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. χ and ϵ are not computed for these.
- `FindPatches_tiwe_Raw.m` Identifies patches in the profiles made by `Process_tiwe_rawprofiles_AP.m`, using potential temperature.
- `Compute_N2_dTdz_patches_tiwe.m` Computes N^2 and T_z for patches, using several different methods. SAves results in a structure 'patches'.
- `Run_tiwe_AP_forPatches.m` Runs the Chameleon processing (including χ and ϵ) for just the patches identified in `FindPatches_tiwe_Raw.m` . This calls `average_data_PATCH_AP.m` instead of `average_data_gen1.m`.
- `Run_tiwe_AP.m` Runs the standard Chameleon processing, producing 1m avg quantities. I modifed this from `run_tw91.m`.
- `Combine_tiwe_avg_profiles.m` Combines the avg profiles made in `Run_tiwe_AP.m` into a single structure with common depths.

3.1 dTdz

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

1. $dtdz_{range}$: Take the range of T over the patch and divided by patch height
2. $dtdz_{line}$: Fit a straight line to sorted T using `polyfit`
3. $dtdz_{bulk}$: 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^2_{range} : 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_{line} : Fit a straight line to sorted potential density using polyfit to get $d\rho/dz$, then compute N2.
3. N^2_{bulk} : Use 'bulk gradient' . This is calculated from the bulk T_z, using a linear fit between density and temperature.
4. N^2_4 : 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. Γ_{range} : N^2_{range}, $dtdz_{range}$
2. Γ_{line} : N^2_{line}, $dtdz_{line}$
3. Γ_{bulk} : N^2_{bulk}, $dtdz_{bulk}$
4. Γ_{range} : N^2_4, $dtdz_{line}$

Values where ϵ is below the noise floor of $log_{10}[\epsilon] = -8.5$ are discarded.

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).

