Investigation into the Atmospheric profiles using GPS Radio Occultation Technology over the Australian Region

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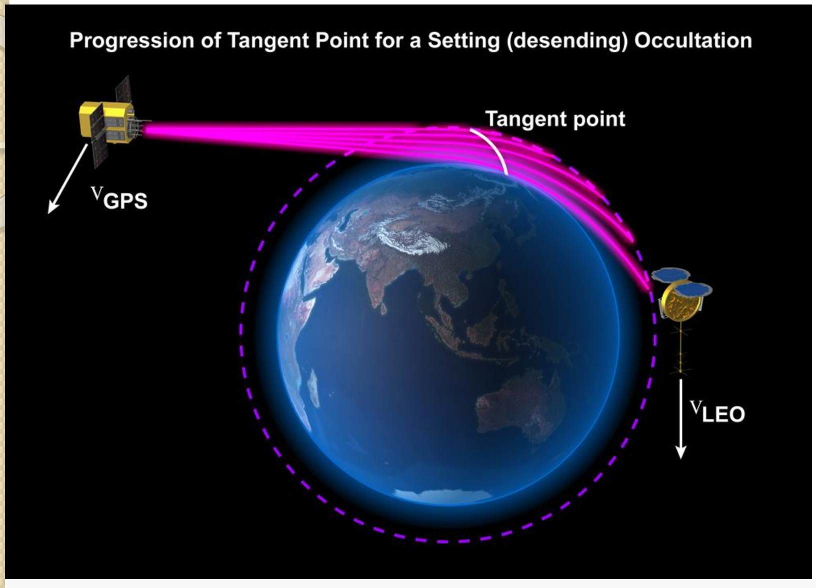
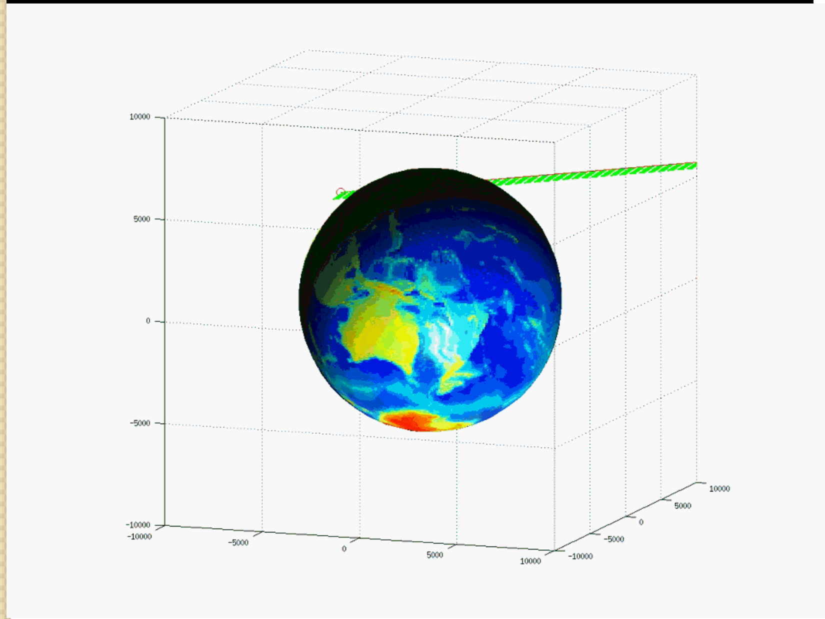
Background



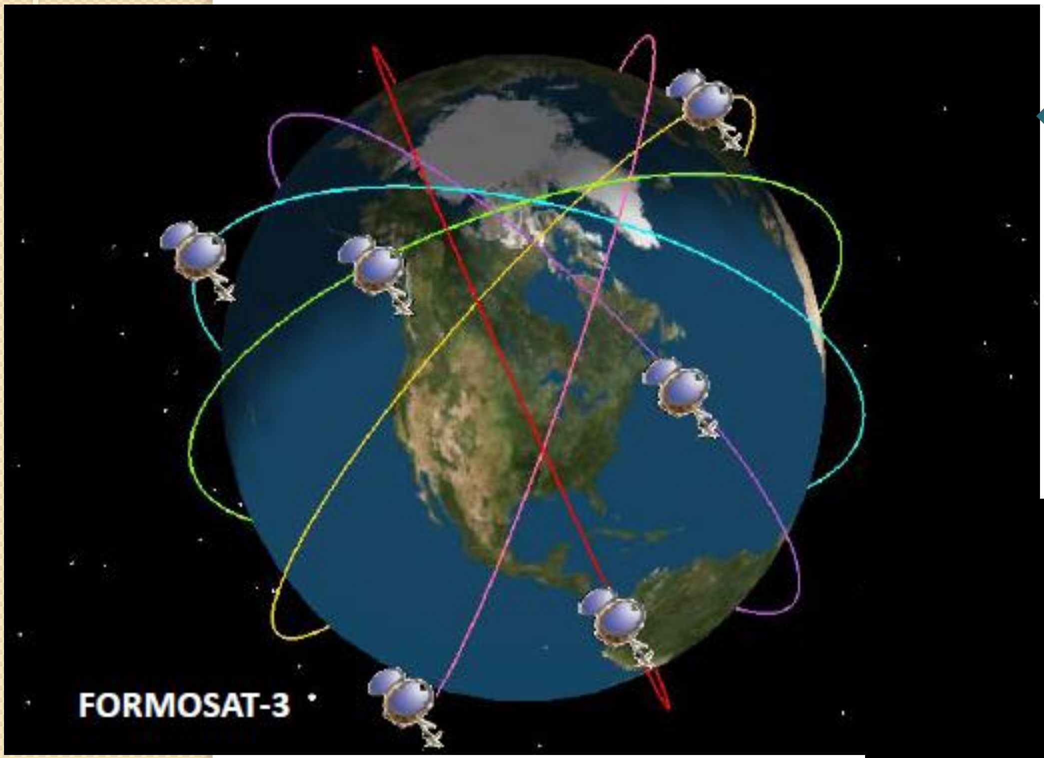


- The Global Positioning System (GPS) radio occultation (RO) is a space-based technique of sounding Earth's atmosphere.

