Concept for a Geospatial Landscape Model to Estimate the Site Specific Forage Supply for Pollinators

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Current challenges of ERA

Current challenges of environmental risk assessment:

- High biodiversity losses
- Massive decline of pollinators and other insects

Pollinators face multiple stressors:

- Food shortage
- Pesticides
- Diseases

Why is the surrounding landscape important?

To protect pollinators, conserve biodiversity of non-target terrestrial plants

Vegetation plays a key role

- Basis of food webs, e.g. providing nectar and pollen
- Providing habitats for animals
- Semi-natural off-crop vegetation elements such as grassy field margins and hedges are crucial for resilience/recovery of populations

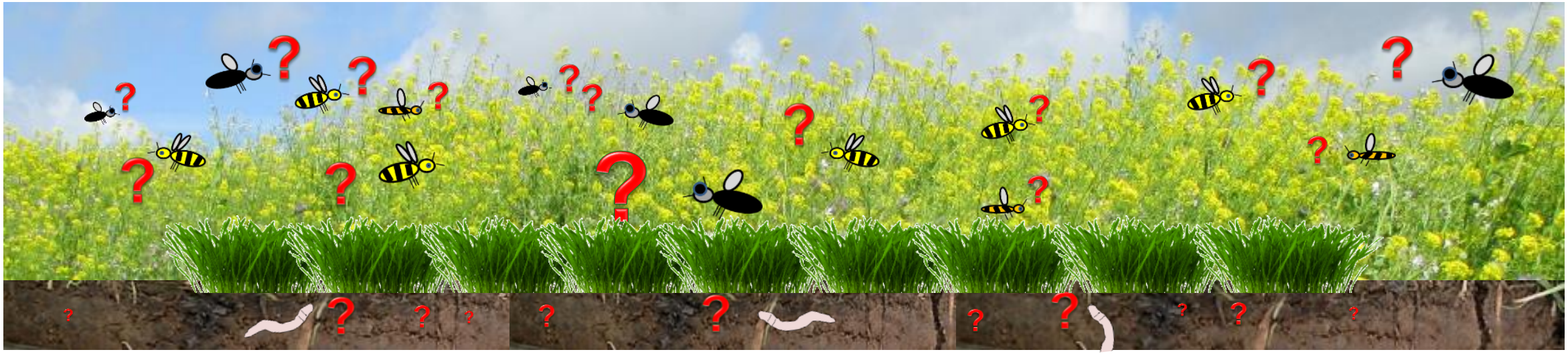


Image: A. Toschki et al. (2018) SETAC Rome

Concept to estimate the site specific forage supply for pollinators

First approach presented here

- Create a map with vegetation units for an existing agricultural landscape
- Estimate the nectar and pollen supply throughout the year

Second, dynamic approach

- Simulate vegetation dynamics using the spatially explicit, process-based GraS-Model

GraS-Model
Hudjetz et al. 2014, Siehoff et al. 2011

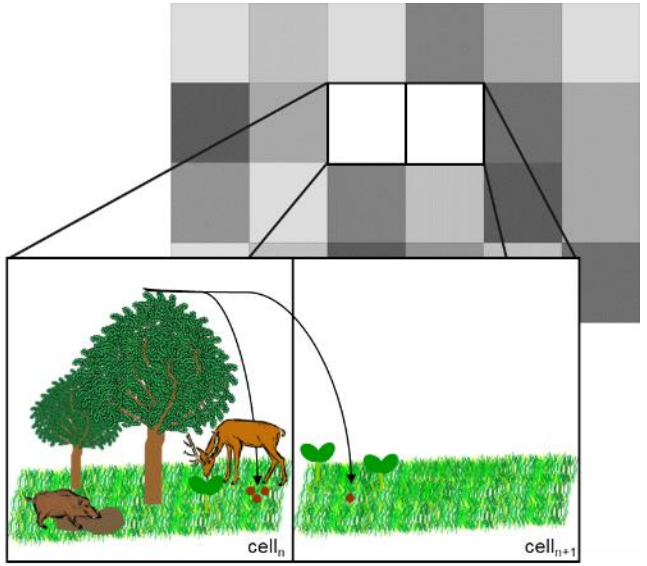


Figure: adapted from Hudjetz S. et al. (2014)

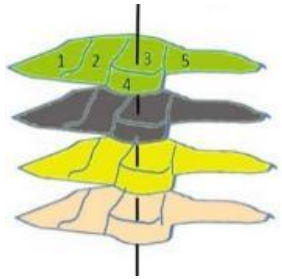
Map with vegetation units

Using available GIS-data

- Create map of a real landscape around a bee hive
- Vegetation units important for pollinators (honey bees)

GIS-database
(cadastral data, agricultulture, etc.)

