Possible dependence of SARS-CoV-2 infection rate on climatic conditions, such as air temperature, air water vapor saturation, and UV radiation

from Roland Quast, Bernd Haaff, Antje Rieder-Haaff, Sabine Roelcke

05. Januar 2021, update 01.03.2021

Abstract

The current pandemic with SARS-CoV-2 and the known mutations of this virus poses an unprecedented medical and economic challenge to the world population.

Measures to inhibit the spread of the virus are essential until sufficient immunization of the world population is achieved.In addition to monitoring the spread of the virus and its gene sequences, consideration of the physicochemical properties of the virus (virus persistence in aerosols, temperature dependence, dependence on humidity and UV radiation) appears relevant to reduce the spread of the virus.Observations as well as literature reviews make a dependence of infection rates on weather conditions.

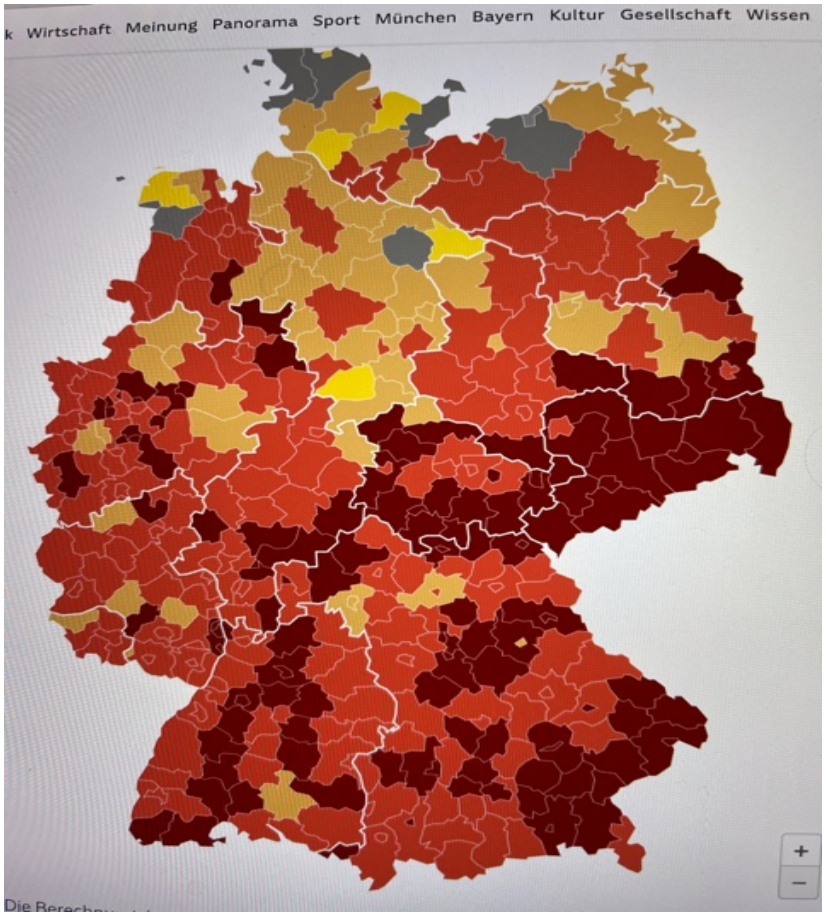
Conclusion:

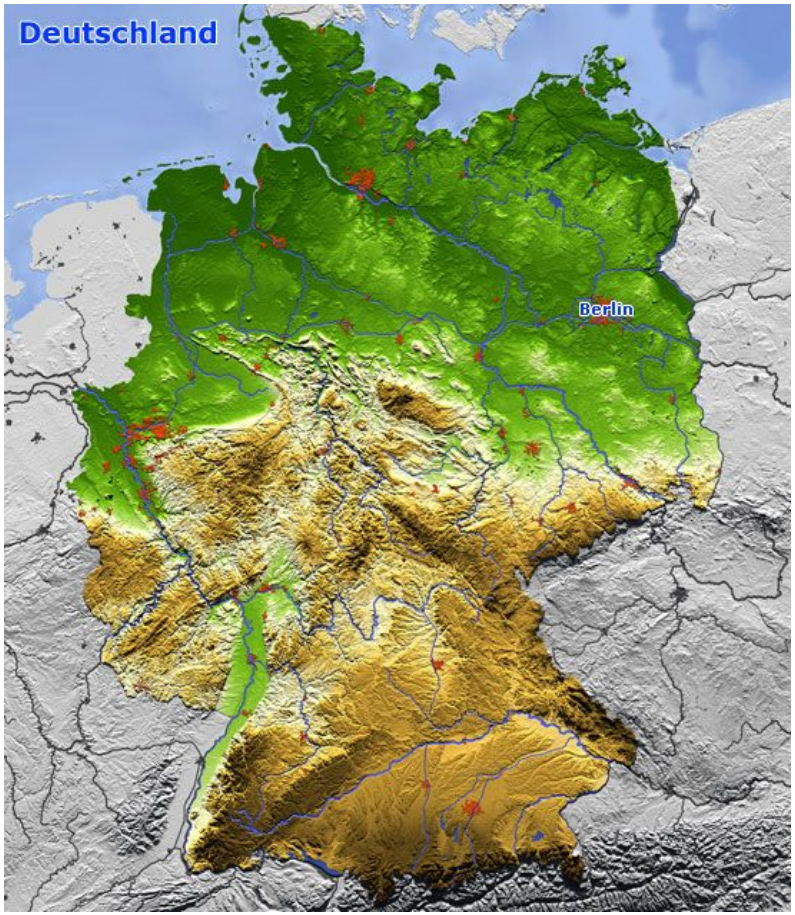
If the findings are correct, infections could be reduced by adapting lifestyles to weather conditions. In particular, do not consider easing restrictions or shutting down a lockdown during cold waves.

Comparison of a visual impression Germany

left graph Number of corona infections per 100 000 by cities and counties

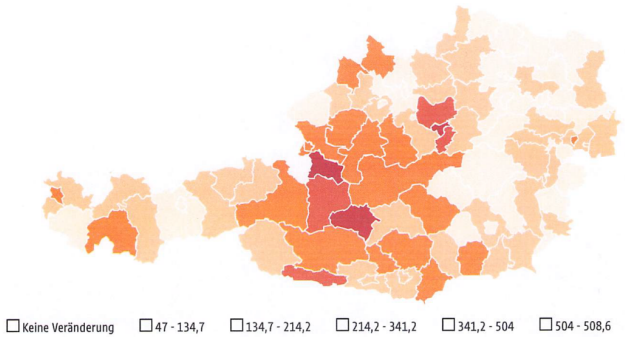
right relief map germany





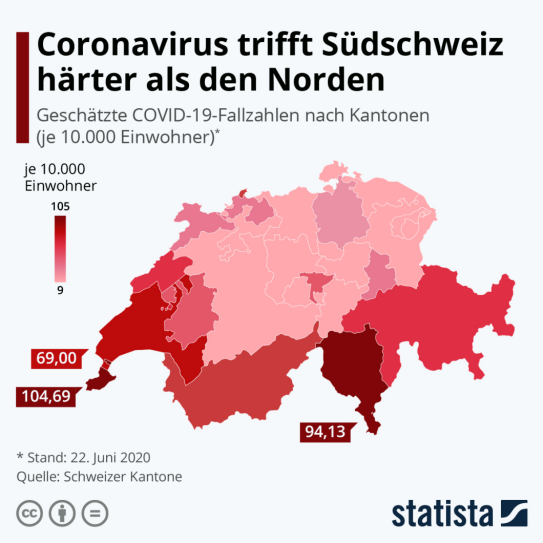
Comparison of a visual impression Austria

left graph Number of corona infections per 100 000 by cities and counties
right relief map Austria



Camparison of a visual impression Swiss

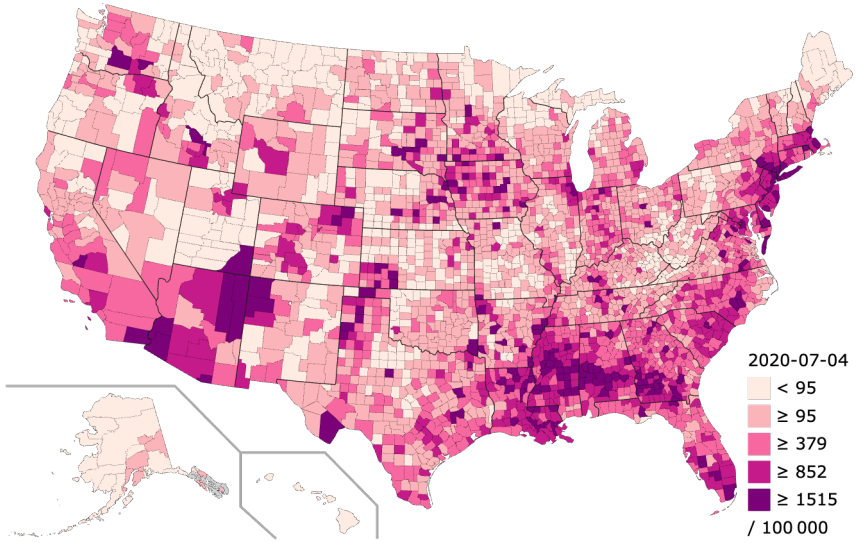
left. graph Number of corona infections per 100 000 by cities and counties
right relief map Swiss



Comparison of a visual impression America

left graph Number of corona infections per 100 000 by cities and counties

right relief map america



Fundamental Considerations:

When reading the daily development of the Corona figures, the distribution of new infections in Germany was reminiscent of an elevation relief map of Germany. Austria and Switzerland also showed similar pictures.

This coincidence could be coincidental, yet it seemed worth considering an analysis of previous publications. Can corona virus infection and disease be related to meteorological data, specifically air temperature and water vapor saturation, and UV radiation?

Based on our observations, we developed the working hypothesis: there is a relationship between disease incidence, air temperature, water vapor saturation, and UV radiation

For this purpose, an analysis of meteorological and geographical conditions :
Different sea levels should be seen epidemiologically different. Temperature, humidity and UV radiation are different at different altitudes.

Another point that can influence the spread of the virus is the air current.
If air currents are strong (westerly winds, easterly winds), the virus will be transported by the wind in aerosol or persist on surfaces if it has a lifetime of up to four days.

Air currents can also cause a deviation of the congruence of the corona infection map with the geographic relief map, air currents cant over the mountains depending on the wind direction and transport viruses in the aerosol.

Physical background atmosphere of the earth

Decrease in temperature with altitude
Up to the end of the troposphere at an altitude of about 11 km, the temperature decreases uniformly in a linear fashion, always assuming a stable weather situation.

Basic rule: per 100 meters the temperature decreases by about 1°C in dry air. When this air mass condenses during the ascent due to cooling, energy is released.

This process lowers the cooling rate of rising air to about 0.7°C per 100 meters. In the process, the air becomes drier.

