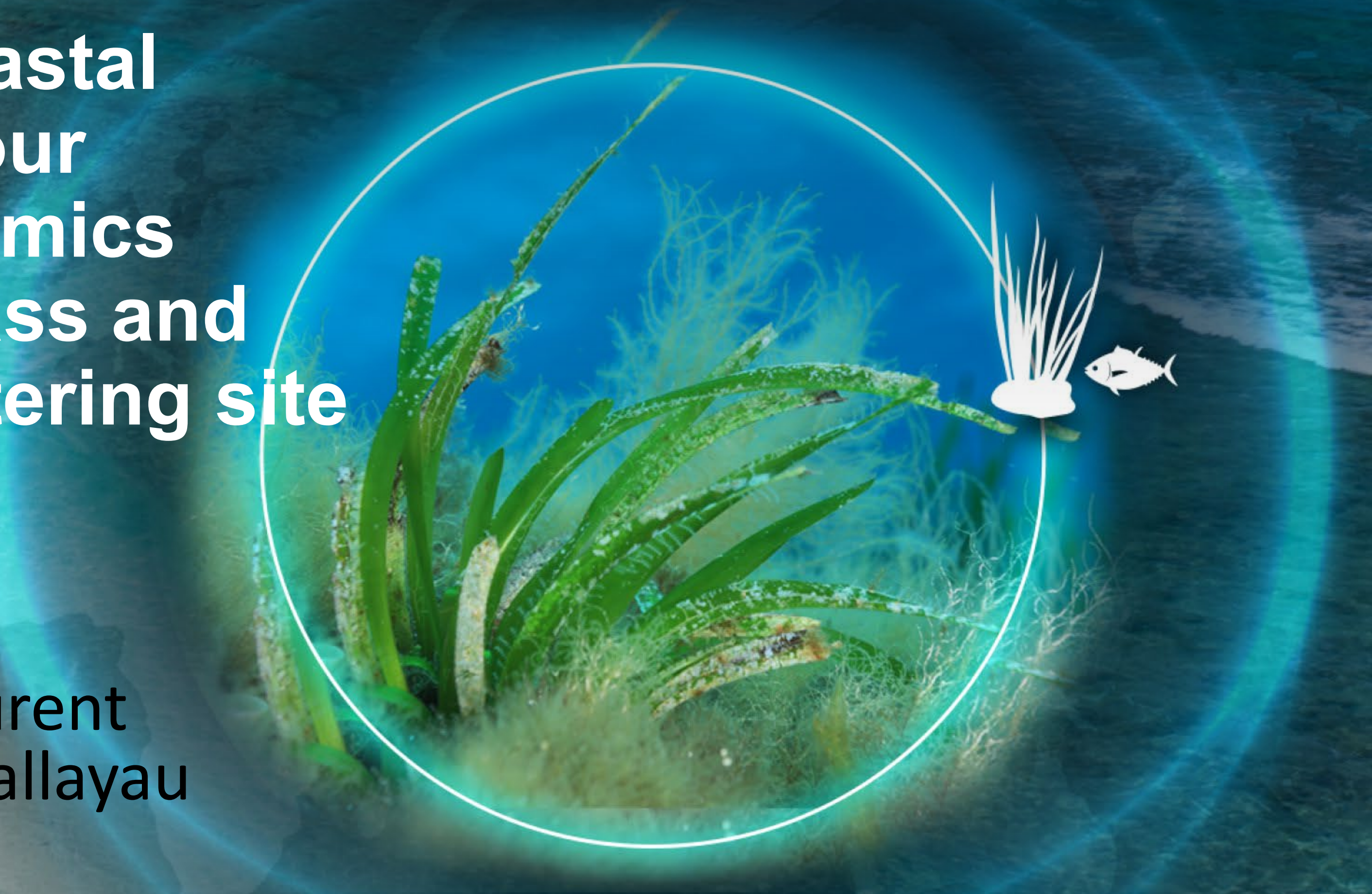
BiCOME - Biodiversity of the Coastal Ocean: Monitoring with Earth Observation

Earth Observation for coastal biodiversity: analysing four decades of coupled dynamics between intertidal seagrass and migratory geese in a wintering site of the Atlantic flyway



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esa BiCOME is funded by the European Space Agency (ESA)

