

Phylogeography as a proxy for population connectivity for spatial modeling of foot-and-mouth disease outbreaks in Vietnam

Umanga Gunasekera¹, Miranda R. Bertram², Andres Perez¹, Jonathan Arzt², and Kimberly VanderWaal¹

¹University of Minnesota Department of Veterinary Population Medicine

²USDA-ARS Plum Island Animal Disease Center Branch

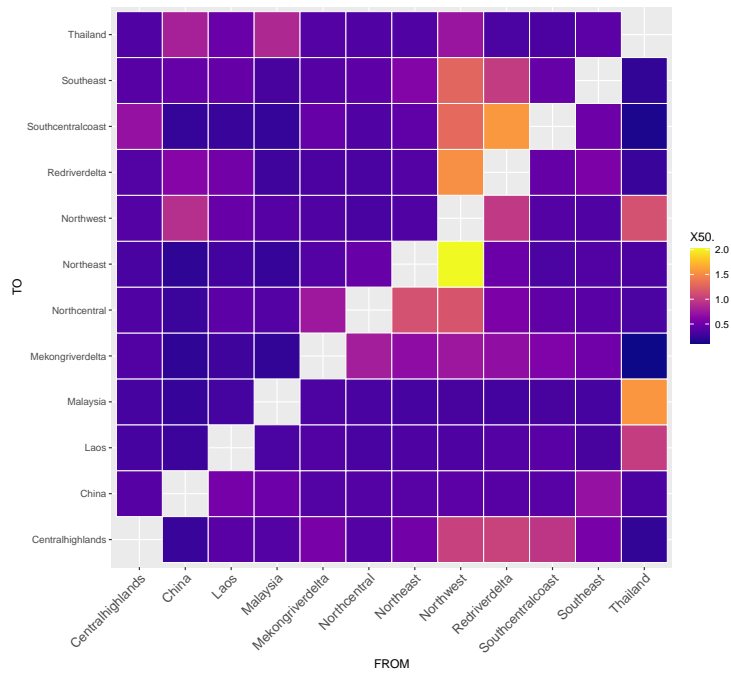
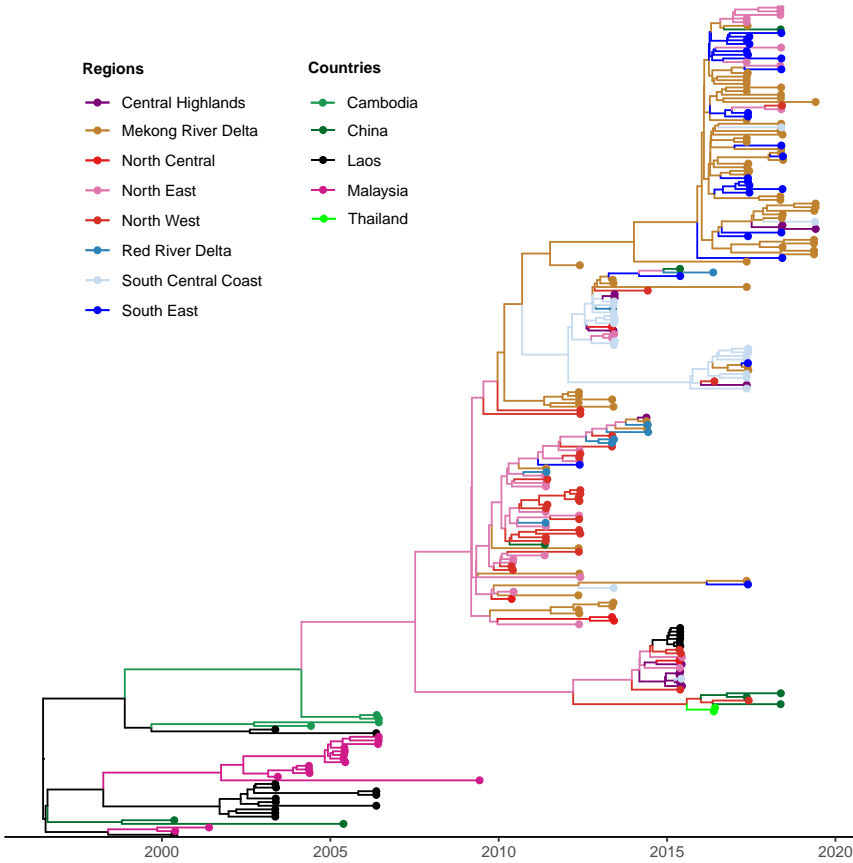
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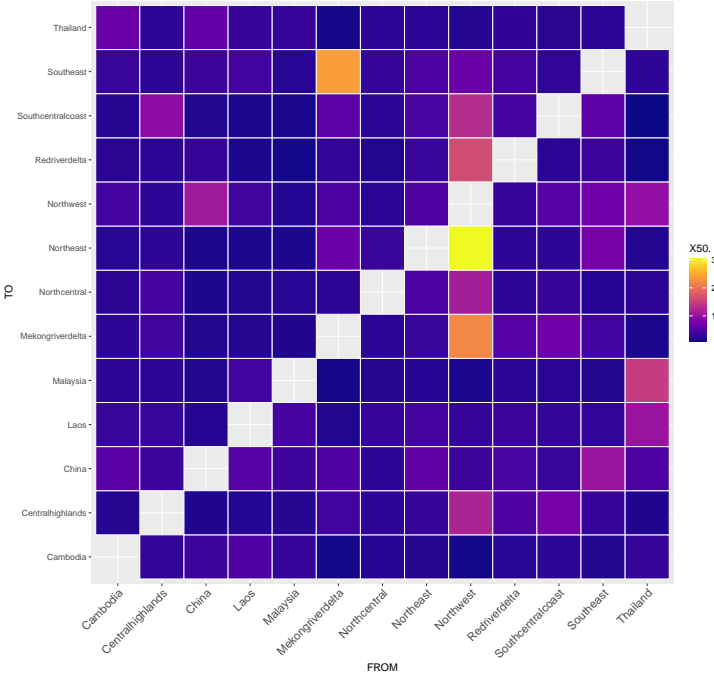
Abstract

