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Analysis of the frequency-dependent response to wave forcing in the extratropics

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Abstract. A quasigeostrophic model for the frequency-dependent response of the zonal-mean flow to planetary-wave forcing at Northern Hemisphere (NH) midlatitudes is applied to 4-D-Var ECMWF analysis data for six extended winter seasons. The theoretical response is a non-linear function of the frequency of the forcing, the thermal damping time α^{-1} , and a scaling parameter μ which includes the aspect ratio of the meridional to the vertical length scale of the response. Regression of the calculated response from the analyses onto the theoretical response yields height-dependent estimates for both α^{-1} and μ . The thermal damping time estimated from this dynamical model is about 2 days in the troposphere, 7–10 days in the stratosphere, and 2–4 days in the lower mesosphere. For the stratosphere and lower mesosphere, the estimates lie within the range of existing radiative damping time estimates, but for the troposphere they are significantly smaller.

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