EQ08 Chameleon-χpod Comparison Notes

Andy Pickering

March 17, 2016

Contents

1 About

This document contains notes related to tests of the χpod method using EQ08 Chameleon data. This is similar to an analysis done with EQ14 data. The plan was to:

1. Process raw Chameleon profiles and apply calibrations.
2. Apply χpod method to Chameleon FP07 T‘ signal, and estimate χ and ϵ.
3. Compare these values to the ‘true’ values: the processed Chameleon data using shear probe data.
4. Examine the sensitivity of the χpod results and comparisons to variable parameters in the χpod calculation.

2 Data and Methods

The raw Chameleon profiles are read and calibrated with `run_eq08_AP.m`, which I modified from the original `run_eq08.m`. This script calls:

- `tag_file_eq08.m`
- `raw_load.m`
- `cali_eq08.m`

The χpod method is applied to each profile in `Calc_Chi_eq08_AP.m`, using the same methods used on CTD-χpod data. The core calculations are done in `get_chipod_chi.m`; much of the other functions are to organize and prepare the data for this calculation.

3 Summary of Data

Figure 1 shows a summary of the processed Chameleon data from the file `eq08_sum.mat`. Figure 2 shows the corresponding summary for the χpod method applied to the data. Qualitatively, the timing, depth-structure, and magnitudes seems to agree well. Differences will be examined more quantitatively later in this document.

