UNESCO Category II Centre on Integrated and Multidisciplinary Water Resources Management, Thessaloniki, Greece

From the Myths of Hercules to the reality of climate change (26-27 November 2020)

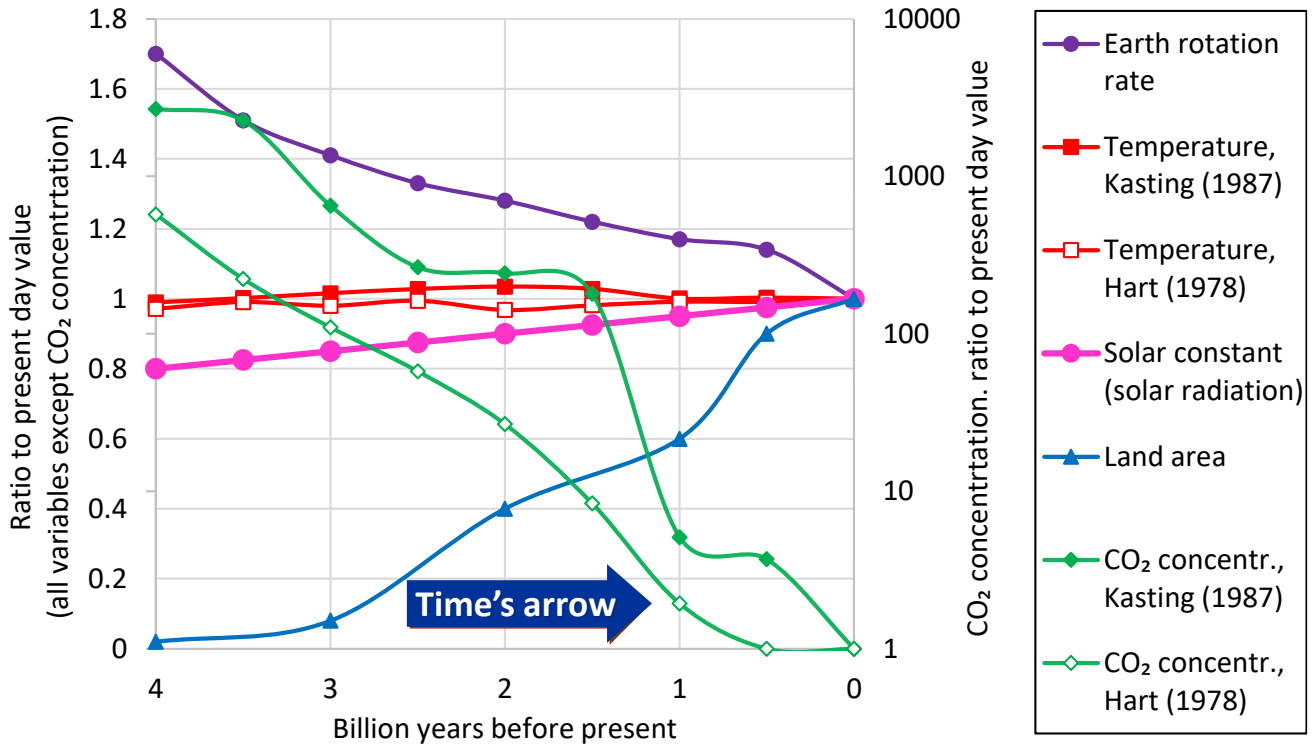
Ancient climate and the modern myth of climate crisis

Demetris Koutsoyiannis
Department of Water Resources and Environmental Engineering
School of Civil Engineering, National Technical University of Athens
(dk@ntua.gr, http://itia.ntua.gr/dk/)

Available online: http://www.itia.ntua.gr/2076/

Part 1
Ancient climate

The reality of climate change is not recent
Climate has been changing for 4.5 billion years



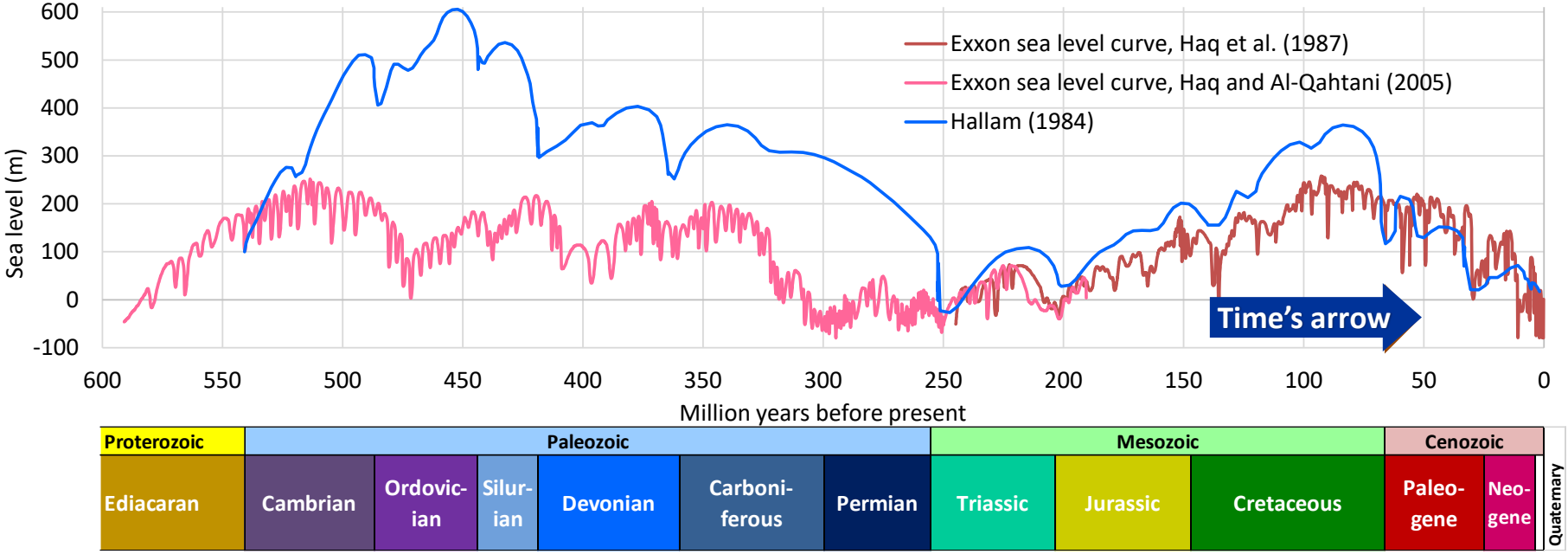
The graph has been constructed from estimates by Kuhn et al. (1989). Temperature is expressed in K and corresponds to 35° latitude; a change in the temperature ratio by 0.01 corresponds to ~2.9 K.

Although the estimates are dated and uncertain, evidence shows existence of liquid water on Earth even in the early period, when the solar activity was smaller by 20-25%. This is known as the faint young Sun problem (Feulner, 2012).

"***Πάντα ρεῖ***" (*Everything flows*): Heraclitus, quoted in Plato's Cratylus, 339-340

"***Μεταβάλλει τῷ χρόνῳ πάντα***" (*Everything changes in course of time*), Aristotle, Meteorologica, I.14, 353a 16

Sea level during the Phanerozoic



Phanerozoic = Paleozoic + Mesozoic + Cenozoic. High sea level suggests high temperature.

Digitized data sources:

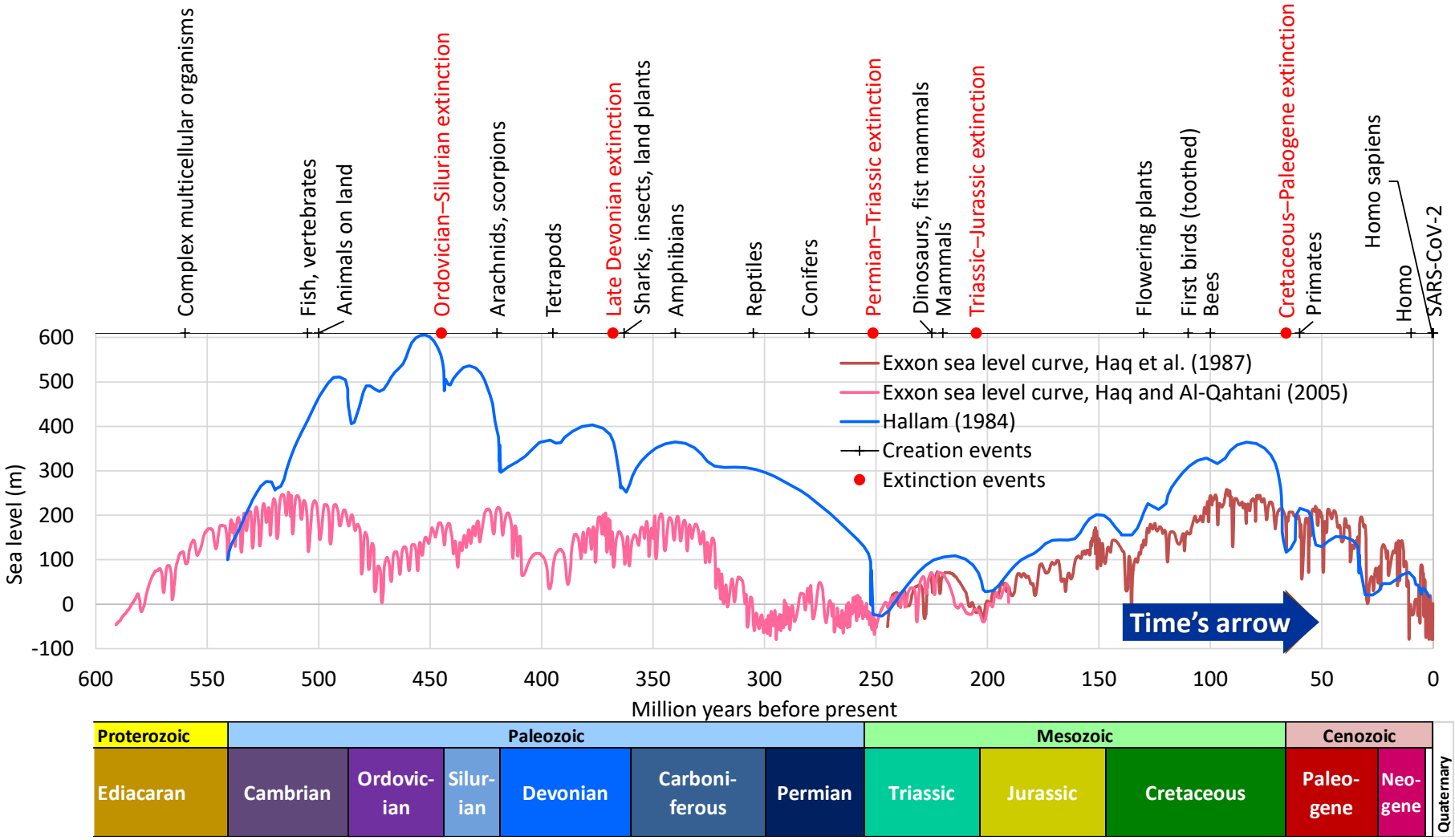
For Haq et al. (1987): https://figshare.com/articles/Haq_sea_level_curve/1005016.

For Haq and Al-Qahtani (2005): https://web.archive.org/web/20080720140054/http://hydro.geosc.psu.edu/Sed_html/exxon.sea; Note though that it has discrepancies from the graph in Miller et al. (2005).

For Hallam (1984), data were digitized in this study using chronologies of geologic eras from the International Commission on Stratigraphy, https://stratigraphy.org/chart.

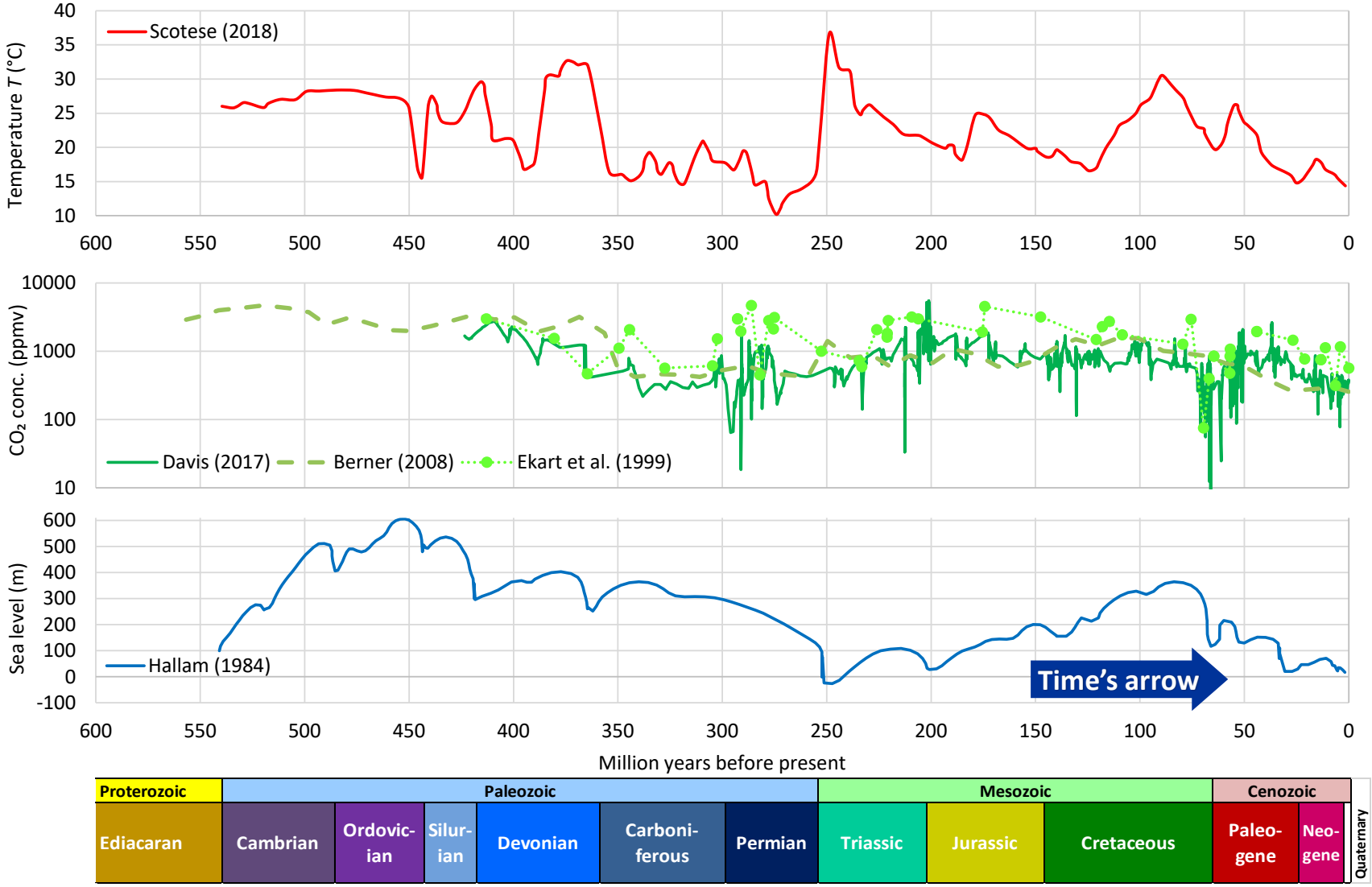
For other reconstructions see van der Meer (2017).