Investigation working hypothesis:
To investigate our working hypothesis: there is a correlation between disease incidence, air temperature, water vapor saturation and UV radiation we examined medical databases.

Search for studies
Corona study found in China

Effects of temperature and humidity on the daily new cases and new deaths of COVID-19 in 166 countries

Yu Wu [1], Wenzhan Jing [1], Jue Liu [1], Qiuyue Ma [1], Jie Yuan [1], Yaping Wang [1] Min Du [1], Min Liu [2]
Affiliations

PMID: **32361460**
PMCID: PMC7187824
DOI: 10.1016/j.scitotenv.2020.139051
Free PMC article

The relationship of temperature + humidity to the frequency of COVID-19 infection/disease is not consistent, but several papers in the literature have shown a decrease in the frequency of disease.
The work of Wu (Effects of temperature and humidity on the daily new cases and new deaths of COVID-19 in 166 countries) describes effects that could be consistent with the observations described.

“A 1 °C increase in temperature was associated with a 3.08% (95% CI: 1.53%, 4.63%) reduction in daily new cases and a 1.19% (95% CI: 0.44%, 1.95%) reduction in daily new deaths, whereas a 1% increase in relative humidity was associated with a 0.85% (95% CI: 0.51%, 1.19%) reduction in daily new cases and a 0.51% (95% CI: 0.34%, 0.67%) reduction in daily new deaths. The results remained robust when different lag structures and the sensitivity analysis were used. These findings provide preliminary evidence that the COVID-19 pandemic may be partially suppressed with temperature and humidity increases. However, active measures must be taken to control the source of infection, block transmission and prevent further spread of COVID-19. “

Search for studies
Corona studies found in USA

Recent studies from the USA. November and December 2020 1/2

•2020 Nov 16;2020.11.13.20231472.
doi: 10.1101/2020.11.13.20231472. Preprint
Role of air temperature and humidity in the transmission of SARS-CoV-2 in the United States

Yiqun Ma, Sen Pei, Jeffrey Shaman, Robert Dubrow, Kai Chen
•PMID: **33236018**
•PMCID: PMC7685329
•DOI: 10.1101/2020.11.13.20231472

Dylan et al. make a dependence of the infectivity of SARS-CoV-2 on air temperature and humidity highly probable.

There is much longer virus persistence in cold air than at higher temperatures. The effect of humidity overlaps the curve. Persistence is lowest at a relative humidity of 60%; this is true at both high temperatures and low, with the effect of humidity being less pronounced at low temperatures than at higher temperatures.
Thus, a U-shaped curve of virus persistence results from the superposition.

Title of the work:

Mechanistic theory predicts the effects of temperature and humidity on inactivation of SARS-CoV-2 and other enveloped viruses

Dylan H. Morris, Kwe Claude Yinda, Amandine Gamble, Fernando W. Rossine, Qishen Huang, Trenton Bushmaker, Robert J. Fischer, M. Jeremiah Matson, Neeltje van Doremalen, Peter J. Vikesland, Linsey C. Marr, Vincent J. Munster, and James O. Lloyd-Smith

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December 17, 2020

Introduction
December 17, 2020

„In late 2019, a new zoonotic coronavirus now called SARS-CoV-2 emerged; it has since caused a global pandemic (COVID-19), and is poised to become an endemic human pathogen. As the northern hemisphere enters winter, many countries in the temperate north have seen an increase in transmission. Epidemiologists anticipated that increase [46, 33] based on observations from other enveloped respiratory viruses, such as endemic human coronaviruses [45] and influenza viruses [39], which spread more readily in temperate winters than in temperate summers. Like the related SARS-CoV-1 virus [38], SARS-CoV-2 displays epidemic dynamics that are strongly shaped by superspreading events, in which one person transmits to many others [20, 29].“

Introduction
December 17, 2020

Virus transmission is governed by many factors, among them properties of the virus and properties of the host population. But anticipating seasonal changes in transmission and preventing superspreading events both require an understanding of virus persistence in the environment, as ambient conditions can facilitate or impede virus spread.
Empirical evidence suggests that SARS-CoV-2, like other enveloped viruses, varies in its environmental stability as a function of temperature and humidity [6, 42], but the joint effect of 2

bioRxiv preprint doi: https://doi.org/10.1101/2020.10.16.341883; this version posted December 18, 2020. The copyright holder for this preprint (which was not certified by peer review) is the author/funder. All rights reserved. No reuse allowed without permission.

16 **Abstract (1)**
December 17, 2020

„Environmental conditions affect virus inactivation rate and transmission potential. Understanding those effects is critical for anticipating and mitigating epidemic spread. Ambient temperature and humidity strongly affect the inactivation rate of enveloped viruses, but a mechanistic, quantitative theory of those effects has been elusive.

We measure the stability of the enveloped respiratory virus SARS-CoV-2 on an inert surface at nine temperature and humidity conditions and develop a mechanistic model to explain and predict how temperature and humidity alter virus inactivation.

We find SARS-CoV-2 survives longest at low temperatures and extreme
relative humidities;

median estimated virus half-life is over 24 hours at 10 C and 40 % RH, but approximately 1.5 hours at 27 C and 65 % RH.

Our mechanistic model uses simple chemistry.“

Abstract (2)
December 17, 2020

„Our mechanistic model uses simple chemistry to explain the increase in virus inactivation rate with increased temperature and the U-shaped dependence of inactivation rate on relative humidity.

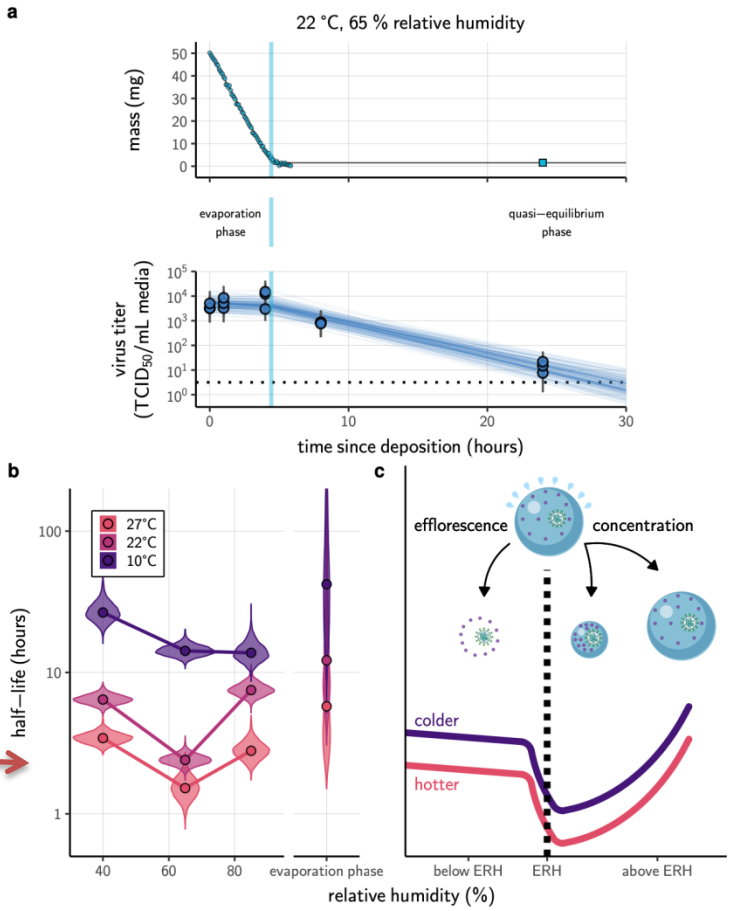
The model accurately predicts quantitative measurements from existing studies of five different human coronaviruses (including SARS-CoV-2), suggesting that shared mechanisms may determine environmental stability for
many enveloped viruses. Our results indicate scenarios of particular transmission risk, point to pandemic mitigation strategies, and open new frontiers in the mechanistic study of virus transmission.“
entnommen aus bioRxiv preprint doi: https://doi.org/10.1101/2020.10.16.341883; this version posted December 18, 2020.

Introduction
December 17, 2020

„For viruses to transmit from one host to the next, virus particles must remain infectious in the period between release from the transmitting host and uptake by the recipient host. Virus environmental stability thus determines the potential for surface (fomite) transmission and for mid-to-long range transmission through the air. Empirical evidence suggests that virus
environmental stability depends strongly on ambient temperature and humidity, particularly for enveloped viruses; examples among enveloped viruses that infect humans include influenza viruses [40], endemic human coronaviruses [25], and the zoonotic coronaviruses SARS-CoV-1 [11] and MERS-CoV [59].“

