

We thank the reviewers for their comments and thorough evaluation of our manuscript. The aim of our paper was to investigate different methods for merging radar and CML data.

Our main take away from the two reviewers is that we should

- Perform a sensitivity analysis of variogram parameters and neighborhood size
- Perform log transformation of ratio data
- Elaborate on CML uncertainties and consequences for interpolation method in the discussion

We agree to investigate these issues.

Please find our reply in blue to the issues raised

The paper entitled “Improving weather radar rainfall estimates by merging with commercial microwave link data: a fully reproducible, large-scale method intercomparison” by Erlend Oydvin and co-authors investigates the contribution of commercial microwave link data to mitigate observation errors and biases in weather radar rainfall data through data fusion. The idea is potentially interesting but the current version of the study includes a major methodological error that in my opinion should prevent publication in the present form.

The authors propose to skip the variogram estimation step of Kriging, which is missing the point of Geostatistics that are based on estimating the spatial variability of the process at hand from data through variogram estimation (e.g., Chilès and Delfiner, 2012). To justify their choice the authors mention their own sensitivity analysis without sharing any result, and cite two papers: Haberlandt (2007) and Goudenhoofdt and Delobbe (2009). But I read these papers and they do not support the idea of not estimating the parameters of the variogram from data. In Haberlandt (2007) the hypothesis is tested, but the author clearly states that “the use of an assumed linear variogram is not recommended, because this shows by far the largest RMSE values for both interpolation methods (p 151)”. And in Goudenhoofdt and Delobbe (2009) the parameters of the variogram are estimated from data. In my opinion what one can conclude from Haberlandt (2007) and Goudenhoofdt and Delobbe (2009) is that the choice of a complex model of variogram is unnecessary in Kriging when a local neighborhood is used for interpolation, and that in this setting a linear model of variogram is good enough. But the idea of using a spherical model of variogram with arbitrary parameters is not at all supported by these references.

We suggest to expand the study to estimate the variogram from data. We further suggest to investigate the effect of neighbourhood size on the interpolated fields.

Another misleading use of a reference is the way the authors cite van de Beek et al. (2012) to justify the choice of the variogram parameters they use. The main point of van de Beek et al. (2012) is to show that variogram parameters vary a lot (in this case in time) depending on rainfall characteristics (cf Fig. 3 in van de Beek et al. (2012)). But in the paper in review the authors pick one single value for the variogram parameters, which is in contradiction with acknowledging the variability of variogram parameters. In addition, the way they derive this value from the work of van de Beek et al. (2012) is totally unknown and not justified. Finally, I would like to point out that van de Beek et al. (2012) focuses on the Netherlands, while the

present paper investigates rainfall in Sweden and Italy, where one can expect that rainfall spatial variability is different.

We suggest keeping this approach as reference to compare with variograms estimated from data (see above).

The problem of variogram estimation is also likely to impair block Kriging. The authors acknowledge that former studies estimated the point covariance from block averaged data (Graf et al. (2021); Goovaerts (2008)), but they renounce to this approach without any justification and prefer to use an arbitrary model of variogram with arbitrary parameters. This is very surprising since two of the co-authors of the present paper are also part of Graf et al. (2021), in which point variogram parameters are estimated in a sound way.

We suggest expanding the study to show the impact of variogram parameters on the interpolated fields.

References:

Chilès, J. P., and Delfiner, P. (2012). *Geostatistics: modeling spatial uncertainty* (Vol. 713). John Wiley and Sons.

Goudenhoofdt, E. and Delobbe, L.: Evaluation of radar-gauge merging methods for quantitative precipitation estimates, *Hydrology and Earth System Sciences*, 13, 195–203, <https://doi.org/10.5194/hess-13-195-2009>, 2009.

Goovaerts, P.: Kriging and Semivariogram Deconvolution in the Presence of Irregular Geographical Units, *Mathematical Geosciences*, 40, 101–128, <https://doi.org/10.1007/s11004-007-9129-1>, 2008.

Graf, M., Hachem, A. E., Eisele, M., Seidel, J., Chwala, C., Kunstmann, H., and Bardossy, A.: Rainfall estimates from opportunistic sensors in Germany across spatio-temporal scales, *Journal of Hydrology: Regional Studies*, 37, 100 883, <https://doi.org/10.1016/j.ejrh.2021.100883>, 2021.

Haberlandt, U.: Geostatistical interpolation of hourly precipitation from rain gauges and radar for a large-scale extreme rainfall event, *Journal of Hydrology*, 332, 144–157, <https://doi.org/10.1016/j.jhydrol.2006.06.028>, 2007.

van de Beek, C., Leijnse, H., Torfs, 625 P., and Uijlenhoet, R.: Seasonal semi-variance of Dutch rainfall at hourly to daily scales, *Advances in Water Resources*, 45, 76–85, <https://doi.org/10.1016/j.advwatres.2012.03.023>, 2012.