# Modelling the Epidemic Spread of Zika Using Mobile Phone Data in Colombia

***D. Perrotta***[1], *E. Frias-Martinez*[2], *M. Luengo-Oroz*[3], *D. Paolotti*[1], *M. Tizzoni*[1], *A. Vespignani*[1,4]. *(1) ISI Foundation, Via chisola 5, Turin, Italy, daniela.perrotta@isi.it. (2) Telefonica Research, Ronda de la Comunicación S/N, Madrid, Spain. (3) United Nations Global Pulse, 370 Lexington Avenue, New York, USA. (4) Northeastern University, 360 Huntington Ave, Boston, USA.*

Human mobility plays a central role in the spatial spread of human infectious diseases. Accurate data on human mobility is therefore key to properly design epidemic models that allow to timely assess the spatial propagation of infectious diseases and to evaluate appropriate control measures and intervention strategies. In this context, the digital traces left by mobile phone users' activity represent a powerful tool for capturing mobility patterns and providing a high-level picture of human mobility at an unprecedented scale. In this study, we investigate the human mobility patterns relevant to the epidemic spread of Zika in Colombia, with the aim of assessing the predictive power of the human mobility derived from mobile phone data compared to more traditional methods, namely census data and mobility models. Figure 1 displays the mobility networks reconstructed for each method. Our results show that the gravity model strongly underestimates the mobility of census data, whereas the mobility determined by the radiation model and the mobile phone data show a comparable performance with high correlations and similarities with census data, thus reproducing well the mobility between departments in Colombia. To model the spread of Zika in Colombia, our approach is based on a metapopulation model that explicitly simulates the spatial epidemic spread as governed by the transmission dynamics of the virus through human-mosquito interactions and promoted by population movements across the country. Following the same methodology adopted in [1], our model integrates detailed data on the spatial heterogeneity of the mosquito abundance and the consequent exposure of the population to the disease, as well as detailed data on the population and the Zika cases. Given the same modelling settings (i.e. initial conditions and parameters), this approach allows to perform numerical simulations of the spatio-temporal progression of the disease by integrating one mobility network at a time to ultimately assess their predictive power by comparing the simulated epidemic profiles with the Zika cases officially reported by the Instituto Nacional de Salud (INS) in Colombia.

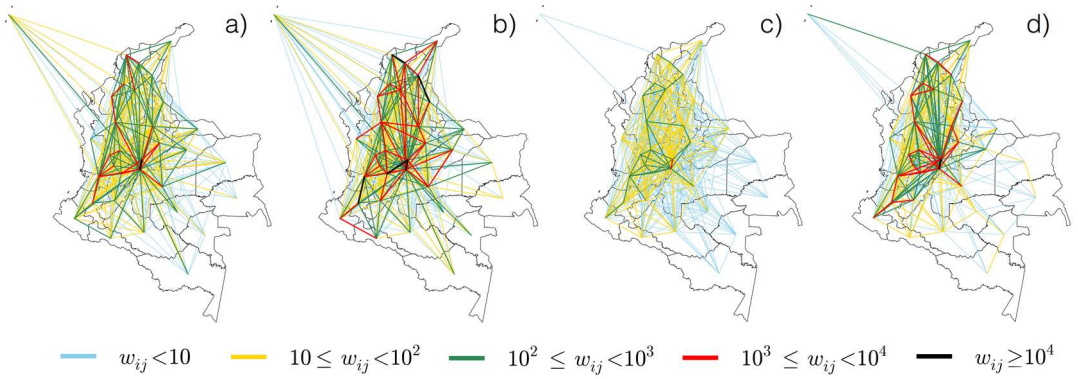


**Figure 1**: Mobility networks describing the flows $w_{ij}$ of people daily travelling between departments in Colombia as generated by a) census data, b) mobile phone data, c) gravity model and d) radiation model.

## References

[1] Q. Zhang et al, *Proceedings of the National Academy of Sciences*, 2017, 114 (22)