An agent-based model of the 2020 international policy diffusion in response to the COVID-19 pandemic with particle filter

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DUST PROJECT

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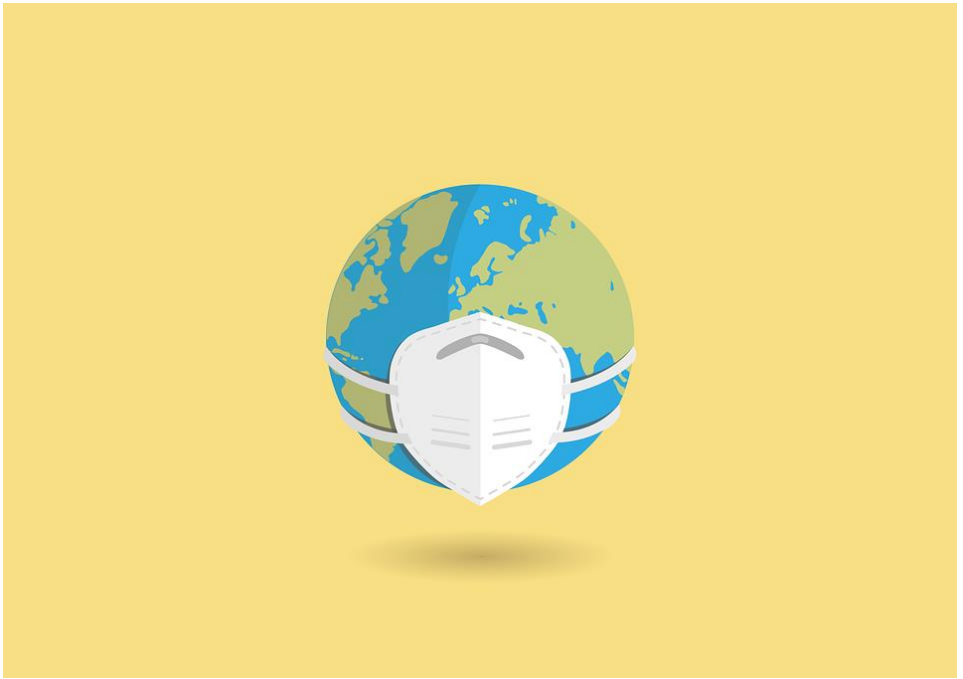
On arXiv: https://arxiv.org/abs/2302.11277

