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Characteristics of the solar signal on the Earth's surface through stratosphere-troposphere coupled process

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Solar influence on climate has been discussed since long time on the assumption that the total solar irradiance (TSI) directly affects Earth's surface. Recent measurements from the space revealed that the variation of the TSI associated with the 11-year solar cycle is about 0.1%, which cannot produce little effect on Earth's climate without a feedback from the atmosphere-ocean system. Several amplifying mechanism are proposed for different variation of solar origin, cosmic ray, visible light, solar ultra violet.

To determine which process is actually operating in the Earth's atmosphere, it needs to investigate not only the global mean temperature, but also its spatial structure. Observed 11-year solar signals in surface temperature can be characterizes by warming in midlatitudes and the absence of warming (or even slight cooling) in the tropics.

Midlatitudes warming of the surface temperature occurs in associated with a downward penetration of stratospheric polar-night jet or the polar-night jet oscillation. Little change in tropical surface temperature is consistent with dynamical nature. Meridional circulation change produces a warming in the tropical lower stratosphere, but little effect on the tropospheric temperature. Such characteristics of solar signal can be expected from that produced through change of the solar ultraviolet. Change of the solar heating in the middle atmosphere modulates wave mean-flow interaction in the stratosphere through two processes: one is the polar-night jet oscillation, and the other is a modulation of the meridional circulation.