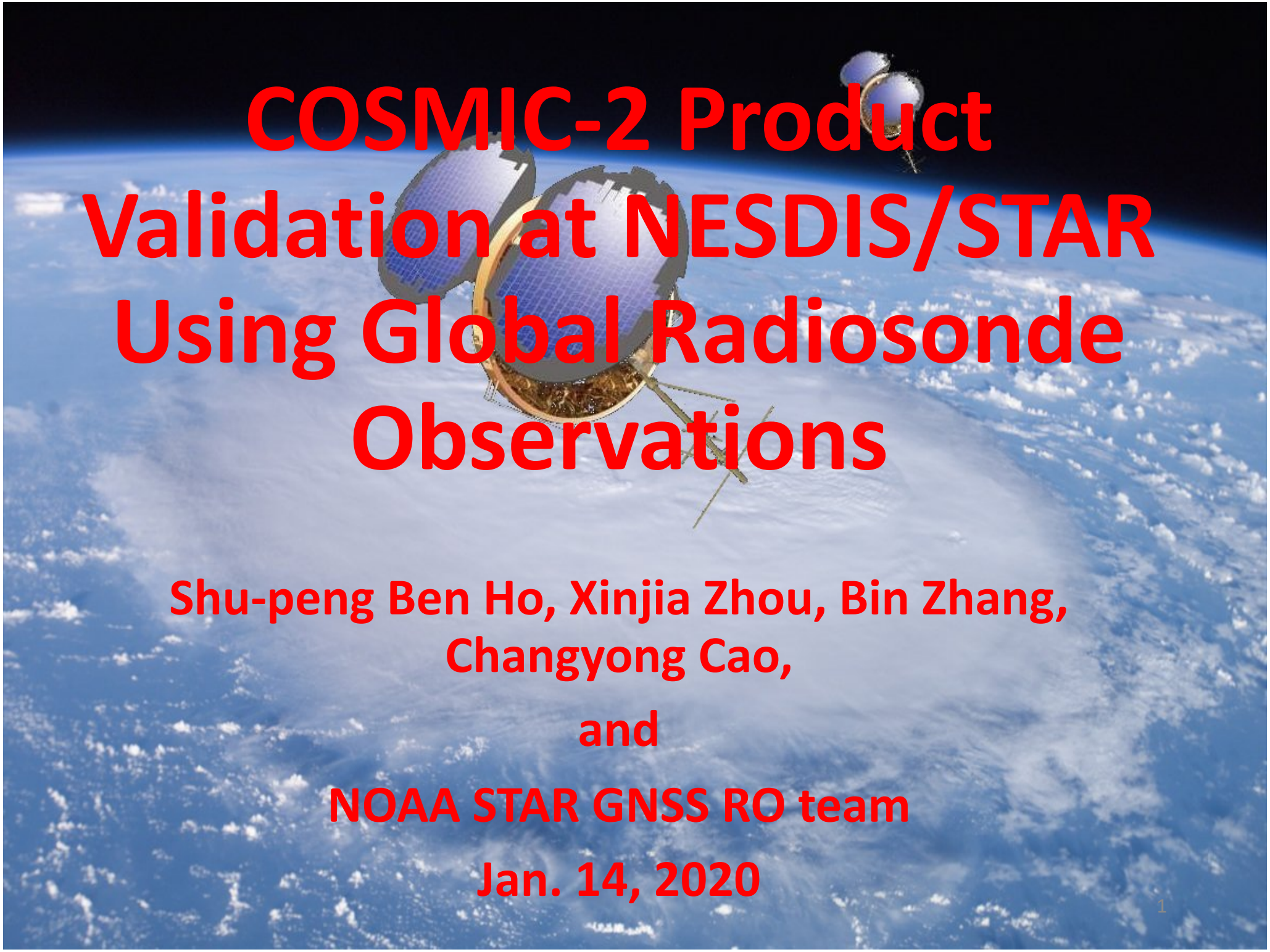

COSMIC-2 Product Validation at NESDIS/STAR Using Global Radiosonde Observations

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and

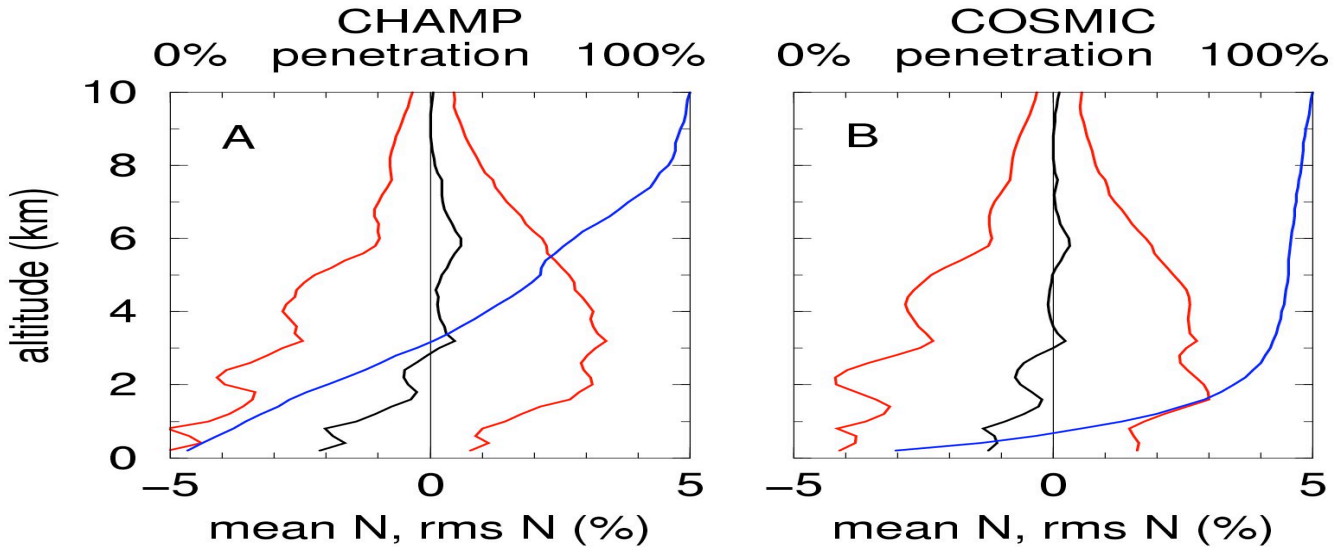
NOAA STAR GNSS RO team

Jan. 14, 2020

Motivation

Is the quality of COSMIC-2 data consistent or better than those of COSMIC-1 in terms of precision, long term stability, accuracy in the lower stratosphere, troposphere, particularly in the lower troposphere ?

High precision (<0.05K), No mission dependent bias (Ho et al., TAO, 2009; Ho et al., JGR, 2009; Anthes, 2007; **Ho et al., 2019, BAMS)**



Anthes et al., 2007 (BAMS)

Fig. 5. Statistical comparison of CHAMP and COSMIC RO-retrieved refractivities between 30S and 30N to ECMWF global analysis for 28 August-22 September 2006. Black and red lines show mean deviation and +/- standard deviation around the mean. Blue lines show the percentage of retrieved profiles that penetrated to a given altitude.

