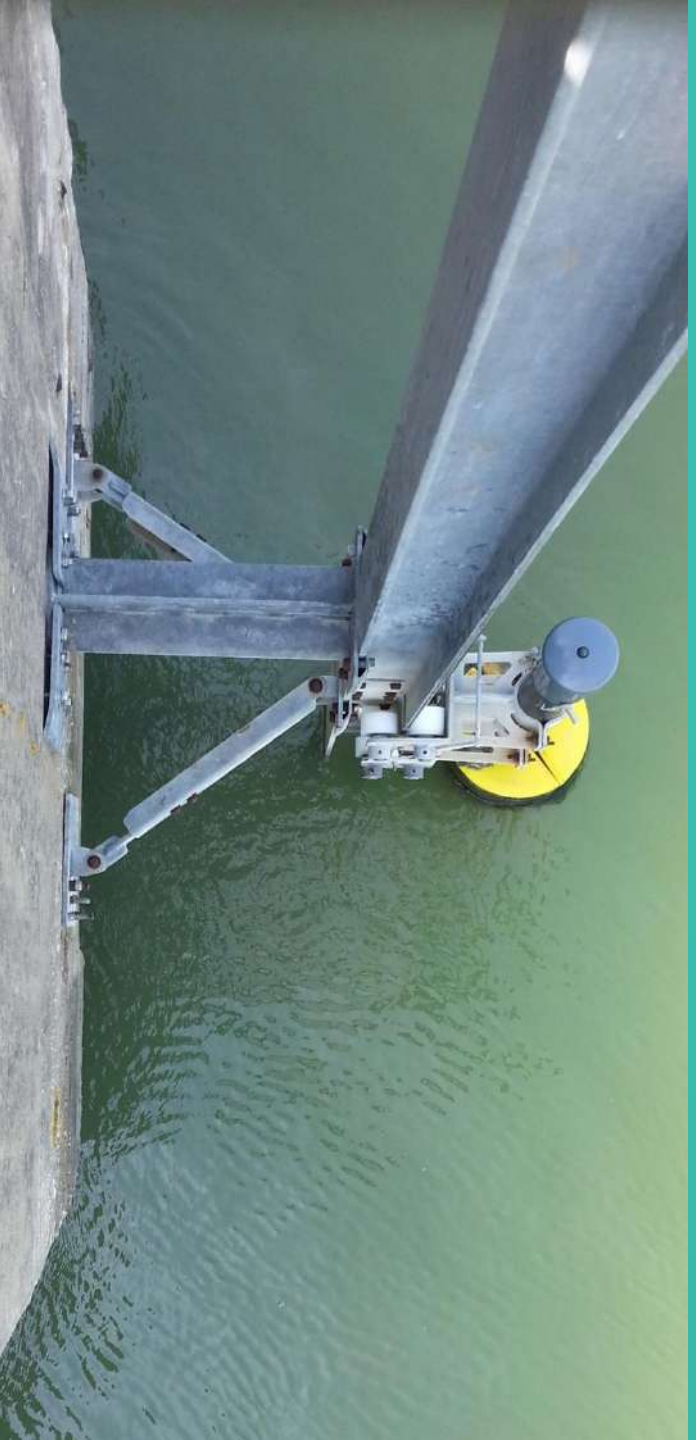


CES Oxygène dessous – 23 novembre 2020

Généralisation de la surveillance continue de la qualité physico-chimique de l'eau des estuaires nord-aquitains

Sabine Schmidt, Iris Diallo, Hervé Derriennic et le consortium MAGEST

exposé-composite extrait d'exposés récents

The estuaries from the French Atlantic coast facing the Bay of Biscay

- Macrotidal and hyper-turbid estuaries

  characterized by a Turbidity Maximum Zone (TMZ) with particle load > 0.5 g L^{-1} in surface water

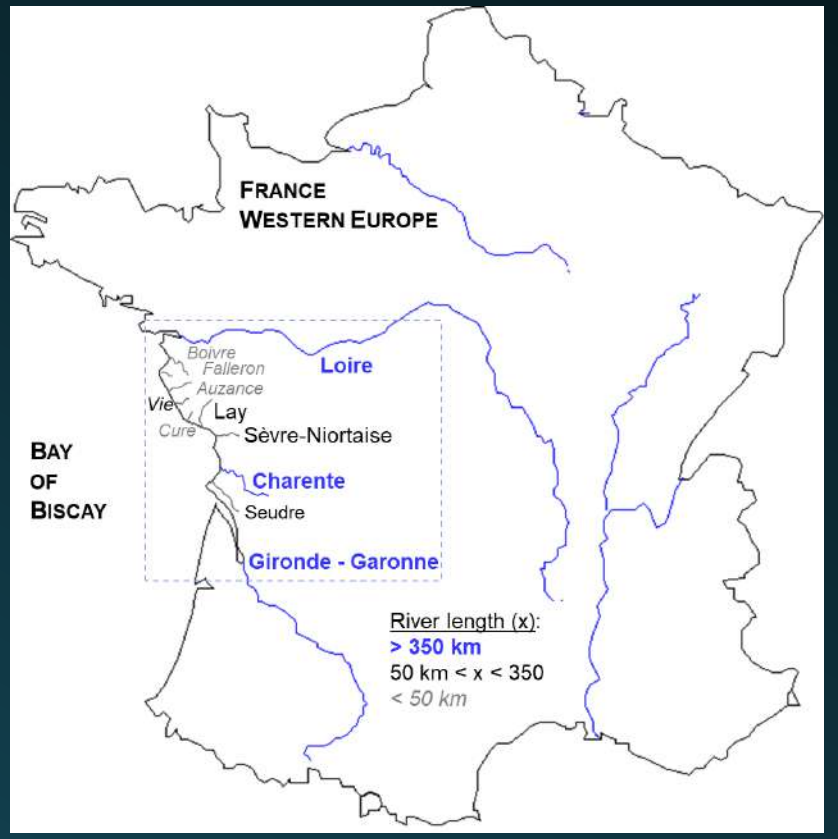
- Essential corridor for emblematic migratory species like sturgeons or eels

