This is the print version of the Skeptical Science article 'Akasofu Proved Global Warming is Just a Recovery from the Little Ice Age ', which can be found at http://sks.to/akasofu.

Akasofu's Magical Thinking was Wrong

What The Science Says:
Akasofu's argument is based on magical thinking and curve fitting without any physical explanation. Climate changes must have a physical cause, for example the increased greenhouse effect.

Climate Myth: Akasofu Proved Global Warming is Just a Recovery from the Little Ice Age

> "The rise in global average temperature over the last century has halted since roughly the year 2000, despite the fact that the release of CO_2 into the atmosphere is still increasing. It is suggested here that this interruption has been caused by the suspension of the near linear (+ 0.5 °C/100 years or 0.05 °C/10 years) temperature increase over the last two centuries, due to recovery from the Little Ice Age..." (Syun-Ichi Akasofu)

The following rebuttal is excerpted from Nuccitelli et al. (2013).

While there are a number of errors in Akasofu (2013), here, only the most critical ones will be addressed, for sake of brevity. There is no particular ordering of importance; each of these errors is significant on its own.

Lack of Physical Mechanisms

The author describes the global mean surface temperature (GMST) record as partly a linear temperature increase caused by a recovery from the LIA. However, a recovery is not a cause and in fact, the author offers no physical mechanism that would reportedly cause such a temperature increase. The author also assumes the linear GMST warming trend will continue indefinitely, despite lacking any proposed physical cause. According the conservation of energy principle, only an energy imbalance at the top of the atmosphere (TOA) could cause a long-term GMST increase.

Even if there were some (hitherto unidentified) energy imbalance that occurred during the LIA, the Earth would relax to a new equilibrium temperature that would consist of rapid initial heating followed by slow heating as the new equilibrium is approached.

The exact opposite has been observed: a slow increase in GMST in the early 20th century, followed by more rapid temperature increases in recent decades. This observation strongly argues against relaxation from an LIA energy imbalance being responsible for the current global warming.

Furthermore, thermal systems do not contain “memory” of past climate states, as inferred by Akasofu (2013). Changes to the total energy of the Earth system are dictated by present energy balances, not by prior climatic states.

Claim of a Halt to Present Heating

The status of the Earth energy balance, and the consequent heating, cooling, or stasis of its temperature can be determined in a number of mutually supporting ways. Perhaps the easiest is to measure changes of the energy stored in the Earth thermal reservoirs, principally the oceans, but also the cryosphere, land, and atmosphere.

There is a wealth of published studies that conclusively show the Earth thermal reservoirs are gaining heat. A careful review of the literature shows that not only are the Earth’s oceans heating, but that the heating has generally increased in recent decades. It is found that heating rates from 1970–2012 are lower than rates

measured from 1980–2012, which in turn are less than 1993–2012 rates.

Other studies have incorporated ocean heat content measurements along with other non-oceanic reservoir storage. They too conclude that the Earth is currently gaining energy (heating) with no halt or even deceleration.

Many studies have used satellites to measure the differences in incoming and outgoing radiation at TOA. Satellite missions such as Clouds and the Earth's Radiant Energy System (CERES) can provide measurements of sufficient accuracy and duration required to balance energy. TOA measurements show that the Earth is currently experiencing an energy imbalance (a net gain of thermal energy) and consequently heating.

The third way to estimate Earth energy imbalance is by thermosteric ocean expansion and associated sea-level rise. Other contributors to sea-level rise are increases in ocean mass through melting of land-based ice and changes in the global distribution of water. Climate scientists use these three methods to provide independent verification that the Earth is, in fact, unbalanced with respect to thermal energy.

The disclosure of continued sea level rise in Akasofu (2013) invalidates the claim that the Earth warming has halted. This claim is also invalidated by recent measurements of ocean heating or TOA radiation, as described in the foregoing. To the best knowledge of the authors, there are no studies that show the Earth is not currently gaining thermal energy and heating.

It appears that the claim of a halt to the Earth heating is based in part on an opinion article that is strongly contradicted by an extensive body of peer-reviewed research, only some of which has been listed here. The claim for a halt to Earth heating furthermore cannot be determined solely by considering atmospheric temperatures; the atmosphere thermal reservoir is responsible for approximately 2% of heat uptake and is subject to significant short-term variability (e.g., ENSO) that in the short-term may mask long-term trends.

Lack of a Two-Century Linear Temperature Increase

Among the claims made in Akasofu (2013) were that a linear temperature increase has occurred over the past two centuries, with a superimposed cyclical GMST influence from the PDO. It is generally accepted that instrumental GMST records can be extended back to the 1850–1880 time period. There is no recognized repository of instrumental GMST data that predate ~1850. In support of our claim, Figure 1 in Akasofu (2013) begins circa 1850 and extends to near the present time—not a two-century duration.