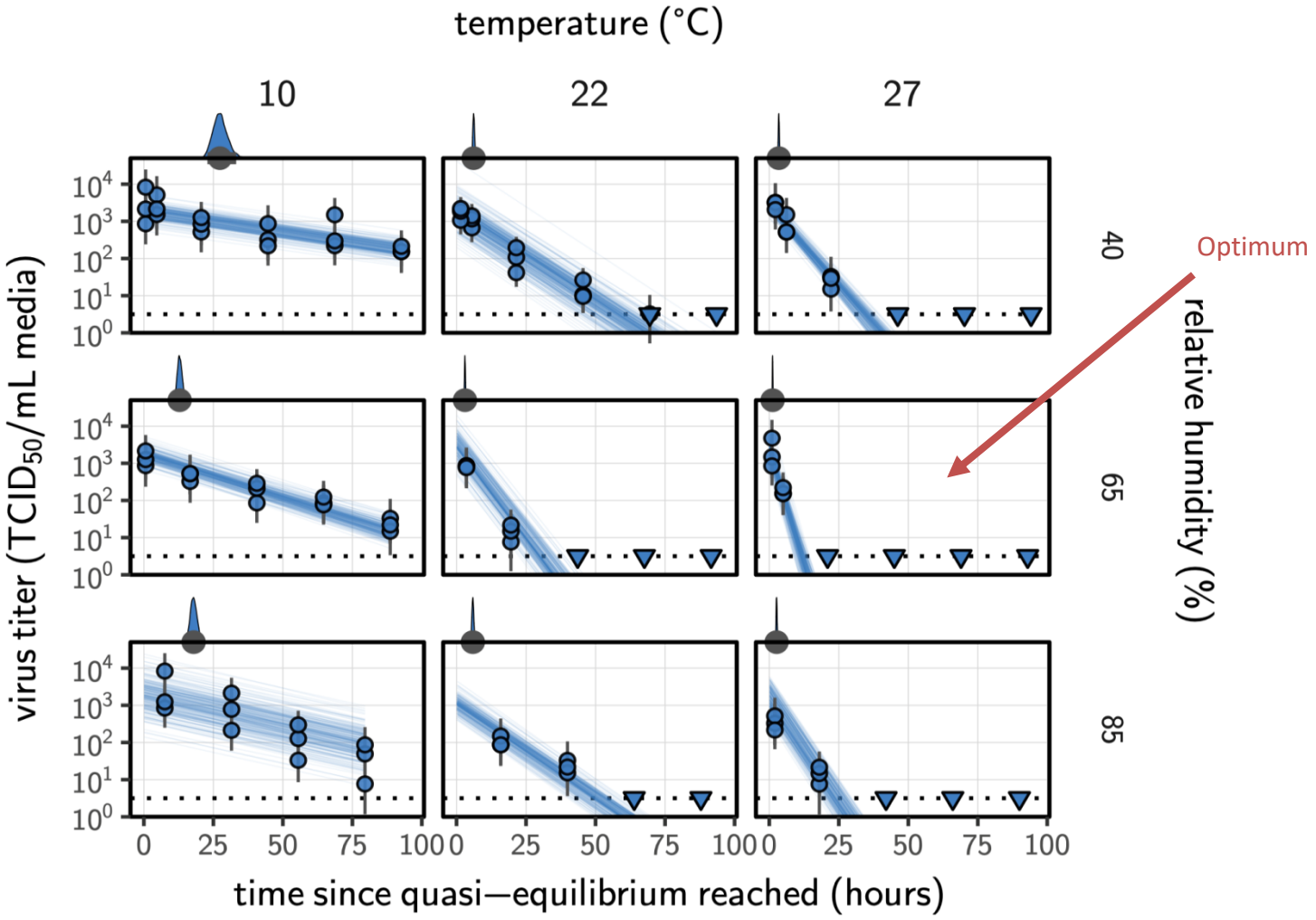
Graphs that illustrate the connection

U-shaped curve



Graphic taken from bioRxiv preprint doi: https://doi.org/10.1101/2020.10.16.341883; this version posted December 18, 2020.

Relationship virus titer - temperature and relative humidity



Graphik taken from bioRxiv preprint doi: https://doi.org/10.1101/2020.10.16.341883; this version posted December 18, 2020.

Influence of UV radiation (studies Homeland Security USA)

Temperature, UV index and relative humidity influence the death of the coronavirus when it is outside our body. For this purpose, the temperature, on the one hand, was examined more closely under laboratory conditions. Another important parameter is the UV index, i.e. the radiation of the sun. The air humidity was also significantly included.

From this mix, it is possible to calculate how long it takes for the viruses to decay in the open air or on surfaces. The calculation shows how many hours it takes for 99 percent of the viruses to die off.
In the best case, with plenty of sun and heat, it takes an hour or less. In the worst case, it takes several hours.
This can be the case, for example, with lots of clouds and rather cooler temperatures.

The extent to which weather can affect the airborne spread of the virus was examined in a study commissioned by Homeland Security.

Homeland Security explored a correlation from the three parameters of temperature, relative humidity, and UV radiation, and plotted it using the Corona Calculator shown on the next slide.

CORONA-Calculator

PANTHR

Estimated Airborne Decay of SARS-CoV-2

Estimated Surface Decay of SARS-CoV-2

Estimated Surface Decay of SARS-CoV-2 (virus that causes COVID-19)

on surfaces under a range of temperatures, relative humidity, and UV Index

Use the sliders to select the UV index (select either 0 or a value between 1.5 and 12), temperature and relative humidity of interest. Information on how long SARS-CoV-2 would be expected to remain stable on surfaces will be displayed in the table below. Users can find the environmental conditions for a specific location by accessing general weather resources online.

SARS-CoV-2 Surface Decay Calculator

UV Index:

0 — 10

2

Temperature: *

74 — 95

68 °F / 23.3°C

Relative Humidity: *

20 — 60

20 %

* Note: Temperature (68°F) and relative humidity (20%) input cannot be changed for UV values greater than 0

Search for studies
Corona study found in Cyprus

Study from Cypria

The influence of weather on SARS-CoV-2 infection incidence was calculated in this study with scientifically sound very significant results.
https://aip.scitation.org/doi/10.1063/5.0037640

Study on the seasonality of SARS-CoV-2 infections.

The influence of weather on SARS-CoV-2 infection incidence was calculated in this study with scientifically sound very significant results.
https://aip.scitation.org/doi/10.1063/5.0037640

“Epidemic models do not account for the effects of climate conditions on the transmission dynamics of viruses. This study presents the vital relationship between weather seasonality, airborne virus transmission, and pandemic outbreaks over a whole year.

Using the data obtained from high-fidelity multi-phase, fluid dynamics simulations, we calculate the concentration rate of Coronavirus particles in contaminated saliva droplets and use it to derive a new Airborne Infection Rate (AIR) index.

Combining the simplest form of an epidemiological model, the susceptible-infected-recovered, and the AIR index, we show through data evidence how weather seasonality induces two outbreaks per year, as it is observed with the COVID-19 pandemic worldwide. We present the results for the number of cases and transmission rates for three cities, New York, Paris, and Rio de Janeiro.

The results suggest that two pandemic outbreaks per year are inevitable because they are directly linked to what we call weather seasonality.

The pandemic outbreaks are associated with changes in temperature, relative humidity, and wind speed independently of the particular season.

We propose that epidemiological models must incorporate climate effects through the AIR index.”

Observations of the relationship between weather conditions and corona

Suggestions for reactions and activities

Analysis theory to practice: cold snap in Spain

On January 09, 2021, there was a massive cold snap in Spain.

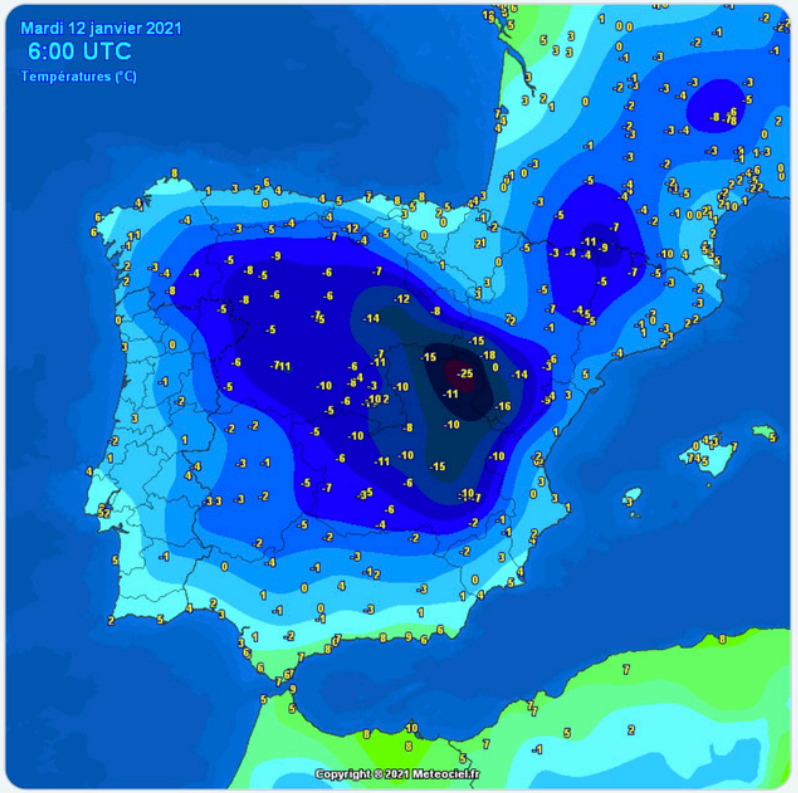
The adjacent map shows low temperatures in deep blue.
This air mass came from northeastern Europe and with its northeasterly flow probably also touched Great Britain, Ireland, the Netherlands and France.

In all these countries there were increased numbers of infections.

The development of corona infections triggered by this influx of cold air is shown in the next slide.

MeteoGib
@MeteoGib

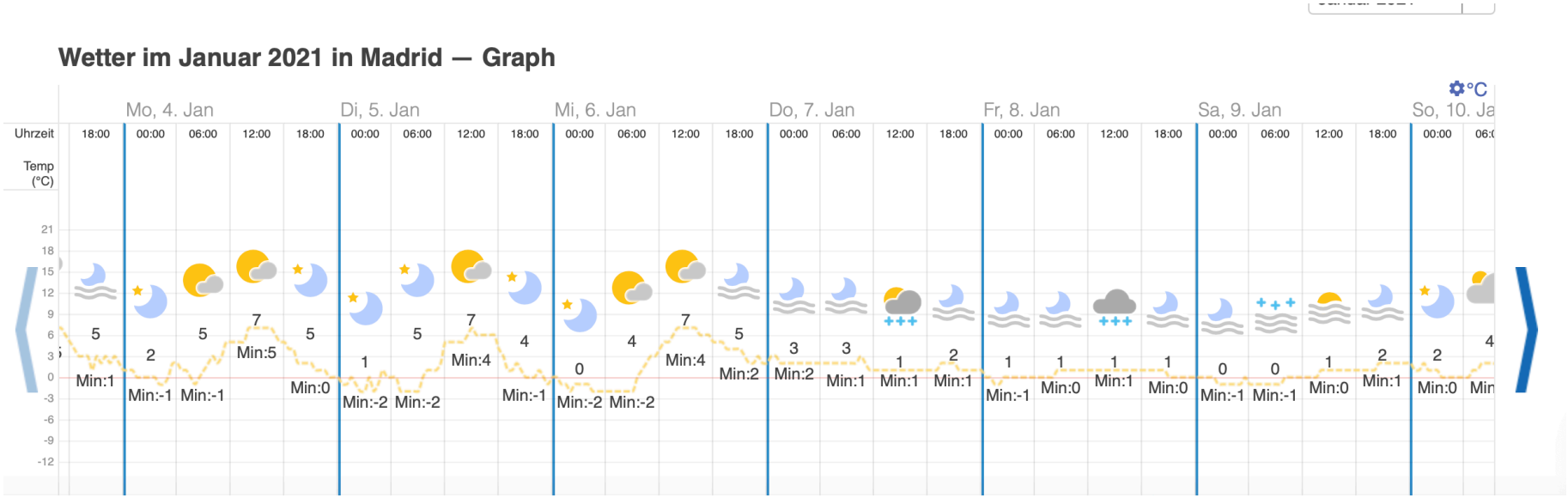
#Iberia temps at 7am, 12/01 - wow, Molina de Aragón seems to have dipped in to the Arctic this morning reporting a freezing -25C and with -16C in Teruel, this in contrast to a much warmer South coast with Fuengirola & Motril 8C and Adra at 9C.



