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Paper 63068

Identifying the most relevant covariates for the development of tick-borne encephalitis (TBE) hazard models at continental scale

Empower the Green Transition

24. May 2022, 10:40 • H2-02

Oral

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Assess contribution

Tick borne encephalitis (TBE) is a severe neurological disease caused by the TBE virus (TBEv), a flavivirus transmitted in Europe mainly by the ticks Ixodes ricinus and I. persulcatus. In nature, TBEv circulation is maintained in the environment by the co-occurrence of three major components: the virus, the vector and the presence of competent hosts, namely rodents. TBEv is typically distributed spatially and temporally as hotspots (foci of infection) and does not mirror the vector and host distributions. In recent decades, the incidence of TBE in human cases in Europe has been rising both in endemic and new regions, with altitudinal and latitudinal shifts, posing an increasing threat to public health. Therefore, the early localization of new TBE foci represents a priority at sanitary community level.

We systematically reviewed the existing literature including data on the drivers associated with the circulation of TBE in Europe: data from sixty-six full text papers were retrieved and analyzed, considering both biotic and abiotic factors.
Our review underlines the high level of heterogeneity, both in study design and type of variables, and the lack of values or thresholds associated with disease emergence.
We therefore aimed at identifying the most important ecological covariates for TBE hazard and at providing useful insights concerning possible uniform future directions. For instance, even though TBE has a typical hotspot distribution, it is present at continental scale and similarly are the distribution ranges of its main vectors and hosts. In order to investigate this aspect, advanced modelling techniques, such as spatial models based on high resolution satellite-derived data, have lately been implemented.

After assessing the main ecological covariates with higher predictive power for TBE hazard, we defined the main data sources, which include Earth Observation Data such as Land Surface Temperature (LST), Normalized Difference Vegetation Index (NDVI) and Land Cover. We subsequently validated our results on reported human cases of TBE and geo-referenced data of TBEv detections in ticks and hosts extracted from literature published between 2010 and 2021. The statistical analysis was focused on two European countries, namely Italy and Finland, which display several TBE foci and well represent the spatial variability of TBEv circulation at European level.