Initial investigation of environment vs policy vs social influences on SARS-CoV-2/COVID-19 incidence, propagation, and mortality rates

Sushel Unninayar[1]
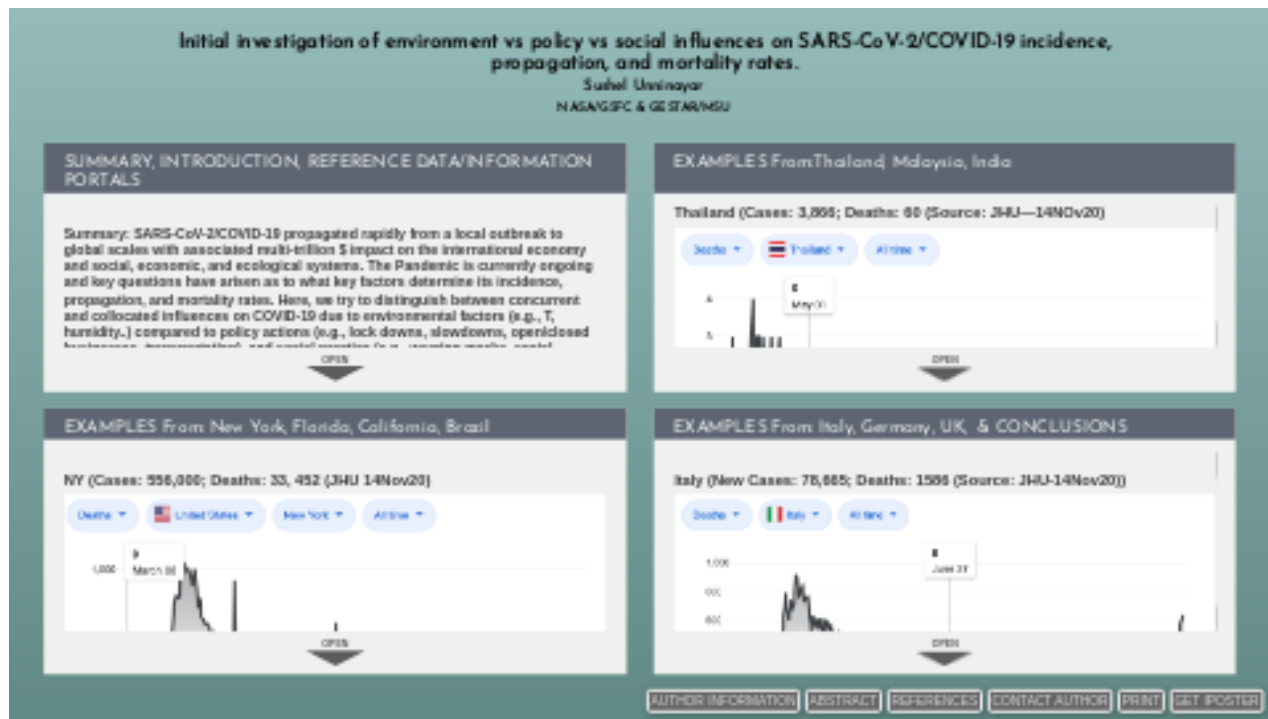
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November 23, 2022

Abstract

SARS-CoV-2/COVID-19 propagated rapidly from a local outbreak to global scales with associated multi-trillion \$ impact on the international economy and social, economic, and ecological systems. The Pandemic is currently ongoing and key questions have arisen as to what key factors determine its incidence, propagation, and mortality rates. Here, we try to distinguish between concurrent and collocated influences on COVID-19 due to environmental factors (e.g., T, humidity..) compared to policy actions (e.g., lock downs, slowdowns, open/closed businesses, transportation), and social practice (e.g., wearing masks, social distancing). Publicly available data and information from selected countries/regions around the world are used in this initial analysis. Preliminary results suggest that policy actions and social practice have a dominating influence on the propagation and containment (or not) of COVID-19, possibly enabled by or associated with concomitant environmental factors.
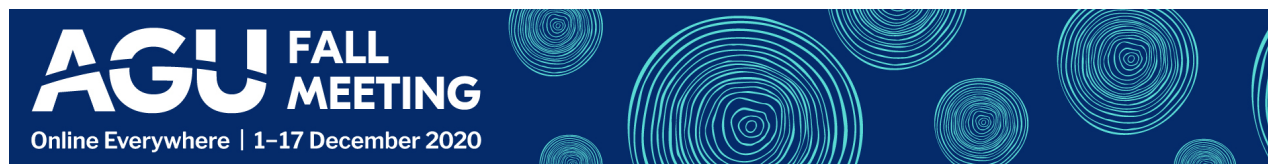
Initial investigation of environment vs policy vs social influences on SARS-CoV-2/COVID-19 incidence, propagation, and mortality rates.

Sushel Unninayar

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PRESENTED AT:

SUMMARY, INTRODUCTION, REFERENCE DATA/INFORMATION PORTALS

Summary: SARS-CoV-2/COVID-19 propagated rapidly from a local outbreak to global scales with associated multi-trillion $ impact on the international economy and social, economic, and ecological systems. The Pandemic is currently ongoing and key questions have arisen as to what key factors determine its incidence, propagation, and mortality rates. Here, we try to distinguish between concurrent and collocated influences on COVID-19 due to environmental factors (e.g., T, humidity..) compared to policy actions (e.g., lock downs, slowdowns, open/closed businesses, transportation), and social practice (e.g., wearing masks, social distancing). Publicly available data and information from selected countries/regions around the world are used in this initial analysis. Preliminary results suggest that policy actions and social practice have a dominating influence on the propagation and containment (or not) of COVID-19, possibly enabled by or associated with concomitant environmental factors.

Case Examples from: Group/Slide Set A: New York (USA), Florida (USA), California (USA), Brazil; Group/Slide Set B: Thailand, Malaysia, India; Group/Slide Set C: Italy, Germany, UK, South Africa. These three groups cover a range of climate, geographical, and cultural zones as well as N-Hemisphere vs S-Hemisphere seasonal timing differences.

We submit that the data series for SARS-CoV-2/COVID-19 are not long enough to yield robust statistical analysis. Here we take the approach that if there are significant correlates, the data should speak for itself--namely it should become apparent upon even casual visual inspection. Thus, we present all data in time series graphical form. All data are from publicly available sources as detailed in the references.

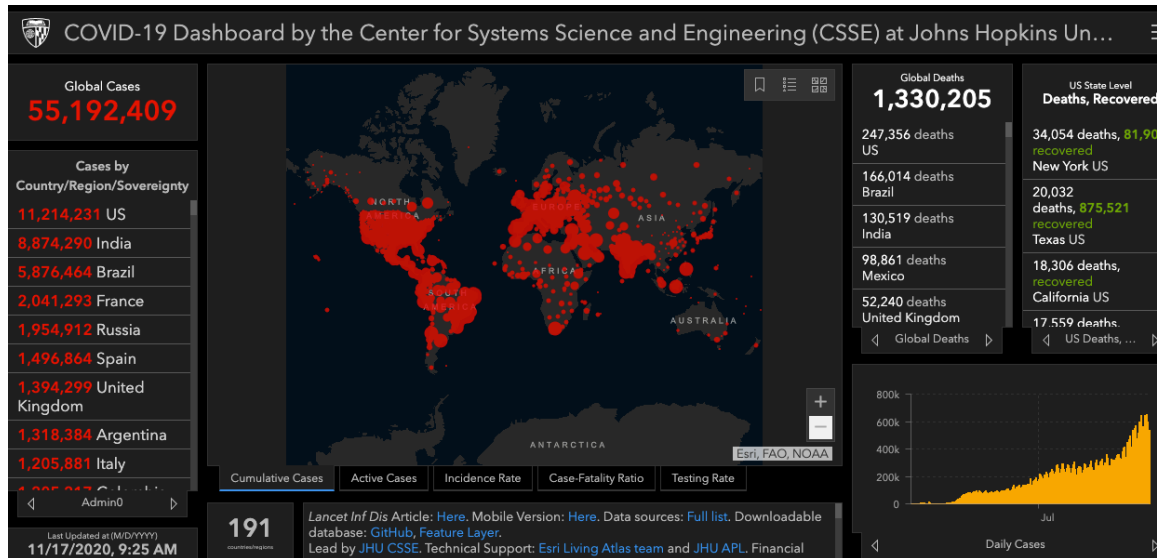**Sources: References: JHU, EU-Copernicus/ECMWF, Wikipedia: COVID-19-Pandemic Data; Details in the References.**

INTRODUCTION:

COVID-19-Global Environmental Context. Global Cases: 55,192.409; Deaths: 1,330,206 (JHU, 16Nov20)
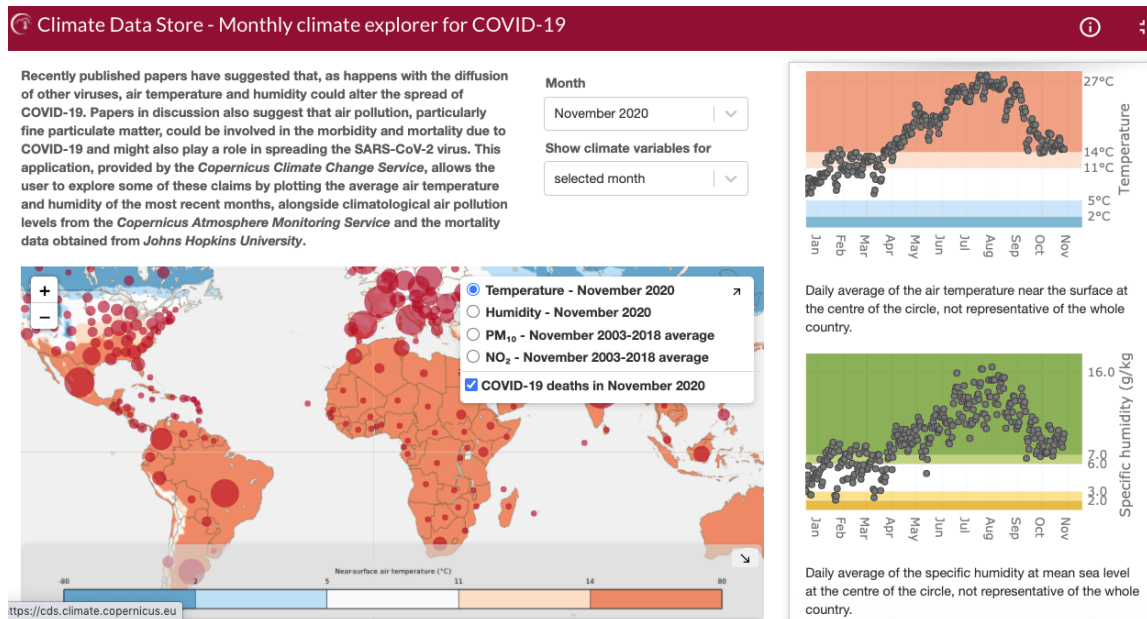
1. Most viral infections like influenzas or flu are seasonal and the common cold is more likely in winter. SARS-CoV-2 is hypothesized (based on these other Coronaviruses) to be (at least partially) environmentally (T/Humidity) sensitive. Some studies support that virus survives longer on surfaces in colder temperatures than higher temperatures, and lower specific humidity than higher. But, propagation was quick from Wuhan, China to the world (global) mainly via travel routes and contact between people to both tropical and mid-and-higher latitude countries with warm and cold climates.

2. Higher T could impact the virus survival directly by destabilizing its proteins and lipids and by providing more energy for evaporating (drying out) droplets?

3. Low H and colder T are more hospitable for the SARS-CoV-2 virus while warmer T and higher SH impacts how long it remains infectious on most surfaces.

4. Lower specific humidity could impact the airborne virus droplets by evaporatively decreasing droplet size leading to increased aerosolization and residence time, n tael distance?

5. Larger droplets are thought to be the main coronavirus carrier; tiny droplets dry out quickly. But the viruses can be still active. Some evidence that airborne virus particles can be infective. Hence air filters/purifiers.

6. UV radiation (Sun exposure) may also have an effect in inactivating the virus. Moisture (dissolves), sunlight (UV light) and heat (molecular motion) all make the virus less stable.

7. Soap dissolves the fat membrane and the virus falls apart. Disinfectants or liquids, wipes, gels containing alcohol have a similar effect but not as good as normal soap.

8. Primary infection is through the respiratory tract (both lower and upper) where the SARS-CoV-2 spike protein latches on to ACE-2 receptors, but external surfaces also offer intermediary transmission pathways.The ideal surface for the virus is organic and the proteins and fatty acids in the dead cells of the skin interact with the virus through both hydrogen bonds and fat-like hydrophilic interactions.

9. SARS-CoV-2 consists of a small set of genes enclosed by a sphere of fatty lipid molecules. Viruses don't survive too long by themselves—they need bodies to occupy and cells to control and replicate. The virus appears to be able to infect ACE-2 bearing cells in other organs, including the gut and blood vessels—Thus potentially causing damage to not just the lungs.

10. Since this paper was drafted in mid-November, SARS-CoV-2/COVID-19 rates have trended upwards in the USA and many other countries.

Main Reference Data Portals (Details in References):

COVID-19 Dashboard by Center for Systems Science & Engineering (CSSE), Johns Hopkins Univsersity, Baltimore, MD, USA
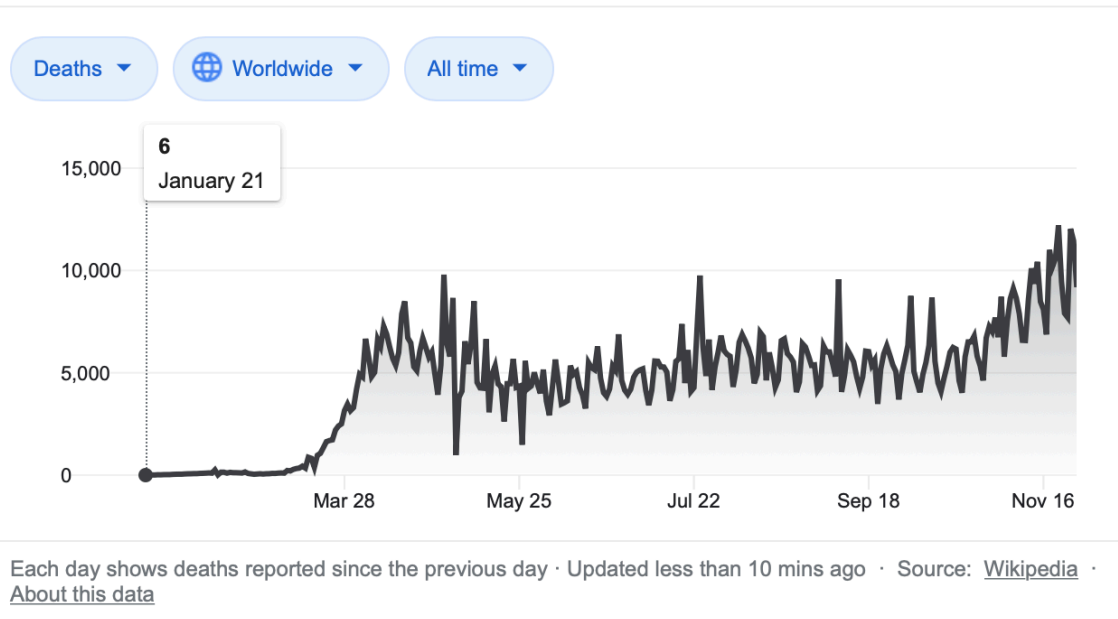
EU-Copernicus Climate Data Services, Climate Data Store-Climate Explorer for COVID-19 (Met. Data From C3S ERA5 Reanalysis; COVID-19 data from JHU):
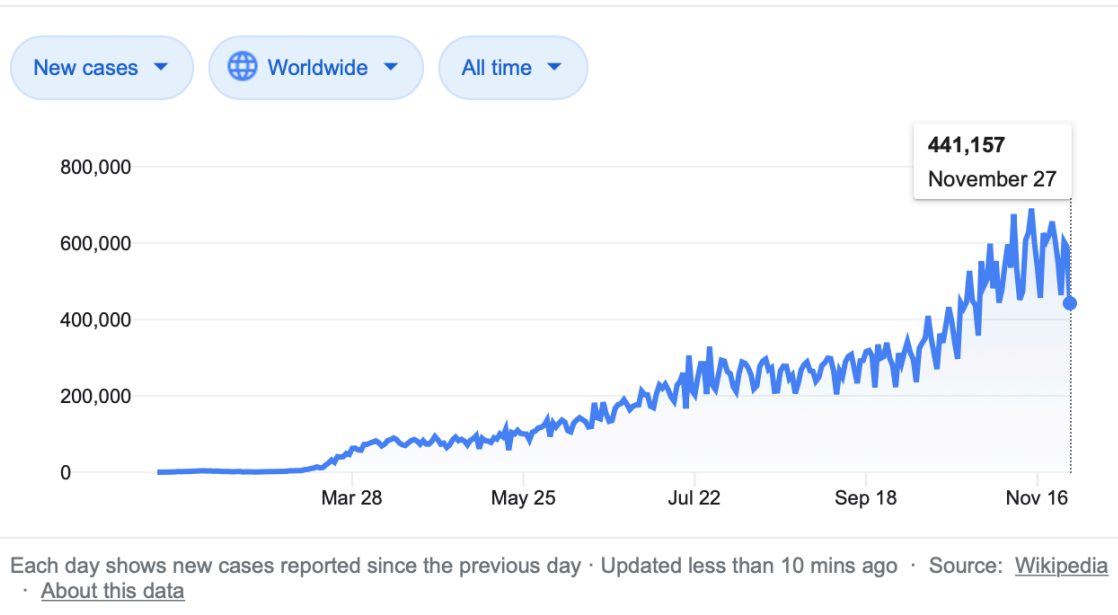

Coronavirus (COVID-19) Statistics Data (from Wikipedia--data from multiple sources)
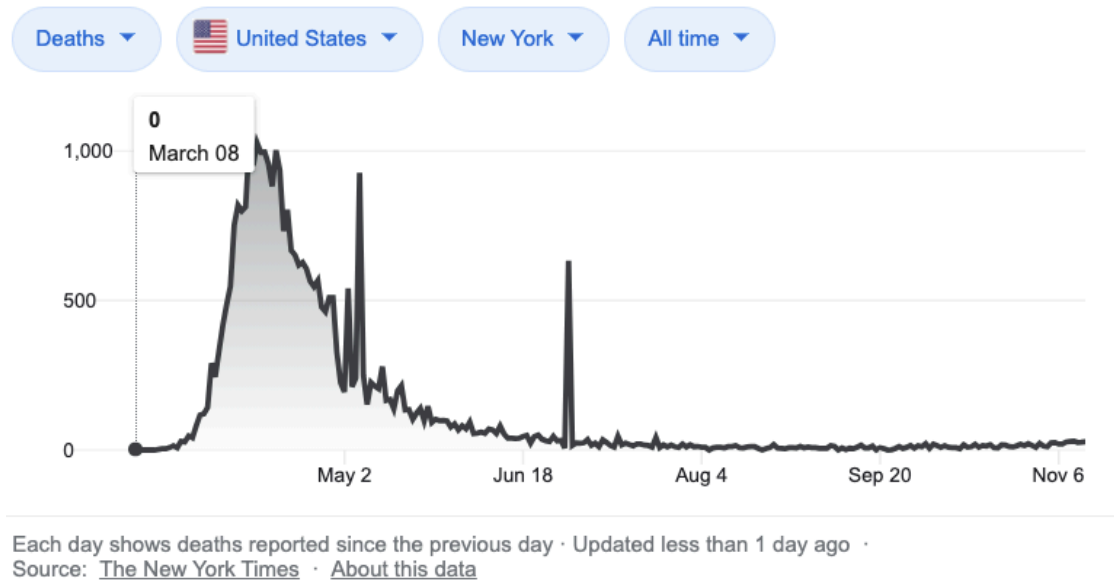
Daily change

Deaths ▾   🌐 Worldwide ▾   All time ▾

6
January 21

Each day shows deaths reported since the previous day · Updated less than 10 mins ago · Source: Wikipedia · About this data

Coronavirus (COVID-19) Statistics Data (from Wikipedia--data from multiple sources

Daily change

New cases ▾   🌐 Worldwide ▾   All time ▾

441,157
November 27

Each day shows new cases reported since the previous day · Updated less than 10 mins ago · Source: Wikipedia · About this data

GROUP A: EXAMPLES FROM: NEW YORK, FLORIDA, CALIFORNIA, BRAZIL

NY (Cases: 556,000; Deaths: 33, 452 (JHU 14Nov20)

Each day shows deaths reported since the previous day · Updated less than 1 day ago ·
Source: The New York Times · About this data

Each day shows new cases reported since the previous day · Updated less than 1 day ago ·
Source: The New York Times · About this data

Policy/Social

March: State of emergency declared, universities, theaters, closed, stay-at-home orders extended thru end April

June: NY has lowest infection rate in USA—rate of increase less than 0.25% per day since 6 June.
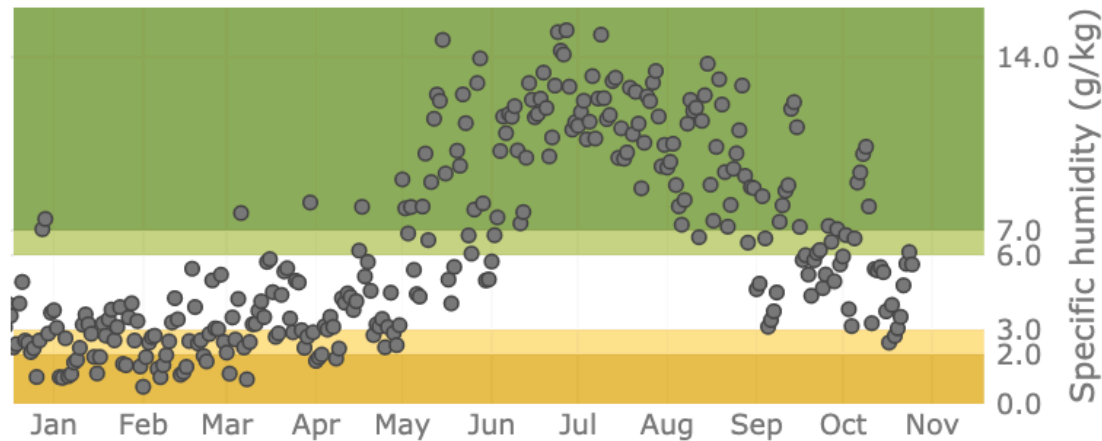
Sept: Maintained infection rate below 1%

Sept 26: Increased infection rates in several neighborhoods in Brooklyn, Rockland county communities—Spring valley & Monsey

Oct: Cluster initiative action—restrictions in cluster areas

Nov: Statewide restrictions: Bars, gyms, businesses with liquor licenses close by 10.00pm, restaurants close by 10.00pm, non-essential gatherings limited to 10 people
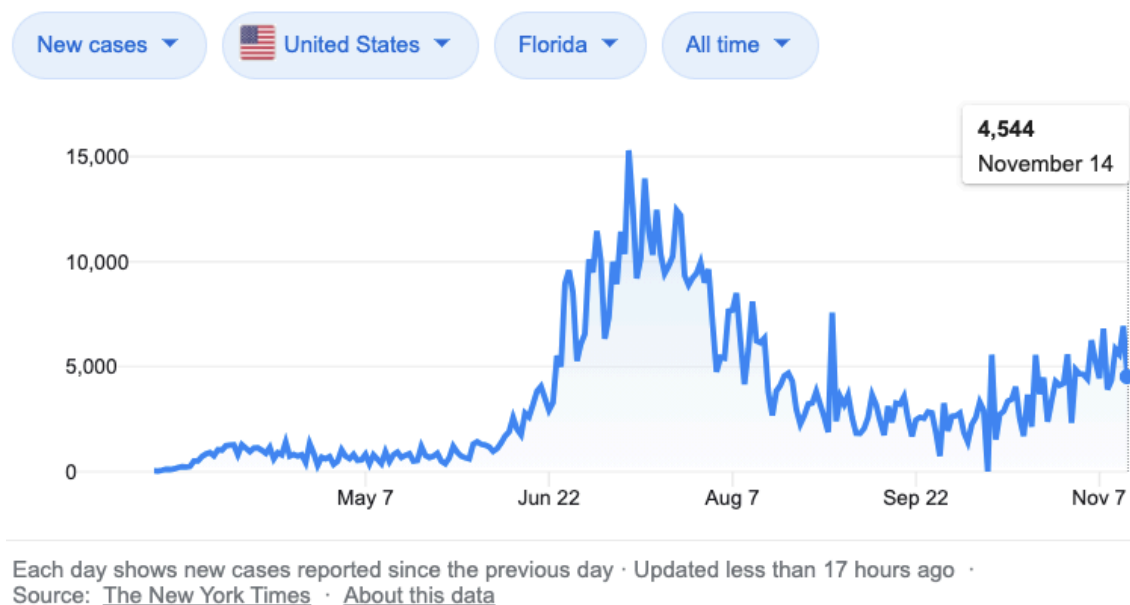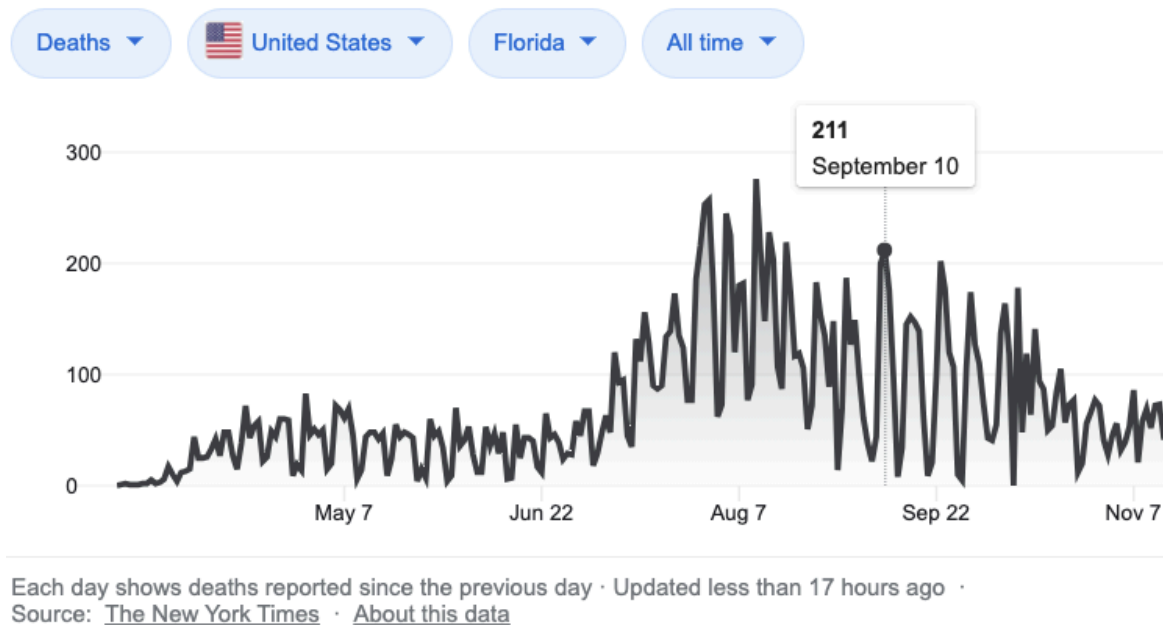
Daily average of the air temperature near the surface at the centre of the circle, not representative of the whole country.

Daily average of the specific humidity at mean sea level at the centre of the circle, not representative of the whole country.

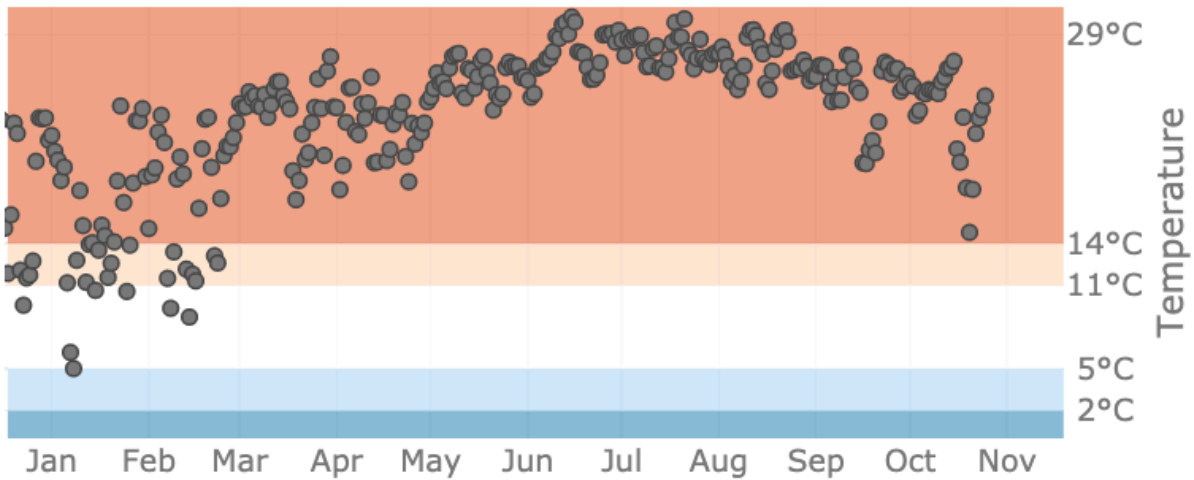**Florida (Cases: 875,096; Deaths: 17,469 (JHU: 15Nov20)**

Deaths ▾   🇺🇸 United States ▾   Florida ▾   All time ▾

211
September 10

Each day shows deaths reported since the previous day · Updated less than 17 hours ago ·
Source: The New York Times · About this data

New cases ▾   🇺🇸 United States ▾   Florida ▾   All time ▾

4,544
November 14

Each day shows new cases reported since the previous day · Updated less than 17 hours ago ·
Source: The New York Times · About this data

Social/Policy

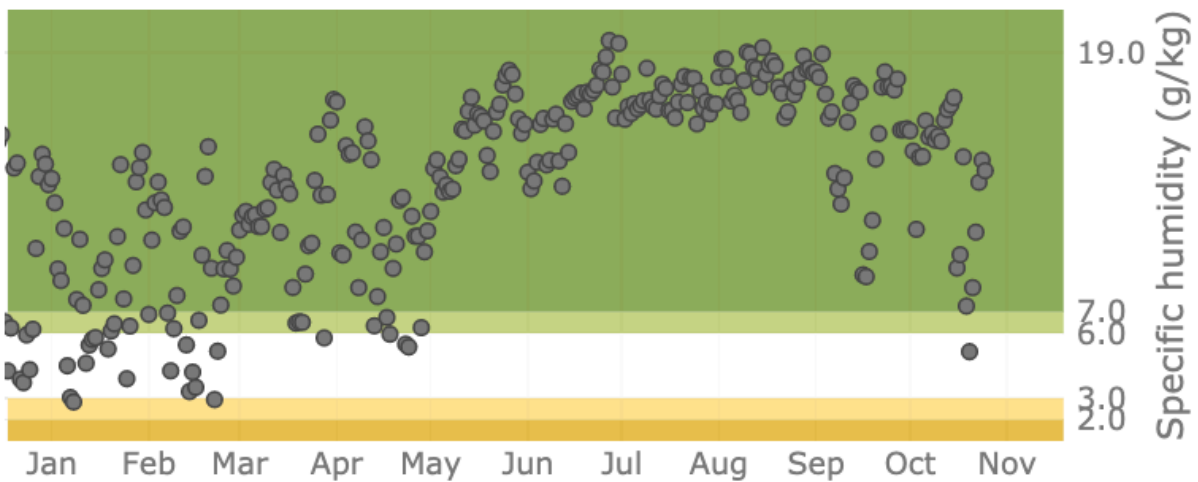**March: CDC evidence of community spread**

April: Executive order to restrict activities within the state to essential services

Sept 25: Executive order to begin reopening the state; prohibits local govt. from imposing fines or shutting down businesses, and from mask mandates

November: Florida has 3rd highest count of confirmed cases and 4th highest deaths in US
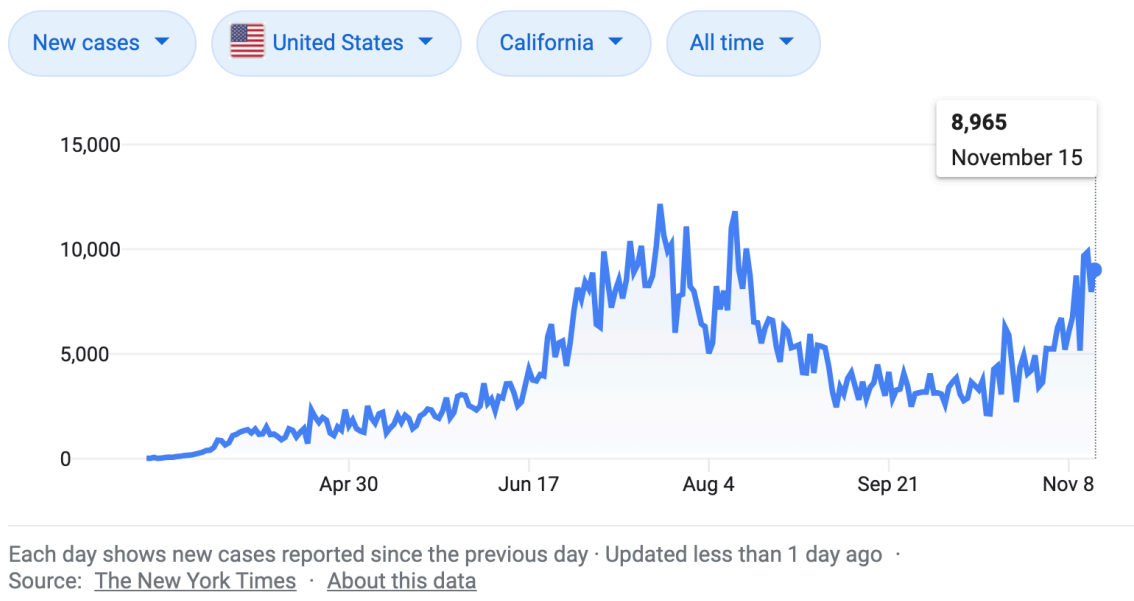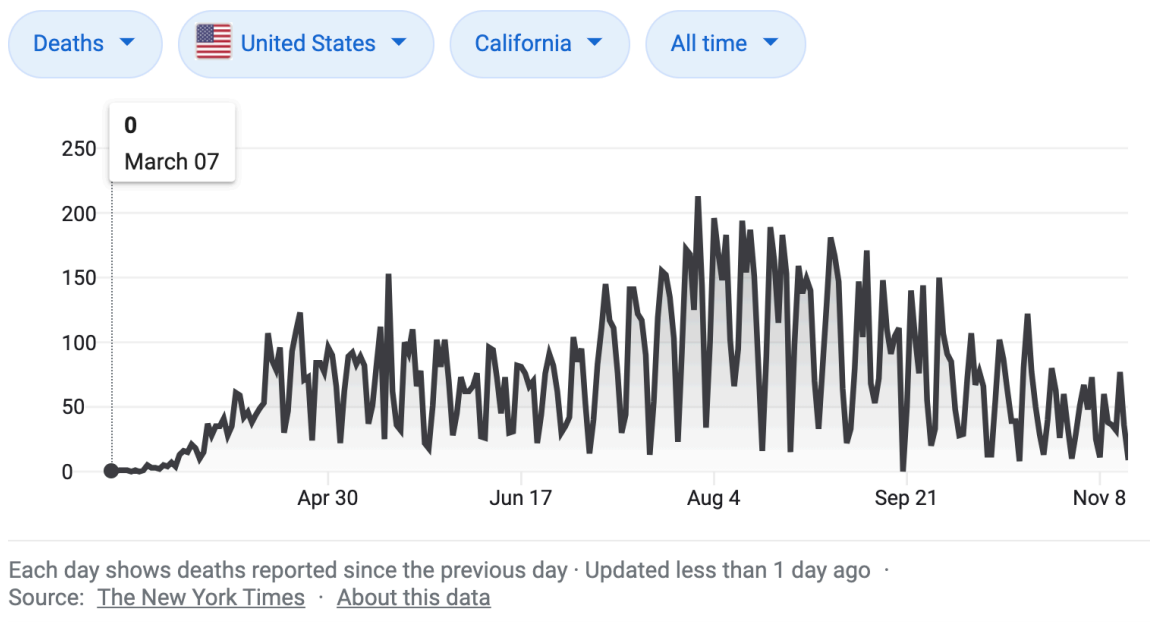
Daily average of the air temperature near the surface at the centre of the circle, not representative of the whole country.

Daily average of the specific humidity at mean sea level at the centre of the circle, not representative of the whole country.

CA (New Cases: 1,036990; Deaths: 18,278 (JHU, 15Nov20)

Deaths ▾   🇺🇸 United States ▾   California ▾   All time ▾

Each day shows deaths reported since the previous day · Updated less than 1 day ago ·
Source: The New York Times · About this data

New cases ▾   🇺🇸 United States ▾   California ▾   All time ▾

Each day shows new cases reported since the previous day · Updated less than 1 day ago ·
Source: The New York Times · About this data

Social/Policy

Mach 12: Ban on public gatherings >250 people, social >10 people; schools closed March 13 through end March

March 19: Mandatory stay-at-home order issues

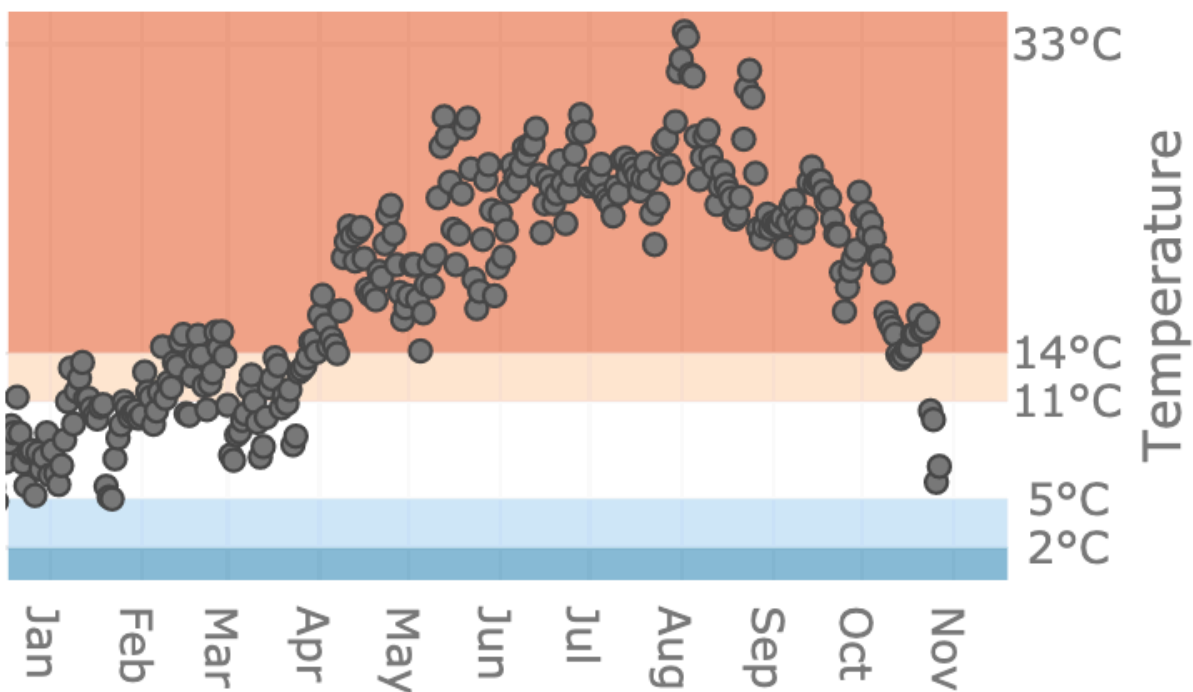**April 1: Closure all public and private schools**

April 13: Western States pact-Oregon, Washington, California

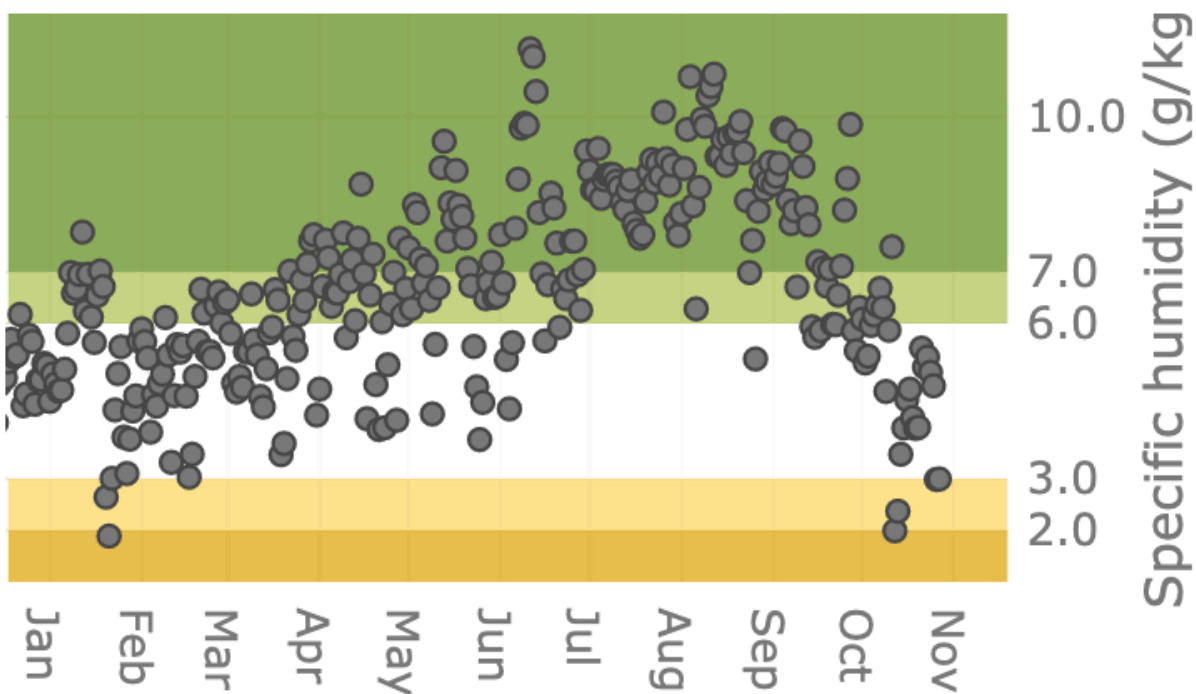**June 18: State-wide mask wearing mandate in most public spaces due to rising cases and deaths**

July 1: Closure indoor businesses, gyms, movie theaters, gyms

Aug 28: Guidelines for lifting restrictions—Blueprint for safer economy
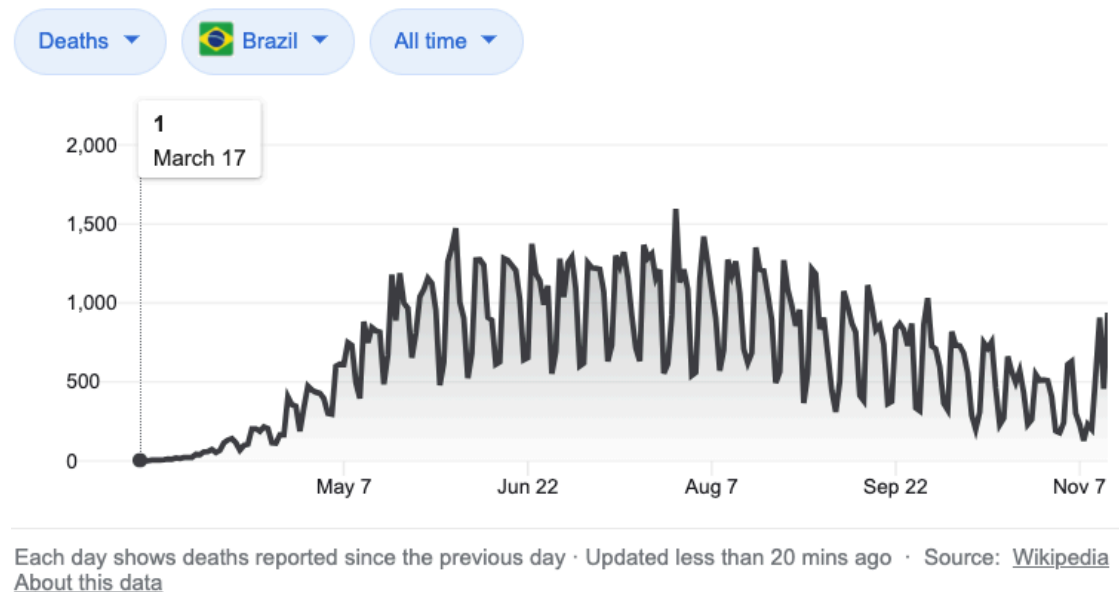
Nov 13: Mandated requirements for all gatherings: > 3 households prohibited; gatherings must be outdoors; physical distancing; Wearing face masks

Daily average of the air temperature near the surface at the centre of the circle, not representative of the whole country.

Brazil: (Cases: 5,848,959; Deaths: 165,658 (JHU: 15 Nov 20)

Deaths ▾   🇧🇷 Brazil ▾   All time ▾

Each day shows deaths reported since the previous day · Updated less than 20 mins ago · Source: Wikipedia
About this data

New cases ▾   🇧🇷 Brazil ▾   All time ▾

Each day shows new cases reported since the previous day · Updated less than 20 mins ago · Source: Wikipedia
· About this data

Social/Policy

March 13: Ministry health recommends travelers to Brazil self isolate for 7 days

March 27: Temporary ban on foreign travelers

**March: National Govt Administration: Downplays COVID-19 as a common flu and critical of
state directed lockdown measures**

**May 9: State Govt. of Rio Grande do Sol established new social distancing plan—ranked
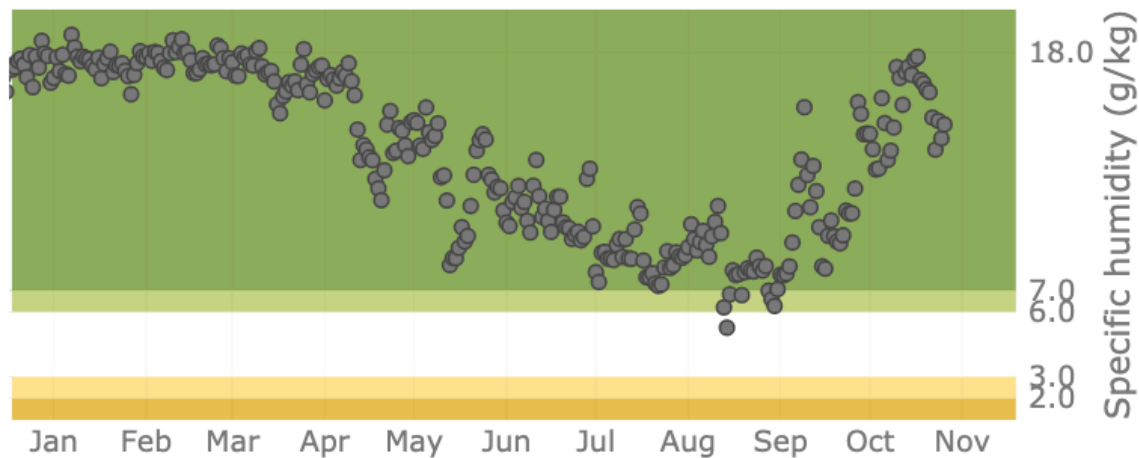by sector from low risk to high**

June 19: Country reported 1.o million cases

Aug: Three joint ventures began testing a new COVID-19 vaccine—debated by anti-vaccine groups

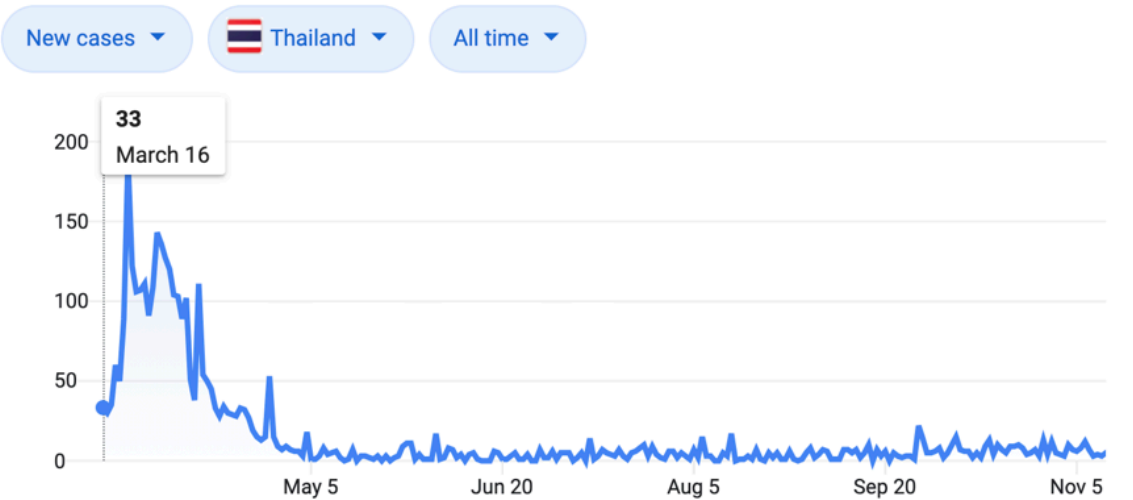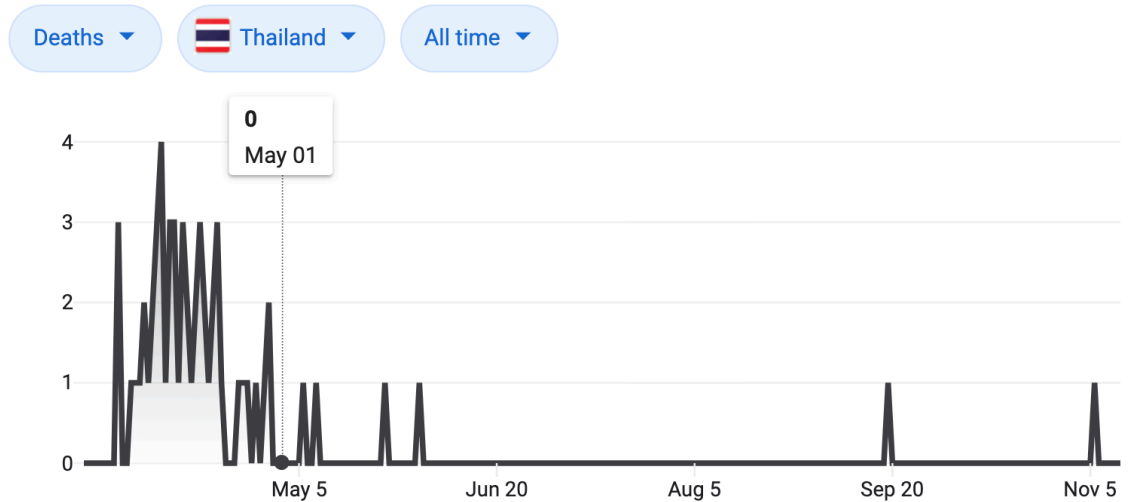**Sep: Brazil 3rd highest cases in world behind India and USA**

Daily average of the air temperature near the surface at the centre of the circle, not representative of the whole country.

Daily average of the specific humidity at mean sea level at the centre of the circle, not representative of the whole country.

GROUP B: EXAMPLES FROM:THAILAND, MALAYSIA, INDIA

Thailand (Cases: 3,866; Deaths: 60 (Source: JHU—14NOv20)

Each day shows deaths reported since the previous day · Updated less than 20 mins ago · Source: Wikipedia ·
About this data

Each day shows new cases reported since the previous day · Updated less than 20 mins ago · Source: Wikipedia
· About this data

Policy/Social:

13 Jan: First case outside China

26 March: Declaration of state of emergency

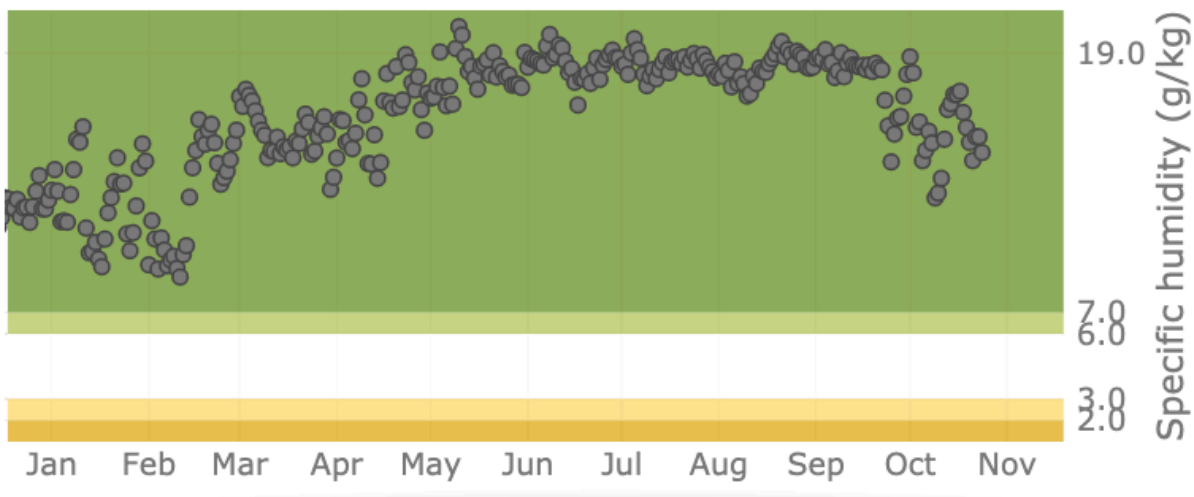**4 April: Lockdown—varying degree; international flights suspended**

Mid-May onwards: Locally transmitted infection rate near-zero--~ 100 days without local coronavirus transmission. Curfew lifted in July Nation mostly open: business, malls, gyms, restaurants
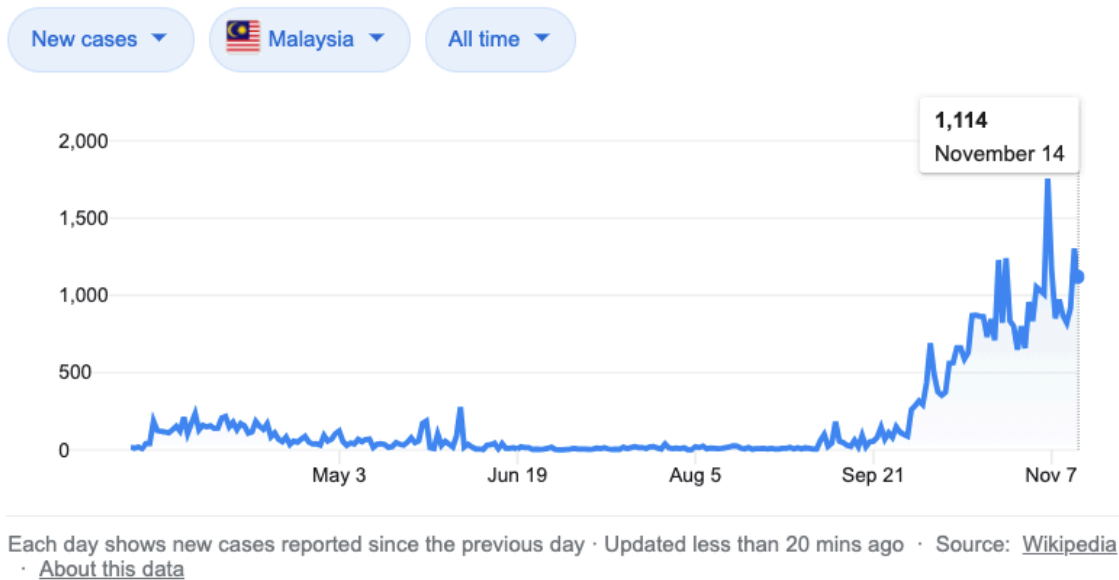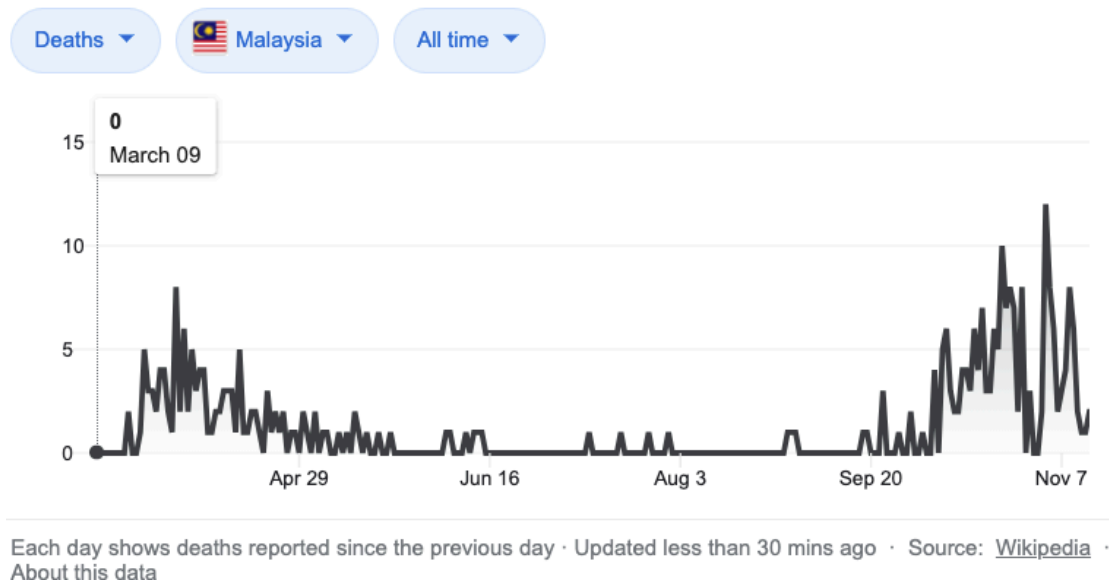
Aug: schools fully open

Oct--Current: Continued: 14-day mandatory quarantine for tourist travel except some provinces; if test positive on arrival, isolation. contact tracing and isolation ongoing

Daily average of the air temperature near the surface at the centre of the circle, not representative of the whole country.

Malaysia (Cases: 46,209; Deaths: 306 (JHU, 15Nov20)

Deigths ▾   🇲🇾 Malaysia ▾   All time ▾

0
March 09

Each day shows deaths reported since the previous day · Updated less than 30 mins ago · Source: Wikipedia · About this data

New cases ▾   🇲🇾 Malaysia ▾   All time ▾

1,114
November 14

Each day shows new cases reported since the previous day · Updated less than 20 mins ago · Source: Wikipedia · About this data

Social/Policy

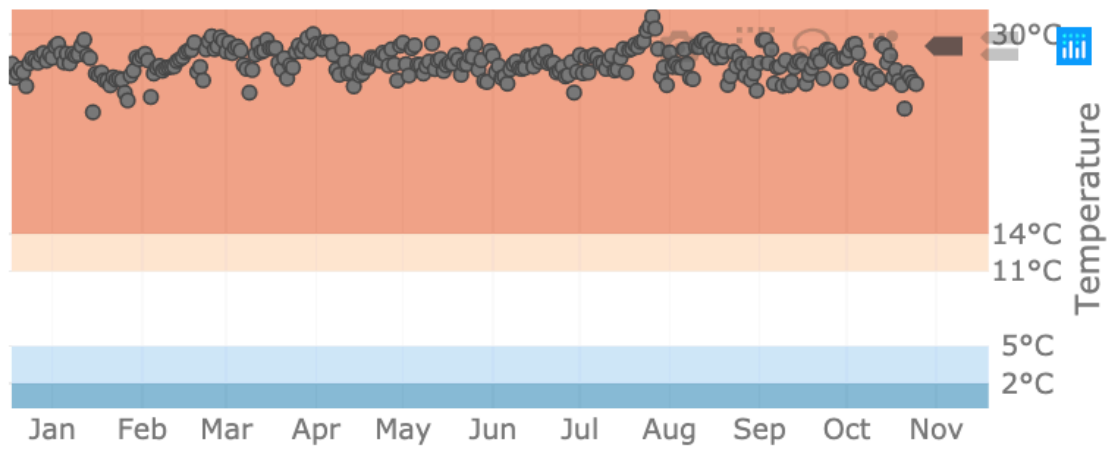**Late Jan: First cases—from China via Singapore**

March: Large clusters after religious gatherings in KL

16 March-mid-May: Nationwide movement control order & social distancing announced; travel restrictions
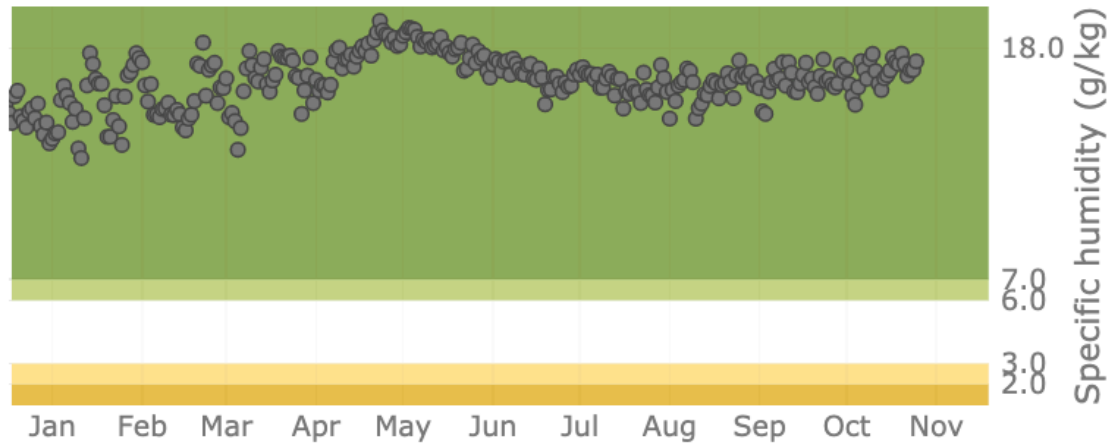
12 May: Conditional movement control-Easing of restrictions—First phase after lockdown. Most businesses open

June: Schools, religious places of worship reopen,…

Through Nov: Periodic case spikes within local communities, immigrant enclaves, detention centers, prisons, , health facilities
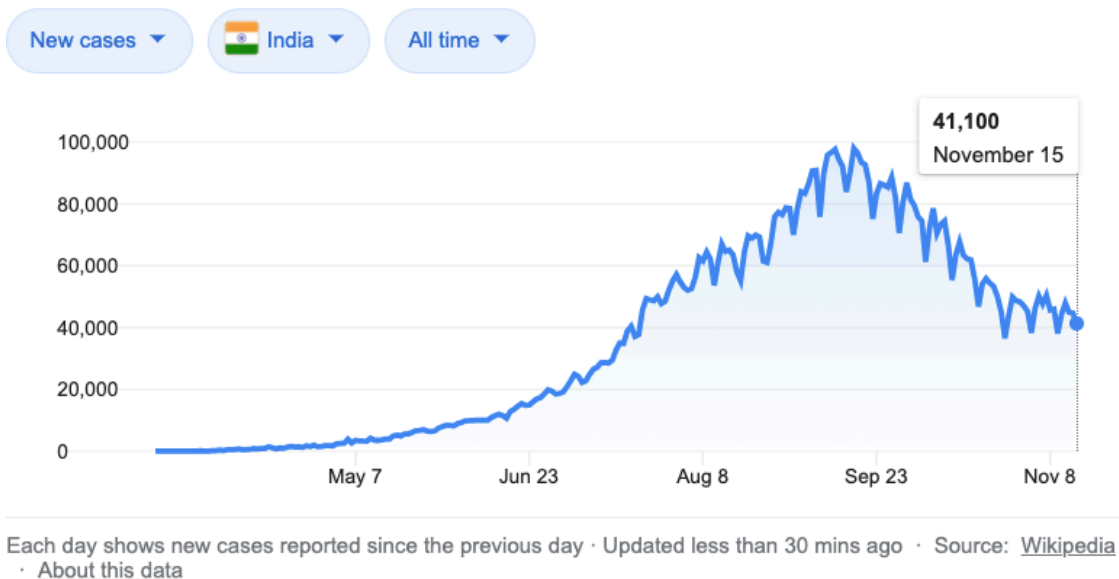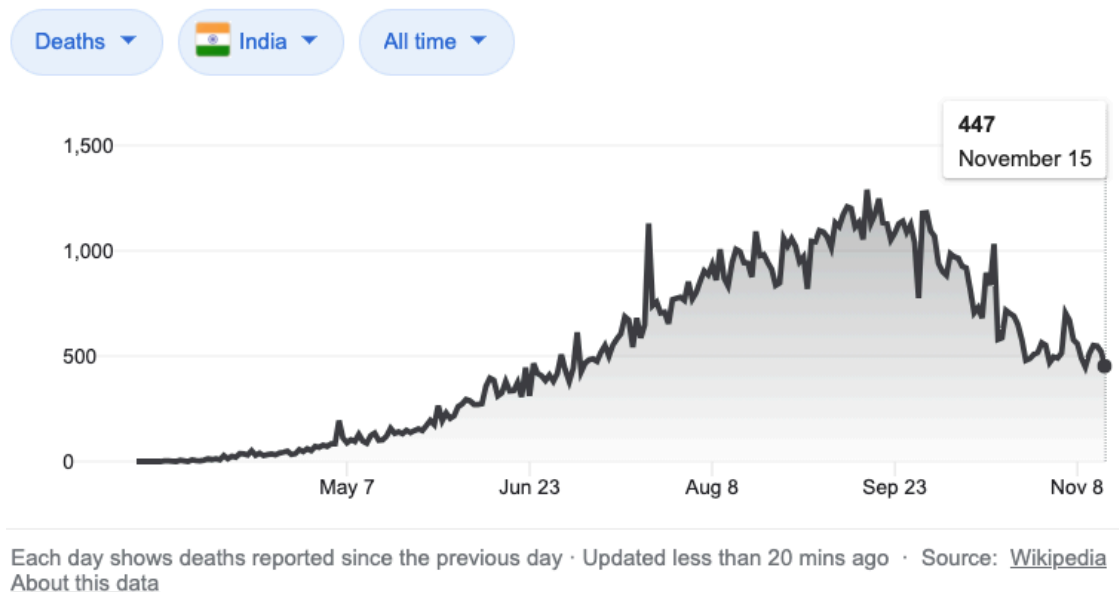
Daily average of the air temperature near the surface at the centre of the circle, not representative of the whole country.

Daily average of the specific humidity at mean sea level at the centre of the circle.

India (Cases: 749,182; Deaths: 20,206 (JHU: 15Nov20)

Each day shows deaths reported since the previous day · Updated less than 20 mins ago · Source: Wikipedia · About this data

Each day shows new cases reported since the previous day · Updated less than 30 mins ago · Source: Wikipedia · About this data

Social/Policy

January: First cases reported 30 January 2020
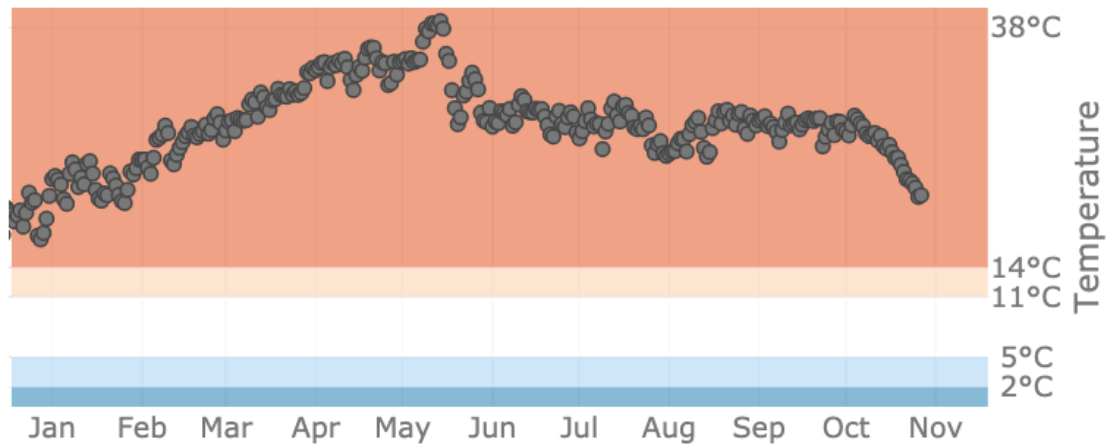
March 22: 14 day voluntary public curfew

March 24: Nationwide lockdown for 21 days
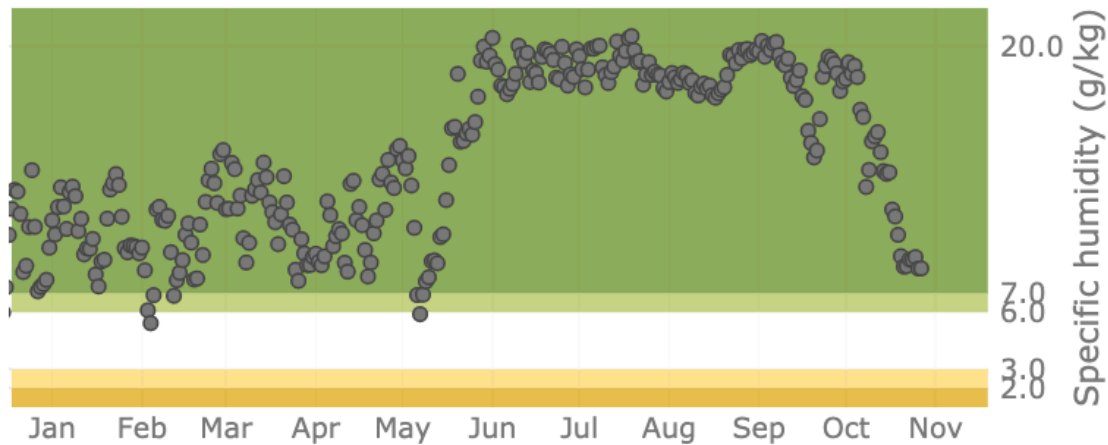
April 14: Lockdown extended thru 3 May

June 1: Govt. started unlocking barring "containment" zones

July 20: Claim that fatality rate was among lowest in world with 2.41% and declining

October: Govt. announced that the pandemic had peaked and may come under control by Feb 2021. Has over 30 anti-COVID vaccines in various stages of development
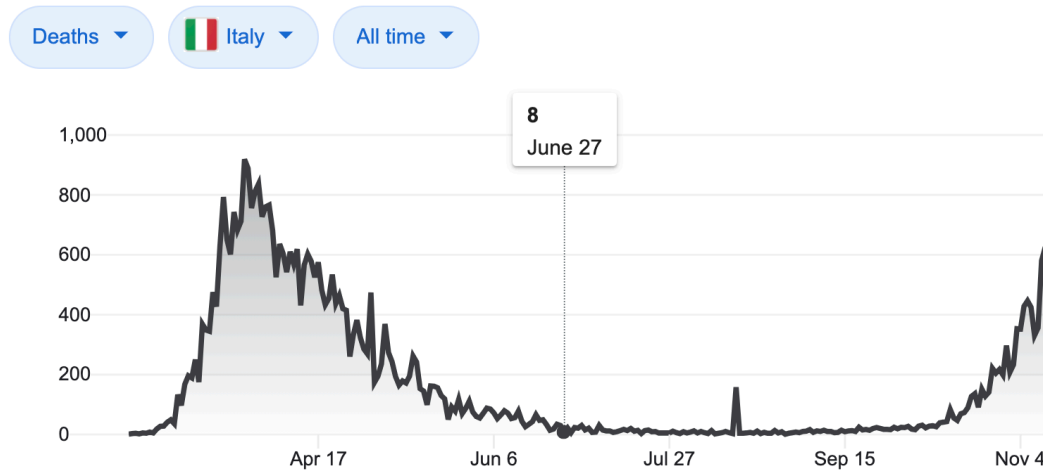

Daily average of the air temperature near the surface at the centre of the circle, not representative of the whole country.
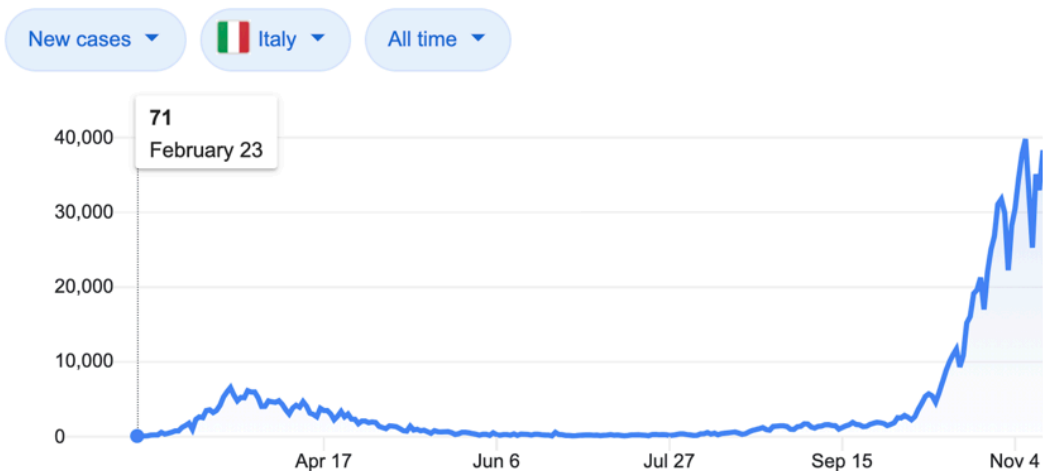

Daily average of the specific humidity at mean sea level at the centre of the circle, not representative of the whole country.

GROUP C: EXAMPLES FROM: ITALY, GERMANY, UK, SOUTH AFRICA; & CONCLUSIONS

Italy (New Cases: 78,665; Deaths: 1586 (Source: JHU-14Nov20))

Each day shows deaths reported since the previous day · Updated less than 20 mins ago · Source: Wikipedia · About this data

Each day shows new cases reported since the previous day · Updated less than 20 mins ago · Source: Wikipedia · About this data

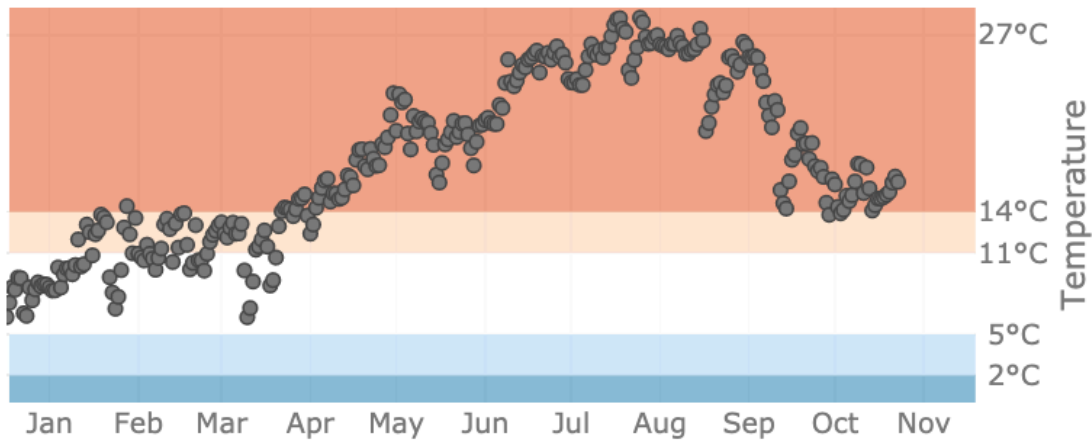**Policy/Social:**

Jan/Feb: Unprepared; first country w/COVID in Europe; decentralized response; high impact
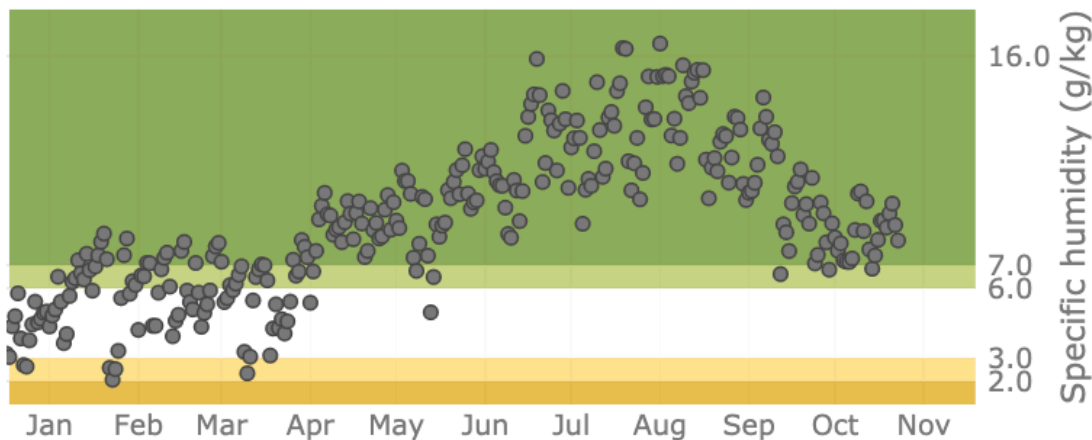
March: National lockdown

May-Sept/Oct: Lockdown lifted--most activities reopened following specific rules. But state of emergency (preparedness) extended until 15 Oct 2020.

Nov 3: New restrictions nationwide: Curfew, masks required, closed gyms, museums, swimming, cinemas/theaters.
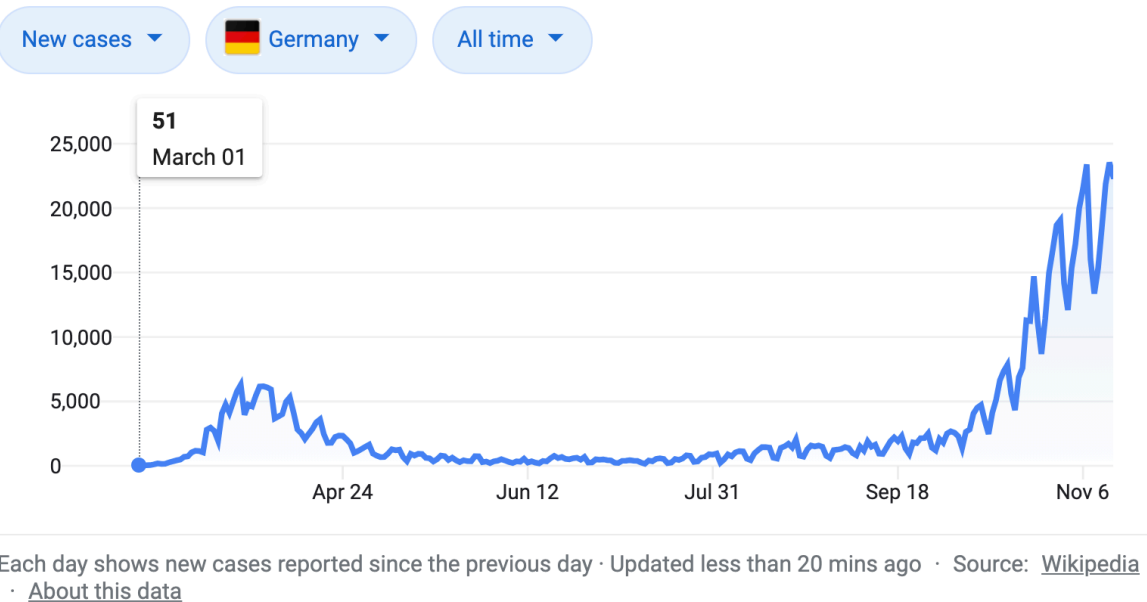

Daily average of the air temperature near the surface at the centre of the circle, not representative of the whole country.

Daily average of the specific humidity at mean sea level at the centre of the circle, not representative of the whole country.

Germany (Cases: 746,945; Deaths: 12,453 (JHU—14Nov20)

Deaths ▾ 🇩🇪 Germany ▾ All time ▾

2
March 09

Each day shows deaths reported since the previous day · Updated less than 20 mins ago · Source: Wikipedia · About this data

New cases ▾ 🇩🇪 Germany ▾ All time ▾

51
March 01

Each day shows new cases reported since the previous day · Updated less than 20 mins ago · Source: Wikipedia · About this data

Social/Policy

Jan-early Feb: First cases near Munich; first large cluster March

Mid-March: Borders closed, curfews imposed in 6 states, other stats prohibited physical contact with >1 person outside household

April/May: Fragile intermediate success achieved, restrictions eased.

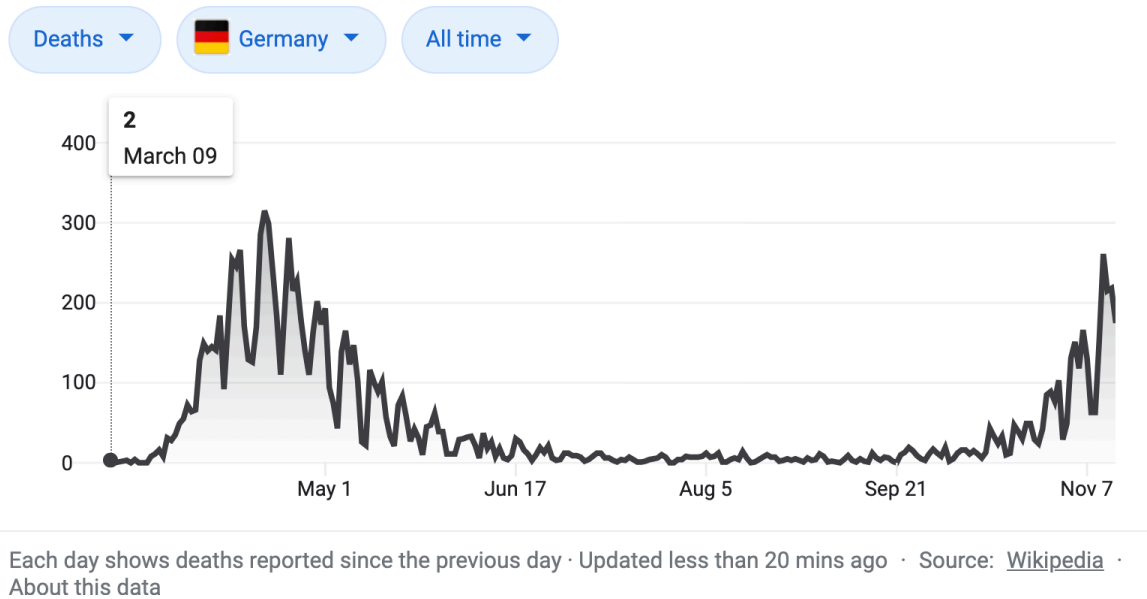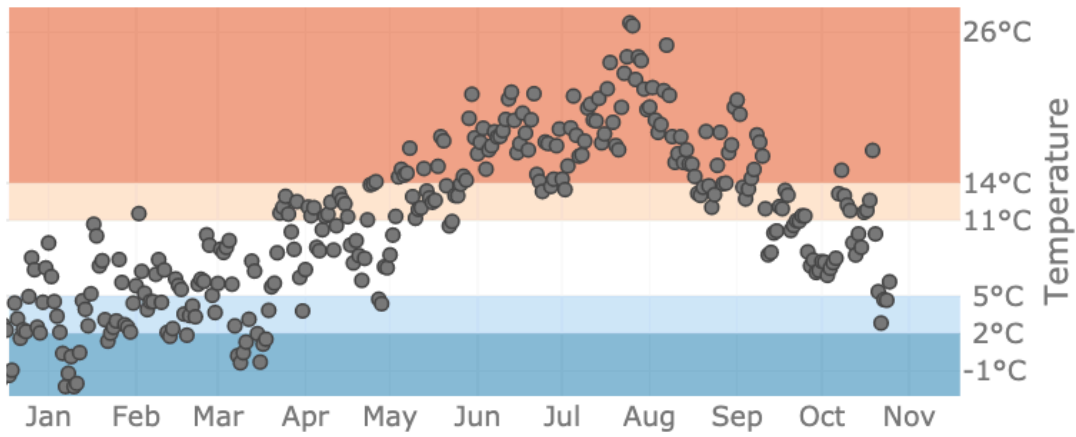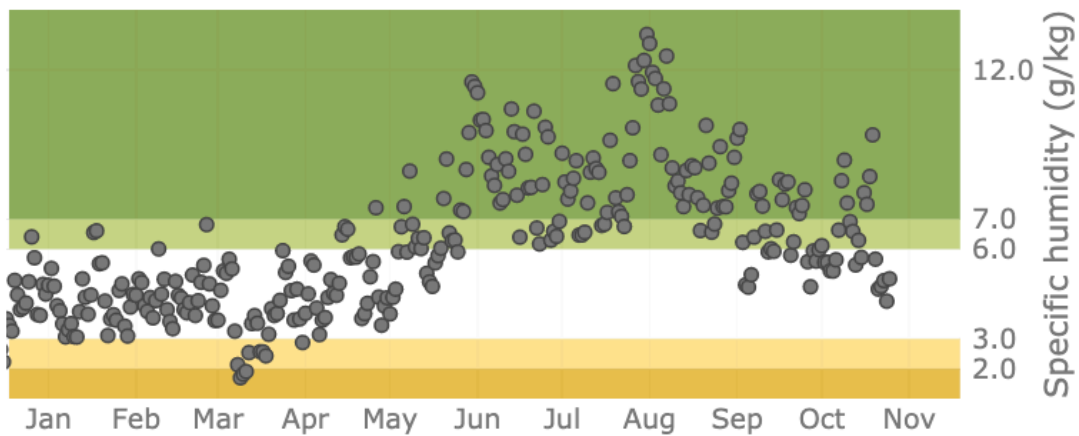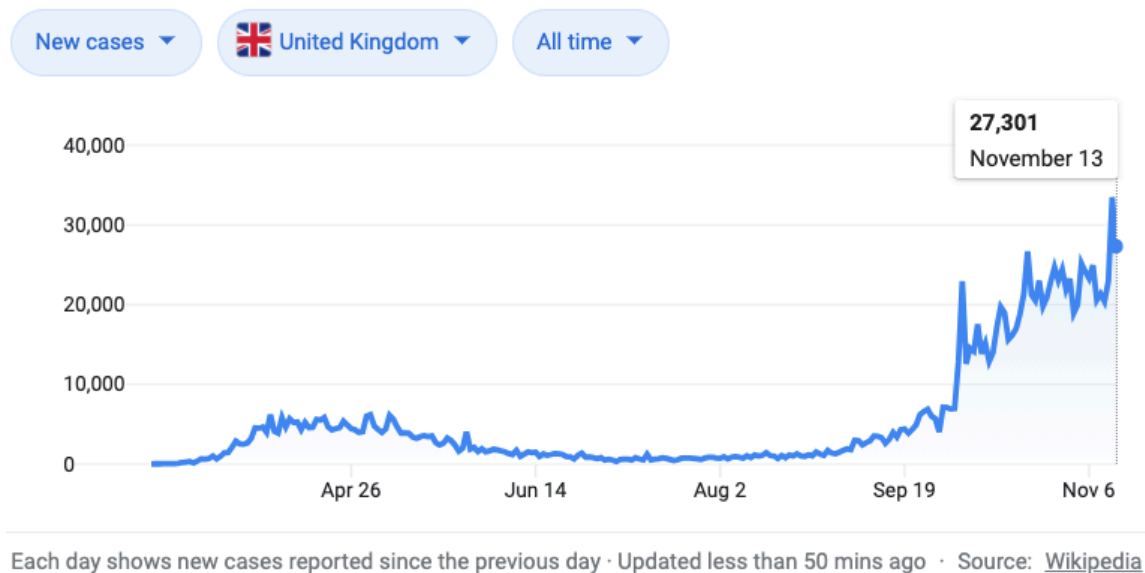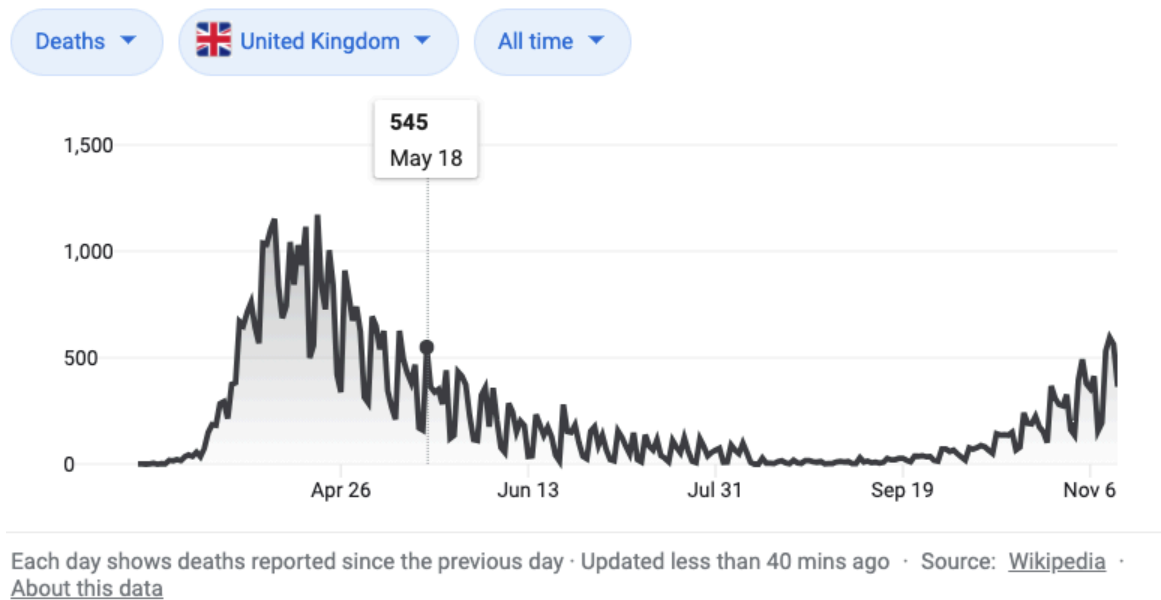**Nov: Partial lockdown due to sharp rise in infection numbers**

Daily average of the air temperature near the surface at the centre of the circle, not representative of the whole country.

Daily average of the specific humidity at mean sea level at the centre of the circle, not representative of the whole country.

UK (Cases: 1,128,6763; Deaths: 45,053 (Source: JHU, 14Nov20)

Deaths ▾   🇬🇧 United Kingdom ▾   All time ▾

545
May 18

1,500

1,000

500

0

Apr 26   Jun 13   Jul 31   Sep 19   Nov 6

Each day shows deaths reported since the previous day · Updated less than 40 mins ago · Source: Wikipedia · About this data

New cases ▾   🇬🇧 United Kingdom ▾   All time ▾

27,301
November 13

40,000

30,000

20,000

10,000

0

Apr 26   Jun 14   Aug 2   Sep 19   Nov 6

Each day shows new cases reported since the previous day · Updated less than 50 mins ago · Source: Wikipedia

Policy/Social:

Feb: Launched info campaign to slow virus, drive thru' screening

March: Stay home orders issued; shit down schools, businesses, facilities, amenities, places of worship

Mid-April: Social distancing, masks, flattened curve; low daily cases thru Aug

Mid-June: Non-essential shops reopened; use of public transport increases
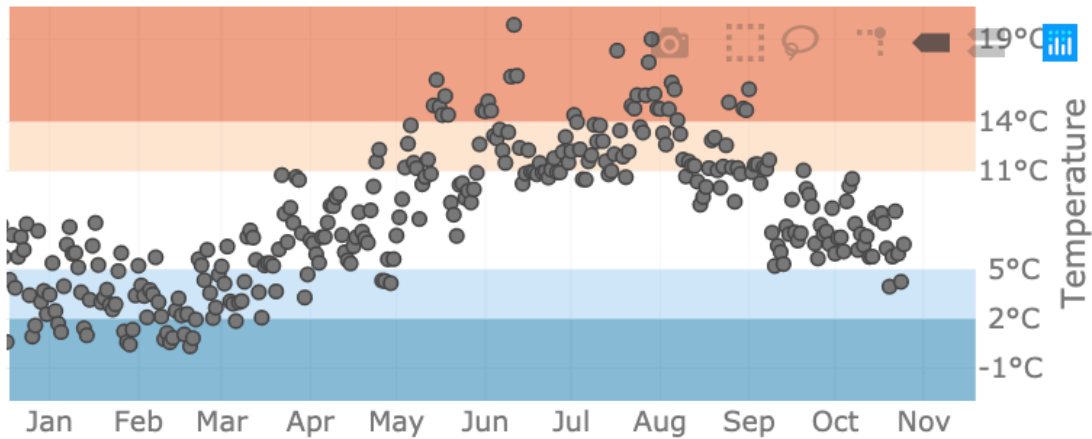
Aug-onwards: Resurgence

Sept: New restrictions on gatherings, social distancing

AGU - iPosterSessions.com
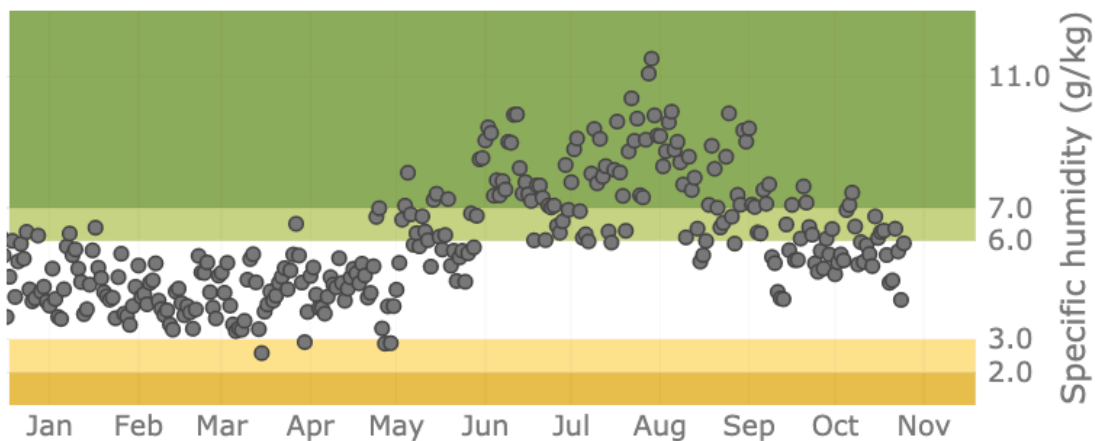
12/15/20, 11:23 AM

Oct: Tier-3 lockdowns—close pubs; Tier-2 lockdowns London—banning people mixing indoors privately

Oct 31: National Lockdown

Nov 12/13: Test and release program introduced at airports with 7 day self isolating quarantine
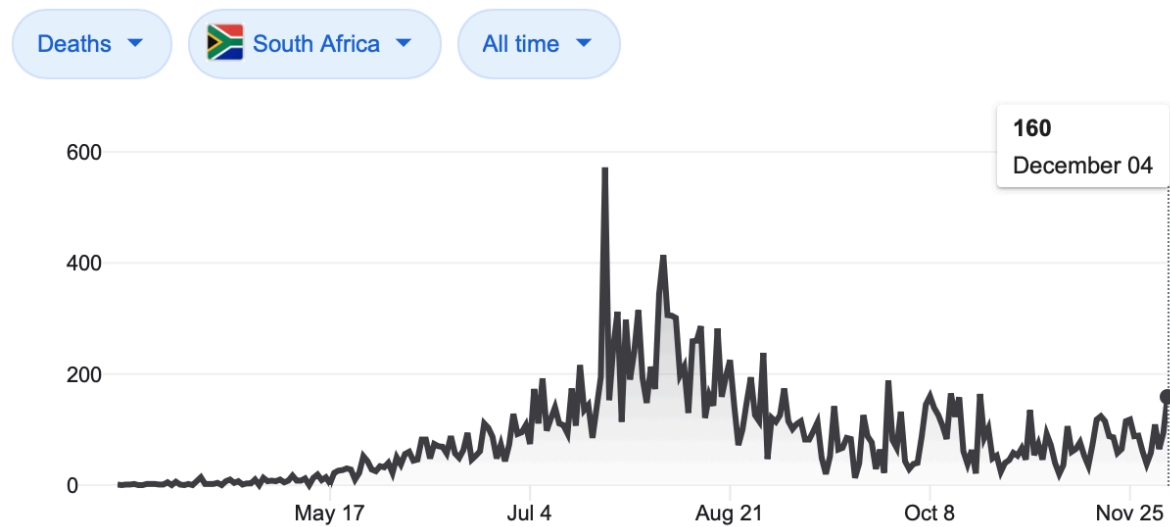

Daily average of the air temperature near the surface at the centre of the circle, not representative of the whole country.

Daily average of the specific humidity at mean sea level at the centre of the circle, not representative of the whole country.
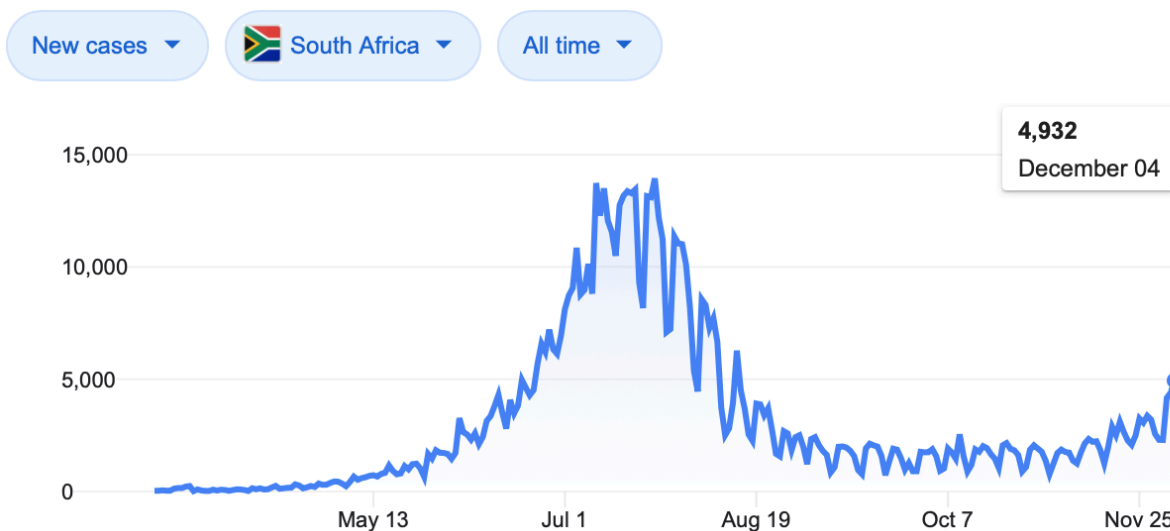
South Africa (Cases: 749,182; Deaths: 20,206 (JHU, 16Nov20)

Daily change

[Deaths ▼]   [🇿🇦 South Africa ▼]   [All time ▼]

160
December 04

Each day shows deaths reported since the previous day · Updated less than 40 mins ago · Source: Wikipedia · About this data

Daily change

[New cases ▼]   [🇿🇦 South Africa ▼]   [All time ▼]

4,932
December 04

Each day shows new cases reported since the previous day · Updated less than 10 mins ago · Source: Wikipedia · About this data

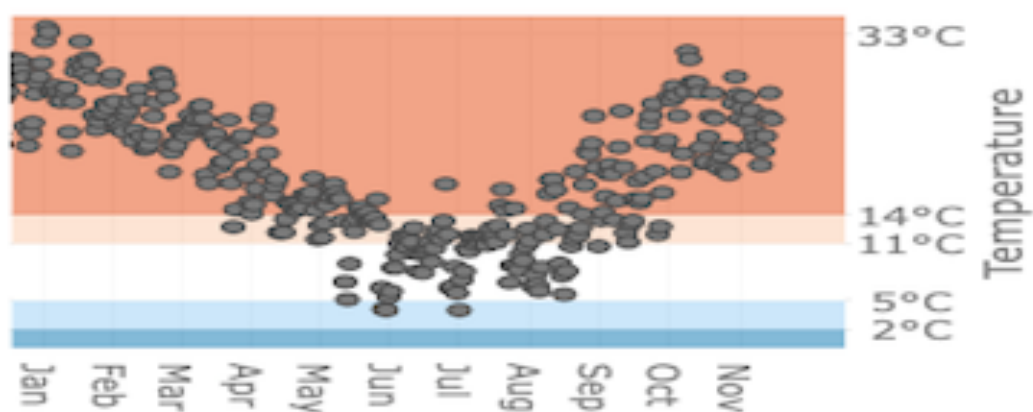**Social/Policy**

March 5: First case brought in from Italy

March 15: Declaration of national state of disaster
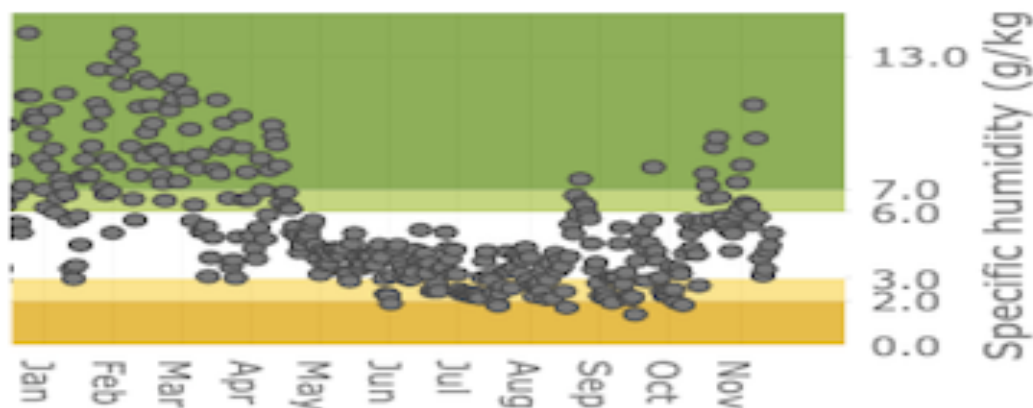
March 27: National lockdown

May 1: Phased easing of lockdown restrictions

Sept 21: Restrictions lowered to alert level

(As of Nov 2020, SA has highest number COVID cases in Africa, with a relatively low death rate (fatality rate 3% as of Nov 15)

Daily average of the air temperature near the surface at the centre of the circle, not representative of the whole country.

Daily average of the specific humidity at mean sea level at the centre of the circle, not representative of the whole country.

CONCLUSIONS

Viral infections like influenzas or flu are seasonal and the common cold is more likely in winter. SARS-CoV-2 is hypothesized (based on these other Coronaviruses) to be (at least partially) environmentally (T/Humidity) sensitive. Some studies support that virus survives longer on

surfaces in colder temperatures than higher temperatures, and lower specific humidity than higher.

Environmental factors (T, H, UV) may play a role directly in the survival of the virus on droplets and surfaces once expelled from an infected person, and indirectly by the human response to the environment and weather--e.g., open air vs indoor gatherings, sopciasl distancing...

Preliminary results suggest that policy actions and social practice have a dominating influence on the propagation and containment (or not) of COVID-19, possibly enabled by or associated with concomitant environmental factors

Policy actions appear to be non-uniform in many parts of the world. And varying controls divided between national and state governments. Better results in containment are seen where the policy and social response have been consistent and well managed

Well designed policy and social response together with unfavorable (to the Virus) climate conditions appear to be a positive contributor to the containment of the virus.

Until vaccines are available globally, relaxed social and policy responses together with favorable seasonal climate appears to be leading to expanded COVID-19 outbreaks

Since this paper was writted in Mid-November, SARS-COV-2/COVID-19 rates have trended up in the USA and many ther countries.

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ABSTRACT

SARS-CoV-2/COVID-19 propagated rapidly from a local outbreak to global scales with associated multi-trillion $ impact on the international economy and social, economic, and ecological systems. The Pandemic is currently ongoing and key questions have arisen as to what key factors determine its incidence, propagation,and mortality rates. Here, we try to distinguish between concurrent and collocated influences on COVID-19 due to environmental factors (e.g., T, humidity..) compared to policy actions (e.g., lock downs, slowdowns, open/closed businesses, transportation), and social practice (e.g., wearing masks, social distancing). Publicly available data and information from selected countries/regions around the world are used in this initial analysis. Preliminary results suggest that policy actions and social practice have a dominating influence on the propagation and containment (or not) of COVID-19, possibly enabled by or associated with concomitant environmental factors.

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