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The compost bomb: thermal instability in peatland soils

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A simple model is constructed to investigate the effect of thermal energy generated by microbial respiration on soil temperature and soil carbon stocks, specifically in peat soils. Stability analysis shows a potential tipping point in the system beyond which a sudden large increase in soil temperature and decrease in soil carbon is predicted. Stability of the system depends on a dimensionless number, itself dependent on the effective soil thermal conductivity and the temperature sensitivity of microbial respiration. The influence of soil moisture on the effective thermal conductivity, and therefore the stability of the system, is also investigated. These results suggest that peatland soils insulated by a moss or lichen layer are potentially destabilised under certain conditions of warming and drying.