

Spatial and temporal distribution of marine debris in seafloor habitats of the Balearic Islands

Carme Alomar*, Salud Deudero, Beatriz Guijarro

Instituto Español de Oceanografía. Centre Oceanogràfic de les Balears. Moll de Ponent s/n, 07015 Palma de Mallorca, Spain – [*c.alomar@ba.ieo.es](mailto:c.alomar@ba.ieo.es)

Introduction

The Mediterranean basin is a hotspot of marine biodiversity and it is considered a sensitive ecosystem exposed to invasive species, fishing and tourism activities, numerous maritime routes and densely coastal urbanized zones which can increase marine debris. Former research has already demonstrated high values of macrodebris and microplastics (MPs) in seafloor habitats, 4.0 ± 1.8 kg/ha (1) and 0.90 ± 0.10 MPs/g (2) respectively and ingestion of macrolitter and MPs has been documented in fish species (*Boops boops*, *Galeus melastomus*, *Mullus surmuletus*, *Engraulis encrasicolus*, *Sardina pilchardus*) (3) warning of the possible potential risks and ecological effects of this pollutant. Consequently, it is essential to analyze a large temporal and spatial dataset reporting quantities and patterns of marine debris which are essential to understand their ecological effects and adopt measures to protect the marine environment in accordance with the European Marine Strategy Framework Directive (MSFD).

Material and Methods

Field work

- ✓ Scientific bottom trawls from the MEDITS survey around the Balearic Islands
- ✓ Time series: 2001 - 2015, same sampling procedure over the years
- ✓ Depth range: 50 - 800 m
- ✓ Number of stations: 41 - 69 trawls/year
- ✓ Marine debris classified into 7 categories: coal, glass, rubber, fishing material, paper, plastic and cloth and standardized to weight of marine debris to surveyed area (kg/km²)

Data analysis

- ✓ Ordinary kriging on standardized data (kg/km²) to study the predicted spatial distribution of plastic in the Balearic Islands (ArcGIS 10.4.1)
- ✓ Permutational multivariate analysis of variance (PERMANOVA) to test significant differences among locations for the plastic fraction

Aims

- ✓ Evaluate spatial and temporal distribution and patterns of marine debris in the Balearic Islands, western Mediterranean
- ✓ Assess plastic debris in seafloor habitats at mesoscale level including samples from coastal to offshore areas



Discussion and conclusions

Results from a long time series (15 years) bottom trawl surveys reflect the presence of macrodebris in seafloor habitats from coastal areas (0.3 nautical miles) to offshore areas (22 nautical miles) around the Balearic Islands with mean values ranging up to 7.61 ± 30.17 kg/km² (Fig. 1). These results suggest that this region of the Mediterranean Sea is similarly exposed to other areas of the basin since marine debris values are in range with those obtained in Greece (6.7 - 47.4 kg/km²) and Turkey (18 to 2186 kg/km²) also caught with bottom trawl nets (4,5). Regardless of the wide range of values obtained in all studies it is important to highlight that the plastic fraction was the most abundant and common in all areas. However, in our research there is no clear temporal pattern according to marine debris categories but the plastic fraction is present in all hauls containing marine debris during 15 years (Fig. 2). Amongst marine debris categories originating from sea-based and land-based source, the plastic fraction may drift and disperse long distances sinking into seafloor habitats and having implications for marine organisms across the food web (3).

Highest values of marine debris and the plastic fraction (Fig 3.) are given in the northwestern part of the Balearic Islands, thus environmental and anthropogenic features found between the north and the south of these islands along with major currents characterizing the regional circulation (Northern and Balearic currents) (6) are probably having an important role in marine debris distribution and deposition in this apparently sinking zone.

