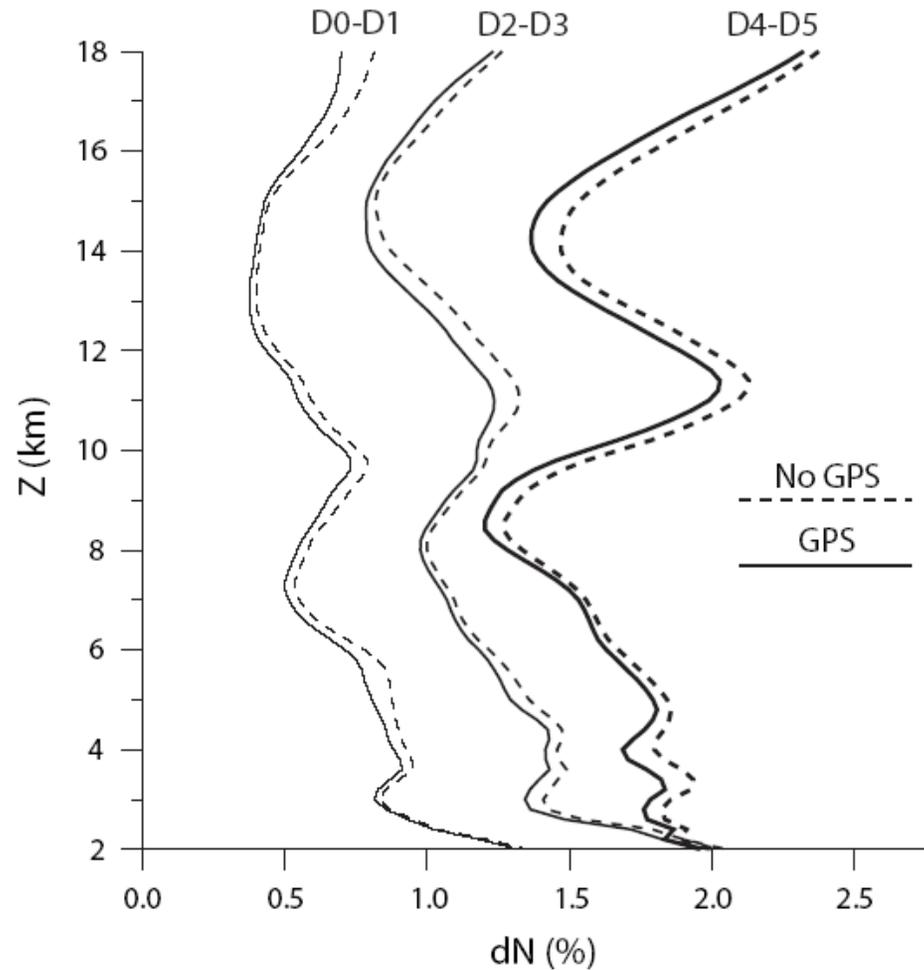
- GPS RO refractivity
- TEMP (RAOBS/PIBAL)
- SYNOP (SFC/SHIP/BUOY)
- AIRCFT (AIREP/PIREP/AIRCAR)
- ATOVS soundings (Tv and Z)
- MODIS soundings (T, Q, and Z)
- SSM/I (rainrate, liquid water, PW, and SFC wind)
- Satellite wind
- QuikSCAT (SFC wind)

Verification with an independent analysis

(average of forecasts after 4 cycles of assimilation)



Verification against GPS RO observations



Summary

- COSMIC was successfully launched, and we have already collected excellent data during test phase.
- Operational data production will begin by the end of June. The data can support real-time operational NWP. Data latency is less than 2 hours.
- Assimilation results using earlier mission have demonstrated the impact of GPS RO data on Antarctic regional analysis and prediction.
- Data are freely available. Just sign up at COSMIC web site:
<http://www.cosmic.ucar.edu/>