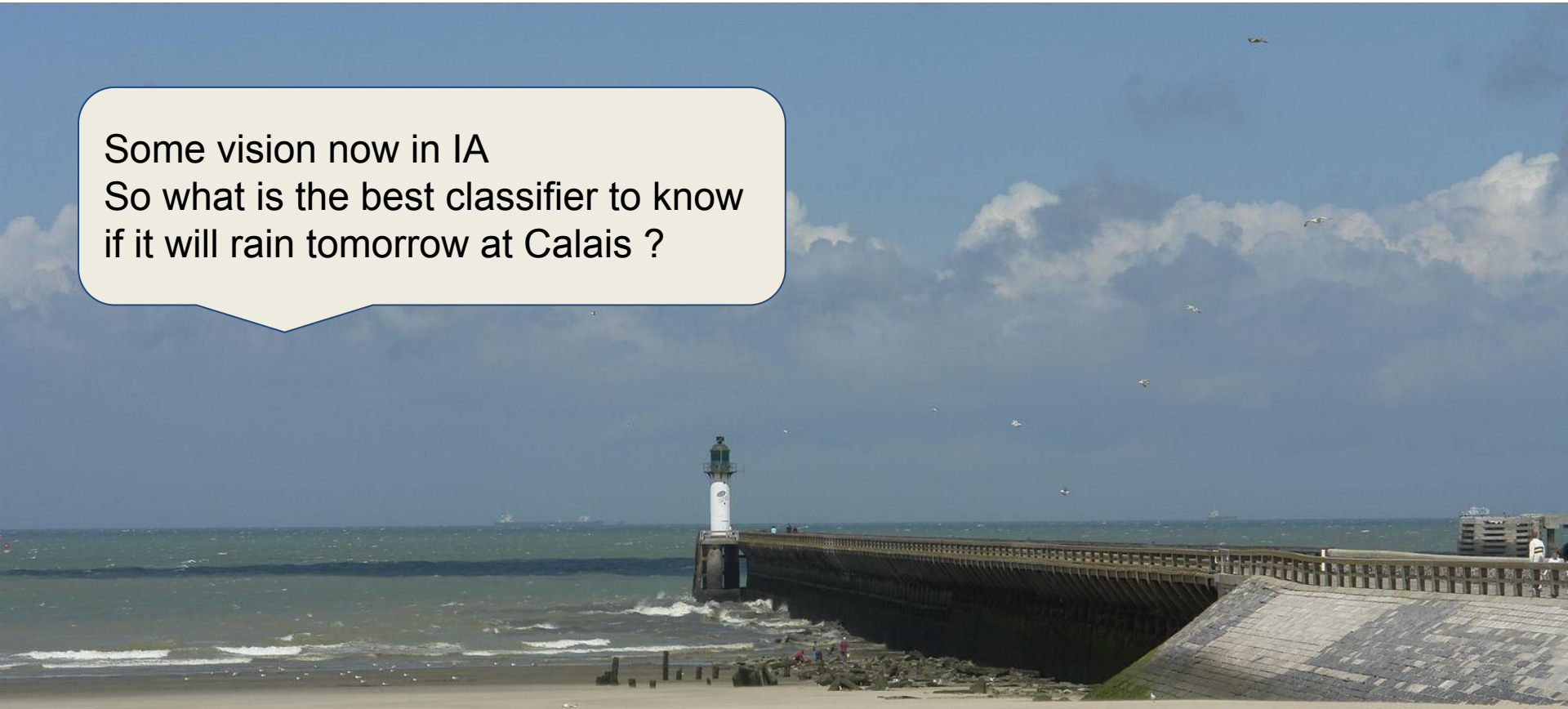
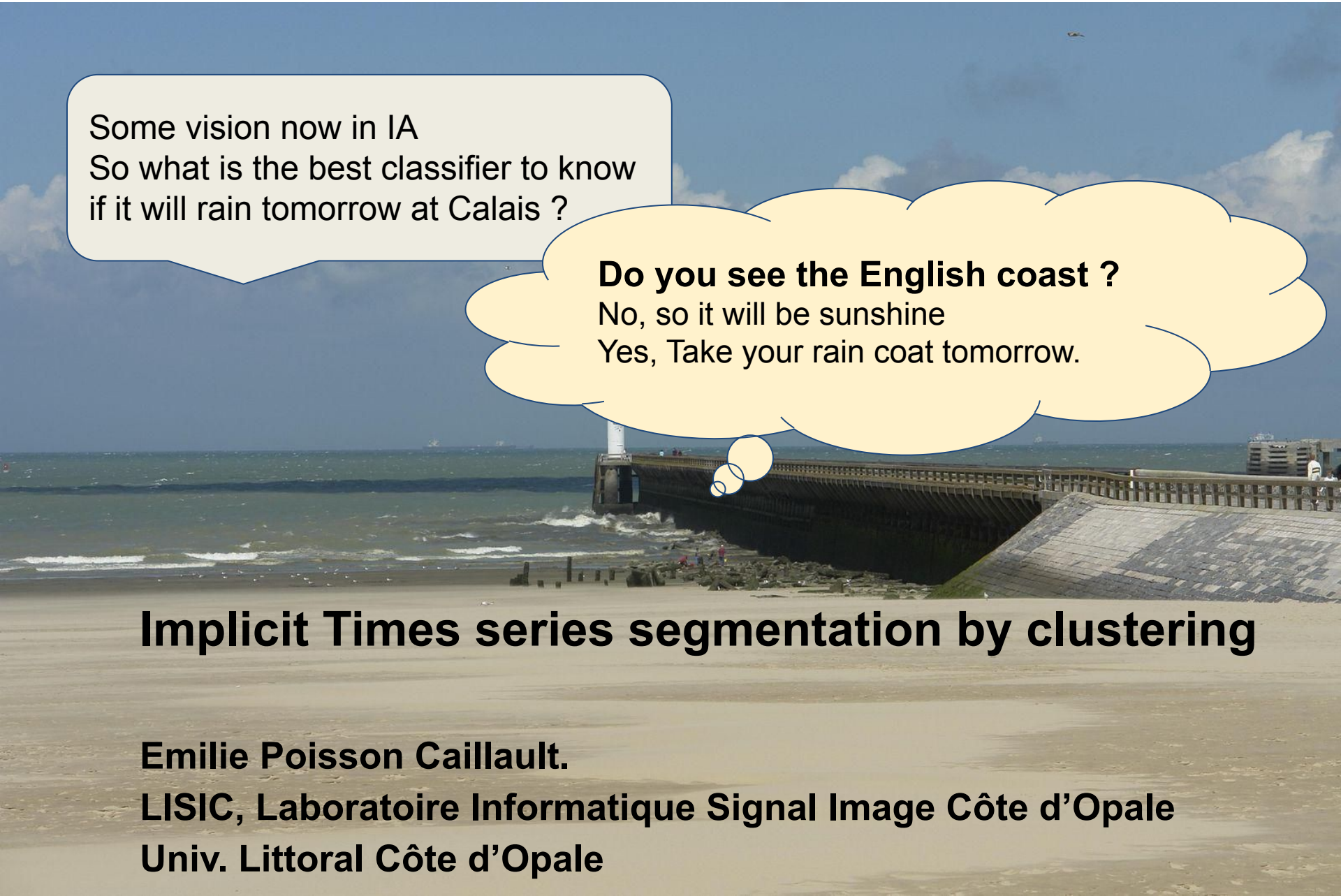


