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Reply on RC1

J. Robert Logan et al.

Author comment on "Accounting for non-rainfall moisture and temperature improves litter decay model performance in a fog-dominated dryland system" by J. Robert Logan et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-16-AC2, 2022

We would like to thank the reviewer for their comments and note that the original review is in *italic* with our reply following.

This manuscript describes a study that quantified the effects of non-rainfall moisture on litter decomposition across a fog gradient in the Namib desert. Non-rainfall moisture (relative humidity and dew) is thought to be important source of moisture in very dry ecosystems, yet few studies have quantified the effects on litter decomposition. The manuscript describes the results of a multi-year litter mass loss study and tests different temperature and moisture relationships in a simple decay model. They show that including non-rainfall moisture improves the decay model performance.

I enjoyed reading this manuscript. It is very well written and I really appreciate the author's efforts to submit a polished document. I did not see any grammatical or technical mistakes. The study is interesting and provides a novel model that could be tested in other ecosystems. The methods use were appropriate and sound to my knowledge.

I do wonder how applicable is this model/study to other ecosystems? The Namib desert is extreme, would this non-rainfall moisture effect be as prominent in a less extreme but still foggy ecosystem? Is this effect big enough to detect in ecosystems with more decomposition?

This is an excellent point and we thank the reviewer for these comments. Yes, our study was conducted at a site with extremely little rainfall and we are therefore not able to directly extrapolate the effect of NRM on mass loss in more mesic sites. However, NRM's role in litter decay has been observed in a wide range of ecosystems including Mediterranean shrublands (Gliksman, 2018; Dirks et al., 2010), salt-marshes (Newell et al., 1985), hyperarid deserts (Logan et al., 2021), and temperate steppes (Wang et al., 2017). One study found that NRM played a substantial role even a mesic prairie with mean annual precipitation of 897 mm (Evans et al., 2020), suggesting that NRM is important even when rainfall is relatively frequent. Our contribution in this paper is therefore not demonstrating the importance of NRM to litter decomposition in general, but showing that the frequency of NRM events strongly predicts litter mass loss across a wide range of

moisture conditions and that this can be easily modeled using relative humidity data. Although this study was conducted at the dry end of an aridity gradient, it still represented an eight-fold magnitude of NRM frequency, showing that NRM can be easily incorporated into litter decay models. Explicitly incorporating NRM into models in mesic systems, where rainfall plays a greater role, will likely require including both rainfall and NRM-sensitivity functions to identify the relative role of each as rainfall increases.

We have elaborated on this point by including a paragraph in the discussion to discuss these points and believe that this strengthens the paper. Thank you again for your questions and suggestions!