



Universität Augsburg  
Centre for  
Climate Resilience

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Renke Lühken, Patrick Gutjahr, Christian Voll, and Elke Hertig

## Regional and Seasonal Variability in the Impacts of European North Atlantic Circulation Patterns (CPs) on Mosquito Populations in Germany

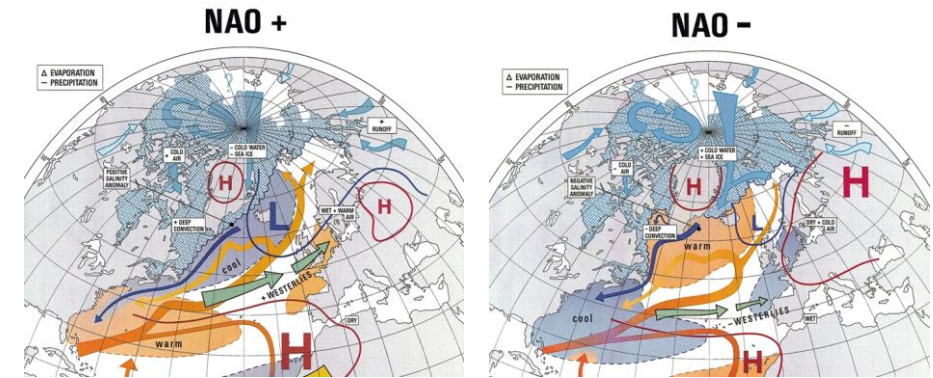
European Geosciences Union (EGU) General Assembly  
2026

Vienna, 03.-08.05.2026

Chair of Regional Climate Change & Health  
University of Augsburg

# Outline

- Introduction
- Data & Methods
- Results:
  - Mosquito dataset from active surveillance across Germany
  - Mosquito-related ecoclimatic regionalization for Germany
  - Species composition across MERs
  - Large-scale CPs of the EUNA region
  - Optimal lags of climate and teleconnection predictors for mosquito abundance forecasting in Germany
- Conclusions



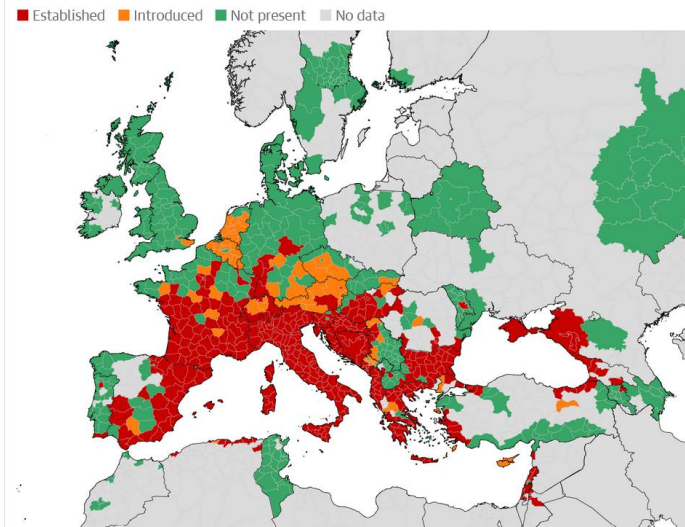
Wanner et al. (2001)



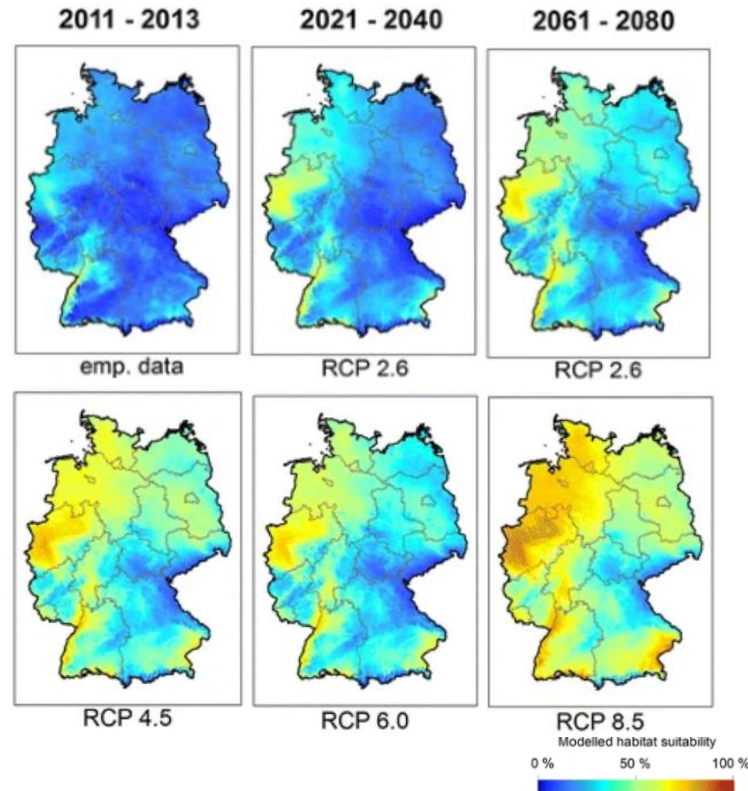
*Aedes albopictus*. Source: frank600/Getty Images/iStockphoto

# Climate change is increasing mosquito habitat suitability & WNV risks in Germany

## Habitats of the invasive Asian tiger mosquito have expanded throughout Europe



Source: European Centre for Disease Prevention and Control (ECDC)



Koch et al. (2016) Modelled habitat suitability of *Ae. albopictus* in Germany under climate change

