Tick Talkers

Forecasting the Impact of Climate Change on Lyme Disease Proliferation

BACKGROUND

With the anticipated rise in temperatures resulting from climate change, ticks - known carriers of certain diseases - may become more active in Germany in the coming years. If people are not careful and fail to take appropriate precautions to protect themselves from tick bites, the risk of contracting tick-borne diseases such as Lyme borreliosis may increase, leading to more people becoming affected by these illnesses.

RESEARCH QUESTION

How do climate change-induced factors, such as elevated temperatures and human-related activities impact the proliferation of ticks and the subsequent prevalence of Lyme disease in Bavaria, Germany?

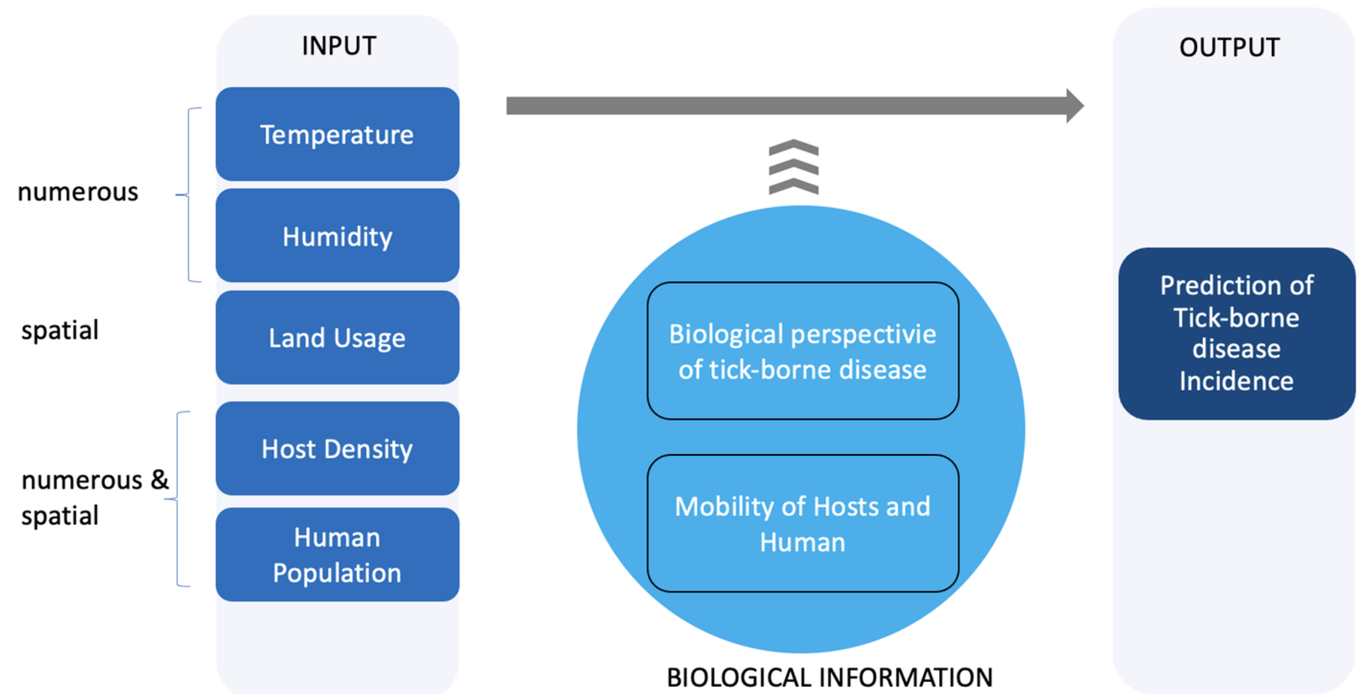
RESEARCH GOAL

Our aim is to devise, by the conclusion of TUMJA, a robust predictive model that demonstrates a non-trivial degree of accuracy with errors contained within an acceptable margin, establishing correlations between climate change-driven factors and human activities, and the incidence of Lyme disease in Bavaria. This model will serve to potentially enhance the preparedness and response of pharmacies and medical services by capitalizing on the available data and concentrating on the endemic region.

DELIVERABLES

A comprehensive, peer-reviewed research paper, accompanied by a sophisticated predictive model visualization and an interactive application designed to effectively disseminate our findings and facilitate knowledge transfer.

