The Perpetual Change in Climate and the Technology-Augmented Human Ability of Adaptation

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Μωραίνει Κύριος ὃν βούλεται ἀπολέσαι
Quem vult Deus perire dementat prius
Whom God wishes to destroy, He first deprives of reason

Note: The saying is an **ancient Greek proverb**, which is used in several versions also in Latin and in modern languages. Both **Sophocles and Euripides** provide some poetic variants of it, while the Latin version stems from **Publilius Syrus**. The verb «**μωραίνω**» of the Greek version has produced in English the words "**moron**" and "**moronity**". A strong modern Greek version (from Epirus) is «*Πρώτα παίρνει ο Θεός τη γνώση, κι ύστερα το βιο*» ("*First God takes out the knowledge, and after the life*" where *life* includes also the *living*). See details in Politis (1902).

Whom does He deprive of reason?

Alternative 2
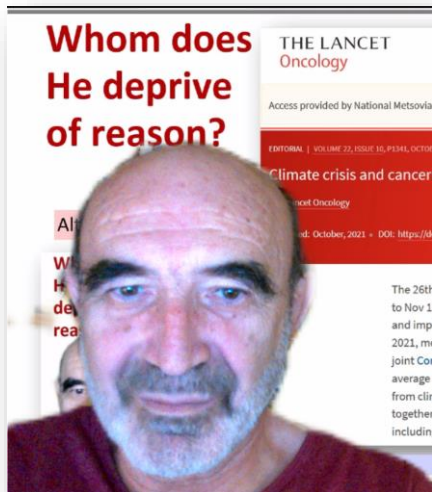
Alternative 1

THE LANCET
Oncology

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Climate crisis and cancer: the need for urgent action

The Lancet Oncology

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The 26th UN Climate Change Conference of the Parties (COP26), hosted by the UK from Oct 31 to Nov 12, 2021, will see world leaders coming together to tackle the ongoing climate crisis and implement measures to reduce carbon emissions to reach net zero by 2050. On Sept 5, 2021, more than 200 leading health journals worldwide, including *The Lancet*, published a joint Comment on the climate emergency calling for urgent action from world leaders to keep average global temperature increases to less than 1·5°C and reduce the impacts on health from climate change. The *Lancet* Countdown on Health and Climate Change is also bringing together experts from across the globe to assess how climate change is affecting our health, including cancer, and how the world, in turn, is responding.
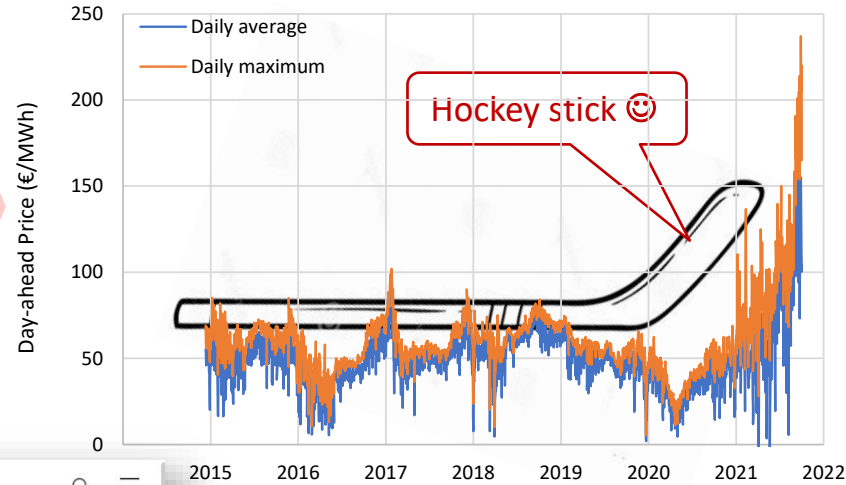
The Lancet Oncology (2021—published a week ago)

Whom does He deprive of reason? (2)

Nb.: The real wealth is energy

Alternative 3

Question A
What do we know about the perpetual change in climate?

Climate has been changing for 4.5 billion years

"**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
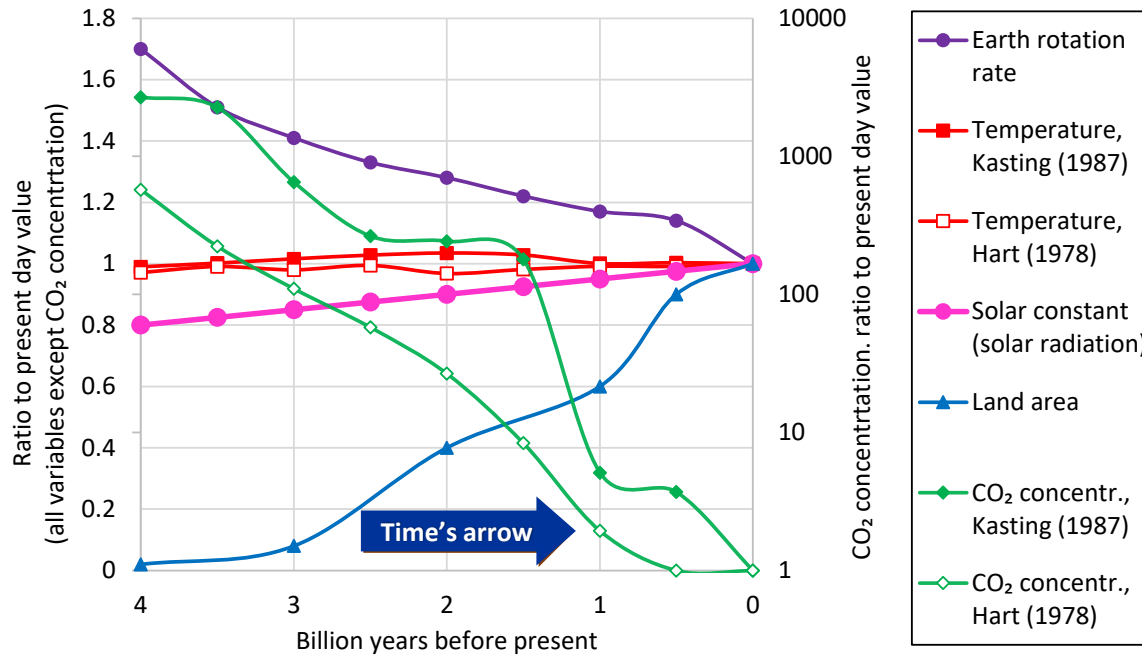
- The graph has been constructed from estimates by Kuhn et al. (1989). Temperature is expressed in K and corresponds to 35° latitude; a change in the temperature ratio by 10% corresponds to ~29 K.

- 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% (the faint young Sun problem; Feulner, 2012).

