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Human travel and time spent at destination: impact on the epidemic invasion dynamics CHIARA POLETTO, MICHELE TIZZONI, ISI Foundation, Turin, Italy, VITTORIA COLIZZA, INSERM and Univ Pierre et Marie Curie, UMR-S 707, Paris, France —
Human mobility has a strong impact on the spatial spread of infectious diseases. Analyses of metapopulation models, that consider the epidemic spreading on a network of populations, show that topological and traffic fluctuations favor the global epidemic invasion. These studies consider markovian mobility (i.e. the memory of the origin of traveling individuals is lost) or non-markovian mobility with homogeneous timescales (i.e. individuals travel to a destination and come back with a homogenous rate). However, the time spent at destination is found to exhibit wide fluctuations. Such varying length of stay crucially affects the mixing among individuals and hence the disease transmission dynamics. In order to explore this aspect, we present a modeling framework that, by using a time-scale separation technique, allows analyzing the behavior of spreading processes on a complex metapopulation network with non-markovian mobility characterized by heterogeneously distributed timescales. Analytical and numerical results show how the degree of heterogeneity of the length of stay is able, alone, to drive a phase transition between local outbreak and global invasion. This highlights the importance of the interplay between mobility and disease timescales in the propagation of an epidemic.

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