COVID 19 Worldwide Growth Rates

Updated: 14th March 2020, 23:51 UTC.

This page presents historical SARS-CoV-2 coronavirus infection information. I try to present it in a way that helps inform about how the virus is progressing throughout the main outbreaks worldwide in a way that allows countries to be compared and perhaps lessons learned. The underlying infection and containment processes are complicated, and conclusions you or I may draw from these graphs are not true predictions. For that, you'd need much more data about what is being done in each country, and about how the data is collected. Comments are my interpretation only. Nevertheless, I hope you find it useful.

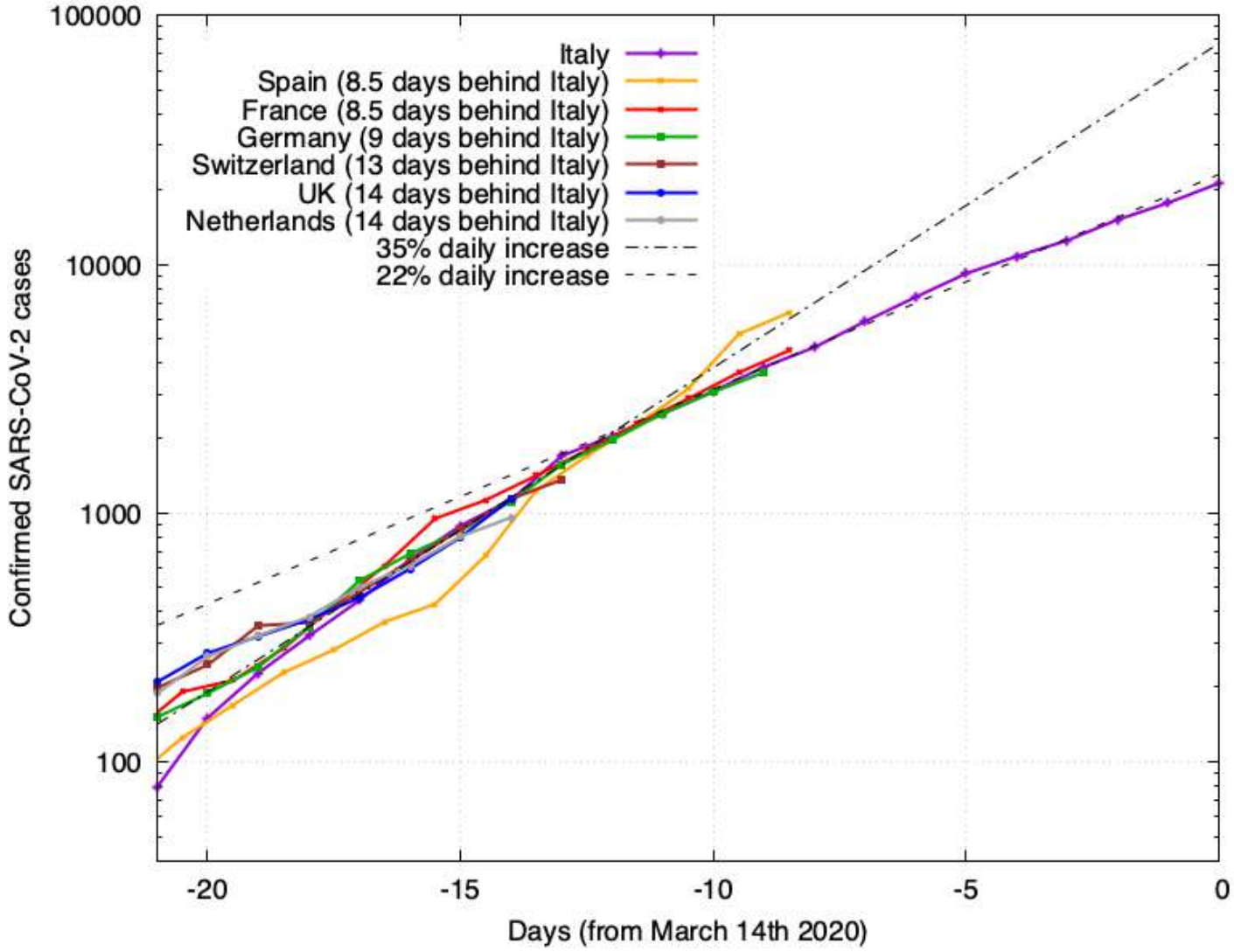
Mark Handley, UCL.

Contents

Some countries are covered in multiple graphs to aid comparison.

