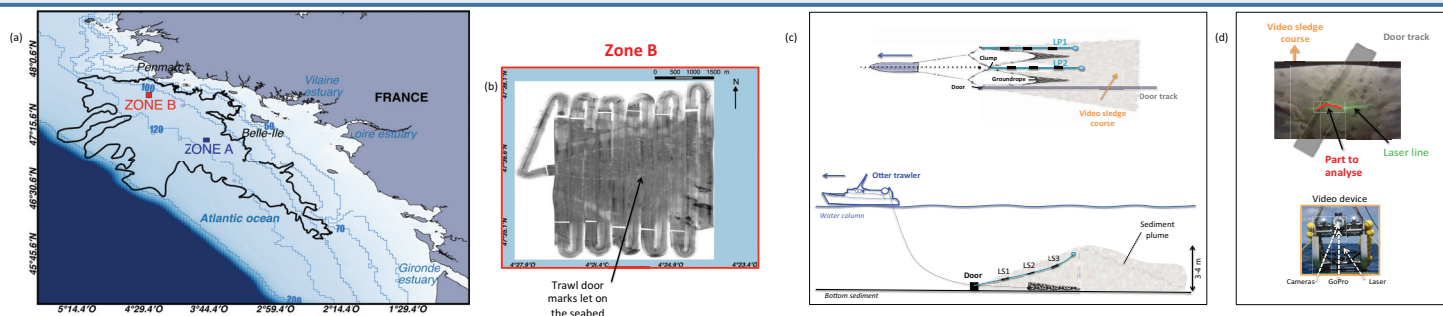


Impact of bottom trawling and contribution to resuspension in the « Grande-Vasière » area (Bay of Biscay, France)

Introduction

Bottom trawling in coastal environments is known to modify the upper sedimentary layer characteristics and to generate significant local resuspension. The "Grande Vasière" is an area in the northern part of the continental shelf of the Bay of Biscay (depths ranged between 70 and 120 m). The low tidal currents and river discharge are favourable for deposition of fine particles (mud) over this area, while only storms can significantly erode the bottom sediment and locally generate deep furrows. Besides, this region is also intensively trawled (Norway lobster fisheries) and seabed measurements made on the more exposed areas revealed a significant decrease (until 30 %) in terms of mud content in the surficial sediment that came up during the last 40 years. These results underline the necessity to improve our understanding of the influence of bottom trawling on the sedimentary dynamic, and particularly in terms of its relative contribution regarding natural forcings. That's why measurements have been done to characterize the trawl parts responsible of the resuspension and evaluate their impact in terms of seabed disturbance; so as to finally estimate an erosion flux induced by the scraping action of the trawl on the seabed. At last, this trawling-induced erosion dynamic is compared to the one associated to the natural forcings action obtained thanks to a three-dimensional hydro-sedimentary modelling system.

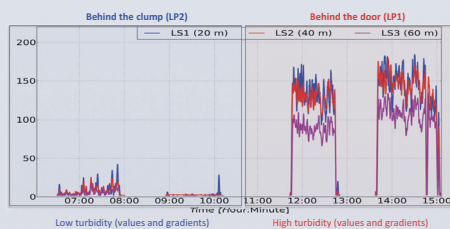
Sampling strategy



In our study case, two small zones with comparable water depths (around 110 m), **A (moderate fishing activity)** & **B (intensively trawled)**, have been selected to study physical impacts induced by bottom trawling (a). On the intensively trawled zone (B), we can easily distinguish the abundance of trawl door tracks on the side scan sonar map (b). The first step of our study consisted in evaluating the most impacting part of the trawl regarding the sediment resuspension with an instrumented line fixed to key parts of the trawl (c), specifically behind the door (LP1) or the clump (LP2). Three turbidity sensors (LS1, LS2, LS3) have been regularly placed on the line every 20 meters with one buoy at its extremity. Regarding the seabed measurements, a video sledge equipped with HD cameras and a laser (d) has been deployed to cross our trawl tracks the day following the track generation in order to evaluate micro-topography disturbances in terms of depths of penetration and associated volumes. Indeed, a laser line is projected on the seabed perpendicularly to the driving direction. The sediment roughness deforms the laser line in the camera picture: hollows lift laser position in the picture, whereas bumps lower it. Finally, a simple trigonometry calculation gives the relative seabed height from the picture's pixel position and the laser beam angle.