Brief Report | [Open access](#) | Published: 05 June 2025

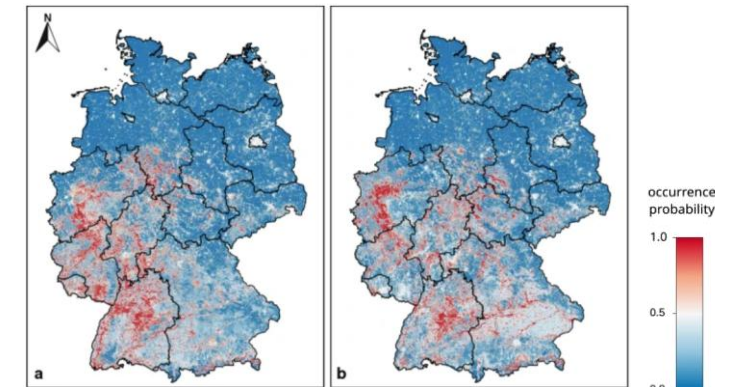
## *Anopheles hyrcanus* (Diptera: Culicidae): yet another invasive mosquito species in Germany

Doreen Werner , Henrike Nehls, Christiane Eska & Helge Kampen

*Parasites & Vectors* 18, Article number: 211 (2025) | [Cite this article](#)

597 Accesses | 4 Altmetric | [Metrics](#)

Werner et al. 2025



Kerkow et al. (2019) Modelled a) current and b) projected distribution of *Ae. japonicus* in Germany



Sendung verpasst?

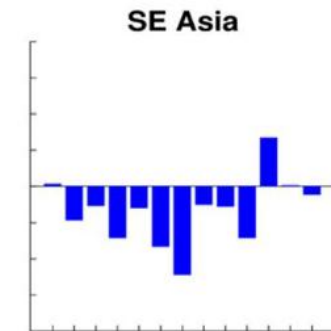
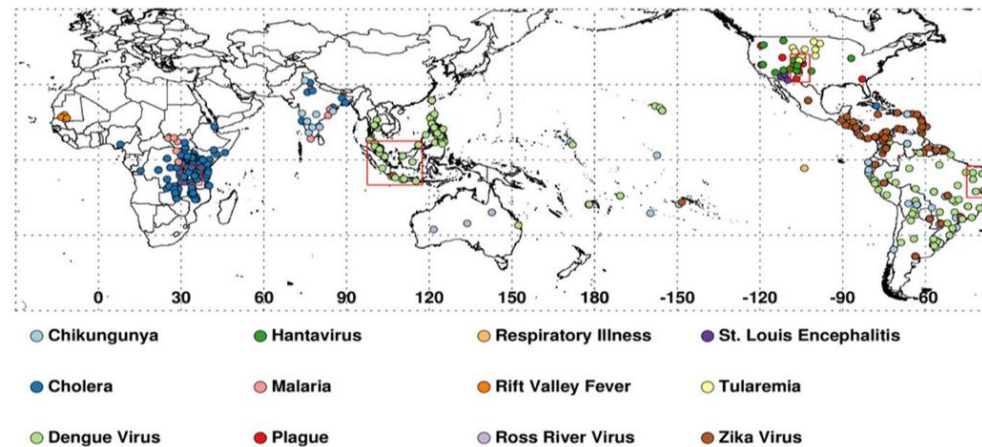
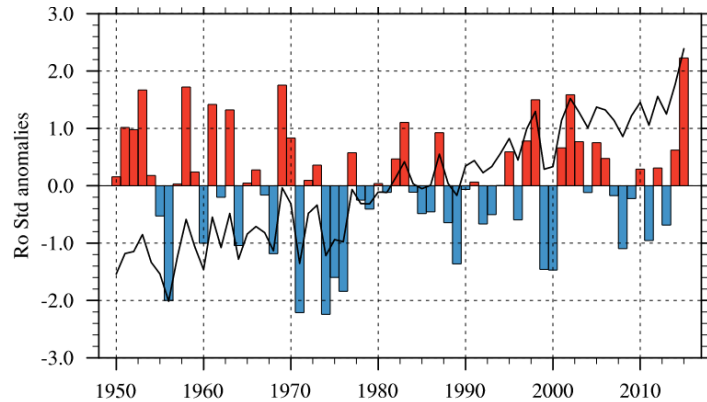
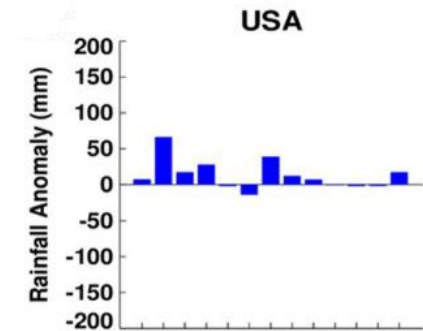
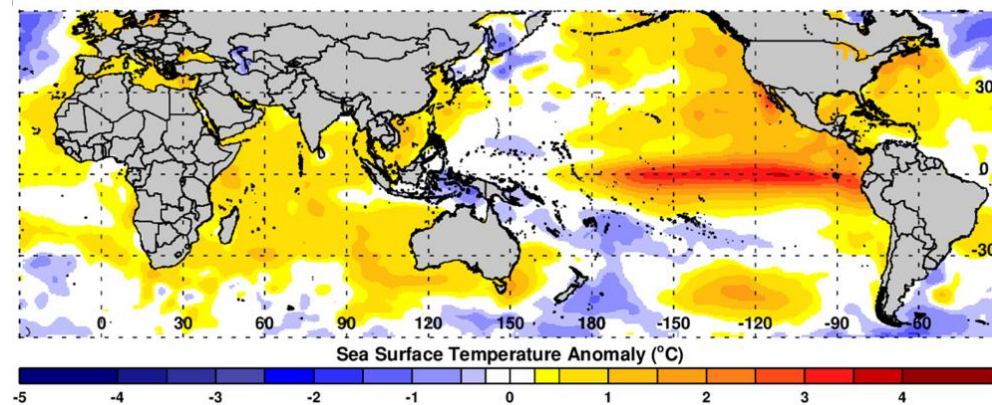
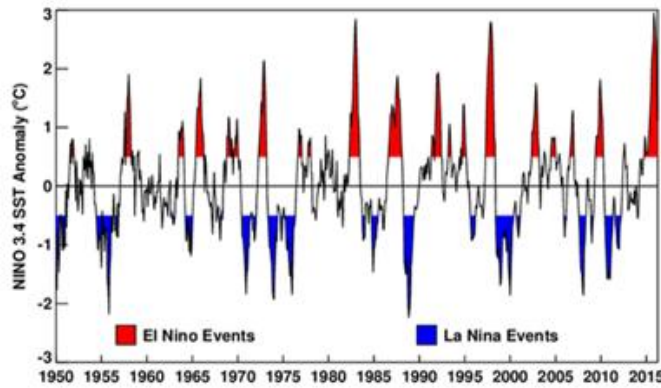
FAQ Klimawandel