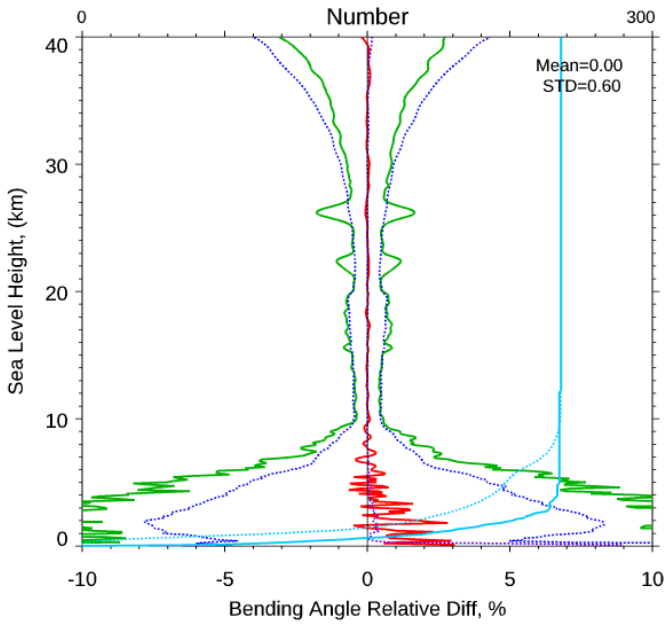
Outlines

Data: **UCAR COSMIC-2 from 6 LEO satellites from 07/16/2019 - 08/15/2019, in situ RS41 and RS92 radiosonde data, and STAR processed C2 bending angle, temperature, and water vapor profiles.**

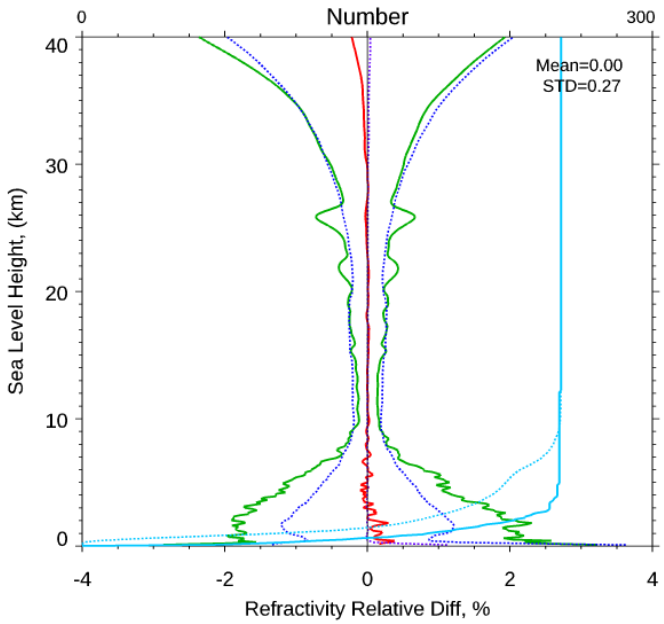
1. Precision : Inter-comparison of C2 early orbit data
2. COSMIC-2/COSMIC vs. GFS-6 hour forecast
3. COSMIC-2/COSMIC vs. RAOB
4. Fractional dynamic bending angle observation error comparisons
5. Conclusions

1. Precision : COSMIC-1 and COSMIC-2

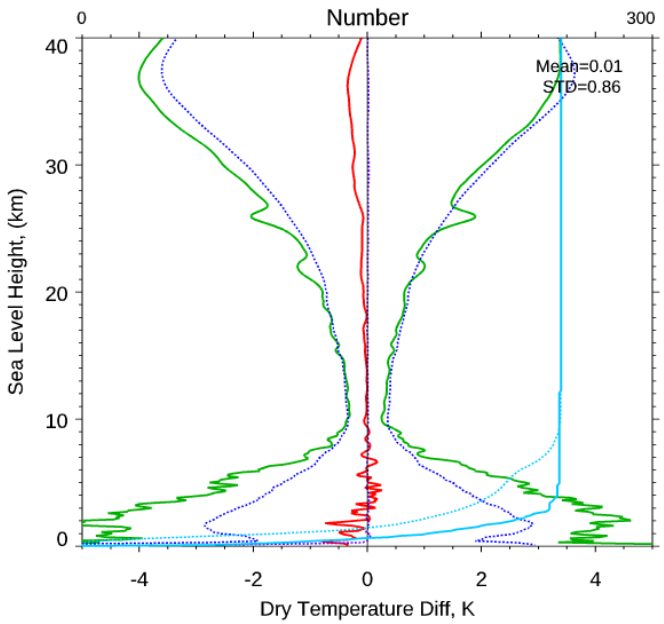
COSMIC2: 2019-07-16 to 2019-07-20, C2E1 and C2E4, in solid line
COSMIC: 2006-04-22 to 2006-10-20, FM3 and FM4, in dashed line, number is normalized to COSMIC2



Bending angle
fractional difference (%)



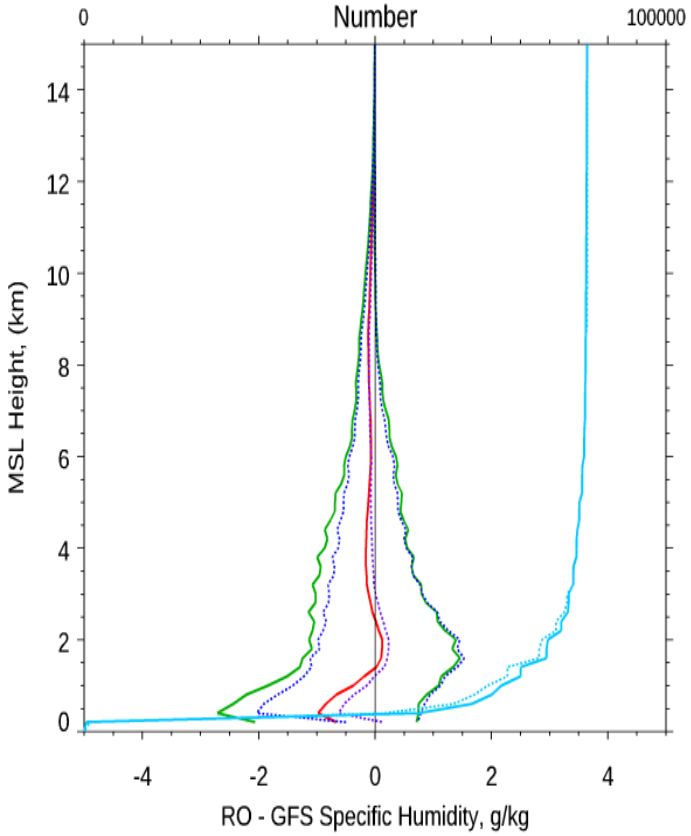
Refractivity
fractional difference (%)



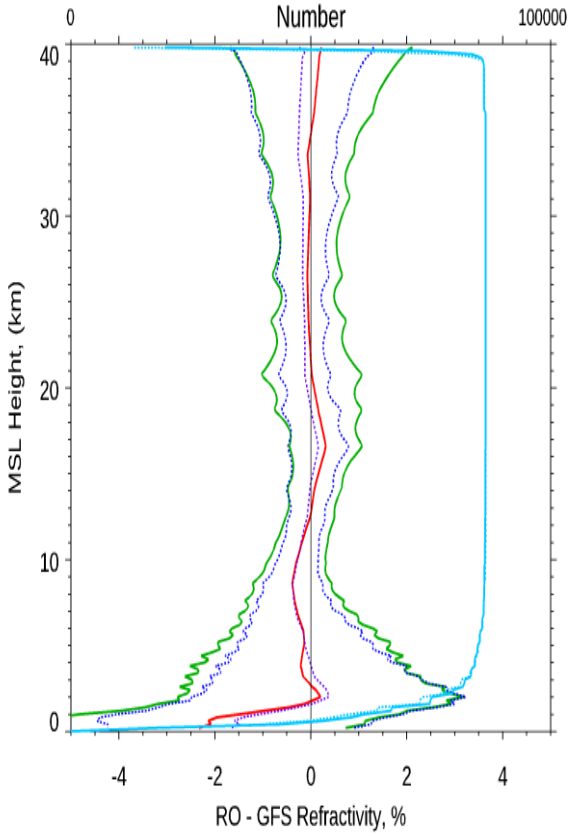
Temperature
Difference (K)

