Improving the success rate of seagrass restoration projects: Development of a new bio-hydro-morphological modelling platform accounting for vegetation growth

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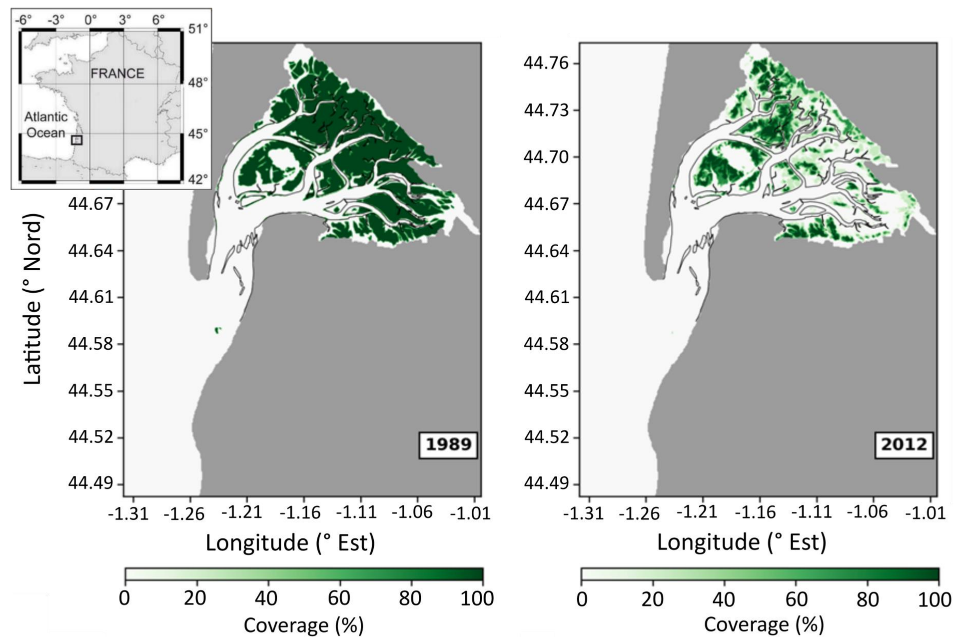
Background

- Seagrasses attenuate currents, wave energy, reduce erosion and submersion risks
- Seagrasses declined worldwide, leading to an increasing **need for restoration**
- But modification of the hydro-sedimentary patterns following seagrass loss makes often impossible to replant seagrasses on the same site
- Many restoration projects fail due to poor selection of the restoration site or magnitude of the restoration action (area, number of seeds,…). **A careful selection of the site and assessment of the restoration action must be conducted**
- **Process-based numerical modelling** is an effective tool to devise a restoration strategy
- Important loss of seagrasses occurred in Arcachon Bay, *Zostera noltei* declined by 45% and *Zostera marina* by 84% since 1989
- This seagrass decline has resulted in higher suspended sediment concentration (SSC) and in the increasing need for dredging in the inner channels



