Assessing the Relative Risk of RVF Introduction to the USA via Airline Traffic

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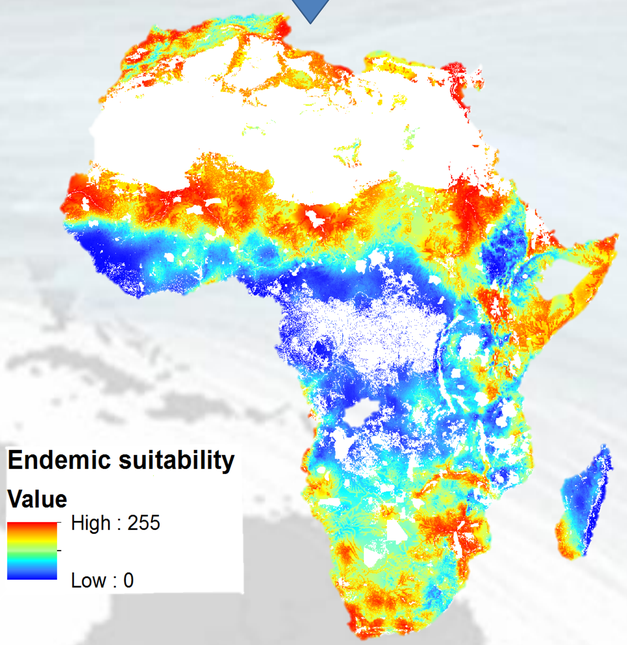
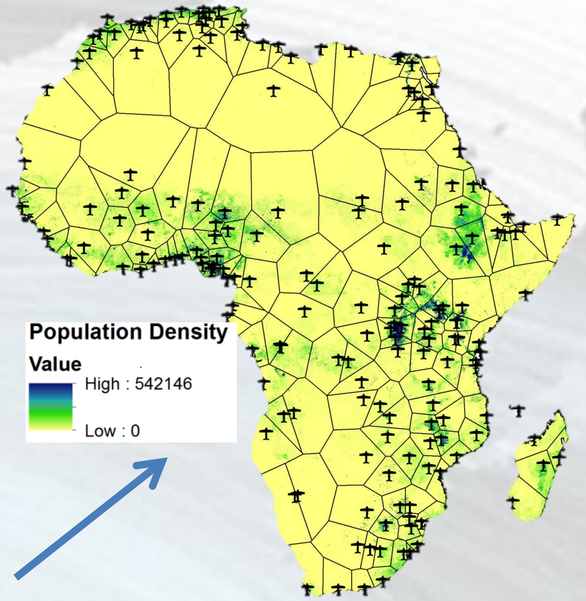
Introduction: The goal of this study is to quantify the relative risk of introduction of Rift Valley Fever (RVF) into airports in the USA. RVF is a multi-host mosquito borne disease which was first recognized in Kenya in 1931 and has since been found throughout the continent of Africa, as well as Saudi Arabia, and Yemen. Outbreaks of the virus can have severe economic impacts, causing large scale spontaneous abortions of livestock fetuses. RVF can also infect humans and cause hemorrhagic fever and death. In this study, we combined information about the life history of hosts, vectors, and pathogens with spatial distribution and movement data in order to quantify introduction pathways of the disease into the United States.

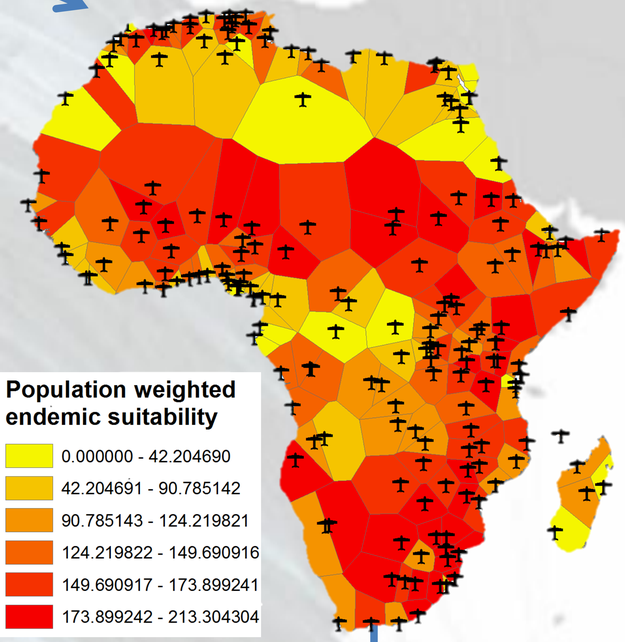
Clements (2006) calculated a suitability index for RVF endemicity using factors such as rainfall, livestock density, and proximity to standing water.



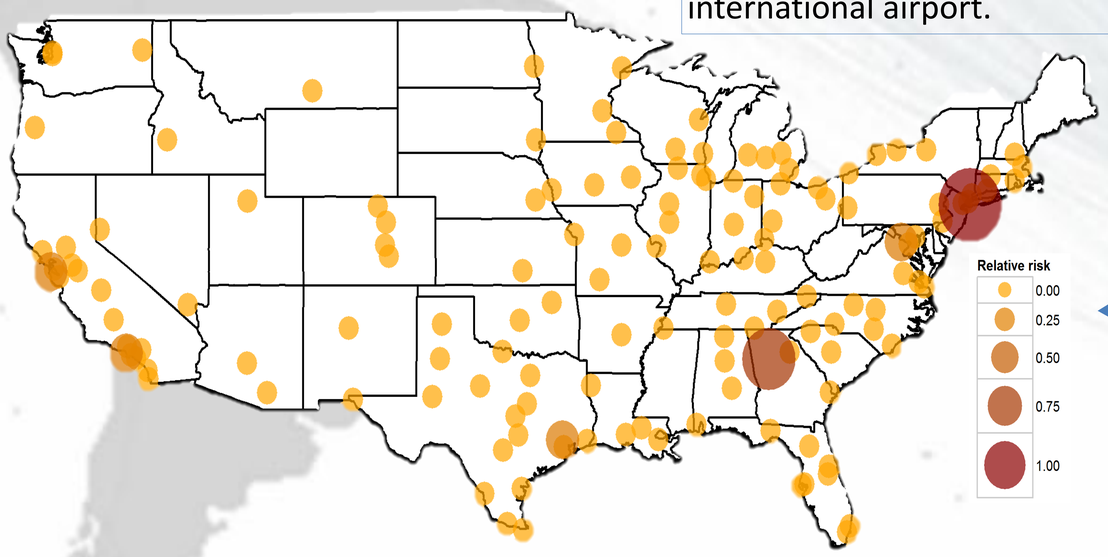


We use this relative risk index and scale it with human population density to determine the relative risk of where infected individuals may exist. We then constructed Voronoi polygons to determine the likely population clusters using each international airport.

We assigned each polygon a weighted risk of an infected individual leaving with RVF.



Now that we know where RVF might leave Africa we can combine this with air traffic data to determine the relative risks of where an infected individual might land in the USA.



Conclusion: We found that JFK in New York and Hartsfield–Jackson in Atlanta were the airports that had the highest risk of RVF introductions. These cities also corresponded to the highest number of travelers arriving from Africa. We have also shown that the risk of introduction is robust to the suitability map used and driven primarily by airline passenger flows. Our future work will look at the role of seasonal introduction risk by combining seasonal risk measures and passenger flows. In addition, we hope to determine whether heterogeneity in traveler behavior (e.g., locations visited by a tourist versus a businessman) drives introduction risk.

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