Patch/Gamma Analysis for TIWEchameleon patches

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Contents

1 Overview

The goal of this analysis is to compute mixing efficency (Γ) for patches in TIWE chameleon profiles, and see if we obtain values close to $\Gamma = 0.2$.

2 Data

Data are made by the 'Chameleon' microstructure profiler near the equator during the 'TIWE' experiment. Data was shared by JN and my local copy is at:
`/Users/Andy/Dropbox/AP_Share_With_JN/date_from_jim/Tiwe91`

I'm using the raw Chameleon data files in:
`/Users/Andy/Dropbox/AP_Share_With_JN/date_from_jim/Tiwe91/cham/tw/`

All my analysis is in the main folder:
`/Users/Andy/Cruises_Research/ChiPod/TIWE`

3 Methods

- `Process_tiwe_rawprofiles_AP.m` Processes raw Chameleon files and saves 'cal2' files which have the raw/ high-res profiles of temp and salinity. These are used to identify patches.
- `FindPatches_tiwe_Raw.m` Identifies patches in the profiles made by `Process_tiwe_rawprofiles_AP.m`, using potential temperature.
- `Run_tiwe_AP_forPatches.m` Runs the Chameleon processing (including χ and ϵ) for just the patches identified in `FindPatches_tiwe_Raw.m` .
- `Run_tiwe_AP.m` Runs the standard Chameleon processing, producing 1m avg quantities.
- `Combine_tiwe_avg_profiles.m` Combines the avg profiles made in `Run_tiwe_AP.m` into a single structure with common depths.
- `Compute_N2_dTdz_patches_tiwe.m` Computes N^2 and T_z for patches, using several different methods.

3.1 dTdz

Temperature gradient is computed for each patch using the following methods:

1. dtdz1 : Take the range of T over the patch and divided by patch height

2. dtdz2 : Fit a straight line to sorted T using `polyfit`

3. dtdz3 : Use the 'bulk gradient' from Smyth et al 2001, which is the rms fluctuation from the background (sorted) temperature, divided by the thorpe scale (the rms re-ordering distances).

3.2 N2

N^2 is computed for each patch using the following methods:

1. N_1^2 : Take the range of potential density over the patch divided by the patch height ($d\rho/dz$), then compute $N^2 = \frac{-g}{\rho_o}\frac{d\rho}{dz}$ where ρ_o is the mean potential density over the patch.

2. N_2^2 : Fit a straight line to sorted potential density using polyfit to get $d\rho/dz$, then compute N2.

3. N_3^2 : Use 'bulk gradient' . This is calculated from the bulk T_z, using a linear fit between density and temperature.

4. N_4^2 : Compute N^2 from the sorted profile (sorted by potential density) using `sw_bfreq`, then take average over the patch. I believe this method is used by some commonly-used overturn codes.

3.3 Mixing Efficiency

Mixing Efficiency Γ is computed from the following equation using differerent N^2 and dT/dz values.

$$\Gamma = \frac{N^2\chi}{2\epsilon T_z^2} \tag{1}$$

χ and ϵ are computed over each patch from the Chameleon data. Gamma is computed for the following 4 combinations:

1. N_1^2, dtdz1

2. N_2^2, dtdz2

3. N_3^2, dtdz3

4. N_4^2, dtdz2

Values where ϵ is below the noise floor of $log_{10}[\epsilon] = -8.5$ are discarded (using these values does have a significant impact on the mean/median of the resulting distribution).

4 Results

- For some reason many χ values below 150db are bad/missing? Not sure why.
- The median Γ computed using the 1m avg data is 0.063 (Figure 2).
- Gamma computed over patches w/ linear fits is slightly higher than the binned gamma, but still less than 0.2 (Figure 3).

