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sDiv working group meeting summary

sTreelines

Spatial pattern emergence from ecological processes at alpine treelines: model-supported hypothesis tests against globally-distributed field data

The overall aim of the sTreelines workshops is to synthesize process knowledge on treeline ecology and biodiversity in a spatially-explicit model and to compare emerging patterns with data collected at treelines globally.

In the first sTreelines workshop we focused on the first part of this aim: synthesizing process knowledge and discussing how to model these processes in an individual-based spatial model to recreate spatial patterns in tree positions and size distributions observed at alpine treelines. At the end of the workshop we had jointly created a conceptual model that is ready to be translated into computer code and tested. Additionally, we discussed how to share treeline-related data among our group but also among the larger scientific community and with involvement of citizen scientists.

The 17 participants, including two remote, were a mix of ecologists specialized in different aspects of treeline research in different parts of the world and ecological modelers more or less familiar with treeline issues. Therefore, the first day of the workshop was used to introduce a common vocabulary and build up a conceptual basis for the rest of the workshop by introducing the treeline questions we would hope to answer with our model. We also covered the basics of individual-based and pattern-oriented modelling via interactive presentations by Volker Grimm and Thorsten Wiegand, respectively. The remainder of the workshop involved group discussions and facilitated white-board activities, enabling us to expand on, and add clarity to, conceptual and practical model details.

To structure our discussions, we roughly followed the logic of the Objectives, Design, Details (ODD) documentation suggested for designing and describing individual based models (Grimm et al. 2010). Volker Grimm added his wealth of experience in this area, allowing us to keep a clear focus in the discussions. Following the ODD structure implies that, after defining the purpose of the model, the agents (e.g. individual trees, spatial units) and their attributes (e.g. species, size, age, health status, temperature, vegetation height) are defined, and the processes that should take place in the model (e.g. establishment, growth, mortality) are defined and described, including their spatial dependencies and scheduling. Of course, this was an iterative process, the structure and even the purpose of the model evolving as we discussed it.

As the plenary sessions were quite fruitful and everybody could provide useful input to understand the relevant processes and to guide decisions about model structure, we decided not to break up into subgroups, as originally planned, but to work as one group to move forward with the main goal of the workshop. The plenary model design sessions thus took up approximately 70% of the workshop, the rest being filled with presentations (ca. 20%) and discussions about other themes like the database (ca. 10%). As a result, and thanks to iDiv's support to extend the workshop for a few days after the weekend with a smaller group of participants, we ended up with a strong conceptual model that should, once programmed into e.g. Netlogo, help understand the effect of basic processes like establishment and mortality on treeline patterns. Once we understand the behavior of this model, the next step will then be to implement many of the processes discussed in the workshop, like effects of various microclimatic modifications by neighbors on tree growth and survival.

Also emerging from our many, constructive conversations with the group was useful clarification and input into a draft manuscript presenting a general descriptive framework of global treeline patterns, which is foundational to our modelling work.

So far, the modelling ideas have been included in two conference contributions:

Bader, M.Y., H.L. Buckley, B.S. Case, *et al*. Poster: How to model the emergence of spatial patterns in alpine treeline ecotones? *Annual meeting of the Arbeitskreis Hochgebirge (High-mountain research circle)* (Feb 2019, Augsburg, Germany)

Bader, M.Y., F. Döweler, B.S. Case, *et al*. Symposium talk: Understanding global variation in treeline spatial patterns: a community database and spatial process model. *15th annual Conference of the International Biogeography Society* (Jan 2019, Malaga, Spain)

All agreed that we received great support from the sDiv staff, both logistically and for the workshop itself, e.g. in offering data exchange facilities. We are confident that everybody enjoyed themselves and that all are looking forward to the second workshop later this year!

Cited reference:

Grimm, V., U. Berger, D. L. DeAngelis, J. G. Polhill, J. Giske, and S. F. Railsback. 2010. The ODD protocol A review and first update. Ecological Modelling **221**:2760-2768.