The Ocean Patterns Indicator

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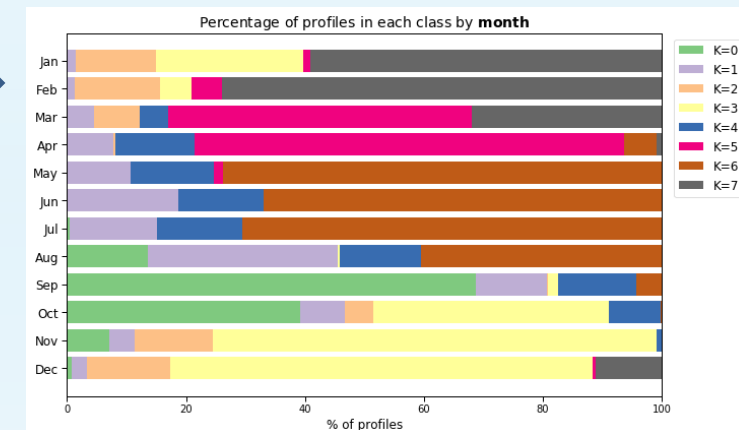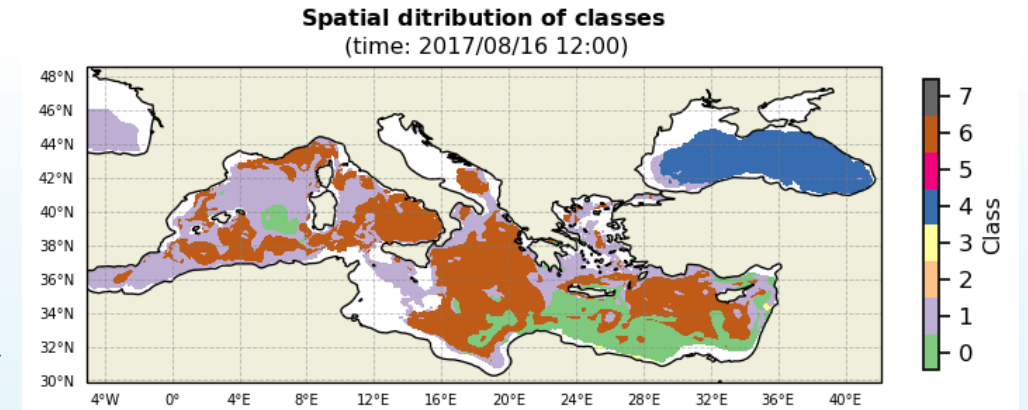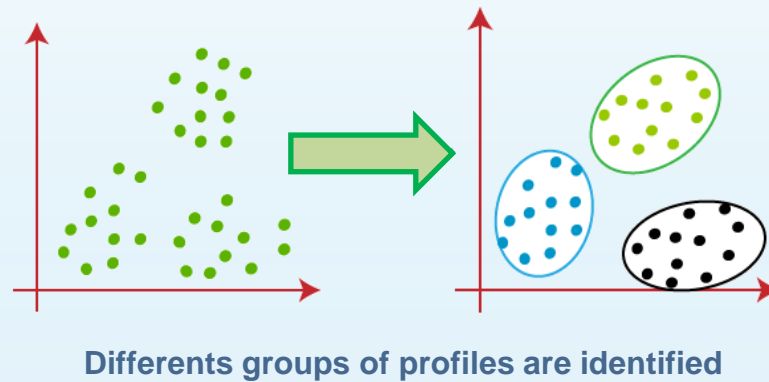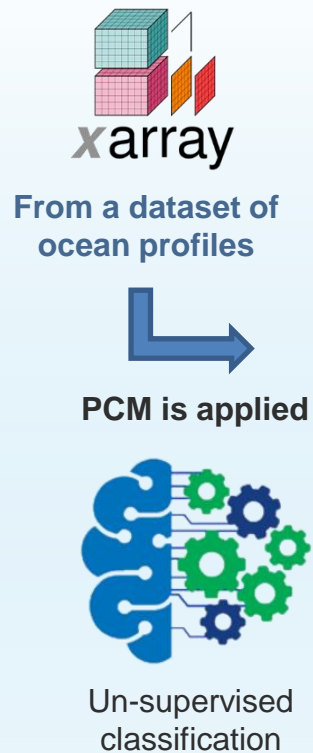
Presentation plan

- What is the Ocean Patterns Indicator?