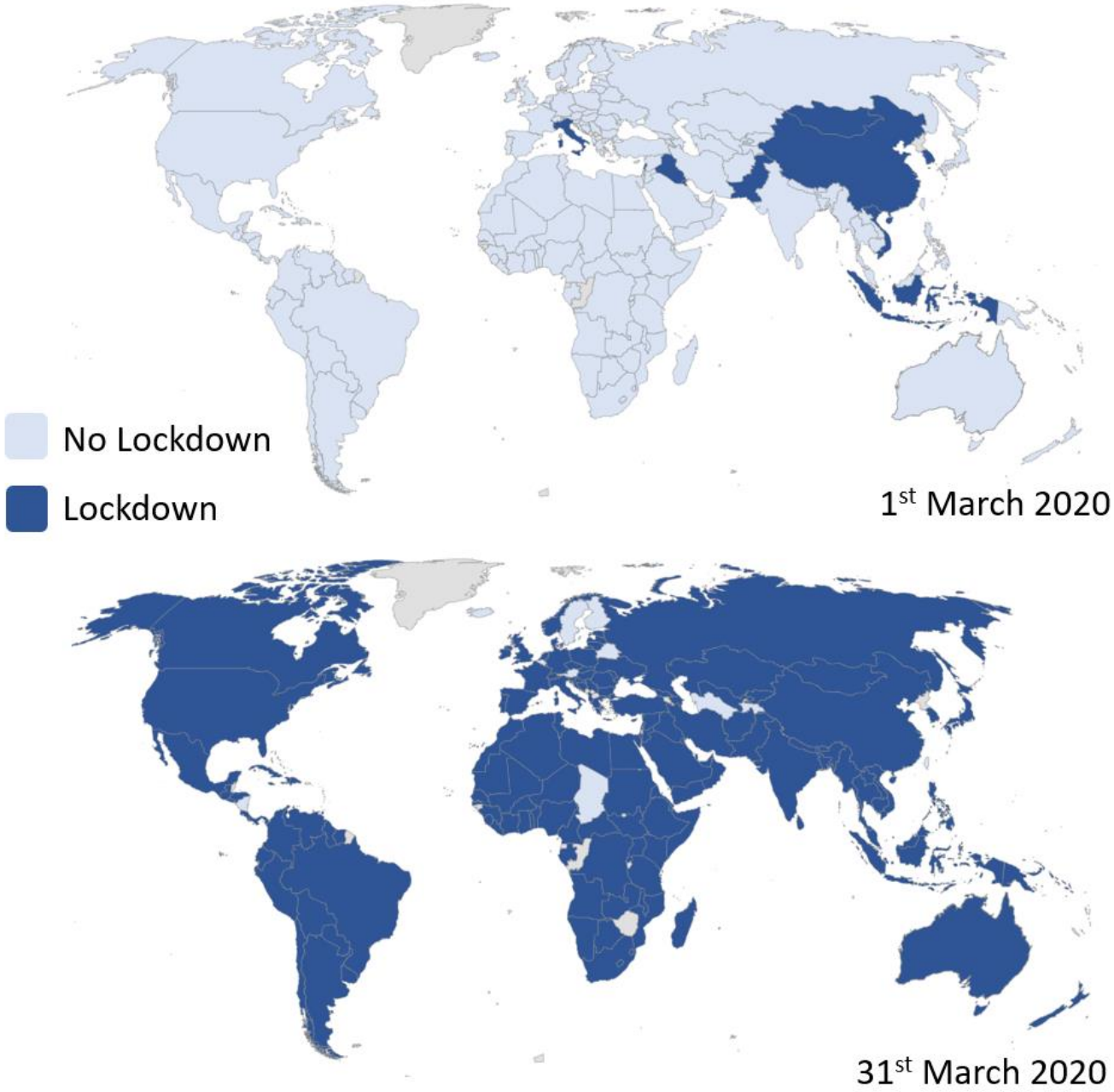
Motivation – A look back on early 2020

The world had Covid19

The world had lockdowns too



Compared to other global problems, the response to the pandemic was surprisingly homogenous



- How did this tipping point occur?
- Could this have been predicted?
- Learn something for other global issues e.g. climate change?

We built an agent-based model of countries

The key idea of the model is peer mimicry

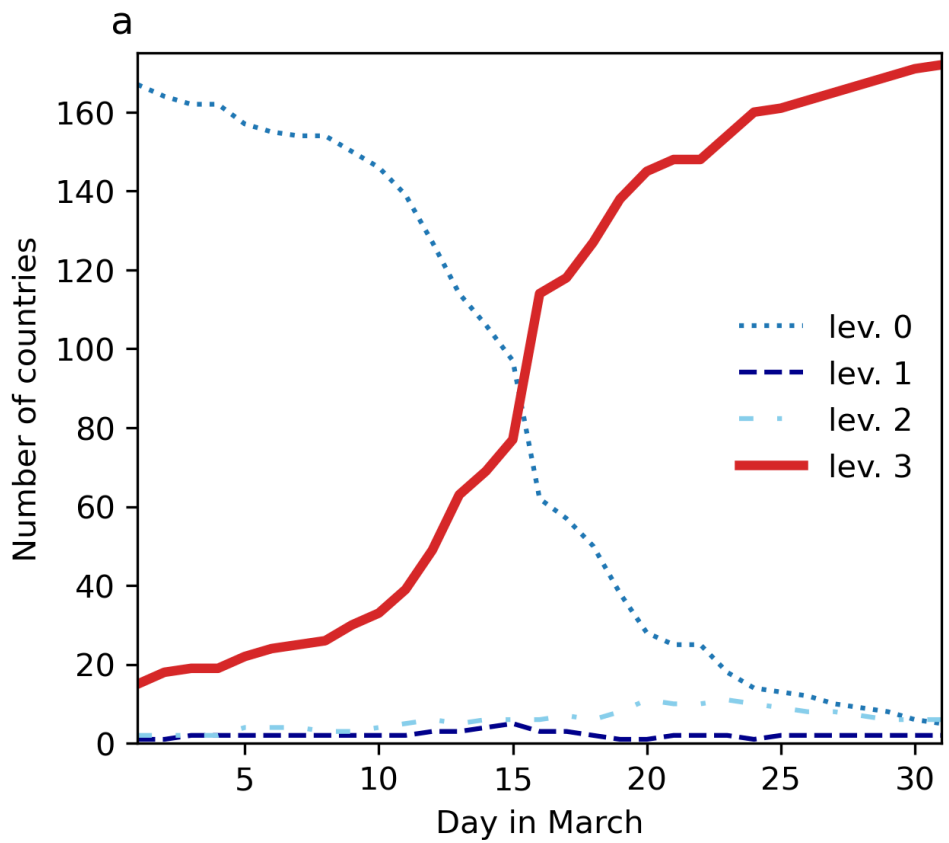
Model setup (i)
– What exactly are we trying to model?