- The Loire and Gironde estuaries are:

  the largest

  subject to long-term, high frequency monitoring

  → summer hypoxia



What about the small estuaries between these two large estuaries?

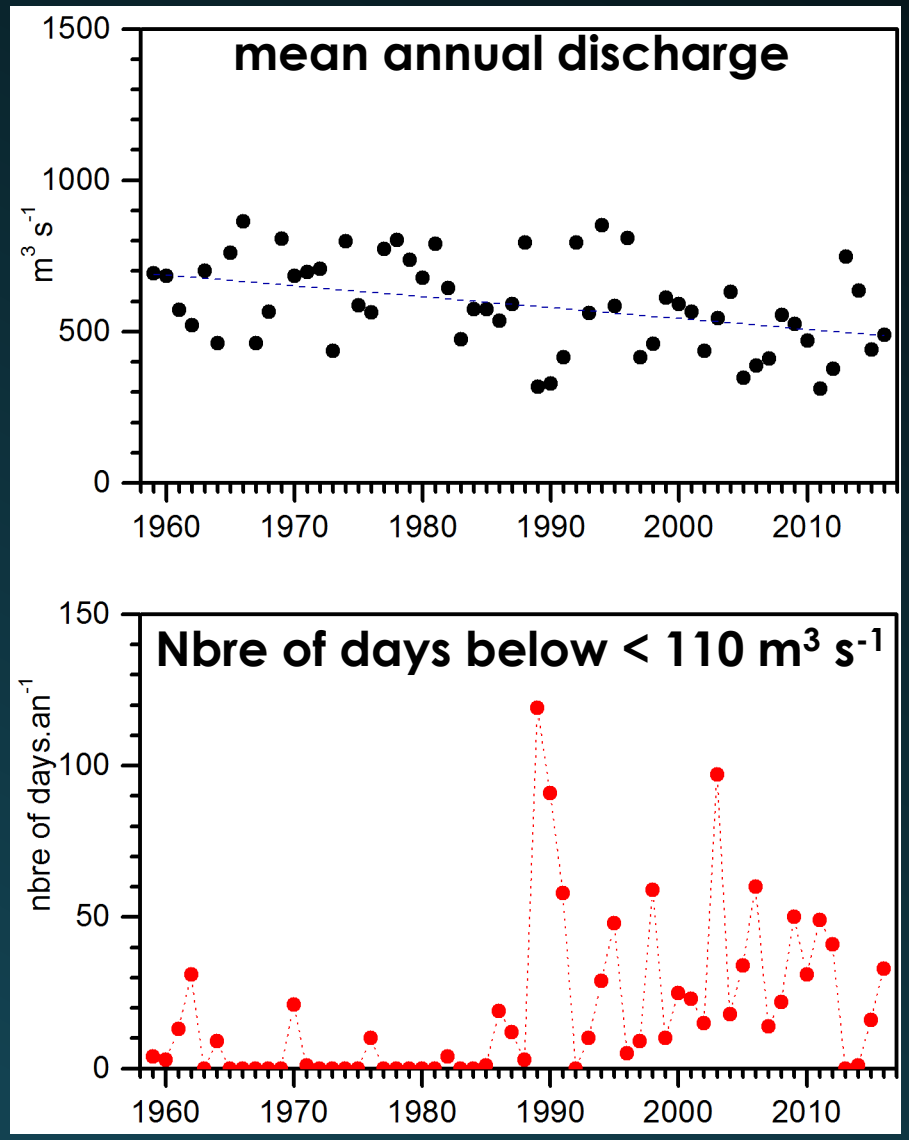
Estuaries under pressure: environmental changes (1)