## Tigermücken - wie gefährlich sind sie?

Stand: 14.07.2023 - 10:53 Uhr

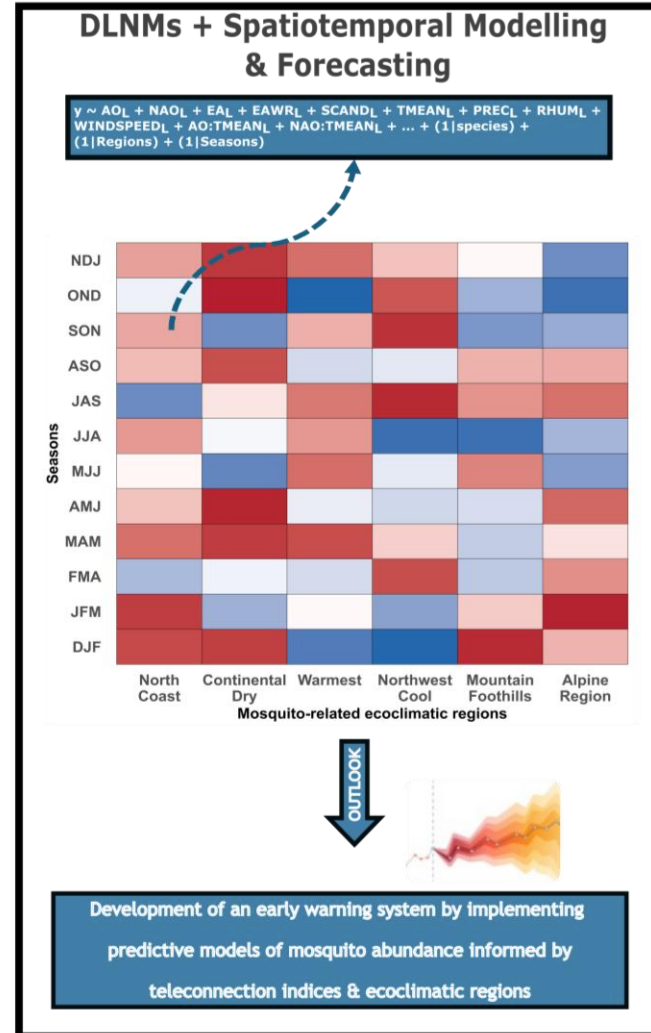
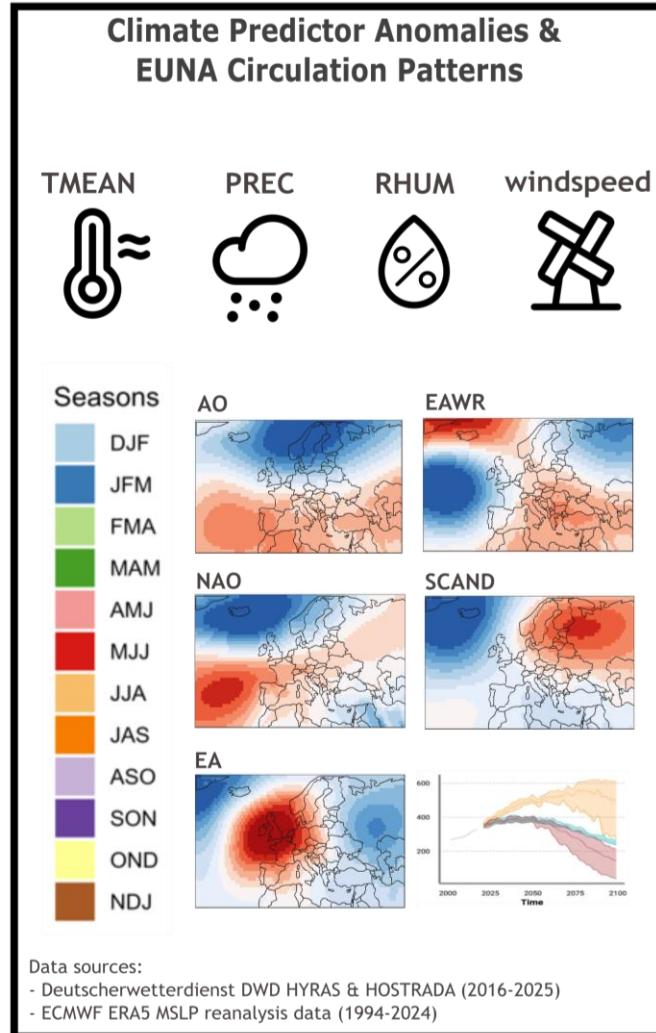
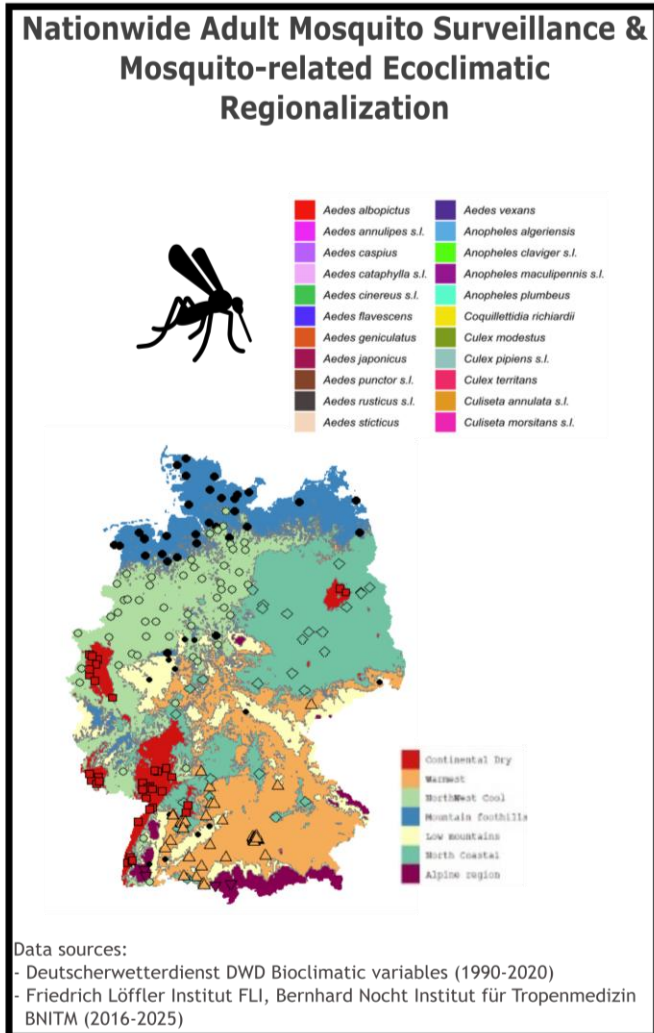
Sommer, Sonne, Tropennächte - leider gehen die auch einher mit Mücken. In den vergangenen Jahren hat sich auch in Deutschland zunehmend die Asiatische Tigermücke verbreitet. Das könnte ein Problem werden.

