Small-scale gravity waves influence on an idealized quasi-biennial oscillation

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Recent observations from the ERA5 reanalysis have revealed wave contributions from a wide range of spatial and temporal scales to the momentum budget of the equatorial stratosphere. Although it is generally accepted that the wave forcing at the equator drives the quasi-biennial oscillation (QBO) of equatorial winds, the individual contribution of each type of wave is still poorly understood. Here, we seek to disentangle the role of different wave types in the momentum budget of an idealized stratosphere. Numerical simulations with increasing spatial resolution are used to infer the sensitivity of the wave spectrum and mean flow oscillation to resolved instabilities. At higher resolution, Kelvin-Helmholtz generated small-scale gravity waves are combined to the background low frequency wave forcing and accelerate the period of mean-flow reversals due to an increased momentum transfer from the wave to the mean flow. This mechanism is confirmed using a simplified one-dimensional model for which the wave properties are specified.