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Interactive comment on "Tropospheric dry layers in the TropicalWestern Pacific: Comparisons of GPS radio occultation with multiple data sets" *by* Therese Rieckh et al.

Anonymous Referee #2

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Summary: This paper's objective is to assess the effectiveness of the GNSS radio occultation (RO) technique in characterizing extremely dry atmospheric layers. Comparisons are made during the CONTRAST campaign in Jan+Feb 2014, to other observations such as AIRS, MTSAT, aircraft and radiosonde profiles, and to reanalyses. The authors note the different sampling and resolution characteristics of these techniques and find good agreement generally between the different methods. The authors conclude that the GNSS RO technique is effective in contributing significant information about dry layers in the tropics and sub-tropics. A combination of case studies and statistics (for 2014) are used.

Review summary: The authors develop a useful study that is a significant contribu-

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Discussion paper

tion to the literature and should be published. However, certain conclusions contained within the paper are too narrowly drawn to be useful and should be modified or replaced. Further detailed comments follow.

Detailed Comments: Page 3, Line 1 (P3,L1): The reference to Randel 2016 is vague. Is this paper in preparation, submitted, etc.?

P 5, L 19: The instrument resolution is not the same as the retrieved product resolution for AIRS. The authors should quote the horizontal resolution of the retrieved temperature and humidity Level 2 products, not the instrument resolution.

P 5, L 28: I believe it is incorrect to suggest that the in-situ measurements have large sampling errors by comparison. Sampling error is the difference between a measurement value and the actual atmospheric state given the sampling volume.

P6, L11: This reads as follows: the time and space criteria consist of three pairs of values. What is meant by "closest" in time and space? Given the pairs, it is ambiguous. Which pair represents the maximal degree of collocation?

P6, L19: It's not clear that the GFS and ERA profile shapes are limited by "lower vertical resolution" (Figure 2). How many levels are there between 0 and 2.5 km? It may be more subtle factors such as model physics, or limited observations, that account for the profile shape.

P10, L7: I agree that AIRS vertical resolution cannot capture the transition, but the number of levels of GFS or ERA may be able. Please state the number of levels in these models for the different lower troposphere altitude ranges.

P11, L10: Please provide reference(s) to the previous work mentioned.

P11, L30: Given the similarities mentioned, is there a compelling reason not to show the aggregate statistics for all the collocation criteria?

P12, L5: Figure 6 as presented has limited value because the contribution of colloca-

tion error to RH scatter is completely unconstrained, thus compromising the value of this information in assessing RO. An attempt should be made to assess the contribution of collocation error (e.g. vary collocation criteria in time and space to assess scatter growth with collocation distance, or use reanalyses to assess – in a lower-bound sense – the contribution from collocation).

P15, L16: Appendix A has limited value, as it represents a single profile, but the difference between 1DVAR and "simple" depends critically on the accuracy of the temperature used in simple. Additional factors affect 1DVAR accuracy. A simulation or analytical treatment of the technique differences would be more useful, that spans a range of temperature errors (among other factors). It would seem more useful to quote the literature on errors of the simple method (e.g. Vergados et al. publications) and compare these errors to what is expected in the 1DVAR. I recommend removing or strongly modifying Appendix A to take these factors into account. If Appendix A is removed, the literature should be consulted as to how 1DVAR and simple might differ, and the appropriate references included and quoted.

P16, L3: I need to be convinced (based on the number of levels) that resolution is what limits GFS and ERA, versus other factors such as physics, or assimilation data set and method, etc.

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