2. COSMIC-2/COSMIC vs. GFS-6 hour forecast

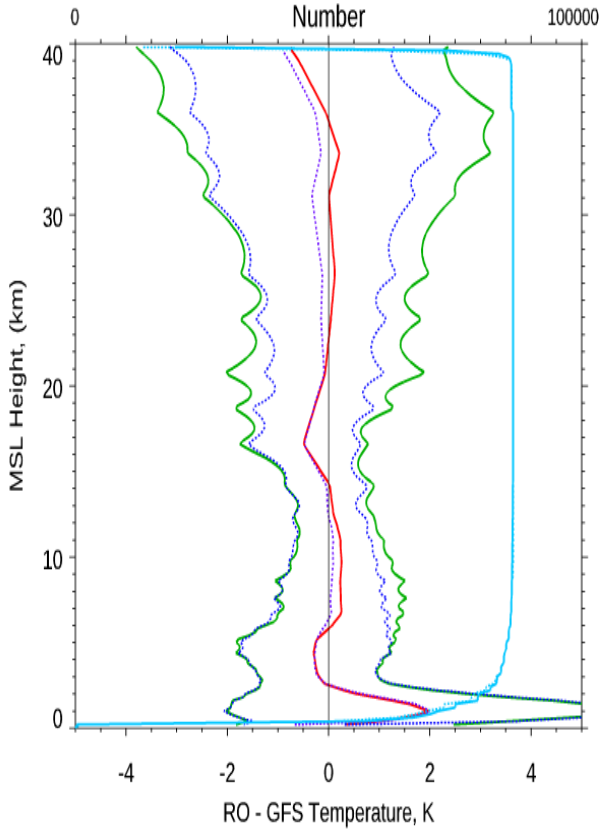
COSMIC2: Oct 2019, in solid line
COSMIC: Oct 2019, in dashed line, number is normalized to COSMIC2



RO – GFS Specific Humidity Difference (%)



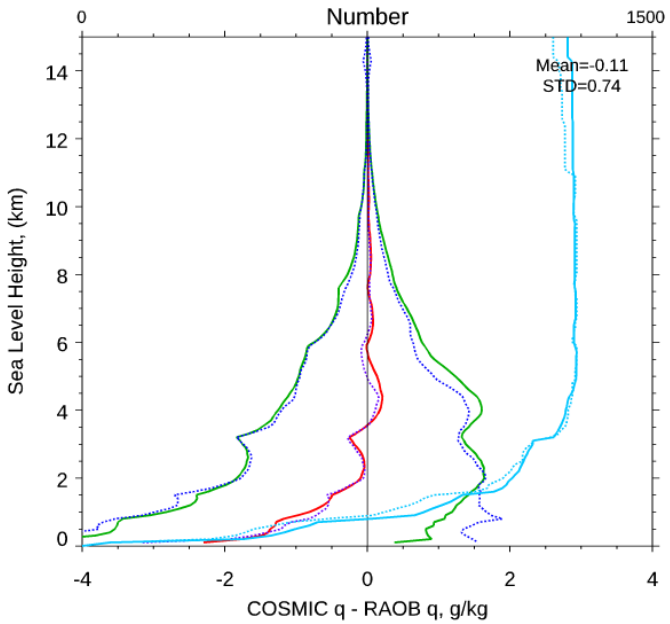
RO – GFS Refractivity Fractional Difference (%)

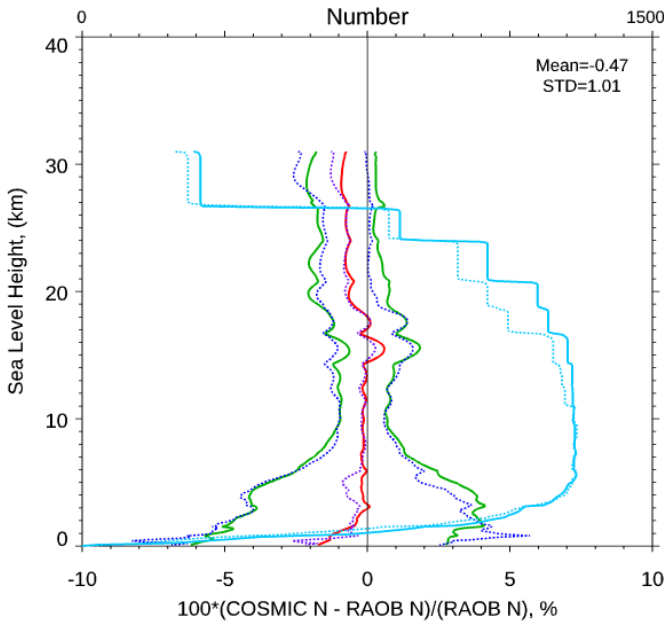


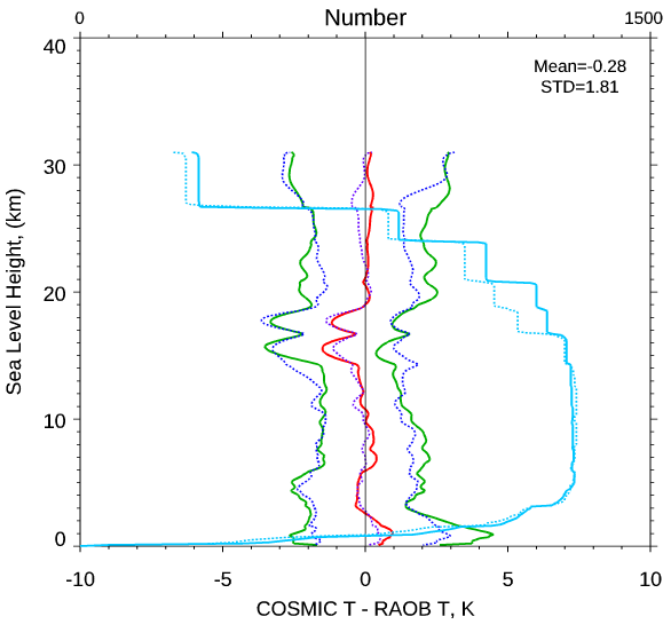
RO – GFS Temperature Difference (K)

3. COSMIC-2/COSMIC vs. RAOB

COSMIC2: Oct 2019, in solid line
COSMIC: Oct 2010-2019, in dashed line, number is normalized to COSMIC2