# ENSO 2015-2016 led to MBD outbreaks in several tropical regions of the world

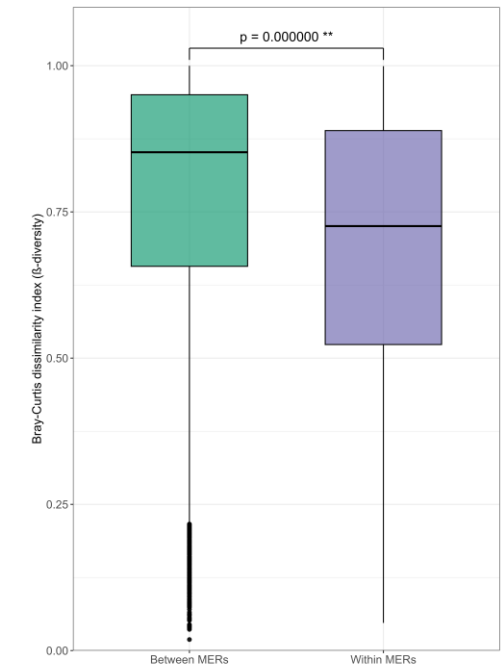
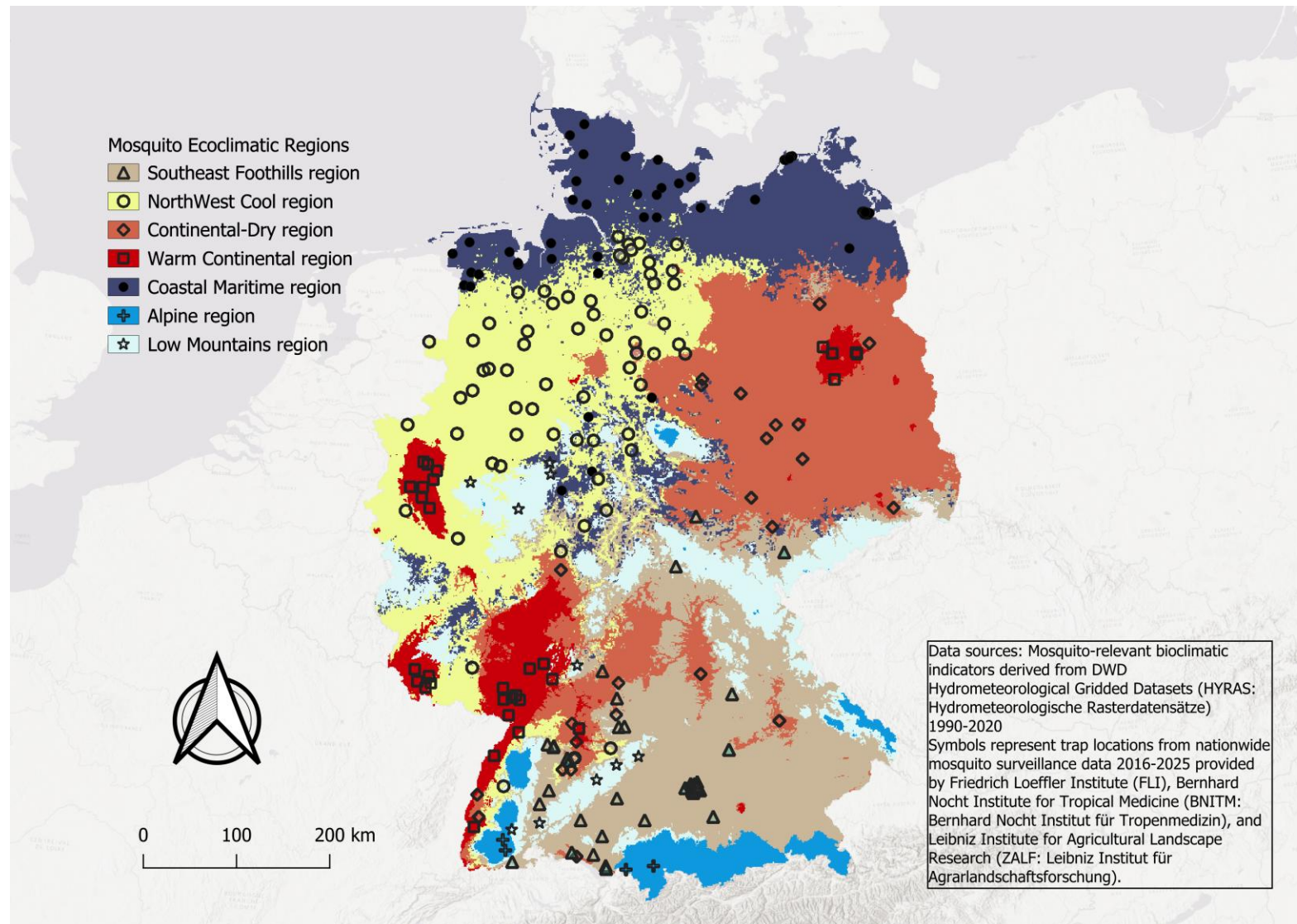


