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## **Towards carbon neutrality by 2040 in La Rochelle metropolitan area (France): quantifying the role of wetlands and littoral zone in the capture and sequestration of blue carbon**

Christine Dupuy, H el ene Agogu e, Benjamin Amann, Fr ed eric Az emar, Nicolas Becu, Lauriane Bergeon, Xavier Bertin, Pierrick Bocher, Emilie Bout, Isabelle Brenon, et al.

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# Towards carbon neutrality by 2040 in La Rochelle metropolitan area (France): quantifying the role of wetlands and littoral zone in the capture and sequestration of blue carbon

Consortium of LRTZC (La Rochelle Territoire Zéro Carbon) project:

Dupuy C., Agogue H., Amann B., Azémar F., Becu N., Bergeon L., Bertin X., Bocher P., Bout E., Brenon I., Carpentier A., Ceaux S., Chaumillon E., Choquet C., Colin B., Deborde J., Dubillot E., Emery C., Ferrari S., Gauchere C., Geairon P., Gilbert S., Jeannin M., Jourde J., Kalenitchenko D., Lachaussée N., Lacoue-Labarthe T., Lanneluc I., Lavaud L., Lavaud S., Lefrançois C., Le Fouest V., Long N., Mahieux P.Y., Mayen J., Marais C., Metzger E., Moncelon R., Ouisse V., Péreau J.C., Pétilon J., Philippine O., Pineau P., Pignon-Mussaad C., Polsenaeere P., Sabot R., Refait P., Reveillac E., Robin F.X., Rouquette H., Sable S., Sauriau P.-G., Tackx M., Turcy P., Vagner M., Vincent J., Volto N.

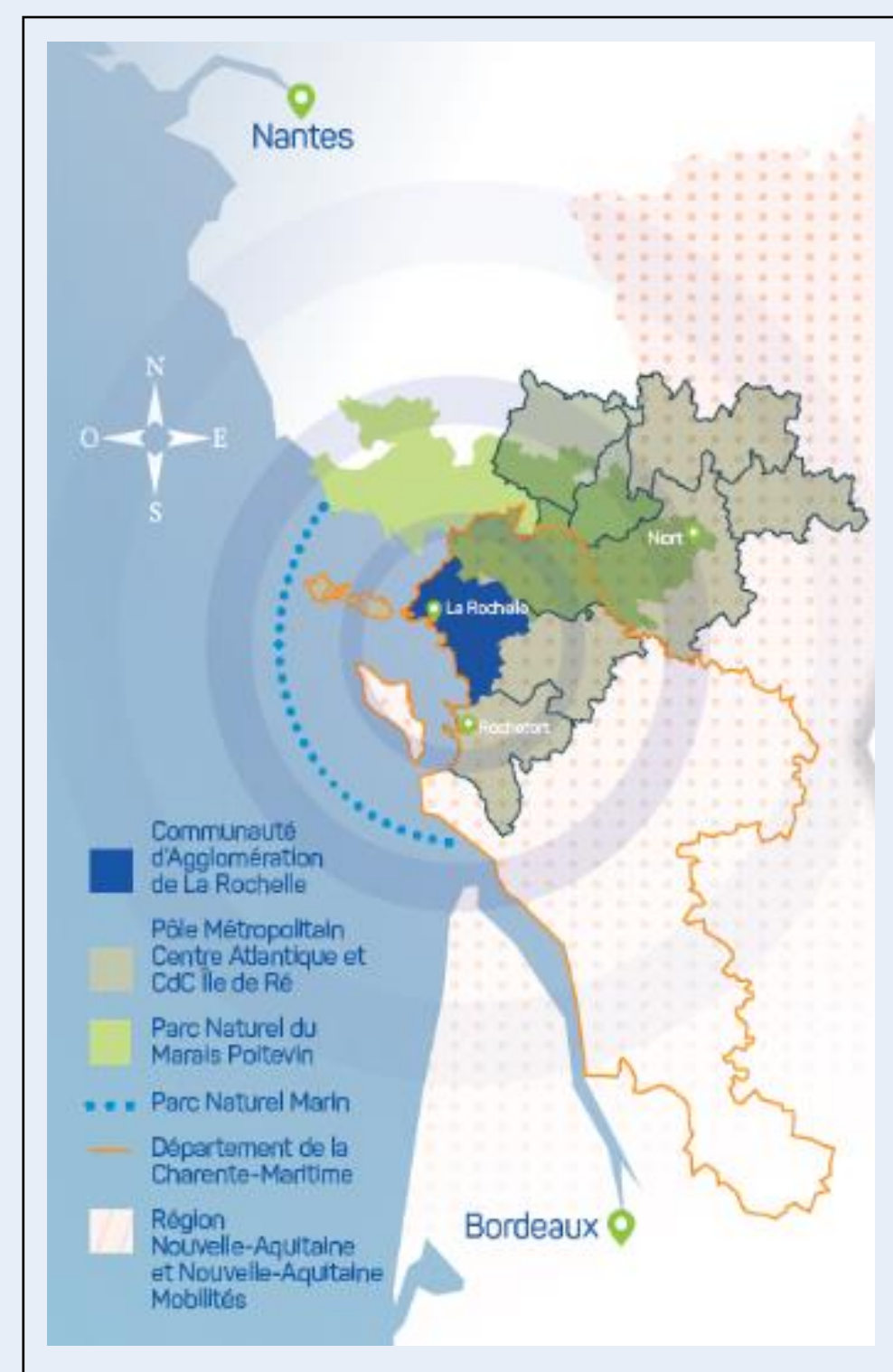
1 UMR 7266 Littoral Environnement et Sociétés (LIENSs), CNRS - La Rochelle University, France, 2 UMR 5245 (CNRS-UPS-INPT), Laboratoire Ecologie Fonctionnelle et Environnement - Toulouse University (Paul Sabatier), France, 3 La Rochelle metropolitan area, France, 4 University of Rennes, UMR BOREA (MNHN), France, 5 MIA - La Rochelle University, France, 6 IFREMER, Littoral, Laboratoire Environnement et Ressources des Pertuis Charentais (LER-PC), France, 7 Univ. Bordeaux, CNRS, BSE UMR 6060, France, 8 AMAP-INRAE, CIRAD, CNRS, IRD, Univ. Montpellier, France, 9 LASIE, CNRS - La Rochelle University, France, 10 LPG, University of Angers, CNRS, France, 11 MARBEC, Univ. Montpellier, Ifremer, IRD, CNRS, Sète, France, 12 UMR 6553 Ecosystèmes, Biodiversité, Evolution (ECOBI), CNRS - University of Rennes, Rennes, France, 13 Institute for Coastal and Marine Research - Nelson Mandela University, Port Elizabeth, South Africa, 14 Union des Marais de la Charente-Maritime, France, 15 La Rochelle town, France, 16 LEMAR, CNRS-IFREMER-University of Brest, France

