AI4COVID: Artificial intelligence and geographical information for monitoring and prediction of Covid-19 outbreak

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Objectives

Our study aimed at

- *presenting a data-driven approach for exploring the spatio-temporal patterns of the pandemic over a regional scale, i.e., Europe and a country scale, i.e., Denmark,*

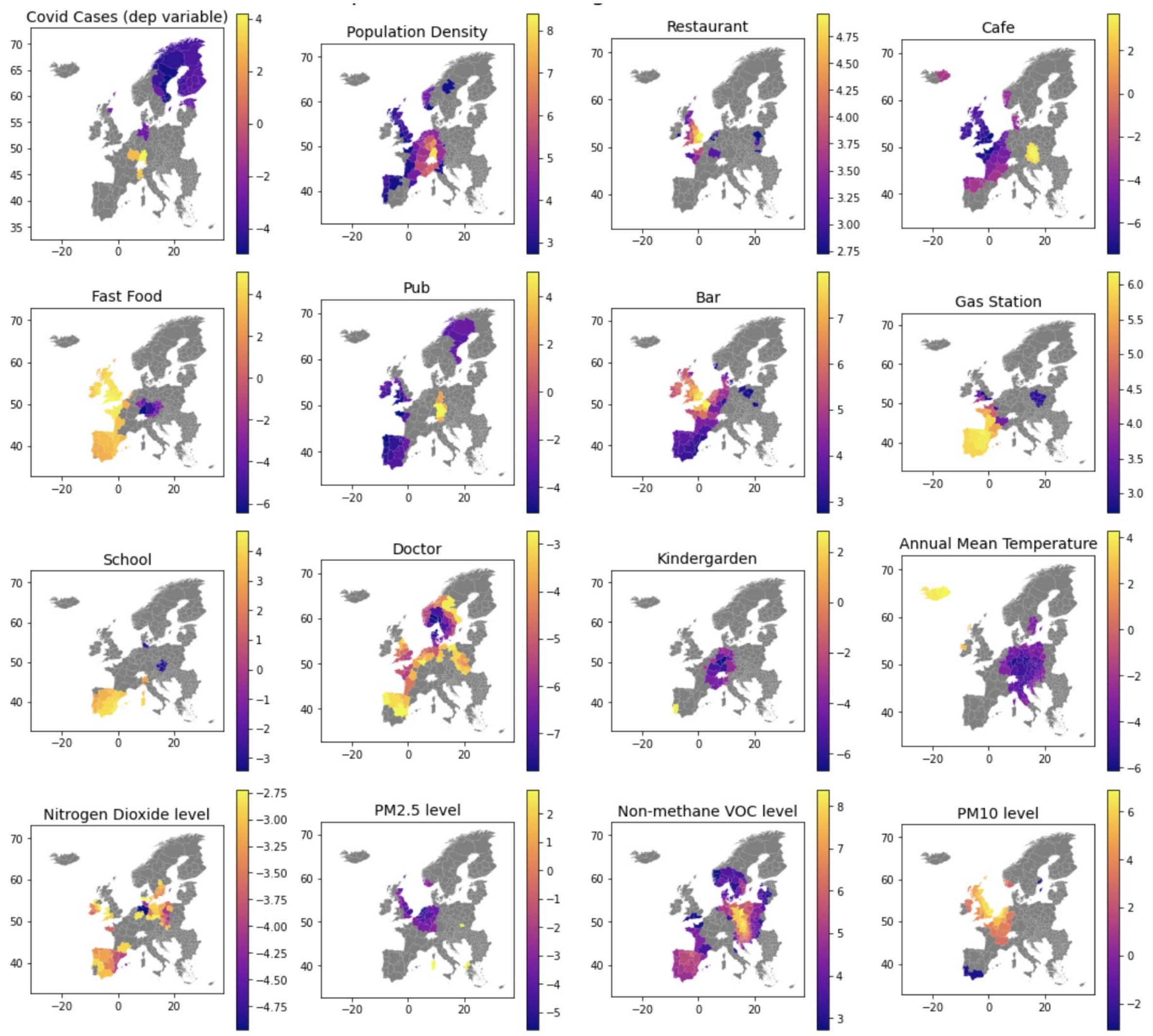
- *Exploring what geographical variables potentially contribute to expediting the spread of the pandemic so that they could be used for lockdown/re-opening planning.*