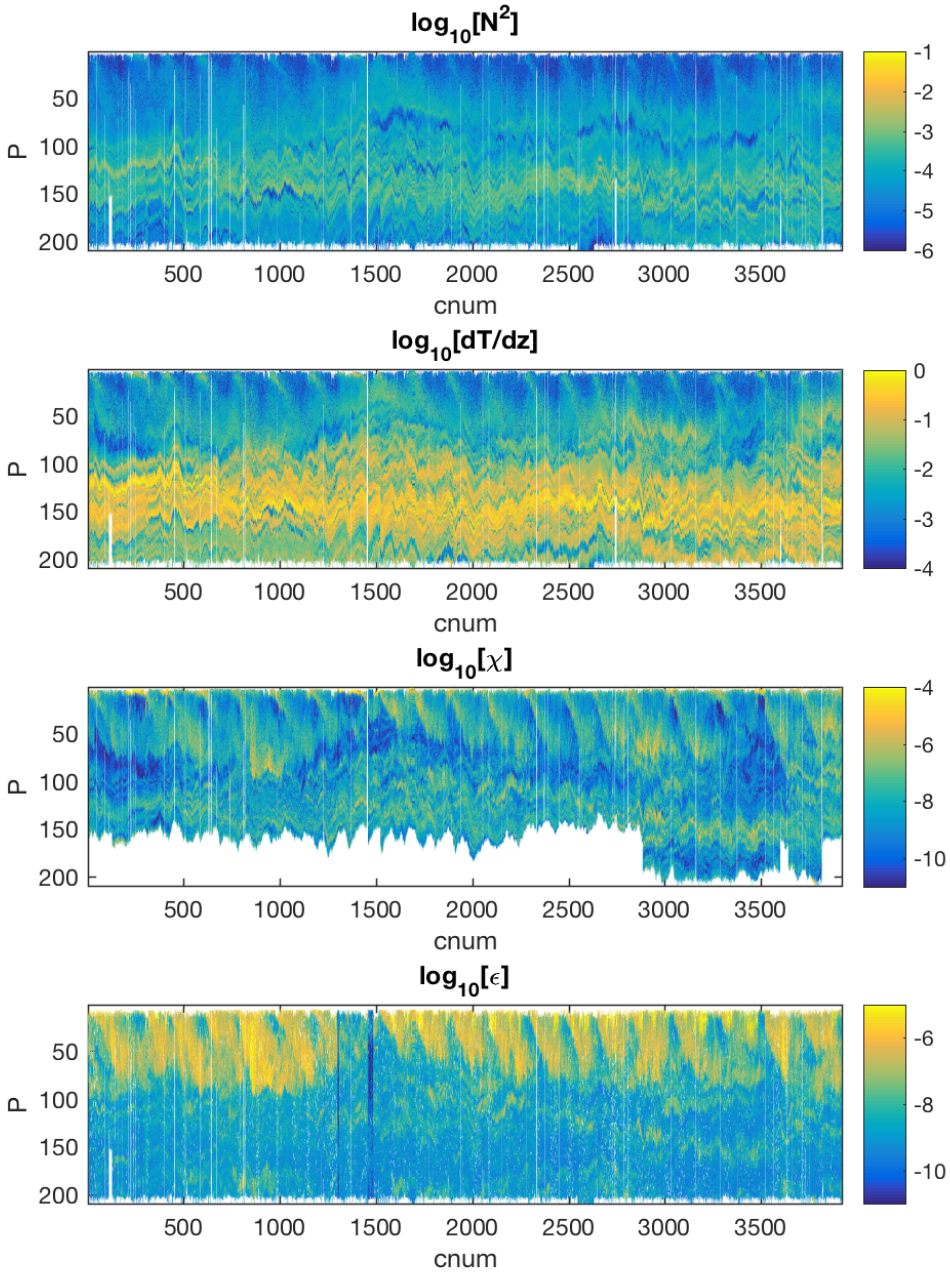

Figure 1: Pcolor of the combined 1m avg chameleon data for TIWE. * Note for some reason many χ values below 150db are bad/missing.