Methods

1 Selection of the restoration site

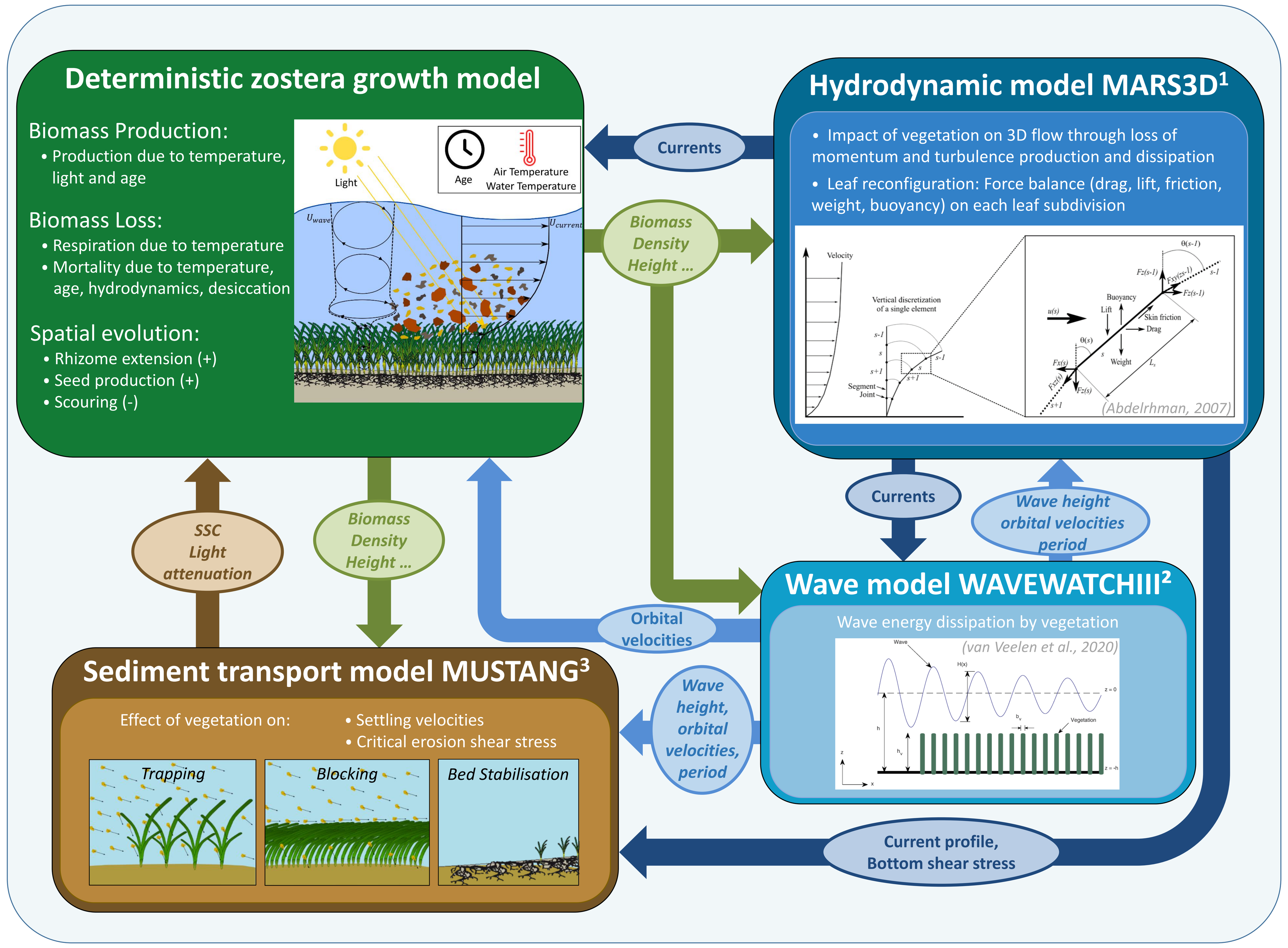
Selection of a **sheltered** site (weak hydrodynamic conditions (waves & currents), computed using an erosion potential ($F_{0.165} = (\tau_{tot}/\tau_{crit}) - 1$), with **high light availability** (low suspended sediment concentration) and a **muddy sediment bed**, which provides better sediment stability.

2 Definition of the restoration action

Modelling the restoration action by trial and error method to determine the **surface area** and **number of seeds** (limited by seed mortality and germination rate, both taken into account in the model) required to have a sufficient density over an area wide enough to activate positive feedback on the hydro-sedimentary processes that enable natural step by step recolonisation of the area by seagrasses.

