Ragweed: diffusional spread and pollen load

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Simulation of diffusion of ragweed and its pollen in Austria and Bavaria until 2050 [1-5]

Ragweed (*Ambrosia artemisiifolia* L.), spreading rapidly in Europe, is an annual weed that causes severe pollen allergies. We simulated the further spread until 2050 based on presence absence data from the years 1990 until 2005 by assigning them to the 4722 cells of the study area (i.e. Austria and Bavaria). For the dispersion we used the leptokurtic kernel

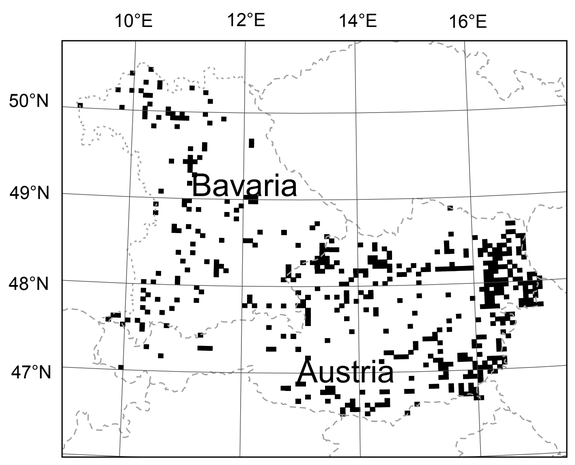
$$S(d) = \left(\frac{d}{d_0}\right)^{-\gamma} \qquad (1)$$

with the distance of the cell centers d, the dispersal distance d_0 and the exponent γ. The probability that a cell becomes infested in the following year is proportional to the product of the spread kernel $S(d)$ and the habitat suitability $H(x)$

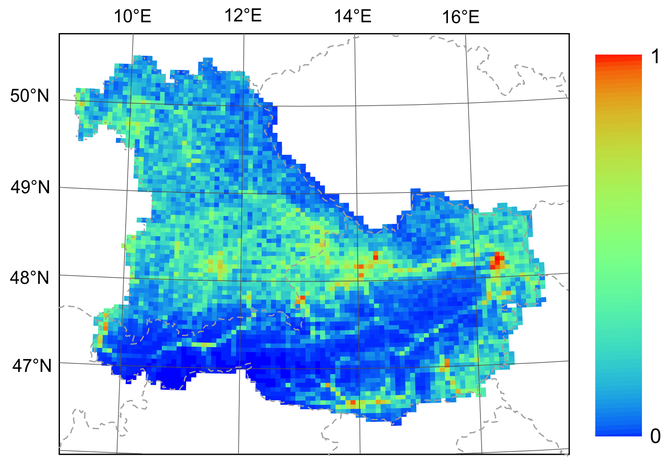
$$P \propto S(d) \cdot H(x). \qquad (2)$$

If this probability is higher than a random number, the cell is infested in the following year (i.e. a Monte Carlo simulation).

Ragweed blooming.



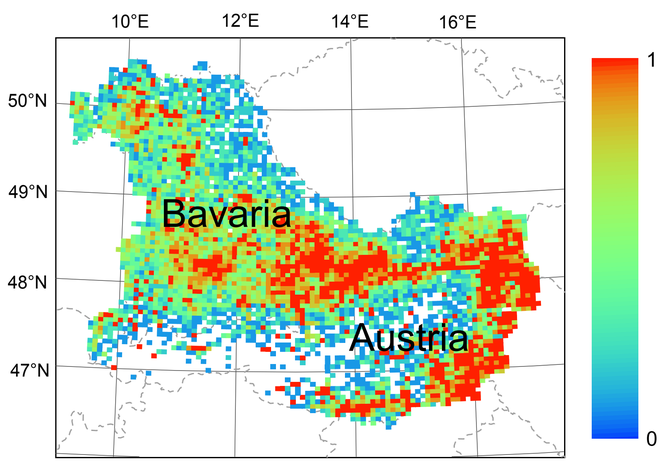
Distribution of grid cells infested by ragweed in 2005.



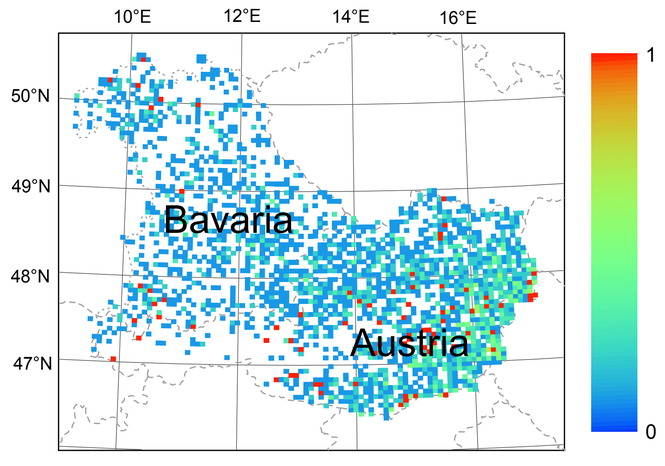
Distribution of habitats suitable to Ragweed.

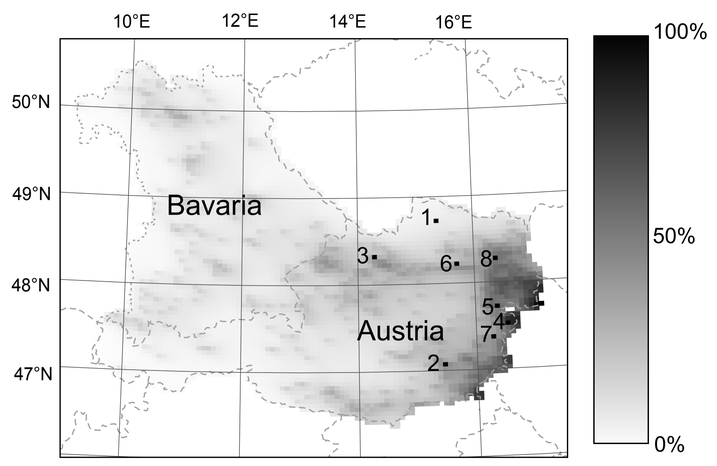
Our simulation predicts severe expansion of ragweed, especially when assuming climate change with $1.5°C$ temperature increase (from 1990-2050). With applying management (i.e. surveying and eradicating ragweed populations) using 15 million Euro annualy the dispersion can be curtailed drastically.

For calculating pollen dispersal we assumed that the drifting time for each pollen grain (i.e. the time it stays in the air) follows an exponential distribution with parameter τ and the empirical distribution of wind directions and velocities is constant for each individual trajectory. By comparing this distribution with pollen counts from eight pollen traps we determined the parameter τ to be 1.72 hours.



Simulated distribution of ragweed in the year 2050 assuming $1.5°C$ temperature increase (from 1990-2050). Left without and right with management. Different colours indicate the probability of infestation





Simulated pollen dispersion (darkest shade indicates maximum pollen load) for the year 2011 and location of eight Austrian pollen traps (black squares with numbering).

Acknowledgements

We thank Stefan Dullinger and Franz Essl from the Faculty Centre of Biodiversity, University of Vienna.
This research was supported by the Austrian Academy of Sciences within the Global Change Programme.

References

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