Europe

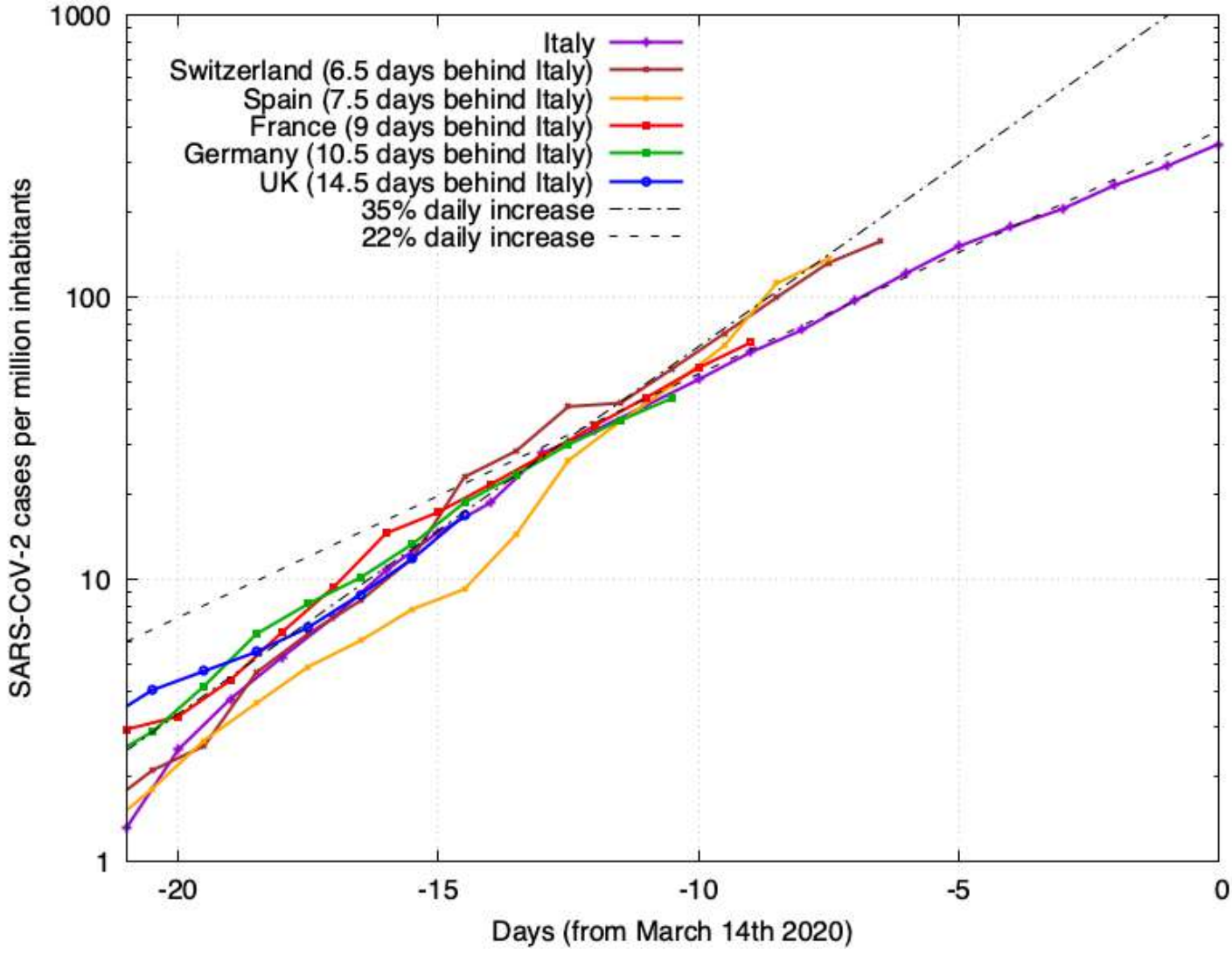
Western Europe, Confirmed Cases



- The graph shows number of confirmed cases, plotted on a log scale, against time. The country curves are shown offset by the amounts shown.
- Italy moved from the original 35% daily increase rate to approximately 22% around March 2nd. Around March 9th, the daily increase reduced to around 20%. This graph corrects a flaw in the official data that was shown previous versions of this graph, where some Milan lab results arrived late. 20% exponential growth is still very high, but slowly isolation measures seem to be helping. More stringent isolation measures taken on March 9th will not yet have had time to affect confirmed cases.
- France and Germany were firmly on a 35% daily increase curve, but for five days (Germany) and eight days (Franch) now have been following Italy onto an increase rate around 22%. This trend is long enough that it likely reflects a real reduction in the underlying increase rate.
- Spain had a large increase yesterday, well above the 35% baseline, but this has not continued today. There's no clear sign yet though that any Spanish limitation measures have worked. It is important to understand though that test results lag new infections by 6-10 days, so recent measures will not yet be reflecting in the data. I have placed the Spanish curve 9 days behind Italy, as this best fits the growth curve, but today's datapoint would place Spain seven days behind Italy.

- Switzerland has been increasing at 35% per day. Today's result was lower, but we cannot yet infer a trend.
- The Netherlands and the UK showed slight decreases early this week, but have since resumed the 35% per day increase. In the UK the dip may have reflected the end of imported cases from Italy during school holidays two weeks previously. The Netherlands showed a lower increase today, whereas the UK increase was slightly higher. Neither result by itself is significant.

Western Europe, Confirmed Cases Per Million Inhabitants

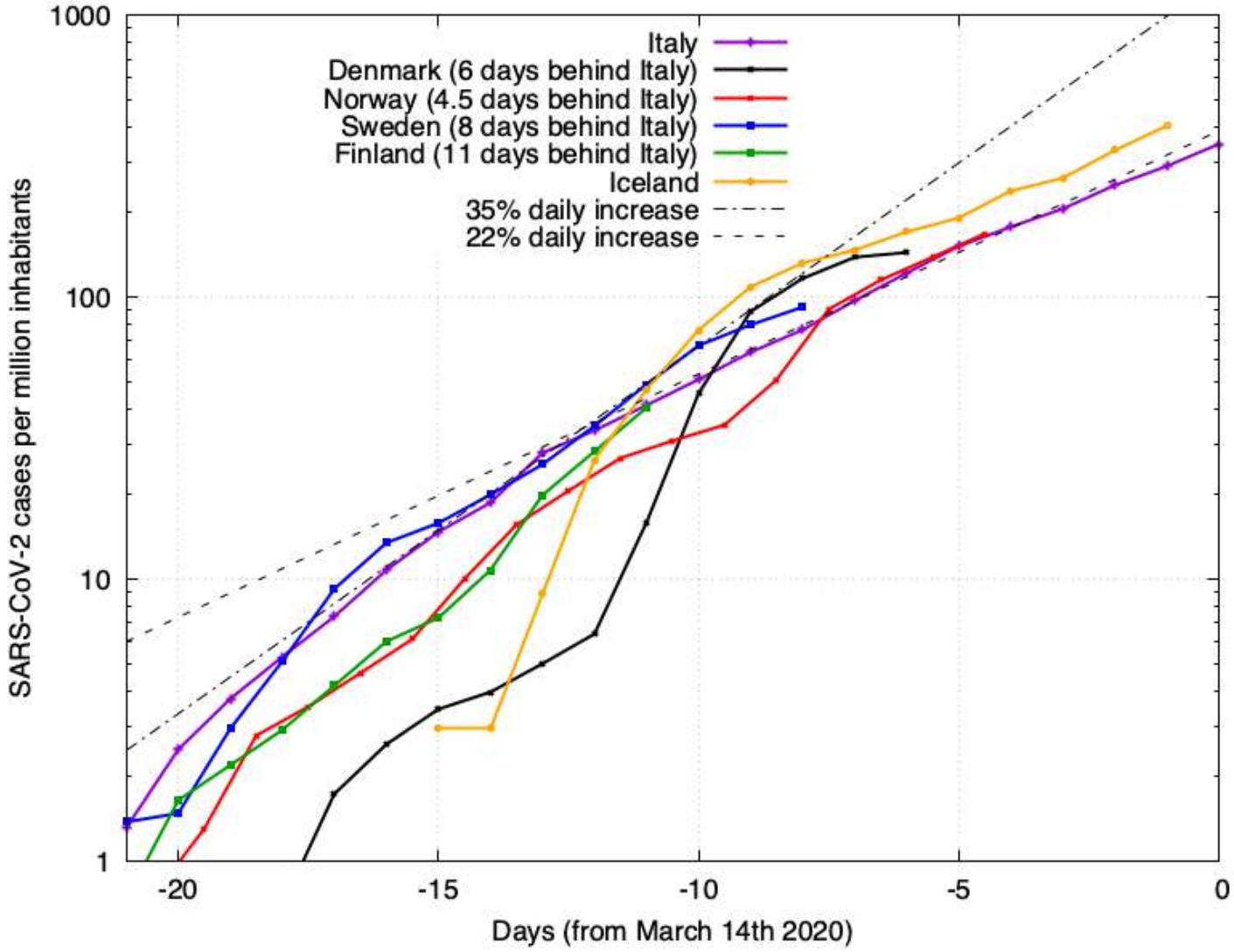


- The graph shows number of confirmed cases per million inhabitants, plotted on a log scale, against time. The country curves are shown offset by the amounts shown.
- Normalizing by population makes little difference for most of the countries shown.
- Switzerland has a relatively small population, and so the number of cases per million inhabitants is much higher. The graph places Switzerland on the 35% line seven days behind Italy, but today's datapoint is closer to 5 days behind Italy as a whole.

