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Analog forecasting (AnDA) and large-ensemble ocean simulations to improve satellite-derived gridded products.

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Context & Approach:

• Investigate AnDA as an alternative, data-driven method to interpolate along-track satellite altimetry data (CMEMS-3DA project).

• Approach: Twin experiment based on the OCCIPUT large-ensemble global ocean simulation.

Fig.: Examples of SSH daily snapshots from 4 members of the OCCIPUT ensemble illustrating different states of the simulated loop current and studied only in the Gulf of Mexico.

The OCCIPUT dataset:

• 50 members x 20 years of daily SSH at 1/4º resolution (e.g. Penduff et al, 2014, Bessières et al 2017).
• Member #1 of the ensemble is taken as the truth.
• Along-track AVISO-like pseudo-observations are extracted from this truth for 2004.
• The 49 members and 19 years left are used as the historical catalog.

Goal:

• Reconstruct AVISO-like gridded products from along-track SSH.
• Compare AnDA with Optimal Interpolation methods.

Application to Lorenz-63:

AnDA outperforms OI because:

• It uses past trajectories to produce realistic reconstructions.
• It uses an adaptive covariance structure (i.e. AnDA "knows" when the reanalysis is good or less good).

Fig.: Reconstruction of the first component of the Lorentz-63 model with AnDA and OI.

Fig.: Daily snapshot of SSH in 2004 in the Gulf of Mexico from the Truth (OCCIPUT simulation member #1, left) and extracted along-track pseudo-obs (right).

Fig.: Daily snapshots of the reconstructed SSH with AnDA (left) and with OI (right).

Fig.: Estimated standard deviation from AnDA (left) and OI (right) reconstructions.

Conclusions:

• AnDA is able to capture high-frequency SSH signals better than OI (e.g. Florida coastal waves).
• AnDA produces realistic SSH trajectories, with a reconstructed variance less sensitive to observational sampling than OI.
• AnDA is significantly dependent on the catalog (its size, resolution, realism, etc).

Further work is on-going to investigate how AnDA behaves in a "cousin" experiment (pseudo-obs. taken from a higher-resolution simulation than the OCCIPUT catalog) and with real observations.