- How a Profile Classification Model (PCM) works?

- Jupyter notebooks
  - Development notebook
  - Prediction notebook

- What are we doing next?

What is the **Ocean Patterns Indicator**?

- PCM (Profile Classification Model): allows to automatically gather ocean profiles in clusters according to their vertical structure similarities. Depending on the dataset, such clusters can show space/time coherence: **the ocean patterns indicators.**
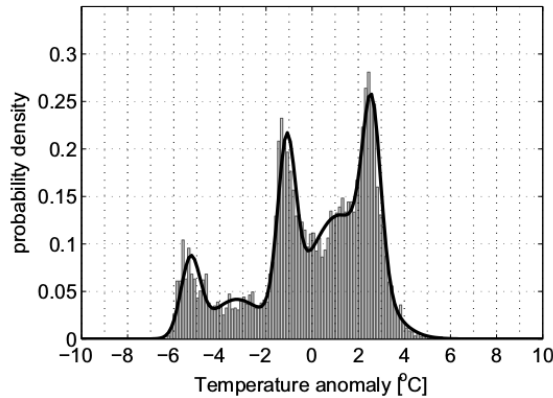

From a dataset of ocean profiles

PCM is applied

Un-supervised classification

Differents groups of profiles are identified

Spatial ditribution of classes
(time: 2017/08/16 12:00)

Percentage of profiles in each class by month

Plot analysis can reveal space/time coherences: the Ocean Patterns indicator

How a Profile Classification Model (**PCM)** works?

🌊 Gaussian Mixture Models method (GMM): decompose the probability density functions (PDF) of the dataset in to a sum of gaussian PDF.

Decomposing PDF in 5 gaussian PDF
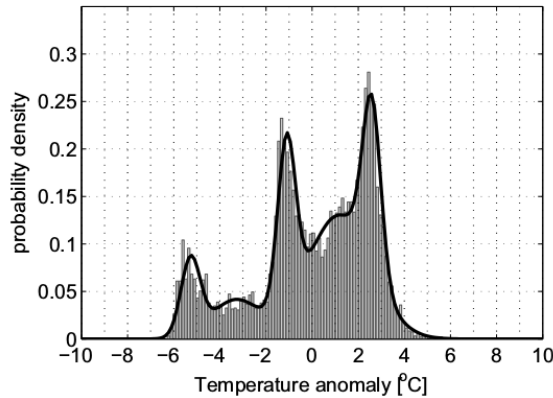
Representation in nz dimensions

Maze et al, Prg.Oc, 2017

🌊 The user should only chose the number of classes

🌊 In the input there is no spatial or temporal information
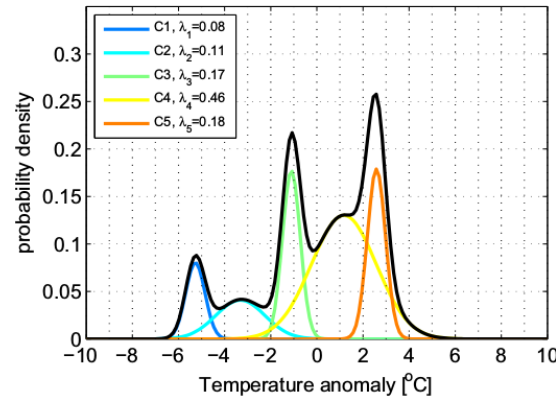
🌊 Probability of a profile to be in a class

How a Profile Classification Model (**PCM)** works?

- Gaussian Mixture Models method (GMM): decompose the probability density functions (PDF) of the dataset in to a sum of gaussian PDF.

Decomposing PDF in 5 gaussian PDF

Representation in nz dimensions

Maze et al, Prg.Oc, 2017

- Ocean Patterns Indicators are computed using the **pyXpcm** python software (see documentation at https://pyxpcm.readthedocs.io)
- For more information about the method see Maze et al, Prg.Oc, 2017.

