Adapting and applying the integrated biogeochemical model ForSAFE-Veg at a subalpine site – processes and prospects

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The ForSAFE-Veg model was originally developed to simulate the integrated response of forest ecosystems to simultaneous changes in atmospheric deposition, climate change and land use. Within the framework of the United Nations' Convention on Long-Range Transboundary Air Pollution, the model was used to develop a method for estimating dynamically calculated critical loads of nitrogen deposition with the change in ground vegetation communities as an end point. This method was adapted to model plant biodiversity at a subalpine site of Loch Vale in the US Rocky Mountains.

To be able to simulate the ecosystem type at Loch Vale, the model was adapted in a number of ways that allowed us to explore the possibility of expanding its applicability from forest stands to a tree line site. We allowed for the calibration of a limited number of model parameters and initial values, as well as the modification of the key processes of nutrient uptake and decomposition.

Despite the current model limitations, the simulated outputs for soil and soil solution chemistry together with the composition of the ground vegetation community compared satisfactorily with measured data at Loch Vale. The model showed that the expected effects of climate change alone will surpass those expected from N deposition, and that that combination of both may lead to the decline or loss of key plant species.

The model application at Loch Vale confirms the potential to expand the model outside of forest ecosystems, while stressing the necessity and advantages of calibrating the model, particularly the vegetation response niches required for the vegetation community module Veg. The current study made use of the model in its current version, implying a range of limitations stemming from the fact that it is primarily developed for forest ecosystems. Yet, the potential for expanding into ecosystems where trees are not dominant or even absent is shown to be substantial. The model needs to be further developed to fully integrate the ground vegetation in the biogeochemical cycle.

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