EQ14 - Computing gamma by patches

Andy Pickering

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Contents

1 Intro

* These notes follow code `Compute_gamma_by_patches.m`

In this analysis i'm tyring to compute Γ for EQ14 Chameleon data by patch instead of just at every point. The equation used is

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

Figure 1 shows the distribution of estimated gammas using all the chamleon data, and using just the data between 60 and 180m depth. The median gamma from both is about 0.02, about ten times smaller than the usually assumed $\Gamma = 0.2$.

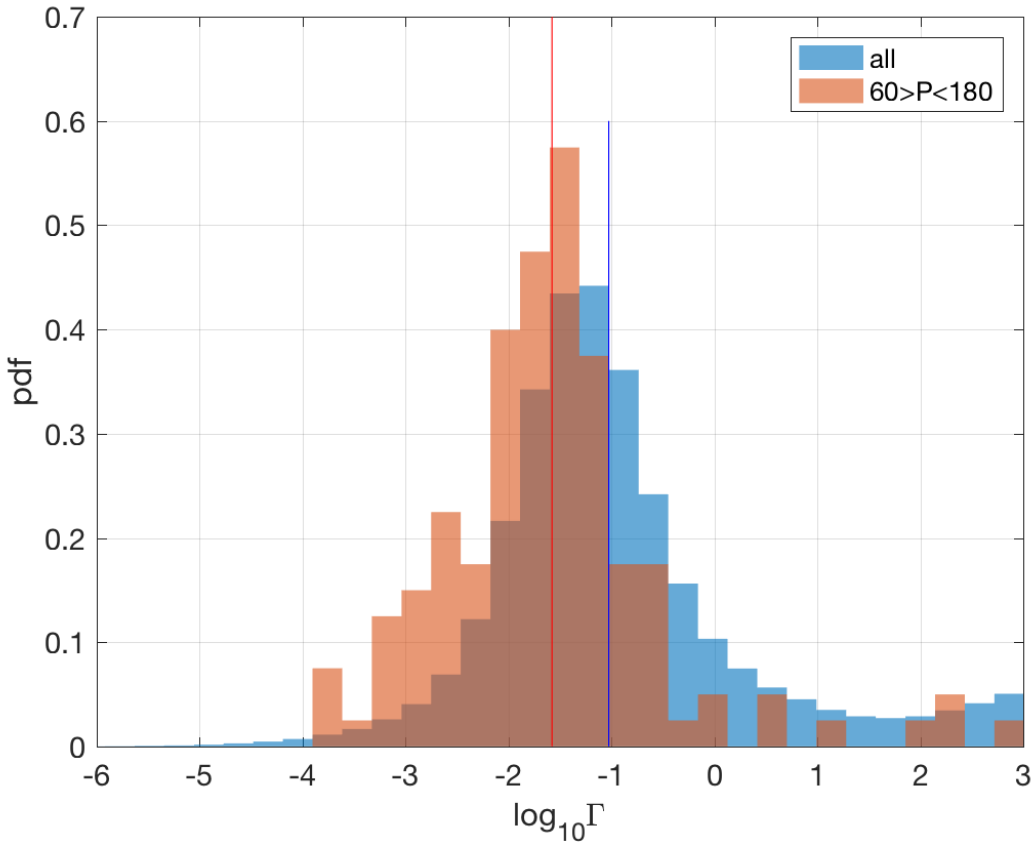

Figure 1: Histogram of Γ for all EQ14 chameleon profiles.

2 Looking at stratification etc.

Looking in more detail at relationships between straitifcation, χ, and Γ as suggested by Emily. See `MakeEmilysPlot.m`. Figure 2 shows 2-D histograms of gamma vs each variable. Figure 3 shows the mean and median values of gamma for bins of chi vs N2.