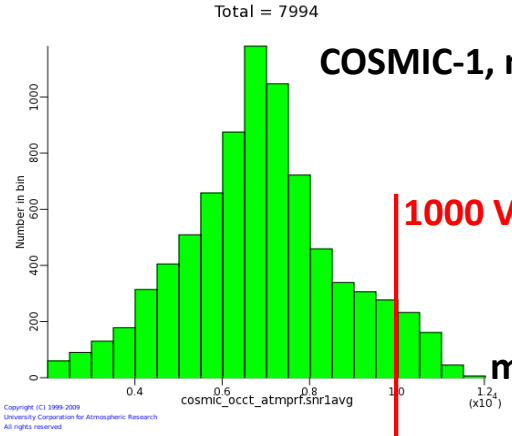






COSMIC-2 vs. RAOB
Within 300 km and 2 hours
Within 45 N and 45 S

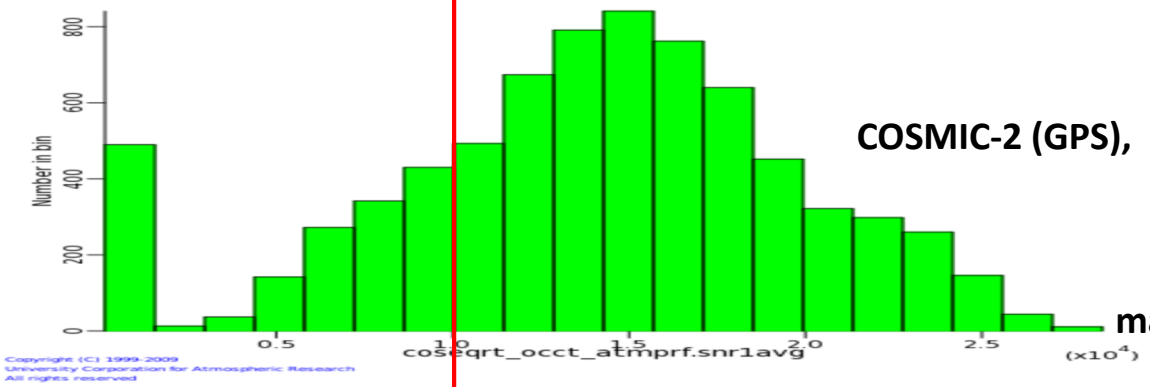
COSMIC-1 vs COSMIC-2 SNRs



COSMIC-1, mean ~700 V/V

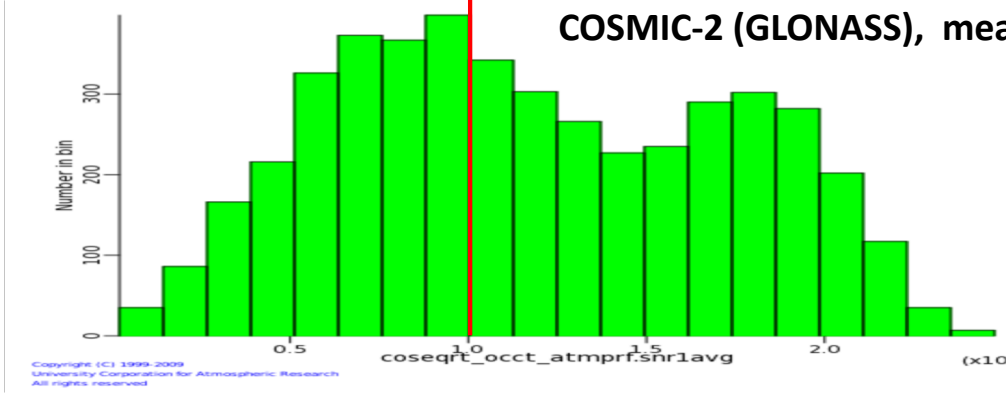
1000 V/V

max. ~1200 V/V (mid. 2017)



COSMIC-2 (GPS), mean ~1500 V/V (BF)

max. ~2800 V/V (BF)

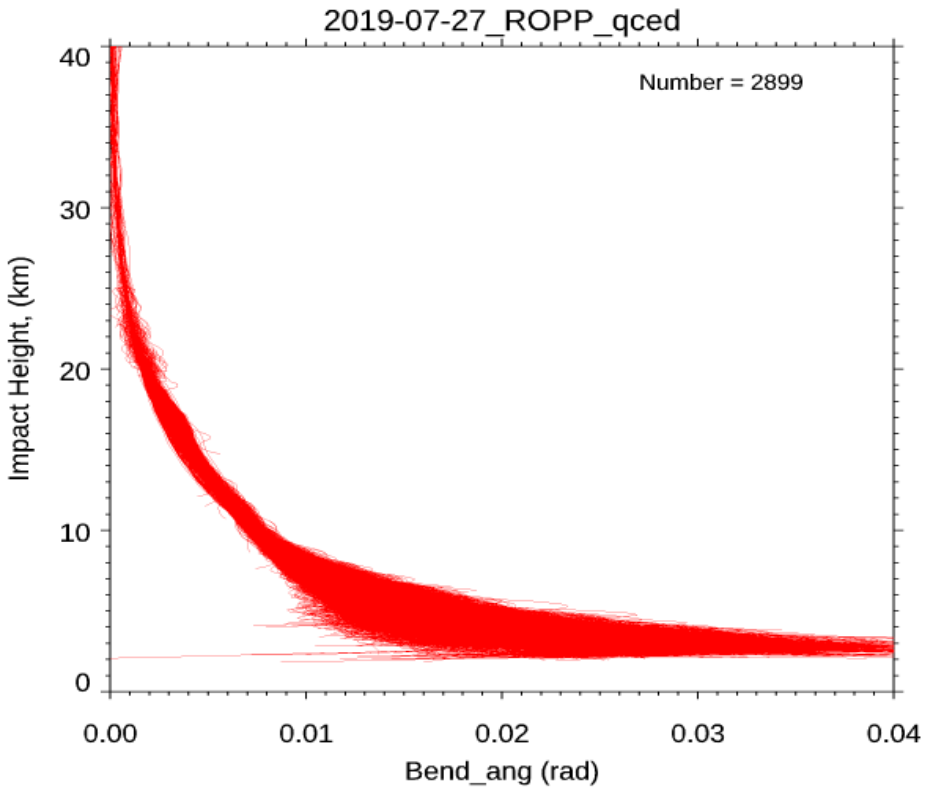


COSMIC-2 (GLONASS), mean ~1200 V/V (BF)

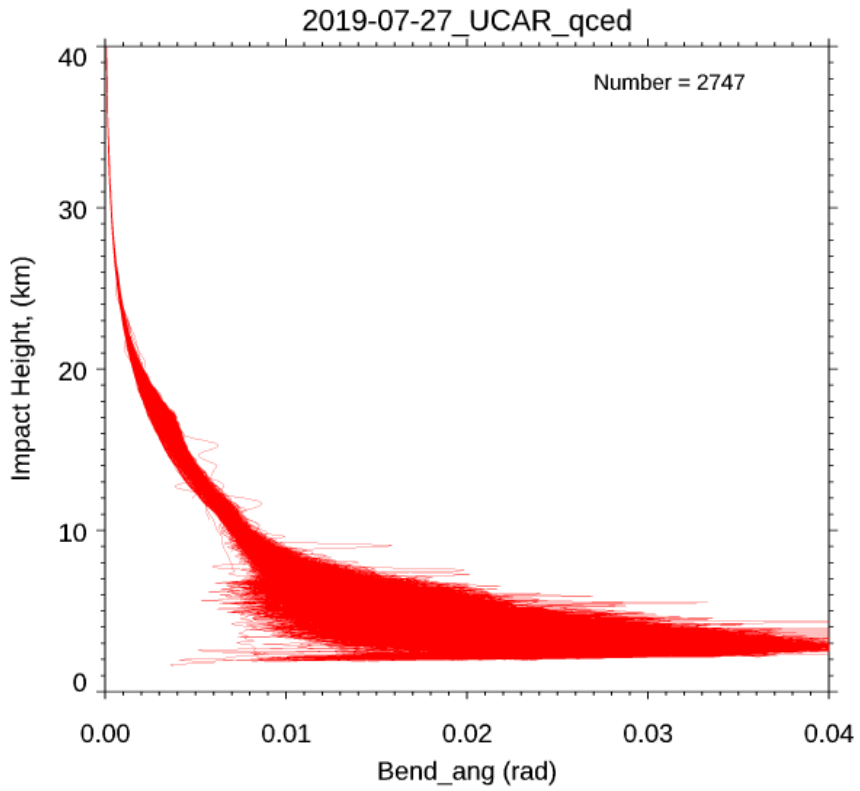
max. ~2500 V/V (BF)

Comparison with STAR Retrievals

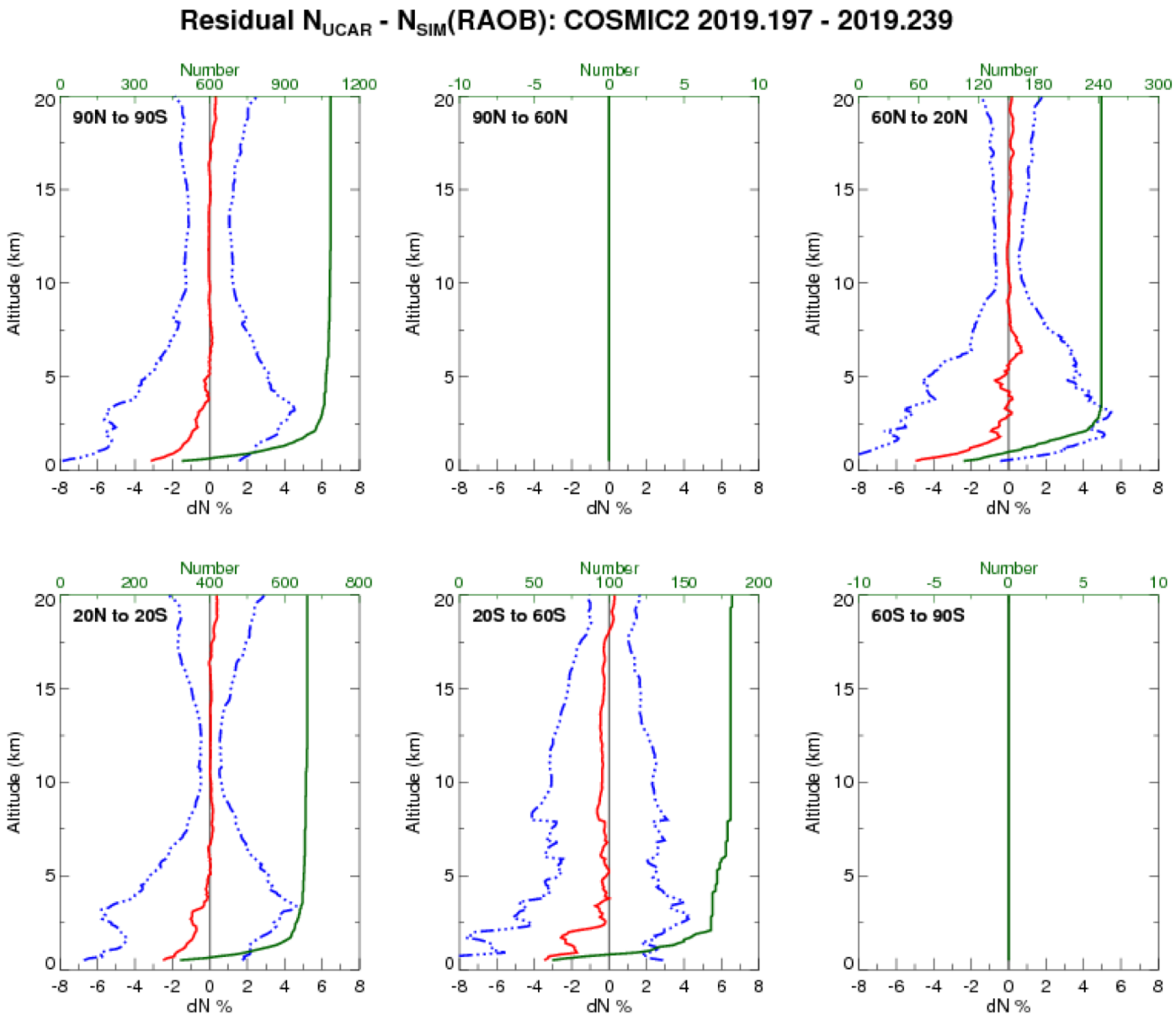
STAR ROPP profiles after QC (removing ~ 20% of data)



