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Modelling fecal bacteria in the Scheldt river and estuary

A. de Brauwere (1,2), J. Passerat (3), P. Servais (3), E. Deleersnijder (1), O. Gourgue (1), B. de Brye (1)

(1) Centre for Systems Engineering and Applied Mechanics (CESAME), Université catholique de Louvain (UCL), Belgium, (2) Analytical and Environmental Chemistry, Vrije Universiteit Brussel (VUB), Belgium, (3) Ecologie des Systèmes Aquatiques (ESA), Université Libre de Bruxelles (ULB), Belgium

With its population density of over 500 inhabitants per km^2, its active industrial development and its intensive agriculture and animal farming, the Scheldt watershed represents an extreme case of surface water and groundwater pollution which in turn has an impact on eutrophication and the ecological functioning of the receiving coastal waters. A Belgian interuniversity collaboration (http://www.climate.be/TIMOTHY) has recently started, aiming to better understand past, present and future changes in the quality of surface, ground and marine waters and to relate them to changing human activities on the watershed. Part of the originality of the new network resides in the coupling of existing hydrodynamical and biogeochemical models to describe the transport and transformation of nutrients and contaminants.

One of these couplings consists of connecting an ecological module to the Second-generation Louvain-la-Neuve Ice-ocean Model (SLIM, http://www.climate.be/SLIM). The results of a first application will be shown, where the ecological module considers the dynamics of one fecal bacteria indicator (Escherichia coli). The power of SLIM is that it solves the governing hydrodynamical equations using finite elements on an unstructured mesh. As such it is able to accurately model the different scales in the domain, going from the Scheldt river, over the estuary (including the special feature of sand banks being periodically submerged), to the North Sea.

This modelling exercise illustrates the combined effect of hydrodynamics, mortality and sedimentation on the abundance of E. coli in the study domain - with a resolution that is impossible to achieve by sampling alone. However, in order to have a reliable and accurate tool, much effort was put on data gathering and the optimal incorporation of this information (e.g. for the initial and boundary conditions, for the estimation of model parameters, or for validation). In addition, the first modelling results helped to guide future sampling campaigns such that data and modelling can be optimally adjusted and a maximum of information can be retrieved.

Although the hydrodynamical model and its coupling to an ecological module may be of scientific interest on their own, it is even more attractive that their output can be interpreted in terms of practical needs, i.e. the abundance of fecal indicators which are directly related to sanitary risk and standards for water quality. In this framework, the model is also intended for assessing the effect of different scenarios for the future, and additional pollution indicators will also be included in the ecological module.