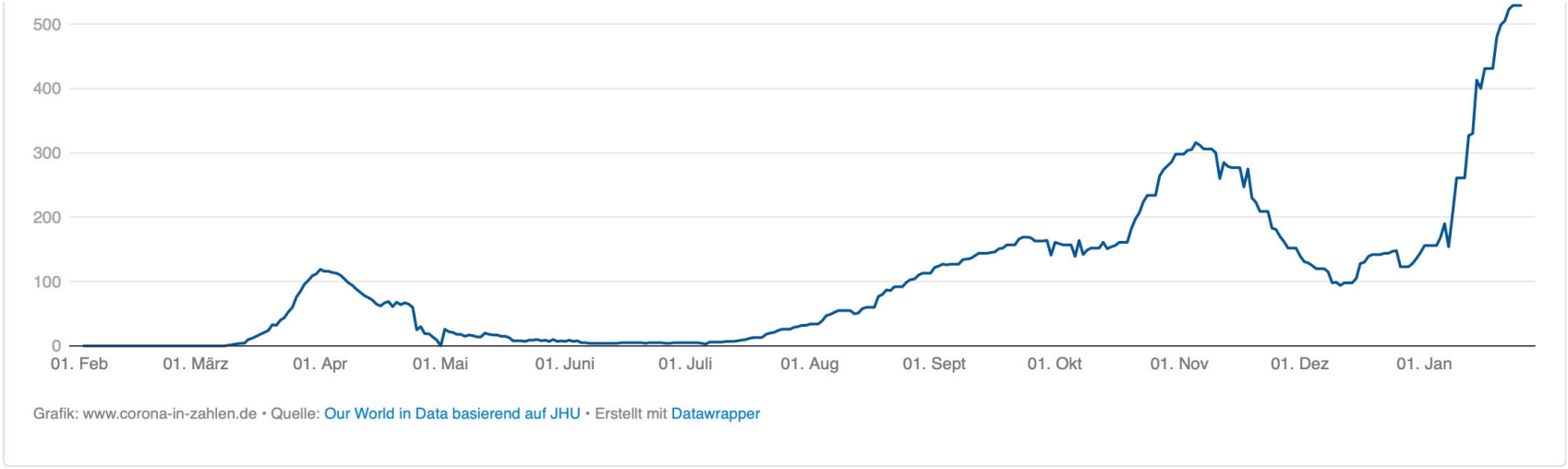
7:03 AM · Jan 12, 2021

76 38 people are Tweeting about this

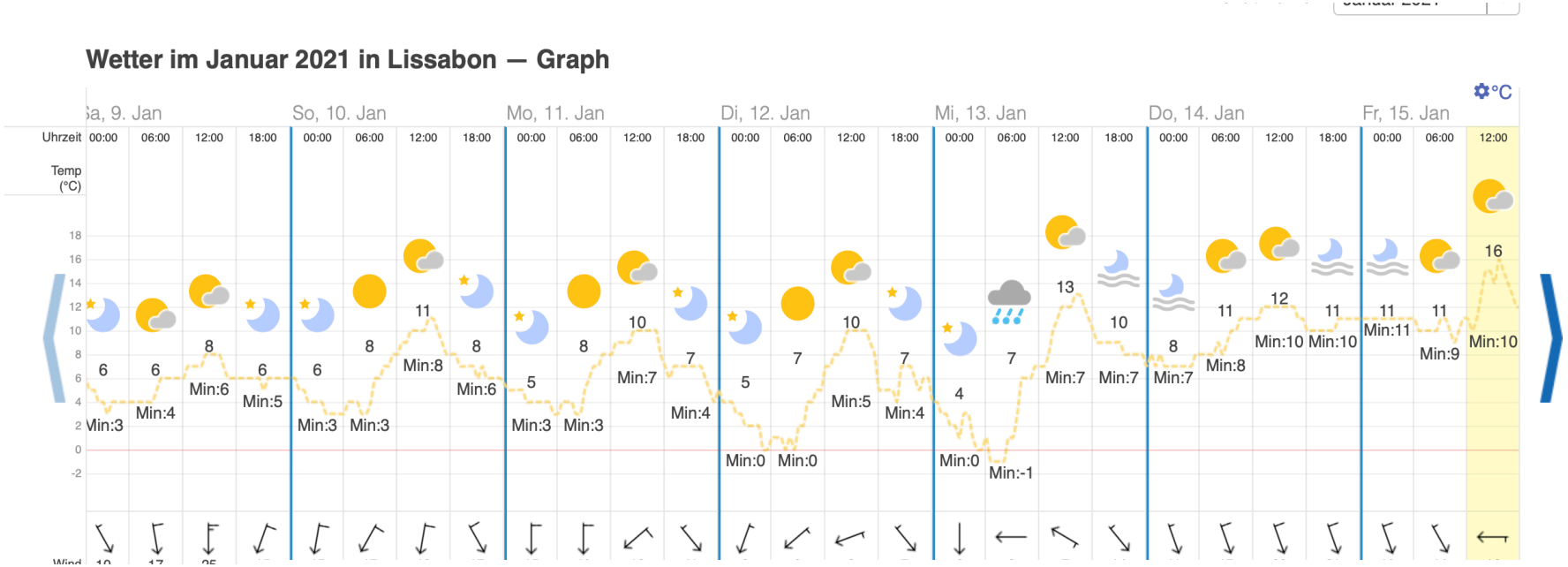
Cold snap Spain begins January 7, one week later high incidence



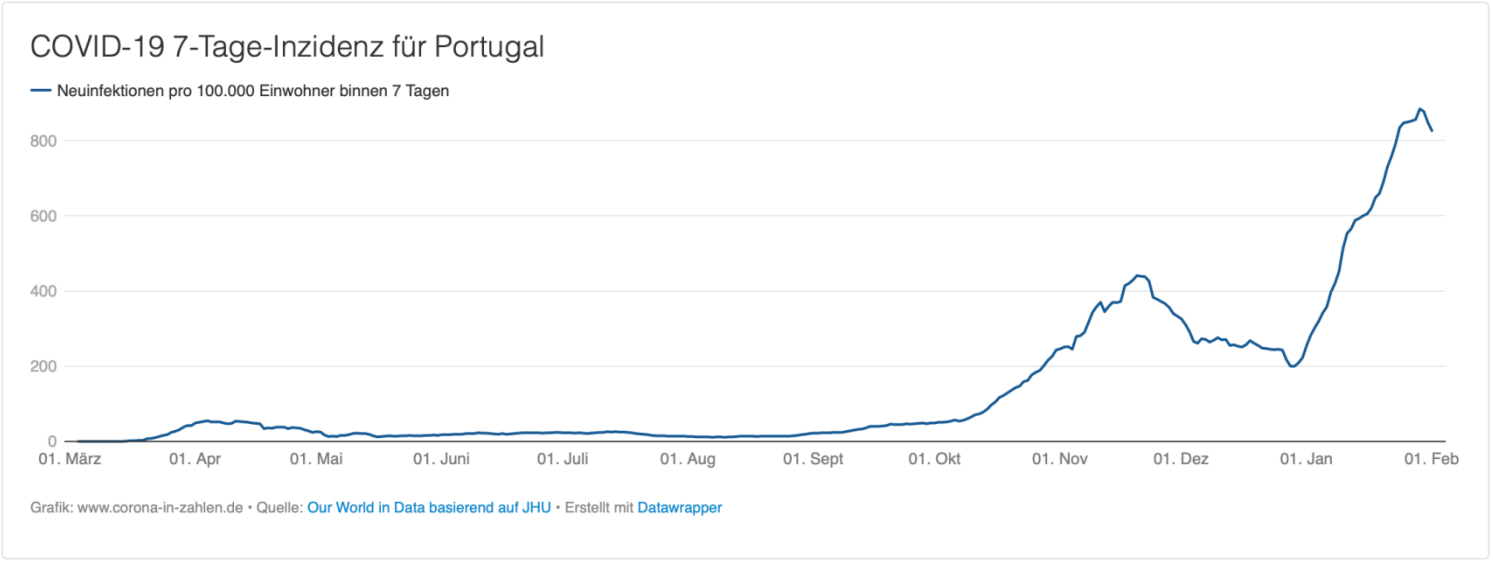
The increase in new infections suggests a connection to the massive coldsnap in january 2021



Cold snap Portugal begins January 8, one week later high incidence



Increase as in Spain



From the weather site wetter.de

This weather service describes on its homepage the correlations, from the research of the Homeland Security.
(read more at www.wetter.de)

From this he creates a new parameter: Corona Decay Index and publishes it in his weather reports.

Temperature, UV index and relative air humidity affect the death of coronavirus when it is outside our body. For this purpose, the temperature was examined more closely under laboratory conditions. Another important parameter is the UV index, i.e. the radiation of the sun, and the humidity of the air was also significantly included. From this mix, it is possible to calculate the period of time in which the viruses decay in the open air or on surfaces. The calculation shows how many hours it takes for 99 percent of the viruses to die off. In the best case, with plenty of sun and heat, this can be done within an hour or less. In the worst case, it takes several hours. This can be the case, for example, with lots of clouds and cooler temperatures. Incidentally, the extent to which weather can influence the spread of the virus in the air was investigated in a study commissioned by Homeland Security.

Below are three examples of predictions with corona decay (given in hours)

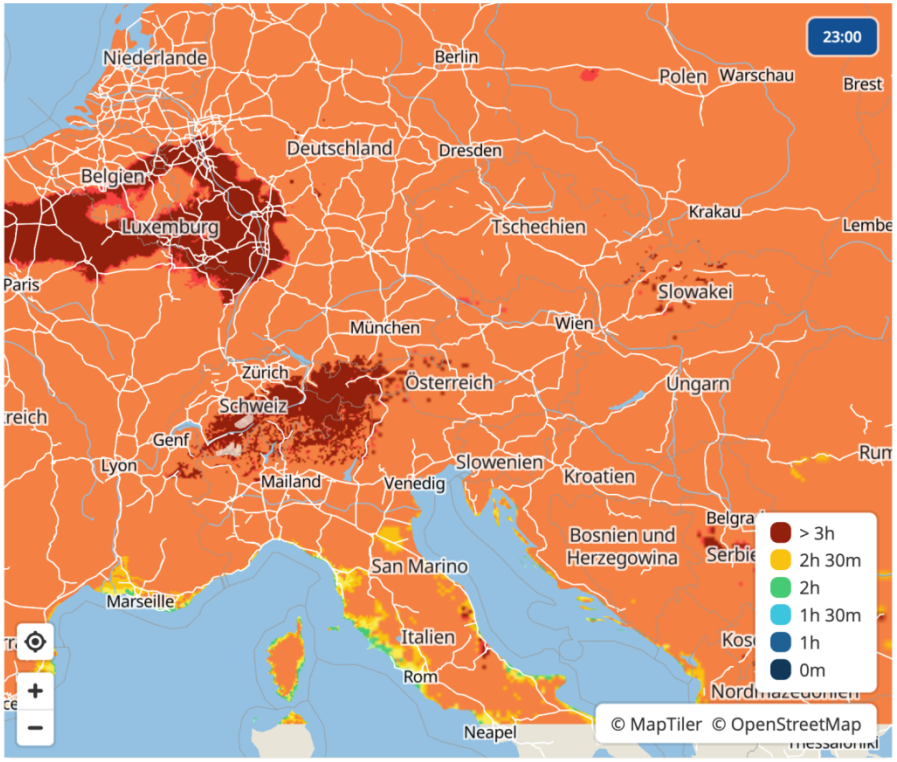
Weather report wetter.de with indication of Corona decay index

These correlations have already been incorporated into the weather report www.wetter.de. If one adds a place to the input wetter.de, the Corona decay index is displayed.

