Processing of COSMIC radio occultation data and cross-center comparison

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M. E. Gorbunov, A. V. Shmakov, S. S. Leroy, K. B. Lauritsen,
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COSMIC data & ECMWF fields

Processed COSMIC data:

- 20 days from each of the years 2007, 2008, 2009 (from 2009: data version 2009.2650 starting April 1);

Processing of atmPhs files with OCC (similar to GRAS SAF ROPP_PP software);

Results are compared to:

- UCAR processed data: atmPrf files (refractivities);
- ECMWF analyses (refractivities);

OCC processing and options

State of the art Fourier integral operator code (CT2) ensures high accuracy (GO used above 25 km)

SO: optimal linear combination based on initialization to ECMWF or 2-parameter fitted MSIS climatology

Quality control based on L2-signal and SO-solution: $Q = Q_{L2} + Q_{SO}$

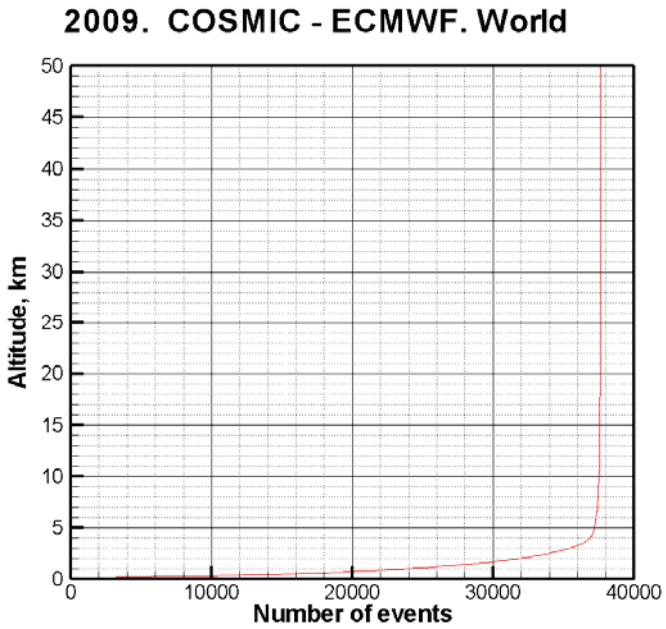
Cutoff of u(t): at SLTA = -250 km

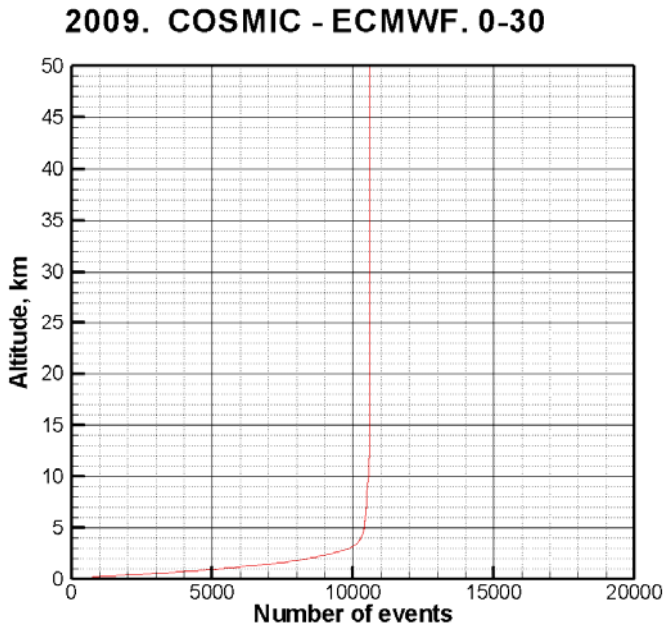
Radio-holographic (RH) filtering:

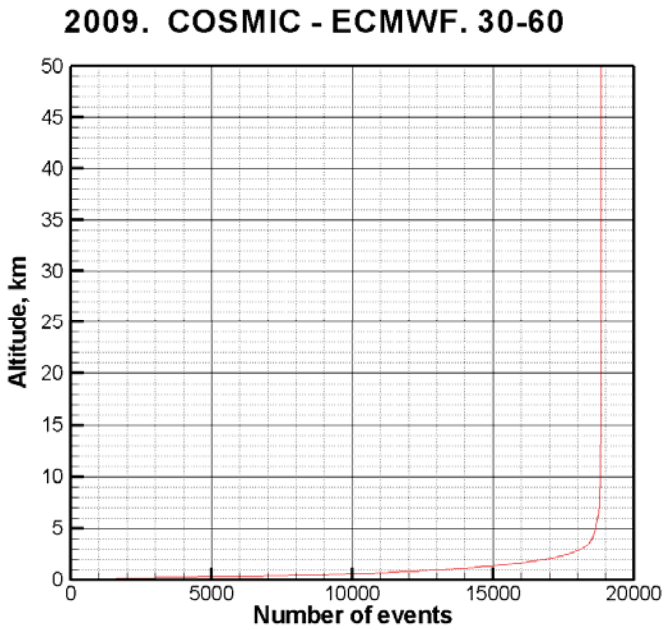
- phase: no; CT-amplitude: yes
- full RH filtering results in positive bias from suppression of large BAs and MP structures in wide-band signal tails [Sokolovskiy, 2009]