Data

We used

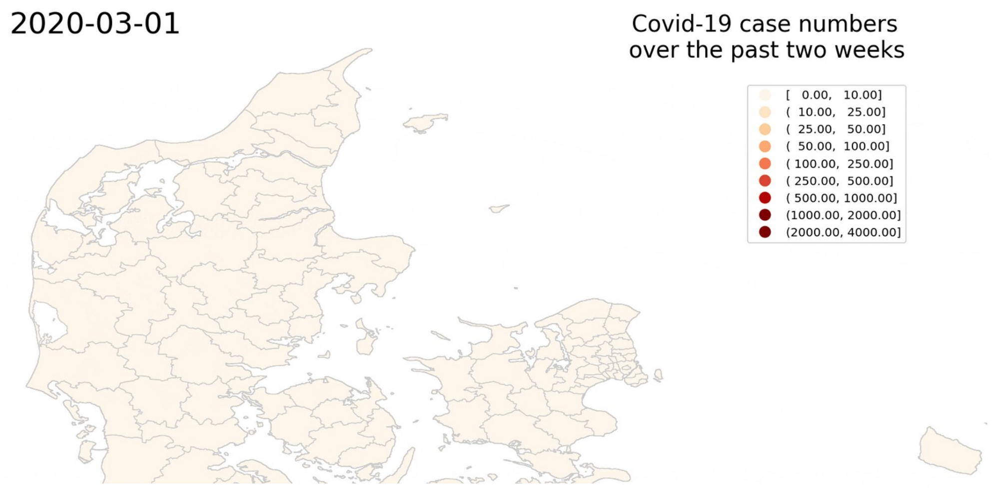
- **Official regional infection rates (source: European Centre for Disease Prevention and Control)**

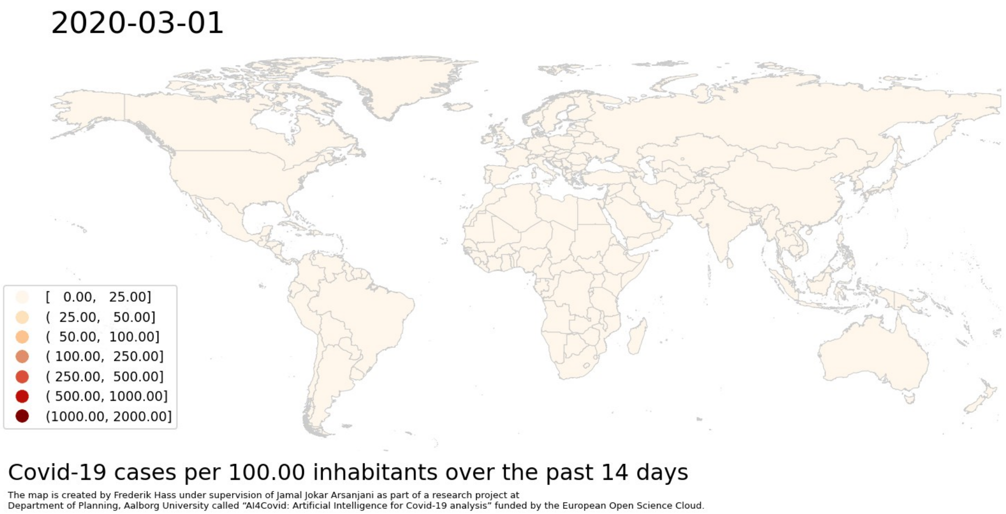
- Population Density,
- Public places per capita e.g., Restaurants, Cafes, Fast Food Places, Pubs, Bars, Gas Stations, Schools, Medical Offices, Kinder gardens,
- Annual mean temperature,
- Nitrogen dioxide,
- Particulate matter < 2.5 µm (PM2.5),
- Non-methane VOCs,
- Particulate matter < 10 µm (PM10)