Implicit Times series segmentation by clustering

Emilie Poisson Caillault.
LISIC, Laboratoire Informatique Signal Image Côte d'Opale
Univ. Littoral Côte d'Opale



Implicit Times series segmentation by clustering

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Some vision now in IA
So what is the best classifier to know if it will rain tomorrow at Calais ?

Do you see the English coast ?
No, so it will be sunshine
Yes, Take your rain coat tomorrow.

se ng

iqu

Short cv

2001 : Polytech'Nantes engineer in computer sciences

2001 : DEA Automation and Computer Sciences, Ecole Centrales Nantes

2005 : PhD, Univ. Nantes at LC2N (IRCCYN Lab).

Architecture and Training of a hybrid Neuro-Markovian System for On-Line Handwriting Recognition

Keywords : TDNN, SDNN, SD-TDNN, MS-TDNN, global discriminant training, MLE-MMI, Mask/Filter in convolution layer.

2006 : Assistant Professor - Univ Littoral in data science and machine learning

2014 : IFREMER delegation

2020 : HDR degree

Contributions to the classification and segmentation of Time series by statistical unsupervised or guided learning

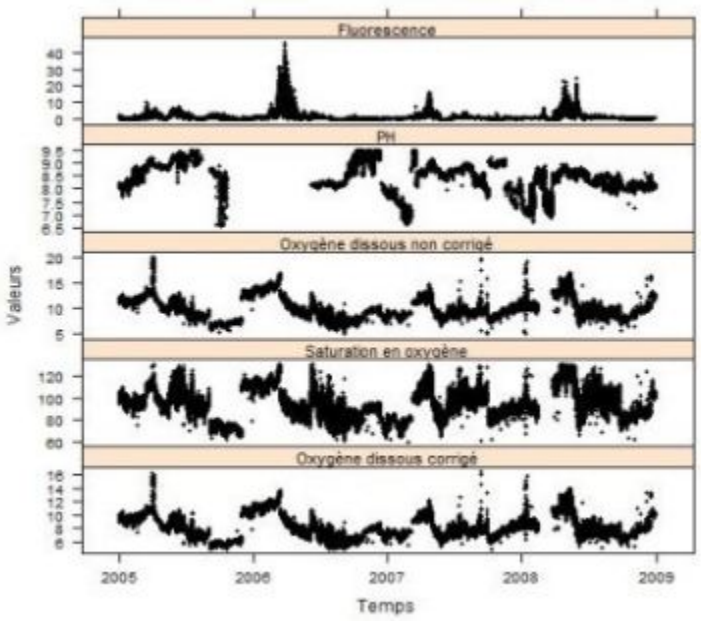
Keywords : similarity, DTW-criteria, DTW-imputation, spectral clustering and multi level approach

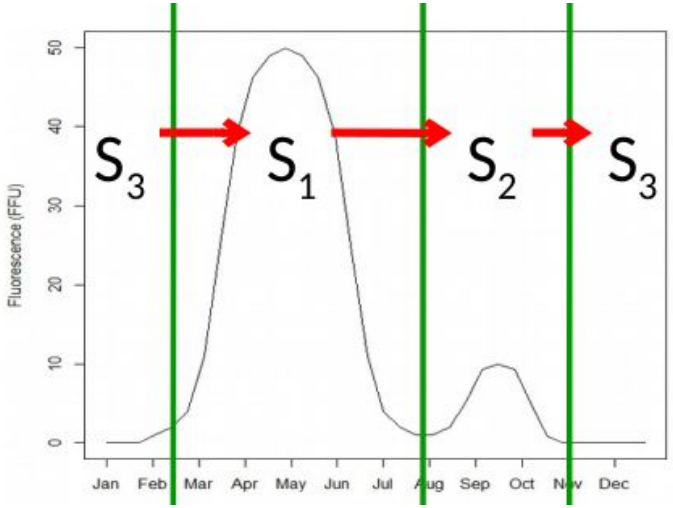
JERICO project
CPER IDEAL
ORIENTOI application
LISIC/IFREMER PhD supervision

a. Pattern clustering and classification
b. time series
c. convolutional neural networks
d. hidden markov models
e. fully unsupervised or constrained spectral clustering
f. elastic distance metrics for signal comparison
g. environmental science computing