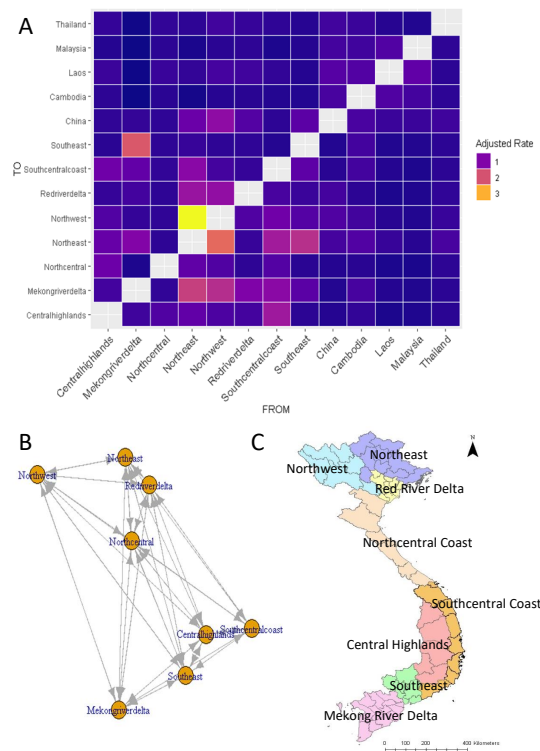
Bayesian space-time regression models are helpful tools to describe and predict the number and distribution of infectious disease outbreaks, identify risk factors, and delineate high-risk areas for disease prevention or control. In these models, structured and unstructured spatial and temporal effects account for various forms of non-independence amongst case counts reported across spatial units. For example, structured spatial effects are used to capture correlations in case counts amongst neighboring provinces that may stem from shared risk factors or population connectivity. For highly mobile populations, spatial adjacency is an imperfect measure of population connectivity due to frequent long-distance movements. In many instances, we lack data on host movement and population connectivity, hindering the application of space-time risk models that inform disease control efforts. Phylogeographic models that infer routes of viral dissemination across a region could serve as a proxy for historical patterns of population connectivity. The objective of this study was to investigate whether the effects of population connectivity in space-time regressions of case counts were better captured by spatial adjacency or by inferences from phylogeographic analyses. To compare these two approaches, we used foot-and-mouth disease virus (FMDV) in Vietnam as an example. We explored whether the distribution of reported clinical FMD outbreaks across space and time was better explained by models that incorporate population connectivity based upon FMDV movement (inferred by discrete phylogeographic analysis) as opposed to spatial adjacency and showed that the best-fit model utilized phylogeographic-based connectivity. Therefore, accounting for virus movement through phylogeographic analysis serves as a superior proxy for population connectivity in spatial-temporal risk models when movement data are not available. This approach may contribute to the design of surveillance and control activities in countries in which movement data are lacking or insufficient.