Normalized by population, Switzerland follows about 12 days behind Lombardy. Thus there may be a little more time, but only if Swiss cases are not themselves localized.

- Spain is shown 7.5 days behind Italy, as this fits the 35% per day curve best, but today's numbers put Spain five days behind Italy. I'm not sure how best to show both on the same graph now that the curves are diverging.

Scandinavia, Confirmed Cases Per Million Inhabitants

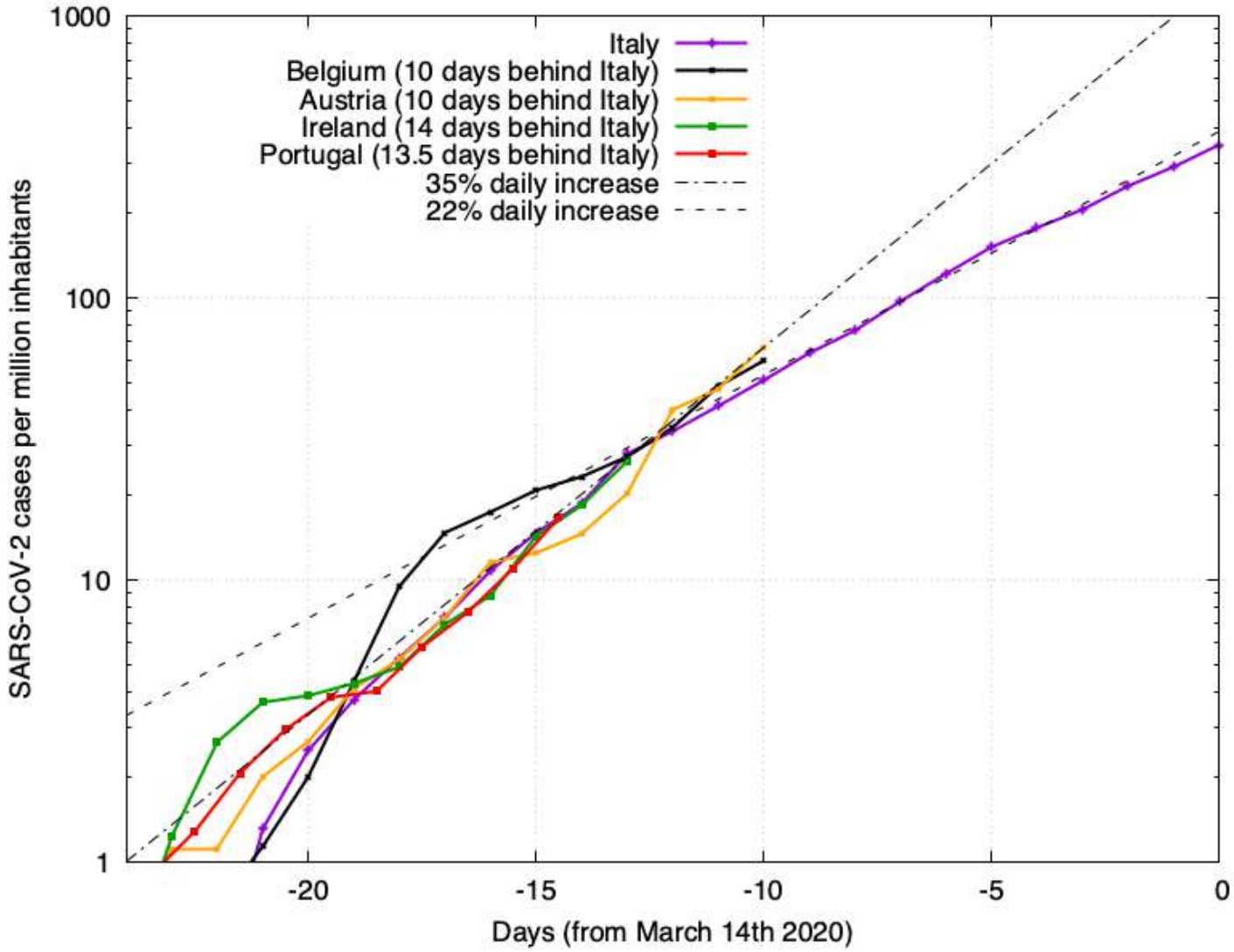


- The graph shows number of confirmed cases per million inhabitants, plotted on a log scale, against time. The country curves are shown offset by the amounts shown.
- Norway was been tracking at roughly 35% daily growth, but the last three days appear to establish a newer trend at around 22%, and follows four days behind Italy, and about ten days behind Lombardy.
- Sweden is very similar, but for now I've left Sweden on the 35% line. The last two datapoints suggest the rate as reduced. Today's datapoint puts Sweden seven days behind Italy.
- Finland has been experiencing a faster increase than 35% for several days. This is unusual, though we have seen it when a country has been catching up on testing

missed cases, or when it is importing a large number of cases from abroad. I said yesterday that It seems likely that this will not be sustained for long. Unfortunately the trend did continue today, so Finland has moved a day closer to Italy.