- The refractivity can be determined from the received GPS signals (bending angle) and profiles of temperature, pressure and water vapour can be determined via a complicated atmsopsheric retrival process.

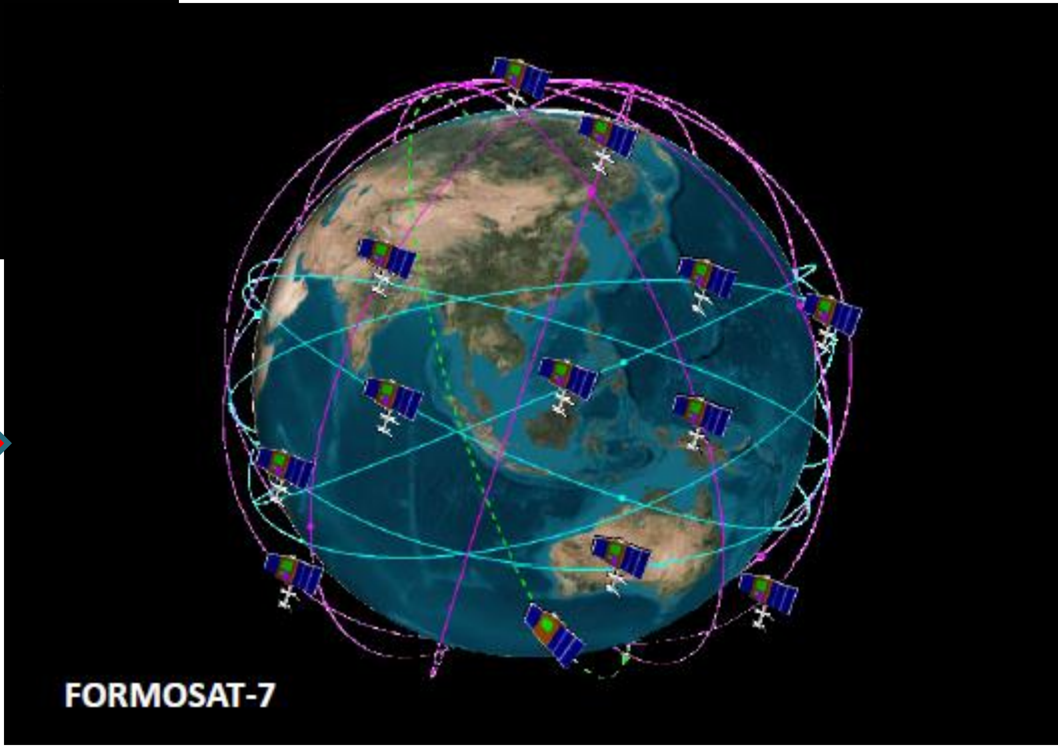
- The GPS RO technique has been shown to produce a positive impact on weather forecasting in the Australian (Le Marshall et al., 2010).

COSMIC 1/2 (FORMOSAT 3/7) Constellations



The first COSMIC/FS3 system consists of six satellites designed to collect more than 2,000 atmospheric soundings each day.

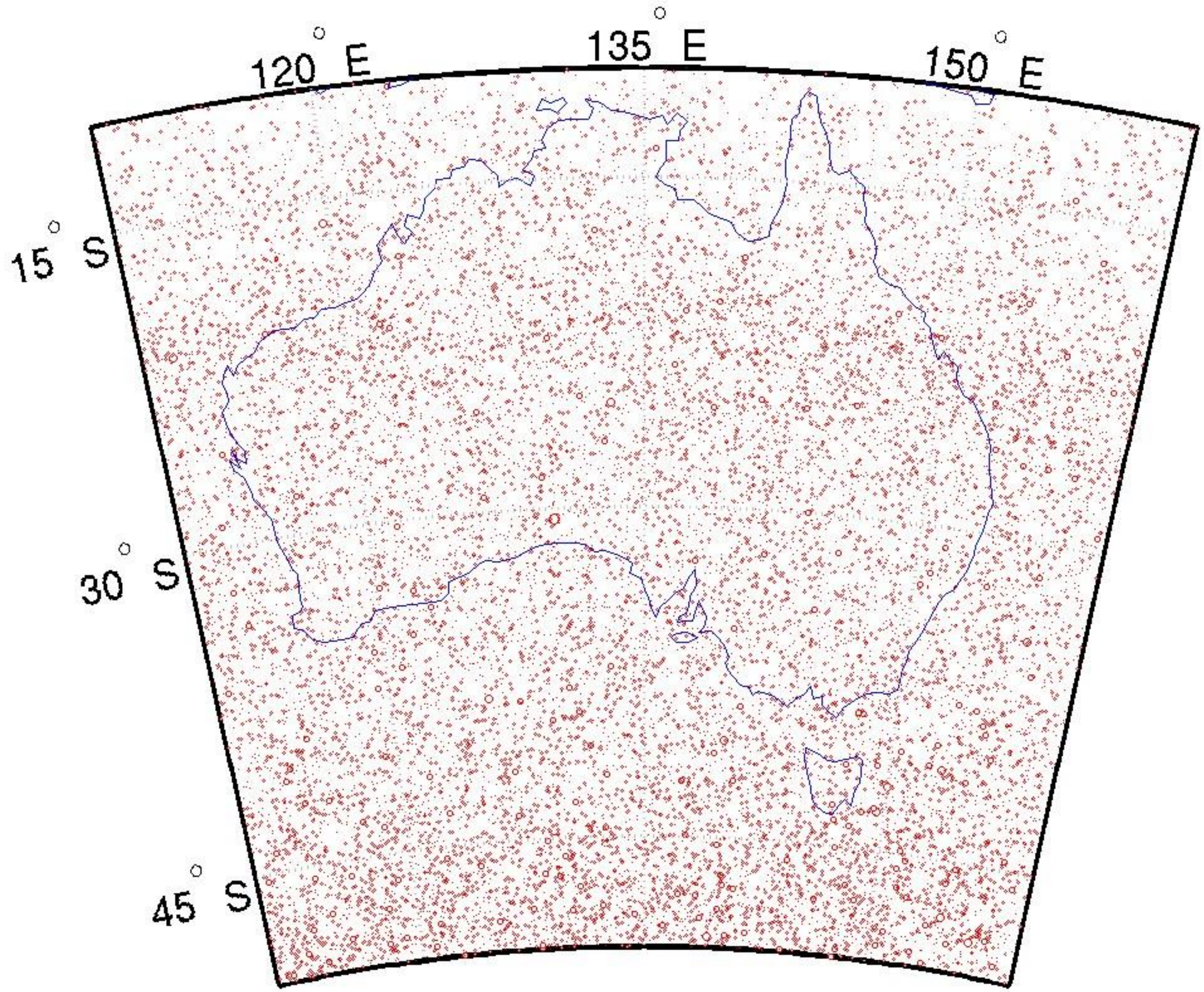
The COSMIC-2/FS7 system will feature 12 satellites designed to collect more than 8,000 soundings per day. In addition to GPS, COSMIC-2 will be able to use signals from the planned European Galileo satellite navigation constellation and possibly the Russian Glonass constellation

