



Did anthropogenic global warming break the AMO – NAO interdependence?

Jacek Piskozub

Institute of Oceanology PAS, Physical Oceanography, Sopot, Poland (piskozub@iopan.gda.pl)

North Atlantic Oscillation (NAO), the index of zonal atmospheric circulation of the extratropical North Atlantic sector and Atlantic Multidecadal Oscillation (AMO) are known to have a lagged correlation], in fact both behave like 65-years oscillations with NAO preceding AMO by $\frac{1}{4}$ of the cycle, making AMO a cumulative function of NAO. This relationship is true for winter (DJFM) NAO that is for the season when it has greatest impact on weather in the area of North Atlantic and adjacent land areas.

Assuming the strong 65-years oscillatory components of AMO and winter NAO are real oscillations, one would expect NAO to continue moving towards negative values after its 1990s maximum. In fact winter NAO did have a negative trend until the 2010 (winter of 2009/10), when it had a record low value. However it has since been positive in most winters, contrary to models basing on relationships which worked well until 2010.

AMO seems to have had its 65-year cycle maximum in 2005 (or close to), the year of the record number of North Atlantic hurricanes. Its values have decreased since but not as quickly as 65 years earlier and it seems to have a plateau in the recent years. This effect could be easily be explained by the fact that AMO is a temperature index and therefore must be contaminated by the global warming. However, the positive NAO values in recent years are not related to global warming in an obvious way. NAO is an index of atmospheric pressure, not temperature, strongly correlated with the strength of mid-latitude westerlies. Its direct dependence on the global temperature has not been shown so far.

In order to check the hypothesis of global warming influence on the NAO index, I performed lagged correlation analysis NAO and global temperature (GISTEMP) as well as directly with the CO₂ forcing (proportional to logarithm of the CO₂ concentration). The results show positive correlations of NAO and global temperature and CO₂ forcing, strongest for 0-years lag (the winter NAO correlated with the values of the preceding year). The correlations are stronger for NAO lagging temperature and forcing than the other way which is consistent with the expected causation (the long period of positive correlation on both sides of zero lag is the expected result of the slow changes in the anthropogenic forcing).

The observed dependence of NAO on greenhouse gas forcing and anthropogenic warming may be the direct cause of the “decoupling” of decadal AMO and NAO relationship and may even end the 65-year oscillation-like behavior of booth indices. This previously unreported phenomenon may be the cause of failure of Arctic sea-ice and Siberian snow NAO/AO prediction algorithms in recent years. It may also mean overwhelmingly positive winter NAO values in the next decades, increasing future winter temperature trends in the region of North Atlantic and adjacent continents.