Performance Evaluation of Radio Occultation Data Processing Software in Southeast Asia

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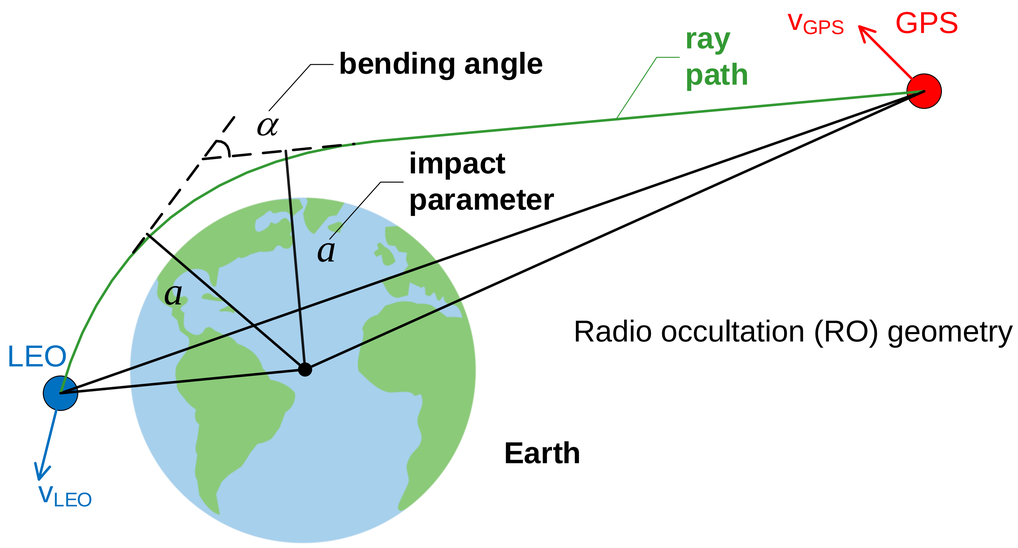
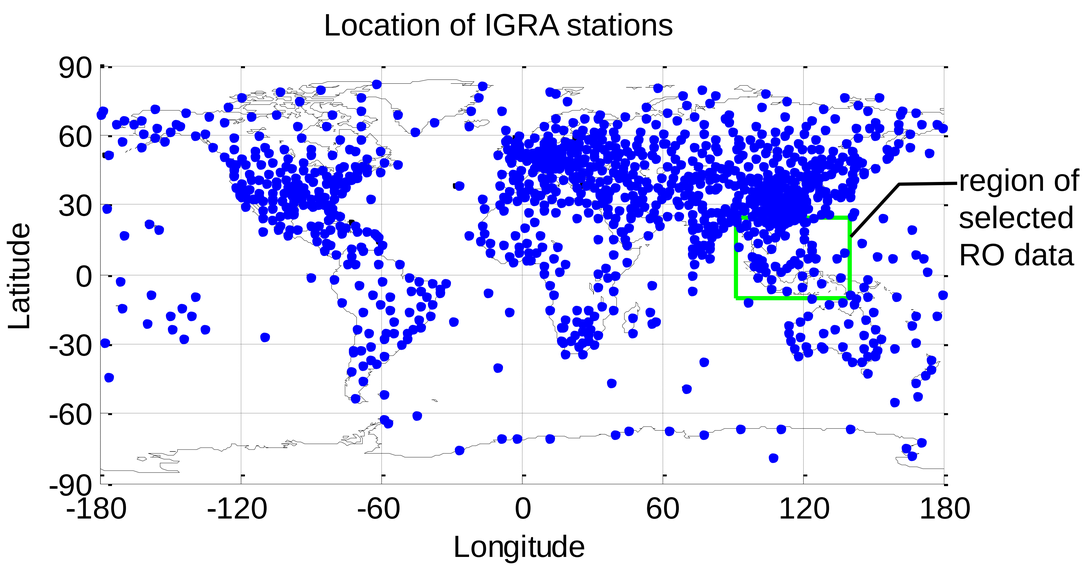
Summary: GPS radio occultation (RO) has evolved from a proof-of-concept to operational constellations providing global weather forecasting, climate monitoring, and ionosphere studies. The COSMIC (Constellation Observing System for Meteorology, Ionosphere, and Climate) mission is currently the largest RO mission. To process the collected RO data, various centers have developed different software. The processing software used by the COSMIC Data Analysis and Archival Center (CDAAC) is continuously evolving and a set of newly reprocessed COSMIC RO data became available in October 2014. Another processing software, the Radio Occultation Processing Package (ROPP) maintained by the Radio Occultation Meteorology Satellite Application Facilities (ROM SAF), provides an open source RO data processing tool adopted by many RO missions. To better assess the performance of ROPP, statistical comparisons are carried out between COSMIC RO data processed using the software by CDAAC and by ROPP. Bending angle and refractivity are used in the comparison. Local profiles generated using European Centre for Medium-Range Weather Forecasts (ECMWF) are used in the refractivity comparison as a reference.