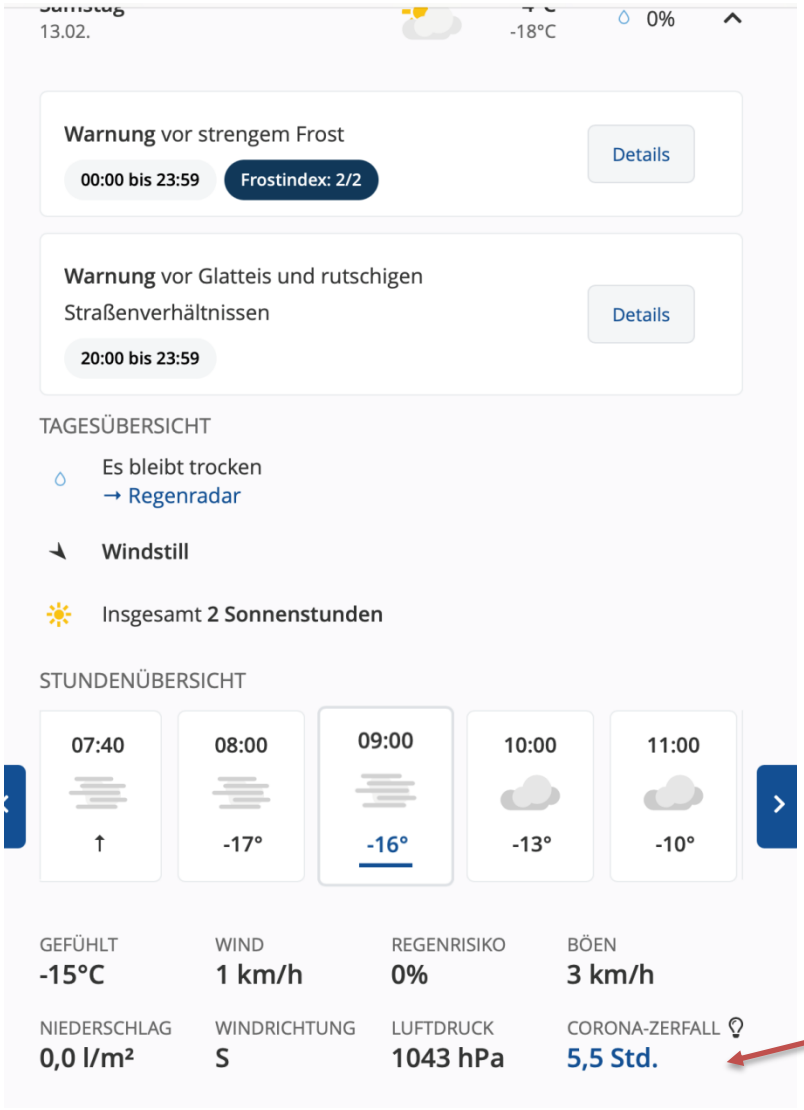
Zerfallsindex für Covid-19

Der Zerfall des Coronavirus in Abhängigkeit vom Wetter

In unserem Radar seht ihr den errechneten Zerfall des Coronavirus an der frischen Luft in Abhängigkeit von der Temperatur, der relativen Luftfeuchtigkeit und insbesondere des UV-Indexes, also der Sonneneinstrahlung.



Forecast wetter.de Hannover. 13.2.21

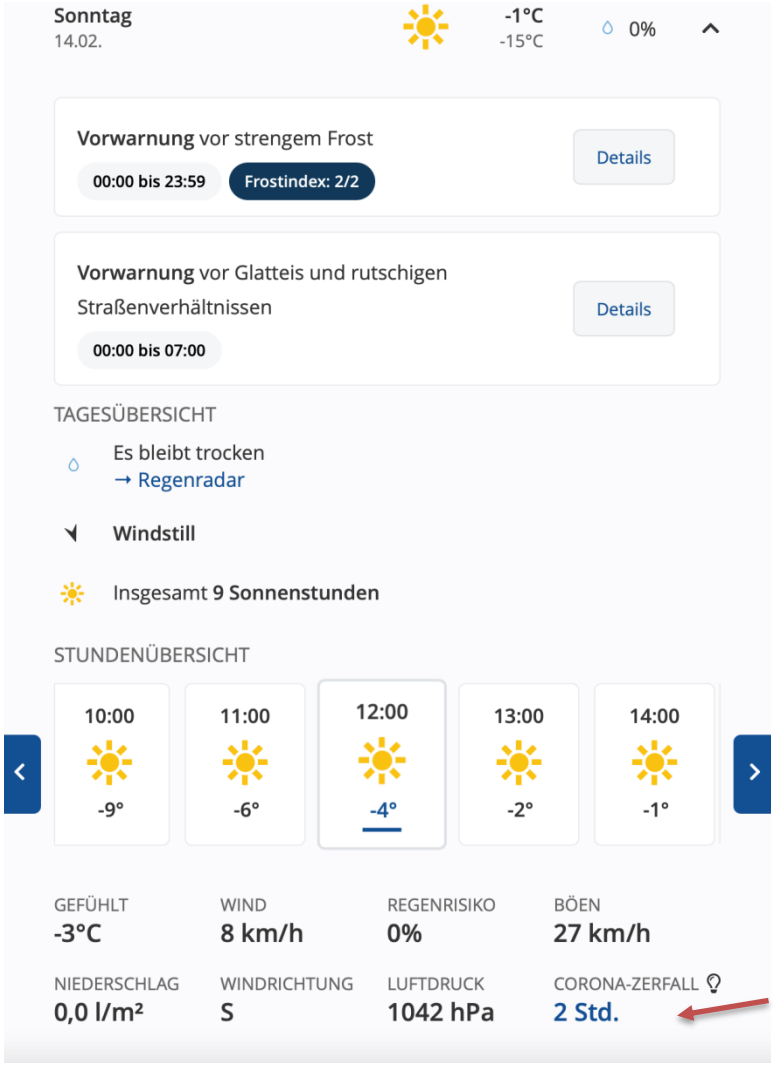


wetter.de gives the. Corona decay in hours.

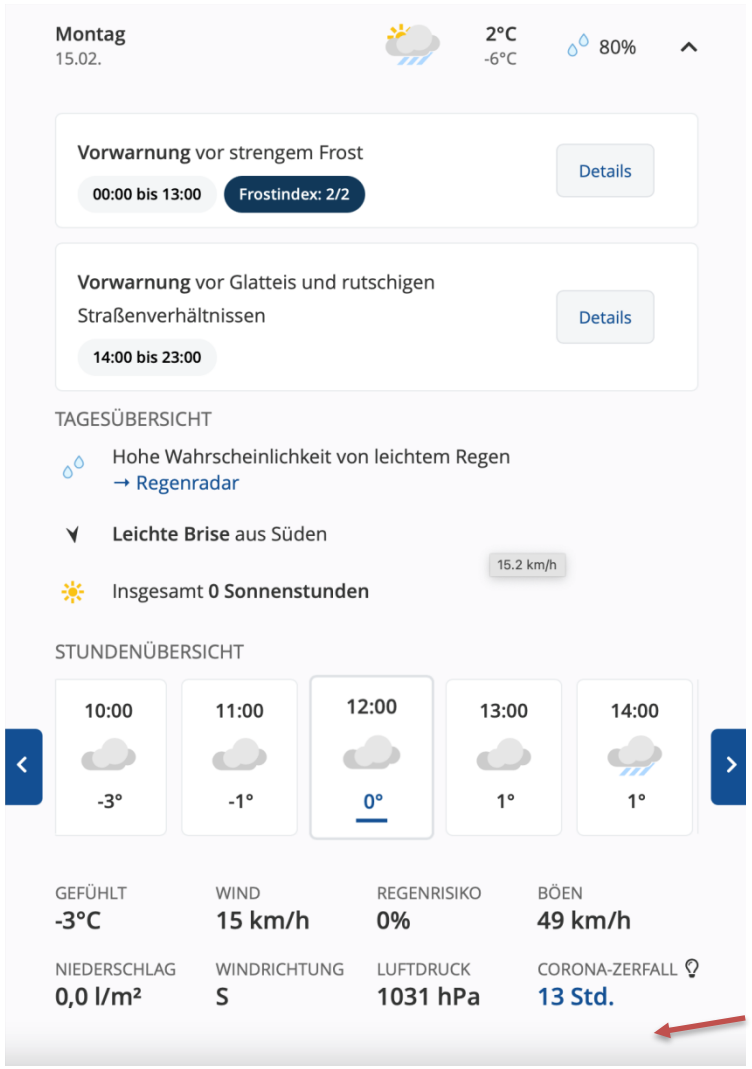
This information is probably based on the SARS-CoV-2 Surface Decay Calclator of the Homeland Security of the USA, already described in the study.

Note the degree of occultation in relation to solar irradiance

weather forecast Hannover. 14.2.21



weather forecast Hannover. 15.2.21



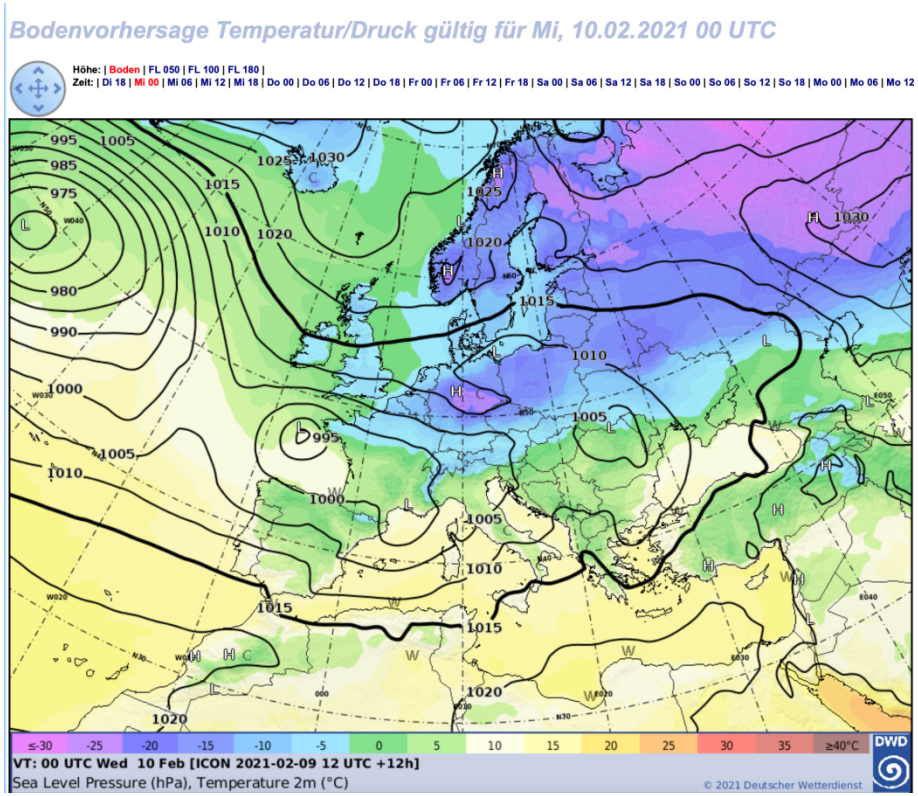
Note the degree of coverage in relation to the solar irradiance

Example of a possible Corona weather warning (predicted cold snap)

Germany experienced a massive cold snap at the beginning of February. Temperatures dropped far below freezing and massive snowfall affected everyday life.

