Integration of the erosion and sediment transport model WaTEM/SeDEM in the nutrient emission model NEMO used to support river nutrient management in Flanders

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Introduction: Nutrient emissions from agricultural activity has an important impact on freshwater systems in Flanders. In order to assess the impact of nitrogen and phosphorus emissions on the receiving water courses, the spatial distributed model NEMO was commissioned by the Flanders Environment Agency (VMM) [1]. An important pathway of nutrient transport is via nutrients bound to sediment, which implies erosion and sediment transport should be estimated adequately. NEMO uses a simplified version of WaTEM-SEDEM [1] as an erosion model to simulate the monthly transport of sediment. In this study, the erosion module of NEMO was refined by incorporating the CN-WS model used at the Department of Environment of the (VPO) Flemish Government [2], This is done to align sediment transport calculations within the Flemish Government. The aim of this study is to present how the NEMO model was updated, and how and why the results between the old and new formulation differ. Finally, the relevance of erosion management for nutrient emission control is discussed.

Methods: First, the input data for the erosion module of NEMO was updated. The RUSLE factors K (soil erodibility), R (rainfall erosivity) and LS (topographic factor) were updated in NEMO to the latest developments within CN-WS [2]. Also, the river network was updated in the land-use module of NEMO. Next, a new erosion module for NEMO was written in the programming language Python. This new erosion module has three major functionalities: create all input data for CN-WS; run CN-WS and use CN-WS output to calculate nutrient fluxes towards the river associated with sediment transport. As the executable of CN-WS is called from the erosion module in NEMO, it is very easy to update CN-WS when a new version is released. This way bugfixes and new features in CN-WS are available in NEMO too. All calculations in NEMO are done on a spatial resolution of 50 m. A new calibration of CN-WS was executed, because calibration factors for CN-WS were only calculated for 5 and 20 m [2].

Results:
The sediment load in Flanders was calculated with the original NEMO erosion module (prior), CN-WS (20 m resolution) and with the updated and calibrated erosion module of NEMO (posterior, see Figure 1).

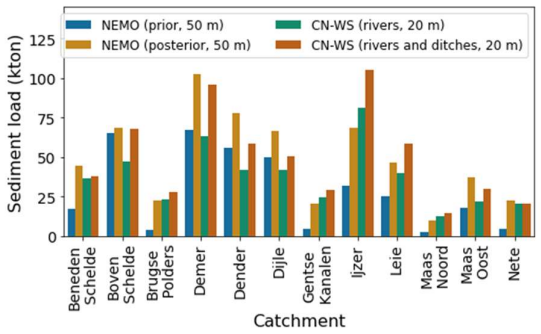

Figure 1:Sediment load in Flanders calculated with the original erosion module (prior, 50 m), the new erosion (posterior, 50 m) module and CN-WS (20 m).

Discussion: The results of the new erosion module of NEMO are comparable with the results of CN-WS, despite the differences in resolution (50 m vs. 20 m). The updated erosion module uses a standardized scenario for the calculation of sediment and nutrient fluxes. However, CN-WS was developed to simulate different erosion control measures in scenarios. To incorporate this functionality in NEMO, it was made possible to read CN-WS output of a dedicated scenario run with information about erosion control measures. Future work will include the evaluation of the incorporation of erosion control measures in NEMO so that river basin management plans can be tested. Also, the value of several other features (e.g. ditches, sewers, small landscape elements) of CN-WS are evaluated for the application on a 50 m resolution in NEMO.

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References: [1] Van Opstal M., et al. (2014) *Technical report* Flanders Environment Agency [2] Deproost et al. (2018) *Technical report* Department of Environment and Spatial Development