Geophysical Research Abstracts
Vol. 16, EGU2014-12579, 2014
EGU General Assembly 2014

Who pressed the pause button on global warming: is the answer in the past?

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Although there is coverage bias in the HadCRUT4 temperature series (Cotan and Way, 2013) or in other global surface temperature sequences, IPCC-AR5 still claimed that "much interest has focused on the period since 1998 and an apparent flattening (‘hiatus’) in trends". According to statistical principle, in fact, this flattening trend is unlikely to be changed by adding the missing 16% area-weighed regional data. In addition, if the "warming hiatus" could not be attributed to the solar output, volcanic eruptions and the green house gases when comparing them to the rhythm of the temperature, then the question arise: who pressed the pause button on global warming? However, it would be a golden opportunity to further understand the ocean as a fundamental role in controlling climate change.

The current hypothesis attributed this “hiatus” to a La Niña-like decadal cooling occurring in the central and eastern equatorial Pacific (Kosaka and Die, 2013). Here we separate the global surface temperature into land surface air temperature (LSAT, adopt from HadCRUT4) and sea surface temperatures (SSTs, adopt from different original data). Obviously, the decadal cooling of the central and eastern equatorial Pacific occurred in 1987, a decade earlier than the beginning of the LSAT flattening (1998), whereas the SSTs of the west Pacific warm pool (WPWP), the Indian Ocean (IO, 20S-20N, 40-110E) and the North Atlantic (NA, here its variation is represented by the Atlantic multi-decadal oscillation or hereafter referred to as AMO) are exactly in phase with the LSAT. The combined data (SSTs, arithmetic mean) of the three ocean areas has the highest correlation with the LSAT (0.91), but the correlation coefficient is reduced (0.54) if adding the decadal variation in the central and eastern equatorial Pacific (here it is represented by the Pacific decadal oscillation or hereafter referred to as PDO). Therefore, the tree ocean areas (WPWP, IO and NA) could be regarded as the key ocean area for the atmospheric temperature change.

The robust evidence comes from the reconstructed long-term time series. A fact that we all know is that the value of the LSAT is lowest in the Little Ice Age (LIA) over the last millennium. However, both reconstructed PDO (MacDonald et al, 2005) and sea surface temperature index of Niño3.4 (Emile-Gay et al, 2013) illustrate high values in the central and eastern equatorial Pacific during the LIA period. So, if we admit that the ocean could determine the land surface temperature, then the key ocean area could not be the central and eastern equatorial Pacific. And meanwhile, we also need reconstructed the SSTs of WPWP, IO or NA over the last millennium to see how the key ocean area changed. The millennial AMO has been reconstructed by Mann et al (2009) with autocorrelation coefficient of 0.99. It really shows a low value during the LIA period. Here we further present a new reconstructed AMO millennial series derived by combining a tree ring width chronology and a stalagmite-lamina thickness chronology with autocorrelation coefficient of 0.67 (Tan et al, 2009). This new sequence lags the observed winter half year (October of last year to February of current year) AMO by 3 years (with correlation coefficient of 0.59), which also shows a low value within the LIA. After removing the impact of millennial-scale solar radiation, the wavelet analysis on the residual composition shows that the decadal oscillation only occurred within the past 200 years. Therefore, it is still difficult to speculate the future trend of the SSTs according to this reconstructed series.

Another related important issue is that the instantaneous growth rates for globally averaged atmospheric CO_2 (see Figure 2.1b in IPCC AR5) is kept very precisely in phase with the SSTs of IO, WPWP and NA on annual to decadal time scale (but lags Niño3.4 by 1 year). If it is impossible to imagine that the atmospheric CO_2 is a dexterous driver for the SSTs, then the reasonable explanation is that the oceanic carbon pool could finely modulate the atmospheric CO_2. Anyway, if it is no doubt that the ocean heats the atmospheric temperature rather than the reverse, then it could be sure that the LSAT will decline in the next few years, because “hiatus” has mainly occurred in the SSTs, not yet in the LSAT.