

Referee Comment 1. I was a little confused by the use of the terms 'low water' and 'high water' for discharge conditions. Usually they are used to indicate tidal elevation. I would therefore suggest replacing these words by 'low discharge' and 'high discharge' or 'low fresh water discharge' and 'high fresh water discharge'.

Yes, we admit that these terms (low water, high water) could be ambiguous in an estuary. To avoid confusion, we will replace them by "low discharge" and "high discharge" as suggested.

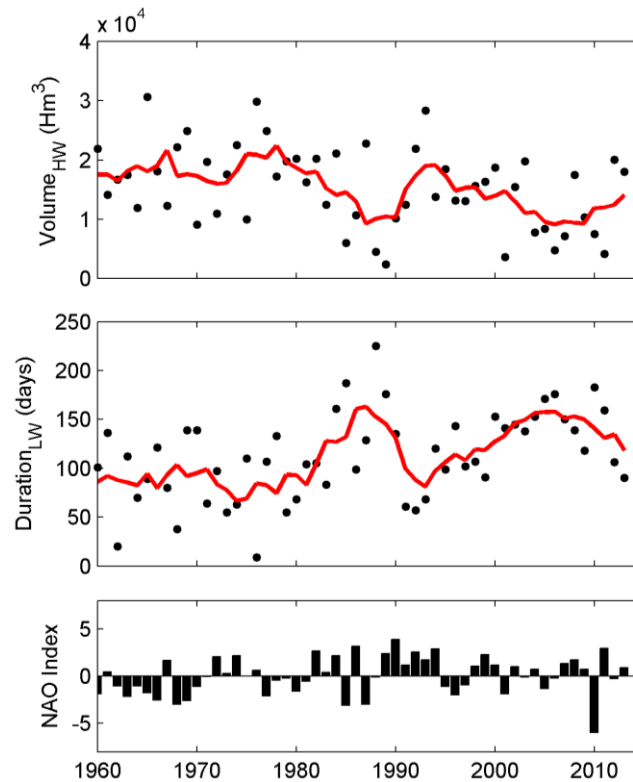
Referee Comment 2. The abstract starts with 'climate change and human activities'. I was immediately focused on these terms, but only very limited information was presented in the ms on these subjects. What do you mean by climate change? Is it global warming and its effect on e.g. precipitation or do you mean climate variability, such as the NAO?

Regarding the latter, the changes in e.g. duration of LW (low discharge) in Fig 15 correspond at a quick view (see http://www.cpc.ncep.noaa.gov/data/teledoc/nao_ts.shtml) with the variations in NAO index. The increase of LW duration in the 80's is correlated partly with a period (79/80-94/95) of positive NAO index. What is the effect of human impact (water usage for irrigation)? Do you have data that show the amount used for this purpose?

Yes, we begin the abstract with "climate change and human activities" to indicate the context of the article, however this is not the specific objective of the work. We know that the annual mean discharge of the Garonne-Gironde system has decreased over the last decades (see section 4.1 1st paragraph). There are already dedicated studies that confirm the influence of both human impact and climate variability in freshwater variations, like those of Mazzega et al. (2014) and Hendrickx and Sauquet (2013), both cited in the article.

Such context is expected to affect natural distribution of estuarine SPM, as explained in the introduction. However we do not have historical data in the tidal Garonne River. Therefore, the objective of the article is to detail turbidity dynamics in the upper reaches of the Gironde estuary in relation with the present-day hydrological conditions, based on a high-frequency turbidity records that covers only the last 10 years. However we are convinced that figure 13 and 14 clearly demonstrate the decisive control of fluvial discharge (duration-low water; winter-volume) on TMZ occurrence in the tidal Garonne. The figure 15 is presented to show that these two indicators have already changed over the period 1959-2014.

