The dance of the wolves and the rabbits

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Management of satellite resources from NASA and commercial entities, with the aim of understanding and predicting the dynamics between the mobility indicators of society and the indicators of increase in the cases of COVID-19, and finally integrating them into a unified framework: the predator prey model.

Introduction

We have observed that in several parts of the world preventive measures of social isolation were taken against COVID-19 that were very effective. However, as the population mobility indicators increase, the positive case indicators show an acceptable positive correlation. This motivated us to ask ourselves if there is any ecological model that allows us to anticipate possible collapse scenarios, and in that search we found the predator prey model.

First step: ACTIVITY AND MOBILITY INDICATORS

We used the resources available in NASA's Black Marble to estimate anthropic activity levels at night, by luminescence from each site, however, since we were unable to access current data, we were unable to correlate them with indicators of positive cases . To access walker and driver data, we use Apple's resources, and to obtain retail and recreation sales, groceries and pharmacies, park activity, transit station activity, workplace activity, and residence activity , we use Google resources

Fig. 1. Argentina on black marble, so beautiful, so fragile.
Earth at Night 2012. Suomi NPP / VIIRS vía NASA Earth Observatory (14)

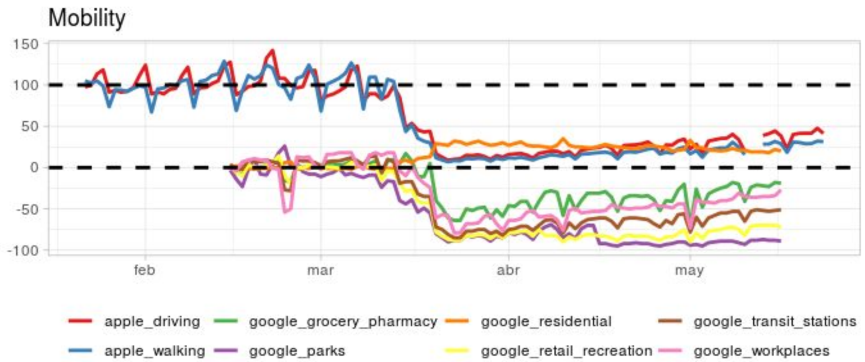

Fig. 2. Indicators of mobility. A drop in activity is also evident as of March 20 (F1) and from that moment on, activities related to the sale of groceries and drugs, in workplaces and transit stations, begin to gradually increase. Park and recreation activities remain low, and residential activities increase and remain stable. Keep in mind that the Apple indicators use 0 as the baseline and the Google indicators use 100 as the baseline.

Second step: POSITIVE CASE INDICATORS

We use the resources available at NASA SEDAC and the Johns Hopkins Center to access the number of infections per day and daily tests performed. From these data, we calculate the daily rate of increase (DGR) and the percentage of daily positive tests (PPT). We went a little further and relied on the bibliography to consider the incubation time of the virus in the correlations, thus adjusting the indicators (DGR_i and PPT_i)

1. DGR = No. of positive cases on day * 100 / No. of positive cases accumulated up to that day.
2. PPT = No. of confirmed cases per day * 100 / Total number of tests performed per day.
3. DGR_i = No. of positive cases 5 days ago * 100 / No. of positive cases accumulated up to 5 days ago.
4. PPT_i = No. of cases confirmed 5 days ago * 100 / Total tests performed 5 days ago.

Fig. 3. NASA SEDAC (3)

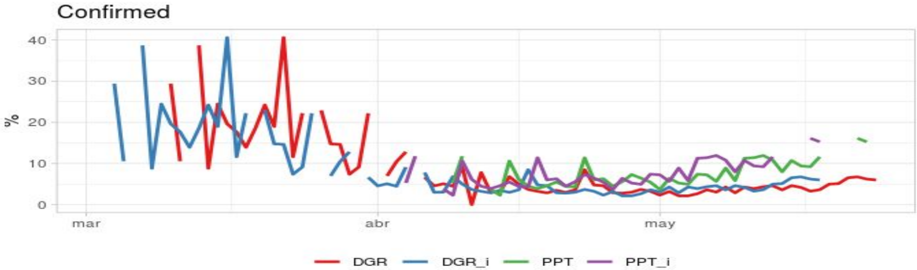

Fig. 4. In the chart of confirmed cases) note that the difference between DGR and DGR_i, and between PPT and PPT_i is 5 days. It is observed that as of F1, on March 20, these indicators decrease significantly. However, they begin to increase gradually.