According to previous knowledge and research, such a massive cold snap also affects the infection rate with SARS-CoV-2. The example of Spain shown above demonstrated this.

The next slide shows the German Weather Service forecast map for temperature and air pressure. Temperatures of up to -25° C were predicted for February 10.



The forecast map for February 10, 2021 showed a drop in temperature up to -25° C. Conditions similar to those experienced in Spain on January 10, 2021 - were foreseen.

Such a weather forecast should be closely observed and may lead to warnings and actions.

For this purpose, the tables shown on the next pages are interesting; they present the connection between low temperatures and increased infection rates using the example of the predicted for 10.02.21. cold snap in Germany.

Coronavirus SARS-CoV-2

COVID-19: Fallzahlen in Deutschland und weltweit

Fallzahlen in Deutschland

Stand: 22.2.2021, 00:00 Uhr (online aktualisiert um 08:30 Uhr)

Die Anzahl der Fälle - und deren Differenz zum Vortag - und die Anzahl der Todesfälle beziehen sich auf Fälle, die dem RKI täglich übermittelt werden. Dies beinhaltet Fälle, die am gleichen Tag oder bereits an früheren Tagen an das Gesundheitsamt gemeldet worden sind. Bei den Fällen in den letzten 7 Tagen und der 7-Tage-Inzidenz liegt das Meldedatum beim Gesundheitsamt zugrunde, also das Datum, an dem das lokale Gesundheitsamt Kenntnis über den Fall erlangt und ihn elektronisch erfasst hat.

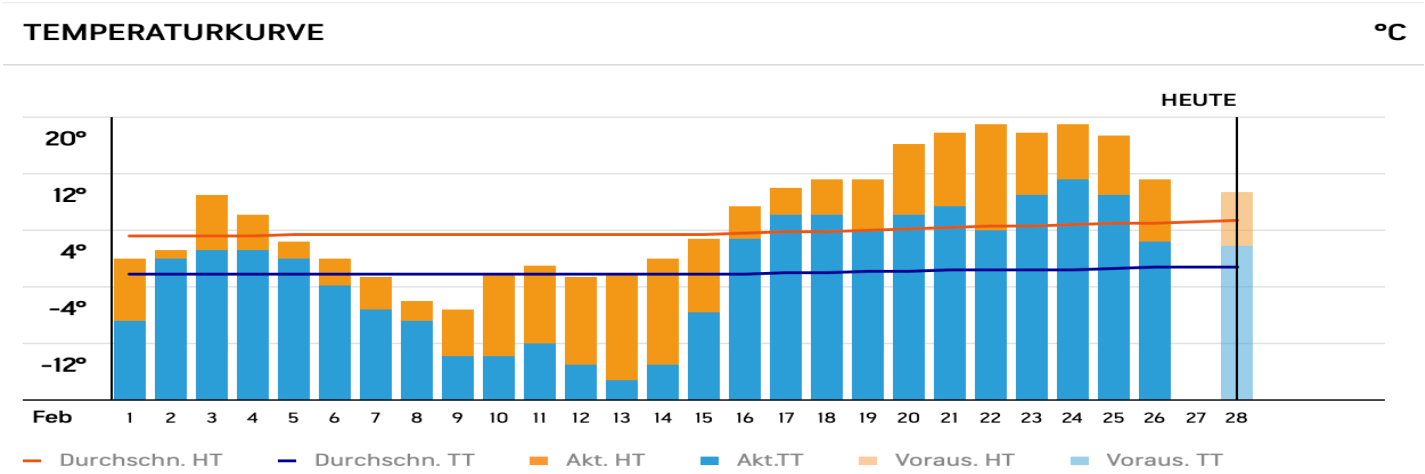
Bundesland	Elektronisch übermittelte Fälle				
	Anzahl	Differenz zum Vortag	Fälle in den letzten 7 Tagen	7-Tage-Inzidenz	Todesfälle
Baden-Württemberg	311.157	303	4.892	44	7.940
Bayern	429.024	732	7.664	58	12.123
Berlin	126.898	73	2.103	57	2.728
Brandenburg	74.955	112	1.600	63	2.914
Bremen	17.485	60	511	75	327
Hamburg	50.292	113	1.182	64	1.223
Hessen	184.447	195	3.755	60	5.672
Mecklenburg-Vorpommern	23.436	78	1.087	68	692
Niedersachsen	159.196	599	5.084	64	4.104
Nordrhein-Westfalen	521.557	918	11.081	62	12.633
Rheinland-Pfalz	100.119	338	2.105	51	2.993
Saarland*	28.056	0	440	45	848
Sachsen	190.814	332	3.045	75	7.460
Sachsen-Anhalt	58.674	194	1.975	90	2.293
Schleswig-Holstein	41.115	112	1.478	51	1.211
Thüringen	73.703	210	2.689	126	2.742
Gesamt	**2.390.928**	**4.369**	**50.691**	**61**	**67.903**

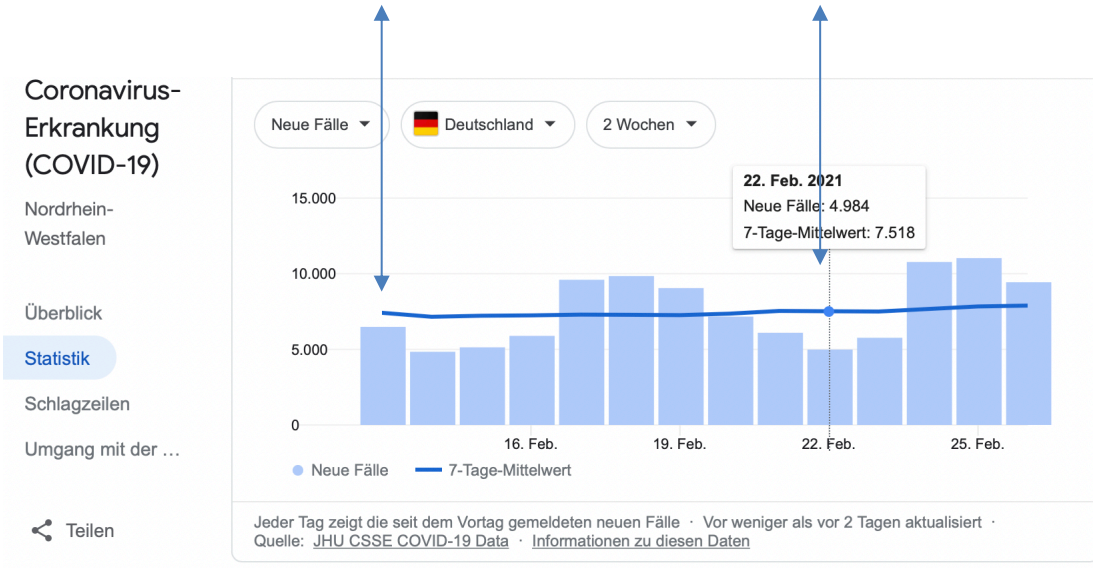
*Aus Saarland wurden gestern aufgrund technischer Probleme keine Daten übermittelt

The cold snap in North Rhine-Westphalia and Lower Saxony caused a significant increase in the number of cases.

Annotation:
The 7-day incidence hangs back 7 days

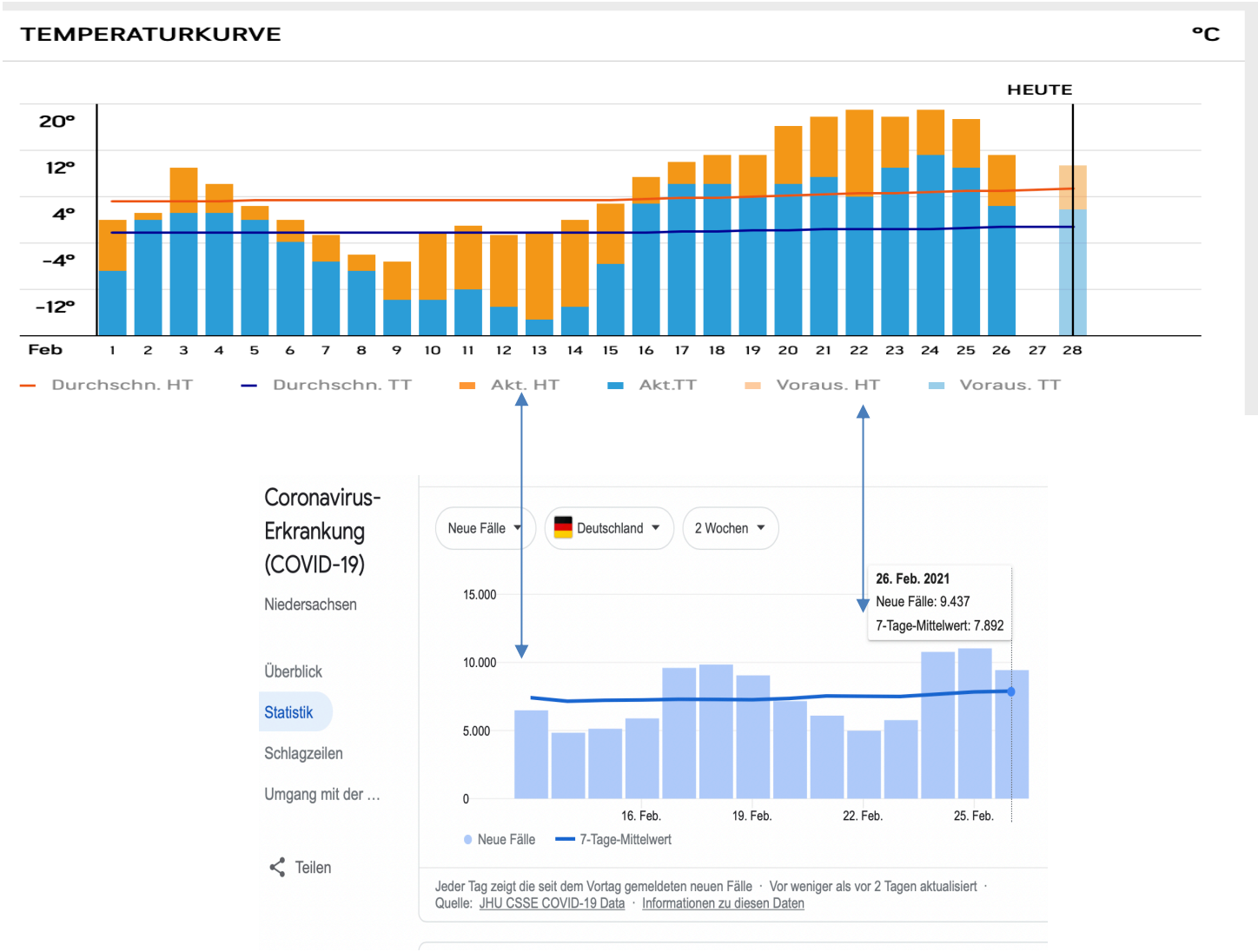
Nordrhein-Westfalen (Accu-Weather)





Cold snap in North Rhine-Westphalia 07.02.21
about one week after temperature drop, COVID-19 disease rate increases.

