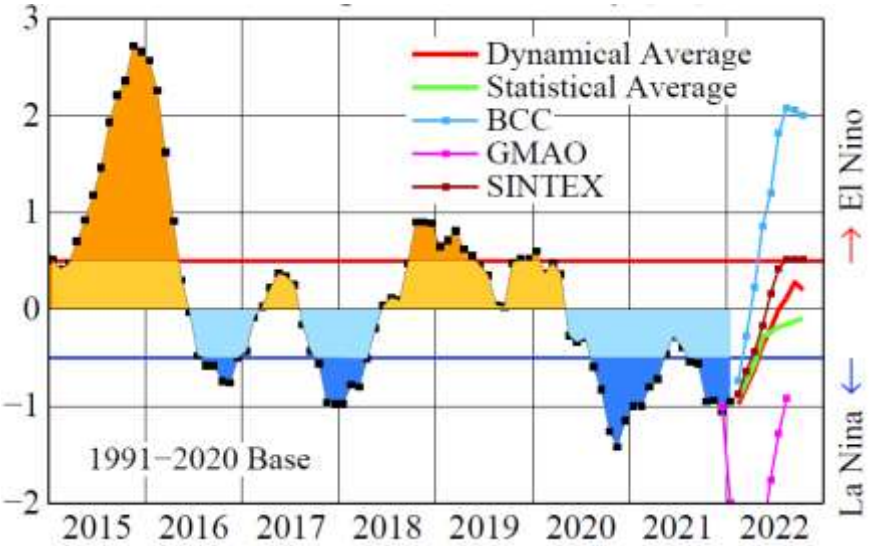

Fig. 1. Nino3.4 temperature anomaly for past 7 years and model projections.

January Temperature Update: The New Horse Race

14 February 2022

James Hansen, Makiko Sato and Reto Ruedy

There's a new horse race in 2022. It's one that we would rather lose than win. If our analysis is right, the world will probably blow through the 1.5°C global warming ceiling this decade; if we're wrong, it could be delayed a decade. We argue[1,2] that the apparent acceleration of global warming in the past decade is driven by an acceleration in the growth rate of human-made climate forcings, especially reduced human-made aerosol cooling – an effect that is not going away and may grow.

The difficulty in sorting out the truth is the large natural variability of global temperature caused especially by ENSO (El Niño Southern Oscillation) developments in the tropical Pacific. A strong double-dip La Niña (Fig. 1) in the past two years brought global temperature back to the 50-year trendline (Fig. 2), which causes some people to doubt the reality of a global warming acceleration.

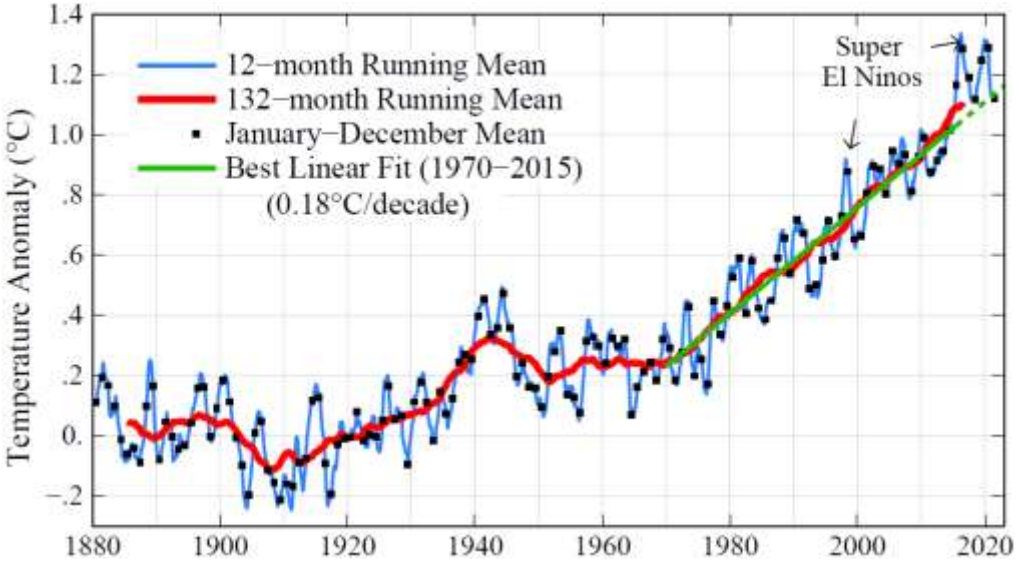

Fig. 2. Global surface temperature relative to 1880-1920 average.

