GAIN
Green Aquaculture Intensification

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773330

A MACHINE LEARNING CLUSTERING ALGORITHM TO IDENTIFY GAPING BEHAVIOUR IN MYTILUS SPP UNDER CONTRASTING ENVIRONMENTAL CONDITIONS

Camilla Bertolini, **Edouard Royer**, Jacob J. Capelle, Tjeerd J. Bouma, Massimo Milan, Roberto Pastres

aquaculture europe 21

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Green Aquaculture INtensification in Europe

- Support the ecological intensification of aquaculture
  - Increasing production and competitiveness of the industry
  - Ensuring sustainability and compliance with EU regulations
- Consortium
  - 10 academic and research institutes
  - 8 companies
  - 2 non-profit organisations

Research areas

- Production optimization
- Valorization of secondary inputs
- Sustainability assessment

Impacts

- Eco-intensification tools
- Professional developments

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VENETIARVM VNIVERSITAS · IN DOMO FOSCARI ·

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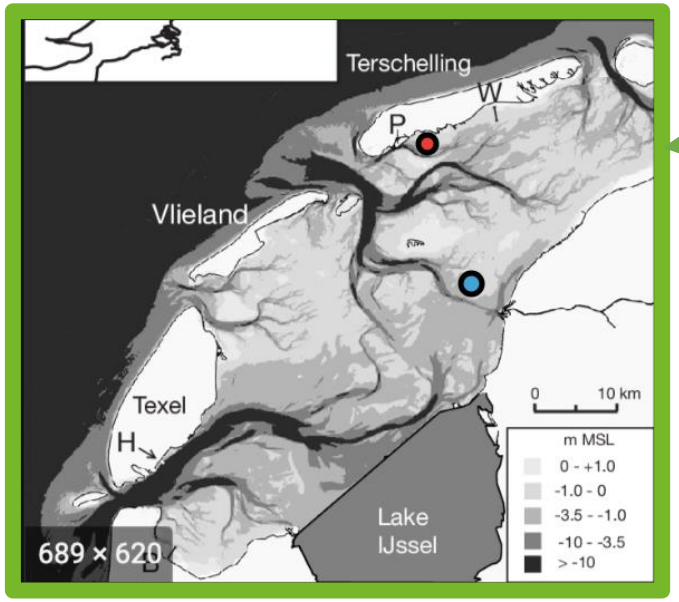
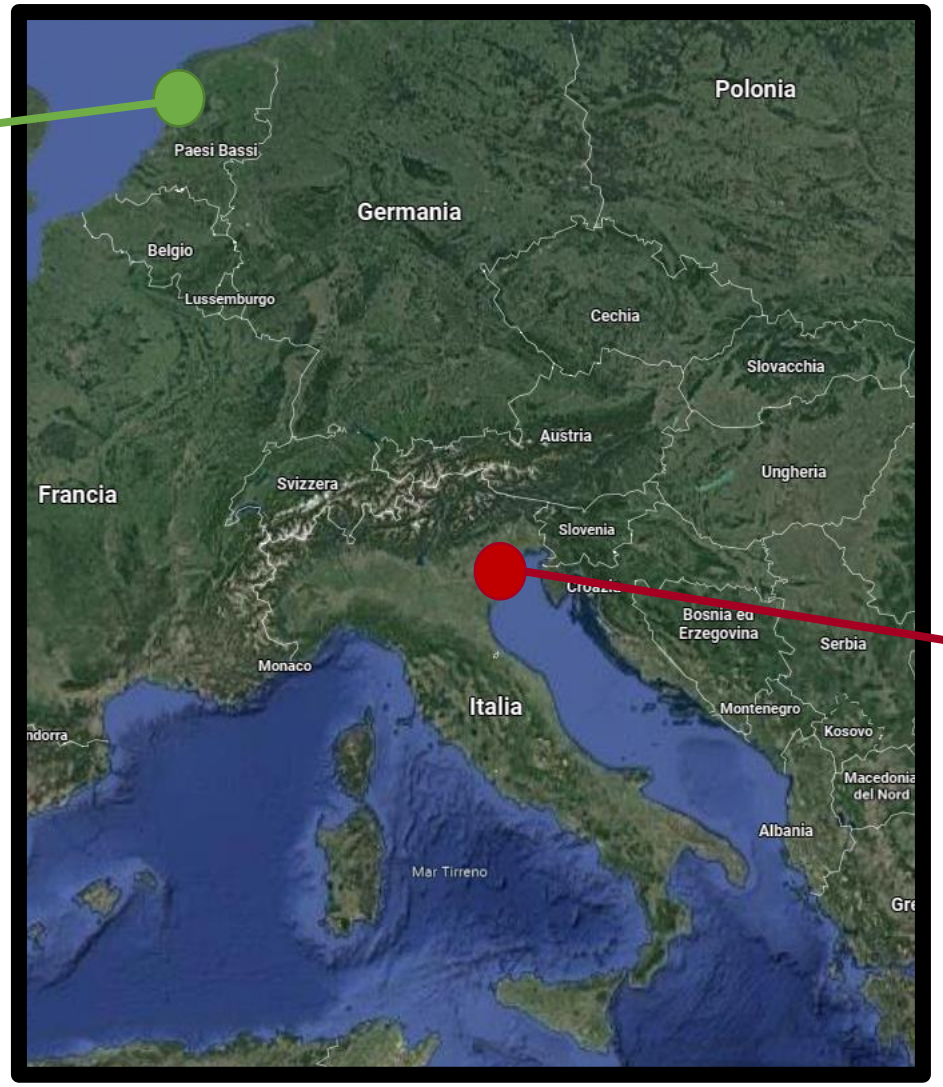


