Late quadratic growth of COVID-19

Axel Brandenburg

Nordita, KTH Royal Institute of Technology and Stockholm University, Stockholm, Sweden

(September 7, 2020)

In Brandenburg (2020), it was shown that in a two-dimensional epidemic model, the normalized averaged number of infections $\langle I\rangle$ grows quadratically in time when the population is not strongly mixed and the local number of infections I is large compared to the number of susceptible ones S that can still be infected. This leads to what is known as peripheral growth, which is always quadratic, but with a time constant that depends on the number of hotspots that are surrounded by an individual front.

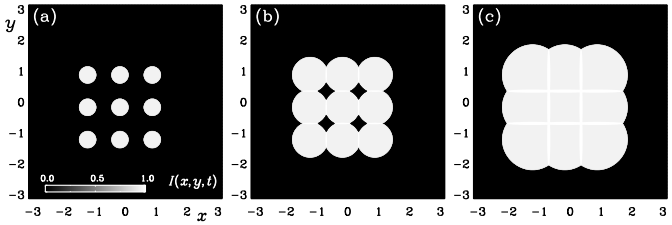

Figure 1: Simulation with 9 hotspots that later merge and overlap. The local distribution of $I(x,y,t)$ is shown in the xy plane for three values of t. The length of the circumference determines the speed of growth. When several hotspots merge, the circumference shortens and the growth slows down.

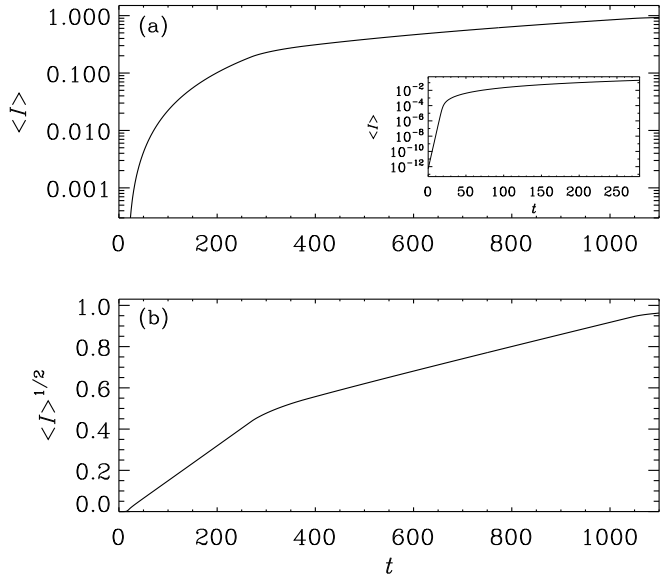

Figure 2: Time series for simulation with 9 hotspots that later overlap. Note that $N^{1/2}\propto\langle I\rangle^{1/2}$ grows linearly with time t, which shows that $N\propto t^2$.

It was shown that the growth is faster when there are more fronts, and it was stated that the growth becomes slower when fronts merge and several hotspots now connected by a common front. The result of a simulation similar to the fiducial run of Brandenburg (2020) is shown in Figures 1 and 2. The value of N is proportional to $\langle I\rangle$. The simulations have been performed with the Pencil Code (Brandenburg & Dobler, 2010).

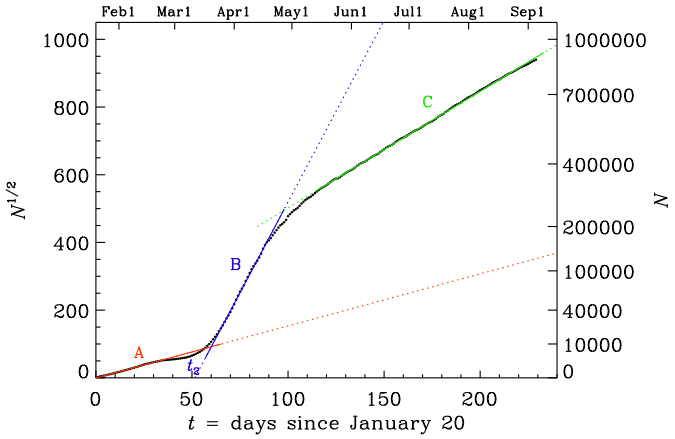

Figure 3: Square root of N (black dots) versus time since January 20, 2020. The actual date is given on the upper axis and the actual values of N are given on the right-hand axis.

A decrease in the slope of $N^{1/2}$ versus t is indeed seen since May 2020; see section C of Figure 3, which is an updated version of Figure 2 of Brandenburg (2020), where only data until April 20 were analyzed. Here, N is actually the number of deaths, which is taken from the worldometers website[1] as a more reliable proxy of the number of infections. During section A, the epidemic was largely confined to China, but during section B many other places in the world got affected.

References

Brandenburg, A. 2020, Infectious Disease Modelling, in press, arXiv:2002.03638 Piecewise quadratic growth during the 2019 novel coronavirus epidemic

Brandenburg, A., & Dobler, W., Pencil Code, Astrophysics Source Code Library, ascl:1010.060, `http://ui.adsabs.harvard.edu/abs/2010ascl.soft10060B` DOI:10.5281/zenodo.2315093.

[1] `http://www.worldometers.info/coronavirus/`