



Interactions between solar forcing and decadal to centennial timescale climate dynamics 1700-2000

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Annually resolved ice core snow accumulation and coral $\delta^{18}\text{O}$ records are shown to contain variability on decadal to centennial timescales resulting from internal atmospheric dynamics as well as solar forcing. The solar signal in the paleorecords was particularly large during the 19th century with a more muted response occurring during the 20th century. The magnitude of the correlation between the paleorecords and the solar forcing is largest at a lag of one to three years, suggesting an oceanic link in the response. The lagged climate response to the solar forcing involves the Hadley and Walker circulations as well as the Pacific North America teleconnection pattern and the Pacific Decadal Oscillation. This leads to variability in regional surface temperatures, atmospheric circulation and precipitation that occur at a lag with respect to the solar forcing. In addition, a reversal in the sign of the correlation between the ice core record, a proxy for surface and atmospheric temperatures in the North Pacific, and the solar forcing occurred around the start of the 20th century. A similar reversal also occurred in the correlation between sea surface temperatures over much of the Pacific Ocean and the solar forcing. We argue that this behaviour is the result of a non-linear resonant interaction between the solar forcing and internal dynamics of the climate system that results in phase reversals and/or amplitude variability in the response. Finally our results suggest that some of the regional warming that has occurred in western Canada over the past century may be associated with the current positive correlation between temperatures in the region and solar forcing.