



Infodemiology: tools to detect & assess infodemics

Manlio De Domenico, Pierluigi Sacco

@manlius84

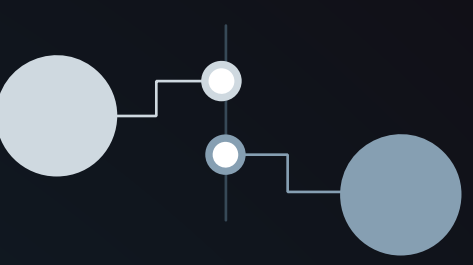
08 April 2020

Collaborators: R. Gallotti, N. Castaldo, F. Valle

Complex Multilayer Networks Lab, Fondazione Bruno Kessler, Italy
Models of Infectious Disease Agent Study (MIDAS) Network
IULM University of Milan, Italy
Berkman Center for Internet & Society, Harvard University, USA



Viruses travels through
Transportation networks
Epidemiology

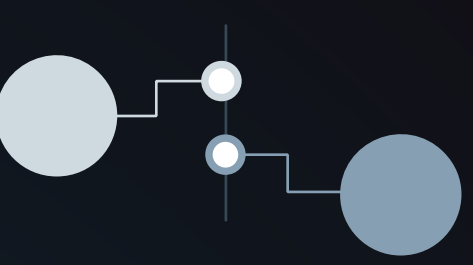




Viruses travels through
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Epidemiology



Information travels through
online social networks
Infodemiology

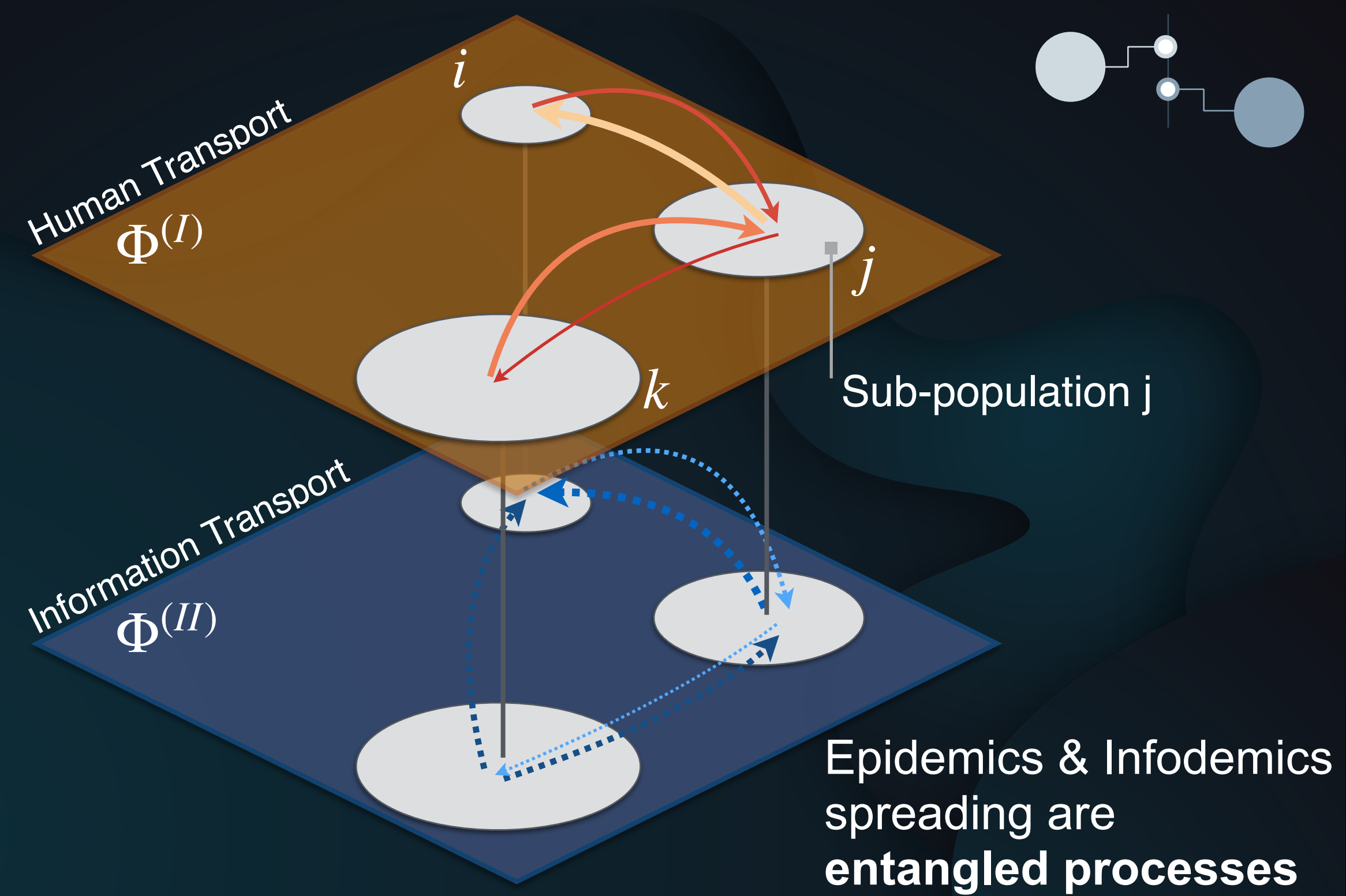




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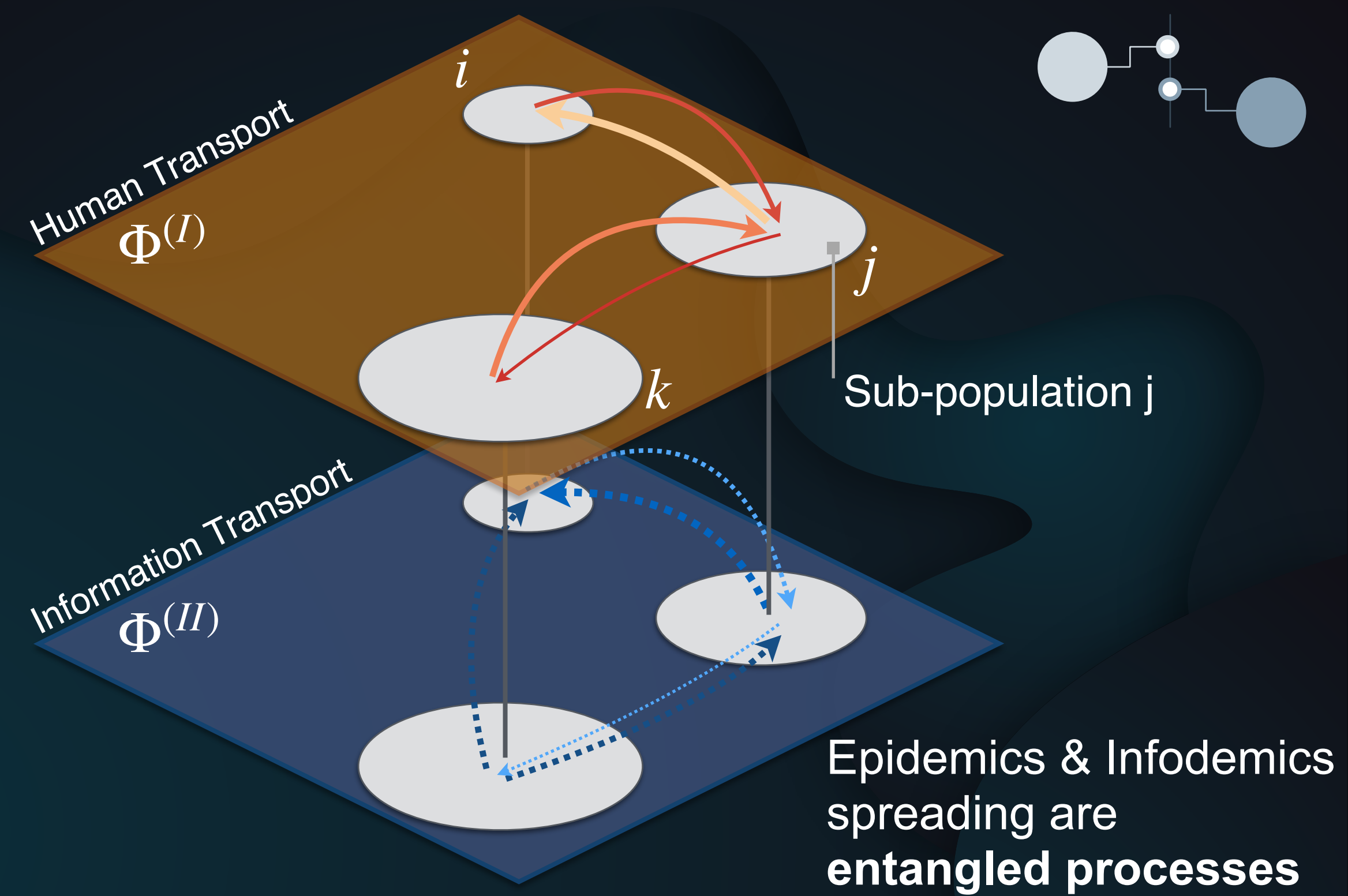
Multilayer networks:
systems of interdependent systems

Buldryev et al, Nature (2010)
Gao et al, Nature Physics (2011)
MDD et al, PNAS (2014)
MDD et al, Nature Comms (2015)
MDD et al, Nature Physics (2016)



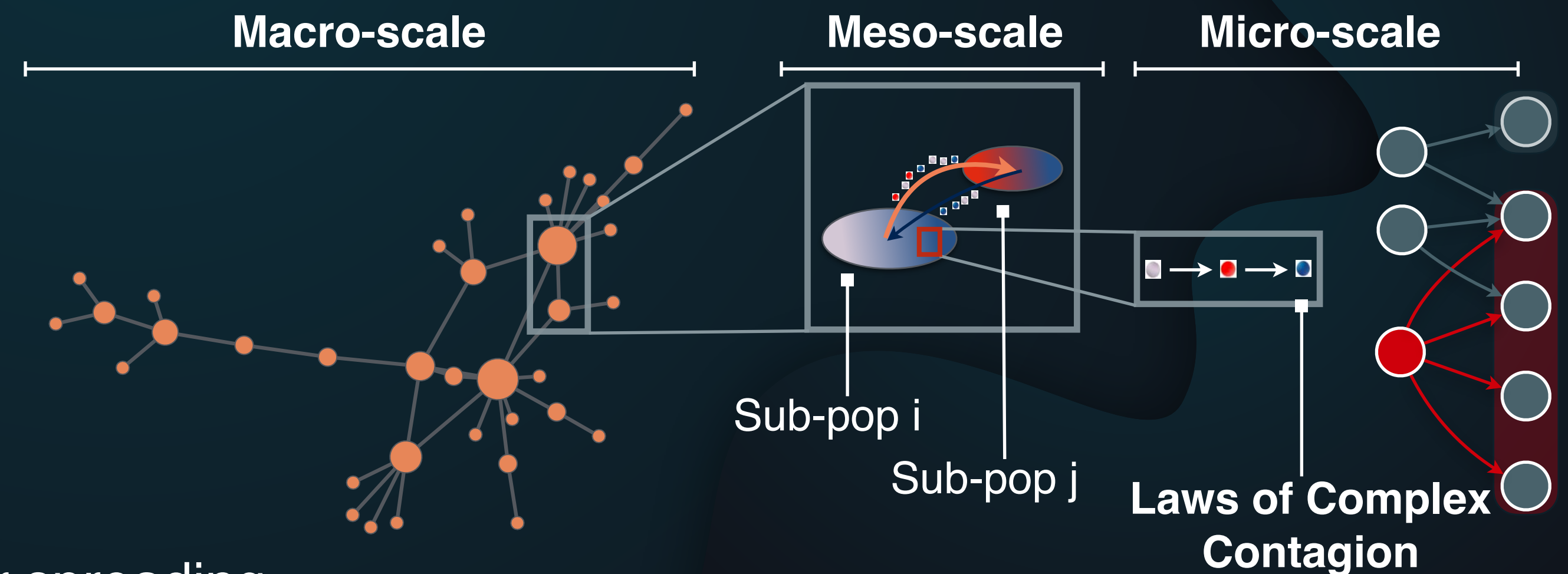
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A paradigm for spreading
phenomena in general:

behavior, emotions, pathogens, **information**



27 JANUARY 2020 
14:29 UTC

**** ** nCoV19 **
**** **
#Wuhan

C19 Inf Observatory Network Science & AI



27 JANUARY 2020
14:29 UTC



**** ** nCoV19 **
**** **
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C19 Inf Observatory

Network Science & AI

From: 21 January 2020 (< 600 cases in China)
To: 7 April 2020 (1.3M cases worldwide)

