GNSS Radio Occultation Sampling Analysis

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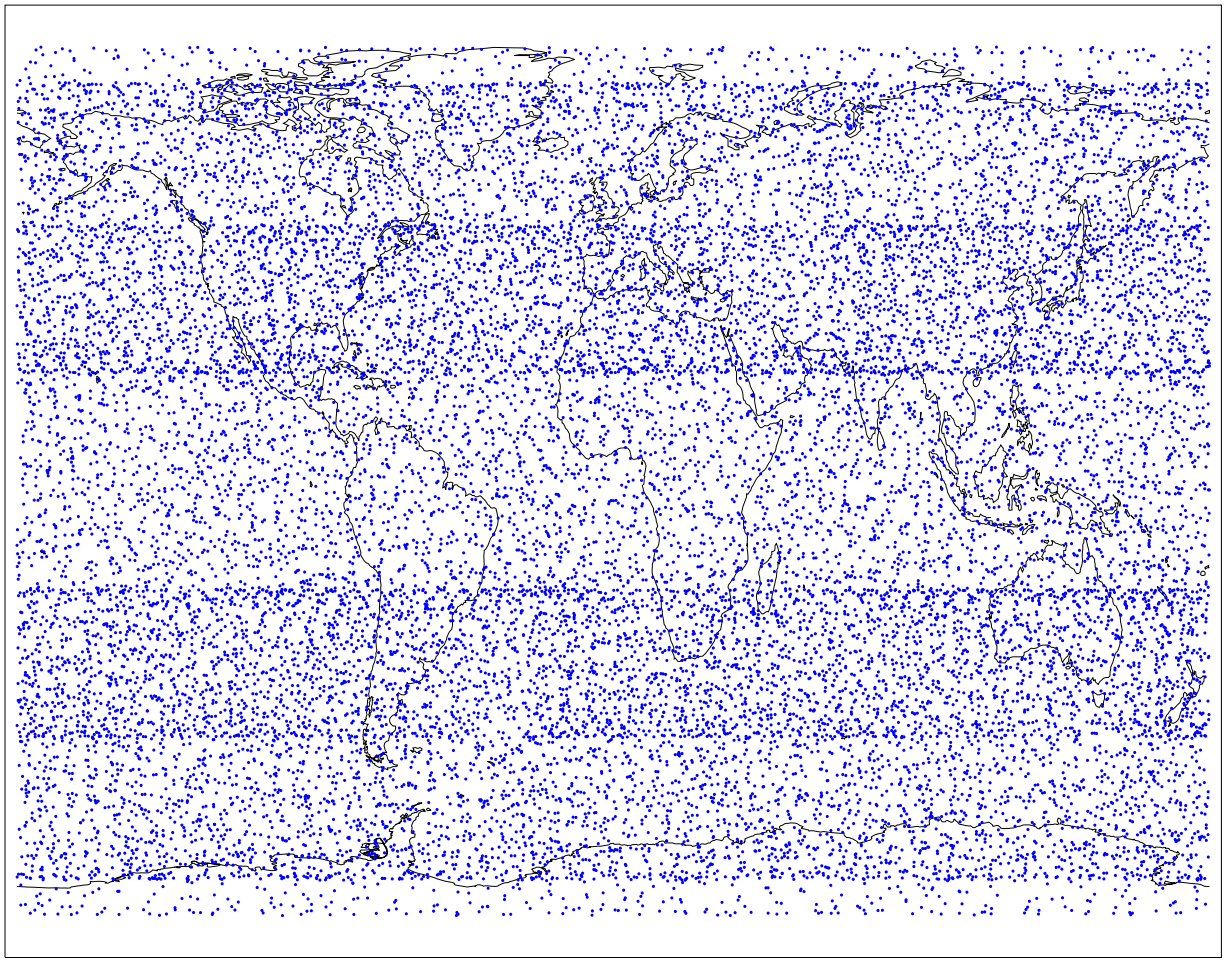
Background

- Inter-annual variability in dry pressure near tropopause is 0.1%, detection times ~10 yrs
- First indicator of climate change as seen in RO is poleward migration of mid-latitude baroclinic zones. Require ~5º meridional resolution
- ***Design:***
  - Dry pressure from NCEP reanalysis, 2000-2007
  - Compute truth from gridded NCEP reanalysis
  - Simulate occultation distribution for 8-yr period and interpolate NCEP reanalysis to locations and times
  - Generate annual averages of interpolated data by simple binning in 5º latitude bins
  - Analyze difference between NCEP reanalysis truth and binned data

