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Guidance on optimal vertical covariance localization based on a convection-permitting 1000-member ensemble

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Appropriate localization is crucial for the success of ensemble data assimilation systems. Localization mitigates sampling errors and damps long-range spurious correlations, which arise from modeling background error covariances using small ensembles. However, finding the best localization function and scale is challenging. Recent studies showed that an optimal localization can depend on various factors such as the atmospheric conditions, the variable of interest, ensemble size, or observation type. Our goal is to improve localization for convective scale data assimilation based on a convection-permitting 1000-member ensemble simulation. The data set covers several forecasts in a high-impact weather period in summer 2016 (Necker et al. 2020a & 2020b). Our latest study aims at finding optimal localization functions and scales in the vertical. We focus on 40-member subsamples and assume the 1000-member ensemble covariance as truth. We estimate optimal localization length scales based on the often-applied Gaspari-Cohn function. Furthermore, we compare the performance of different tapering functions including an exponential-shaped function. The first results indicate that other tapering functions can outperform the Gaspari-Cohn function in the vertical. Optimal localization scales strongly vary between different weather situations. Overall, our analysis assesses covariances and localization between different variables and/or observations covering both model and observation space. This experimental design enables general conclusions independent of a specific data assimilation algorithm.