Geophysical Research Abstracts
Vol. 19, EGU2017-9833, 2017
EGU General Assembly 2017

Phase relations of natural 65 year SST variations, ocean sea level variations over 260 years, and Arctic sea-ice retreat of the satellite era – issues of cause and effect.

Michael Asten

Monash University, School of Earth Atmosphere and Environment, Melbourne, Australia (michael.asten@monash.edu)

We study sea level variations over the past 300yr in order to quantify what fraction of variations may be considered cyclic, and what phase relations exist with respect to those cycles. The 64yr cycle detected by Chambers et al (2012) is found in the 1960-2000 data set which Hamlington et al (2013) interpreted as an expression of the PDO; we show that fitting a 64yr cycle is a better fit, accounting for 92% of variance.

In a 300yr GMSL tide guage record Jeverejeva et al (2008) identified a 60-65yr cycle superimposed on an upward trend from ∼1800CE. Using break-points and removal of centennial trends identified by Kemp et al (2015), we produce a detrended GMSL record for 1700-2000CE which emphasizes the 60-65yr oscillations. A least-square fit using a 64yr period cosine yields an amplitude 12mm and origin at year 1958.6, which accounts for 30% of the variance.

A plot of the cosine against the entire length of the 300yr detrended GMSL record shows a clear phase lock for the interval 1740 to 2000CE, denoting either a very consistent timing of an internally generated natural variation, or adding to evidence for an external forcing of astronomical origin (Scafetta 2012, 2013).

Barcikowska et al (2016) have identified a ∼65yr cyclic variation in sea surface temperature in the first multidecadal component of Multi- Channel Singular Spectrum Analysis (MSSA) on the Hadley SST data set (RC60). A plot of RC60 versus our fitted cosine shows the phase shift to be 16 yr, close to a 90 degree phase lag of GMSL relative to RC60. This is the relation to be expected for a simple low-pass or integrating filter, which suggests that cyclic natural variations in sea-surface temperature drive similar variations in GMSL.

We compare the extent of Arctic sea-ice using the time interval of 1979- 2016 (window of satellite imagery). The decrease in summer ice cover has been subject of many predictions as to when summer ice will reach zero. The plot of measured ice area can be fitted with many speculative curves, and we show three such best fit curves, a parabola (zero ice cover by 2028), a linear fit (zero by 2060) and a 64yr period cosine, where the cosine is a shape chosen as a hypothesis, given the relation we observe between SST natural variations and 260 years of detrended sea level data. The cosine best fit shows a maximum ice coverage in 1985.6 and predicted minimum in 2017.6, which compares with the detrended sea level cyclic component minimum at 1990.6 and predicted maximum at 2023.6CE. Thus the sea-ice retreat lags RC60 by about 10 yr or 60deg in phase.

The consistent phase of sea-level change over 260yr, and the phase lags of sea-ice retreat and sea-level change relative to the natural 65yr cyclic component of SST, have implications in the debate over internal versus external drivers of the cyclic components of change, and in hypotheses on cause and effect of the non-anthropogenic components of change.