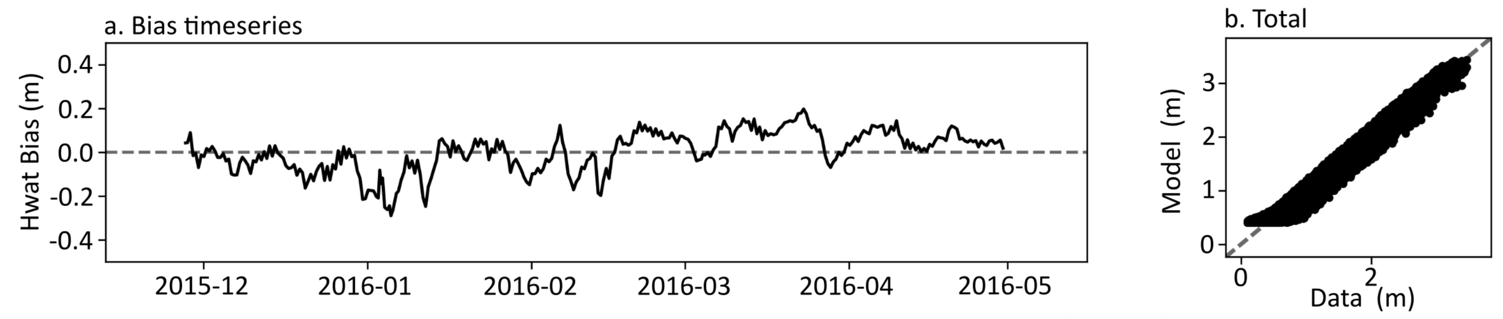
Numerical modelling

➤ Bio-hydro-morphological modelling platform

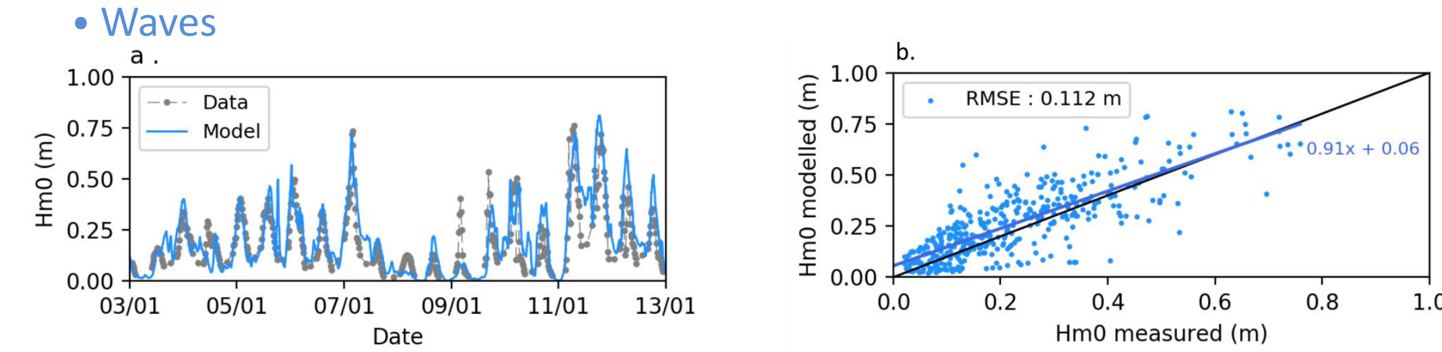


➤ Model Validation

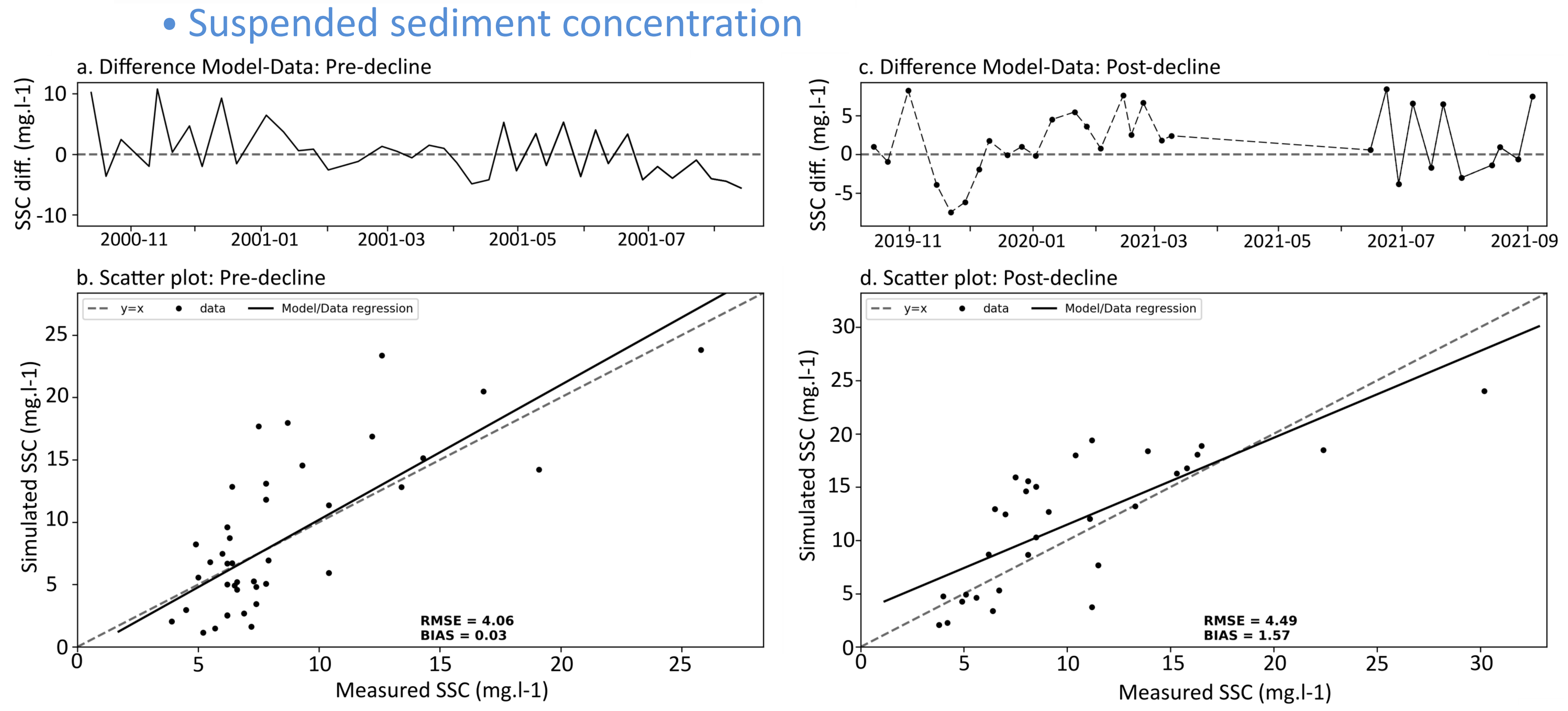
- Currents



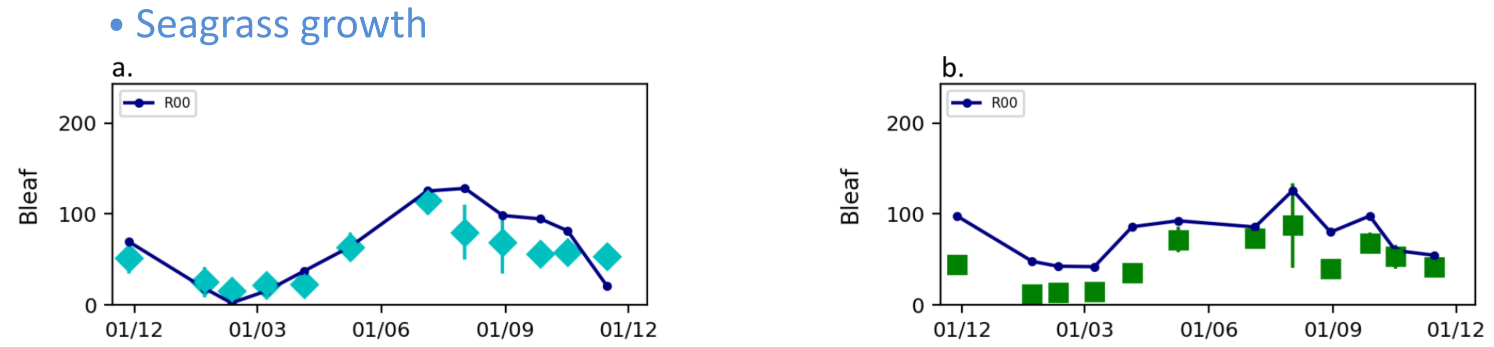
- Waves



- Suspended sediment concentration

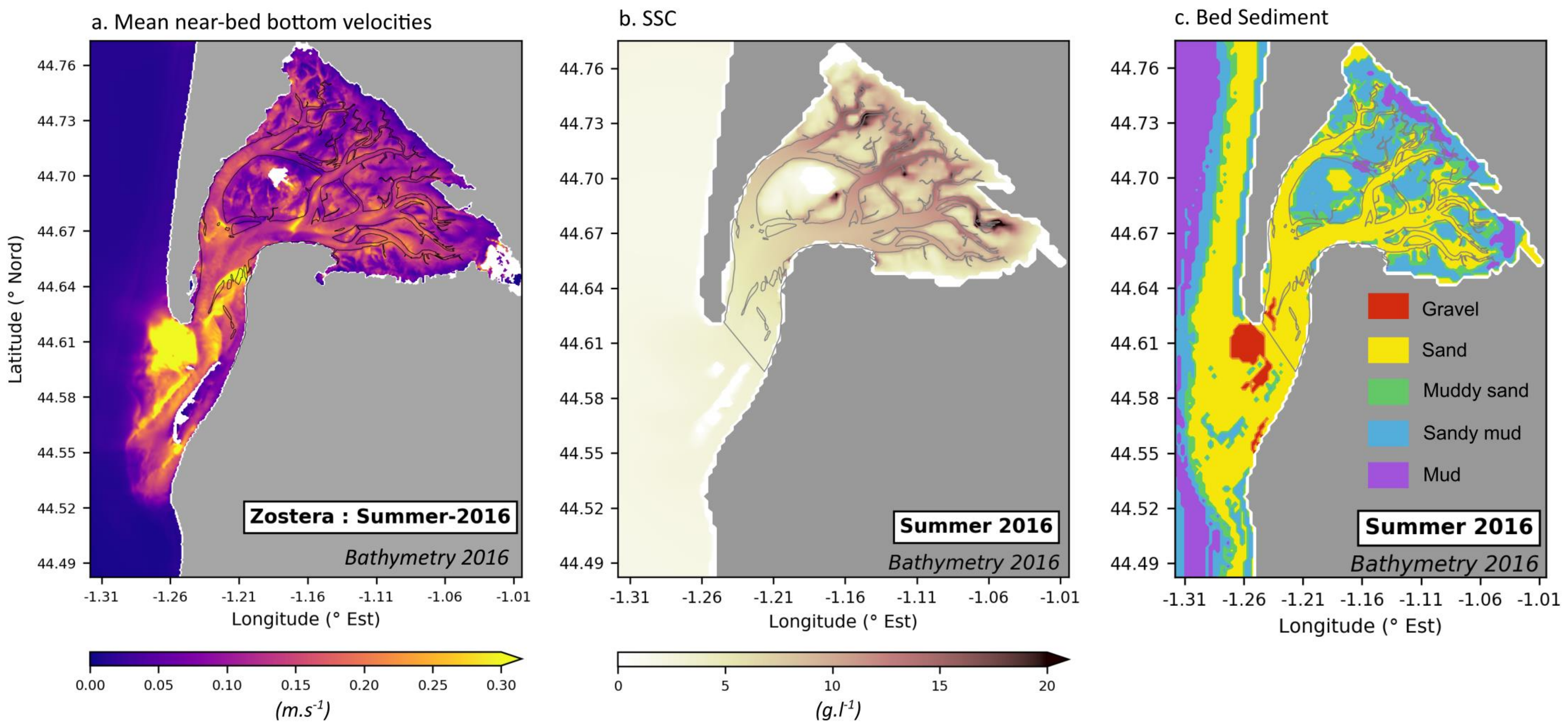


- Seagrass growth



Results

➤ Currents and sediment patterns (post-decline)

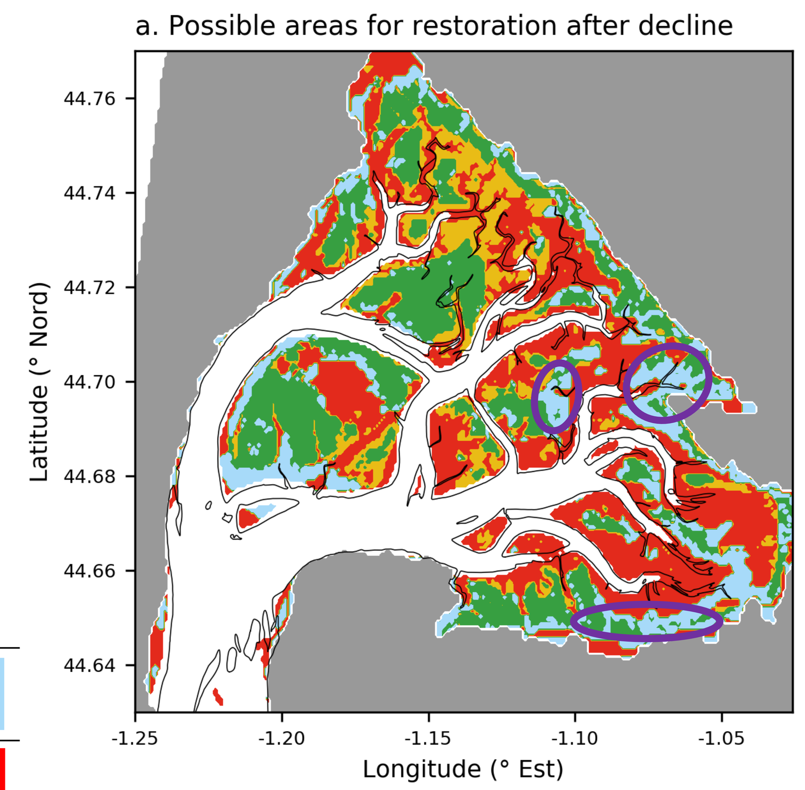


➤ Sites showing favourable conditions for restoration

Some areas (purple ellipses) meet all the requirements for successful seagrass restoration:

- **Weak currents**
- **Relatively low SSC**
- **Muddy bed**

	Presence of *Z.noltei*	Absence of *Z.noltei*
Favourable conditions	(green)	(light blue)
Unfavourable conditions	(yellow)	(red)



Conclusions and perspectives

- The integrated modelling platform will enable to **quantify the appropriate restoration action** that triggers step by step recolonisation and therefore **avoid undertaking expensive unsuccessful restoration projects**
- This study defined areas in which restoration is the most likely to succeed
- An assessment of the impacts of the chosen restoration action on the hydro-sedimentary processes will be conducted to **prevent any undesired consequences** on the ecosystem

Acknowledgements

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