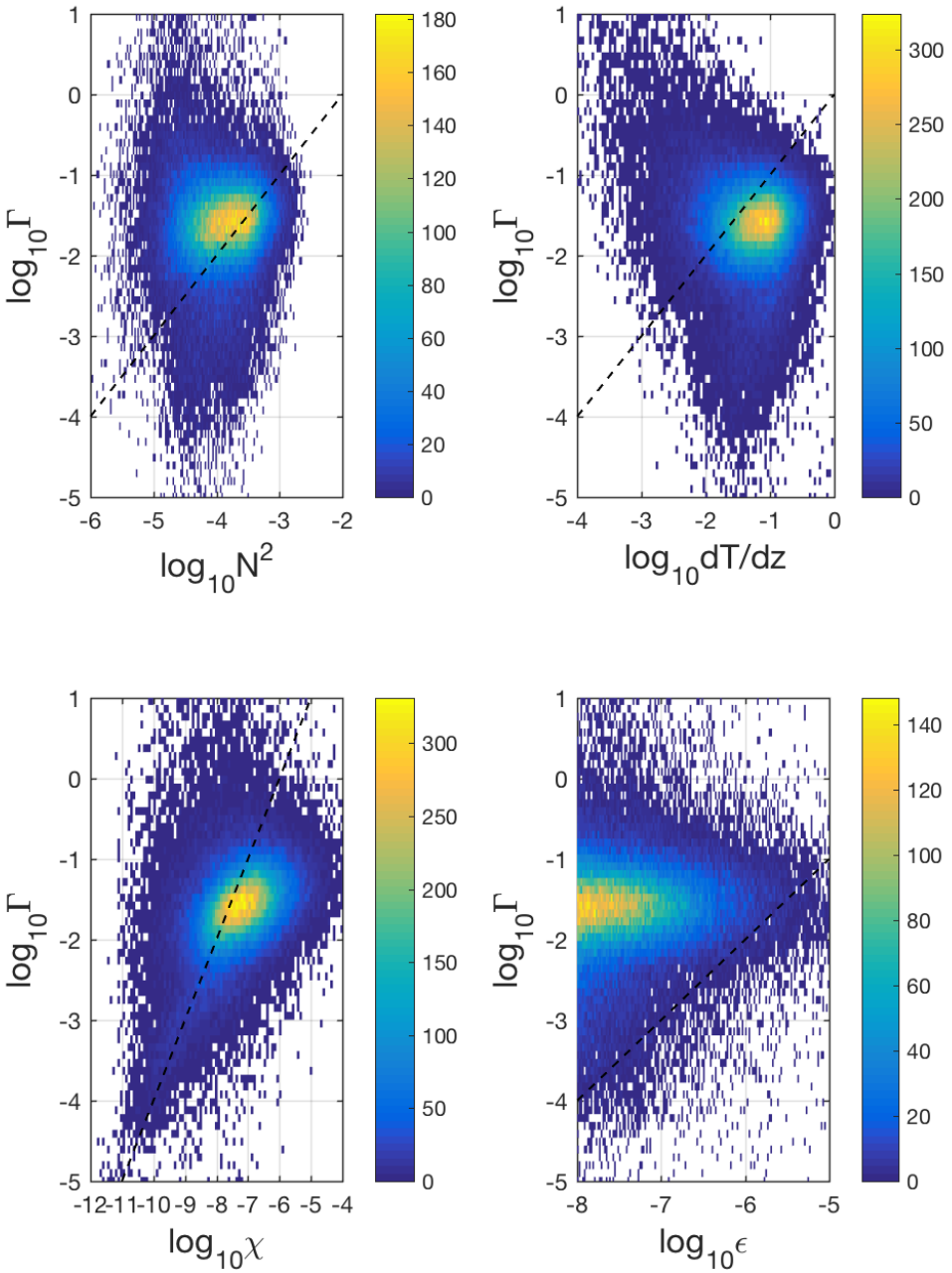

Figure 2: 2-D histograms of Γ vs each variable. Black line shows 1:1 relationship.

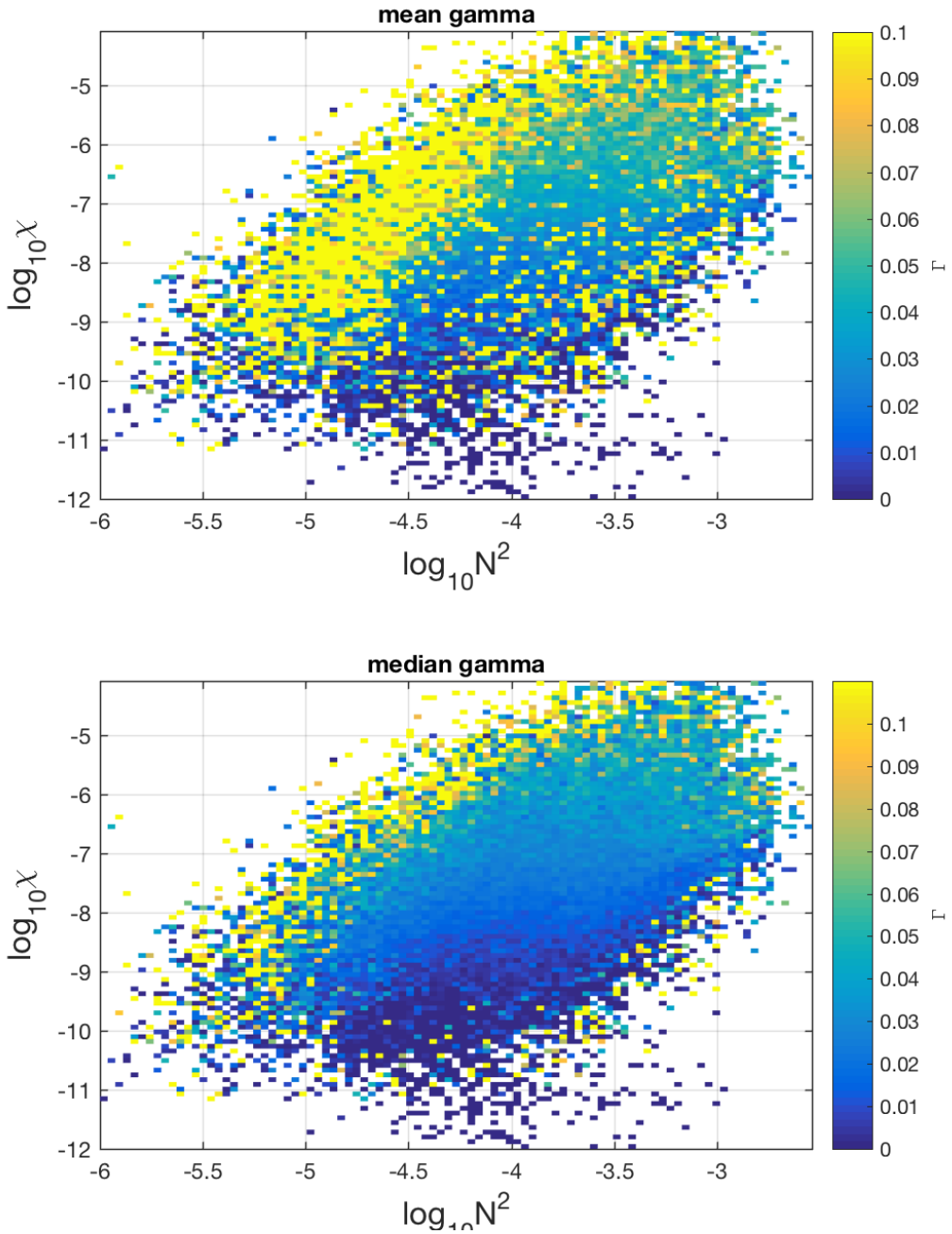

Figure 3: Mean (top) and median (bottom) values of gamma computed for bins of χ and N^2.