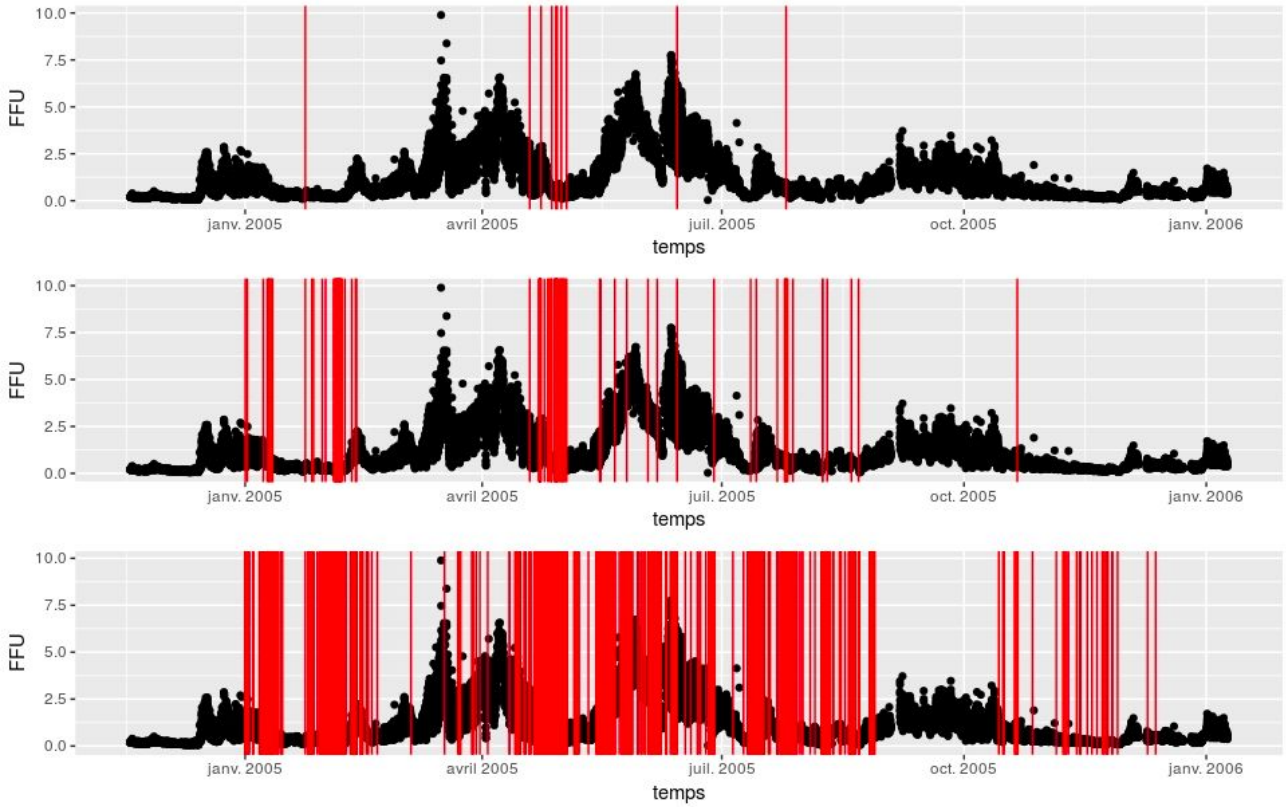
Time Series or Spatial segmentation by clustering

Environmental state ?





Event or region detection



Approaches

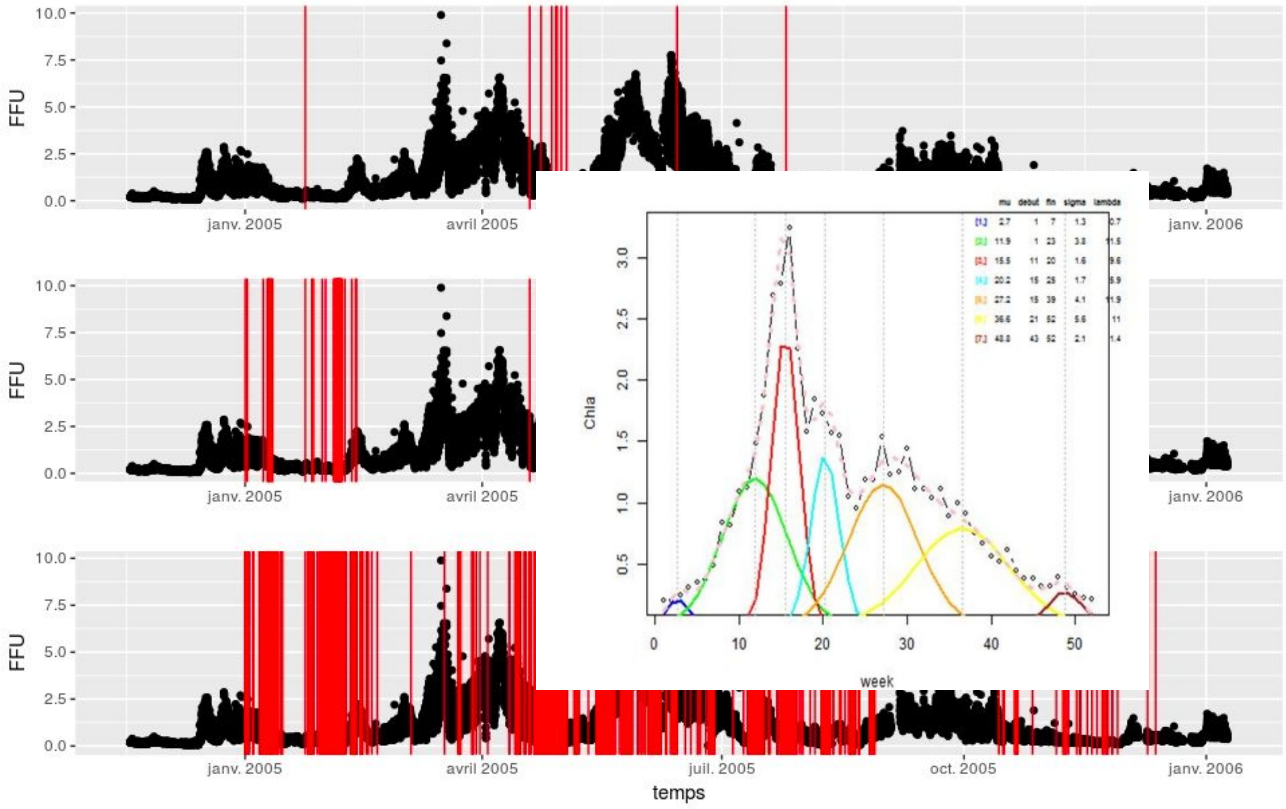
Univariate :
- Breakpoints, PIP, trend
- Explicit segmentation
- Implicit segmentation

