Regular triangle approximation for reduced-order Kalman filter

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Number of error covariance elements is intentionally reduced in sparse assimilation modeling. Here, we compare three regular coarse geometries—triangle, square, and hexagon grid systems to minimize computational requirements in Kalman filtering using a northwestern Pacific model. This study finds that the triangular approximation is more accurate than the others in terms of spatial interpolation from 529 low-resolution points ($\Delta x \sim 1.25°$) to 122,996 high-resolution points ($\Delta x = 1/12°$). The accuracy interpolated from the triangular grid is particularly notable for isotropic distribution (e.g., sea surface height or water temperature). However, the difference between the first two geometries tends to diminish for anisotropic case (e.g., velocity components). In an actual implementation of the reduced-order Kalman filter, a surprisingly large difference is observed between the regular triangular and square approximations.