Review Article

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Why is the Ocean Heat Annual Increase Seven Times that of Global Warming?

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ABSTRACT

Errors, in The Earth's internal heat is leaking into the ocean in amounts that exceed the global warming heat, are addressed. The estimate of global warming is about 0.4°C too low, which causes an overestimate of the time until global warming reaches the IPCC 1.5°C limit. The ratio of the ocean heat content to the global warming heat is corrected. How seafloor stresses may be caused by the increasing temperature differences between the land-ocean and the seafloor is hypothesized.

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Introduction

The World Meteorological Association (WMO, 2025) estimates global warming since the pre-industrial era to be 1.55°C, based on six different time series of global warming [1]. Previously, global warming was taken as, e. g., "the land-ocean temperature index" (NASA, 1880–) [2]. Herein the NASA global warming record is estimated by an exponential least squares approximation starting in 1947, and is then extrapolated back to the pre-industrial year 1740 when global warming was arguably zero. Sea level rise is used to estimate the ratio of the rates of increase of the outsized ocean heat content to the global warming heat [3-5]. The cause of the outsized ocean heat content is reexamined with respect to the temperature difference between the colder seafloor and the warmer land-ocean.
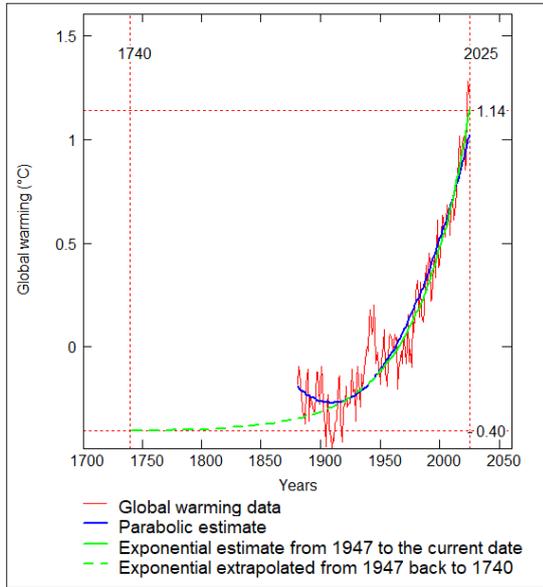
Global Warming Estimate

Figure 1 shows a least squares approximation of the NASA global warming since 1880 which does not explicitly account for the global warming rise since the pre-industrial period [2].
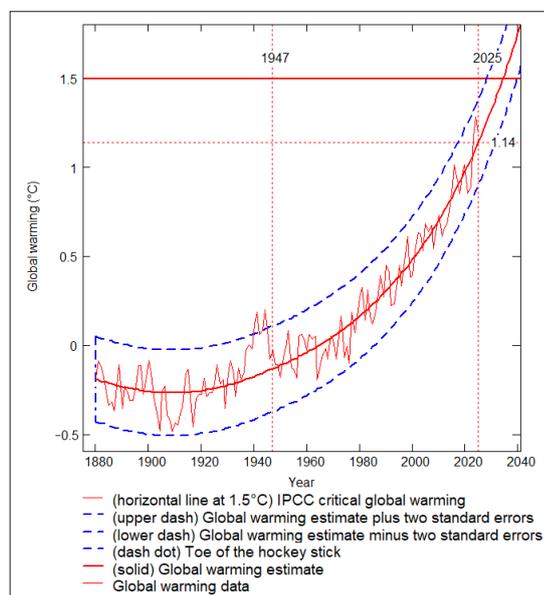

Figure 1: NASA Global Warming vs. Year

This estimate is a parabolic approximation of the data since 1880 concatenated with an exponential approximation of only the data since 1947, when the parabola agreed closely with the exponential, but could not keep up with global warming.