## Importance of aquatic ecosystems in the capture and sequestration of blue carbon

Rising greenhouse gas emissions are causing increasing worldwide impacts and changes on climate patterns, sea level, food production, human lives and livelihoods. Maintaining or improving the ability of coastal aquatic ecosystems and oceans to remove CO<sub>2</sub> from the atmosphere is a crucial aspect for climate mitigation. The vegetated coastal ecosystems are able to catch and to sequester carbon, called Blue Carbon. These ecosystems are key exchange zones that mediate the biogeochemical cycles across the continent, the ocean and the atmosphere. Given the importance of these ecosystems in biogeochemical cycles and their sensitivity to natural and anthropogenic pressures, the carbon cycle within and between compartments and across the interfaces (e.g. atmosphere, ocean...) needs to be addressed.



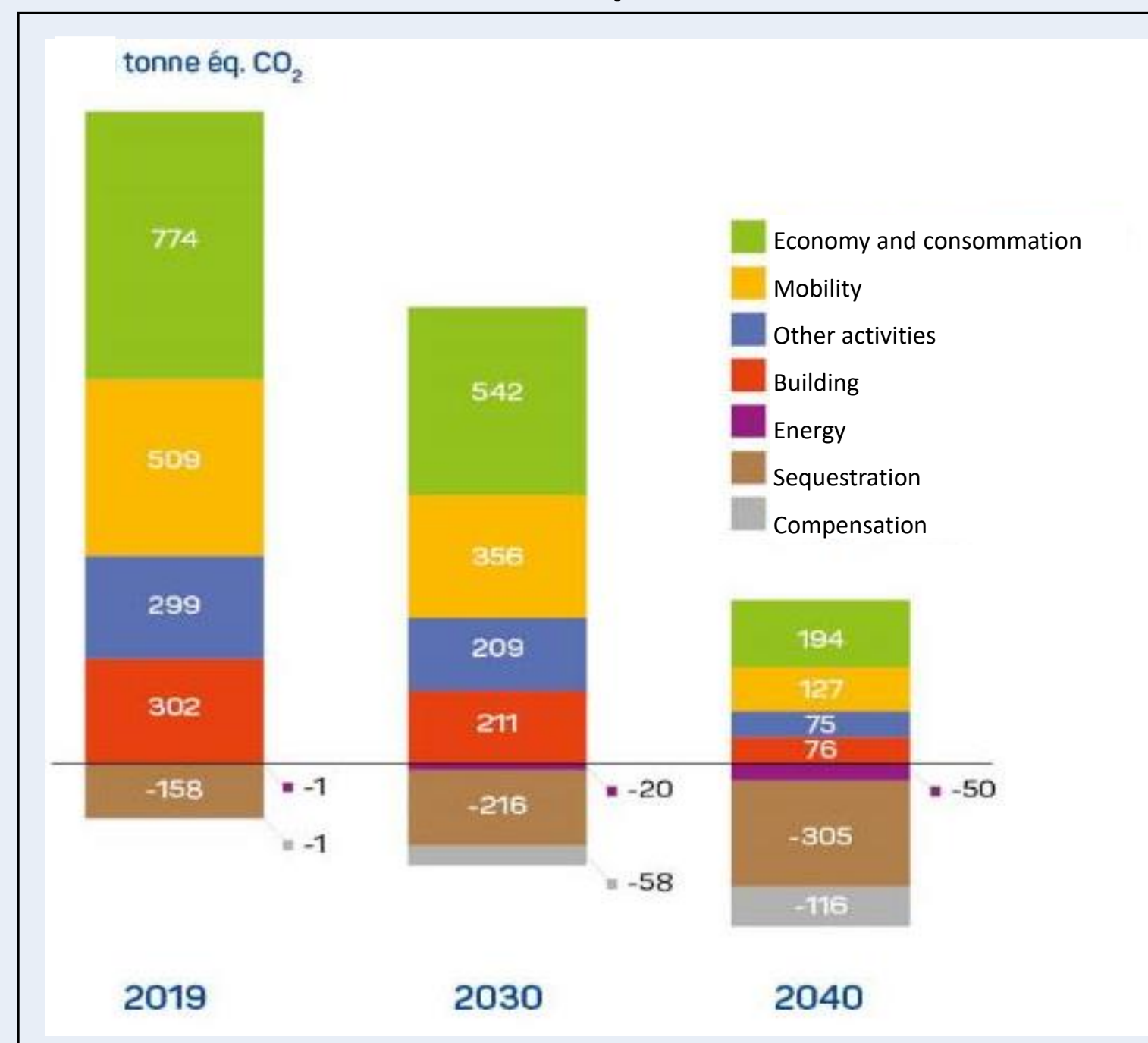
## Objective of LRTZC project: On the regional scale, target the ambition of carbon neutrality in La Rochelle metropolitan area by 2040 through a holistic approach (from measuring CO<sub>2</sub> to raising people's awareness and assessing the impact of exogenous natural factors)