Jupyter notebooks

Jupyter notebooks

4 pretrained models ready to use:
- Reanalysis models
  - temperature (Mediterranean Sea)
  - chlorophyll (Mediterranean Sea)
- Argo floats models
  - temperature (Mediterranean sea)
  - temperature and salinity (North Atlantic, Maze et al, Prg.Oc,2017)
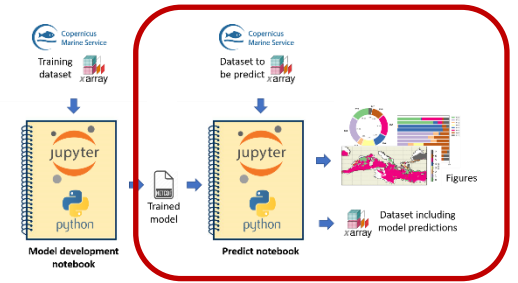
Development notebook

- **Model parameters**: number of classes and variable
- **Load training dataset**: Data are loaded from Copernicus Marine Service (the user will need a CMEMS account)
- **Create model**
- **Plot and metrics to optimize model**

- **Save model**

Prediction notebook

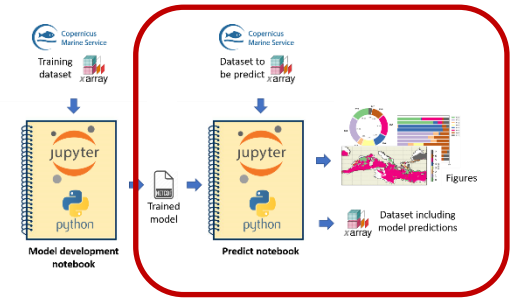- **Load model and dataset**: The user can use the pretrained models or the one developed in the 1st notebook
- **Predict labels:** sort each profile of the dataset into a specific class
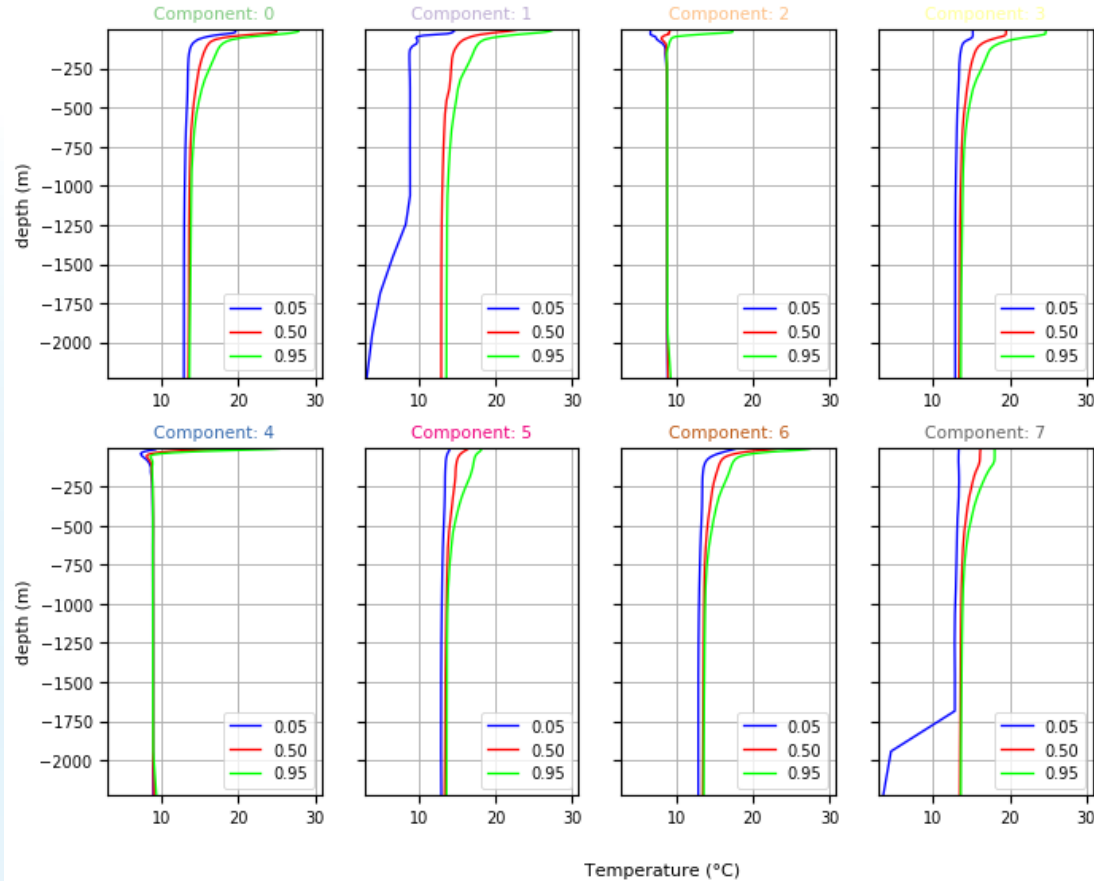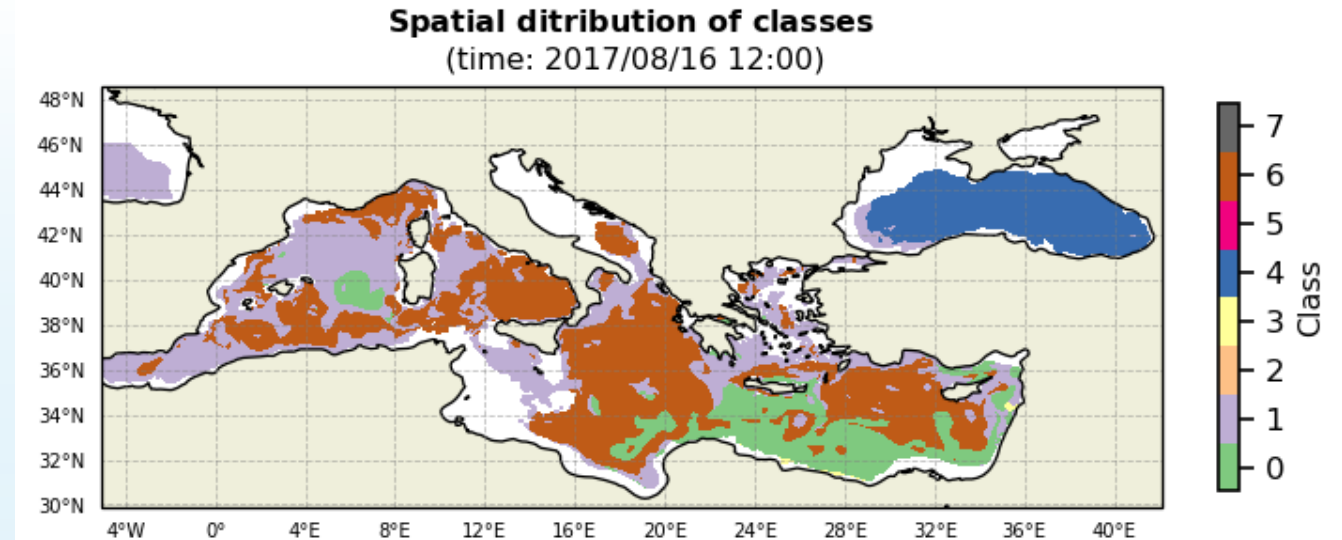- **Plot results**