We agree with the observation that the changes in duration of low discharge (Fig. 15) present some similarities with the NAO index. In fact, we have envisioned a first version of the figure 15 including the NAO index (see below). However we assessed that the article could be considered stodgy with the presentation of 10-yr high frequency turbidity records, to avoid an additional and more speculative discussion on long-term impact in the absence of detailed data on water abstraction on the same time period (1959-2014). If requested by the reviewer, we may replace the figure 15 to include NAO index.



Referee Comment 3. How do you define 'mobile mud'? Is this the same as fluid mud, high concentrated mud suspension or are these low consolidated mud deposits? Are the data given any direct clue for the occurrence of these 'mobile muds', do you have other data that confirm the existence of these features or is their existence derived from the behavior of the turbidity variations?

Yes indeed, in this manuscript, we call "mobile mud" low consolidated mud deposits, that are easily erodible. We discarded the term "fluid mud" that refers precisely to a high-concentrated benthic suspension (several 10s of g L⁻¹ to 100s of g L⁻¹) often formed from settling of particles from the turbidity maximum. As we do not have direct observation of fluid mud existence in the tidal Garonne River, we adopted a more neutral term.

A recent field work conducted about 30 km upstream Bordeaux (not published) suggests the existence of soft mud in the channel when the turbidity maximum is shifted upstream. But in the present case, we admit that its existence is inferred from turbidity records. Indeed peaks in turbidity are most likely associated with the resuspension of unconsolidated mud deposits, the only local source for high sediment concentrations in the water column. Such observation is rather common in estuaries. Uncles et al. (1996; 2006), among others, described the seasonal occurrence of unconsolidated mud layers of up to 1 m thickness in the Tamar and Humber estuaries, and used the term of "mobile mud".

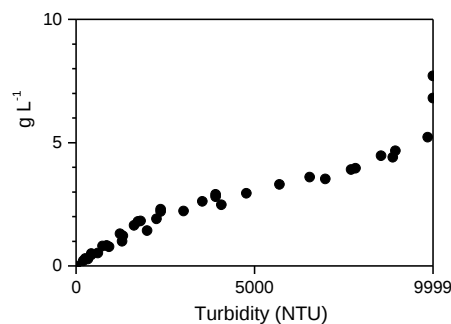
The choice of the term "mobile mud" will be better justified in the manuscript.

Referee Comment 4. I was not completely convinced by the definition of TMZ that you use, ie NTU>1000. A TMZ in an estuary can be present even if the overall turbidity is lower than this value as it depends on the turbidity more upstream and downstream of it. The occurrence of TMZ in estuaries has been discussed a lot in literature, but I don't think that a certain turbidity value was

proposed in order to have have a TMZ. You refer to 'old' papers from Allen et al (1977) and Allen & Castaing (1981) where they have used a threshold for turbidity in a TMZ. What is the scientific basis of using such a threshold?

Indeed in any estuary, a TMZ is defined as a zone where turbidity is higher than in upstream and downstream waters. However, for the Gironde estuary, there are pioneer works of Allen and Castaing that define the threshold of TMZ at 1 g L^{-1} based on numerous field determinations of suspended load distributions.

As our work is in the same fluvio-estuarine system, we use the same TMZ definition (in fact changing the threshold should have been justified), i.e. the TMZ is present when particle load values exceed 1 g L^{-1} . The critical point is in fact the turbidity – SPM relationship, as the automated stations measure turbidity and not particle load. Ongoing works on $[\text{SSC}, \text{g L}^{-1}] = f(\text{Turbidity, NTU})$ curves based on particles collected at Bordeaux and Pauillac show that 1000 and 9999 NTU correspond to about 1 and 5-6 g L^{-1} respectively (Schmidt, personal data, see figure). This justifies the use of 1000 NTU as the threshold of TMZ occurrence.



However this work could serve also to test the historical threshold. When the TMZ is installed at one of the four MAGEST station, we observe that the minimum value of tidally-averaged turbidity is always equal or higher to 1000 NTU, whatever the tidal range. This observation thus reinforces previous works. Figure 3 will be enlarged in the revised version and a horizontal line at 1000 NTU will be added in the figures 3C/D/E/F to better highlight this threshold.

References

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