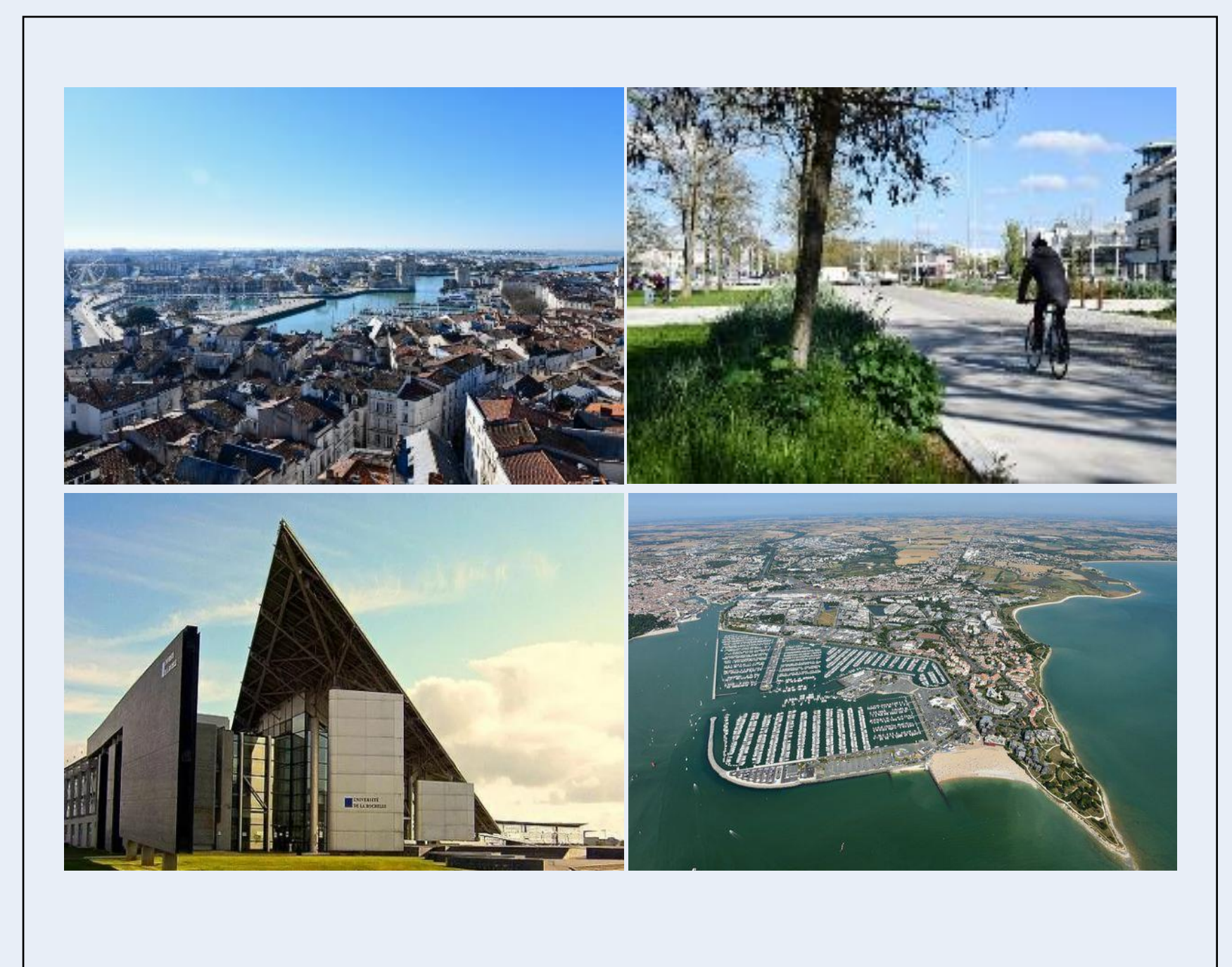
### 9 types of experimental zones



### Diagnostic of carbon budget in La Rochelle metropolitan area



### La Rochelle metropolitan area 170 000 inhabitants, 28 municipalities



### 8 axes to transform La Rochelle metropolitan area with a holistic approach



### Innovations of LRTZC project:

Holistic and methodologic innovations on experimental zones to optimize circular economy and carbon footprint of the territory

Create a territorial data plate-form to evaluate all the actions and develop new actions and uses

Carbon cooperative: a new financial paradigm to mobilize all actors

Governance: implication of more than 130 partners, citizens, public and private structures