Temperature information further back into time must be gathered by natural proxy reconstruction. Proxy reconstructions are less certain than the instrumental record and their accuracy must be discussed when temperature trends are derived. While proxy temperature information was presented in Akasofu (2013), the accuracy and resolution of these proxies was not discussed. Further, the methodology of connecting proxy records to the instrumental record was not discussed.

Central to the claim of linear temperature increase is Figure 3 contained in Akasofu (2013). The author states that "all these results clearly show near linear increases in temperature from about 1800–1850 to 2000." It is the responsibility of the author to mathematically show what is, in our opinion, not correct. To evaluate whether a non-linear trend line better fits the data, Figure 1 has been prepared that shows linear and quadratic trend lines fit to the 1850–2010 data. It is apparent that the quadratic fit yields significant improvements compared to the linear fit. Separate calculations of the trend line residuals confirm this visual conclusion. The present authors here note that even though higher order polynomials fit the data better than a linear choice, here too, no physical mechanism is applied. This is, in truth, a pure mathematical exercise and of little value interpreting climate physics.

Our conclusion that a linear fit is inappropriate is reinforced by Figure 5 from Akasofu (2013). That figure shows a callout box that superimposes a low quality linear approximation to actual temperature information (HADCRUT4). The linear-fit conclusion is also contradicted by Figure 1 in Akasofu (2013), which shows a series of linear trend line fits to temperature data, extending back to approximately 1860. In the legend of the figure, the more recent trend line slopes are more positive which reflect a faster temperature increase in recent decades as opposed to a constant linear trend.

Failure to Consider Many Known Climate Forcings

Aside from the errors with quantitative information, as outlined in the preceding sections, the author

of Akasofu (2013) makes severe errors of omission that demonstrate significant misunderstandings of the intricacies of the Earth's climate. Many factors, aside from carbon dioxide, influence the climate. Some factors are natural (solar variability, orbital changes, volcanoes, natural greenhouse gases, etc.) while others are human-caused (human-emitted greenhouse gases, land-use changes, aerosol production, etc.). The discussion of early 20th century temperature changes must include these other factors. For instance, it is currently believed that the early 20th century temperature increases had a number of instigators, among them increased solar activity and land use changes. In the middle part of the 20th century, anthropogenic emissions of aerosols are thought to be primarily responsible for a temporary cessation of heating. Other factors, such as changes to ocean temperature measurement systems and improvements to the worldwide network of atmospheric measuring capabilities impact the Earth's temperature record.

In the later part of the century, increases in greenhouse gases, particularly CO2 but also nitrous oxide, methane, CFCs, etc. have allowed the human greenhouse effect to play an increasingly dominant role in climate change.

The very simplified, and incorrect, attribution of temperature changes to CO2 as a rhetorical argument is short-sided and demonstrably incorrect.

Mistaken Carbon Dioxide Forcing

A final error is made in relation to the climate forcing caused by CO2. It is well known that the radiative forcing for greenhouse gas concentration changes is not linear with respect to the concentration. For CO2 for instance, the radiative forcing varies with the log of the concentration. The claim in Akasofu (2013) that the presence of a linear increase in temperatures coinciding with a near quadratic increase in CO2 is not, as the author suggests, problematic (even if it were to be occurring).

A proper prediction of the rate of Earth temperature increase would require a knowledge of the rate of change of CO2 and other greenhouse gases, along with changes of other human and natural climate forcings.

Conclusions

While there are other serious shortcomings in Akasofu (2013), for sake of brevity, only some are mentioned here. These errors and misinterpretations lead readers to the mistaken conclusion that GMST can simply be constructed by superposition of a long-term linear trend and a multi-decadal oscillation.

The most critical errors, which are reported here, include the lack of a physical mechanism which has caused the long-term GMST rise, the mistaken statement that global warming has halted, the poorly chosen linear approximation to the Earth's atmospheric temperature evolution, the failure to recognize climate forcings other than CO2, and the misunderstanding of the strength of CO2 as a greenhouse gas. Any one of these errors would render the conclusions drawn in Akasofu (2013) suspect.

It is reasonable, as the author suggests, to consider that the Earth's temperature variations that have a natural component related to multi-decadal ocean oscillations. It is also true that recent atmospheric temperature measurements have significantly slowed their increase compared to previous years. Exploration of the role of the PDO in moderating temperature increases and in distributing heat more efficiently to deep ocean zones is a useful and important endeavor. However, the method carried out in Akasofu (2013) makes errors of such gravity that the central conclusions cannot hold.

Advanced rebuttal written by dana1981

Update July 2015:

Here is a related lecture-video from Denial101x - Making Sense of Climate Science Denial

[*see video at **this link.***]

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