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Multiscale mobility networks and the large scale spreading of infectious diseases[1]

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Among the realistic ingredients to be considered in the computational modeling of infectious diseases, human mobility represents a crucial challenge both on the theoretical side and in view of the limited availability of empirical data. In order to study the interplay between small-scale commuting flows and long-range airline traffic in shaping the spatio-temporal pattern of a global epidemic we *i)* analyze mobility data from 29 countries around the world and find a gravity model able to provide a global description of commuting patterns up to 300 kms; *ii)* integrate in a worldwide structured metapopulation epidemic model a time-scale separation technique for evaluating the force of infection due to multiscale mobility processes in the disease dynamics. Commuting flows are found, on average, to be one order of magnitude larger than airline flows. However, their introduction into the worldwide model shows that the large scale pattern of the simulated epidemic exhibits only small variations with respect to the baseline case where only airline traffic is considered. The presence of short range mobility increases however the synchronization of subpopulations in close proximity and affects the epidemic behavior at the periphery of the airline transportation infrastructure. The present approach outlines the possibility for the definition of layered computational approaches where different modeling assumptions and granularities can be used consistently in a unifying multi-scale framework.

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