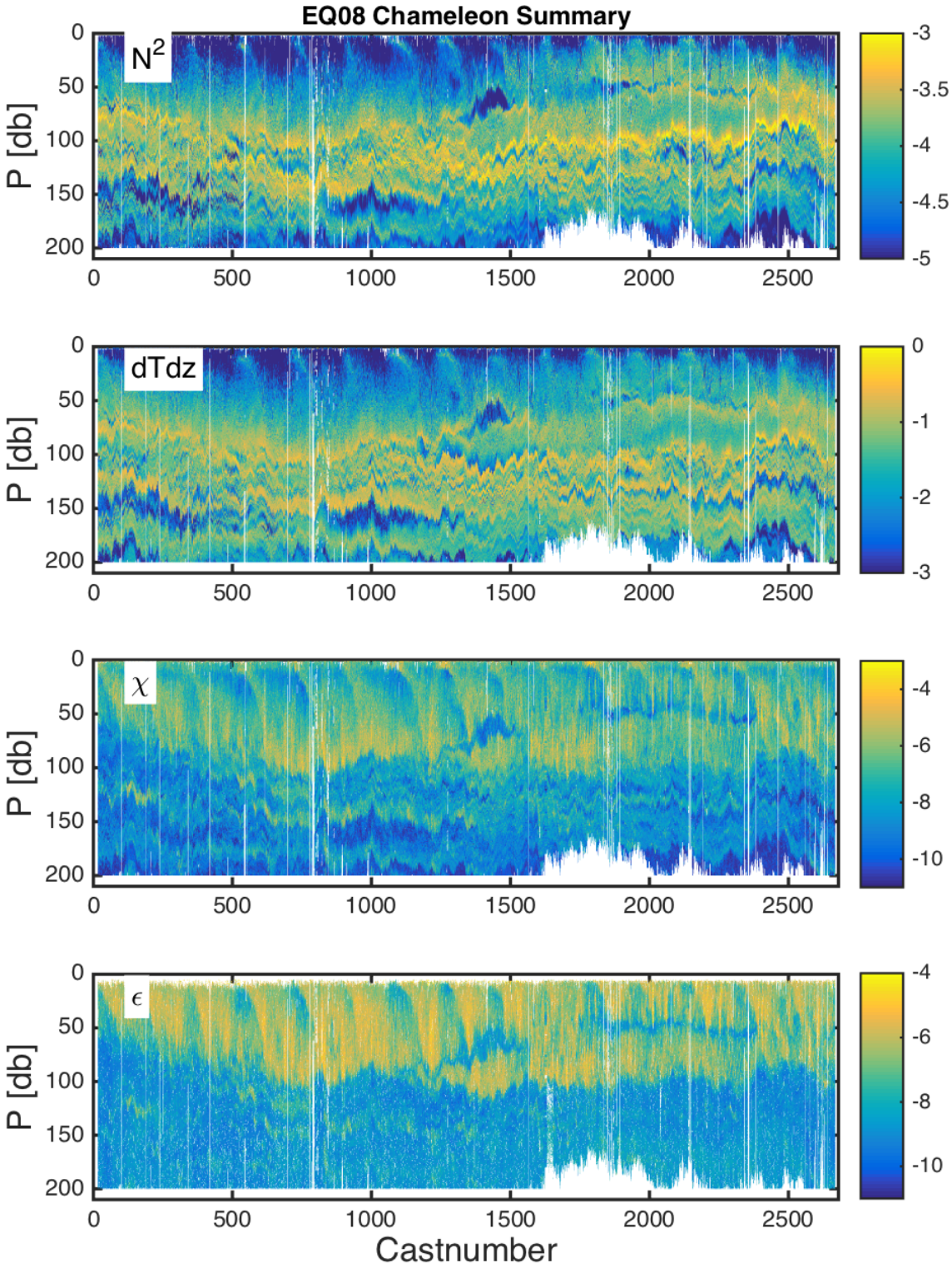

Figure 1: Summary of processed Chameleon data from EQ08 (already processed, NOT what I processed).