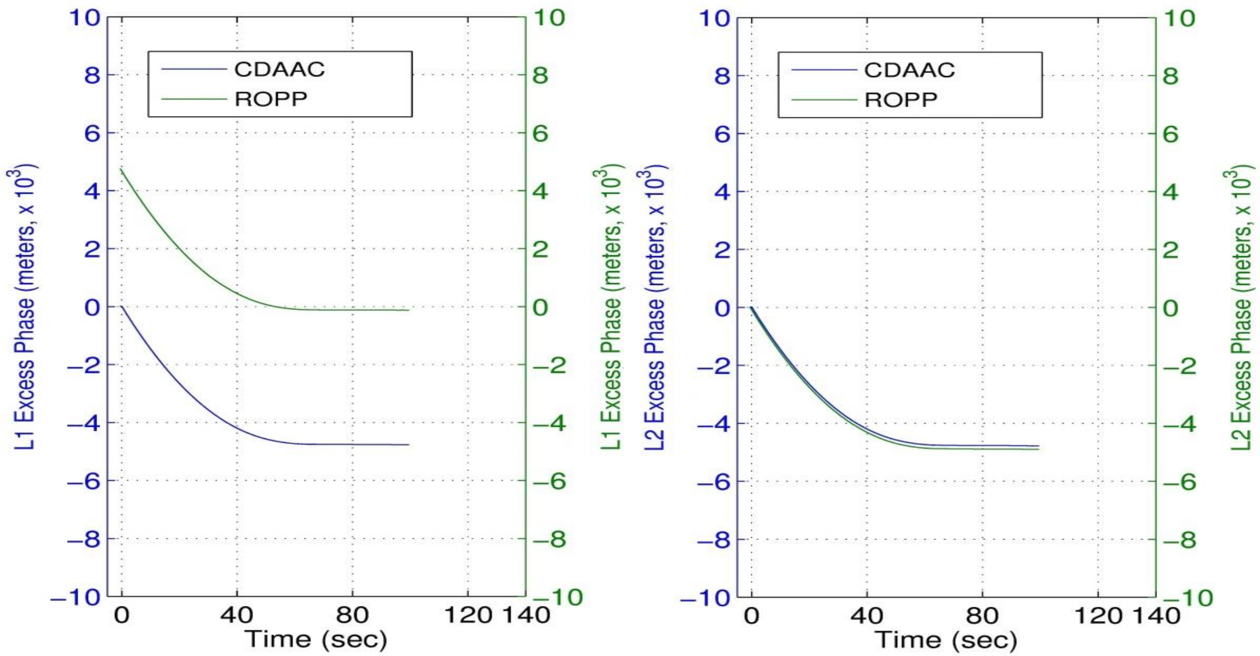


Goal of research

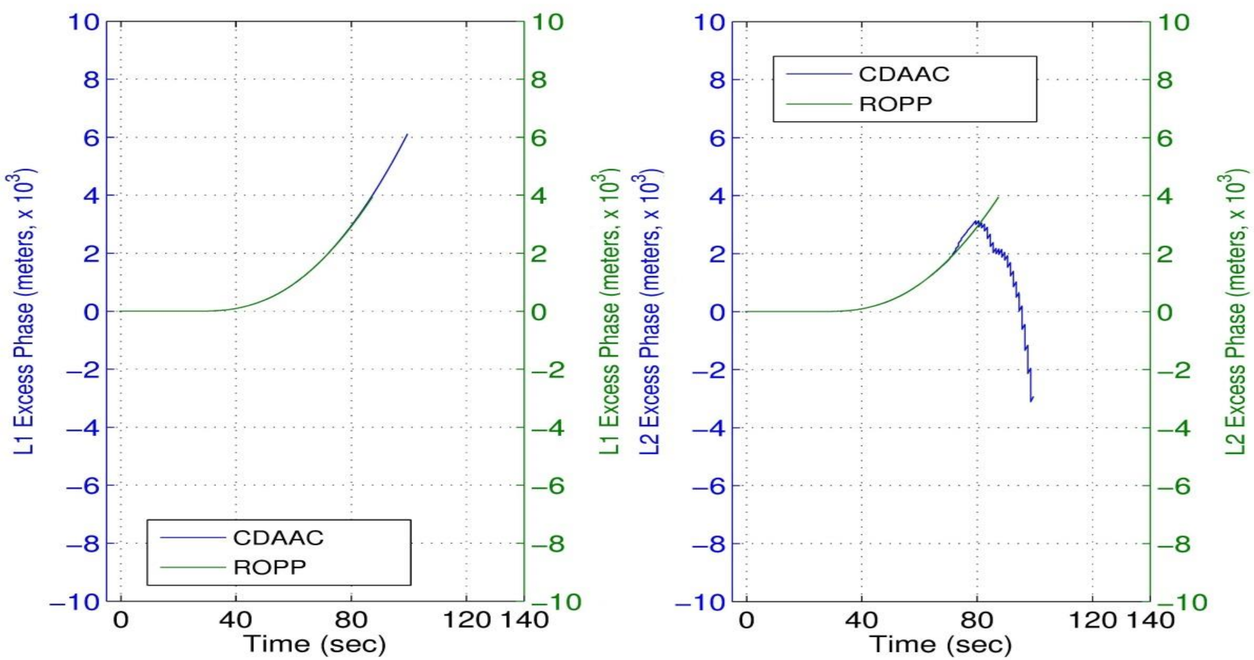
- This research focuses on comparing the atmospheric results from two RO software packages over the Australian region in the Southern Hemisphere .
  - Radio Occultation Processing Package (ROPP V6.0, used by NTPU)
  - COSMIC Data Analysis and Archive Center (CDAAC V2010.2640, used by UCAR).

