ASSESSING THE ECOLOGICAL COVARIATES RELATED TO TICK-BORNE ENCEPHALITIS EMERGENCE IN EUROPE

Francesca Dagostin[1], Valentina Tagliapietra[1], Giovanni Marini[1], Claudia Cataldo[2], Maria Bellenghi[2], Scilla Pizzarelli[3], William Wint[4], Neil S. Alexander[4], Markus Neteler[5], Julia Haas[5], Duccio Rocchini[6,7], Marco Cervellini[6,8], Timothée Dub[9], Luca Busani[2], Annapaola Rizzoli[1]

[1]Research and Innovation Centre, Fondazione Edmund Mach, San Michele all'Adige (TN), Italy. [2]Centre for Gender-specific Medicine, Istituto Superiore di Sanità, Roma, Italy. [3]Knowledge Unit (Documentation, Library), Istituto Superiore di Sanità, Roma, Italy. [4]Environmental Research Group Oxford, United Kingdom. [5]Mundialis GmbH & Co. KG Koelnstrasse 99, 53111 Bonn, Germany. [6]BIOME Lab, Department of Biological, Geological and Environmental Sciences, Alma Mater Studiorum University of Bologna, Bologna, Italy. [7]Department of Spatial Sciences, Faculty of Environmental Sciences, Czech University of Life Sciences Prague, Praha-Suchdol, Czech Republic. [8]School of Biosciences and Veterinary Medicine, University of Camerino, Italy. [9]Department of Health Security, Finnish Institute for Health and Welfare, Helsinki, Finland

BACKGROUND AND AIM

- TBE spatial distribution is showing altitudinal and longitudinal shifts, with **new foci** emerging in non-endemic countries[1,2]
- To geo-locate all known and potential new risk areas it is fundamental to..

Understand the relationships occurring between TBE incidence and several ecological variables and finally assess the principal factors connected to TBE spread

..at the **European scale**

METHODS

1. LITERATURE SEARCH
(MEDLINE, EMBASE, SCISEARCH, BIOSIS, HCAPLUS, SCOPUS).

2. LIST OF COVARIATES
Variables identified through literature screening

3. DATA COLLECTION
- Data of TBE human infections provided by TESSy (ECDC)
- Bioclimatic, environmental, and ecological raw data

4. DATA PROCESSING
- TBE incidence in 10 Countries averaged at the regional level (2017-2020).
- Covariates computation (2017-2020).

5. STATISTICAL ANALYSIS
- Single-variable linear regression to assess the relationship between TBE incidence and each covariate
- Multi-variable linear regression to identify the **best parsimonius model**

Assessment of the MOST RELEVANT COVARIATES affecting TBE incidence in Europe

RESULTS

LITERATURE SEARCH

- We retrieved Information about **covariates** from 62 articles

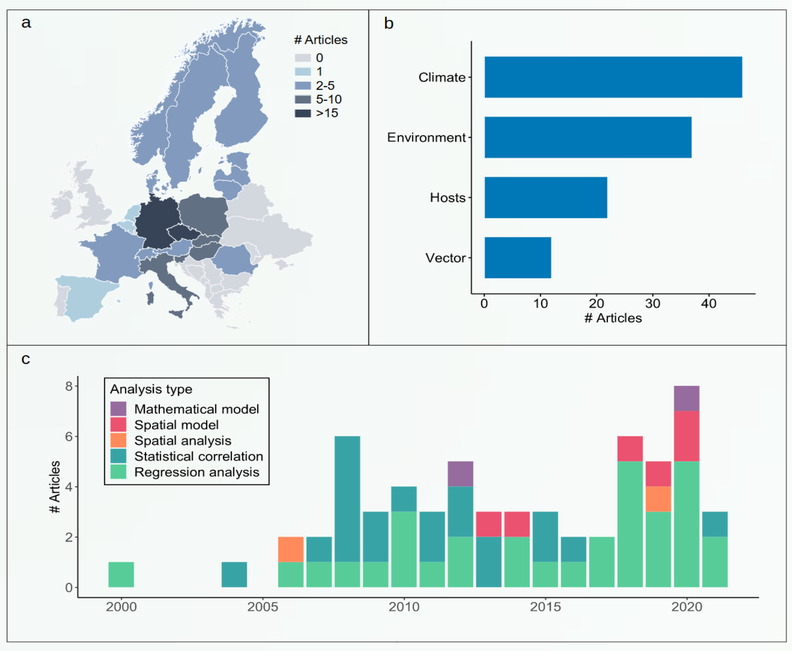


Figure 1 – Main characteristics of the studies included. a) Geographical distribution. b) Type of covariates adopted. c) Number of articles by year of publication and type of analysis.

