WMO COVID-19 Research Board
Task Team (July 2020-Dec 2021)

WORLD METEOROLOGICAL ORGANIZATION

WEATHER CLIMATE WATER

- Interdisciplinary expert group established in June 2020 to support the global response to COVID-19

- **Aim**
- Provide COVID-19 decision relevant knowledge about weather, solar radiation and air pollution
- Provide a platform to discuss science-based insights and form functional partnerships

- **Specific tasks**
- Issue periodic authoritative WMO statements based on rapidly synthesized evidence
- If warranted, help operationalize MAQ-informed risk assessment and predictive modelling
- Foster good practice in interdisciplinary research and operational services
- Promote scientific resources
- Identify knowledge gaps and priorities to orient research investments
- Coordinate with SERCOM Health Study Group
- Recommend and open doors for future research support to the WHO and health community

WMO COVID-19 Research Board
Task Team Members

WORLD METEOROLOGICAL ORGANIZATION

WEATHER CLIMATE WATER

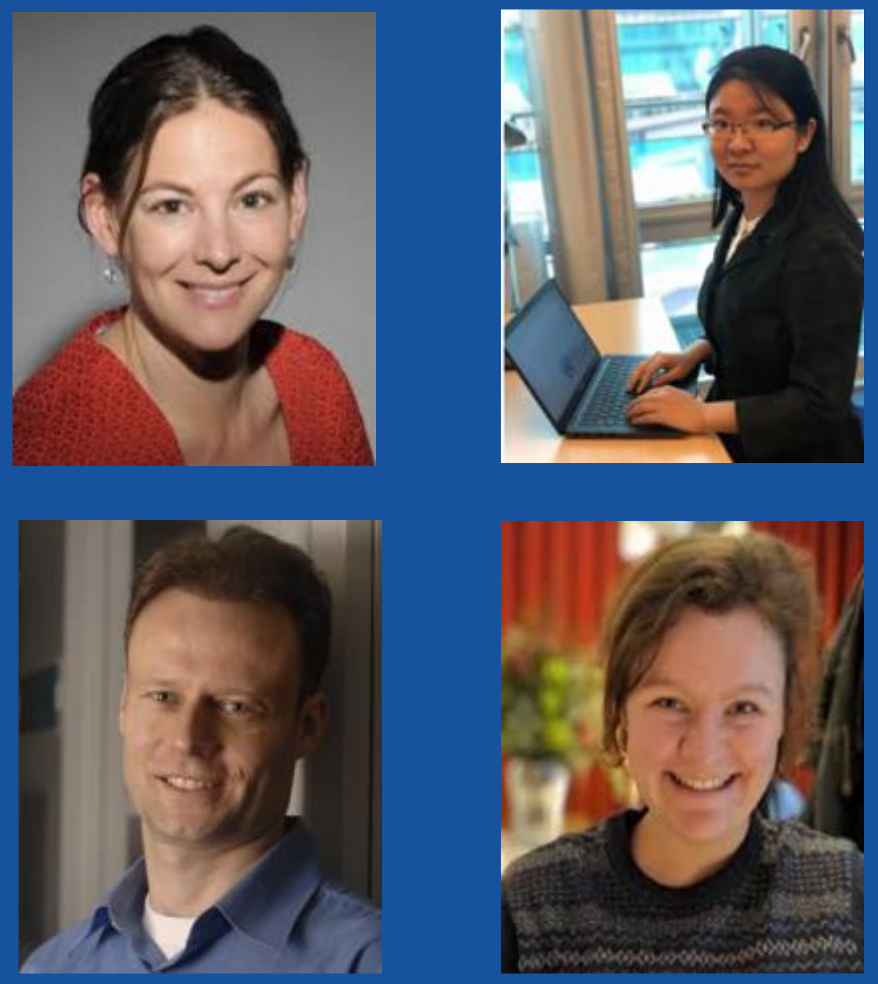
Ben Zaitchik – JHU (Chair)
Judy Omumbo – AAS (Co-Chair)
David Farrell – CIMH
Ken Takahashi Guevara – SENAMHI

Juli Trtanj – NOAA
Rosa Barciela – UK Met Office
Yun Gao – CAMS
Emily YY Chan – CUHK

Sophie Gumy– WHO
Masahiro Hashizume - UTokyo
Rachel Lowe - LSHTM
Nick H. Ogden – PHAC

Henri-Vincent Peuch – ECMWF
Paulo Saldiva – FMUSP
Xavier Rodo – ISGlobal
Tong Zhu - PKU