20,210 events observed in 2010 for the Australian area



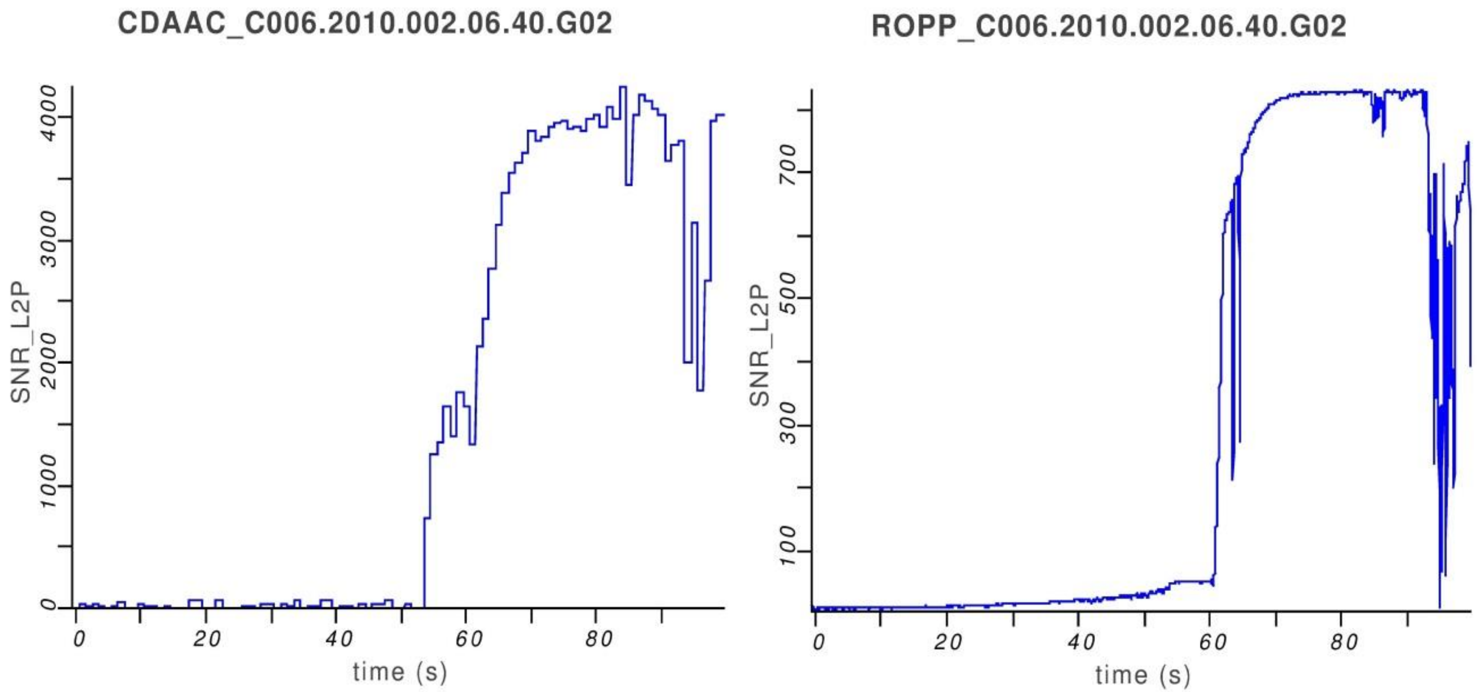


Event 1: C006.2010.003.21.09.G19, 136.0897°E 49.3078°S



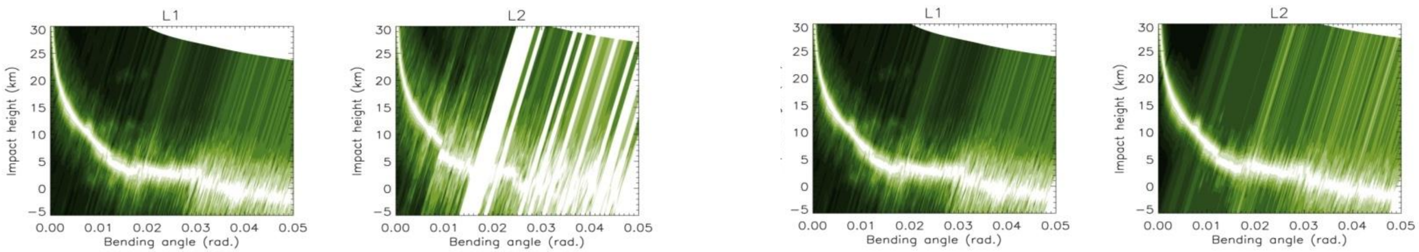
Event 2: C006.2010.002.06.40.G02, 112.9181°E 24.1115°S

The excess phases used in two software packages. (event 1 and event 2)

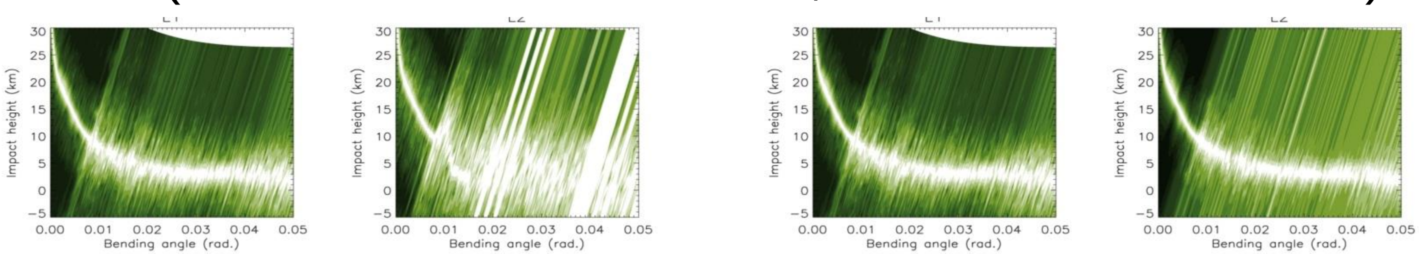


The L2 amplitudes used in two software packages. (event 2)

