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Interhemispheric coupling induced by the Holton-Tan effect and its sensitivity to the solar cycle

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The modulation of the northern winter polar vortex due to the Holton-Tan (HT) effect results in changes of the gravity wave (GW) drag in the mesosphere/ lower thermosphere (MLT). According to the interhemispheric coupling mechanism, one expects an associated modulation of the entire residual circulation from the summer to the winter pole, including a corresponding variability of the southern summer mesopause temperature. In a preceding study we studied this possible vertical and global extension of the HT effect on the basis of the CMAM30 (Canadian Middle Atmosphere Model) data. We found that a clear effect shows up only when sorting the data according to the phases of the 11-year solar cycle. In particular, the strongest interhemispheric coupling induced by the HT effect in January is visible during solar maximum, while the effect is much weaker during solar minimum and even reversed during the transition phases. In the present study we analyze sensitivity experiments with a new version of the KMCM (Kühlungsborn Mechanistic general Circulation Model; T42,L115) that includes self-generated QBO. Different phases of the solar cycle are mimicked by absorption of solar insolation by ozone around the stratopause. The model runs reproduce the behavior as detected from the CMAM30 data, confirming that the primary cause for the solar-cycle-induced variations of the HT effect are due to the solar heating around the stratopause. In order to explain the simulated sensitivity of the MLT to the solar cycle, we will analyze the differences among the model runs with respect to the dynamics of Rossby waves and GWs and their wave-wave and wave-mean flow interactions. For example, the stratospheric planetary wave drag is weaker during solar transition than during both solar minimum and maximum.