Example of the Garonne River
the main tributary of the Gironde estuary

- Decrease of the mean annual discharge

- Increase of the number of days of low discharge

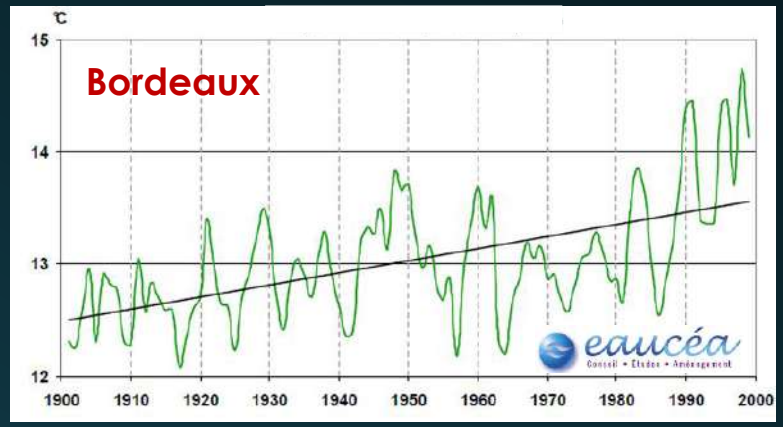
Increased TMZ presence
in the up estuary



Estuaries under pressure: environmental changes (2)

- Mean annual air temperature

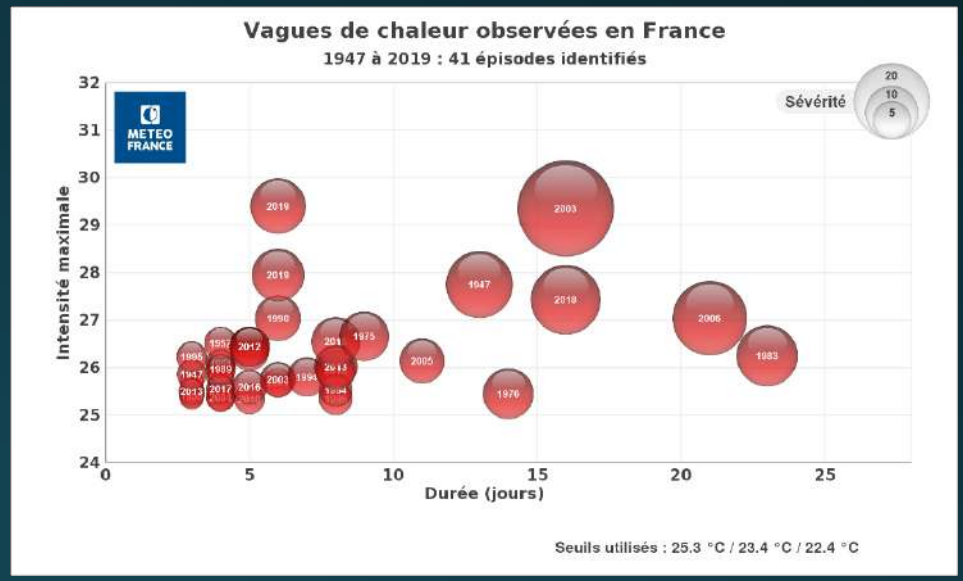
  since 1900 → + 1°C / 100 years



- Heat wave (France)

  1947 – 1999:
  14 in 53 years → 1/~4 yrs

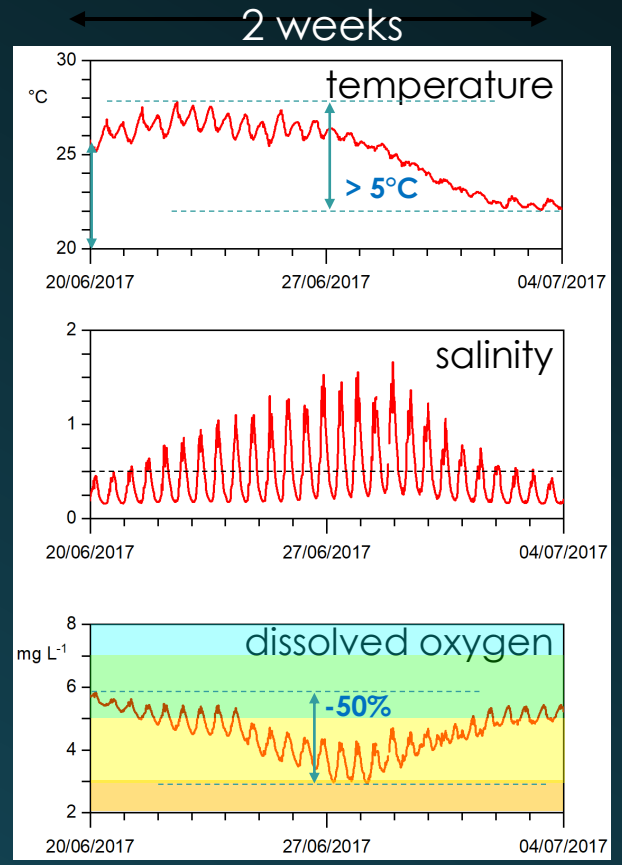
  2000 - 2020:
  12 in 21 years → ~1/2 yrs