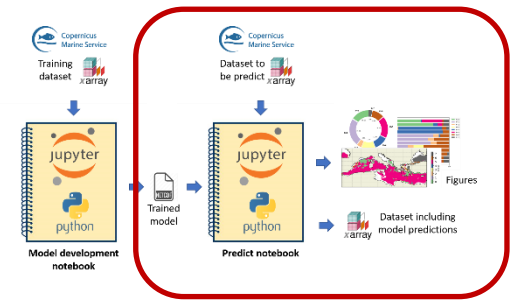- **Save data**

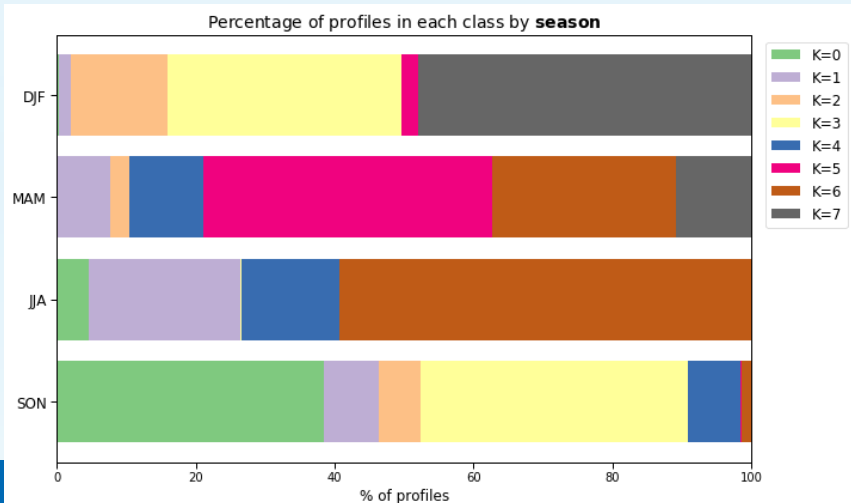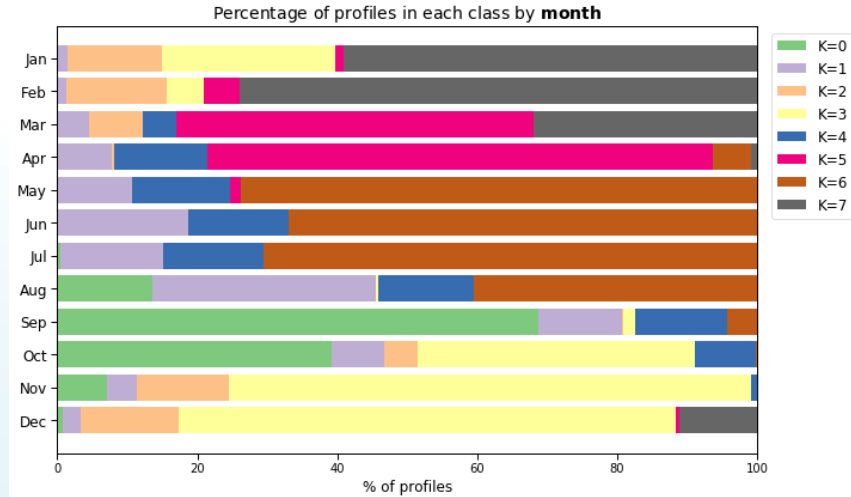# Prediction notebook

