How can we understand the solar signal on the Earth's surface?

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Solar cycle related Earth's surface temperature variation is analyzed to characterize its spatial structure in order to identify the responsible processes. The solar signal in the annual mean surface temperature is characterized by i) mid-latitudes warming and ii) non-warming in the tropics. Mid-latitudes warming in both hemispheres is associated by a downward penetration of zonal wind anomalies from the upper stratosphere during late winter through modulation of the polar night jet in the northern hemisphere, but subtropical jet in the southern hemisphere. Warming signals are particularly apparent over Eurasian continent and ocean frontal zones including a lagged response over the North Atlantic. Local warming occurs in the tropics over Indian and the central Pacific Oceans during high solar activity. However, all over the tropics, this warming is canceled by cooling over cold tongue sectors in Southeastern Pacific and South Atlantic associated with stronger cross-equatorial winds resulted from a northward shift of the upwelling branch of the Hadley circulation.

To understand complex processes involved in the solar signal, the results of an atmosphere-ocean coupled model experiment of the impact of the stratospheric zonal wind change are compared with the solar signals in the observations. This suggests that both tropical and extra- tropical solar signals can result from a circulation change in the upper stratosphere through i) downward migration of wave-zonal flow interaction and ii) stratospheric mean meridional circulation change, supporting indirect solar influence from the stratosphere.

Key words: Sola influence, Stratosphere-troposphere coupling, Atmosphere-Ocean coupling