Plan for modelling lateral flow of DOM in CLM

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Dissolved Organic matter (DOM)

- DOM is defined as the organic matter fraction in solution that passes through a 0.45 μm filter. DOM is often quantified by its carbon content and referred to as DOC.

- The high-latitude soil carbon reservoir may amount to ~1330-1580 PgC (Hugelius et al. 2013, 2014; Tarnocai et al., 2009).

- Yearly lateral flux of carbon from soils to running waters may amount to about a 5th of net ecosystem carbon exchange (~400 TgC/yr) (Bowring et al 2019; McGuire et al. 2009).

- Global estimates of terrestrial C inputs to inland waters is 5.1 PgC/yr (with high uncertainty, Drake et al. 2018).

Global land models ORCHIDEE and JULES have DOC representation.
Why?

DOM link with Ocean waters is important for Norway. Especially for COD spawning.

- Darker coastal waters,
- Climate warming,
- Cod spawning delays

(e.g. Parmesan 2006, Walther et al. 2002)

Green-Blue Project

Funded by Norway Research Council

‘Terrestrial ecosystem change impact on marine ecology’
How?

Make use of River routing models eg. MOSART
Couple SoilBGC model with MOSART to solve mass balance equation for DOM

- **MOSART**

$$d\left(\int CV \, DOC \, dV\right) \over dt = \sum_{\text{inflows}} Q \times DOC - \sum_{\text{outflows}} Q \times DOC + \int CV r \times dV + DOC_{\text{source}}$$

Allochthonous carbon input

Inland water network

To quantify the discharge of DOM to oceans.
Inputs:
1. Throughfall
2. Root exudate
3. Microbialysis
4. Humification
5. Litter/crop residue decomposition
6. Organic amendments

Outputs:
7. Microbial degradation
8. Microbial assimilation
9. Lateral flow
10. Sorption
11. Leaching

The processes highlighted in blue are planned for implementation.

Bolan et al. 2011, Advances in Agronomy
INPUT

**Throughfall**

- **Wet atmospheric deposition**
- **Dry deposition** (canopy exudation, aerosol bound organic compounds)

**Equations**

- **TF\_wet** = 3 mgC per L

\[
TF_{\text{DRY}} = M_{\text{LEAF}} \cdot 9.2 \times 10^{-4} \frac{\text{dt}}{\text{day}},
\]

**DOC production in SOILS** (KgC/m2/day)

First order kinetics

**Throughfall**

\[
F_{P_{k,i}} = \beta_{zi} \cdot S_{C_\text{k}} \cdot \left(1 - e^{-K_{\text{d}} \cdot F_{\text{S}}(S) \cdot F_{\text{T}}(T_{\text{soil}}) \cdot F_{V}(v) \cdot D_{\text{f}}}ight) \cdot e^{-\tau_{zi}}.
\]

- **Weighting factor**
- **Amount of carbon in soils**
- **Empirical factor for a decrease in decomposition rate**
- **Rate modifiers due to moisture and temperature**

**Fraction of vegetation**

- **Dependence on Silt and clay content**

Plan to include:

**Vertical transport (Soil layer process DOC; cryoturbation)**

\[
\frac{\delta \text{DOC}_i(z)}{\delta t} = \text{IN}_\text{DOC}_i(z) - k_i(z) \cdot \phi \cdot \text{DOC}_i(z) + \text{Diff} \frac{\delta \text{DOC}_i^2(z)}{\delta z^2},
\]

**Diffusion co-efficient**

Account for Net change in DOC to Carbon cycle balance

\[
\text{NEP} = \text{NPP} - R_H + \text{DOC}_{\text{net}}
\]

\[
\frac{\partial C_i}{\partial t} = R_i + \sum_{j \neq i} (i - r_j) T_{ji} k_j C_j - k_i C_i + \text{DOC}_{\text{net}}
\]

Add net change in DOC from routing

Runoff Evaluation

Monthly means (1950-2015)

Annual means (1950-2015)

Annual Cycle Climatology (2005-2014)
H1: Dominant snowmelt high water. 3 months with the highest average runoff belong to spring or early summer (typically May-July).

L1: Dominant low water flow in winter, caused by snow accumulation. 2 months with the lowest runoff both belong to winter or early spring (typically: February-March).

H3: Dominant rain highwater

L3: Dominant summer low water
River Discharge Evaluation

Glomma river Basin, Norway

GRDC station data
CLM-BGC simulation

LATITUDE: 59.600000 * LONGITUDE: 11.120000 *
ELEVATION: 100.0 m    Area: 40221 km²

LAT: 60.8 LON: 11.56 Elevation: 180m, Area 154 450 km²

LAT: 60.25 LON: 11.68 Elevation: 129m, Area 20300 km²

LATITUDE: 59.600000 * LONGITUDE: 11.120000 *
ELEVATION: 100.0 m    Area: 40221 km²

LANGNES

ELVERUM

SKARNES

SOLBERGFOSS
THANK YOU
FOR YOUR ATTENTION