Life evolution and sea level during the Phanerozoic

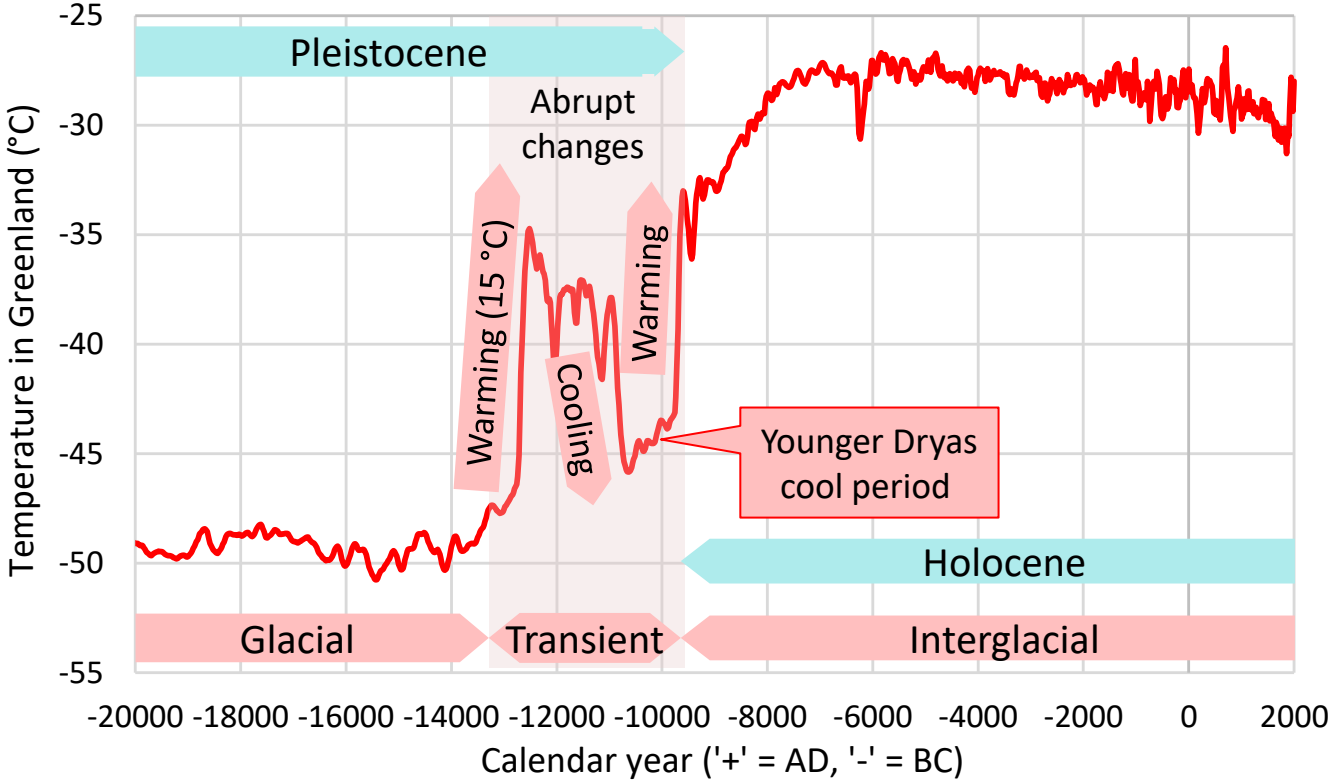


- Q: When did extinction happen? On temperature rise or fall?

Co-evolution of temperature, CO_2 concentration and sea level in the Phanerozoic



Focus on the last deglaciation: temperature



Experimental drilling on the Greenland Ice Cap in 2005, https://earthobservatory.nasa.gov/features/Paleoclimatology_IceCores

Noticeable facts:

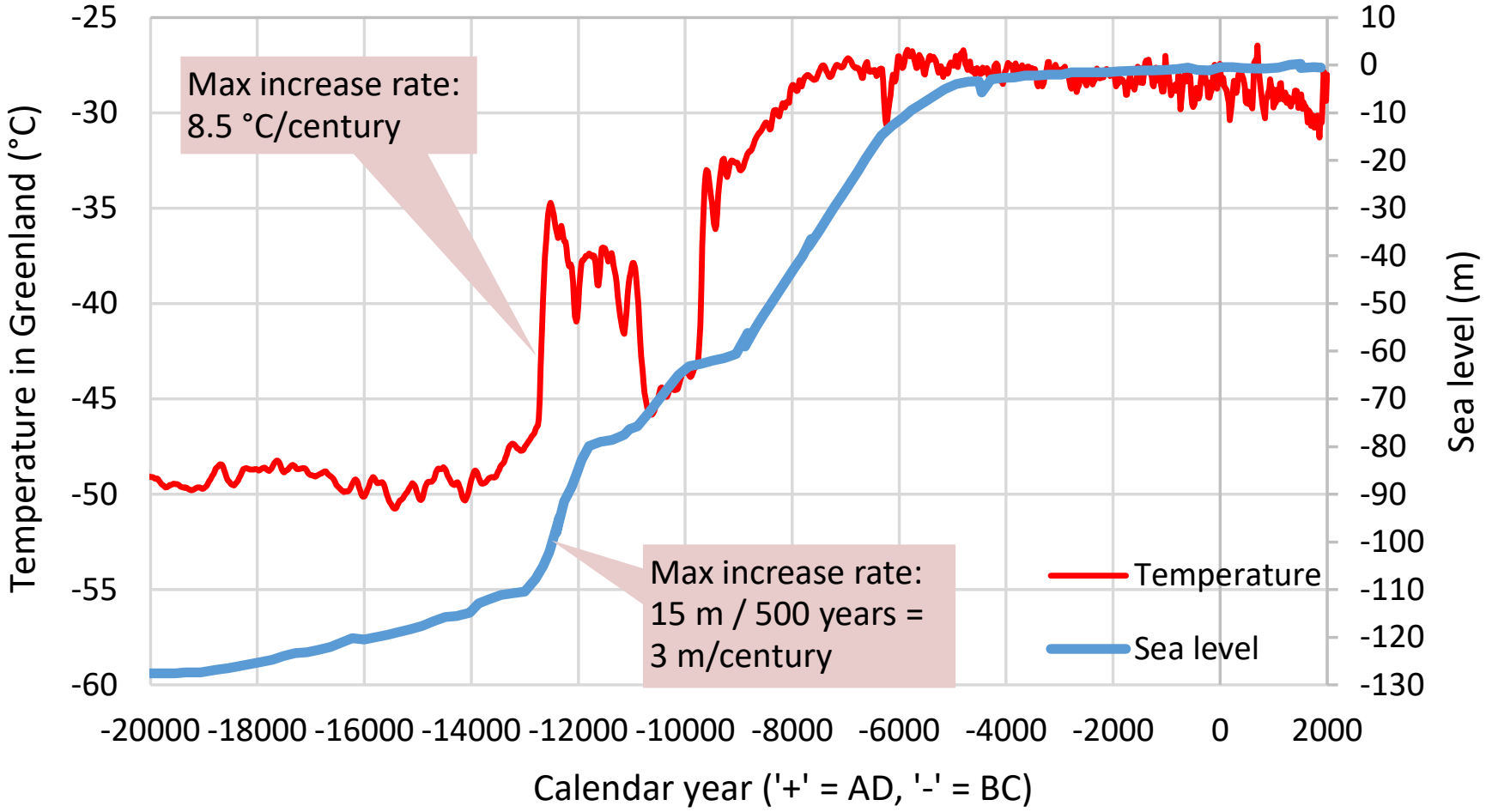
(1) The difference of the interglacial from glacial temperature is > 20 °C.

(2) In periods of temperature increase, the maximum rate of change has been 8.5 °C/cent.

(3) In periods of decrease, the maximum rate has been -4.3 °C/century.

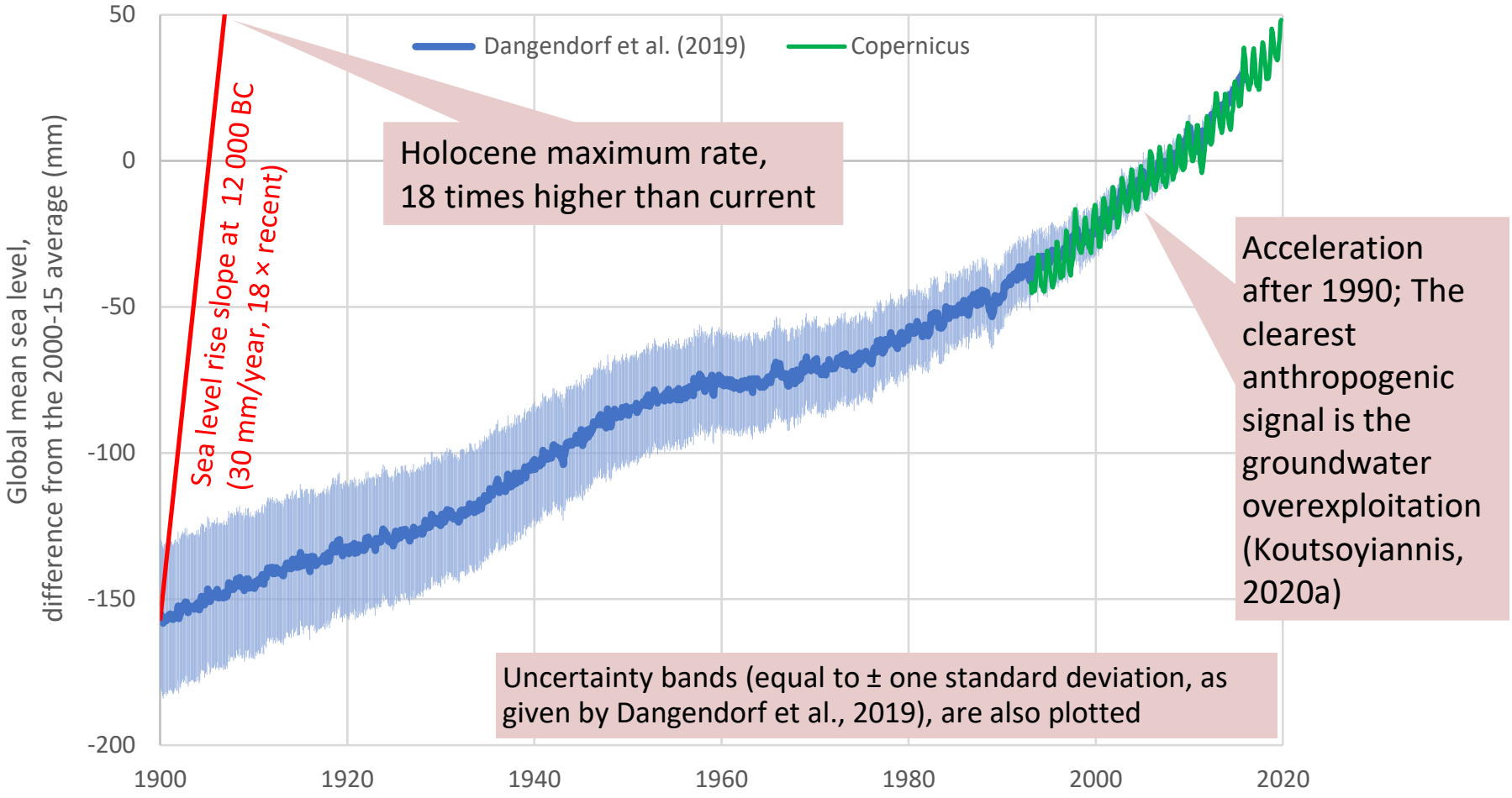
Data: Temperature reconstruction from Greenland ice cores; averages from GISP2, NGRIP and NEEM Ice Drilling locations as given by Buizert et al. (2018) for a 20-year time step (available from https://www.ncdc.noaa.gov/paleo-search/study/23430).

