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Comment

## ***Interactive comment on “An investigation of seasonal temperature trends in the Antarctic using CHAMP GPS radio occultation data” by K. Zhang et al.***

### **Anonymous Referee #1**

Received and published: 2 March 2011

### **General comment**

The manuscript deals with radio occultation (RO) measurements of upper-atmosphere temperatures in the Antarctic. Two separate issues are addressed. First the question of how well RO temperature profiles agree with traditional radiosonde observations is addressed by a statistical comparison between collocated RO and radiosonde observations. Second, observed temperature trends in the Antarctic are derived from RO observations covering seven years. The first part of the study is based on data from the CHAMP and COSMIC missions, whereas the second part is based solely on CHAMP data.

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Both these issues are important – collocation studies can potentially improve our understanding of the error characteristics of the data that we use, while the quantification of atmospheric temperature trends is of a broader scientific interest. It may be tempting to cover it all in one paper, but it may be better spent time to go deeper into one field rather than doing a shallow job in two fields.

Furthermore, for these type of studies to be useful one has to carefully consider the implications of the statistics of the data at hand – statistical significances, effects of under-sampled variability, small number of data points, etc. This is not given enough weight in the present study, particularly not in the trends analysis (see the specific comments below).

The general impression of the paper is that the first part – the evaluation study – has the potential to give some insight into the problem at hand, whereas the second part – the trends study - has not been given nearly enough thought. It is unlucky that the title of the paper point out the part of the study that appears to be work in progress.

### **Comments on the evaluation study**

For collocation studies to be meaningful, the impact of the choice of collocation criteria should be small in comparison to the impact of other errors. Hence, it is a merit of this study that it explicitly addresses this issue. Here, I would suggest a reference to Staten and Reichler [2009] who recently did a comprehensive study on the impact of collocation criteria for COSMIC data.

For an improvement of the evaluation study the following issues should be addressed:

+ if radiosonde data from 38 stations are used, of which only 3 are located in the Antarctica, one cannot really say that the study compares data in the Antarctic region.

+ Figure 1 shows the locations of 17 stations in the Antarctic: 14 WMO stations and 3 Australian stations. Have the WMO stations been used in the study? If not, why? Where are the other 35 Australian stations that were used in the study located?

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+ One wonders how the individual profiles compares? A few examples, say one or two for the South Pole and one or two for the coastal region would give the reader a better insight.

+ How where the confidence intervals computed?

### **Comments on the trends study**

While the subject of atmospheric temperature trends is important, it is also a field that requires a careful treatment of errors and variability in the data. Trends in the climate are viewed with observational data that have intrinsic uncertainties, against a backdrop of natural diurnal, synoptic, and seasonal variability that is partly under-sampled.

It could be questioned whether any trends – even if significant - over a 7-year time span have much to say about the longer-term climate trends. This would be questionable for annual global averages, and even more so for regional seasonal or monthly averages.

The available CHAMP data are sparse. Within each monthly 5 degree (latitude) by 10 degree (longitude) grid box there is only a few observations made by CHAMP. How many? This is not described in the paper. There are no descriptions of the sampling errors and no discussions about the significances of the trends. How uncertain are the trends derived in the papers? I would guess quite uncertain, but I have to guess since this information is not provided in the paper.

The question of climate trends is interesting, but due to the lack of information mentioned above there is simply no information to be gained from the present study. The conclusions seem premature and the strange appearance of the trends plots raises questions about the significance of the trends found. It appears to be work in progress and my recommendation is to work a whole lot more on the statistical issues before publishing it.

### **Conclusions and a suggestion**

My conclusion is that the collocation study is worth to be published after a major re-

vision that includes addressing the issues raised above. However, the trends study should not be published.

A suggestion would be: change the title of the paper, concentrate on the evaluation study, and come back to the trends study as a separate work in the future. That trends study should then consider previous publications in the field and address the fundamental statistical issues that arise when trying to detect small trends from variable data using uncertain and sparse observations.

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Interactive comment on Atmos. Meas. Tech. Discuss., 4, 511, 2011.

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