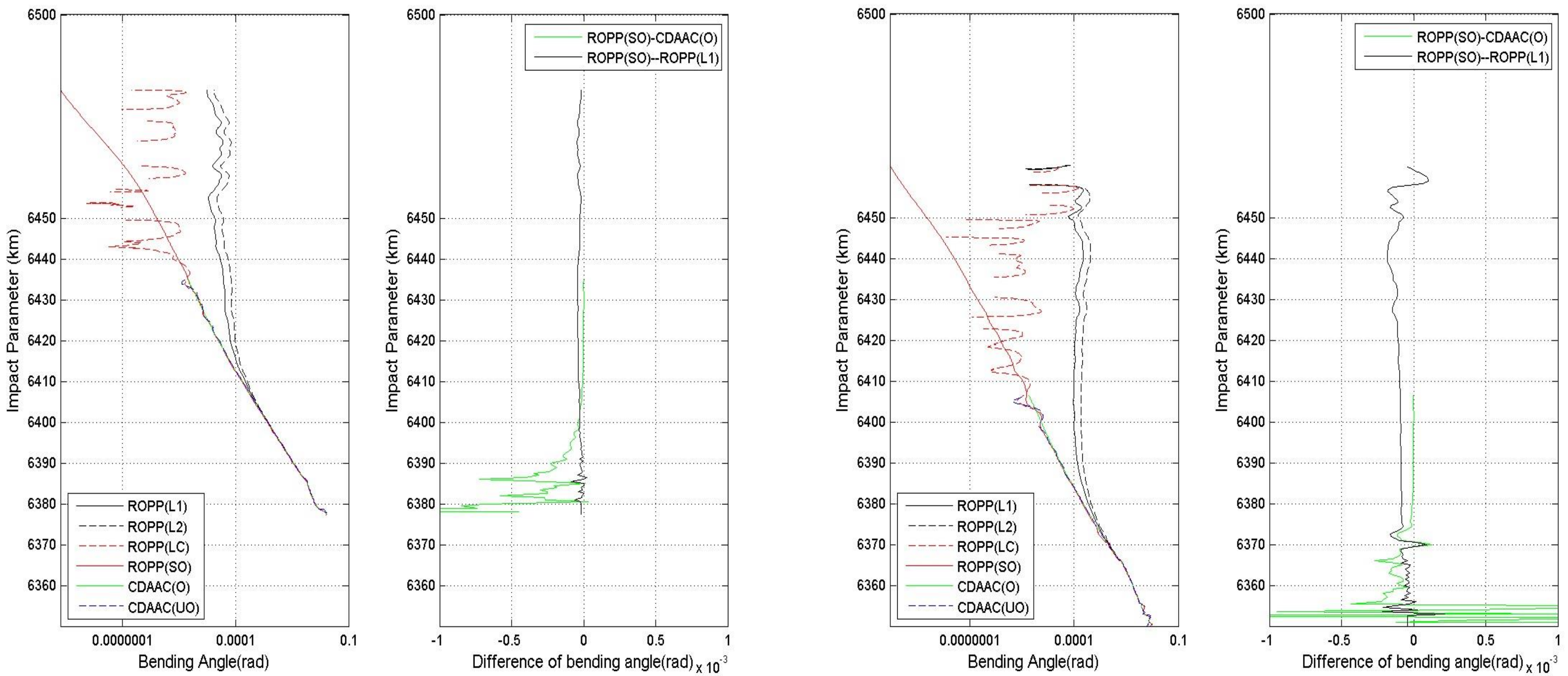
- The minimum of the average from 5-35 km in refractivity difference is 0.1335 (RO event 1:C006.2010.003.21.09.G19, E136.0897° S49.3078°) and the maximum is 0.9646 (RO event 2:C006.2010.002.06.40.G02, E112.9181° S24.1115°).



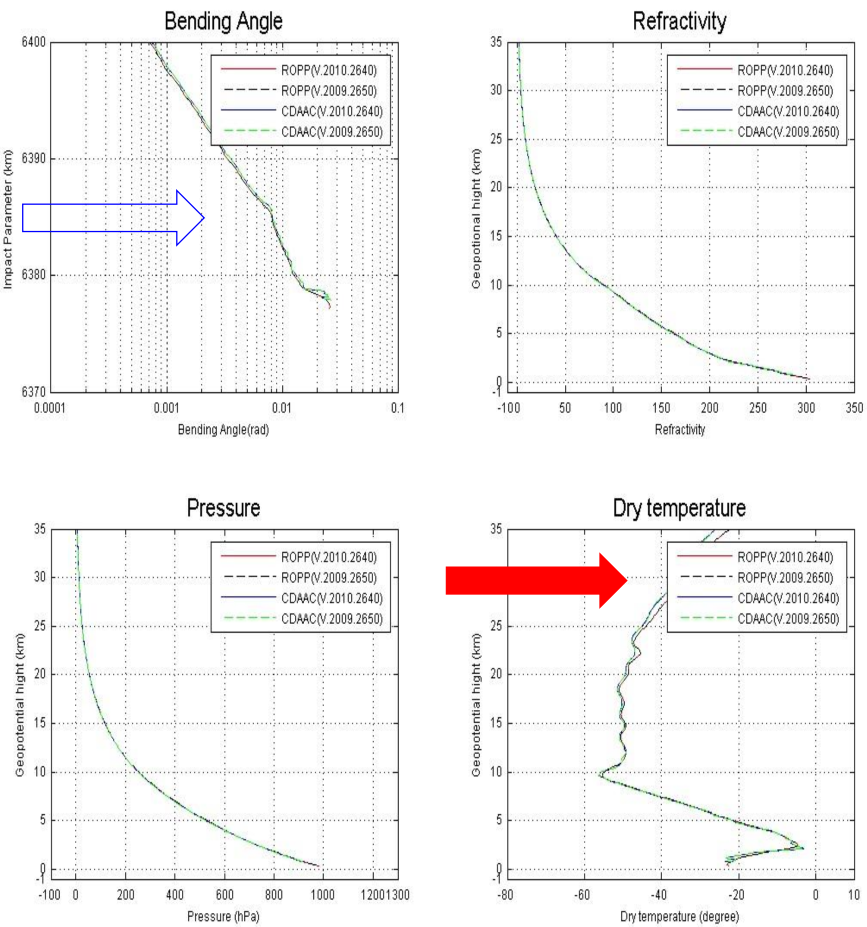
The L1 and L2 spatial spectra of RO event 1 (C006.2010.003.21.09.G19, E136.0897° S49.3078°).