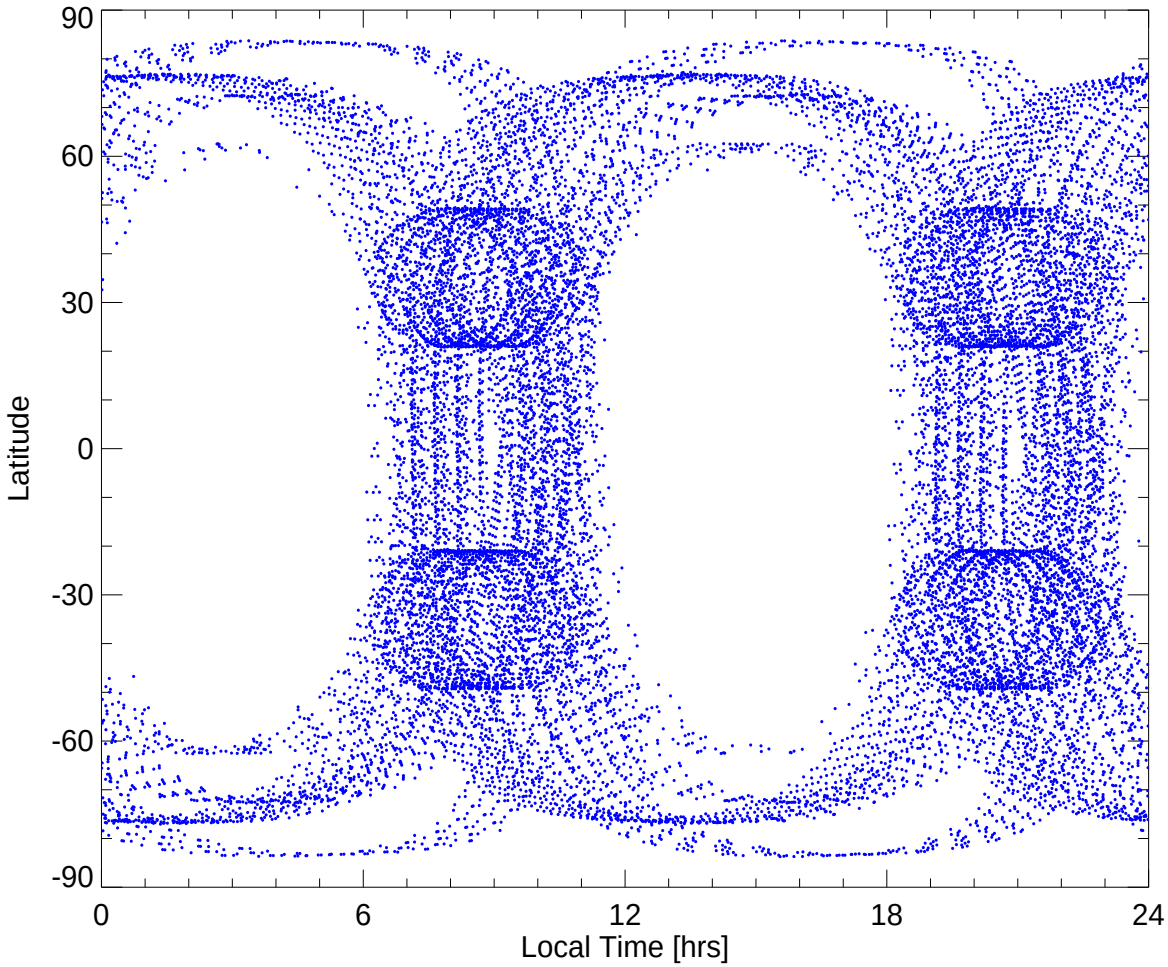
Radio Occultation Geometry

- Active microwave limb sounding with MEO transmitters and LEO receivers
- Transmitters:
  - GPS: 12-hr orbits (20,000km altitude), 55º inclination, six orbits separated 60º in ascending node, four satellites per orbit.
  - Galileo: 12-hr orbits, 56º inclination, three orbits separated 120º in ascending node, nine satellites per orbit.
- Receivers:
  - Three in 90º inclination orbits
  - One in 13:30 sun-synchronous orbit
  - One in prograde precessing orbit (81.5º inclination)
  - COSMIC (Six at 72º inclination)

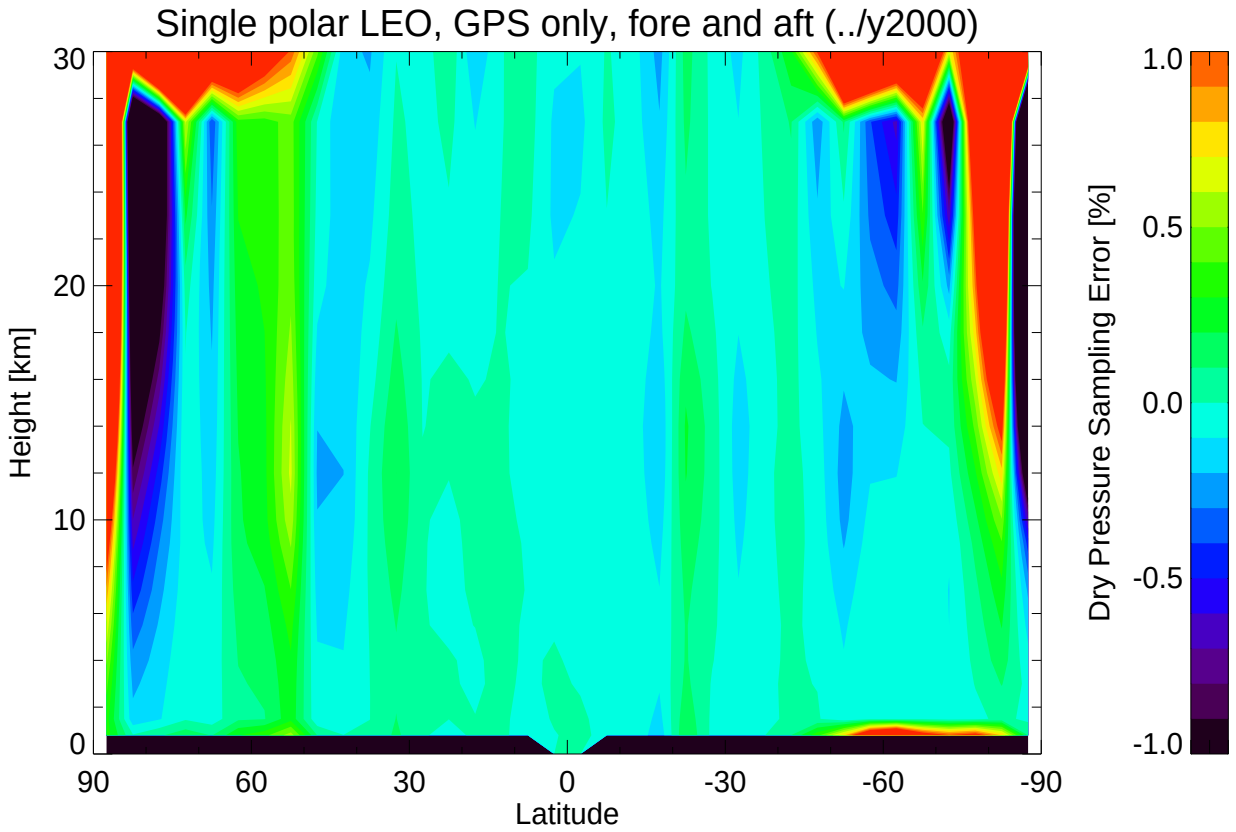
Example distribution, one month (1)