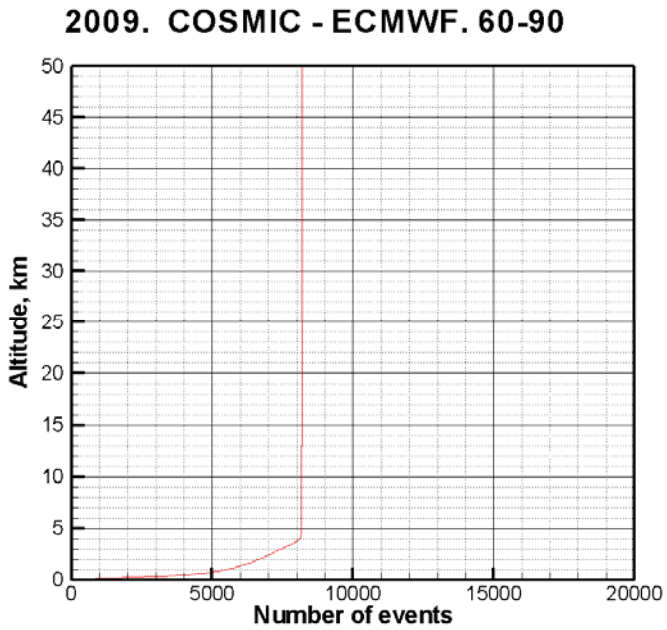
OCC 2009: #occ

About half the profiles penetrate down to 1 km

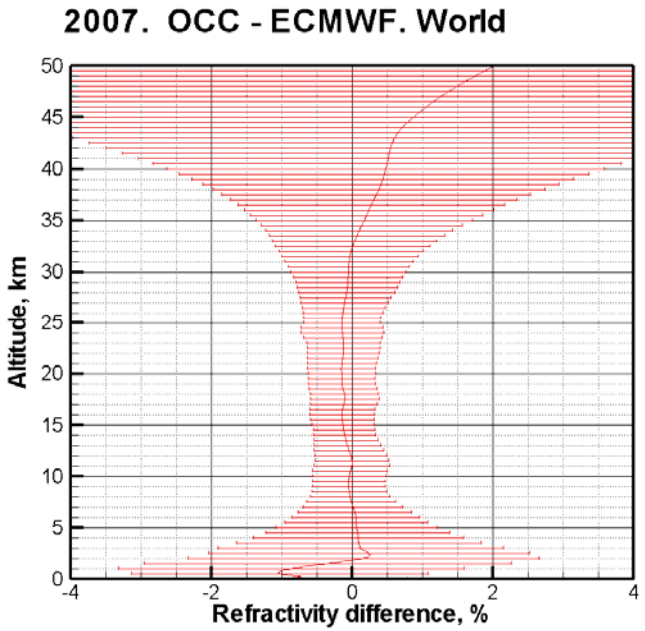


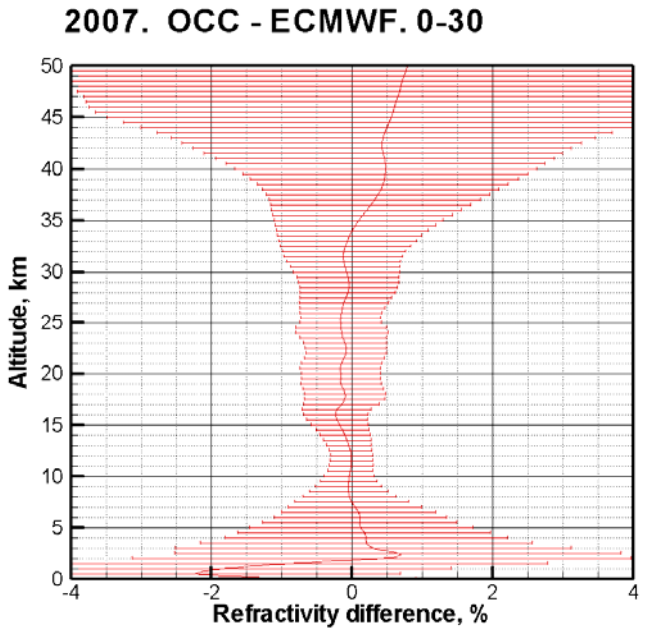


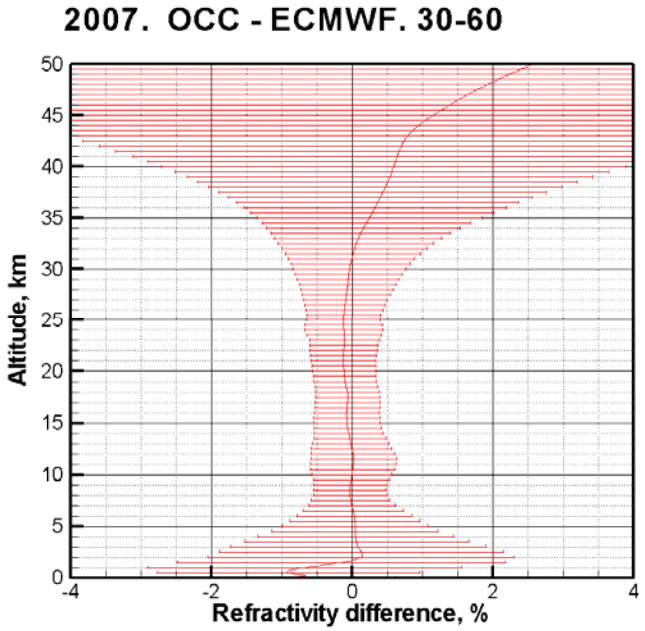


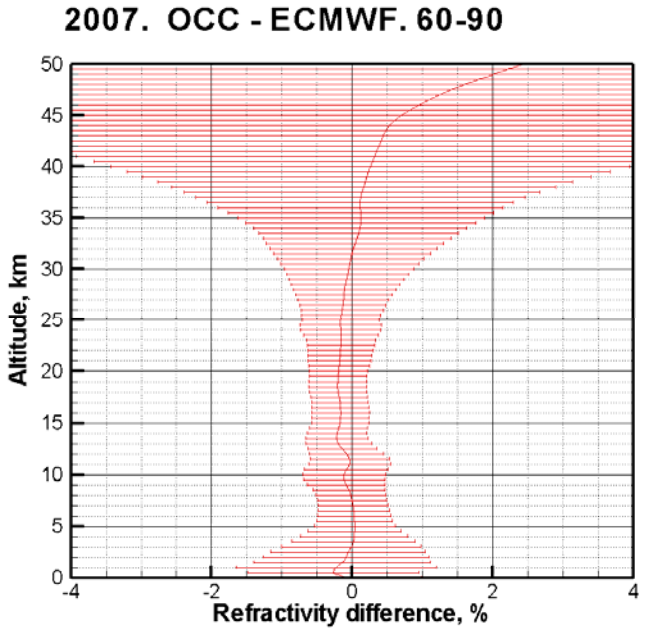


