Machine learning in oceanography
2 examples at LOPS : PyxPCM & OSnet
Balem K., Maze G., Tokunaga S.
PyXpcm: Ocean Profile Classification Model for Xarray objects

https://pyxpcm-dev.readthedocs.io
Selection of argo profiles

Selection of PDFz

Observed PDFz

B: Model PDFz

Detailed Model PDFz
- Random sample of Argo temperature profiles in the North Atlantic
- Different groups of temperature profiles are identified automatically
- Which corresponds to coherent regions of the ocean

Maze, G., et al., Progress in Oceanography, 2017
Application example
Delayed time validation of argo profiles near a front
SVM prediction (predict the separation between clusters) in the gulfstream:
Model trained with full CORA dataset and SVM predicted per decade.

Balem, K., Maze, G., 2019
OSnet (from “ocean state neural network”) : a multi-layer perceptron for predicting ocean thermo-halinity
The data

- 15 years worth of ARGO data quality controlled for research (2001 - 2016).
- For each ARGO profile, the sea level anomaly is interpolated from Aviso.
- 255 million measurements (5 fold cross-validation)

(T,S) = f(lat,lon,t,z,sla)

MLP-like structure: ~500K free parameters to adjust

Inputs:
- Longitude
- Latitude
- Pressure
- Date
- Sea level anomaly

...
Map of ocean temperature at 100m depth:
Example of a time series and a seasonal cycle (predicted in locations of fixed moorings for comparison)

Lack of data (a), and no more data (b) in the training dataset
Effect of altimetry:
OSnet simulates vertical turbulence by predicting temperature and salinity for multiple case of sea level anomaly.

S. Tokunaga, G. Maze, ADMT 2019

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Thank you