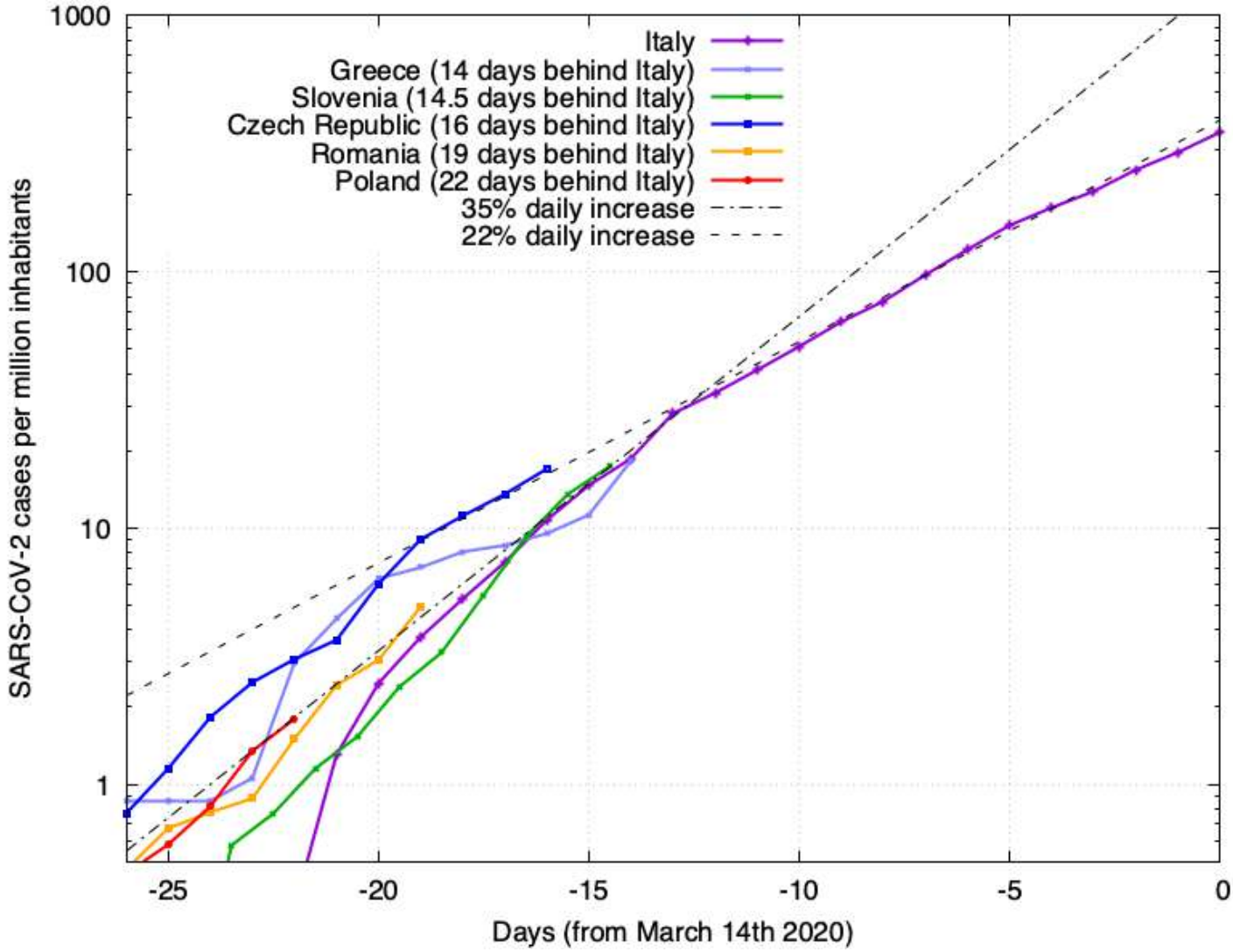
- Iceland suffered a large number of imported cases relative to its very small population. However, since that burst stopped, the increase rate had been lower than any other European country, indicating that measures taken there are helping significantly. The increase is still exponential though. Today's data is not yet available.
- Denmark imported a large burst of cases, particularly from Austria. The rate went from 35% initially, to ~150% daily increase for three days. The trend stabilized back near the 35% per day line, and significant mitigation measures were very rapidly introduced. These will, however, not show in the graph for another 4-7 days. Today's datapoint shows a lower increase rate, but testing policy changed on March 12, so this may not indicate an actual reduction in the underlying increase rate.

Ireland, Austria, Belgium, Confirmed Cases Per Million Inhabitants



- The graph shows number of confirmed cases per million inhabitants, plotted on a log scale, against time. The country curves are shown offset by the amounts shown.
- Austria has been tracking up the 35% per day increase curve for quite some time, though for some reason the data is noisier than neighbouring countries. No obvious signs of mitigation efforts in the data yet.
- The Belgian curve is strange. It seems likely that cases were spreading without being detected and then detection started to catch up. Belgium now seems to be on a similar 22% daily increase curve to Italy, though today's data point is above that.
- The Irish data is somewhat noisy, as the absolute counts are not so high. The general impression is that subject to this noise, Ireland is tracking roughly along the 35% daily increase curve.

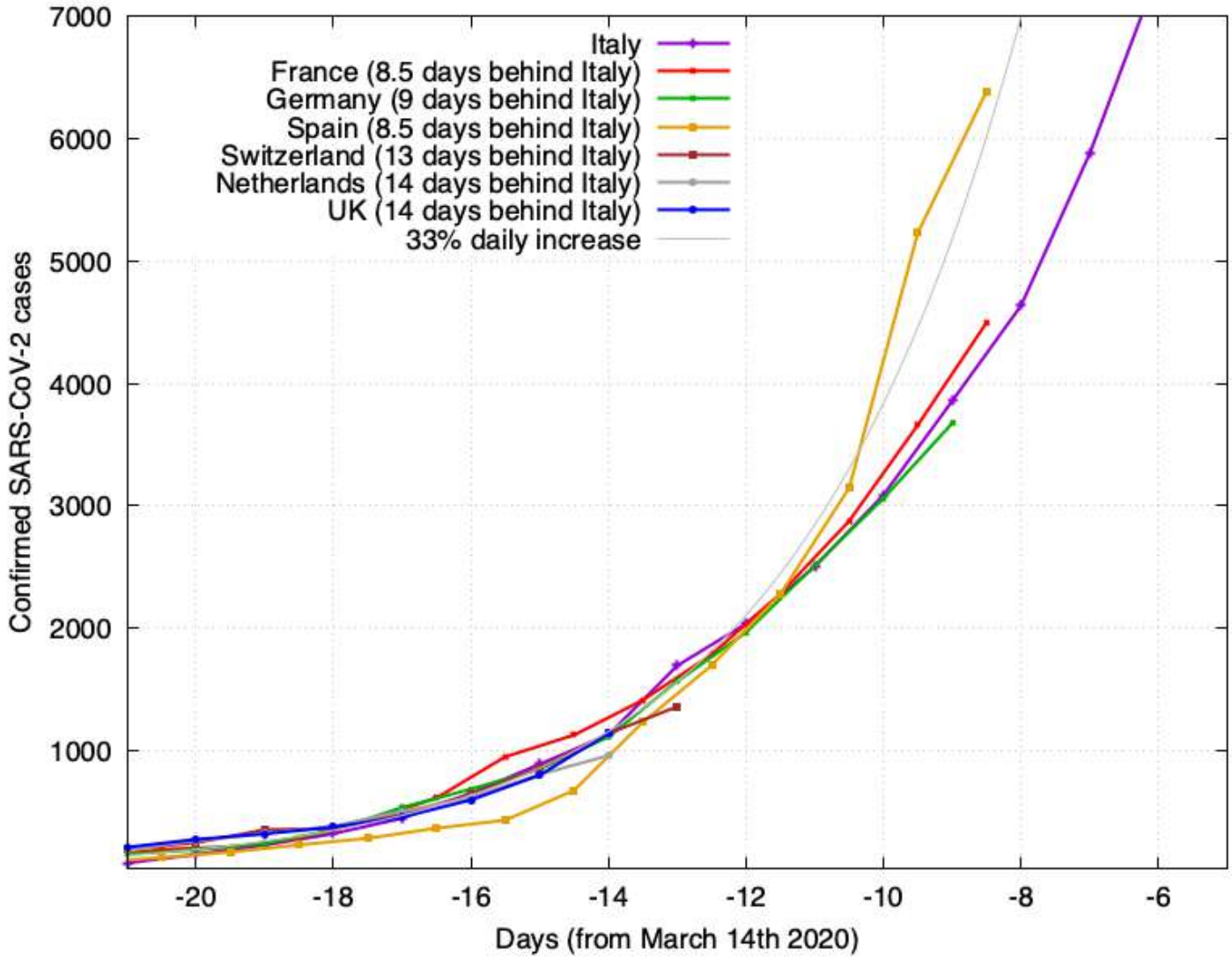
Greece, Poland, Czech Republic, Slovenia, Romania, Confirmed Cases Per Million Inhabitants