Focus on the last deglaciation: coevolution of temperature and sea level



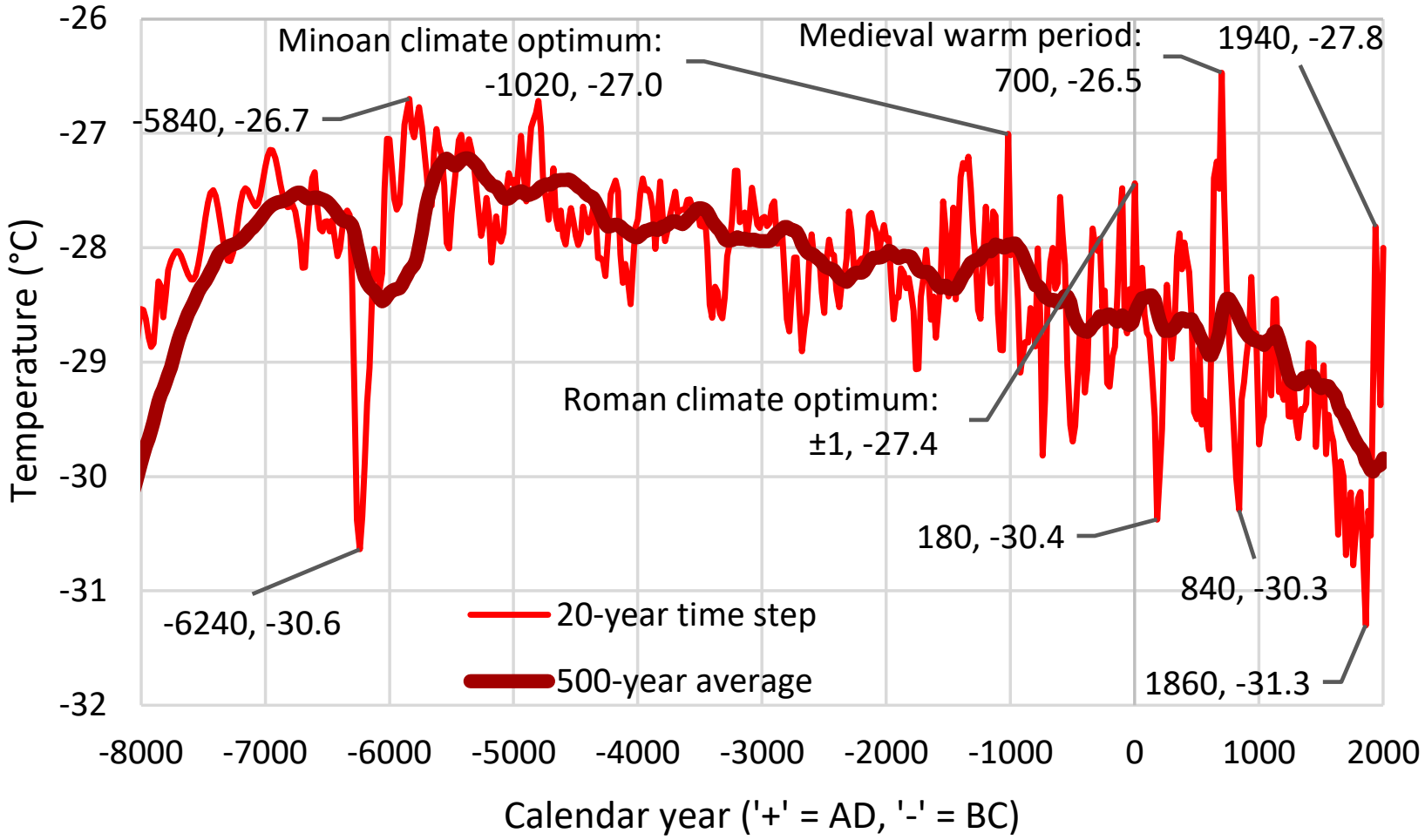
Source: https://commons.wikimedia.org/wiki/File:Post-Glacial_Sea_Level.png

Comparison with recent global sea-level rise



Data:
(1) Dangendorf et al (2019): Synthesis of satellite altimetry with 479 tide-gauge records (https://static-content.springer.com/esm/art%3A10.1038%2Fs41558-019-0531-8/MediaObjects/41558_2019_531_MOESM2_ESM.txt)
(2) Copernicus: satellite altimetry for the global ocean from 1993 to present (http://climexp.climexp-knmi.surf-hosted.nl/getindices.cgi?WMO=CDSData/global_copernicus_sla&STATION=global_sla_C3S&TYPE=i&id=someone@somewhere)

Focus on the last 10 thousand years: temperature



(1) 1940 was warmer than present. (2) The warmest period was around 700 AD. (3) There has been a dominant cooling trend for more than 7000 years.

Data: Greenland ice cores as in a previous slide.

Part 2
The myth of climate crisis (or emergency)

European Union's climate emergency (and opposition)

News
European Parliament

Headlines | Press room | Agenda | FAQ | The new Parliament and the new Commission

The European Parliament declares climate emergency

Press Releases PLENARY SESSION ENVI 28-11-2019 - 13:01

- Commission must ensure all proposals are aligned with 1.5 °C target
- EU should cut emissions by 55% by 2030 to become climate neutral by 2050
- Calls to reduce global emissions from shipping and aviation

"Parliament declares climate emergency. MEPs want immediate and ambitious action to limit effects of climate change"© 123RF/EU–EP

EU should commit to net-zero greenhouse gas emissions by 2050 at the UN Conference, says Parliament.

https://www.europarl.europa.eu/news/en/press-room/20191121IPR67110/

Literally our countries live now under a state of emergency.

Should we be scared for the climate or for the emergency state?

I am one of the signatories on opposition

CLINTEL THERE IS NO CLIMATE EMERGENCY

There is no climate emergency

A global network of 700 scientists and professionals has prepared this urgent message. Climate science should be less political, while climate policies should be more scientific. Scientists should openly address uncertainties and exaggerations in their predictions of global warming, while politicians should dispassionately count the real costs as well as the imagined benefits of their policy measures.

Natural as well as anthropogenic factors cause warming

The geological archive reveals that Earth's climate has varied as long as the planet has existed, with natural cold and warm phases. The Little Ice Age ended as recently as 1850. Therefore, it is no surprise that we now are experiencing a period of warming.

Warming is far slower than predicted

The world has warmed at less than half the rate predicted by IPCC on the basis of modeled anthropogenic forcing and radiative imbalance. It tells us that we are far from understanding climate change.

Climate policy relies on inadequate models

Climate models have many shortcomings and are not remotely plausible as global policy tools. They blow up the effect of greenhouse gases such as CO_2. In addition, they ignore the fact that enriching the atmosphere with CO_2 is beneficial.

CO_2 is plant food, the basis of all life on Earth

CO_2 is not a pollutant. It is essential to all life on Earth. Photosynthesis is a blessing. More CO_2 is beneficial for nature, greening the Earth: additional CO_2 in the air has promoted growth in global plant biomass. It is also good for agriculture, increasing the yields of crops worldwide.

Global warming has not increased natural disasters

There is no statistical evidence that global warming is intensifying hurricanes, floods, droughts and suchlike natural disasters, or making them more frequent. However, there is ample evidence that CO_2-mitigation measures are as damaging as they are costly.

https://clintel.org/world-climate-declaration/
https://clintel.org/greece-wcd/

The emergency is in climate models—not in the real world
Recent predictions of climate models and the Pythia legacy

- Pythia's power relied on ambiguous predictions:

  "*ἤξεις ἀφήξεις οὐ θνήξεις ἐν πολέμω*" or "*you will go you will come not in the war you will die*" (put a comma before or after "not").

- Modern climate predictions (or "projections") owe their success to the distant time horizon to which they refer (e.g. 2100); this makes them resistant to falsifiability.

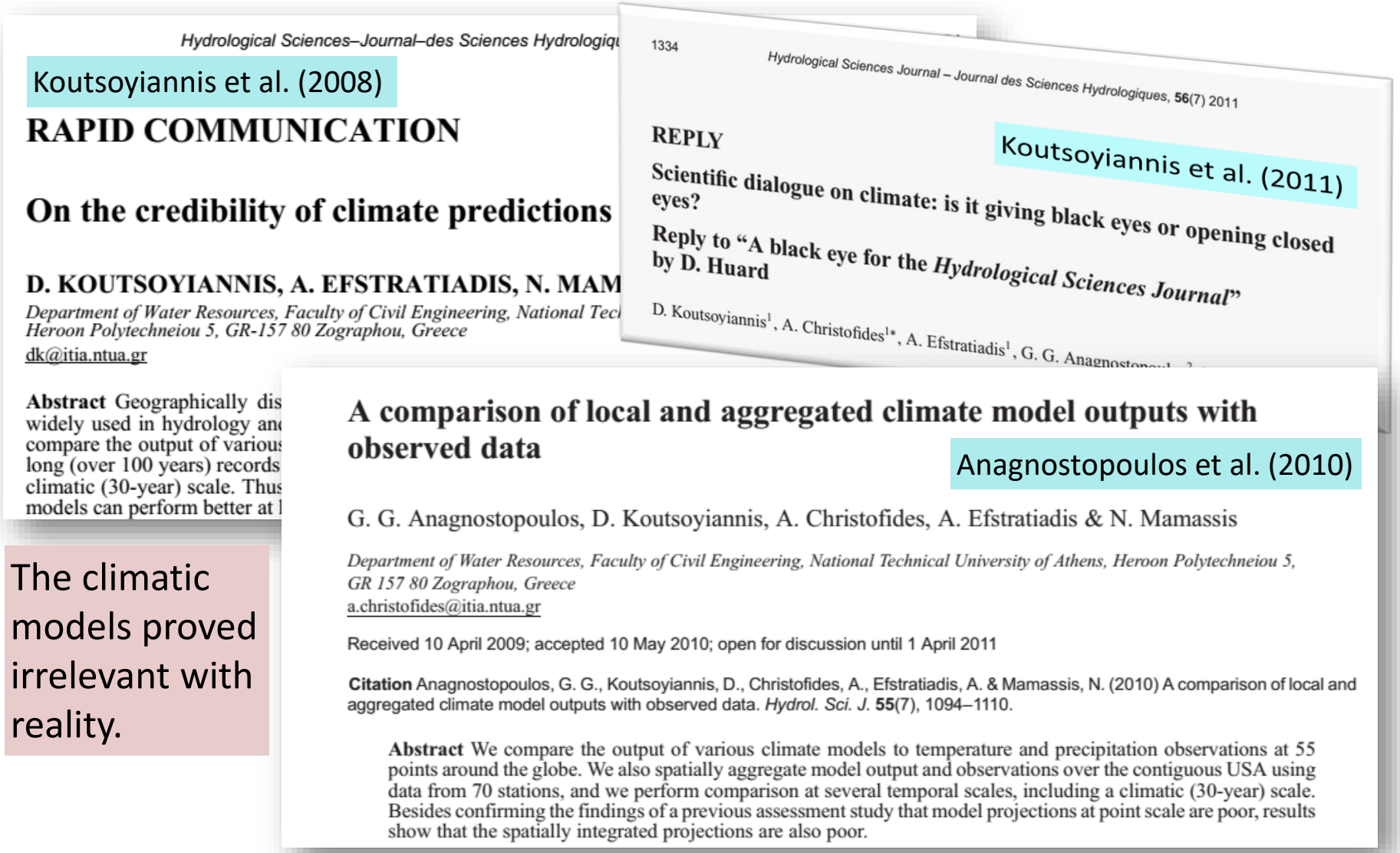
Pythia (in the **oracle** in **Delphi**) inspired by pneuma rising from below (from wikipedia)

Climate model outputs

"Predicting is a guessing game for fools"

Schwab and Malleret (2020), *Covid-19: The great reset*. World Economic Forum.

Systematic testing of climate model outputs against observations



Hydrological Sciences–Journal–des Sciences Hydrologiqu

Koutsoyiannis et al. (2008)

RAPID COMMUNICATION

On the credibility of climate predictions

D. KOUTSOYIANNIS, A. EFSTRATIADIS, N. MAM

Department of Water Resources, Faculty of Civil Engineering, National Tec
Heroon Polytechneiou 5, GR-157 80 Zographou, Greece
dk@itia.ntua.gr

Abstract Geographically dis
widely used in hydrology an
compare the output of variou
long (over 100 years) records
climatic (30-year) scale. Thus
models can perform better at

1334 Hydrological Sciences Journal – Journal des Sciences Hydrologiques, **56**(7) 2011

Koutsoyiannis et al. (2011)

REPLY

Scientific dialogue on climate: is it giving black eyes or opening closed eyes?

Reply to "A black eye for the *Hydrological Sciences Journal*" by D. Huard

D. Koutsoyiannis[1], A. Christofides[1*], A. Efstratiadis[1], G. G. Anagnostopou

A comparison of local and aggregated climate model outputs with observed data

Anagnostopoulos et al. (2010)

G. G. Anagnostopoulos, D. Koutsoyiannis, A. Christofides, A. Efstratiadis & N. Mamassis

Department of Water Resources, Faculty of Civil Engineering, National Technical University of Athens, Heroon Polytechneiou 5, GR 157 80 Zographou, Greece
a.christofides@itia.ntua.gr

Received 10 April 2009; accepted 10 May 2010; open for discussion until 1 April 2011

Citation Anagnostopoulos, G. G., Koutsoyiannis, D., Christofides, A., Efstratiadis, A. & Mamassis, N. (2010) A comparison of local and aggregated climate model outputs with observed data. *Hydrol. Sci. J.* **55**(7), 1094–1110.