Societal innovation to support the cultural transformation of La Rochelle metropolitan area



### Objectives of the blue carbon axis:

- Assess and monitor carbon capture and sequestration on the wetlands and littoral zone: sink or a source of CO<sub>2</sub> to the atmosphere?
- Protect the littoral zone to the submersion and erosion
- Development of decision-making tools for scientists and stakeholders
- Support the territory actors towards the blue carbon mutation
- Replicability of the project in national and international metropolitan areas

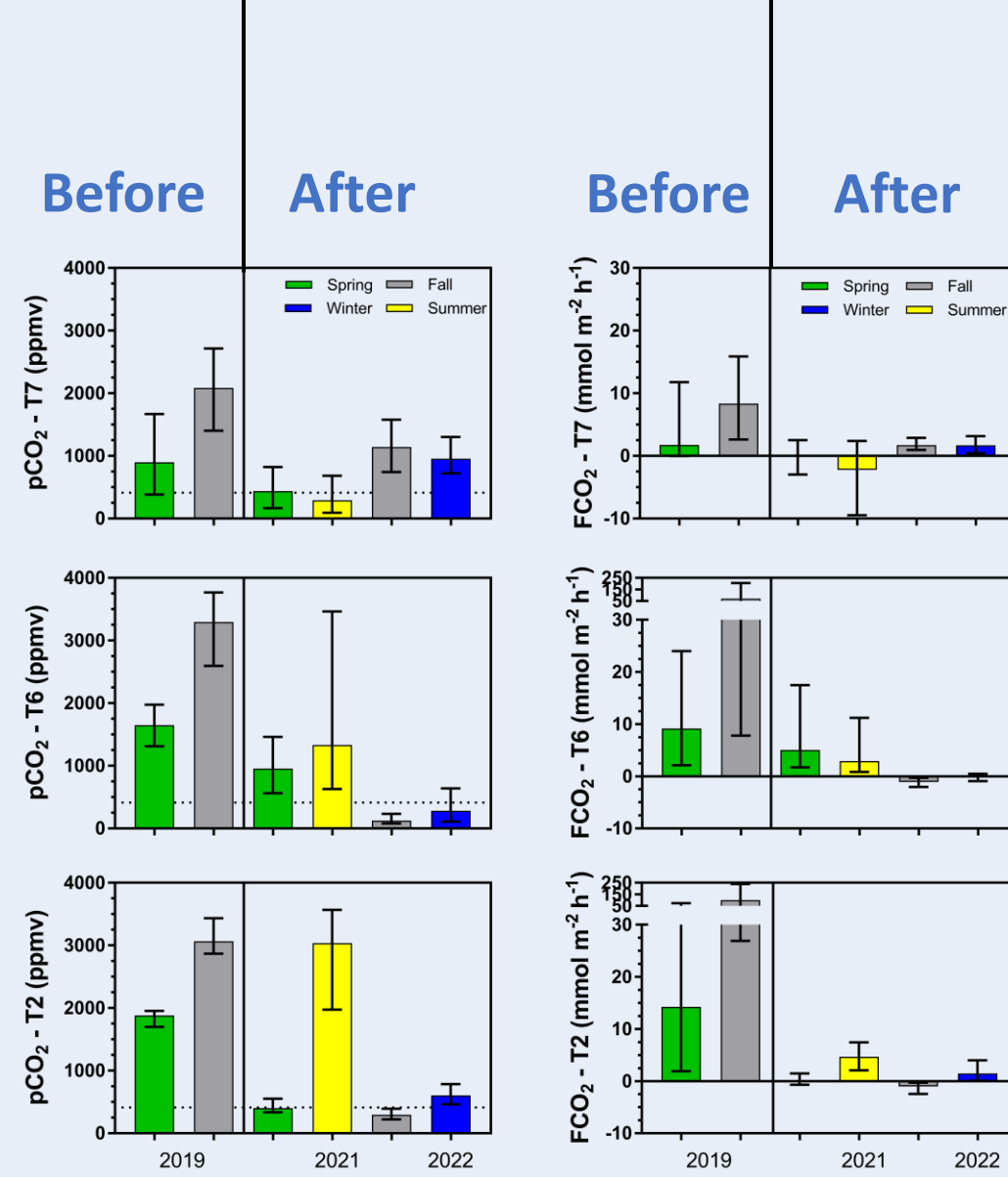
## First results on the Blue Carbon axis