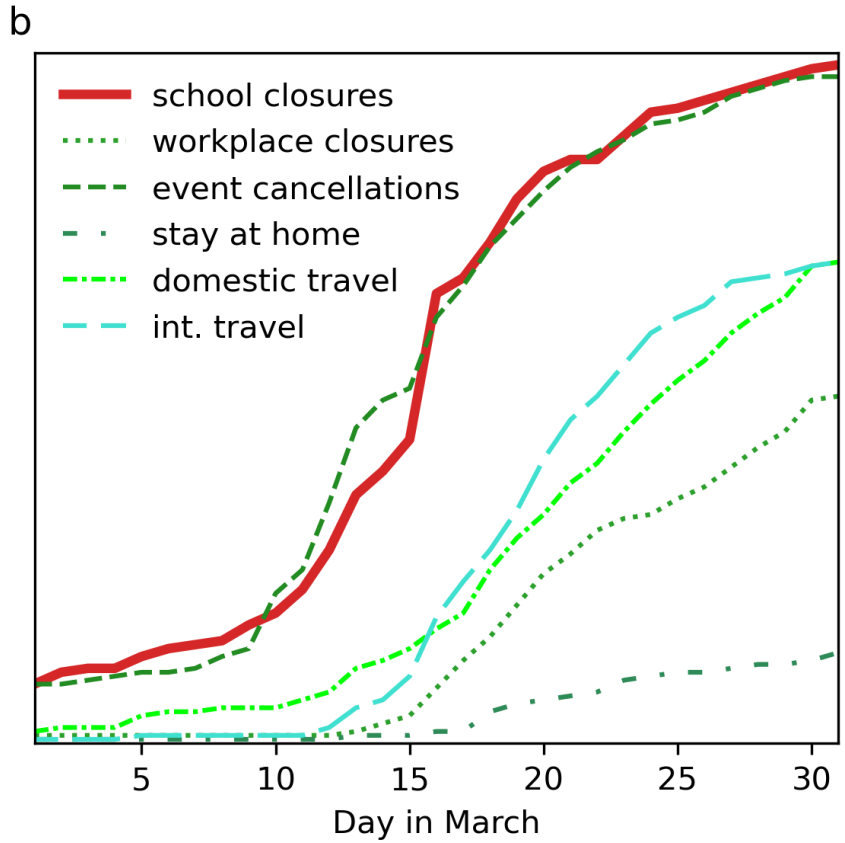
The model is concerned with March 2020

and a binary variable

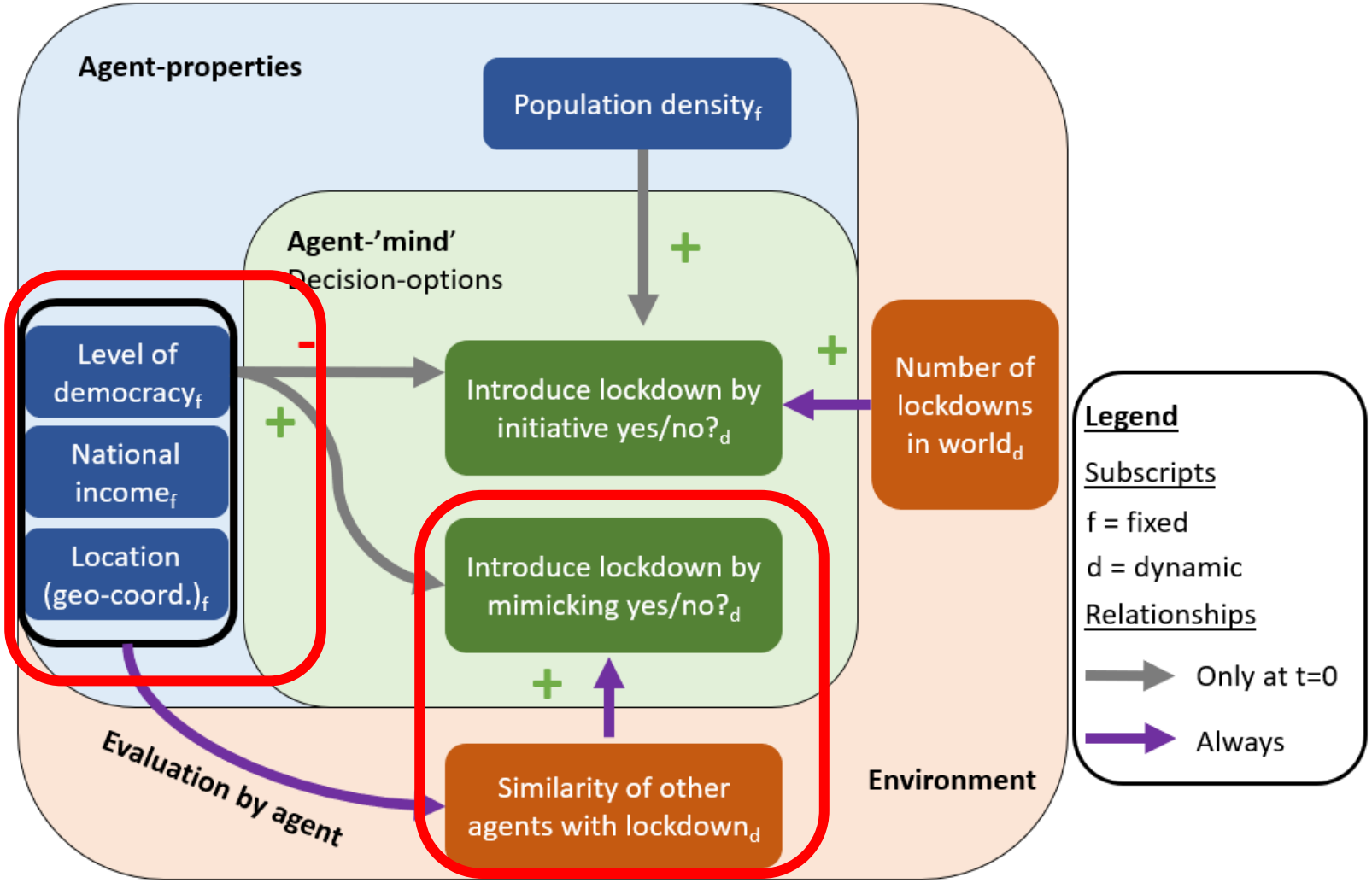
<u>Lockdown or no</u>

<u>no Lockdown</u>

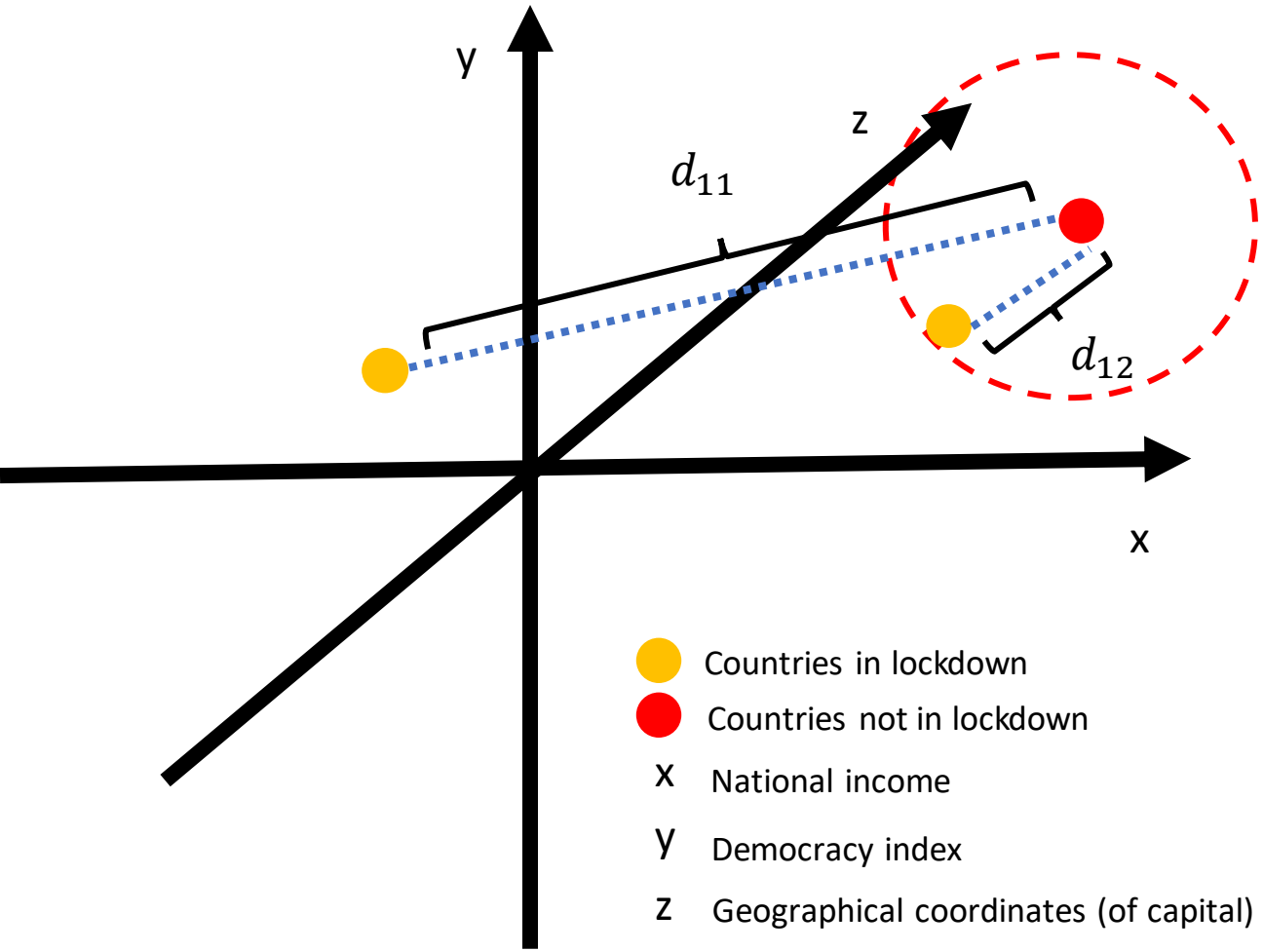