Co-evolution of temperature, CO₂ concentration and sea level in the Phanerozoic
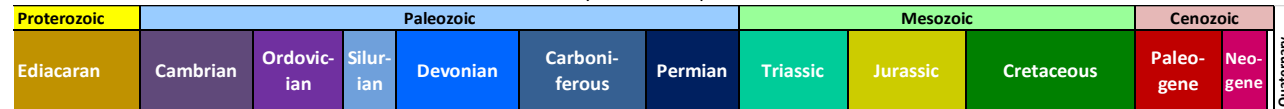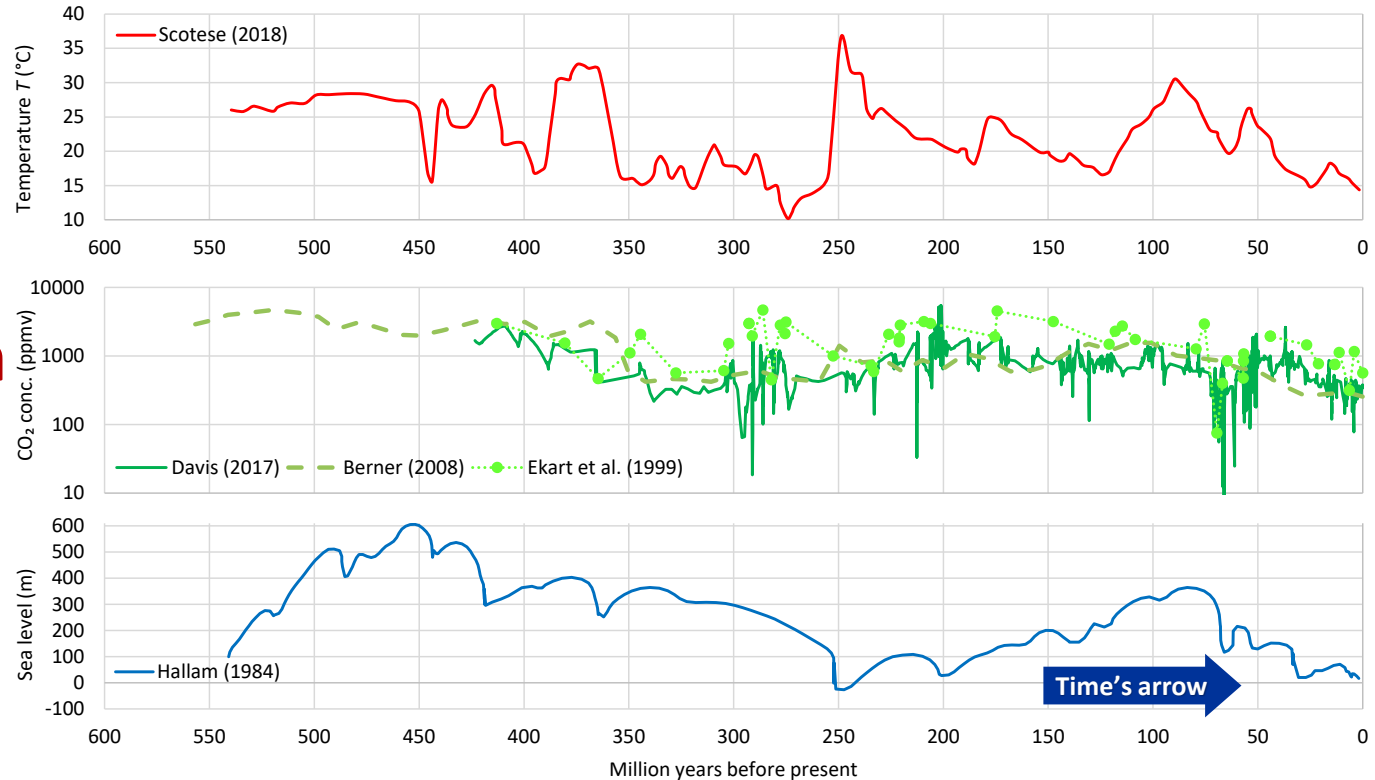
Instrumental data: The Roda Nilometer (the longest instrumental record on Earth)
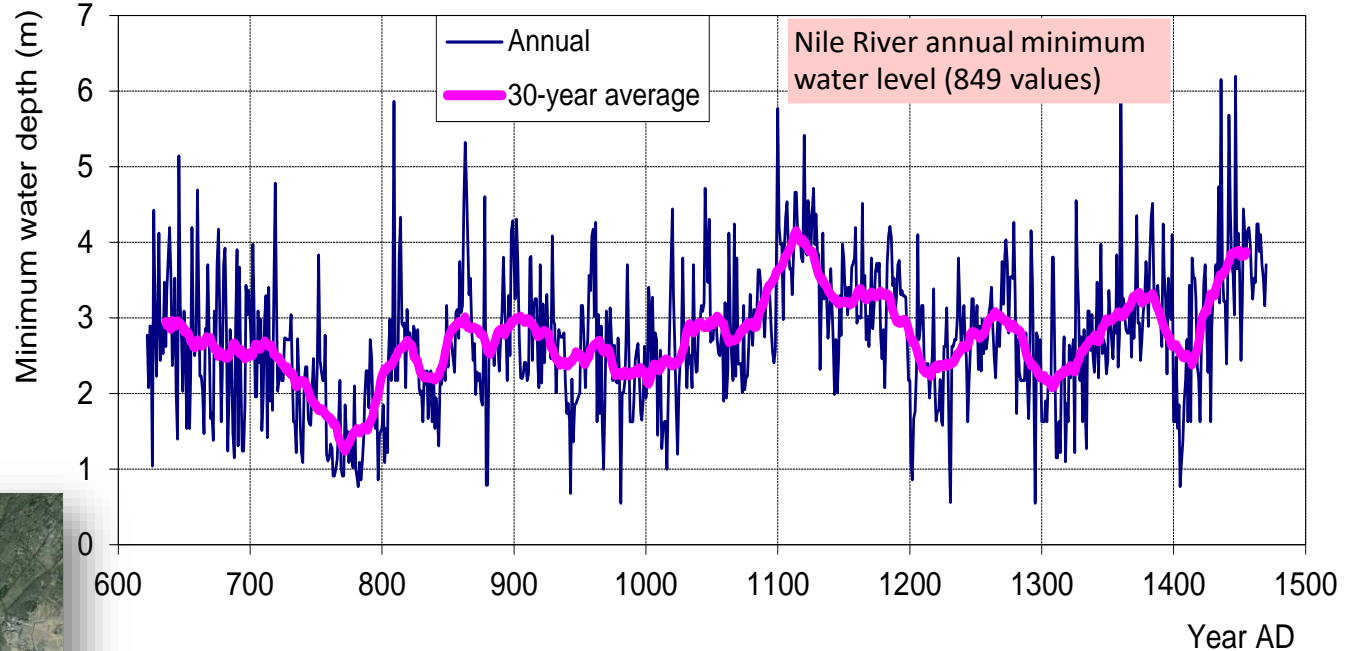
Nile River annual minimum water level (849 values)

Modern long records of instrumental data: Rainfall in Bologna

- The mean annual values for 50 years after 1820 show an upward trend. A classical statistical test for a linear trend using merely these data values would reject the stationarity hypothesis at a *p*-value of 7.7×10^{-4}.

- "Trends" are for kids. **Adults** use better descriptions of **long-term variability**, such as **Hurst-Kolmogorov (HK) dynamics**.

