

Climate Change Simulations of Usutu Virus Dynamics in Vienna

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Background: The emergence and spread of infectious diseases in mid-latitudes, so far mainly observed in the tropics, considerably increase under the current situation of climate change. A recent example is the Usutu virus (USUV) outbreak in Vienna, Austria. USUV is closely related to the West Nile virus (WNV) in the U.S. and caused mass mortalities mainly of blackbirds (*Turdus merula*). The USUV flavivirus persists in a natural transmission cycle between vectors (mosquitoes) and host reservoirs (birds) and leads – once endemic in a population – to periodic outbreaks.

Method: In an epidemic model to explain the USUV dynamics in Austria 2001–2005 (Rubel et al., 2008), USUV dynamics were mainly determined by an interaction of bird immunity and environmental temperature. To investigate future scenarios, we entered temperature predictions from five global climate models into the USUV model and also considered four different climate-warming scenarios defined by the Intergovernmental Panel on Climate Change, IPCC (20 different model-scenario combinations). We downscaled the 20 time series of predicted temperatures (through the year 2100) to represent the region around Vienna.

Results: Our simulations predict that USUV will persist in the host population after the epidemic peak observed in 2003. USUV-specific annual blackbird-mortality time series predict that the outbreak frequency increases successively from the beginning to the end of the century. Simulations of worst-case scenarios result in an endemic equilibrium with a decline of the blackbird population of about 24 percent. Additionally we calculated the annually averaged basic reproduction number for the period 1901–2100. The latter depict that undetected major outbreaks before 2000 were unlikely, whereas it is likely that the USUV becomes endemic after 2040 (Fig. 1).

Conclusions: We demonstrated that USUV epidemics are forced by environmental temperature and investigated future scenarios based on climate predictions. Our process model is proposed to investigate and explain the dynamics of the continental-scale WNV epidemics in North America.

