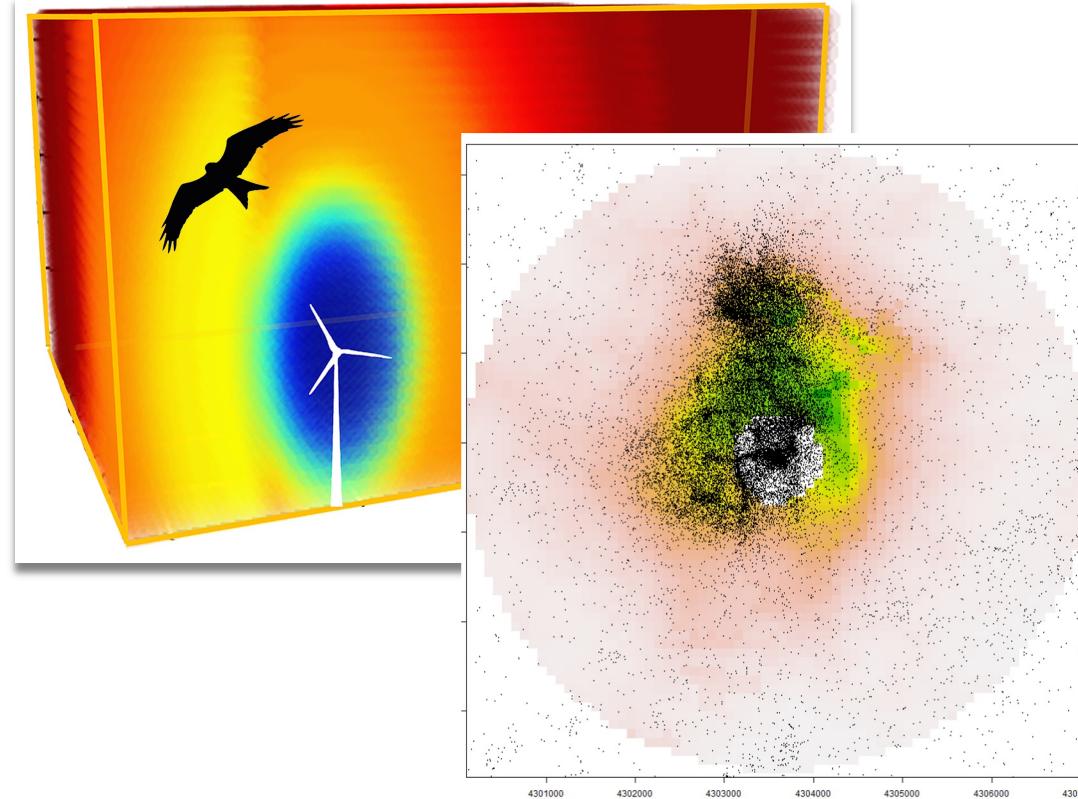


Habitat modelling for red kites in the context of the hybrid model

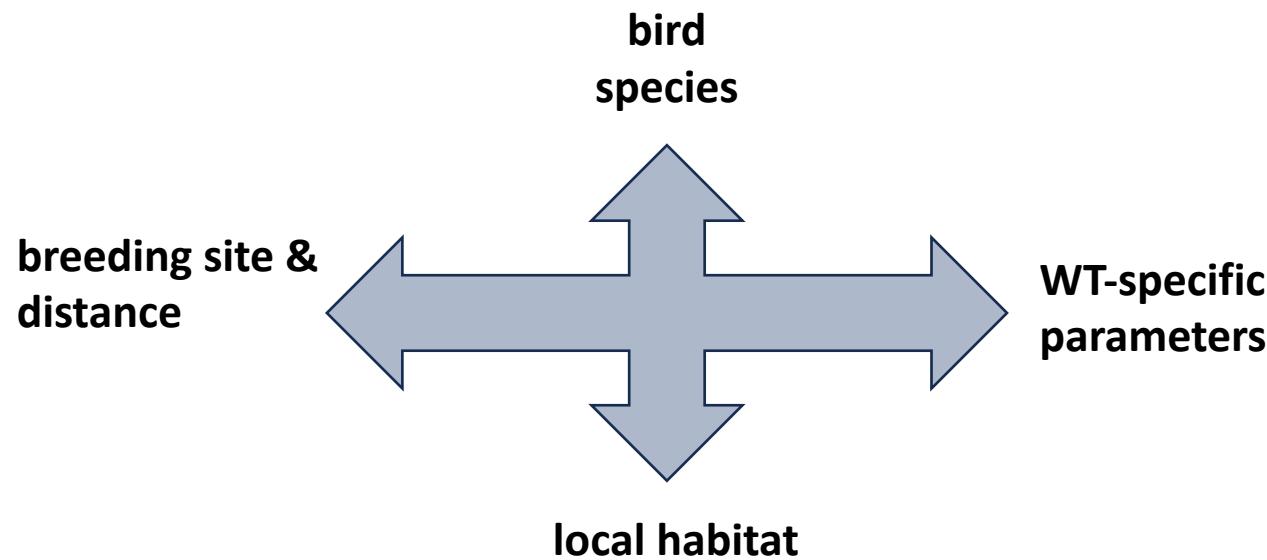
Moritz Mercker

in collaboration with

Bionum & BioConsult SH & TB Raab



- Amendment of the Federal Nature Conservation Act (July 2022): By summer 2023, proposal for the **introduction of a probabilistic method for the mathematical calculation of collision probability**
- Hessian Ministry of the Environment commissions Bionum / Bioconsult SH with a pilot study
- Intensive monitoring (KNE):
- "Probabilistic sub-working group" (UAG-2)
- "Project Accompanying Working Group"



Is the risk of bird strikes calculable?
If so, with what certainty?