Abstract We compare the output of various climate models to temperature and precipitation observations at 55 points around the globe. We also spatially aggregate model output and observations over the contiguous USA using data from 70 stations, and we perform comparison at several temporal scales, including a climatic (30-year) scale. Besides confirming the findings of a previous assessment study that model projections at point scale are poor, results show that the spatially integrated projections are also poor.

The climatic models proved irrelevant with reality.

Is hydrological cycle intensifying?

- Short reply: No, not at all.
- Read details in Koutsoyiannis (2020a).

Hydrol. Earth Syst. Sci., 24, 3899–3932, 2020
https://doi.org/10.5194/hess-24-3899-2020

Hydrology and Earth System Sciences
Open Access
EGU

Koutsoyiannis (2020a)

Revisiting the global hydrological cycle: is it intensifying?

Demetris Koutsoyiannis

Department of Water Resources and Environmental Engineering, School of Civil Engineering, National Technical University of Athens, Heroon Polytechneiou 5, GR 157 80 Zografou, Greece

Correspondence: Demetris Koutsoyiannis (dk@itia.ntua.gr)

Received: 11 March 2020 – Discussion started: 20 March 2020
Revised: 31 May 2020 – Accepted: 30 June 2020 – Published: 7 August 2020

Abstract. As a result of technological advances in monitoring atmosphere, hydrosphere, cryosphere and biosphere, as well as in data management and processing, several databases have become freely available. These can be exploited in revisiting the global hydrological cycle with the aim, on the one hand, to better quantify it and, on the other hand, to test the established climatological hypotheses according to which the hydrological cycle should be intensifying because of global warming. By processing the information from gridded ground observations, satellite data and reanalyses, it turns out that the established hypotheses are not confirmed. Instead of monotonic trends, there appear fluctuations from intensification to deintensification, and vice versa, with deintensification prevailing in the 21st century. The water balance on land and in the sea appears to be lower than the standard figures of literature, but with greater variability on climatic timescales, which is in accordance with Hurst–Kolmogorov stochastic dynamics. The most obvious anthropogenic signal in the hydrological cycle appears to be the over-exploitation of groundwater, which has a visible effect on the rise in sea level. Melting of glaciers has an equal effect, but in this case it is not known which part is anthropogenic, as studies on polar regions attribute mass loss mostly to ice dynamics.

«Πεπαιδευμένου γάρ ἐστιν ἐπὶ τοσοῦτον τἀκριβὲς ἐπιζητεῖν καθ' ἕκαστον γένος, ἐφ' ὅσον ἡ τοῦ πράγματος φύσις ἐπιδέχεται»

(It is the mark of an educated man to look for precision in each class of things just so far as the nature of the subject admits.)

Aristotle, *Nicomachean Ethics*, 1094b.

1 Introduction

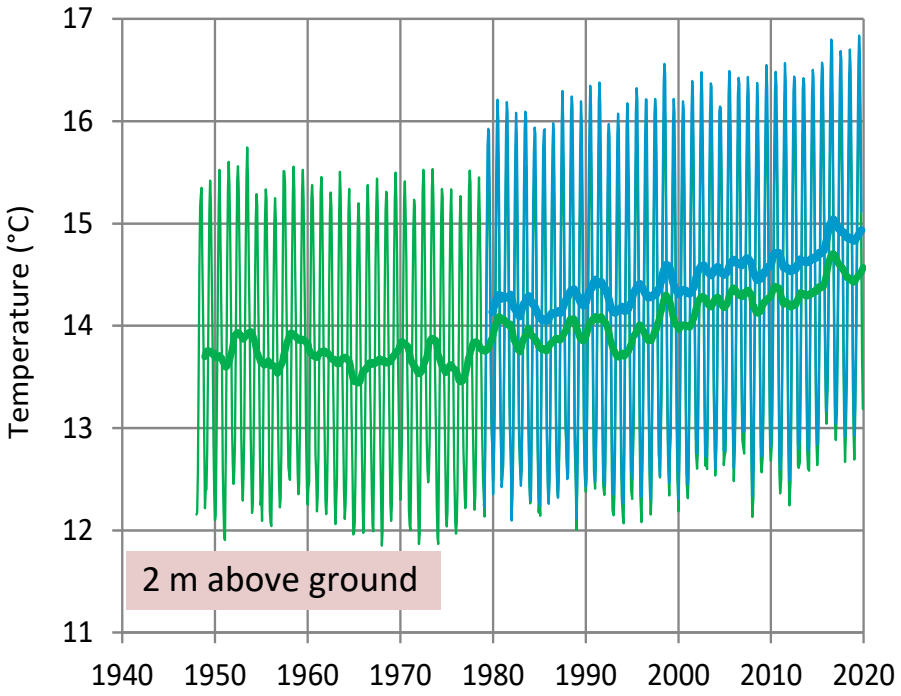
If the dark side of concerns about Earth's climate is *fear*, the bright side is *data*. The latter single-word label means to include the technological advances in monitoring atmosphere, hydrosphere, cryosphere and biosphere, the gathering and processing of huge amounts of ground- and space-based observations for the land and sea parts of the Earth, and the free availability of data. Hydrological processes on the global scale extend over all these spheres, and our knowledge of them benefits from these data.

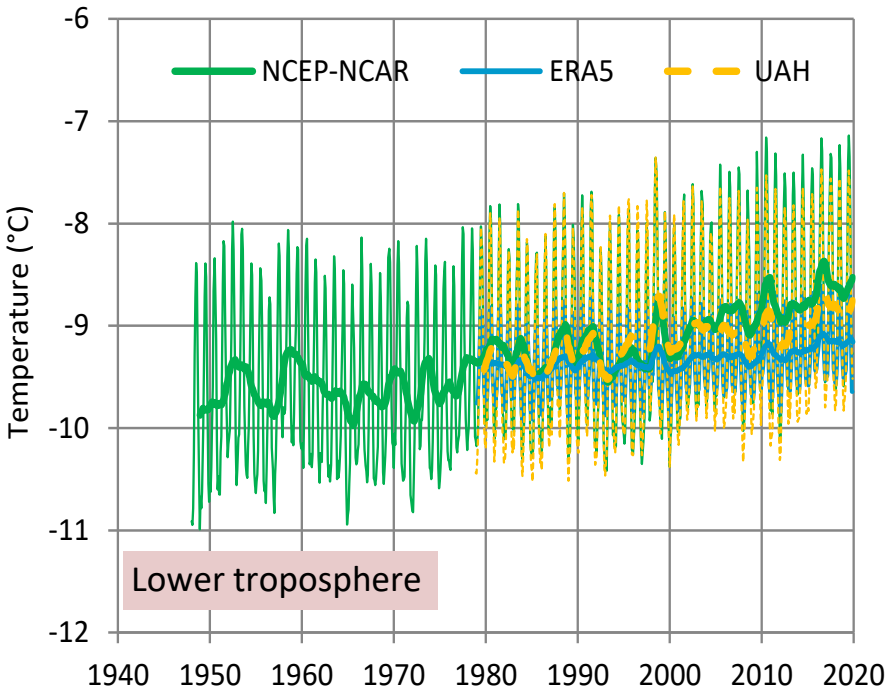
The availability of different types of data allows revisiting the global hydrological cycle and improving its quantified knowledge. It can also be useful in testing the climatological hypotheses that are relevant to hydrology. Among them, most crucial is the conjecture that, in a warming climate, atmospheric moisture is changing in a manner in which the relative humidity remains constant but specific humidity increases, according to the Clausius–Clapeyron relationship. As a result, the established view is that the global atmospheric water vapour should increase by about 6 %–7 % $°C^{-1}$ of warming. This gives rise to what has been called the intensification of the hydrological cycle. Because of the alleged intensification, the role of hydrology becomes thus important in the climate agenda from a sociological point of view; some of the most prominent predicted catastrophes are related to water shortage and extreme floods (Koutsoyiannis, 2014a).

Hence, the purpose of this study is to revisit the hydrological cycle in an era of climate change concerns and rich data availability, with an emphasis on the following points:

1. providing an overview of and retrieving a great number of global hydroclimatic data sets;

Atmospheric temperature averaged over the globe





Noticeable fact: During the recent years, climatic temperature increases at a rate of:

- 1.9 °C/century at the ground level, or
- 1.3 °C/century at the lower troposphere.

Compare with the rate 8.5 °C/century in the distant past.

Source of graph: Koutsoyiannis (2020a); data: (1) NCEP/NCAR R1 reanalysis; (2) ERA5 reanalysis by ECMWF; and (3) UAH satellite data for the lower troposphere gathered by advanced microwave sounding units on NOAA and NASA satellites (see Koutsoyiannis, 2020a for the data access sites).

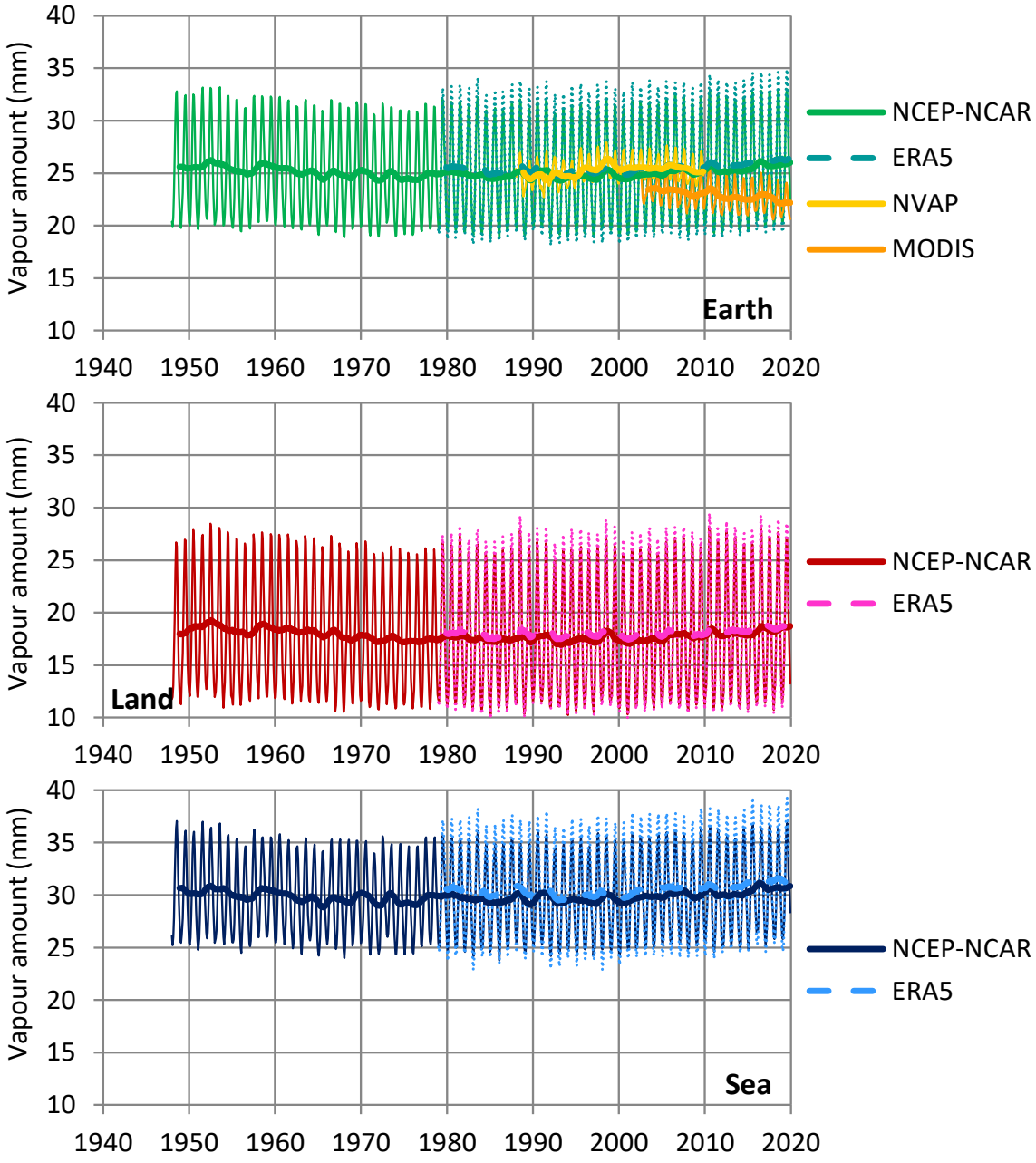
Thin and thick lines of the same colour represent monthly values and running annual averages (right aligned), respectively.

Water vapour amount: Does it increase?

- The water vapour amount in the atmosphere (most often misnamed as *precipitable water*) is fluctuating—not increasing monotonically.
- This falsifies the IPCC (2013) conjecture that it would increase.
- Interestingly, the satellite data (mostly MODIS) show a decreasing vapour amount.

