

Reviewer #2

Review: *“The land-sea coastal border: A quantitative definition”, by Sánchez-Arcilla et al.*

Recommendation: *major revision.*

Summary: *The authors attempt to provide a quantitative and generalizable definition of “land-sea” zone, i.e., cross-shore width of that particular marine area that is strongly affected by the presence of the continent. The methodology is based on the measure of anisotropy of specific, vectorial and/or scalar fields of environmental parameters. For this work, the authors use wind velocity and significant wave height from well-calibrated and validated numerical outputs.*

General comments

The work the authors present is really intriguing and I particularly like the idea of defining a "coastal zone" by using environmental variables in a quantitative fashion. However, while the specific variables the authors consider in this application (i.e. wind velocity and significant wave height) are particularly suitable for the study area they might not work for a different environment, where, for instance, wind and wave patterns do not actually characterize the coastal zone. As stated by the authors, river plumes or, more in general, biogeochemical processes may lead for a better definition of a "coastal area" and, as a consequence, the methodology here proposed might not be suitable. All this is at the base of my main criticism:

to state that such a methodology provides a "quantitative definition for the land-sea (coastal) transitional area" is too strong; although I like generalizations, I still believe that a "land-sea (coastal) transitional area" can be defined by starting from the specific physical, and/or biogeochemical, and/or geological, and/or ecological process we want to investigate.

(pp. 5, lines 8-12) The following definition has been added to the text: “Although other definitions of the coastal boundary can be based on river plumes or biogeochemical processes, it has been intended to focus on a more hydro-dynamical expression of such boundary for wave-driven coasts.”

We have also specified through the text (Abstract, Introduction and pp.5) that we only focus on wave-driven environments.

A second comment regards the poor connection between the pure mathematical/statistical part and the environmental application. I would have

appreciated a better explanation of the statistics by starting from the environmental data, also discussing physical meanings and assumptions. To present the theoretical background as it is leaves the reader with some doubts regarding the feasibility of the methodology.

(pp.5, lines 5-8) It is intended to show that, as one approaches the coast, the wind and the wave fields should present a higher geometric anisotropy, that is, they should present predominant wind and wave directions. Furthermore, there should be a geo-statistical boundary to the value of this anisotropy that could help define a coastal boundary.

Specific, minor comments

Abstract - replace “perpendicular” with “cross-shore” in line 2

The suggested change has been carried out.

Introduction - There are several definitions of what a Land-sea border is (Shaw et al., 2008; Geleynse et al., 2012). I would avoid (at least, at the beginning) to frame the land-sea border within this specific definition. Instead, it would be better to state that over land-sea border areas occur specific met-ocean dynamics that actually characterize land-sea coastal border. The aim of this work is to quantitatively define the extension of this area. (see general comment).

We agree with this. Hence, the definition by Wright is obviated from the “Introduction”.

Thank you very much for the references. The text has been revised as follows:

“There is, thus, a need for a systematic and objective definition of the coastal fringe that considers underlying processes and that has general applicability allowing for the time/space dynamics of this fringe. This type of approach has been explored in the literature, where for instance Sánchez-Arcilla and Simpson (2002) reviewed a number of possibilities based on a dynamic balance of competing processes (i.e. drivers) such as inertial effects, geostrophic steering, sea bed friction or water column stratification. Another suitable option is to focus on the consequences of such processes, such as the nearshore morphodynamic features (Geleynse et al., 2012) (i.e. deltas, sand spits, overwash fans, beach berms). Both complementary classifications requires spatial data that needs to be updated accordingly within timescales that may range from years (i.e. long-term erosion due to sea level rise) to days (i.e. storm-scale).”

- “Sentinel data” (in line 3-pag 2) ; the general reader might not be familiar with

the sentinel missions and, therefore, might not understand that here authors are referring to satellite data. Please, introduce the Remote Sensing approach properly.

This version does not put so much emphasis on the Sentinel satellites, but rather on wave altimeter data in general. The following sentences replace the original lines 3 and 4: “The recent advent of high resolution and short revisit time provided by them offer an alternative source of information for such a coastal zone definition although with some limitations since the data may start degrading at a few kilometres (order 10km) offshore from the coast (Cavaleri and Sclavo, 2006; Wiese et al., 2018; Cavaleri et al., 2018).”

- “Because of that” (in line 5-pag 2); Please, be more specific. It’s not clear the use of Sentinel data in defining land-sea limits and what the authors mean with degradation of data. “necessary”; too strong, I would write “useful” rather than necessary.

The following sentences replace the original lines 5 to 8: “ The land boundaries induce error in the satellite observations. Hence, it is useful to use high resolution numerical simulations supported by in-situ data so that land-sea boundary effects are properly captured for the subsequent coastal definition that will be based on the inhomogeneity introduced by the presence of the land boundary.”

- “coastal anisotropy” (in line 13-pag 13); I would write “anisotropy of environmental parameters” rather than coastal anisotropy

The suggested change has been carried out. The following sentences replace the original lines : “The aim of this paper is to analyse the geo-statistical anisotropy of nearshore wind and waves, in wave-driven coasts. From that, what follows is to propose a new quantitative and objective definition for the land-sea border that benefits from these high-resolution (spatial and temporal) fields and from the underlying process-based knowledge. This definition can be useful to determine a set of criteria for numerical purposes (e.g. nesting coastal domains) but also for more practically oriented applications (e.g. offshore limit for outfall dispersion).”

Theoretical background - $G(x)$ in line 10 should be $G(y)$, as far as I am missing something;

The recommended correction has been carried out.

As I suggest in the General Comments, this section would be much clearer (and the ms much stronger) if the theoretical background is explained by starting from environmental variables. As it is, the reader might get confused.

Thank you so much for the recommendation. We would like to leave the explanation with environmental variables to the Methodology. The Theoretical background is intended to be an introduction of the mathematical tools used.

Study area - By reading the section it comes natural to think that the analysis is particularly suitable for this study area, thus difficult to generalize

It is intended to propose this methodology. The proposed limit to the coastal fringe is not to be generalized, but the methodology can help find the indicated one for each coast.

References

Shaw, J. B., Wolinsky, M. A., Paola, C., & Voller, V. R. (2008). An image based method for shoreline mapping on complex coasts. Geophysical Research Letters, 35(12).

Geleynse, N., Voller, V. R., Paola, C., & Ganti, V. (2012). Characterization of river delta shorelines. Geophysical Research Letters, 39(17).