Population dynamics of a soil arthropod simulated using an individual based population model and established fate model data

Dirk Nickisch[1*)] & Torben Wittwer[1)]

[1)] RIFCON GmbH, Goldbeckstraße 13, 69493 Hirschberg, Germany
[*)] Email: dirk.nickisch@rifcon.de

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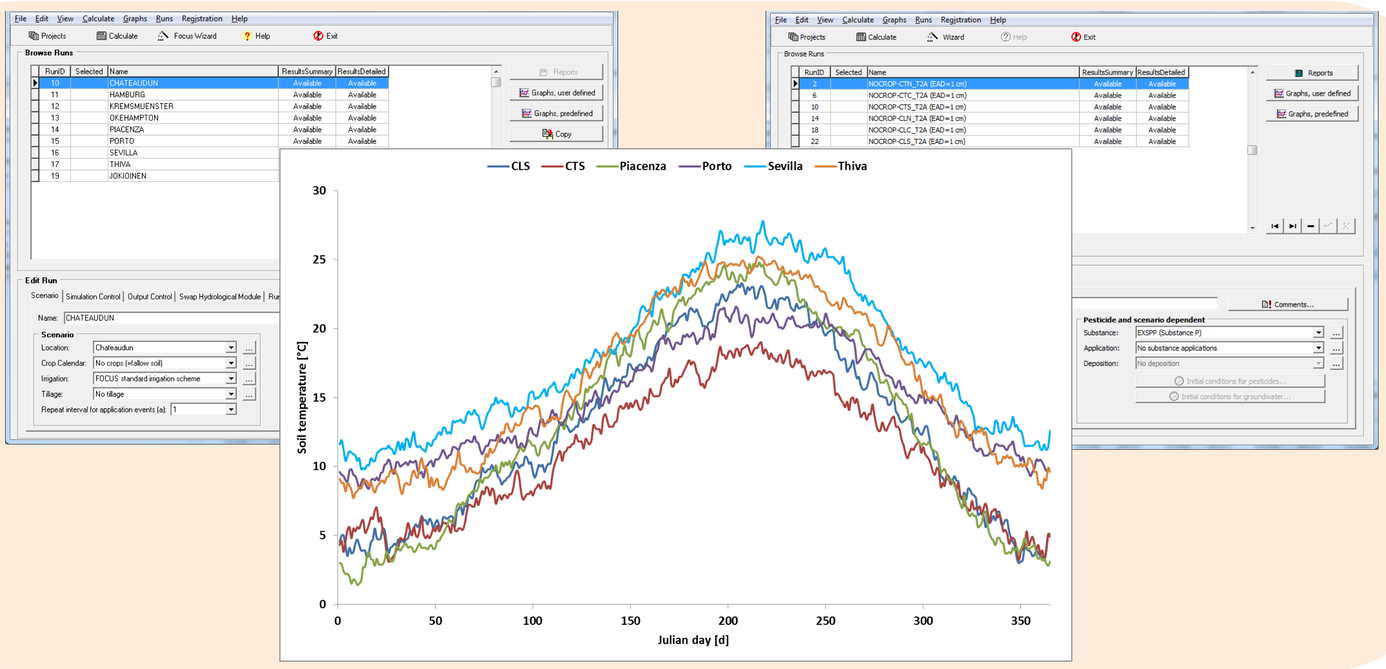
Overview

Many of the available ecotoxicological models deal with protection goals that address field populations. Effect models are often stochastic and spatially explicit. This however makes these models more complex in comparison to the established deterministic exposure models and therefore considerable effort is needed for their verification, validation and comprehensive communication.
Since effect modelling for European environmental risk assessments (ERA) aims to predict effects on populations of the model organisms which arise from environmental exposure, we find it meaningful to use, in ecological models, the relevant data from the established fate models. This can make the modelling approaches more harmonised and probably would enhance their acceptability.
We illustrated the usability of data on environmental conditions which agree with the established environmental fate models and could as well demonstrate the implications of different environmental conditions on springtail populations.
For this purpose, an individual based population model (*SpringSimPy*) was used, which represents the life-cycle of springtails in a temperature dependent framework. Soil temperature series were calculated with the groundwater model Pearl. Further, weather data given for available scenarios from current exposure ERAs were used.