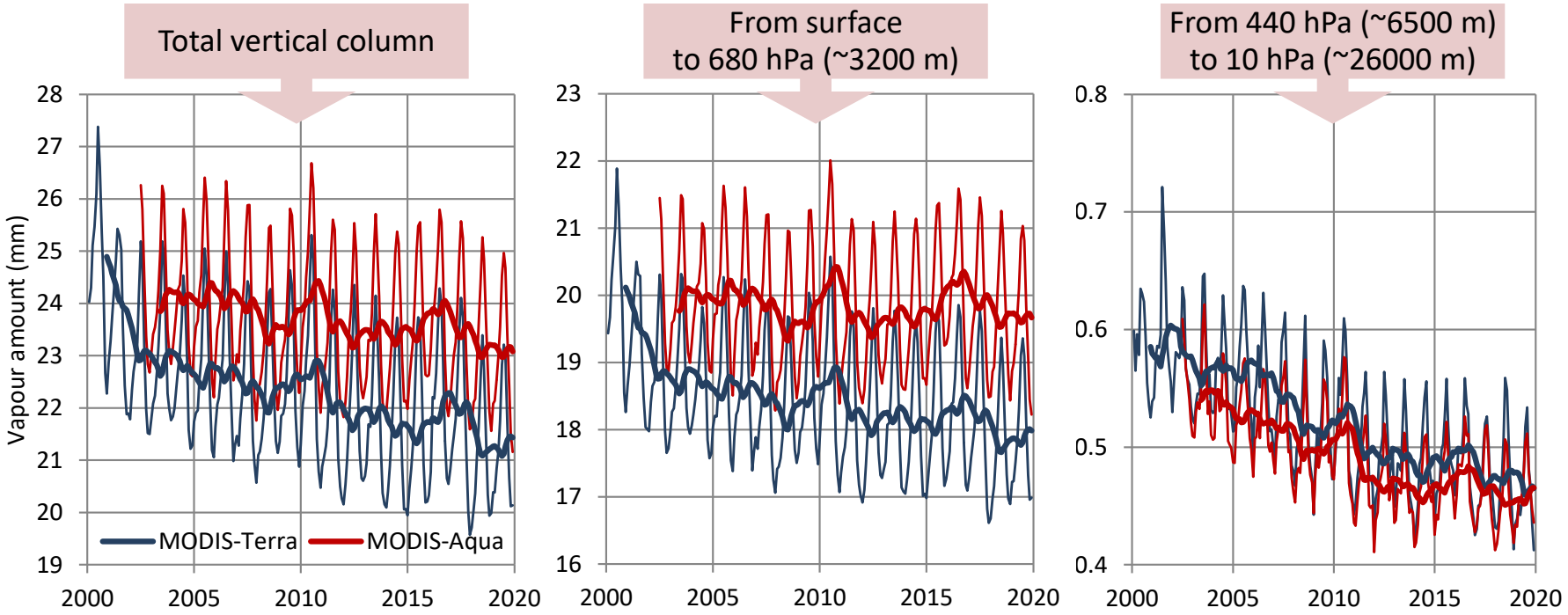
Thin and thick lines of the same colour represent monthly values and running annual averages (right aligned), respectively.

Source of graph: Koutsoyiannis (2020a); reanalysis data (NCEP-NCAR & ERA5): http://climexp.knmi.nl; satellite data, NVAP: Vonder Haar et al. (2012) (Figure 4c, after digitization); satellite data, MODIS: https://giovanni.gsfc.nasa.gov/giovanni/; averages from Terra and Aqua platforms.



Satellite data of the 21st century for water vapour amount: Is there an increasing trend?

- Both Terra and Aqua satellite platforms for all atmospheric levels suggest decreasing trends.
- Hence, the data are opposite to the IPCC conjecture.

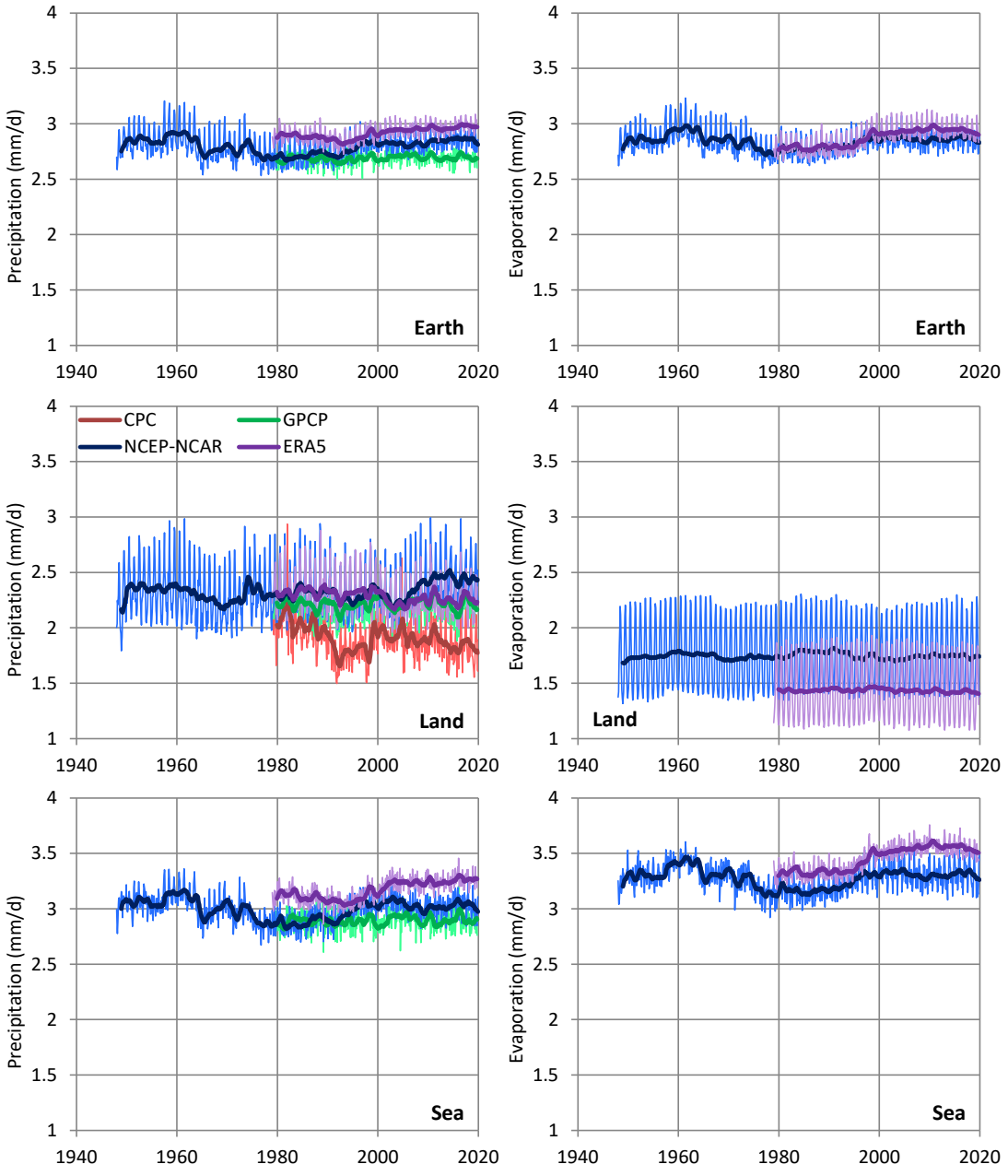


Source of graph: Koutsoyiannis (2020a); MODIS data: https://giovanni.gsfc.nasa.gov/giovanni/

Thin and thick lines of the same colour represent monthly values and running annual averages (right aligned), respectively.

Precipitation and evaporation: Do they increase?

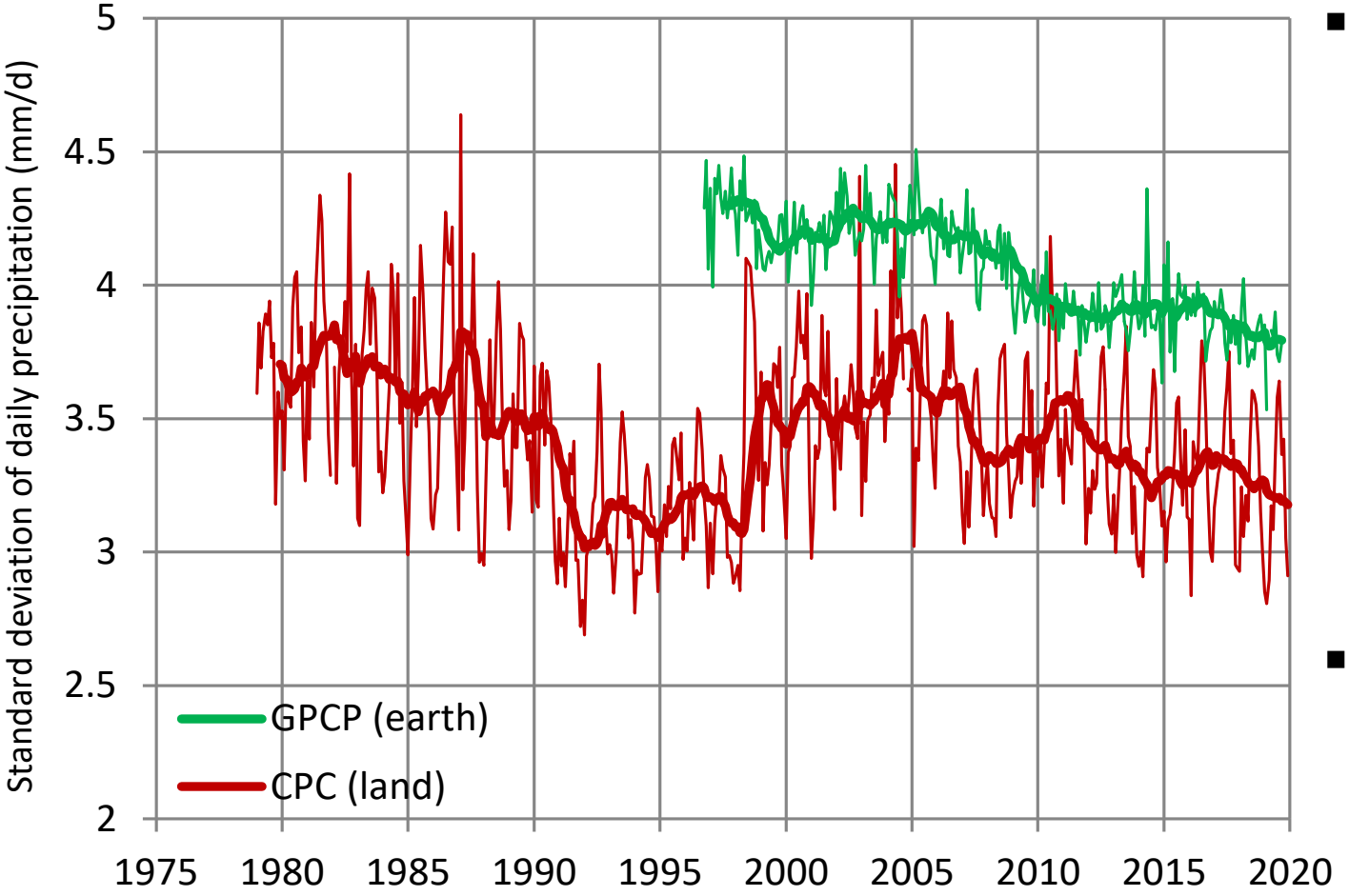
- Both precipitation and evaporation are fluctuating—not increasing monotonically.
- Hence, the IPCC conjecture is falsified.



Thin and thick lines of the same colour represent monthly values and running annual averages (right aligned), respectively.

Source of graph: Koutsoyiannis (2020a); reanalysis data (NCEP-NCAR & ERA5), gauge-based precipitation data gridded over land (CPC), and combined gauge and satellite precipitation data over a global grid (GPCP): http://climexp.knmi.nl

Daily precipitation variability: Is it increasing?



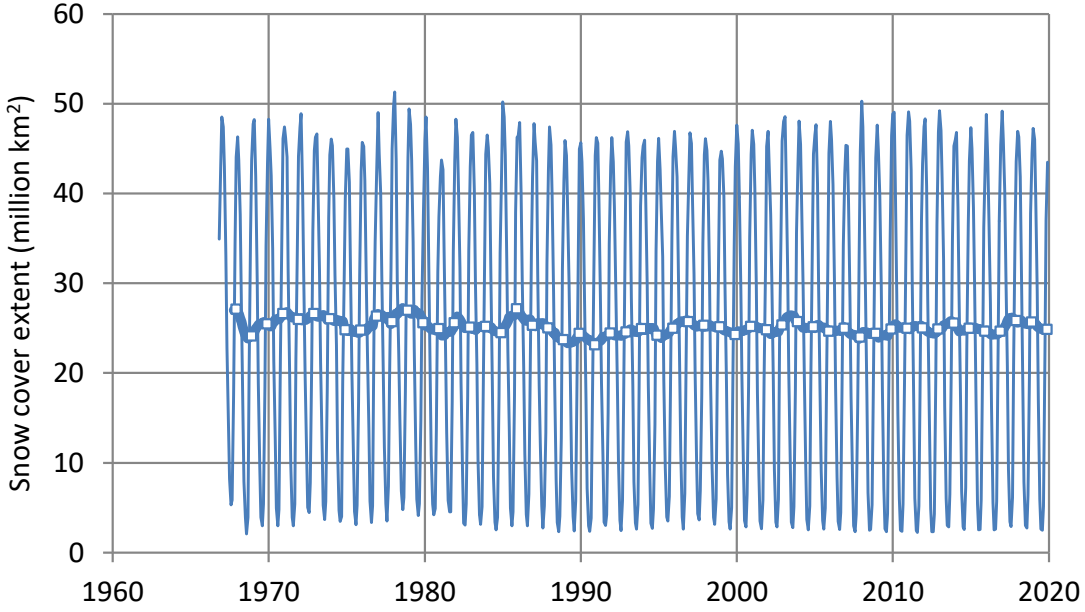
- The standard deviation of daily rainfall, areally averaged, as seen both from CPC and GPCP observational data, decreases, thus signifying deintensification of extremes in the 21st century.
- Again, it will be more prudent to speak about fluctuations rather than deintensification.