3 Identifying Patches

I first identify patches (overturns) using potnential density computed from 1m binned temperature and salinity from Chameleon profiles. This is dones w/ `IdentifyPatches.m`.

- Figure 4 shows the distribution of patch sizes from all profiles (exluding those above 20m and below 180m). Only about 11% of the orginal patches are in this good depth range. Most of the patches are very small (1-2m).
- Figure 5 shows ϵ with overturn locations plotted over. The majority of the identified overturns occur between 20-60m, associated with the diurnal cycle of turbulence. These probably shouldn't even be included in the chipod analysis since the assumed dynamics do not hold.
- Below that, overturns generally co-occur with larger ϵ measured by chameleon shear probe. There are some that occur where chameleon ϵ is small, however.
- Figure 6 shows distributions of all data versus just data within the identified patches. Patches are associated with lower N2 and dtdz, and higher epsilon. The distribution of chi does not appear to be significantly different.

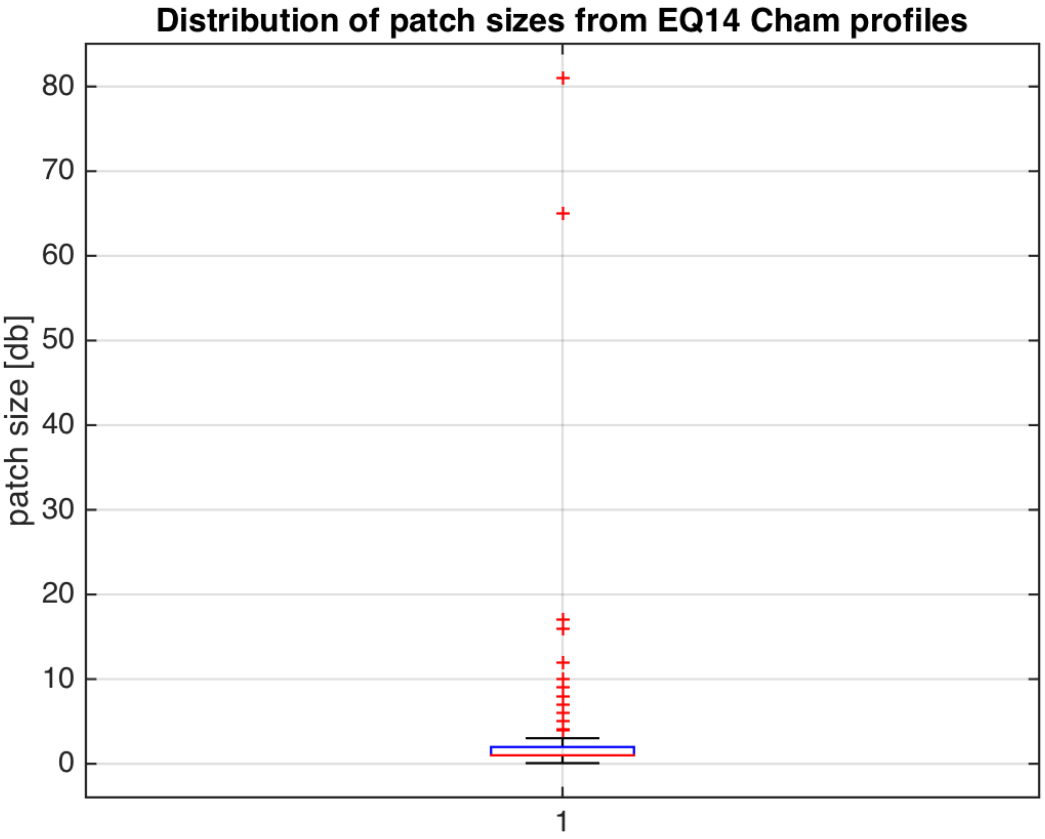

Figure 4: Boxplot of the patch sizes for all EQ14 chameleon profiles. Only patches occuring at depths between 20 and 180 m are considered.

