Maps & Macroscopes: Gaining Insights from BIG Data

Local Short-term Decisions vs. Global Long-term Decisions
**Impact of Air Travel on Global Spread of Infectious Diseases**

Epidemic spreading pattern changed dramatically after the development of modern transportation systems.

In pre-industrial times disease spread was mainly a spatial diffusion phenomenon. During the spread of Black Death in the 14th century Europe, only few traveling means were available and typical trips were limited to relatively short distances on the time scale of one day. Historical studies confirm that the disease diffused smoothly generating an epidemic front traveling as a continuous wave through the continent at an approximate velocity of 200-400 miles per year.
The SARS outbreak on the other hand was characterized by a patchy and heterogeneous spatio-temporal pattern mainly due to the air transportation network identified as the major channel of epidemic diffusion and ability to connect far apart regions in a short time period. The SARS maps are obtained with a data-driven stochastic computational model aimed at the study of the SARS epidemic pattern and analysis of the accuracy of the model's predictions. Simulation results describe a spatio-temporal evolution of the disease (color coded countries) in agreement with the historical data. Analysis on the robustness of the model's forecasts leads to the emergence and identification of epidemic pathways as the most probable routes of propagation of the disease. Only a few preferential channels are selected (arrows: width indicates the probability of propagation along that path) out of the huge number of possible paths the infection could take by following the complex nature of airline connections (light grey; source: IATA).
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