Model setup (ii)



Model setup (iii) – Decision making in 3-d



Actually normalized and not Euclidean!

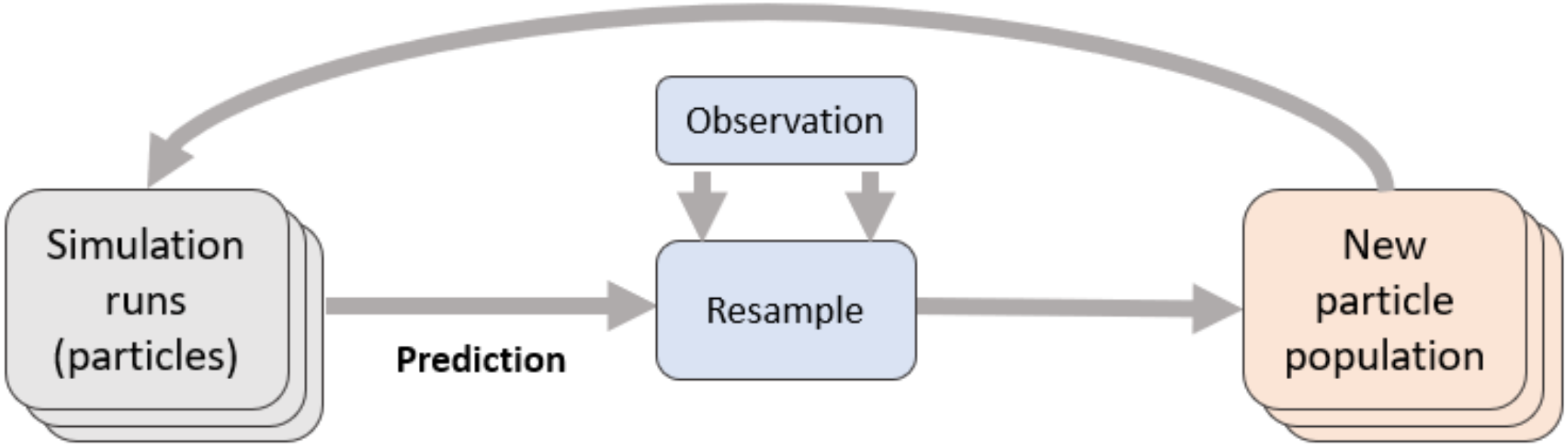
$$d_{ij} = \frac{1}{3}\left(\underbrace{\frac{(x_i - x_j)}{(x_{max} - x_{min})}}_{\text{income similarity}} + \underbrace{\frac{(y_i - y_j)}{(y_{max} - y_{min})}}_{\text{political similarity}} + \underbrace{\frac{H(z_i, z_j)}{H_{max}}}_{\text{geo. proximity}} \right)$$