Multivariate :
- Explicit segmentation
  Scattering moments
- Implicit segmentation

cut process:
- Suitable for trend analysis
- Imposes clustering/matching before labelling

.... Tedious for the expert
.... Costly in terms of calculation

Event or region detection



Detection of mixture of patterns
Requires a priori

- Forms of event (gaussian?)
- Series statistics

Approaches

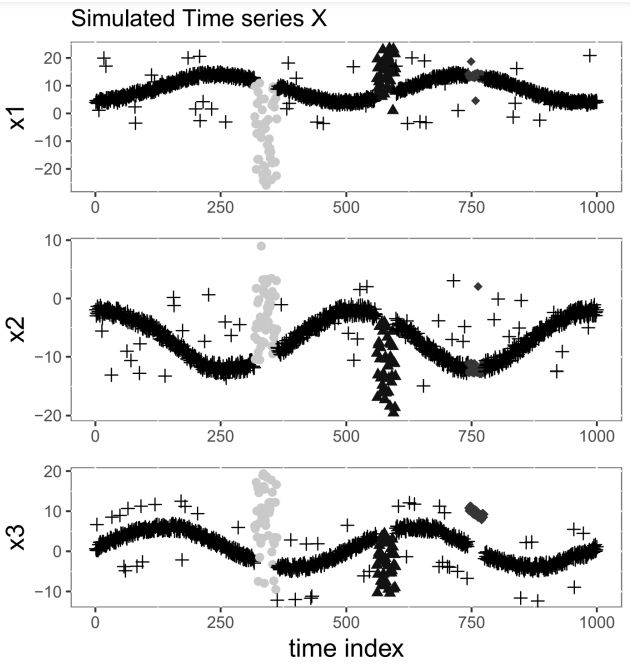
Univariate :
- Breakpoints, PIP, trend
- **Explicit segmentation**
- Implicit segmentation

Multivariate :
- **Explicit segmentation**
  Scattering moments
- Implicit segmentation

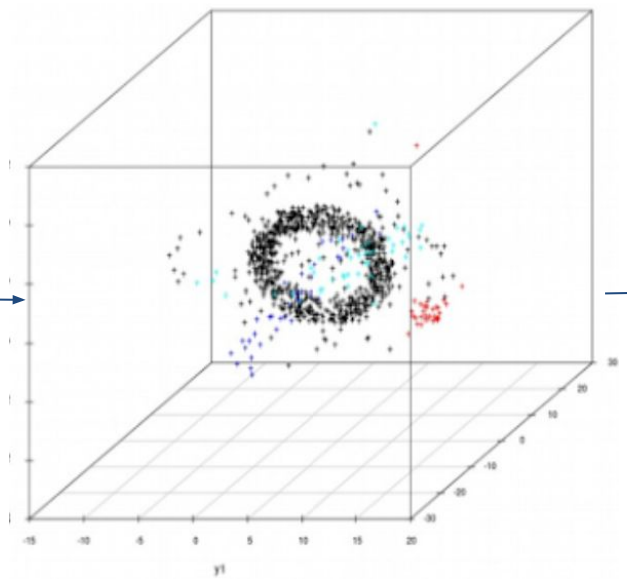
Article : Towards Chl-a Bloom Understanding by EM-based Unsupervised Event Detection. Emilie Poisson CAILLAULT and Alain LEFEBVRE. Full accepted paper. OCEANS 2017 MTS/IEEE, Aberdeen, Scotland, 06/2017

Implicit segmentation by clustering approach

1- Compute similarities between Observation features → W
2 - Apply Partitioning algorithm in this Observation space
3 - Analyse obtained dynamics and sometimes correct it.