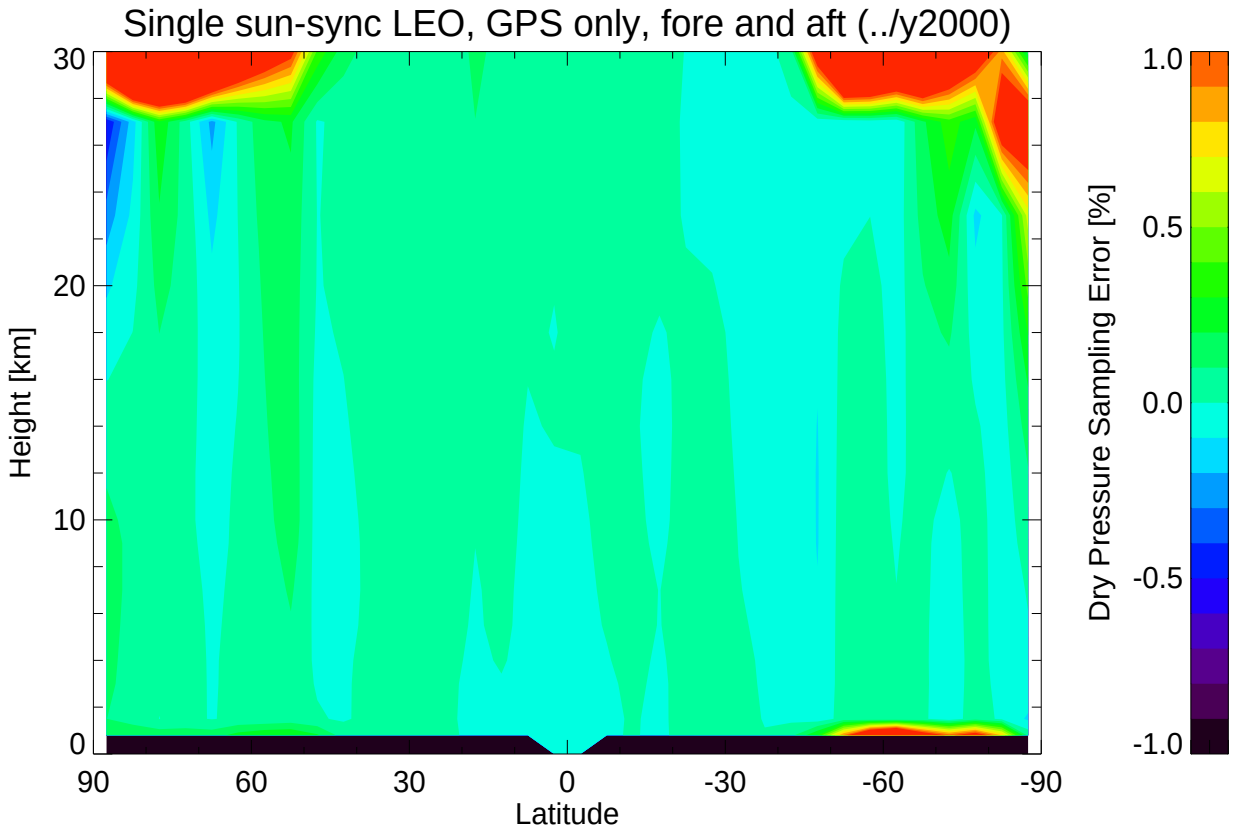
Example distribution, one month (2)



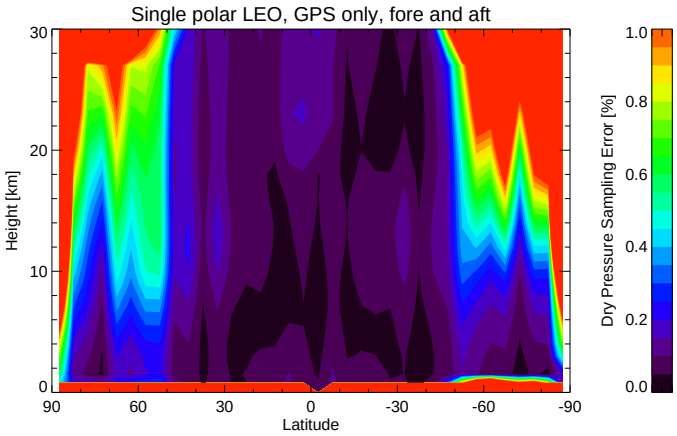
Annual binning–truth difference (1)