### Atmospheric CO<sub>2</sub> fluxes in aquatic ecosystems

#### Freshwater marsh of Tasdon



#### Renaturation of the marsh



Methodology: seasonal 24h cycle measurements with sensors at 3 stations

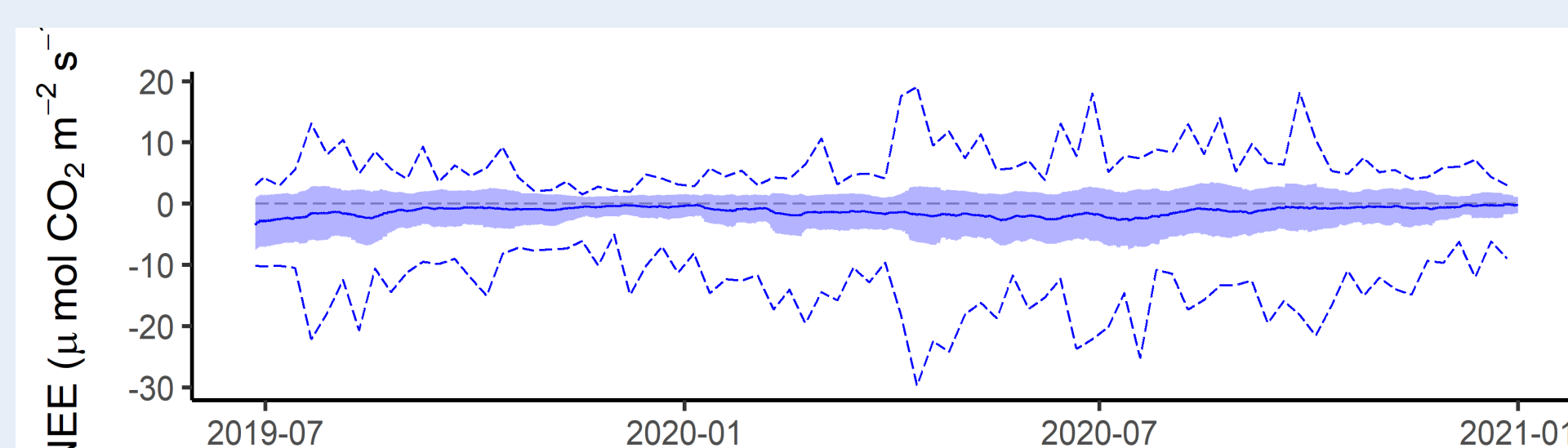
- Between 2019 and 2021: significant decrease in water pCO<sub>2</sub> from oversaturated (CO<sub>2</sub> source) to near balance, undersaturated (CO<sub>2</sub> sink) waters following the renaturation and reconnection of the marsh to the coastal zone.

