Notes on averaging chipod profiles and comparison to Chameleon data for EQ08 and EQ14

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Contents

1 Overview

Comparing average profiles of χpod estimates (assuming $\gamma = 0.2$) to Chameleon data for the EQ08 and EQ14 experiments. Individual χpod estimates tend to be biased low, but if we average many profiles together do the average profiles agree?

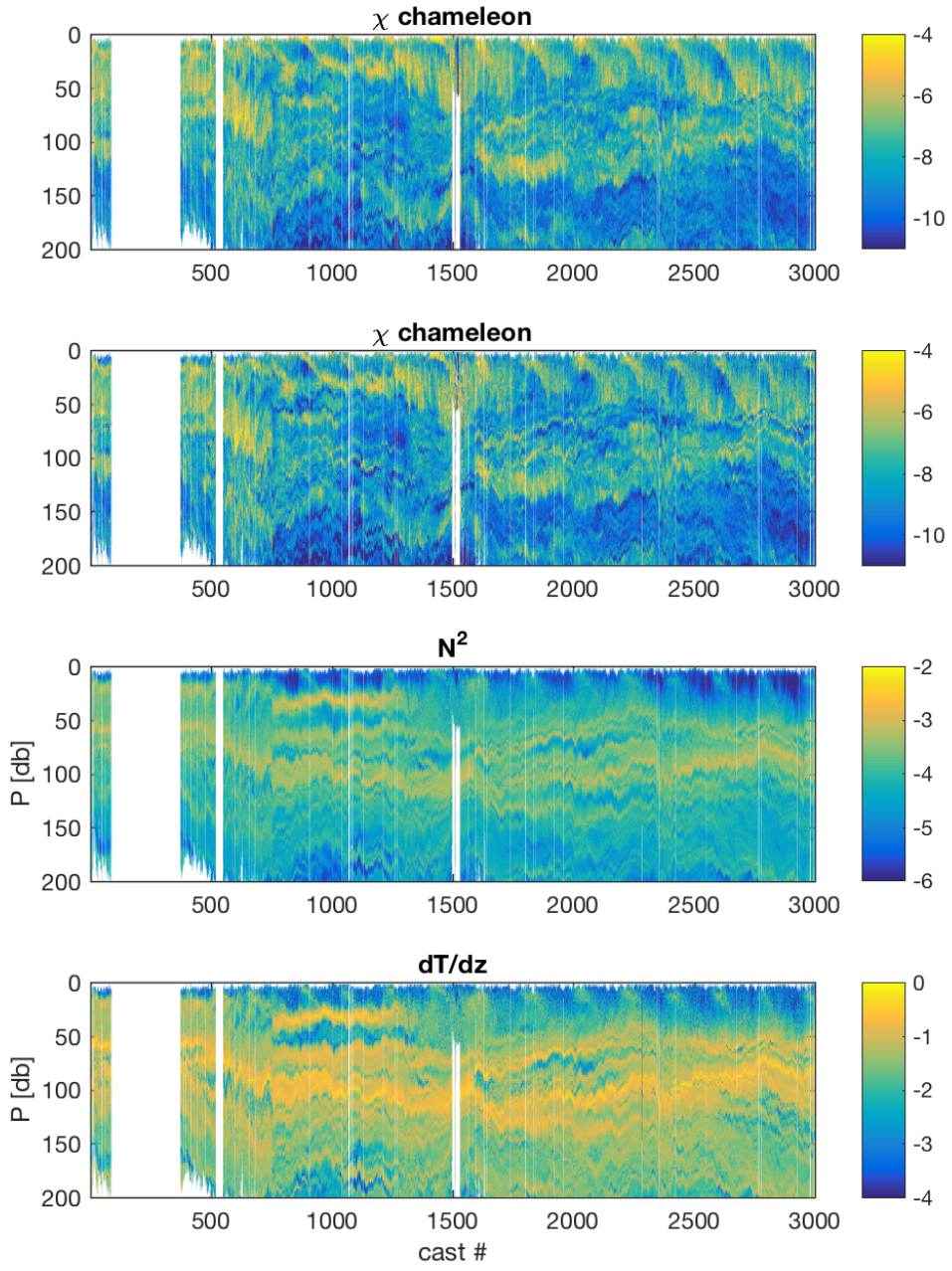

Figure 1: Comparison of χ from chameleon method and chi-pod method, for EQ14 chameleon profiles. Each profile was averaged in 2m bins. Values of below chameleon noise floor (-8.5) have been naned out.