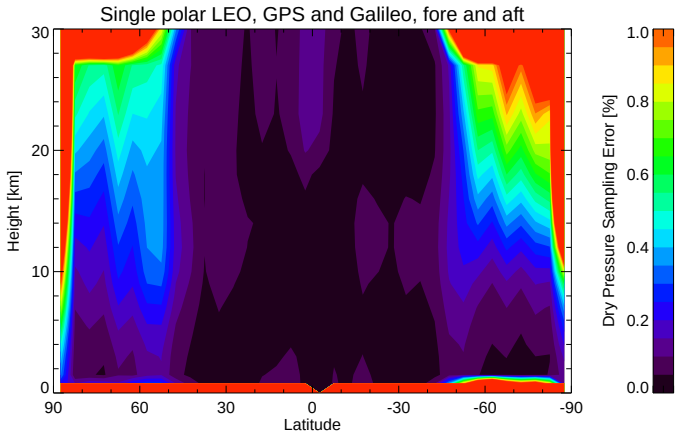


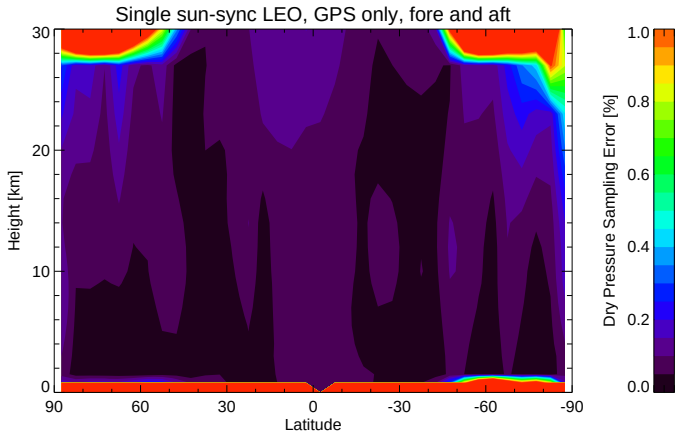
Annual binning–truth difference (2)

