The influence of atmospheric circulation on marine air temperature

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Atmospheric circulation is an important influence on local climate, affecting meteorological variables such as temperature, precipitation, cloud cover and humidity. There are strong relationships between surface meteorology and atmospheric circulation in many areas. The extent to which these relationships can explain past climate variability however is unclear, especially over the oceans.

We develop a statistical model that can represent the relationships between temperature and atmospheric circulation and use this to estimate the contribution of atmospheric circulation to variations in marine air temperature from 1851-2010. The uncertainty in the relationships is calculated. Atmospheric circulation patterns are defined from calculations of flow direction and flow curvature (indicating the position of the nearest cyclone/anticyclone), based on Sea Level Pressure (SLP). Both observational and reanalysis-based fields of SLP and marine air temperature are analysed.

Estimated and observed marine air temperatures show significant correlations; especially over the northern hemisphere, Tropical Pacific and mid-latitudes of the southern hemisphere. We show that atmospheric circulation has an important influence on past marine air temperature variability although there are other effects such as climate change, variations in ocean circulation or observational biases. Periods where other influences on marine air temperature are important and can be identified using the uncertainty estimates. This can highlight issues such as observational biases. The approach can be extended to other marine meteorological variables such as sea surface temperature or cloud cover to improve our understanding of past marine climate variability.