Figure 2: Global Warming Estimates of NASA Data Since 1740

Figure 2 shows the NASA global warming data and the two estimates. The exponential is extrapolated back to 1740 that is arguably the start of the Industrial Revolution when global warming was 0°C. Figures 1 and 2 show the 1.14°C estimate of the current NASA global warming. However, if the global warming axis values are adjusted so that global warming is 0°C in 1740, then the current global warming estimate is boosted to 1.54°C . From Figure 4 of [3], wherein the large annual swings of the global warming data are seen to be systematic, the mean and standard deviation of the exponential global warming differences between NASA global warming and another global warming record, divided by $\sqrt{2}$, are both 0.02°C from 1947 to 2024, so the IPCC 1.5°C limit may already be breached as shown in Figure 3[3,6].
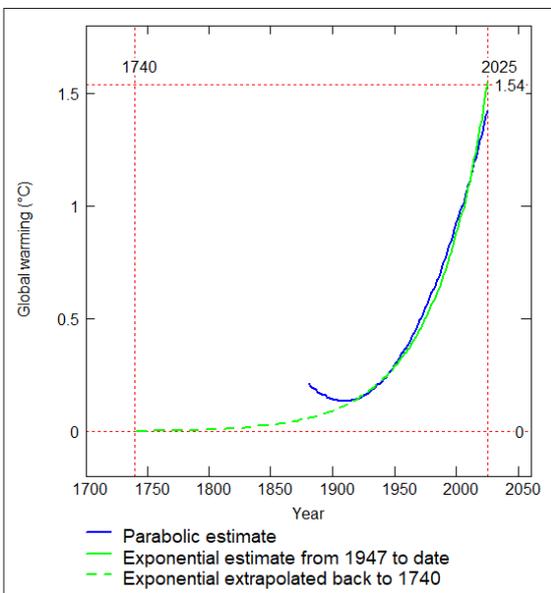

Figure 3: Global Warming Estimates of NASA Data Adjusted to Show 0°C of Global Warming in 1740

A more accurate analysis of global warming data that uses six global warming records, including both records used in [3], agree in a statistically combined time series that global warming is 1.55°C (WMO, 2025), so the IPCC 1.5°C limit has definitely been breached [1,3].

The Ratio of the Rates of Change of the Ocean Heat Content to the Global Warming Heat

Figure 4 shows relationships among annual rates of change of heat in reservoirs, and corrects Figure 7 of [3]. ΔOHC and ΔGWH are the rates of change of ocean heat content and global warming heat, respectively [3,5].
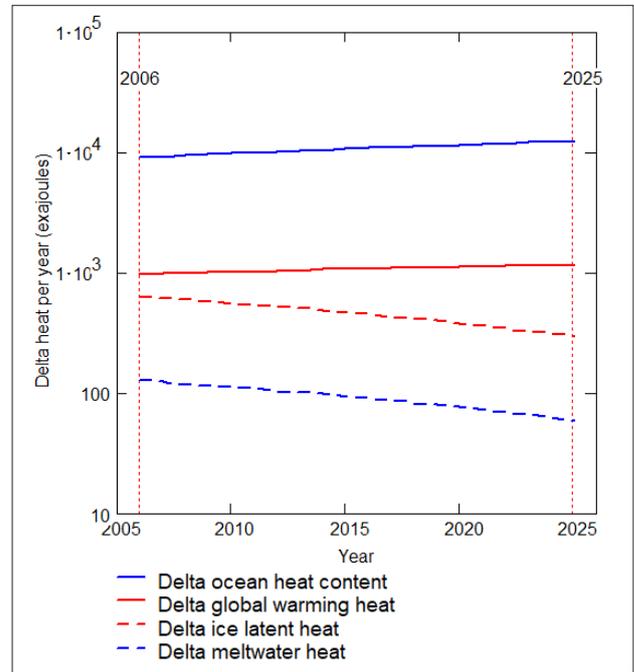

Figure 4: Corrected Estimates of Annual Heat Increments

The annual change in the meltwater heat , in Figure 7 of [1], is erroneously shown as larger than the annual change in the ice latent heat . Figure 4 is based upon the NASA global warming being 1.54°C in 2025, but if the current global warming is taken as 1.14°C, then the curves do not change, because their rates of change are independent of their history [3].

