

## ***Interactive comment on “Areal rainfall estimation using moving cars as rain gauges – a modelling study” by U. Haberlandt and M. Sester***

### **Anonymous Referee #1**

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#### General comments:

This manuscript presents an interesting method of observing rainfall, addressing the issue of insufficient networks for high time resolution data. Although it clear that the manuscript provides a modelling studying, which demonstrates the potential of the proposed methodology, the study is based on assumptions which are quite general some of which need further qualification. Issues regarding the reliability of the proposed method of providing accurate observations need to be expanded, since the quality of rainfall data has a direct impact upon its subsequent use. The author assumes the windscreen wiper frequency is linked with rainfall intensity; however the inherent error would be huge, making the scheme unusable. The author needs to do some experi-

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ments to show how good or bad the link is between wiper frequency and rainfall rate. Without this the the rest of the paper is built on weak foundations and should be rejected.

### Specific points

1. Pg. 4741 Lines 22-26. Calibrating rainfall rate and windscreen wiper frequency is achieved using traditional rain gauges as a comparison. It is suggested that rain gauge data will have to be interpolated to car location. What would be the likely magnitude of error and level uncertainty in doing this? Is it possible to reduce the uncertainty in the calibration process by using measurements from vehicles which pass within a chosen tolerable distance of a traditional rain gauge?

2. Pg. 4741.Line 25. Here it is suggested that radar data could be used in additional to rain gauges for calibrating the rainfall rate with windscreen wiper frequency. How would this be done to maximise the benefits of each method of precipitation estimation while minimising their drawbacks? For example weather radar provides us spatial information that cannot be measured by rain gauges. But it provides rainfall estimates rather than measurements. These estimates can be adversely affected by bright band, anaprop etc.

3. Page 4745 lines 2-4. Many in the hydrological community do not consider rainfall observations derived from weather radar as 'truth'. First of all they do not give a direct measurement of rainfall which reaches the ground. Rather rainfall amounts are inferred by the Z-R relationship which is an empirical relationship and varies according to the type of rainfall and geographic location and so can introduce error into the rainfall estimates. Moreover rainfall intercepted by weather radar does not always reach the ground, what is more the radar beam can overshoot rainfall occurring in the sky or it may even intercept the bright band layer. If you are going to use radar as 'truth' you need make a strong case for doing so. Although rain gauges do not give the spatial information that weather radar can provide the rainfall measurement from them is

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considered to be more reliable and is usually used in the calibration of weather radar.

4. Pg.4749 Lines 8 &9. Can you clarify how the cars are randomly generated? It is not realistic for all roads to have uniform traffic density. Some roads will be more used than others. This will have an impact upon the reliability of the proposed method of rainfall measurement to produce accurate rainfall measurements. Although it is clear that allowance has been made for different traffic density according to the time of day, it is not clear if you considered the effect of bias due to some roads being more used than others

5. Pg.4749 Lines 9-1. How was the point location chosen? I.e. is the measured rainfall allocated to the nearest raster cell centre point?

6. Pg. 4750 Lines 11-13. How are the values in Table 2 calculated?

7. Pg. 4753 Line 15. I could not understand this sentence.

8. Accurate rainfall measurements are necessary for water resource management and flood forecasting. Therefore it is important to be aware of the errors in measurement and to know how confident we can be that the measurements are accurate. What are the potential sources of error in using windscreen wipers to measure rainfall? How large are they? Could these be amplified by rainfall at high or low intensities? How could they be mitigated?

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 4737, 2009.

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