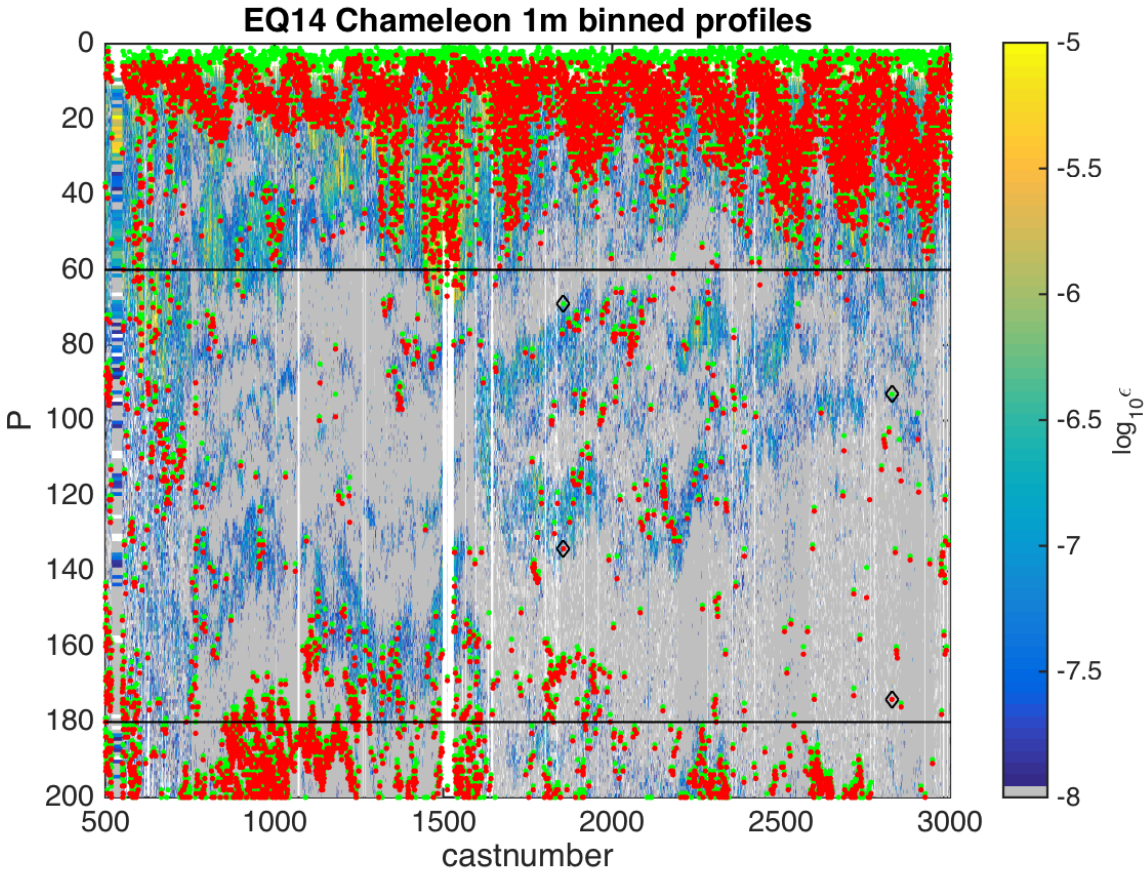

Figure 5: ϵ measured by chameleon shear probes on EQ14 profiles. Identified overturns are plotted in green/red. Black diamonds indicate overturns larger than 20m, these are ignored (there are only 2).

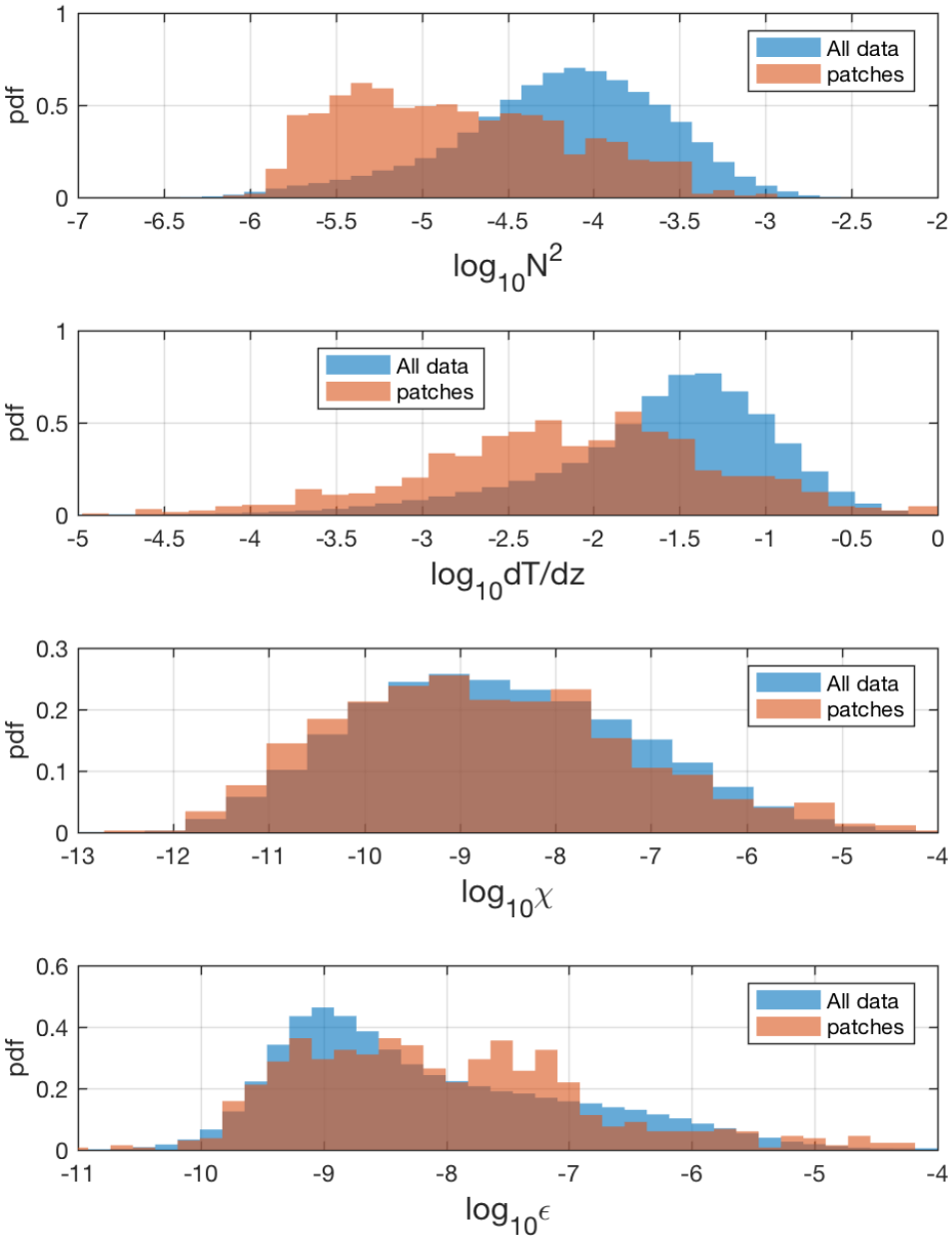

Figure 6: Distributions of N2,dtdz,chi,eps from EQ14 chameleon profiles, for all data and just within patches.