OCC-ECMWF: 2007 REF

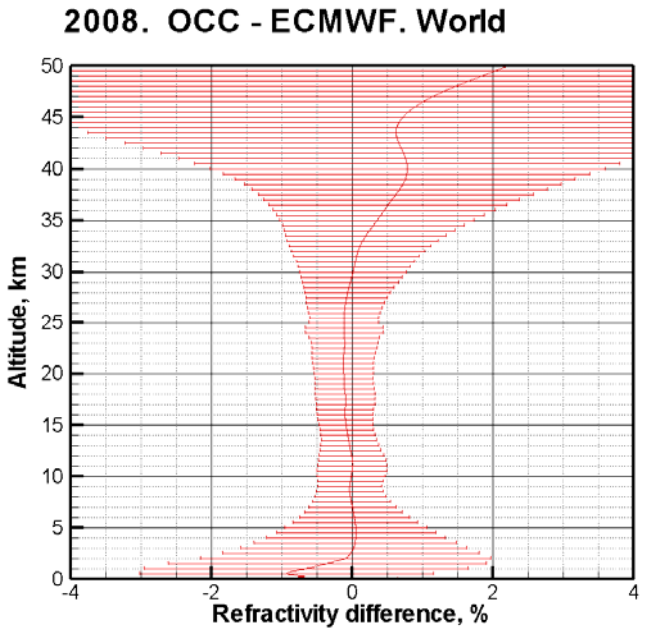


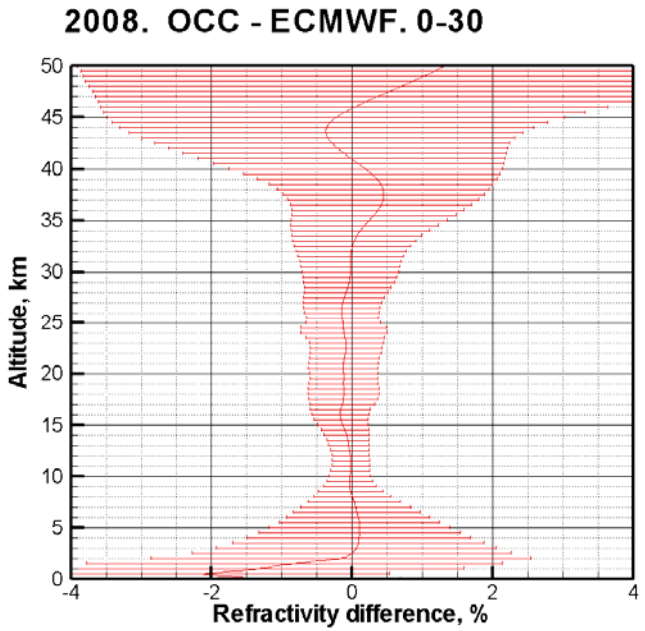


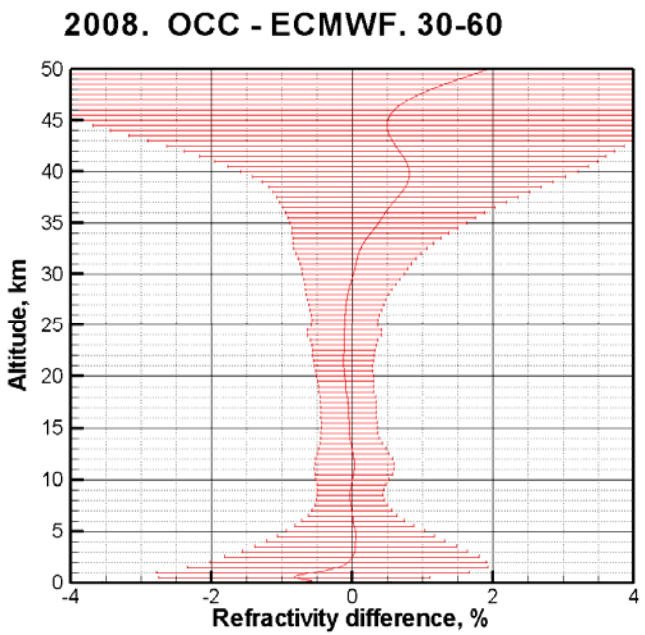


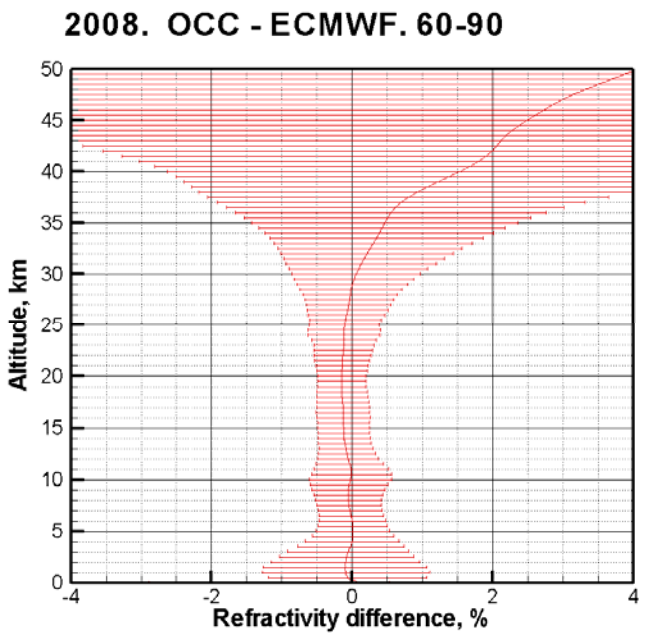


OCC-ECMWF: 2008 REF

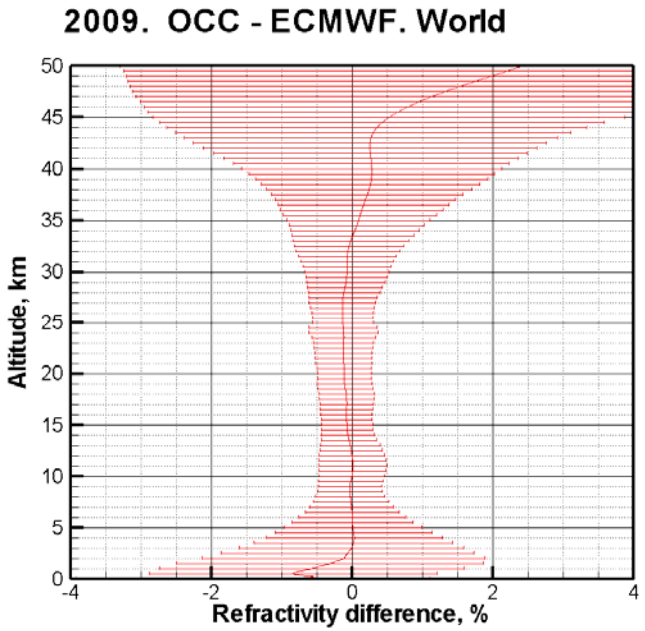