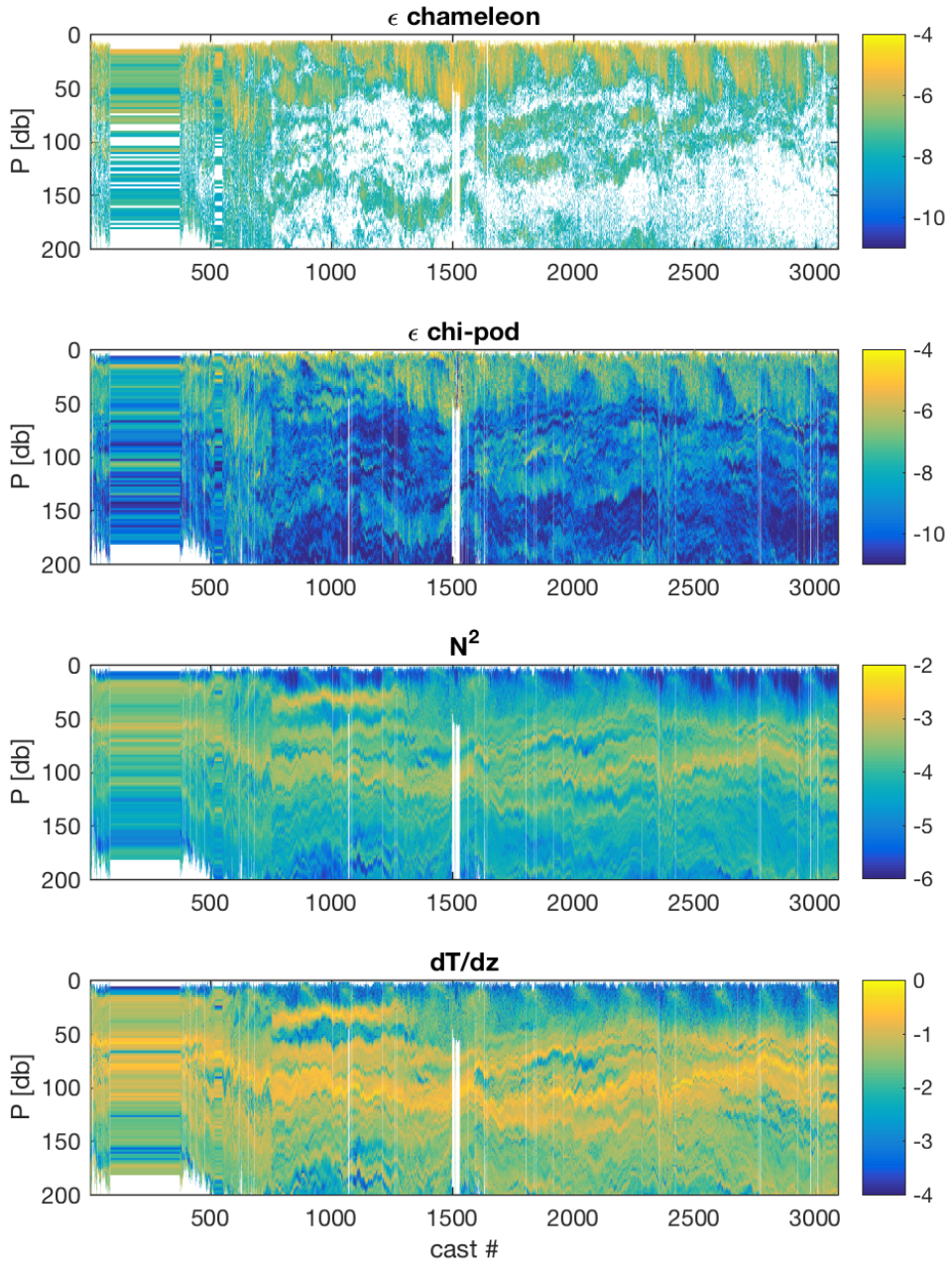

Figure 2: Comparison of ϵ from chameleon method and chi-pod method, for EQ14 chameleon profiles.

