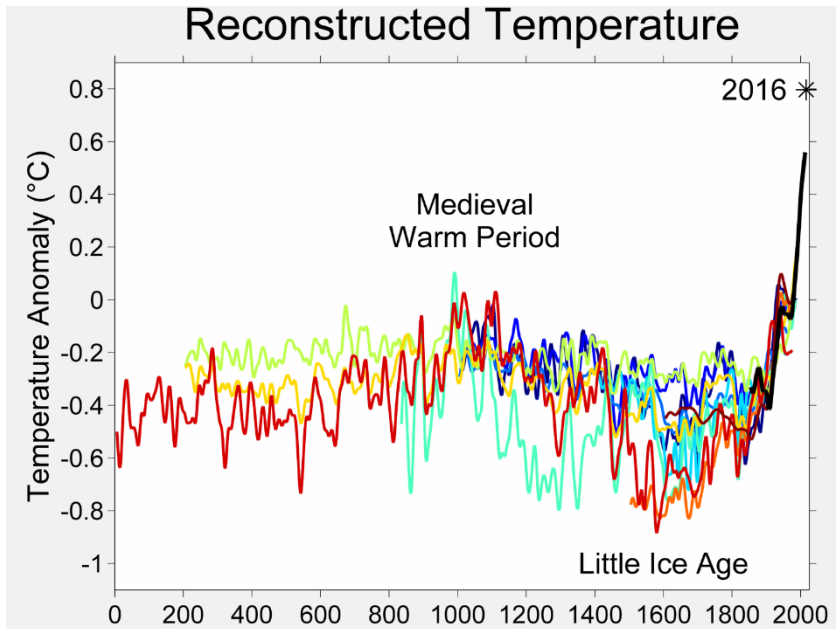


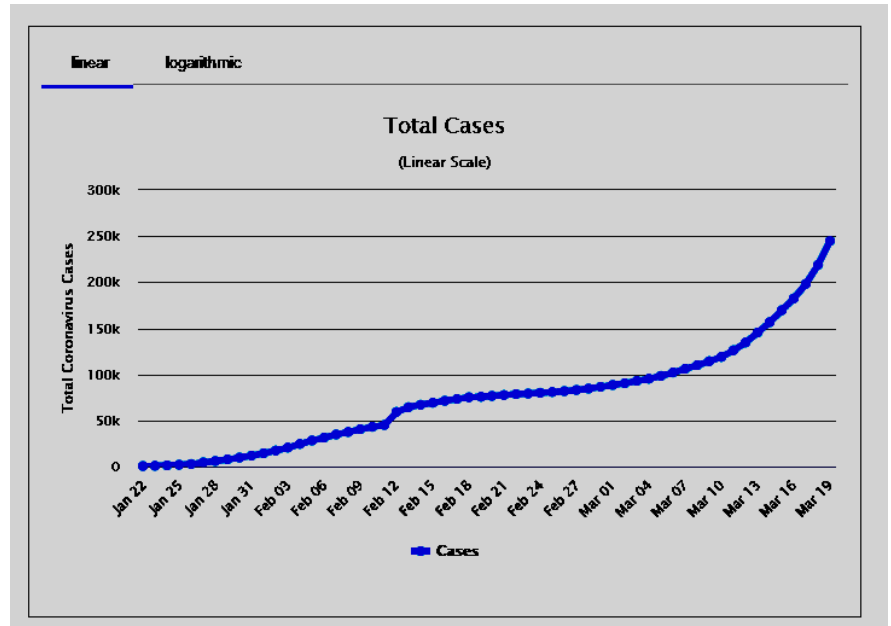
UNCERTAINTY in SCIENCE & LIFE

We will look at this in various ways. Focus on:

