Modeling exports of dissolved organic carbon from landscapes: A review of challenges and opportunities

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Science Question

- Numerous models have been developed to estimate dissolved organic carbon (DOC) export. What are the challenges in applying these models, and what are the potential opportunities for future model development?
- What is the global DOC budget?

Analysis

- For this study, we searched 34 models using Google Scholar, Web of Science, and ScienceDirect with keywords “dissolved organic carbon”, “DOC”, “export”, “flux”, “model”, and “simulation”.
- By reviewing and analyzing these DOC export simulation models, we identified challenges for selecting the most appropriate model to estimate the DOC export from a landscape.
- To investigate the influence of aquatic processes on the land-to-ocean terrestrially derived DOC flux, we synthesized existing studies and developed a global terrestrially derived DOC flux budget.

Results/Significance

- Considering their core structure and estimation methodologies, we categorized the 34 models into three distinct types: indicator-driven, hydrology-forced, and process-based models.
- Modeling DOC production faces challenges like integrating climate change impacts, addressing dilution response, estimating the soil DOC pool, and representing the terrestrial ecosystem. In modeling DOC leaching, challenges include the influence of climate change, dilution response, and representing soil properties. For DOC transit modeling, the key challenges are the influence of climate change, the effect of microbial abundance, variation in decay rates, and the impact of flow speed on retention time.
- We estimated that about 376 ± 92 TgC/year of DOC leaches from soils to inland waters. Within the inland waters, approximately 132 ± 32 TgC/year of DOC is mineralized, and about 94 ± 23 TgC/year is buried in sediments.

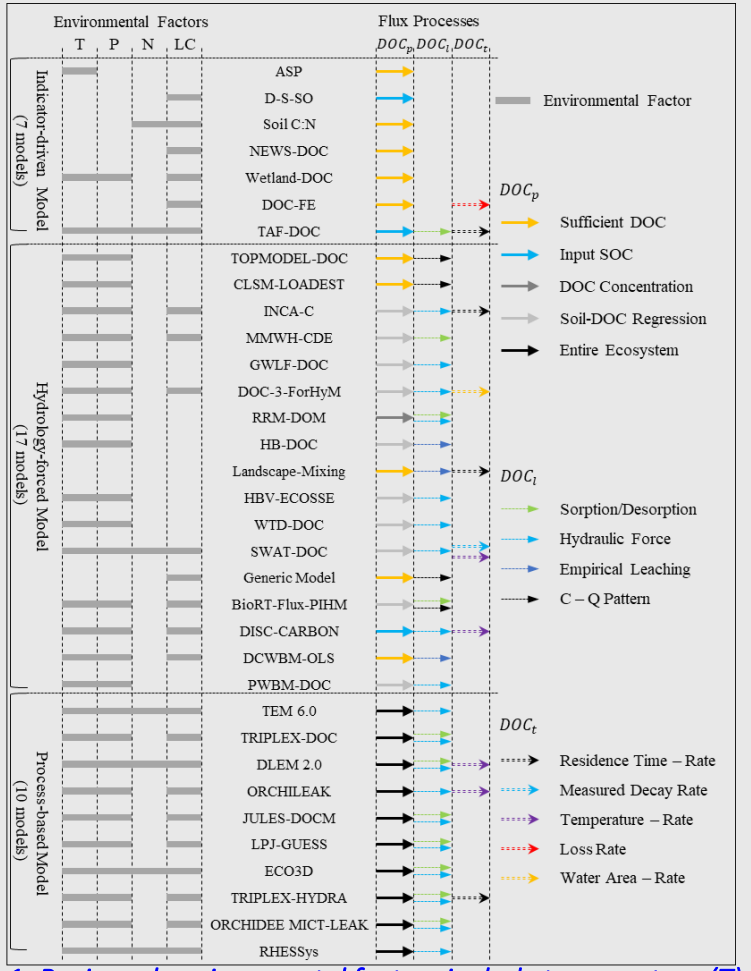

Figure 1: Reviewed environmental factors include temperature (T), precipitation (P), nitrogen input or available soil nitrogen (N), and land cover type (LC). Summarized approaches used to model the DOC production in the soil (DOC_p), leaching from soils to inland waters (DOC_l), and transit through inland waters (DOC_t).

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