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Atmospheric Chemistry and Physics Discussions



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

**Anonymous Referee #1**

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## General comments

This is an interesting study that tests our understanding of zonal mean dynamics using analysis data. In its current form, the paper appears to have a major oversight in the regression fitting of the radiative damping rate and meridional scale parameters. This paper requires the orginal analysis to be corrected, which will likely involve additional analysis, before it can be accepted for publication.

## Specific comments

1) From the estimates given at the top of the second column of p. 1395 in Prinn



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(1977), the radiative relaxation time for a perturbation with a vertical wavelength of 5 km outside of the PBL is about 24 days instead of 89 days from the infinite homogeneous grey-absorbing medium approximation. For perturbations that are close to the sea surface (conducting ground), the damping time is less than a day. With $H_a = 2$ km this essentially means perturbations overlapping the PBL. But over insulated ground the damping time is about 13 days. From this, it is difficult to see how 2 days could be a characteristic radiative damping timescale for the troposphere unless characteristic disturbances have vertical scales less than 1 km, which is clearly not the case. It is only for $z << (\rho(0)_a \bar{\sigma}_r)^{-1} \approx 0.5\,\mathrm{km}$ above conducting ground that such a short radiative damping timescale is applicable.

The statement made at the top of page 1406 by the authors contradicts Prinn (1977) unless they are talking about the near surface behaviour. The near surface behaviour cannot explain the low values of $\alpha^{-1}$ obtained between 700 hPa and 100 hPa.

2) Equation (3) can be rewritten as $\alpha = \omega\sqrt{(\mu/r)^2 - (1+\mu)^2}$. From this equation it is apparent that there are multiple choices of $\alpha$ and $\mu$ for each value of $r(\alpha, \mu, \omega)$. In particular, for a very small range in $\mu/(1+\mu)$ the range in $\alpha^{-1}$ can be very large. It is not made clear in the paper how the least squares fitting procedure was carried out. Was there an additional constraint imposed? Without an additional constraint the fit for $\alpha$ and $\mu$ is not unique and values of $\alpha^{-1}$ of 20 days and much longer are consistent with the values of $\mu/(1+\mu)$ obtained by the authors. In order to fit for $\alpha$, $\mu$ has to be obtained independently from the data. Perhaps a Fourier decomposition of the zonal wind tendency and forcing into latitudinal harmonics can facilitate this.

3) The assimilation process is not represented in equations (1) and (2) but has a non trivial impact on the dynamics. For instance, it induces balance adjustment involving the production of gravity waves. These waves must be filtered in some fashion. The process amounts to a momentum forcing not represented in $\bar{M}$. To analyze this is a challanging problem that is beyond the scope of this paper. However, it deserves mention.



**ACPD**

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