230M+

Tweets analyzed

35M+

News analyzed



71% Reliable



29% Unreliable/
Biased



58% Humans



42% Non-Human



CoMuNe lab

COMPLEX MULTILAYER NETWORKS



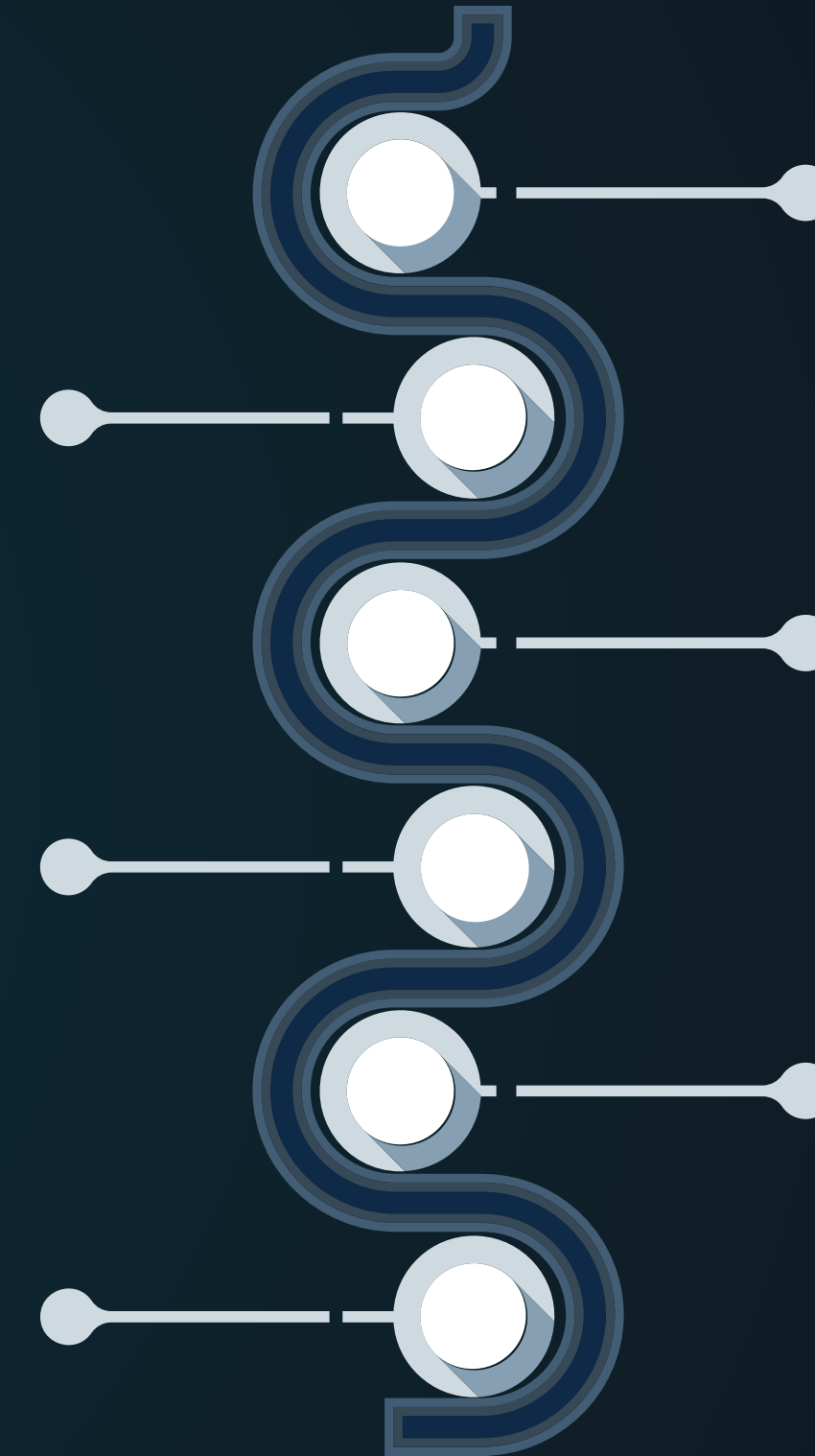
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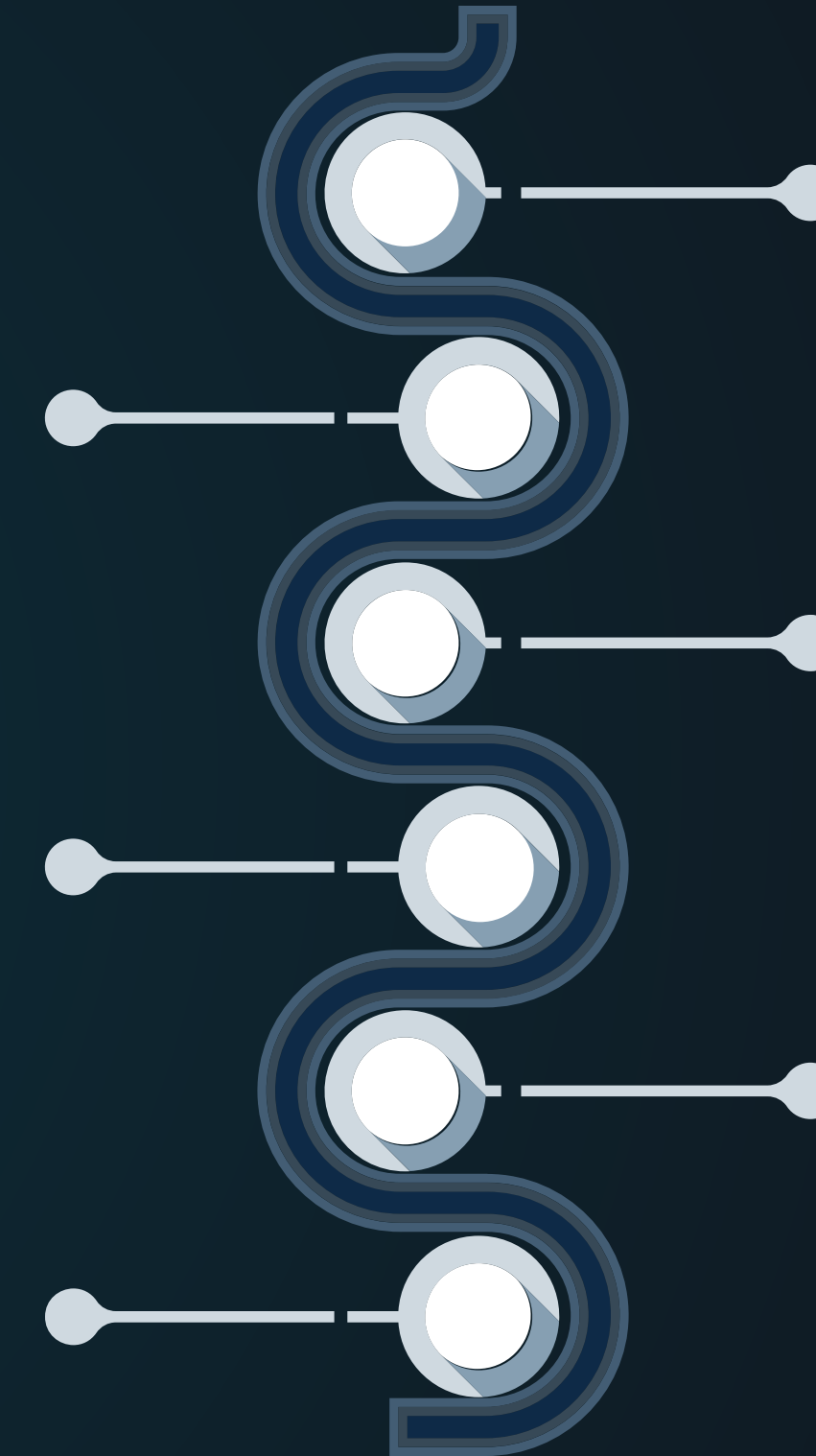
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Metadata Extraction



ArcGIS
Geocode



C19 Inf Observatory

Network Science & AI

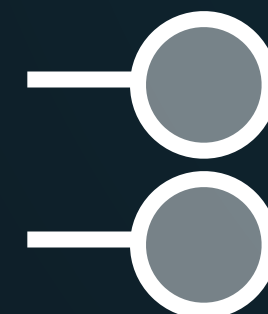
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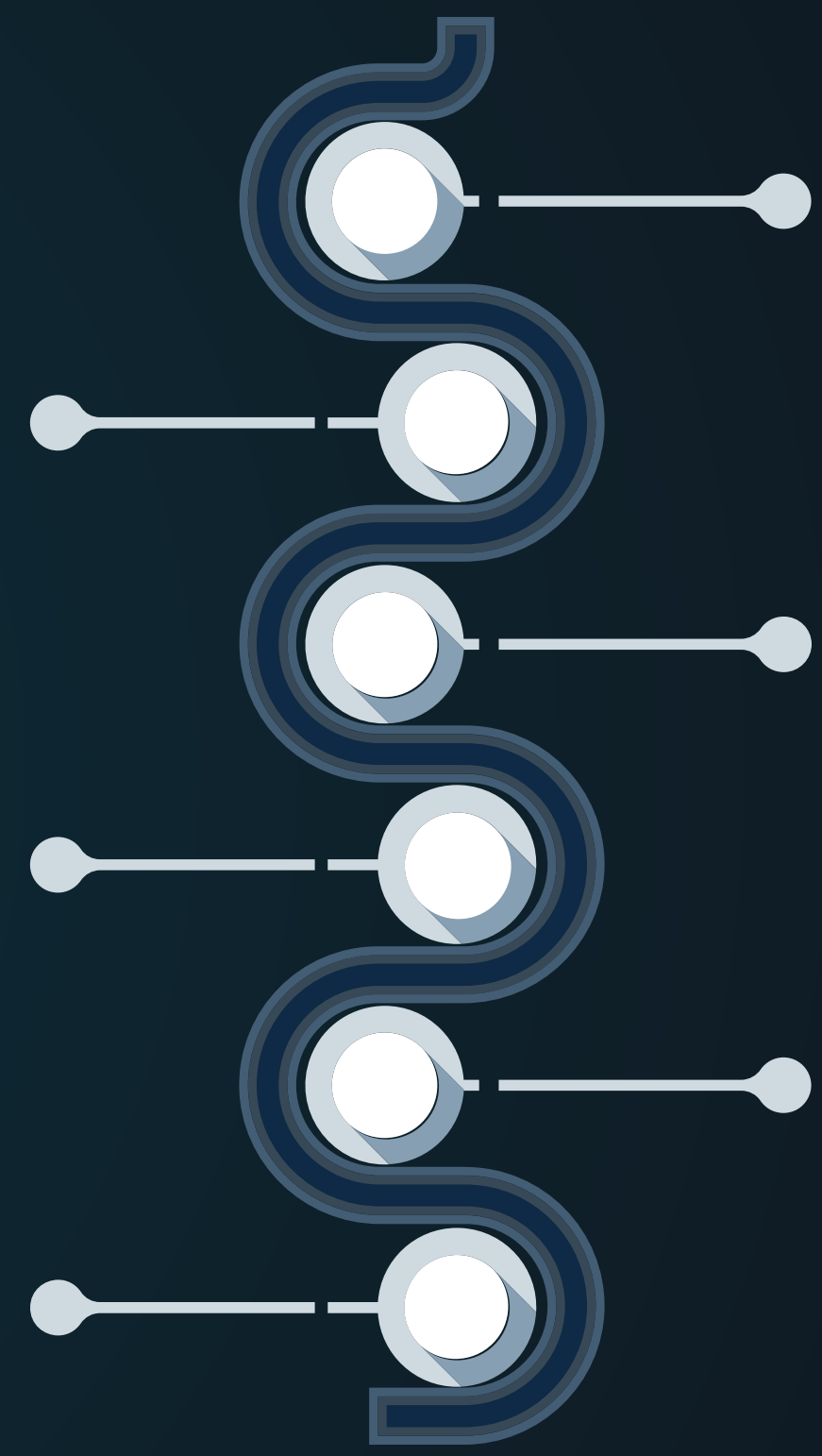


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Bot/Human
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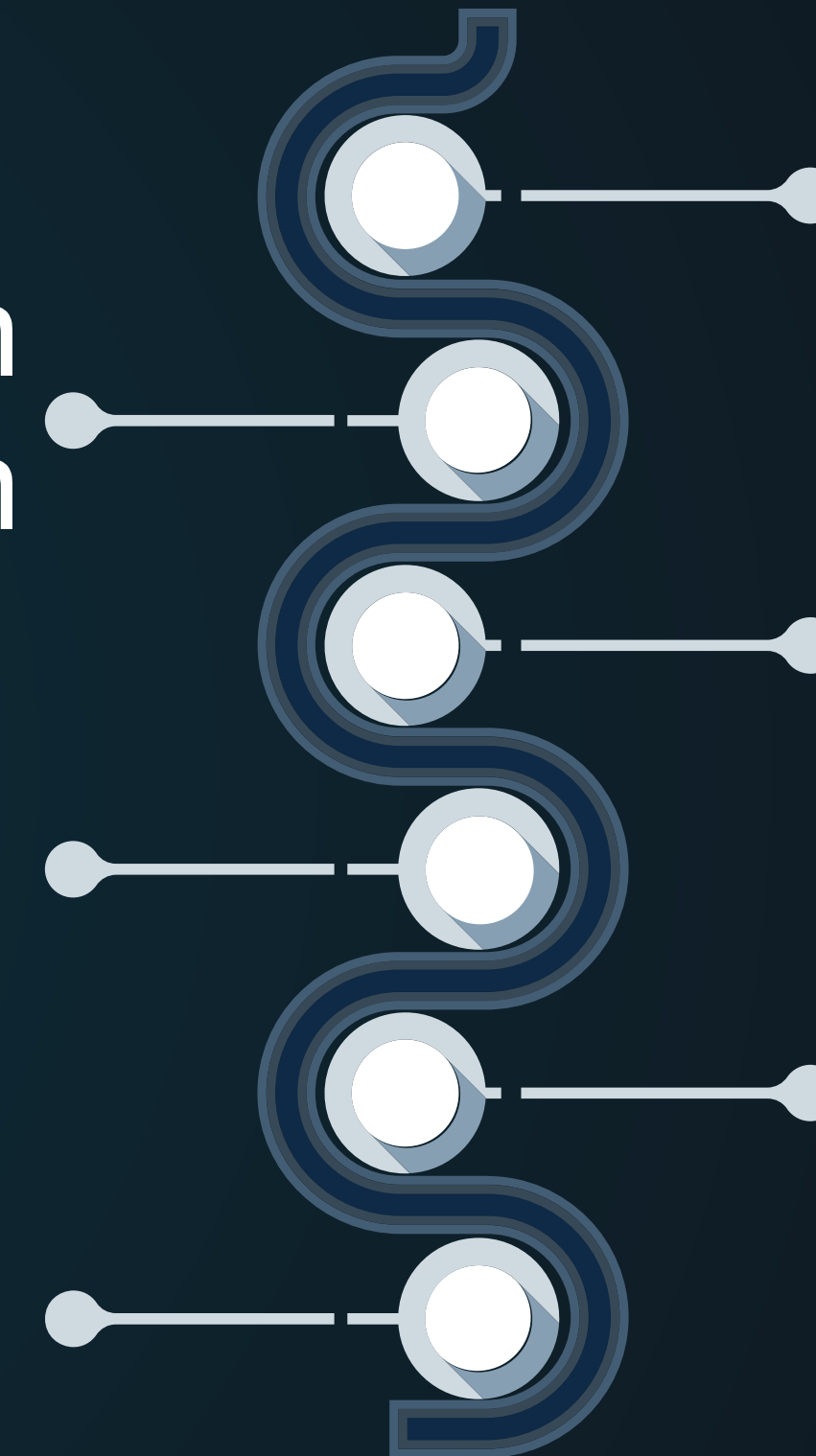
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Psycho
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C19 Inf Observatory

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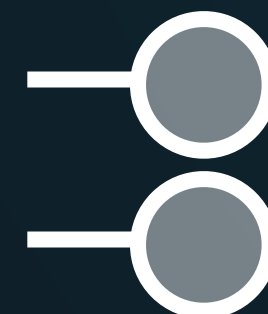
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COMPLEX MULTILAYER NETWORKS

Stella, Ferrara, MDD, *PNAS* (2018)

Arttime, Gallotti, D'Andrea, Sacco, MDD, *Submitted* (2020)

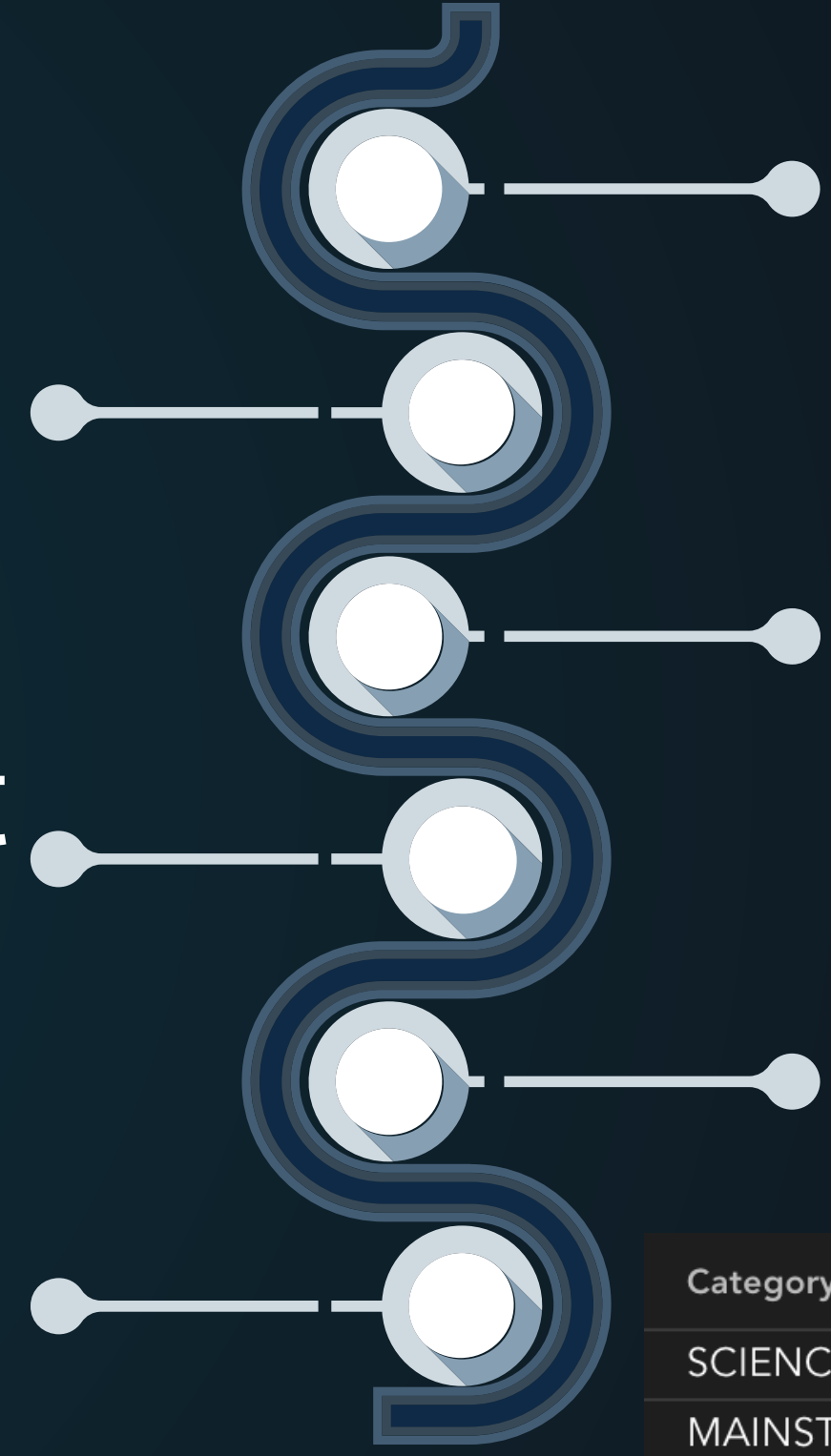
Gallotti et al, *To be Submitted* (2020)



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Metadata Extraction



ArcGIS
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Fact
Checking



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Category	Type
SCIENCE	Reliable
MAINSTREAM MEDIA	Reliable
SATIRE	Unreliable
CLICKBAIT	Unreliable
OTHER	Unknown
SHADOW	Unknown
POLITICAL	Unreliable
FAKE/HOAX	Unreliable
CONSPIRACY/JUNKSCI	Unreliable



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Metadata Extraction



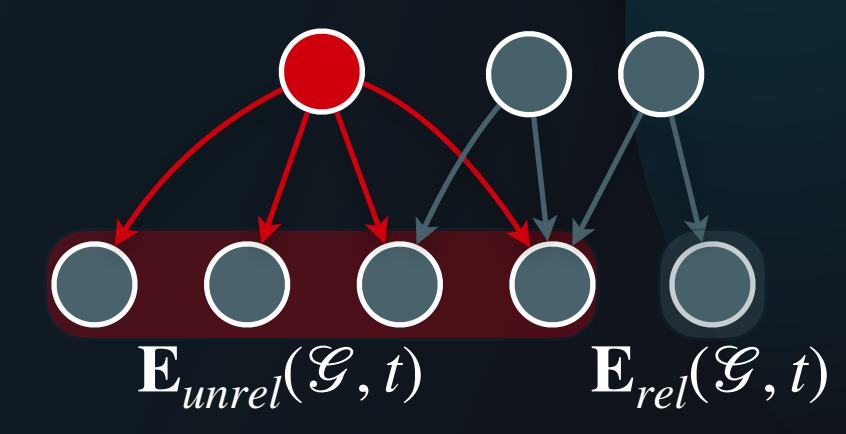
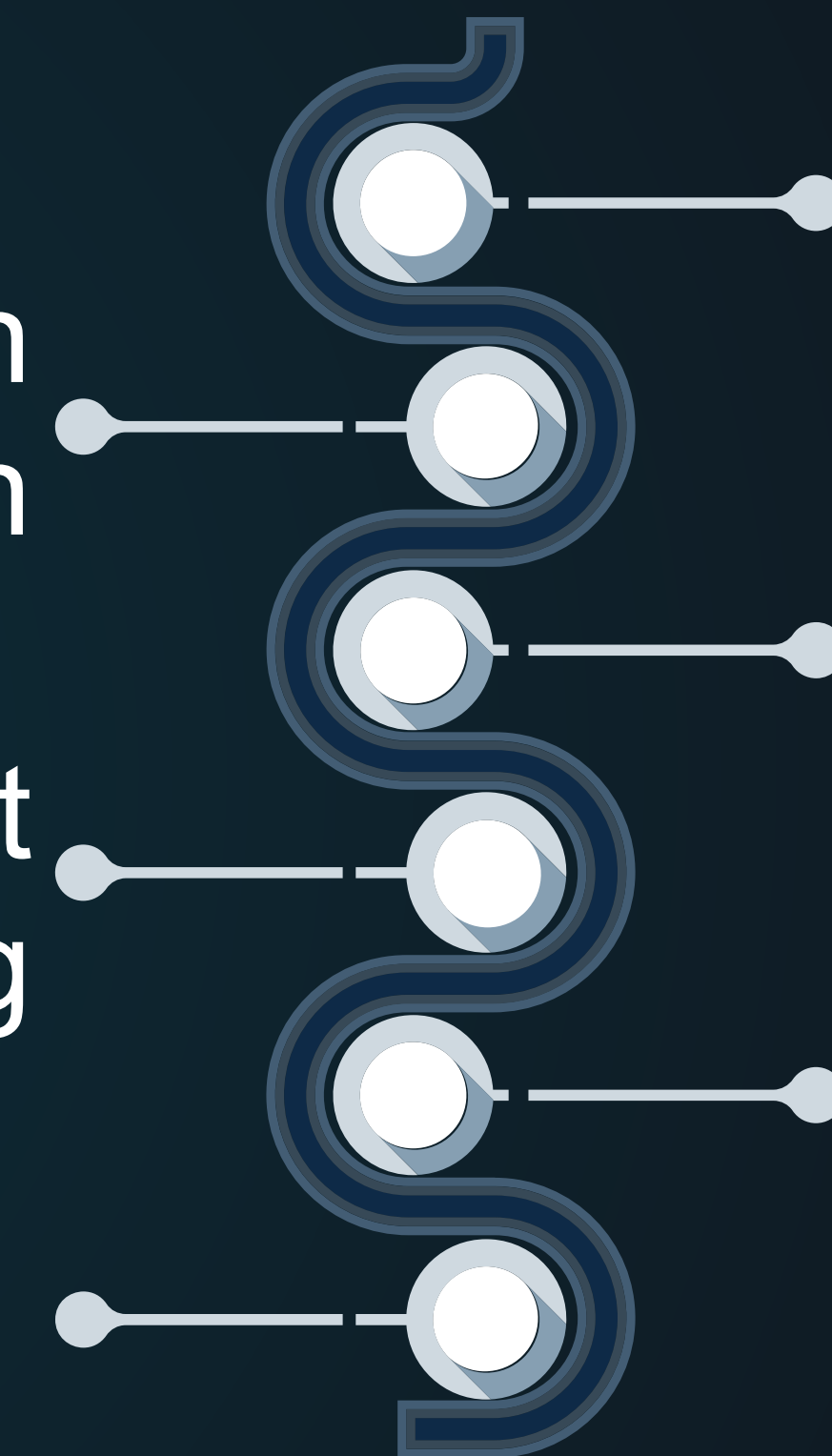
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Information
Cascades







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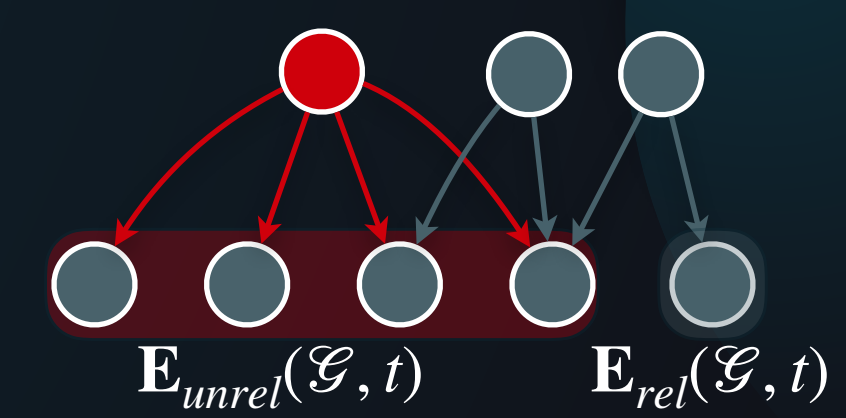
Fact
Checking

Risk
Analysis

ArcGIS
Geocode

Psycho
Linguistics

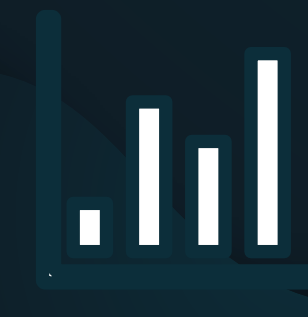
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 Spatio-temporal
Infodemic Risk Index

$$IRI(\mathcal{G}, t) = \frac{E_{unrel}(\mathcal{G}, t)}{E_{rel}(\mathcal{G}, t) + E_{unrel}(\mathcal{G}, t)}$$



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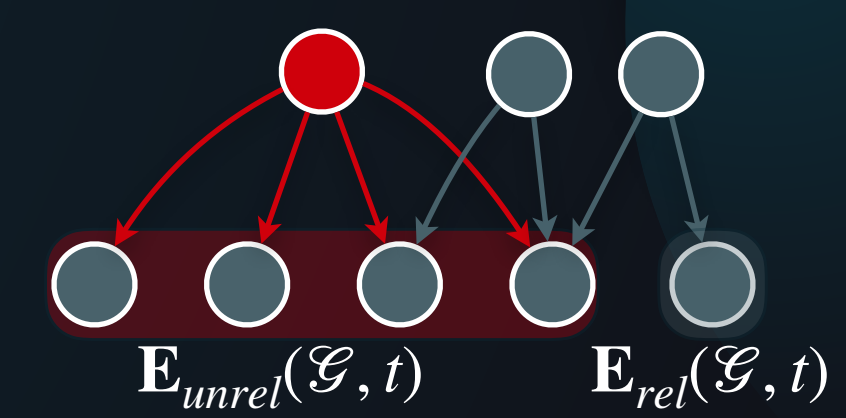
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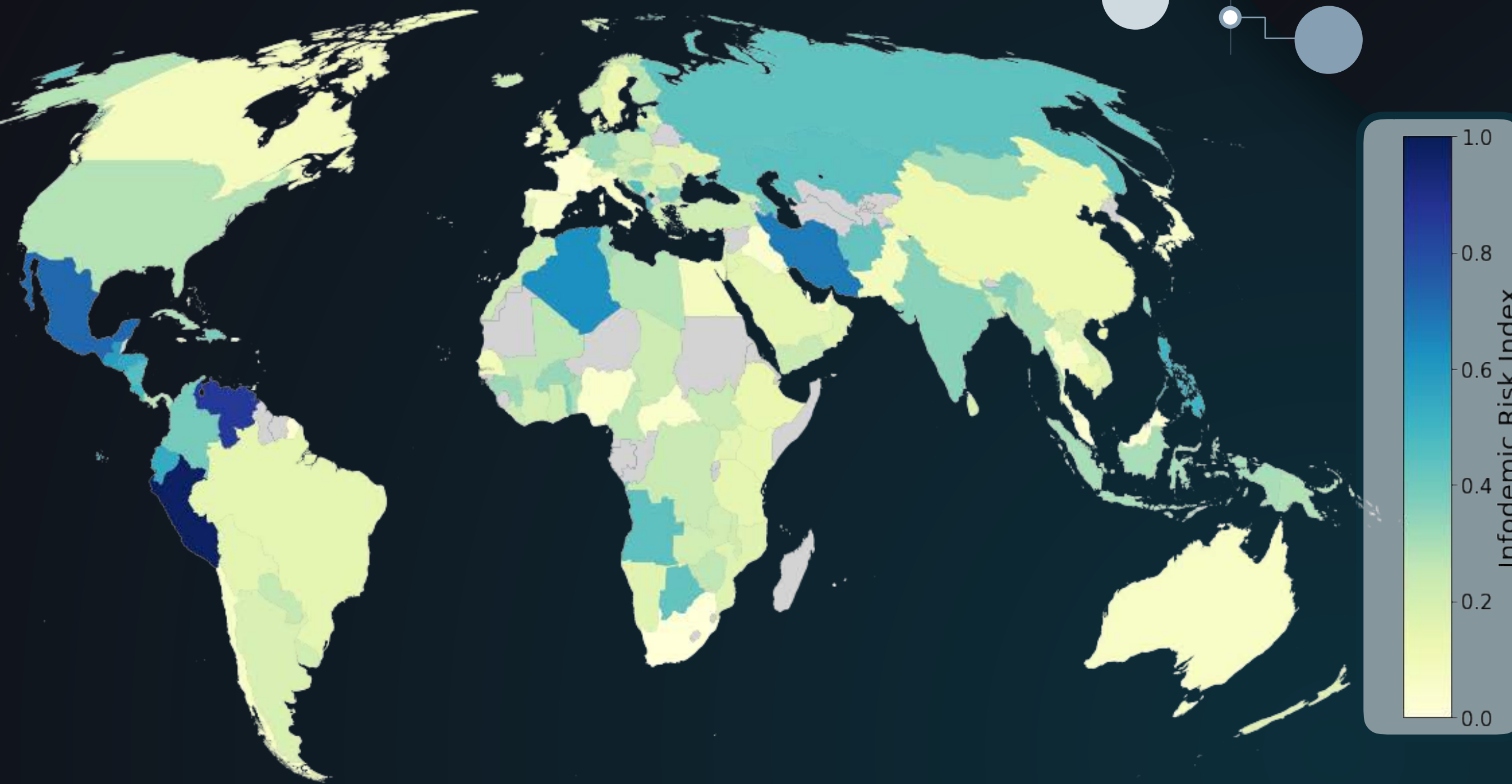
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 Infodemic equivalent of Epidemic attack ratio

$$IRI(\mathcal{G}, t) = \frac{E_{unrel}(\mathcal{G}, t)}{E_{rel}(\mathcal{G}, t) + E_{unrel}(\mathcal{G}, t)}$$



Source:

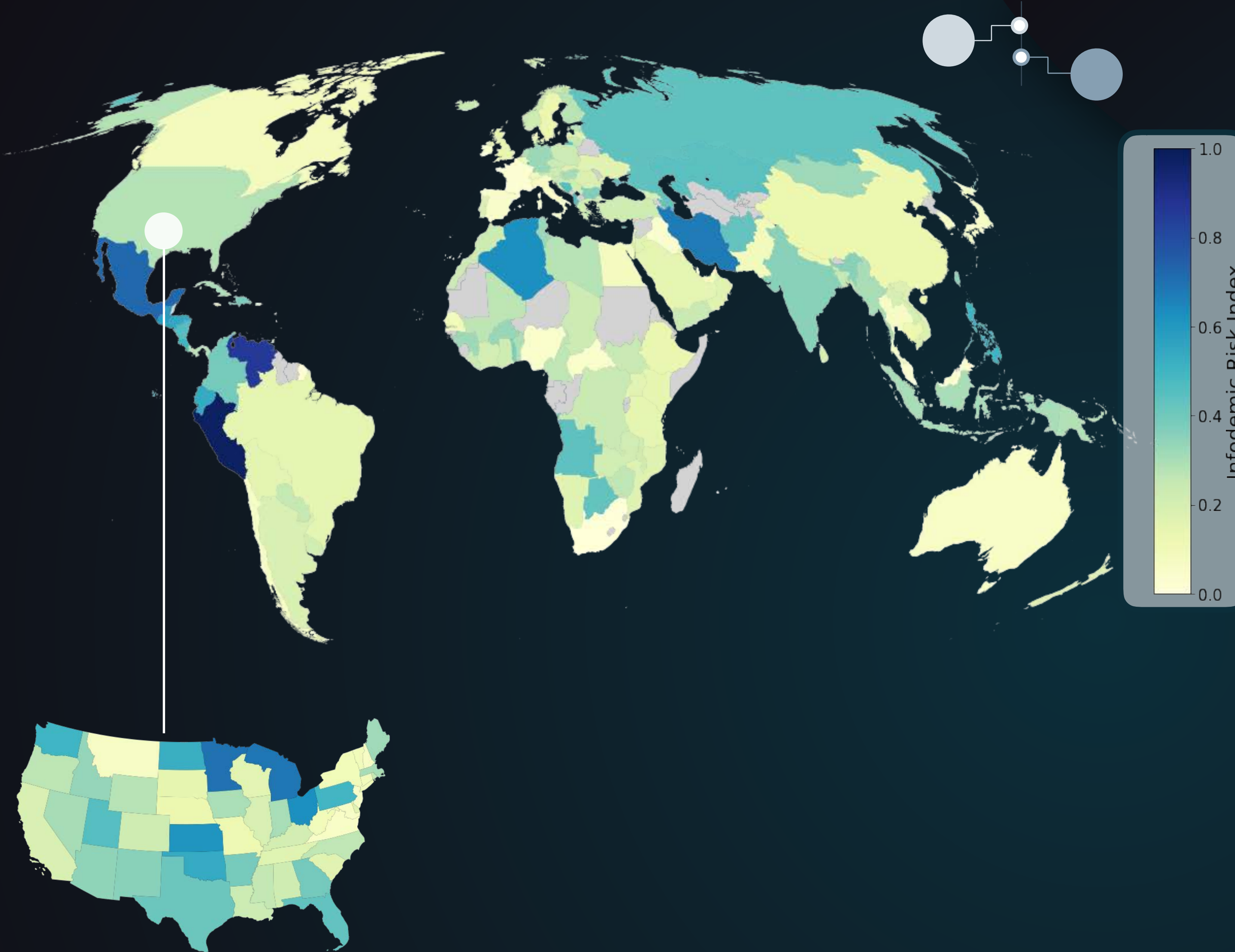
COVID19 Infodemic
Observatory

covid19obs.fbk.eu

Source:

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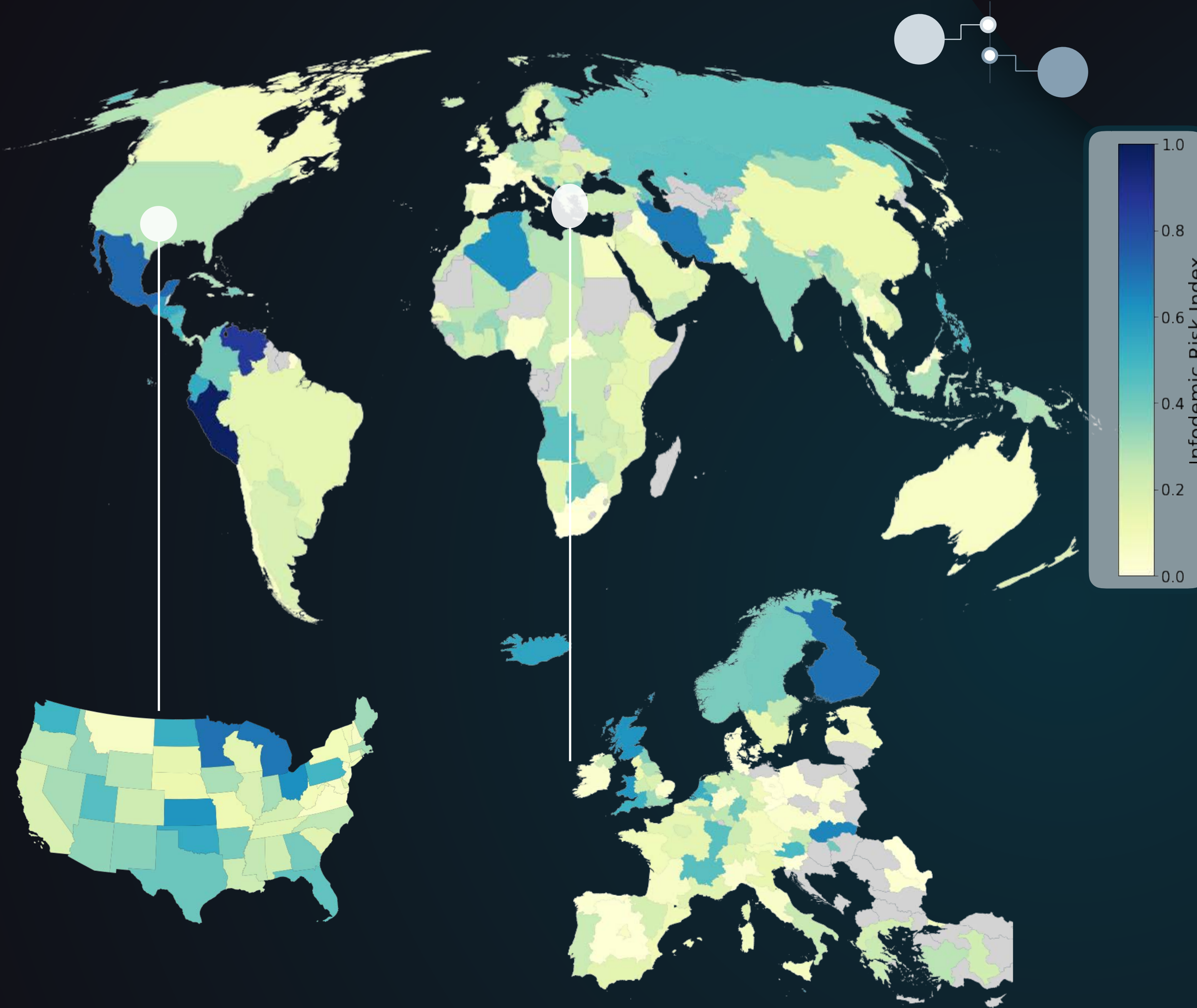


MULTISCALE SPATIO-TEMPORAL ANALYSIS

Source:

COVID19 Infodemic
Observatory

covid19obs.fbk.eu

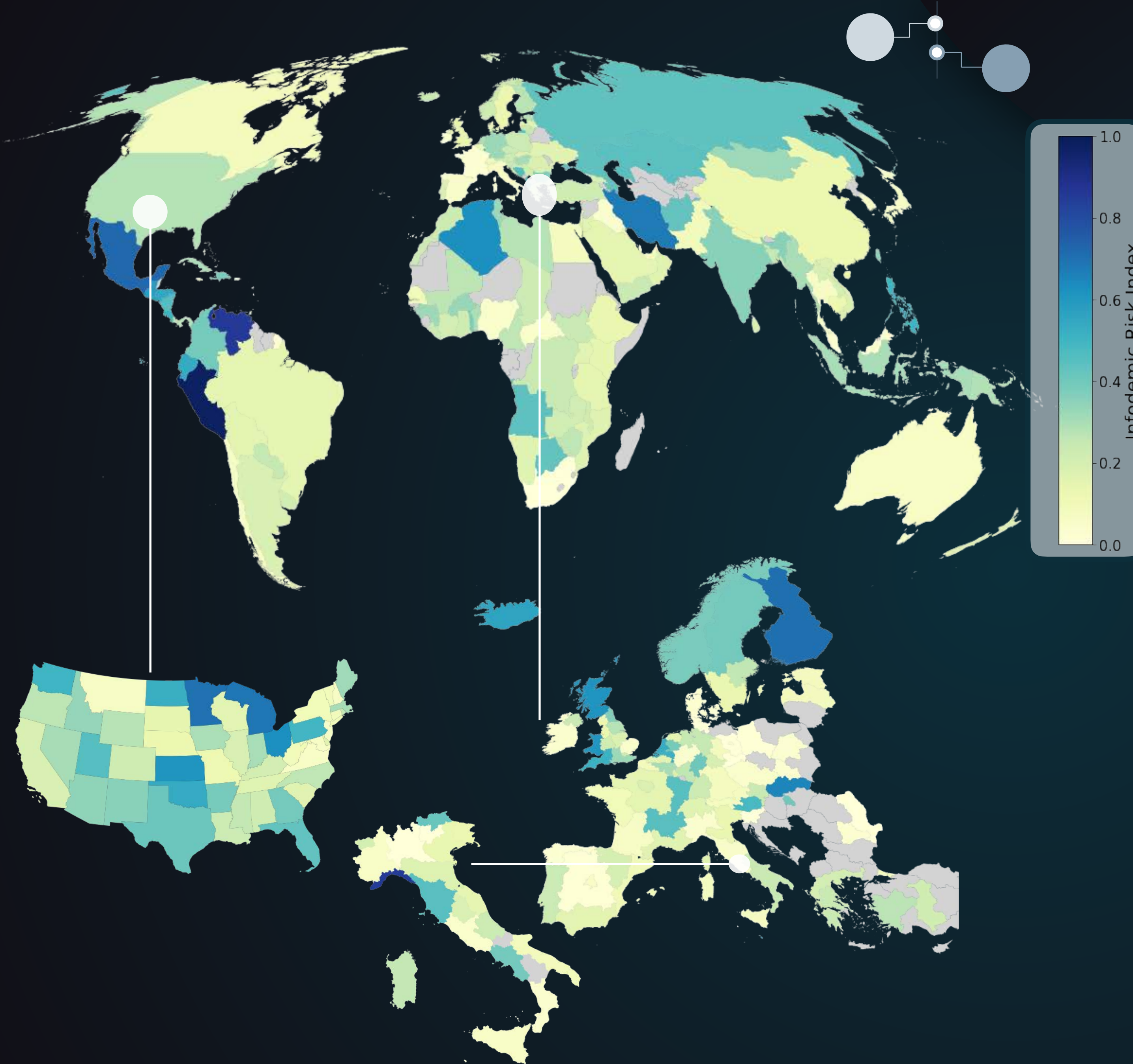


MULTISCALE SPATIO-TEMPORAL ANALYSIS

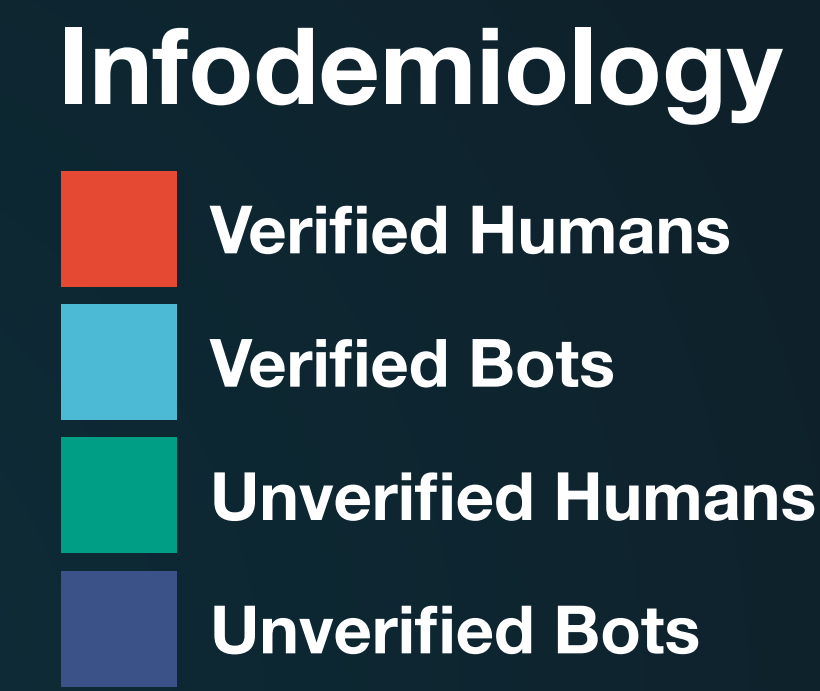
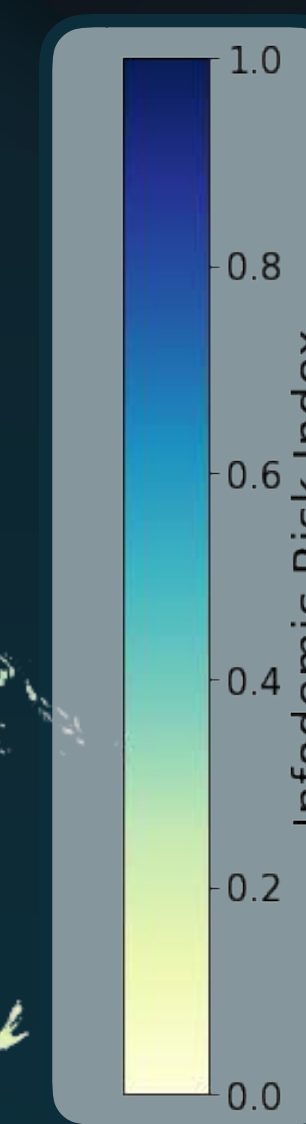
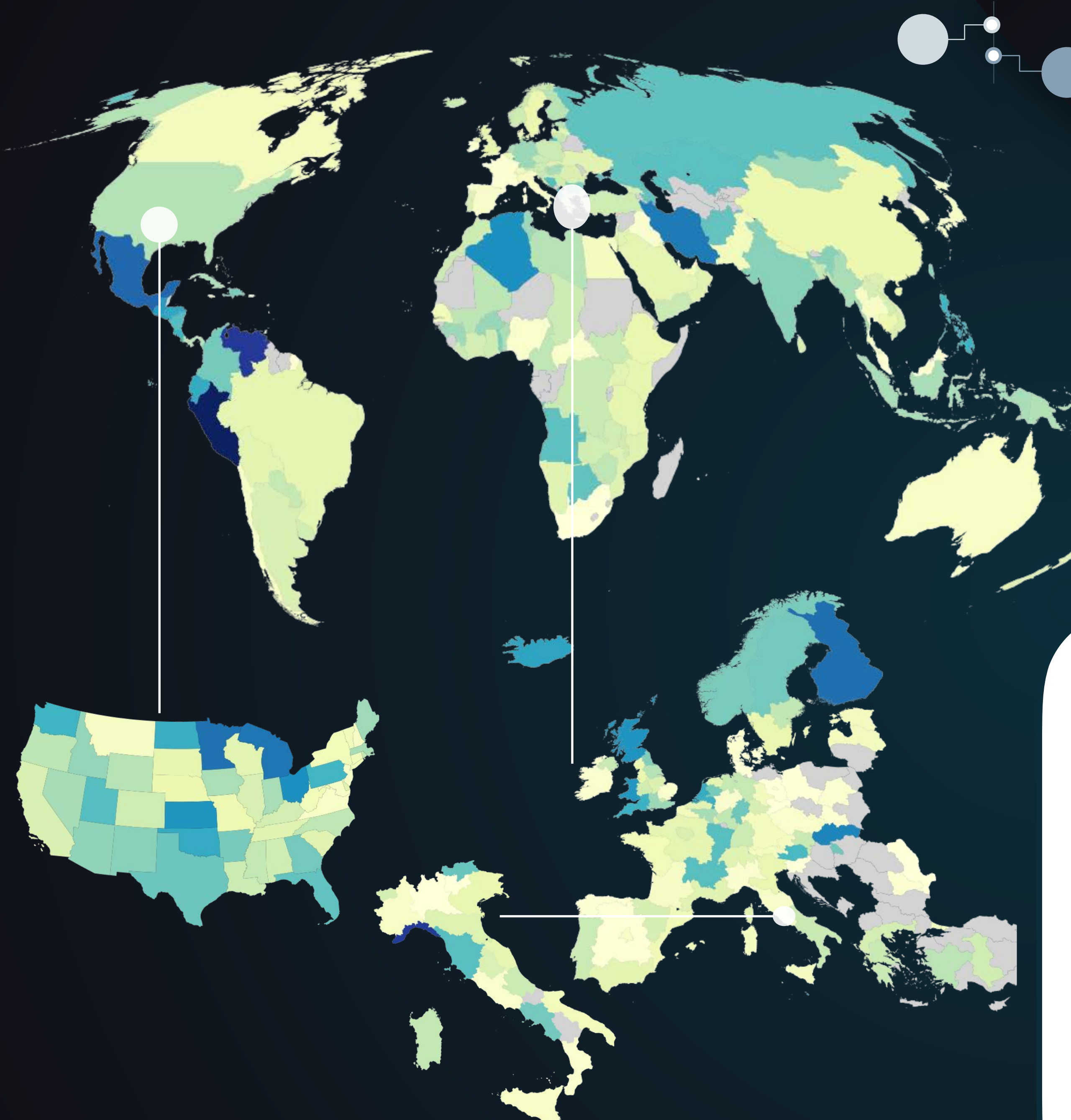
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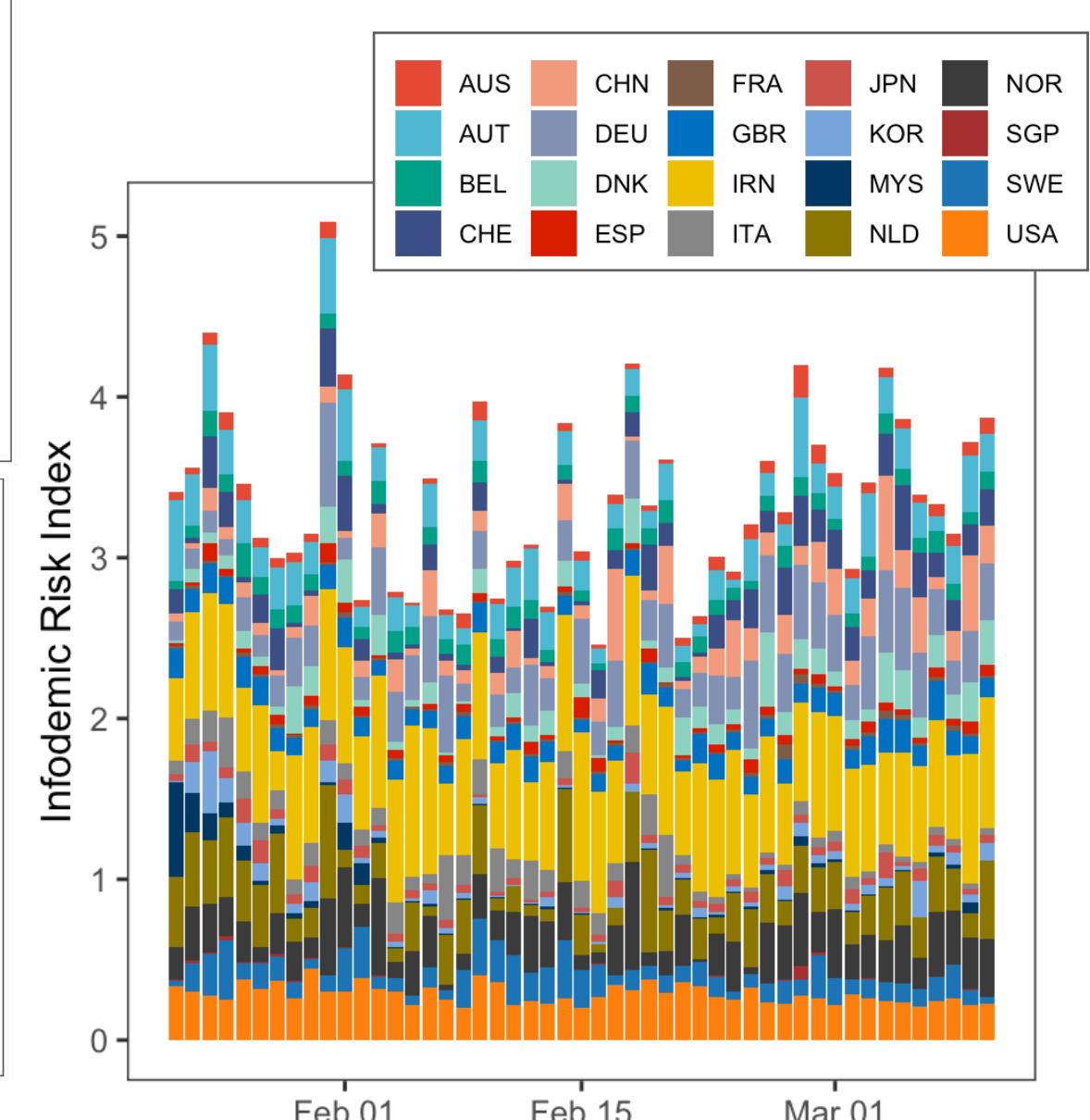
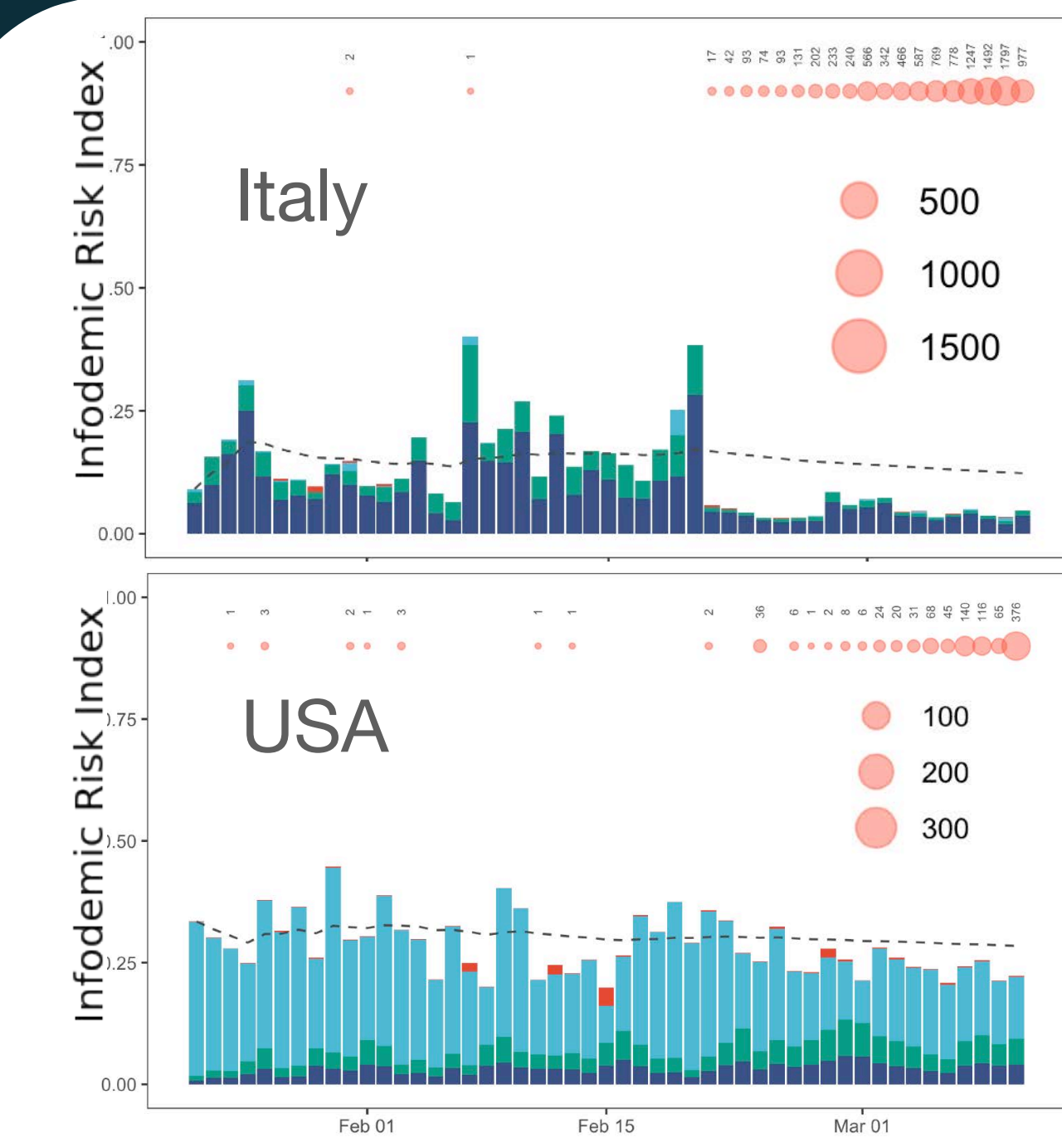
MULTISCALE SPATIO-TEMPORAL ANALYSIS



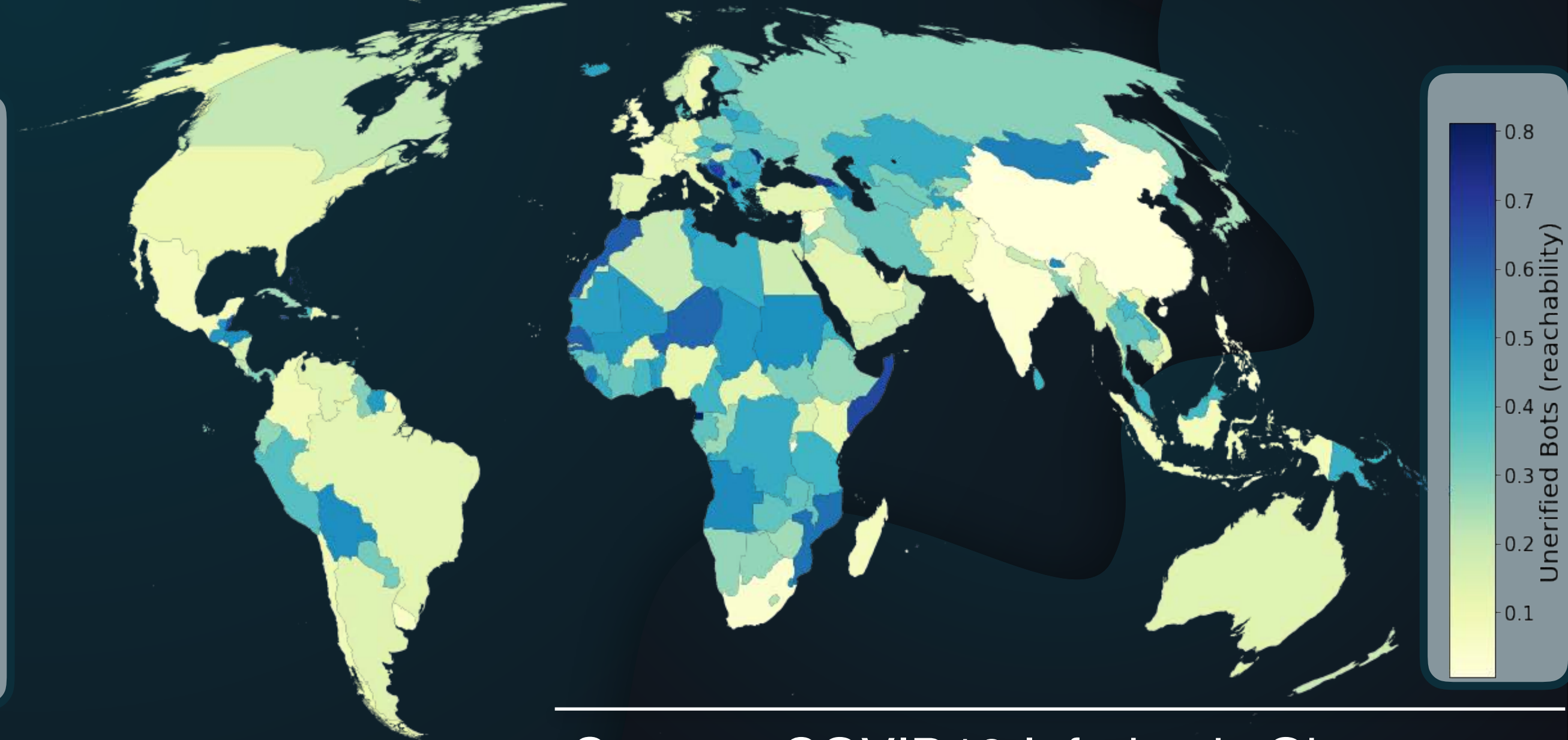
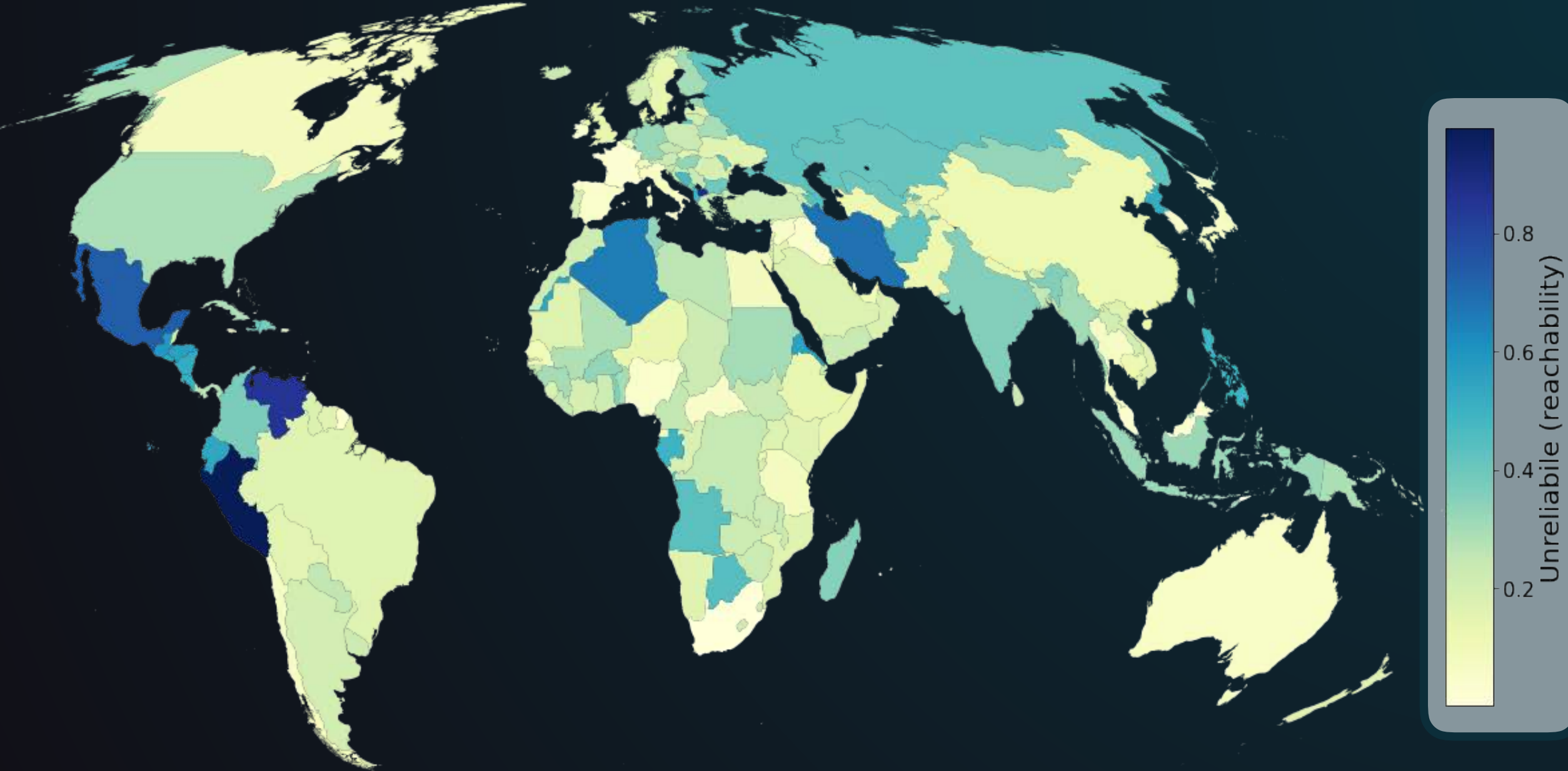
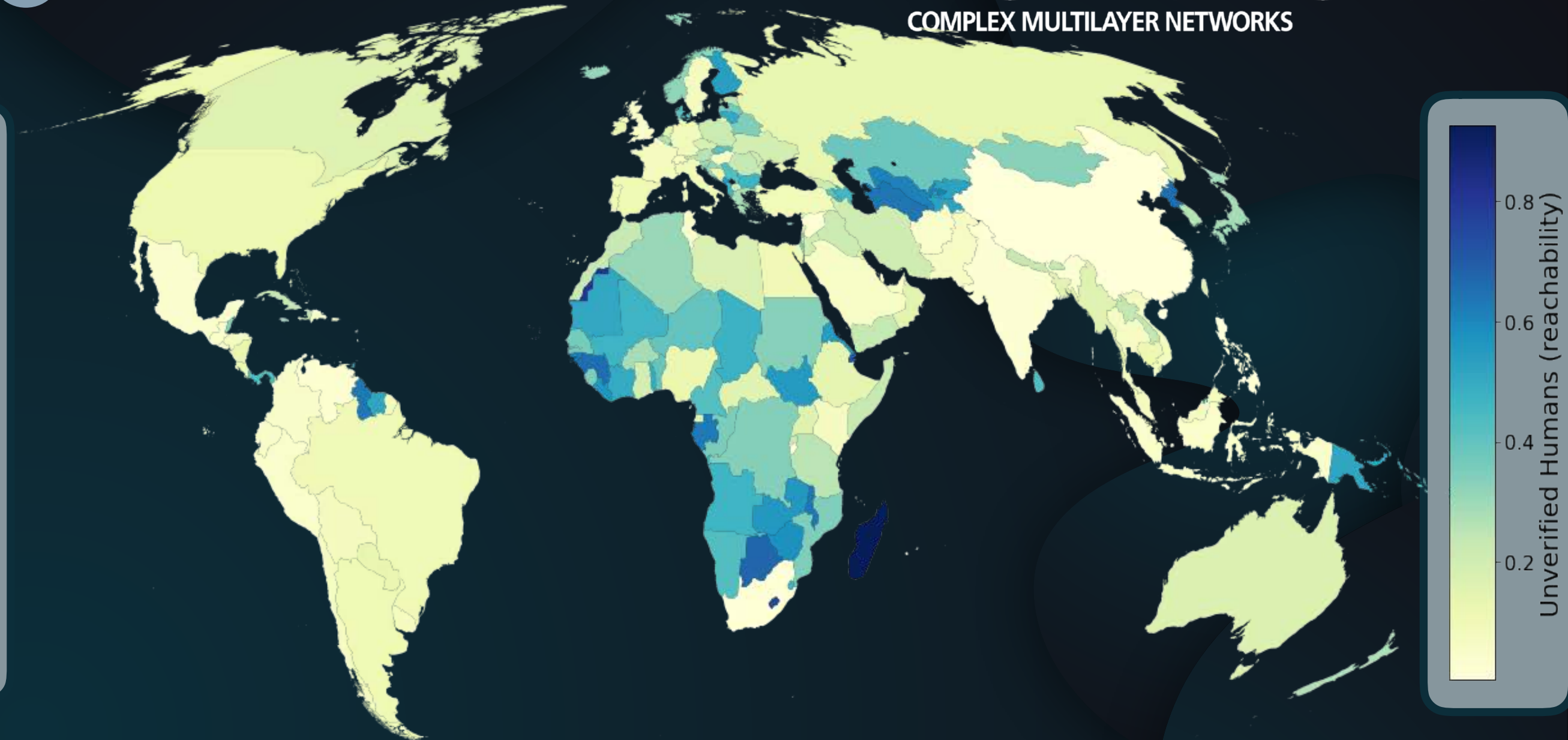
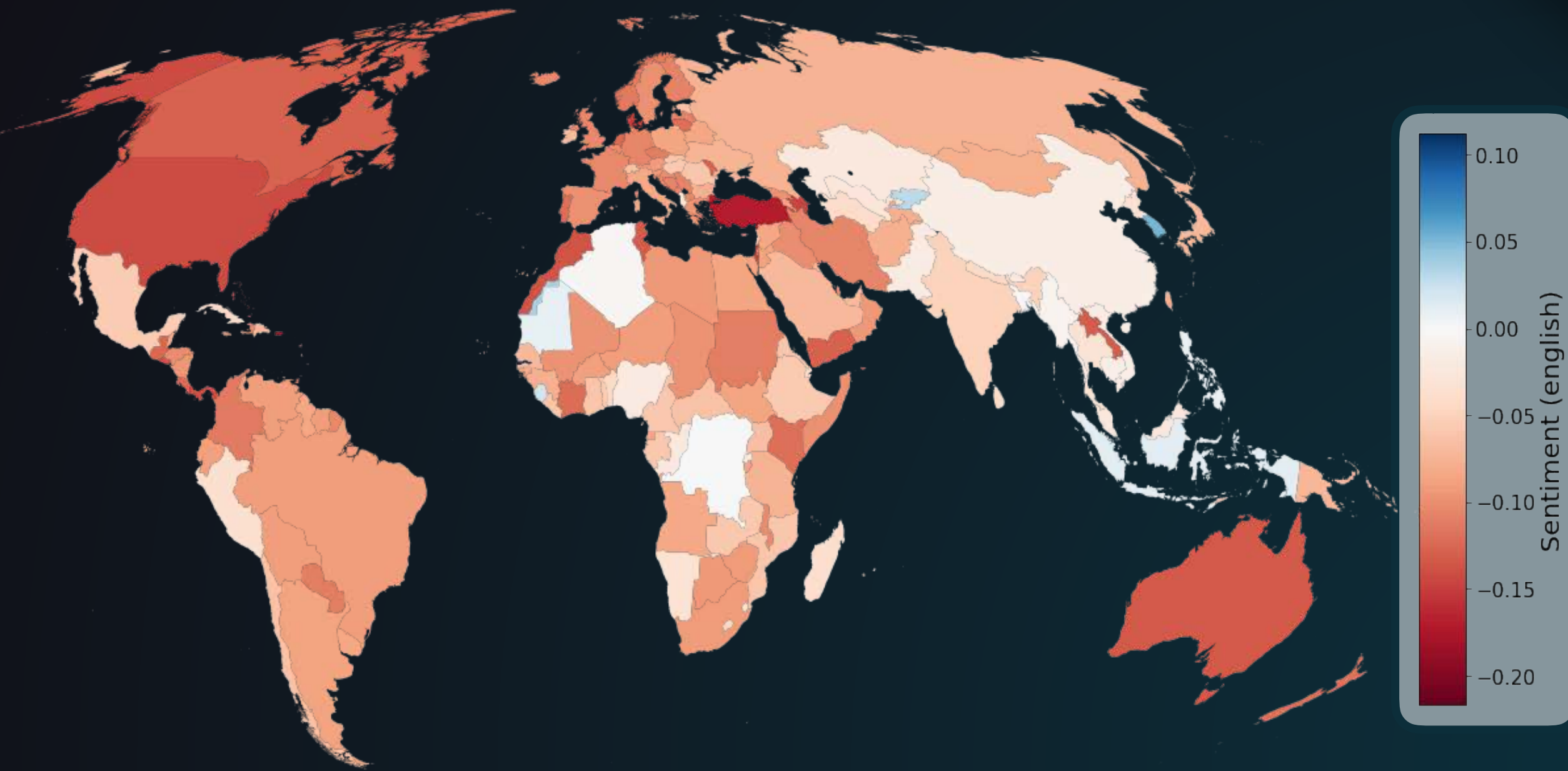
Source:

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MULTISCALE SPATIO-TEMPORAL ANALYSIS



MULTIMODAL ANALYSIS

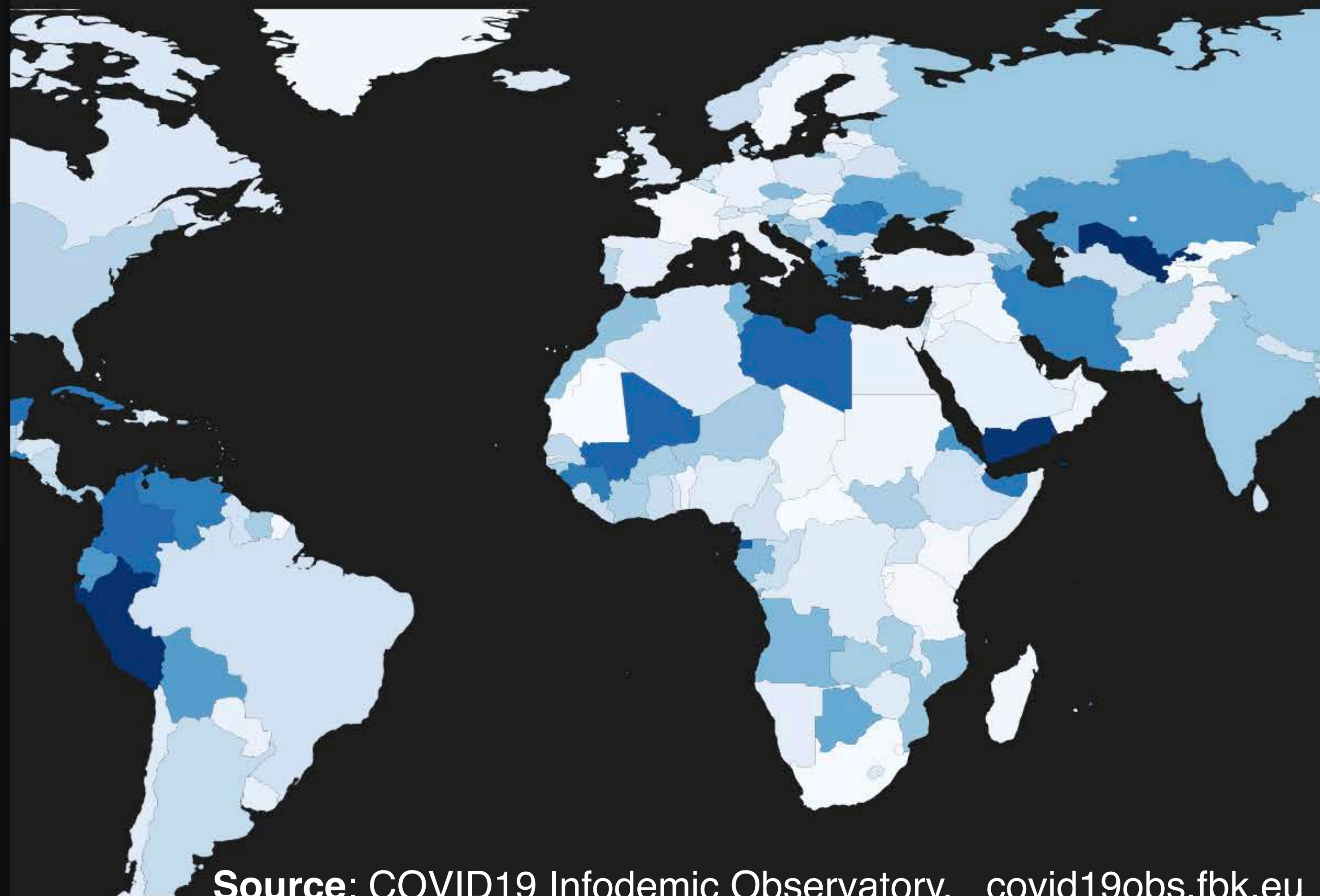
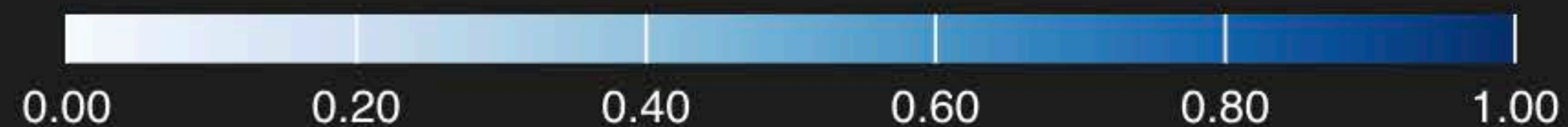
Source: COVID19 Infodemic Observatory
covid19obs.fbk.eu

Risk Index

0.23



4/4/2020



Source: COVID19 Infodemic Observatory. covid19obs.fbk.eu

EPIDEMIC

TWEETS

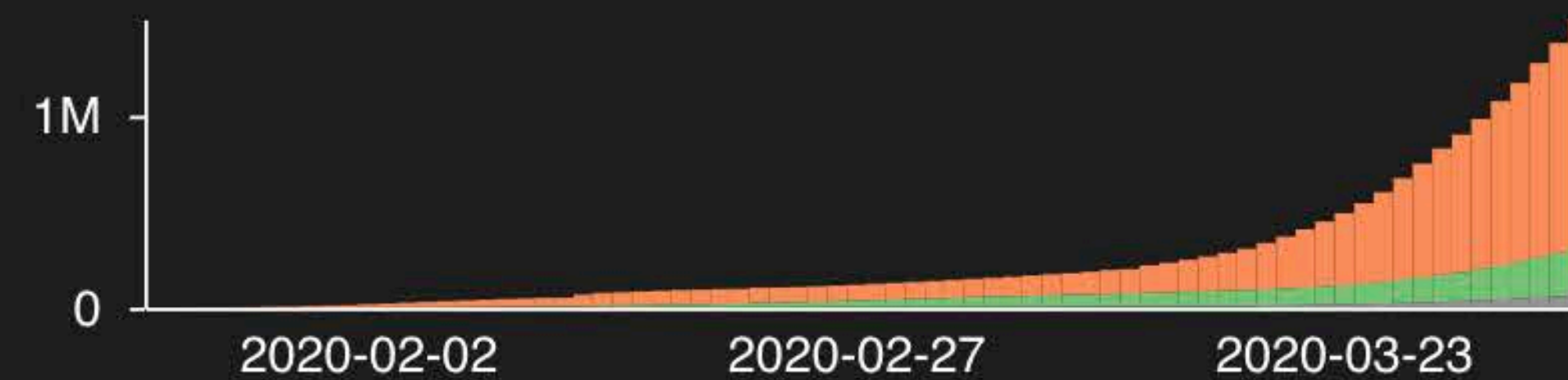
ECONOMY



C

R

D



SOCIAL BOTS/HUMANS

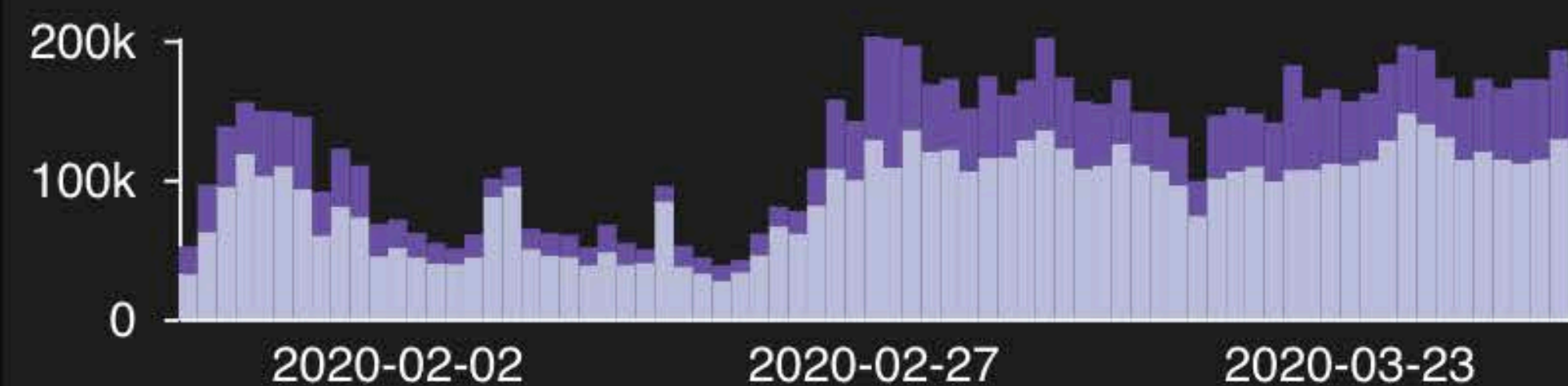
RELIABILITY

EXPOSURE



UF

RF



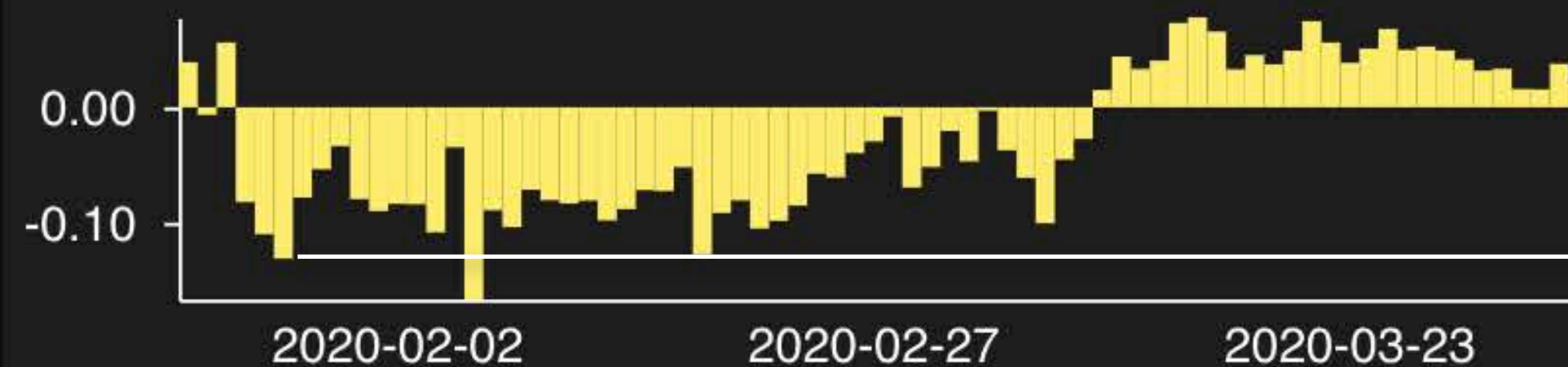
SENTIMENT

EMOTIONAL

PSYCHOLOGICAL



S

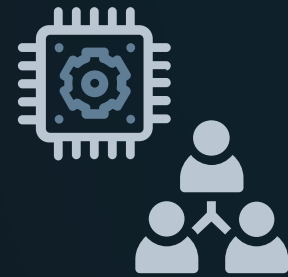




Infodemics entangled to other phenomena



Systemic perspective is required



Machine-assisted & crowd-based strategies to scale

TAKE-HOME MESSAGE

Dr. Manlio De Domenico

Head of Complex Multilayer Networks Lab
Division of Digital Society, Fondazione Bruno Kessler (Trento, Italy)

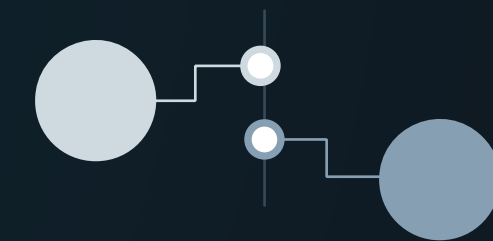
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+39 0461 314 544

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CONTACTS



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