*comprehensive data
base*

components of the hybrid-model

statistical evakuation

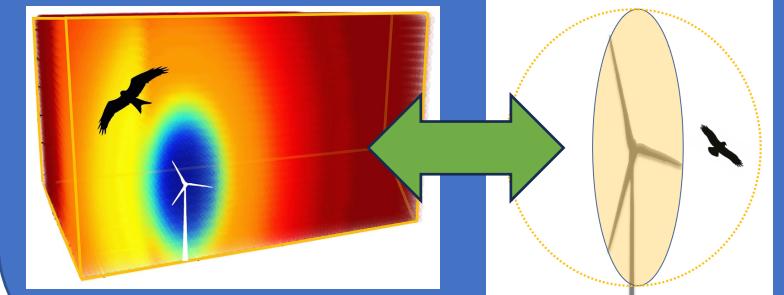
prediction model

habitat selection

hybrid-model

3D flight
distribution

collision risk
model



flight height

flying vs. resting

flight speed

application hybrid-model

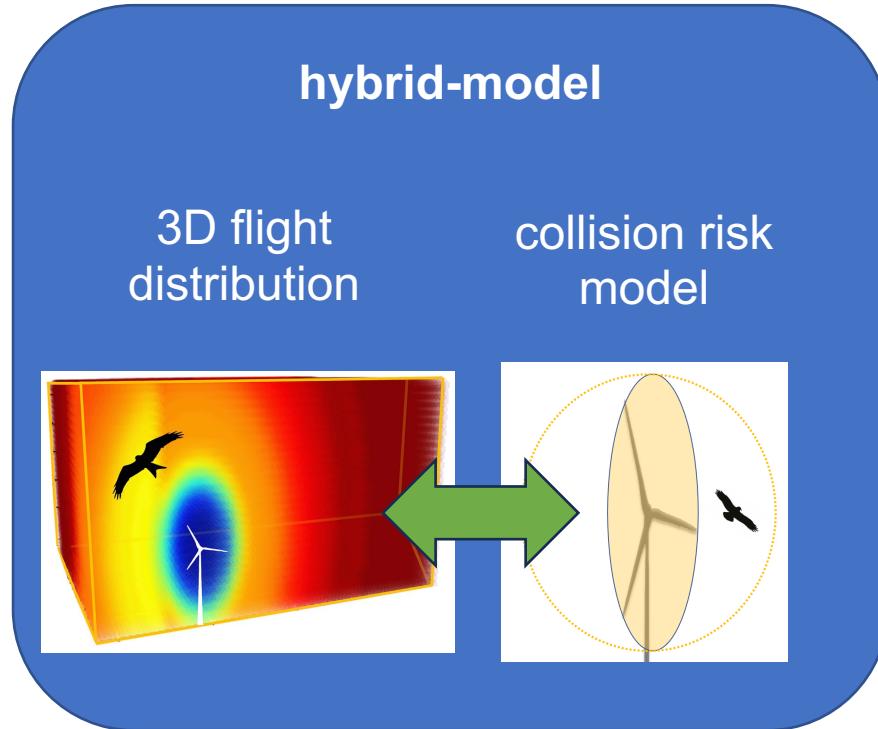
input data

breeding site
coordinates

habitat information

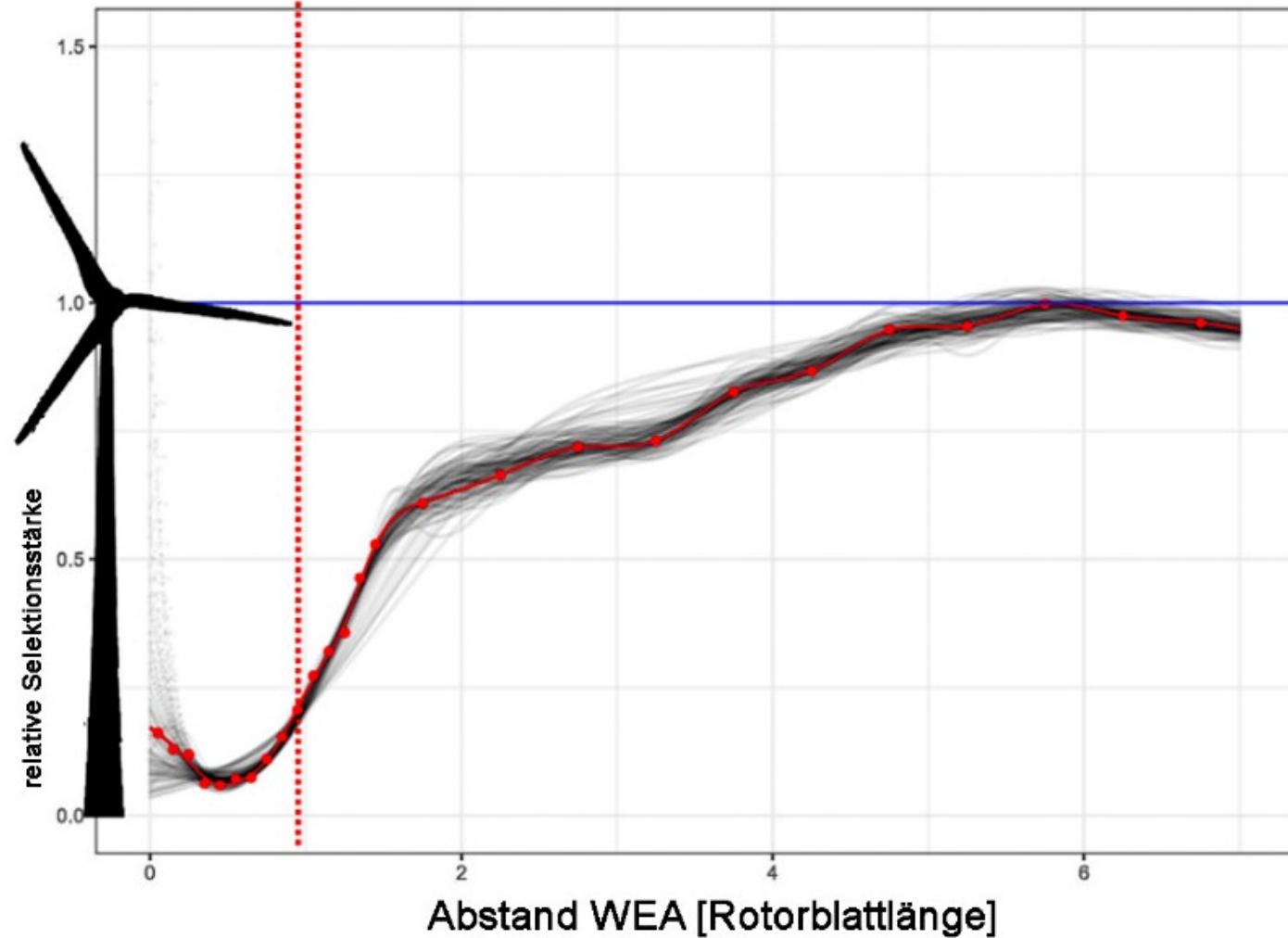
wind turbine data

calculation rule

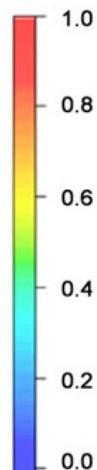
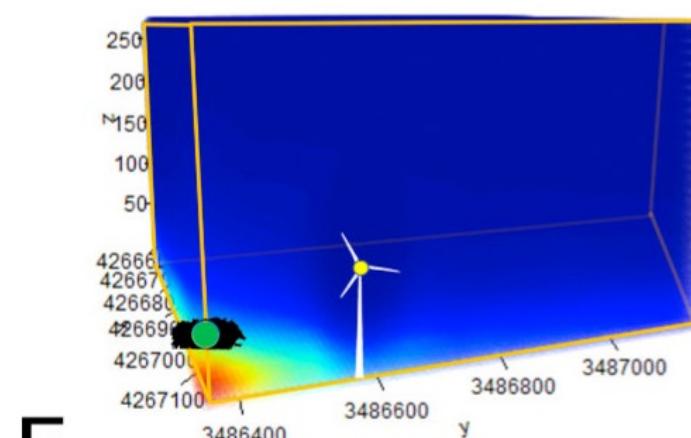
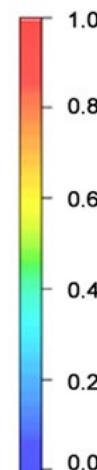
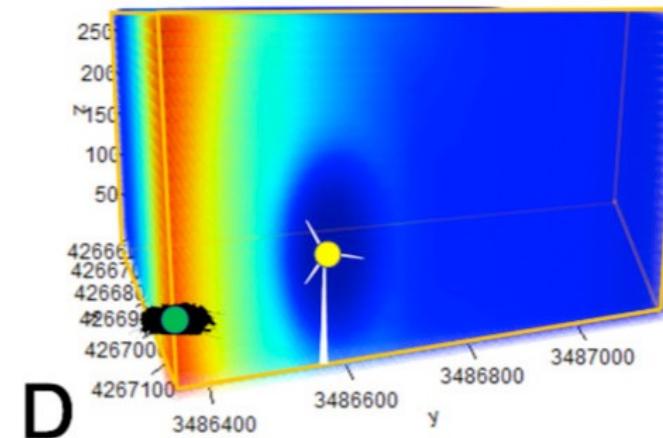
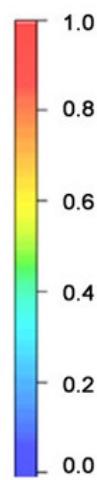
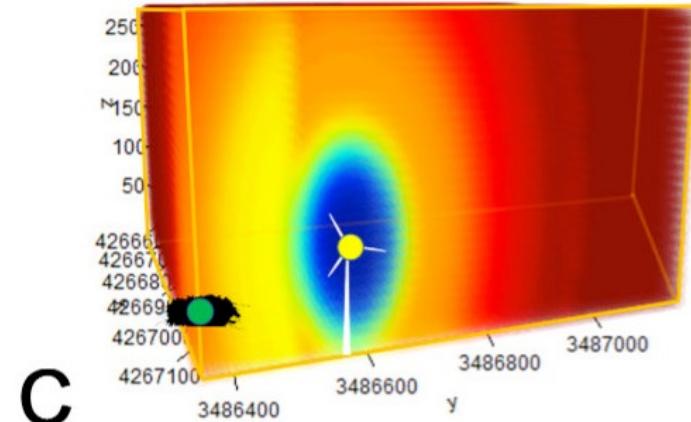
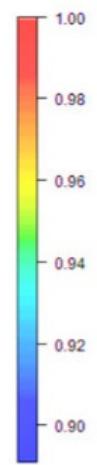
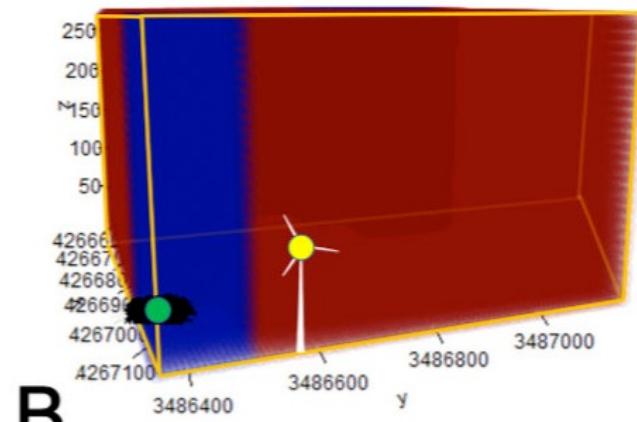


assessing the risk

comparios with
threshold model

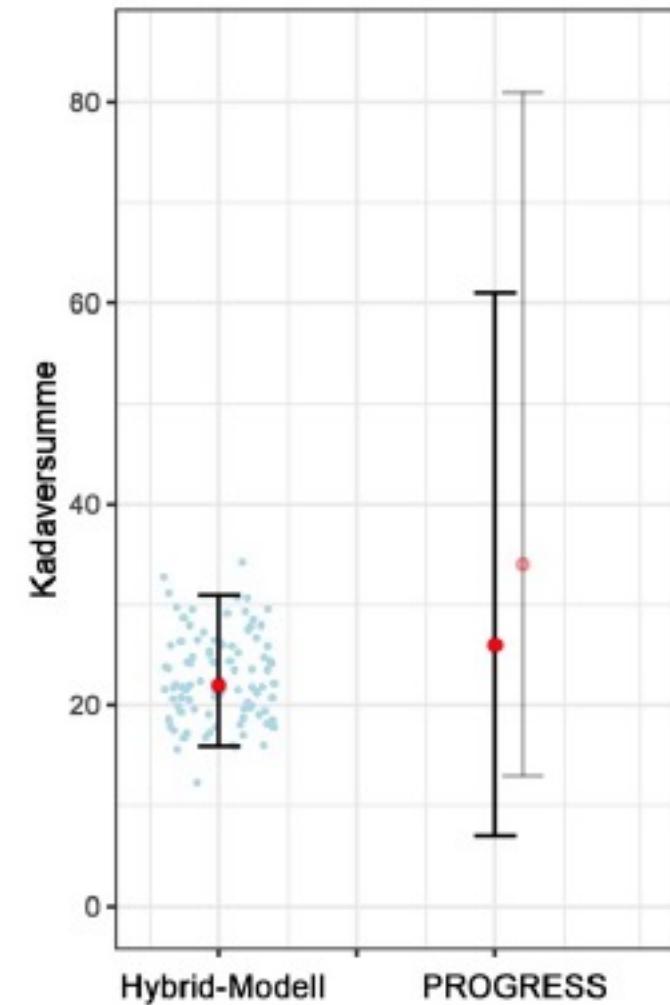
**3D-Meso-avoidance**

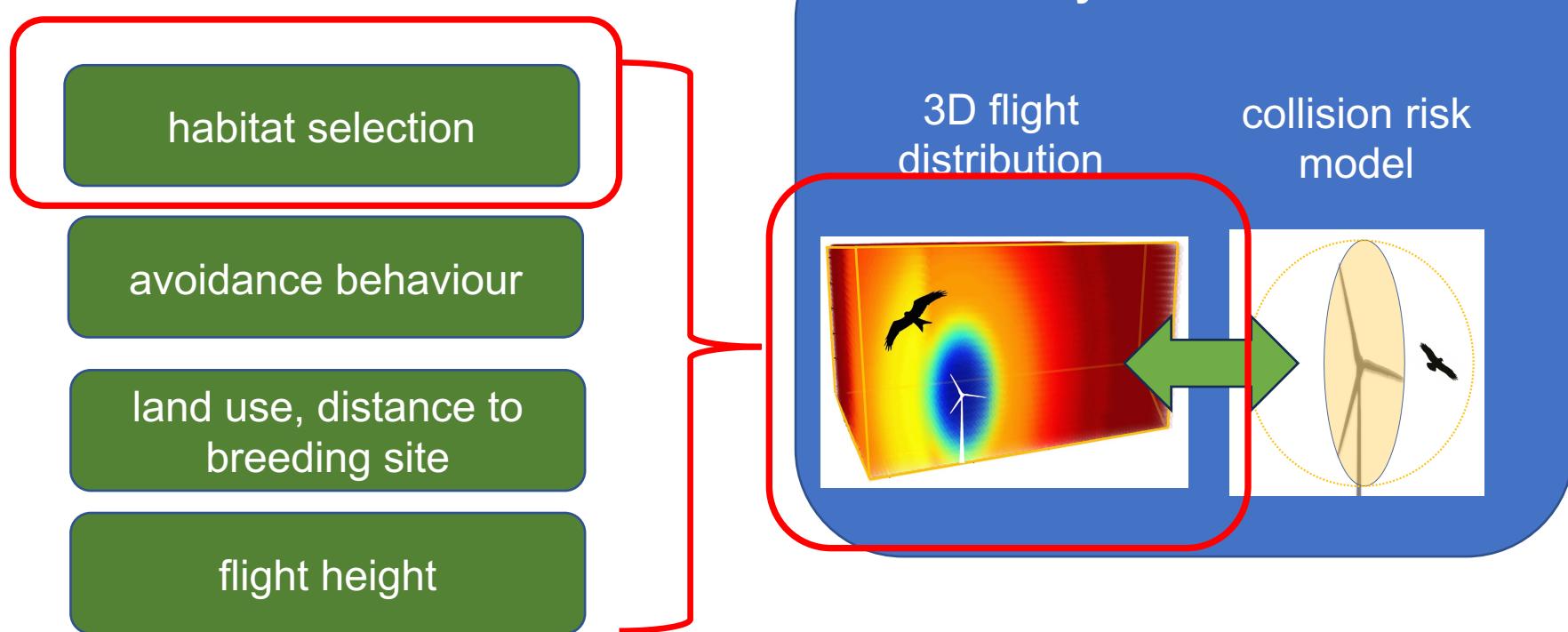
~ 86 %



model validation

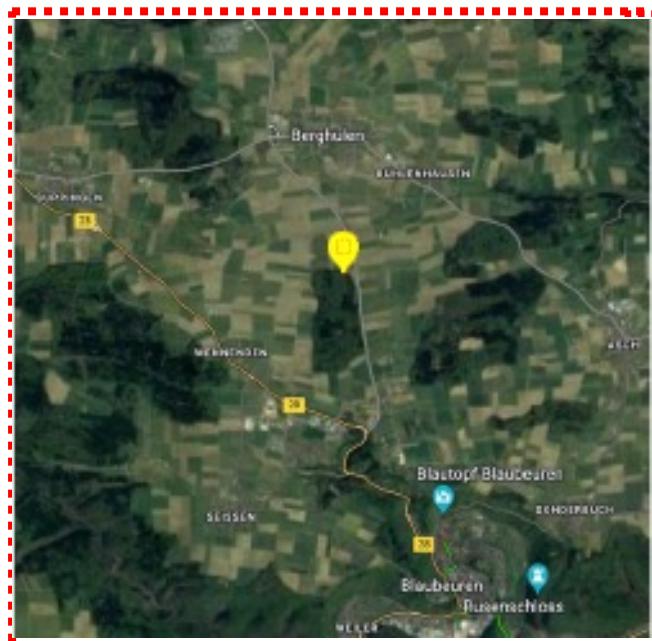
- Reichenbach et al (2023)
- Grünkorn et al (2016)/PROGRESS
- Bellebaum et al (2013)