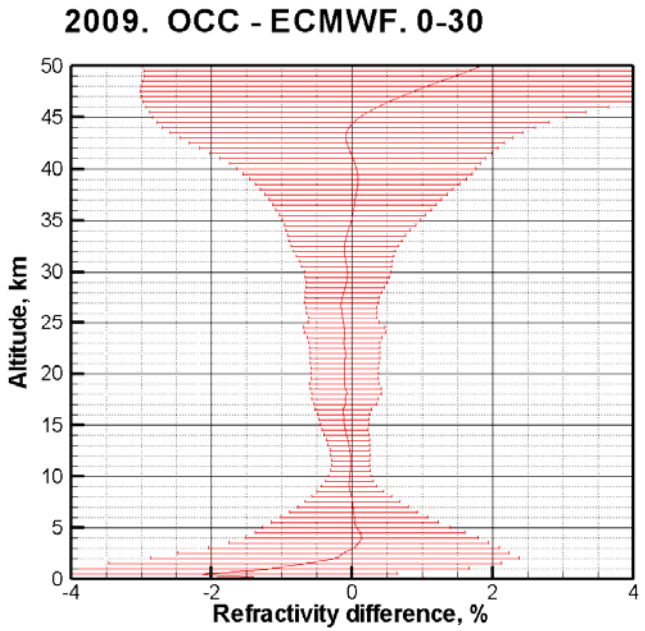


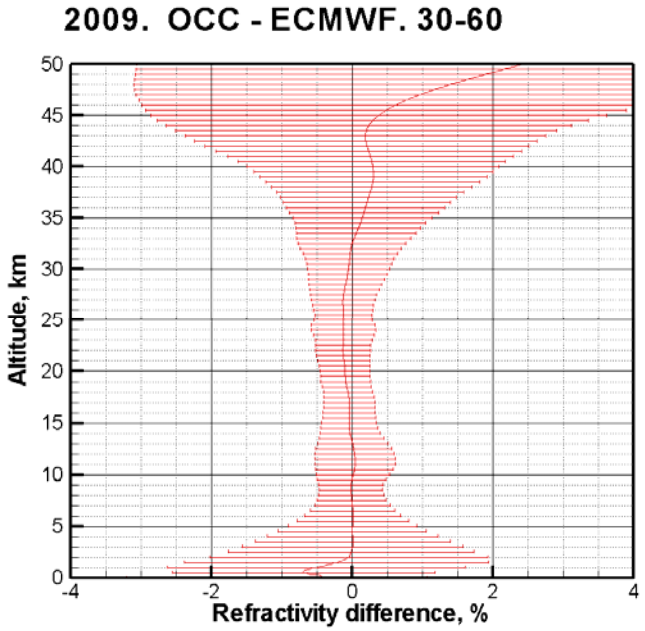


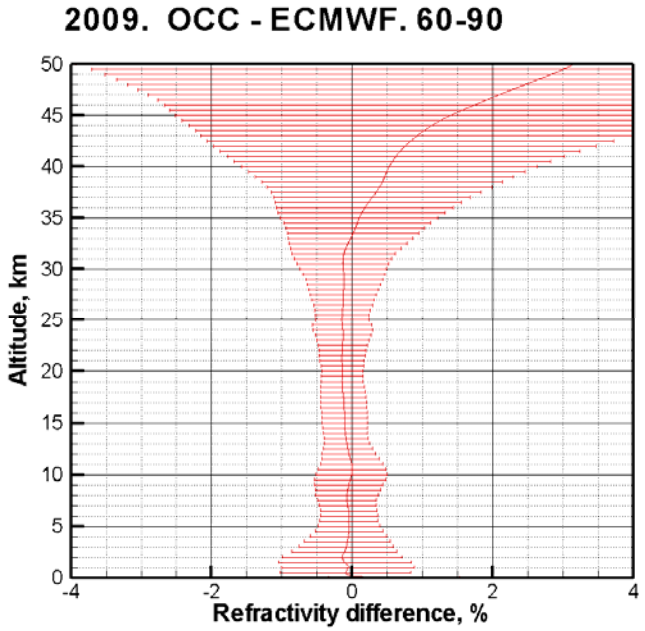


OCC-ECMWF: 2009 REF

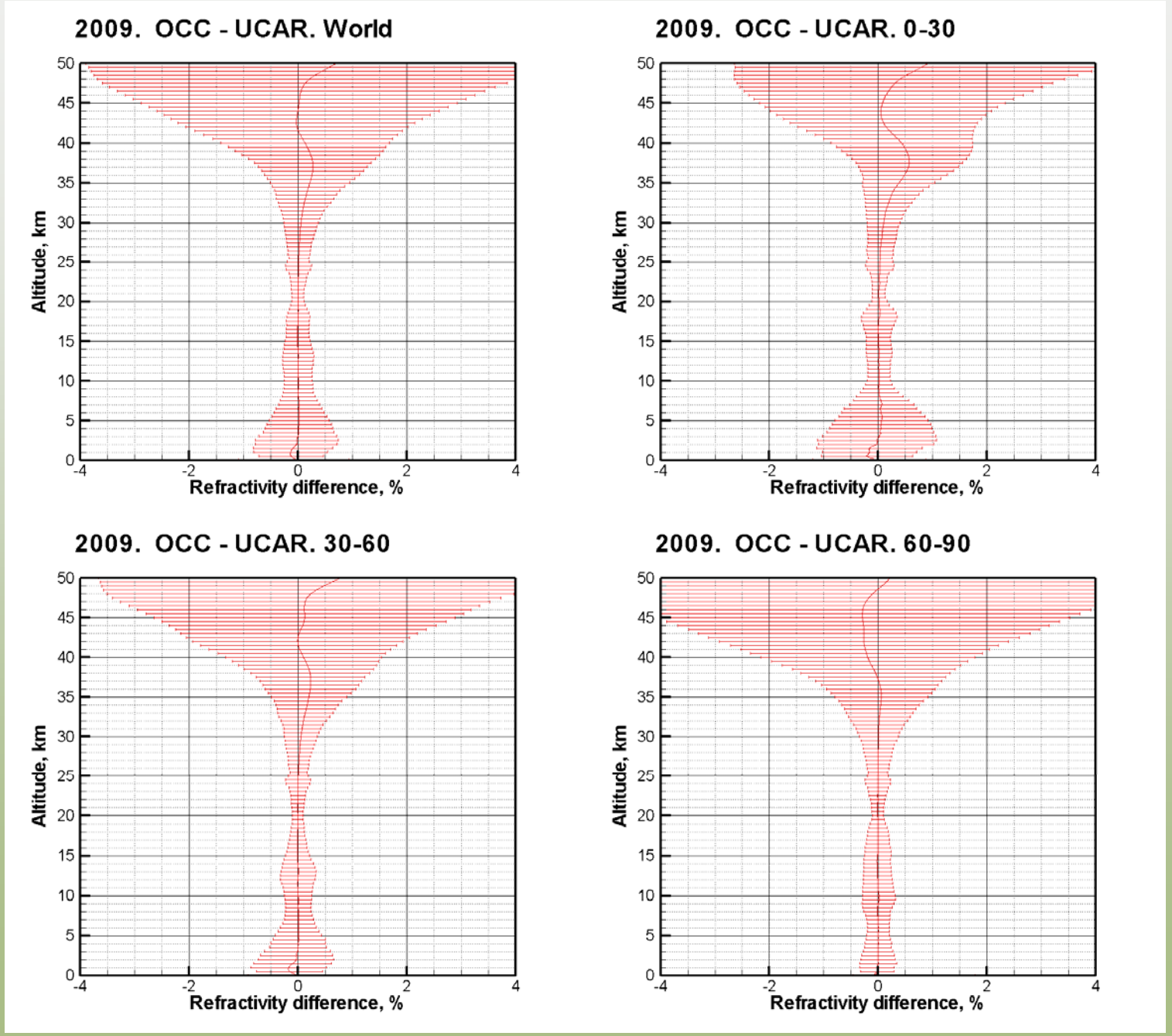




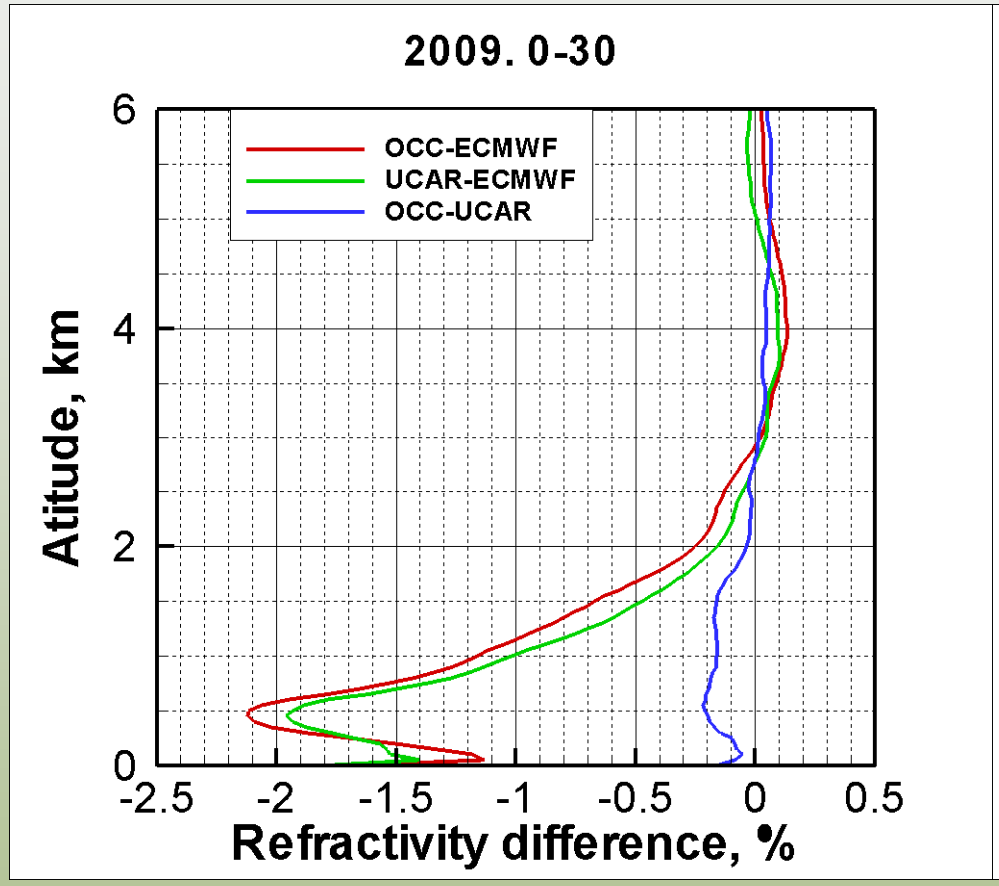


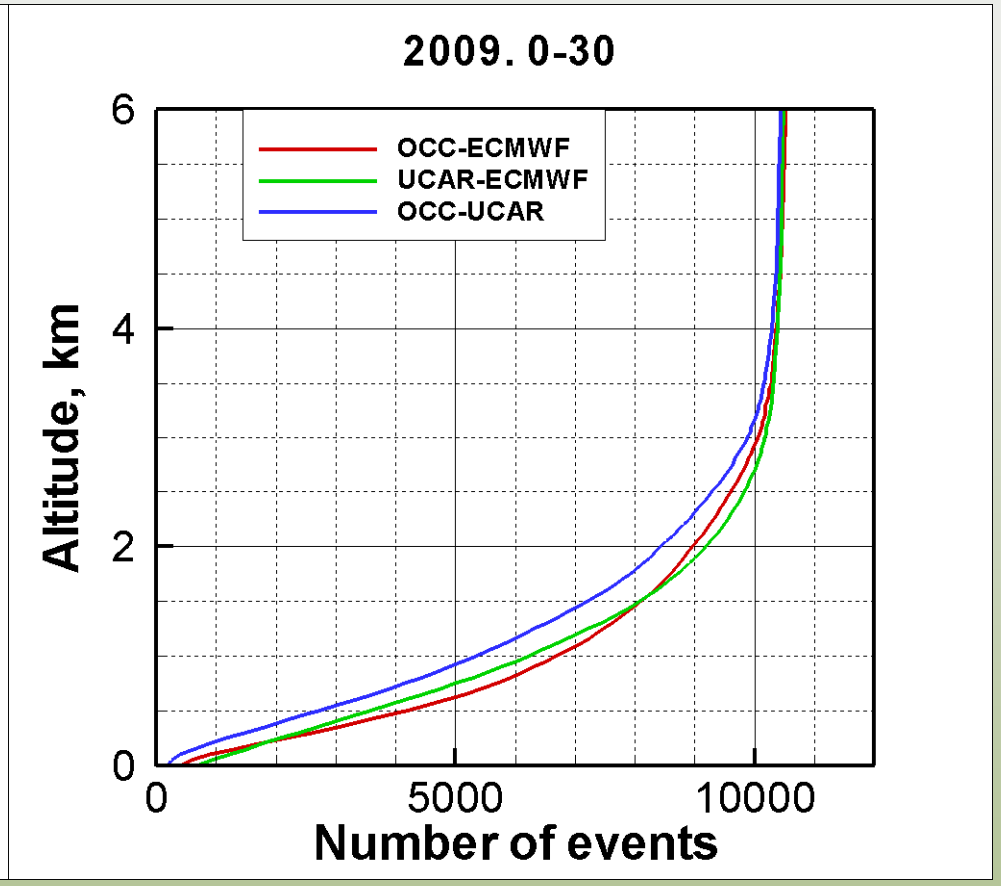