UCAR profiles after QC (removing ~ 20% of data)

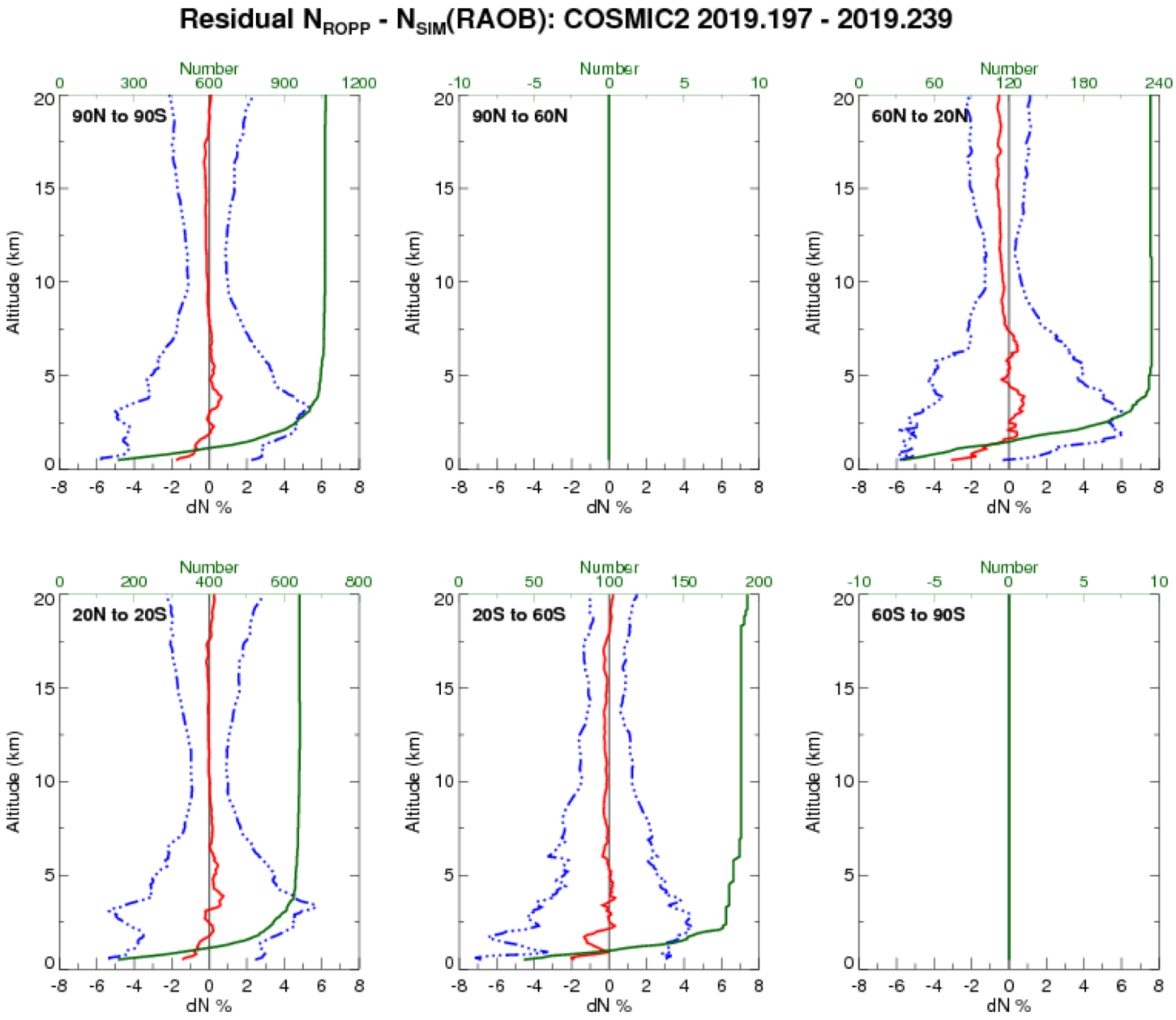


UCAR COSMIC2 N – RAOB N



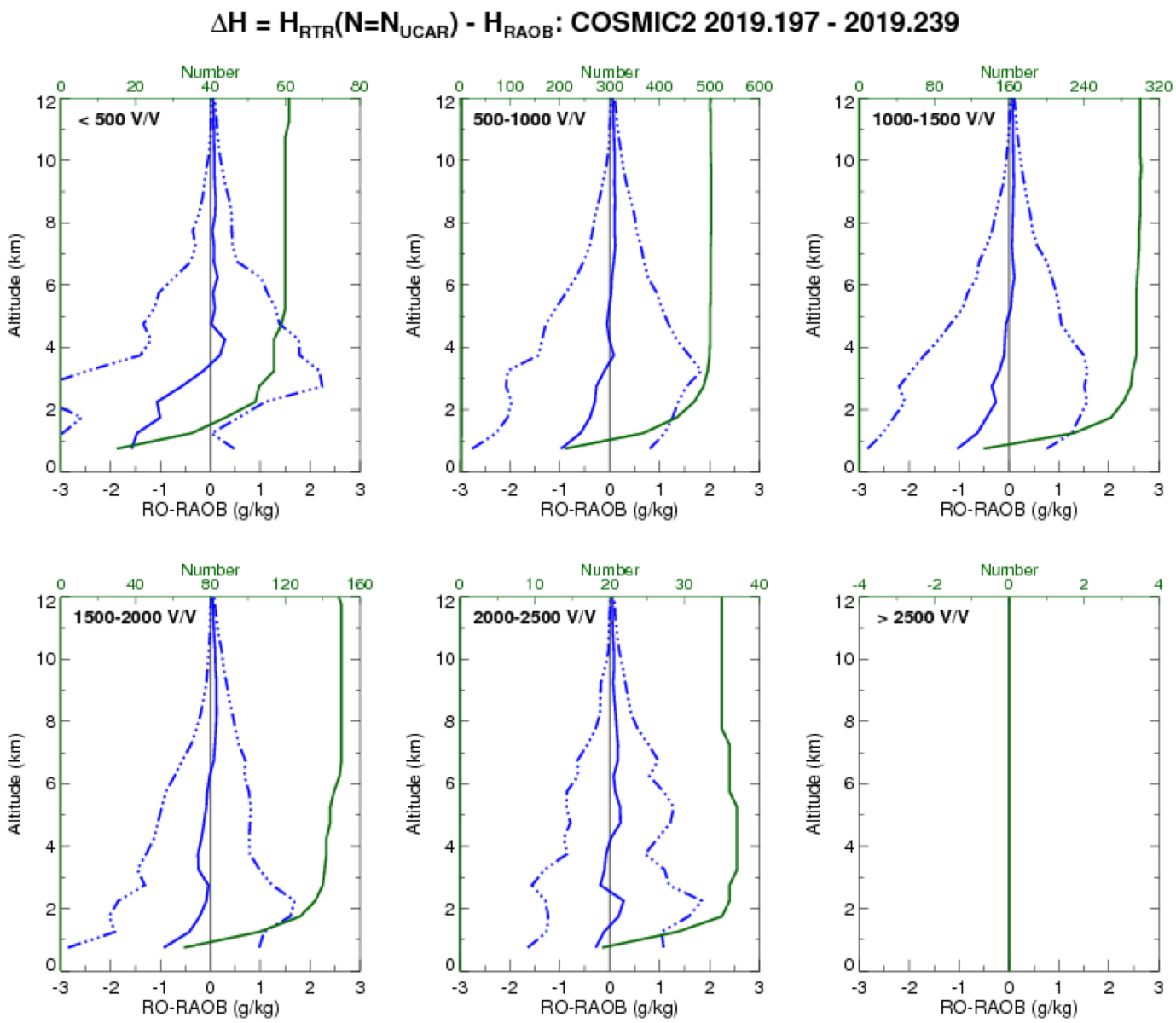
N_{UCAR}

STAR COSMIC2 N – ROAB N

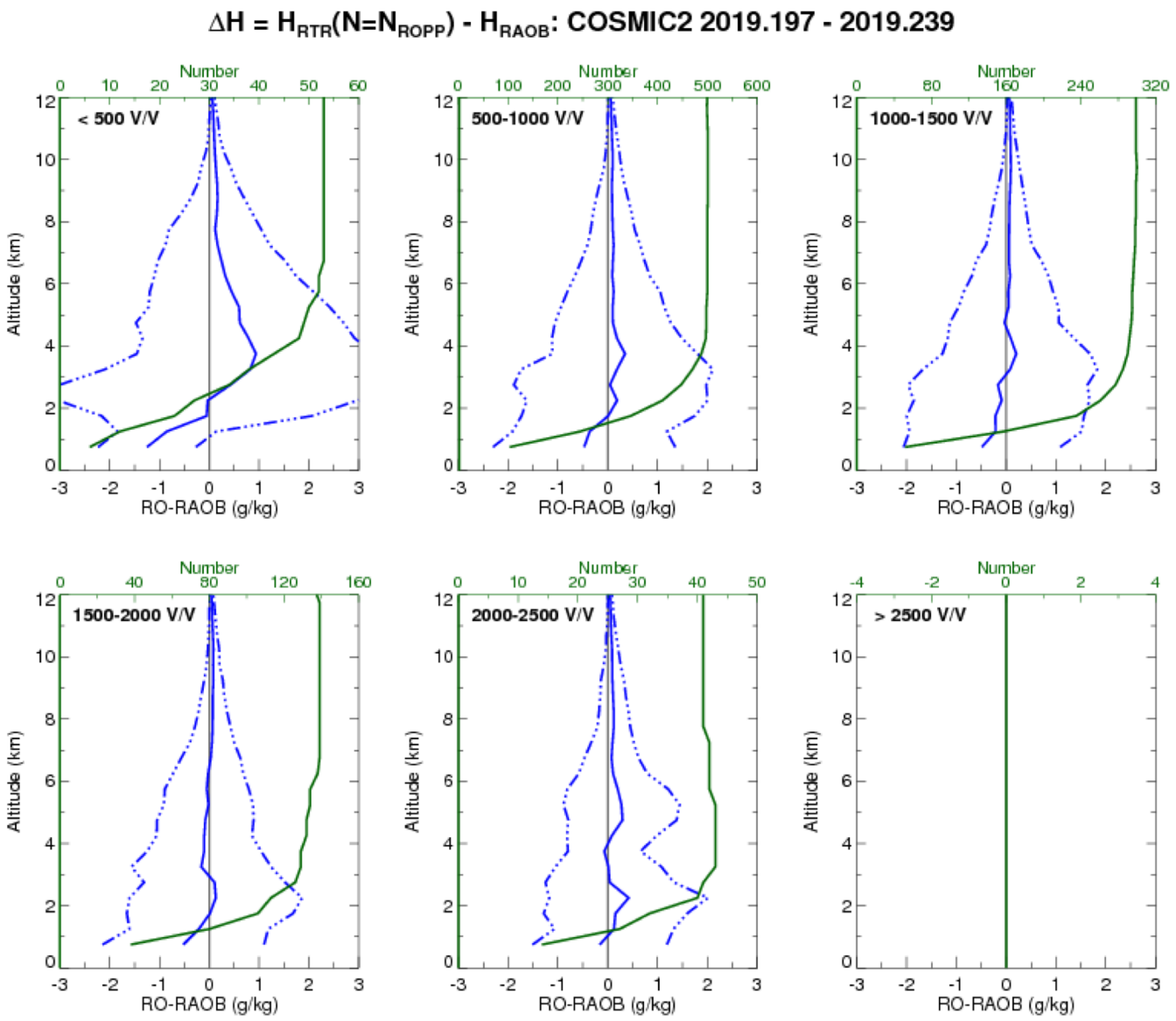