Caminade et al. 2017; Anyamba et al. 2019

# Data & Methods



# Mosquito ecoclimatic regionalization (MERs) for Germany



**Data source:**

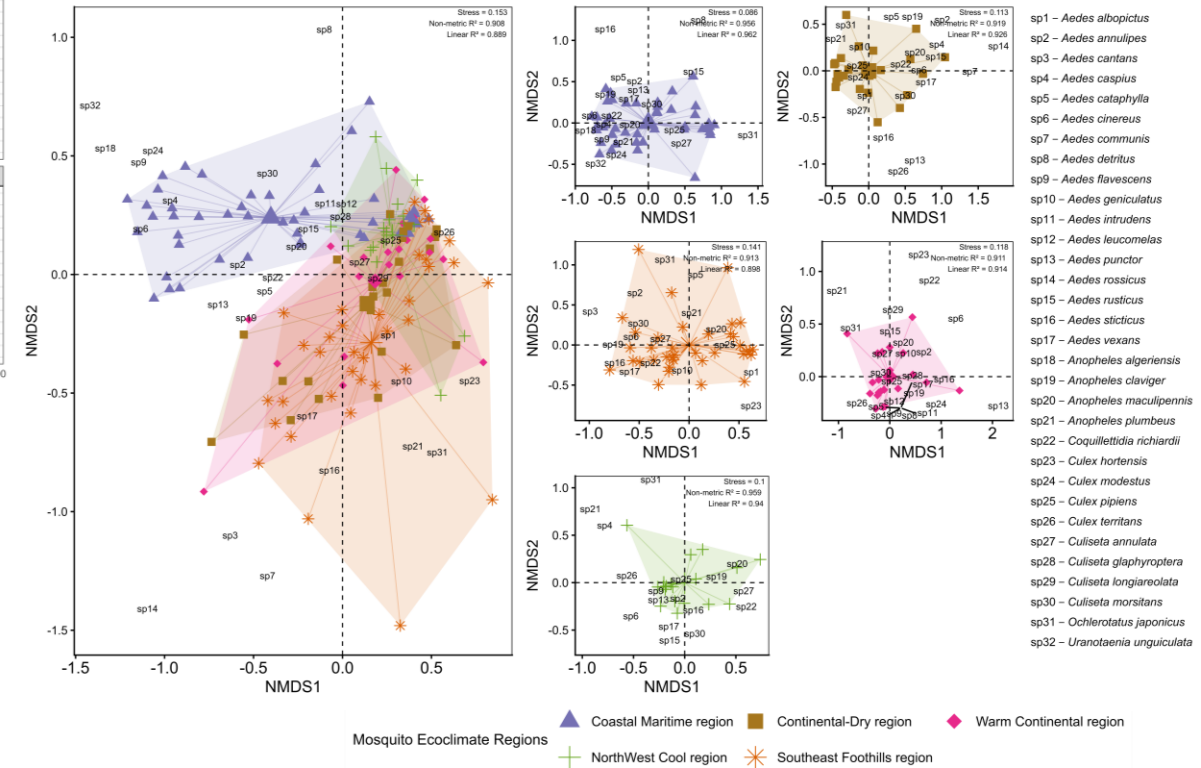
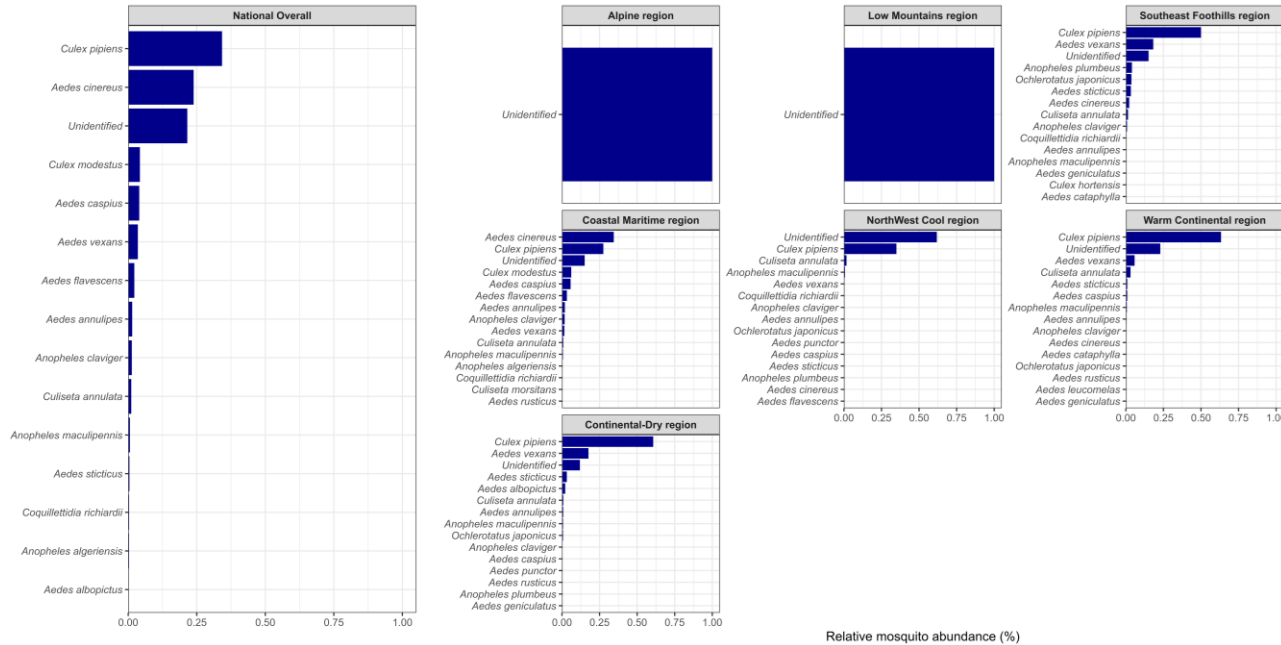
- DWD TMEAN, PREC, RHUM & WS 1x1km (1990-2020)

**Mosquito-related variables:**

- Bioclimatic variables
- Overwintering potential
- Adult survival probability
- Lifecycle completion probability

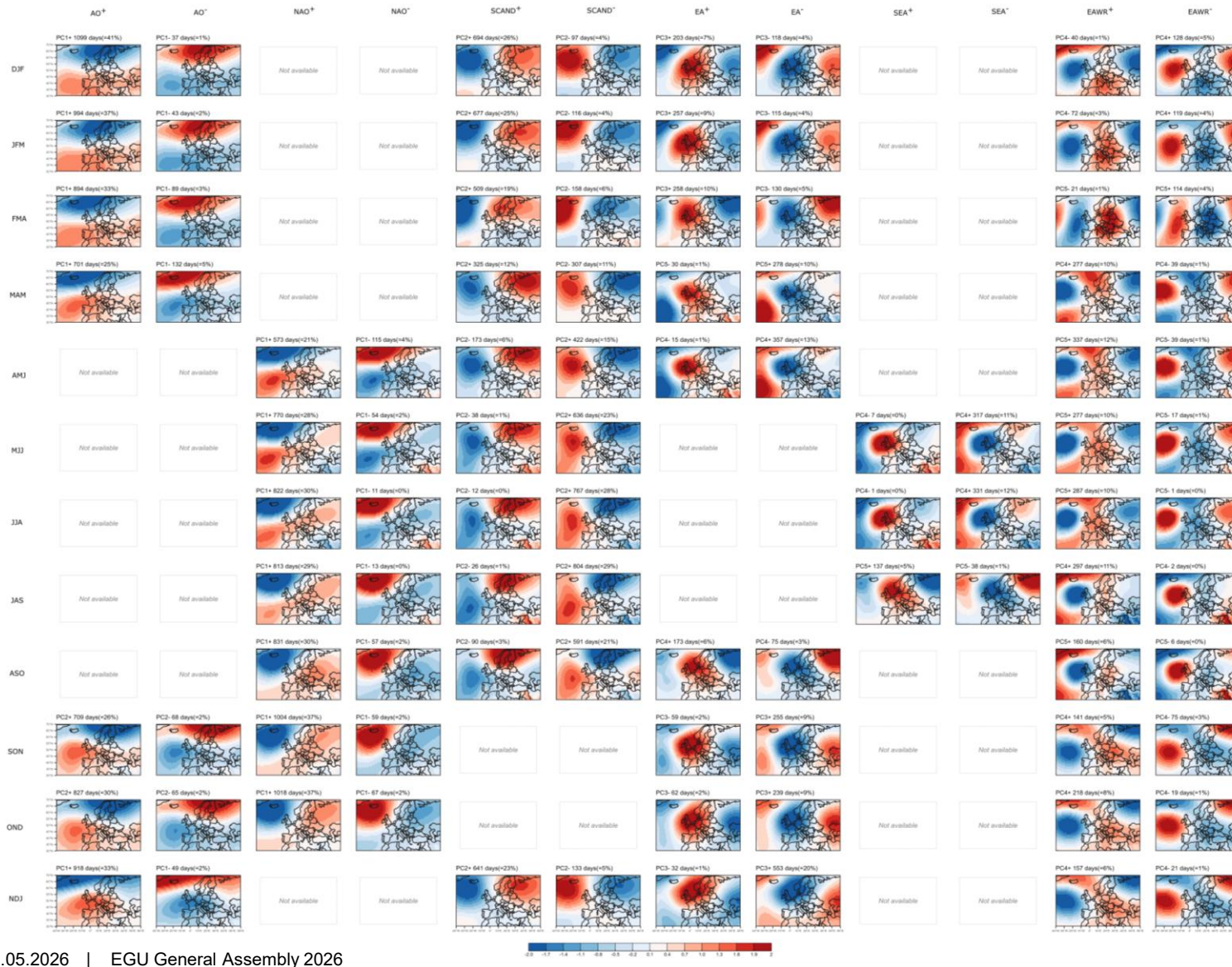
**Method: kmeans cluster analysis**

# Regional variability in mosquito abundance, diversity and composition



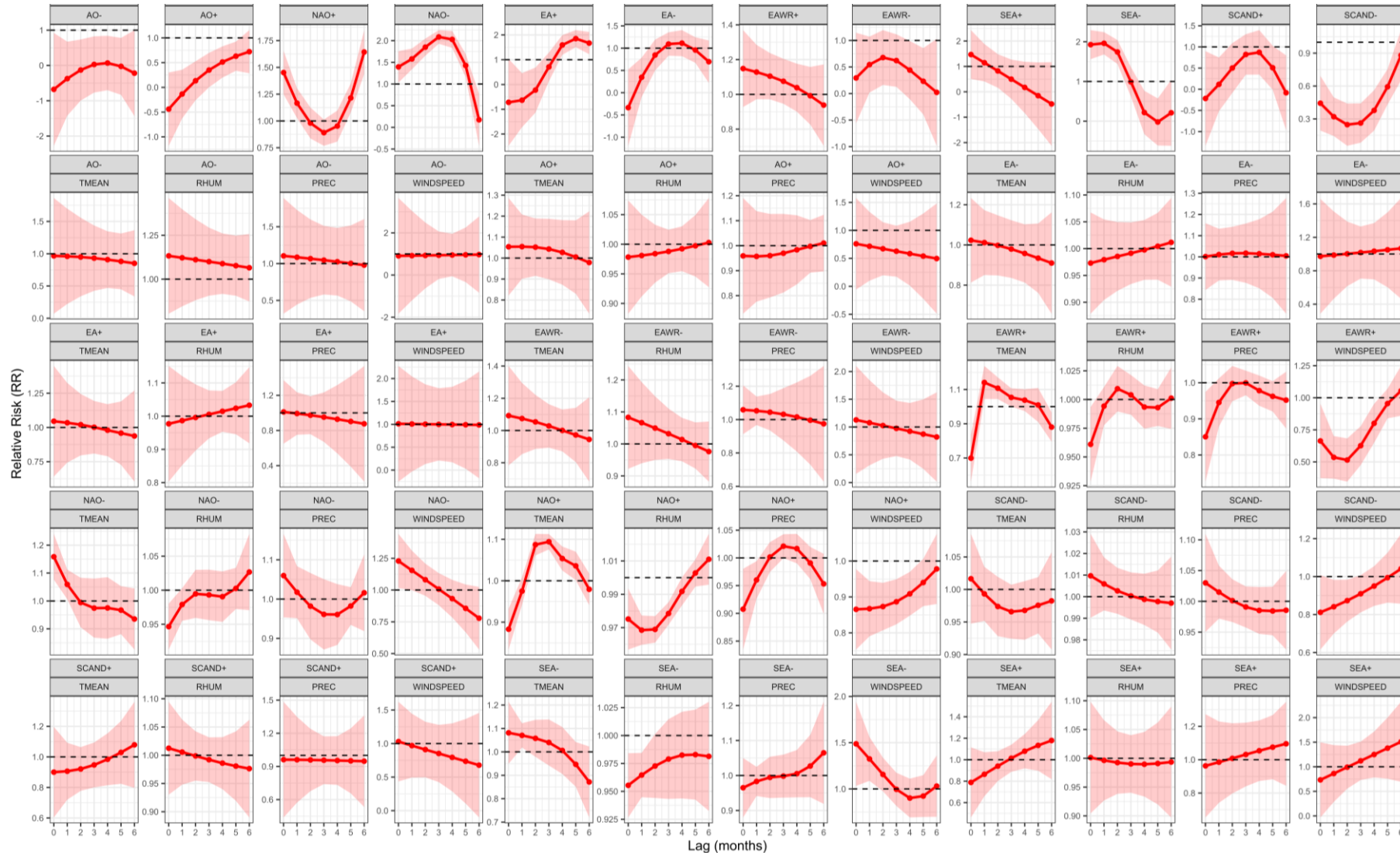
**Methods:**  
- Non-metric multidimensional scaling (NMDS) + Bray-Curtis dissimilarity index

# Large-scale CPs of the European-North Atlantic region



Data source:  
 - ECMWF ERA5 MSLP Reanalysis data (1995-2025)  
 Method: Tmode PCA

