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El Nino and the Antarctic Oscillation – decadal variability in the Antarctic climate system

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Southern Hemisphere climate variability is dominated by two oscillating drivers: the El Nino Southern Oscillation (ENSO) (1) and the Antarctic Oscillation (AAO) (2). This Tropical-Polar dipole is a complex structure with significant spatial and temporal variability as well as inherent leads and lags and multifaceted interference patterns. Combined, the two forcings have the potential to partially off-set or enhance their influence on each other and the Southern Hemisphere as a whole. It is therefore important to consider these drivers not in isolation but as an interactive tandem.

Examining ENSO and AAO correlation patterns in Antarctic meteorological and ice core data identifies significant shifts in the phase relationship between these drivers. Fogt and Bromwich (3) showed that ENSO-Antarctic teleconnection is strongest during Southern Hemispheric spring and summer. While the summer correlation remained unchanged over the last two decades, the spring correlation was stronger during the 1990s and weaker during the 1980s. In Marie Byrd Land, the correlation between ENSO and snow precipitation changed sign, from positive in the 1980s to negative in the 1990s (4). In addition, the positive correlation between ENSO and temperature (from ERA-40 reanalysis) in the Ross Sea during the 1980s is only marginally significant and increases substantially in the 1990s (5). Moreover, since the 1970s the AAO's index changed towards a high polarity coincident with more frequent and stronger El Nino events during this time period. In contrast to the ENSO teleconnection, the AAO trend towards high polarity is strongest during summer and autumn (2). When phase relationships between AAO and ENSO and Victoria Land summer temperatures are analysed, a combined AAO – ENSO index appears to lead summer temperatures in the 1980s and to lag summer temperature in the 1990s (6).

Here I discuss potential forcing mechanisms that could explain some of the non-stationary decadal variability. Programmes such as Antarctica in the Global Climate System are well suited to encourage and synthesise the multidisciplinary research necessary to further our understanding of the drivers that shape our climate system.

References:

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