RothC for forest soils

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RothC

CO₂

RESIDUE

soil surface

DPM
k=10 y⁻¹

RPM
k=0.3 y⁻¹

BIO
k=0.66 y⁻¹

HUM
k=0.02 y⁻¹

IOM

Input: CO₂

Feedback:
- DPM → RPM
- RPM → BIO
- BIO → HUM
- HUM → IOM
- IOM → RESIDUE
- RESIDUE → CO₂
Soil carbon changes over 100 years at Rothamsted Geescroft Wilderness
Measured and simulated changes in soil carbon after afforestation of former vineyards and cereal fields with Pinus radiata near Barcelona.

Initial drop in soil C upon planting but increase thereafter

Romanya et al. (2000) EJSS
Measured and simulated changes in soil carbon after afforestation of former vineyards and cereal fields with *Pinus radiata* near Barcelona.

RothC and CENTURY models can both describe these changes.

*Romanya et al. (2000) EJSS*
Change in forest SOC – climate & litter

A2 scenario HADCM3
Change in forest SOC in tC/ha (climate, NPP and litter)

-15 -10
-10 -5
-5 -0.1
no data
0.1 - 5
5 - 10
10 - 15
15 - 20
20 - 50
50 <
RothC – advantages and drawbacks

- **Advantages**
  - Simple & transparent
  - Very widely tested
  - Can be initialised
  - All pools are measurable (see Skjemstad *et al.* (2004), Shirato *et al.* (2006) and Zimmermann *et al.* poster – see next slide)

- **Drawbacks**
  - No above ground component - but there are coupled versions that do have – RothC / Biota & JULES
  - No litter layer - but GENDEC used in Australian implementation. Or could couple with other models (e.g. EFISCEN or 4C; Smith *et al.*, 2006; Faubert *et al.*, 2006)
  - Does not work on highly organic soils (e.g. peats) - but ECOSSE C&N model under development
Very good correlation between measured fractions and modelled pools (Zimmermann et al.)

- **bulk soil < 2 mm**
  - disruption with 22 J ml⁻¹ wet sieving to 63 µm
  - **fraction < 63 µm**
  - suspension < 0.45 µm
  - **fraction > 63 µm**
  - density-separation \( \rho = 1.8 \text{ g cm}^{-3} \)
  - **6 % NaOCl oxidation**
  - **s + c**
  - **DOC**
  - heavy fraction
  - light fraction
  - **rSOC**
  - **S + A**
  - **POM**

- **BIO**
  - modelled / tC ha⁻¹: 0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
  - quantified / tC ha⁻¹: 0.0 0.5 1.0 1.5 2.0

- **RPM**
  - modelled / tC ha⁻¹: 0.0 0.5 1.0 1.5 2.0 2.5
  - quantified / tC ha⁻¹: 0.0 4 8 1 12 16

- **DPM**
  - modelled / tC ha⁻¹: 0.0 0.5 1.0 1.5 2.0
  - quantified / tC ha⁻¹: 0.0 2 0 4 0 6 0 8 0 10 0 12 0 14 0

- **HUM**
  - modelled / tC ha⁻¹: 0.0 2 0 4 0 6 0 8 0 10 0 12 0 14 0 16
  - quantified / tC ha⁻¹: 0 24 6 8 1 0 1 2 0 1 4 0
Nitrogen Component of ECOSSE Model

INPUTS
- Max. Water level
- Rain, PET
- NPP, LU Type

EXTERNAL
- Dynamic model (eg. BIOTA)
- Static model (eg. MIAMI)
- Satellite estimates

INPUTS
- Air Temp
- Soil Parameters

EXTERNAiL
- Dynamic hydrology model (eg. SWIM)
- HOST classes
- Measurements

Leached N
- Water Module
- Temperature Module
- Acidity Module

NO3-
- Water Module
- Temperature Module
- Acidity Module

NH4+
- Water Module
- Temperature Module
- Acidity Module

Plant N
- Temperature Module
- Decomposition

RPM
- Temperature Module
- Decomposition

DPM
- Temperature Module
- Decomposition

HUM
- Temperature Module
- Decomposition

IOM
- Temperature Module
- Decomposition

N2O & N2
- NH3
- Plant N

NH4+
- NO3-
- Plant N

NO3-
- NH4+
- Plant N

Leached N
- Water Module
- Temperature Module
- Acidity Module

Water
- Module
- Temperature
- Acidity

Texture
- Module
- Decomposition

Acidity
- Module
- Decomposition

Temperature
- Drivers
- Decomposition

Oxygen
- Module
- Decomposition