- (i) Global Temperatures & Climate Change
- (ii) Coronavirus Escalation



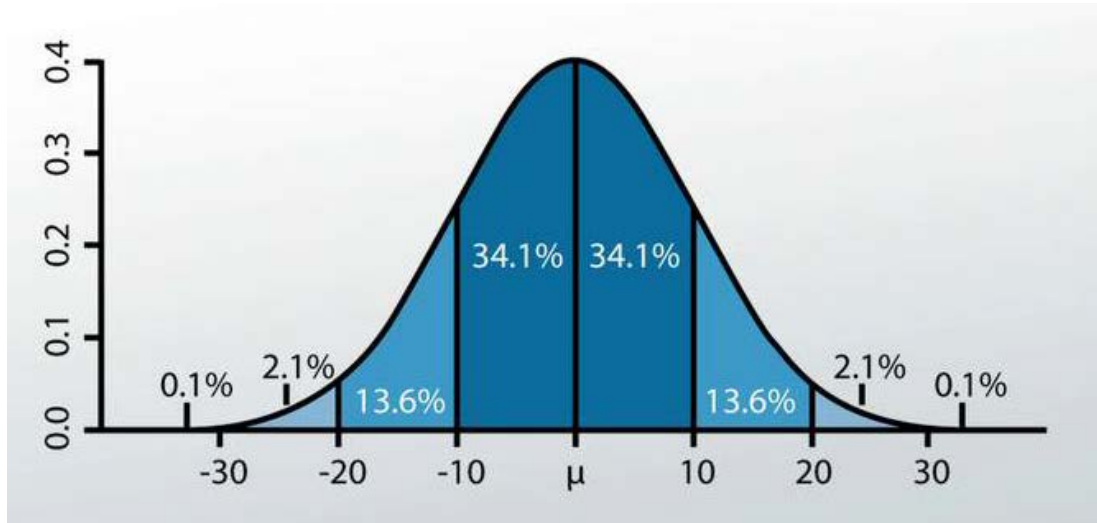
Global T, last 2000 yrs,
Different measures



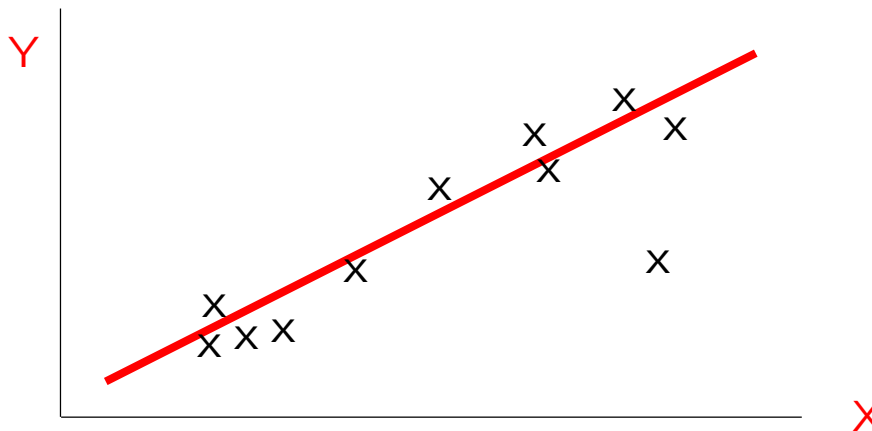
Recorded Coronavirus cases,
from Jan 22, 2020, to Mar 20, 2020

RANDOM ERRORS & "FALSE POSITIVES"

In the videos you have looked at, you saw that we can get "false positives" ; way out on the edge of the Bell curve



Question – how do we know we have a false positive?



Are any of these results false?

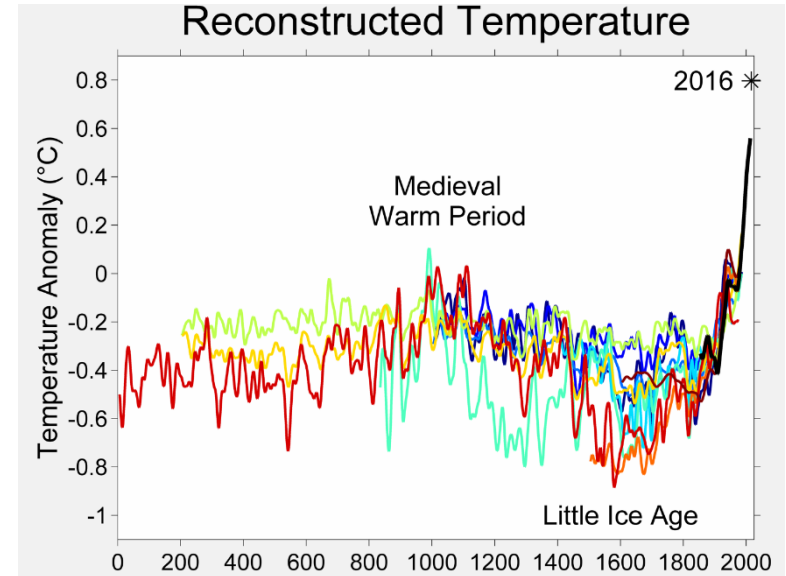
SOME DETAILS ON CLIMATE CHANGE

Temp record for last 2,000 yrs

These different measures include:

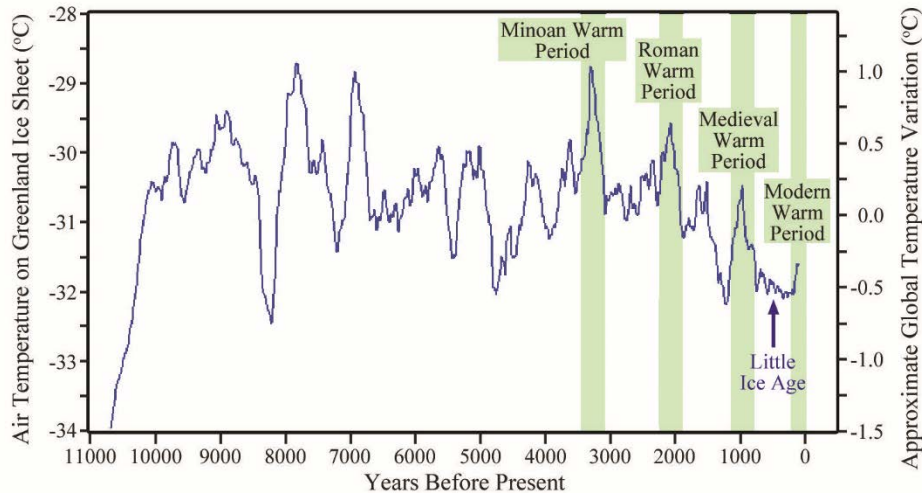
- Tree rings
- Ice cores
- Lake sediments
- Corals

Note they are GLOBAL AVERAGES

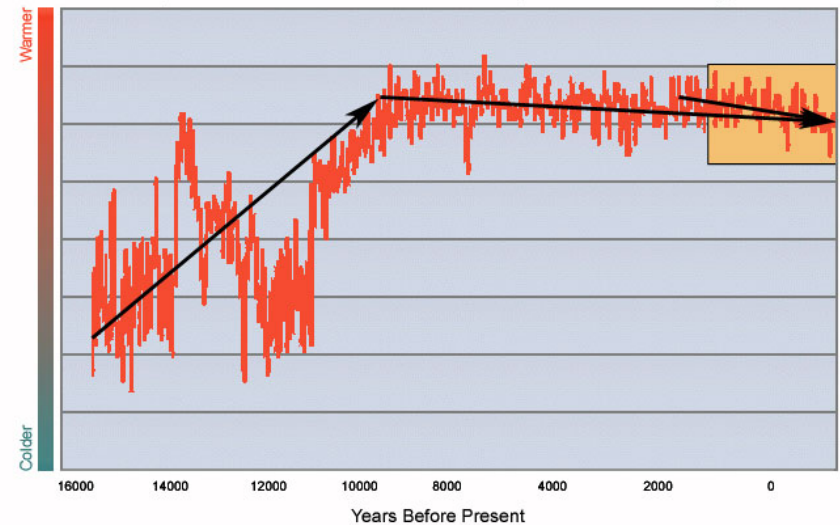


Temp record for last 16,000 yrs

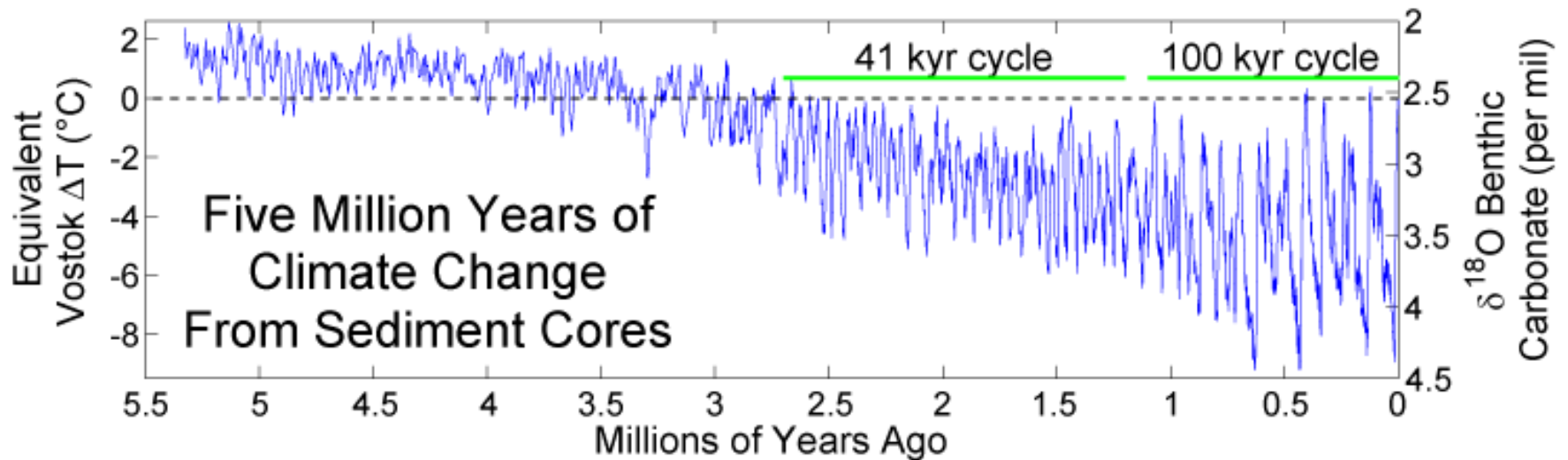
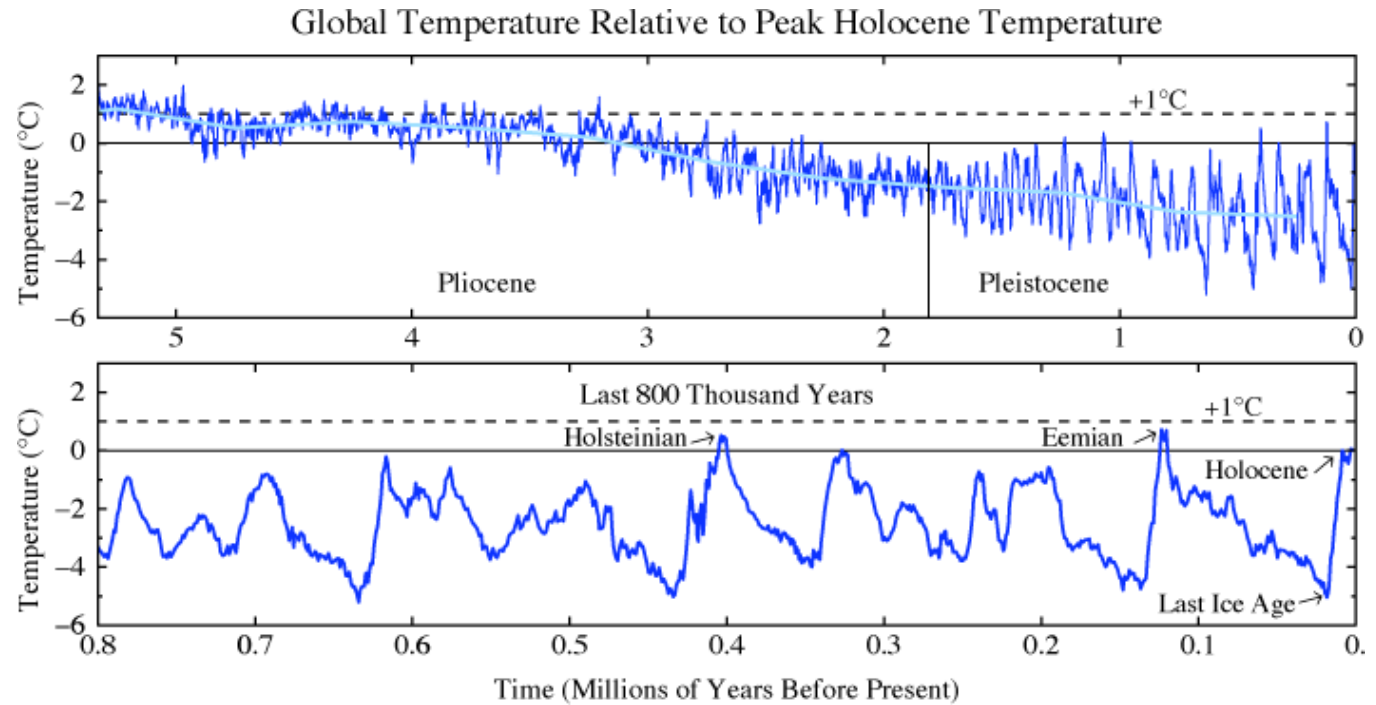
Global Temperature Variation Over the Last 10,000 Years



16,000 Years of Global Temperature Change

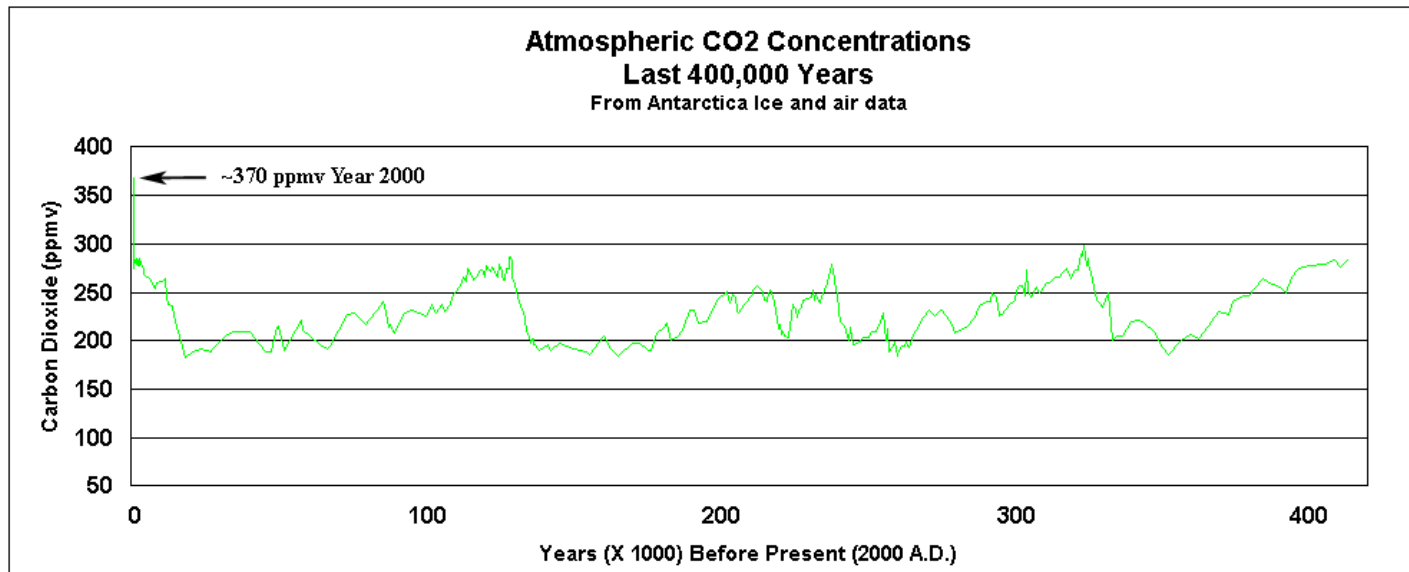
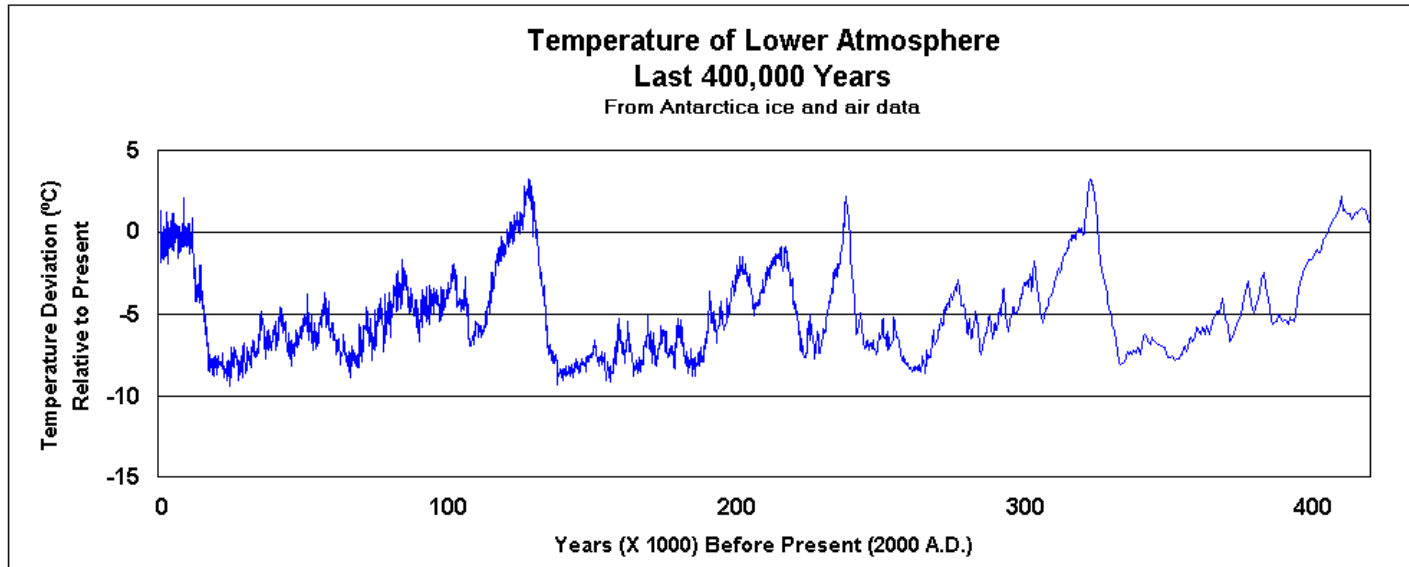


Temp record for last 5 million yrs



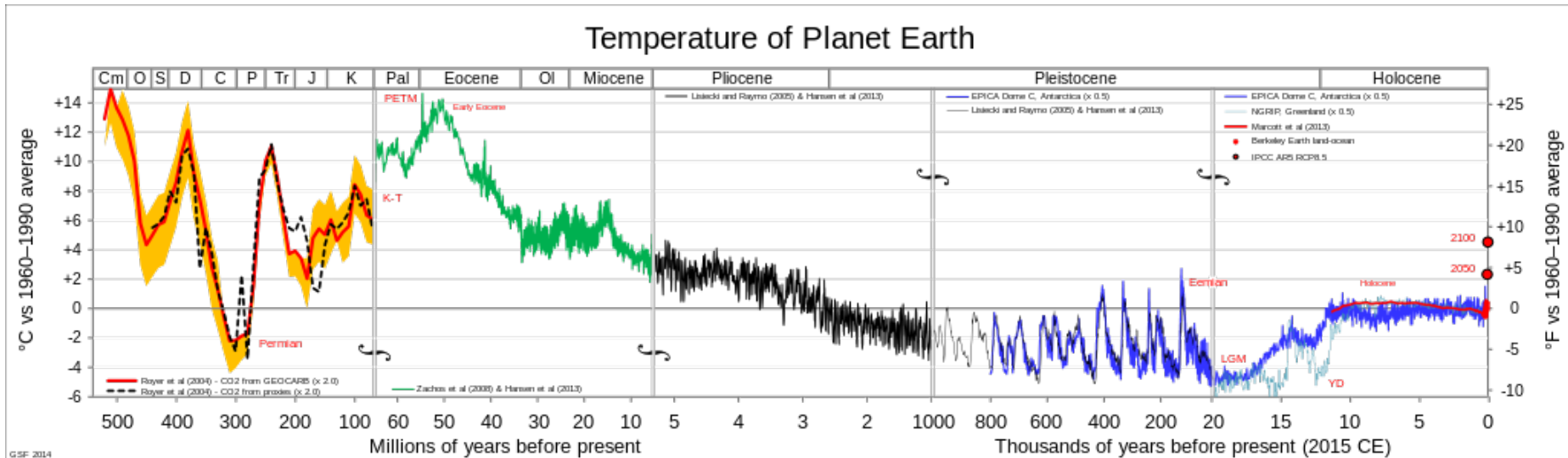
CORRELATION between T & CO₂ LEVELS

We show this over a 400,000 yr period



TEMPERATURE RECORD OVER THE LAST 550 MILLION YRS

You need to look carefully at this plot



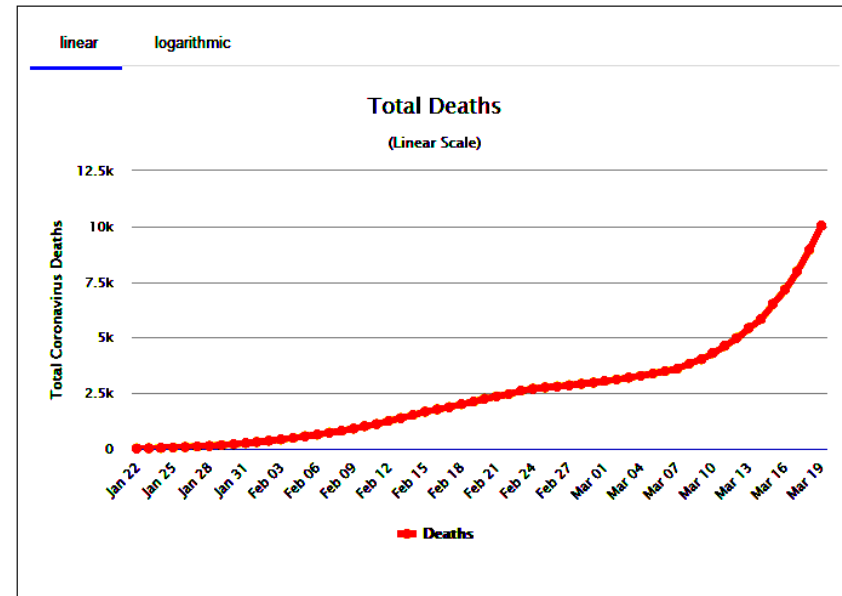
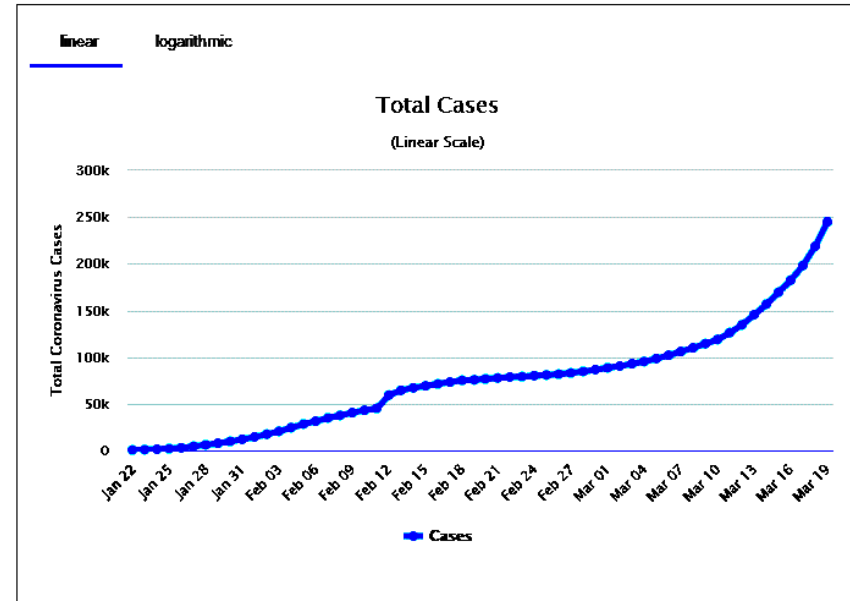
Questions you should ask yourself:

- Is this the best way to be plotting this data?
- How else could you plot it?
- What are the errors in this data (random or systematic)?
- What are the uncertainties in the data and where do they come from?
- Most important - WHAT DO WE LEARN FROM THIS DATA?
- Also important - HOW DO WE CORRELATE IT WITH OTHER DATA