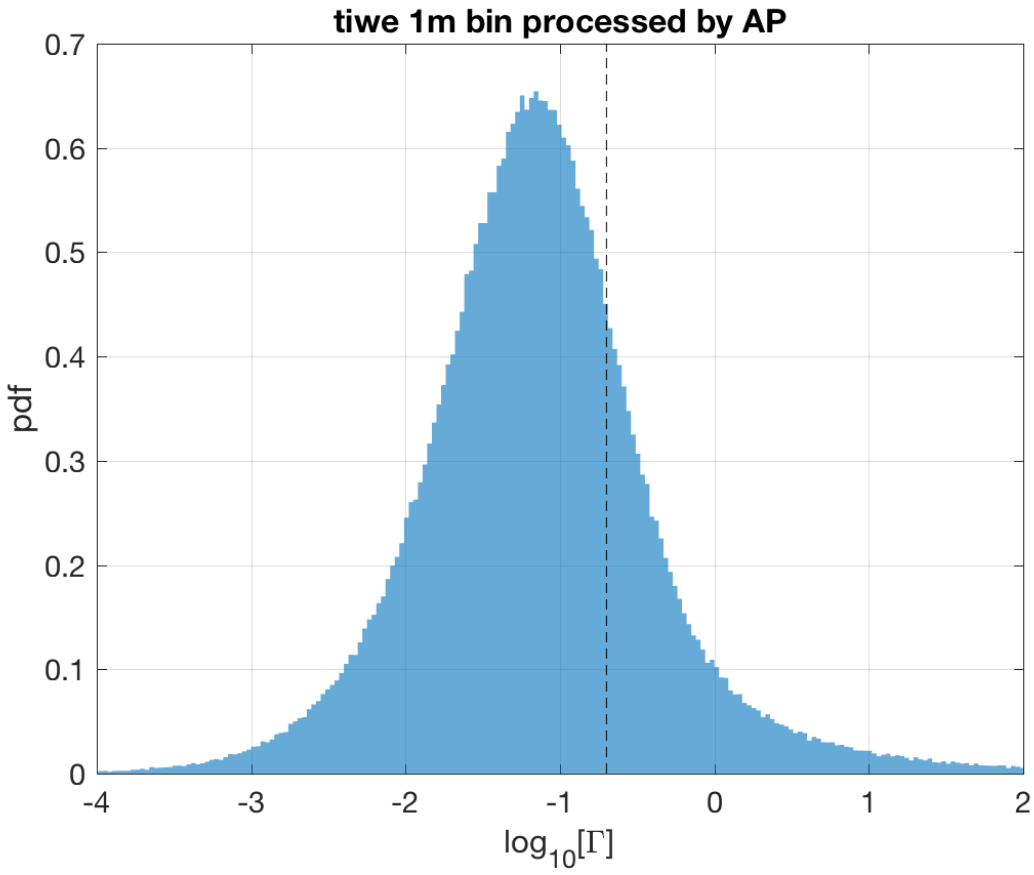

Figure 2: Histogram of Γ for 1m avg chameleon profiles. Vertical dashed line shows $\Gamma = 0.2$.

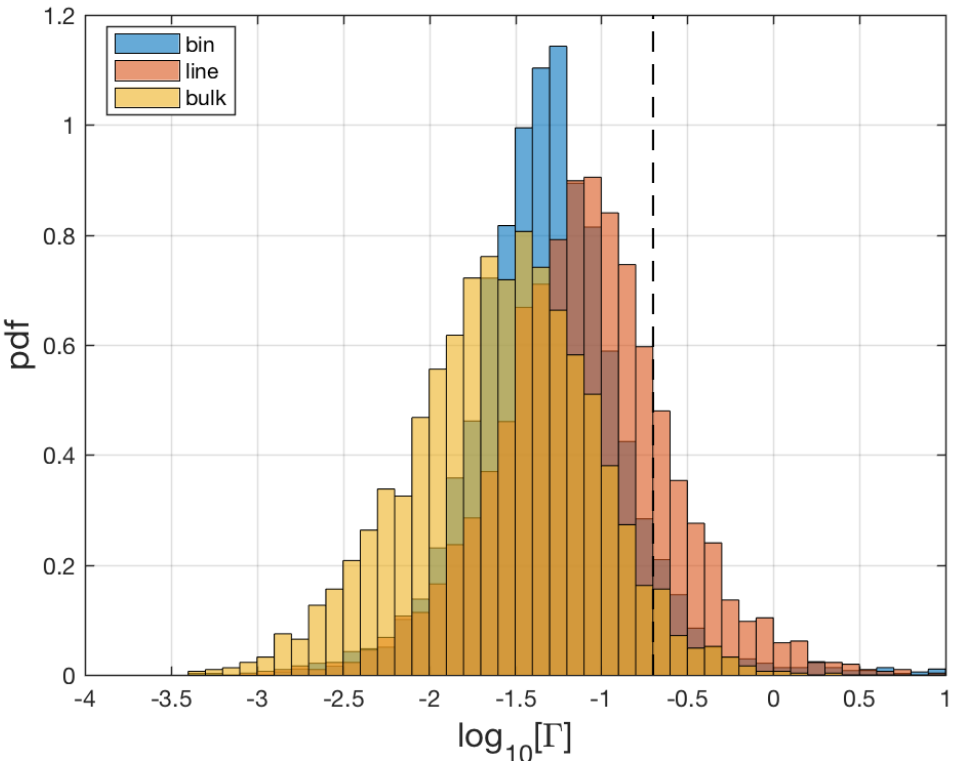

Figure 3: Histogram of Γ for patches, using different estimates of N^2 and T_z. Vertical dashed line shows $\Gamma = 0.2$.