Temperature course Lower Saxony(Accu-Weather)



Cold snap in Lower Saxony 07.02.21
about one week after temperature drop, COVID-19 disease rate increases.

Examples of possible consequences from the findings obtained

Tyrol

In Tyrol, skiing was released for Austrian citizens. The increased infection rate that has now arisen is attributed to virus mutants.

However, an admissible justification would also be the criteria temperature, humidity and UV radiation, which in the meantime have emerged as decisive factors. These are optimal for the spread of the SARS-CoV-2 virus during skiing.

A border closure now justified by mutants may be scientifically questioned.

Czech Republic

Border controls to Germany

In the border area between Bavaria and the Czech Republic, a high infection rate with the Corona virus is detected on both sides.

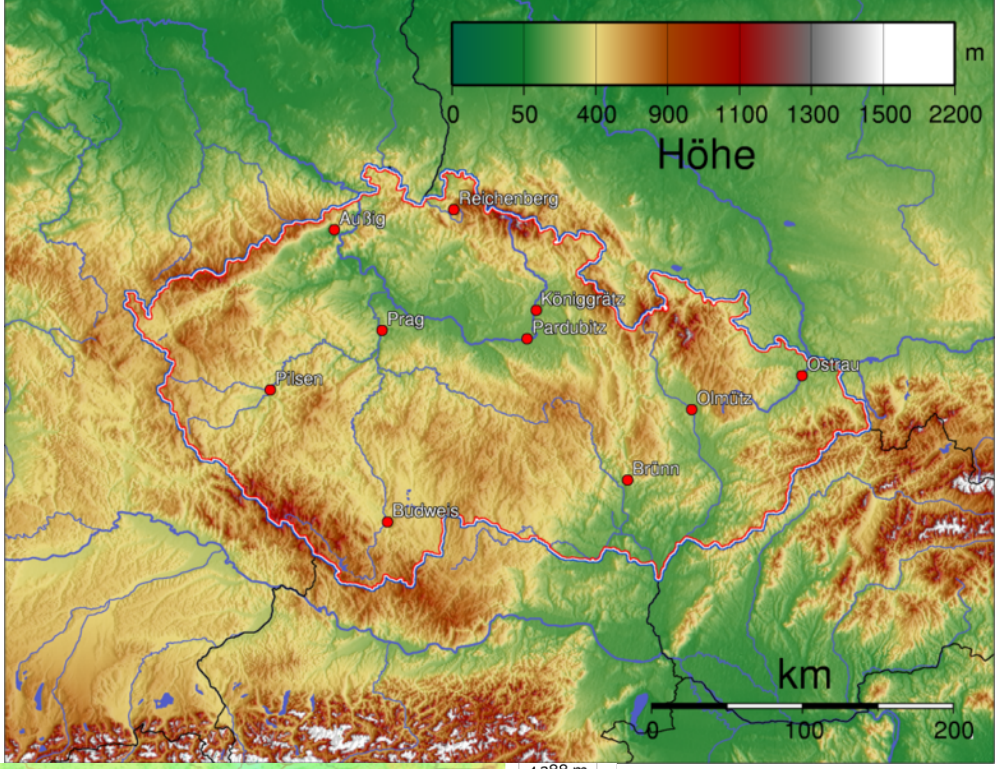
As a reason for the increased infection rate with SARS-CoV-2 in the border area, among other things, virus mutations are brought forward. However, these have not yet been researched in terms of their effect and contribution to the overall incidence.

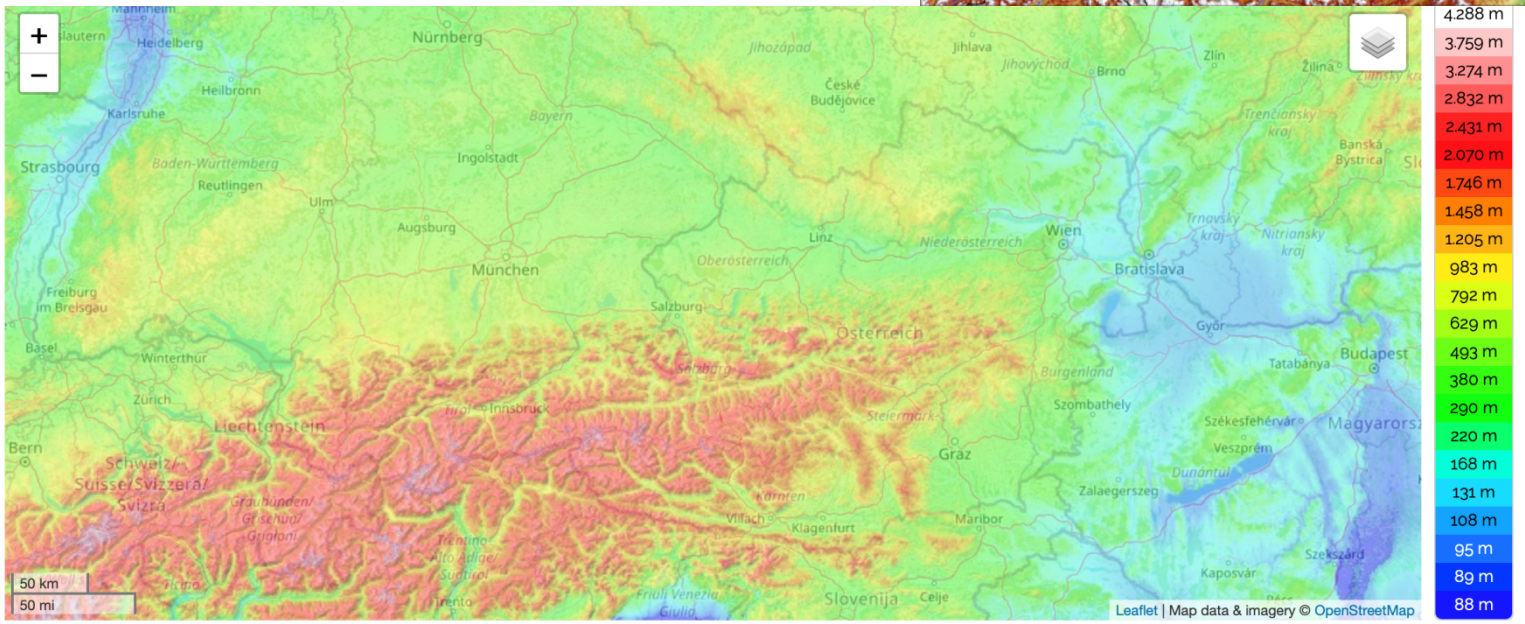
Also here a possible, permissible reason would lie with the criteria temperature, air humidity and UV-radiation, which crystallized out.

Under certain circumstances, these parameters can also be explained by the geographical situation; both countries have similar mountain heights in the border area, as the following slide shows.

Czech Republic and Germany
have similar geographical conditions

This could explane the similar infection rates.





Bayern, Deutschland (48.94676 11.40387)

Summary of the likely relevant components

There is no doubt that the fight against the current pandemic caused by SARS-CoV-2 should be based on several pillars.

- The reduction of contacts between people
- Protection of highly vulnerable groups
- Fast and reliable diagnostics
- Effective protection of people at risk through masks
- Vaccination of the population as quickly as possible
- There seems to be another important pillar of virus control that deserves increased attention: Laws of virus transmission in aerosols, virus persistence and infectivity depending on air temperature and relative humidity, and the influence of UV radiation. These factors change with the weather.E

It is highly likely that the lessons learned can contribute significantly to the containment of the pandemic.

Theoretically conceivable consequences of action, if further analyses would scientifically confirm working hypothesis.

Control everyday life by weather forecast (leisure, sports, shopping traffic, business traffic).

For outdoor exercise, one could take into account:

In high pressure area (means low temperature in winter) and low humidity, there are stricter restrictions due to higher risk of virus infection.

Solar radiation can have a positive effect.
The corona decay index takes this into account and shows it.
wetter.de has already implemented it in the weather report in the form of the Corona decay index parameter indicated on the weather report.

If we learn to deal with it, very helpful means can develop to contain the infection rates with SARS-CoV-2.

The liquid content of aerosols plays an important role in many processes in the atmosphere, as they affect the optical properties, leading, for example, to haze or altered effects of aerosols on climate.

So at higher humidity levels, droplets grow faster, fall to the ground sooner, and are less likely to be inhaled by healthy people. "Humidity levels of at least 40% in public buildings and mass transit would therefore reduce not only the impact of COVID-19, but also that of other viral diseases such as seasonal influenza. The authorities should incorporate the humidity factor in future indoor guidelines," urges Dr. Sumit Kumar Mishar of the CSIR - National Physical Laboratory in New Delhi.

For countries in cool climates, the researchers recommend a minimum indoor humidity level. Countries in tropical and hot climates, on the other hand, should ensure that indoor spaces are not extremely overcooled by air conditioning systems.

When the air is extremely cooled, it dries the moisture from the air and particles. This makes people feel comfortable in the room, but the dry particles also stay in the air longer.

From the researchers perspective, more attention should be paid to indoor air to prevent future disease outbreaks.

The moisture content of indoor air is an important aspect but not the only one. In addition, fresh outdoor air can reduce the risk of transmission. And, of course, the measures already known and practiced: Keeping sand away, as few people per room volume as possible, and wearing masks. The lowest risk of infection is still where there are no viruses in the air.

Theoretically conceivable consequences of action, if further analyses would scientifically confirm working hypothesis.

Room temperature and humidity according to the studies (stores, lodging establishments, restaurants, culture and sports).

The previous safety concepts have worked quite well. Increased infection rates in restaurants and hotels have not yet been clearly identified and documented.
This probably also applies to stores.