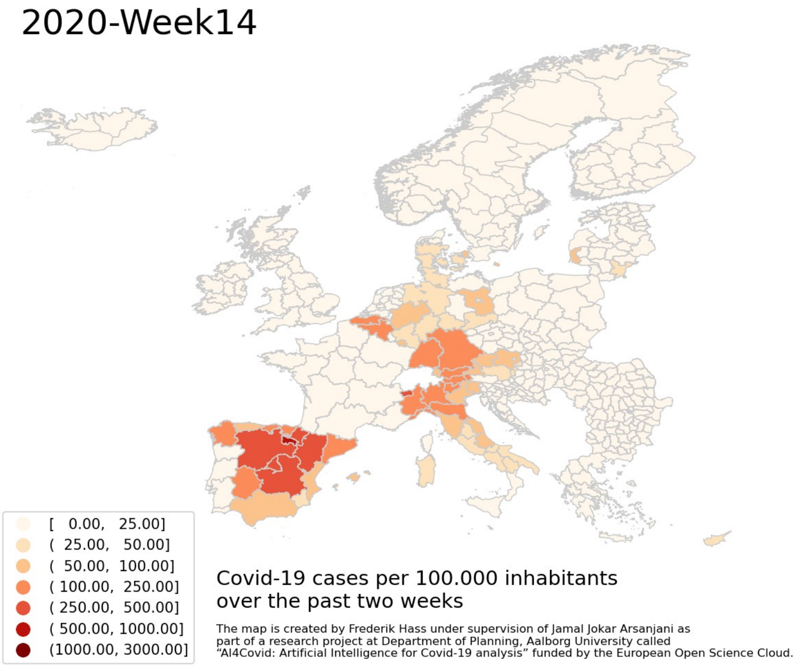


Methods-1

- Historical development of the pandemic

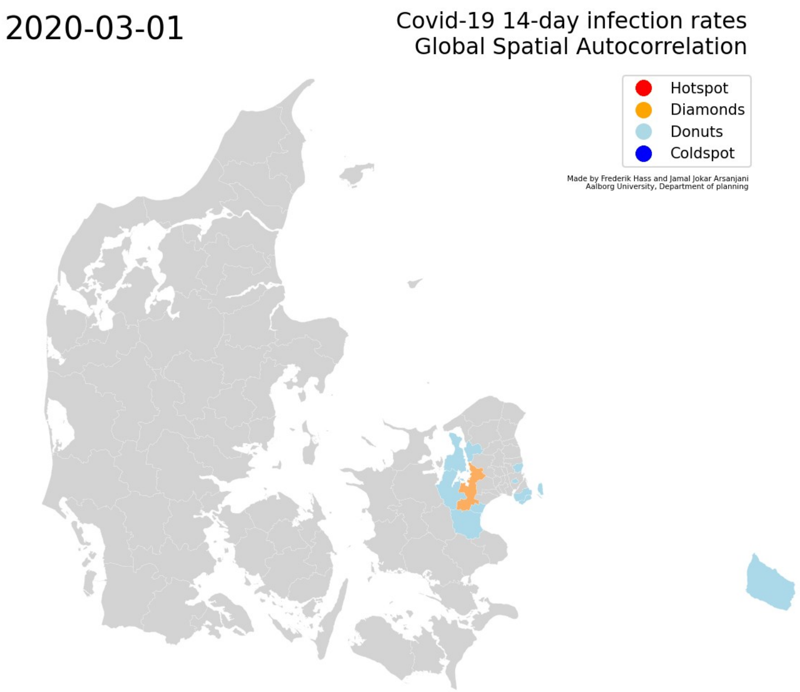


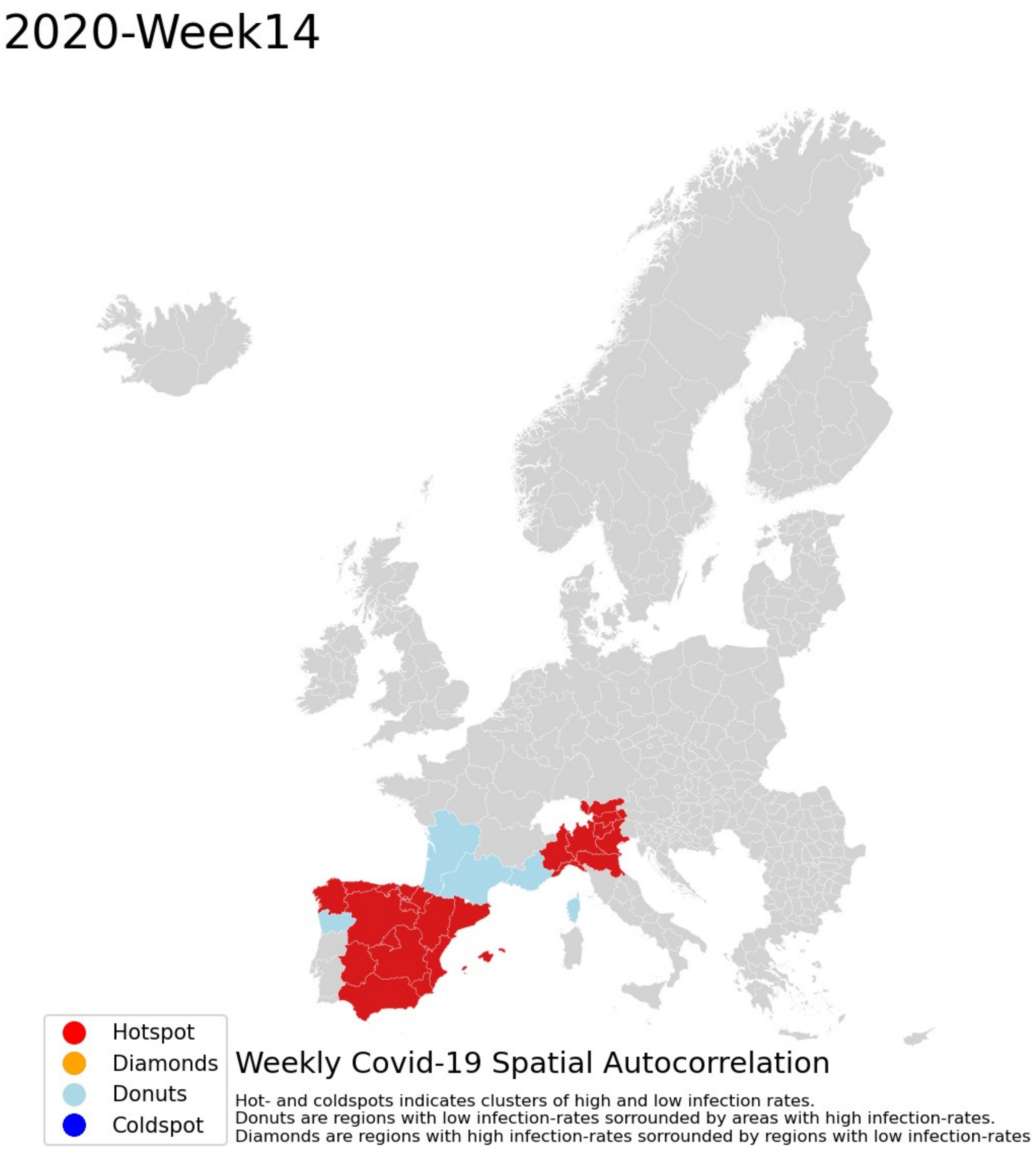