The sea level rise, the 16°C average temperature of the ocean, the specific heat capacities of water and ice, and the specific latent heat of fusion of ice are used in calculating the dashed curves. Ninety-one percent of the global warming heat is in the ocean [4,7,8]. The ratio of the rates of change of ocean heat content to

global warming heat is then $ratio = \frac{\Delta OHC + \Delta MWH}{\Delta GWH + \Delta ILH} - 0.91$. The $\Delta MWH > 0$

are the annual differences in the freezing cold meltwater heat warmed by the 16°C ocean [7]. This heat is supplied by the ocean heat content. The $\Delta ILH > 0$ are the annual differences in the ice latent heat that is absorbed by the ice during melting. This heat is supplied by the global warming heat. The global warming heat and the ocean heat content are assumed to be independent.
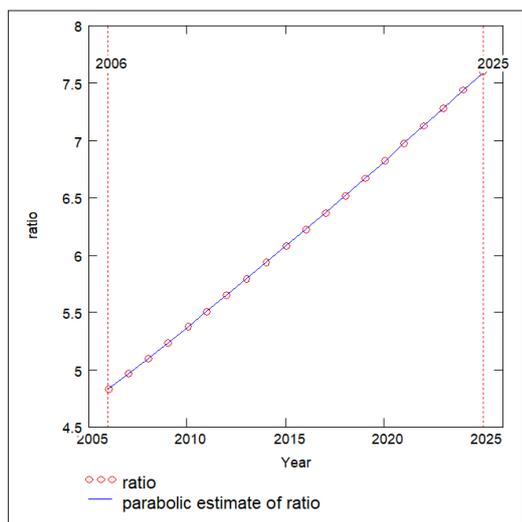
Figure 5: $ratio = \dfrac{\Delta OHC + \Delta MWH}{\Delta GWH + \Delta ILH} - 0.91.$

The Figure 5 curve shows that the ratio is a concave-upward parabola. The rate of increase of the ocean heat content now exceeds seven times that of the global warming heat. By a process of elimination, this outlandish increase of the ocean heat content since about 1969 must originate from the Earth's internal heat [9].

Stresses and Strains in the Earth's Crust
An error in describes a hypothetical continuous belt of molten rock poured in a great circle around the earth before the Industrial Revolution [3]. The ring has been subjected to the global warming temperature rise. If the ring is floating on the ocean, then the scenario in is not in error, but if the ring rests on the seafloor, then the undersea part of the ring will not be as much affected by thermal expansion of the Earth as the part on land, because the increase in the ocean heat content at 1100 fathoms is only one-eighth that at the surface [3,10]. Furthermore, the average ocean depth is deeper yet, about 2000 fathoms [11]. In contrast, hotspots at the surface can erupt, can cause molten lava to flow into the ocean, and can have expanding undersea hydrothermal vents that can increase ocean heating. The hotspots and vents will be enlarged by the thermal expansion of the Earth. However, exactly how the Earth's internal heat is causing the outsized increase in the ocean heat content is unknown because the positions and ocean heat contributions of all the undersea thermal vents have not been measured [12].

The thermal expansion of the warmer land is not the same as the thermal expansion of the colder seafloor because the warming land pulls the seafloor upward. These forces are increased by the higher coefficient of thermal expansion of granite that underlies the warmer land vs. the lower coefficient of the basalt that underlies the cooler seafloor [13,14]. These forces could cause cracking of the seafloor and result in new leakage of the Earth's internal heat into the ocean, because rock is relatively weak in tension as compared to compression. In short, it is not obvious if or whether the shape of the Earth is being changed by global warming.

Assumptions and Approximations
Smooth estimates of noisy data make possible its noise-free numerical differentiation. Annual data of global warming, ocean heat content, global warming heat, and sea level rise are noisy, so they are estimated by smooth least squares approximations. The global warming heat is assumed to be independent of the ocean heat content. The least squares approximation of the exponential global warming is computed by the Levenberg-Marquardt method [15-17].

Summary and Conclusions
The IPCC 1.5°C global warming limit has been breached. The ratio of the ocean heat content to the global warming heat has increased from 4.8 in 2006 to 7.6 in 2025. By a process of elimination, the Earth's internal heat must be causing the outlandish rise in ocean heat content. Global warming may be changing the shape of the Earth.

Appendix Disclaimer
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