

# The influence of meteorological and oceanographic events on the temporal variation of solid waste deposition on gradient estuarine shorelines

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## Introduction

The synergy between marine debris and solid waste management is especially complex since the items may come from regions other than the places where the waste is stranded. According to Krelling *et al.* (2017), there is a flow of marine debris from inner estuarine areas to adjacent beaches in its outlets. It suggests that the solid waste's dispersal dynamics depends on the action of environmental factors. The present study aims at establishing relationships between debris deposition and small-scale meteorological and oceanographic events (precipitation, wind, tide, and river flow) in Southern Brazil.

## Material and Methods

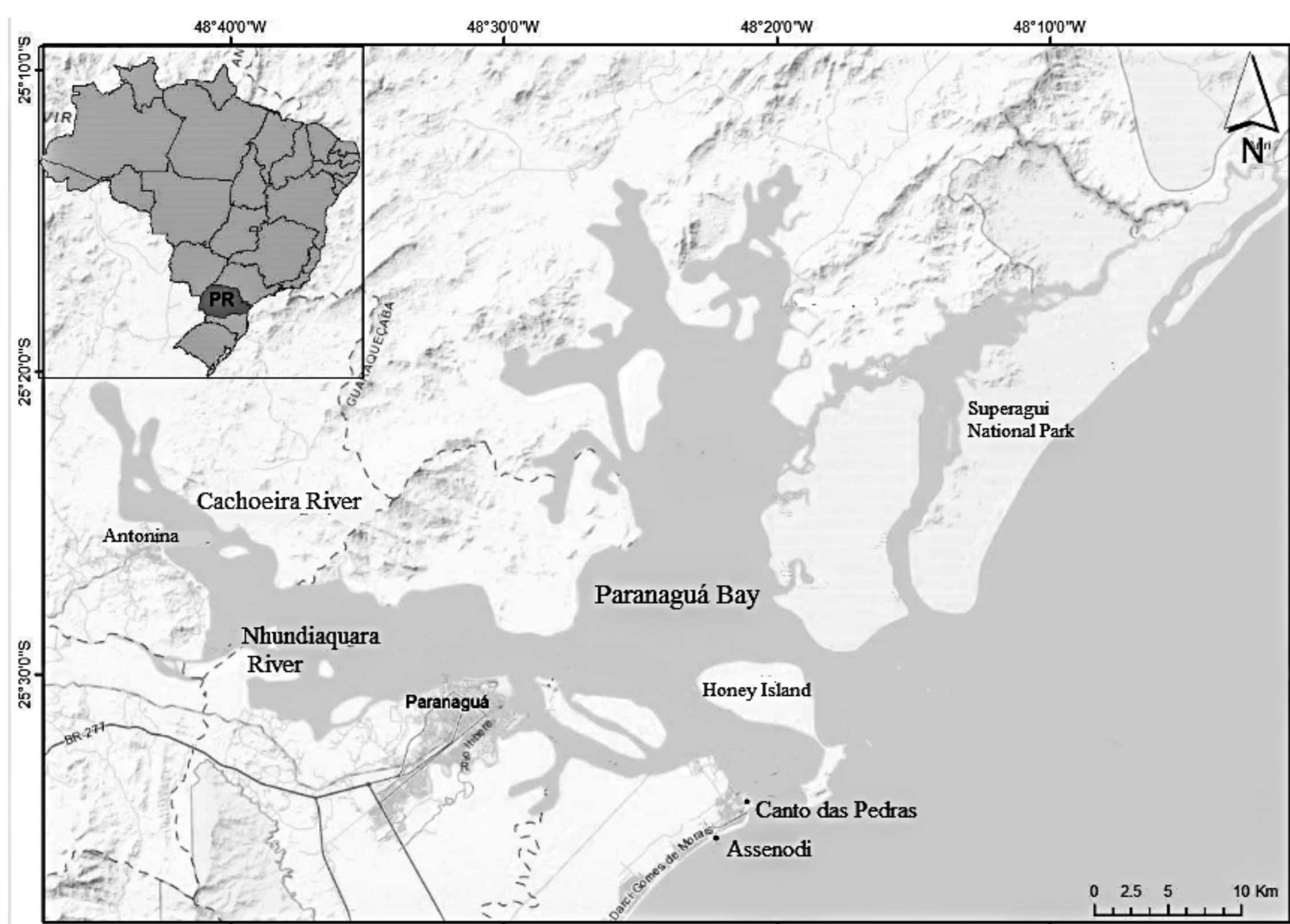


Figure 1. Map of the Paranaguá Estuarine System, State of Paraná, Brazil, indicating the Cachoeira and Nhundiaquara rivers and the two sampling sites: Canto das Pedras and Assenodi.

Two sites were sampled in the southern outlet area of Paranaguá Estuary Complex (PEC), in Pontal do Paraná, Brazil (Figure 1). The innermost site is sheltered from the direct action of oceanic waves (Canto das Pedras). It is dominated by, not only along-shore currents and by tidal currents, but also by indirect action of waves (Angulo and Araújo, 1996). The outermost site is exposed to the direct action of waves, and southerly and easterly winds.

The samples were collected for 60 consecutive days during diurnal low tides, between Autumn and Winter of 2015. All macrolitter (bigger than 2.5 cm) within the transects were collected between the waterline and the most recent strandline, aiming to samples only items arrived/stranded during the last two tidal cycles.

## Results and Discussion

The largest accumulation of marine debris was in Canto das Pedras (1920 items; most sheltered point) in relation to Assenodi (760 items; most exposed point, Figure 2). The greater influence of domestic plastic waste was observed for both sites, suggesting the influence of residues coming from municipalities inside the PEC.

