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The importance of stationary waves for the maintenance of the Northern Annular Mode as deduced from model experiments

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Using a simple global circulation model, the role of the stationary waves in the maintenance of the tropospheric annular mode (AM) is examined. In order to distinguish between the influence of synoptical and stationary waves on the AM, several model experiments are carried out under perpetual January conditions where the stationary wave forcing by orography and land-sea heating contrasts are applied in different combinations. Based on these experiments, we interpret the difference between the observed AMs of the northern and southern hemisphere. In the lower troposphere, all of these model experiments display an AM-like pattern. From the zonal angular momentum budget, we find that the common mechanism is the feedback between baroclinic eddies and the zonal mean zonal wind which maintains the AM. But, the AMs of the experiments show different embedded anomalous stationary waves and different amplitudes of the zonally symmetric component. For orographic stationary wave forcing alone, the barotropic wind anomaly is decelerated due to the mountain torque. This means a weakening of the AM. For the stationary wave forcing of both orography and land-sea heating, the experiment exhibits a positive feedback between the stationary waves and the AM which compensates the mountain torque effect. This feedback results from the linear zonal-eddy coupling process and produces a strong AM with an atlantic and pacific center of action. We reason that a realistic northern AM can only be simulated when this process is included.