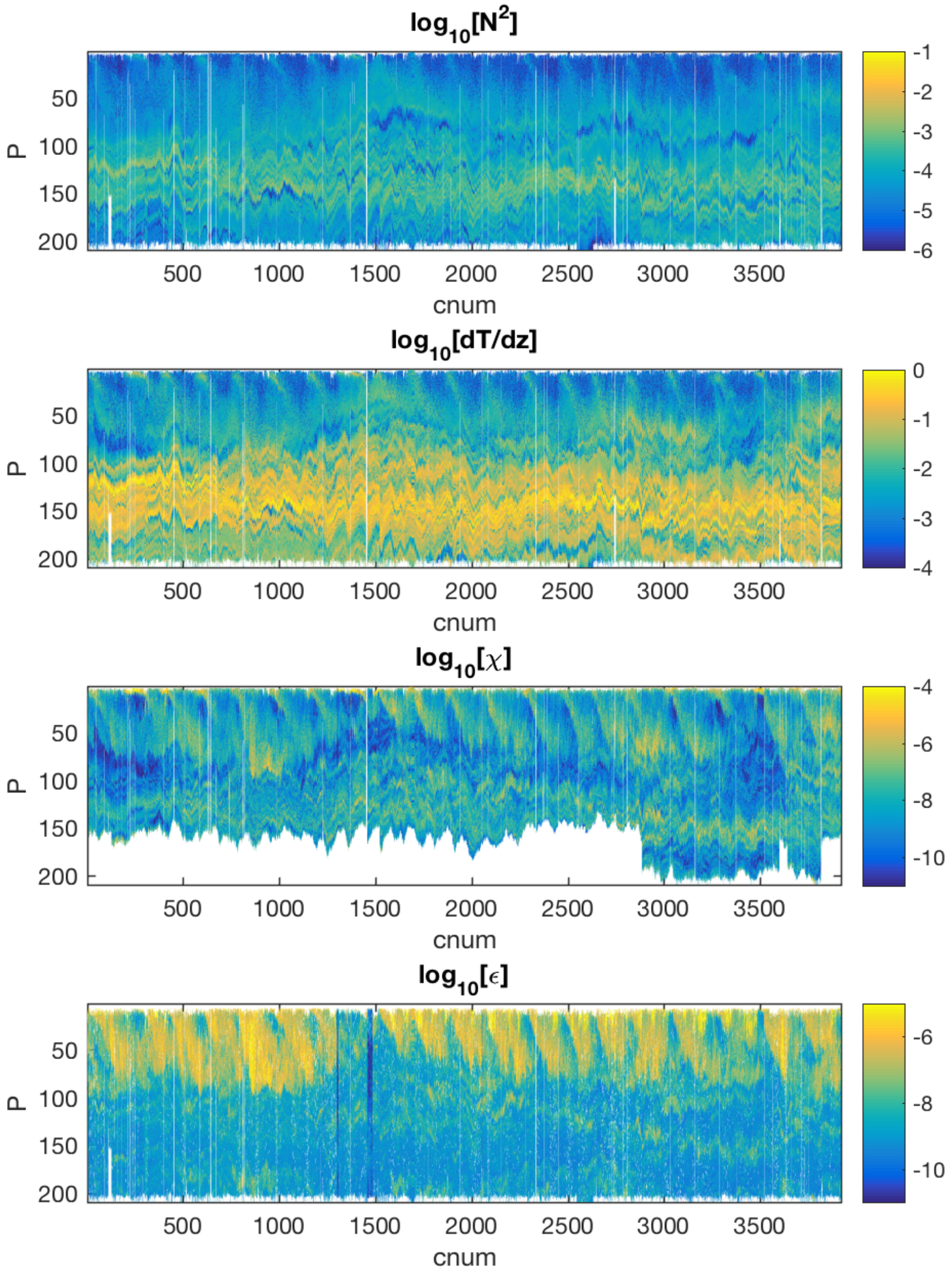

Figure 1: Pcolor of the combined 1m avg chameleon data for TIWE. * Note for some reason many χ values below 150db are bad/missing.