Wadden Sea

Mytilus edulis



Venice

Mytilus galloprovincialis

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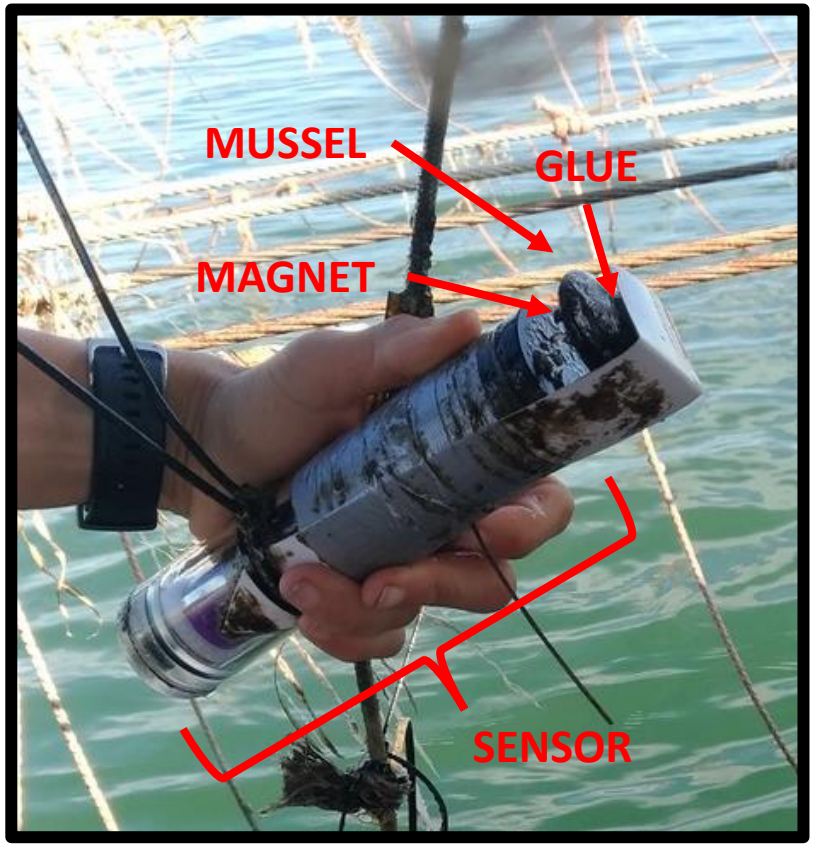
Sensors

