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Atmospheric Measurement Techniques Discussions



# *Interactive comment on* "Wuhan Atmospheric Radio Exploration (WARE) radar: implementation and initial results" *by* C. Zhou et al.

**Anonymous Referee #2**

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Wuhan Atmospheric Radio Exploration (WARE) Radar: Implementation and Initial Results By Chen Zhou, Haiyin Qing, Gang Chen, Xudong Gu, Binbin Ni, Guobin Yang, Yuannong Zhang, and Zhengyu Zhao

The manuscript presents initial and selected results of the Wuhan Atmospheric Radio Exploration (WARE) Radar. The authors provide a motivation of the research they plan to conduct with the system and demonstrate the capabilities of the radar by showing data from the troposphere up to the mesosphere. However, the different scientific aspects are rather short. The citations given by authors are more or less a very short summary of what has been done 20-30 years ago and some recent advances with other MST radars seem to be not discussed. Reading the manuscript leads to the impression that there are many different aspects presented, but they are not discussed



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and threated as it should be done. Each of the presented scientific sections requires further analysis and the presented results should be related in more detailed to more recent papers in those fields. Further, there is a remarkable amount of language mistakes that require a careful language editing. The number of mistakes is too numerous to be listed in the review. Major scientific comments: Concerning section 2: This section contains the basic information about the radar system and the authors demonstrate the enthusiasm working with the radar system. The description and technical aspects of the radar are rather short and lack some interesting information that is of relevance for the later conclusions of the authors. Does the system have inferometric capabilities? What are the experiment settings for the tropospheric and mesospheric modes e.g. PRF, range resolution, pulse coding etc.? Do the authors estimate the radial wind velocities applying additional coherent or incoherent integrations? Can the system perform multi-beam experiments (sequential or parallel)? How many different beams are included in a single experiment? How many data points are recorded or what is the temporal resolution of the derived winds or power profiles? This information is of importance to the reader as they support the conclusions drawn by the authors. The number of coherent and incoherent integrations is of relevance on the quality of spectral information and is important to understand the altitude coverage of the system. Also the experiment settings contain helpful information about likely range aliasing effects and so forth, which could be one reason why they manipulated Figure 2.

Section 3: The authors compare the winds derived from their DBS observations to rawinsonde data. How many rawinsonde flights were conducted? How far did the rawinsonde drift away from the radar? Are there some mountain ridges close to the radar site that can generate mountain waves? See discussion of recent wind comparison (Lee et al., 2014, NERC Aberyswth) or MAARSY (Stober et al., 2011)? Why did the authors use 20° off-zenith beams for the mesospheric wind observations? This leads to a huge observation volume and the wind observation becomes more complex (e.g. Browing and Wexler 1967, Waldteufel and Corbin 1973, Stober et al., 2014, AMT). To get a 'good' wind estimated from such a huge volume at least the horizontal divergence



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should be included. Are the discrepancies in Figure 1 related to orography or to the increasing distance between the rawinsonde and the radar? The authors did definitely manipulate Figure 2 by including a rectangle of constant contour level between 76 - 81 km altitude and a Doppler shift between 25-50 m/s. The reviewer encourages the authors to show the data as it is. They should discuss why they did not take into account this part of the spectrum or show a different example rather than changing the Figure. The shown data on tropopause heights needs also some further analysis. I hardly can see the tropopause height from Figure 3. This should be discussed in much more detail. The reviewer also misses a comment; Why is the tropopause height of importance?

Aspect sensitivity: The section of the aspect sensitivity is completely misleading. The authors mainly refer to rather old publications and ignoring the recent possibilities of the new systems and the advances that have been done. The examples shown in Figure 5 are not suitable to discuss this issue. Aspect sensitivity requires a much more detailed analysis and should not be inferred from a single measurement. Usually long averaging times are required to get rid of random effects. How can the power become larger with increasing off-zenith angle? This is against the complete theory of aspect sensitivity - maybe the concept is wrong or incomplete? Did the authors check the mean angle of arrival? Maybe the beam volume was not completely filled? Typical MST 'scatterers' are patchy, viz. the assumption of complete volume filling is not always satisfied. Tides: The reviewer was not aware that atmospheric tides can be found in the troposphere at least with fairly reasonable amplitudes. As far as I know the diurnal tide is generated in the troposphere by water vapor and the semi-diurnal tide the stratosphere by ozone, but for both tides the amplitudes increase with altitude and become dominant modes in the mesosphere. A closer inspection of the lomb-scargle spectrum shown in Figure 7 indicates a significant offset from 12 and 24 hours. The peaks show a period of 12.3 and 24.5 hours, which is far outside of what I would expect to be a tide. I expect that the tropospheric winds are dominated by synoptic processes as fronts and high and low pressure systems. The authors should discuss those points.



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However, the reviewer sees a great potential for the authors to perform high quality contributions to the scientific fields that they touched in this paper. In particular, the presented AGW analysis shows the high quality of their work and skills as well as the power of the radar. The tropospheric wind measurements show the great potential of the WARE radar to be used for AGW studies in that altitude region.

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Interactive comment on Atmos. Meas. Tech. Discuss., 7, 11901, 2014.