



Predicting biochemical oxygen demand in European freshwater bodies

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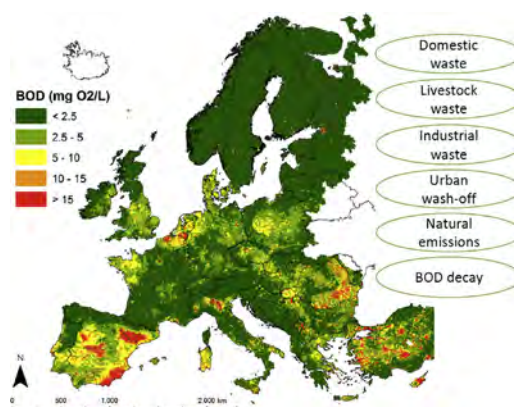
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HIGHLIGHTS

- A new BOD conceptual model was developed using the most updated datasets.
- Model parameters could be well identified using European BOD monitoring network.
- Organic pollution (BOD > 5 mg/L) still affects about 14% of European surface waters.
- In North Europe, livestock waste contributed 38–49% of BOD loads to the sea.
- Domestic waste was the major source of BOD to the Mediterranean and Black seas.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:

Received 24 December 2018

Received in revised form 15 February 2019

Accepted 16 February 2019

Available online 21 February 2019

Editor: Damia Barcelo

Keywords:

BOD

Green⁺

Water quality

Organic pollution

Water Framework Directive

ABSTRACT

Biochemical Oxygen Demand (BOD) is an indicator of organic pollution in freshwater bodies correlated to microbiological contamination. High BOD concentrations reduce oxygen availability, degrade aquatic habitats and biodiversity, and impair water use. High BOD loadings to freshwater systems are mainly coming from anthropogenic sources, comprising domestic and livestock waste, industrial emissions, and combined sewer overflows. We developed a conceptual model (GREEN⁺_{BOD}) to assess mean annual current organic pollution (BOD fluxes) across Europe. The model was informed with the latest available European datasets of domestic and industrial emissions, population and livestock densities. Model parameters were calibrated using 2008–2012 mean annual BOD concentrations measured in 2157 European monitoring stations, and validated with other 1134 stations. The most sensitive model parameters were abatement of BOD by secondary treatment and the BOD decay exponent of travel time. The mean BOD concentrations measured in monitored stations was 2.10 mg O₂/L and predicted concentrations were 2.54 mg O₂/L; the 90th percentile of monitored BOD concentration was 3.51 mg O₂/L while the predicted one was 4.76 mg O₂/L. The model could correctly classify reaches for BOD concentrations classes, from high to poor quality, in 69% of cases. High overestimations (incorrect classification by 2 or more classes) were 2% and large underestimations were 5% of cases. Across Europe about 12% of freshwater network was estimated to be failing good quality due to excessive BOD concentrations (>5 mg O₂/L). Dominant sources of BOD to

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