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Hydrologic control on the spreading of diseases: on the space-time evolution of a cholera epidemic.

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We study how river networks, acting as environmental corridors for pathogens, affect the spreading of cholera epidemics. Specifically, we compare epidemiological data from the real world with the space-time evolution of infected individuals predicted by a theoretical scheme based on reactive transport of infective agents through a biased network portraying actual river pathways. The data pertain to a cholera outbreak in South Africa which started in 2000 and affected in particular the KwaZulu-Natal province. The epidemic lasted for two years and involved about 140,000 confirmed cholera cases. Hydrological and demographic data have also been carefully considered. The theoretical tools relate to recent advances in hydrochory, migration fronts and infection spreading, and are novel in that nodal reactions describe the dynamics of cholera. Transport through network links provides the coupling of the nodal dynamics of infected people, who are assumed to reside at the nodes. This proves a realistic scheme. We argue that the theoretical scheme is remarkably capable of reproducing actual outbreaks, and indeed that network structures play a controlling role in the actual, rather anisotropic propagation of infections, in analogy to spreading of species or migration processes that also use rivers as ecological corridors.