Methods-2

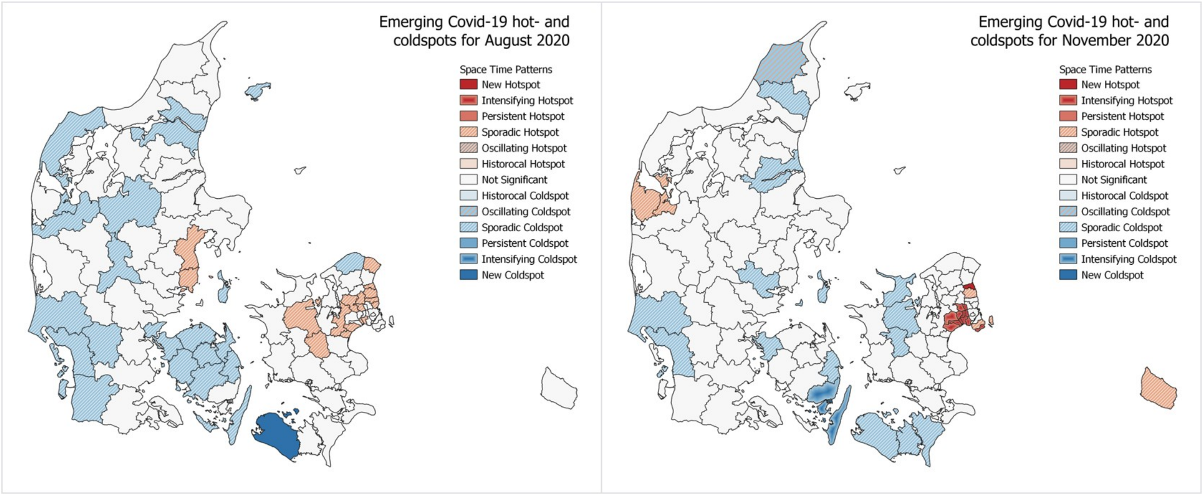
- we measured **spatial autocorrelation** to extract relevant indicators that could explain the dynamics of the pandemic.

