



The ENSO or there and back again. Trying to understand the connection between its decadal variability and processes indexed by PDO, NAO and AMO

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Recent research suggests that decadal variability in ENSO influence not only tropical Pacific SST values but also modulate the rate of change of global temperatures. It may be the main reason for the so called “global warming hiatus” of recent years. This makes it not only an interesting subject of scientific studies but also a subject of interest for general population. Especially predicting average decadal ENSO activity would be important, if it would help predict the rate of global warming on decadal scales.

The only hope for such predictions in foreseeable future would come from understanding the relationship of ENSO variability in decadal scales to cycles of natural variability. Several climate indices have quasi-cyclical components of about 60-70 years. The most obvious example is AMO, a proxy for Atlantic meridional overturning circulation (AMOC) variability. However also variability of NAO, the index of atmospheric zonal circulation in the North Atlantic sector, has component of similar period significantly correlated with AMO lagged by about 15 years. Even variability of PDO the index of multidecadal variability in Northern Pacific has a component of similar period and phase as NAO. Then, PDO correlates also with ENSO on decadal scales.

Correlation does not imply causation. This raises the question whether there are physical mechanisms behind the correlations. Tropical Pacific temperatures have been shown to influence surface pressure in the North Eastern Pacific influencing zonal circulation which may explain the PDO – NAO “teleconnection”. Zonal winds influence the rate of deep water production in Labrador and Greenland seas, which may explain its influence on the rate of change in deep water production (the NAO – AMO correlation lagged by $\frac{1}{4}$ cycle). AMO being a proxy of AMOC (heat transport from South to North Hemisphere) obviously influences the inter-hemispherical temperature difference. We have recently showed the statistically significant anticorrelation of this NH-SH temperature difference on ENSO, explaining it by the influence on the position of ITCZ and trade winds.

We use statistical analysis of climate indices and discuss the underlying physical processes to argue for existence of causal connection between them. This study tries to create a framework for understanding climate variability in Pacific and Atlantic sectors on multidecadal scales as a quasi-cycle of about 65 years involving both ocean and atmospheric circulation involving processes indexed by PDO, NAO, AMO and influencing ENSO variability on decadal scales. We do not believe this is the final word in this field. Rather a good start.