- **Venice: Multiparametric buoy (Tecnos SaS)**
- **Wadden sea: Logger (JFE Advantech)**
- **Both sites: Hall effect sensors (BIOPHYS)**



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Sampled data

VENICE

- **Water** (Ts = 12 min)
  - Temperature
  - Oxygen
  - Chlorophyll
  - Turbidity
- **Mussel** (Ts = 5min)
  - Gaping
- **Time period**: > 6 months

WADDEN SEA

- **Water** (Ts = 5 min)
  - Temperature
  - Chlorophyll
  - Turbidity
- **Mussel** (Ts = 1min)
  - Gaping
- **Time period**: One month

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Daily Gaping

- **Input data**
  - **Gaping** timeseries (from 0 = min to 1 = max)
  - **Variable** to classify: **daily dynamics**

- **Method**
  - K-means **clustering algorithm** (unsurpervised ML)
  - Optimal number of clusters: Elbow method + Visual analysis
  - **3 clusters**

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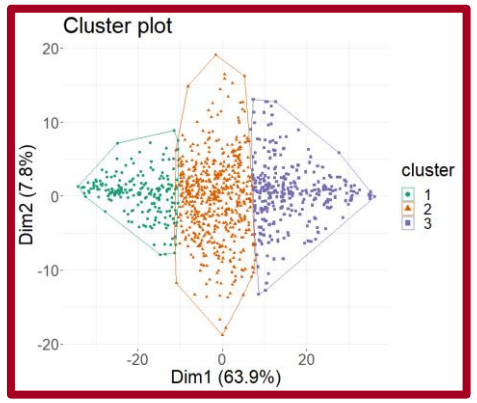
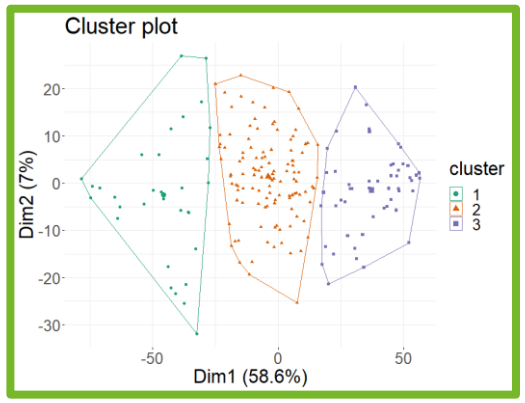
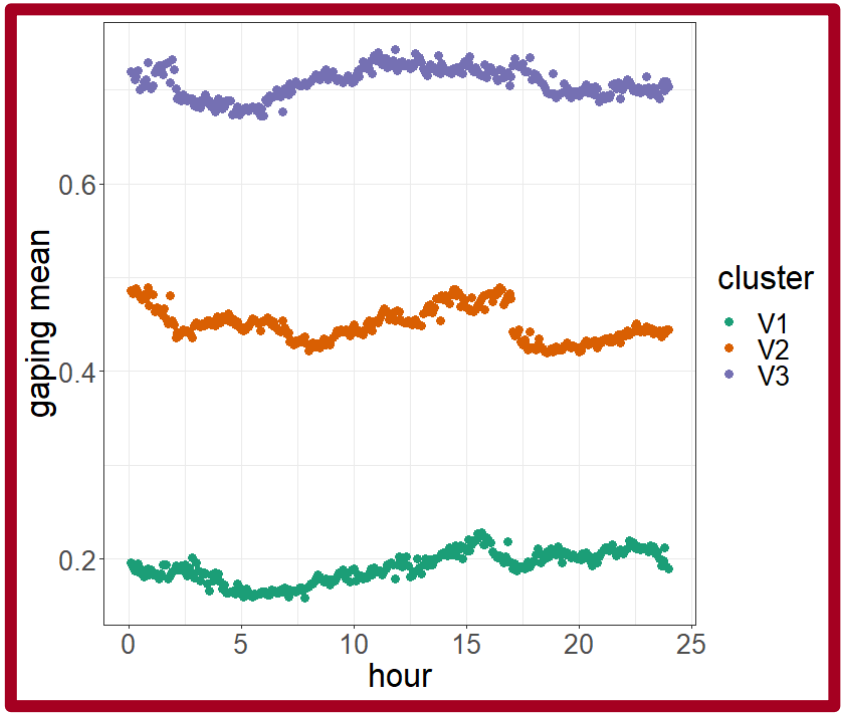
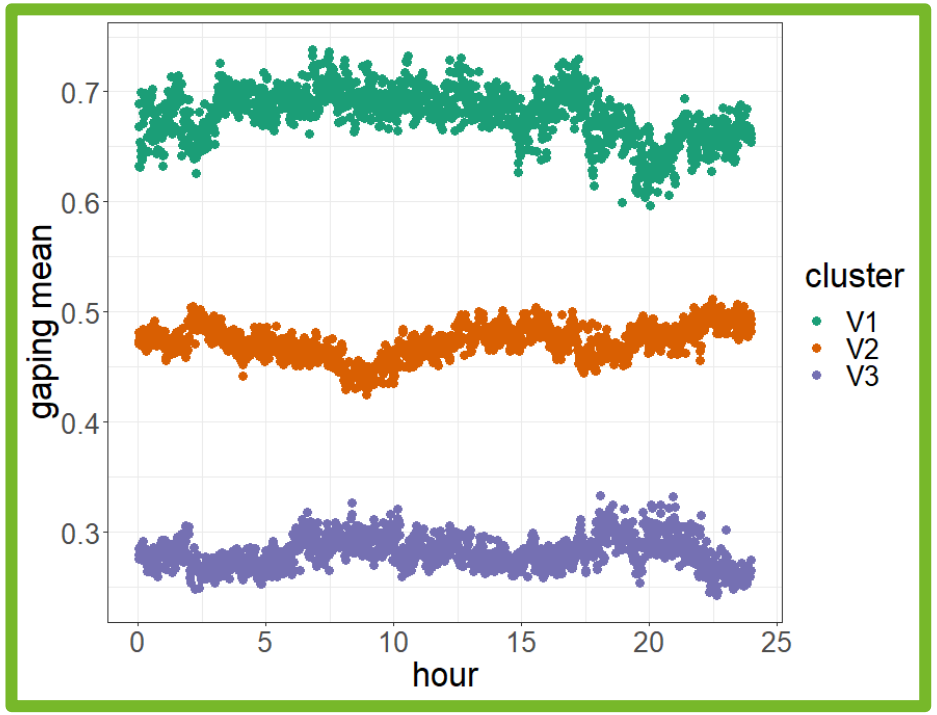