How to monitor a macrotidal estuary

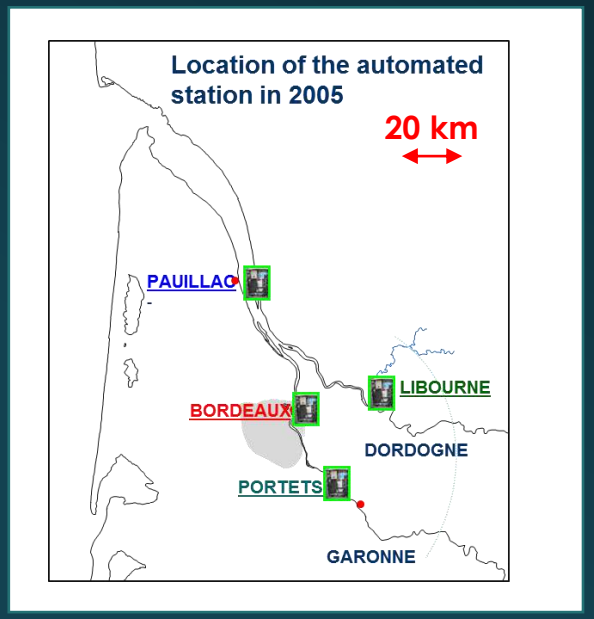
- High variability of water height, salinity … during tidal cycles

Example of the variability of temperature, salinity and dissolved oxygen in surface waters of Bordeaux during a heat wave (June 2017)



Implies a quasi-continuous survey

MAGEST: a long-term, multi-sites, high-frequency monitoring of the Gironde estuary



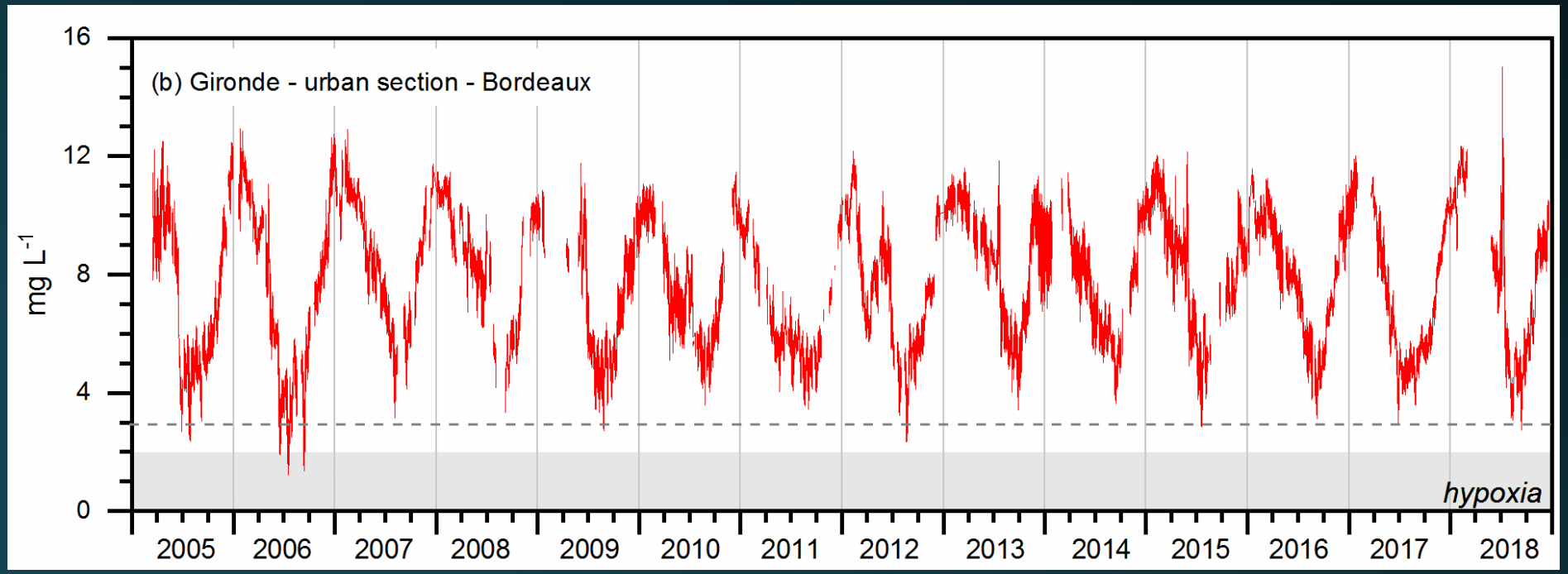
- Since 2004, MAGEST provides real-time measurements of :

  salinity
  temperature
  turbidity
  dissolved oxygen

  every 10 to 20 min

- Originality of this network
  - strong interactions between research and local public authorities,
  - development of manager's oriented-tools.

Variability of dissolved oxygen at different timescales in Bordeaux



- The record had permitted to define the conditions that induce hypoxia (temperature > 25°C; low discharge, …).

Lanoux A., Etcheber H., Schmidt S., Sottolichio A., Chabaud G., Richard M. & Abril G. (2013). Factors contributing to hypoxia in a highly turbid, macrotidal estuary (the Gironde, France). Environmental Science: Processes & Impacts 15, 585–595.

Schmidt S., Bernard C., Escalier J.-M., Etcheber H. & Lamouroux M. (2017) Assessing and managing the risks of hypoxia in transitional waters: a case study in the tidal Garonne River (South-West France). Environmental Science and Pollution Research 24, 3251–3259.