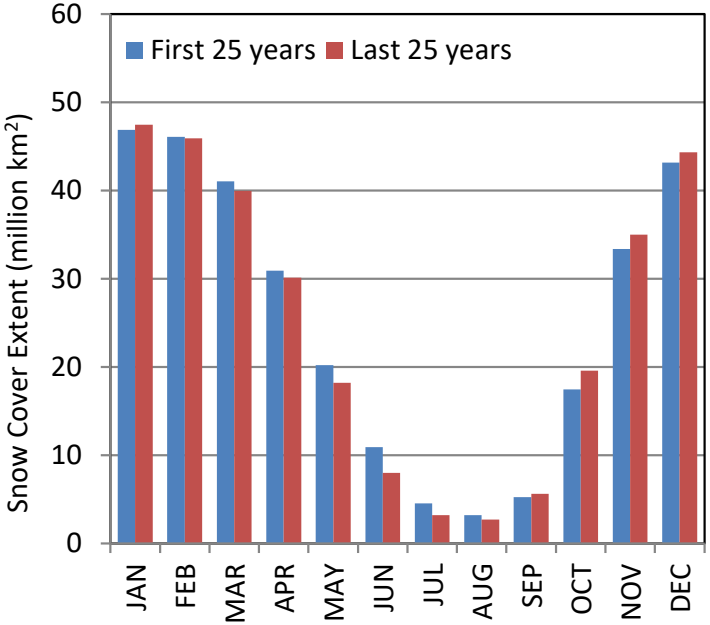
Source of graph: Koutsoyiannis (2020a); gauge-based precipitation data gridded over land (CPC), and combined gauge and satellite precipitation data over the entire Earth (GPCP): http://climexp.knmi.nl

Thin and thick lines of the same colour represent monthly values and running annual averages (right aligned), respectively.

Snow: Does it tend to disappear?

- The snow part of precipitation is interesting to examine, as snow is more directly related to temperature and also affects Earth's albedo.
- Systematic satellite observations of snow cover extent exist only for the northern hemisphere.
- Despite temperature increase, no noticeable change appears on the annual basis.
- However, there are perceptible changes in the seasonal variation (right panel): in the most recent period the snow cover has decreased during the summer months and increased during the autumn and winter months.

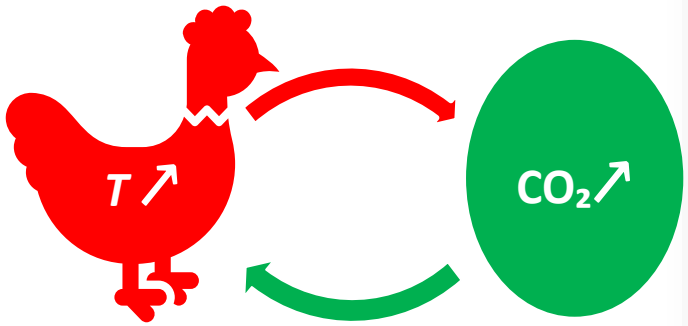




Source of graph: Koutsoyiannis (2020a); source of snow cover data: Global Snow Laboratory (GSL), https://climate.rutgers.edu/snowcover/table_area.php

Thin and thick lines represent monthly values and running annual averages (right aligned), respectively. Squares are annual averages aligned at December of each year.

Causation between CO_2 & temperature: "ὄρνις ἢ ᾠὸν;" ("hen or egg?")



Note: Plutarch first posed this type of causality as a philosophical problem using the example of the hen and the egg: "*Πότερον ἡ ὄρνις πρότερον ἢ τὸ ᾠὸν ἐγένετο*" (Πλούταρχος, Ηθικά, Συμποσιακὰ Β, Πρόβλημα Γ) —*Which of the two came first, the hen or the egg?* (Plutarch, Moralia, Quaestiones convivales, B, Question III).

Koutsoyiannis and Kundzewicz (2020)

Article

Atmospheric Temperature and CO_2: Hen-Or-Egg Causality?

Demetris Koutsoyiannis [1,*] and Zbigniew W. Kundzewicz [2]

1 Department of Water Resources and Environmental Engineering, School of Civil Engineering, National Technical University of Athens, 157 80 Athens, Greece
2 Institute for Agricultural and Forest Environment, Polish Academy of Sciences, 60-809 Poznań, Poland; kundzewicz@yahoo.com
* Correspondence: dk@itia.ntua.gr

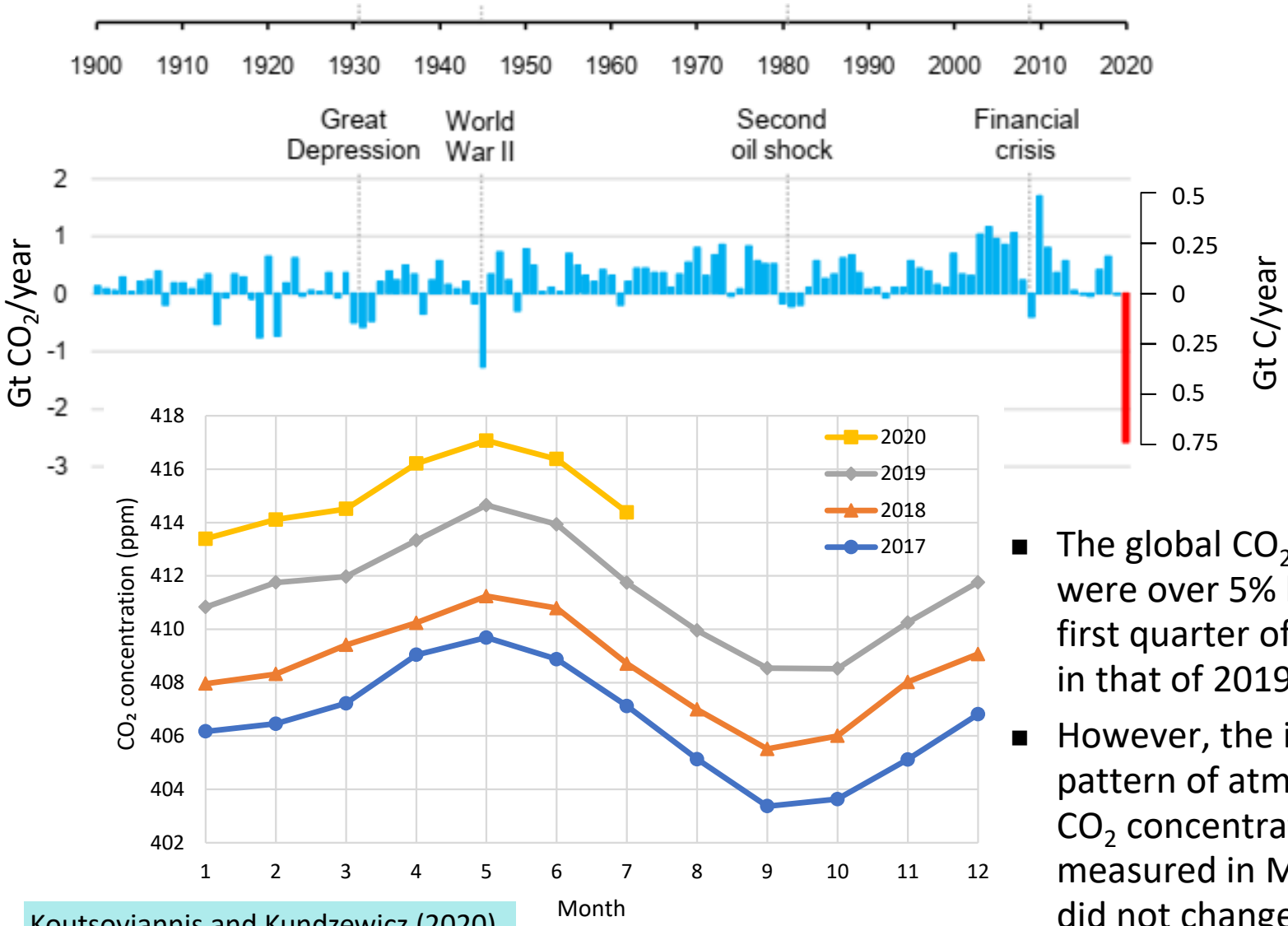
Received: 7 September 2020; Accepted: 16 November 2020; Published: 25 November 2020

Abstract: It is common knowledge that increasing CO_2 concentration plays a major role in enhancement of the greenhouse effect and contributes to global warming. The purpose of this study is to complement the conventional and established theory, that increased CO_2 concentration due to human emissions causes an increase in temperature, by considering the reverse causality. Since increased temperature causes an increase in CO_2 concentration, the relationship of atmospheric CO_2 and temperature may qualify as belonging to the category of "hen-or-egg" problems, where it is not always clear which of two interrelated events is the cause and which the effect. We examine the relationship of global temperature and atmospheric carbon dioxide concentration in monthly time steps, covering the time interval 1980–2019 during which reliable instrumental measurements are available. While both causality directions exist, the results of our study support the hypothesis that the dominant direction is $T \rightarrow CO_2$. Changes in CO_2 follow changes in T by about six months on a monthly scale, or about one year on an annual scale. We attempt to interpret this mechanism by involving biochemical reactions as at higher temperatures, soil respiration and, hence, CO_2 emissions, are increasing.

Keywords: temperature; global warming; greenhouse gases; atmospheric CO_2 concentration

Πότερον ἡ ὄρνις πρότερον ἢ τὸ ᾠὸν ἐγένετο (Which of the two came first, the hen or the egg?).

COVID-19 and an unfortunate experiment

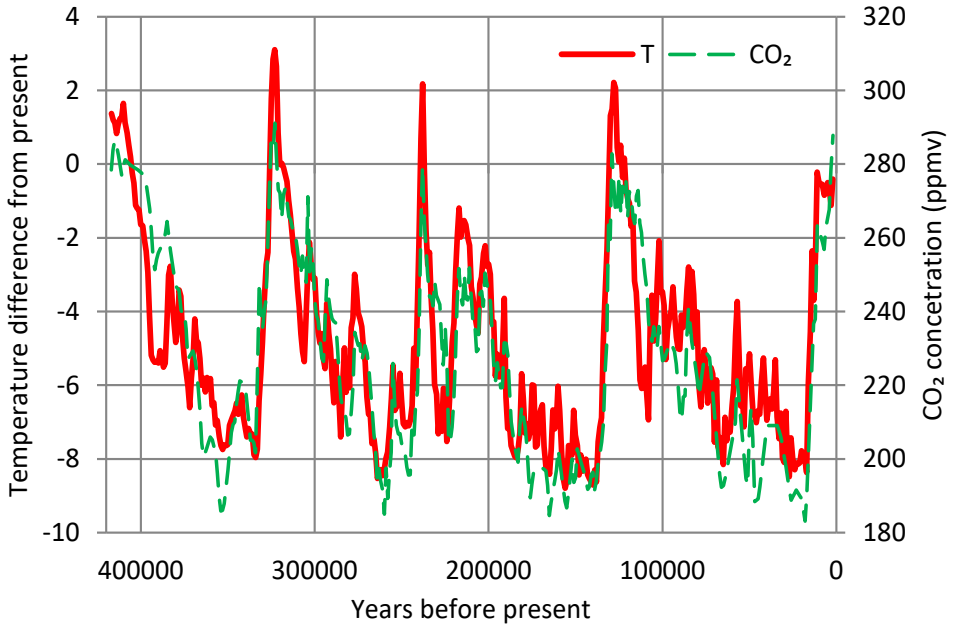


Koutsoyiannis and Kundzewicz (2020)

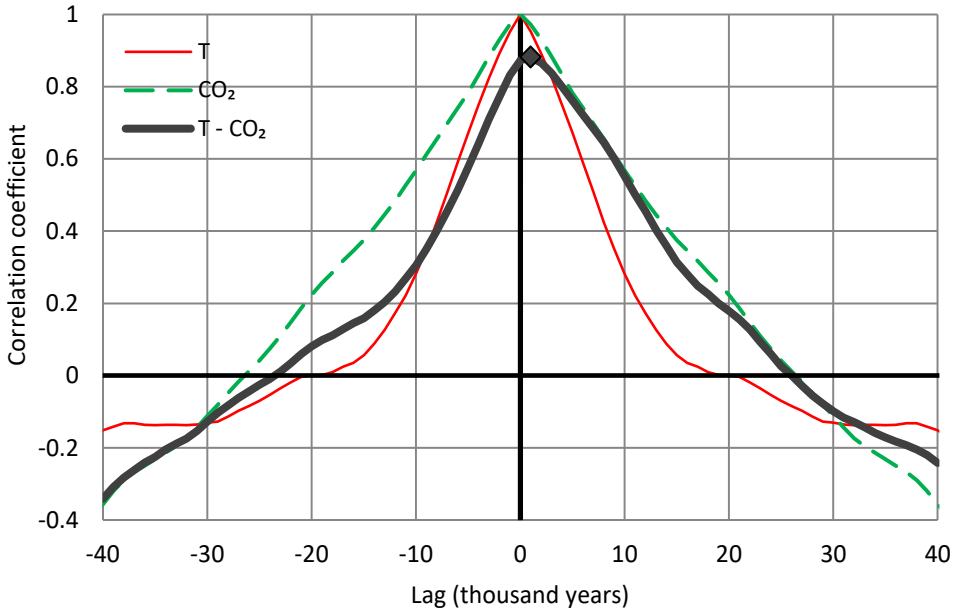
- The global CO_2 emissions were over 5% lower in the first quarter of 2020 than in that of 2019 (IEA, 2020).
- However, the increasing pattern of atmospheric CO_2 concentration, as measured in Mauna Loa, did not change.

Palaeoclimatic data in search of causality

Time series of temperature and CO_2 concentration from the Vostok ice core, covering part of the Quaternary (420 000 years) with time step of 1000 years.



Auto- and cross-correlograms of the two time series. The maximum value of the cross-correlation coefficient is 0.88 and appears at lag 1 thousand years.