Vertical structure (quantiles)
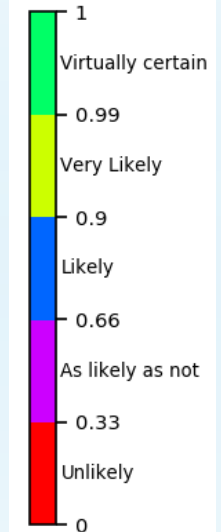

Spatial distribution

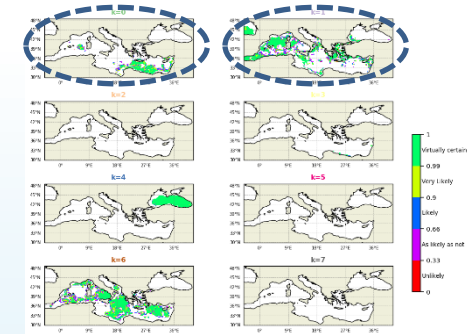

Spatial ditribution of classes
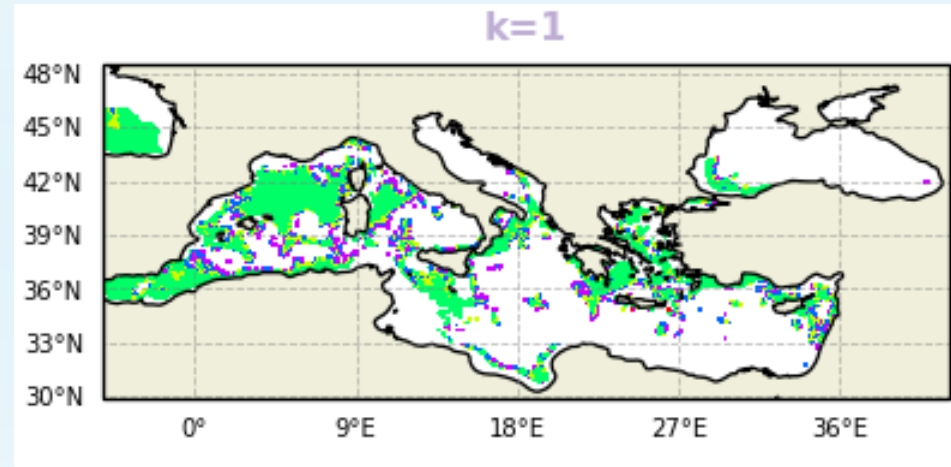(time: 2017/08/16 12:00)

