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Accounting for localization in ensemble network design experiments

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In order to conduct network design experiments for a forecast system, methods are needed to evaluate the potential benefit of hypothetical observations. Ideally these methods are flexible enough to accommodate multiple observation types and forecast lead times, while being computationally fast enough to evaluate many potential observational network layouts. For ensemble forecasts, this can be achieved by assuming a linear sensitivity between the background ensemble perturbations and a forecast quantity of choice. This assumption enables estimating how much the ensemble variance of a chosen forecast quantity would be reduced for an arbitrary combination of observation locations and types, without the need to run additional forecasts. These variance reduction estimates need to take the localization used in the data assimilation framework into account, so that the estimates are consistent with the ensemble forecast system they are derived for. This localization aspect has so far received little attention.

In this presentation we compare two methods to take localization into account when estimating the benefit of hypothetical observations. One method requires inverting the background ensemble covariance matrix. The other method avoids the inversion, but needs to be provided with estimates of signal propagation over time. We use a simple linear advection toymodel to show that while both methods can function well, due to their various strengths and weaknesses they are suited to different applications.