(x1,x2,x3,t)



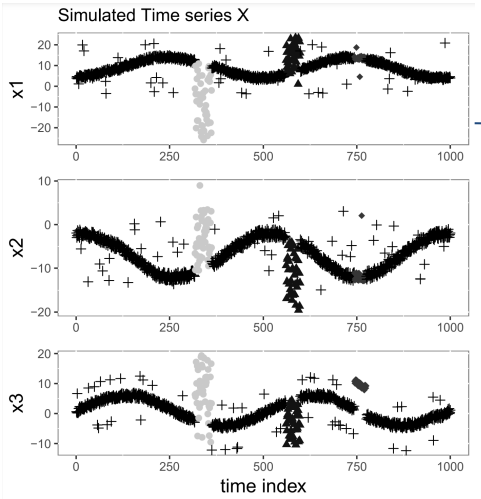
(x1,x2,x3)

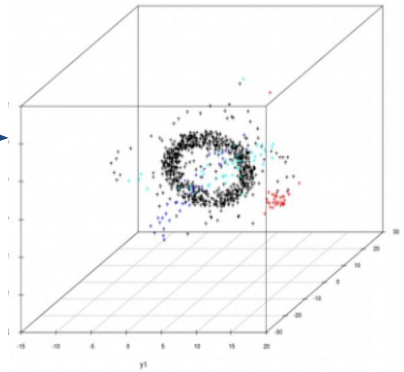
Clustering

(x1,x2,x3) + label

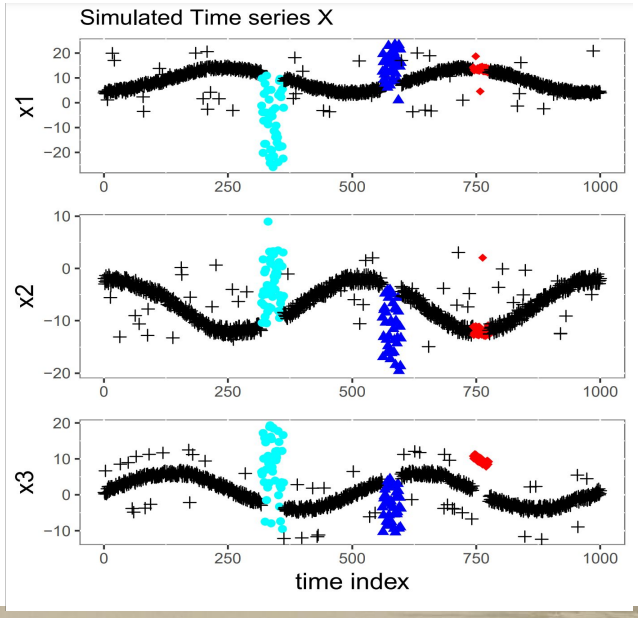
Implicit segmentation by clustering approach

1- Compute similarities between Observation features → W
2 - Apply Partitioning algorithm in this Observation space
3 - Analyse obtained dynamics and sometimes correct it.



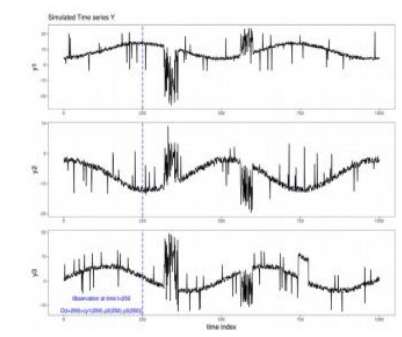


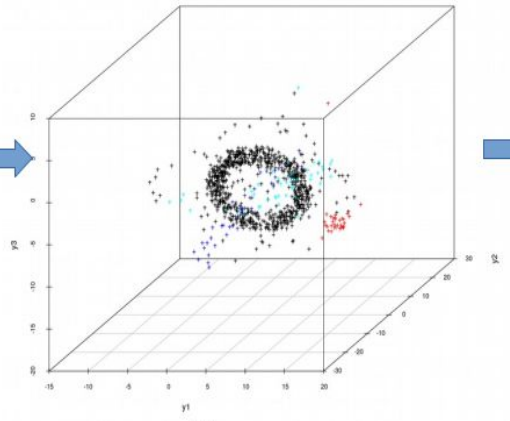
Clustering

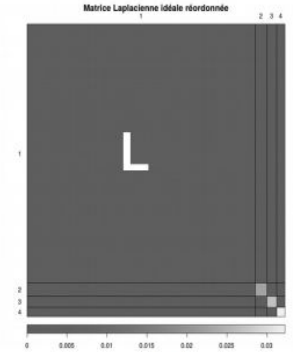


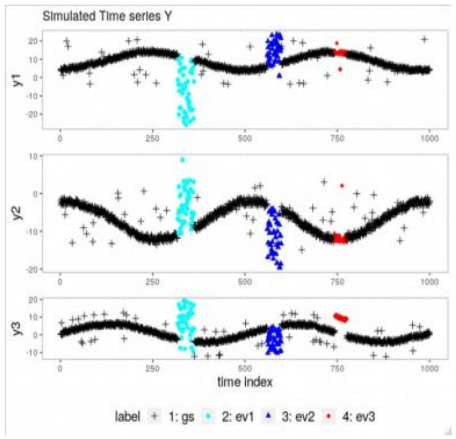
Implicit segmentation by spectral clustering approach

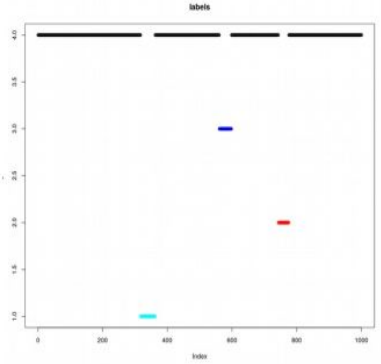
1- Compute similarities between Observation features -> W
2- Compute Laplacian matrix from W
3- Extract eigenvectors V and eigenvalues -> detect K principal values
4 - Partitionning data in the normed K-first vector eigenspace U (PAM)