Dataset details Station: BOLOGNA, Italy, 44.50°N, 11.35°E, +53.0 m
Period: 1813-2018 (206 years)
Source of graphs: Koutsoyiannis (2021b)
Sources of data: also detailed in Koutsoyiannis (2021b)
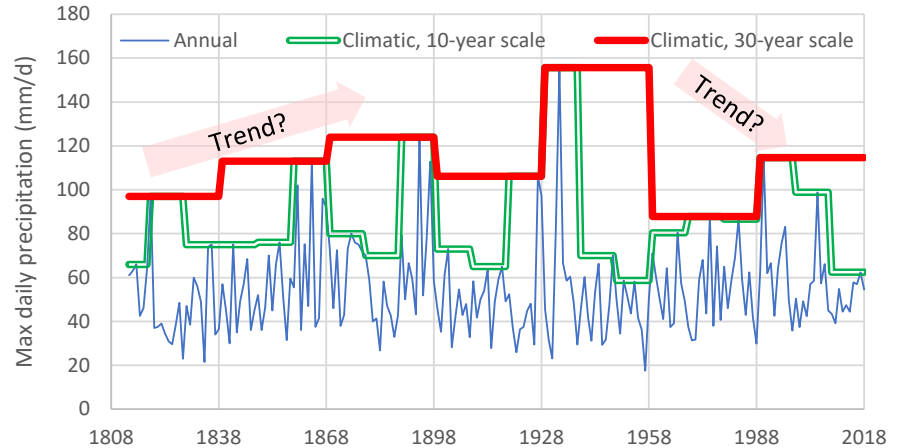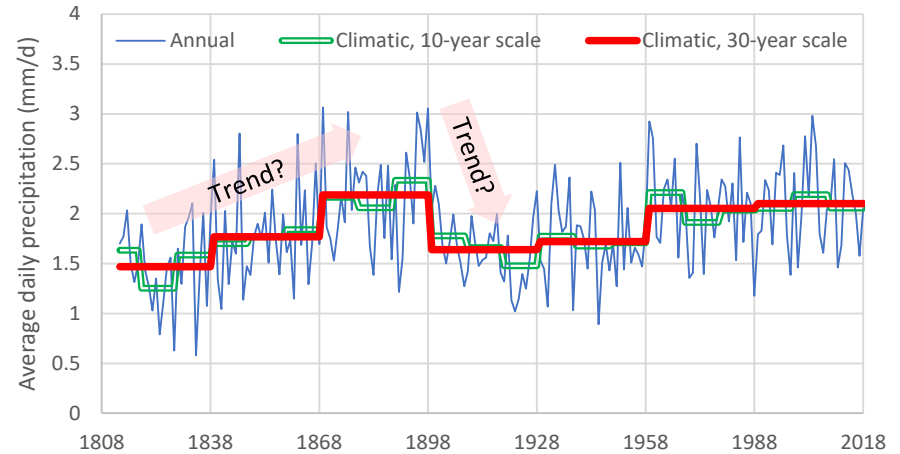
Catastrophic events: The Dust Bowl – the drought-related disaster in the Southern Great Plains in USA (1930s)

- During the 1930s, the USA experienced one of the **most devastating droughts**, which affected almost 2/3 of the country and parts of Mexico and Canada (Schubert et al., 2004).

- The drought became infamous for the numerous **dust storms** that occurred in the Southern Great Plains.

- **Dust clouds** from the Northern Great Plains **reached even the East Coast** and enveloped it from Virginia to New England (Lee and Gill, 2015).

Source of the photos: https://en.wikipedia.org/wiki/Dust_Bowl
Upper: A dust storm approaches Stratford, Texas, in 1935.
Lower: Buried machinery in a barn lot; Dallas, South Dakota, May 1936

Question B
Why climate mitigation does not make sense?
Reply: Mitigation presupposes prediction
but: *"Predicting is a guessing game for fools"*
(Schwab and Malleret, 2020; The Great Reset)*

*Interestingly, **World Economic Forum's "*The Great Reset*"**, while admitting the futility of predicting, builds upon predicting and, by mixing the "**Covid-19 pandemic**" (appearing 14 times) along with "**climate change**" (appearing 37 times), supports the idea of **a great reset** (see also Koutsoyiannis, 2021a).

Explanation why climatic predictions have been irrelevant to reality are provided in the next slides.

Does atmospheric water show intensification of hydrological cycle?

- IPCC (2013a) conjectured that the **water vapour** amount in the atmosphere **would increase** and the **hydrological cycle would intensify**.

- However, the water vapour amount is fluctuating—not increasing monotonically (**prediction falsified**).

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

Source of graph: Koutsoyiannis (2020); 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.
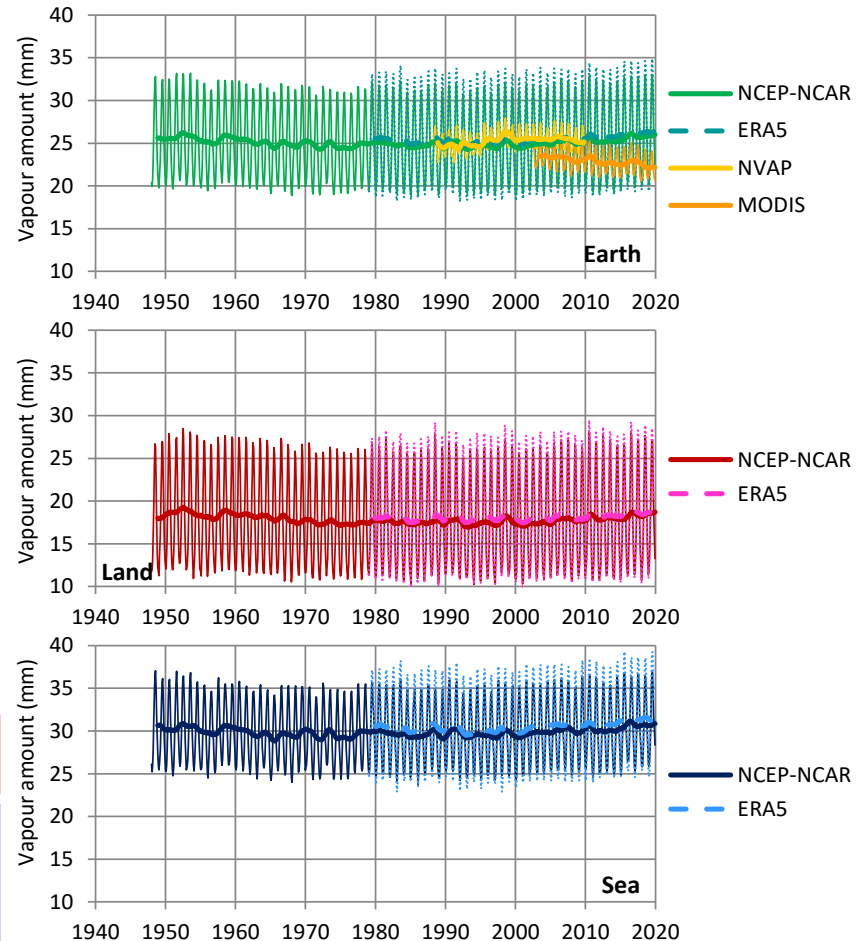
Do satellite data of the 21st century show increasing presence of water vapour amount?

- Both Terra and Aqua satellite platforms for all atmospheric levels suggest **decreasing** trends.
- Hence, the data are **opposite to the IPCC conjecture**. Apparently this suggests that climate models do not represent the physics correctly.

Total vertical column

From surface to 680 hPa (~3200 m)

From 440 hPa (~6500 m) to 10 hPa (~26 000 m)

MODIS-Terra   MODIS-Aqua

Source of graph: Koutsoyiannis (2020); 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.

Do precipitation and evaporation increase?

- Both precipitation and evaporation are **fluctuating**—not increasing monotonically.