- The Greek data is very noisy; it is hard to establish any trend, but it vaguely follows the 35% increase regime over a two week timescale.

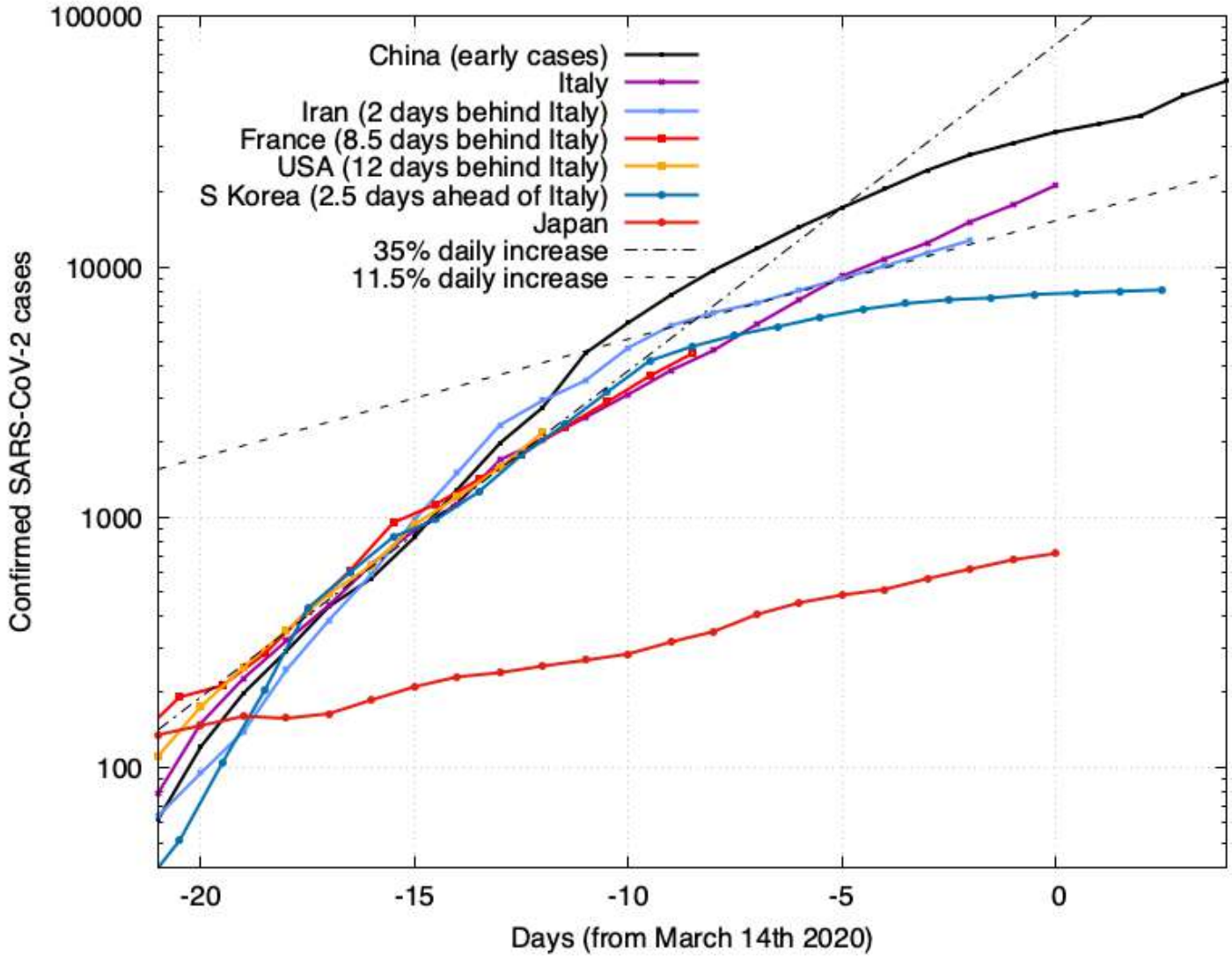
- Slovenia has recently been seeing sustained faster than expected increases. This may be due to importing cases from a neighbour with a higher infection rate. Today's datapoint more closely matches the expected 35% increase.
- The Czech Republic had been following the typical 35% line, but for the last three days appears to have reduced to match the 22% daily increase rate than Italy followed. I've placed The Czech data 16 days behind Italy to match this line, but today's datapoint is 14 days behind Italy.
- Romania has been following the 35% increase rate line fairly consistently, though cases are still relatively low.
- Poland is in the best shape at the moment. Not only are cases per million inhabitants pretty low, but Poland has already taken strong mitigation efforts. I don't expect this to show in the data til around March 19th though; today's increase was right on the 35% line.

Western Europe, Confirmed Cases Per Million Inhabitants, Linear Scale



- The graph shows number of confirmed cases, plotted on a linear scale, against time. The country curves are shown offset by the amounts shown.
- I normally use a log scale on the y-axis because exponential growth gives a straight line on a log-linear graph. This allows exponential growth rates to be compared. However, many readers don't like log-linear graphs, so this one is for them. It has to be truncated, or you cannot see any information. It doesn't really show anything additional over the log graphs, except it looks scarier.