WMO Secretariat Support



Joy Shumake-Guillemot
Lu Ren
Jürg Luterbacher
Rosa von Borries

Website:
https://community.wmo.int/activity-areas/health

First Report on MAQ Factors and COVID-19

Aims

1. Expert evaluation informed by peer reviewed literature on MAQ factors affecting SARS-CoV-2/COVID-19
2. Provide a concise overview on the understanding of MAQ influences on SARS-CoV-2/COVID-19
3. Present best practices for analysis and communication of MAQ-informed studies of COVID-19 risk

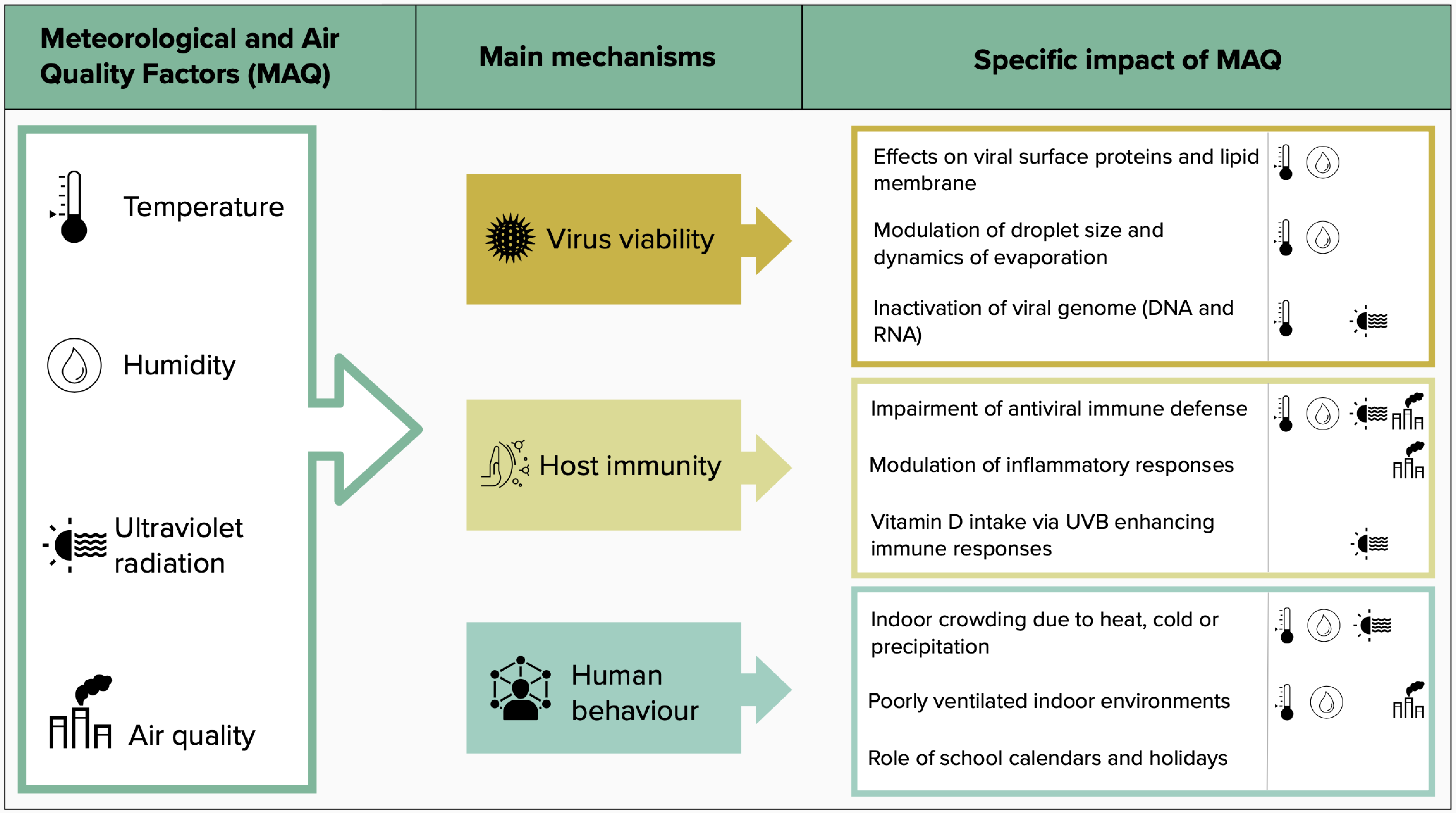
Principal Audience: Scientific communities, National Meteorological Services and WMO Regional Climate Centers, WHO and Collaborating centers, National Governments, Media, General public

Process

- Validation (Sept)
- Drafting (Oct – Dec)
- Open Review (Dec-Jan)
- Webinars Beijing + Virtual (Jan)
- **Official Publication (Mar)**

Proposed mechanisms of MAQ influence

To provide a concise overview on the understanding of MAQ influences on SARS-CoV-2/COVID-19



Key findings – State of Understanding

WORLD METEOROLOGICAL ORGANIZATION

WEATHER CLIMATE WATER

- Epidemiological studies of COVID-19 to date have given sometimes conflicting results regarding influence of meteorological conditions on transmission dynamics.