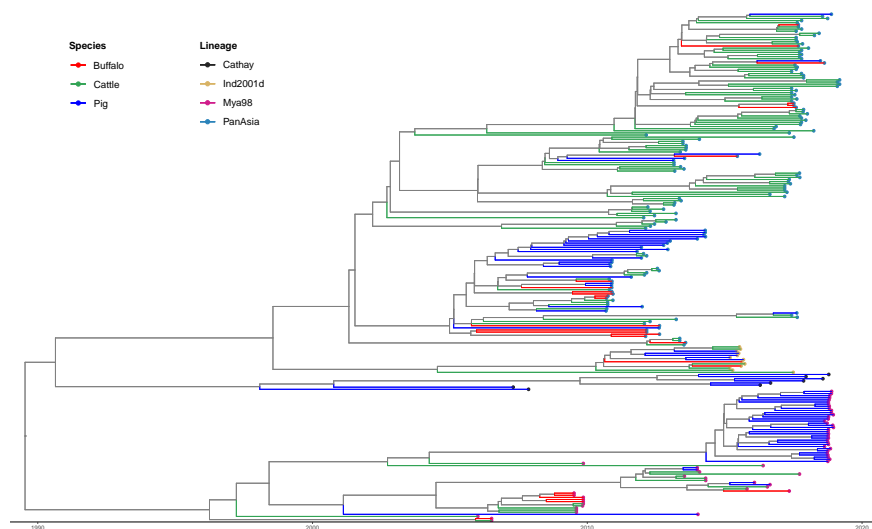
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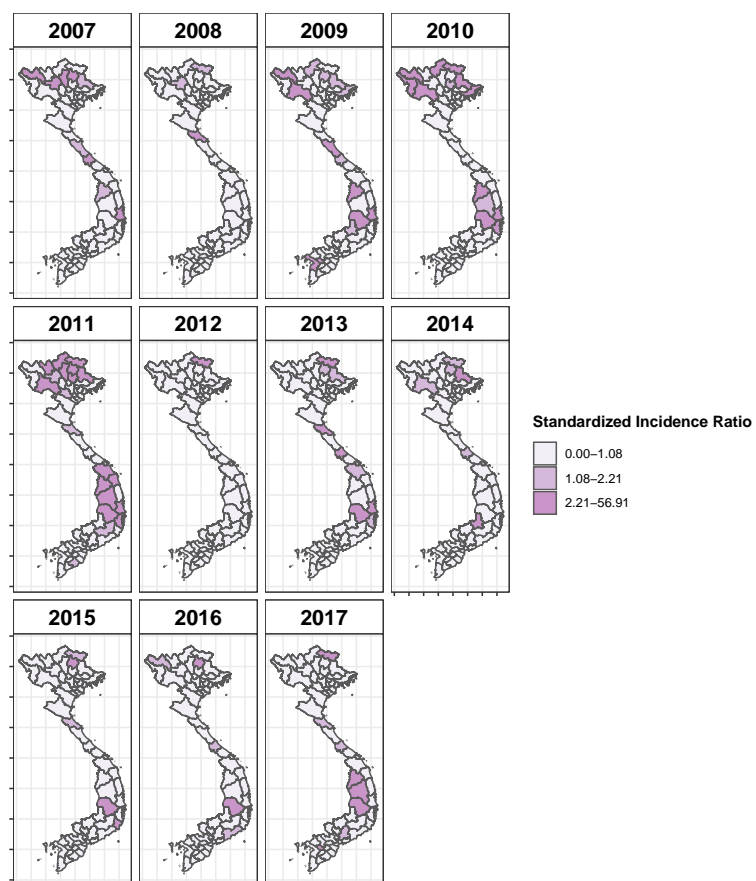
