Do microplastics affect marine ecosystem productivity?

Tineke Troost¹, Terence Desclaux¹-², Heather A. Leslie¹, Myra D. Van der Meulen¹, A. Dick Vethaak¹-³

¹Deltares (NL), ²Ecole Central de Nantes (Fr), ³VU University Amsterdam (NL)

Introduction

Marine and coastal ecosystems are among the largest contributors to the Earth’s productivity. Experimental results indicate negative impacts of microplastics (MPs; < 5mm) on individual algae or zooplankton organisms. Consequently, pelagic marine primary and secondary productivity may be negatively affected by the presence of plastic particles in the water column.

In this study we estimated the impacts of microplastics on pelagic productivity in the North Sea using a modelling approach.

Methods

We extended the Delft3D-GEM ecosystem model for the North Sea (Los et al., 2008; Blauw et al., 2009) to include zooplankton on the basis of Dynamic Energy Budget (DEB) theory as described by Kooijman (2000). MP concentrations in the Southern North Sea were included by means of a forcing function resulting from a study by Stuparu et al. (2015).

The model used in this study includes a simplified but integral food web (i.e. nutrients, four algal species, and zooplankton) as well as full spatial and temporal variability.

Impacts of MPs on relevant process parameters of algae (respiration rate) and zooplankton (caloric ingestion rate) were calibrated based on data from literature.

Various runs were performed and resulting productivities in the Southern North Sea were compared to those of the base model without MPs.

References


Conclusions

» Although model results suggested that MP exposure does not affect the total pelagic primary or secondary production of the North Sea as a whole, relative changes in secondary production locally ranged up to ±10%.

» In addition, the modeling approach reveals large knowledge gaps which may guide future research.

This work was supported by the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement No. 308370.