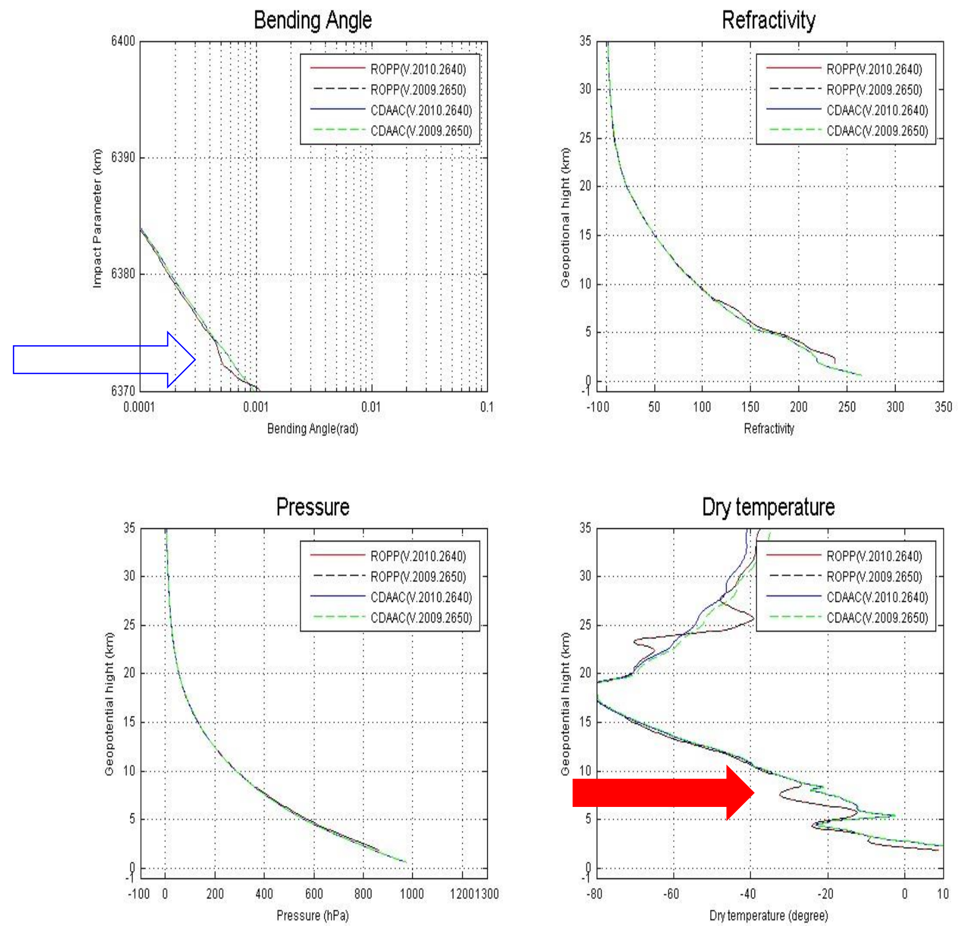
The L1 and L2 spatial spectra of RO event 2 (C006.2010.002.06.40.G02, E112.9181° S24.1115°).



➢The ROPP(SO) and CDAAC(O) are the best methods of the two software packages. The difference between the two methods at the lower troposphere is shown in Figure revealing the large fluctuations. This kind of the strong fluctuation appears in almost all events in the study period.

