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Pathogen emergence under temporal heterogeneity

One of the key factors driving the emergence of disease is changes to climate. Climate change is expected to not only alter the mean of various environmental variables but also their variability. The effect of changes to the environmental mean on pathogen emergence has received considerable attention.

In this work we propose a theoretical approach to investigate the effect of changes to environmental variability on pathogen emergence and develop a multi-type branching process incorporating temporal heterogeneity and pathogen adaptation.

Previous studies have found that increases to environmental variability cause a decrease to pathogen emergence in a non-evolutionary system. Our results agree with this finding and find this is also true when pathogens must adapt to survive and cause an epidemic. It has also been shown that the effects of incorporating evolution can often outweigh other effects, we find however even in an evolutionary system temporal heterogeneity can significantly affect pathogen emergence. The greatest effect being on pathogens whose survival is not strongly dependent on its need to adapt and pathogens already adapted to its environment but with low infectivity.