Results

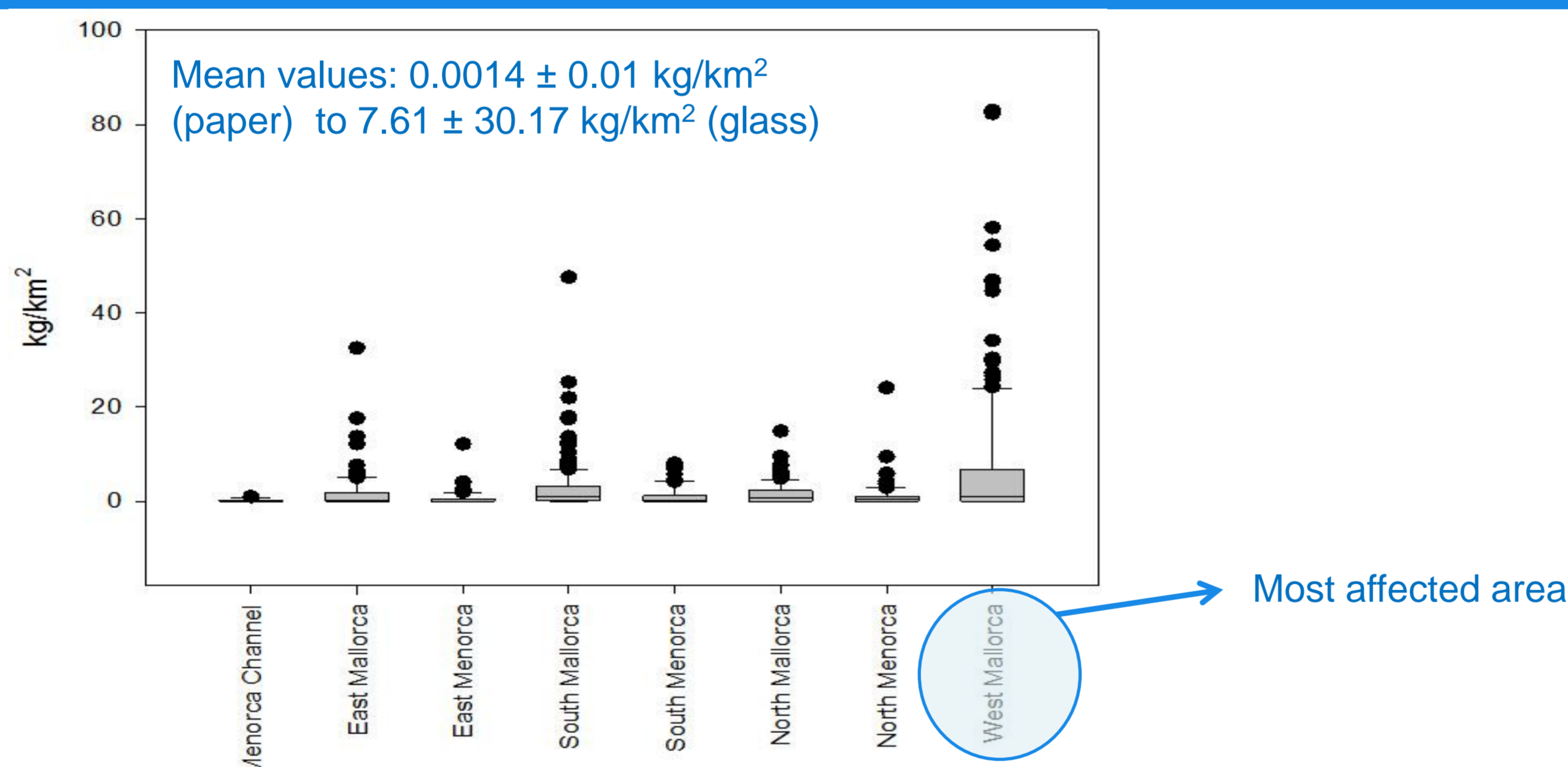


Fig. 1- Mean values for all marine debris categories for a 15 year time series

In 2009 and 2015 > 50% of marine debris in hauls was plastic and in 2001, 2005, 2007, 2012: it was the most common category