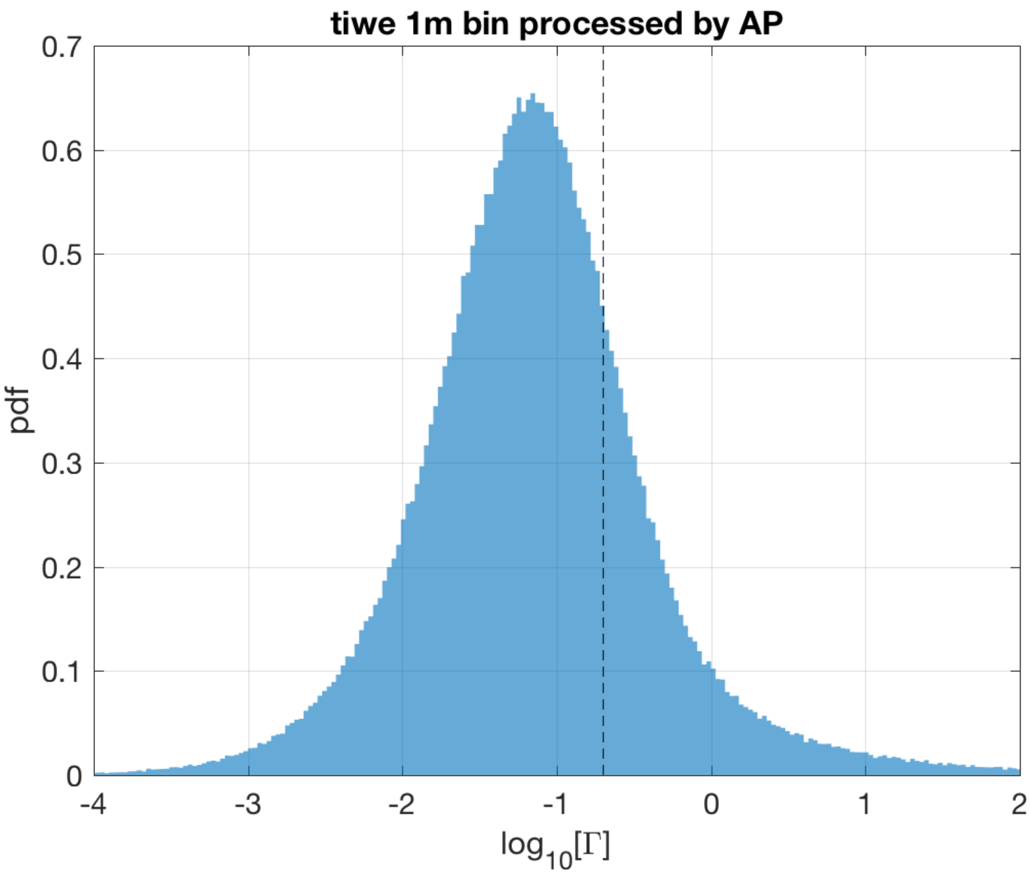

Figure 2: Histogram of Γ for 1m avg chameleon profiles. Vertical dashed line shows $\Gamma = 0.2$.

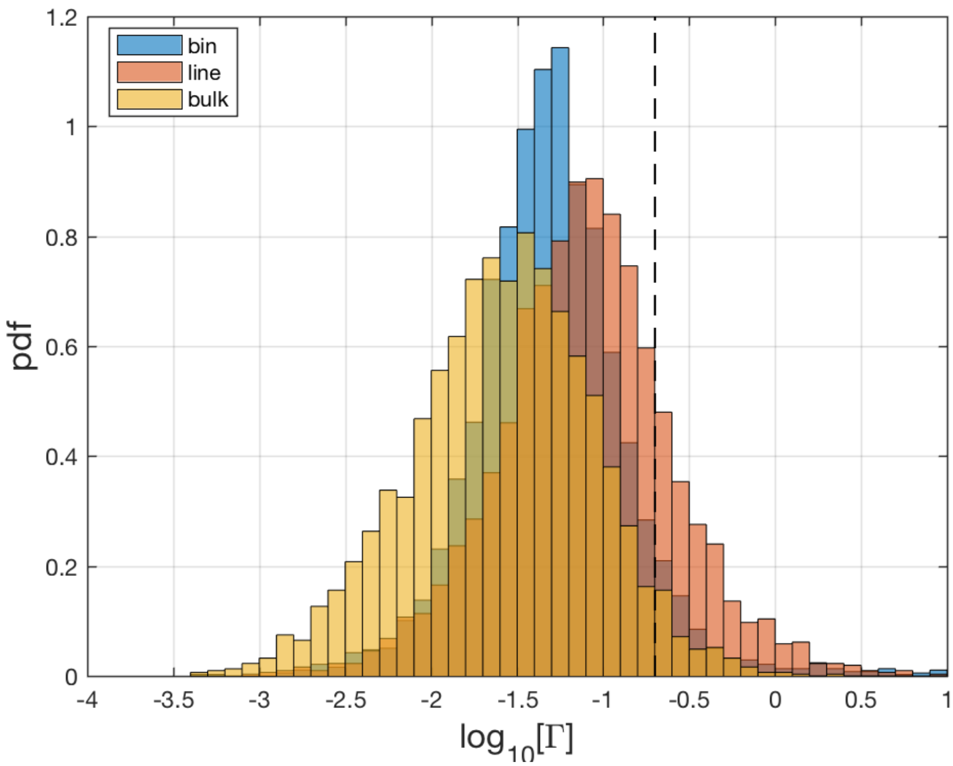

Figure 3: Histogram of Γ for patches, using different estimates of N^2 and T_z. Vertical dashed line shows $\Gamma = 0.2$.

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). Gamma computed from my patch values is smaller than 0.2 (median 0.08), while gamma from Bill's values is larger than 0.2 (median 0.4),(Figure 5).

**Note that the number of patches I found is much larger than those in Bill's data. I'm not sure if this is because he joined some patches, or only looked at certain profiles, or had some other threshold? His data doesn't give info on patch locations or profiles so I can't compare them directly to mine.

