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Response of the middle atmosphere to ENSO events in North Hemispheric winter within Chemistry Climate Model-WACCM3

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The influences of El Niño and La Niña sea surface temperature anomalies on the middle atmosphere have been analyzed in a chemistry climate model-the Whole Atmosphere Community Climate Model (WACCM3), and in the ERA-40 reanalysis data set. Monthly mean data have been used to carry out some statistical analyses and dynamical diagnoses. Our conclusions show that conspicuous temperature anomalies in the stratosphere have been observed in both El Niño and La Niña years. According to different zonal wave numbers, these anomalies exhibit diverse distribution patterns in El Niño and La Niña years which ascribe to different scales of planetary wave actions. In El Niño winter, wave actions are concentrated in December and January, leading to more disturbances of the stratospheric polar vortex and higher frequencies of stratospheric sudden warming (SSW) in these periods. Moreover, based on the three-dimensional Eliassen-Palm (E-P) flux, we have revealed that the main wave actions are located in the eastern hemisphere and push the polar vortex to the opposite side, and these movements of the vortex are closely connected to the weather and climate in corresponding areas. Whereas, in La Niña winter, February and March are the major active months for planetary waves, and most SSW events take place in these phases. Distributions of E-P flux indicate that wave fluctuations are centralized between 90^{o}E-180^{o}E, resulting in a shift of the polar vortex and some variations of the related atmospheric circulations. In addition, dynamical analyses using the parameterized gravity waves denote that the mesospheric meridional residual circulation (RC) is closely connected to the gravity wave drag, which is directly influenced by the temperature and zonal wind patterns in different phases of El Niño and La Niña years. These anomalous processes of RC may influence the distribution of atmospheric compositions and can be further explored in the future.