2 Comparing individual estimates of ϵ

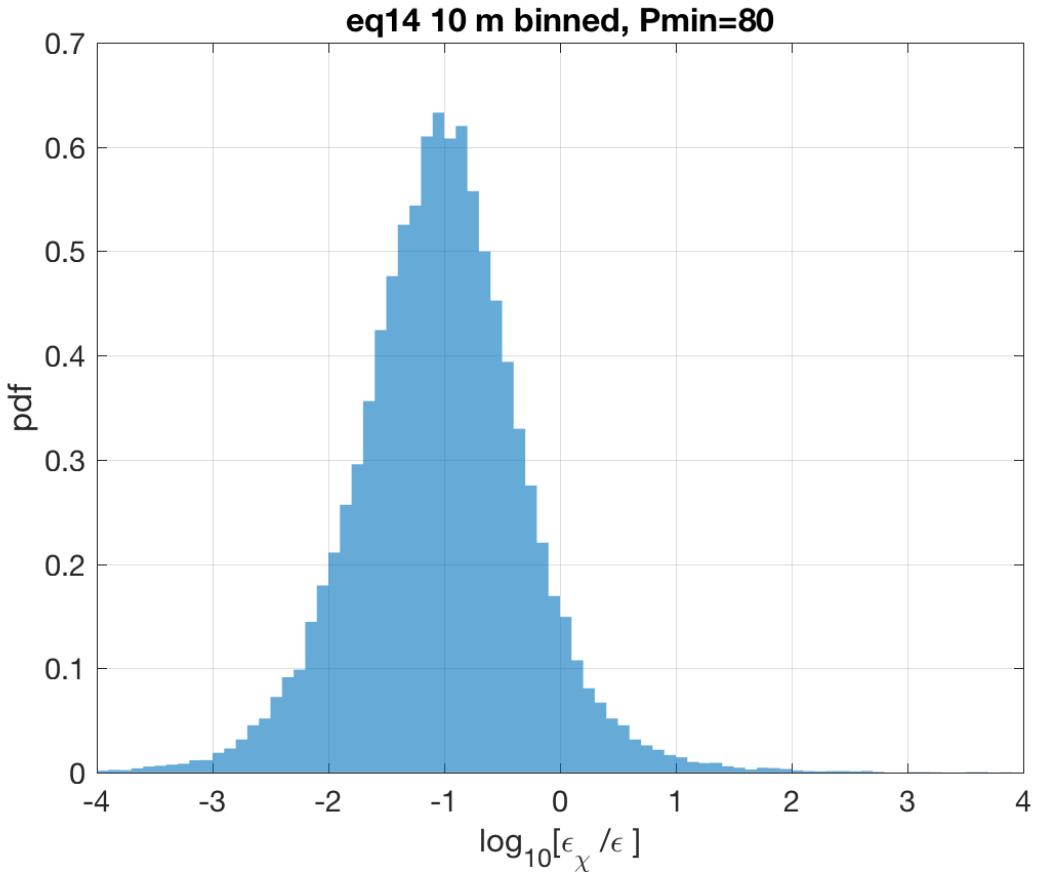

Figure 3: EQ14: Histogram of the ratio of ϵ estimates from χpod method to the chameleon values, for χpod method applied to 1m binned profiles, and applied to just patches. Estimates for each profile were averaged in 10m depth bins.

3 Normalized eps vs chi plots

Assuming that

$$\gamma = \frac{N^2 \chi}{2\epsilon < T_z >^2} \tag{1}$$

, plotting $[\epsilon/N\hat{2}]$ vs $[\chi/t_z^2]$ should follow a straight line with slope equal to $1/2\gamma$.