4 Computing gamma by patch

The next step is to compute Γ over each patch. I will use N^2 and dT/dz averaged over the patch (since most patches are very small, this probably won't differ too much?). For χ and ϵ, I should compute these from spectra over the entire patch. This will involve hacking into the chameleon processing codes a bit... Before I do this, I will try just using the 1m binned values within each patch.

So far this doesn't seem to be giving me anything close to $\Gamma = 0.2$ (figure 7). Figure 8 shows gamma plotted vs patch size. It seems like the maximum gamma decreases linearly with patch size. We can also see that gamma is dominated by a very large number of small values, especially for smaller patch sizes.

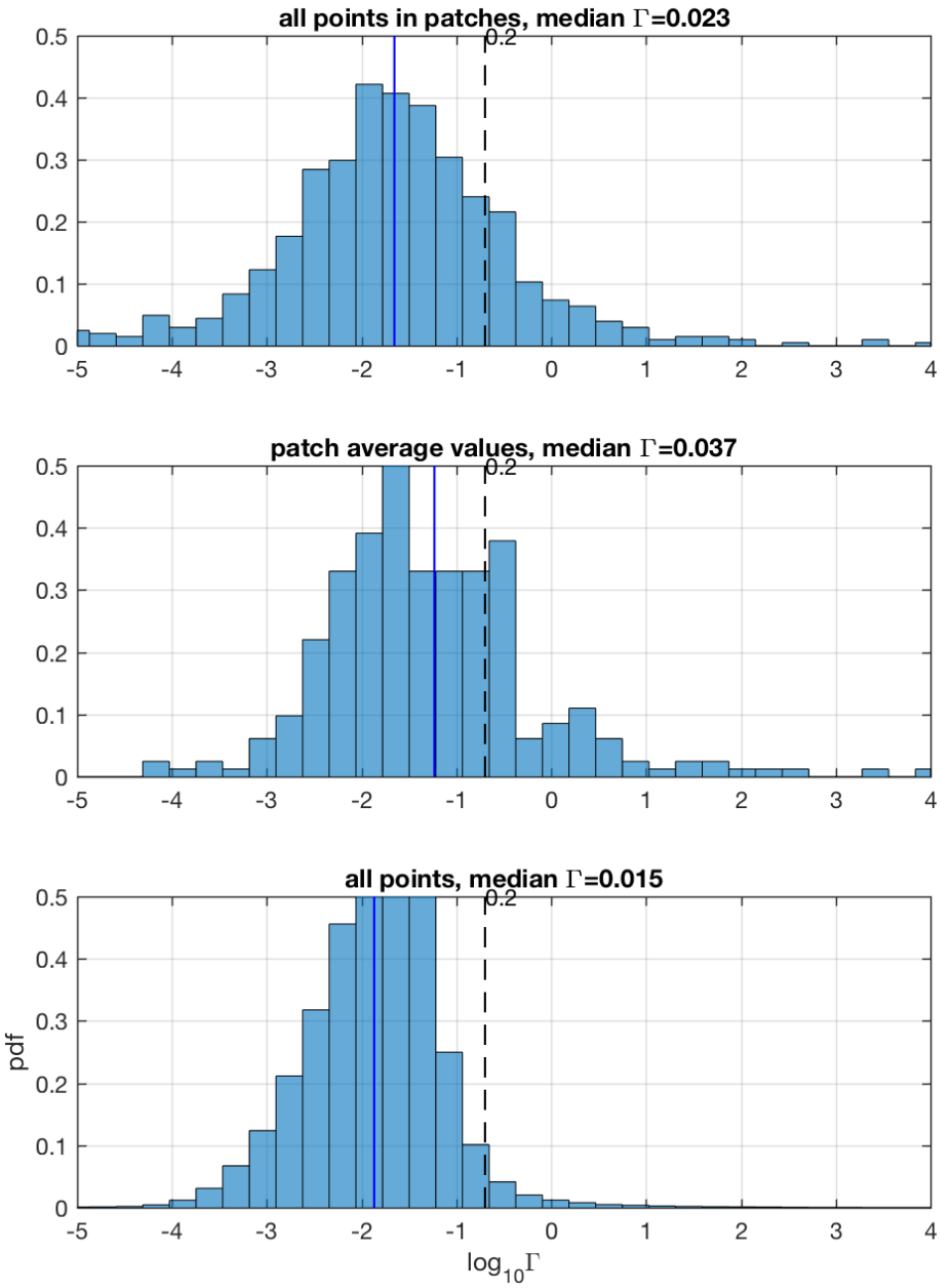

Figure 7: Histograms of gamma for (1) all points within patches (2) using averaged values from patches (3) using all points. Only data between 60-180m depth is used for all. Blue line shows median of each distribution, and black dashed line is 0.2.