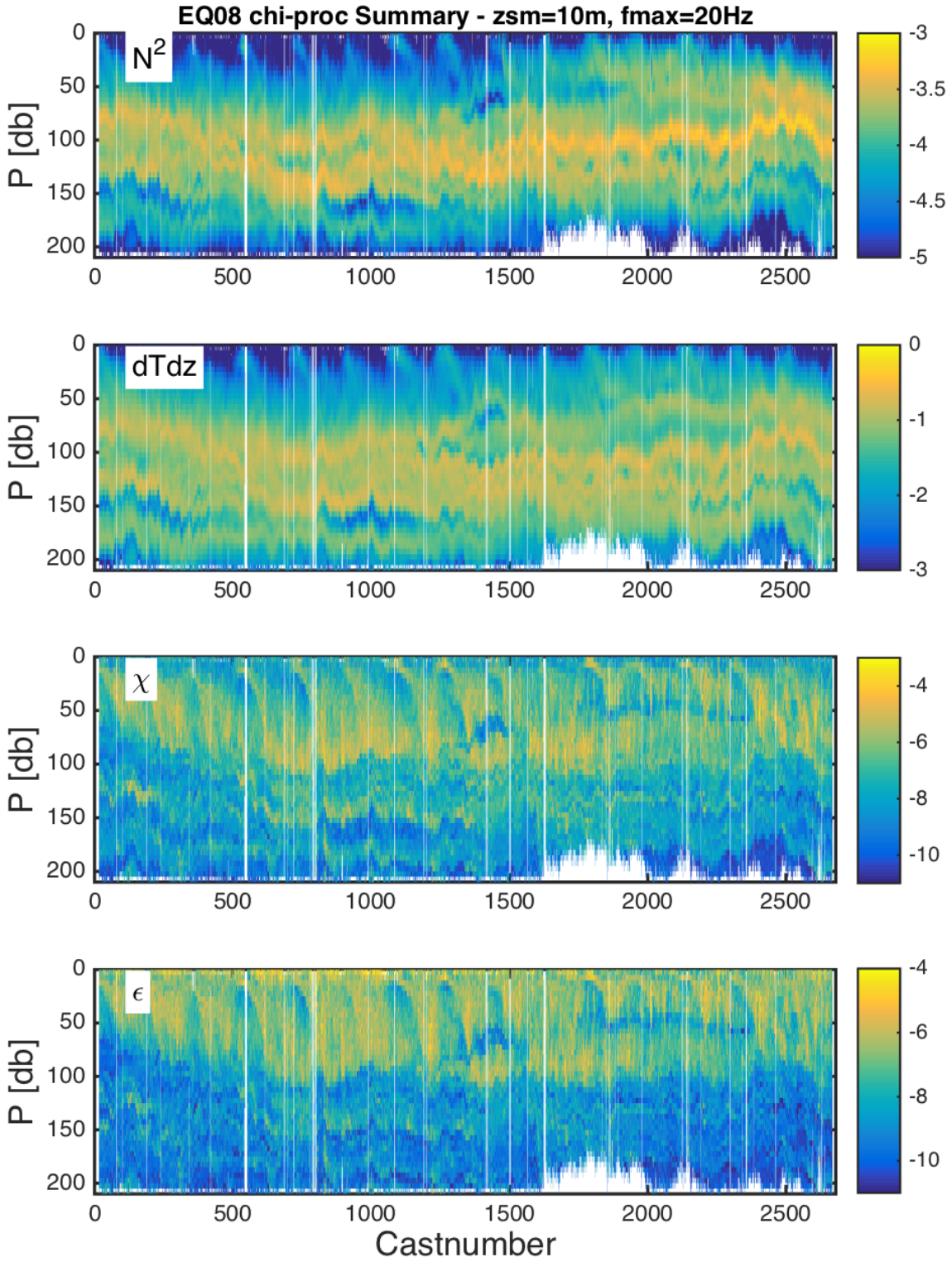

Figure 2: Summary of χpod method applied to Chameleon data from EQ08.

4 Effect of Smoothing N2 and dTdz

I ran χpod processing with different values of `z_smooth`, the vertical scale over which N^2 and dT/dz are averaged. Figure 3 shows the results. χ is not affected very much, while ϵ tends to be increased for smaller values of zsmooth.

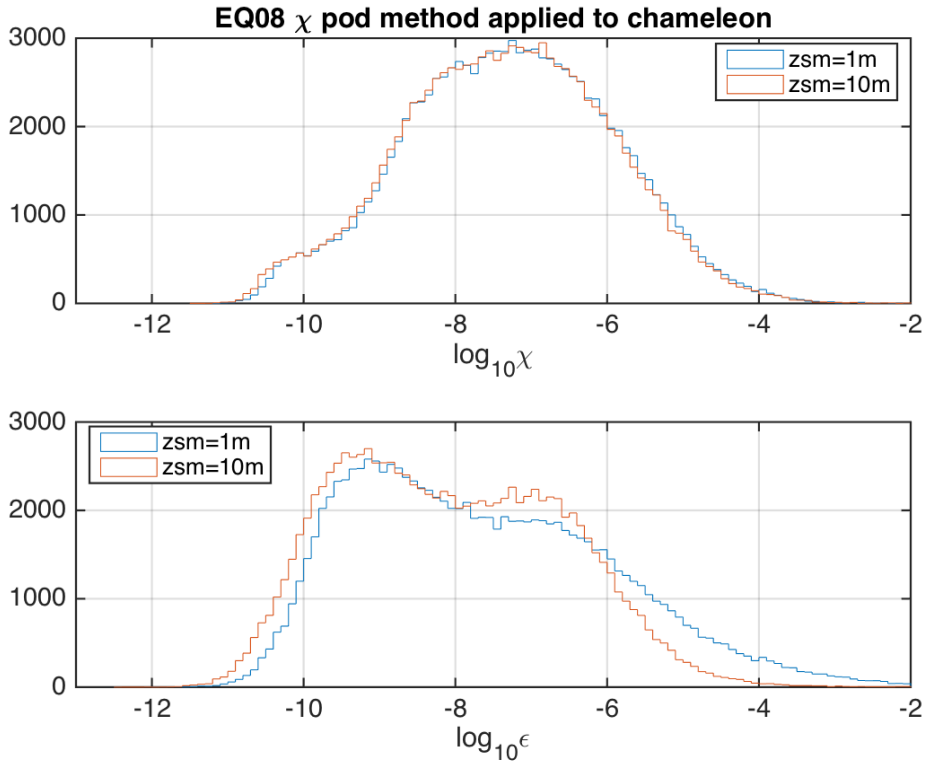

Figure 3: Histogram of χ and ϵ from χpod method and 'true' chameleon data, for 2 different values of the 'zsmooth' parameter.

5 Effect of Frequency Response Correction

Applying a frequency response correction to the dT/dt data does not appear to have much of an effect on the results (Figure 4).