3 daily average gaping value

- 70 %
- 45 %
- 20 %





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Gaping + Water

- **Input data**
  - **Gaping** and **environmental** data (from 0 = min to 1 = max)
  - **Variable** to classify: **daily means**

- **Methods**
  - K-means **clustering algorithm** (unserpervised ML)
  - Optimal number of clusters: Elbow methods + Visual analysis
  - **3 clusters**

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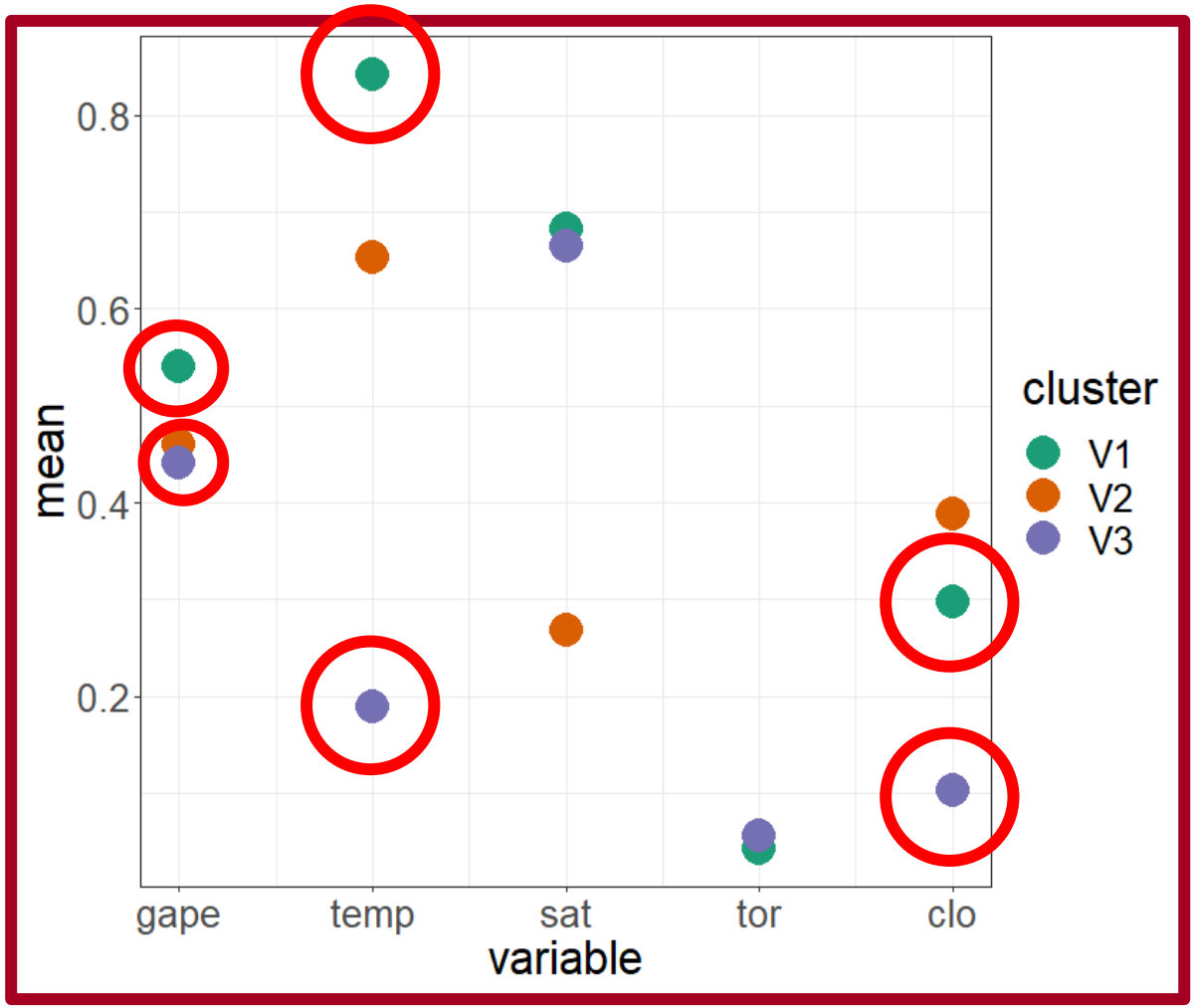
Gaping + Water

VENICE

- **Wider gaping**
  - Higher T°C
  - Medium Chla
- **Narrower gaping**
  - Lower T°C
  - Low Chla