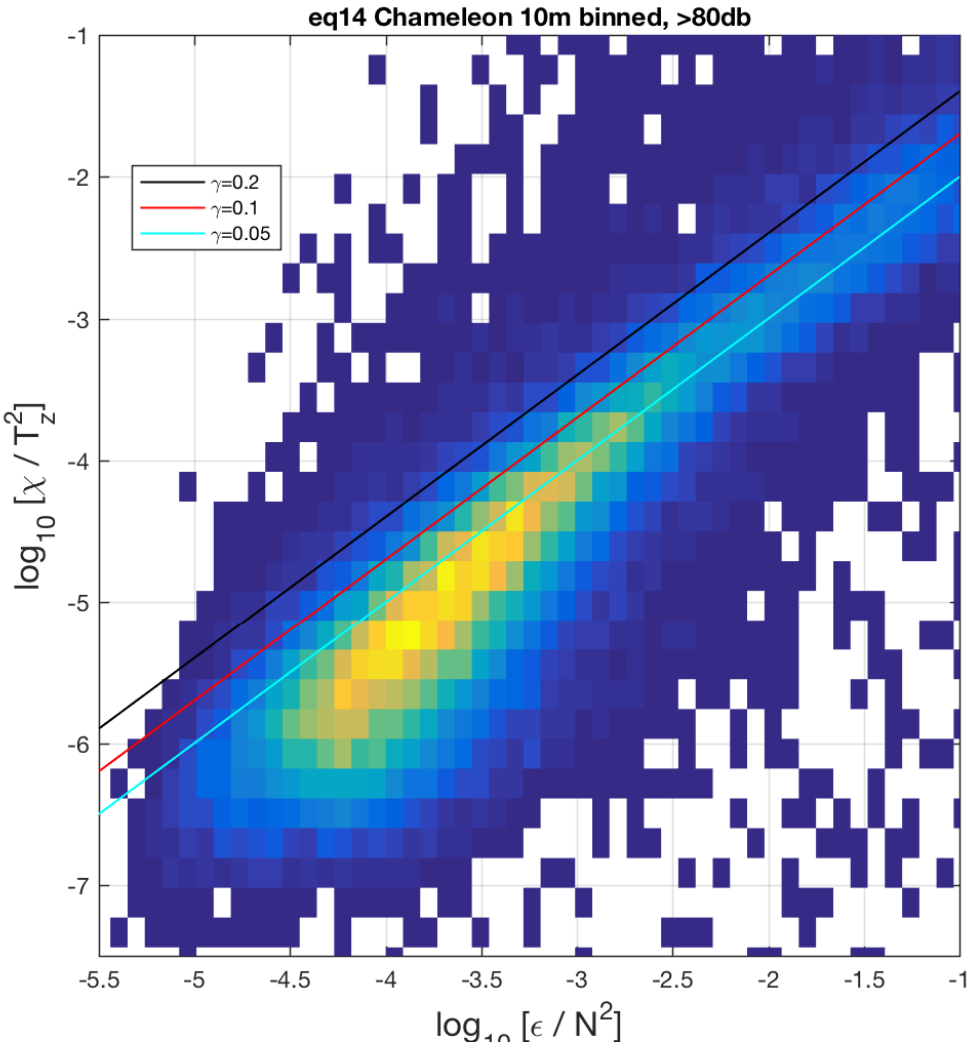

Figure 4: EQ14: 10m binned chameleon $\epsilon/N\hat{2}$ vs χ/t_z^2 for *below 80db*. Lines show different values of γ. Values of ϵ below noise floor ($log_{10}\epsilon < -8.5$) are discarded also.

4 Comparing time-averaged profiles of ϵ

- Averaging profiles seems to improve the comparisons.
- χpod average profiles can be dominated by a few points, which may be spikes/bad data.
- What are appropriate thresholds to use? Should I discard chi-pod epsilon lower than -8.5 (same as chameleon?).