Scénarios d'évolution → intensification des périodes d'hypoxie dans la Garonne aval et test de l'impact des stratégies de mitigation

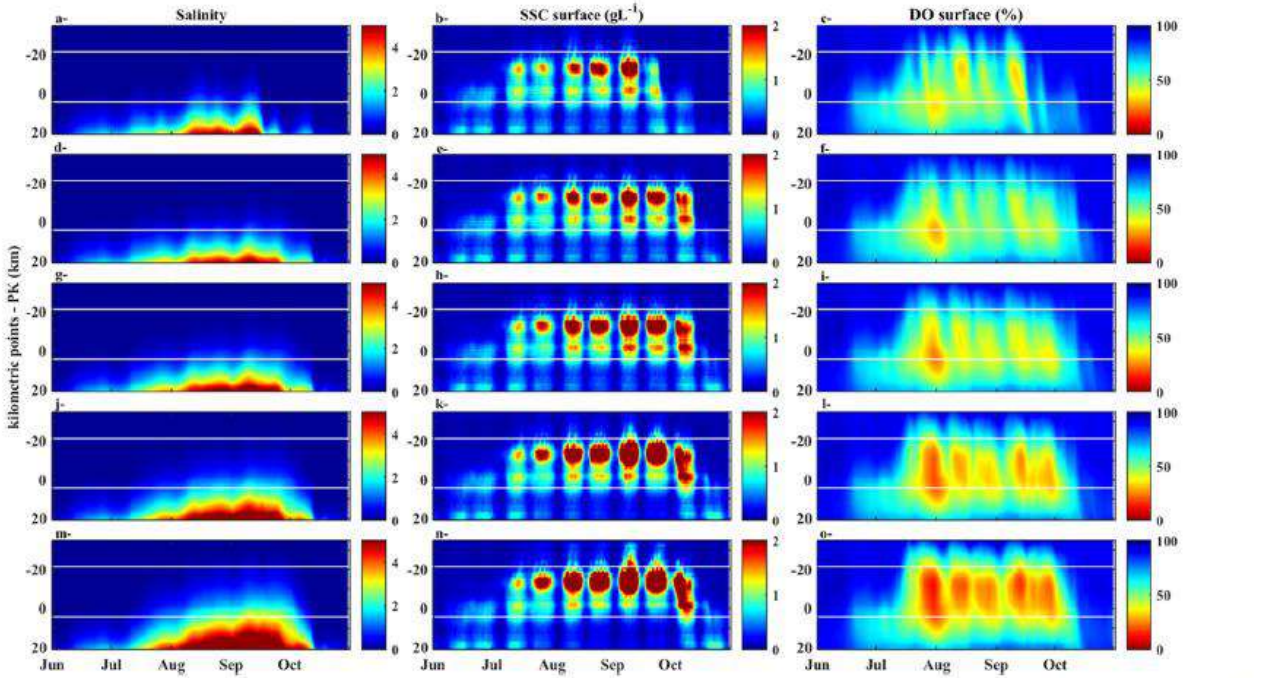


Fig. 4 Spatiotemporal evolution of simulated surface daily average parameters along the Tidal Garonne River section: salinity (left), SSC (middle, in g L^{-1}) and DO (right, in %sat). The simulations correspond to the reference with a summer mean Garonne discharge of 145 $m^3 s^{-1}$ (a–c) and to the following four scenarios: 100 $m^3 s^{-1}$ (d–f), 80 $m^3 s^{-1}$ (g–i), 60 $m^3 s^{-1}$ (j–l), and 40 $m^3 s^{-1}$ (m–o). The y-axis represents the kilometric points, and the white lines represent Bordeaux and Portets

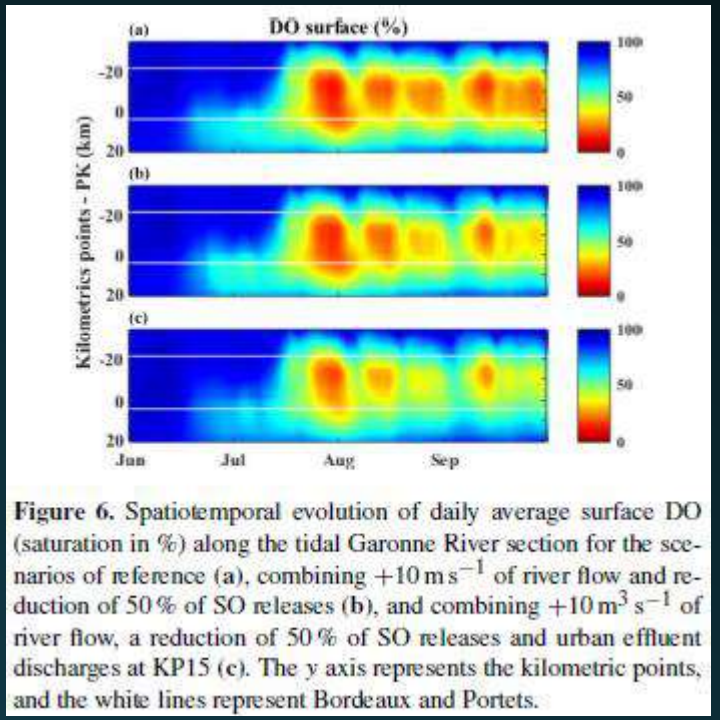


Figure 6. Spatiotemporal evolution of daily average surface DO (saturation in %) along the tidal Garonne River section for the scenarios of reference (a), combining +10 $m s^{-1}$ of river flow and reduction of 50 % of SO releases (b), and combining +10 $m^3 s^{-1}$ of river flow, a reduction of 50 % of SO releases and urban effluent discharges at KP15 (c). The *y* axis represents the kilometric points, and the white lines represent Bordeaux and Portets.

Lajaunie-Salla K., Sottolichio A., Schmidt S., Litrico X., Binet G., Abril. G. (2018) Future intensification of summer hypoxia in the tidal Garonne River (SW France) simulated by a coupled hydro-sedimentological-biogeochemical model. Environmental Science and Pollution Research, 25, 31957-31970.

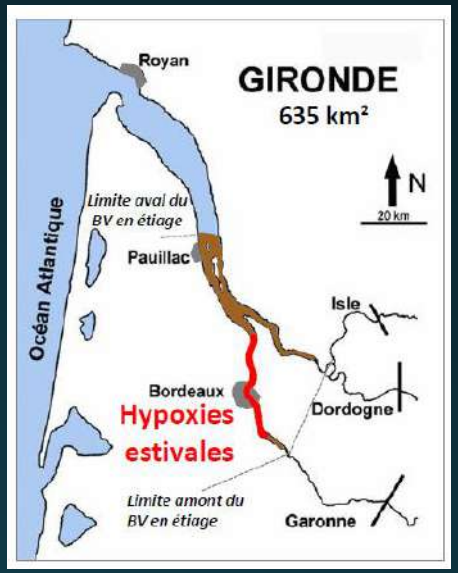
Lajaunie-Salla K., Sottolichio A., Schmidt S., Litrico X., Binet G., Abril G. (2019) Comparing the efficiency of hypoxia mitigation strategies in an urban, turbid tidal river, using a coupled hydro sedimentary– biogeochemical model. Natural Hazards Earth Syst. Sci., 19, 2551-2564.

Vers une stratégie d'observation des estuaires nord-atlantiqes

Le bilan des suivis continus SYVEL et MAGEST depuis 2004
des longitudinales 2017-2018

HYPOXIES SAISONNIERES RECURRENTES
Voire ANOXIE (au moins dans les eaux de fond)

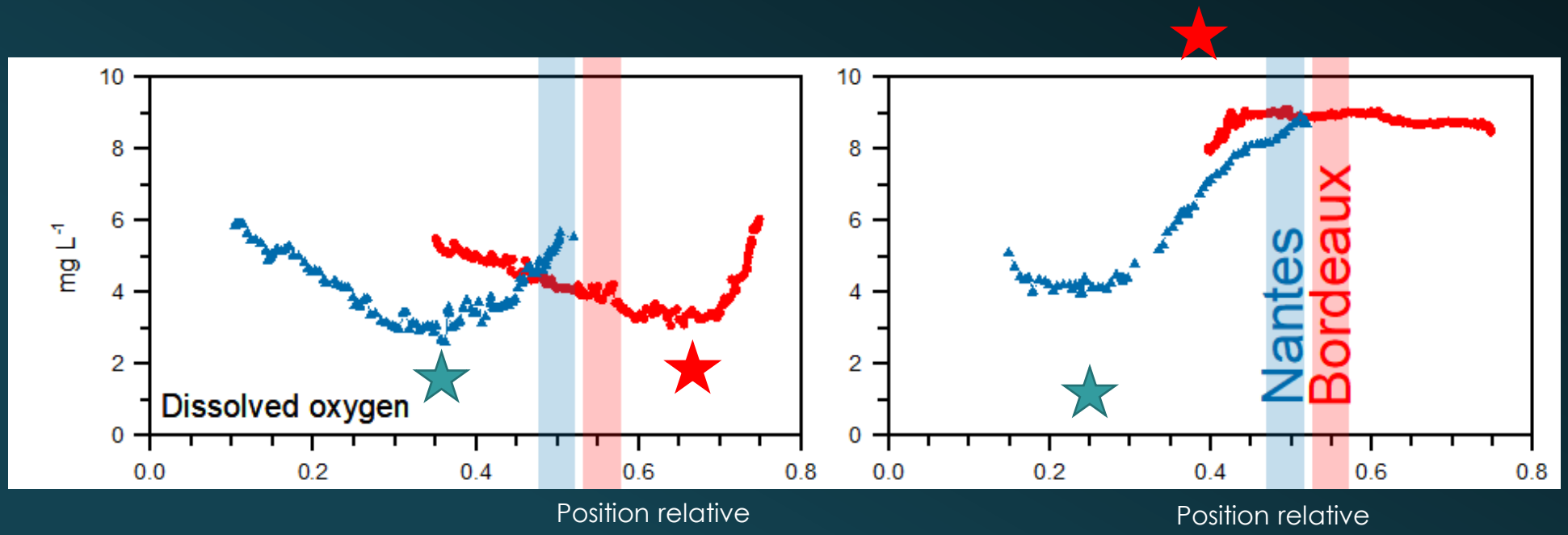
DESOXYGENATIONS ESTIVALES
HYPOXIES EXCEPTIONNELLES



ce qui n'était pas attendu sur la base des caractéristiques de ces estuaires

Vers une stratégie d'observation des estuaires nord-atlantiqes

Le bilan des suivis continus SYVEL et MAGEST
des longitudinales 2017-2018



Occurrences estivales:
à l'aval de l'estuaire de la Loire
positions (et extensions) plus variables dans l'estuaire fluvial de la Gironde

