Geophysical Research Abstracts
Vol. 16, EGU2014-13373-2, 2014
EGU General Assembly 2014

Future changes in Elevated Stratopause Events

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The polar winter stratosphere is not only coupled to the troposphere by Sudden Stratospheric Warmings (SSW) but it is also coupled to the mesosphere. The strength and height of the polar winter stratopause is determined by the poleward downward branch of the mesospheric residual circulation. During SSWs the propagation of the waves driving this residual circulation is changed and thus also height and strength of the stratopause. Several observational and modelling studies have shown that the stratopause height can increase strongly after some SSWs leading to a stratopause that lies well above the winter mean. The stratopause then descends back to its winter mean height. During the descent of the stratosphere mesospheric air can intrude into the stratosphere and thus influence the chemical composition of stratospheric air. Several studies have shown that the development of a strong Planetary wave 1 amplitude in the mesosphere is a common feature during the onset of Elevated Stratopause events (ESE). With a changing climate it is to be questioned if and how the development and strength of ESEs changes.
In this study the possible change in ESE characteristica in the future is investigated using time slice simulations of the chemistry-climate model ECHAM/MESSy (EMAC). Changes in stratospheric winds are always accompanied by changes in wave propagation and thus by changes in wave driving for the residual circulation and stratopause height and strength. Only those changes in daily stratopause height are declared as ESE that exceed the 99.5% percentile of daily change in stratopause height and have a newbuilt stratopause that lies above its respective winter mean height. The dynamic threshold for ESE detection allows to compare data sets with different climatologies. Composite analyses are performed on the ESE simulated in recent past and the future. The robustness of the composites is tested using the Monte Carlo Method. We show that the number of ESE increases in the future. ESE with higher changes in stratopause height can be found in the simulation of the future. The ESE simulated in past and future will be examined concerning their differences during onset and decay, also considering the type of SSW they follow. In both simulations the majority of ESE follow displacement SSWs.