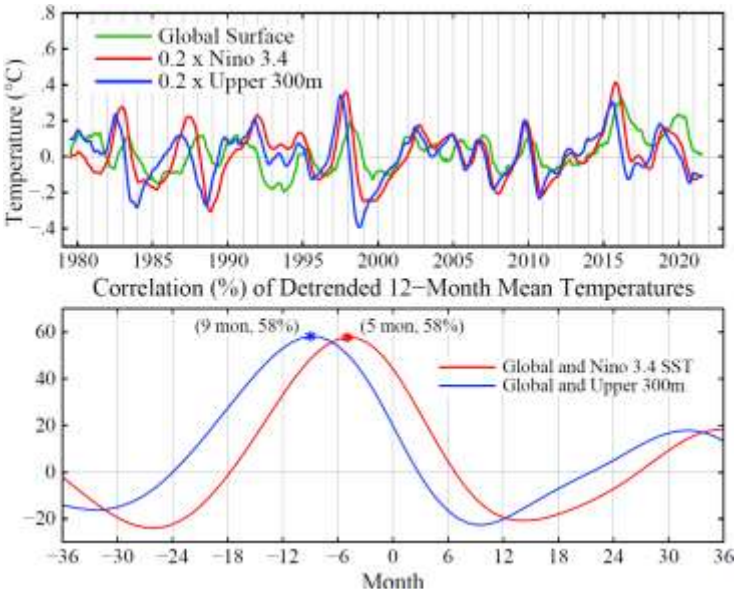

Fig. 3. Global, Nino3.4, and Nino-region upper 300m 12-month running-mean detrended temperature anomalies and their correlation. Global temperature lags Nino3.4 by 5 months and the 300 m mean temperature by 9 months.

If only that were true. Unfortunately, we anticipate that global temperature will rise steeply, well above the trend line – not that we would be happy to stay on the trend line. How steeply global temperature rises depends in part on hard-to-predict ENSO. Columbia University's International Research Institute for Climate and Society (IRI) collects and distributes model predictions monthly, which are also made available by the Climate Prediction Center of NOAA's National Center for Environmental Prediction. The full range of Niño predictions by climate models (Fig. 1) extends from a strong La Niña to a Super El Niño, but, except for those two extreme cases, most of the other 22 models yield Niño-neutral conditions continuing into late 2022. One of the models (included in Fig. 1) just touches the +0.5°C Niño3.4 temperature that separates Niño-neutral from El Niño, while three models go below –0.5°C into La Niña territory.

In our temperature update last month,[3] we speculated that an El Niño could begin later in 2022, and, if so, 2023 was likely to be the warmest year in the instrumental record. We expect that even a little futz of an El Niño, such as the one in 2019 (Fig. 1), would produce record temperatures, because Earth is now substantially out of energy balance. Here we first comment on why we think that an El Niño is possible, then note how irregular and difficult to predict Niño variations are, and finally suggest a diagnostic that tracks acceleration of global warming independent of ENSO.

Global temperature anomalies relative to the trend line are compared in Fig. 3 with anomalies of Niño3.4 temperature and anomalies of temperature in the upper 300 meters of ocean in the Niño region. Correlations of both Niño3.4 and the upper 300 meters with global temperature are significant (almost 60%), but the upper 300m provides a more useful indicator because it precedes global temperature change by 9 months.

As arm chair observers of Niño data, we noted that the temperature of the upper 300 meters of ocean in the equatorial Pacific is now rising rapidly in connection with an eastward propagating Kelvin wave that will reach the coast of South America in March. If this results in sufficient warming of the ocean surface near South America, it would work in the sense needed to help

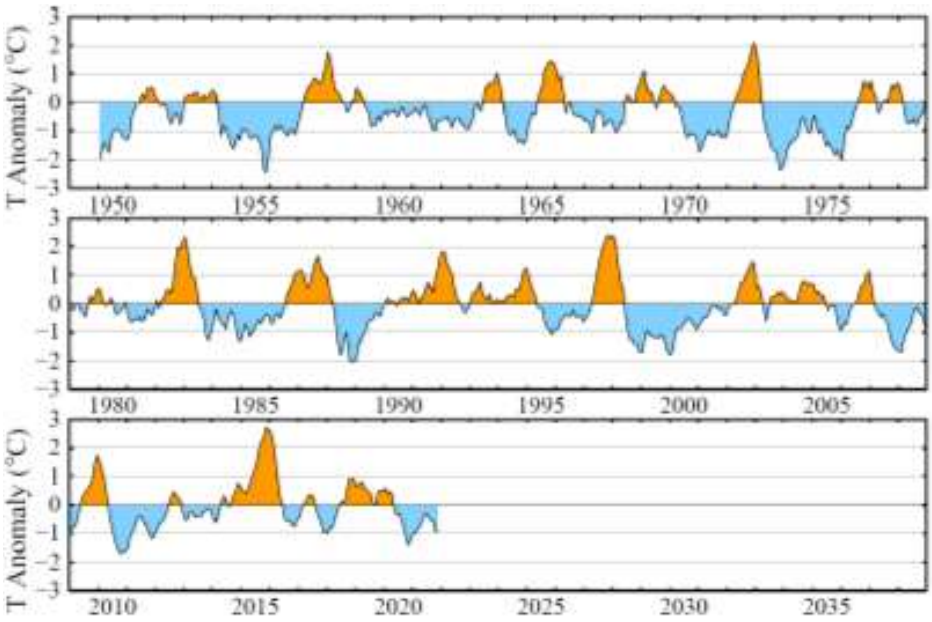

Fig. 4. Nino3.4 temperature anomaly since 1950 relative to 1991-2020 mean. Data through January 2022. Data source: NOAA Climate Prediction Center El Ninos (part of the orange area) are defined by the NOAA Climate Prediction Center as the periods when this temperature anomaly exceeds +0.5°C for three consecutive months.