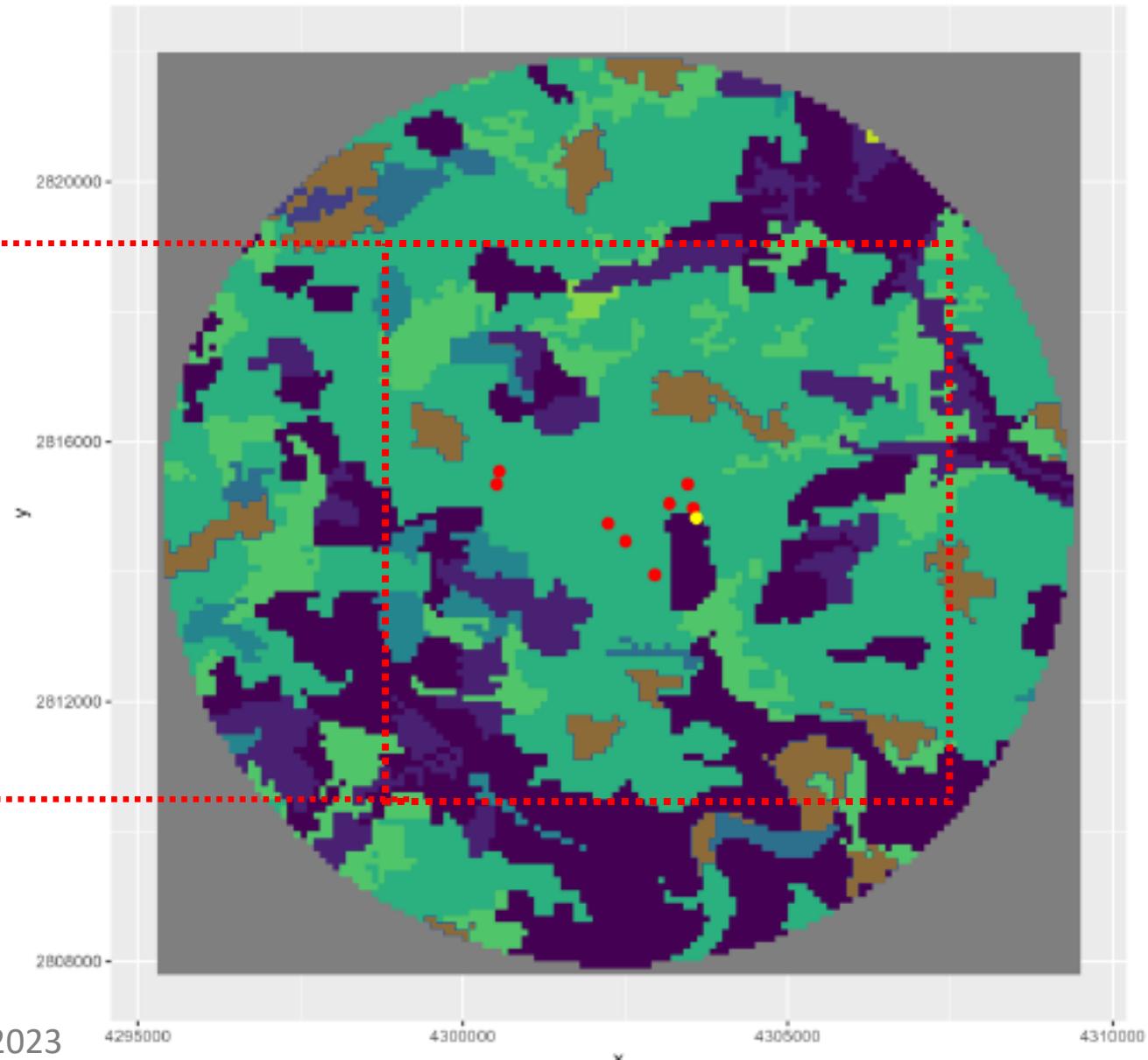
A priori given: „Athos“

284.1967 GPS-fixes (2020-2022)



(c) Google maps

yellow point: breeding site
red points: wind turbines

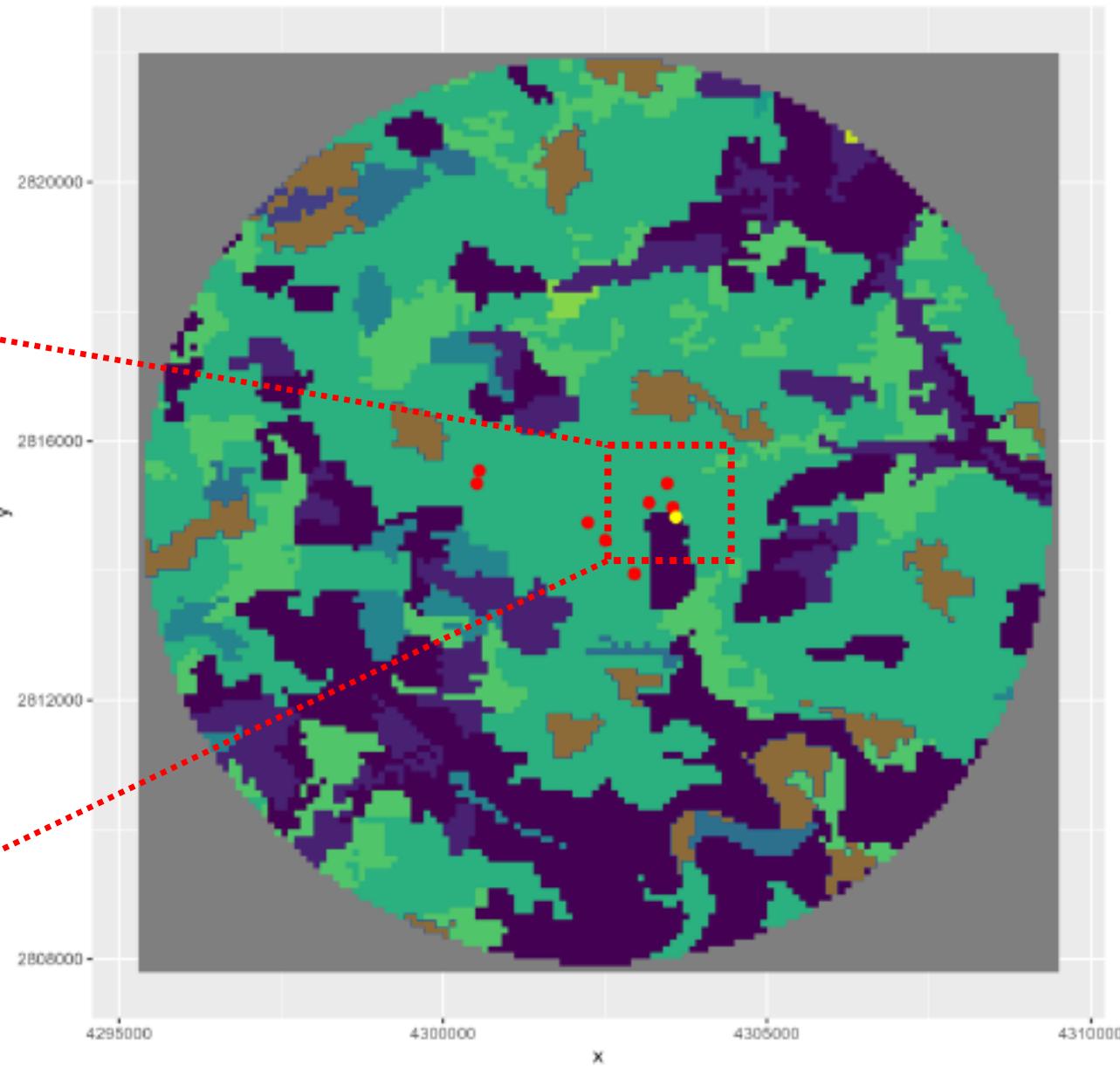


closest distance breeding site –
WT: 160 m



(c) Google maps

yellow point: breeding site
red points: wind turbines

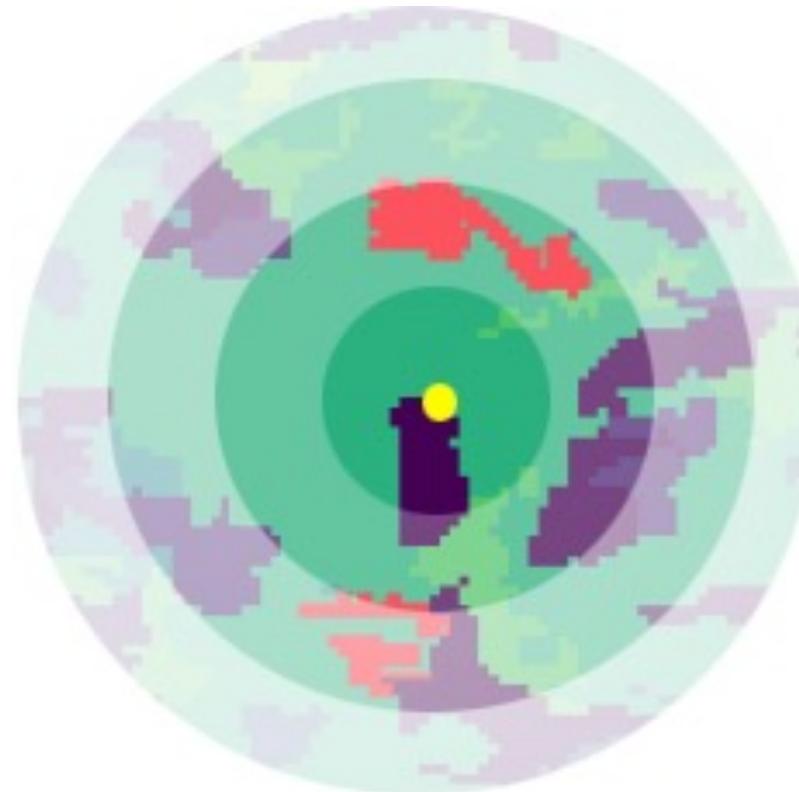
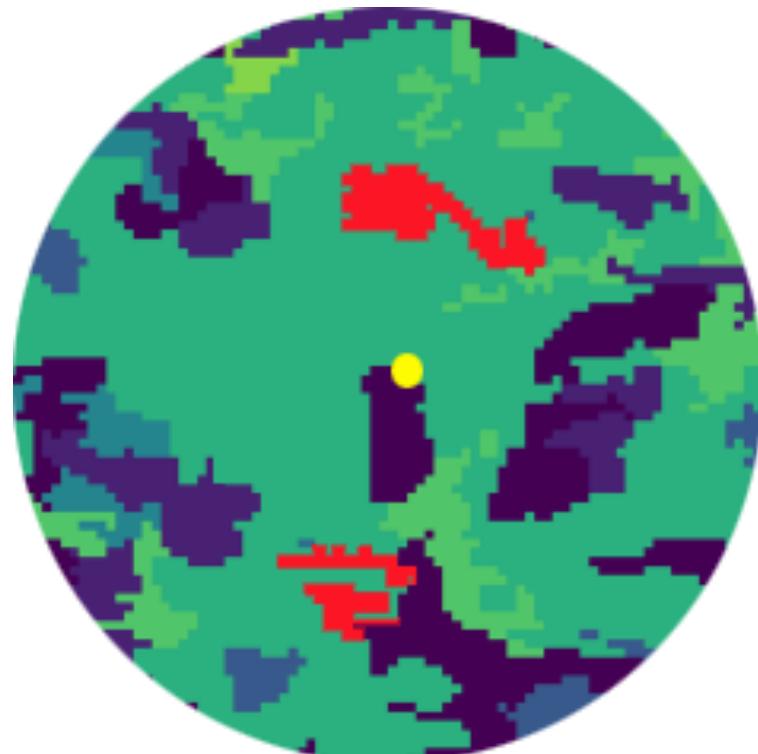


Does the hybrid model give a realistic estimate of habitat use?

- Extensions compared to previous approaches:
 - Strictly empirically based estimation of habitat effects
 - Estimation of the associated uncertainties
 - Consideration not only of the habitat itself, but also of variables dependent on it (e.g. distance to the habitat)

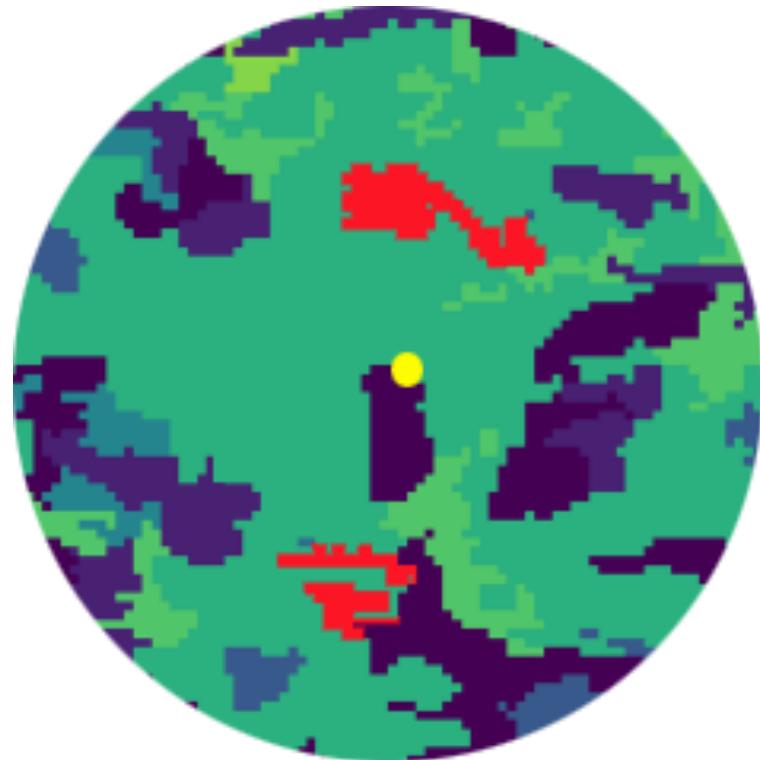
- Consider not only the habitat itself, but also variables dependent on it (e.g. distance to the habitat and/or barrier effects).