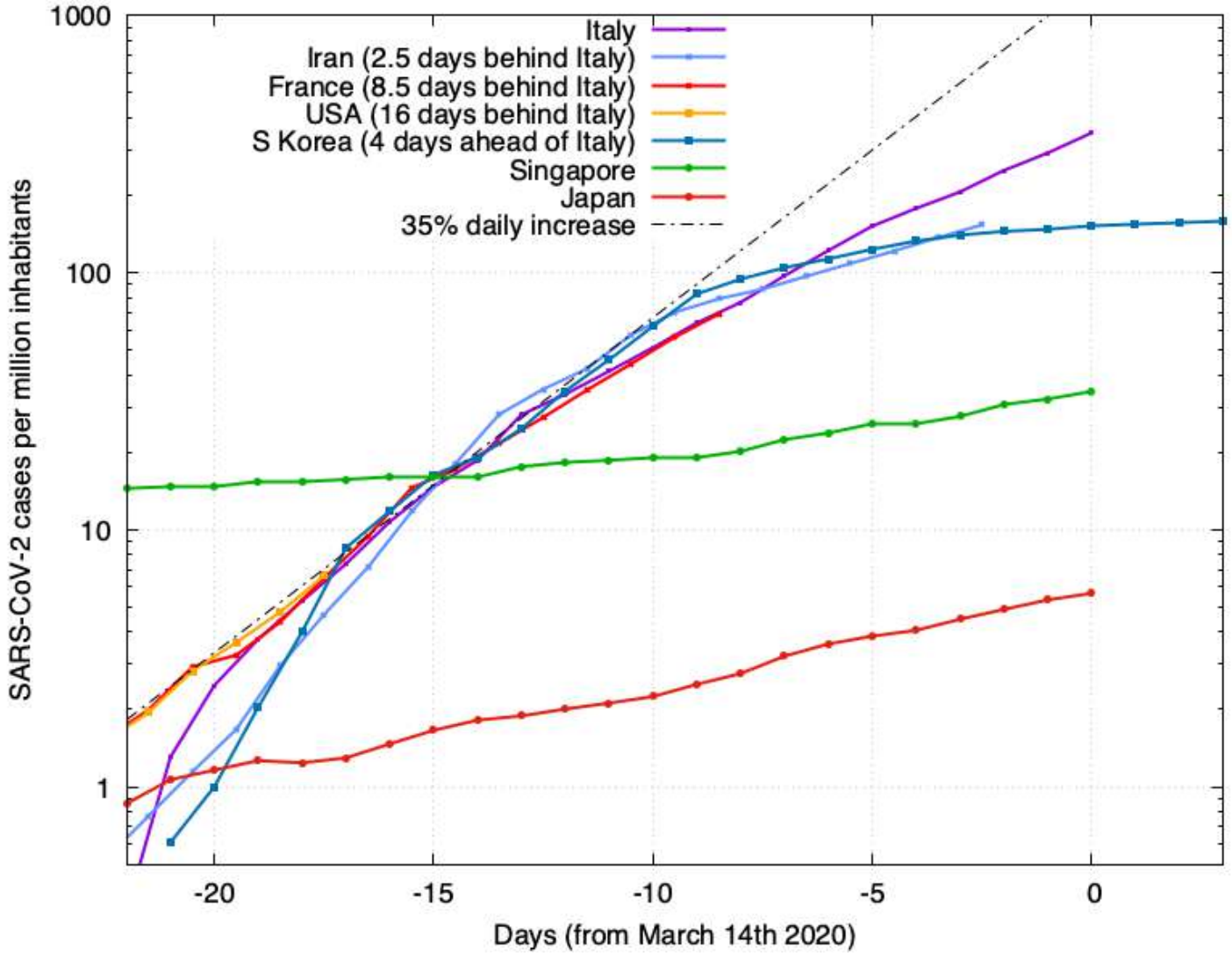
World, Confirmed Cases



- The graph shows number of confirmed cases, plotted on a log scale, against time. The country curves are shown offset by the amounts shown.
- The early part of the China curve is shown for comparison. I'm not sure how accurate the numbers are in the early stage because they didn't initially know what to look for, and the way of measuring changed part way through this period. The initial increase rate is fairly consistent with the 35% daily growth seen in Europe.
- Other than China, South Korea is the only country to have a high sustained increase rate, and then bring the virus under control.

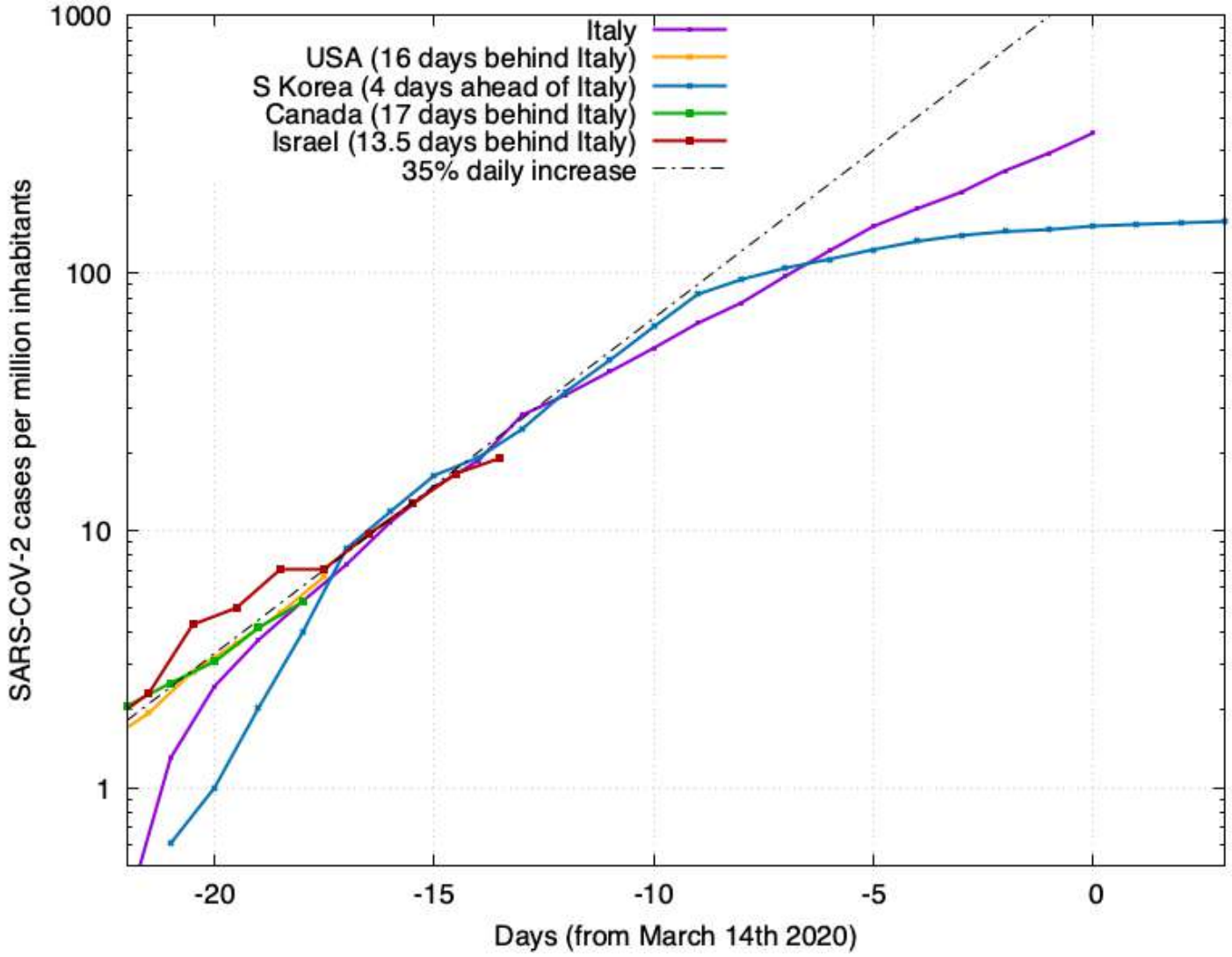
- Iran tracked a little above a 35% increase rate until six days ago. Since then, Iran has experienced consistent 11.5% exponential growth. This is likely to indicate that measures take there have been effective, but exponential grown at 11.5% per day still indicates a doubling of cases every 6 days, as opposed to 2.5 days at 35% daily increase.
- The USA is tracking very closely along the 35% growth line. Testing in the US has been very limited, so the absolute numbers are likely to be undereported compared to other countries. Such under-reporting does not change the inferred daily increase percentage, but it does change the timeline. If the number of actual cases in the US is underreported by, say, 50% compared to Italy, this would move the US 2.5 days closer to Italy.
- Cases in the US are concentrated in a few states, in a similar way to how cases in Italy are concentrated in Lombardy.
- Japan is an enigma. The testing rate there is low, so cases may be being underreported. However consistently missing the same fraction of cases would not affect the exponential growth doubling time, which has been consistent for a long time. It seems more likely that early measures taken there are being effect at reducing the increase rate, but are not sufficient to avoid exponential growth altogether.