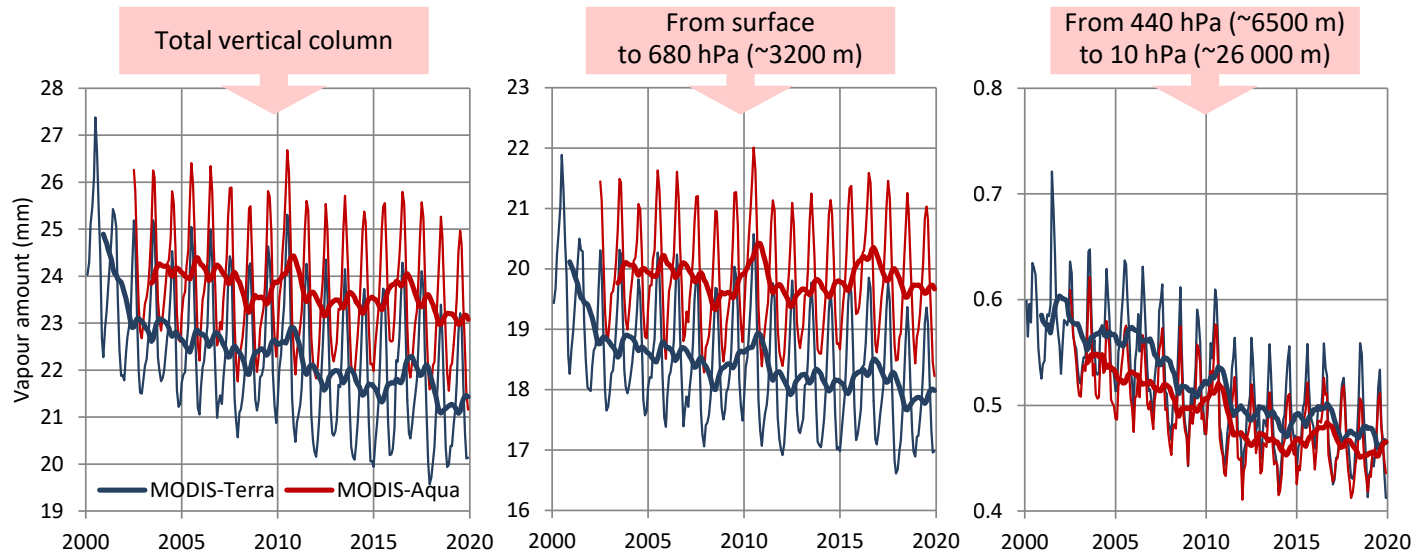- Hence, **the IPCC conjecture is falsified**.

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

Source of graph: Koutsoyiannis (2020); 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

Is monthly maximum daily precipitation increasing?

- The graphs show the variation of an index of **extreme rainfall**, which is the monthly maximum daily precipitation, areally averaged over the continents.

- In all continents, this index is **fluctuating**—not increasing monotonically.

- In particular, the satellite observations show **decreasing**, rather than increasing trends in the 21st century.

Thin and thick lines represent monthly values and running annual averages (right aligned).

Source of graph: Koutsoyiannis (2020); 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

Is daily precipitation variability 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.

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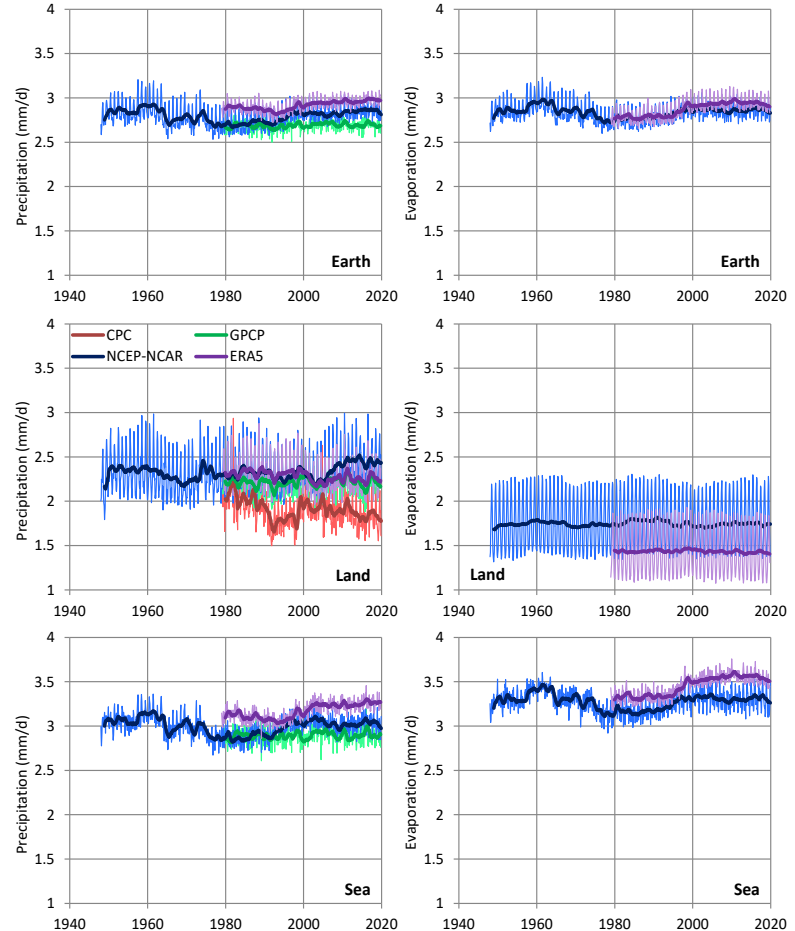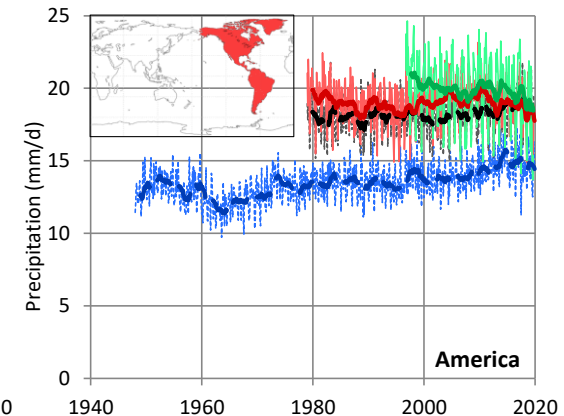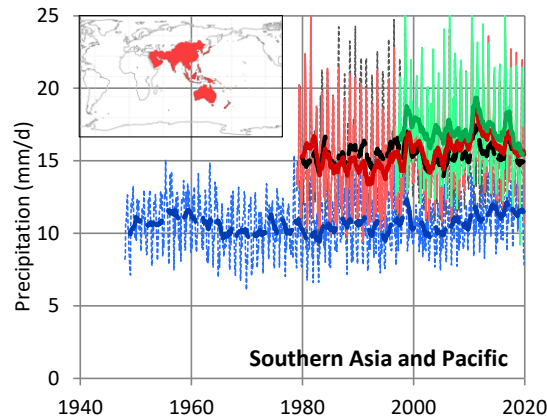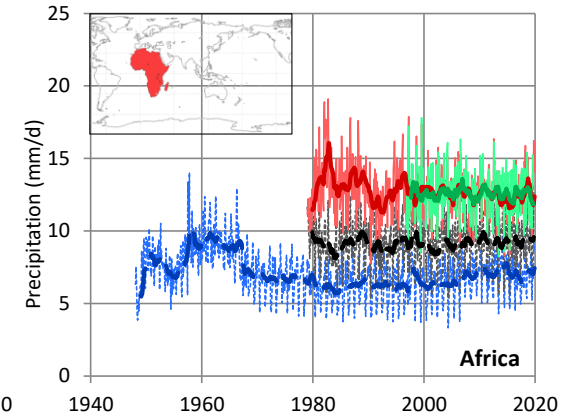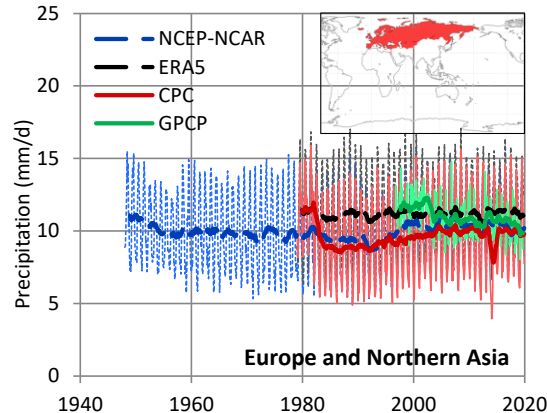