OCC-UCAR: 2009 REF



Zoom on tropical bias, 2009 data



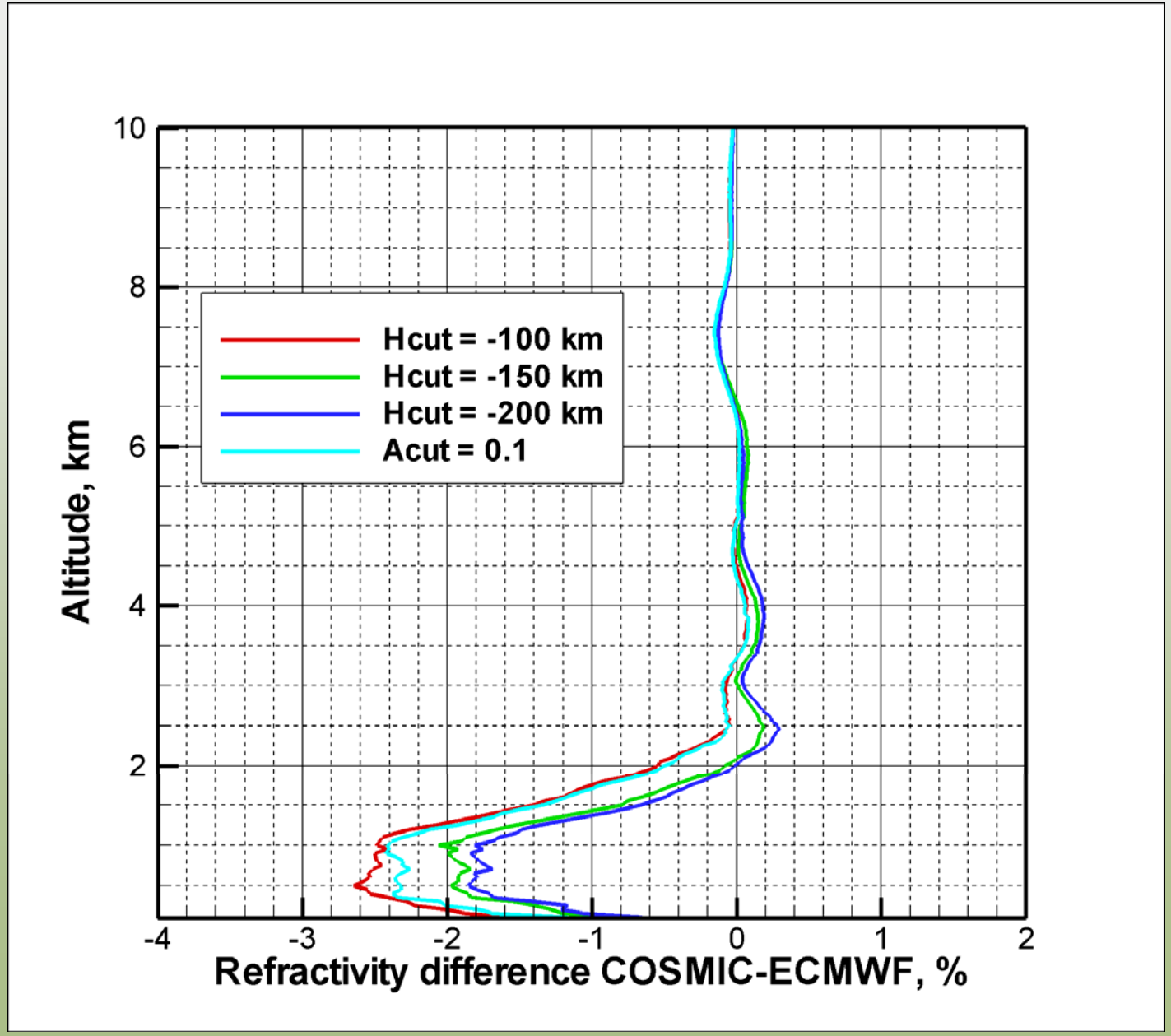


Tropics (0-30^0), with RH-filtering

RH filtering:

phase: yes

CT-amplitude: yes

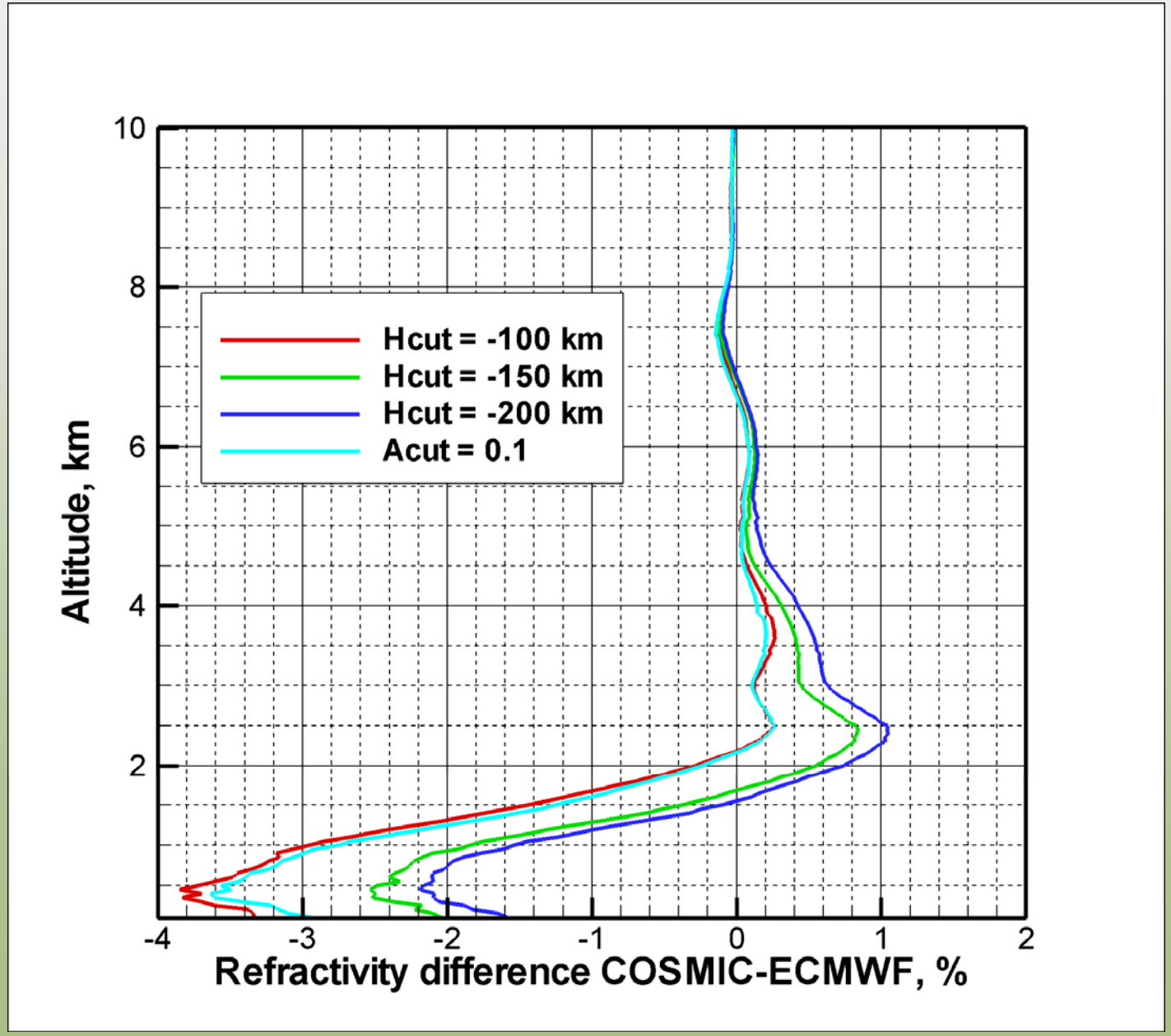


Tropics (0-30^0), with no RH-filtering

RH filtering:

phase: no

CT-amplitude: no

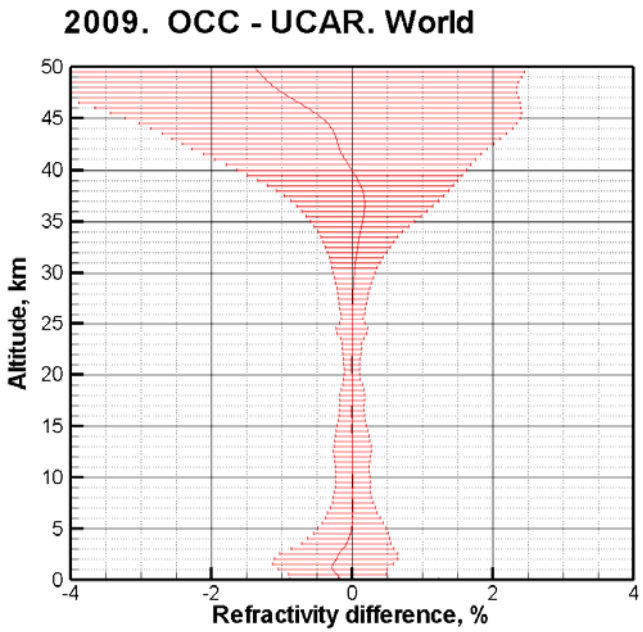


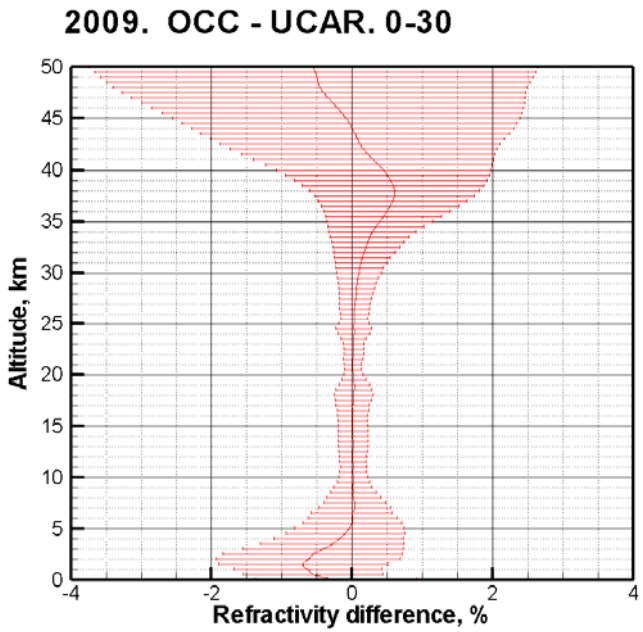
OCC-UCAR: 2009 REF, alternative options

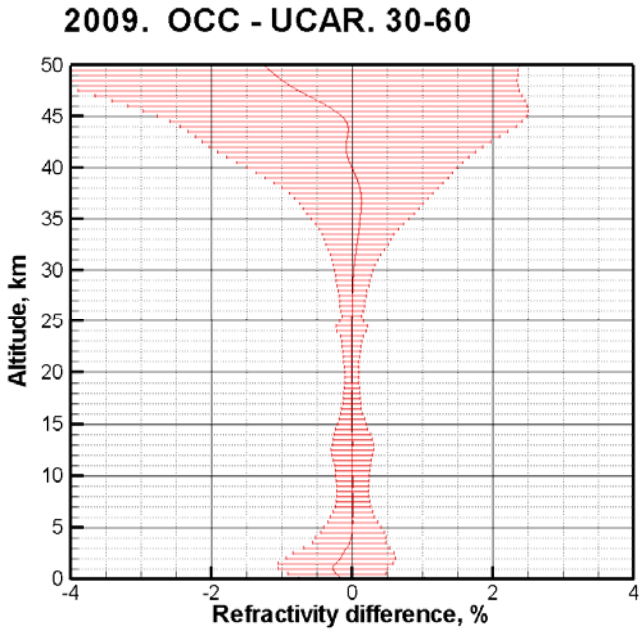
Cutoff at SLTA = -150 km

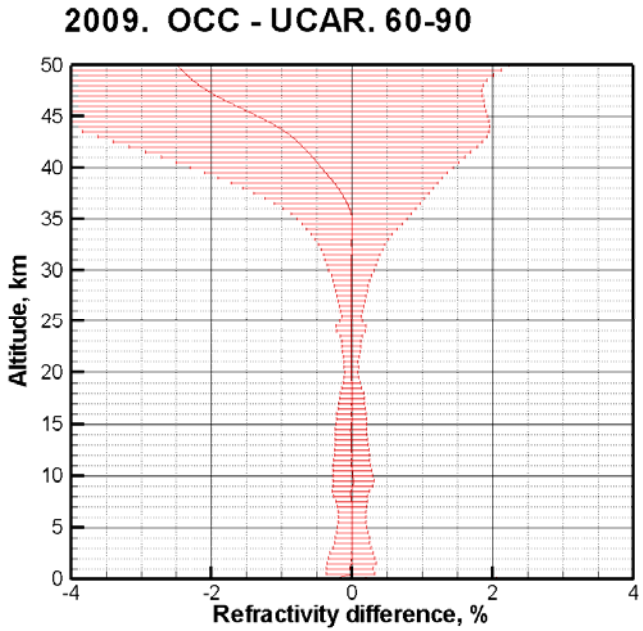
RH filtering: phase: yes

2-parameter MSIS fit







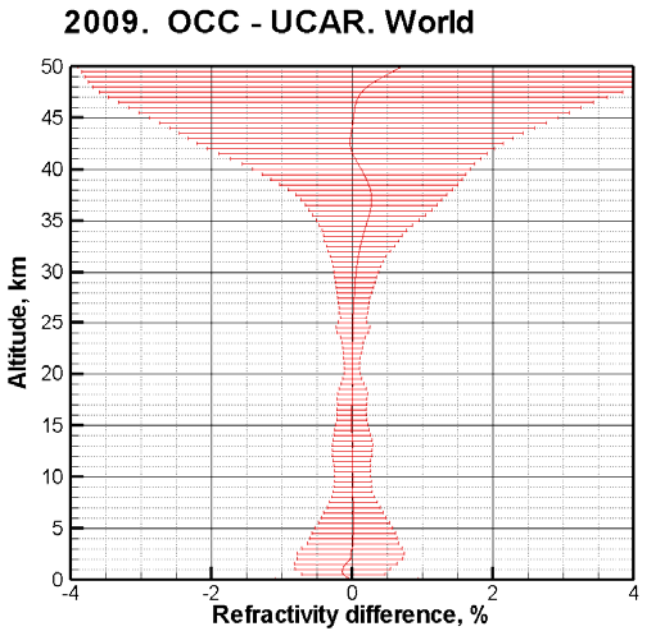


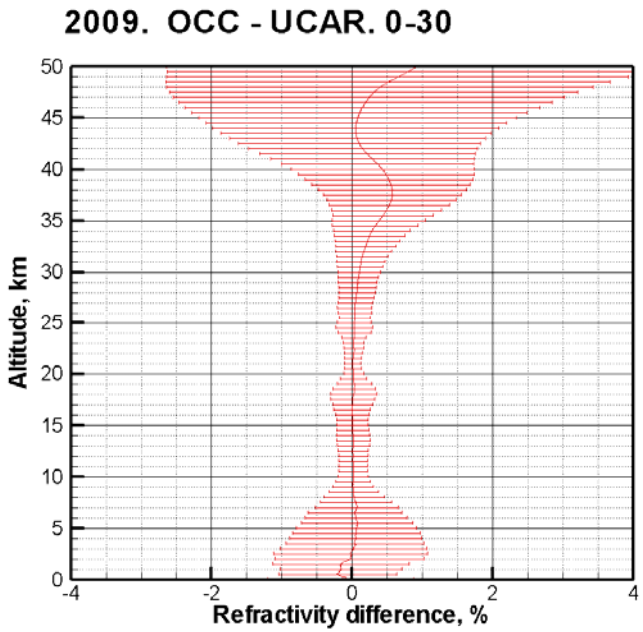
OCC-UCAR: 2009 REF, optimal options

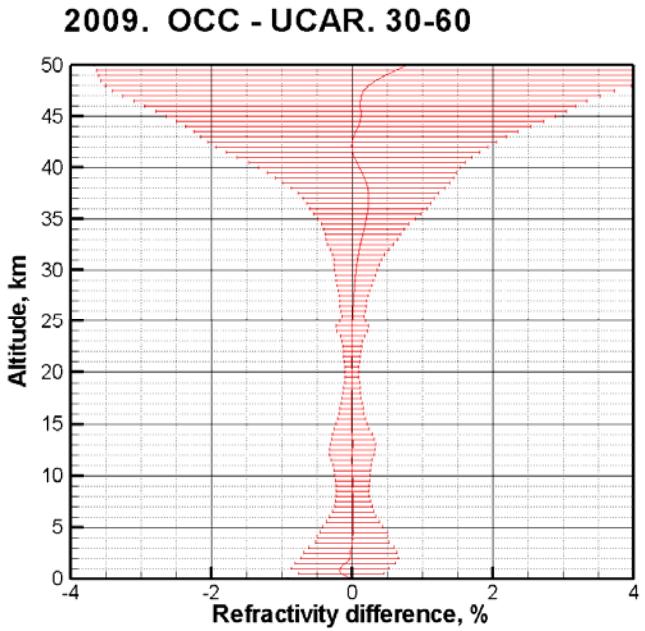