GIS data analyses



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Map with vegetation units

Bee hive
(near Wolfsburg, Germany)

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Nectar and pollen availability

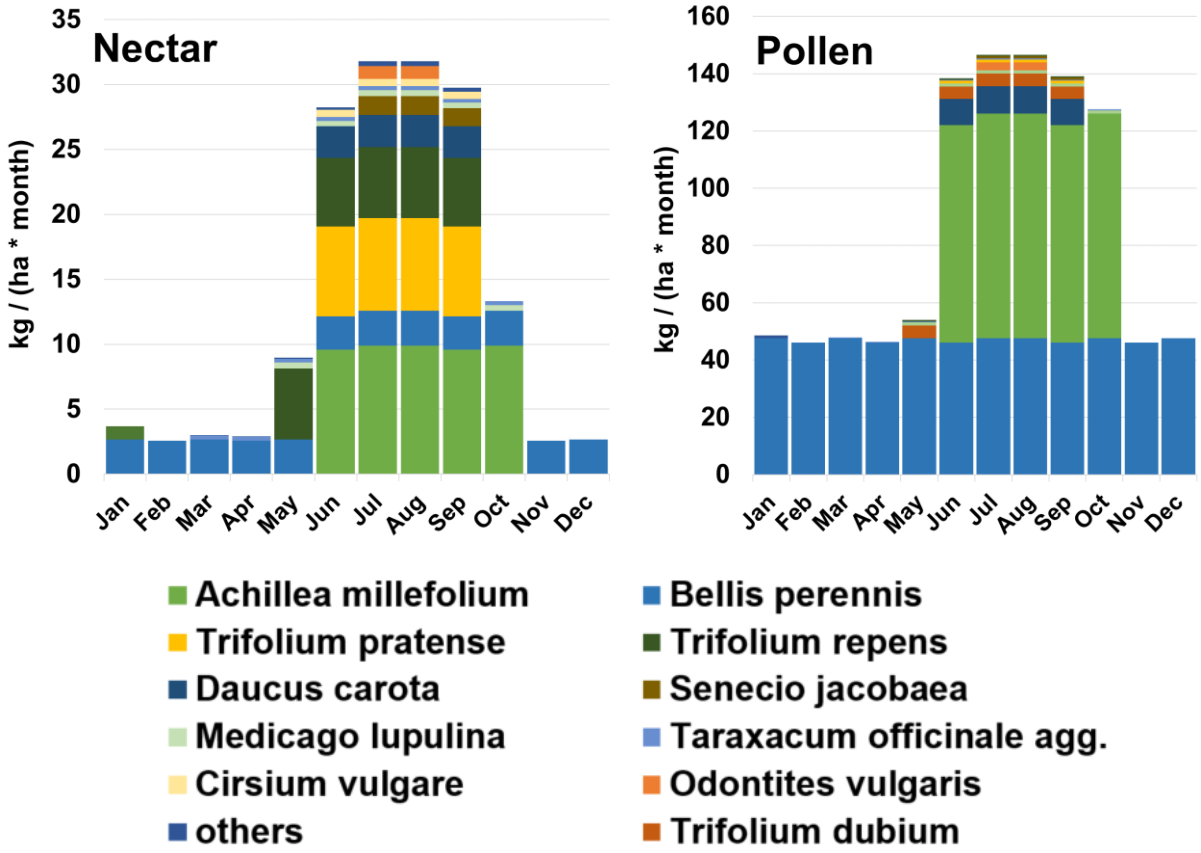
Literature survey

- Phytosociological data (off-crop)
- Plant species data (e.g. flowering time, amount of nectar and pollen)

phytosociological data
plant species data

- species abundance in vegetation units
- off-crop vs in-crop
- flowering time
- nectar and pollen supply

