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Aridity and decomposition processes in complex landscapes

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Decomposition of organic matter is a key biogeochemical process contributing to nutrient cycles, carbon fluxes and soil development. The activity of decomposers depends on microclimate, with temperature and rainfall being major drivers. In complex terrain the fine-scale variation in microclimate (and hence water availability) as a result of slope orientation is caused by differences in incoming radiation and surface temperature. Aridity, measured as the long-term balance between net radiation and rainfall, is a metric that can be used to represent variations in water availability within the landscape. Since aridity metrics can be obtained at fine spatial scales, they could theoretically be used to investigate how decomposition processes vary across complex landscapes. In this study, four research sites were selected in tall open sclerophyll forest along a aridity gradient (Budyko dryness index ranging from 1.56 –2.22) where microclimate, litter moisture and soil moisture were monitored continuously for one year. Litter bags were packed to estimate decomposition rates (k) using leaves of a tree species not present in the study area (*Eucalyptus globulus*) in order to avoid home-field advantage effects. Litter mass loss was measured to assess the activity of macro-decomposers (6mm litter bag mesh size), meso-decomposers (1 mm mesh), microbes above-ground (0.2 mm mesh) and microbes below-ground (2 cm depth, 0.2 mm mesh). Four replicates for each set of bags were installed at each site and bags were collected at 1, 2, 4, 7 and 12 months since installation. We first tested whether differences in microclimate due to slope orientation have significant effects on decomposition processes. Then the dryness index was related to decomposition rates to evaluate if small-scale variation in decomposition can be predicted using readily available information on rainfall and radiation. Decomposition rates (k), calculated fitting single pool negative exponential models, generally decreased with increasing aridity with k going from 0.0025 day^{-1} on equatorial (dry) facing slopes to 0.0040 day^{-1} on polar (wet) facing slopes. However, differences in temperature as a result of morning vs afternoon sun on east and west aspects, respectively, (not captured in the aridity metric) resulted in poor prediction of decomposition for the sites located in the intermediate aridity range. Overall the results highlight that relatively small differences in microclimate due to slope orientation can have large effects on decomposition. Future research will aim to refine the aridity metric to better resolve small scale variation in surface temperature which is important when up-scaling decomposition processes to landscapes.