- Transmission dynamics appear to have been **controlled primarily by government interventions**, which makes it challenging to tease apart any weather signatures in reported data. Other relevant drivers include changes in human behaviour and demographics of affected populations.

- Previous studies have shown that **other respiratory viruses**, such as influenza and other human coronaviruses are sensitive to environmental conditions, with higher temperatures and increased humidity reducing transmission potential, which means they tend to peak in winter in temperate regions. This has fuelled expectations that transmission of COVID-19 will be seasonal.

Key findings – State of Understanding

WORLD
METEOROLOGICAL
ORGANIZATION

WEATHER CLIMATE WATER

- The **underlying mechanisms** that drive seasonality of respiratory viral infections are thought to be a combination of direct impacts on virus survival, impacts on human resistance to infection, and indirect influence of weather via changes in human behaviour.

- **Laboratory studies of SARS-CoV-2**, the virus that causes COVID-19, have yielded some evidence that the virus survives longer under cold and dry, and given low levels of ultraviolet radiation. However, it is not clear if meteorological influences on the virus impact transmission rates under real world conditions, given gov interventions.

- There is evidence that **chronic and short-term exposure to air pollution** exacerbates symptoms and increases mortality rates for some respiratory diseases. This is consistent with early studies of COVID-19 mortality rates, but these results need to be confirmed and consolidated by controlling for individual-level risk factors. There is no direct, peer reviewed evidence of pollution impacts on the transmission of SARS-CoV-2 at this time.

Key findings – Best Practices for Research and Forecasts

WORLD METEOROLOGICAL ORGANIZATION

WEATHER CLIMATE WATER

- Process-based modelling studies anticipate that **COVID-19 transmission may become seasonal over time, suggesting Meteorology and Air Quality (MAQ) factors may support monitoring and forecasting of COVID-19 in the coming months and years.**

- **Research quantifying links between MAQ factors and COVID-19 is needed**. It is critical that modelling studies properly account for confounding factors, consider both direct and indirect MAQ effects, address limitations in the COVID-19 data record, report uncertainty ranges, evaluate predictive skill, and apply appropriate statistical or process-based modelling techniques.

- Peer-reviewed studies have the potential to influence public health decisions and public perceptions of disease risk. For this reason, it is critical that researchers, publishers, and information providers **maintain high standards for analysis and evaluation of emerging studies**.

- Just as importantly, **clear and active communication between researchers, the media, and decision makers is required** to ensure that scientific findings are applied to policy in an appropriate, objective, transparent and responsible manner.

Note on Potential for Operationalization

TOR:
If, over the first 12 months strong scientific evidence will support the relevance of environmental conditions as drivers of transmission, the TT should benchmark the possibility of the operationalization of predictive modelling capabilities and coordinate with WMO specialized centers for the operationalization;

Status Statement: (As of Jan 2021)
No (Limited) robust operational potential.

To date, insufficient evidence that temperature, humidity, air quality, and solar radiation influence COVID-19 transmission, in ways that these conditions can be used for predictive modeling.

- Reassessment planned for June 2020

WORLD METEOROLOGICAL ORGANIZATION

GEO HEALTH

Tackling the data challenge

Unified real-time environmental-epidemiological data for multiscale modeling of the COVID-19 pandemic

Hamada S. Badr[1*], Benjamin F. Zaitchik[2], Gaige H. Kerr[3], Nhat-Lan H. Nguyen[4], Yen-Ting Chen[4], Patrick Hinson[4], Josh M. Colston[4], Margaret N. Kosek[4], Ensheng Dong[1], Hongru Du[1], Maximilian Marshall[1], Kristen Nixon[1], Arash Mohegh[3], Daniel L. Goldberg[3], Susan C. Anenberg[3], and Lauren M. Gardner[1]

[1] Department of Civil and Systems Engineering, Johns Hopkins University, Baltimore, MD 21218

