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Toward modelling termite impacts on carbon stability and methane emissions in greenhouse gas modelling

Umar Farooq [a], **Chiara Pasut** [b], **Ying-Ping Wang** [c], **Ben Macdonald** [a], **Senani Karunaratne** [a]

[a] CSIRO Agriculture and Food, Canberra, Australian Capital Territory, Australia, [b] CSIRO Agriculture and Food, Waite Campus, South Australia, Australia, [c] CSIRO Environment, Clayton, Victoria, Australia
Email: umar.farooq@csiro.au

Abstract: Termites are pervasive ecosystem engineers whose foraging, mound-building, and soil-processing activities modify the incoming organic matter decomposition pathways and its stability (Njoroge et al., 2025). These processes can substantially influence the stability of soil organic carbon (SOC) and methane (CH_4) fluxes across tropical and semi-arid landscapes. Despite strong empirical evidence of these impacts, they are not represented mechanistically in process-based biogeochemical and land-surface models, contributing to uncertainty greenhouse-gas inventories—up to 150 Tg/year for CH_4 and over 30% for SOC estimates in termite-active regions (Ito, 2023; Njoroge et al., 2025). This study is focused on developing a simplified framework to represent termite-mediated effects on SOC and CH_4 dynamics at the site scale within an existing nutrient biogeochemical model. The framework considered termites as a biotic driver of incoming organic matter turnover in soils, incorporating their influence on litter decomposition and associated CH_4 production. Parameterisation is based on values synthesised from published studies, supplemented by site observations where available. The updated model will be applied in a small set of contrasting site-level simulations to explore how termite activity affects SOC stability and CH_4 emissions under different environmental conditions. Model evaluation will involve comparisons with available CH_4 flux measurements and SOC change estimates from the literature and targeted field datasets. By providing a tractable and adaptable framework, this work offers a first step toward integrating termite-driven processes into process-based nutrient and greenhouse-gas modeling. Although conceptually simple, the approach enables preliminary quantification of termite contributions to SOC and CH_4 budgets, and establishes a foundation for refinement as more detailed data become available.

REFERENCES

Ito, A. (2023). Global termite methane emissions have been affected by climate and land-use changes. *Scientific Reports*, *13*(1), 17195. https://doi.org/10.1038/s41598-023-44529-1

Njoroge, D. M., Dossa, G. G. O., Schaefer, D., Zuo, J., Ulyshen, M. D., Seibold, S., Zanne, A. E., Oberle, B., Harrison, R. D., Liu, S., Li, X., Birkemoe, T., Taylor, M. K., Burton, P. J., Lindenmayer, D. B., Kouki, J., Adhikari, Y., & Cornelissen, J. H. C. (2025). The effects of invertebrates on wood decomposition across the world. *Biological Reviews*, *100*(1), 158–171. https://doi.org/10.1111/brv.13134

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