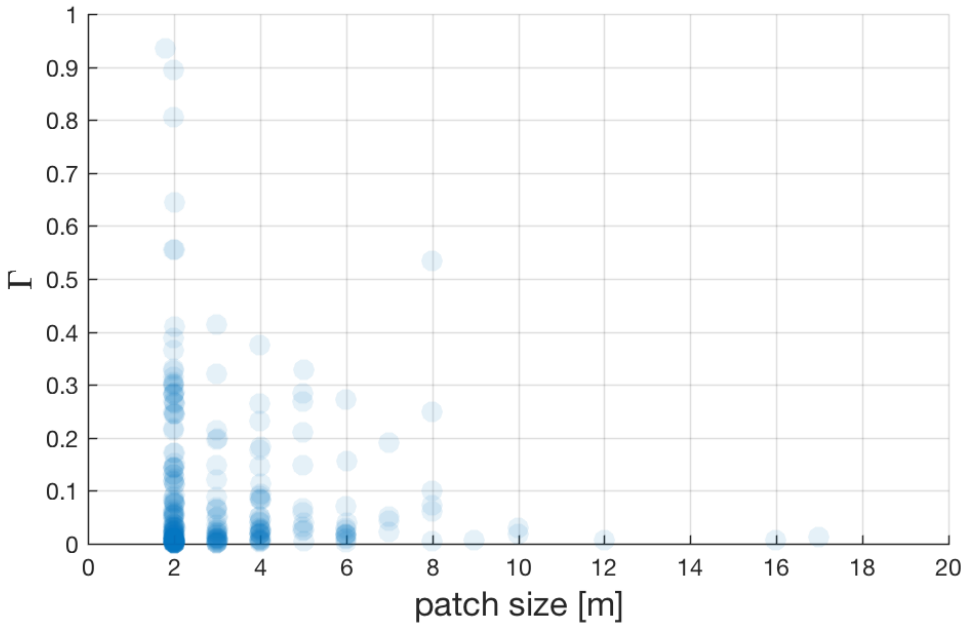

Figure 8: Scatter plot of gamma vs patch size for EQ14 profiles.

5 TIWE Comparisons

Jonathan shared the entire TIWE folder (from Ganges I think?) with me on Dropbox. There are a lot of different folders/versions. Im going to try using the processed mat files for each cast in `Tiwe91/mat_Greg_analysis/`.

I first combine all the profiles in `Combine_TIWE.m`, interpolating each profile onto the same depth vector w/ 1m spacing. Figure 9 shows data from all the combined profiles. Note that something seems weird with dT/dz; many profiles have a constant near-zero dTdz below 150m. Other than that, the data look qualitatively similar to EQ14.

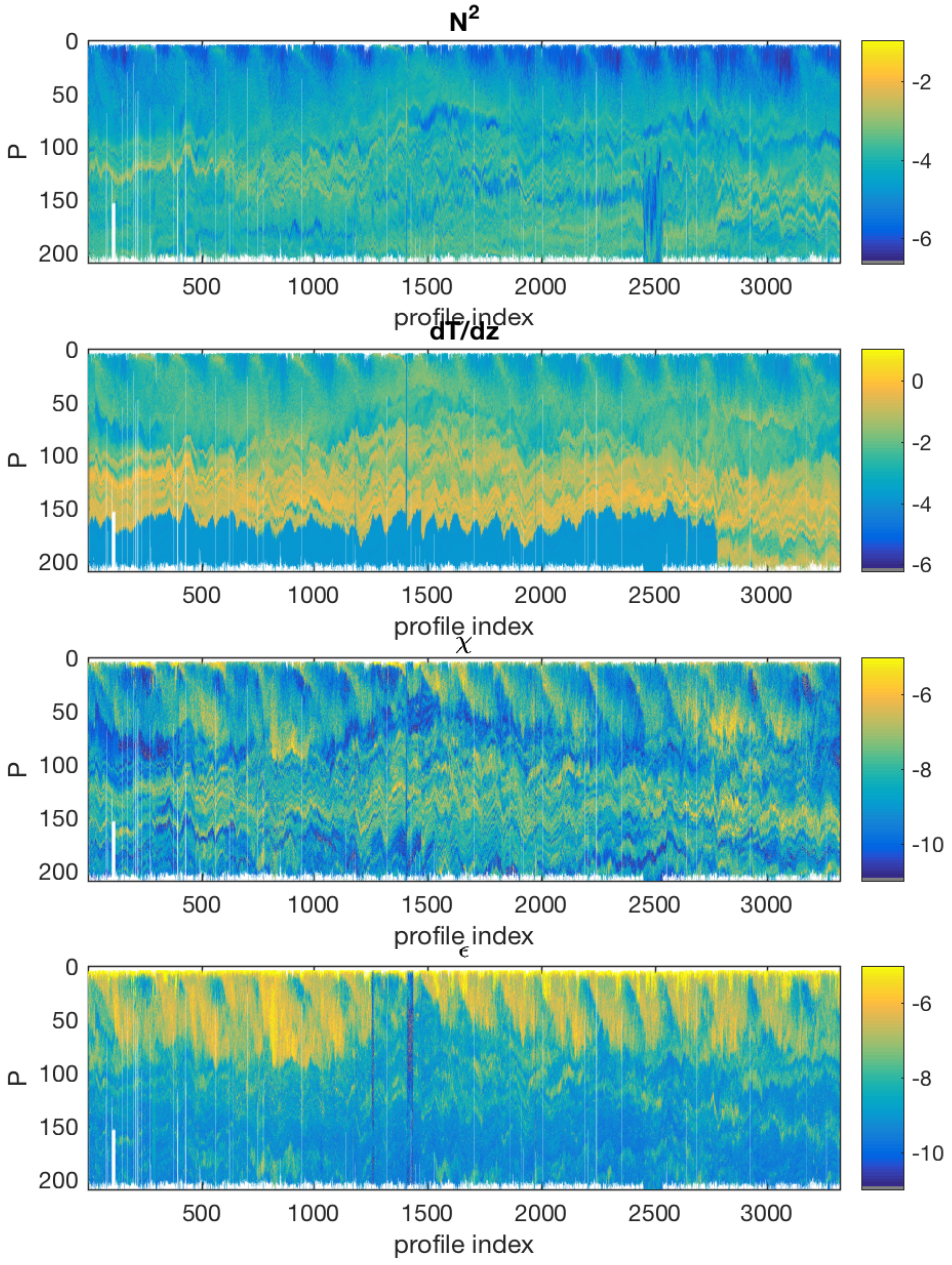

Figure 9: N2,dtdz,chi, and eps from combined TIWE data.