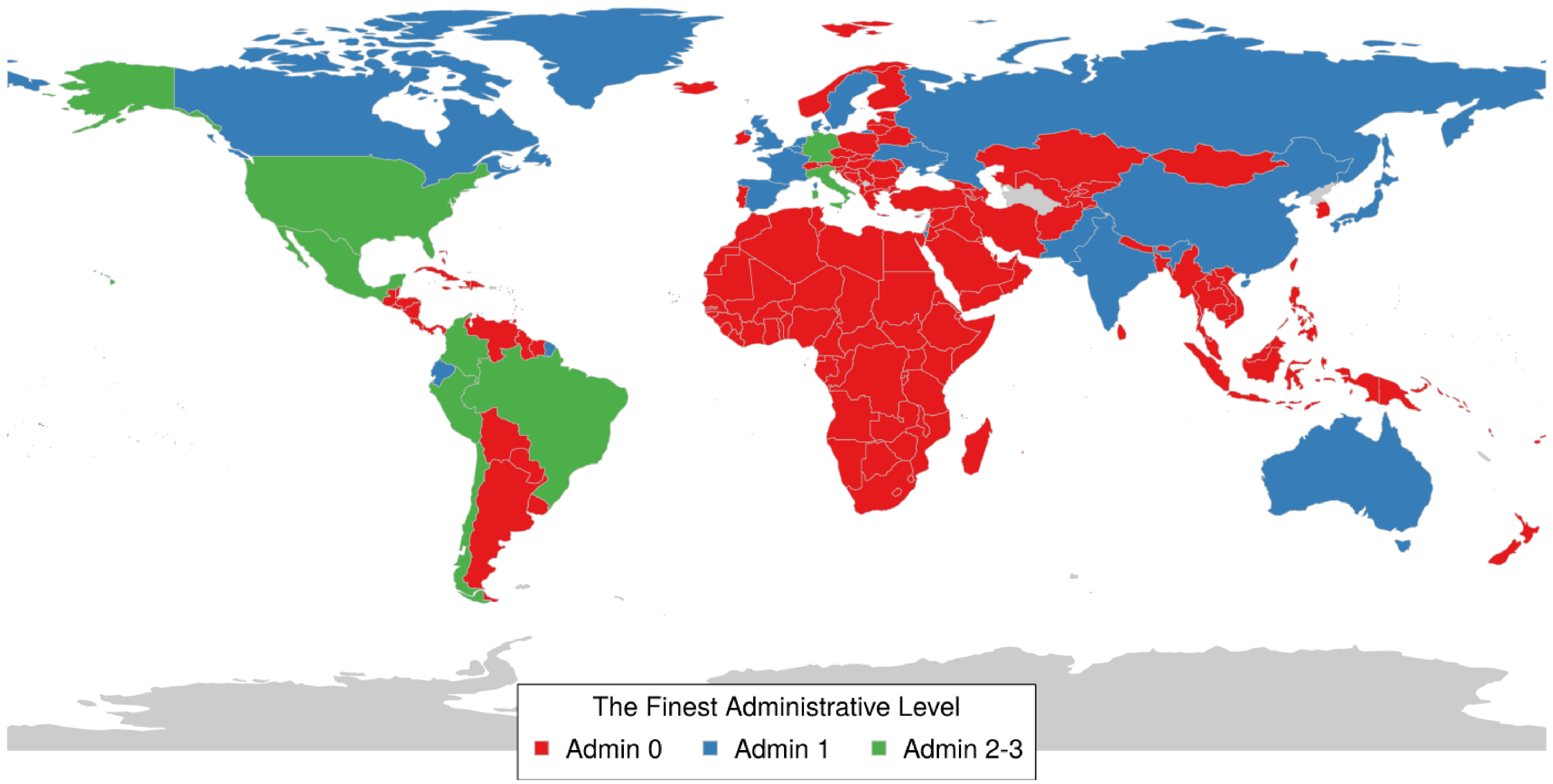
[2] Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, MD 21218

[3] Department of Environmental and Occupational Health, Milken Institute School of Public Health, George Washington University, Washington, DC 20052

[4] Division of Infectious Diseases and International Health, University of Virginia School of Medicine, Charlottesville, VA 22903

https://github.com/CSSEGISandData/COVID-19_Unified-Dataset

Creating a unified, reliable data record



https://github.com/CSSEGISandData/COVID-19_Unified-Dataset

- Maps all geospatial units globally into a unique standardized ID.

WORLD METEOROLOGICAL ORGANIZATION

GEO HEALTH

Creating a unified, reliable data record

United States:

US	36	061	10476
Admin 0	Admin 1	Admin 2	Admin 3
Country	State	County	District
ISO 3166 1 2 letters	**FIPS** + 2 digits	**FIPS** + 3 digits	**ZCTA** + 5 digits

Europe:

IT	C	4	6
Admin 0	Admin 1	Admin 2	Admin 3
Country	State *	County **	District
ISO 3166 1 2 letters	**NUTS 1** + 1 digit/letter	**NUTS 2** + 1 digit/letter	**NUTS 3** + 1 digit/letter

Global:

BR	SP	3550308	
Admin 0	Admin 1	Admin 2	Admin 3
Country	Province/State	County ***	District
ISO 3166 1 2 letters	**ISO 3166 2** principal divisions	**Local 2** country specific	**Local 3** country specific

https://github.com/CSSEGISandData/COVID-19_Unified-Dataset

- Maps all geospatial units globally into a unique standardized ID.
- Standardizes administrative names and codes at all levels.
- Standardizes dates, data types, and formats.

* *NUTS 1 level represents groups of subregions (or equivalent) for some European countries (e.g., Italy).*
** *NUTS 2 level represents subregions (or equivalent) for some European countries (e.g., Italy).*
*** *This administrative level may represent municipalities (or equivalent) for some countries (e.g., Brazil).*

Creating a unified, reliable data record

Column	Type	Description
ID	Character	Geospatial ID, unique identifier
Date	Date	Date of data record
Cases	Integer	Number of cumulative cases
Cases_New	Integer	Number of new daily cases
Type	Character	Type of the reported cases
Age	Character	Age group of the reported cases
Sex	Character	Sex/gender of the reported cases
Source	Character	Data source: JHU[1], CTP[2], NYC[3], NYT[4], SES[5], DPC[6], RKI[7], JRC[8]

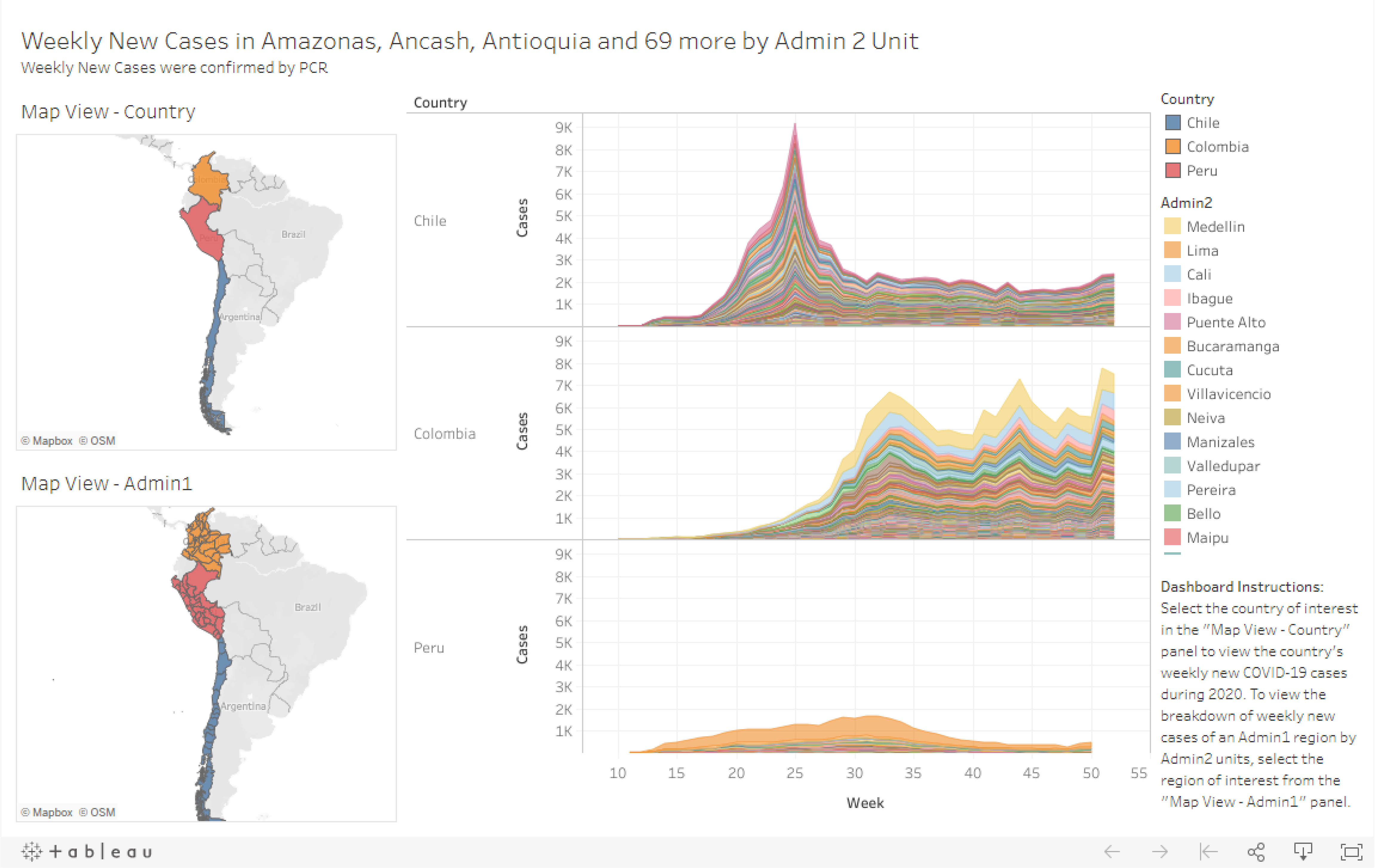
Type	Description
Active	Active cases
Confirmed	Confirmed cases
Deaths	Deaths
Home_Confinement	Home confinement / isolation
Hospitalized	Total hospitalized cases excluding intensive care units
Hospitalized_Now	Currently hospitalized cases excluding intensive care units
Hospitalized_Sym	Symptomatic hospitalized cases excluding intensive care units
ICU	Total cases in intensive care units
ICU_Now	Currently in intensive care units
Negative	Negative tests
Pending	Pending tests
Positive	Positive tests, including hospitalised cases and home confinement
Positive_Dx	Positive cases emerged from clinical activity / diagnostics
Positive_Sc	Positive cases emerging from surveys and tests
Recovered	Recovered cases
Tested	Cases tested = Tests - Pending
Tests	Total performed tests
Ventilator	Total cases receiving mechanical ventilation
Ventilator_Now	Currently receiving mechanical ventilation

https://github.com/CSSEGISandData/COVID-19_Unified-Dataset

- Maps all geospatial units globally into a unique standardized ID.
- Standardizes administrative names and codes at all levels.
- Standardizes dates, data types, and formats.
- Unifies variable names, types, and categories.

Creating a unified, reliable data record

https://github.com/CSSEGISandData/COVID-19_Unified-Dataset



- Maps all geospatial units globally into a unique standardized ID.
- Standardizes administrative names and codes at all levels.
- Standardizes dates, data types, and formats.
- Unifies variable names, types, and categories.
- Merges data from all credible sources at all levels.

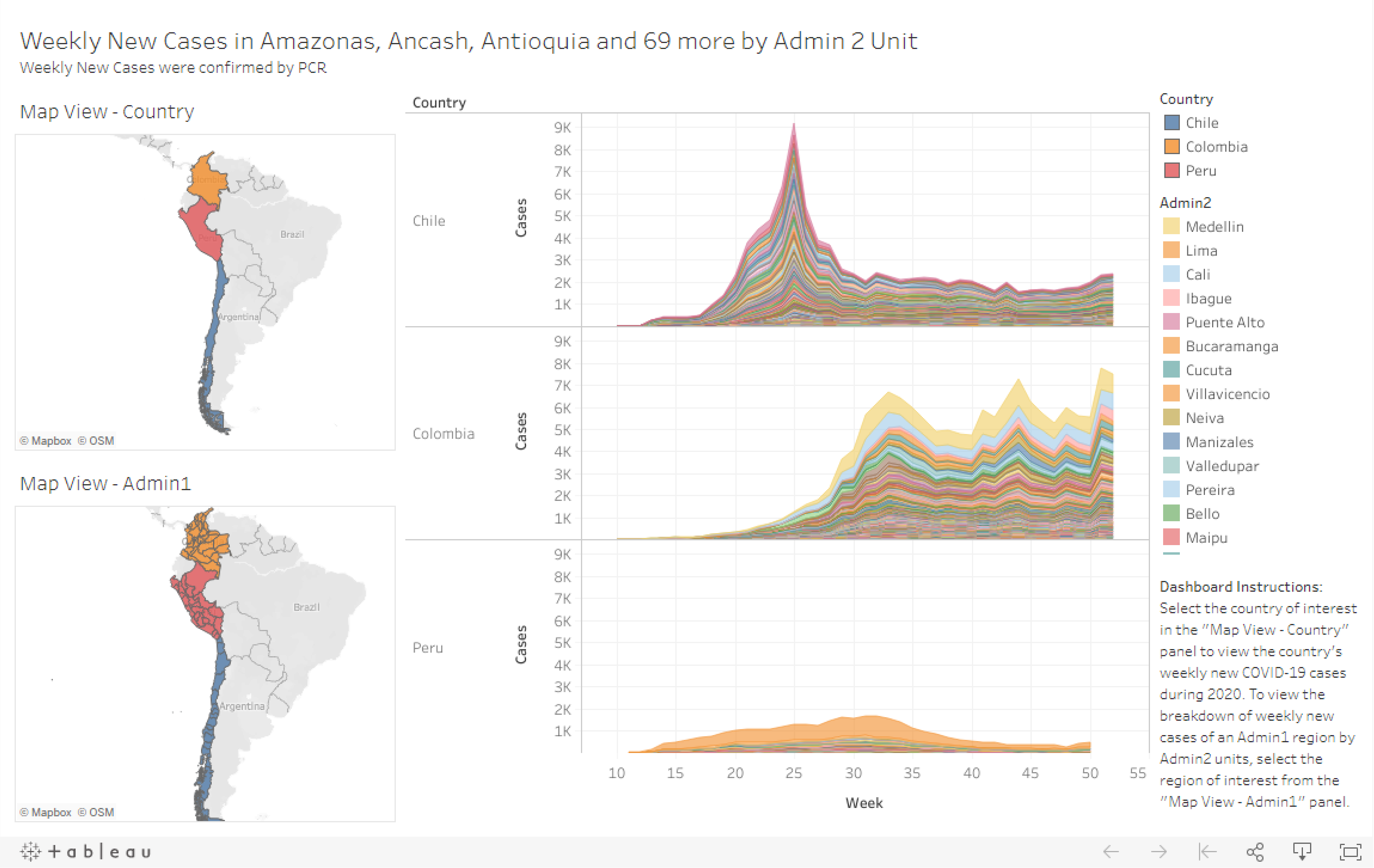
Lani Nguyen, UVa

WORLD METEOROLOGICAL ORGANIZATION

GEO HEALTH

Creating a unified, reliable data record

https://github.com/CSSEGISandData/COVID-19_Unified-Dataset



- Maps all geospatial units globally into a unique standardized ID.
- Standardizes administrative names and codes at all levels.
- Standardizes dates, data types, and formats.
- Unifies variable names, types, and categories.
- Merges data from all credible sources at all levels.
- Cleans the data and fixes confusing entries.

Lani Nguyen, UVa

Creating a unified, reliable data record

Column	Type	Unit	Description
ID	Character		Geospatial ID, unique identifier (described above)
Date	Date		Date of data record
T	Double	°C	Daily average near-surface air temperature
Tmax	Double	°C	Daily maximum near-surface air temperature
Tmin	Double	°C	Daily minimum near-surface air temperature
Td	Double	°C	Daily average near-surface dew point temperature
Tdd	Double	°C	Daily average near-surface dew point depression
RH	Double	%	Daily average near-surface relative humidity
SH	Double	kg/kg	Daily average near-surface specific humidity