- We selected for further analysis **31 covariates,** *i.e.* the ones adopted in at least 2 articles:

BEST PARSIMONIOUS MODEL (LMM)

```
Log(TBE_incidence) ~ Mean winter temp + Mean diurnal temp range + Autumnal cooling rate +
% of forested area + EVI + M. glareolus + A. flavicollis + Deer presence + Deer presence² +
(1|Reporting Country)
```

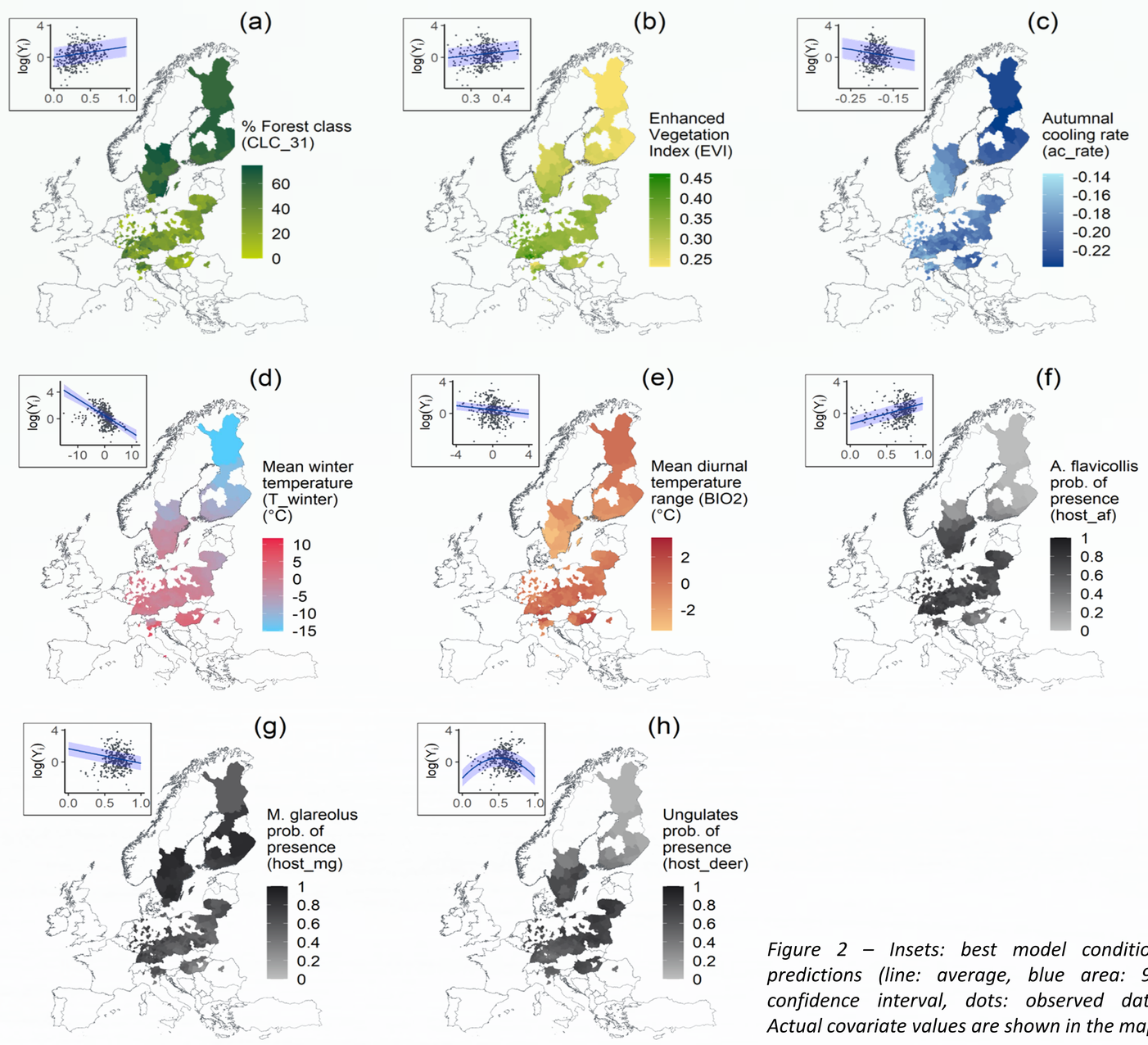
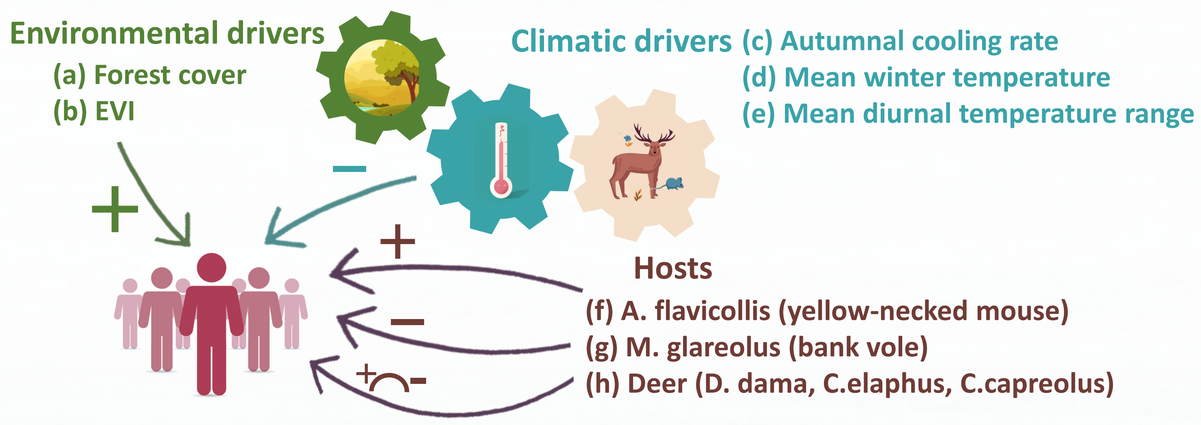


