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Yicun Zhen, Pierre Tandeo, Stéphanie Leroux, Julien Le Sommer, Sammy Metref, Pierre Ailliot, Ronan Fablet, Bertrand Chapron, Cédric Herzet, Thierry Penduff, et al.

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**IMT Atlantique**  
Bretagne-Pays de la Loire  
École Mines-Télécom

# 3DA: Data-Driven Data Assimilation

## Applications to the Lorenz system and simulated sea surface heights

### Authors

Yicun Zhen  
Pierre Tandeo  
Stéphanie Leroux  
Julien Le Sommer  
Pierre Ailliot  
Ronan Fablet  
Bertrand Chapron  
Cedric Herzet  
Thierry Penduff  
Jacques Verron

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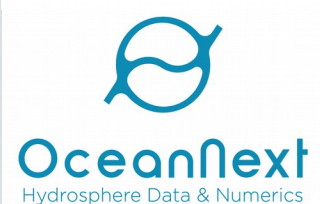
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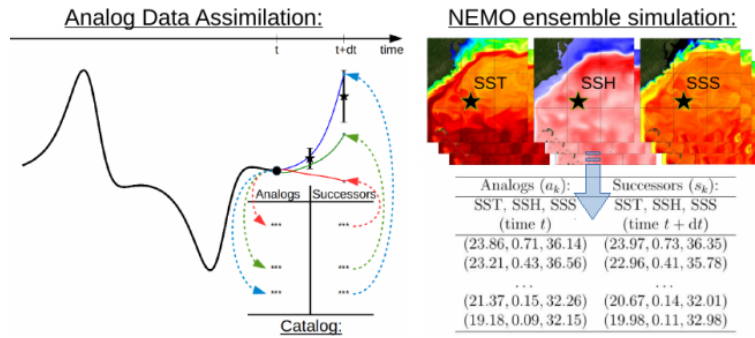
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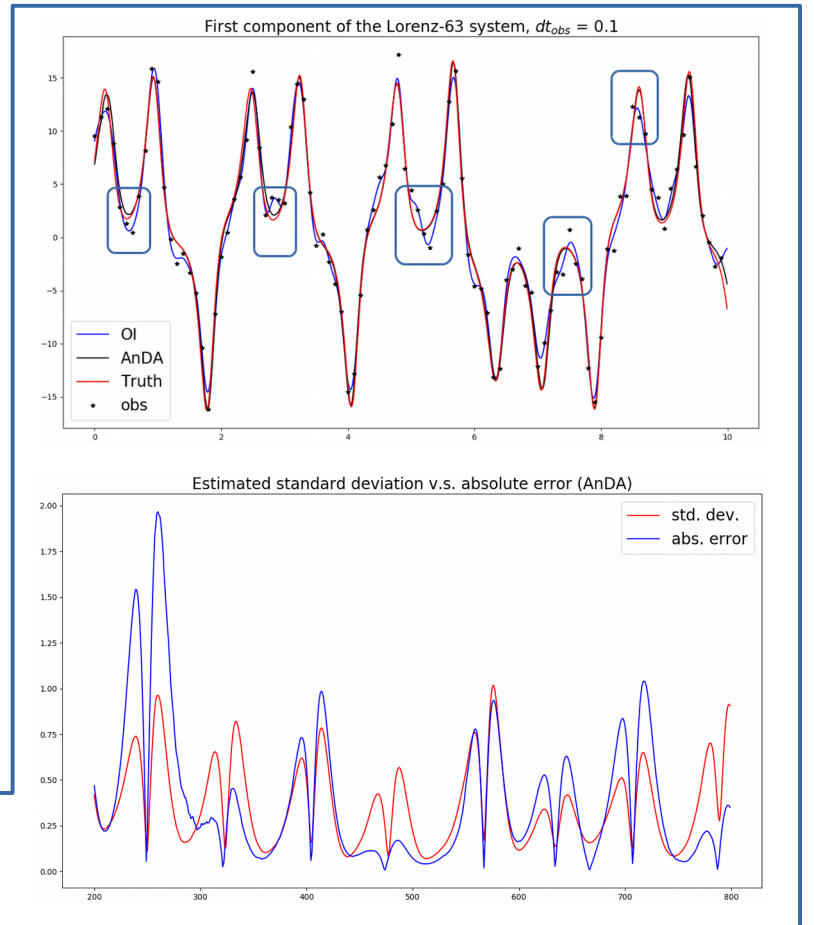


### Method[1]: Analog Forecast + EnKS



- ▶ 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.

