

Role of Stratospheric Cooling on the Tropical Troposphere and the Ocean

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Large changes in circulation have occurred around the end of 1990's in the troposphere and the ocean as well as in the lower stratosphere, such as an advancement of the onset of Asian summer monsoon, cooling of the equatorial eastern Pacific connected to the hiatus of the global warming, and cooling in the tropical lower stratosphere. Whether or not a causal relationship exists among these phenomena, is an interesting yet challenging question.

We, therefore, investigate a transient phenomenon as well as long-term change or recent trend to gain insight into the relationship between changes in the stratosphere and the ocean. For this, we select sudden cooling events in the tropical lower stratosphere during the boreal summer. Stratospheric temperature decreased in association with an increased upwelling induced by an enhancement of planetary wave activity in the SH. Increased upwelling is apparent in the UTLS region of the summer hemisphere particularly around 15N-25N, where the ascending branch of the Hadley circulation is in line with the upwelling branch of the Brewer-Dobson circulation. Because this connected zone is situated poleward of the climatological center of the ascending branch of the Hadley circulation, enhancement of the upward velocity in this region shifts the Hadley circulation poleward, which leads to an increase in the cross-equatorial surface flow from the winter to summer hemisphere. This increase of the southerlies decreases the SSTs in the equatorial eastern Pacific.

Impact of the SSTs on the lower stratosphere through changes in convective activity is well known. Adding to this, the present study suggests a possibility that a change in stratospheric circulation induces anomalous SSTs in the tropics.

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