N STAR

UCAR COSMIC 2 W – RAOB W



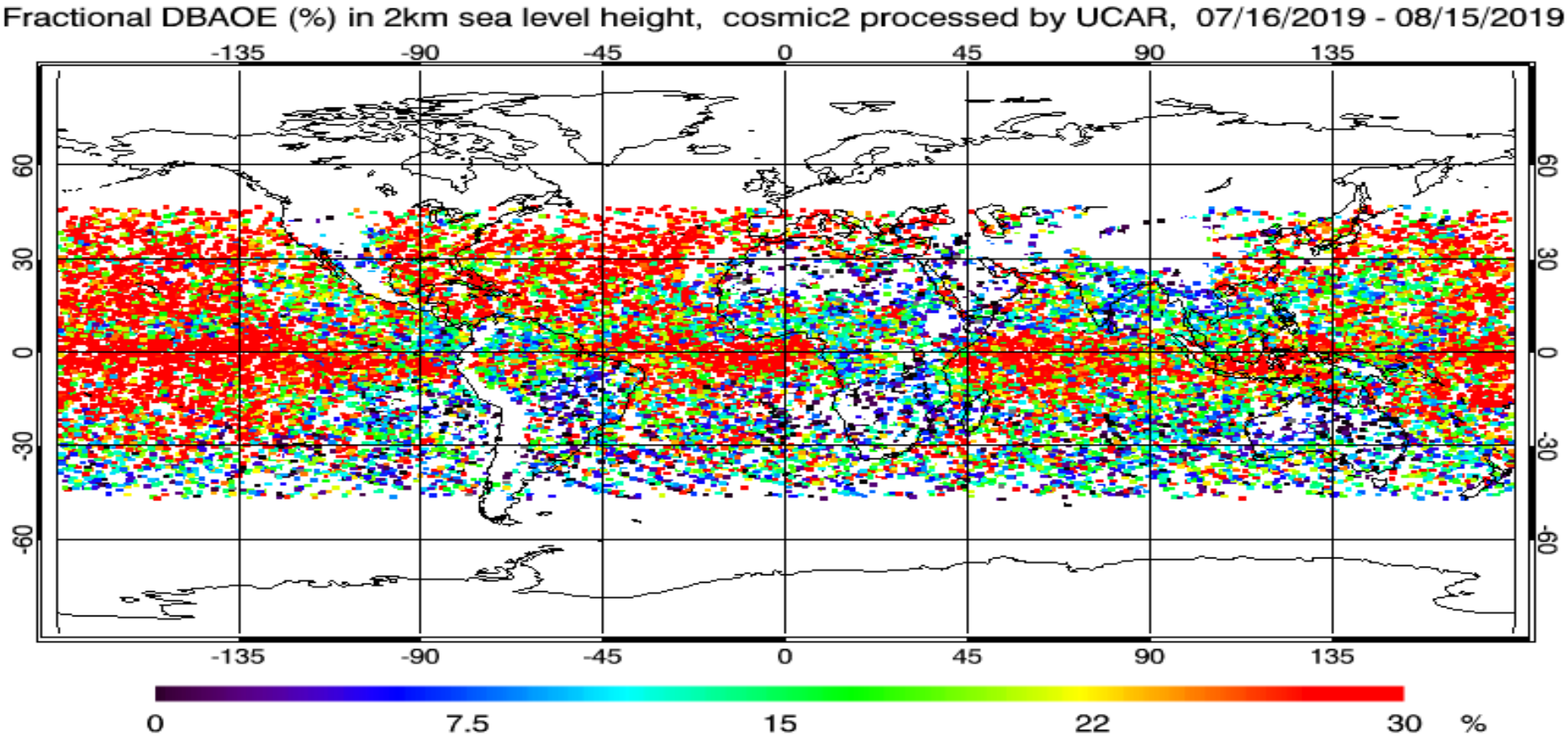
STAR COSMIC2 W – RAOB W



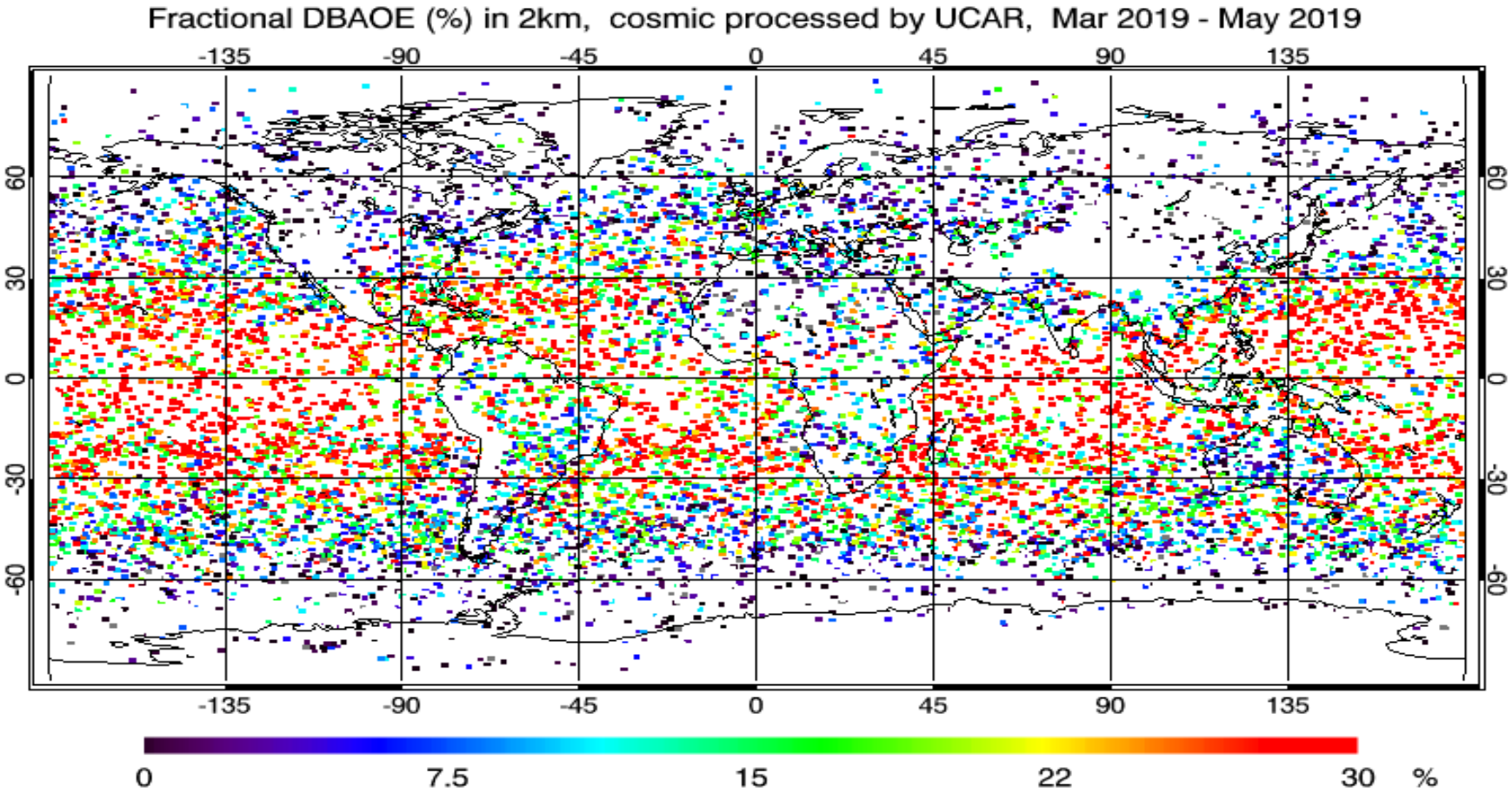
4. Fractional DBAOE comparisons

Fractional DBAOE is defined as 100% x LSW/2 / bending angle