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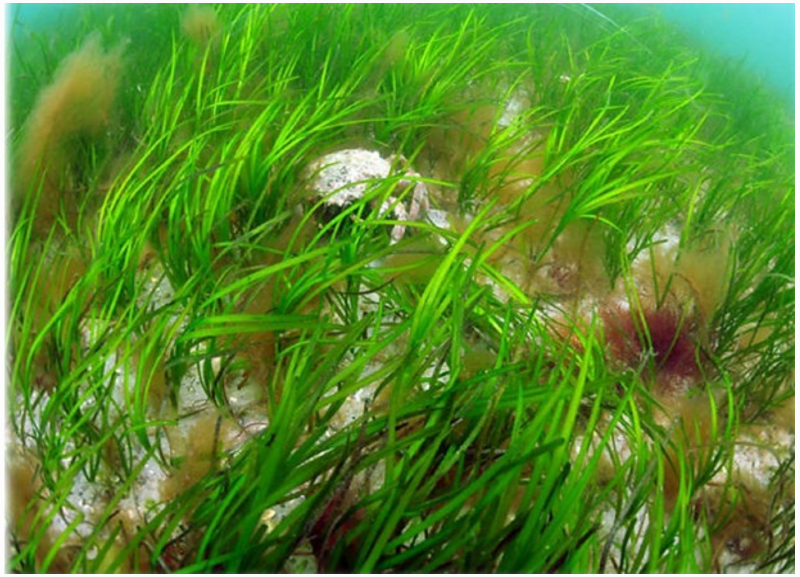
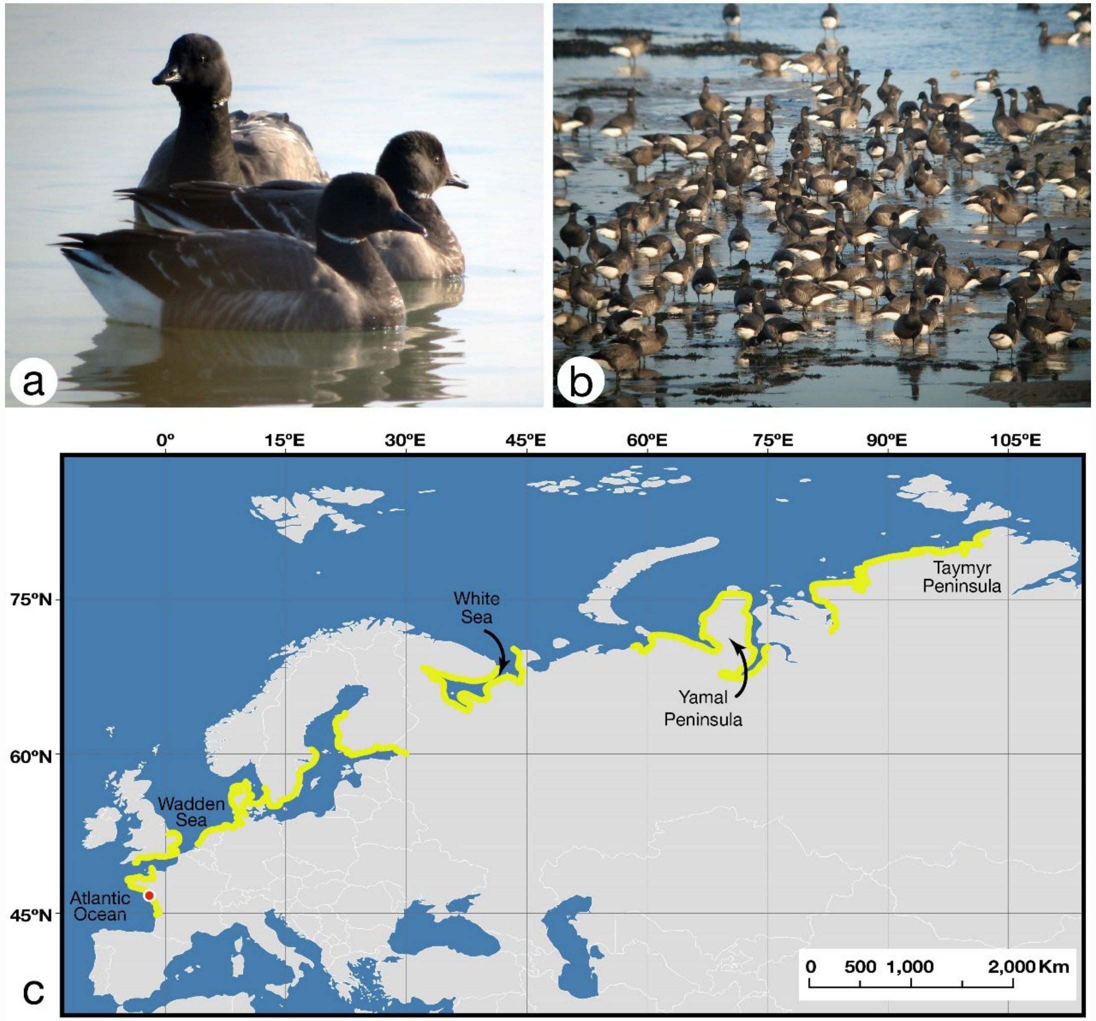
Seagrass ecosystems

- **Seagrass ecosystem services**: blue carbon, wave energy reduction, sediment stabilization, nursery, shelter and food for many fauna species ➔ **protected habitats**
- **Highly dynamic** ➔ which are drivers of such variability?
- Less attention paid for **trophic interactions on temporal dynamics and trends**



Brent geese (*Branta bernicla bernicla*)