MA	Double	%	Daily average moisture availability (NLDAS)[14]
RZSM	Double	kg/m2	Daily average root zone soil moisture content (NLDAS)[14]
SM	Double	kg/m2	Daily average soil moisture content (NLDAS)[14]
SM1	Double	m3/m3	Daily average volumetric soil water layer 1 (ERA5)[15]
SM2	Double	m3/m3	Daily average volumetric soil water layer 2 (ERA5)[15]
SM3	Double	m3/m3	Daily average volumetric soil water layer 3 (ERA5)[15]
SM4	Double	m3/m3	Daily average volumetric soil water layer 4 (ERA5)[15]
SP	Double	Pa	Daily average surface pressure
SR	Double	J/m2	Daily average surface downward solar radiation (ERA5)[15]
SRL	Double	W/m2	Daily average surface downward longwave radiation flux (NLDAS)[14]
SRS	Double	W/m2	Daily average surface downward shortwave radiation flux (NLDAS)[14]
LH	Double	J/m2	Daily average surface latent heat flux (ERA5)[15]
LHF	Double	W/m2	Daily average surface latent heat flux (NLDAS)[14]
PE	Double	m	Daily average potential evaporation / potential latent heat flux (ERA5)[15]
PEF	Double	W/m2	Daily average potential evaporation / potential latent heat flux (NLDAS)[14]
P	Double	mm/day	Daily total precipitation
U	Double	m/s	Daily average 10-m above ground Zonal wind speed
V	Double	m/s	Daily average 10-m above ground Meridional wind speed

https://github.com/CSSEGISandData/COVID-19_Unified-Dataset

- Maps all geospatial units globally into a unique standardized ID.
- Standardizes administrative names and codes at all levels.
- Standardizes dates, data types, and formats.
- Unifies variable names, types, and categories.
- Merges data from all credible sources at all levels.
- Cleans the data and fixes confusing entries.
- Integrates hydrometeorological variables, air quality estimates, policy data, and key demographic factors at all levels.