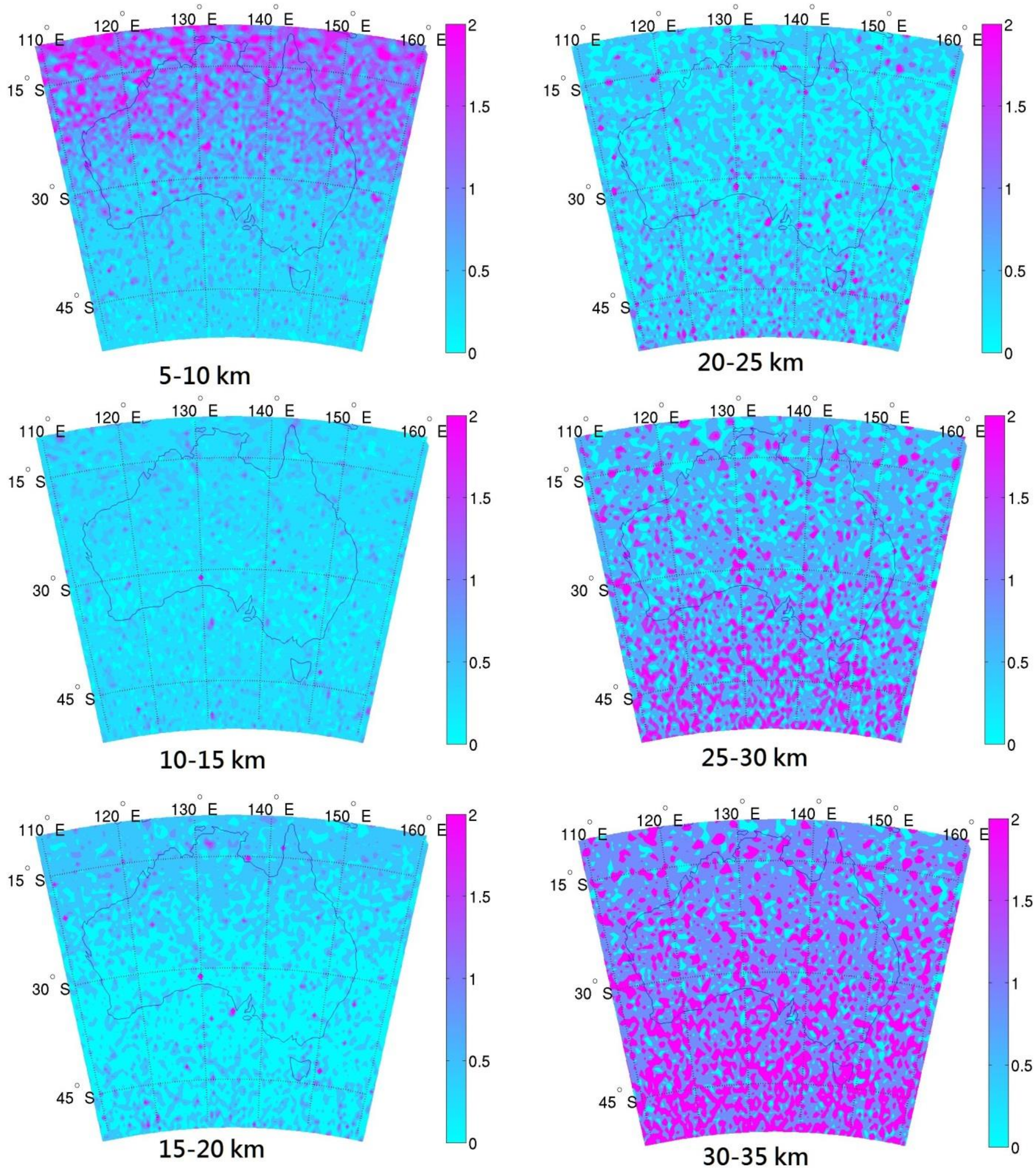


Event 1



Event 2

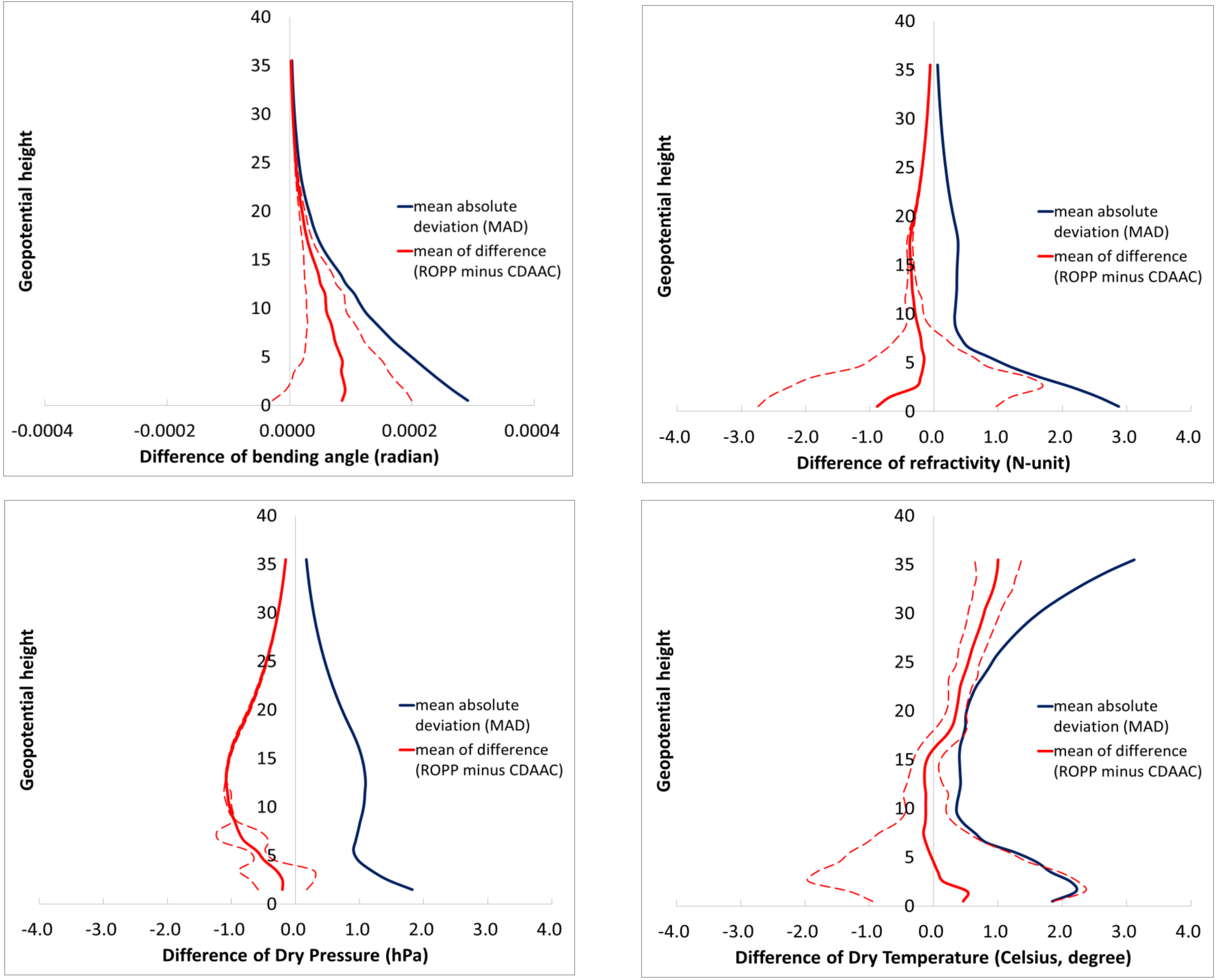
- The retrieved atmospheric profiles using ROPP and CDAAC (V2009.2650 and V2010.2640) for event 1 and event 2.