COSMIC2



cosmic, 2019 spring

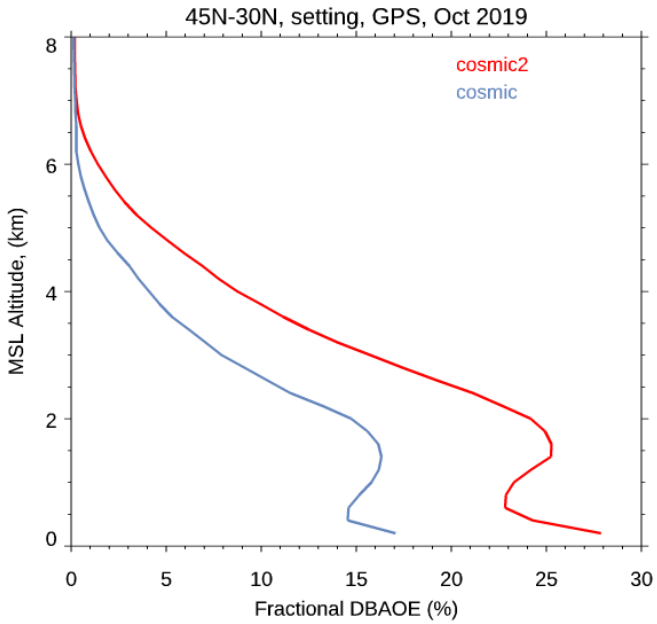


Fractional DBAOE comparisons

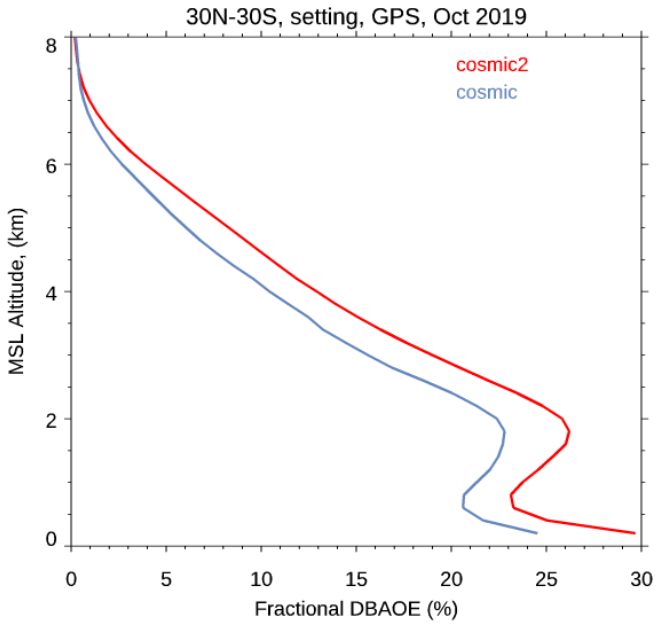
Fractional DBAOE is defined as 100% x LSW/2 / bending angle