Creating a unified, reliable data record

Column	Type	Unit	Description
ID	Character		Geospatial ID, unique identifier
PM2.5[18]	Double	$\mu g/m^3$	Fine particulate matter (PM2.5) concentration (2014-2018 mean)
PM2.5_PopWtd[18,39]	Double	$\mu g/m^3$	Fine particulate matter (PM2.5) concentration (2014-2018 mean, population weighted)
NO2[19]	Double	ppbv	Nitrogen dioxide (NO2) concentration (2014-2018 mean)
NO2_PopWtd[19,39]	Double	ppbv	Nitrogen dioxide (NO2) concentration (2014-2018 mean, population weighted)
Access_City[36,37]	Double	Minute	Travel time to nearest cities
Access_Motor[38]	Double	Minute	Travel time to health care facilities, with motorized transport
Access_Walk[38]	Double	Minute	Travel time to health care facilities, without motorized transport
Diabetes[24,25]	Double		Age-adjusted percent prevalence of adults (>=18 years old) with diagnosed diabetes
Obesity[26-28]	Double		Percent of obese adults (body mass index of 30+)
Smoking[29,30]	Double		Age-adjusted percent prevalence of adults who are current smokers
COPD[31]	Double		Age-standardized percent prevalence of chronic obstructive pulmonary disease by sex (Total)

https://github.com/CSSEGISandData/COVID-19_Unified-Dataset

- Maps all geospatial units globally into a unique standardized ID.
- Standardizes administrative names and codes at all levels.
- Standardizes dates, data types, and formats.
- Unifies variable names, types, and categories.
- Merges data from all credible sources at all levels.
- Cleans the data and fixes confusing entries.
- Integrates hydrometeorological variables, air quality estimates, policy data, and key demographic factors at all levels.

Creating a unified, reliable data record

Type	Description
CX	**Containment and closure policies**
C1	School closing
C2	Workplace closing
C3	Cancel public events
C4	Restrictions on gatherings
C5	Close public transport
C6	Stay at home requirements
C7	Restrictions on internal movement
C8	International travel controls
EX	**Economic policies**
E1	Income support
E2	Debt/contract relief
E3	Fiscal measures
E4	International support
HX	**Health system policies**
H1	Public information campaigns
H2	Testing policy
H3	Contact tracing
H4	Emergency investment in healthcare
H5	Investment in vaccines
H6	Investment in vaccines
H7	Vaccination policy
H8	Protection of elderly people
MX	**Miscellaneous policies**
M1	Wildcard
IX	**Policy indices**
I1	Containment health index
I2	Economic support index
I3	Government response index
I4	Stringency index
IC	**Confirmed cases**
ID	**Confirmed deaths**
IXD	*Policy indices (Display)*
IXL	*Policy indices (Legacy)*
IXLD	*Policy indices (Legacy, Display)*

https://github.com/CSSEGISandData/COVID-19_Unified-Dataset

- Maps all geospatial units globally into a unique standardized ID.
- Standardizes administrative names and codes at all levels.
- Standardizes dates, data types, and formats.
- Unifies variable names, types, and categories.
- Merges data from all credible sources at all levels.
- Cleans the data and fixes confusing entries.
- Integrates hydrometeorological variables, air quality estimates, policy data, and key demographic factors at all levels.

Creating a unified, reliable data record

Type	Description
CX	**Containment and closure policies**
C1	School closing
C2	Workplace closing
C3	Cancel public events
C4	Restrictions on gatherings
C5	Close public transport
C6	Stay at home requirements
C7	Restrictions on internal movement
C8	International travel controls
EX	**Economic policies**
E1	Income support
E2	Debt/contract relief
E3	Fiscal measures
E4	International support
HX	**Health system policies**
H1	Public information campaigns
H2	Testing policy
H3	Contact tracing
H4	Emergency investment in healthcare
H5	Investment in vaccines
H6	Investment in vaccines
H7	Vaccination policy
H8	Protection of elderly people
MX	**Miscellaneous policies**
M1	Wildcard
IX	**Policy indices**
I1	Containment health index
I2	Economic support index
I3	Government response index
I4	Stringency index
IC	**Confirmed cases**
ID	**Confirmed deaths**
IXD	*Policy indices (Display)*
IXL	*Policy indices (Legacy)*
IXLD	*Policy indices (Legacy, Display)*

https://github.com/CSSEGISandData/COVID-19_Unified-Dataset

- Maps all geospatial units globally into a unique standardized ID.
- Standardizes administrative names and codes at all levels.
- Standardizes dates, data types, and formats.
- Unifies variable names, types, and categories.
- Merges data from all credible sources at all levels.
- Cleans the data and fixes confusing entries.
- Integrates hydrometeorological variables, air quality estimates, policy data, and key demographic factors at all levels.
- Optimizes the data for machine learning applications.

Thank You

ZAITCHIK@JHU.EDU