Modelling the seasonal occurrence and distribution of human-pathogenic bacteria within the German Bight, southern North Sea

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Abstract and motivation

In recent years, the occurrence of human-pathogenic bacteria of the genus Vibrio in the North Sea and the Baltic Sea has come into the focus of many marine research activities, as different Vibrio strains caused harmful infections, especially in summers 2003, 2006, 2010 and 2014 (Böer et al., 2013). Furthermore, it is anticipated that under global warming conditions, the occurrence of pathogenic Vibrio spp. will increase. Therefore, research activities, as different time series stations and in different water depths (FVCOM: green line / data: blue line).

The FVCOM modeling system (Chen et al., 2003) has been used to understand and predict the occurrence and distribution of harmful Vibrio spp. within the North Sea (Fig. 1) with a special focus on the German Bight including the shallower Wadden Sea areas and the estuaries of Emms, Weser and Elbe. Within this system, a biological module has been implemented, which considers specific Vibrio strains, and functional groups of phyto- and zooplankton and bacteriophages as potential host- and predator-organisms.

This modeling system has been applied to a hot summer season in 2006. It has been demonstrated that this system can reproduce the observed hydrodynamic conditions within the North Sea, and reasonable temporal and spatial patterns of Vibrio abundances have been obtained.

The FVCOM Modeling System

The Biological Module

The Biological Module

Vibrio – Bacteriophages Submodul:

- Vibrio species
- induced mortality by specific Bacteriophages

NPZ-Submodule:

- Nutrients, Phytoplankton, Zooplankton
- uses nitrogen units
- parameters adapted to North Sea region and taken from:
  - Cossins and Bowler (1987), Baretta-Bekker et al. (1997)
  - Collos and Berges (2002), Franks and Chen (1996)
  - Gutknecht et al. (2013)

Time series of Vibrio spp. at Helgoland

Without much tuning, the correct order of Vibrio concentration is captured.

Model Validation and results

References