#### Salt marsh of Ré Island



Methodology: Atmospheric Eddy Covariance system since summer 2019

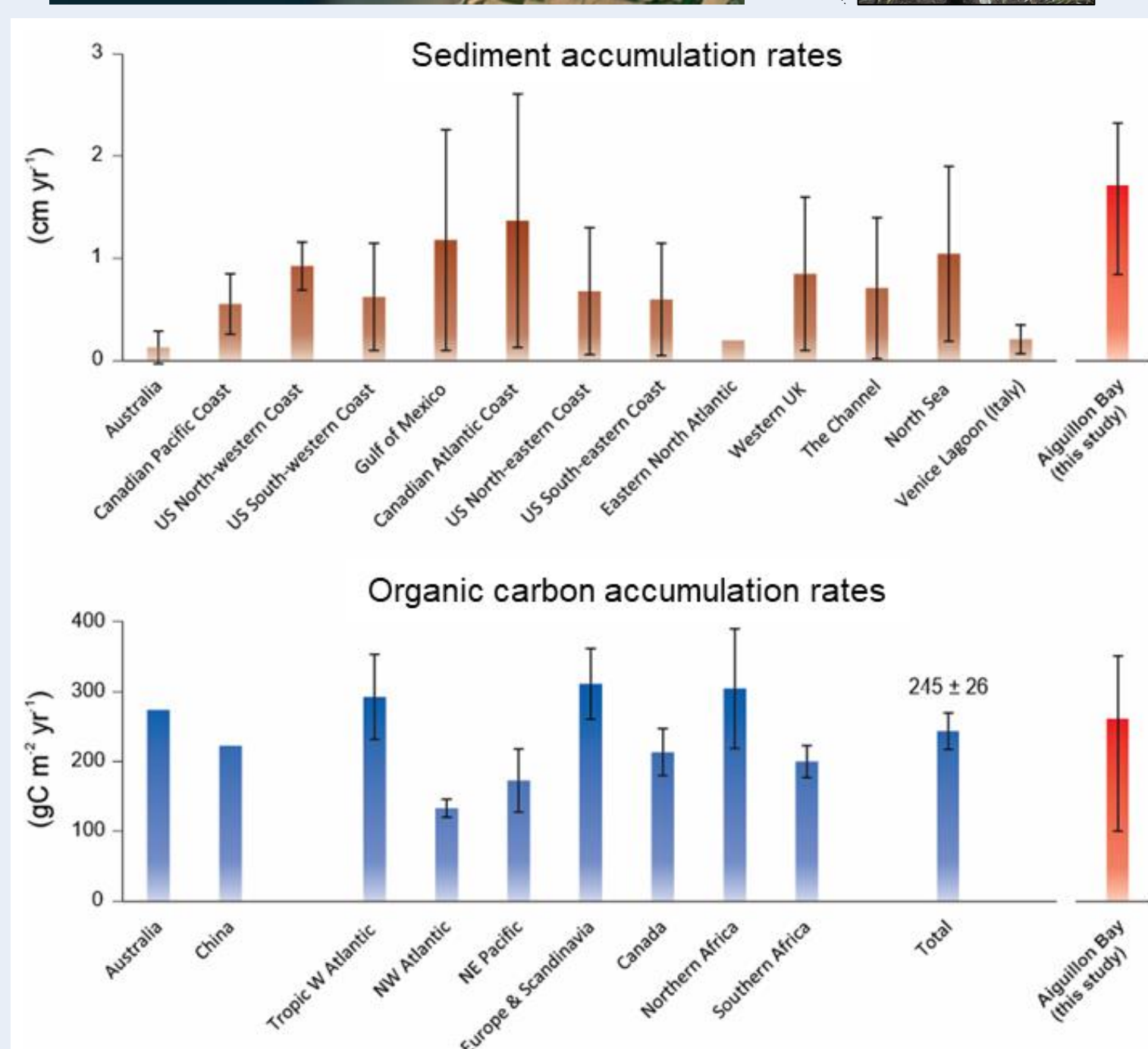
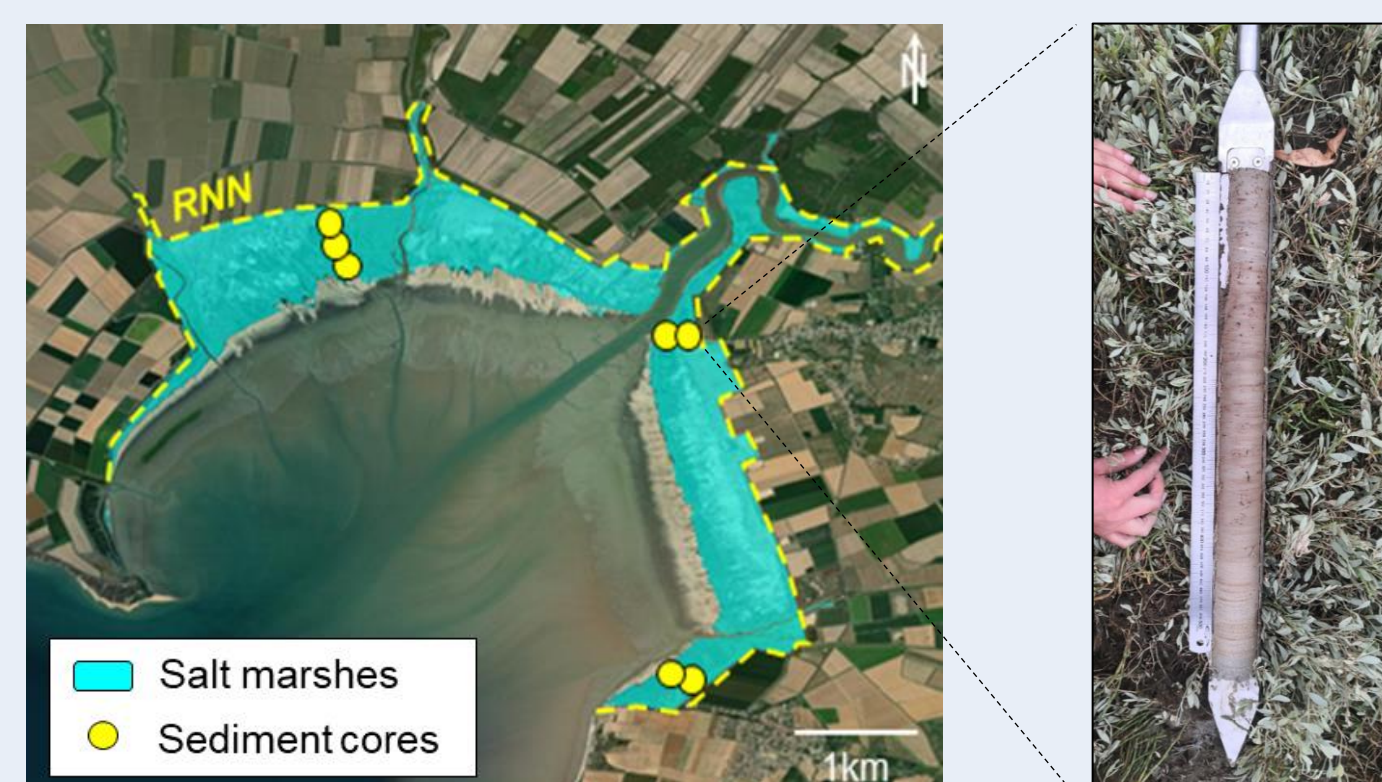
In 2020:  
Net ecosystem exchange (NEE):  
-1,41 ± 3,61 μmolCO<sub>2</sub> m<sup>-2</sup>s



