Inter-seasonal and interhemispheric coupling initiated by a major sudden stratospheric warming accompanied by an elevated stratopause event

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The polar winter stratopause is formed and maintained by the meridional circulation which is driven by the gravity wave forcing in the mesosphere. During a major sudden stratospheric warming (SSW), the stratopause descends significantly. Occasionally, soon after a major SSW, the stratopause disappears and subsequently reforms at a significantly high altitude of about 80km. This phenomenon was recently discovered by satellite observations and is referred to as an elevated stratopause (ES) event. Meanwhile, recent studies discovered that the signal of the zonal mean temperature anomaly associated with an SSW propagates from one hemisphere to the other across the equator. For instance, observational studies showed that the northern polar stratospheric temperature and the southern polar mesospheric cloud occurrence correlate to each other. It is considered that this interhemispheric coupling (IHC) is induced by the modification of the meridional circulation in the middle atmosphere. Modeling studies have discussed the mechanisms of these two phenomena by a quantitative analysis, but their analysis is mainly based on the behavior of parameterized gravity waves at the present time. Moreover, observational studies of gravity waves from the perspective of the IHC have just begun. Therefore, much is unknown about these two phenomena. This study focuses on the IHC associated with the ES by using Microwave Limb Sounder satellite data in the time period from 2005-2016. It was shown that three ES events occurred in the northern hemisphere during almost the same calendar days for the analyzed time period. After about six months of these three ES events, the temperature maximum at the southern tropical region is intensified more strongly than in other years. An empirical orthogonal function (EOF) analysis is performed on half-monthly zonal-mean temperature anomaly data from January to August. As a result, a corresponding anomaly pattern is found as the first EOF mode. This result suggests the existence of the inter-seasonal IHC associated with the ES events. Furthermore, the ES events and the southern tropical temperature maximum are related to the time evolution of the polar night jet in the northern hemisphere and the easterly phase of the stratospheric semiannual oscillation in the equatorial region. In this presentation, we will discuss a plausible mechanism of the inter-seasonal IHC associated with the ES events based on the analysis of the wave properties by using the transformed Eulerian-mean equations.