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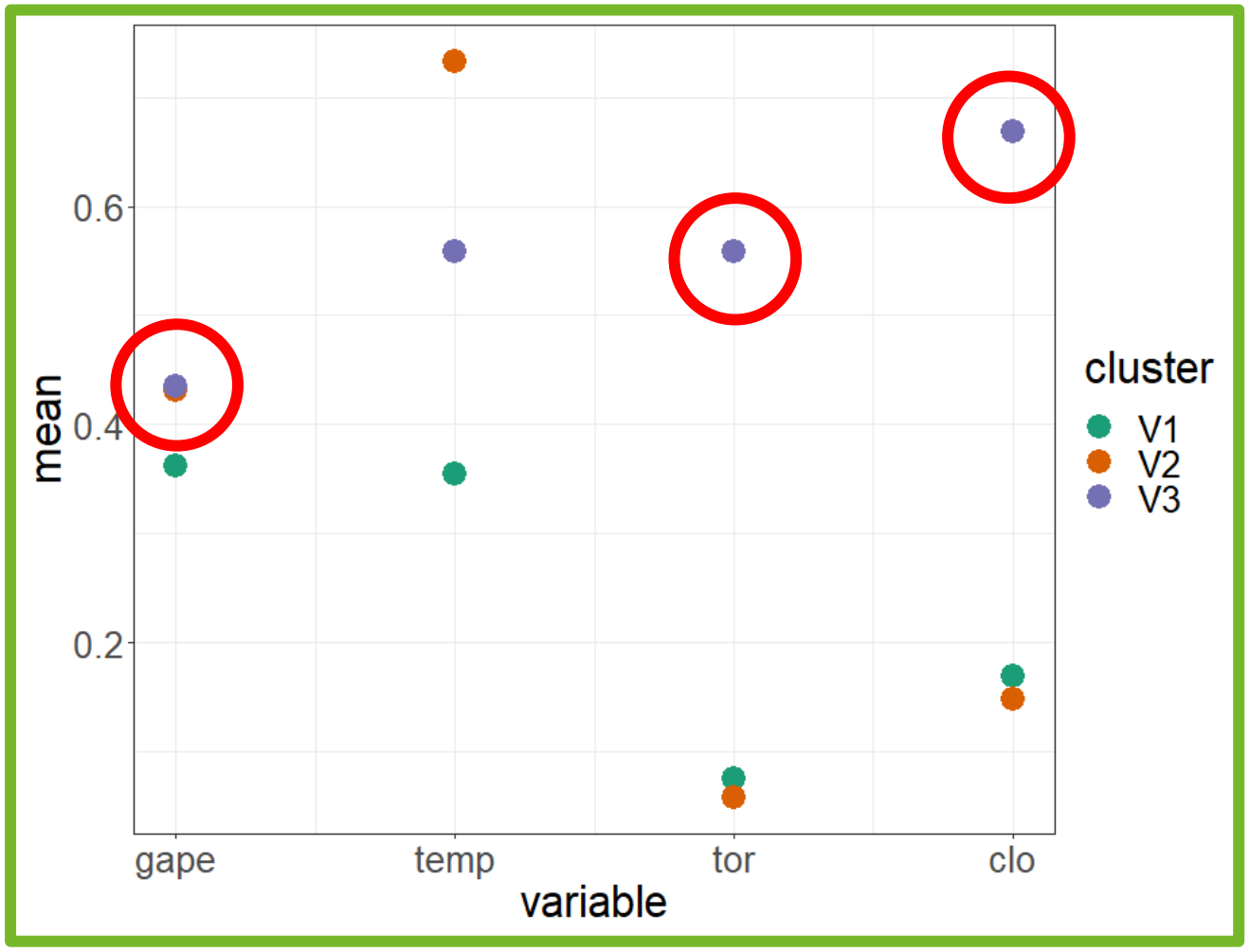
Gaping + Water

WADDEN SEA

- **Wider gaping**
  - High Chla
  - High Turbidity



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Detrended gaping

- **Input data**
  - **Daily detrended gaping** data (= daily dynamics – daily average)
  - **Variable** to classify: **daily detrended dynamics**

- **Methods**
  - K-means **clustering algorithm** (unserpervised ML)
  - Optimal number of clusters: Elbow methods + Visual analysis
  - **2 clusters**

