

Metadata for

Spatio-temporal assessment of GHG emissions and nutrient sequestration linked to agronutrient runoff in global wetlands

Authors

Chiara Pasut, Fiona H.M. Tang , David Hamilton, William J. Riley , Federico Maggi

Contact

c.pasut@sydney.edu.au

Background

The BAMS4 (Biotic and Abiotic Model for SOM-version 4) reaction network is a simplification of the Soil Organic Matter (SOM) reaction network described in Pasut et al., (2020) and elaborated from Riley et al., (2014), Tang et al., (2019), and Ceriotti et al., (2020). It consists of two organic polymer pools of PolyC and PolyCN, three organic monomer pools of MonoC, MonoCN, and MonoCS, representing the organic carbon, nitrogen, and sulfur, and two inorganic carbon molecules (CH_4 and CO_2). The C cycle includes 4 microbial functional groups, fungi F_{DEP} , heterotrophs B_{AER} , methanogens B_{MGB} , and methanotrophs B_{MOB} , which control the depolymerization, mineralization, CH_4 genesis, and CH_4 oxidation, respectively. The C cycle was coupled with the N and S cycles, which include nitrification, denitrification, nitrogen fixation, S pools reduction, S pools oxidation, and thiosulfate and sulfur trioxide disproportionation. Each C, N, and S pool can be present in aqueous, protected (e.g., on the mineral surface binding), or gaseous phases. Each reaction includes specific microbial functional groups (ammonia-oxidizing bacteria B_{AOB} , nitrite-oxidizing bacteria B_{NOB} , denitrifying bacteria B_{DEN} , sulfur reducing bacteria B_{SSRB} , thiosulfate- and sulfide-reducing bacteria B_{ThSRB} , sulfate-reducing bacteria B_{SRB} , thiosulfate- and sulfide-disproportioning bacteria B_{SDB} , and photolithoautotroph-oxidizing bacteria B_{SOB}) represented in Figure 1.

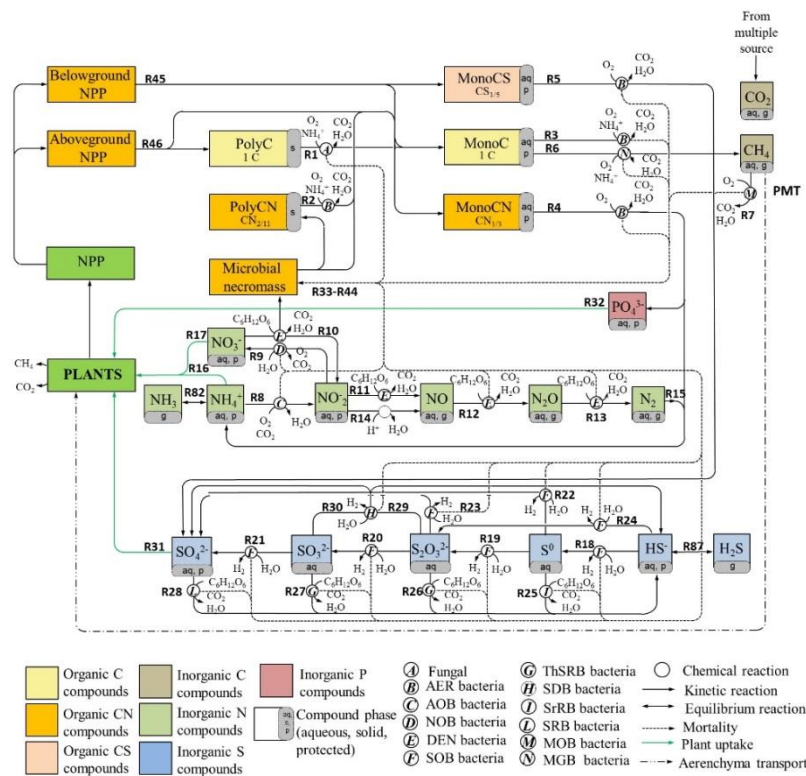


Figure 1--BAMS4 reaction network. RX identifies the reactions, which are expanded in SI in Pasut et al., (2020)

Contents

We distribute the output data from our global simulation of wetlands affected by agricultural runoff. The computational domain involves about 25,000 grid cells globally distributed describing the wetlands, and neglects lakes, rivers, rice paddies, saline estuaries, salt marshes, and reservoirs (Poulter et al., 2017). We include 14 maps and videos for the principal greenhouse gasses GHG (CH_4 , CO_2 , and N_2O), wetland extension area, soil temperature, soil moisture, long-term average soil pH, carbon input, long-term average annual carbon, long-term average soil carbon, nitrogen, and sulfur sequestration rate. This data release includes also the following plant-dependent variables: CH_4 plant emission efficiency for aerenchyma transport, C:N and C:S ratio of litter in grassland, forest, and shrubland, N_2 fixation rate in grassland, forest, shrubland, and wetland, and the average root density for forest, grassland, shrublands, and wetland.