Prediction notebook

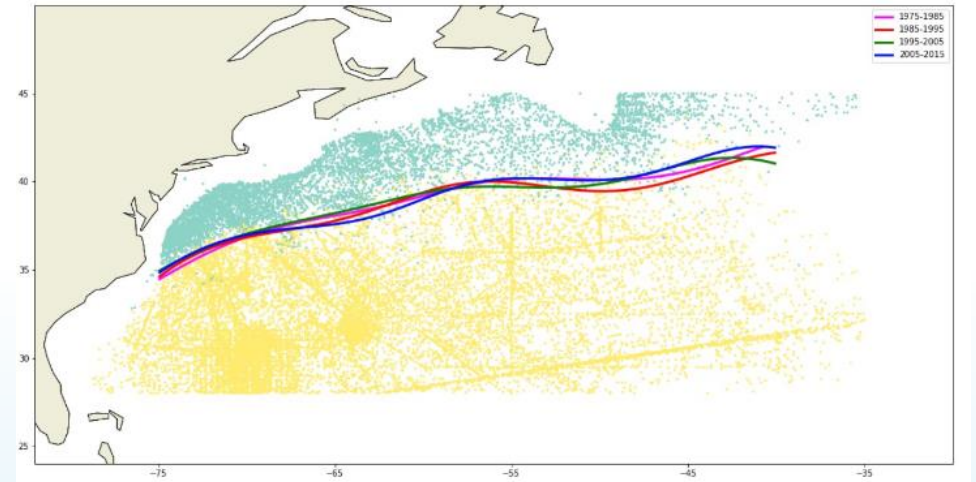**Temporal distribution**

Robustness

Examples of applications

Balem and Maze, 2019

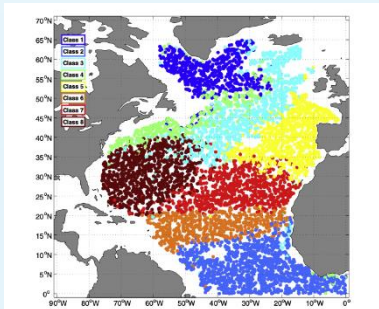## Examples of applications
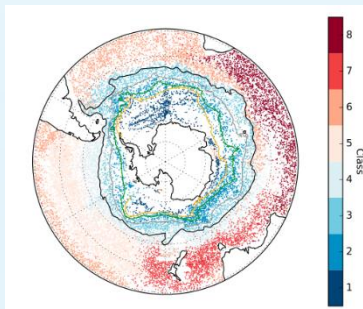
- Study of a region with natural boundaries
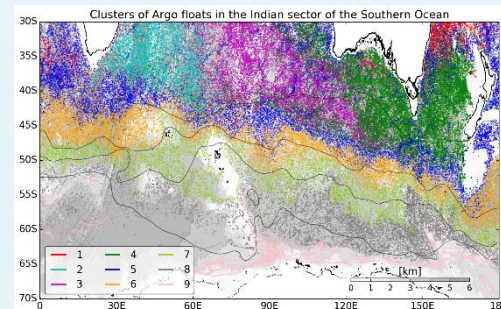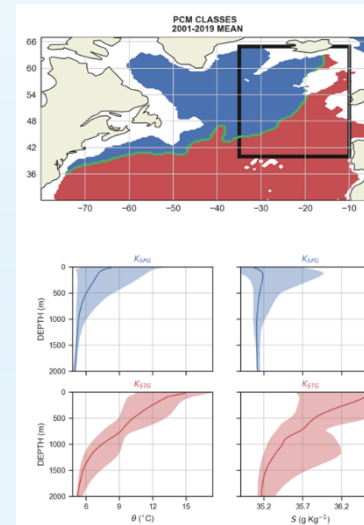- Structure of frontal regions
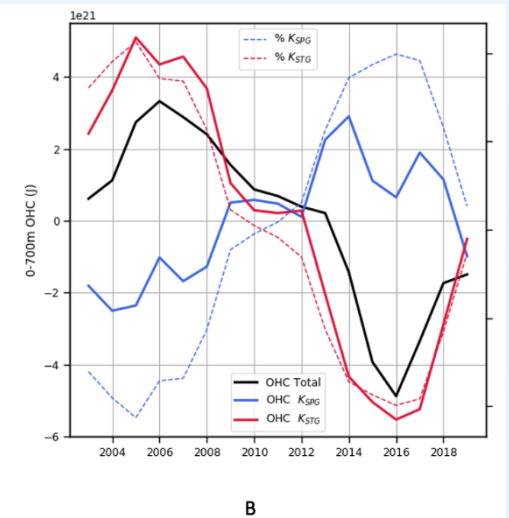- Model evaluation
- .....

Maze et al, Prg.Oc, 2017

Jones et al, J. Geophys. Res, 2019

Rosso et al, J. Geophys. Res, 2019

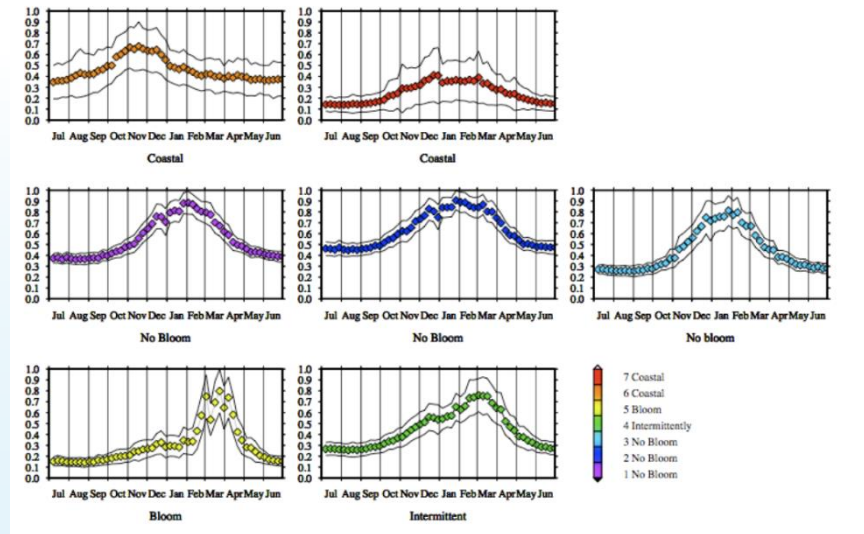Desbruyeres et al, Nature (rev.), 2020

To summarize

- The ocean patterns indicator is an easy way to analyse and explore an ocean region using Machine Learning

- PCM can be applied to all types of oceanographic profiles:
    - From 3D numerical simulations or in-situ observations
    - With one or more physical or biogeochemical variables

Feel free to play!

What are we doing next?

🌀 **Ocean regimes indicator**

   🌀 Classification of time series

D'Ortenzio et al,
Biogeosciences 2009