Mar 26, 2020

Suitability Map of COVID-19 Virus Spread V.4

Gianpaolo Coro[1]

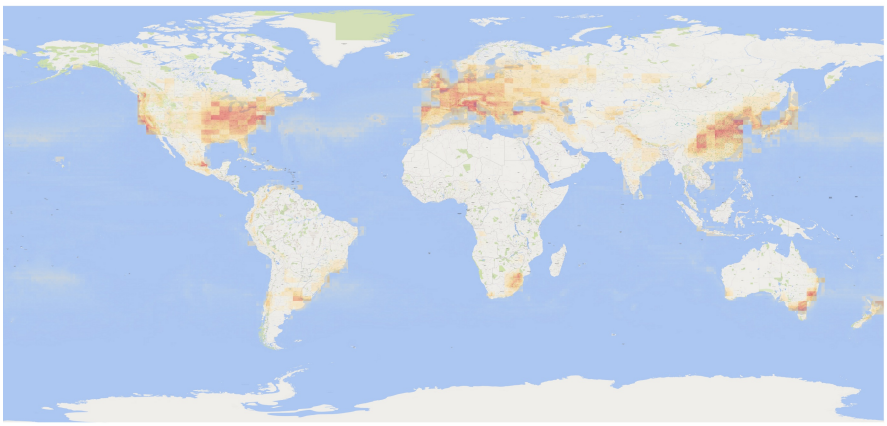
[1]CNR

1 Works for me dx.doi.org/10.17504/protocols.io.bd88i9zw

Coronavirus Method Development Community

Gianpaolo Coro
CNR

ABSTRACT



This image reports a Maximum Entropy model that estimates *suitable* locations for COVID-19 spread, i.e. places that could favour the spread of the virus just in terms of environmental parameters.

The model was trained just on locations in *Italy* that have reported a rate of new infections higher than the geometric mean of all Italian infection rates. The following environmental parameters were used, which are correlated to those used by other studies:

- Average Annual Surface Air Temperature in 2018 (NASA)
- Average Annual Precipitation in 2018 (NASA)
- CO2 emission (natural+artificial) averaged between January 1979 and December 2013 (Copernicus Atmosphere Monitoring Service)
- Elevation (NOAA ETOPO2)
- Population per 0.5° cell (NASA Gridded Population of the World)

The model file (in ASC format) and all parameters used are attached.
A higher resolution map and also the model file (in ASC format) and all parameters are available at the external link (Zenodo).

The model indicates highest correlation with *infection rate* for CO2 around 0.03 gCm^−2day^−1, for Temperature around 11.8 °C, and for Precipitation around 0.3 kg m^-2 s^-1, whereas Elevation and Population density are poorly correlated with *infection rate*.

One interesting result is that the model indicates, among others, the Hubei region in China as a high-probability location, and Iran (around Teheran) as a suited location for virus' spread, but the model was not trained on these regions, i.e. it did not know about the actual spread in these regions.

Evaluation:
A *risk score* was calculated for each country/region reported by the JHO monitoring system (https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html). This score is calculated as the summed normalised

Citation: Gianpaolo Coro (03/26/2020). Suitability Map of COVID-19 Virus Spread. https://dx.doi.org/10.17504/protocols.io.bd88i9zw

probability in the populated locations divided by their total surface. This score represents how much the zone would potentially foster the virus' spread.

We assessed the reliability of this score, by selecting the country/regions that reported the *highest rates of infection*. These zones were selected as those with a rate higher than the upper confidence of a log-normal distribution of the rates.

The agreement between the two maps (covid_high_rate_vs_high_risk.png, where violet dots indicate *high infection rates* and countries' colours indicate estimated *high risk score*) is the following:

Accuracy (overall percentage of correctly predicted high-rate zones): **77.25%**
Kappa (agreement between the two maps): **0.46** (Good, according to Fleiss' intepretation of the score)

This assessment demonstrates that our map can be used to estimate the risk of a certain country to have a high rate of infection, and indicates that the influence of environmental parameters on virus's spread should be further investigated.