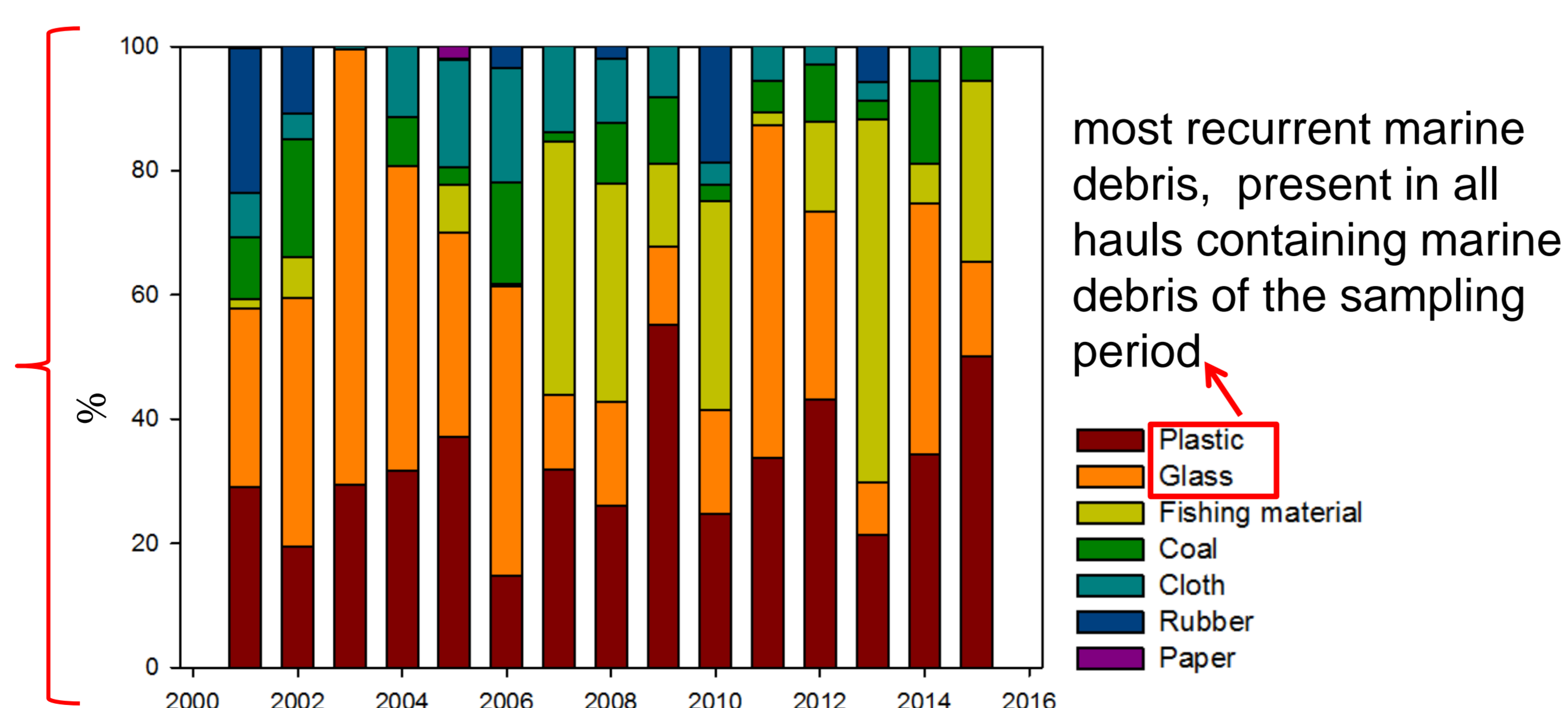


Fig. 2-Marine debris (%) according to 7 debris categories in bottom trawl surveys off the Balearic Island