5 Comparison to previous analysis

Bill send me results of a previous patch analysis for tiwe: `events_TIWE.mat` . Here i'll compare my results to those. See `compare_patches_tiwe_AP_Bill.m` . It looks like my values of N^2, T_z, and χ tend to be smaller than Bill's (Figure 4).

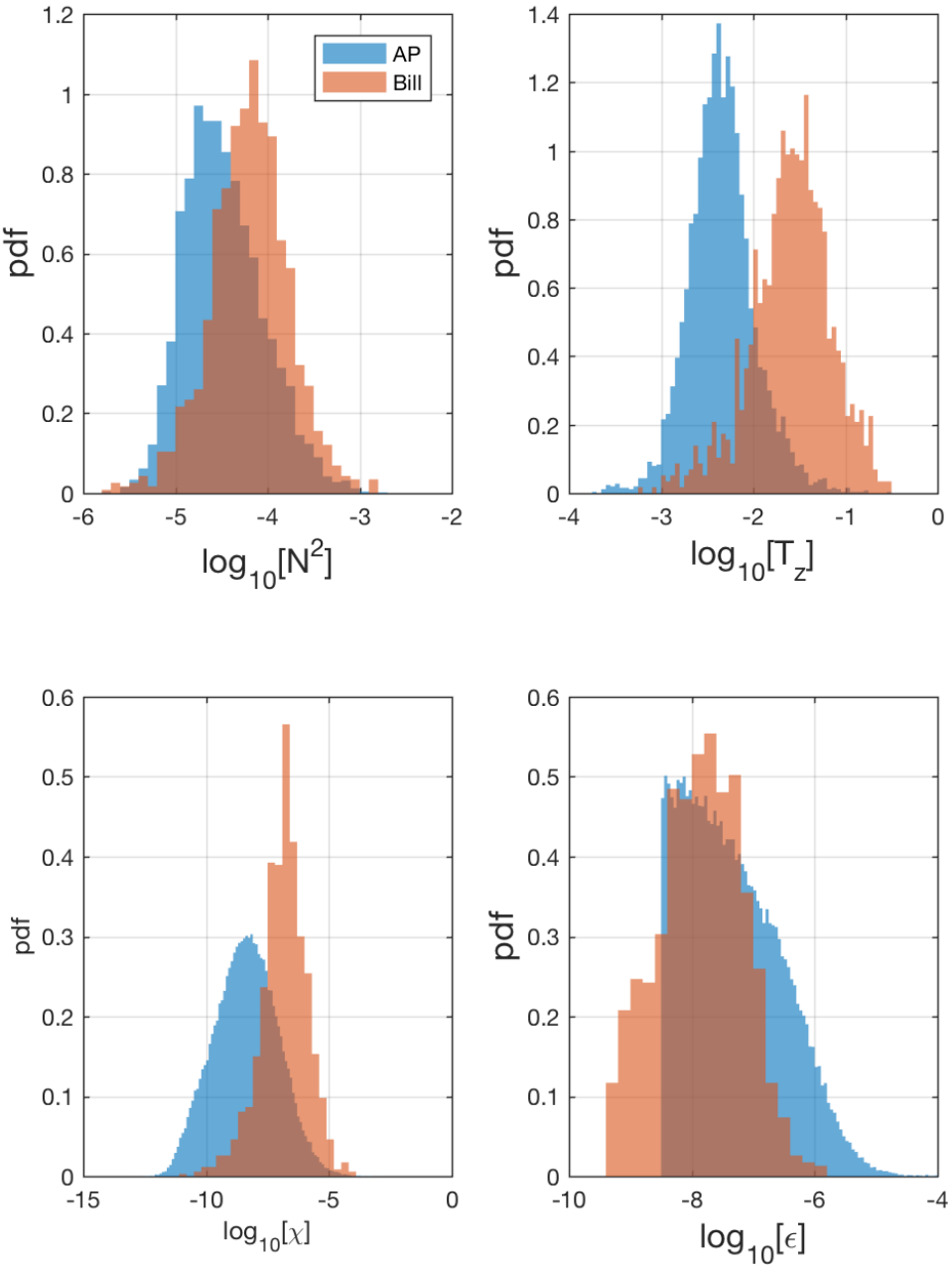

Figure 4: Histograms of N^2 , T_z, χ, and ϵ for patches analyzed by myself and Bill.