# Optimal lags (months) of CPs and internal weather characteristics relevant for mosquito abundance forecasting

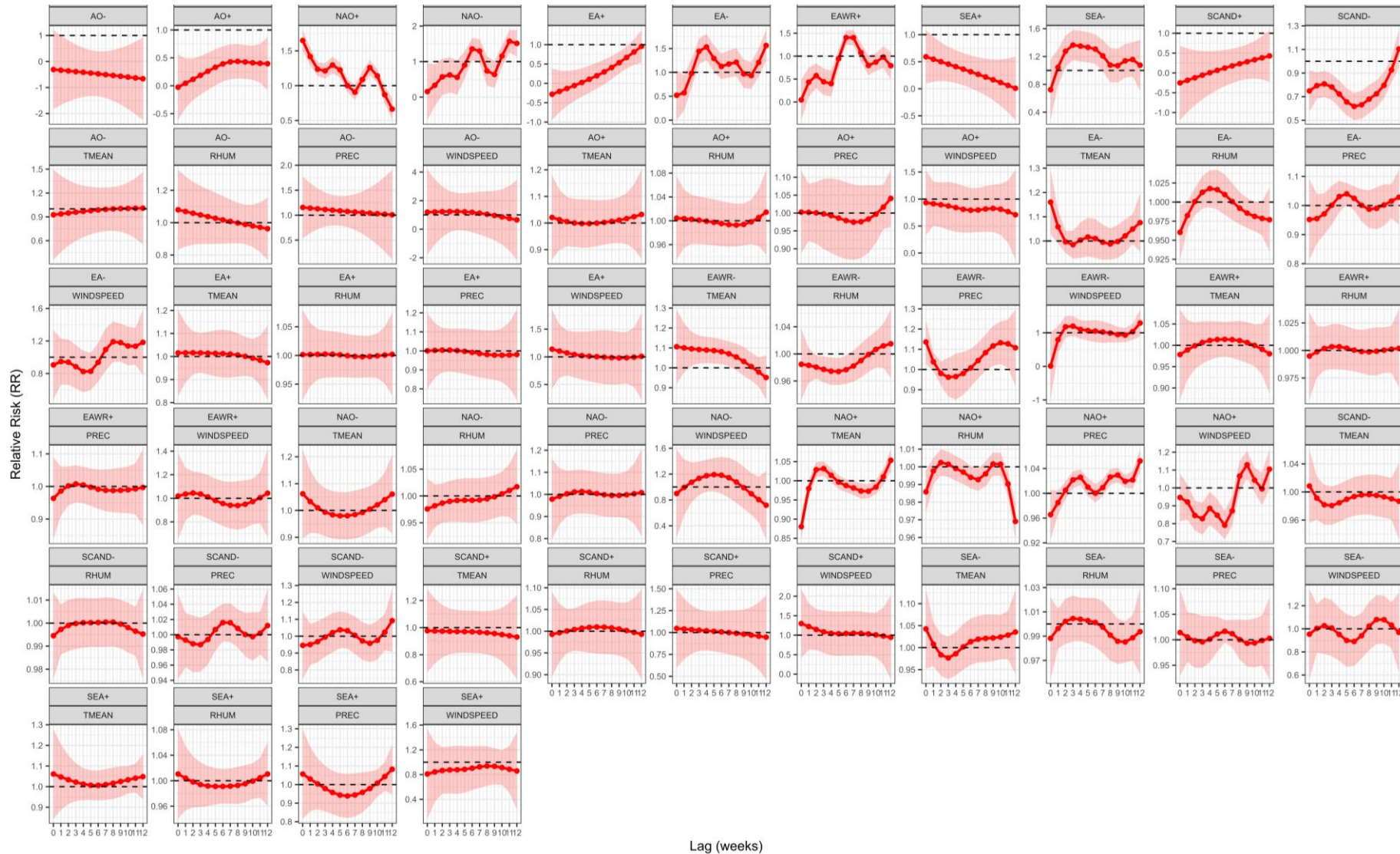


**Optimal lags (months)**  
 NAO<sup>+</sup>(6)  
 NAO<sup>-</sup>(3)  
 SEA<sup>-</sup>(1)

NAO<sup>+</sup>:TMEAN (3)  
 NAO<sup>-</sup>:TMEAN (0)  
 EAWR<sup>+</sup>:TMEAN (1)  
 SEA<sup>-</sup>:TMEAN (1)  
 NAO<sup>-</sup>:WINDSPEED (0)  
 SEA<sup>-</sup>:WINDSPEED (0)

Methods:  
 - Distributed lag interaction models (DLIM) +  
 Generalized additive model (GAM)

# Optimal lags (weeks) of CPs and internal weather characteristics relevant for mosquito abundance forecasting



**Optimal lags (weeks)**

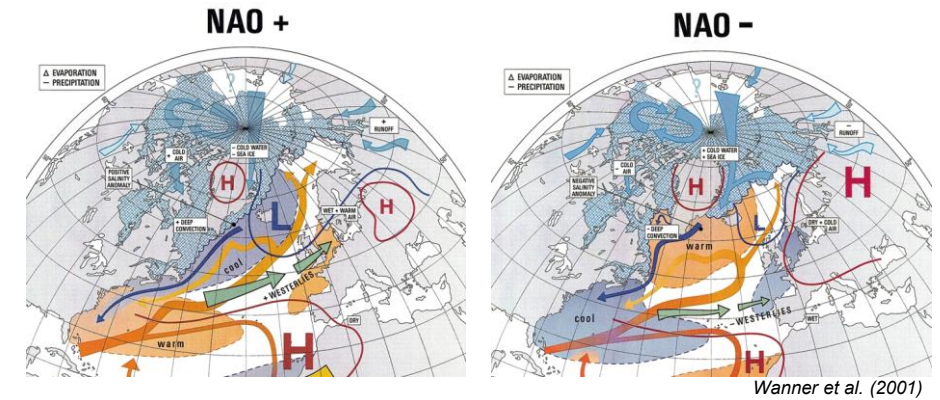
NAO<sup>+</sup>(0)  
 NAO<sup>-</sup> (11)  
 SEA<sup>-</sup> (3)  
 EA<sup>-</sup> (12)  
 EAWR<sup>+</sup>(6)

NAO<sup>+</sup>:TMEAN (12)  
 EA<sup>-</sup>:TMEAN (0)  
 EAWR<sup>-</sup>:TMEAN (2)  
 EA<sup>-</sup>:PREC (5)  
 NAO<sup>+</sup>:PREC (12)  
 NAO<sup>+</sup>:WINDSPEED (9)

Methods:  
 - Distributed lag interaction models (DLIM) +  
 Generalized additive model (GAM)

# Key Takeaways

- *Culex pipiens* dominates across all regions while invasive species *Aedes albopictus* and *Ochlerotatus japonicus* are widespread indicating increasing climatic suitability for invasion risk and/or introduction of new MBDs in Germany
- There is strong regional variability in mosquito abundance, diversity and community composition
- Large-scale circulation patterns exhibit measurable lagged influences on mosquito abundance.
- These findings provide a basis for improving short-term mosquito abundance forecasting in Germany



*Aedes albopictus*. Source: frank600/Getty Images/iStockphoto

# Thanks for listening!

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