If $d_{ij} < threshold\ for\ lockdown\ adoption$

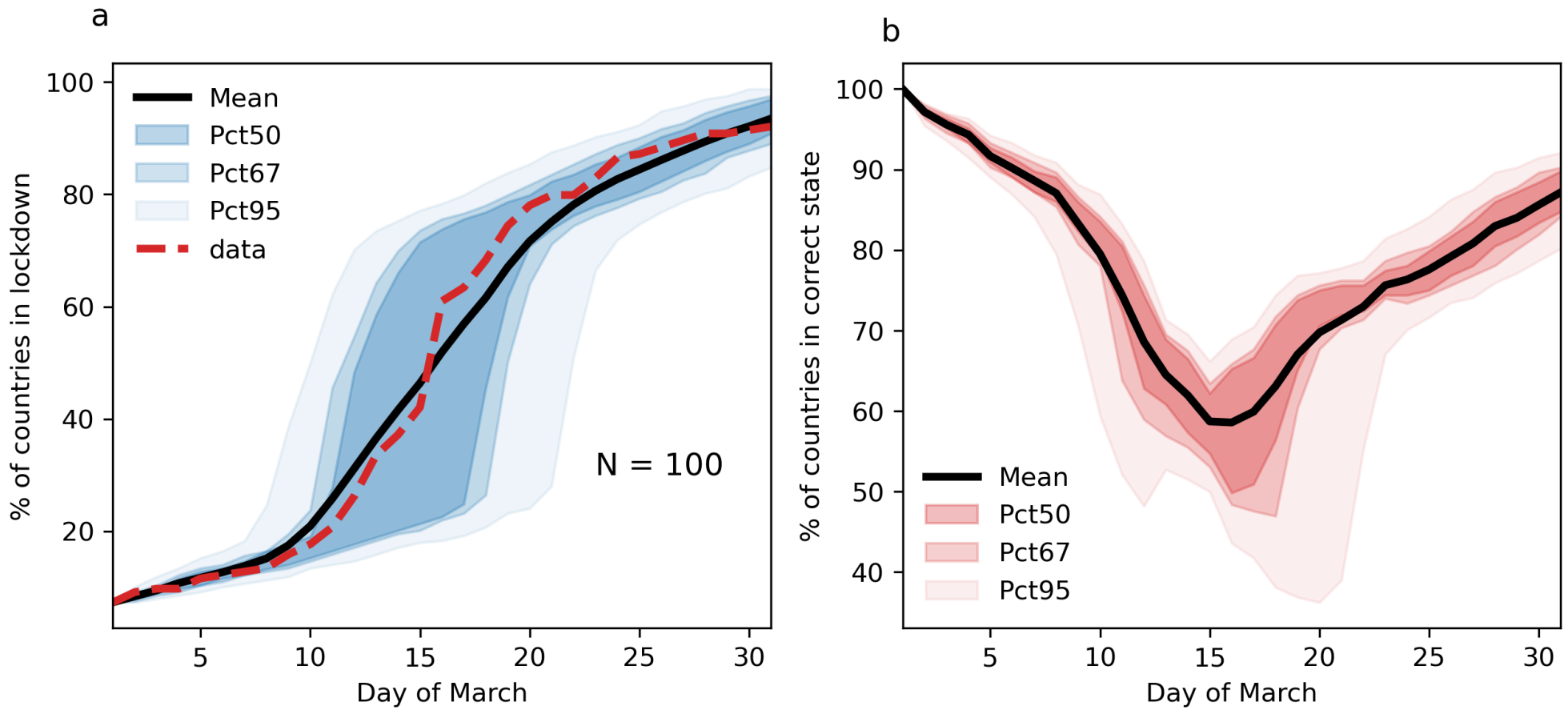
Then introduce lockdown