Mean Fractional DBAOE, Oct 2019

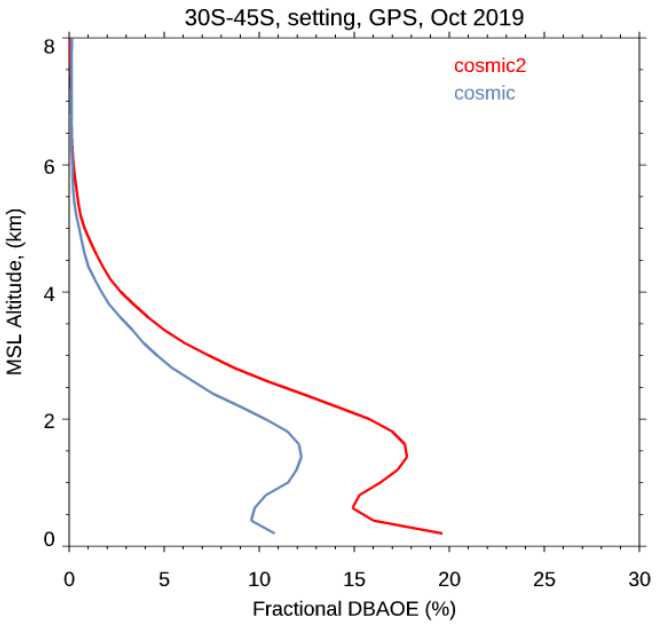
45N-30N



30N-30S

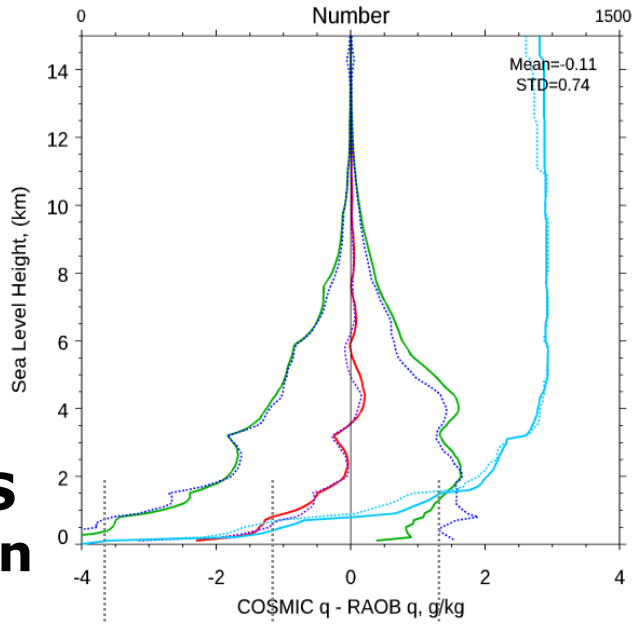


30S-45S

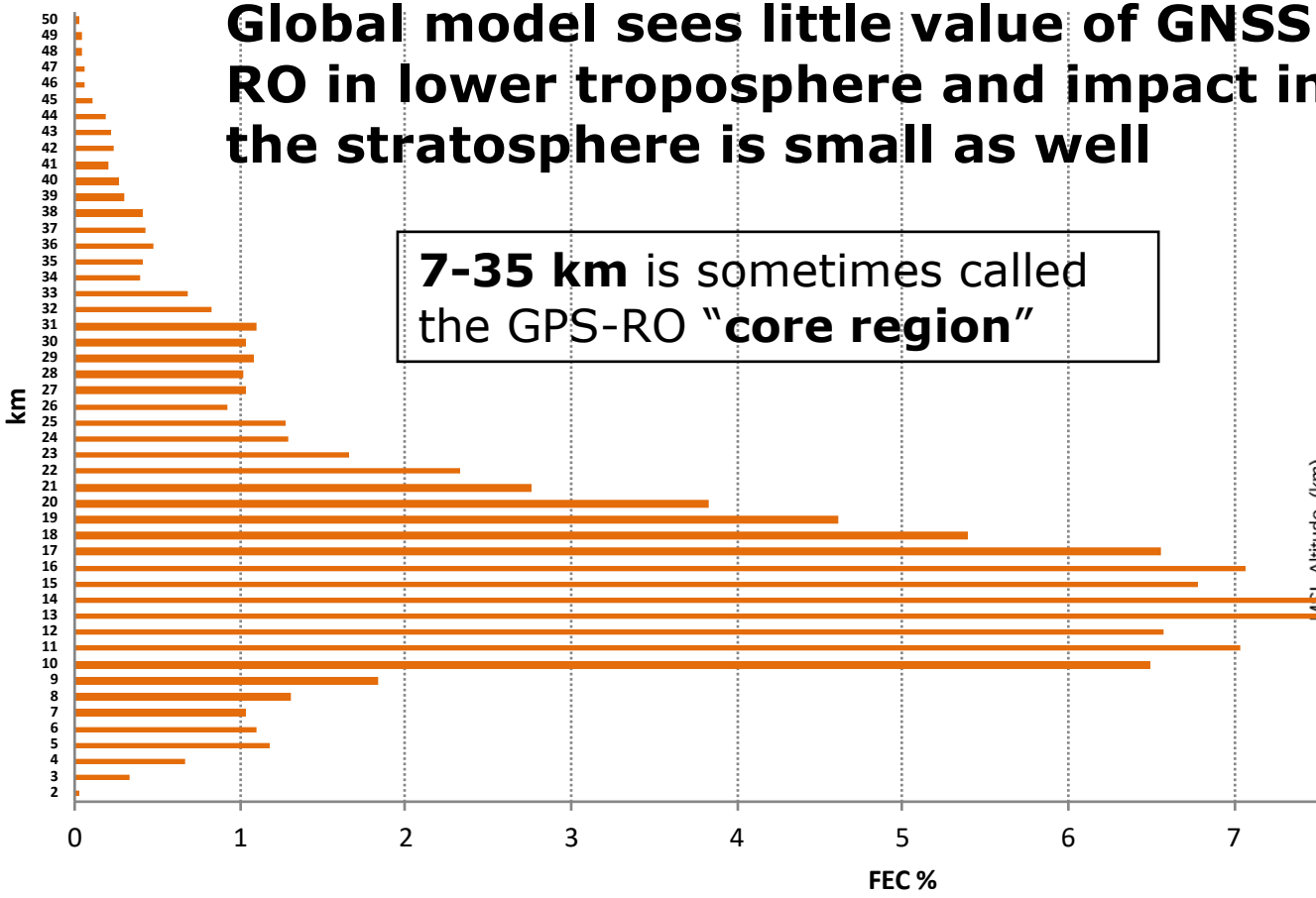


5. Conclusions

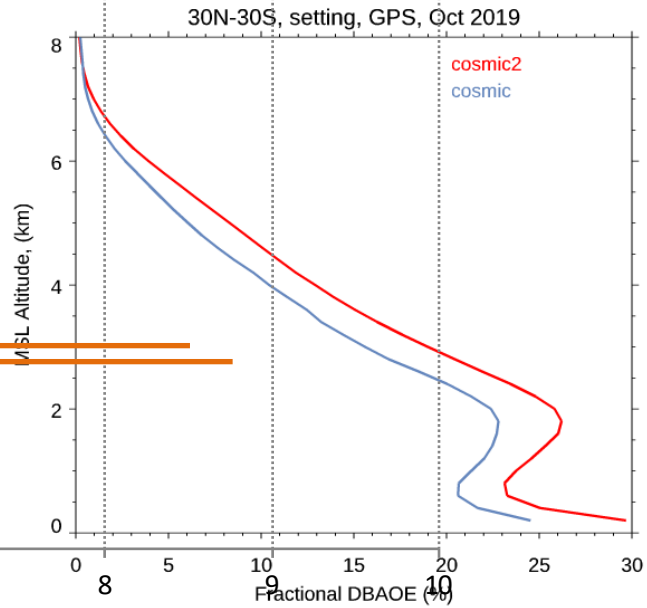
Heights where GNSS-RO is reducing the 24hr forecast errors



Global model sees little value of GNSS RO in lower troposphere and impact in the stratosphere is small as well



7-35 km is sometimes called the GPS-RO "**core region**"



NOAA/STAR in-house Expertise to support CWDP/COSMIC-2 Tasks