World, Confirmed Cases Per Million Inhabitants



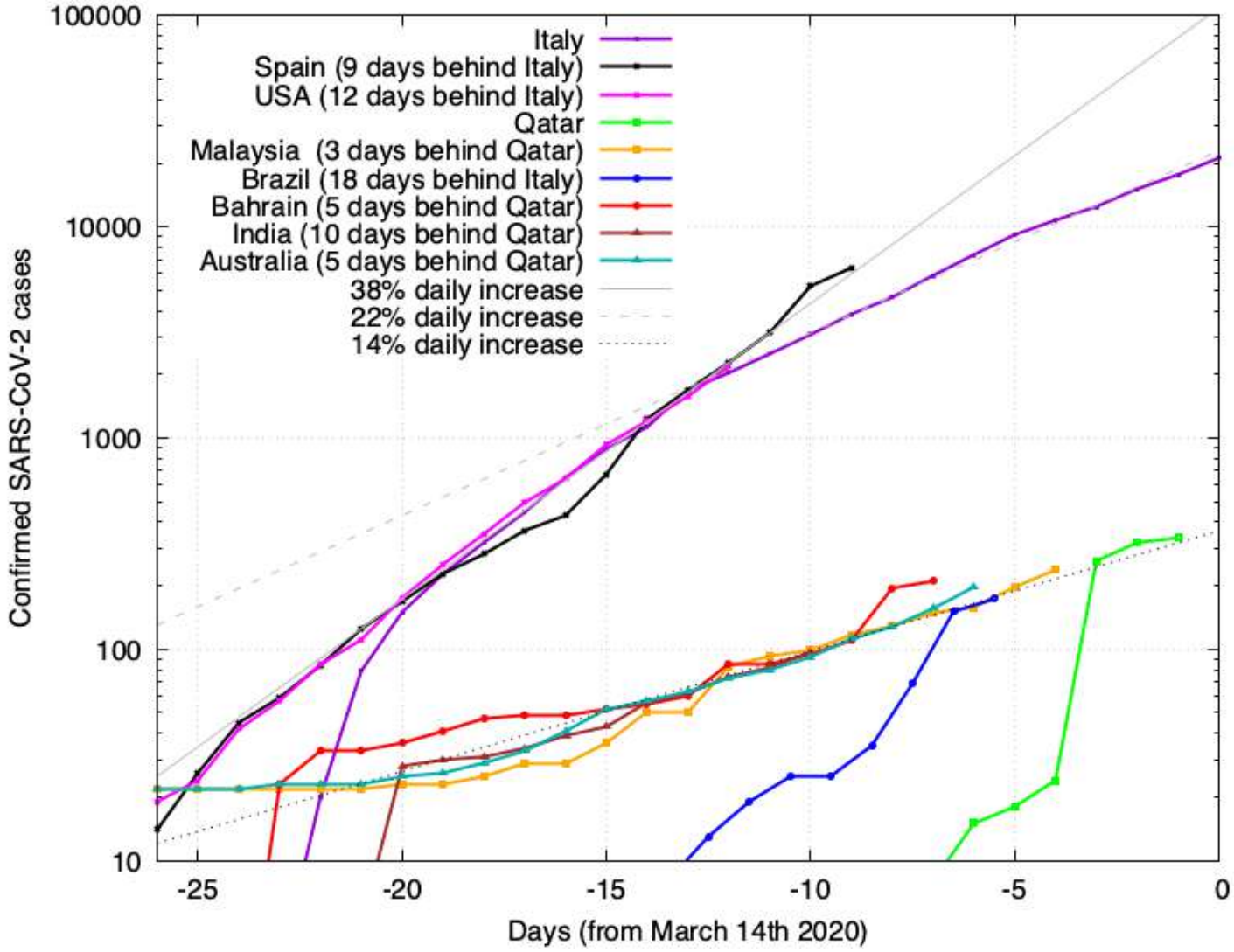
- The graph shows number of confirmed cases per million inhabitants, plotted on a log scale, against time. The country curves are shown offset by the amounts shown.
- Showing cases per million inhabitants does not greatly change the overall picture compared to the previous graph.
- In this view, the US moves a few days further behind Italy. This is probably deceptive, and it might be better to show data for Washington State, for example, on this graph.
- I've added a curve for Singapore, which contained the initial imported cases very well. The graph shows a worrying slow but steady super-exponential growth recently though, perhaps indicating that current measures are starting to not be effective, or that more cases are being imported again.