E.g. *Lolio-Cynosuretum* (grassland)



Forage supply as input for BEEHAVE

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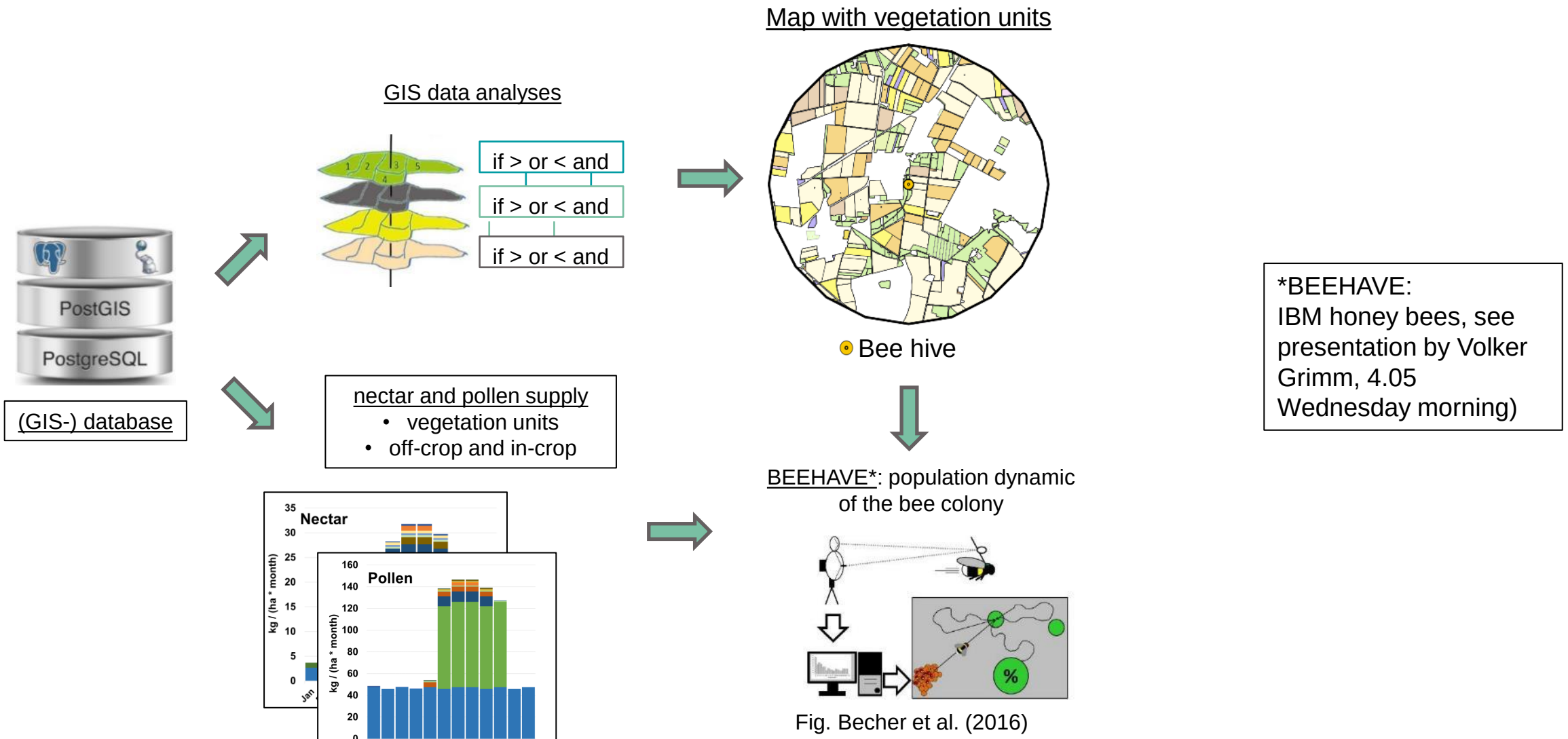


*BEEHAVE:
IBM honey bees, see presentation by Volker Grimm, 4.05 Wednesday morning)