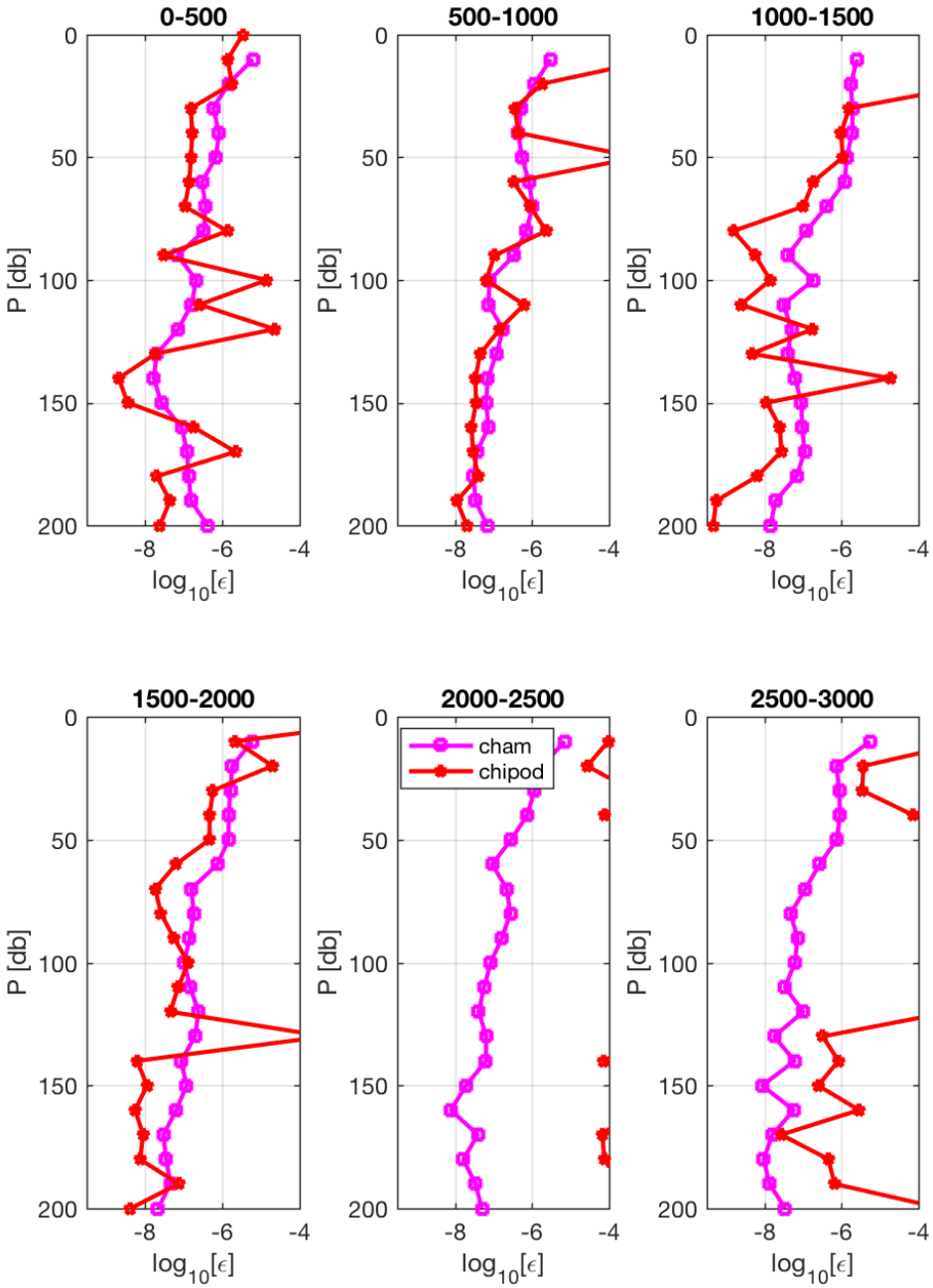

Figure 5: EQ14 : Profiles of ϵ, averaged over 500-cast chunks. Different lines are 1m binned Chameleon ('cham'), χpod method applied over 1m bins ('bin'), and χpod method appplied to patches ('patch'). *Note χpod estimates where $log_{10}\epsilon > -4$ are discarded. Title of each panel gives profile range used, as well as the number of good profiles actually in that range.

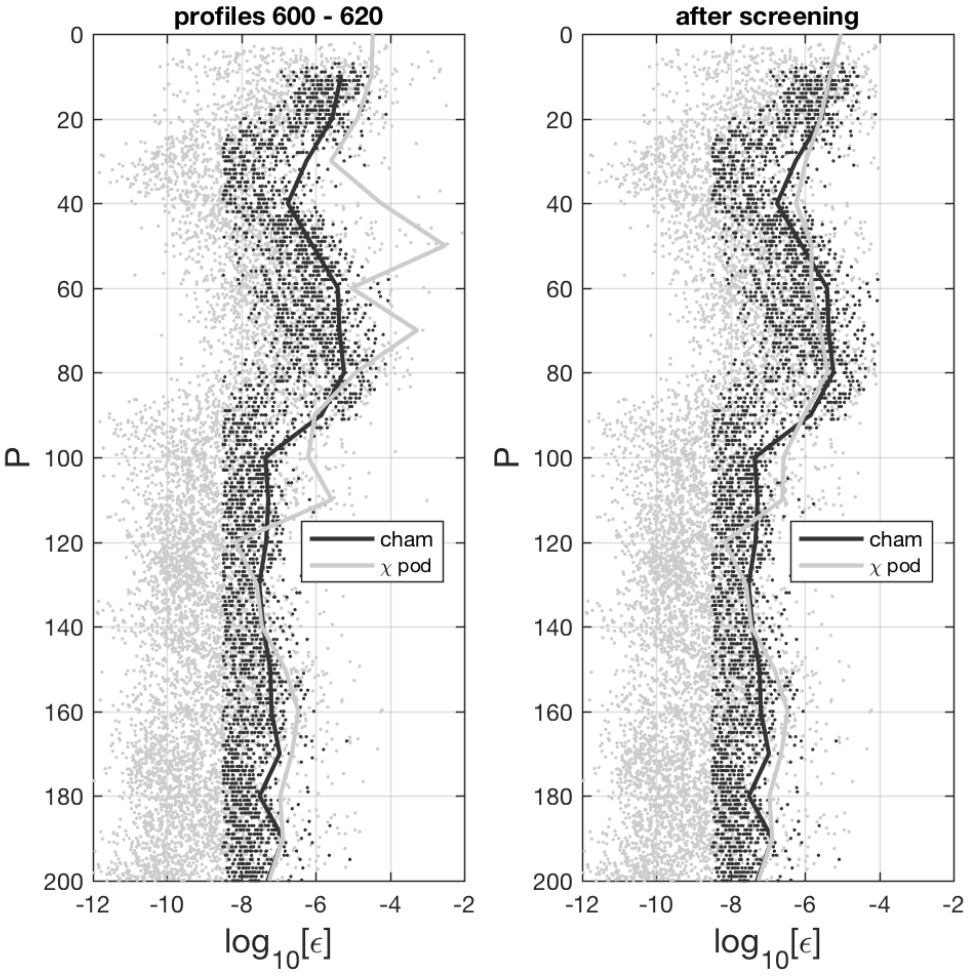
profiles 600 - 620
after screening
P
log10[ϵ]
cham
χ pod
0
20
40
60
80
100
120
140
160
180
200
-12
-10
-8
-6
-4
-2

