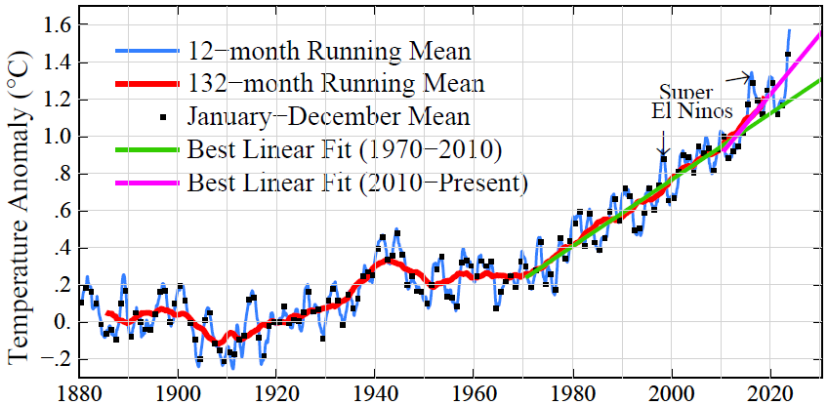

Fig. 1. Global temperature relative to 1880-1920 based on the GISS analysis. [1,2] **Warming rate is 0.18°C/decade for 1970-2010, 0.32°C/decade for 2010-present.**

The World Will Cool Off – A Bit – and Other Good News!

27 June 2024

James Hansen, Makiko Sato, Pushker Kharecha, Leon Simons

Abstract. We note news about successful actions to reduce human-caused climate change, based on initiatives of young people supported by Our Children's Trust. But first we address misconceptions about the current unprecedented global warming rate.

"The Big Story" (titled *Scorching heat wave may portend climate future*) in *The Hill* last Thursday quoted Jonathan Overpeck, dean of the School for Environment and Sustainability at the University of Michigan, as saying, now that the El Nino has ended "we're really looking at the next few months to **tell us whether something dramatic is surprising us** in the global temperatures. If it starts cooling off, [and] it hasn't started to do that yet, we can ascribe [these] more unusual temperatures to the El Nino. If it keeps rocketing up, we'll have to think about **why climate change [is] accelerating**." [emphases are in *The Hill* article]

Although what Jonathan said is consistent with what some others are saying, we're concerned about potential public misunderstanding. The world will soon start to cool off (see below), but that does not mean that we can ascribe the current unusual global heating to El Nino. Also, the rate of global warming really is accelerating (see below), even though global temperature will soon begin to decline. However, the global warming acceleration does not imply some dramatic surprise in our understanding of climate physics. The two large human-made climate forcings – greenhouse gases (GHGs) and aerosols – account for accelerated global warming. The growth rate of these two forcings accelerated in the past 15 years.

The global warming rate since 2010 has accelerated to 0.32°C per decade, 78% faster than the 0.18°C per decade rate in 1970-2010 (Fig. 1). The impact of the acceleration on global temperature is large by 2030 (Fig. 1). Already the global anomaly of the 12-month mean temperature relative to preindustrial time is about +1.6°C (slightly less in the GISS analysis relative to 1880-1920 and slightly more than +1.6°C in other analyses relative to 1850-2000). The 12-month mean temperature is now approximately at its peak driven by the recent El Nino. The tropics, as expected, are transitioning into the La Nina state. By the end of 2024, global mean temperature will have declined significantly, but the annual 2024 global temperature should readily exceed the prior (2023) record.

The El Nino/La Nina cycle is the largest cause of interannual global temperature variability. The recent El Nino was only of moderate strength and Earth's current energy imbalance is unusually large. Thus, the global temperature decline with the budding La Nina is likely to be only about 0.2°C to about 1.4°C, so for practical purposes the Nino-average global temperature has already reached +1.5°C relative to preindustrial global temperature.