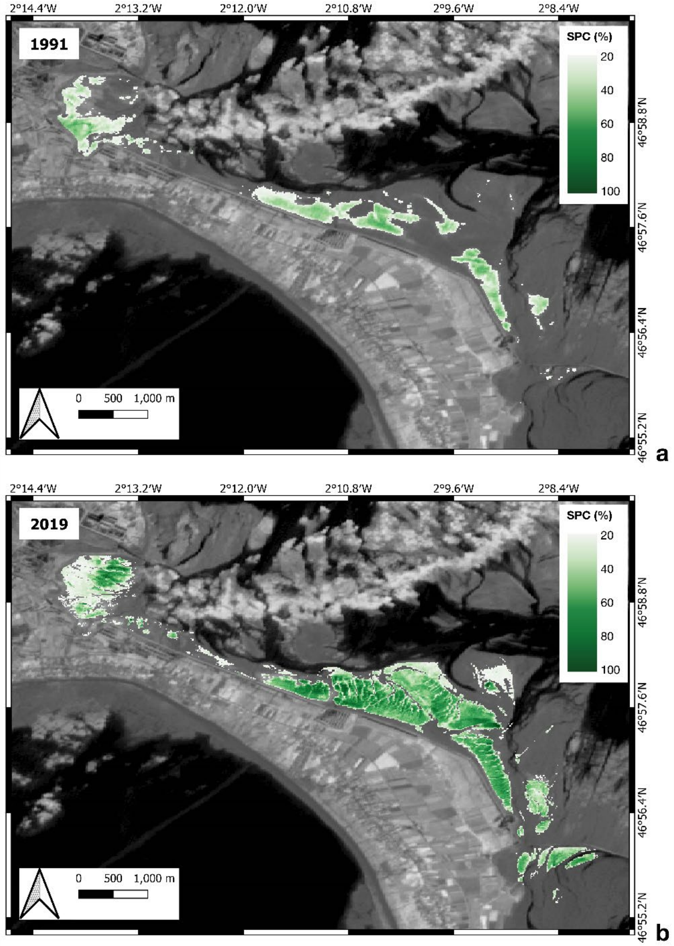
- Migratory herbivore that feeds mainly on seagrass (*Zostera* spp.)
- Brent goose flyway:
  - Summer: beeding in the Tamyr Peninsula
  - Autum and Winter: West Atlantic coast
  - Intermediate stop-overs in the White, Baltic and Wadden Seas



Objectives

- To investigate the **relationship** between **seagrass** habitat (dominated by *Z. noltei*) and **bird** population.
- Demonstrating the **potential of high-resolution satellite remote sensing** for the **conservation** and ecology of two intertwined and protected species.

Datasets



Seagrass Essential Biodiversity Variables (EBVs)

- Multi-mission satellite data (SPOT, Landsat, S2) from 1985 – 2020
- Algorithms calibrated from in situ data (Zoffoli et al., 2020; 2021)
- EBVs: Density (D), habitat extent for percent cover >20% (A20) and >50% (A50)
- Landsat archive ➔ phenological cycle

