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SÉMINAIRE

Network-based approaches for the spatial spreading of communicable diseases

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Mathematical and computational approaches based on network theory and complex system dynamics are increasingly showing their potential to address open problems on the spreading of communicable diseases on a spatially structured and heterogeneous human population. I will review my recent research work in this direction presenting studies on both fundamental problems and specific epidemic events. On the theoretical side, I will show how the mathematical formalism of reaction-diffusion processes and metapopulation networks can shed light on the impact of the complex features characterising individuals' mobility patterns on the propagation of emerging infections. How do traveling flows, journey duration and difference in travel frequency impact local mixing and transmission of influenza-like diseases? How do the mobility of individuals and their distribution in space determine dominance/co-dominance regimes in case of multiple interacting strains of the same pathogen? Besides these fundamental research questions, the same formalism can form the basis of data-driven computational models for the spatial spreading of real infection events. In case of an epidemic emergency, such models represent valuable tools for estimating in real time the transmission potential of the disease, providing assessment of the epidemic situation and projections of possible unfolding scenarios. I will discuss the two paradigmatic examples of the 2009 H1N1 pandemic and of the MERS-CoV outbreak.