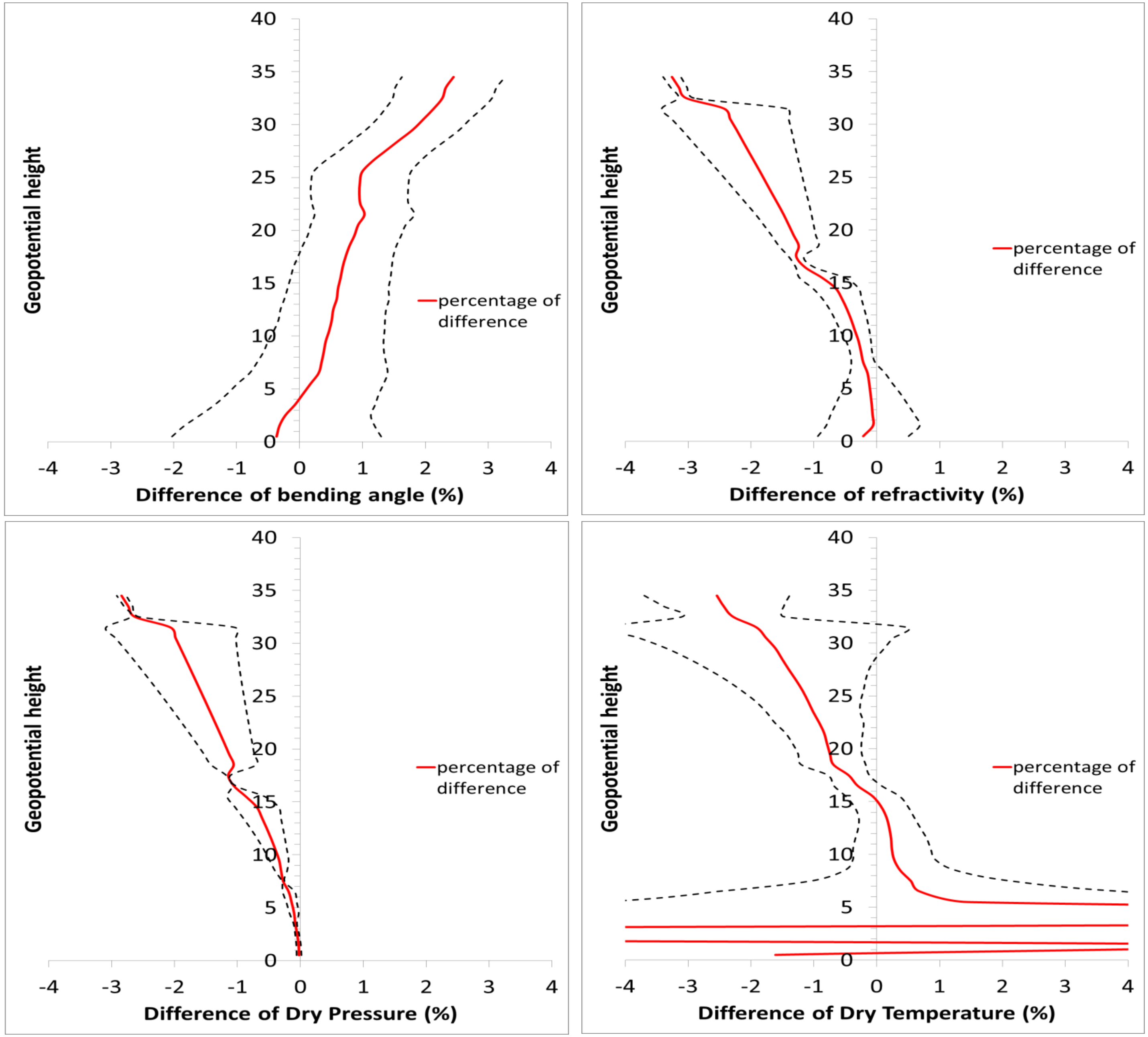
The mean absolute deviation (MAD) in dry temperature between two software packages from

Comparison of atmospheric profiles using ROPP and CDAAC using 20,210 RO events binned into six atmospheric layers.

	Bending Angle (rad)		Refractivity (N- units)		Pressure (hPa)		Dry Temperature (C deg.)	
Altitude from the ground surface (km)	Mean of difference	MAD of difference	Mean of difference	MAD of difference	Mean of difference	MAD of difference	Mean of difference	MAD of difference
05-10	0.0000672	0.0002147	-0.2049	0.5365	-0.8266	0.9681	-0.1160	0.7695
10-15	0.0000579	0.0001408	-0.3330	0.3509	-1.0662	1.0804	-0.1280	0.3986
15-20	0.0000434	0.0000840	-0.3528	0.3547	-0.8922	0.8953	0.1597	0.4561
20-25	0.0000280	0.0000457	-0.2363	0.2364	-0.5784	0.5828	0.4345	0.6893
25-30	0.0000151	0.0000232	-0.1412	0.1414	-0.3546	0.3627	0.6633	1.2399
30-35	0.0000080	0.0000121	-0.0819	0.0823	-0.2116	0.2250	0.9109	2.2384



Comparison of atmospheric profiles using ROPP and CDAAC with the statistical mean and the mean absolute deviation (MAD) of the mean.



Comparison of atmospheric profiles using ROPP and CDAAC with the fractional difference.

Conclusions

- The bending angle results with the mean values do not agree with the results from the GRAS SAF report. However, the fractional difference result shows a negative bias at heights below approximately 5 km.
- The negative bias in refractivity is consistent with the GRAS SAF report.
- The pressure parameter also shows a negative bias between the two processing software packages.
- . The dry temperature also shows a negative bias at altitudes from 5 to 16 km.

Conclusions

- Altitudes of 0-25 km, 0-16 km and 6-23 km exhibit differences of less than 1% in bending angle, pressure and dry temperature, respectively.
- In general, the difference in bending angle, refractivity, and pressure increase with altitude, but these differences are always less than 3%. The difference in dry temperature is also less than 3% at heights above 5 km.