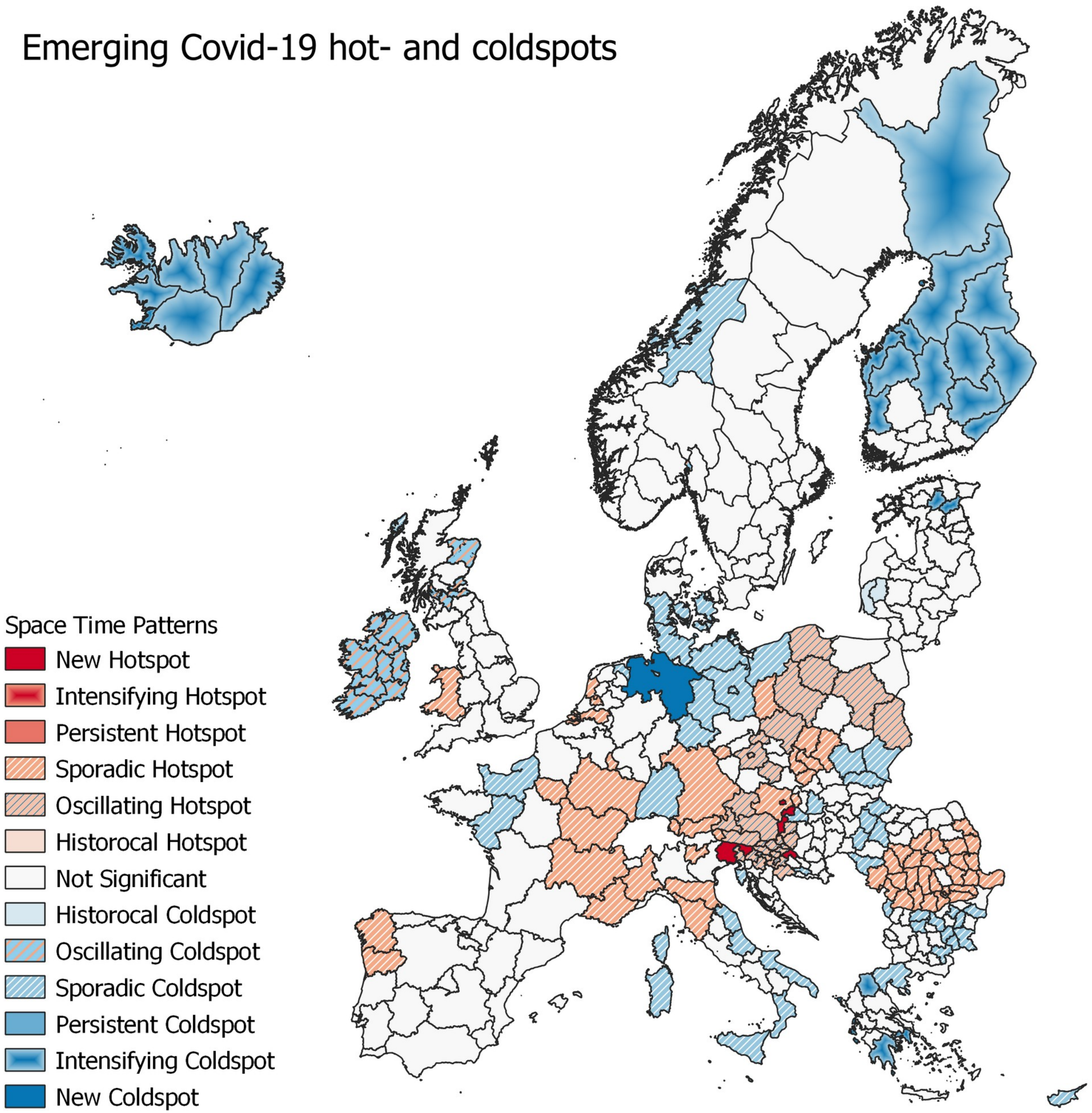




Methods-3

- we measured **space-time autocorrelation** to extract relevant indicators that could explain the dynamics of the pandemic.





Methods-4

- In order to explore the potential correlation between the chosen underlying factors and the pandemic spread, we applied:
  - statistical methods e.g., ordinary least squares (OLS), geographically weighted regression (GWR)

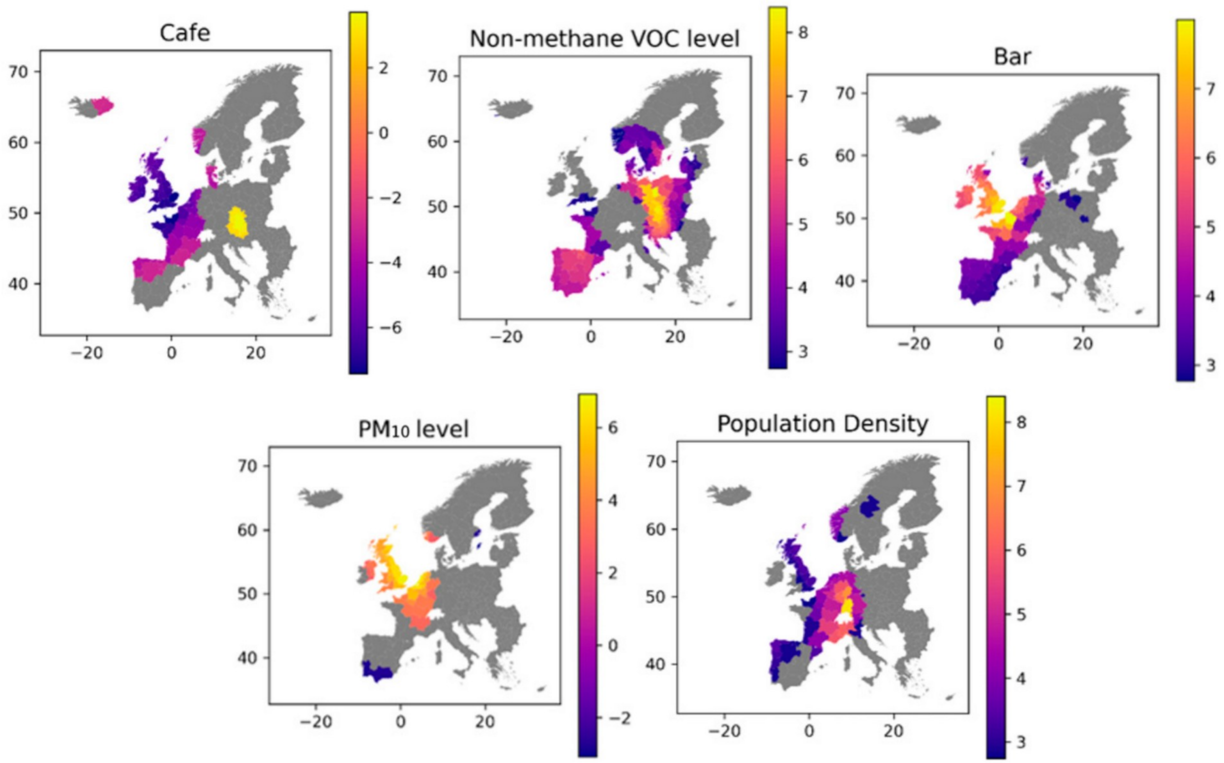
Model	Res Sum Squares	AIC	AICc	R^2	Adjusted R^2
OLS	219.230	927.850	931.448	0.453	0.432
GWR	66.922	654.585	752.719	0.833	0.765