If the findings from the studies are implemented and room temperature and humidity are increased, the risk of infection is lower. At 25° C and a humidity of 60%, the virus lives only a few hours.

The following page describes interesting considerations for room climate.
These measures seem reasonable:
Establish as high a temperature as possible
Establish high humidity
Only short shock ventilation to maintain room temperature
No cooling down of the rooms with air conditioners

Theoretically conceivable consequences of action, if further analyses would scientifically confirm working hypothesis

Room temperature and humidity according to the studies(air traffic)

Conditions in the aircraft

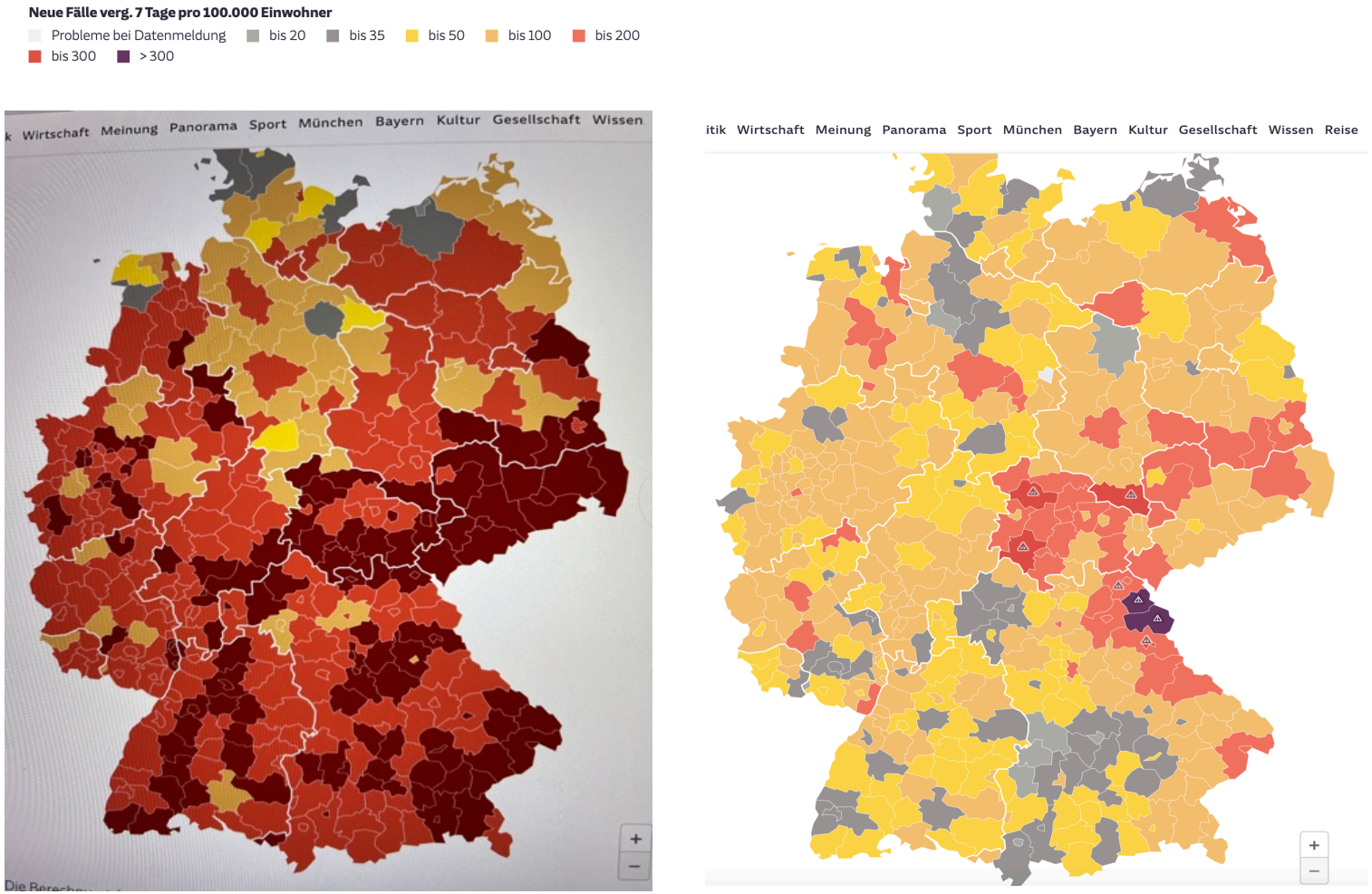
Good conditions can be created in the cockpit and cabin. Built-in HEPA filters have not been sufficiently clarified in terms of their effectiveness on SARS-CoV-2.
However, the tendency to infection could be reduced by increasing the temperature.
Energy for this is sufficiently available. Humidification is technically difficult; tons of water would have to be carried. A lot of drinking must be done.

Continental differences

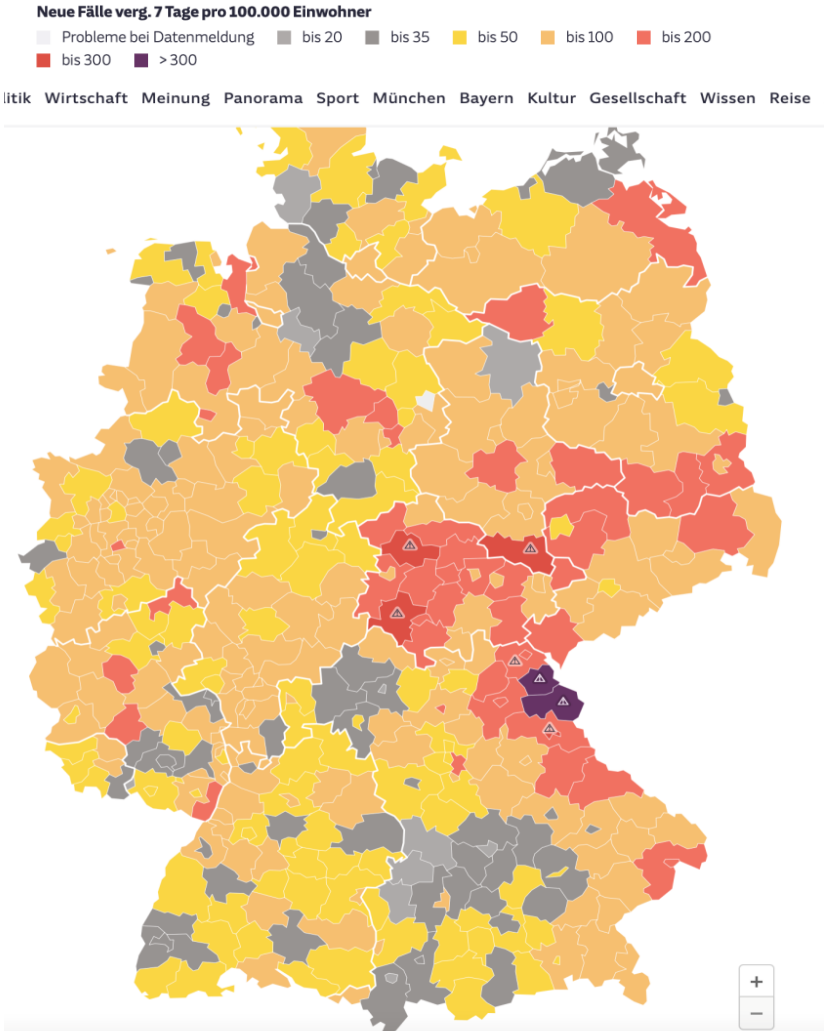
In intercontinental air transport, new thinking is needed under Corona. Temperature differences and associated relative humidities result in different conditions and infection rates for the northern and southern hemispheres.

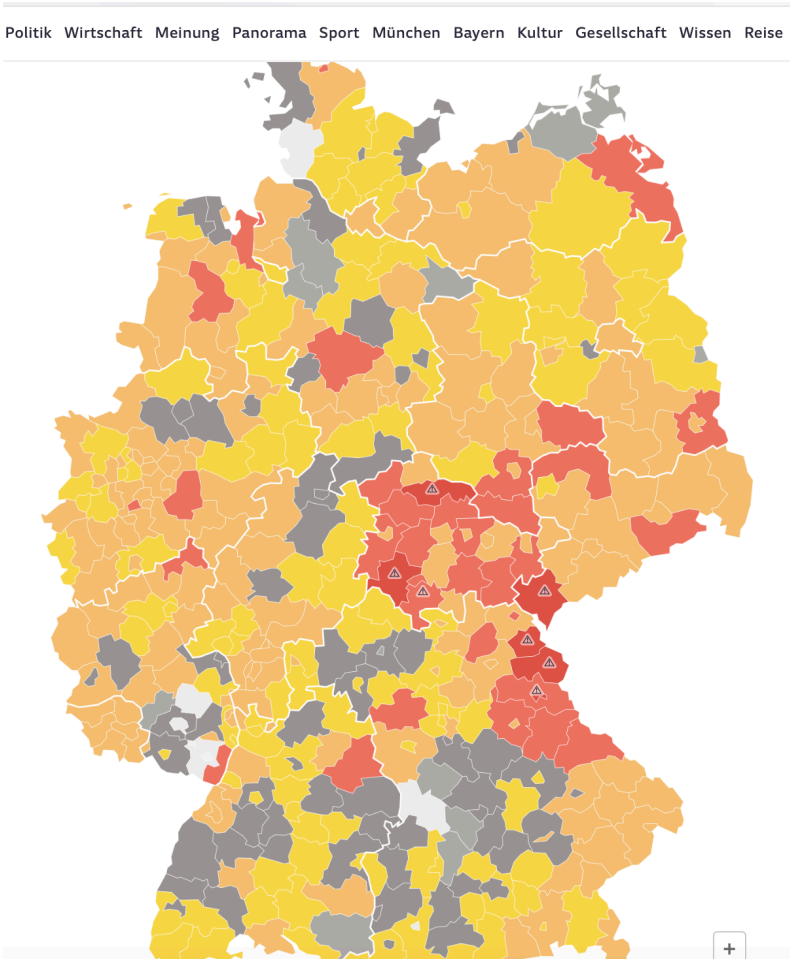
This should be analyzed and considered in a standardized way for long-haul air traffic and for travel. Weather is likely to be one of the determining factors.

To substantiate our working hypothesis, here is a comparison of the new cases at the beginning of our study on 15. Dezember 2020 and today, 22. Februar 2021 (Süddeutsche Zeitung)



Comparison of new cases on February 22 and February 27, 2021(Süddeutsche Zeitung)





Theoretically conceivable consequences of action, if further analyses would scientifically confirm working hypothesis.

These are models of thought based on the evidence to date and make no claim to be realized. However, based on the study results to date, their formulation is justified.

This work should be s food for thought for other disciplines to research in this direction.
Physicians, virologists, aerosol specialists, hygienists and meteorologists could, perhaps with the help of artificial intelligence, develop meaningful models to combat this pandemic.

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March 2021