Vers une stratégie d'observation des estuaires nord-aquitains

- Synthèse des caractéristiques d'un estuaire nécessaire, mais insuffisante

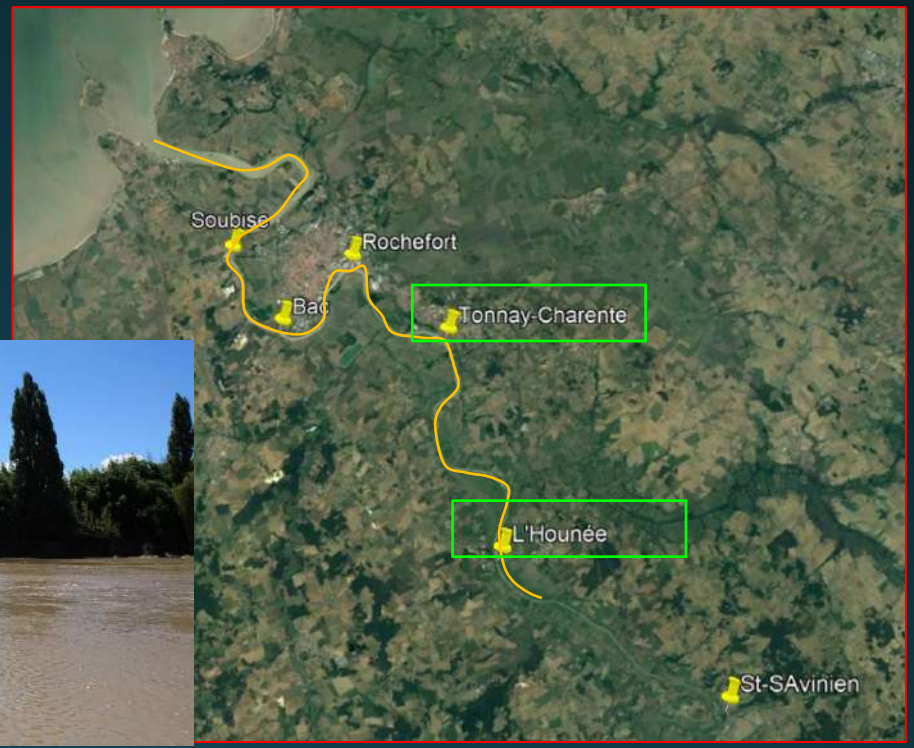
Débit
Temps de résidence (solide/liquide)
Température
Salinité
Agglomérations/STEPs

- Réaliser 1-3 longitudinales entre juin et août pour définir le(s) site(s) à instrumenter

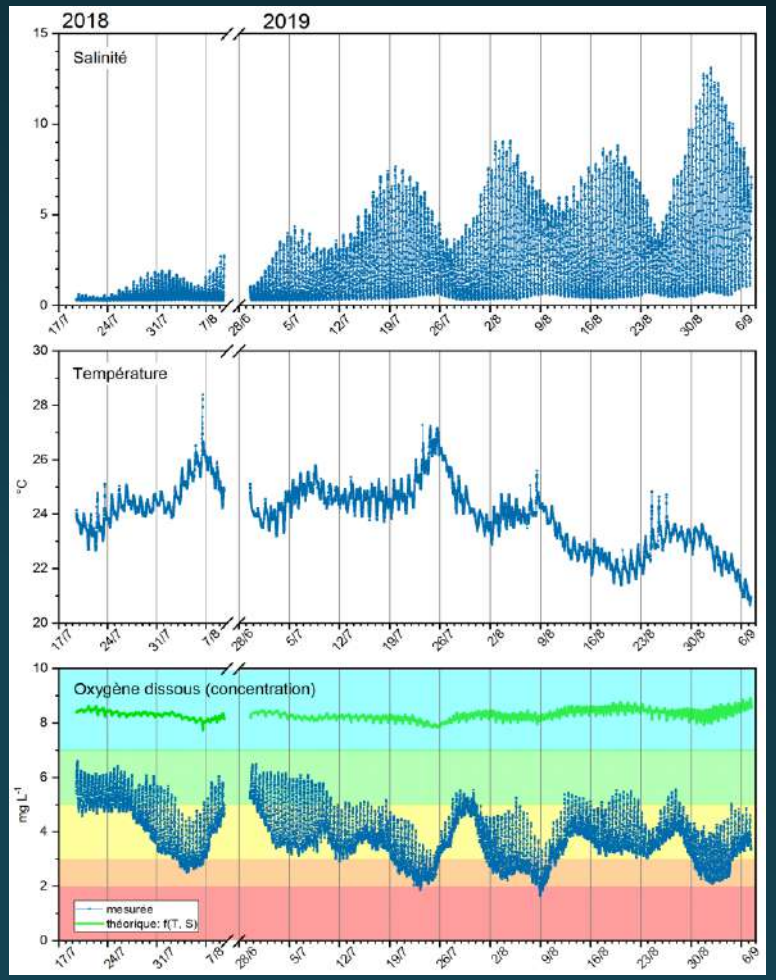
Schmidt S., Diallo I.I., Derriennic H., Fallou H., & Lepage M. (2019) Exploring the susceptibility of turbid estuaries to hypoxia as a prerequisite to designing a pertinent monitoring strategy of dissolved oxygen. Frontiers in Marine Science 6, 352.