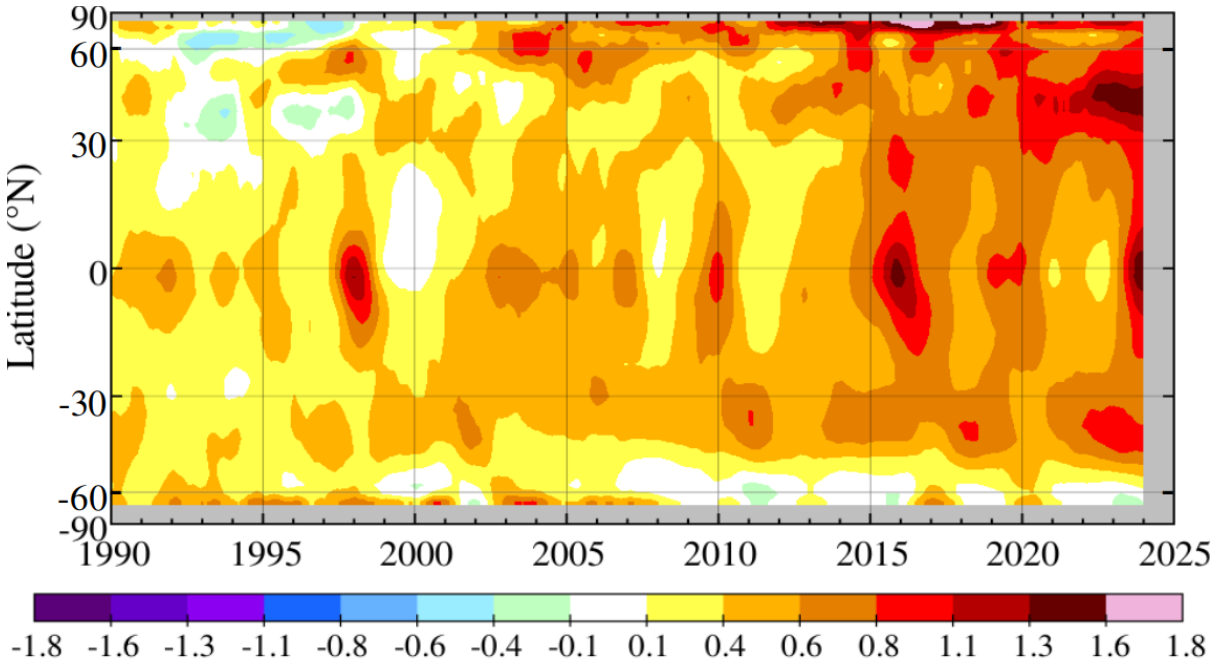

Fig. 2. Zonal-mean SST (12-month running mean) relative to 1951-1980 base period.

The June 2024 global temperature will be the 13th consecutive month with record high global temperature in the GISS global temperature analysis, the longest such string of records in the GISS analysis. However, during the 16-month period from June 2015 through September 2016 there were 13 monthly records, one tie, and two months that came within 0.03°C of being a record. Thus, there were 16 consecutive months of record or near-record high temperatures in 2015-16. The string of record or near-record monthly temperatures in 2023-24 will be one month shorter (15 months) because September 2024 will surely be cooler than the unusually hot September 2023 (described by Zeke Hausfather as "gobsmackingly bananas" hot). [July and August 2024 might be slightly cooler than the same months in 2023, but the temperatures should not differ much, given the thermal inertia of the ocean mixed layer. Only in September 2024 do we expect to see a perceptible decline in the 12-month running mean global temperature.] The relatively "cooler" period that should be ushered in by September this year, i.e., the period in which global temperature remains lower than its present +1.6°C peak, may last a few years. Let's hope we can use this period for a calm assessment of the climate situation and adoption of policies that at last are effective and help to alleviate the anxiety of young people (see below).

The unprecedented global warming of the past year gives the impression of a supergiant El Nino (Fig. 1), while, in fact, the El Nino was only of moderate strength. However, no new physics is needed to explain this uniquely strong global warming. Sea surface temperature (SST) is a particularly valuable diagnostic of the climate system: the large thermal inertia of the ocean's upper mixed layer allows the SST to smooth out the "noise" caused by cloud variability. For this reason, SST is even more revealing of mechanisms than even Earth's energy imbalance, which (due to changing clouds) is extremely noisy on monthly time scales. Fig. 2 shows that the recent unusual global warming was the product of two phenomena: (1) low latitude transition from a strong La Nina to a moderate El Nino, and (2) longer-term (post-2010) warming at middle latitudes (especially in the Northern Hemisphere).

Thus, we ascribe[3] the post-2010 acceleration of warming and the deceptive appearance of a supergiant El Nino to reduction of human-made tropospheric aerosols, mainly reduction of sulphates from power plants and other sources (especially in China) and regulations on sulphates in ship fuels. Midlatitude Northern Hemisphere warming (Fig. 2) is informative. Warming from reduction of aerosol sources in China would be largely complete by 2020, given the nature of the temperature response function (Fig. 4 of reference 3), which is similar

in all realistic global climate models. The fresh jolt of midlatitude warming in the Northern Hemisphere after 2020 is likely a result of the reduction of ship aerosols, which are especially effective due to their emission in relatively pristine marine air. We will soon have a paper that is more quantitative on this topic.

So, what is the good news? It concerns the matter of climate anxiety. When we are honest about the status of the climate science – and there is no other path for science – that honest assessment becomes a source of anxiety, especially for young people, which is the last thing that they need today. At least a partial solution is for young people to feel empowered to affect their future. That is the theme and principal objective *Sophie's Planet*, which JEH is finally in the process of finishing. A wonderful example of such empowerment has just been provided by young people in Hawaii with the support of Our Children's Trust and Earthjustice. A lawsuit brought by young people against the Hawaii Department of Transportation has been settled with the government of Hawaii agreeing to take numerous steps to speed up the reduction of greenhouse gas emissions. Graded by its impact on global emissions, it's a small step, but it is a step in the right direction, which is a great leap from the direction that their elders were headed.

---

[1] Lenssen NJL, Schmidt GA, Hansen JE *et al.* Improvements in the GISTEMP uncertainty model, *J Geophys Res Atmos* **124(12)**, 6307-26, 2019

[2] Hansen J, Ruedy R, Sato M *et al.* Global surface temperature change. *Rev Geophys* **48**:RG4004, 2010

[3] Hansen J, Sato M, Simons L *et al.* Global warming in the pipeline. *Oxford Open Clim Chan* **3(1)**, doi.org/10.1093/oxfclm/kgad008, 2023