Source of graph: Koutsoyiannis (2020); gauge-based precipitation data gridded over land (CPC), and combined gauge and satellite precipitation data over the entire Earth (GPCP): http://climexp.knmi.nl
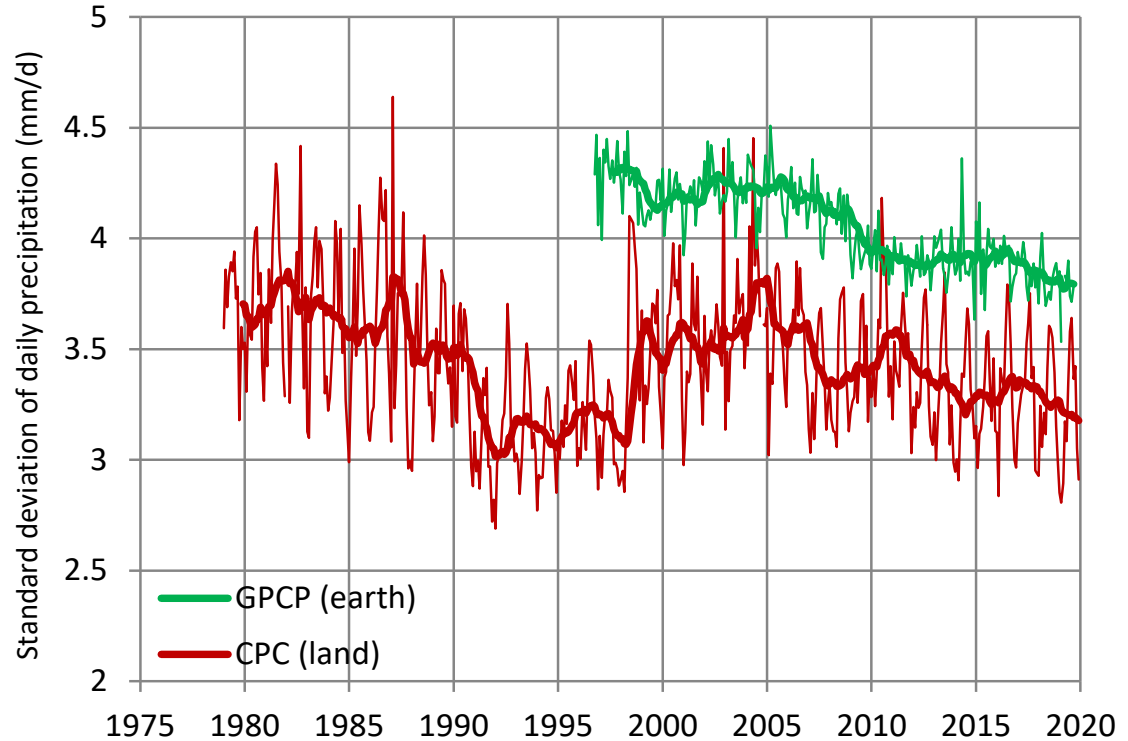
Do climate models provide guidance for the future?

- Short answer: No.
- Long answer: They have not provided skill for the past. Notice: (1) the **large error** of the "Multimodel" ensemble in terms of the mean; (2) the increasing trend of climate model outputs after 1980, which **did not appear in reality**.

Thin and thick lines represent monthly values and running annual averages (right aligned).

Source of graph: Koutsoyiannis (2020); observations come from the combined gauge and satellite precipitation data over a global grid (GPCP); climate model outputs are for the scenario "RCP8.5" (frequently referred to as "business as usual"); "Multimodel" refers to CMIP5 scenario runs (entries: CMIP5 mean – rcp85) and "Single model" refers to CCSM4 – rcp85 (ensemble member 0), where CCSM4 stands for Community Climate System Model version 4, released by NCAR. Data and model outputs are accessed through http://climexp.knmi.nl
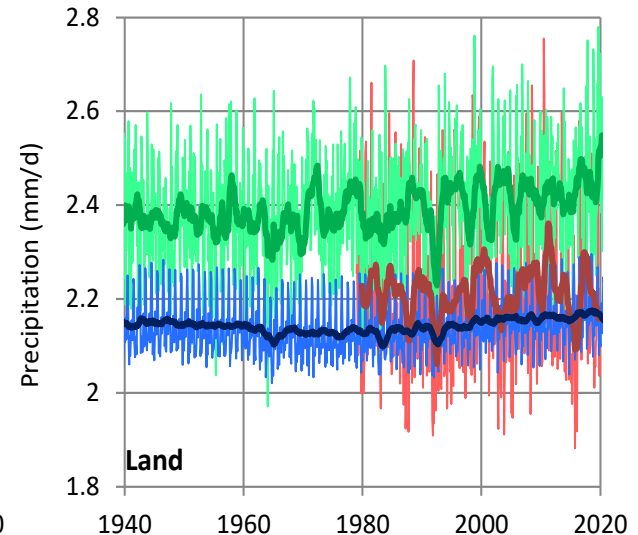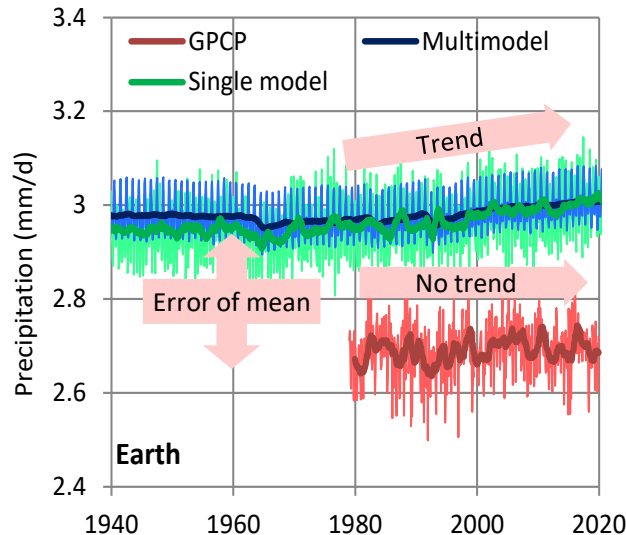
Do climate models reproduce real-world rainfall?

- Short answer: No.

- Long answer: Simulations of point rainfall have mostly **negative efficiencies**. Areal rainfall simulations are **irrelevant to reality** even at climatic scales.