previous approaches

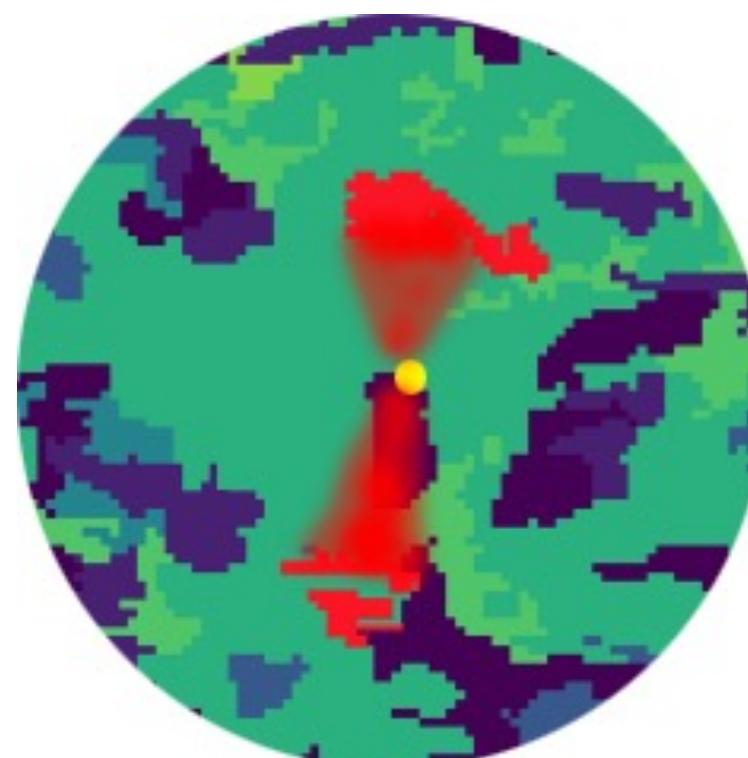
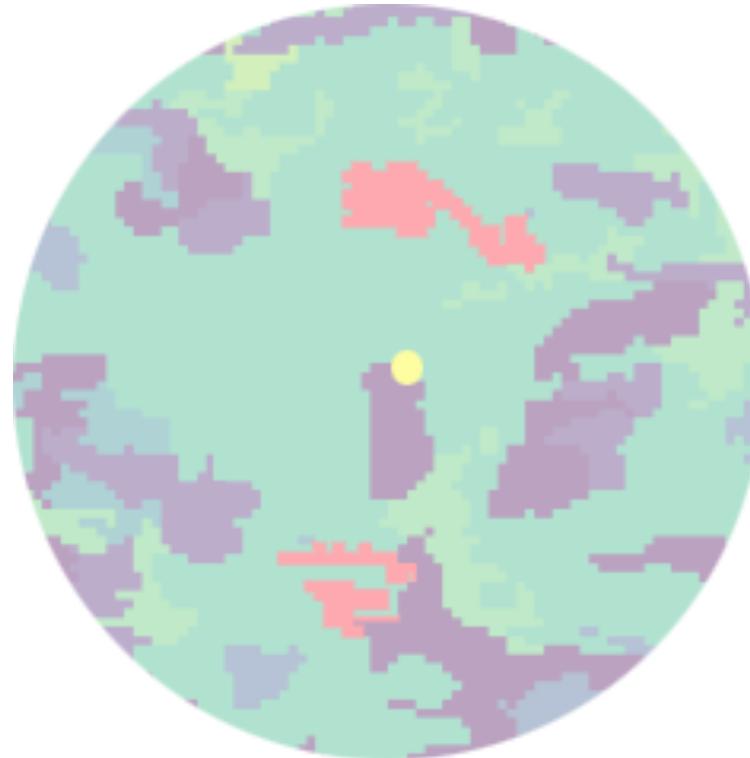


- Consider not only the habitat itself, but also variables dependent on it (e.g. distance to the habitat and/or barrier effects).

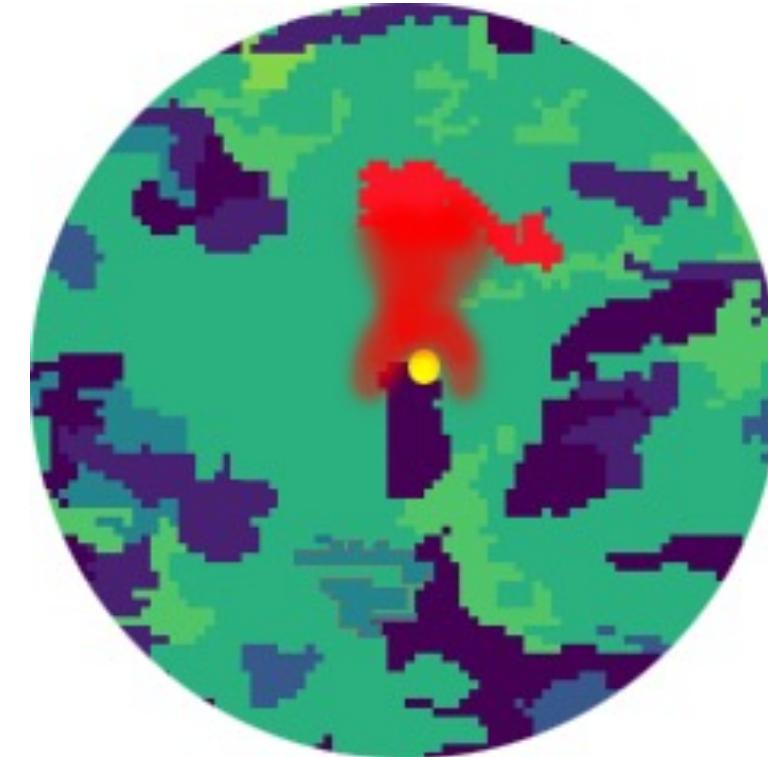
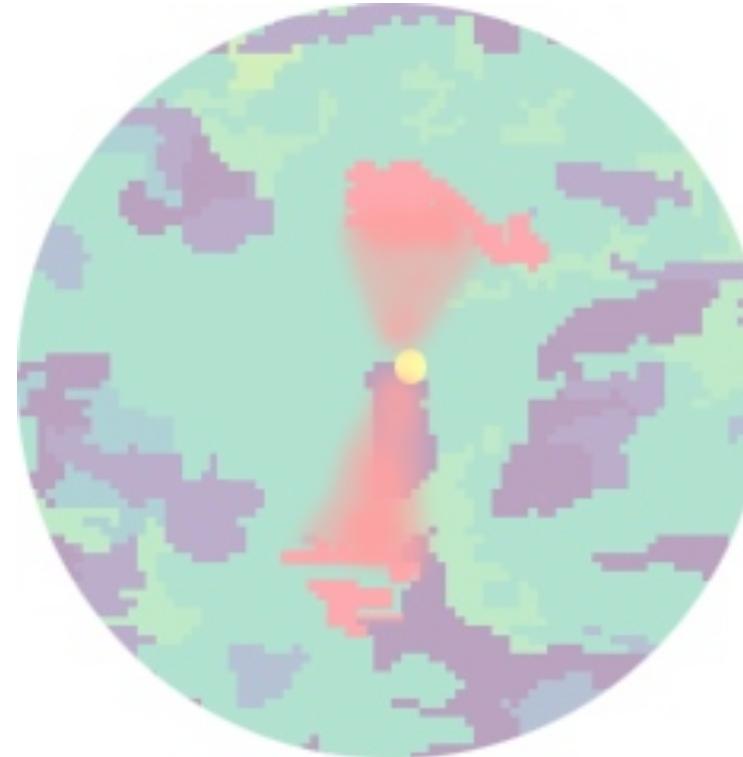
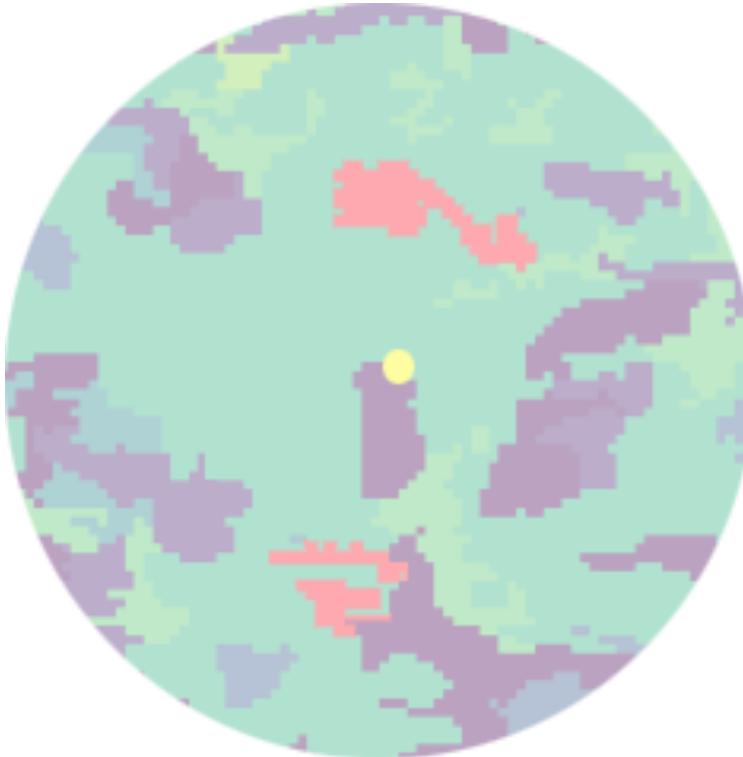
previous approaches



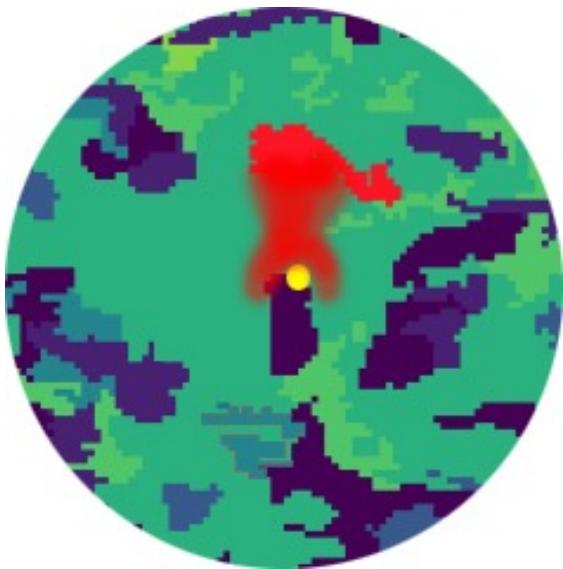
- Consider not only the habitat itself, but also variables dependent on it (e.g. distance to the habitat and/or barrier effects).



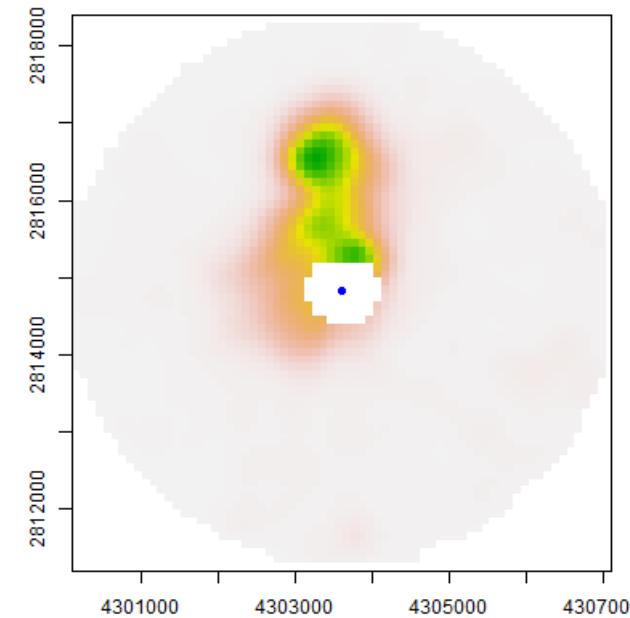
- Consider not only the habitat itself, but also variables dependent on it (e.g. distance to the habitat and/or barrier effects).



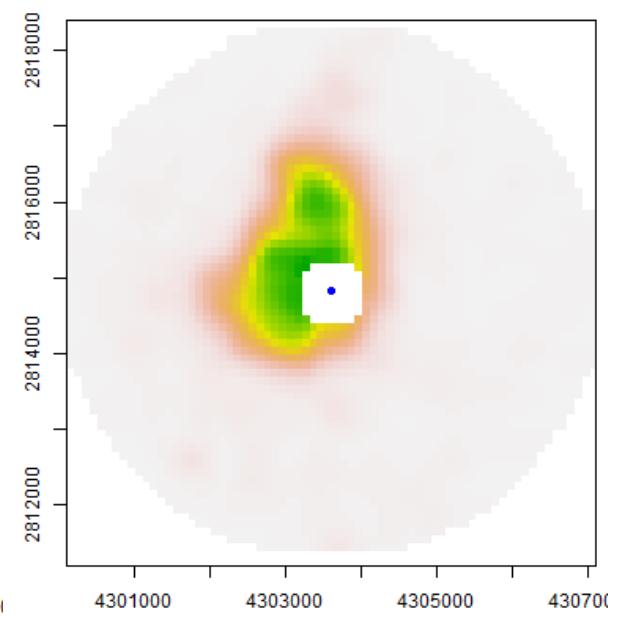
- Consider not only the habitat itself, but also variables dependent on it (e.g. distance to the habitat and/or barrier effects).