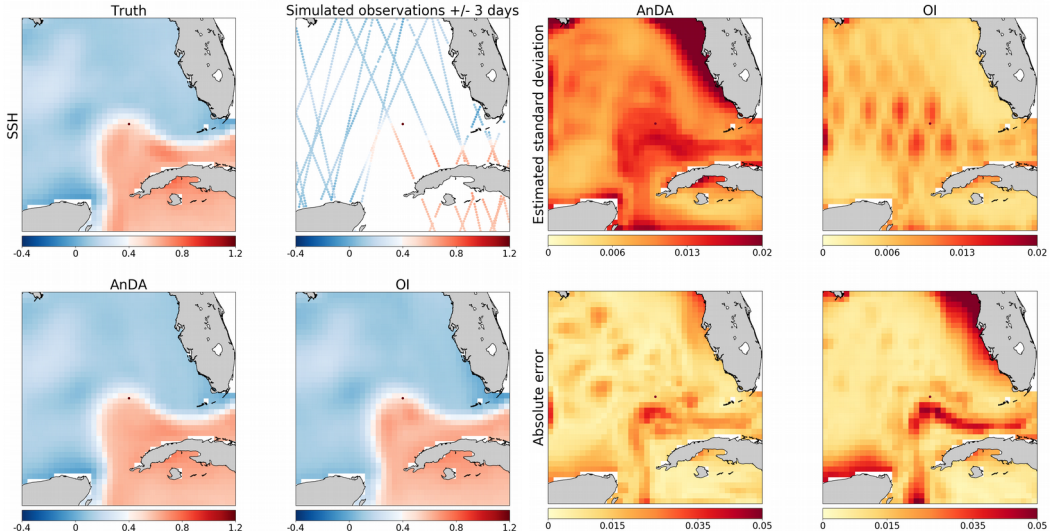
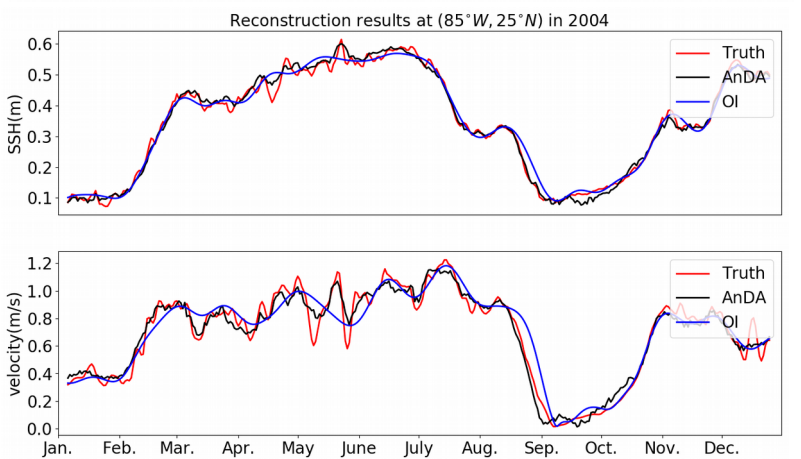
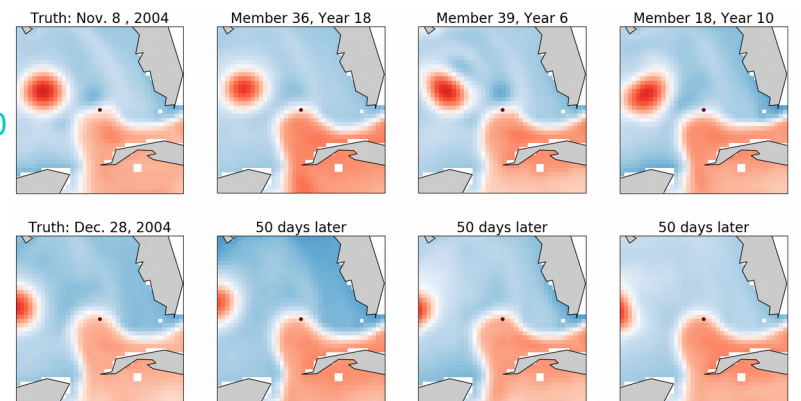
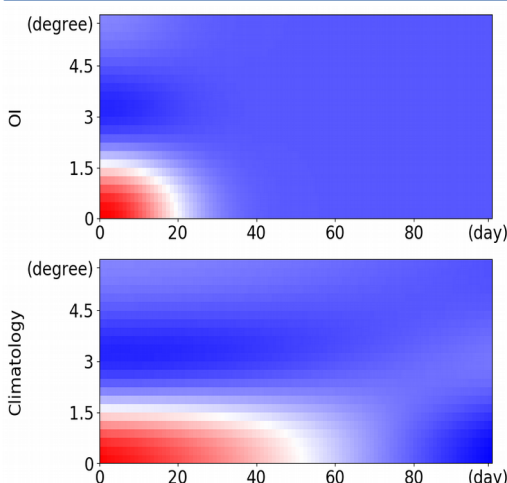


### OSSE of simulated sea surface height (SSH) in the Gulf of Mexico

- ▶ 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)  $B = B_{clim,x} \otimes \exp(dt^2/L_t^2)$  where  $B_{clim,x}$  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. Iguensat 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

Contact : yicun.zhen@imt-atlantique.fr