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The Power of Many: Utilizing Citizen Science Data in Species Distribution Models to Forecast Urban Avian Biodiversity in the Metropolis Ruhr, Germany

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I. Research Aim & Objectives

Urban areas as a compound of several divers habitat structures can make major contributions to conservation goals and preservation of biodiversity. Especially in the Ruhr Metropolis, where high diverse landscapes are predominant and large concentrations of people as potential volunteers are available, combining Citizen Science (CS) data and Remote Sensing (RS) techniques with the predictive power of Species Distribution Models (SDM) can play an important role to comprehensively investigate and evaluate avian biodiversity representing keystone species in urban ecosystems.

We utilize unstructured presence-only CS data to predict biodiversity hotspot areas of endangered species in Ruhr Metropolis giving a reference picture for future landscape development and in-situ research.

II. Study Area Metropolis Ruhr

- located in Western Germany with an area of ca. 4500 km²
- largest conurbation in Germany based on 53 entities and >5 Mio. inhabitants (RVR 2023)
- highly diverse and dense landscape structure
- ongoing post-industrial transformation towards a knowledge-based society lead to severe land use changes and urban sprawl

III. Research Design

- Data extraction of 27 planning relevant (endangered) breeding bird species from CS dataset for breeding period (Apr. to Jul.) in years 2019 -2021
- Simulation of Pseudo-Absence records for Presence-Only Data
- Environmental parameters were derived from RS datasets by spatial interpolation (Kriging & cubic convolution) and data processing
- SDM ensemble construction by 9 sophisticated model algorithms conducted with biomod2 (Thuiller et. al 2022)
- Evaluation of Model quality by 70:30 training:testing cross-validation using TSS (>0.5) and AUC (>0.7) score assessment
- Assessment of habitat suitability by Binary Transformation using TSS threshold
- Conduction of hotspot analysis by spatial statistics (Fig.3)