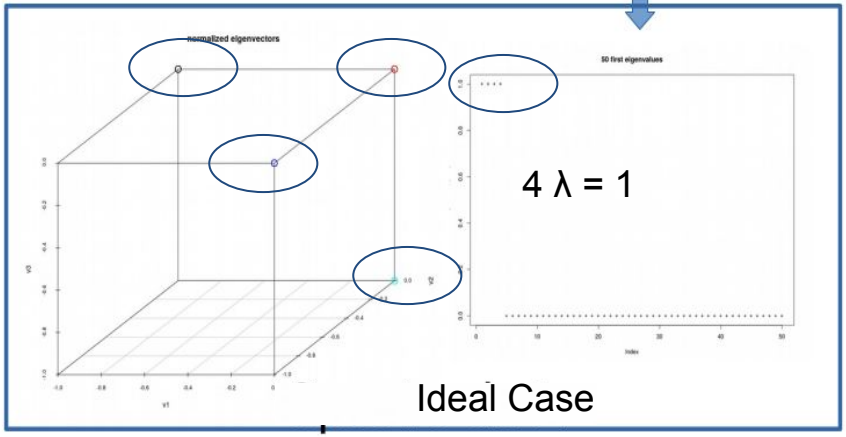








Ideal Case



Ideal Case

NJW-SC
Ng et al, 2001

PAM-SC

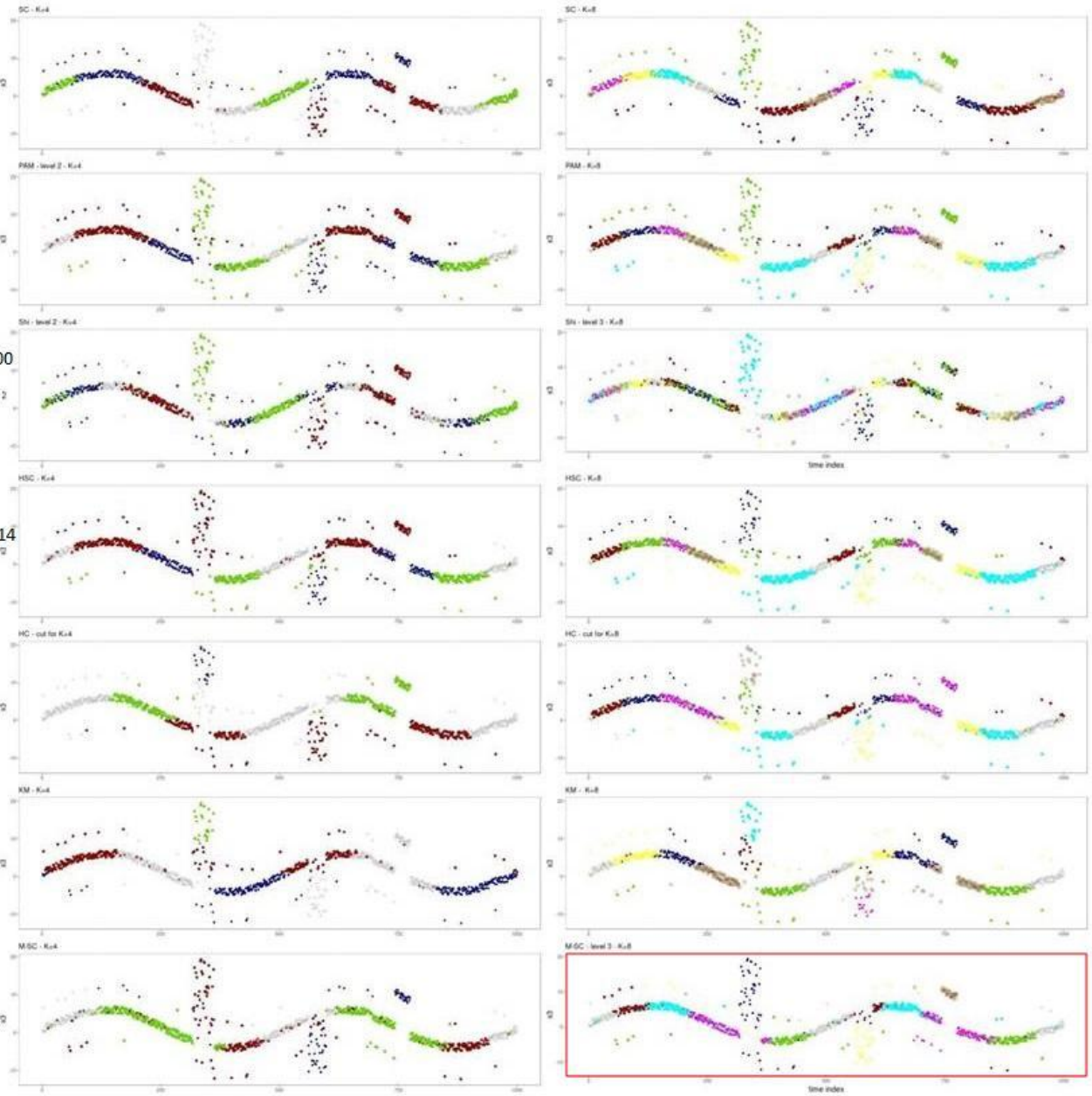
Bi-SC
Shi etMalik, 2000

H-SC
S-Garcia et al. 2014

