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Interactive comment on "Analysis of the frequency-dependent response to wave forcing in the extratropics" *by* A. J. Haklander et al.

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We gratefully acknowledge your comments and questions, which are indeed helpful to improve the manuscript. Some important points have been addressed, and we think that all comments deserve separate answers.

Answers to specific comments:

1) For the calculation of the thermal damping time and scaling parameter, variations with timescales shorter than about 4 days have been omitted from the analysis, see p. 1404/1405. Non-physical high-frequency variability in the fields due to the adjustment of the assimilation model to a balanced state therefore should not affect the calcu-

lation of the damping rate and the scaling parameter too much. Furthermore, Eq. (4) indeed does not incorporate the zonal-mean zonal momentum deposition due to breaking gravity waves, which is known to play an important role in the mesosphere. We have put more emphasis on these issues in the revised manuscript.

2) We should indeed be clearer about the fact that we are estimating the effective thermal damping time, which in the troposphere can be quite different from the radiative damping time (e.g. Wu et al., 2000). For instance, the timescale of radiative cooling in the tropical troposphere is estimated to be of the order of 2 weeks. However, when the damping times are assumed to represent vertical heat transport by cumulus convection, the effective Newtonian cooling timescale can reduce to less than a day. The 'Newtonian cooling' in the model by Garcia (1987) therefore should include all thermal dissipative processes (e.g. turbulent heat transfer and convection), which tends to produce an effective thermal damping time which is shorter than the radiative damping time. These issues have been addressed more carefully in the revised manuscript.

3) Eq. (3) can be written as $r^{-2} \equiv a + b\omega^{-2}$, with $a \equiv (1+\mu^{-1})^2$ and $b \equiv \alpha^2\mu^{-2}$. Finding estimates for a and b then implies performing a linear least-squares regression analysis with r^{-2} and ω^{-2} as known dependent (y) and independent (x) variables, respectively. Thus, the unknowns are a and b, which can both be computed with a standard least-squares method. As we have more than one pair of (x, y), the least-squares fit is unique. The estimated high-frequency limit of r equals $1/\sqrt{a}$, the estimated radiative damping time $(\sqrt{a} - 1)/\sqrt{b}$. We have posed no further constraints on the regression analysis. We have included a more detailed description of the least-squares fitting procedure in the revised manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 1399, 2006.