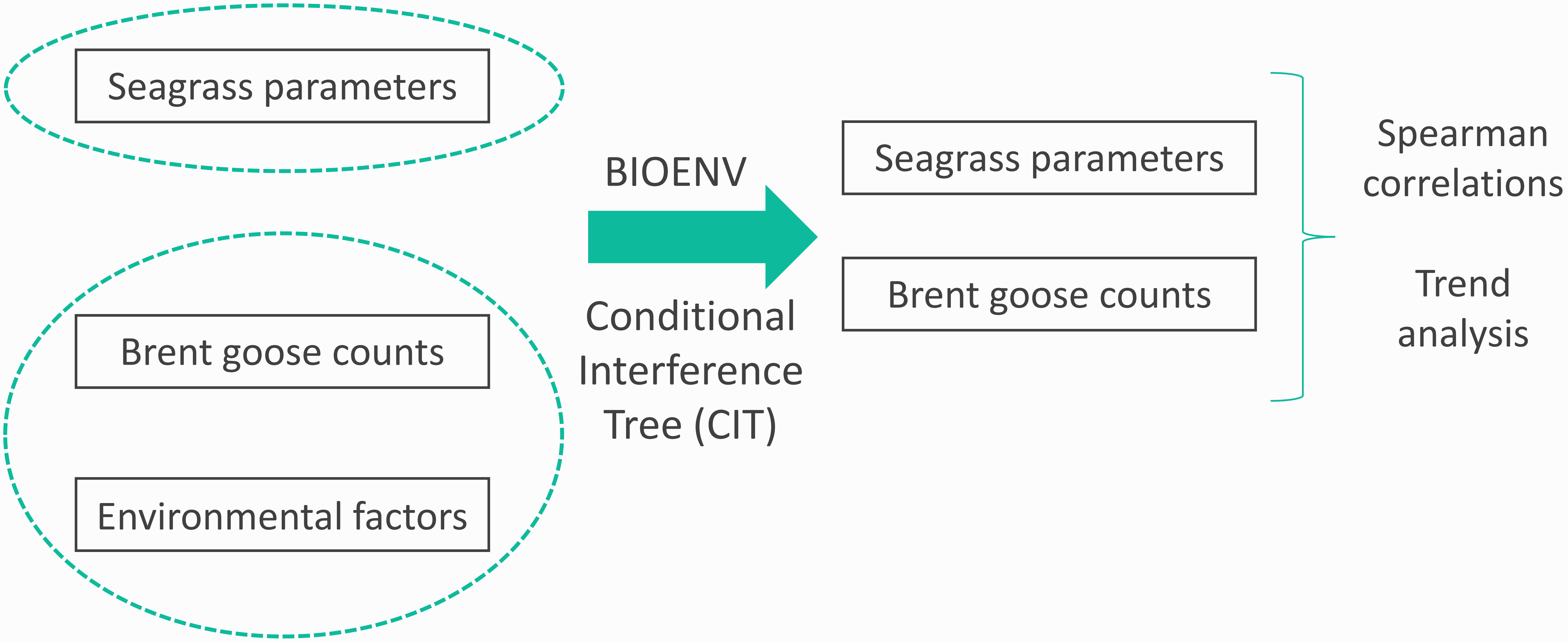
Brent goose data

- Monthly counts (September – April) from 1976 – 2020

Environmental data

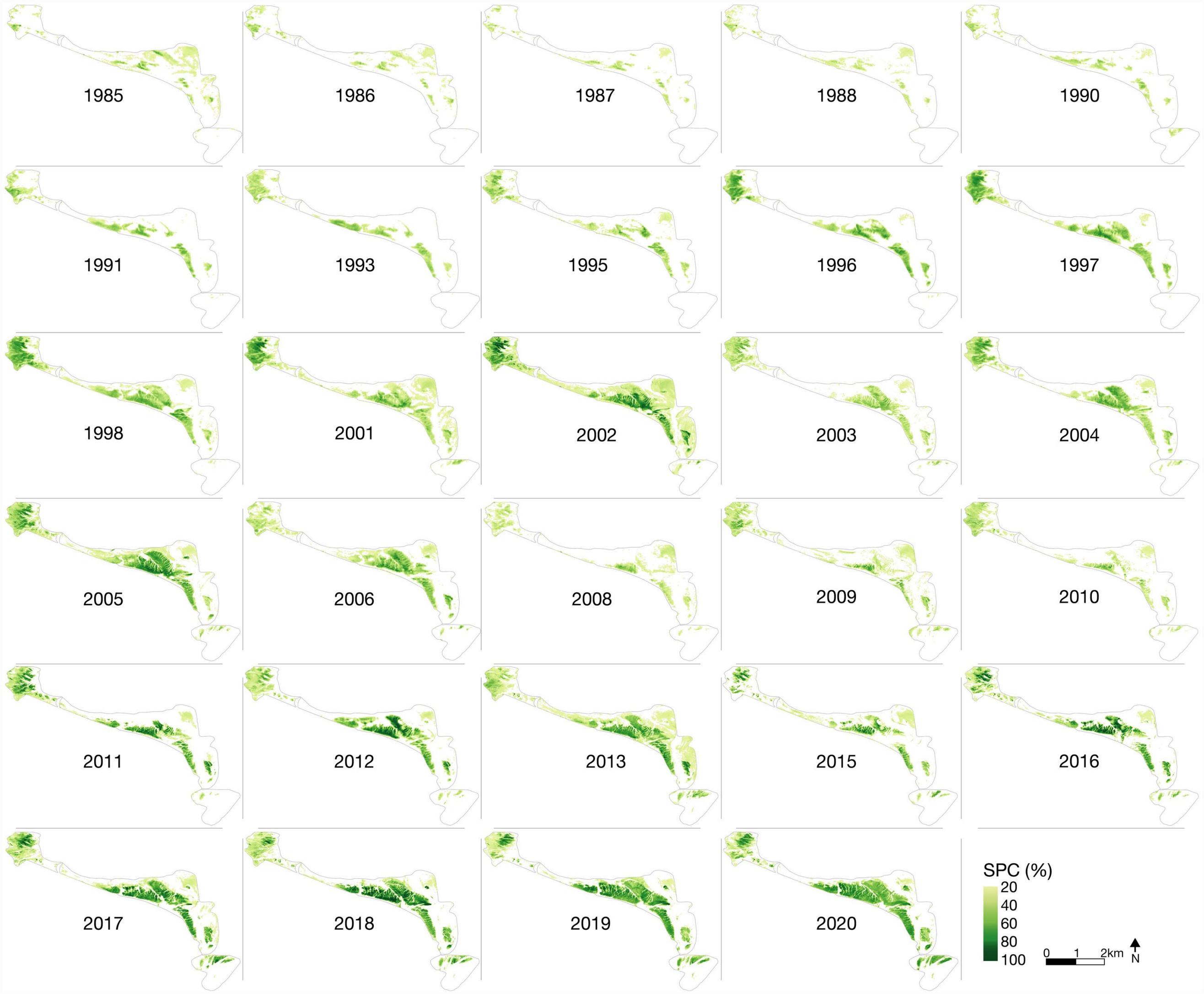
- Air Temperature, SST, rainfall, wave height, solar radiation, flow of Loire river, sea level
- 1985 – 2020