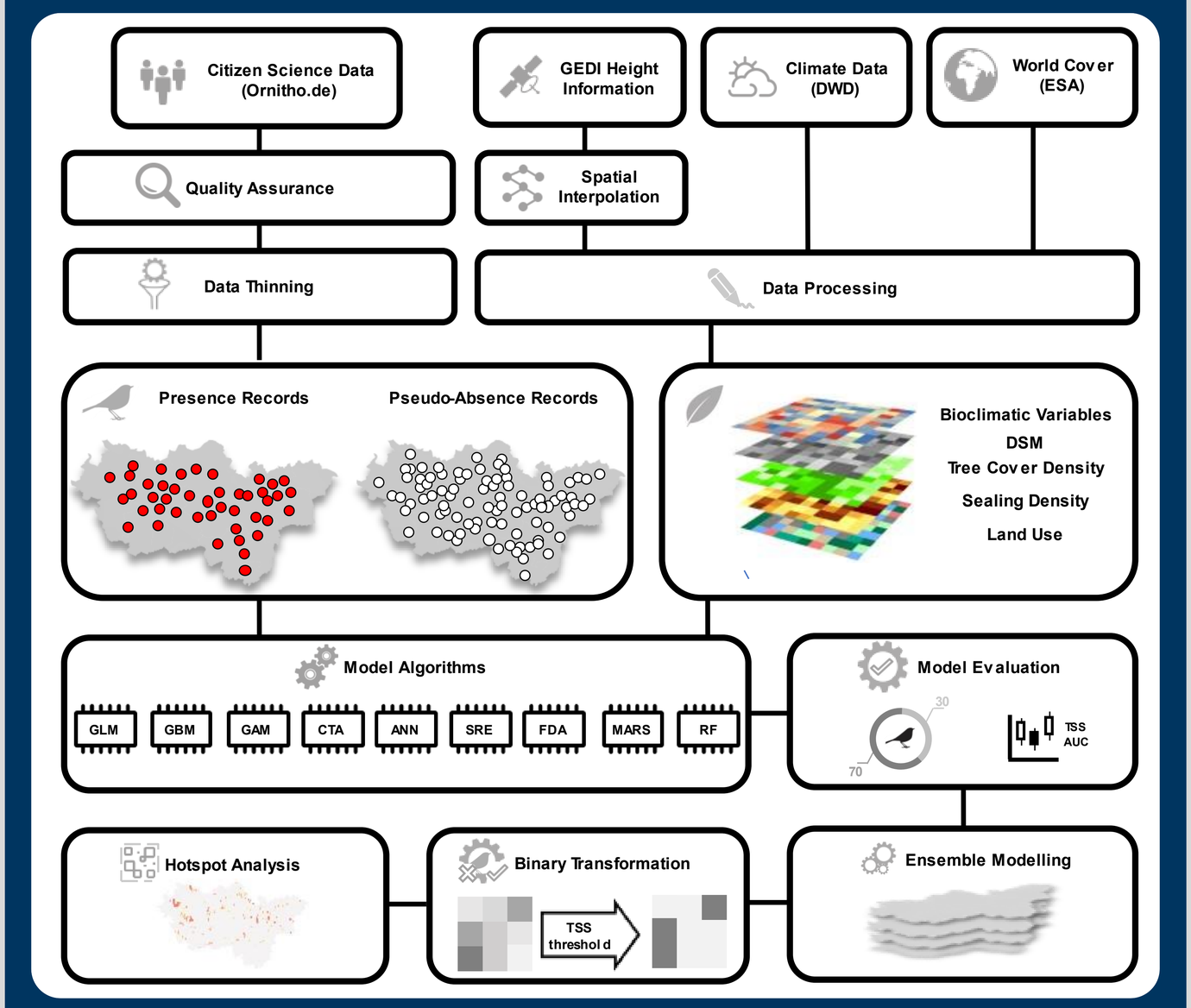

Fig.1 Research workflow for SDM ensemble construction and evaluation

IV. Results & Discussion

- Evaluation results show high predictive (ensemble) models for all studied avian species (Fig.2)
- We identified 339 km² (~8 %) within the Metropolis Ruhr which are highly suitable for more than 12 planning relevant species (Fig. 3)

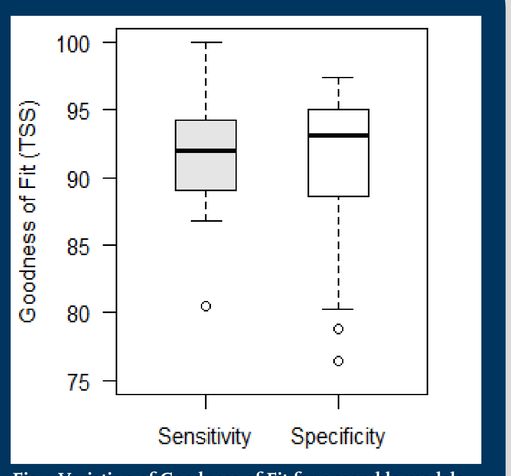

Fig.2 Variation of Goodness of Fit for ensemble models over 27 avian species

- Most hotspots in periurban parts are located in already legally protected areas, in contrast highly urbanized hotspots can be found on conversion areas

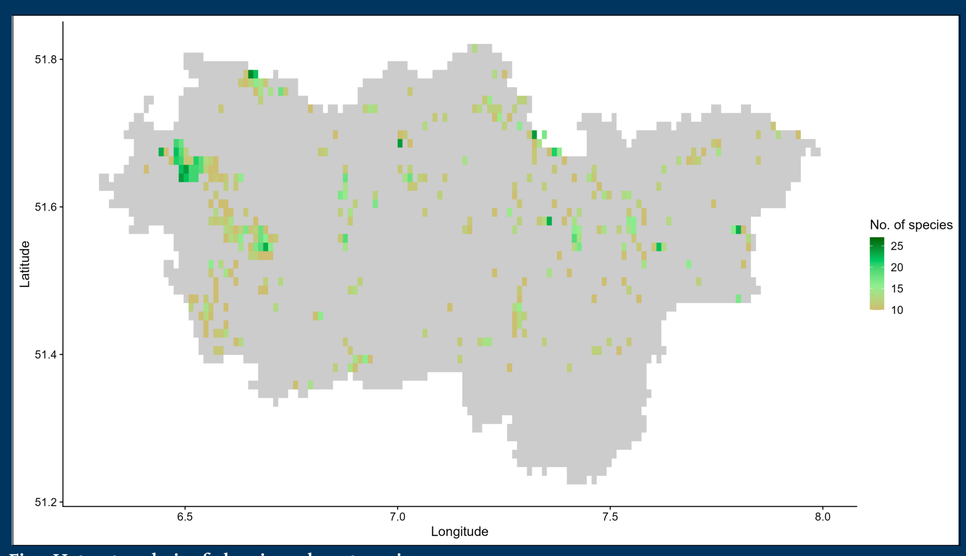

Fig.3 Hotspot analysis of planning relevant species

V. Conclusion & Outlook

- SDMs in combination with RS and CS data are highly capable of predicting biodiversity in dense urban landscapes
- A conducted hotspot analysis allows identification of vulnerable sites in Metropolis Ruhr worth safeguarding in terms of urban planning.
- Within urbanized entities conversion areas are proven as hotspot areas

➢ Integration of future land use predictions and climate projections of General Circulation Models (GCMs) will be used to address range shifts caused by urban sprawl and climate change to demonstrate impacts on urban avian bird community

References

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