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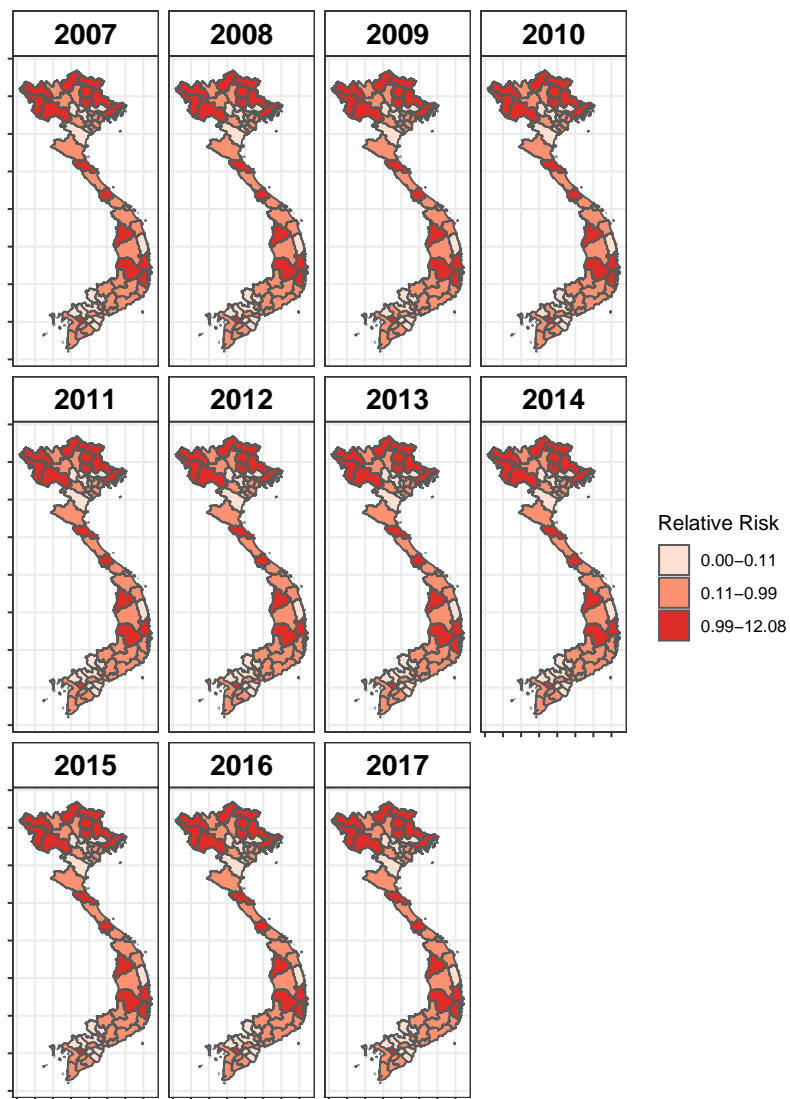