Data analysis

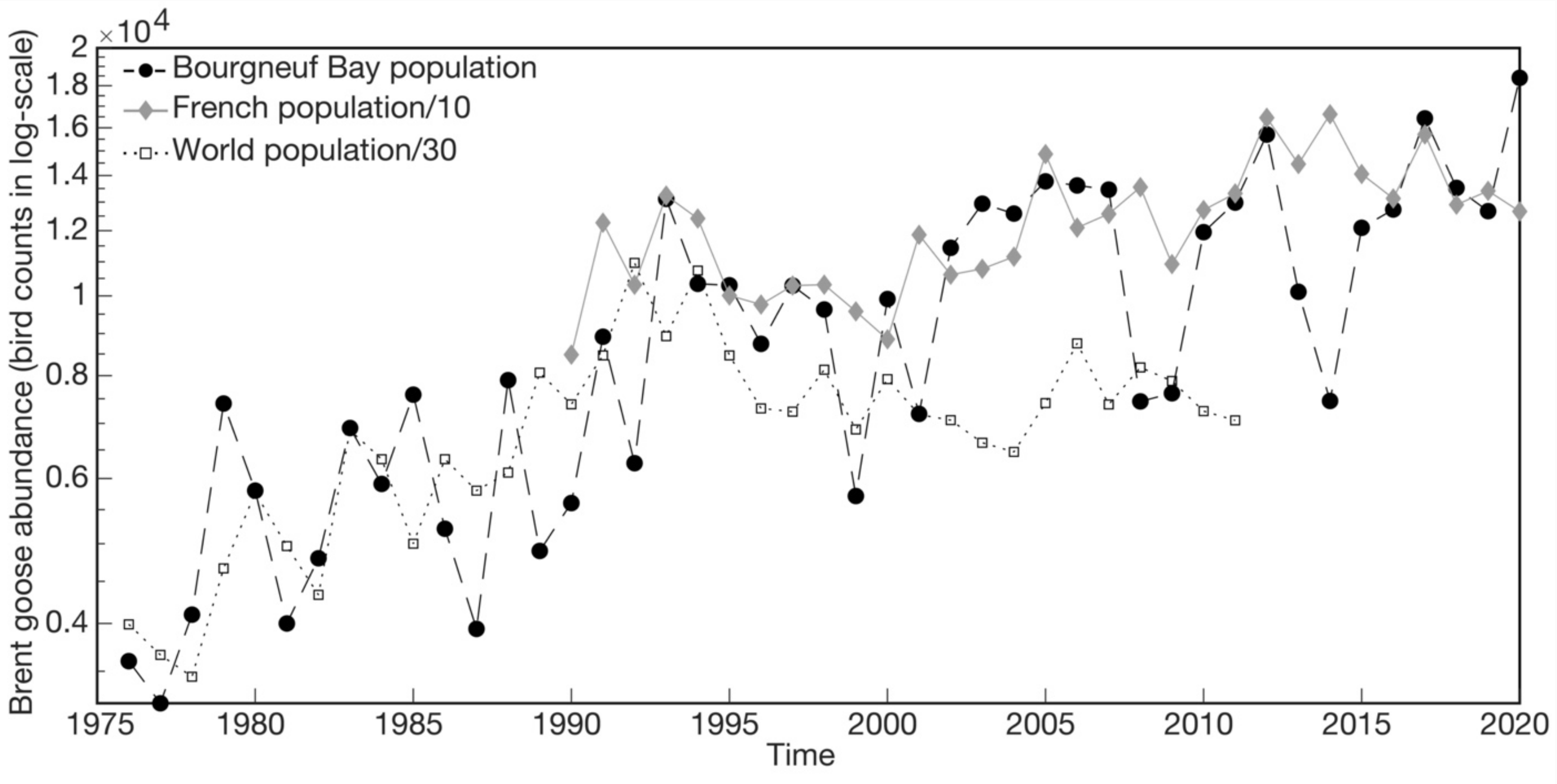


Seagrass time-series

- Increasing in seagrass parameters from 1985
- High interannual variability



Brent goose population at different geographic scales



- **Global population** peaked ~1992. **French population** continued to increase
- **Higher variability** in Bourgneuf Bay and declines coincide with decreases in seagrass