Source: Anagnostopoulos, et al. (2010); see also reviews by Pielke Sr. (2017) and Essex and Tsonis (2018)

Comparison of 3 IPCC TAR and 3 IPCC AR4 climate models with historical series of more than 100 years length in 55 stations worldwide
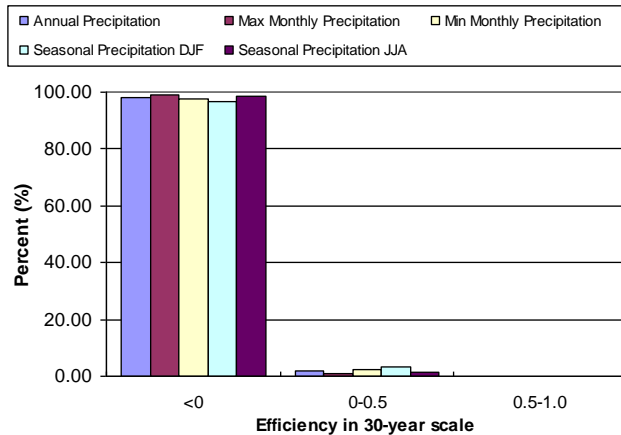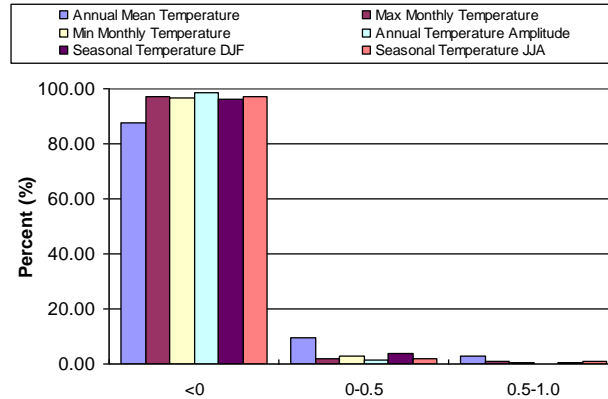
Comparison of 3 IPCC AR4 climate models with reality in sub-continental scale (contiguous USA)

Legend (top chart): Annual Mean Temperature, Max Monthly Temperature, Min Monthly Temperature, Annual Temperature Amplitude, Seasonal Temperature DJF, Seasonal Temperature JJA

Legend (middle chart): Annual Precipitation, Max Monthly Precipitation, Min Monthly Precipitation, Seasonal Precipitation DJF, Seasonal Precipitation JJA

Legend (right chart): Observed, CGCM3-20C3M-T47, PCM-20C3M, ECHAM5-20C3M

Efficiency: -97 to -375

Do climate models simulate the real-world rainfall extremes?

- Tsaknias et al. (2016—multirejected paper) tested the reproduction of extreme events by three climate models of the IPCC AR4 at 8 test sites in the Mediterranean which had long time series of temperature and precipitation.

- They concluded that model results are **irrelevant to reality** as they seriously underestimate extreme events.

Upper row: Daily annual maximum precipitation at Perpignan and Torrevieja; Lower row: empirical distribution functions of the data in upper row

Source: Tsaknias et al. (2016)
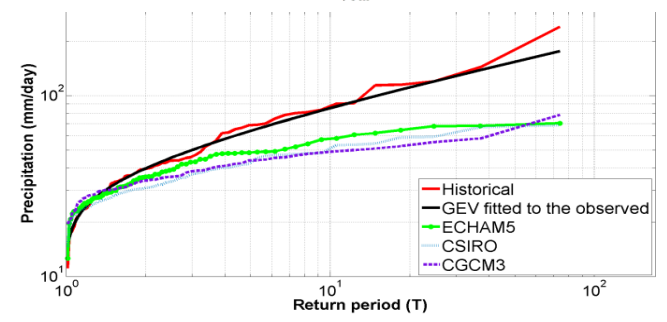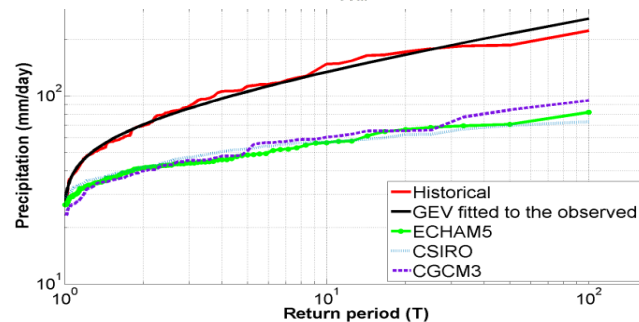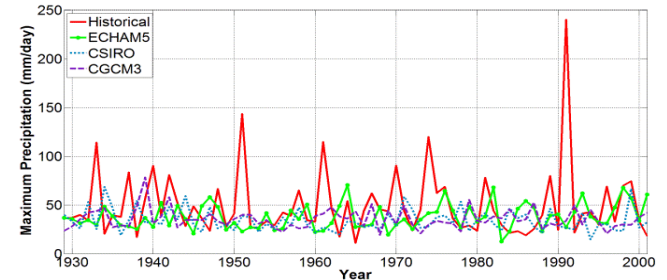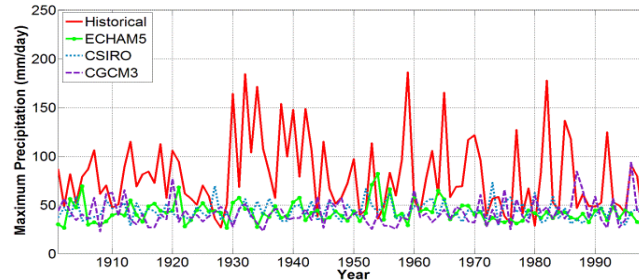
Question C
Why adaptation is always necessary– and effective?

Adaptation will be the dominant response

- It is **agnostic**
  - indifferent to natural *vs* human-caused changes

- It is **proportional**
  - adapt more if the change is greater

- It is **local**
  - politically palatable as spending is "here and now"
  - does not require global consensus

- It is **autonomous**
  - It will happen on its own

- It is **effective**

But adaptation is much easier if you're richer (and we know what we're adapting to)

Source: This slide is copied from Koonin (2021b) and is explained in Koonin (2015, 2021a).

Koonin also cites IPCC (2013b) according to which "*For most economic sectors, the impact of climate change will be small relative to the impacts of other drivers*".

He estimates that, even under extreme scenarios of temperature **increase by 8 °C**, the economic **impact on the global GDP will be less than 15%**.

Compare this with the economic impact of the increased price of energy in just one month.

Adaptation to natural disasters: Has it worked in the last century?

- The **risk from natural disasters** has been **spectacularly decreased**.

- Currently, it is in the bottom of the list of risks from all hazards.

- We **owe that decrease to engineering and technology**.

- Instead of casting pessimistic prophesies for the future, in the last century engineers improved hydro-technology, water management, and risk assessment and reduction.

Source: Koutsoyiannis (2021b).
Data from https://ourworldindata.org/world-population-growth;
https://ourworldindata.org/ofdacred-international-disaster-data
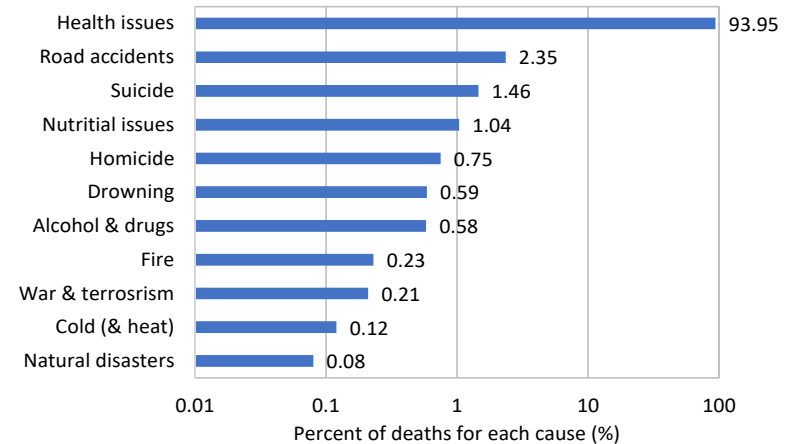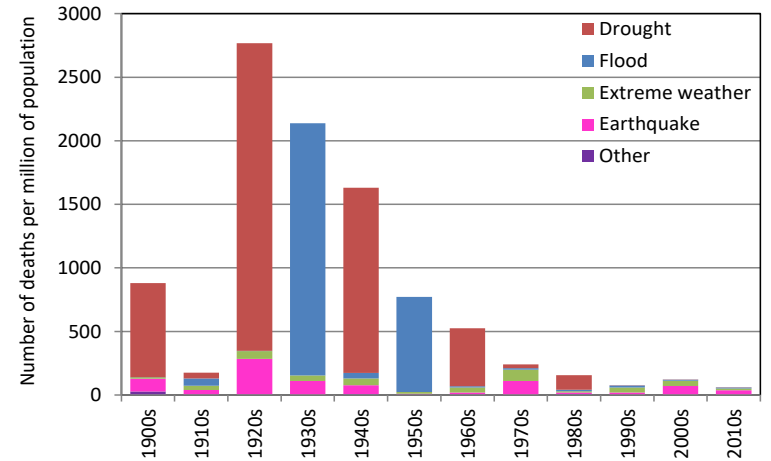
A success story of drought management by adaptation:

The Athens water supply and the 7-year drought around 1990
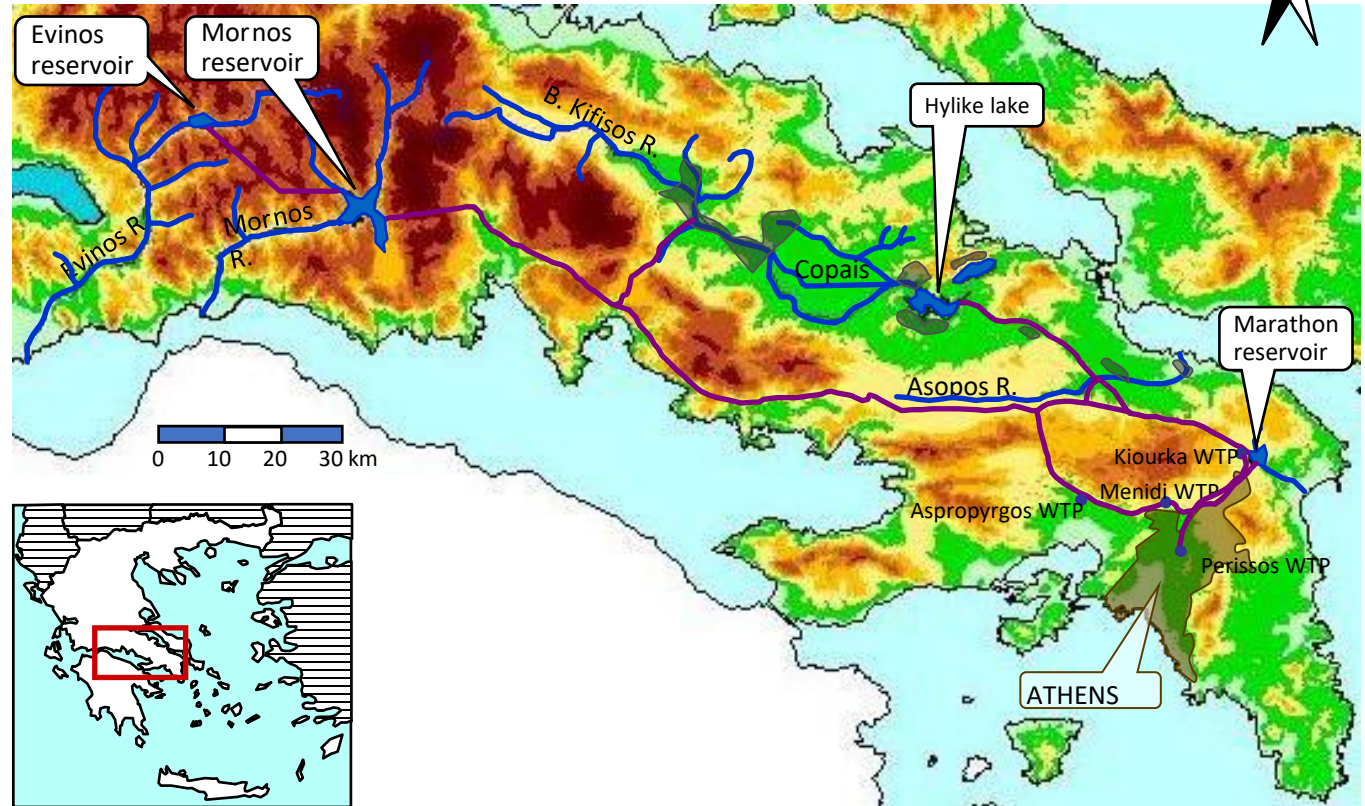
Climatic conditions at one of the catchments supplying Athens

The historical time series of Boeoticos Kephisos runoff up to 1986/87

A multi-year «trend» is observed

A similar «trend» in the rainfall time series

Explains the «trend» in runoff

Next was a shocking drought

Intense and persistent: Mean flow less than half compared to historical average; duration 7 years
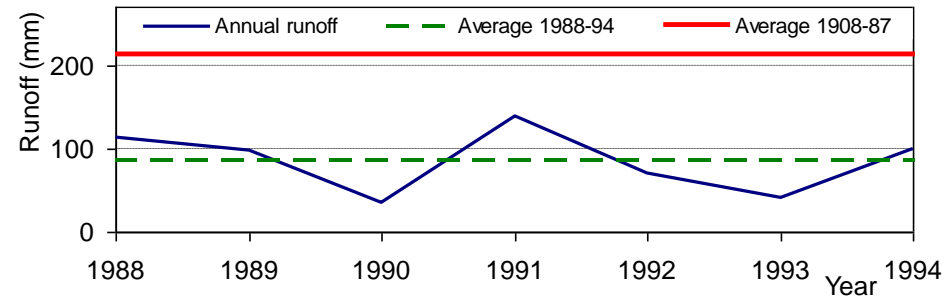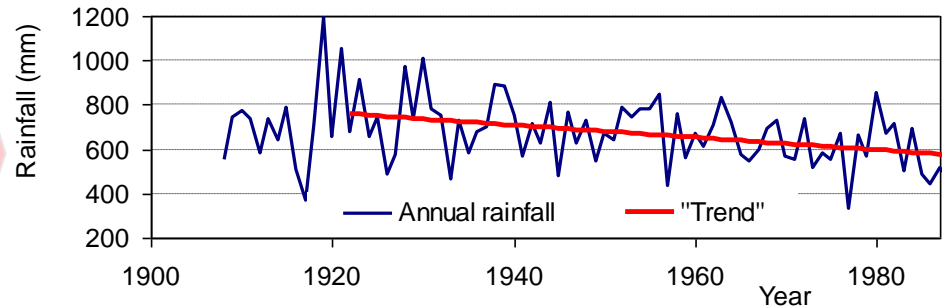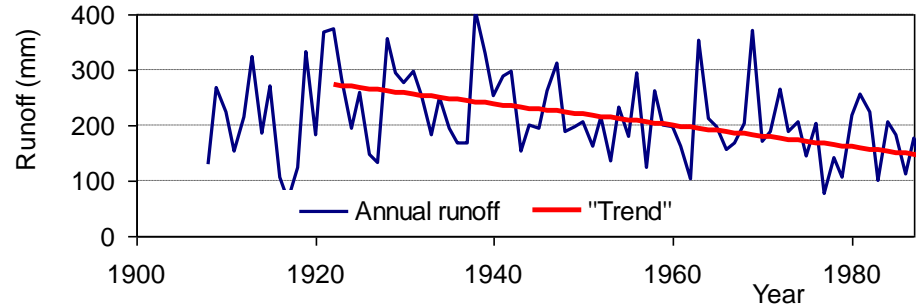
Handling the long-lasting drought in Athens

- Close collaboration of (a) the National Technical University of Athens, (b) the Athens Water Supply and Sewerage Company (EYDAP), and (c) The Ministry of Environment and Public Works.