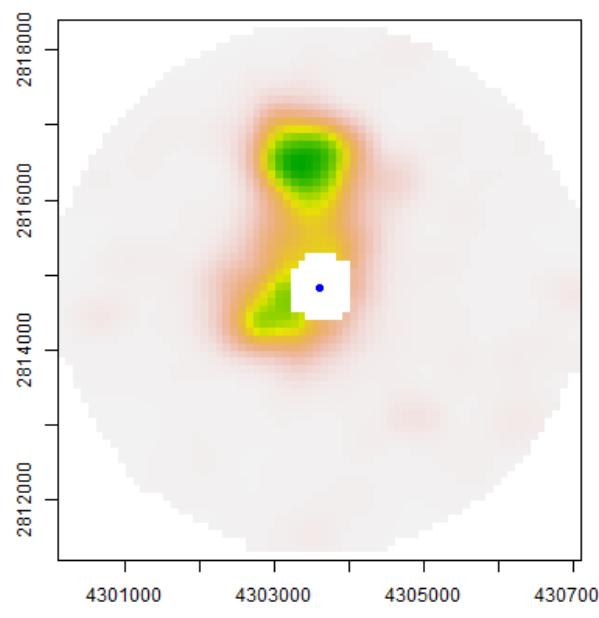
Athos GPS 2020

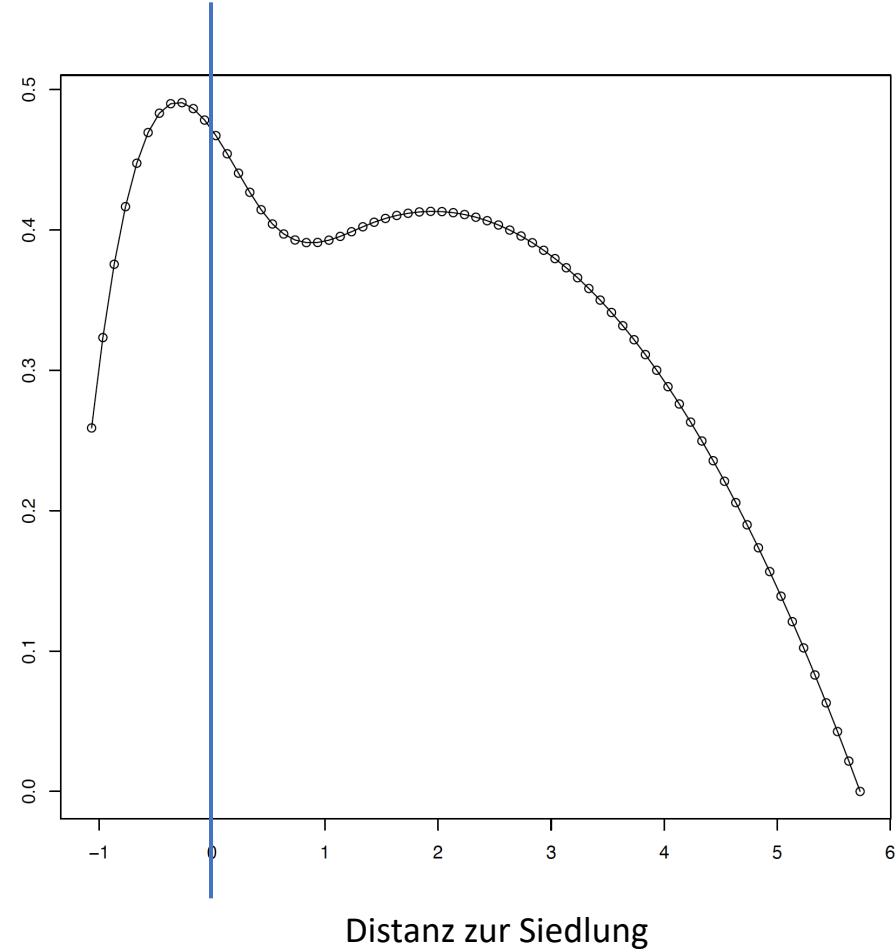


Athos GPS 2021



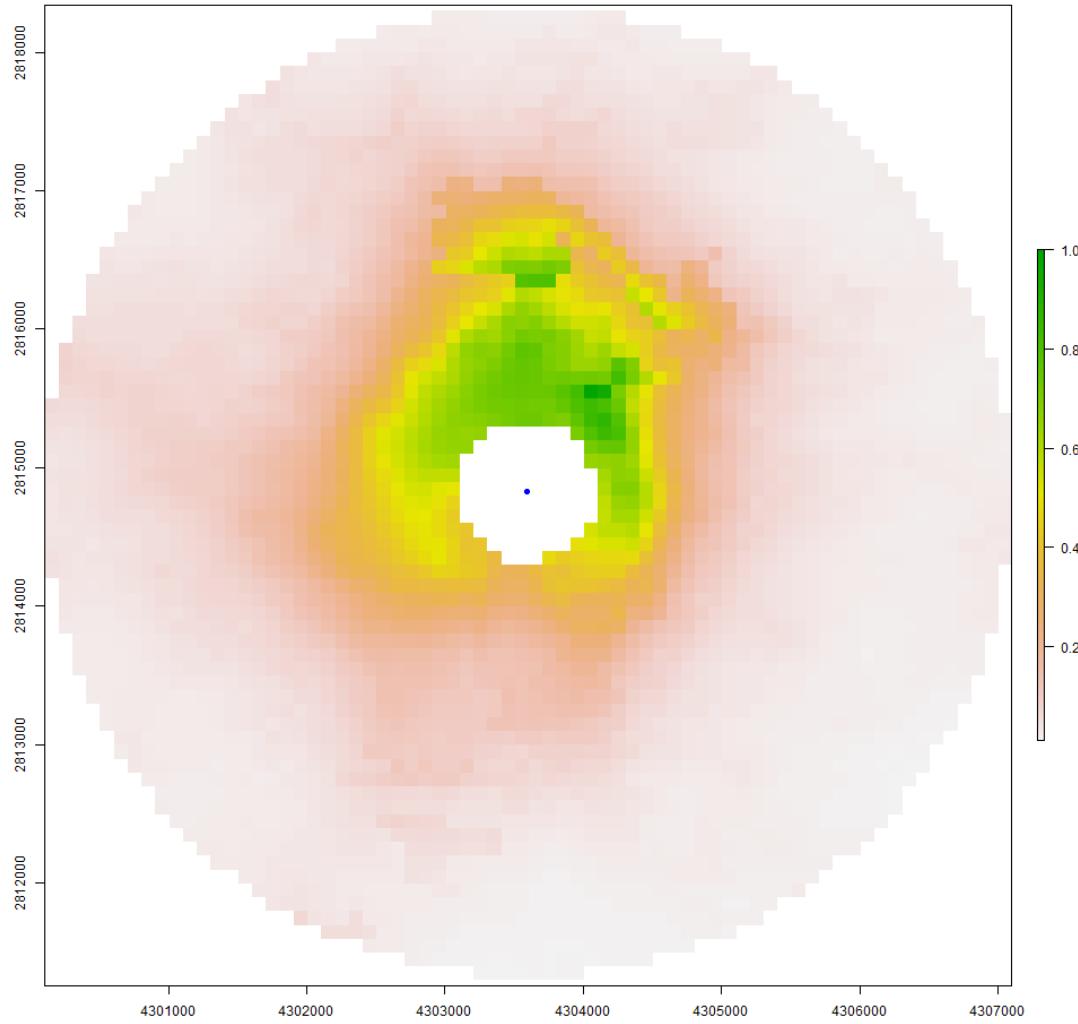
Athos GPS 2022



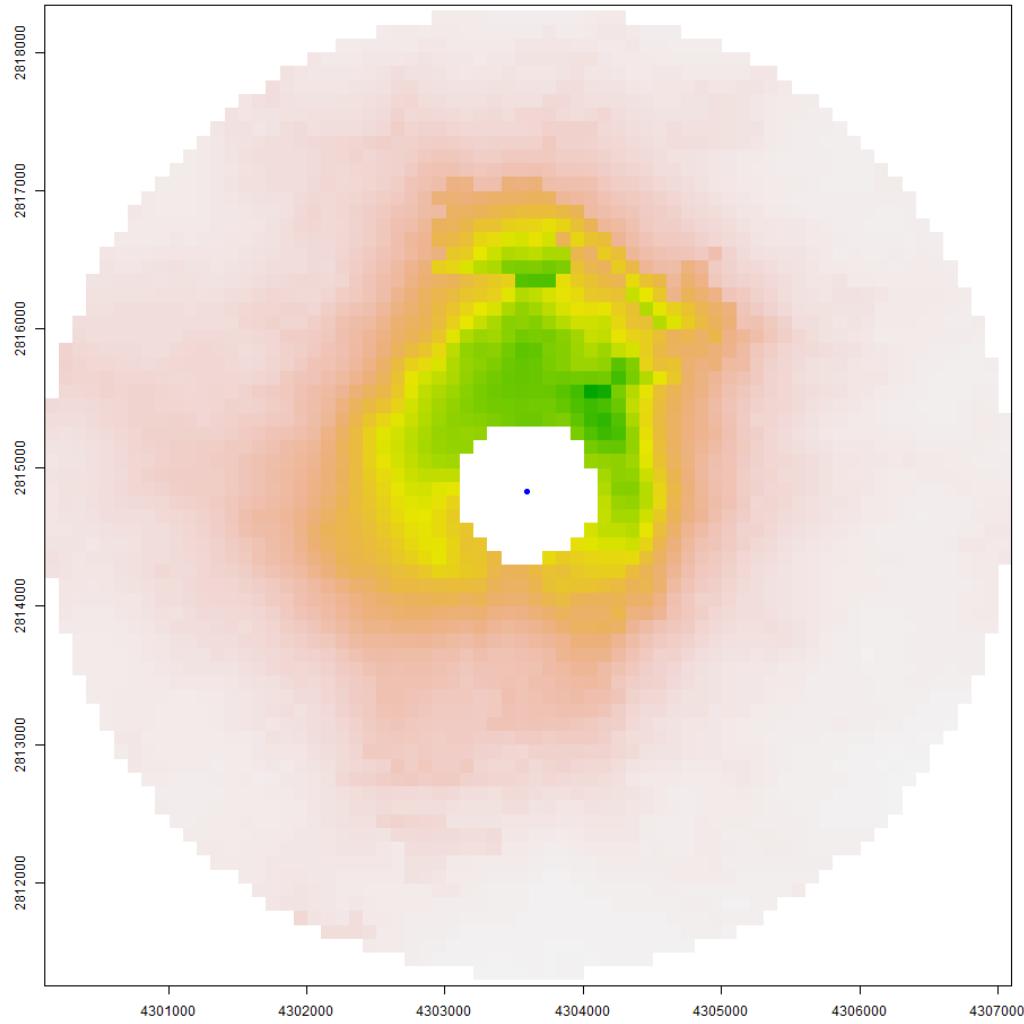


Recent model improvements:

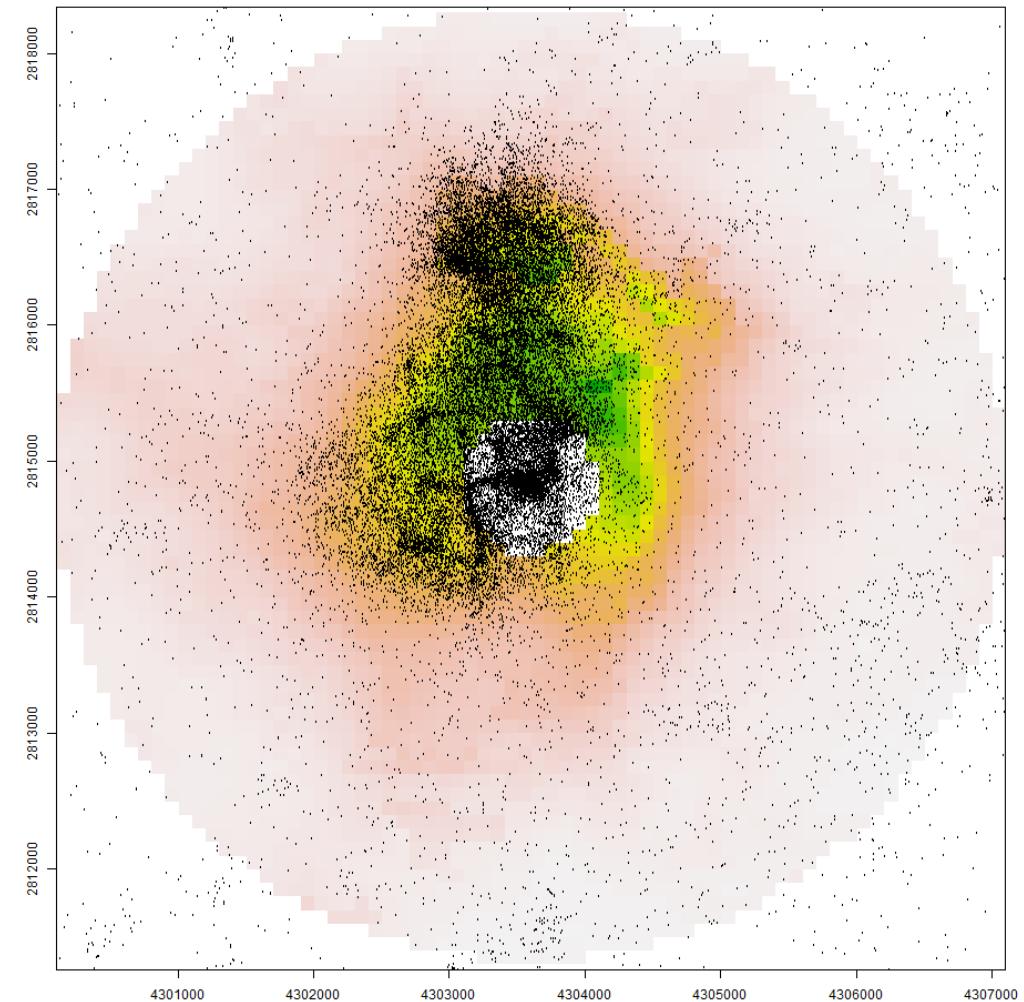
- Separated by gender (cf. Mammen et al 2023)
- Barrier effects forest & settlement
- Non-linear correlations (splines)