### References

Angulo, R. J., Araújo, A. D., 1996. Classificação da costa paranaense com base na sua dinâmica, como subsídio a ocupação da orla litorânea. Bol. Parana. Geociências.

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Krelling A. P., Souza M. M., Williams A. T., Turra A. 2017. Transboundary movement of marine litter in an estuarine gradient: Evaluating sources and sinks using hydrodynamic modelling and ground truthing estimates. Marine Pollution Bulletin.

Regarding the influence of meteorological and oceanographic events on the temporal variation, differences were observed between sites (Figure 3). After a 4-day rainfall, the two sites are influenced by the increased abundance of marine debris; Accumulated winds influenced both sites within a 2-day action period in Assenodi (open ocean) and a 3-day period in Canto das Pedras (PEC's innermost area); Tides influenced both sites differently, indicating a linear relation in Assenodi and a unimodal behavior in Canto das Pedras. Freshwater influts influenced only the inner most site with debris accumulation in the most significant model in Canto das Pedras.

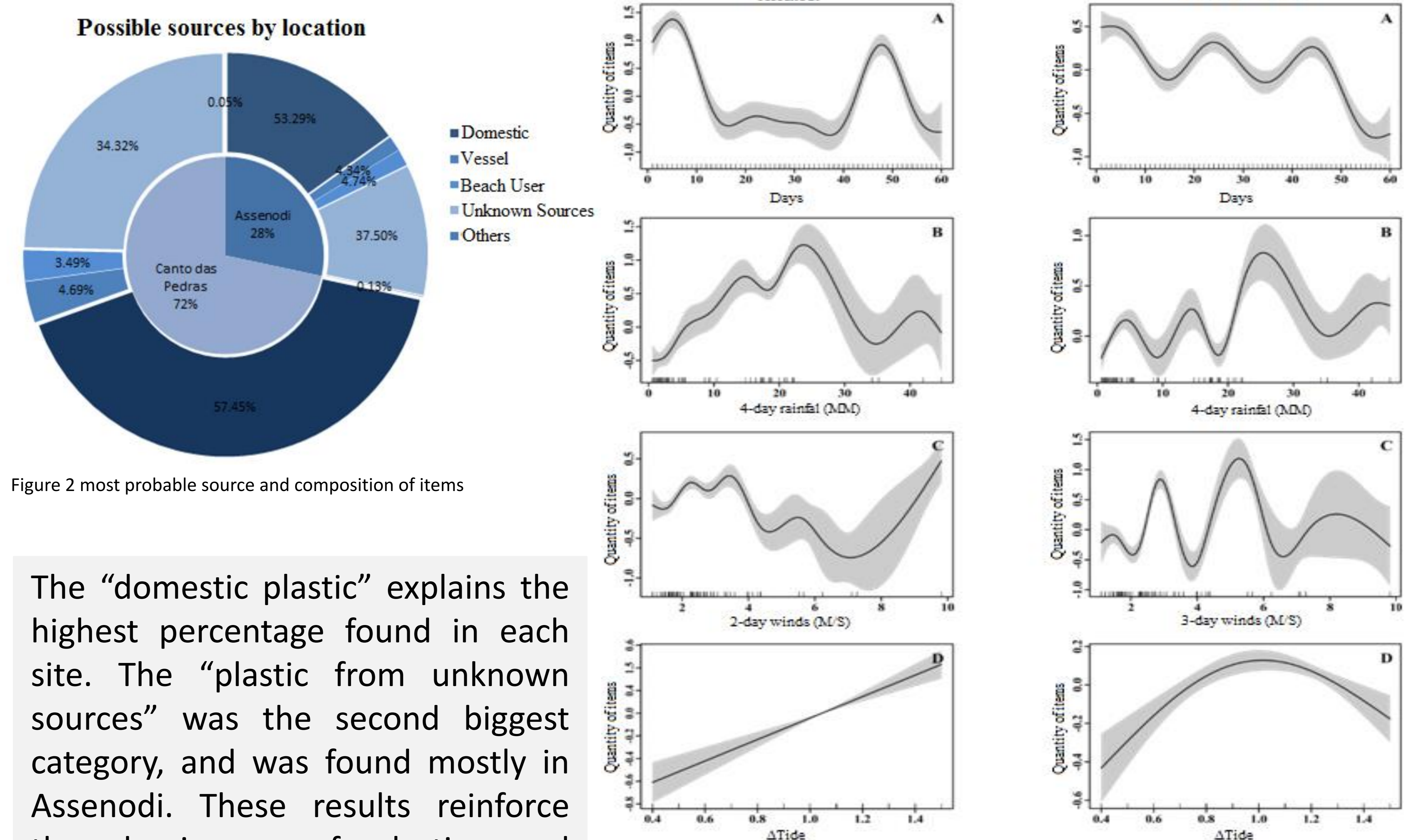


Figure 2 most probable source and composition of items

The "domestic plastic" explains the highest percentage found in each site. The "plastic from unknown sources" was the second biggest category, and was found mostly in Assenodi. These results reinforce the dominance of plastics and previous findings (Krelling *et al.*, 2017) indicating land-based sources from the most urbanized areas of the innermost part of the PEC.

## Conclusions

Large daily variation in amount of beach debris and daily variation dependent on the location of the estuarine gradient (outlet > oceanic portions). The Effect of meteorological and oceanographic events differed between sites, evidenced by the amount and type of litter deposited. These events can be used as a proxy for guide beach cleaning efforts of the next projects.