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Response to Comments on "Assessing the Risk of Engineered Nanomaterials in the Environment: Development and Application of the nanoFate Model"

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After carefully reviewing the comments from Cohen et al., we have compiled the following clarifying statements.[1] First, we did not intend to imply that MendNano is a steady-state model. We recognize that MendNano is a dynamic model though many aspects in the publication appear to rely primarily on steady state assumptions. As the authors of MendNano, we are sure that Cohen et al. are more familiar with their model than anyone else. Generalizations on our part may be due to limited space. Second, our statement regarding MendNano's capabilities was not that the model cannot be used to look at different land uses or water types, but rather that from the published works, we were under the impression that only one type can be considered at a time.

We did not consider nor state that dissolution is independent of particle size. Rather that, as a screening tool, we chose to limit the complexity required by introducing particle size distribution not unlike other existing models and most MFA models.[2−4] This necessitated simplifying the calculations so that the amount of data necessary to run the model was manageable. In addition, we felt that modeling dissolution patterns at the individual particle scale when trying to represent a much larger region would not be efficient. The dissolution equation was written to focus on the loss of the nanoparticle, which is why C is concentration of nanoparticle and not dissolved ion, so the negative is not a typo.

In regard to atmospheric dry deposition, we again elected throughout the model not to incorporate a distribution of particle sizes because nanoFate is meant to be a screening level tool. The referenced equation relies on Stoke's Law[5] and is used in nanoFate to calculate deposition of both ENMs associated with aerosols and individual or small aggregates of ENMs of a specified particle size. Particle radius is therefore accounted for in the calculation of both wet and dry deposition in R_p (particle radius), and as with other models that use this equation, if the particles are of varying sizes, then there will be some variability in the predictions. This equation is a reasonable simplification of a rather complex process, which may be improved when better models of atmospheric deposition (wet and dry) of nanoparticles are developed.

The primary reason for not explicitly considering multiple particle sizes is due to a lack of experimental data to parametrize the model with realistic particle size distributions for each environment.[6,7] Among other limitations, the fact that, at the time, we did not have realistic distributions of ENM size at the point of release to the environment made it difficult to include particle size in a screening level model. The goal was to holistically and mechanistically consider the most significant processes without making the model too difficult to use. These simplifications are common in environmental modeling and acceptable if clearly communicated and justified scientifically.[8]

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Notes

The authors declare no competing financial interest.

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