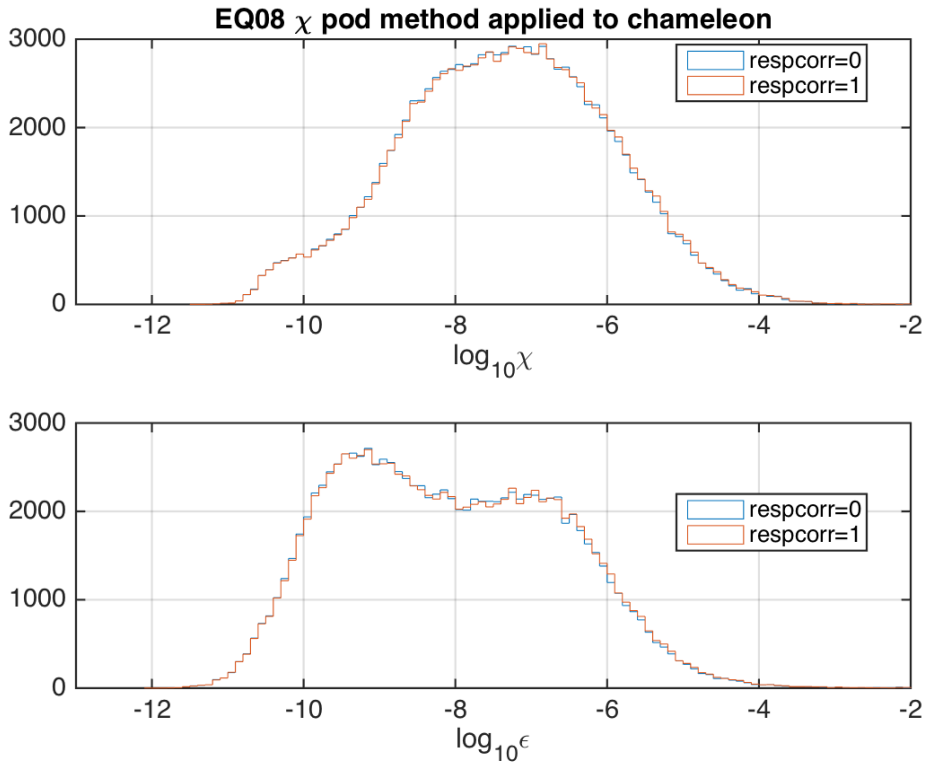

Figure 4: Histogram of χ and ϵ from χpod method and 'true' chameleon data, with and without frequency response correction.

6 Effect of 'fmax' Parameter

The 'fmax' parameter sets the maximum frequency to integegrate the temperature gradient spectrum up to in `get_chipod_chi.m`.