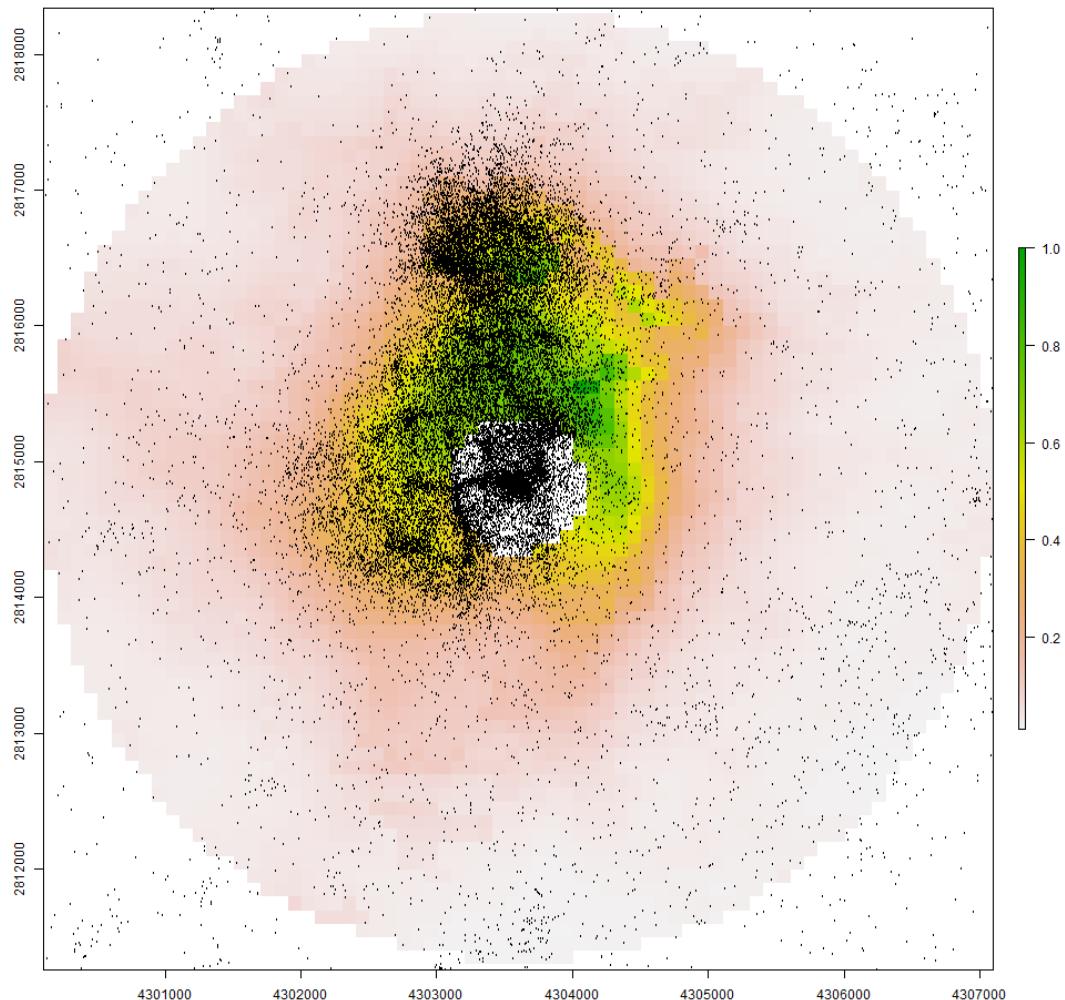


- Hybrid model fit without Athos data
- 500 m around the breeding site removed for display reasons (very strong concentration there)

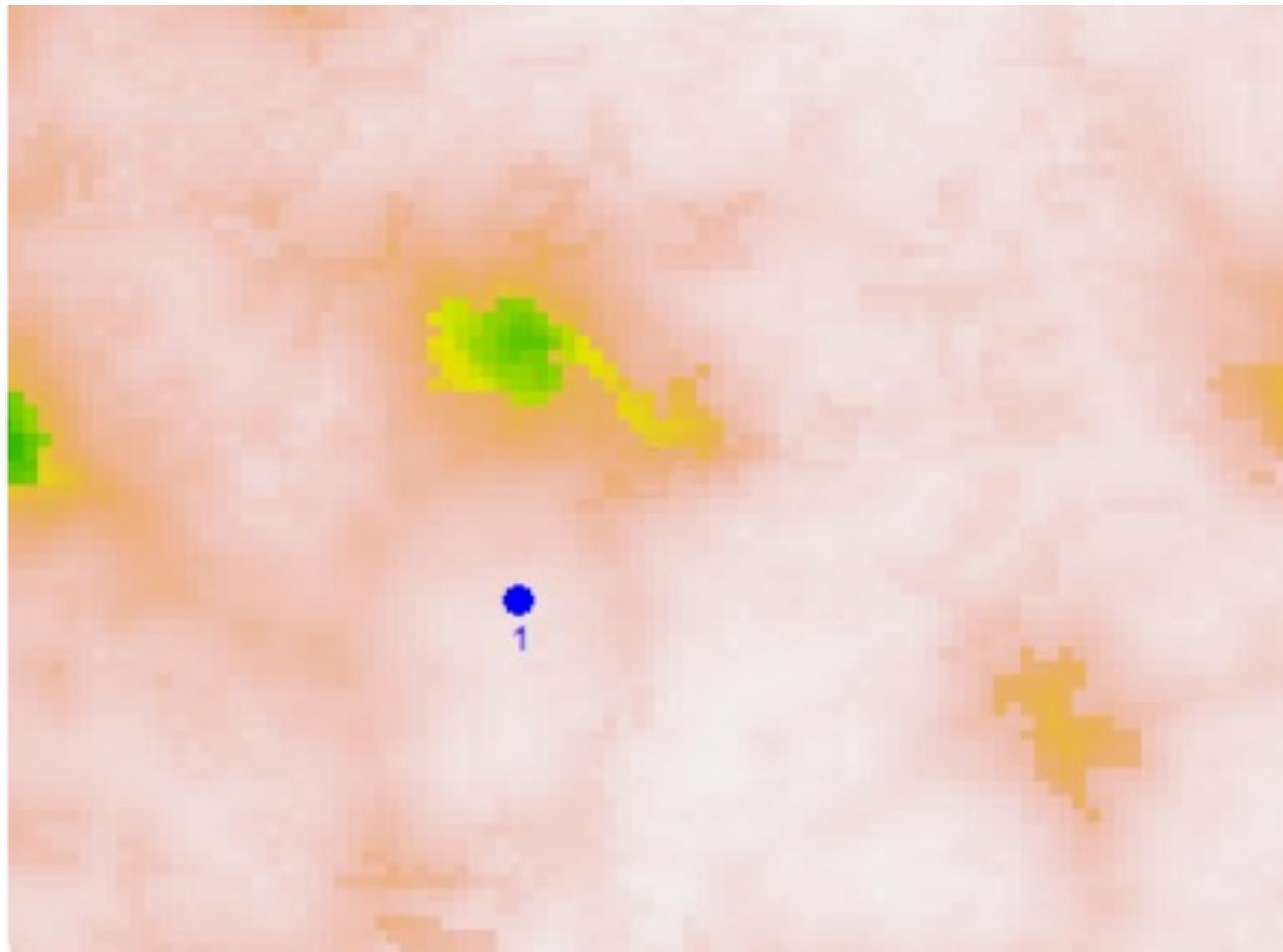


hybrid-model prediction

hybrid-model prediction
+ GPS-fixes (all years)



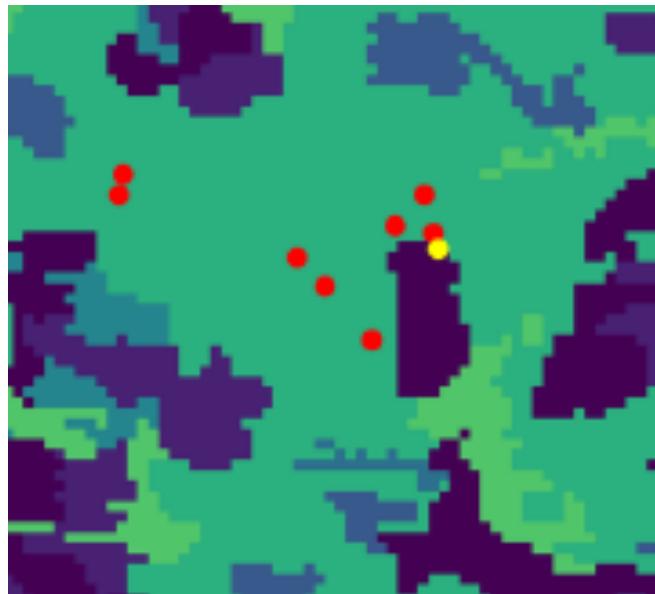
- Very good agreement hybrid prediction vs. tracking data
- Individuality of animals (is it really like that?
→ possibly only variables not known)
although:
- Very (locally&temporally) coarse CLC habitat
- Much of the planned/proposed improvements not yet made



blue: breeding site

Predicted relative habitat use without relation to a breeding site

Berechnete Kollisionsrisiken (pro Individuum und Jahr)

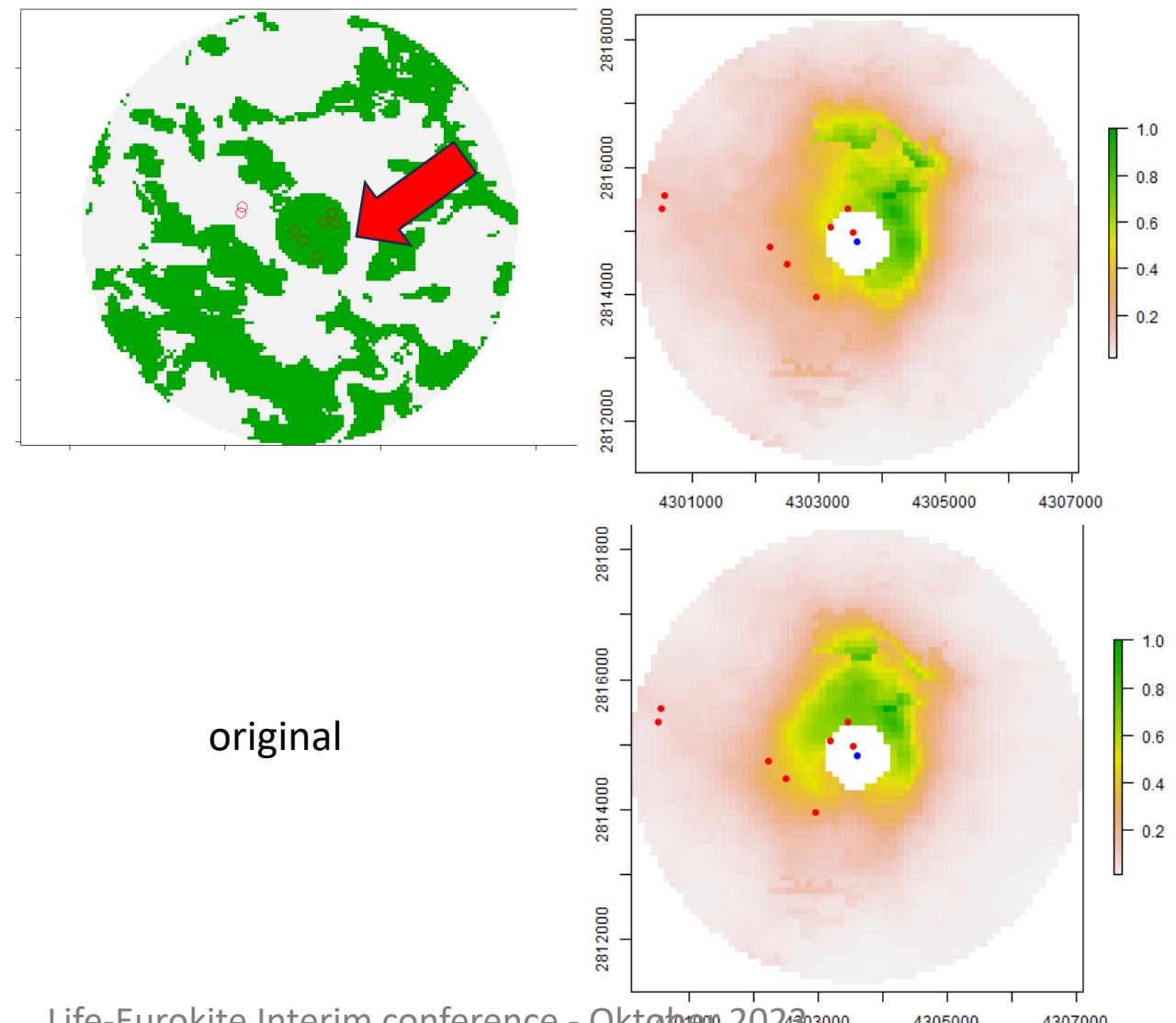


yellow: breeding site
red: wind turbines

Turbine	Jahr	Dist_breed	Col_risk	Nabenhoehe	R_Rotor
1	2022	1357	0,0097	98	41
2	2022	3113	0,0019	70	24
3	2022	3113	0,0008	70	24
4	2022	1148	0,0132	141	58,5
5	2022	469	0,0104	138	41
6	2022	160	0,0413	138	41
7	2022	538	0,0117	138	41
8	2022	1083	0,0027	78	22
SUMME	2022NA		0,0917NA	NA	

