Observations show that the quasi-biennial oscillation (QBO) and the 11-year solar cycle perturb the polar vortex via planetary wave convergence at high latitudes, a mechanism first proposed by Holton and Tan in 1980. These perturbations lead to an increase of stratospheric sudden warming events, and consequently observable increases in temperature and O3 abundance at polar latitudes. However, these observations have not been studied in models definitively. Here we test whether the observed O3 changes can be reproduced in chemistry-transport models. We constrained the Whole Atmosphere Community Climate Model version 4 (WACCM4) with the observed wind fields and 11-year UV variability and ran the model from 1979 to 2014. The simulation was diagnosed in four groups: westerly QBO phase and solar minimum, westerly QBO phase and solar maximum, easterly QBO phase and solar minimum, and easterly QBO phase and solar maximum. We showed that the simulated O3 changes among these four groups agree very well with the observation. The linkage between the Holton-Tan mechanism and polar O3 in the model are examined.