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Predicting the dynamics of infectious diseases according to climate change

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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. Recent examples are the Usutu virus (USUV) outbreak in Austria or the West Nile virus (WNV) spread across North America since 1999. Both are arthropod-borne virus (arbovirus) circulating between arthropod vectors (mainly mosquitoes of the *Culex pipiens* complex) and avian amplification hosts. While USUV infection leads to a high mortality of mainly blackbirds (*Turdus merula*), WNV causes cumulative infections of humans, thousands of perished horses and a mass mortality of black birds (*Corvus brachrhynochs*).

To explain the USUV dynamics in Austria 2001 - 2005 a process model was developed [1]. It has been demonstrated, that the USUV dynamics was mainly determined by an interaction of developing proportion of the avian hosts immune and climatic factors affecting the mosquito population. This mechanism is implemented into the model that simulates the seasonal cycles of mosquito and bird populations as well as the virus cross-infections. Observed monthly climate data are specified for the temperature-dependent development rates of the mosquitoes as well as the temperature-dependent extrinsic-incubation period. The model reproduced the observed number of dead birds in Austria between 2001 and 2005, including the peaks in the relevant years.

Forcing the model with temperature predictions from climate models enable to simulate disease dynamics for climate warming scenarios [2]. For the latter the *Tyndall Centre for Climate Change Research* dataset (TYN SC 2.0), based on 4 emissions

scenarios defined by the *Intergovernmental Panel on Climate Change* (IPCC) *Special Report on Emission Scenarios* (SRES), is used. A total of 20 time series of temperature predictions [3] have been selected to force the USUV model. The simulations cover the period 1900 - 2100. USUV will persist in the host population after the epidemic peak observed in 2003. Simulations of worst-case scenarios result in an endemic equilibrium with a decline of the blackbird population of 23.7 %. On average, however, a constant annual bird mortality of 7.3 - 11.9 % was predicted for the end of the century.

References

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