Files

Name (Size)

1_covid_suitability_preview.png (**5.7 MB**)
md5:dea4e66a1c66d0dfc3b0872adfaa020f

2_covid_suitability_v2_Hi_Resolutionv2.png (**47.3 MB**)
md5:069727a6c5656d276c475606c9b96d47

Altitude.asc (**1.9 MB**)
md5:ca91c4d56654b77bf572eef1a42af7a5

CO2.asc (**5.1 MB**)
md5:0ed217e20ab32aad4ab96e5403670ee4

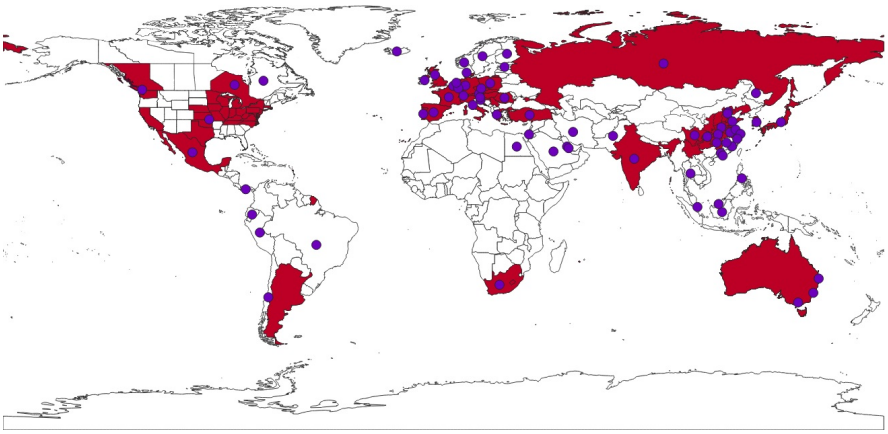
MaxEnt_Temperature_Precipitation_Elevation_CO2.asc (**2.8 MB**)
md5:79639fd3540c68450d86fde288edb264

Population.asc (**4.6 MB**)
md5:57aa6c172b3fc036c08d0560f01436ba

Precipitation.asc (**5.5 MB**)
md5:3ab587ea0e0fbe3fcbd9ea6b7844271a

Temperature.asc (**4.7 MB**)
md5:7ea930f59e5ff627a18383f02737f78d

Citation: Gianpaolo Coro (03/26/2020). Suitability Map of COVID-19 Virus Spread. https://dx.doi.org/10.17504/protocols.io.bd88i9zw



MD5 checksum: This is the file fingerprint, which can be used to verify the file integrity.

References

Coro, G., Panichi, G., Scarponi, P., & Pagano, P. (2017). Cloud computing in a distributed e-infrastructure using the web processing service standard. Concurrency and Computation: Practice and Experience, 29(18), e4219.

EXTERNAL LINK

https://zenodo.org/record/3719184

THIS PROTOCOL ACCOMPANIES THE FOLLOWING PUBLICATION

kc3tGqo8DKKjZSSeO8eZJfOnbHaWhcFINWd6SWxfBsQmOAhJapkQuzo3m9H8p9w8NnxUk1ZiT+cmenGeWL9PQN8gnlZRGrIL10pw3kF/06vZSkzzSrUYJ7BhF+wvXakJdzTE2EcOkE2B7yKTAGcNietn84lscRufecYgTsqucuwUuOluM+MRHDCOfPpd2DWF

MATERIALS TEXT

This experiment was done using the DataMiner cloud computing system of the D4Science e-Infrastructure and the BiodiversityLab Virtual Reseach Environment. (https://services.d4science.org/group/biodiversitylab/)

Gianpaolo Coro. (2020). Suitability Map of COVID-19 Virus Spread

Citation: Gianpaolo Coro (03/26/2020). Suitability Map of COVID-19 Virus Spread. https://dx.doi.org/10.17504/protocols.io.bd88i9zw

Citation: Gianpaolo Coro (03/26/2020). Suitability Map of COVID-19 Virus Spread. https://dx.doi.org/10.17504/protocols.io.bd88i9zw

This is an open access protocol distributed under the terms of the **Creative Commons Attribution License** (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited