The climate on Earth – do we really understand it?

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It is well-known that the climate on Earth has undergone big changes during geological times. These can be reasonably well reconstructed from a variety of geological archives which carry time series of proxies (e.g. stable- and radio-isotope ratios, trace gases) that are sensitive to the respective climatic conditions. Useful archives are for example cores from lake and ocean floor sediments, glacial and polar ice sheets, and loess deposits. Also tree rings, glacial moraines, cave deposits (speleothems), ground water and ocean currents, etc., provide signatures of past climatic conditions.

Some basic phenomena are reasonably well understood, such as the coming and going of the ice ages which are mainly due to the variation of Earth's orbital parameters and its concomitant variations of solar insulation on Earth. This theory was developed by Milutin Milankovich during the first half of the 20th century and was confirmed by measurements of the above mentioned proxies in several geological archives (Hays et al. 1976, EPICA Community Members, 2004). Another phenomenon which is well recognized is the heat transport by global ocean currents (Broecker 1991).

However, all this information stems essentially from times when human influence was absent. Today, we are clearly interested to understand how human's presence influences the climate on Earth. But since it is the first time that humans can make an impact on climate changes, we are faced with the problem to disentangle its influence from natural variations. And here we encounter a polarization of opinions rarely seen before. The reason is that besides the science of climate change – with all its recognized uncertainties (Koonin 2024) – there are strong economic and political issues at stake. This makes it particularly difficult to evaluate the scientific background and to predict what will happen in the near future.

The majority of climate scientists support the conclusion of the IPCC (Intergovernmental Panel on Climate Change) that man-made emission of greenhouse gases, particularly CO_2 from combustion of fossil-fuel, causes the increase of the Earth`s surface temperature. This goes back to some early prediction more than 100 year ago (Arrhenius 1896). Opposed to this view is a collection of scientists from different fields, who strongly believe that natural causes - and not humans – are the main drivers of the climate changes we observe today. A particularly prominent figure is John Clauser, a Nobel Laureate in Physics of 2022, who claims that water vapor far outpaces the influence of CO_2 on climate, which he calls the 'cloud thermostat'.

In this presentation, I will try to present a "balanced" view of how much we understand about the complex interplay of human-induced and natural climate changes.

References

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