- Understanding that droughts are **regular natural events**—not associated to human influences.

- Proper modelling the drought within a **stochastic Hurst-Kolmogorov framework** (Koutsoyiannis, 2011).

- Development of a sophisticated **decision support system** (Koutsoyiannis et al., 2003).

- Transparency and veritable information to the **population** of Athens, and its **engagement in the management of the crisis**.

- Design and implementation of an increasing block rate **pricing structure**, combined with water **conservation legislation measures** (Xenos et al., 2002).

- Increased water supply through **technological measures** (see next slide).

Results of the crisis management

- **Not even in one house in not even one day** throughout this 7-year period was there a **water supply failure** due to the drought.

- The water **consumption** of Athens was **decreased by 1/3**.

- New groundwater resources were exploited.

- **In 1.5 year**, a new tunnel was constructed and operated, **diverting water from the Evinos River** to Athens.

- In another 4 years, the new dam on the Evinos River was completed, thus increasing the water quantity transferred to Athens.

- Now Athens has a perfect water supply system.

A plausible scenario for handling the next drought in Athens

- The drought will be attributed to the **anthropogenic climate change**.

- It will be managed by the newly established **Greek Ministry of Climate Crisis**.

- Climate modellers will be appointed to run global and regional climate models, which will predict that the situation will be persistently worsening in the coming years.

- Urgent measures to **immediately shut down the lignite power stations** will be taken.

Rejected approach 1: Based on climate-models

- Outputs from **3 climate models for 2 future scenarios** were used (Koutsoyiannis et al., 2007).

- The **original climate model outputs** (not shown) had **no relation to reality** (highly negative efficiencies at the annual time scale and above).

- After adaptations (or "**cosmetic lifting**", also known as "downscaling") the climate model outputs improved with respect to reality, thus achieving about zero efficiencies at the annual time scale.

- **For the past**, despite adaptations, the proximity of models with reality was **not satisfactory.**

- **For the future**, the runoff obtained by adapted climate models was **too stable**.

- **Conclusion: It is dangerous** (too risky) **to use climate model projections**.

Boeoticos Kephisos runoff produced with downscaled climate model outputs, superimposed to Monte Carlo confidence limits (MCCL) produced with HK statistics under stationarity
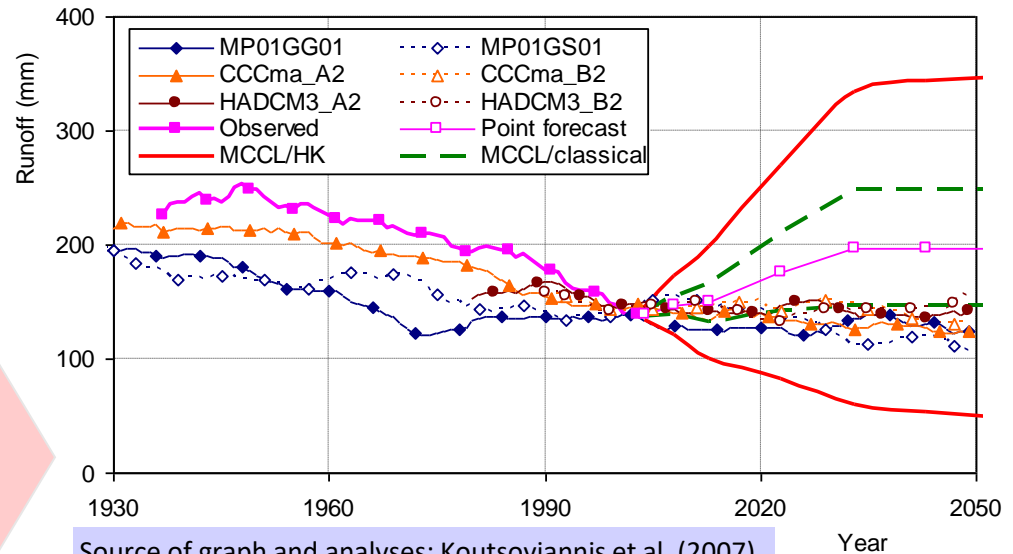
Source of graph and analyses: Koutsoyiannis et al. (2007).

Rejected approach 2: Trend based

- The "trend model" is **worse than** that of a constant average (see table).

- According to the "trend model", the flows would **disappear** a little after 2050...

- In reality **all three reservoirs spilled** in 2006 and again two of them in 2020 and 2021.

- **Conclusion**: It is **absurd** to use such simplistic methods such as **trend extrapolations**.

Source: Koutsoyiannis (2021b).
See additional evidence about the inappropriateness of trends in Iliopoulou and Koutsoyiannis (2020).

Root mean square errors (in m³/s) for the two validation periods for the linear-trend model and the constant-mean model, fitted to the calibration period (1937-87)

Validation period	1907-37	1987-2019
Assuming linear trend	13.4	12.7
Assuming constant mean	9.3	10.3

Boeoticos Kephisos runoff and projected trend
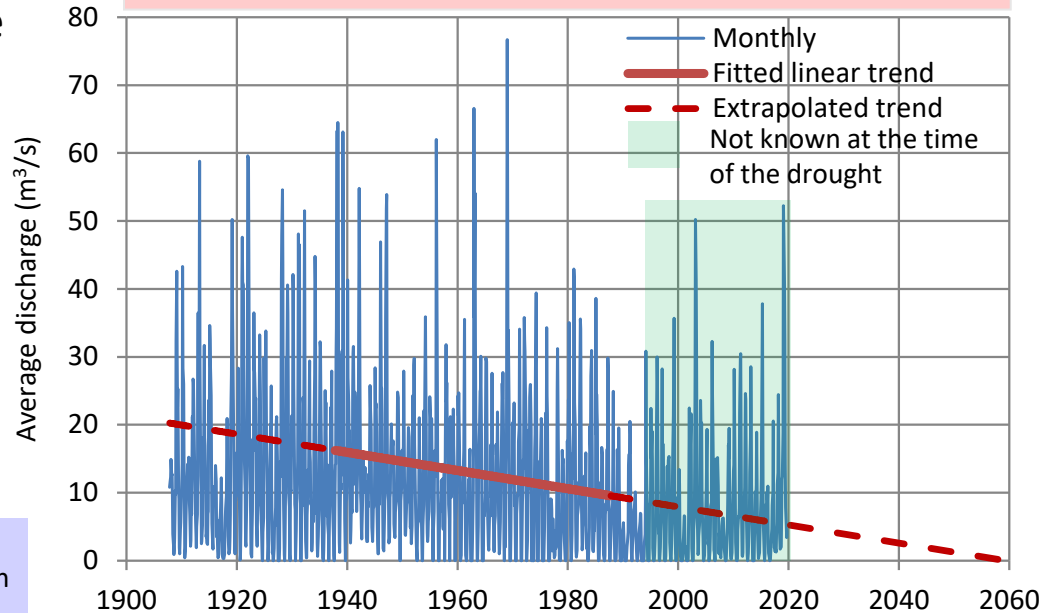
Concluding remarks

- Change is Nature's style. It occurs at all time scales.

- Change is unpredictable.

- *"The future is unknowable, but the past should give us hope"* (Winston Churchill, 1958).

- In the past, adaptation has been the humans' response to change.

- If we return to reason, this will also be the case in the future.

- Technology has augmented the human ability of adaptation. The results have been spectacular in the last century.

- Human adaptation requires human intelligence. On the contrary, «μωρία» (moronity) results in devastation.

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