CO<sub>2</sub> Sink: - 485 gC/m<sup>2</sup>/yr (- 4,85 tCeq/ha/yr or -17,78 tCO<sub>2</sub>eq/ha/yr)

### Long-term carbon accumulation in aquatic ecosystems

#### Salt marshes of the Aiguillon Bay

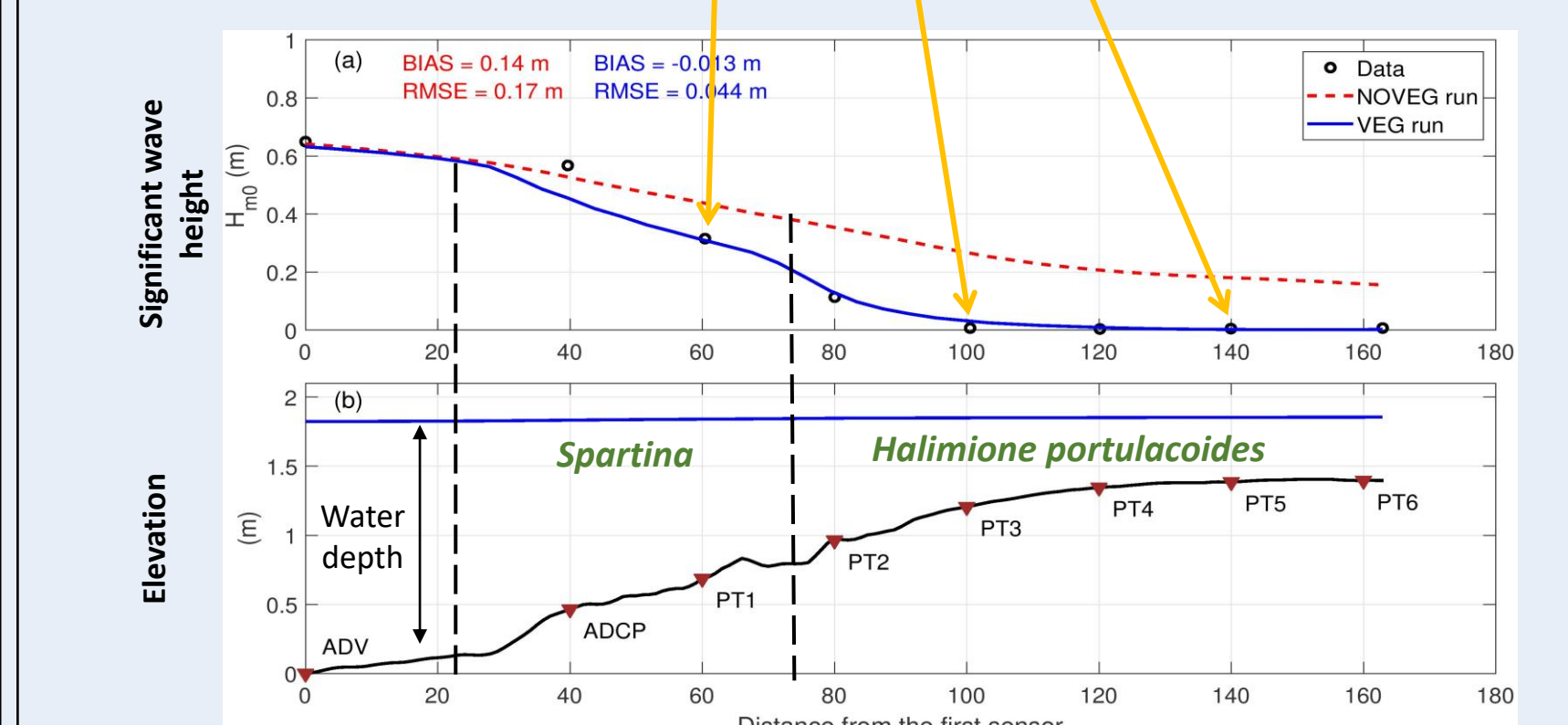
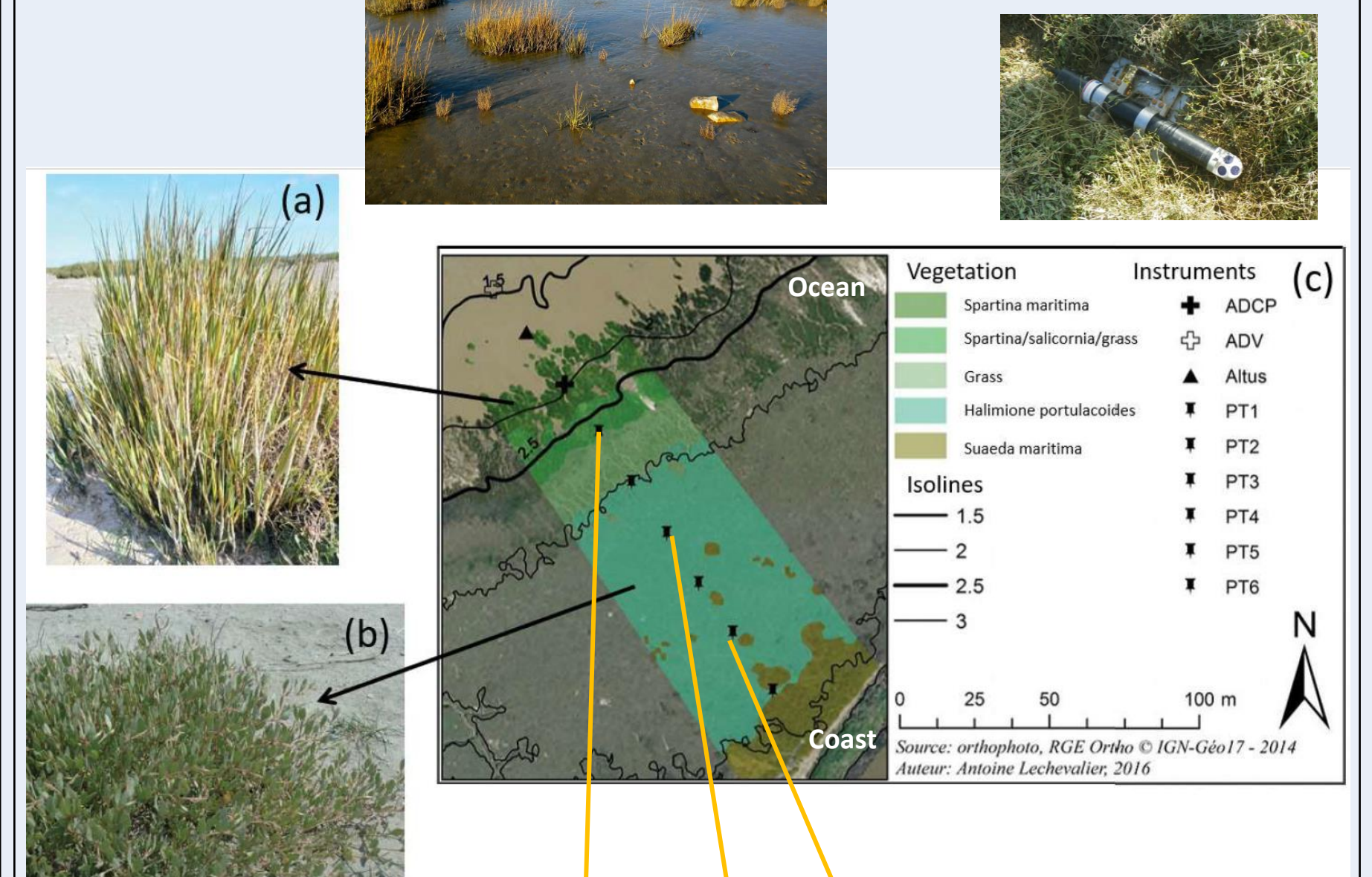


- High sediment accumulation rates >1 cm/yr lead to relatively high carbon accumulation rates in salt marshes of the region.

- Potential long-term carbon sequestration rates are within the order of 4 – 13 tCO<sub>2</sub>eq/ha/yr.

### Nature-based solutions for littoral zone protection

#### Salt marsh



- Vegetation accounts for 65% of wave dissipation across the salt marsh.
- Work in progress aims at quantifying the lowering of mean water level that accompanies wave propagation over vegetated bottom.

All the partners of LRTZC project: La Rochelle metropolitan area, La Rochelle town, Universities of La Rochelle, Toulouse, Rennes, Bordeaux, Montpellier, Angers, Brest, IFREMER (La Tremblade, Sète), Union des Marais de la Charente-Maritime, France and Institute for Coastal and Marine Research - Nelson Mandela University in South Africa

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