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Interactive comment on "Airborne laser scan data: a valuable tool to infer partial beam-blockage in urban environment" *by* R. Cremonini et al.

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The article is an interesting preliminary view of the potential benefits to radar blockage estimation by using very high resolution LIDAR mapping of buildings and other features not present in common digital elevation maps (DEMs). Some of the potential issues/limitations are also introduced, such as temporal changes and structures that are not well characterized by their horizontal footprint in the LIDAR database.

However the article is weak in many ways. There are unstated assumptions and a lack of important detail in the methodology. These might be hiding scientific significance and quality. The writing is not good. There are many errors with English grammar, starting with an error in the title itself, but the writing also has a lot of organizational issues, such as statements that do not follow logically the ones preceding them. The paper needs major revision.

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Discussion paper

One significant unstated restriction is that the theoretical blockage calculations are for a stationary antenna pointing in a fixed direction. Most weather radars are operated to collect azimuthal averages, combining 16 to 64 azimuthal samples over intervals of 0.5 to 1.0 degrees of azimuth. When considering blockage from real weather radar data this azimuthal averaging must be considered. This distinction is particularly important for vertical obstructions of intermediate extent, such as chimneys or towers (Hanasaari power plant), where the contribution to a larger azimuthal average will be less than to the worst single direction.

Another unstated assumption is that the beam is uniformly filled with precipitation targets, especially in the vertical. The authors mention winter as a motivating consideration and in winter the assumption of uniformity in elevation is often broken. See Tabary (2007) "The New French Operational Radar Rainfall Product. Part I: Methodology" Section 3c in J. Weather and Forecasting.

In terms of methodology, most of the equations given are ones one might find in any introductory text on weather radar. More detail needs to be given about the exact equations used for blockage estimation and how they are solved numerically. As mentioned in the paper, there already exist a few studies using Lidar DEM's, so how does the methodology here compare to them?

The case of September 22, 2014 is shown and apparently used to estimate blockage from observations for comparison to the calculations, but there are only hints how this was done. One can guess that one or more plots of rainfall accumulation were plotted as a function of azimuth at one of more ranges. If so, show an example. What is the estimated accuracy of these estimates? For example if my understanding is correct, does one get similar numbers from different ranges? Also, as mentioned above, information about azimuthal averaging of the observed data is required for context.

I like the idea of getting an estimate of blockage uncertainty by adding some random errors to the antenna pointing axes. However the justification for the range of errors

is not clear. What is meant when the article says “The antenna pointing accuracy for the three weather radar (sic) is about 0.1°”. When considering where an antenna is pointing there are a number of considerations: How precise is the read back angle mechanism? Are the read back angles biased? How reproducible are the angles between scans (antenna control)? Antenna control in elevation is known to be an issue in some antenna systems and can have important implications for blockage, even if sun pointing show the hardware is good. In addition, the range of azimuthal averaging can depend on factors like temperature in the radome.

Minor issues:

PPI maps showing calculated blockage might be nice, especially for comparison to Figure 5 (accumulation).

How computationally expensive is all this? How would one use it operationally, or does one use it only for understanding? In the absence of good antenna control one might need to rely on read back angles (assuming these to be accurate) and multiple calculations, since angles might change from scan to scan.

Any comment on the advantages of theoretical calculations from terrain height versus purely empirical estimation of blockage from radar echo statistics, as done on Sept 22?

Table 2 and 3 are inconsistent with each other and to a certain degree the text. Table 2 gives blockage as a range. Would it be better to give as an average (or median) “+/-“ the standard deviations (or interquartile)? Table 3 omits estimation of variability.

Figure 8, the panorama, should be introduced earlier, in the discussion of Kumpala radar on page 3. Is it worth just extracting sections of the overall panorama for the individual features discussed in the text? For example, the subsection of the panorama with the Paavalin church that corresponds to Figure 3 is too small to see. The panorama is interesting, but is it all needed here? More detail about the panorama would be good. How were the panoramas created? Presumably the antenna is inside a

radome. Images from a deck several metres below the antenna axis can be misleading when one considers objects that are relatively close to the radar. (4m height difference changes a target at 1km by 0.2 degrees) For example the impression of the Paavalin church at 190 degrees would probably be different.

It probably does not matter much, but it should be mentioned that obstacles less about 1km away from a weather radar may start to be in the near-field of the antenna, depending on the antenna size. If this is the case, geometrical optics start to be questionable.

Title has grammatical error: Should be either “Airborne laser scan data: a valuable tool to infer partial beam-blockage in an urban environment” or “Airborne laser scan data: a valuable tool to infer partial beam-blockage in urban environment environments”

Numerous grammatical errors seem to grow in number through the paper. At a minimum, careful vetting is needed for the title, abstract, intro and conclusion.

”The 3” at line 14 on page 5 took a while for me to figure out.

The spelling “meters” is used for the unit of measurement. Contrast with “vapour”. The article should consistently use American or International spelling of English. The journal can recommend which one.

The reference to Lang (2009) probably belongs in sentence about dual polarization.

The “Doppler snake” is a fanciful expression invented by Elena. Call it the zero-isodop.

This is disjointed: “<The> Figure 8 shows the 360° panoramic view from the antenna tower of Kumpula radar: the main obstacles like Paavalin Kirkko bell tower, residential buildings in Itä-Pasila and YLE Studiotalo buildings with their television tower are clearly visible. The obstacle shapes have been gathered using a simple linear model; this approximation leads to underestimations or over-estimations in case of masts or complex shape buildings.” I can only guess what the authors are trying to say. What are they referring to when they say “obstacle shapes have been gathered using a simple linear model”?

As a remark, the application of LIDAR's extends well beyond urban environments. Blockage calculations for rural radars frequently fail because of forest canopy or individual trees within a few tens of kilometres of the site. Of course, in mid-latitudes blockage by deciduous trees can be seasonal, making ALS results different summer to winter.

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