Resources

BAMS4 was integrated in a general-purpose multiphase and multi-species bioreactive transport simulator, BRTSim-v4.0e solver. The BRTSim-v4.0 solver package can be downloaded at <https://sites.google.com/site/thebrtsimproject/home> or from the mirror <https://www.dropbox.com/sh/wrfsp9f1dvuspr/AAD5iA9PsteX3ygAJxQDxAy9a?dl=0>.

File format

Resolution: $0.5^\circ \times 0.5^\circ$ (approximately 55 km at the equator)

Pixel resolution: 360 by 720

Coordinates: standard WGS84

Bounding box: 180°E - 180°W ; 90°S - 90°N

Metadata table summary

| Variable | frequency | Period | Units | File Format | File name | Note |
|---|---------------------------|-----------|---|--------------|---|----------------------------------|
| CH ₄ | Monthly | 2000-2017 | G CH ₄ /m ² /month | NetCDF4, mp4 | CH4_Flux_2000_2017.mp4 BRTSim-BAMS4_CH4.nc | |
| CO ₂ | Monthly | 2000-2017 | g CO ₂ /m ² /month | NetCDF4 mp4 | CO2_monthly_Flux_2000_2017.mp4 BRTSim-BAMS4_CO2.nc | |
| N ₂ O | Monthly | 2000-2017 | g N ₂ O /m ² /month | NetCDF4 mp4 | N2O_monthly_Flux_2000_2017.mp4 BRTSim-BAMS4_N2O.nc | |
| Wetland area extension <i>fw</i> | Monthly | 2000-2017 | - | NetCDF4 mp4 | fw_monthly_2000_2017.mp4 BRTSim-BAMS4_fw.nc | |
| Soil temperature | Monthly | 2000-2017 | °C | NetCDF4 mp4 | T_monthly_2000_2017.mp4 BRTSim-BAMS4_SoilTemperature.nc | root zone 0-100 cm depth |
| Soil moisture | Monthly | 2000-2017 | kgH ₂ O/m ² /month | NetCDF4 mp4 | SoilMoist_monthly_2000_2017.mp4 BRTSim-BAMS4_SoilMoisture.nc | root zone 0-100 cm depth |
| Soil pH | Monthly long-term average | 2000-2017 | - | NetCDF4 mp4 | pH_longTermAvgmonthly.mp4 BRTSim-BAMS4_pH.nc | root zone 0-100 cm depth |
| Soil carbon | long-term average | 2000-2017 | annual, kg C m ² | NetCDF4 | BRTSim-BAMS4_SoilCarbon.nc | root zone 0-100 cm depth |
| Carbon input | Monthly | 2000-2017 | g C/m ² /month | NetCDF4 mp4 | C_input_monthly_2000_2017.mp4 BRTSim-BAMS4_C_input.nc | |
| C, N, and S sequestration rate | Annual long-term average | 2000-2017 | g C-N-S/m ² /year | NetCDF4 | Csequestration.nc Nsequestration.nc Ssequestration.nc | |
| CH ₄ plant emission efficiency | | | - | NetCDF4 | CH4PlantEfficiency.nc | Grassland, forest, and shrubland |
| C:N and C:S ratio of litter | | | - | NetCDF4 | C_N_EcosysRatios.nc C_S_EcosysRatios.nc | Grassland, forest, and shrubland |
| N ₂ fixation | | | | NetCDF4 | N2EcosysFixation.nc | Grassland, forest, and shrubland |
| Root density | | | | NetCDF4 | RootDensity.nc | Grassland, forest, and shrubland |

Reference

Cerioti, G., Tang, F. H., & Maggi, F. (2020). Similarities and differences in the sensitivity of soil organic matter (som) dynamics to biogeochemical parameters for different vegetation inputs and climates. *Stochastic Environmental Research and Risk Assessment*, in press.

Maggi, F., Gu, C., Riley, W., Hornberger, G., Venterea, R., Xu, T., . . . Oldenburg, C. (2008). A mechanistic treatment of the dominant soil nitrogen cycling processes: Model development, testing, and application. *Journal of Geophysical Research: Biogeosciences*, 113 (G2).

Pasut, C., Tang, F. H., & Maggi, F. (2020). A mechanistic analysis of wetland biogeochemistry in response to temperature, vegetation, and nutrient input changes. *Journal of Geophysical Research: Biogeosciences*, 125 (4), e2019JG005437.

Poulter, B., Bousquet, P., Canadell, J. G., Ciais, P., Peregon, A., Saunio, M., . . . others (2017). Global wetland contribution to 2000- 2012 atmospheric methane growth rate dynamics. *Environmental Research Letters*, 12 (9), 094013.

Riley, W., Maggi, F., Kleber, M., Torn, M., Tang, J., Dwivedi, D., & Guerry, N. (2014). Long residence times of rapidly decomposable soil organic matter: application of a multi-phase, multi-component, and vertically resolved model (BAMS1) to soil carbon dynamics. *Geoscientific Model Development*, 7 (4), 1335-1355.

Tang, F. H., Riley, W. J., & Maggi, F. (2019). Hourly and daily rainfall intensification causes opposing effects on C and N emissions, storage, and leaching in dry and wet grasslands. *Biogeochemistry*, 144 (2), 197-214.