Next i'll compare the distributions of each variable to the EQ14 data (Figure 10). N2 and epsilon look very similar. Chi from tiwe is a bit narrower but they have similar medians. Dt/dz from tiwe has a spike at those weird small values, and then a sort of two-peak distribution. Figure 11 shows the same plots with the bad dtdz values removed.L

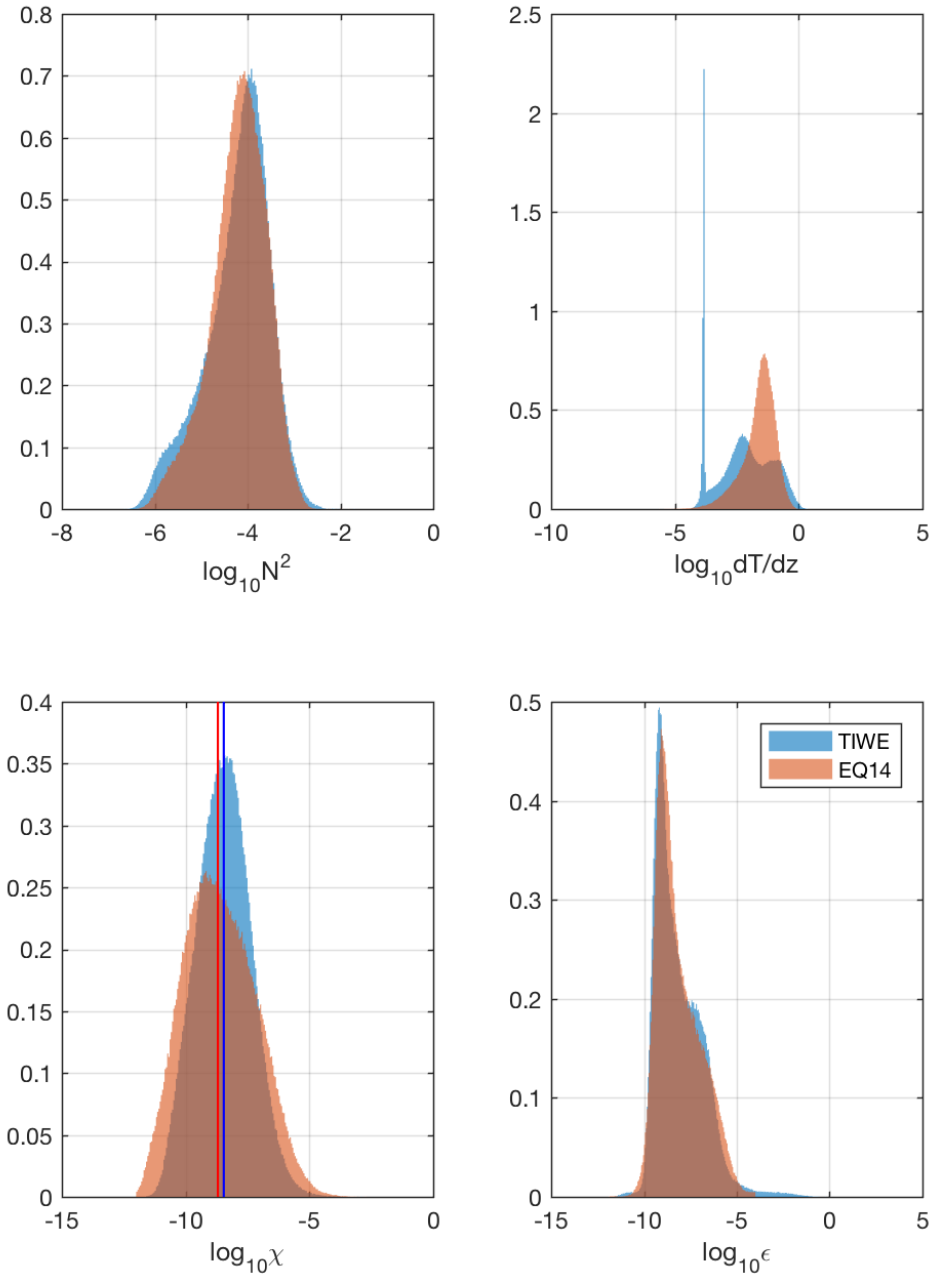

Figure 10: Histograms of N2,dtdz,chi, and eps from combined TIWE data and EQ14 data.

