Atmos. Meas. Tech. Discuss., 7, C2075–C2077, 2014
www.atmos-meas-tech-discuss.net/7/C2075/2014/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Assimilation of GNSS radio occultation observations in GRAPES" *by* Y. Liu and J. Xue

Anonymous Referee #2

Received and published: 8 August 2014

1 General comments

This paper provides a summary of the method by which radio occultation (RO) data are assimilated into CMA's GRAPES model and the impact RO has on NWP forecasts. The summary of the assimilation system is mostly very clear, though it perhaps gives the impression that the refractivity observation operator presented here is original, whereas it is very similar to the implementation used at the Met Office (particularly the use of information on a staggered grid).

The forecast impact is shown relative to a baseline system comprising only conventional observations and clear improvements are seen using a range of metrics. Some

results showing the impact of RO in a system with all observations would improve the paper considerably.

2 Specific comments

These comments are in the order in which the issues appear in the manuscript.

1. Page 7614, line 23: A statement is made regarding the delay in exploiting RO for Earth-based meteorology. A reference is required here.
2. Page 7615, line 18 onwards: The advantages of RO are described. The disadvantages should also be included for completeness (e.g. low horizontal resolution etc.).
3. Page 7617: It is stated on line 4 that potential temperature is in the model but in equation (1) it does not appear in the state vector.
4. Page 7617: The reason why the potential temperature is derived from the model Exner and geopotential height, rather than using the actual model potential temperature should be explained.
5. Page 7620: Is the bi-weight method applied to all observations in the window, or is it applied to the different instruments separately? This could affect the observations that pass/fail the QC.
6. Section 3.3: The details of the observation operator, particularly the handling of model levels and the use of Exner-derived potential temperature, are very similar to the refractivity operator described in this report by Rennie (2008): 'The Assimilation of GPS Radio Occultation data into the Met Office global model' (http:

//www.metoffice.gov.uk/archive/forecasting-research-technical-report-510). Although the implementations are not identical, the similarities are striking, so the authors should make it clear that the operator is significantly based on previous work.

7. Page 7621: Vector quantities in equations (specifically $\mathbf{x}$ and $\mathbf{y}$) should be bold.

8. Page 7222: The linear interpolation of Exner pressure could introduce systematic biases in the forward model. The reason for selecting this interpolation scheme should be stated.

9. Page 7623: In equation (13) the value 0.608 should be expressed symbolically and its meaning as a physical constant described.

10. Page 7623: The vertical correlation of observation errors is not mentioned. For refractivity, these correlations are significant so they should be used in the assimilation. If they have not been, this decision should be explained.

11. Section 3.4: This section is well-written and the conclusions seem justified. However, results showing the impact of RO in a full system (i.e. with other satellite observations) are not presented here. If the authors have carried out any experiments to test this, then these results should also be included for completeness. If such experiments have not been carried out, I encourage the authors to at least provide a discussion of the issue, particularly with regard to anchoring the bias corrections of satellite radiance observations, and any plans they have to investigate this further.

12. Page 7630: Part of the title of the Lanzante paper is listed as an author.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 7613, 2014.