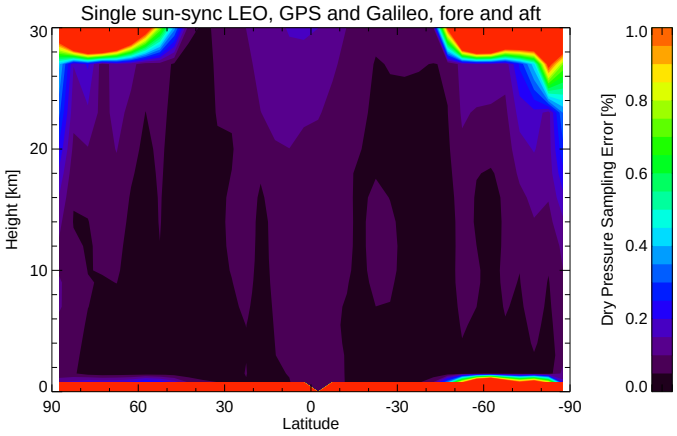


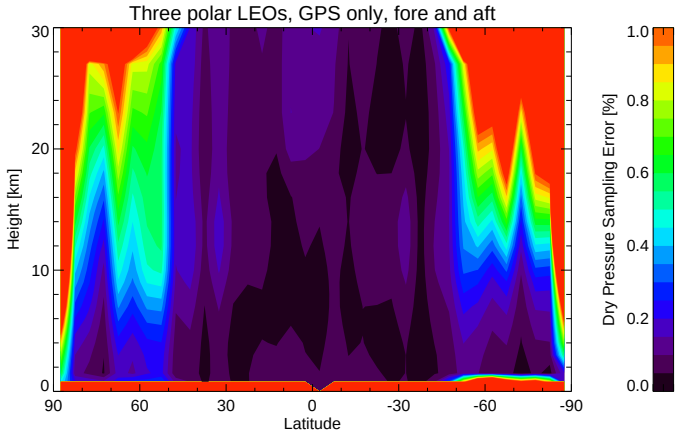
Cumulative sampling error

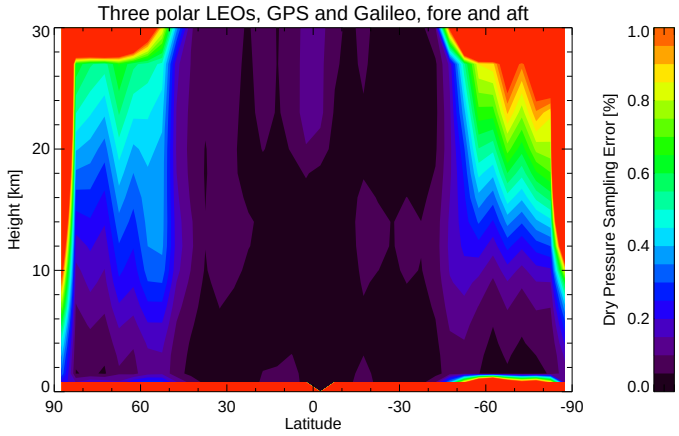