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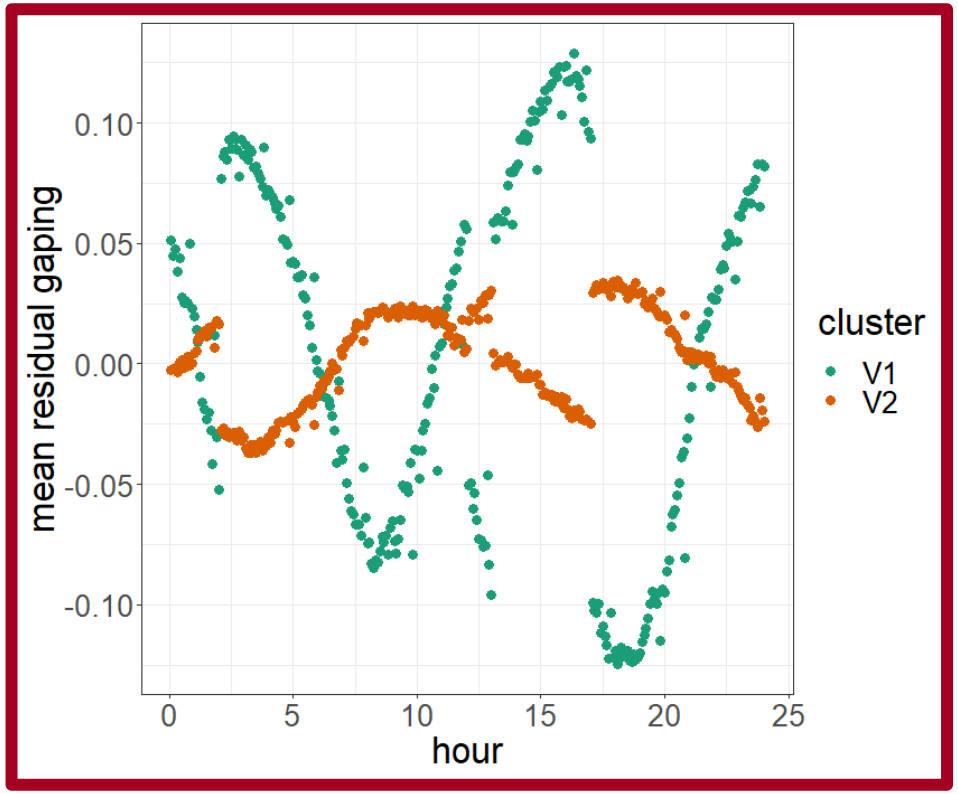
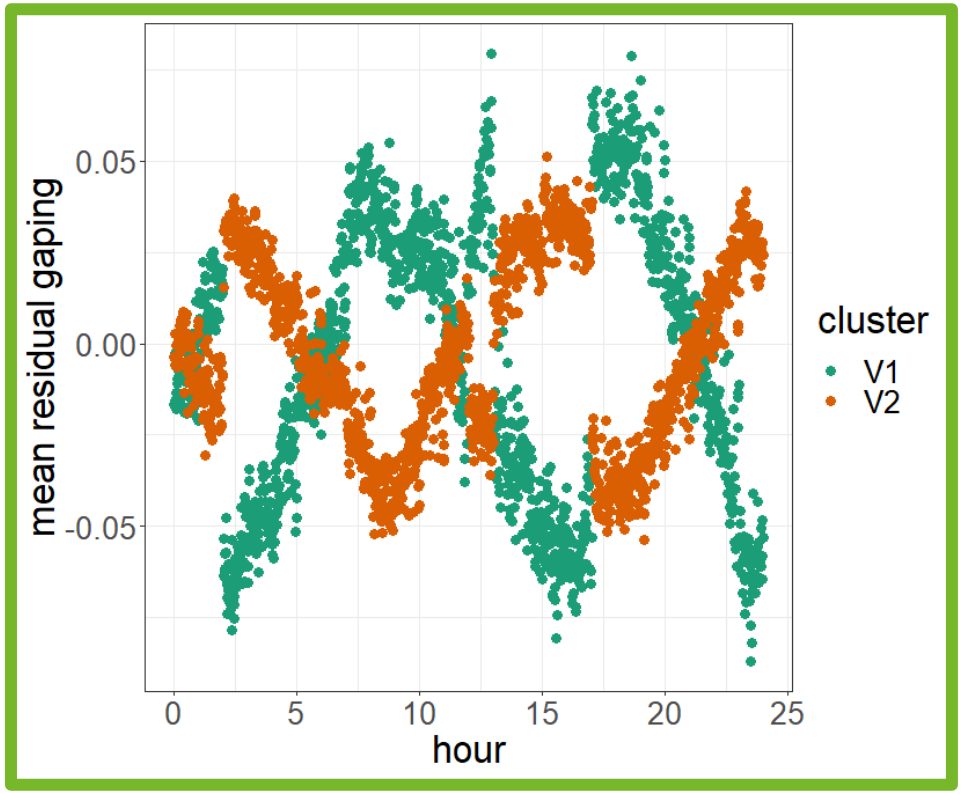
Detrended gaping



