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Planetary waves modulating the effect of energetic electron precipitation on polar vortex

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During the winter, a strong westerly wind surrounds the cold polar stratosphere, forming the polar vortex. In the northern hemisphere the polar vortex is affected by energetic electron precipitation (EEP) which originates from the magnetosphere and is driven by the solar wind. EEP forms reactive nitrogen and hydrogen oxides, NOx and HOx, which destroy ozone and, thus, affects the radiative and thermal balance in the atmosphere. Several studies have shown that the EEP decreases ozone in the winter polar stratosphere and enhances the polar vortex in the northern hemisphere. This EEP effect on polar vortex is also found to depend on different factors such as the quasi-biennial oscillation (QBO) and sudden stratospheric warmings (SSW). Both the QBO and SSWs are believed to modulate the EEP effect via planetary waves, disturbances originating mainly from the troposphere, but the role of planetary waves in this context has not been studied in detail. In this work we examine the EEP effect on northern polar vortex and its dependence on planetary waves. We use the principal component analysis to examine the intensity and spatial distribution of planetary waves in the northern wintertime stratosphere. We then calculate multi linear regressions to estimate the zonal wind responses to EEP also considering planetary waves. We find that the EEP effect on the northern polar vortex is increased when planetary waves are focused at the equatorward side of the polar vortex, while the overall intensity of planetary waves does not significantly modulate the EEP effect.