Ninth Workshop Dynamical Systems Applied
to Biology and Natural Sciences DSABNS 2018
Turin, Italy, February 7-9, 2018

MEASLES: SYNCHRONIZATION, LOCAL PERIODICITIES AND HUMAN MOBILITY

Andrea Parisi[1,2]* and Ramona Marguta[2]

[1] CHICAS group – Lancaster Medical School, Faculty of Health and Medicine, Lancaster University, Lancaster LA1 4YG (UK)

[2]BioISI – Biosystems and Integrative Sciences Institute, Departamento de Física, Faculdade de Ciências da Universidade de Lisboa, Campo Grande Ed. C8, 1749-016 Lisboa (Portugal)

andreaparisi.physics@gmail.com (*corresponding author)

Several studies have explored the influence of human mobility on the global spread of infectious diseases, however few studies have explored its influence on the local characteristics of the oubtreaks. Recent research on our side already has shown how local and global dynamics of measles are affected by human mobility by tuning the importance of the different underlying driving mechanisms: here we show that synchronization is a key feature to understand the time series observed at national or supranational level.

We explore the dynamics of an SIR model parametrized for measles in the pre-vaccination era on the British Isles, and show how human mobility has a direct impact on local synchronization, periodicity and persistence. We recently introduced a simulation program that explores the geographic spread of infectious diseases using individual based simulations on high resolution gridded maps, and permits to simulate extremely large geographical areas. Human mobility is implemented through the Radiation Model, and the dynamics move individuals daily among a set of preferred locations. Parallel computation combined with a code generator for epidemiological models permits fast execution of simulations of complex models.

Synchronization and periodicities observed among local communities are affected by the intensity of the human mobility. While areas of biennial periodicity tend to be, on averge, synchronized in phase, opposition of phase is actually quite common and stable. The common occurrence of opposition of phase might explain extended periods of opposition of phase observed in pre-vaccination time series of some locations in England and Wales, which had previously been explained as the result of propagating disease waves.

 ISBN: 978-989-98750-4-3

References

[1] R. Marguta, A. Parisi (2016). *Periodicity, synchronization and persistence in pre-vaccination measles* J. R. Soc. Interface, 13, 20160258 (2016) doi: 10.1098/rsif.2016.0258

[2] R. Marguta, A. Parisi (2016). *Impact of human mobility on the periodicities and mechanisms underlying measles dynamics* J. R. Soc. Interface, 12, 20141317 (2015) doi: 10.1098/rsif.2014.1317

[3] R. Marguta, A. Parisi (2016). *Human mobility and the Dynamics of Measles in Large Geographical Areas* in "Proceedings of ECCS 2014", Springer Proceeding in Complexity. S. Battiston et al. (eds.), pp 169-179 (2016) doi: 10.1007/978-3-319-29228-1_15

 ISBN: 978-989-98750-4-3