→ all 11 years 1 collision per breeding individual

Predicting the effect of measures: Addition of unattractive habitat near WT's with manipulated habitat



Turbine	Jahr	Dist_breed	Col_risk
1	2022	1357	0,0050
2	2022	3113	0,0025
3	2022	3113	0,0009
4	2022	1148	0,0072
5	2022	469	0,0068
6	2022	160	0,0369
7	2022	538	0,0077
8	2022	1083	0,0026
SUMME	2022 NA		0,0696

→ Alle 14,4 Jahre eine Kollision (pro Brutindividuum)

strategy for the final habitat model

- Land use & habitat data
- Barrier effects
- Breeding site dependency
- non-linear dependencies
- seasonal differences
- → 3,000 variables

variable selection



100 most important predictors

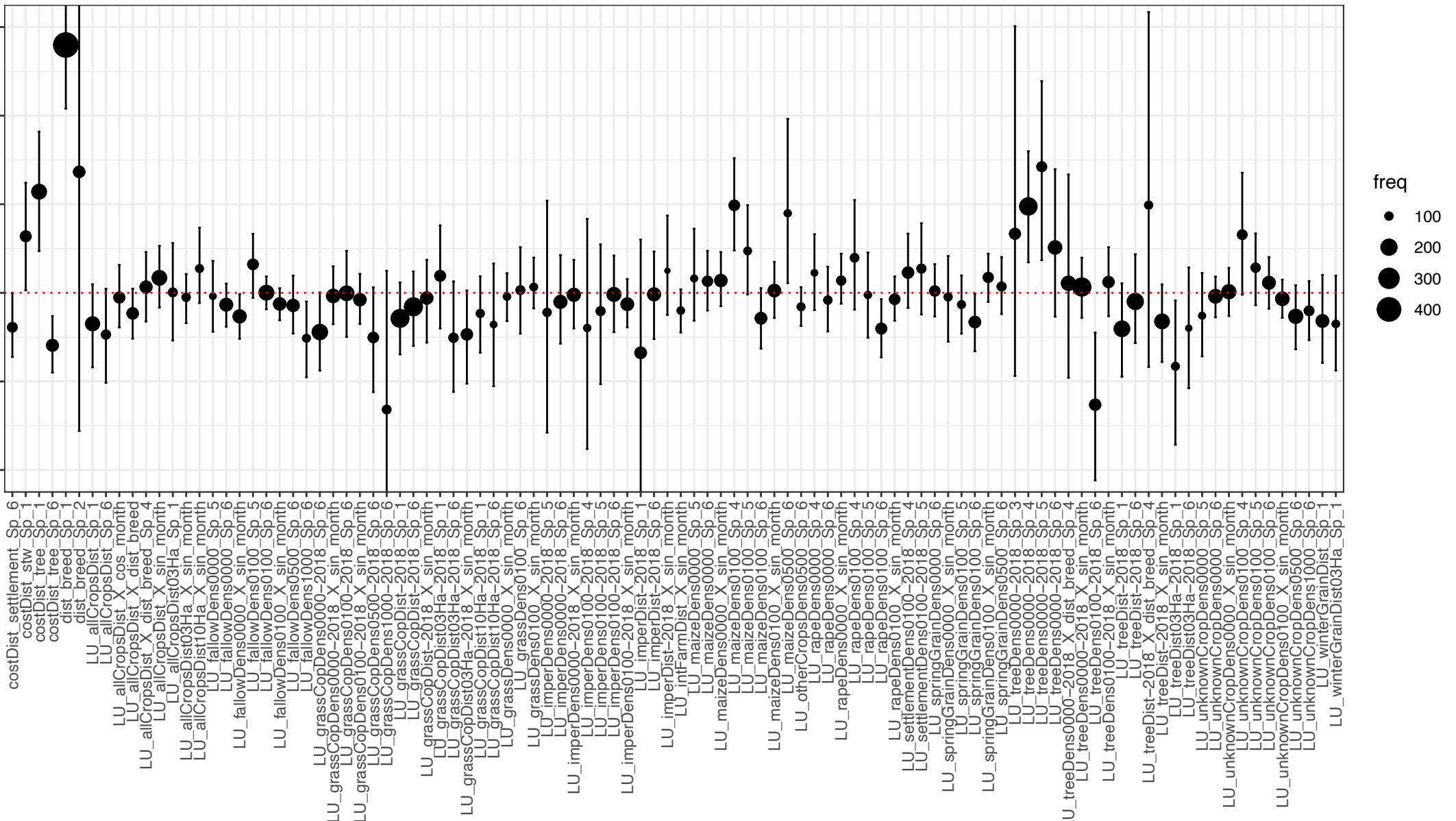
sex?

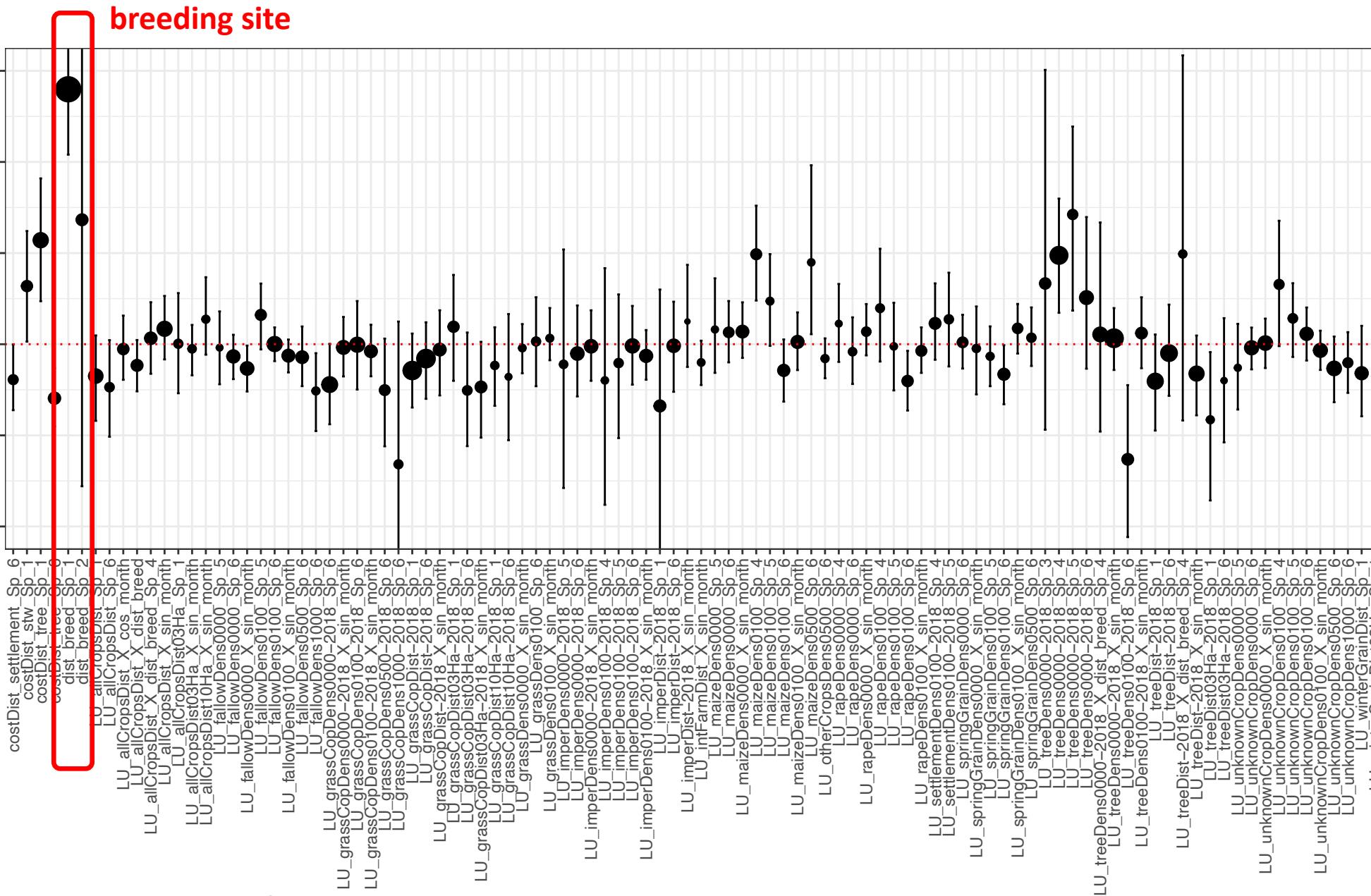
large-scale
landscapes?

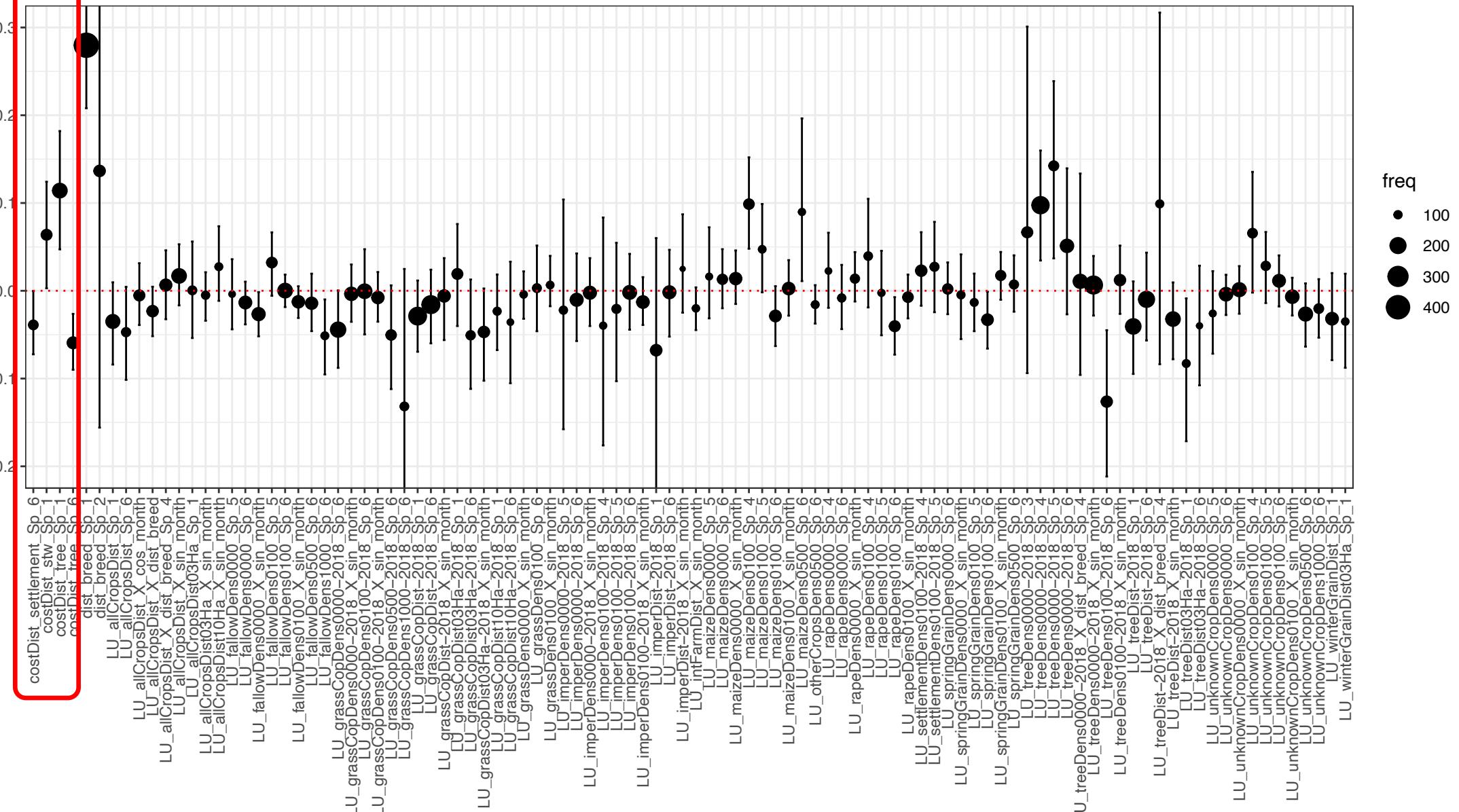
weather?