HC

K-means

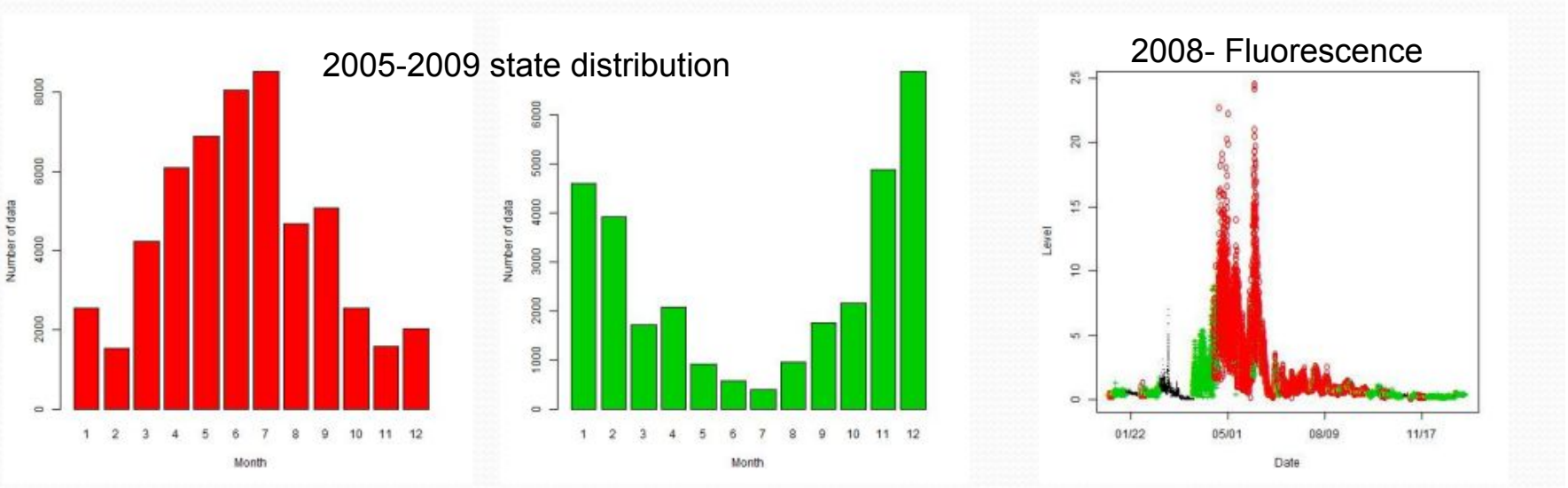
M-SC



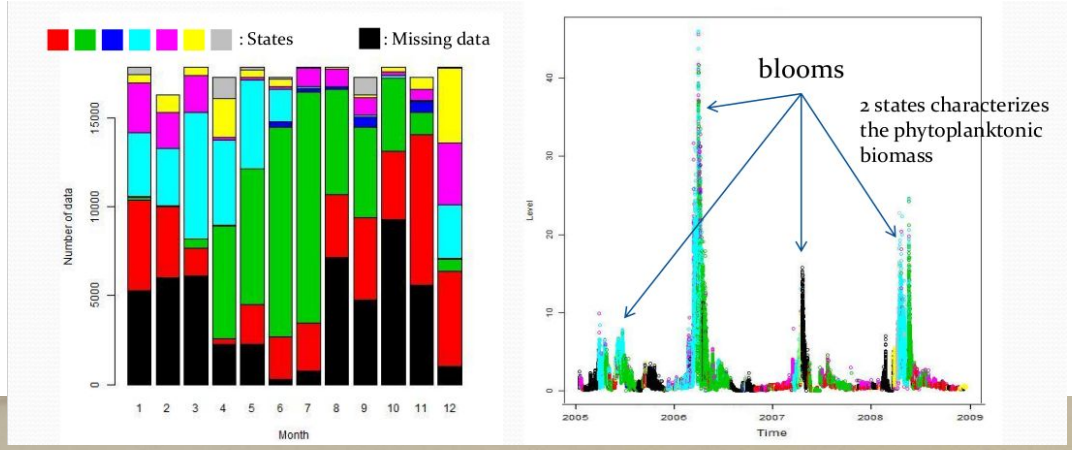
MSC
Kelly's talk

Long-term series : Marel Carnot application. (K. Rousseeuw phD)