Third step: CORRELATION BETWEEN MOBILITY INDICATORS AND POSITIVE CASES

We observe that the mobility indicators correlate positively with the increase in the daily growth rate (DGR), the daily growth rate adjusted by incubation period (DGR_i), the percentage of positive tests (PPT) and the percentage of positive tests adjusted for incubation period (PPT_i). Exceptionally, these indicators are negatively correlated with residential activity, and that is to be expected, the more people there are in their homes, the less mobility there is in the population. This suggests that the more mobility there is in the population, the greater the transmission of the virus.

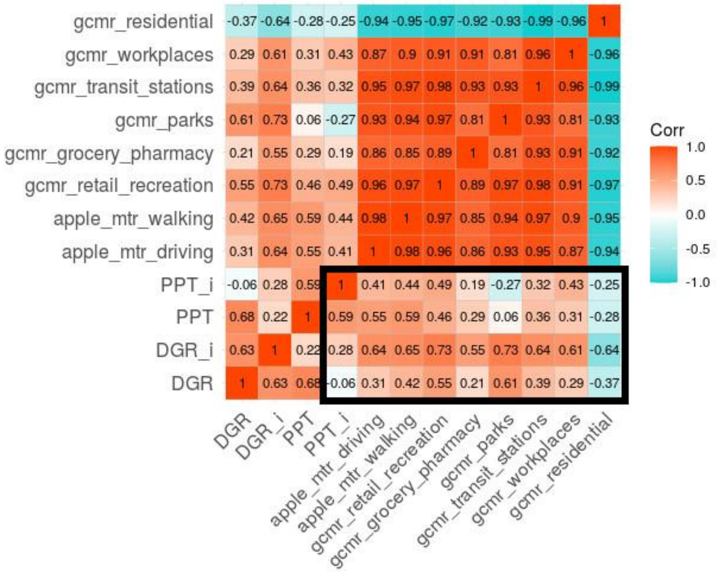

Fig. 5. Correlations.

Step Four: PREDATOR PREY MODEL

This graph shows the dynamics in the predator prey model. We could consider, for example, an indicator of mobility (such as activities in transit stations), or night luminescence in blue, compared to an indicator of positive cases such as (DGR or PPT) in red. Choosing which parameter to use and to what extent it will be included in the predator and prey model should be the exhaustive result of a previous modeling for each site. We would like to be able to deliver the project with a more detailed approach, but due to the lack of time and the lack of data at the present time, we limited ourselves to presenting an initial idea.

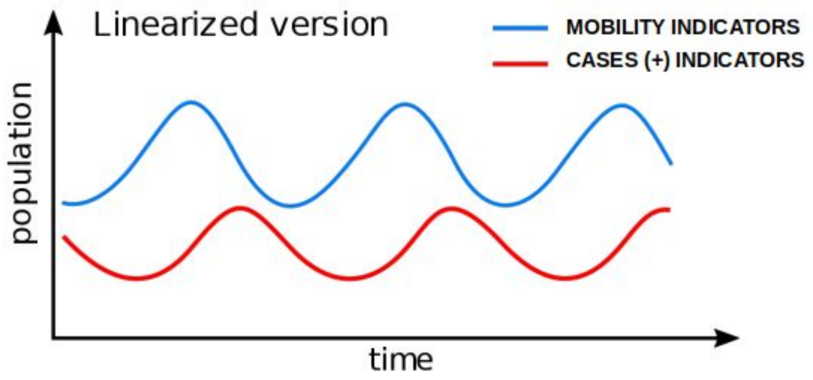

Fig. 6. Predator prey model.

What would be the next steps?

As the days pass and we have more data on the interaction between the mobility of the population and the number of infections, we will be able to model these variables with greater precision to include them in the predator prey model with a specific adjustment for each site. Based on this knowledge, the next step is the development of applications, APIs, libraries, among other automated tools that allow the design of a more dynamic preventive social isolation, which helps to regulate the number of infected without exceeding the load capacity of health units. By establishing regulated preventive social isolation, positive cases of COVID-19 would be controlled, allowing societies greater flexibility in the flow of activities to avoid psychological and socioeconomic collapse. In parallel, the time frame is extended to decrease predatory efficiency (β) through the development of new treatments or perhaps an improvement in the acquired immunization of people.

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Thanks for your time!!!