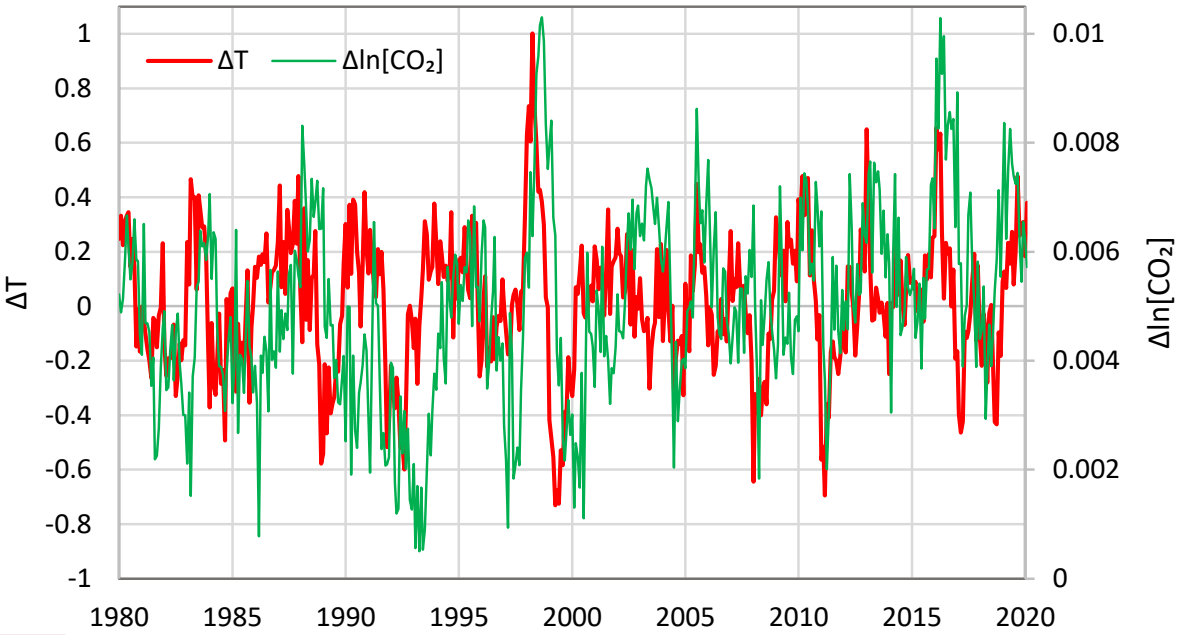


This suggests that the dominant causality direction is $T \rightarrow CO_2$ and is consistent with Milankovitch's climate theory, not Arrhenius's.

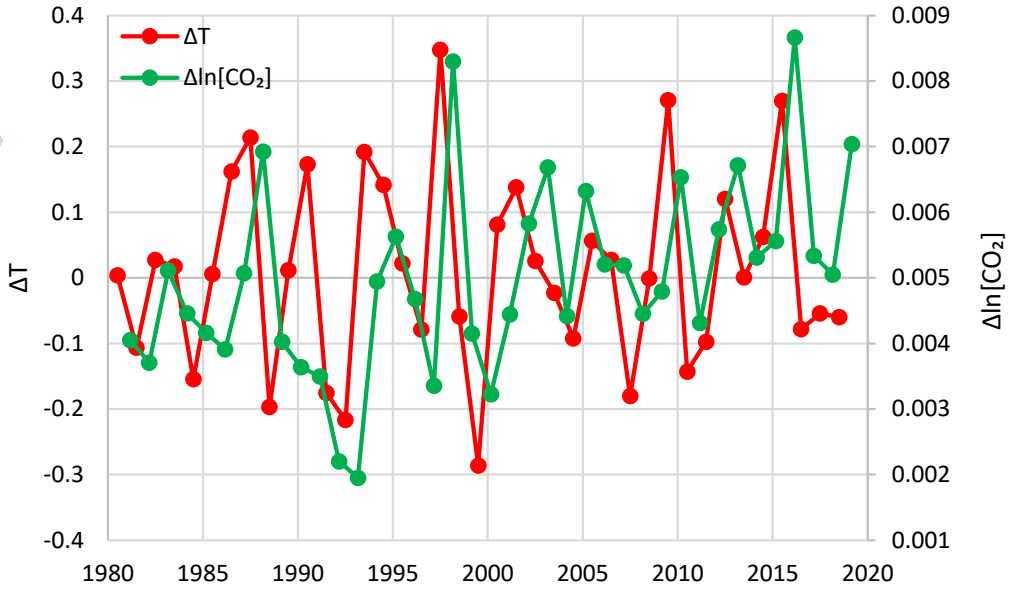
Adapted from Koutsoyiannis (2019)

Recent instrumental temperature and CO_2 data

Differenced monthly time series of global temperature (UAH) and logarithm of CO_2 concentration (Mauna Loa)



Annually averaged time series of differenced temperatures (UAH) and logarithm of CO_2 concentration (Mauna Loa). Each dot represents the average of a one-year duration ending at the time of its abscissa.



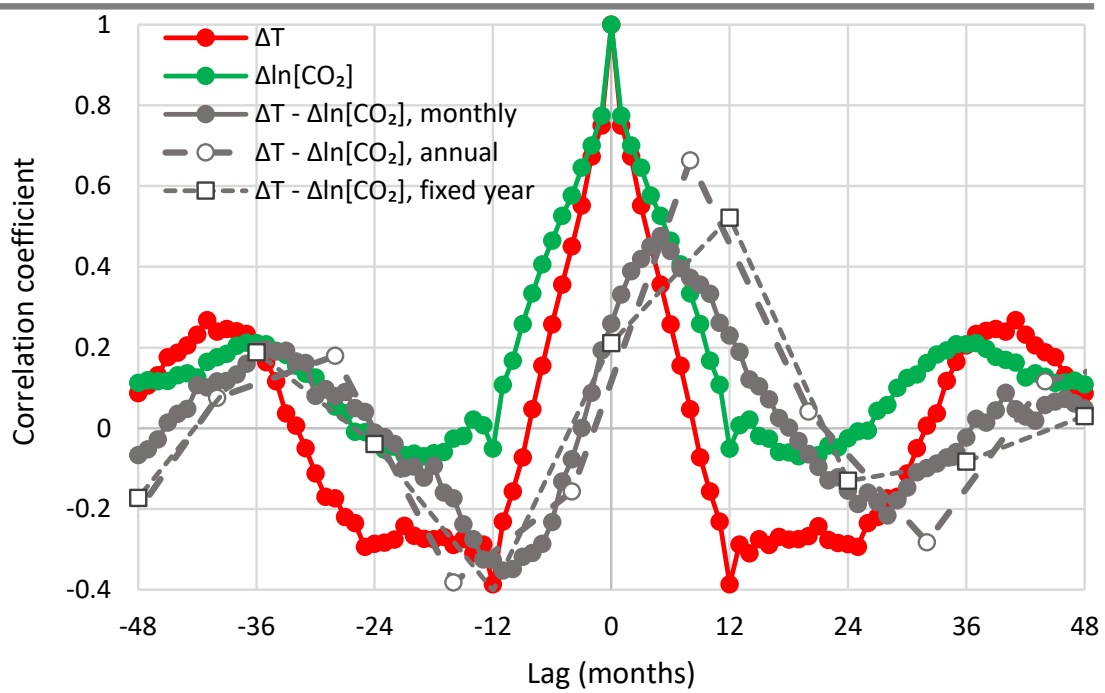
Which is the cause and which the effect?

Koutsoyiannis and Kundzewicz (2020); notice that logarithms of CO_2 concentration are used for linear equivalence with temperature.

Changes in CO_2 follow changes in global temperature

Auto- and cross-correlograms of the differenced time series of temperature (UAH) and logarithm of CO_2 concentration (Mauna Loa)

Which is the cause and which the effect?



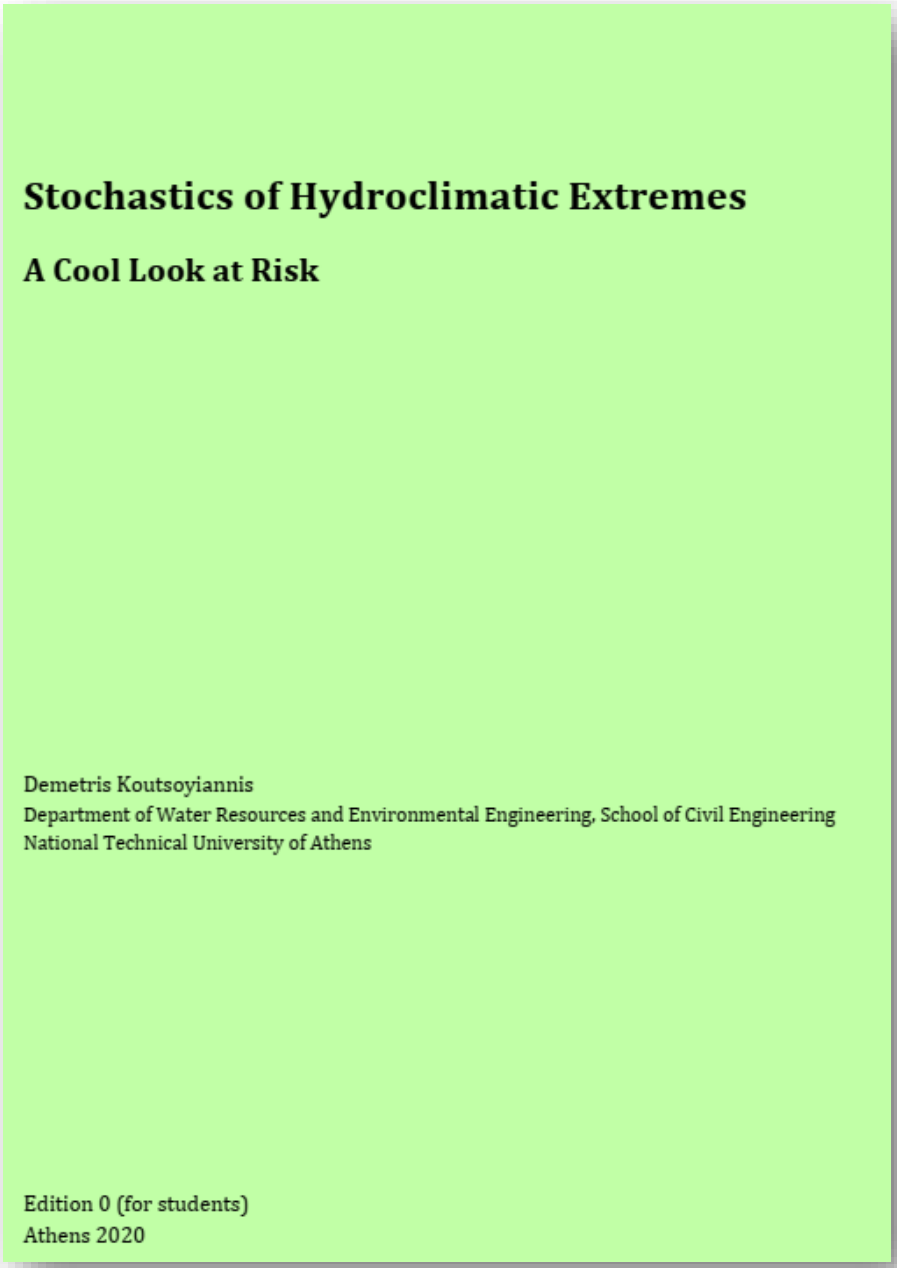
Maximum cross-correlation coefficient (MCCC) and corresponding time lag in months

	Monthly time series		Annual time series – sliding annual window		Annual time series – fixed annual window	
Temperature - CO_2 series	MCCC	Lag	MCCC	Lag	MCCC	Lag
UAH – Mauna Loa	0.47	5	0.66	8	0.52	12
UAH – Barrow	0.31	11	0.70	14	0.59	12
UAH – South Pole	0.37	6	0.54	10	0.38	12
UAH – Global	0.47	6	0.60	11	0.60	12
CRUTEM4 – Mauna Loa	0.31	5	0.55	10	0.52	12
CRUTEM4 – Global	0.33	9	0.55	12	0.55	12

Koutsoyiannis and Kundzewicz (2020)

A cool look at risk

- See details in Koutsoyiannis (2020b).
- The book is open access for free (in Itia.ntua.gr and in ResearchGate)