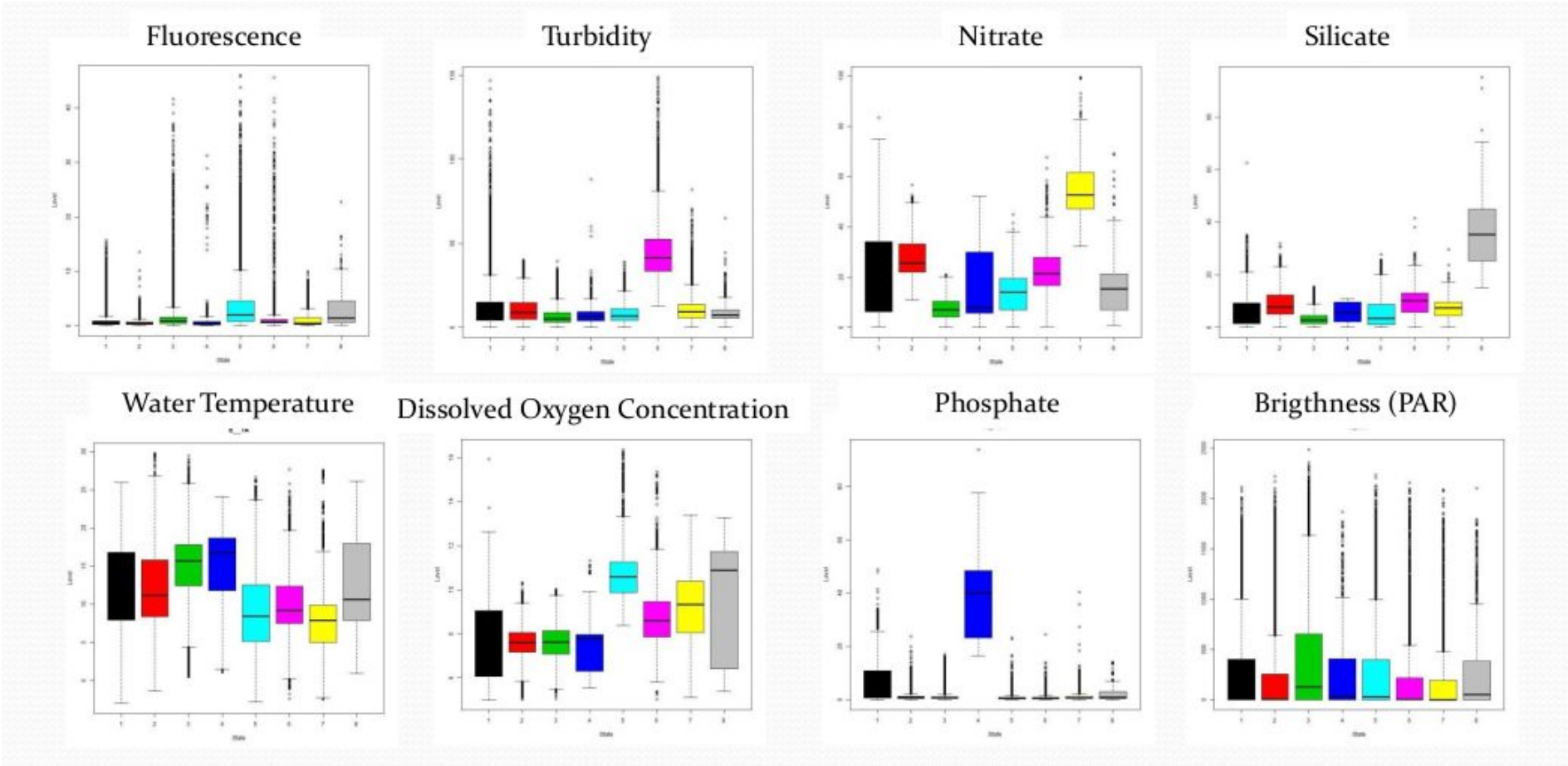
SC with K=2: Identification of non productive period vs productive period.



SC with K=7: Identification of blooms, pre/post-blooms, rare events

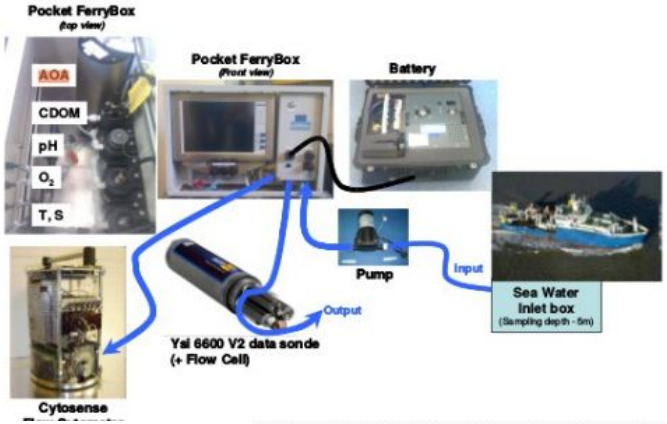


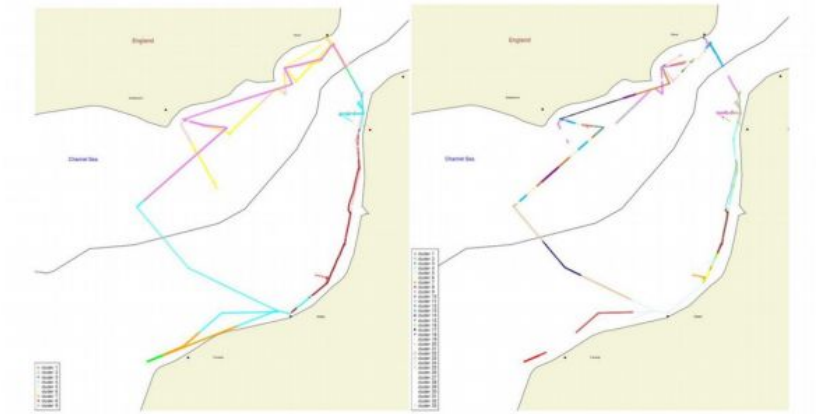
Long-term series : Marel Carnot application. (K. Rousseeuw phD)

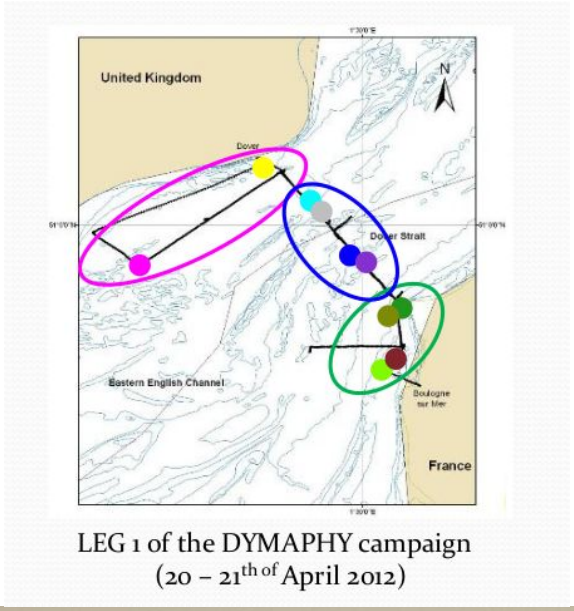


interface in R-package : uHMM and sClust

Short-term spatio time series : DYMAPHY Leg (MEPS'2019)







LEG 1 of the DYMAPHY campaign
(20 – 21th of April 2012)

Eco-regions
Coastal zone vs large zone