Figure 6:

5 Effects of averaging in different-sized depth bins

I tried making plots of normalized chi vs eps, and scatterplots of chi-pod vs chameleon epsilon, for data averaged in different-sized depth bins (for each profile, not across profiles). They don't seem to change.

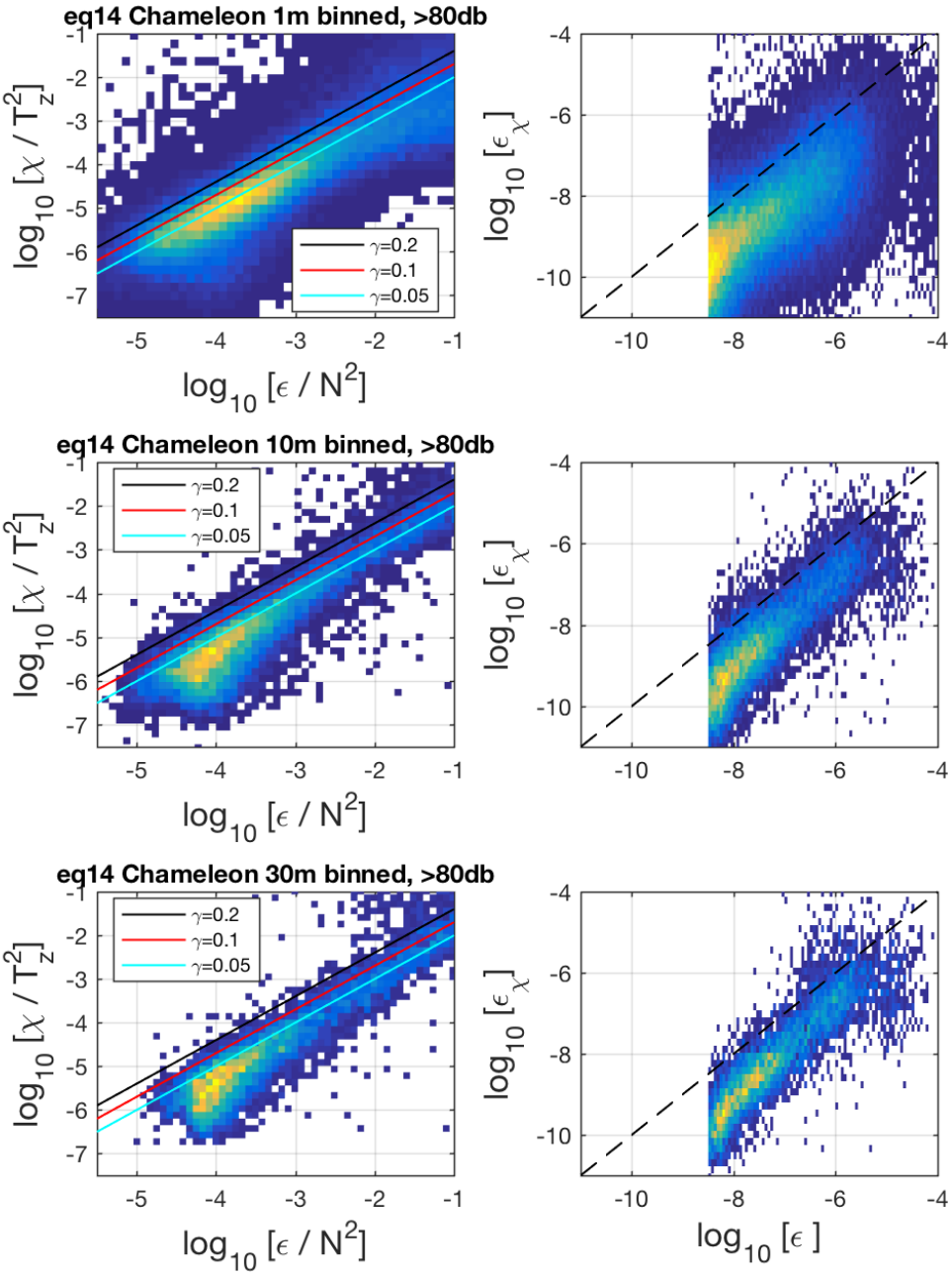
eq14 Chameleon 1m binned, >80db
eq14 Chameleon 10m binned, >80db
eq14 Chameleon 30m binned, >80db
γ=0.2
γ=0.1
γ=0.05
log10 [χ / Tz2]
log10 [ϵ / N2]
log10 [ϵχ]
log10 [ϵ]