FINAL HABITAT MODEL





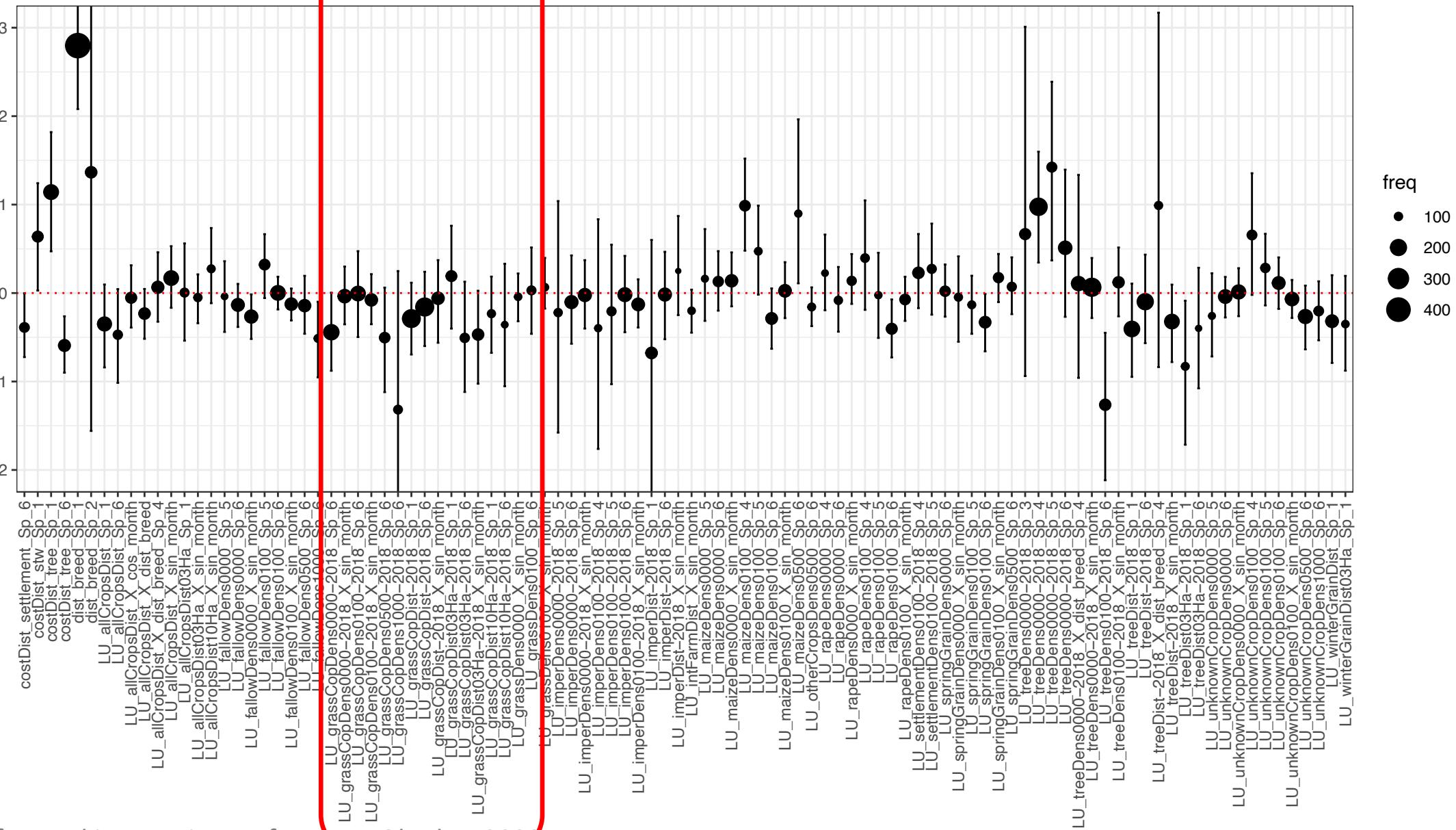
barrier effects


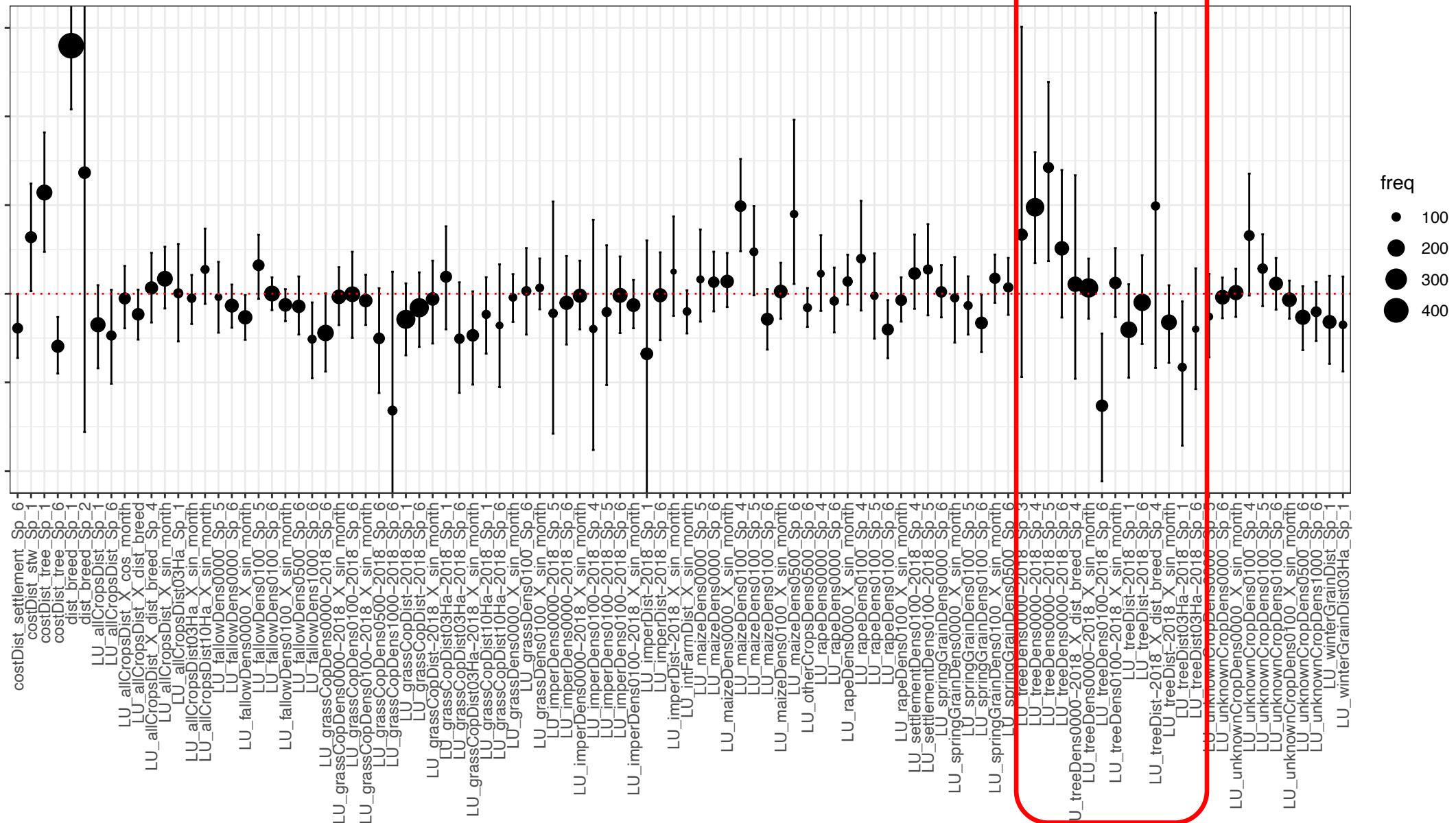
introduction

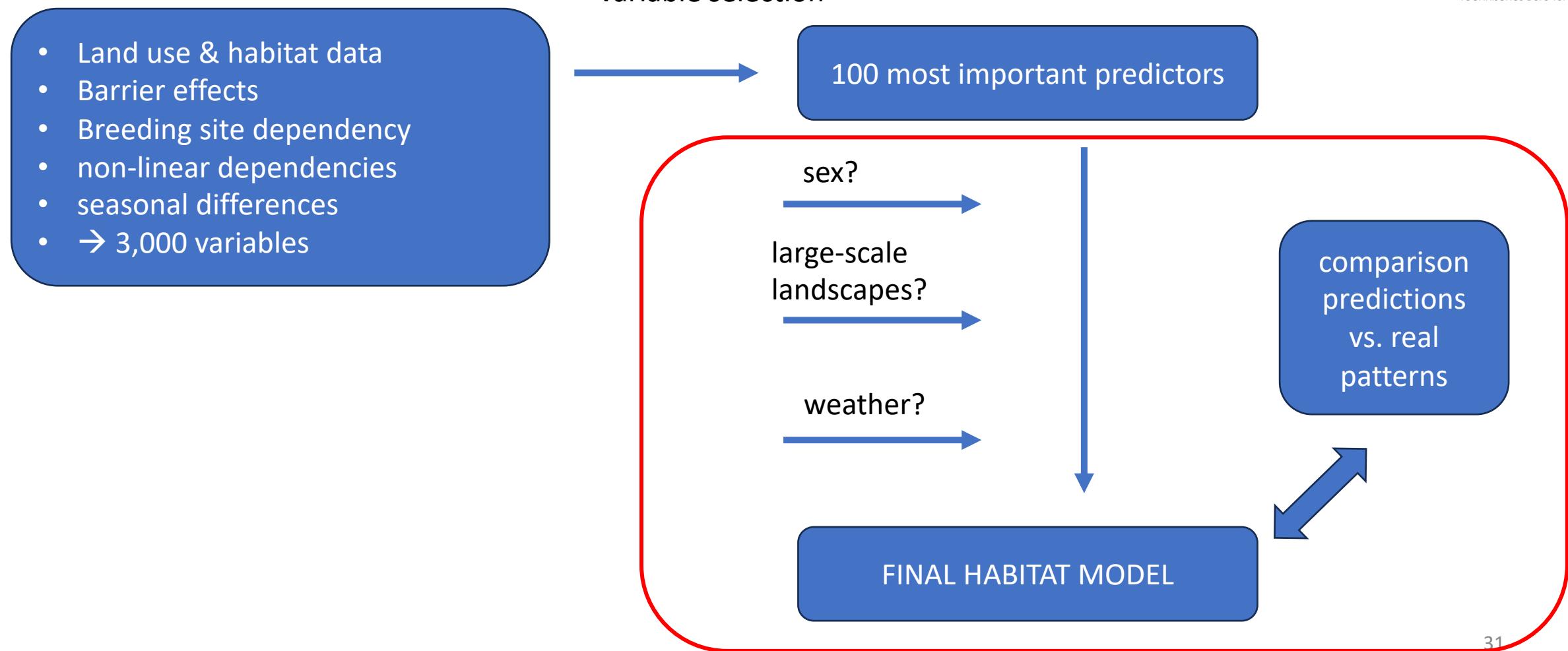
hybrid-Model

habitat modelling

outlook

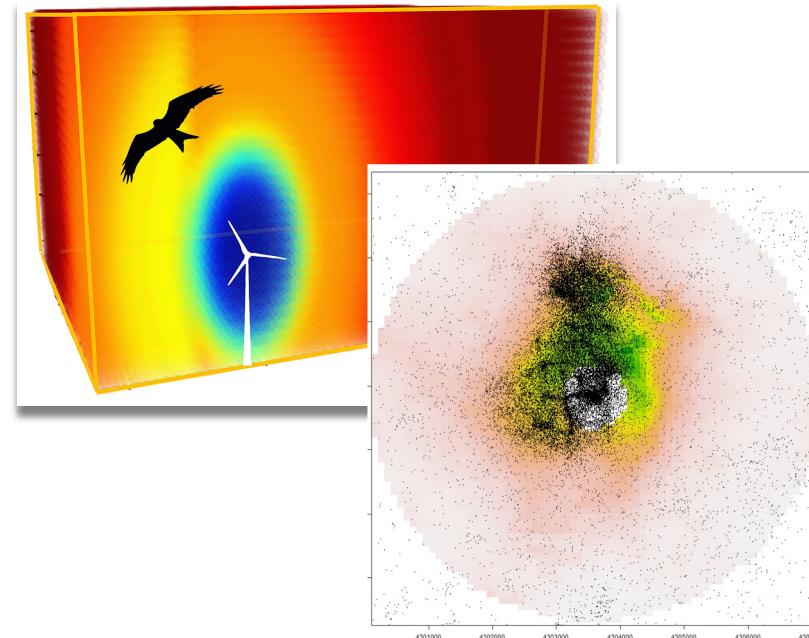






outlook

- Final improvements of the model including finalisation for the red kite possible by the turn of the year
- Other species: by mid-2024 White-tailed Eagle, White Stork and Black Kite, ...



THANK YOU FOR YOUR ATTENTION

And to: Rainhard Raab, Jan Blew, Thilo Liesenjohann, Jannis Liedtke, Rainer Raab, Fabian Wolfgang, Eike Julius, the sub-workgroup probabilistic, the KNE and many others