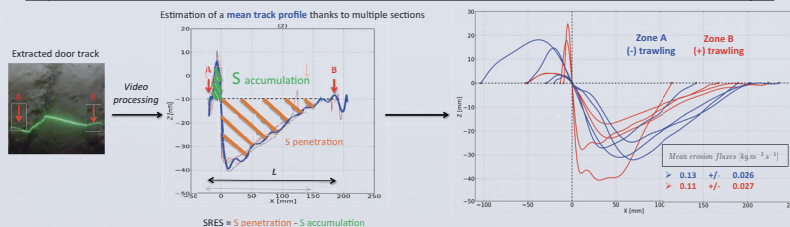
Results

(1) What are the most impacting parts regarding the resuspension ?



SSC (Suspended Sediment Concentrations) measurements made thanks to the instrumented line directly fixed to the trawl revealed that trawl doors are responsible of the main part of the resuspension with turbidity values 10 times higher than those measured behind the clump.

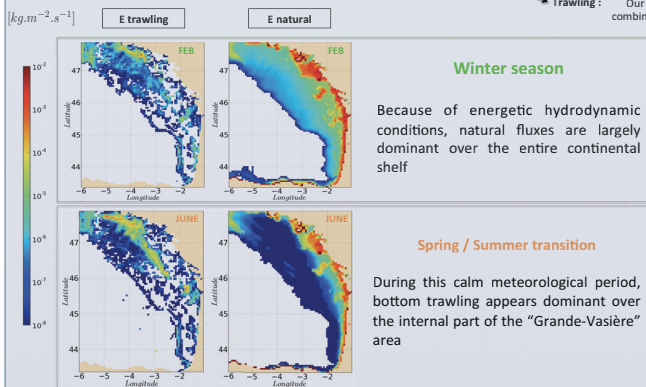
(2) Using door tracks to evaluate the erosion flux induced by bottom trawling



The video processing tool allowed highlighting asymmetric tracks let by trawl doors on the seabed, with a penetration part and an accumulation part. The evaluation of the fraction of the bottom sediment injected in the water column (surface SRES that corresponds to the difference of surfaces linked to each part of the track) combined with other information such as the door spread, the bottom sediment concentration, or the trawler speed permitted at last to estimate an experimental erosion flux consistent between the two zones and with other results of existing publications of around $0.12 \text{ kg} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$.

(3) Comparisons of trawling and natural dynamics

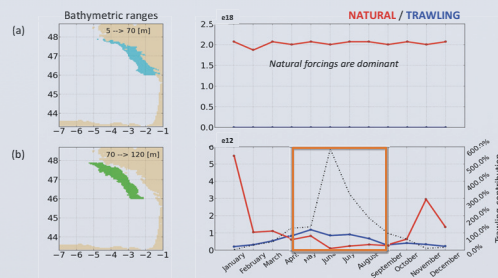
Monthly averaged erosion fluxes



Winter season
 Because of energetic hydrodynamic conditions, natural fluxes are largely dominant over the entire continental shelf

Spring / Summer transition
 During this calm meteorological period, bottom trawling appears dominant over the internal part of the "Grande-Vasière" area

Monthly averaged mass of resuspended sediments [kg]



At the level of the shallow bathymetric range close to the coast (a), natural forcings are largely dominant during all the year. However, for depths ranged between 70 and 120 m (b), bottom trawling erosion can reach 6 times the natural one during the high season of fishing, while its relative contribution ranges between 15 and 50 % of the rest of the year. Finally, it appears that the annual resuspended mass of sediment by bottom trawling represents around 50 % of the one relative to natural forcings action over the internal part of the "Grande-Vasière" area.

Perspectives

The erosion dynamic induced by bottom trawling will be implemented in the pre-existing hydro-sedimentary modelling system. Consequently, a more precise quantification of the relative contribution of bottom trawling on the sediment fluxes and dynamics, will be proposed at the regional scale as well as the assessment of the seasonal and interannual variabilities.