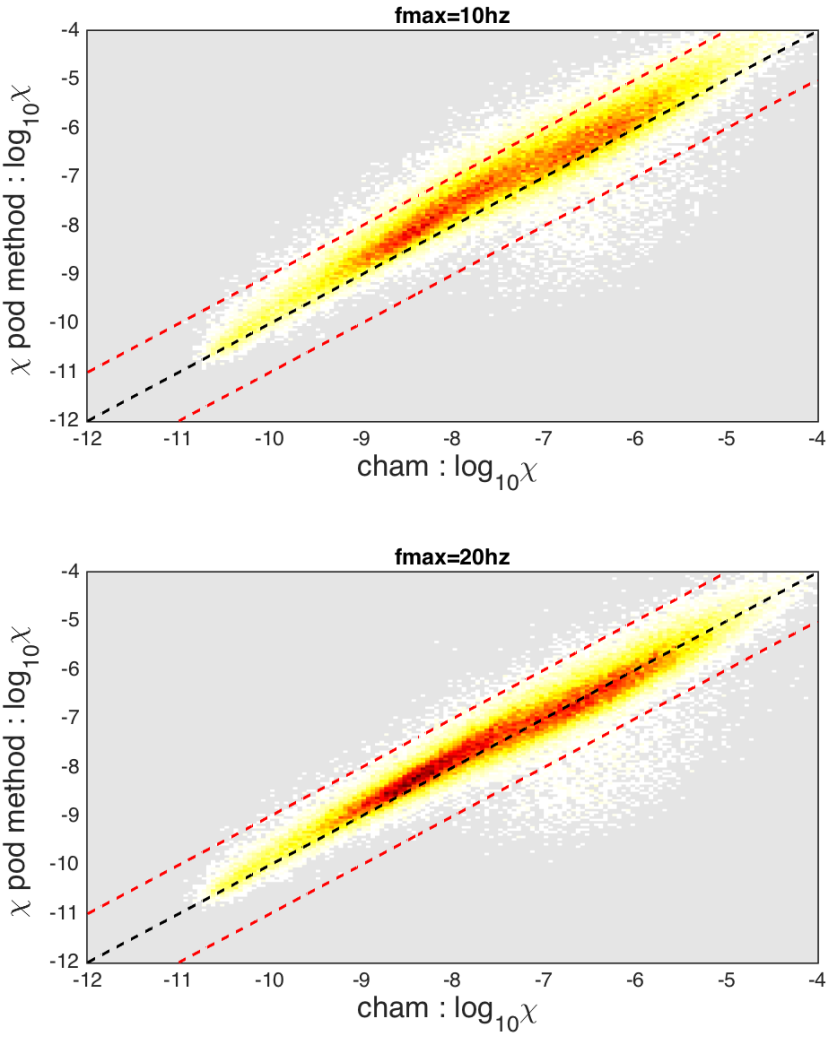

Figure 5: 2D histogram of χ from χpod method and 'true' chameleon data, for 2 different values of the 'fmax' parameter. Black dashed line is 1:1, red is $\pm$ an order of magnitude.

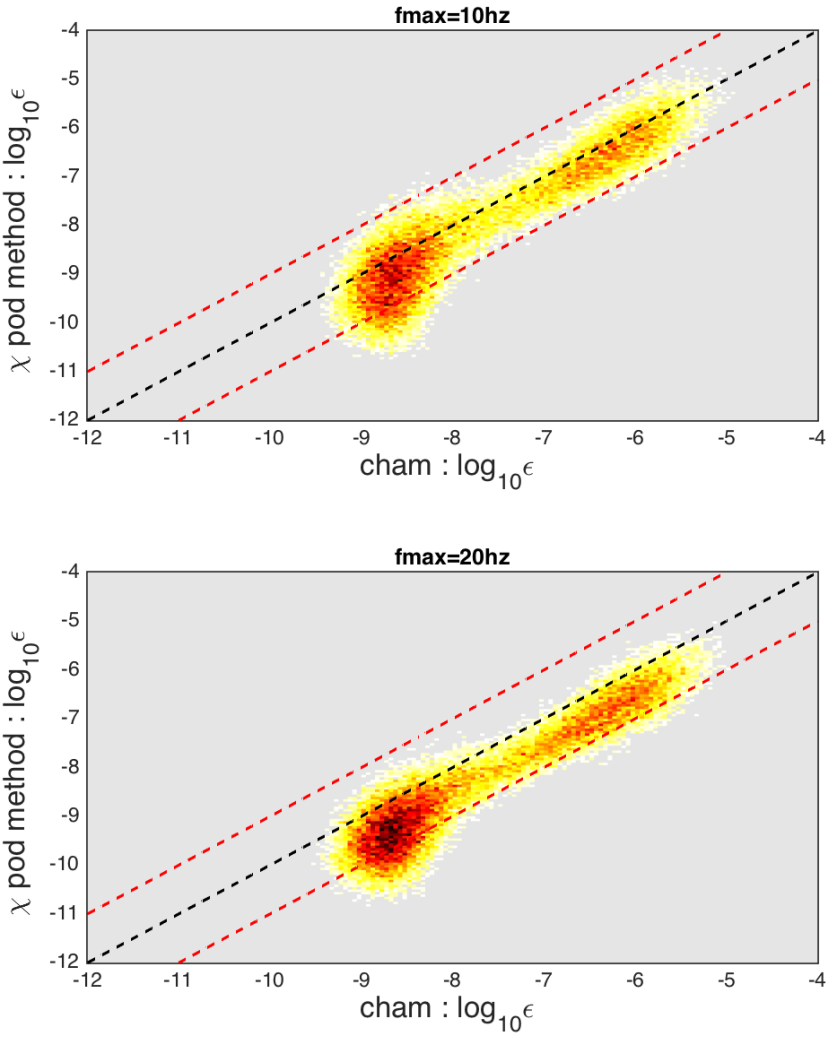

Figure 6: 2D histogram of ϵ from χpod method and 'true' chameleon data, for 2 different values of the 'fmax' parameter. Black dashed line is 1:1, red is $\pm$ an order of magnitude.

7 K_T versus K_ρ in this dataset

One of the assumptions made in the chipod method is that $K_T = K_\rho$. I tested this by computing these values in `CompareKtKrho.m` from chameleon data according to the formulas

$$K_T = \frac{1}{2}\frac{\chi}{< dT/dz >^2} \tag{1}$$

$$K_\rho = 0.2\epsilon/N^2 \tag{2}$$

where I use a mixing efficiency of $\Gamma = 0.2$. It appears that K_T is consistently smaller than K_ρ, by about a factor of 3-4 (Figure 7).