Figure 7:

6 Effects of averaging different numbers of proifles

I tried making plots of normalized chi vs eps, and scatterplots of chi-pod vs chameleon epsilon, for data averaged across different numbers of profiles. This doesn't seem to change either, which is strange because it looked like when I plotted average profiles they were matching better for more averaging....

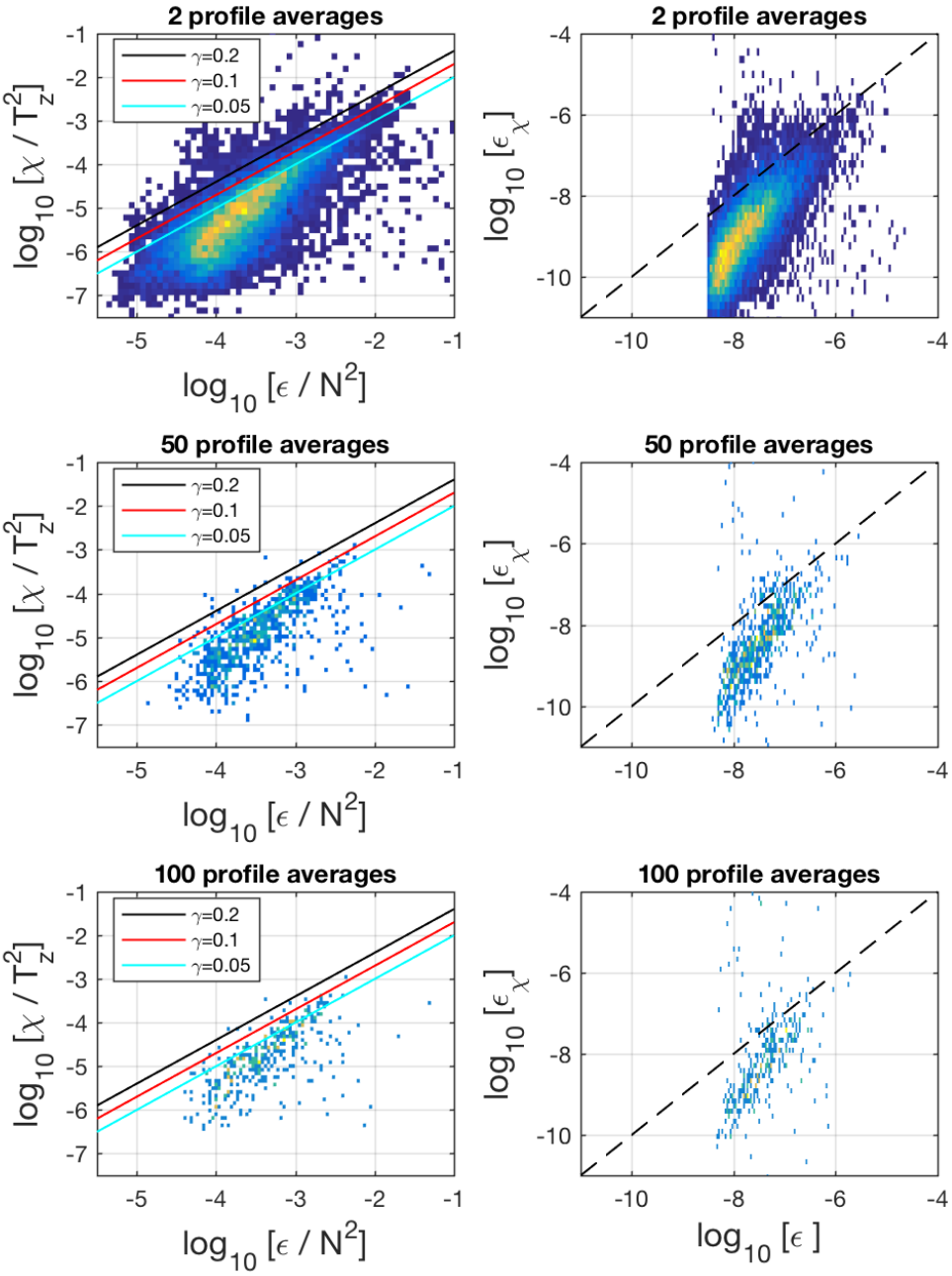
2 profile averages
50 profile averages
100 profile averages
γ=0.2
γ=0.1
γ=0.05
log10 [χ / Tz2]
log10 [ϵ / N2]
log10 [ϵχ]
log10 [ϵ]

