KIT
Karlsruhe Institute of Technology

KIT-Campus Alpin
IMK-IFU: Atmospheric Environmental Research
Institute of Meteorology and Climate Research
Atmospheric Environmental Research (IMK-IFU)

Integrating process-based land-use and ecological models to assess global change impacts on European bumblebee species and pollination service

Postdoctoral Researchers International Mobility Experience (PRIME)

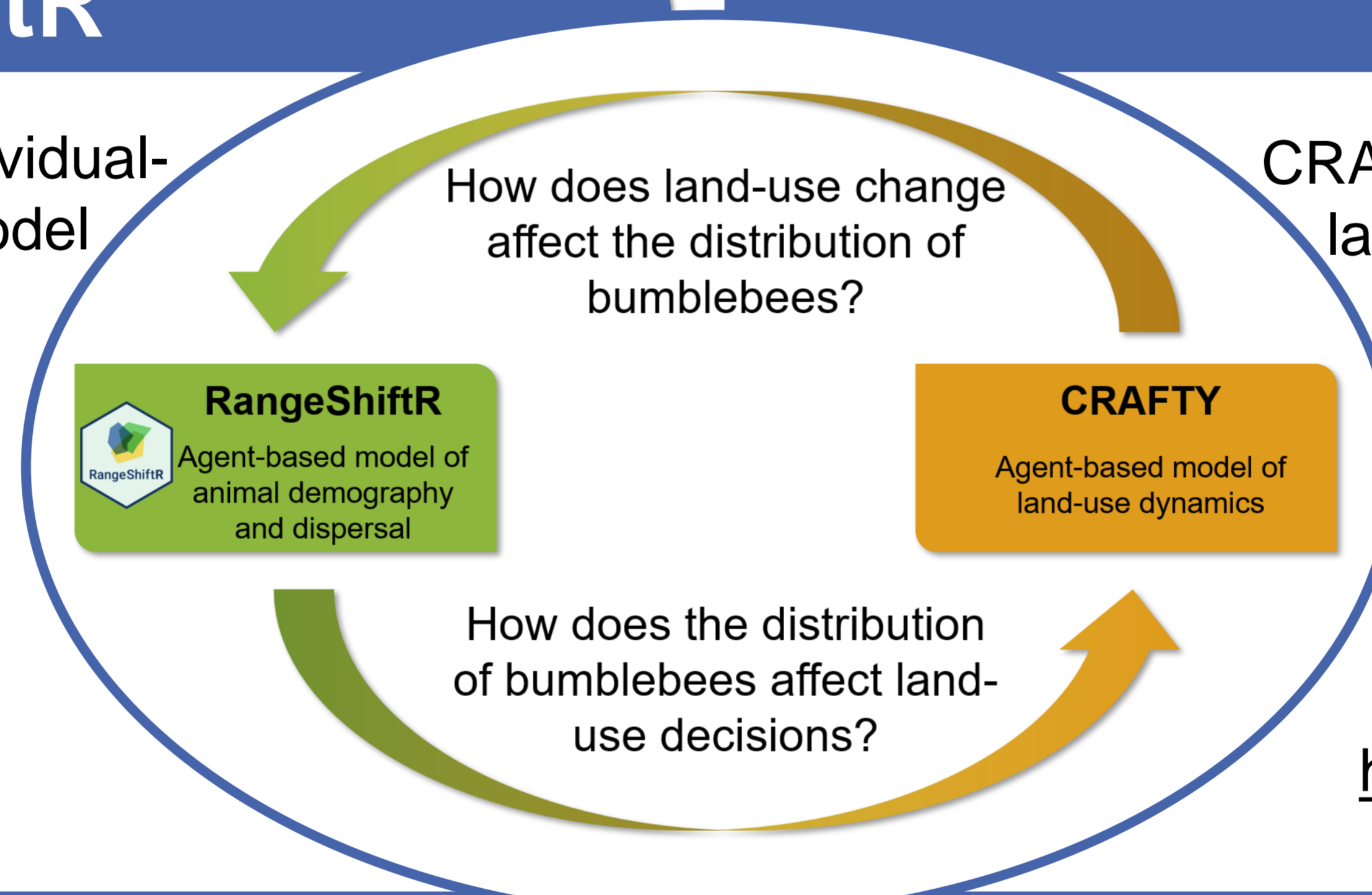**Reinhard Prestele**

Background

- **Bumblebees** substantially contribute to the pollination of food crops and wild plants (global estimated economic value of insect pollination: ~€153bn)
- Agricultural intensification, land-use and climate change threaten bumblebees and their habitat; around half of 68 European bumblebee species are declining; up to 55 species are projected to lose most of their habitat by 2100
- Current modeling approaches almost exclusively rely on statistical approaches that lack a suitable representation of bumblebee habitat and miss key ecological processes (e.g., population dynamics, dispersal)
  - ➢ Land-use impacts on bumblebees may currently be underestimated and conservation strategies may fail to achieve their objectives

RangeShiftR

RangeShiftR is a state-of-the art, individual-based, spatially explicit simulation model of species ecology. It integrates key ecological processes of population dynamics and dispersal behavior of individuals to assess species range dynamics under environmental change.

https://rangeshifter.github.io/

How does land-use change affect the distribution of bumblebees?

RangeShiftR
Agent-based model of animal demography and dispersal

CRAFTY
Agent-based model of land-use dynamics

How does the distribution of bumblebees affect land-use decisions?

CRAFTY

CRAFTY is a state-of-the art, agent-based, large-scale simulation model of land-use change. It simulates land-use change as the result of decision-making by land managers in response to local resource availability, as well as institutional and political boundary conditions.

https://github.com/CRAFTY-ABM

Objectives & Research questions

- Establish an innovative modeling framework, building on the latest knowledge from process-based ecological and land-system modeling, including bi-directional interactions between bumblebees and land-use decisions
- Explore the effects of local-scale land management strategies (e.g., reduced use of pesticides) and European-scale conservation strategies (e.g., subsidies for planting hedgerows, etc.) on bumblebees and pollination service
- Project the future distribution of European bumblebees under different levels of socioeconomic and climatic change using the recent scenario framework of the IPCC

- How does ecologically more detailed modeling affect the projections of future bumblebee distributions?

- How do changes in bumblebee distributions affect crop pollination and what are the consequences for land-use decisions?

- What are suitable policy options to reduce land-use impacts on bumblebees and avoid severe declines in associated pollination service?

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