Fig. Becher et al. (2016)

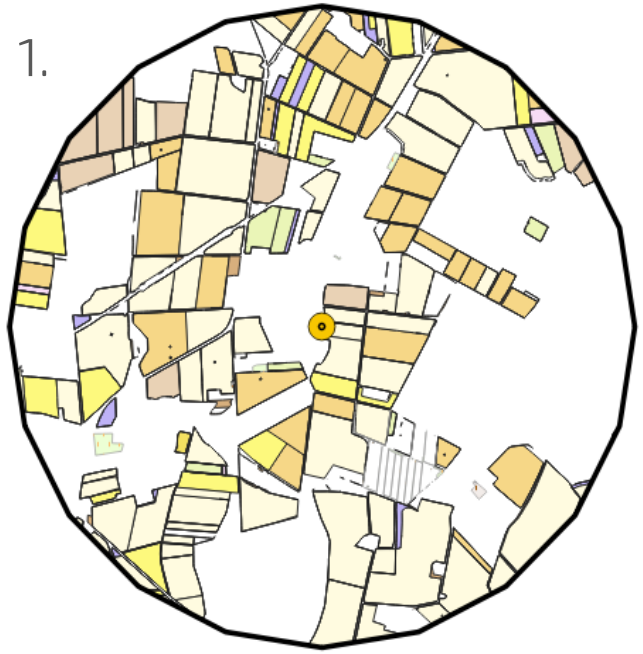
BEEHAVE Simulations

Simulations for two landscape scenarios

1. Arable crops (only in-crop)

2. Arable crops + grassland (in-crop + one semi-natural off-crop vegetation type)

1.



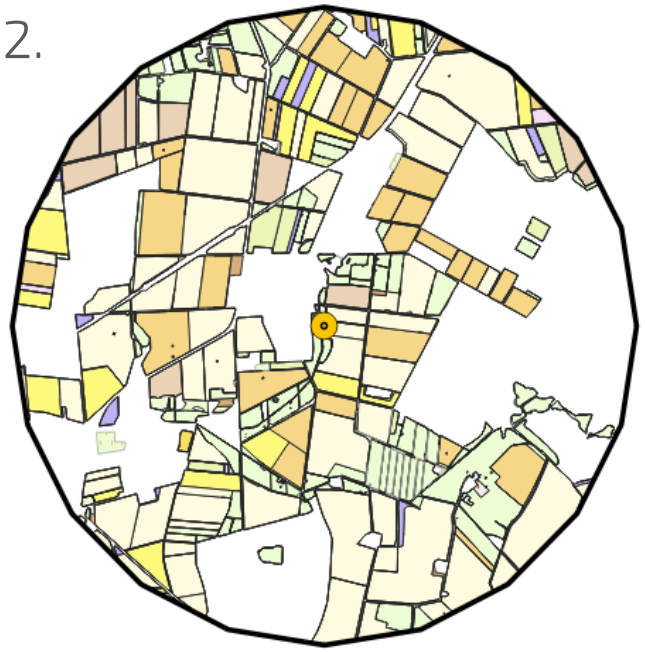
Arable crops in the area relevant for the bees:

- Rapeseed
- Clover or lupins
- Maize
- Sunflowers

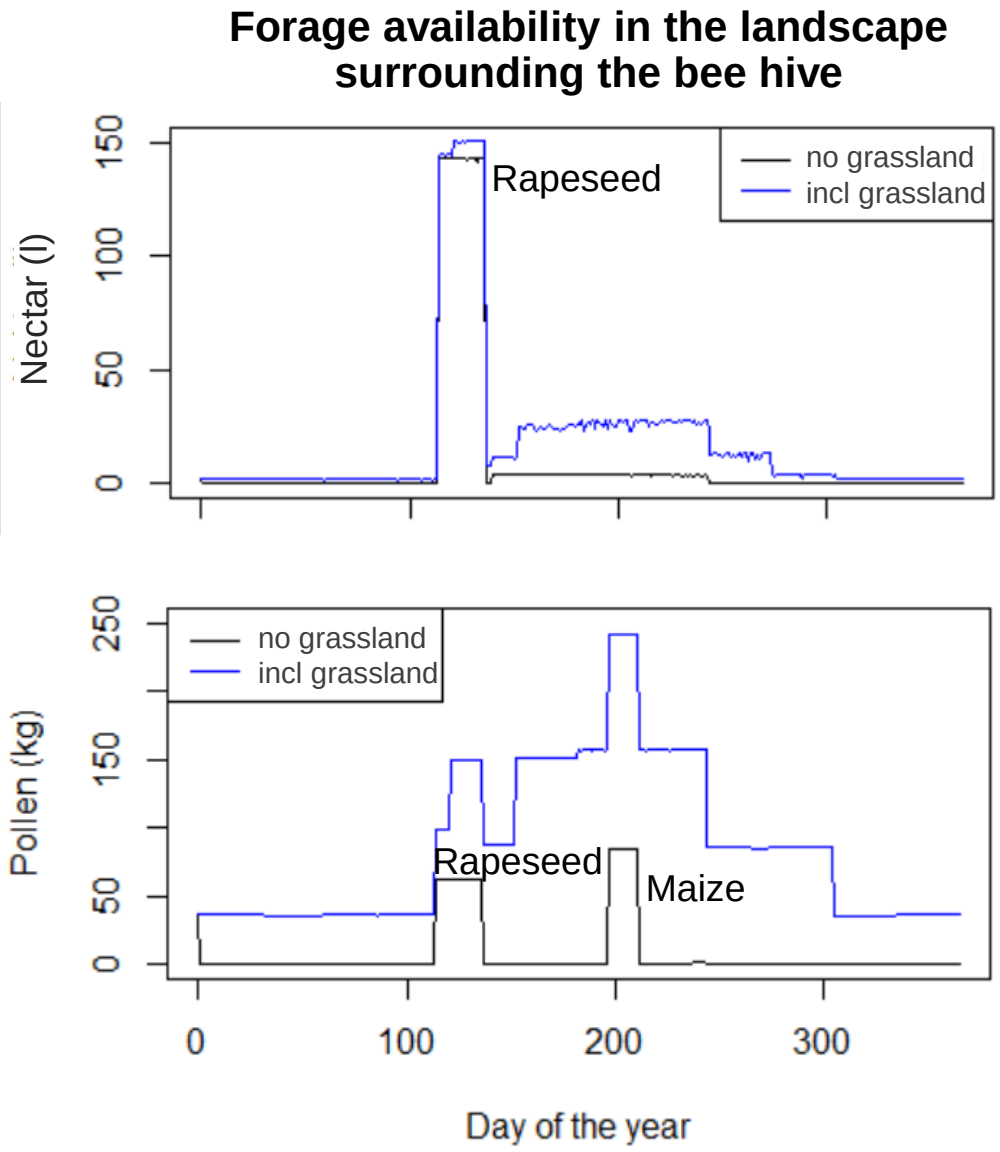
Semi-natural vegetation:

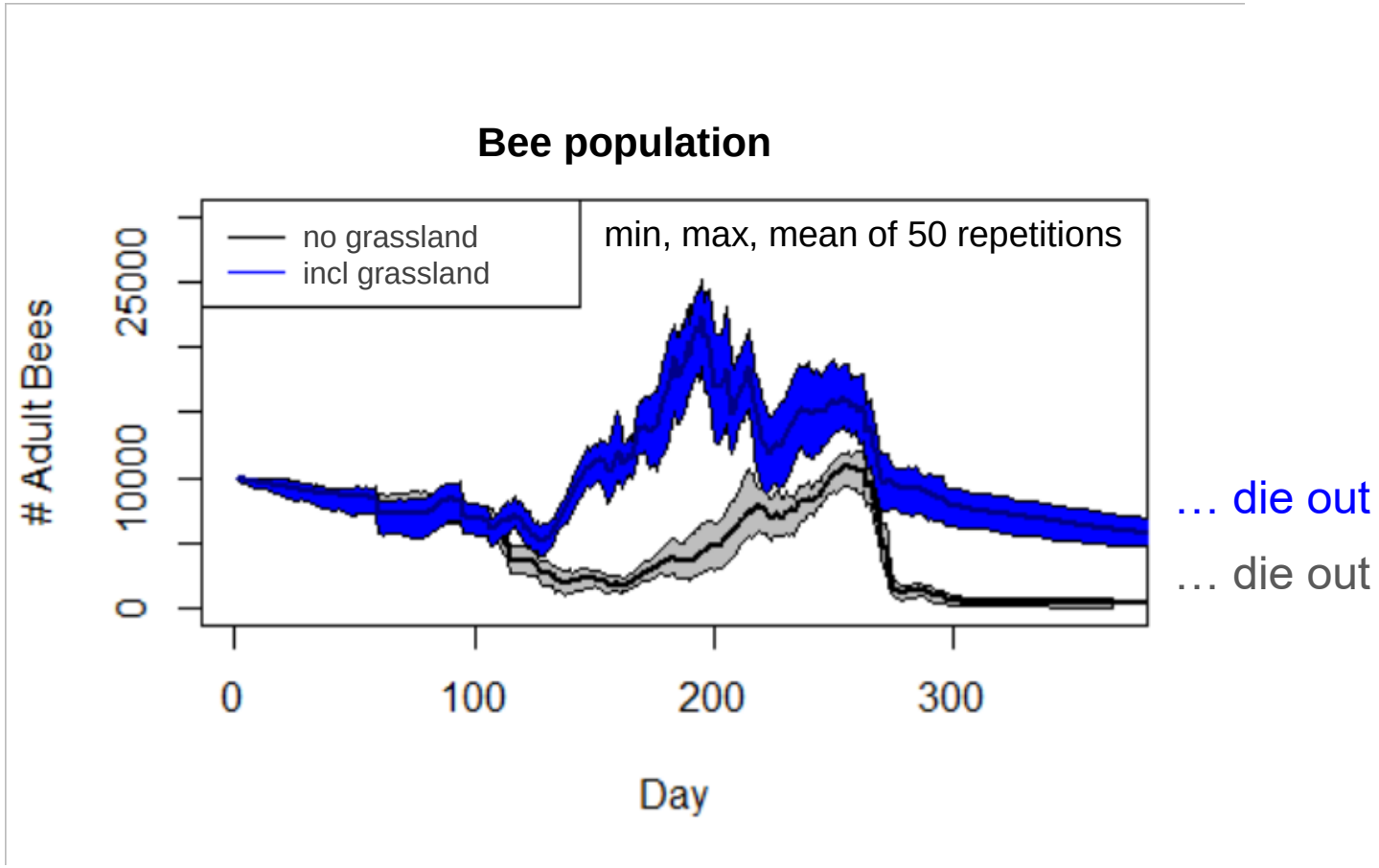
- Grassland (10%)

2.



BEEHAVE Simulation Results





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… die out

Outlook

VIBEE-PROJECT.NET
ETABLIERUNG DIGITALER INDIKATOREN DER BIENENVITALITÄT IN AGRARLANDSCHAFTEN

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Further semi-natural off-crop vegetation types missing to ensure survival of bee population.

Vegetation types that will be included:

- grassy field margins, hedges, water/forest edges

Validation data are collected over the whole season

- counting of a colony's flight activity using electronic bee counters (BeeCheck)
- the weight of the beehives (5 minutes resolution)
- weekly analyses of the pollen collected by the bees
- field data of surrounding vegetation including flowering plants

The presented modelling approach can be adjusted for other pollinators and other landscapes.

Semi-natural vegetation dynamics can be modelled using the process-based GraS-Model.

Goal: assess the landscape and develop a minimum quality standard for pollinators.

Conclusion

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Concept development

- estimation of forage supply for a real agricultural landscape possible
- relative importance of different vegetation units in space and time, no exact prediction of nectar/pollen supply

First time, that real landscape data including data-based semi-natural off-crop vegetation was used as input for BEEHAVE

- earlier BEEHAVE simulations focused on in-crop forage supply, assumptions for off-crop
- first landscape data-based evidence to support these assumptions

The surrounding semi-natural off-crop vegetation is important to explain population dynamics.

Change our perspective

- from single species – single stressor
- to a landscape perspective with biocoenoses and multiple stressors

Thank you!

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