Figure 8:

7 γ computed from averaged quantities

If we compute gamma from time-averaged N^2, T_z, χ, ϵ do we get $\gamma = 0.2$? Estimates from the averaged data are larger (Figures **??**,9) but still slightly less than 0.2 .

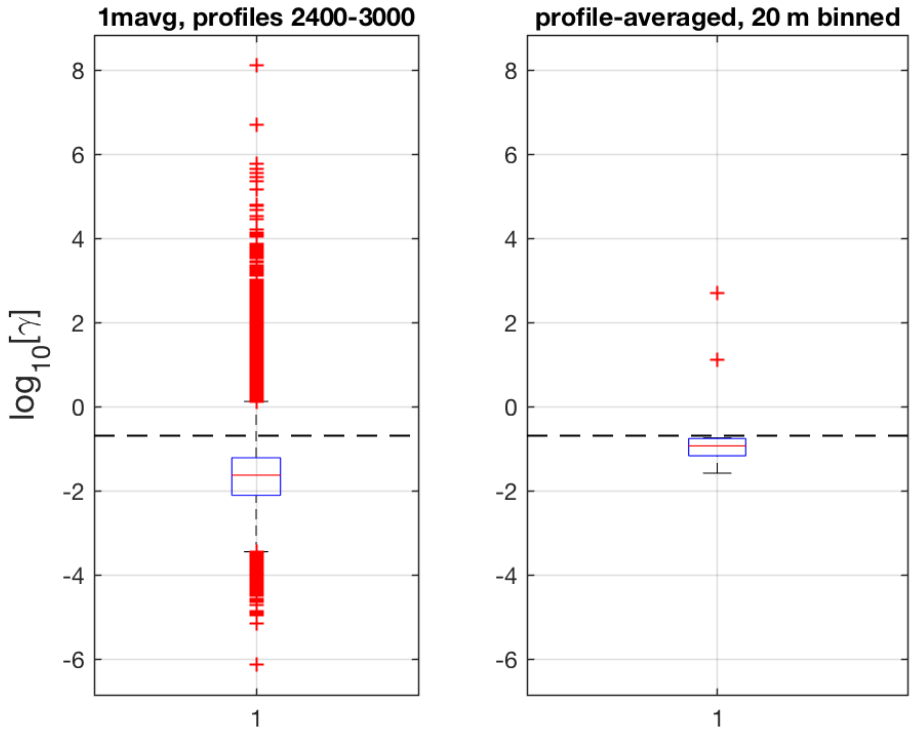

Figure 9: Boxplots of $log_{10}[\gamma]$ for a set of profiles from EQ14. Left is for all 1m avg data. Right is for data from all profiles averaged in 10m bins. Horizontal dashed line indicates $\gamma = 0.2$.

8 How many profiles need to be averaged to converge?

Next I wanted to see how many profiles we need to average for the χpod profile to converge to the chameleon profile. Obviously this will depend on the specific profiles used and the characteristics of the turbulence, but here they seem to converge after about 100-150 profiles.

9 Summary