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Title:

Speed of Bluetongue Epizootic Wave in France during the 2006-2008 Outbreak

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In 2006-2009 northwest Europe experienced a major Bluetongue outbreak, an infectious disease of ruminants transmitted by biting midges belonging to the genus *Culicoides*. Bluetongue Virus, the causal agent, was introduced near Maastricht in the Netherlands, close to the borders with Germany and Belgium, in summer 2006. Bluetongue spread rapidly, infecting 2,000 farms across Belgium, Germany, the Netherlands, France and Luxembourg in 2006, and more than 30,000 farms in 2007 reaching Denmark, the United Kingdom, Switzerland, and the Czech Republic. By the end of 2009, Bluetongue had spread to most of the countries in northwest Europe.

France was particularly impacted by the disease in 2007-2008. We explored the spatial dynamics of Bluetongue to understand where and how fast the disease spread. Using a trend-surface analysis model combined with a spatial error simultaneous autoregressive model, we estimated the speed of the Bluetongue epidemic wave based on clinical cases in France in 2007-2008. Overall, Bluetongue spread from north-eastern to south-western France with an average estimated velocity of 5.6 km/day. However, the diffusion was not homogeneous, and the velocities differed between areas and time periods, varying between 2.1 and 9.3 km/day. To understand what has influenced the speed of spread across the country, we also investigated the effect of environmental conditions on the estimated velocities. We specifically studied the effect of host density, host vaccination, landscape pattern, and lagged meteorological conditions as a proxy of vector abundance and activity.

Our study showed that Bluetongue spread in France was primarily local, consistent with the active flight of *Culicoides* and local movements of farm animals. Beside the expected effect of host density and vaccination on Bluetongue spread, we highlighted the effect of landscape pattern and 2-month lagged meteorological conditions as major factors influencing the velocity of the epizootic wave.

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