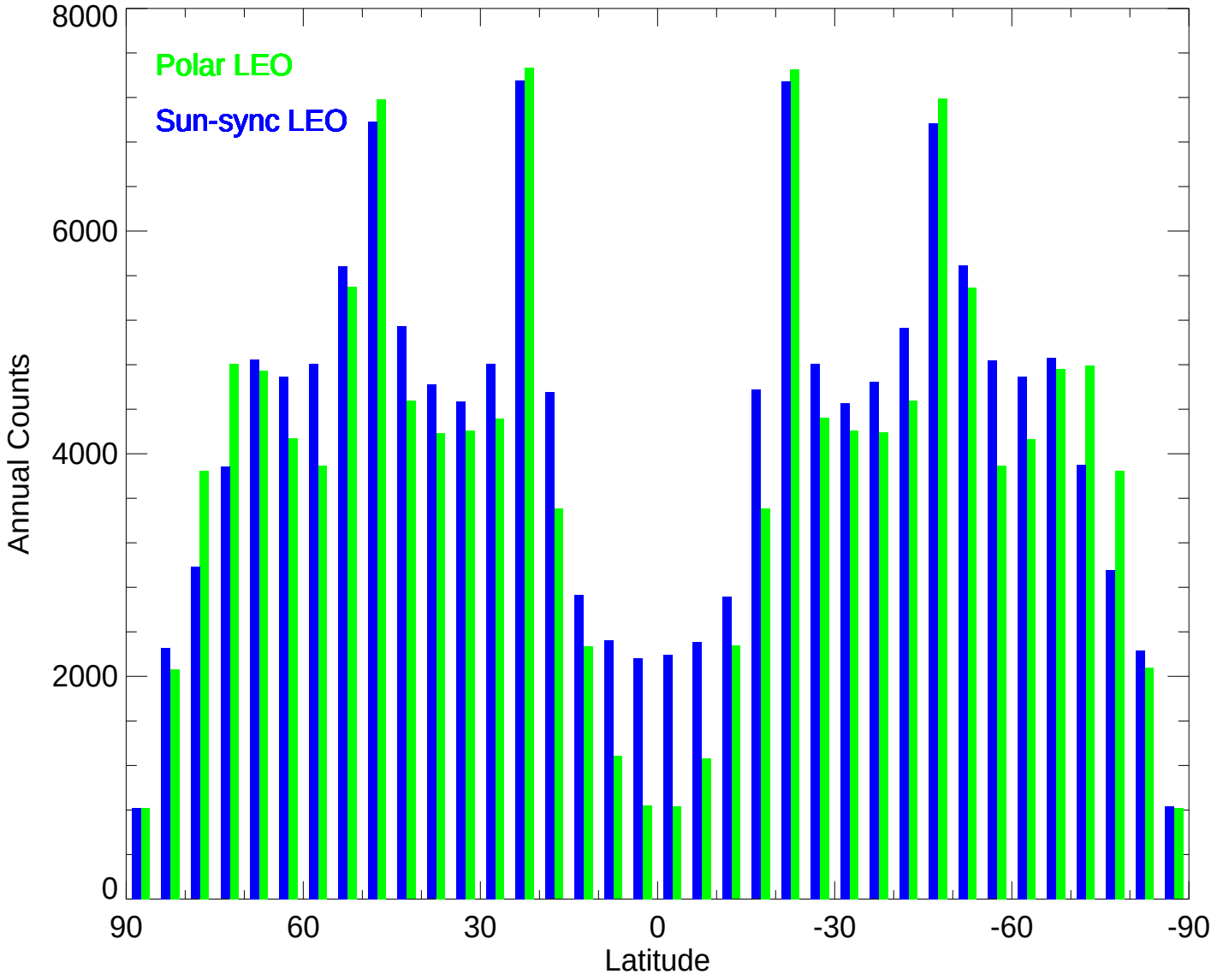




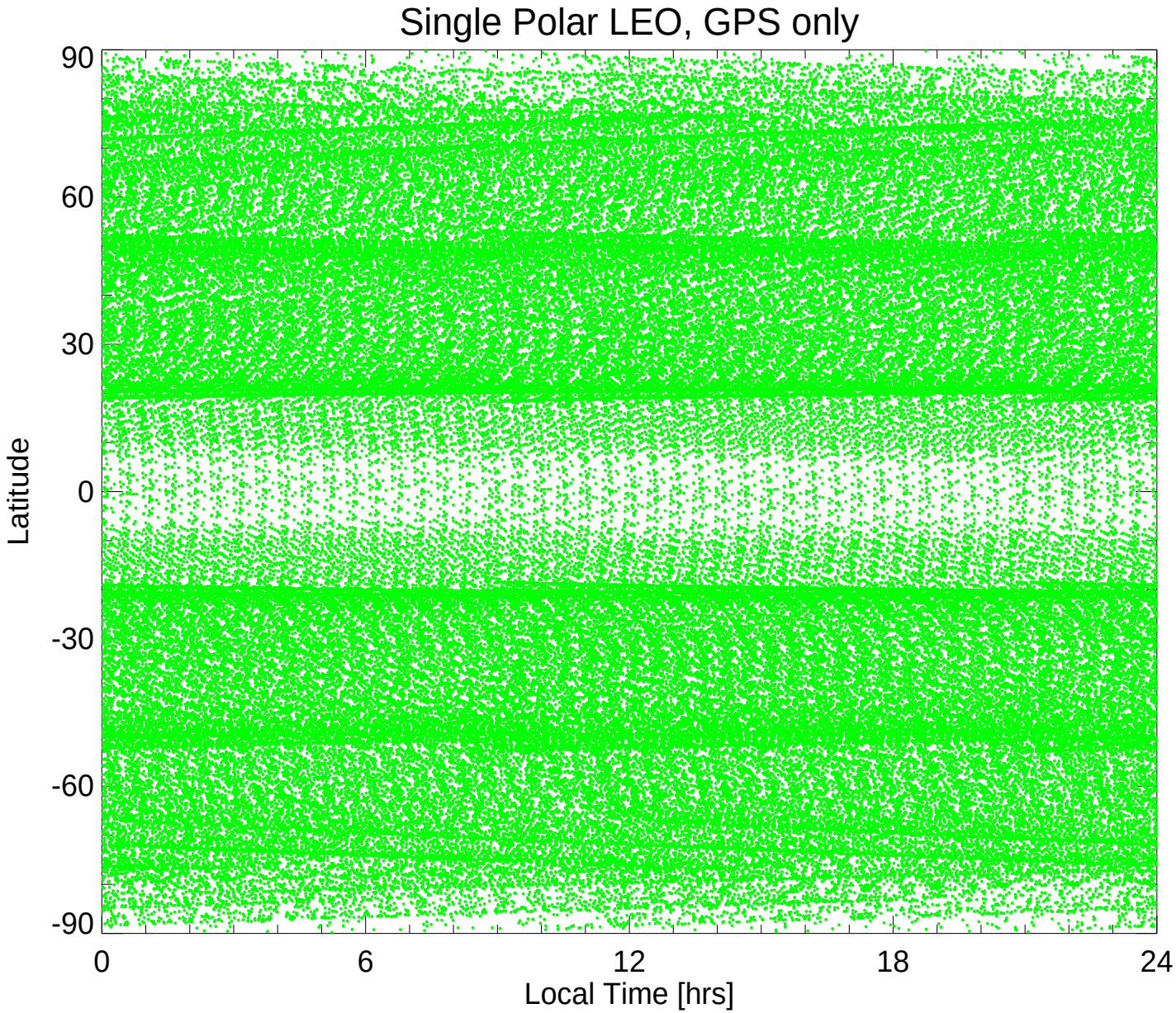




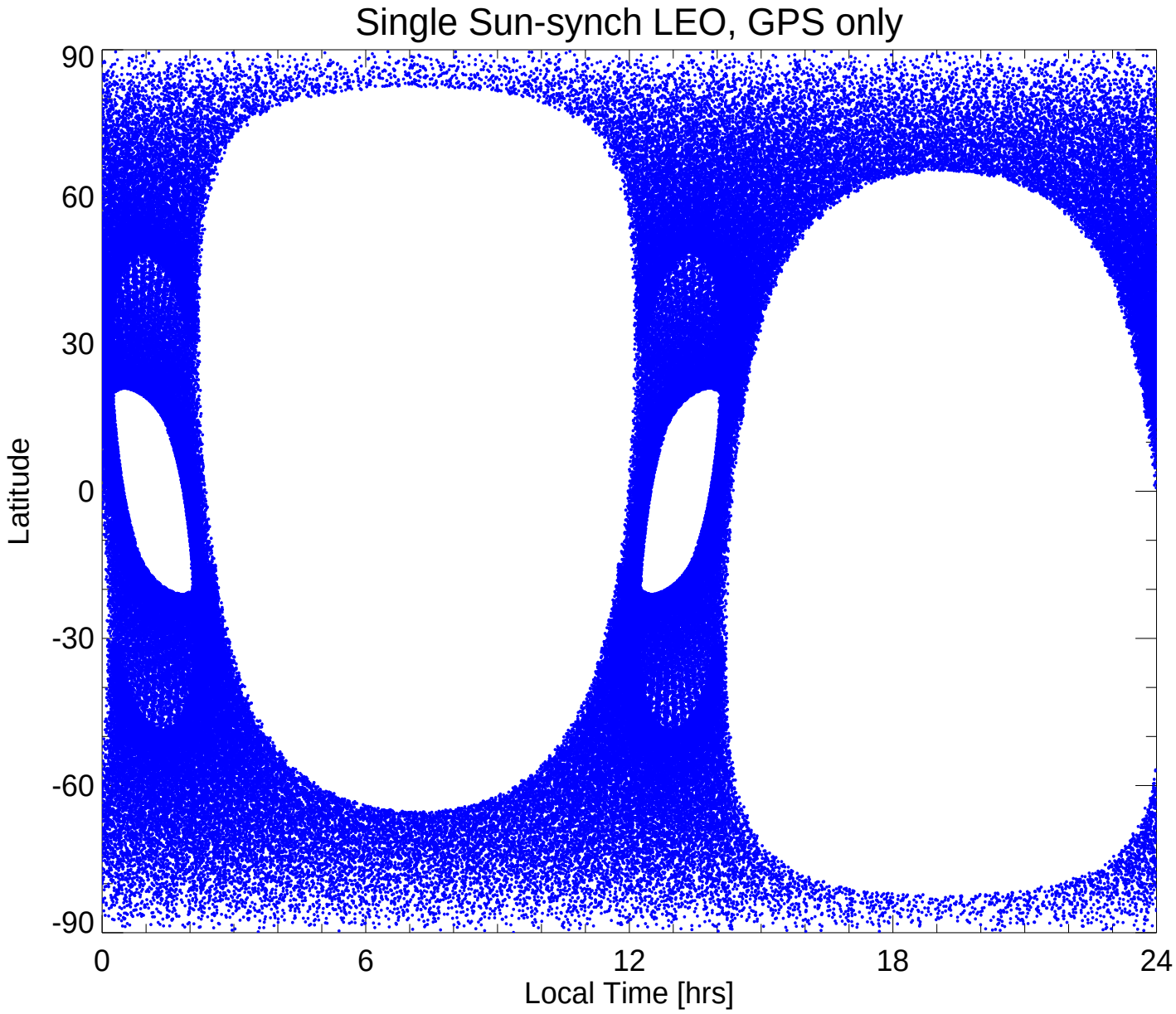
