

## A look back at the "slowdown" in warming between 1998 and 2013

An initial assessment of the studies published up to spring 2013 led the IPCC to conclude that the reduction in the warming trend between 1998 and 2012 (see Figures 5 and 7 in the associated article "The Earth's average temperature") could be due about half to external factors (mainly a decrease in solar activity and an increase in the number of small volcanic eruptions over the period) and half to internal variability. Other evoked causes such as the increase in the concentration of particles of aerosols of anthropogenic origin or the variation in the water vapour content of the stratosphere seemed to be able to be discarded.

Since this first assessment, the slowdown in the trend has been confirmed one more year before a resumption of warming marked by three successive records of global average temperature compared to 1880 (from 2014 to 2016). Since this assessment, more than a hundred publications have also been published on the subject. Some of them have put the volcanic influence on the period into perspective and a significant role of solar activity could not be demonstrated. Conversely, the thesis of a role of internal variability was supported until recently with the hypothesis of a heat transfer from the surface ocean to the deep ocean, which cools the surface. Other papers have also put the importance of trend reduction into perspective by emphasizing the contribution of poorly covered polar areas in the reconstructions. One study [1] shows that if the Arctic Ocean regions were added to the HadCRUT4 reconstruction, the temperature trend over the period 1998-2012 could be increased by 0.06°C to 0.12°C.

However, at the time of writing, there are still different views on the interpretation of even a more moderate slowdown, with some authors favouring the role of the Pacific Ocean and its decadal oscillation, others favouring the Atlantic and the multi-decadal variability of the *Atlantic Meridional Overturning Circulation* (AMOC). This slowdown, which must be corrected by taking into account satellite data over the Arctic Ocean, thus appears to be the effect of a combination of natural factors including the internal variability of the climate system and the variability of external factors (sun and volcanoes) [2].

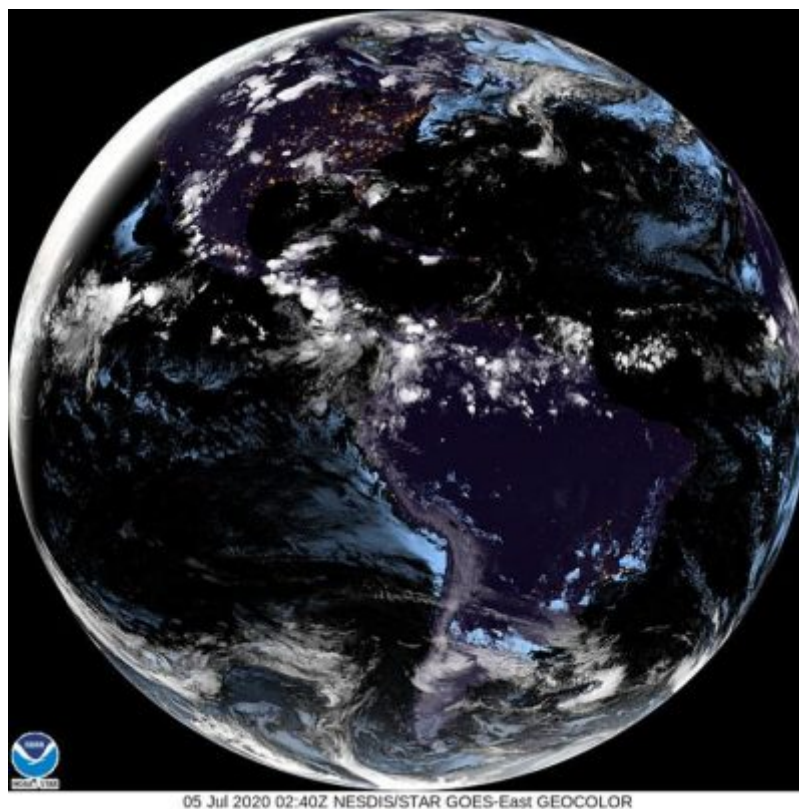


Figure. GOES-East satellite image of 28 June 2020 at 19:10 UTC. [Source: NOAA/NESDIS website]

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## Notes and References

**Cover sticker.** [Source: NOAA/NESDIS website]

[1] Cowtan, K., Way, R. G. (2014) Coverage bias in the HadCRUT4 temperature series and its impact on recent temperature trend. *Quarterly Journal of the Royal Meteorological Society*, 140, 1935-1944. DOI: 10.1002/qj.2297

[2] Medhaug, I., Stolpe, M. B., Fischer, E. M., Knutti, R. (2017) Reconciling controversies about the 'global warming hiatus'. *Nature*, 545, 41-47. DOI ::10.1038/nature22315

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