Cutoff at SLTA = -250 km

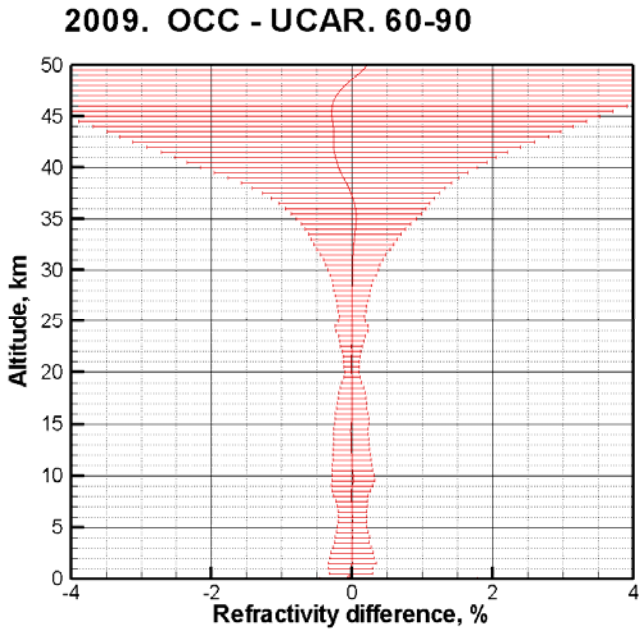
RH filtering: phase: no

Initialization to ECMWF







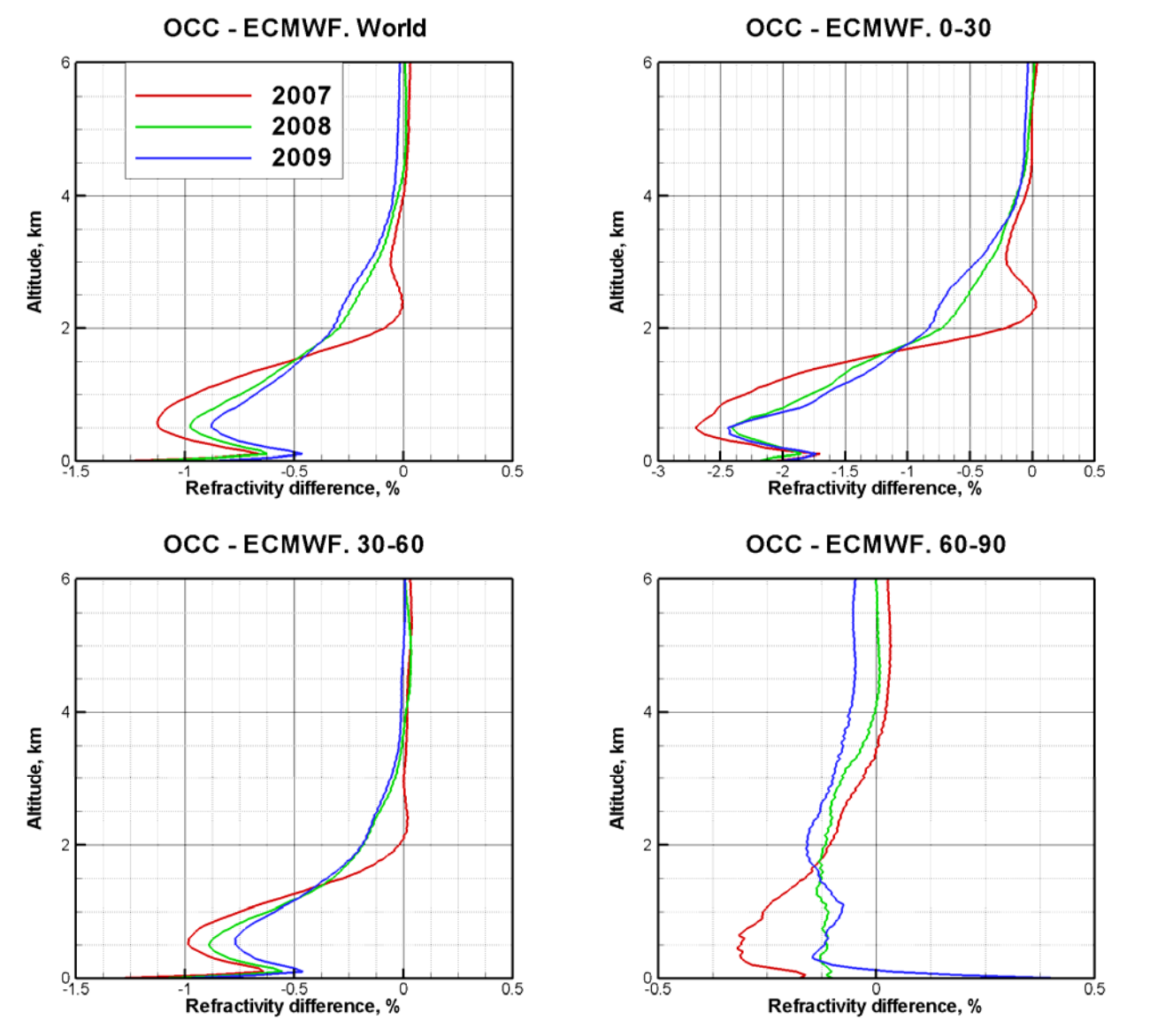


OCC-ECMWF differences : 2007, 2008, 2009

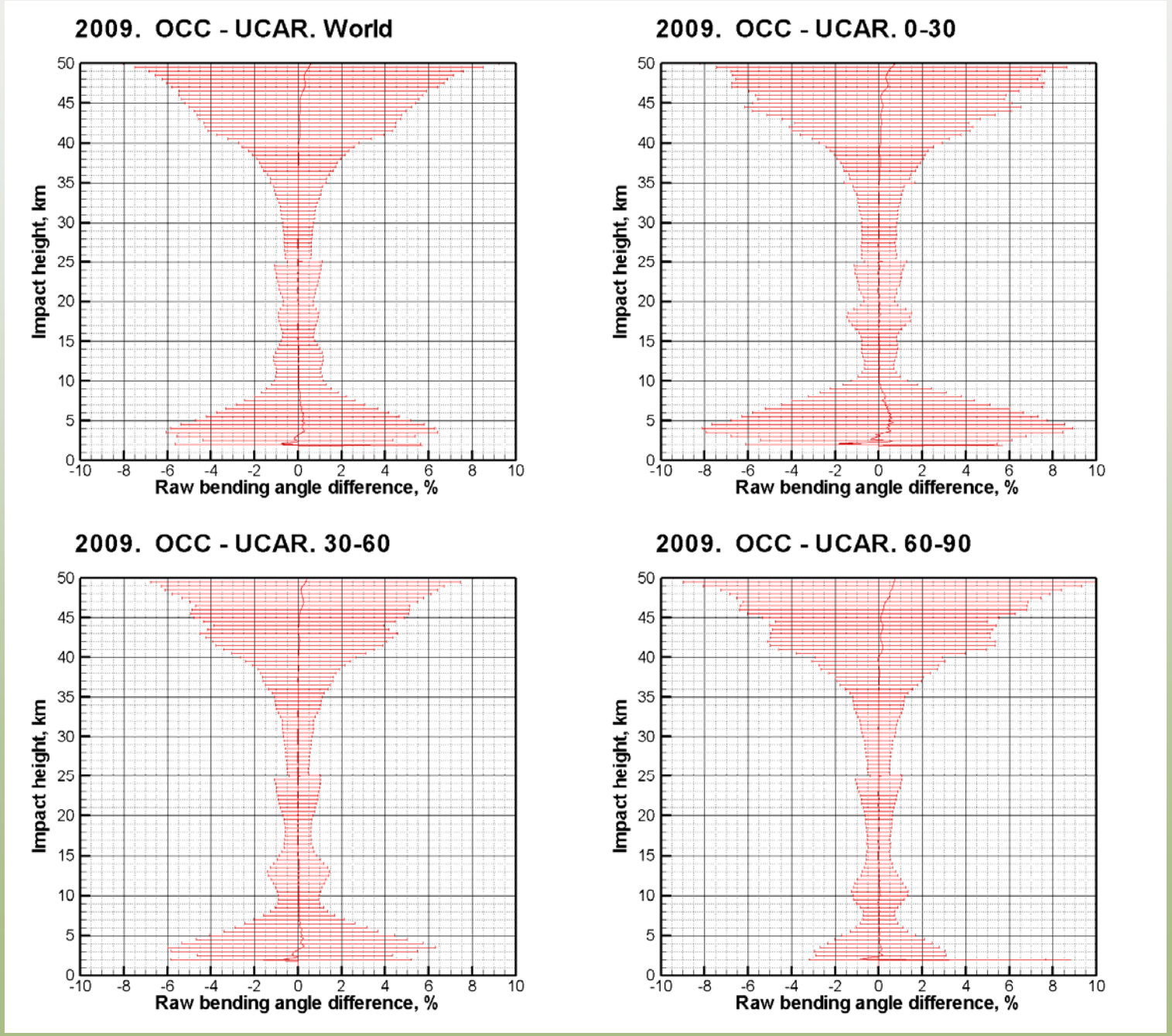
Change in ECMWF cycle 32r3 in 2008:

i) COSMIC RO assimilated to surface

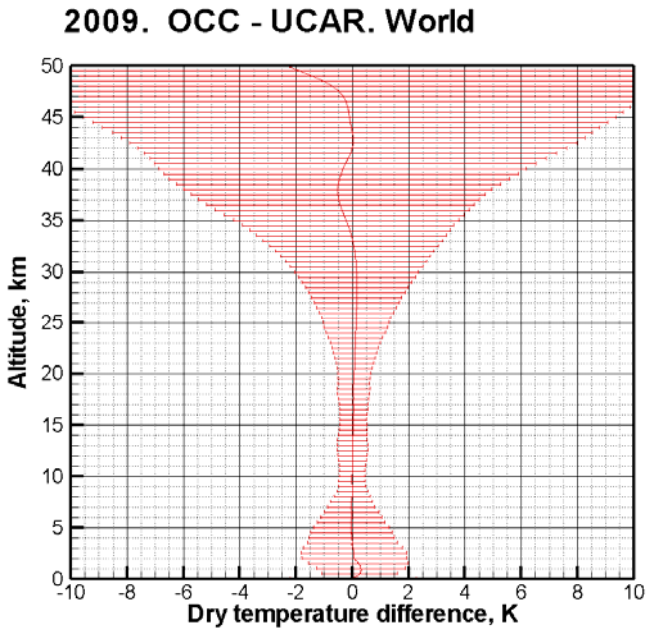
ii) updated convection and entrainment physics

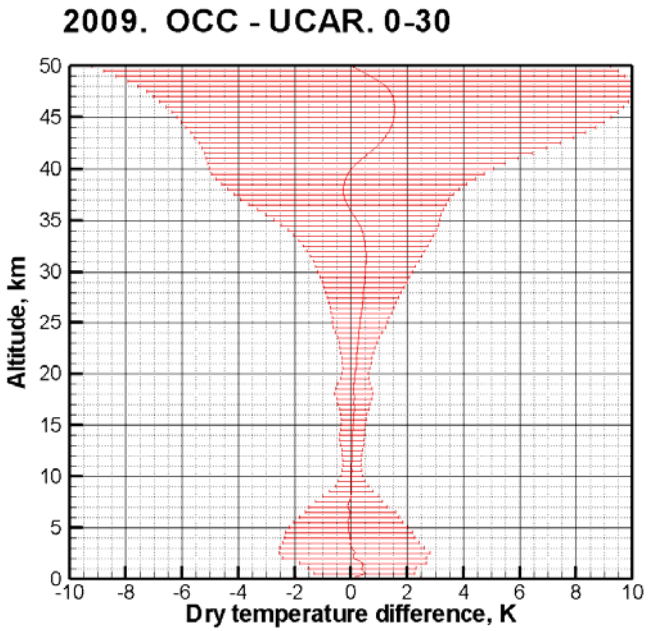


