The impact of microclimatic temperature on vector-borne disease transmission in Denmark

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Background

- Replication of arboviruses within the vector depends on the temperature surrounding the vectors – the microclimatic temperature
- The threshold temperature for Bluetongue virus (BTV) replication in Culicoides is approximately 15°C
- Most mathematical models for virus development in vectors use the standard meteorological temperature instead of the microclimatic temperature

Objectives

- To quantify the difference between the meteorological temperature and the microclimatic temperature
- To model the microclimatic temperature of different habitats using standard meteorological parameters as input variables
- To compare the impact of the microclimatic and meteorological temperature on vector-borne disease transmission

Methods

Site: Strødam, Denmark
Data Collection: May-October 2015

Meteorological vs. Microclimatic temperature

There were more microclimatic hours with temperatures >15°C compared to the meteorological stations both in cooler (May) and warmer months (August) (Fig.2 and Fig.3)

Compared to meteorological temperature, microclimatic temperature showed a faster bluetongue virus development in Culicoides (Fig.4)

Modelling microclimatic temperature

We were able to express microclimatic temperature of different habitats as a function of meteorological temperature, solar radiation, wind-speed, precipitation, humidity, months and time of the day in multiple linear regression analysis

Discussion

- There are large variations between meteorological and microclimatic temperature
- Microclimatic temperature fasten virus development compared to meteorological temperature
- Instead of measuring, we can model and thus predict the microclimatic temperature for whole Denmark
- Since vectors are short lived, a small differences in virus development time can greatly influences the vector borne diseases transmission