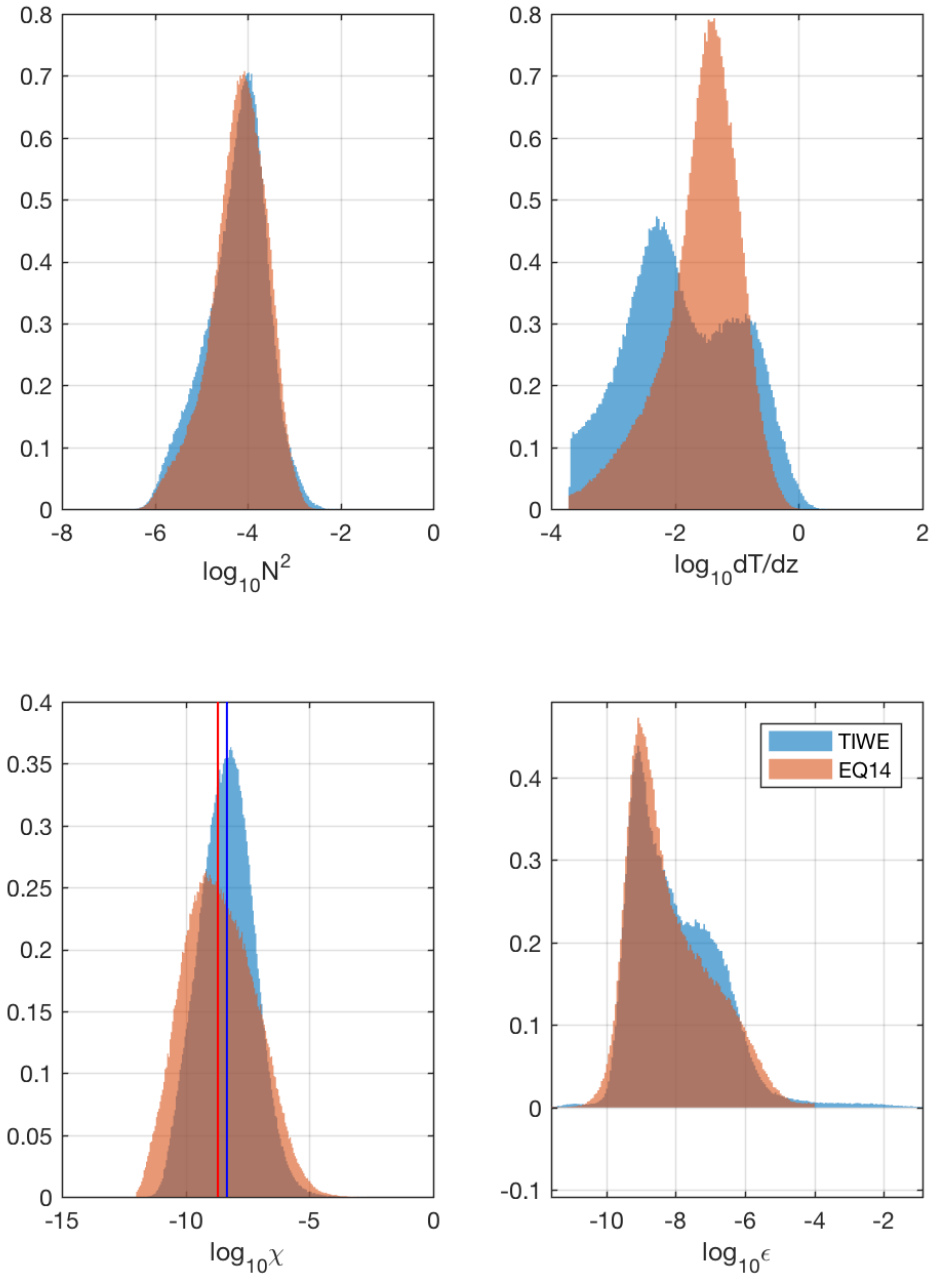

Figure 11: Histograms of N2,dtdz,chi, and eps from combined TIWE data and EQ14 data, with bad dT/dz values not included.

What does gamma look like for the tiwe data? Figure 12. Gamma from tiwe is larger than eq14, with a median of about 0.06 , compared to 0.02 .

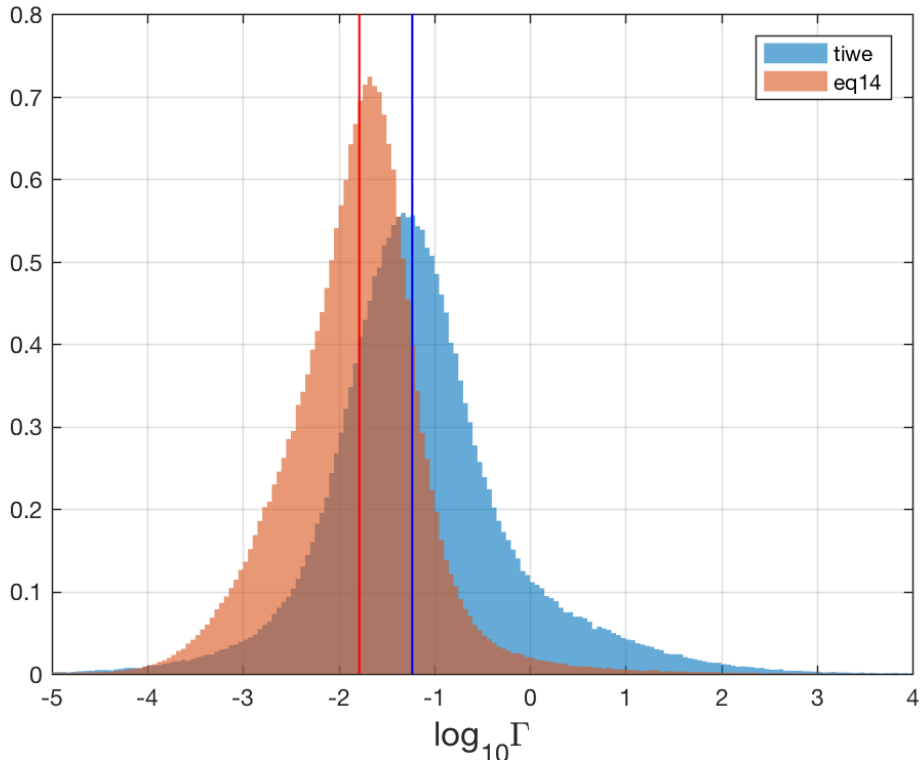

Figure 12: Histograms of gamma computed fromcombined TIWE data and EQ14 data.