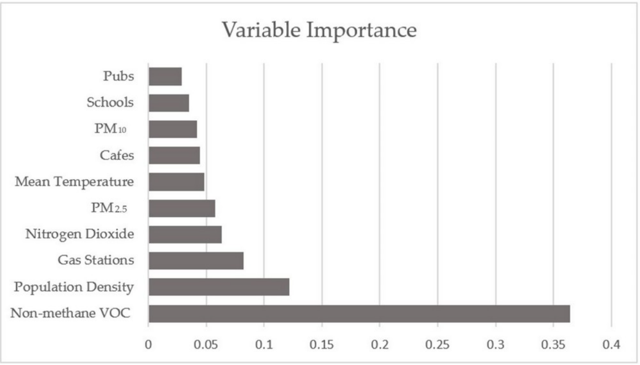
  - machine learning methods

Area	Nr. of Regions	Model	Accuracy	MAE
Europe	401	Random Forest	**52%**	**0.079**
		Lasso	36%	0.153
		Support Vector Regression	51%	0.151
Europe—Hot- & Coldspots	128	Random Forest	**76%**	**0.099**
		Lasso	74%	0.285
		Support Vector Regression	73%	0.256
Europe—Hotspots	56	Random Forest	19%	**0.177**
		Lasso	- %	0.217
		Support Vector Regression	- %	0.221
Denmark	98	Random Forest	**61%**	**0.095**
		Lasso	35%	0.233
		Support Vector Regression	41%	0.232

Findings

- Our findings indicate that **population density**, **public places** such as cafes and bars, and **pollution levels** are the most influential explanatory variables.





Lessons learned

- Pollution levels can be explicitly used to monitor lockdown measures and infection rates.
- Through identifying hot- and cold spots of infections, varying lockdown measures can be reinforced.
- The most influential driving forces could be used for prediction of upcoming infections.
- Some soft factors could not be incorporated in our models since they are not measurable.
- There is a need for fine scale data e.g., neighbourhood level as opposed to country/provincial/municipality level.

Conclusions

- Geographical data, tools and methods can provide unique insights to understanding the evolution of the pandemic.

- Our choice of data and methods along with the achieved results can empower health authorities and decision makers with an interactive decision support tool, which can be useful for imposing geographically varying lockdowns/re-openings.

- As per future work, we suggest including further variables that reflect lockdown levels of individual regions over time. Such a variable could be made from quantification of adopted policies and pollution levels.

Thank you for your attention

Hass, F.S.; Jokar Arsanjani, J. The Geography of the Covid-19 Pandemic: A Data-Driven Approach to Exploring Geographical Driving Forces. *Int. J. Environmental Research and Public Health* 2021, *18*, 2803. https://doi.org/10.3390/ijerph18062803

Our data and approach is accessible at https://github.com/jimjoker/Covid-19_geographic_analysis

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