Figure 2 – Insets: best model conditional predictions (line: average, blue area: 95% confidence interval, dots: observed data.). Actual covariate values are shown in the maps.

REMARKS



Establishing the precise ecological conditions that favor TBE spread is a challenge, which is reflected in the high heterogeneity of covariates that have been investigated in existing literature.

This work will therefore provide essential inputs for the implementation of modern modeling approaches aimed at predicting the risk of spatio-temporal disease spread.

References

1. Daniel, M., Danielová, V., Kríz, B., Jirsa, A., Nozicka, J., 2003. Shift of the tick Ixodes ricinus and tick-borne encephalitis to higher altitudes in central Europe. Eur. J. Clin. Microbiol. Infect. Dis. Off. Publ. Eur. Soc. Clin. Microbiol. 22, 327–328. https://doi.org/10.1007/s10096-003-0918-2
2. Kreusch, T.M., Holding, M., Hewson, R., Harder, T., Medlock, J.M., Hansford, K.M., Dowall, S., Semper, A., Brooks, T., Walsh, A., Russell, K., Wichmann, O., 2019. A probable case of tick-borne encephalitis (TBE) acquired in England, July 2019. Euro Surveill. Bull. Eur. Sur Mal. Transm. Eur. Commun. Dis. Bull. 24. https://doi.org/10.2807/1560-7917.ES.2019.24.47.1900679

Contacts

francesca.dagostin@fmach.it

This work was funded by the European Union's Horizon 2020 research and innovation programme under Grant Agreement MOOD N°874850.