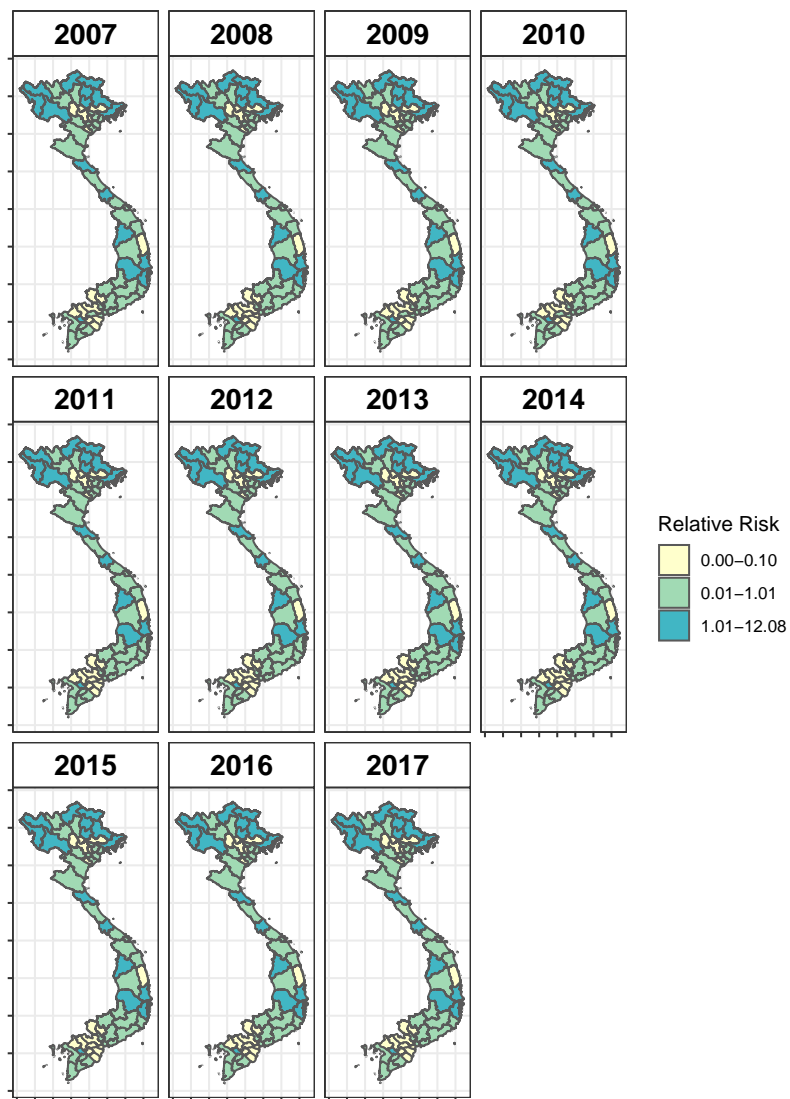


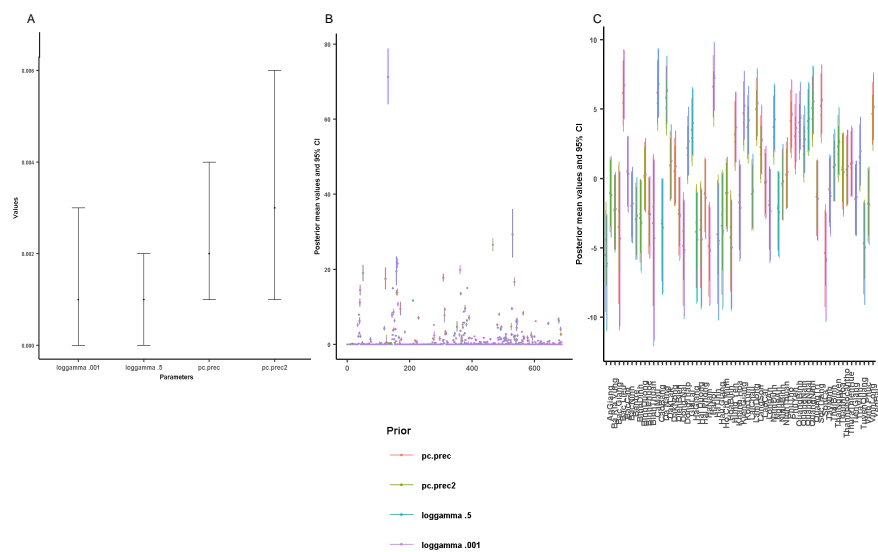












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