Else No lockdown

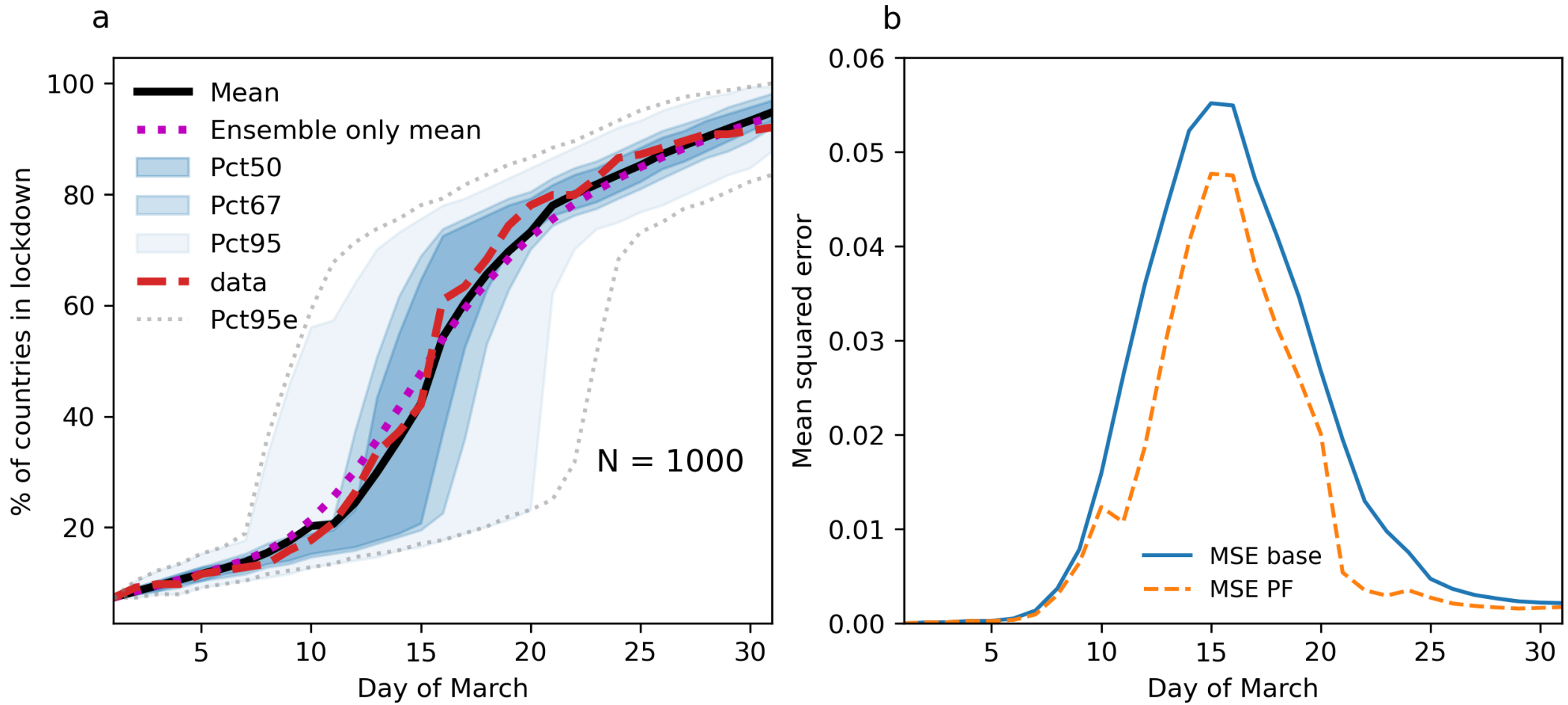
Data assimilation for complex system control



