Assignment: Dynamic species distribution model

The habitat range of species is determined by its ecological niche. The ecological niche can be computed by statistically summarising the environmental parameters at all the locations, where the species has been observed. Typical niche-parameters are the mean annual precipitation, the mean annual temperature, or the elevation. Mapping the niche-parameters back to geographic space, we get informed about how suitable is a region for this species.

However, the results of purely statistical mapping do not fully match with the actual distribution of species. The reason is adaptive interaction like competition processes. Process models can help to overcome this shortcoming of statistical model.

Your task

After the end of the ice age, two species "treeA" and "treeB" started to expand back into Central Europe from two different places. Their today's distribution boundaries are determined by environmental gradients, as well as their competition strength.

Your model represents this phenomenon in an abstract environment. The study area is a quadratic grid with 100 by 100 cells. Choose the starting cells of species yourself.

What is the share of tree A and tree B in the study area, after the system has stabilised?

Instructions

1. Habitat suitability index (environmental gradient)

The habitat suitability index (HSI) is different for the two species. It is a linear gradient between 66% and 100% suitability from west to east and from east to west respectively.

These gradients can be easily initialised in the global section as follows:

```
init {
    ask forest {
        hsiA <- 66 + location.x / 3;
        hsiB <- 99 - location.x / 3;
    }
}
```

2. Germination probability.

The HSI determines the germination probability for each respective species. An HSI value of 75% equals with a germination probability of 75% at this location.

3. Tree growth

Under optimal conditions, the two trees grow equally well into all directions (Eden growth, see lesson on Spatial Processes).

4. Tree competition

Young trees up to an age of 5 years can germinate in the same cell, but only one of them can survive. Species A wins the competition with a probability of 70%.

Submit

- A report with the following content
  - a short documentation of how you have extended the Eden growth model
  - the overview and design part of the ODD protocol.
  - Provide a screenshot of the map and
  - Provide a time series chart.
  - State the final share of trees quantitatively.
  - Interpret your results: Which result did you expect? Did the model outcome match your expectations?

- The documented model as part of a .zip file of the 'UNIGIS models' project that you create at the end of this module and that includes all assignment models.