

# Quantifying the impact of cross-border flux on disease dynamics

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Countries all over the world have implemented various cross-border policies such as mandatory testing, quarantining upon arrival, and travel restrictions to minimize the risk of infection. The strength of these measures has varied over time. The aim of this study is twofold. First, we develop a spatially explicit SIR-type mechanistic model to assess the epidemiological consequences of allowing cross-border mobility between two countries under different epidemic conditions. We show that the time to achieve the peak of infection is significantly changed if cross-border mobility is allowed during disease outbreak. Moreover, if we compare between the scenarios with and without cross-border flux, the difference in peak timings in two countries is reduced in the latter case. Next, based on stochastic simulation, we present a method for estimating cross-border mobility flux between two regions from the difference in peak-timing in infection under some reasonable assumptions. As a case study, we apply the method to data from the Germany-Poland border region and quantify heterogeneity in cross-border fluxes along the border during the COVID-19 pandemic.