2 oscillation amplitudes as already observed by Bertolini et al. (2021) using different method (wavelet analysis)



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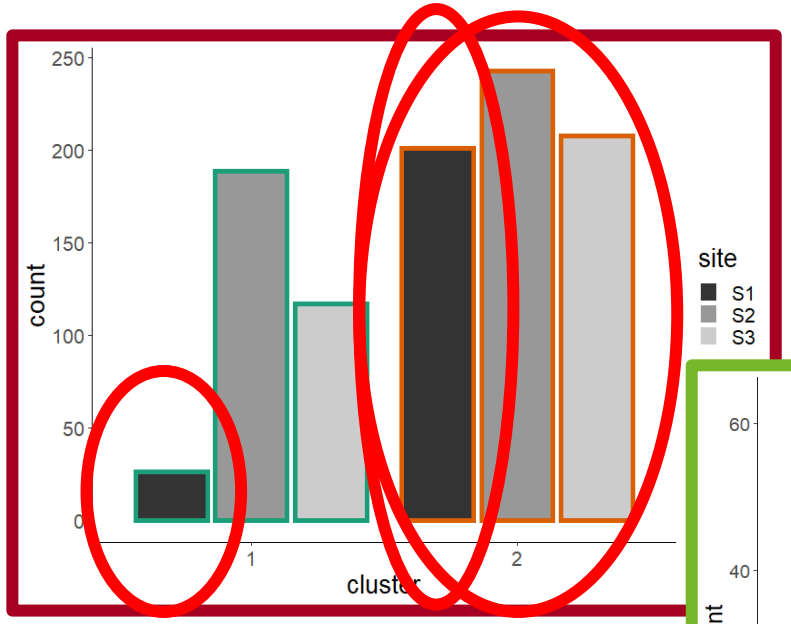
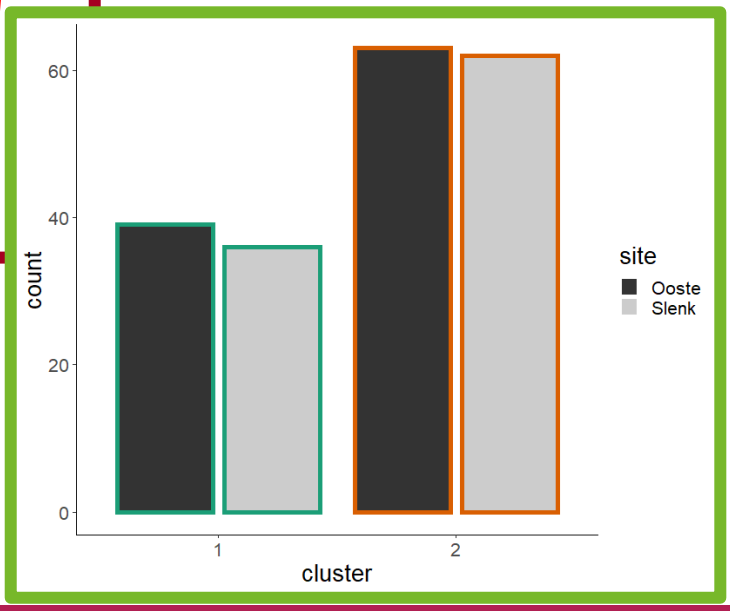
Detrended Gaping – Site effect

- **Venice**
  - Higher number of days with a lower amplitude of oscillation
  - Particularly evident in S1 (near to sea inlet)
- **Wadden Sea**
  - No clear site effect or clear predominance of one behaviour





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Conclusions

- **Results**
  - **3 clusters** of daily mean value
  - **Different environmental drivers** => Different growing/sampling conditions
  - **2 daily detrended patterns** => already observed using another method

- **Potential applications**
  - Improvement of **bioenergetic models**
  - **Precision shellfish farming :** using real-time gaping monitoring in order to better **forecast growth**, and then **productivity**

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Thank you for your attention !

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Università degli Studi di Padova

NIOZ

Venezia2021
Programma di ricerca scientifica per una laguna "regolata"