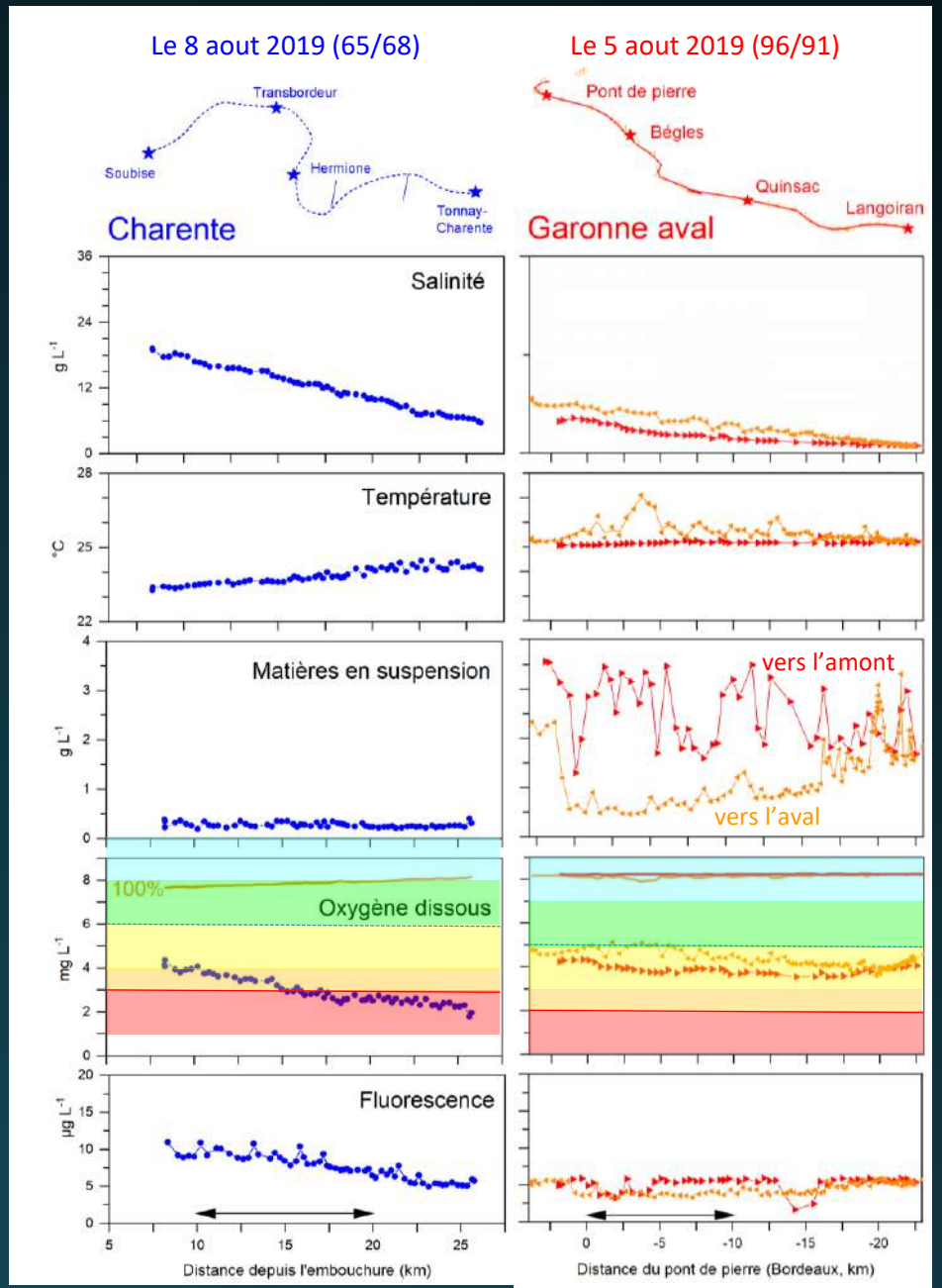
Vers une instrumentation de l'estuaire de la Charente

En 2019, instrumentation de sites-test et réalisation de longitudinales



Vers une instrumentation de l'estuaire de la Charente ?





Résultats inattendus: des désoxygénations plus marquées en Charente qu'en Gironde-Garonne !

Extension du reseau aux estuaires nord-atlantique

A la fin de l'année 2020, 12 isites instrumentés sur les estuaires Gironde – Seudre - Charente

Les nouveaux sites sont équipés des sondes Wimo+ (+pH)

Le Verdon site
at the Gironde mouth

Thanks
for
your attention