support the Bjerknes feedback – warming in the east tends to affect atmospheric pressure so as to reduce the strength of the prevailing easterly winds, thus helping warmer surface water in the western Pacific to slosh back toward South America, as required for an El Niño. That's not enough though. Kelvin waves seemingly propagating a warm anomaly toward South America are common. Most of them don't kick off an El Niño. Conditions need to be right and the fickle, changeable zonal winds need to provide a kick-in-the-pants – westerly wind anomalies pushing warm surface water toward South America. Good timing of Madden-Julian Oscillation (MJO) activity (eastward propagating 30-60 day weather variability in the tropical atmosphere) can help. So, Niño developments are noisy and hard to predict.

Fig. 4 suggests that there is little rhyme or reason to the oscillations from La Niña to El Niño states. It's no wonder that in a review of the status of Niño model performance, Barnston et al.[4] found that the statistical models were not improving as the length of the empirical data increased. Dynamical models had improved, but still had only 60 percent correlation with observations at 6-month lead times. Nevertheless, as climate models and the initial conditions have improved, it's possible that the best models have considerable skill now. ENSO has worldwide consequences, especially for people living off the land at low latitudes, so an updated model-by-model review would be helpful.

Given the difficulty of Niño predictions, how can we assess the reality and magnitude of global warming acceleration? We suggest comparing detrended global and Niño3.4 temperatures (Fig. 5). The acceleration of global warming in the past six years is apparent. We would be very happy if the blue curve for global temperature declined to a level at or below the red curve for Niño3.4, showing that global warming acceleration was a mirage. Unfortunately, we expect the blue curve (global temperature) to rise at least as fast as the red curve, albeit with a lag of about five months.

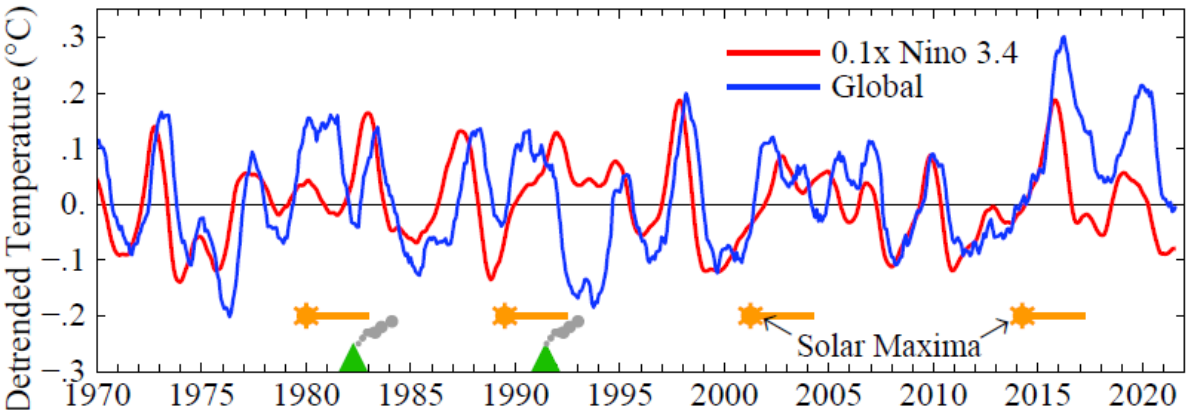

Fig. 5. Correlation of global and Nino temperatures is 60 percent with global temperature lagging the Nino3.4 anomaly by 5 months.

We will keep tabs of and report on this horse race – between the blue and red curves – as the year progresses. Somehow, this horse race does not seem to be as much fun as the one we followed month by month in 2020, as that year competed with 2016 to be the warmest. Nevertheless, George Jones is joyful and unperturbed as he calls the race and correctly opines that "the winner loses all!"

George has the right attitude. We need the public, especially young people, to realize that the climate threat should be viewed as an opportunity to fix a number of other problems, as noted in recent communications available on www.columbia.edu/~jeh1, e.g., commentary on the well-intentioned but poorly advised Don't Look Up.[5]

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[1] Hansen, J. and M. Sato, July Temperature Update: Faustian Bargain Comes Due, 13 August 2021.
[2] Simons, L., Hansen J.E., Dufournet, Y., 2021, Climate Impact of Decreasing Atmospheric Sulphate Aerosols and the Risk of a Termination Shock. Annual Aerosol Science Conference 2021. http://dx.doi.org/10.13140/RG.2.2.22778.62408
[3] Hansen, J., M. Sato and R. Ruedy, Global Temperature in 2021.
[4] Barnston, A.G., M.K.Tippett, M.L. L'Heureux, S. Li and D.G. DeWitt, Skill of real-time seasonal ENSO model predictions during 2002-11:Is our capability increasing? Bull. Amer. Meteorol. Soc. , May, 631-651, 2012.
[5] Hansen, J., "Don't Look Up," the American Dream, and an Appeal, 14 December 2021.