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Resonant excitation of Kelvin waves by interactions of subtropical Rossby waves and the zonal mean flow

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Kelvin waves are an important component of the tropical wave circulation. While the excitation of Kelvin waves by tropical convection is well understood, the influence of subtropical Rossby wave dynamics on the Kelvin waves has received relatively little attention. Our research investigates a Kelvin wave excitation mechanism through interactions of Rossby waves and the zonal subtropical jet. The investigation is carried out with a spherical rotating shallow-water model, using a quasi-geostrophic zonal jet as initial condition. The basis functions of the model are the eigensolutions of the linearized equations, which are identified with atmospheric waves. The model formulation thus includes the Rossby and Kelvin waves as prognostic variables. With an external forcing that impacts only the Rossby waves, Kelvin waves can be excited in the model through the wave-mean flow interactions and wave-wave interactions. The main finding is that Kelvin waves are resonantly excited by interactions of the Rossby waves and the mean flow, provided the Doppler-shifted frequencies of the Rossby waves and the Kelvin waves match. The wave-mean flow interactions are found to be stronger than the wave-wave interactions. The resonant Kelvin wave excitation is one of the possible mechanisms for the influence of the extratropical circulation on tropical waves.