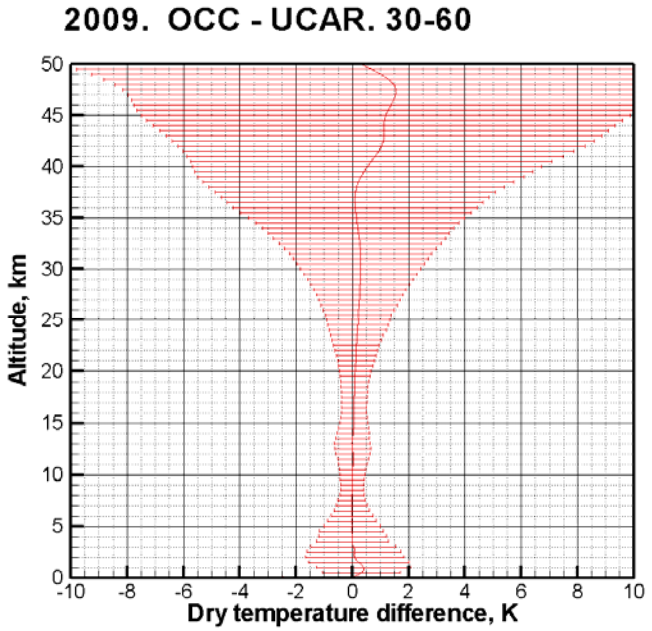
OCC-UCAR: 2009 raw BA

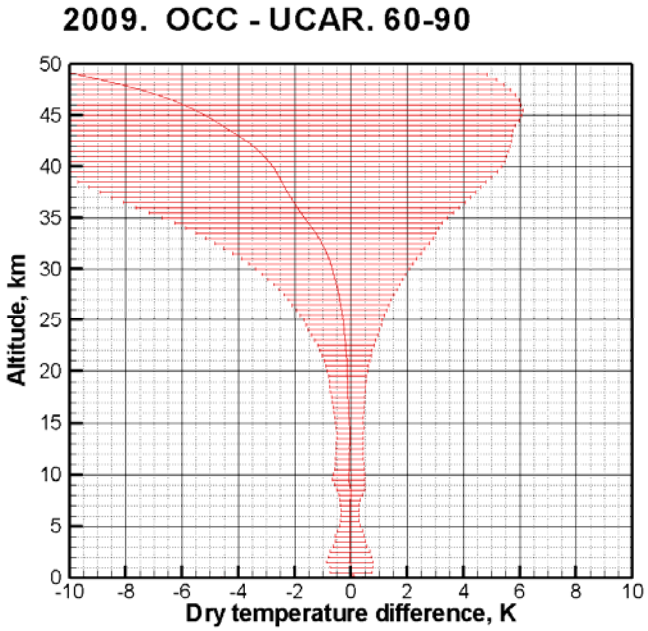


OCC-UCAR: 2009 Tdry









Results

Comparison of OCC and UCAR refractivities for three different years (2007, 2008, 2009)

Tropics:

- relative difference is smaller than 0.1% for 2-30 km (and smaller than 0.03% for 9-25 km)
- 0.2% bias below 1 km, due to different cutoff and filtering

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