Material & Methods

SpringSimPy requires temperature series as input data:

- Soil temperature series calculated with FOCUS Pearl 4.4.4 for southern zone scenarios Piacenza, Porto, Sevilla and Thiva
- Soil temperature series calculated with Soil Pearl 1.1.1. Beta 6 for southern zone scenarios CTS and CLS
- No crop cover was considered in our calculations
- Simulation time was 26 years including a warm up period of 6 years



Results

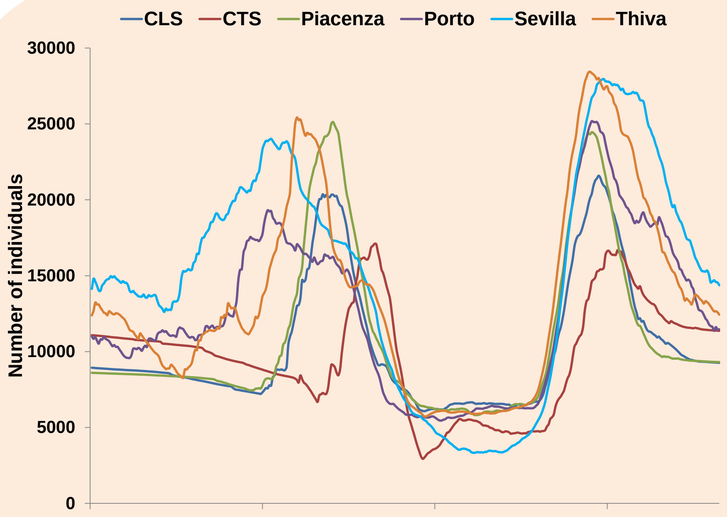


Figure 1: Springtail population abundance (average values) simulated with *SpringSimPy* using different soil temperature series calculated with Pearl models.

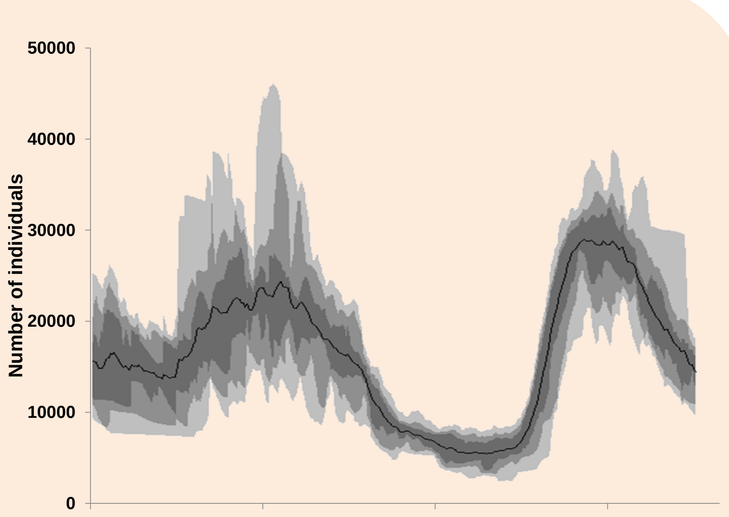


Figure 2: Annual fluctuations of population abundances, location Sevilla, 25/75th %tile (dark grey), 10/90th %tile (mid grey), min/max (light grey).

Modelling runs:

- CTS, showing lowest annual mean soil temperatures, resulted in lowest abundances in summer and autumn
- Sevilla showed high abundances during spring times because of an early start of reproduction, but abundances lower or in the range of the CTS scenario during summer times
- Significant decrease of number of individuals during summer period can be traced back to an associated reduction in food availability in the model

Outcome

- Validated weather data, readily present in the current efate risk assement, cover a variety of situations
- The variability in the standard exposure assessment scenarios could even be visualized on the level of populations of non-target organisms with the aid of an effect model
- More than one scenario per regulatory zone should be simulated, as the results convey here, in order to have a complete assessment and to cover uncertainty of the assessment
- We believe that more harmonization of exposure and effect assessment scenarios would serve the overall risk assessment

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