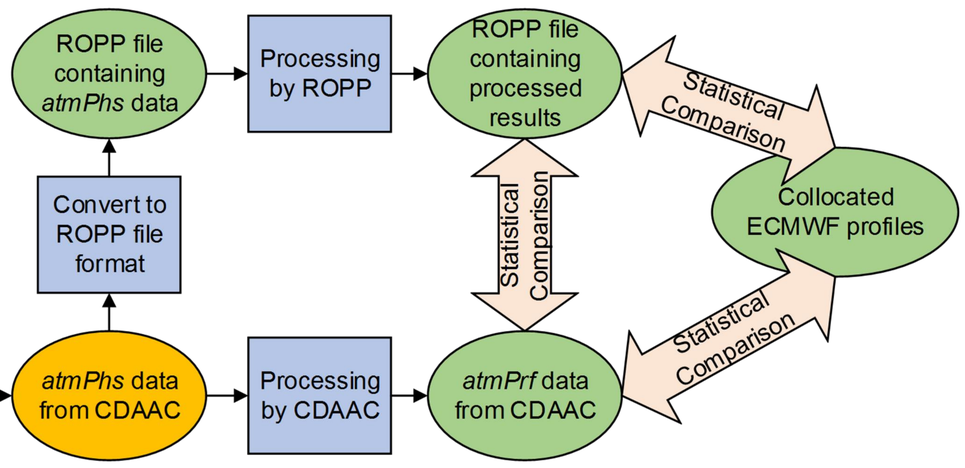
Introduction

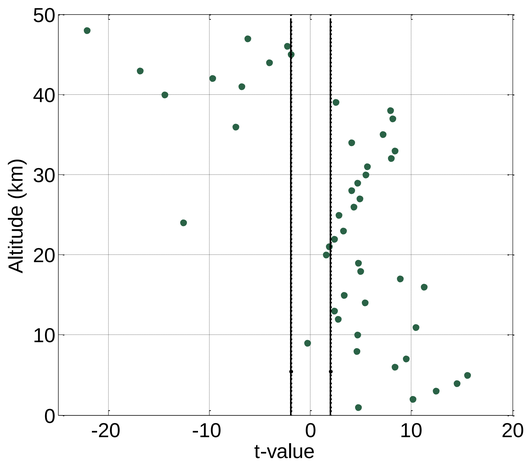


Radio occultation (RO) geometry

RO Data Processing



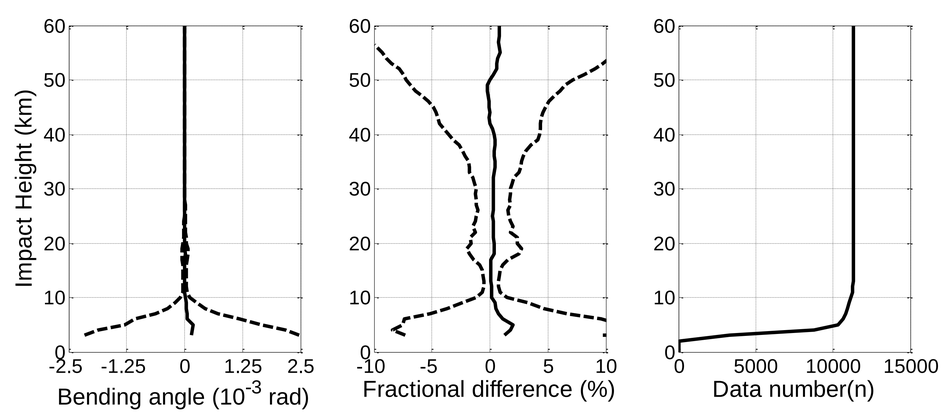


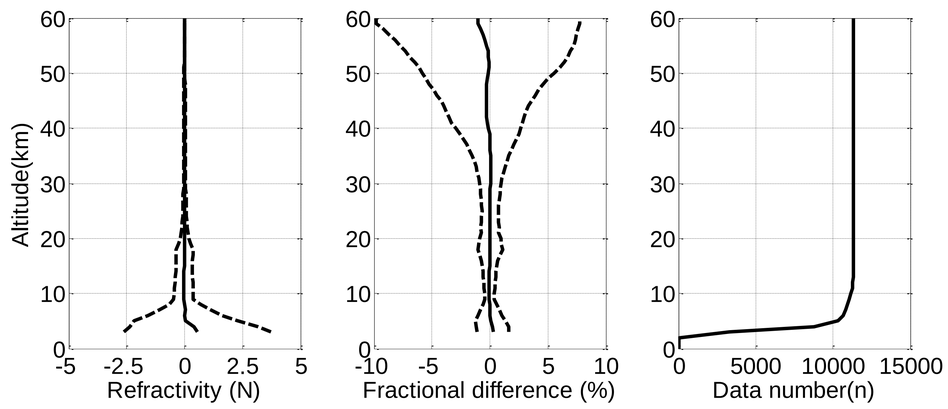


- A t-test is performed to verify statistical significance, with significance level of 0.05.
- Hypothesis: average refractivity difference between CDAAC and ECMWF is significantly different from the average refractivity difference between ROPP and ECMWF.
- The results indicate that the hypothesis can be accepted in most altitude regions

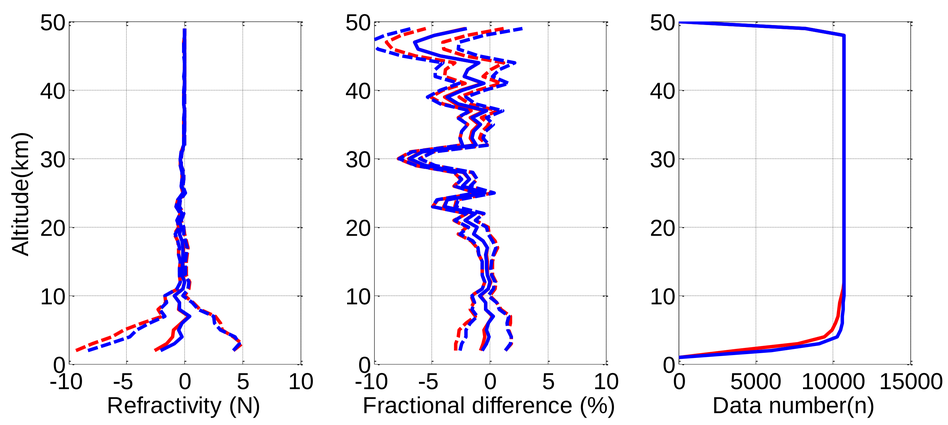
Results

ROPP and CDAAC bending angle and refractivity difference comparison.
: Mean of the (fractional) difference
: Standard deviation of the (fractional) difference





CDAAC processed results and ECMWF profiles, as well as ROPP against ECMWF comparison
: Mean of difference for COSMIC and ECMWF, ROPP and ECMWF
: Standard deviation of difference for COSMIC and ECMWF, ROPP and ECMWF



The refractivity (N unit) comparison between CDAAC and ROPP processed results

Altitude (km)	COSMIC-ECMWF(mean)	COSMIC-ECMWF(s.d.)	ROPP-ECMWF(mean)	ROPP-ECMWF(s.d.)
0-10	-0.79 (-0.39%)	3.27 (1.60%)	-0.55 (-0.29%)	2.89 (1.41%)
10-20	-0.21 (-0.64%)	0.33 (0.75%)	-0.23 (-0.66%)	0.29 (0.67%)
20-30	-0.28 (-3.44%)	0.08 (0.80%)	-0.28 (-3.40%)	0.08 (0.82%)
30-40	-0.03 (-1.77%)	0.02 (1.14%)	-0.03 (-1.62%)	0.03 (1.42%)
40-50	-0.02 (-3.63%)	0.01 (2.34%)	-0.02 (-3.62%)	0.02 (3.51%)

Conclusion

- A comparative study of CDAAC processed results and ROPP processed results is carried out.
- At about 4 km, both the bending angle and refractivity standard deviation between CDAAC and ROPP processed results are the largest, being about 2.3 micro radian and about 3 N units, respectively.
- ROPP performs slightly poorer than CDAAC at altitude above 30 km, and slightly better at other altitude regions.

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