World, Confirmed Cases Per Million Inhabitants



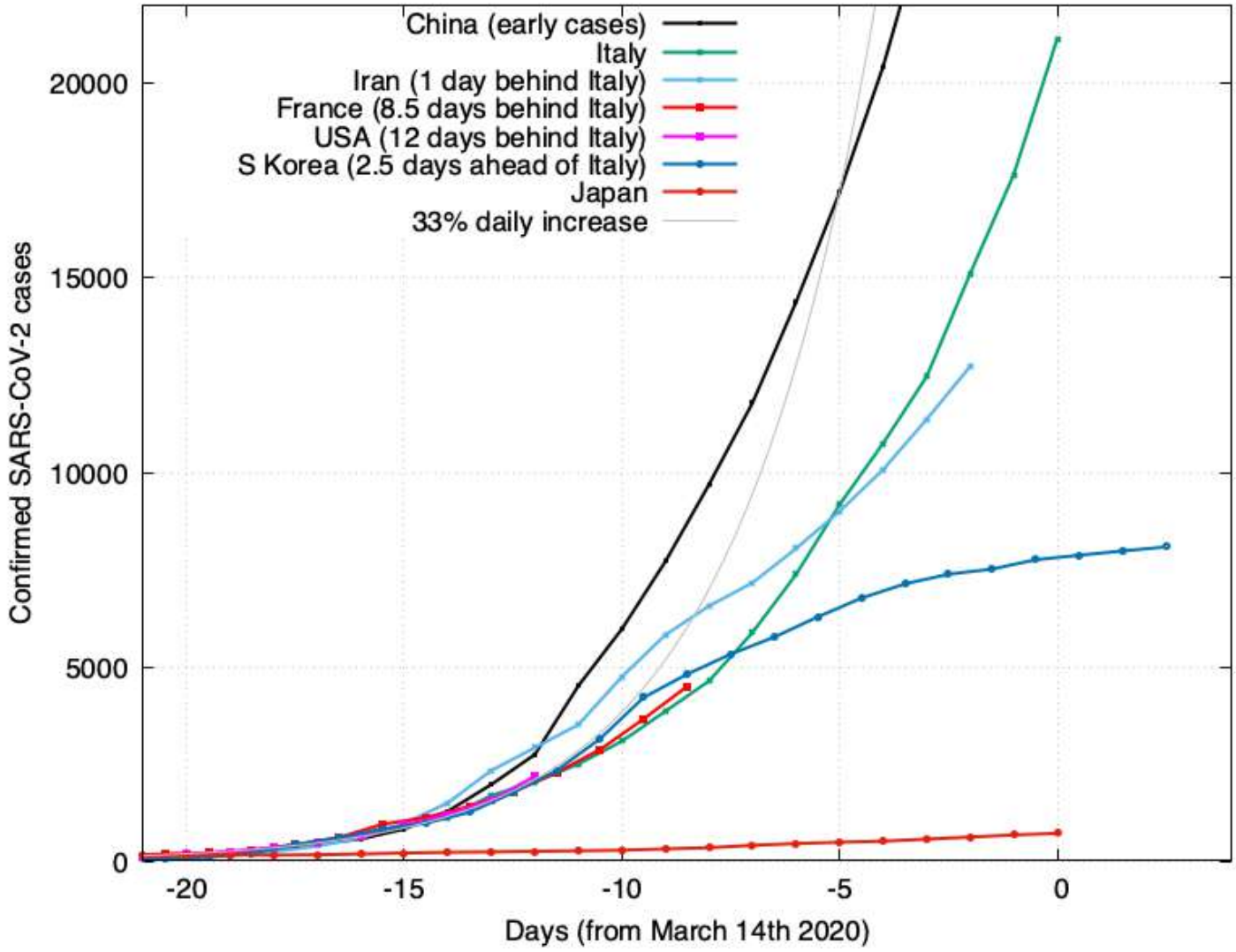
- The graph shows number of confirmed cases per million inhabitants, plotted on a log scale, against time. The country curves are shown offset by the amounts shown.
- Canada and Israel are both tracking along the 35% daily increase curve that most other countries have followed before social isolation measures were introduced.
- It is too early to say if Israel's lower increase today was significant.

World, Confirmed Cases, Warm Countries



- Very few warm countries have enough cases to establish a clear increase rate trend. The graph shows number of confirmed case for some typical "cool" countries and some "warm" ones. During the timescale shown, Spain had experienced cool weather.
- Australia, Malaysia, India and Bahrain are all experiencing about 14% daily growth. It is possible that this is due to their warm climate, but I don't think there's really enough data here to be sure.
- Brazil and Qatar have both recently experenced a very rapid increase in cases. This seems likely to be due to the virus spreading in some communities unnoticed, and testing is now catching up as happened in Italy, or due to a sudden influx of imported cases, as happened in Denmark. Both are showing the first signs of stabilizing, and both appear to be near the 14% increase rate, so I've placed them on this line. This placement is very tentative - it will require several days more data to have any confidence in this.

World, Confirmed Cases, Linear Scale



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Thoughts

While you're sitting pondering your mortality, think how astounding it is that one single viral particle from a bat can replicate so far, so fast, and cause so much trouble! Biology is truly amazing!

FAQ

Q: Where does the data come from?

Where possible, the data comes from the relevant national authorities, as they tend to be more up to date. In some cases I'm using the WHO daily briefing, but they lag the national authorities somewhat. The wikipedia pages contain links to the national authorities.

Q: Can I have your data?

A more complete dataset is the Johns Hopkins one. It tends to lag the national data sources and the WHO, but it is complete and machine readable.

Q: Different countries are testing at different rates. How can you compare the data?

So long as the fraction of actual cases being detected does not change, this does not affect any inference we can make about the growth rate. 35% growth is still 35% growth, whether we measure 100% of the cases or 50%.

If, for example, Italy is detecting 50% of the cases and the US is detecting 25% of cases, this affects any predictions of how far the US is behind Italy At 35% growth, cases double every 2.5 days, so this undersampling would show the US 2.5 days further behind than it really is.

Likely no-one except Korea and Singapore are getting close to 100% of cases. Probably everyone is detecting at least 20% of cases, because those require medical attention. We don't really know what fraction of cases are missed, but the difference in sampling between countries might skew the delays by a few days in either direction.

Q: Comparing with Italy as a whole is flawed. Shouldn't you be comparing with Lombardy?

Perhaps. Certainly cases in Italy are concentrated in the North at the moment. Lombardy is running about 6 days ahead of the rest of the country, as measured by cases per million inhabitants. The problem is that cases in some other countries, notably France, Spain and the USA, are also concentrated, so comparing these entire countries with Lombardy is biased in the other direction. These graphs give a crude indication, but they're never going to be able to track problems down to the local level, where an individual town is overwhelmed by cases before this becomes commonplace in a country. Just remember, to compare with Lombardy, a rough approximation is to move the Italy curve 6 days to the right.

Q: Why didn't you show my country?

A1. Until the number of cases reaches around 100, the data tends to be too noisy to draw conclusions

A2. The graphs are pretty cluttered as it is.

A3. I'll add more as I find time.

Q: You aren't an epidemiologist. Why should I listen to you?

You probably shouldn't. I'm a computer scientist and I've spend decades analysing data, but you should talk to a real epidemiologist if you want to understand the underlying causes. Computer scientists do know a lot about exponential growth though.

Q: I'm a journalist. Will you appear on my TV show?

No. You should have a real epidemiologist on your TV show.

Mark Handley, UCL.