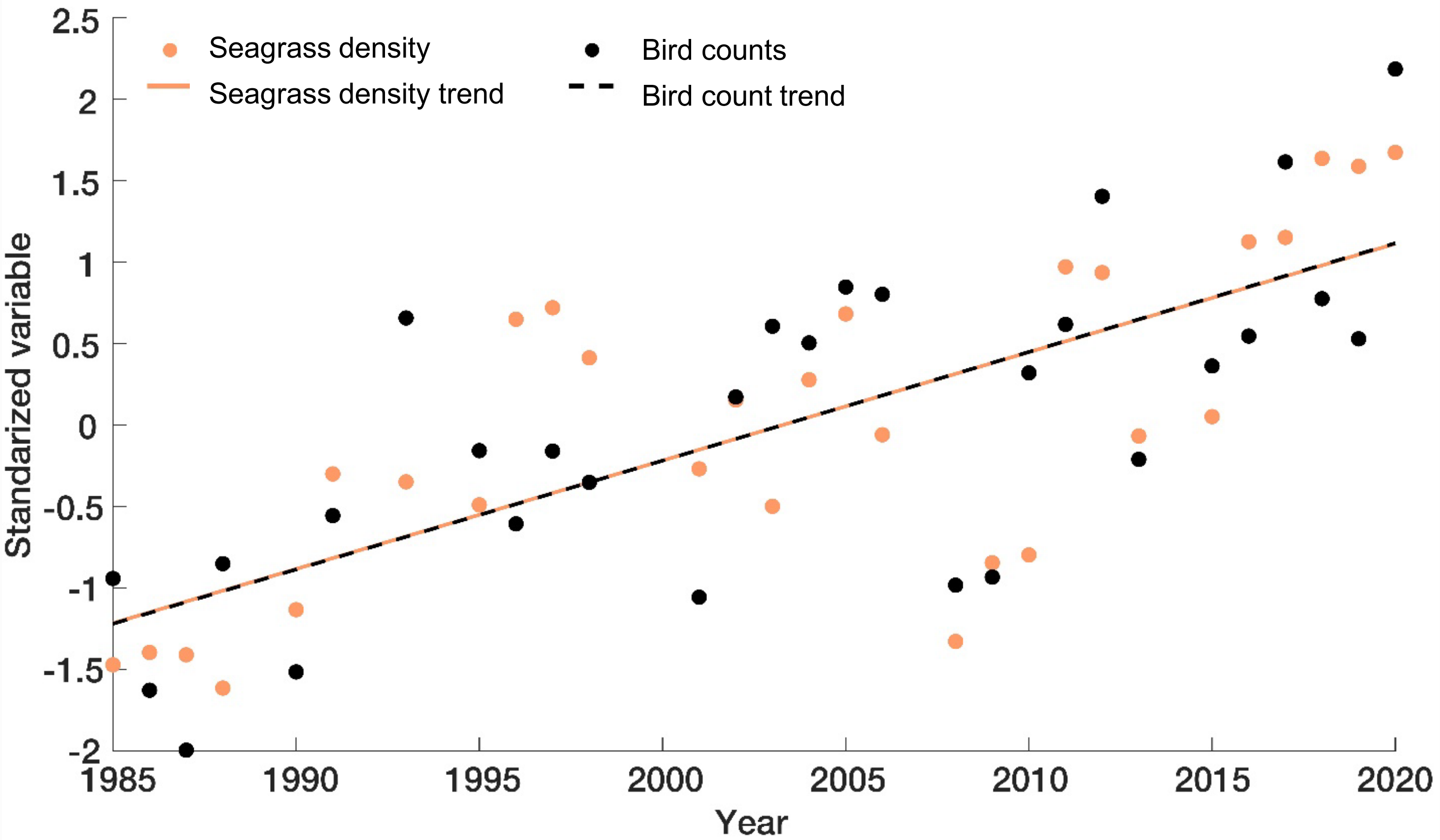
Birds Seagrass | Seagrass Birds

	Birds during preceding winter	Birds following seagrass peak
Seagrass density	0.64	0.74
Seagrass surface (>20%)	0.65	0.56
Seagrass surface (>50%)	0.68	0.70

Spearman rank correlation (all coefficients with p-value < 0.05)

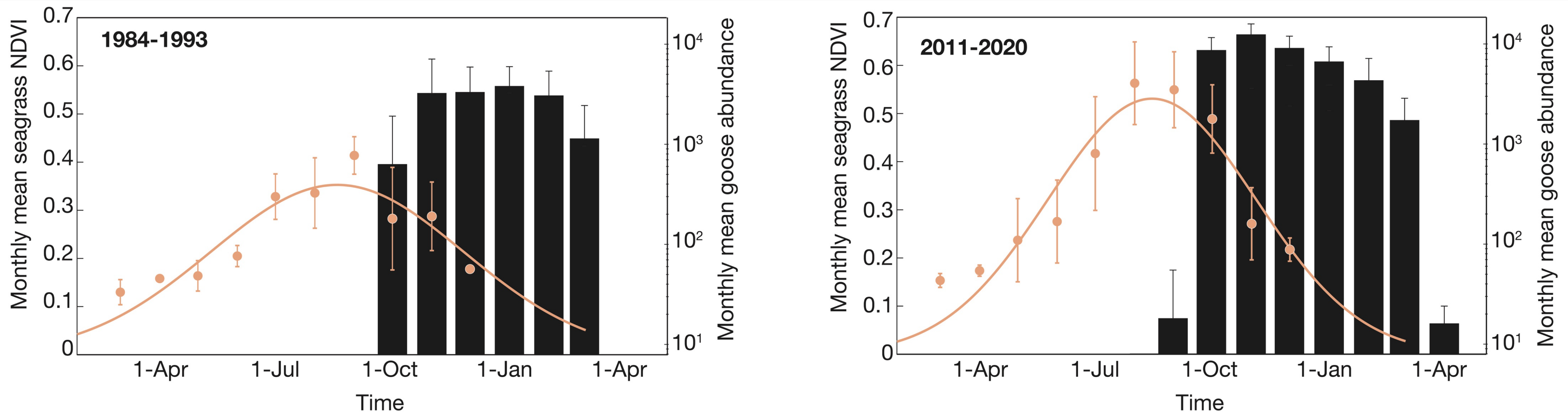
Positive feedbacks between geese and seagrass in two ways:

- Birds during preceding winter ➔ timing of both populations. Sediment reworking, seed propagation, fertilization by faeces, etc.
- Birds following seagrass peak ➔ bottom-up interpretation