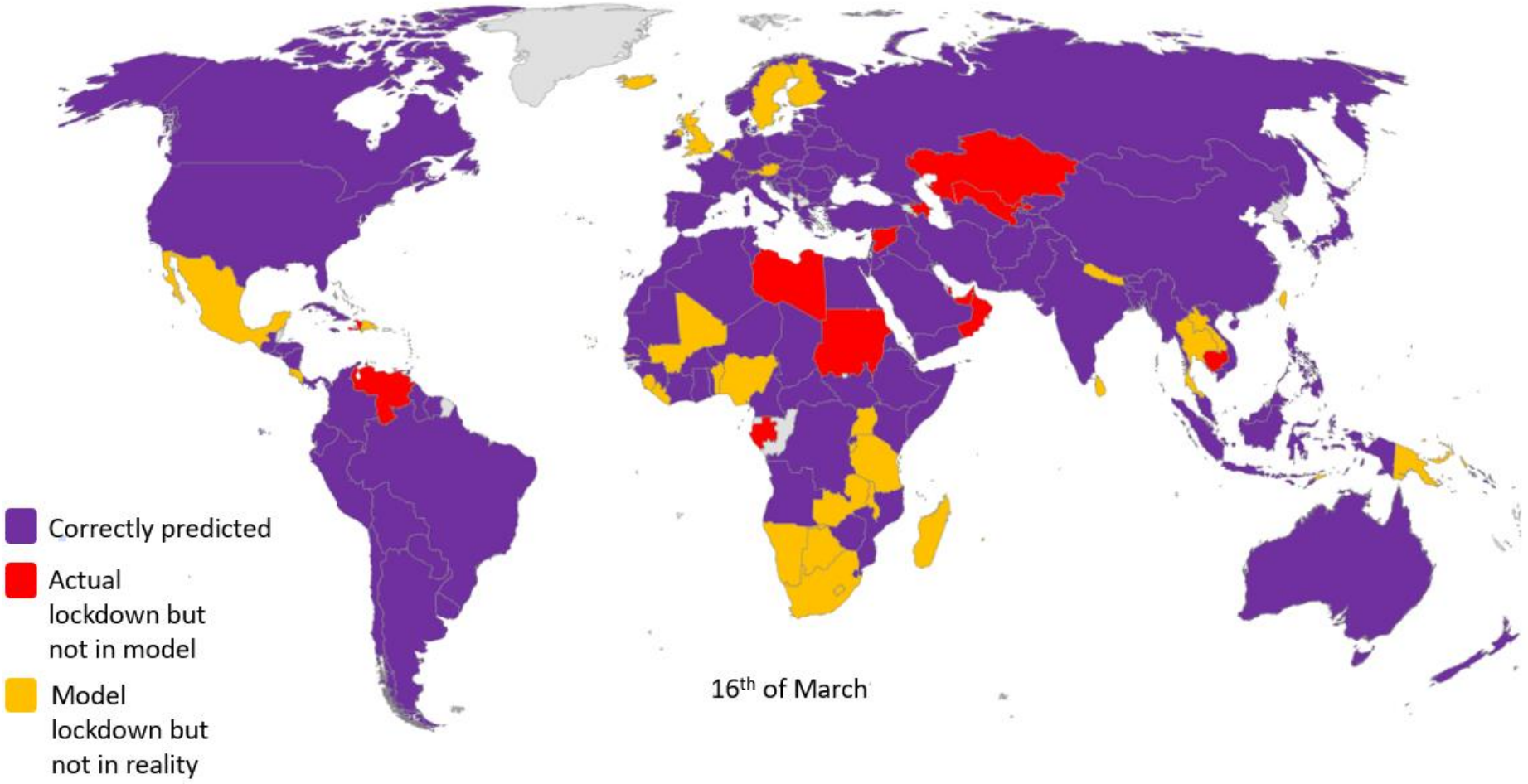
This model works well for the aggregate pattern and “okay” for the individual countries



Data assimilation makes the predictions better



A specific simulation run on 16th of March 2020



Takeaway

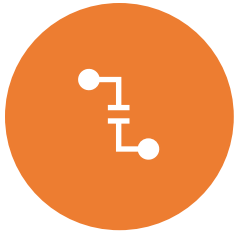
Even big international-level issues can be agent-based

Social science and data assimilation need not be strangers

Peer mimicry plays a role in international politics

It is critical for countries to set examples in crisis situations!

Discussion



Model generalizability so far limited – are the mechanisms valid for other case studies?

Predicting rapid transitions is challenging – ABM + Data assimilation only one approach

A more complex model might unlock promising data assimilation opportunities

Important references

Data on lockdown policies from

- Ritchie, H., et al. (2020). Coronavirus pandemic (covid-19). Our World in Data. https://ourworldindata.org/coronavirus.

One of several studies supporting peer mimicry as diffusion mechanism

- Sebhatu, A., Wennberg, K., Arora-Jonsson, S., & Lindberg, S. I. (2020). Explaining the homogeneous diffusion of COVID-19 nonpharmaceutical interventions across heterogeneous countries. Proceedings of the National Academy of Sciences, 117(35), 21201-21208.

For more references see paper on arXiv https://arxiv.org/abs/2302.11277