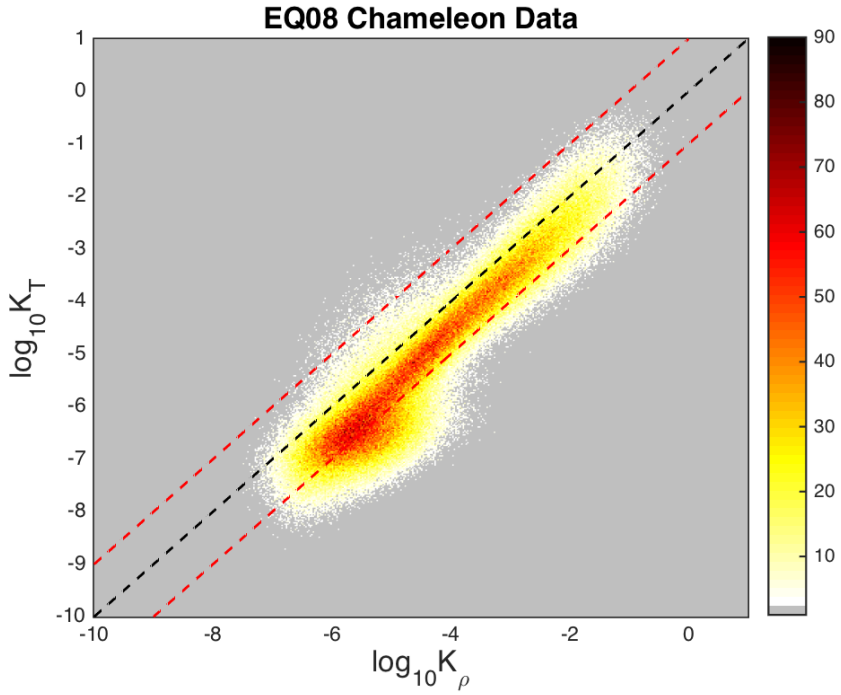

Figure 7: 2D histogram of K_T vs K_ρ from chameleon data in EQ08. Black dashed line is 1:1, red is $\pm$ an order of magnitude.

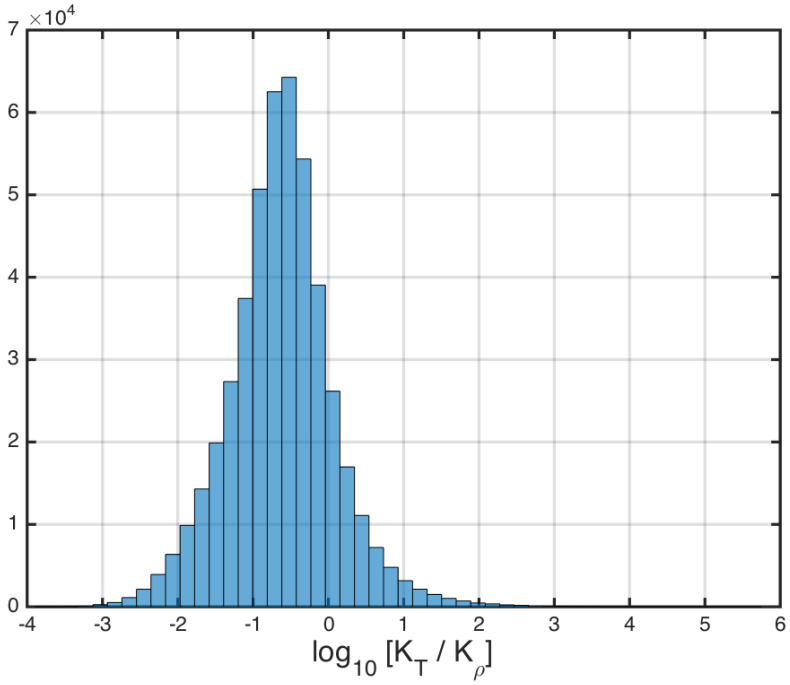

Figure 8: Histogram of the ratio of K_T to K_ρ from chameleon data in EQ08.

8 Summary

- Applying a frequency response correction has little/no effect.
- Smaller values of zsmooth give similar χ but tend to produce larger ϵ values.
- fmax affects the results; a value of 20Hz seems to give better agreement in χ, but ϵ is smaller than the true values.
- From chameleon data, K_T is consistently less than K_ρ by about a factor of 3-4. This could explain why the χpod ϵ values are smaller than the true values.