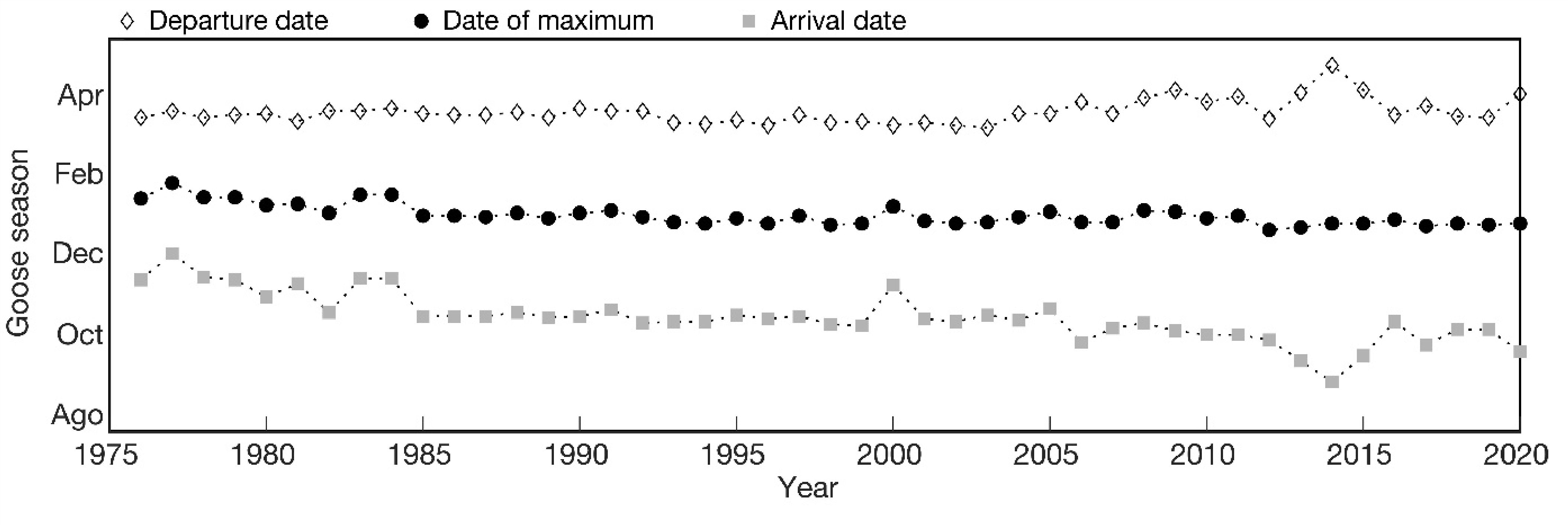
- Increasing trends in seagrass parameters, different from other meadows worldwide
- Seagrass parameters and goose abundance ➔ same trends (p-value > 0.05)

Seagrass and Brent goose phenology



- Same phenology in seagrass season but increasing in magnitude
- Different proportion in goose season

Brent goose wintering season along 45-years in Bourgneuf Bay



- **Phenological change** in wintering season: Earlier maximum and arrival and delayed departure
- **Expansion** in goose season, likely due to higher food availability
- Later departure might produce a **phenological mismatch**

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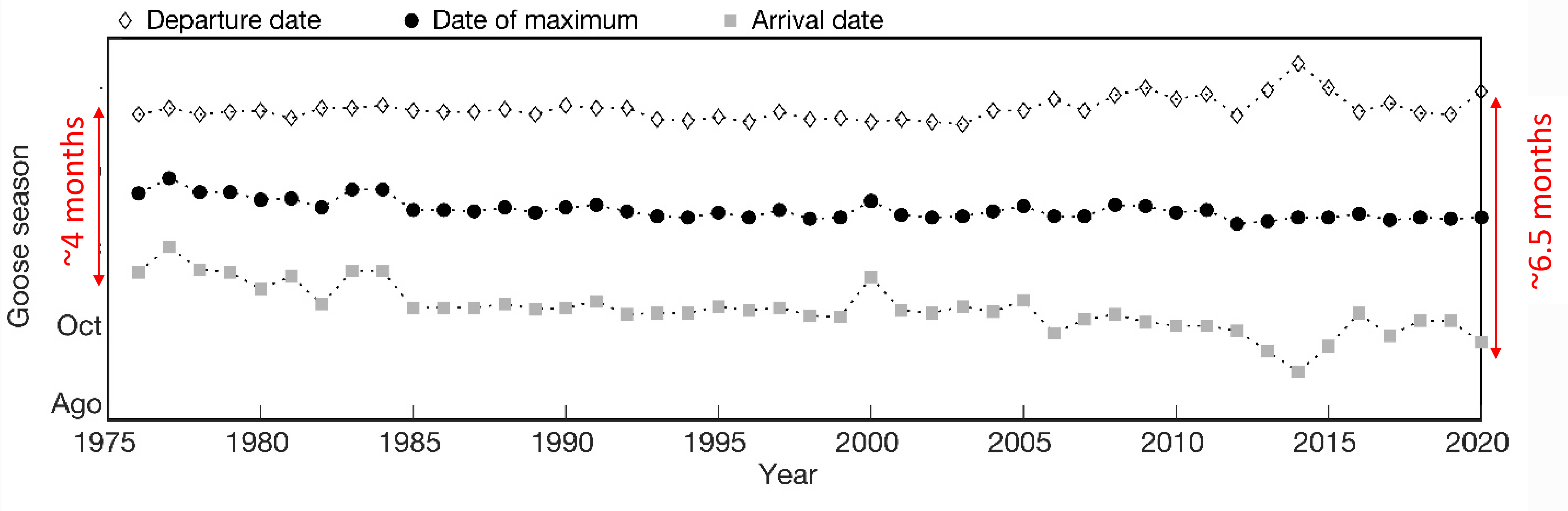

