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

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Introduction

WaTEM-SEDEM is a raster-based soil erosion and sediment transport model (Van Oost et al., 2000; Van Rompaey et al., 2001; Verstraeten et al., 2003) that is used as a submodule in two simulation models used by the Flemish Government. On the one hand it is used in CN-WS, a coupled hydrological-sediment transport model, and on the other hand it is used in NEMO, a nutrient transport model. The aim of the current presented project is to integrate the version of WS in CN-WS in NEMO. This integration has several advantages:

- Only one WaTEM-SEDEM code has to be maintained
- Easy to update
- Results are comparable

WaTEM-SEDEM (Soil erosion by water and tillage and sediment deposition and transport model)

- Spatially distributed model
- Developed at KU Leuven
- Multiple flow algorithm
- Based on **RUSLE** (Renard et al., 1997)
  - Erosion = R*K*LS*C*P
- **Transporting** sediment through landscape
  - TC = kTC*R*K*LS
- If amount of sediment < TC: **Erosion**
- If amount of sediment > TC: **Sedimentation**

Methods and results

a. Preparation

- Re-implementing sediment module in NEMO:
  - Create inputdata for CN-WS, run CN-WS, read results CN-WS
  - Distribute nutrients and calculate nutrient fluxes towards rivers according to calculated routing and sediment fluxes in CN-WS
- Compare and align (sediment related) input data of NEMO and the data used for the Flemish application of CN-WS
  - R and K and LS-factors are now calculated in the same way
  - Update landuse data and digital elevation model
  - Calibrate CN-WS for spatial resolution NEMO (50m)

b. Modelling

- Sediment load in Flanders was calculated with the original Sediment module in NEMO (prior) and the updated sediment module (with CN-WS, posterior) both on a spatial resolution of 50 m (see fig 1).
- The sediment load to rivers and ditches was also calculated with CN-WS on a resolution of 20m (see fig 1) .
- Despite differences in resolution and, thus, details in land use and routing, results are comparable

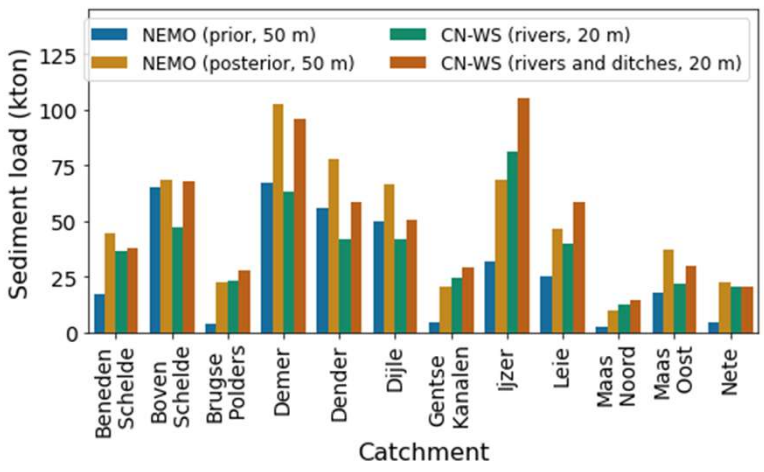

Figure 1: Sediment load in Flanders calculated with the original sediment module (prior, 50m), the new module (posterior, 50m) and CN-WS (20m)

NEMO (Nutrient Emission Model)

- Modelling N (Nitrogen) and P (Phosphorus) emissions from agriculture to surface water
- Spatially distributed model (resolution 50*50m)
- Developed at KU Leuven (Van Opstal et al., 2014).
- Used at Flemish environmental agency for nutrient management in Flanders

- Sediment transport creates important flux of nutrients towards surface water
- Coded in python, modular-setup
- Sediment fluxes are calculated with simplified and static python version of WaTEM-SEDEM in the 'sediment' module (slow)

CN-WS

- Combination of Curve-Number model and WaTEM-SEDEM
- Most developed version of WaTEM-SEDEM at the moment
- Active development @Fluves and @KULeuven, funded by Flemish government
- Code reviewed and debugged (Deproost et al., 2018)
- Code optimized for speed
- Good documentation available (lot's of tutorials, detailed explanations about the model) – see figure 2
- SOON: open-source! Everyone can use it and can contribute to the code

https://cn-ws.github.io/

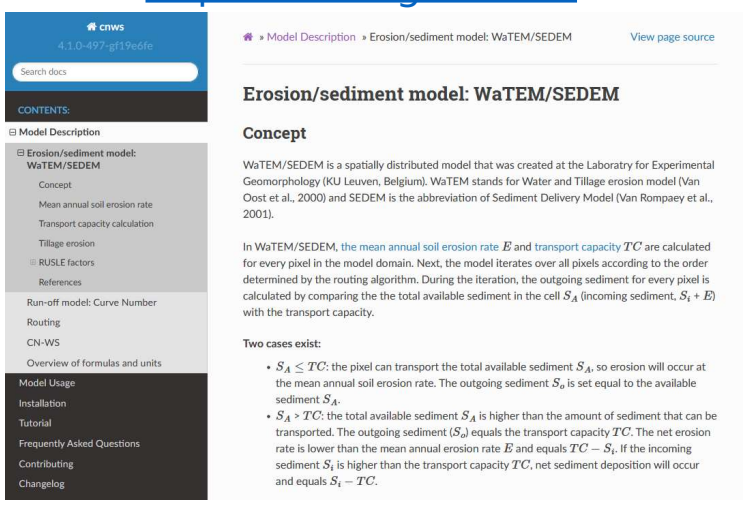

Figure 2: screenshot of documentation website cn_ws, soon available on github

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