Sampling density



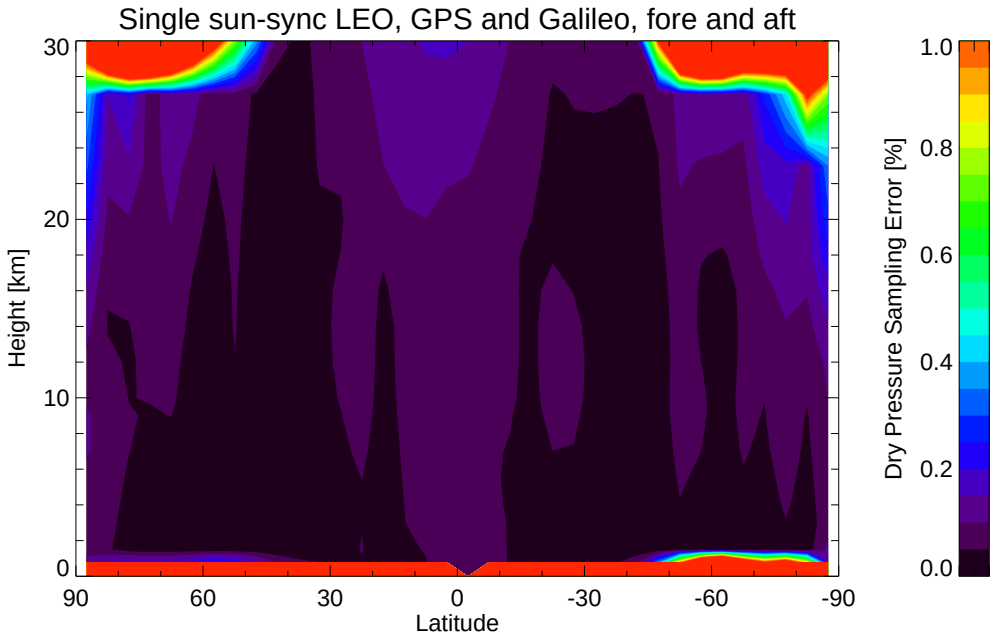
Local time sampling (1)

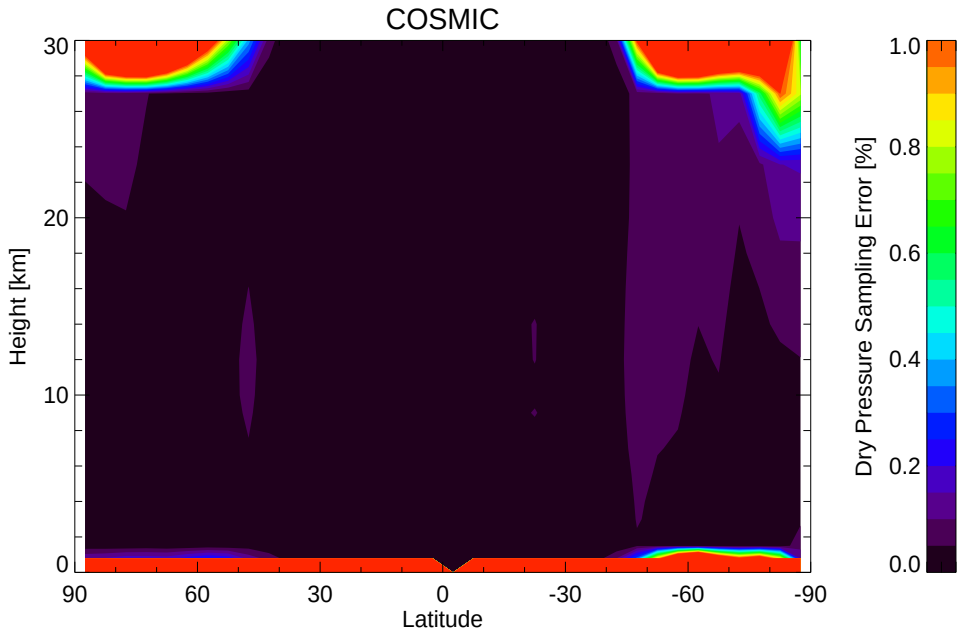


Local time sampling (2)

