3DA: Data-Driven Data Assimilation Applications to the Lorenz system and simulated sea surface heights
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Method[1]: Analog Forecast + EnKS

- Given a huge historical dataset \( \mathcal{C} \) (the catalog);
- Given the current state estimate \( x_t \), search for the analogs of \( x_t \) within \( \mathcal{C} \);
- Build a local model based on the analogs and the corresponding successors;
- Apply the local model on \( x_t \) to do the forecast.

Comparison of Analog Data Assimilation (AnDA) with optimal interpolation (OI) on Lorenz 63 model: only the first component is involved.

OSSE of simulated sea surface height (SSH) in the Gulf of Mexico

- Dataset: the OCCIPUT[2] simulated SSH, 50 members, 20 years
- Truth: member #1 in year 20
- Observations: simulated along-tracks from the real altimetry in 2004
- (AnDA) catalog: member #2-#50, in year 1 - year 19
- (AnDA) ensemble size: 1000
- (OI) \( B = B_{\text{clim}} \otimes \exp(dt^2/L_t^2) \) where \( B_{\text{clim}} \) is the spatial climatology calculated from the OCCIPUT dataset
- (OI) \( L_t = 20 \) (days)
- (OI) radius of influence = 1.5 (degrees)

Summary:
- AnDA captures more small scale flows
- AnDA produces more informative variance maps
- AnDA relies on catalog

References:
[1] R. Lguensat et al., The analog data assimilation, MWR, 2017
[2] L. Bessières et al., Development of a probabilistic ocean modelling system based on NEMO 3.5: application at eddying resolution, GRL, 2017

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