Introduction of two models to estimate the airborne spread of foot-and-mouth disease virus

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The application of epidemic models during the first days after the confirmation of a virus outbreak should significantly contribute to minimize its costs. Here we describe two epidemic (or atmospheric) models for the calculation of the airborne spread of virus and its application to foot-and-mouth disease (FMD). Goal of both models is to provide geographical maps depicting infection risk for various animal species to support the National health authorities.

The first model is a so-called Gaussian dispersion model to calculate 3-dimensional virus plumes. It is a deterministic model based on a diffusion equation with an existing analytical solution. This model is the standard method applied in epidemiological decision-support systems, but limited to homogeneous atmospheric conditions. Further it doesn't consider for structured topography as it is important for application in the European Alps. The second model is the so-called Lagrangian particle model, a stochastic model of much higher complexity. It calculates the spread of virus by considering both, heterogeneous wind fields and turbulence, the latter calculated with Monte-Carlo method.

Here we focus mainly on a decision-support system with a Gaussian dispersion model. Additional tools of this decision-support system are: A veterinary data base of geo-referenced premises, a geographical information system (GIS), and, as an external part running at the National Weather Service, a numerical weather prediction (NWP) model. The system has been applied for the first time during the Austrian real-time exercise on FMD, instructed by the European Union, in November 2004.

The final discussion comprises results of this real-time exercise as well as future applications of the Lagrangian particle model.