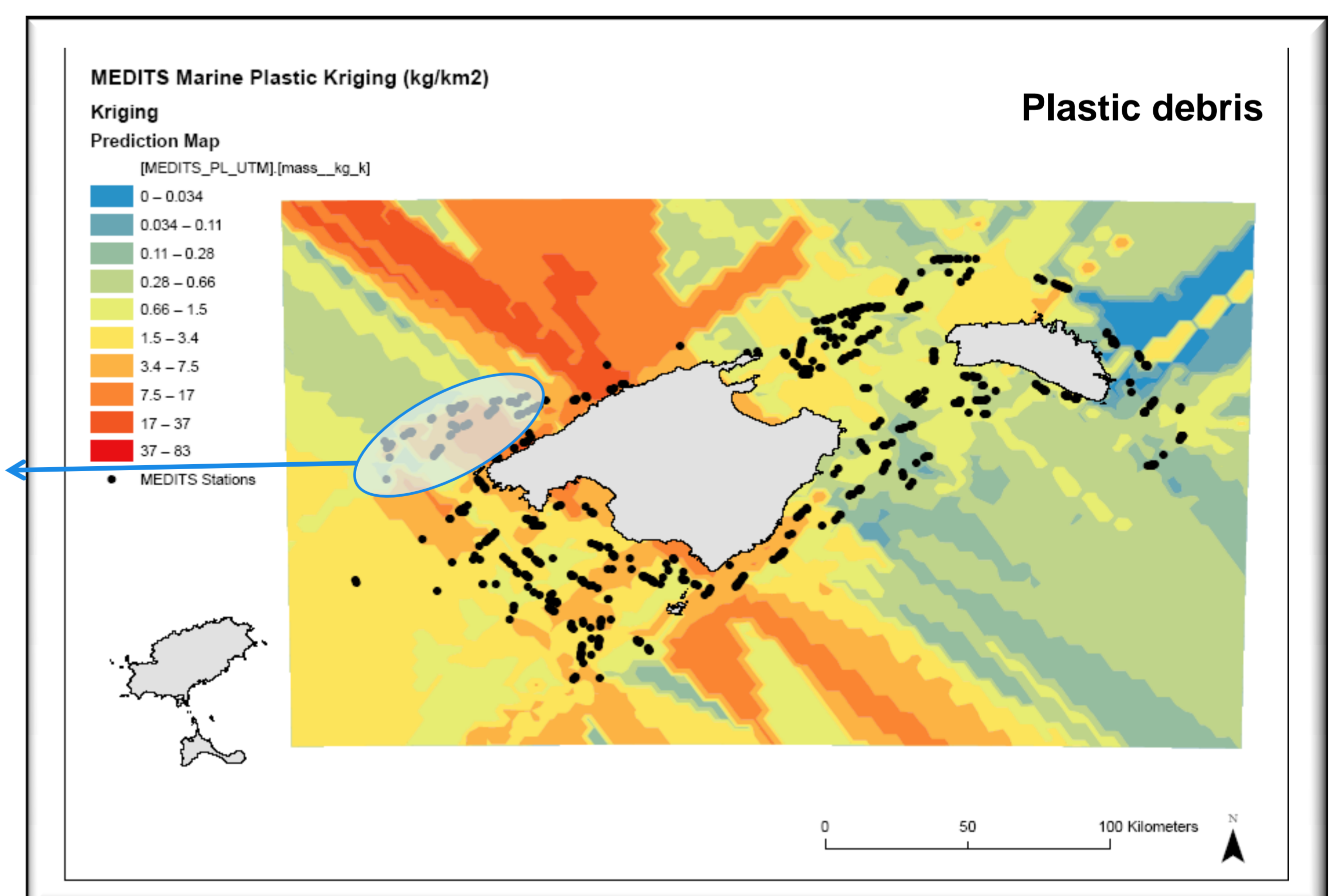


Fig. 3-Plastic distribution in the Balearic Islands based on ordinary kriging analysis

- ✓ Individual plastic values range up to **83 kg/km²**
- ✓ Significant differences amongst locations (PERMANOVA $p < 0.001$) with highest values in western Mallorca (blue circle)

Acknowledgements

Scientific surveys were funded by IEO and by the EU from 2007 onwards and partially by Ajuts per dur a terme Accions Especials de Recerca i Desenvolupament 2015-2016 del Govern de les Illes Balears:Ref;17/2015. Special thanks to M. Compa for figure 1.

References

- (1) Pham, C.K., Ramirez-Llodra, E., Alt, C.H.S., et al., 2014. Marine Litter Distribution and Density in European Seas, from the Shelves to Deep Basins. PLoS ONE 9, e95839.
- (2) Alomar, C., Estarellas, F., Deudero, S., 2016. Microplastics in the Mediterranean sea: Deposition in coastal shallow sediments, spatial variation and preferential grain size. Marine Environmental Research, 115: 1-10.
- (3) Deudero, S., Alomar, C., 2015. Mediterranean marine biodiversity under threat: reviewing influence of marine litter on species. Marine Pollution Bulletin 98(1-2), 58-68.
- (4) Koutsodendris, A., Papatheodorou, A., Kougiourouki, O., Georgiadis, M., 2008. Benthic marine litter in four Gulfs in Greece, Eastern Mediterranean: abundance, composition and source identification. Estuarine Coastal Shelf Science 77, 501-512.
- (5) Güven, O., Gülyavuz, H., Deval, M.C., 2013. Benthic debris accumulation in bathyal grounds in the Antalya Bay, Eastern Mediterranean. Turk. J. Fish. Aquat. Sci. 13, 43-49.
- (6) López-Jurado, J. L., Marcos, M. and Monserrat, S., 2008. Hydrographic conditions affecting two fishing grounds of Mallorca island (Western Mediterranean): during the IDEA Project (2003-2004). Journal of Marine Systems, 71(3), 303-315.