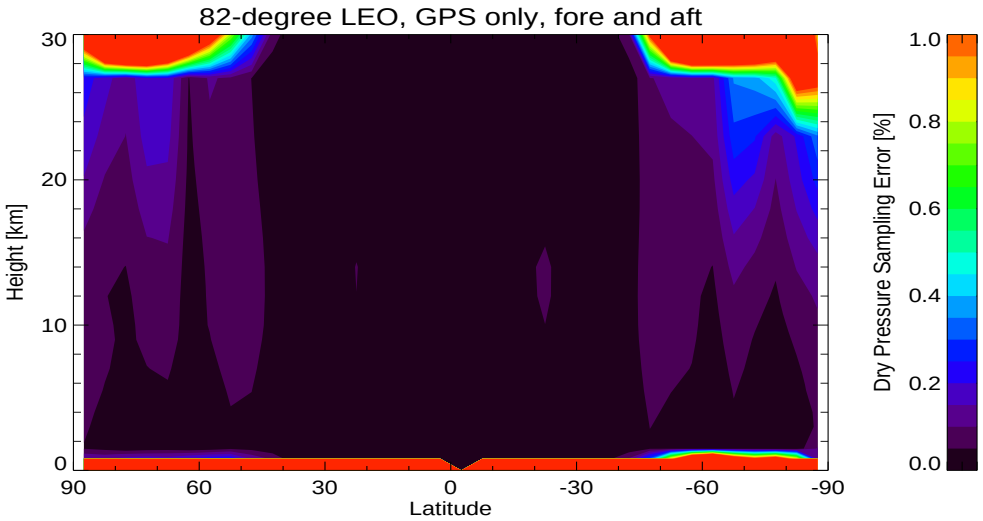


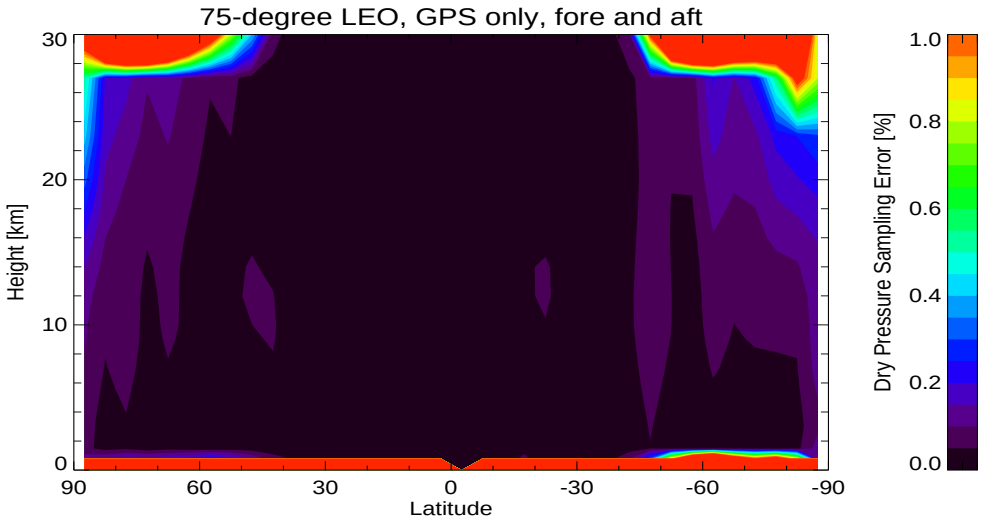
CLARREO & COSMIC

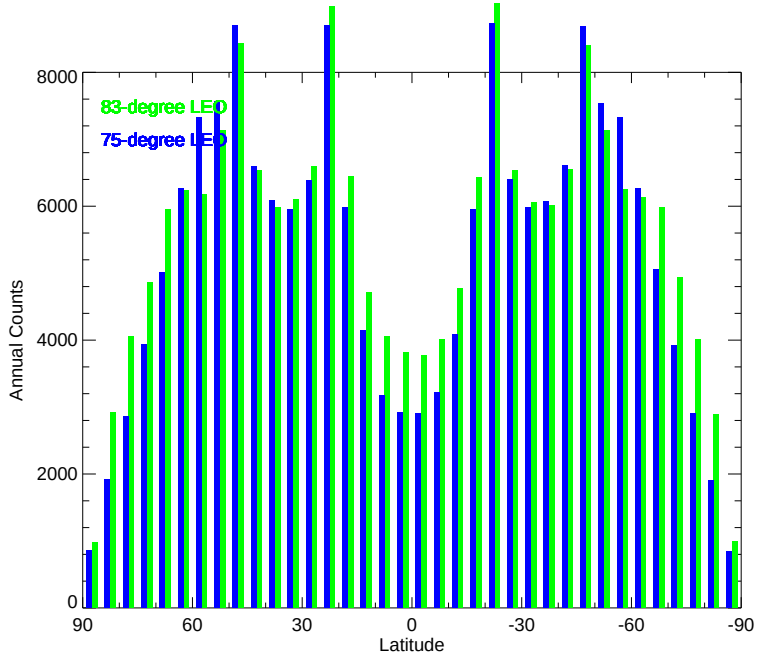




Rapidly precessing orbits







Preliminary conclusions

- Polar orbit yields large sampling error at high latitudes. Substantial improvement when Galileo tracking is added. Tripling the number of polar orbiters improves little (?).
- Sun-synchronous orbit yields much smaller sampling error at high latitudes but degraded performance in tropics.
- Sun-synchronous LEO orbits are preferred. Yet to determine how well rapidly precessing orbits perform.

Near future work…

- Find the cause of the polar *vs.* sun-synchronous performance difference.
- Investigate the sensitivity to orbit deviations.
- Test the simulator against actual COSMIC and CHAMP distributions.
- Hope to recruit Tony to verify findings.