MODEL ILLUSTRATION



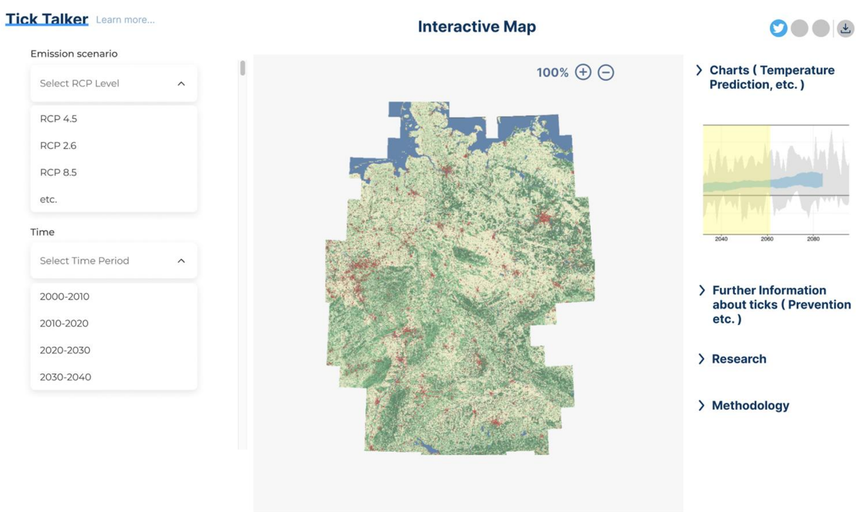
HIGHLIGHTS UPDATES

Multi-Modality Implementation

Introduction of a multimodal model, designed to accept input variables encompassing temperature, humidity, and land usage.

Interactive Map

Design of the first prototype of our interactive map, which will provide users a risk level of infection based on Landkreis. Different scenarios showing the climate change will be considered.



RESEARCH HIGHLIGHTS

- **Identification of research gap**
  - Previous regressive models study the correlation between the interaction of climatic and human activities with vector borne diseases, in which a specie of tick is a vector host. However, there are no prediction models.
  - The most recent regressive study took place in 2018 in the state of Vermont, USA [1] or the migration of tick species through whole Europe [2].
  - We are bridging the gap by developing a **predictive** and **regional** model.

- **Expanding our network**
  - **Journals**: Listing of publication requirements (Tentative Journal: Mary Ann Liebert Journal)
  - **Contact:** Planification of an strategic contact with key players such as the bavarian health state office (Bayerisches Landesamt für Gesundheit und Lebensmittelsicherheit) and the chair of Epidemiology, part of the department of Sport and Health Science at the Technical University of Munich.

TIMELINE AND MILESTONES

Nov. – Apr. 2023
FOUNDATIONS & PRELIMINARY EXPLORATION
Grasp Lyme disease and climate impacts; collect and pre-process data; establish hypotheses; build toy models; initiate numerical techniques exploration.

Apr. – Jul. 2023
IN-DEPTH ANALYSIS & EXPERT COLLABORATION
Investigate specific topics; review related projects; comprehend time series models; gather extra data; conduct expert interviews; collaborate with research departments for opinions and insights.

Jul. – Oct .2023
MODEL INTEGRATION & ENHANCEMENT
Combine findings with model for improvement and validation; acquire climate forecasts; apply diverse modelling techniques; boost spatial-temporal features.

Oct. 2022 – Jan. 2024
MODEL REFINEMENT & COMPARISON
Evaluate and fine-tune models; interpret outputs; compare models; finalize the optimal model.

Feb. 2024 – Jun .2024
PAPER COMPLETION & PRESENTATION
Write and finalize research paper; visualize predictive model; create interactive application; ensure valuable publication; present final product.

Technische Universität München
TUM: Junge Akademie
Class 2023

OCT 2023

Members
Franka Exner
Claudia Guardamarra Serrano
Xufan Lu
Carolin Niedermaier
Letizia Wörrlein
Shaoming Zhang

Tutors
Leonardo Giannotti
Daniel Khadra

Supervisors
Prof. Dr. Niklas Fanelsa
Prof. Dr. Enkelejda Kasneci

Reference
https://survstat.rki.de
https://www.dwd.de

Contact Information
TUM: Junge Akademie Class 2023 Colim
colim@ja.tum.de

inspired by TUM: Junge Akademie

Bibliography
[1] Climate Change, Lyme Disease, and Other Tickborne Diseases in Vermont (2018). Vermont Department of Health.
[2] Effects of Climate Change on Ticks and Tick-Borne Diseases in Europe (2008). J. S. Gray, H. Dautel, A. Estrada-Peña, O. Kahl, and E. Lindgren. Interdisciplinary Perspectives on Infectious Diseases. Volume 2009, Article ID 593232, 12 pages doi:10.1155/2009/593232]