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Concluding remarks

- Stronger statistical relationship between seagrass and birds than other environmental factors ➔ Birds as main explanatory variable of seagrass dynamics
- **Mutualistic *Z. noltei* – Brent goose** interaction ➔ **positive correlations** and **increasing trends** in both populations over the last 4-decades
- **Extension** in goose **wintering season** in Bourgneuf Bay
- Global interconnections with climate and trophic interactions affect local populations ➔ protection policies for migrant animals require global coordination
- EO makes possible to evaluate seagrass dynamic at habitat-level in global scales

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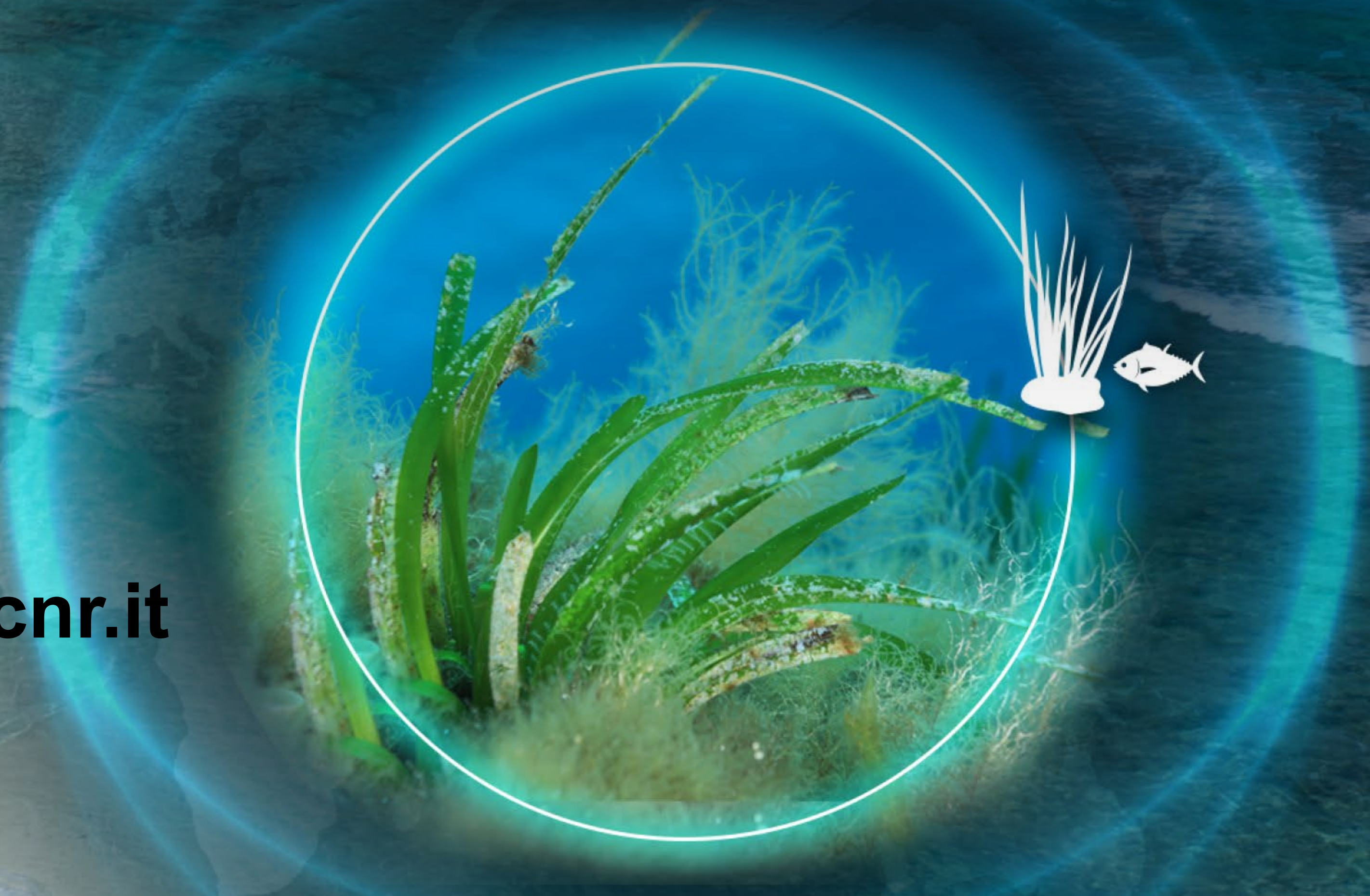
Thank you



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