Change as seen in a long daily precipitation record

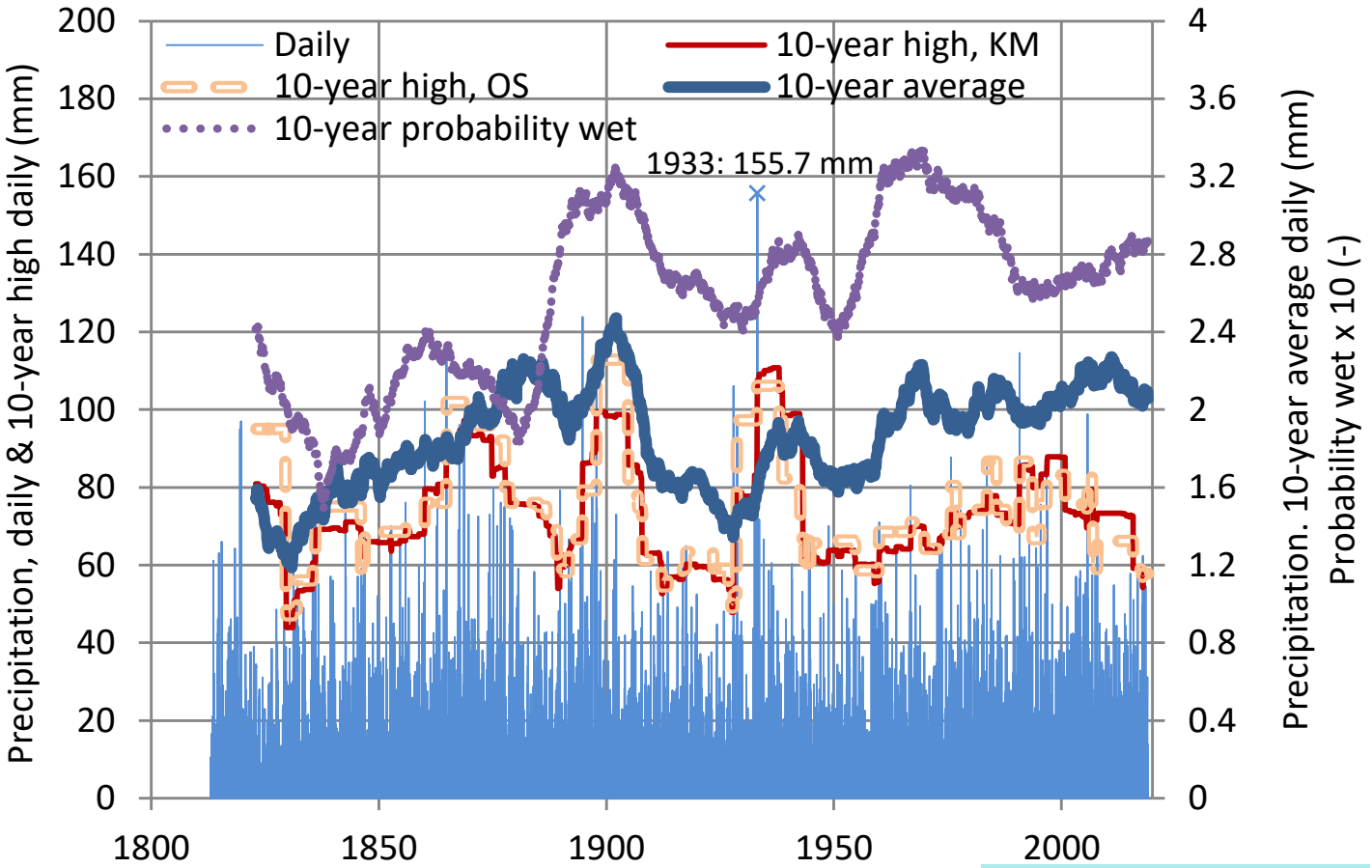
All 10-year **climatic indices** have varied substantially and irregularly:

The average by **100%** (from 1.2 to 2.4 mm).

The probability wet by **120%** (from 0.15 to 0.33).

The high daily precipitation by **150%** (from 44 to 110 mm/d).

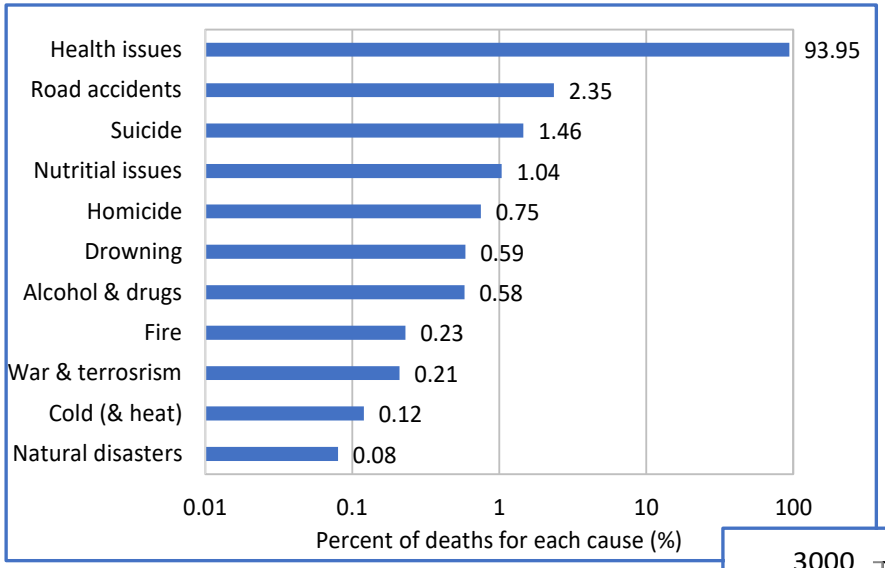
Why hydrologists have given so much energy in studying impacts framed by IPCC within **2-6%**?



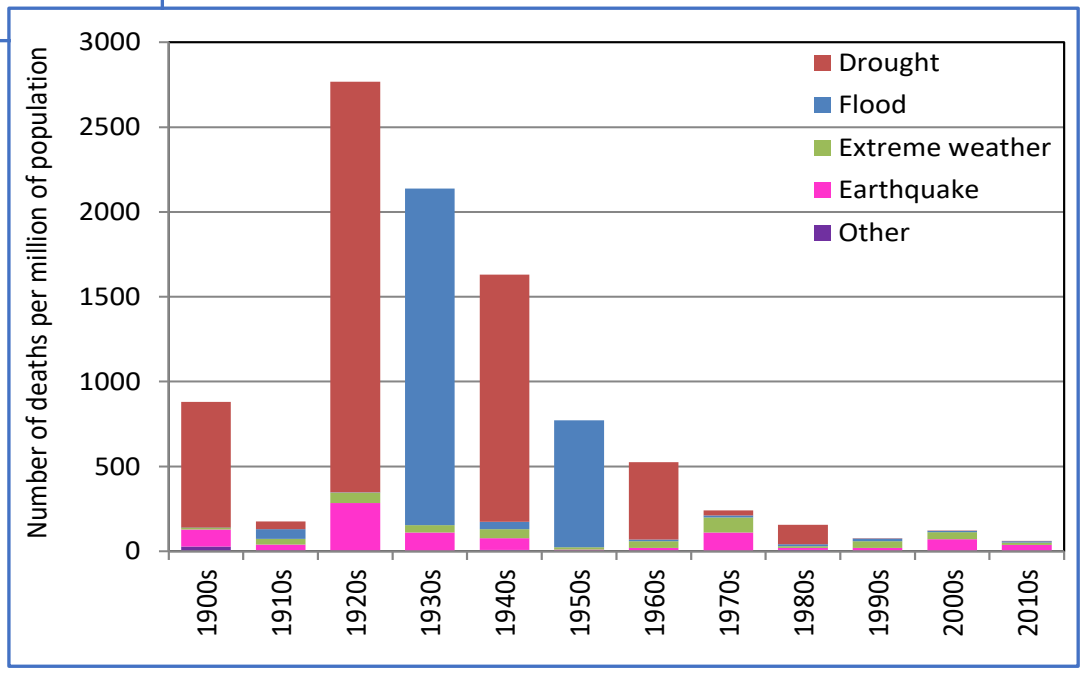
From Koutsoyiannis (2020b)

Data: **Bologna, Italy** (44.50°N, 11.35°E, +53.0 m). Available from the Global Historical Climatology Network (GHCN) – Daily (https://climexp.knmi.nl/gdcnprcp.cgi?WMO=ITE00100550). Uninterrupted for the period 1813-2007: 195 years. For the period 2008-2018, daily data are provided by the repository Dext3r of ARPA Emilia Romagna. **Total length: 206 years.**

Epilogue: Engineers' epinicion on actual risk reduction



- Instead of casting pessimistic prophesies about the future, engineers have improved hydro-technology, water management, and risk assessment and reduction.
- If they are allowed to continue this, the future could be bright.



Upper graph: Koutsoyiannis (2020b); data from https://ourworldindata.org/grapher/share-of-deaths-by-cause?time=latest
Lower graph: Koutsoyiannis (2020a,b); data from https://ourworldindata.org/world-population-growth; https://ourworldindata.org/ofdacred-international-disaster-data

References

- Anagnostopoulos, G.G., Koutsoyiannis, D., Christofides, A., Efstratiadis, A., and Mamassis, N., 2010. A comparison of local and aggregated climate model outputs with observed data. *Hydrological Sciences Journal*, 55 (7), 1094–1110, doi: 10.1080/02626667.2010.513518.
- Berner, R.A., 2008. Addendum to "inclusion of the weathering of volcanic rocks in the GEOCARBSULF model" (R. A. Berner, 2006, v. 306, p. 295–302). *American Journal of Science*, 308, 100–103.
- Buizert, C., Keisling, B.A., Box, J.E., He, F., Carlson, A.E., Sinclair, G., & DeConto, R.M., 2018. Greenland-wide seasonal temperatures during the last deglaciation. *Geophysical Research Letters*, 45, 1905–1914, doi: 10.1002/2017GL075601.
- Dangendorf, S., Hay, C., Calafat, F.M. et al., 2019. Persistent acceleration in global sea-level rise since the 1960s. *Nat. Clim. Chang.,* 9, 705–710, doi: 10.1038/s41558-019-0531-8.
- Davis, W.J. 2017. The Relationship between Atmospheric Carbon Dioxide Concentration and Global Temperature for the Last 425 Million Years. *Climate*, 5 (4), 76.
- Ekart, D.D., Cerling, T.E., Montanez, I.P., and Tabor, N.J., 1999. A 400 million year carbon isotope record of pedogenic carbonate: implications for paleoatmospheric carbon dioxide. *American Journal of Science*, 299 (10), 805-827.
- Feulner, G., 2012. The faint young Sun problem. *Reviews of Geophysics*, 50(2), doi: 10.1029/2011RG000375.
- Hallam, A., 1984. Pre-Quaternary sea-level changes. *Annu. Rev. Earth Planet. Sci.,* 12, 205–243, doi: 10.1146/annurev.ea.12.050184.001225.
- Haq, B.U., and Al-Qahtan, A.M., 2005. Phanerozoic cycles of sea-level change on the Arabian Platform. *Geoarabia*,10 (2).
- Haq, B.U., Hardenbol, J., and Vail, P.R., 1987. Chronology of Fluctuating Sea Levels Since the Triassic. *Science*, 235 (4793), 1156-1167, doi: 10.1126/science.235.4793.1156.
- IEA (International Energy Agency), 2020. *Global Energy Review 2020*, IEA, Paris https://www.iea.org/reports/global-energy-review-2020.
- IPCC (Intergovernmental Panel on Climate Change), 2013. *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, 1535 pp., http://www.climatechange2013.org/report/.
- Koutsoyiannis, D., 2019. Time's arrow in stochastic characterization and simulation of atmospheric and hydrological processes. *Hydrological Sciences Journal*, 64 (9), 1013–1037, doi: 10.1080/02626667.2019.1600700.
- Koutsoyiannis, D., 2020a. Revisiting global hydrological cycle: Is it intensifying?, *Hydrology and Earth System Sciences*, 24, 3899–3932, doi: 10.5194/hess-24-3899-2020.
- Koutsoyiannis, D., 2020b. *Stochastics of Hydroclimatic Extremes - A Cool Look at Risk*, National Technical University of Athens, 330 pp., http://www.itia.ntua.gr/2000/.
- Koutsoyiannis, D., Christofides, A., Efstratiadis, A., Anagnostopoulos, G.G., and Mamassis, N., 2011. Scientific dialogue on climate: is it giving black eyes or opening closed eyes? Reply to "A black eye for the Hydrological Sciences Journal" by D. Huard. *Hydrological Sciences Journal*, 56 (7), 1334–1339, doi: 10.1080/02626667.2011.610759.
- Koutsoyiannis, D. Efstratiadis, A., Mamassis, N., and Christofides, A., 2008. On the credibility of climate predictions. *Hydrological Sciences Journal*, 53 (4), 671–684, doi: 10.1623/hysj.53.4.671.
- Koutsoyiannis, D., and Kundzewicz, Z.W., 2020. Atmospheric Temperature and CO_2: Hen-or-Egg Causality? *Sci*, 2 (4), 83, doi:10.3390/sci2040083, 2020.
- Kuhn, W.R., Walker, J.C.G. and Marshall, H.G., 1989. The effect on Earth's surface temperature from variations in rotation rate, continent formation, solar luminosity, and carbon dioxide. *Journal of Geophysical Research: Atmospheres*, 94(D8), 11129-11136.
- Miller, K.G., Kominz, M.A., Browning, J.V., Wright, J.D., Mountain, G.S., Katz, M.E., Sugarman, P.J., Cramer, B.S., Christie-Blick, N., Pekar, S.F. 2005. The phanerozoic record of global sea-level change. *Science*, 310 (5752), 1293-1298, doi: 10.1126/science.1116412.
- Schwab, K. and Malleret, T., 2020. Covid-19: The Great Reset. World Economic Forum, Geneva, Switzerland.
- Scotese, C.R. 2018. Phanerozoic Temperatures: Tropical Mean Annual Temperature (TMAT), Polar Mean Annual Temperature (PMAT), and Global Mean Annual Temperature (GMAT) for the last 540 Million Years. Earth's Temperature History Research Workshop, Smithsonian National Museum of Natural History, 30–31 March 2018, Washington, D.C., https://www.researchgate.net/publication/324017003
- van der Meer, D.G., van den Berg van Saparoea, A.P.H., van Hinsbergen, D.J.J., van de Weg, R.M.B., Godderis, Y., Le Hir, G., and Donnadieu, Y., 2017. Reconstructing first-order changes in sea level during the Phanerozoic and Neoproterozoic using strontium isotopes, *Gondwana Research*, 44, 22-34, doi: 10.1016/j.gr.2016.11.002.
- Vonder Haar, T.H., Bytheway J.L., and Forsythe, J.M., 2012. Weather and climate analyses using improved global water vapor observations. *Geophys. Res. Lett.*, 39, L16802, doi: 10.1029/2012GL052094.