DATA on CORONAVIRUS OUTBREAK (COVID-19)

These plots seem straightforward, so we can ask:

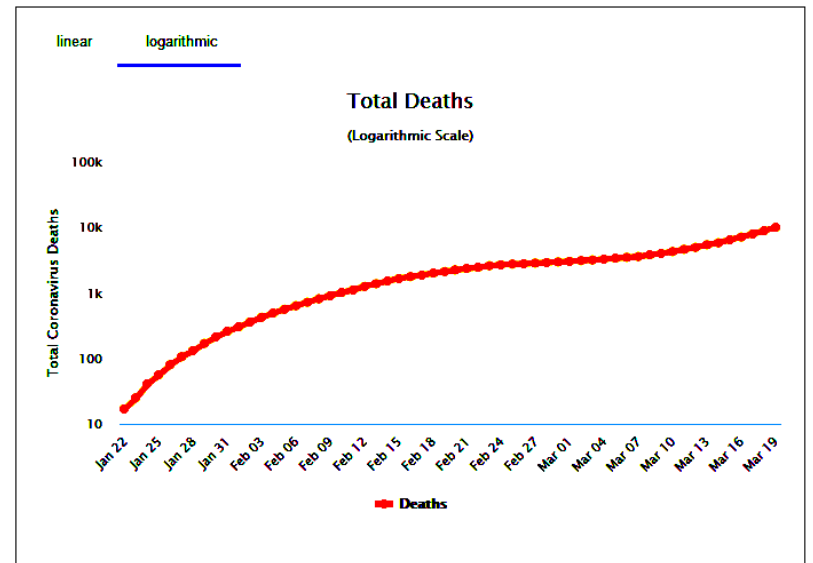
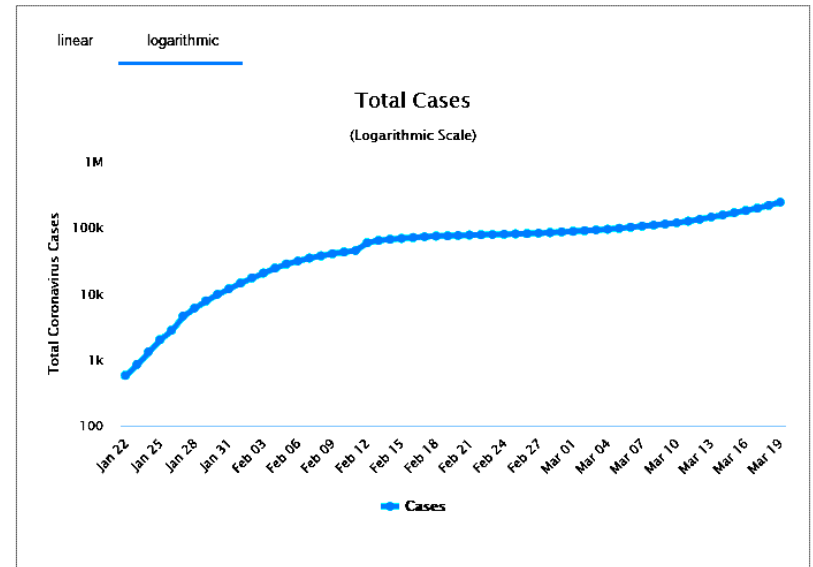
- What does each one tell us?
- How are they correlated with each other?
- What kinds of error are involved in getting this data?
- How do we think they will extrapolate into the future (what factors control this, & how uncertain are they)?



Now let us replot the data as LOG-LINEAR PLOTS

Let's ask the same questions again....

- What does each one tell us?
- How are they correlated with each other?
- What kinds of error are involved in getting this data?
- How do we think they will extrapolate into the future (what factors control this, & how uncertain are they)?



SUMMARY

As we know already, there are lots of errors in data collection, & these may be random or systematic

If we try to compile data using different measures of the same quantity, we often see both random and systematic differences between these (cf climate change data)

When we have many factors playing a role in the final results, there will often be large fluctuations that look like random errors but are possibly real (cf climate change data)

It is REALLY IMPORTANT to replot data in different ways, to look for hidden features and even hidden patterns (such as the existence of multiply-periodic oscillations in climate data, and the existence of various exponential rates in COVID-19 data).