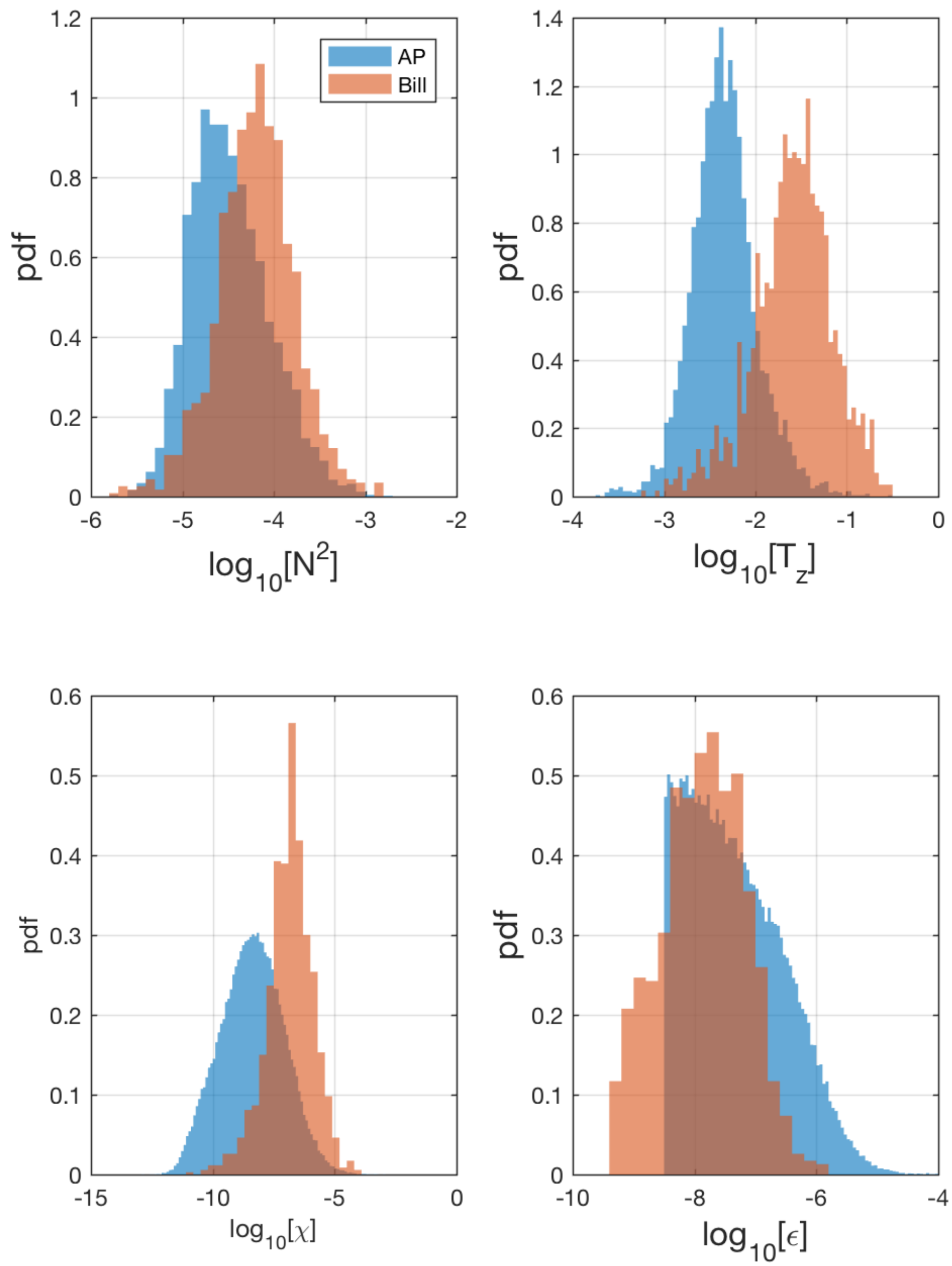

Figure 4: Histograms of N^2 , T_z, χ, and ϵ for patches analyzed by myself and Bill.

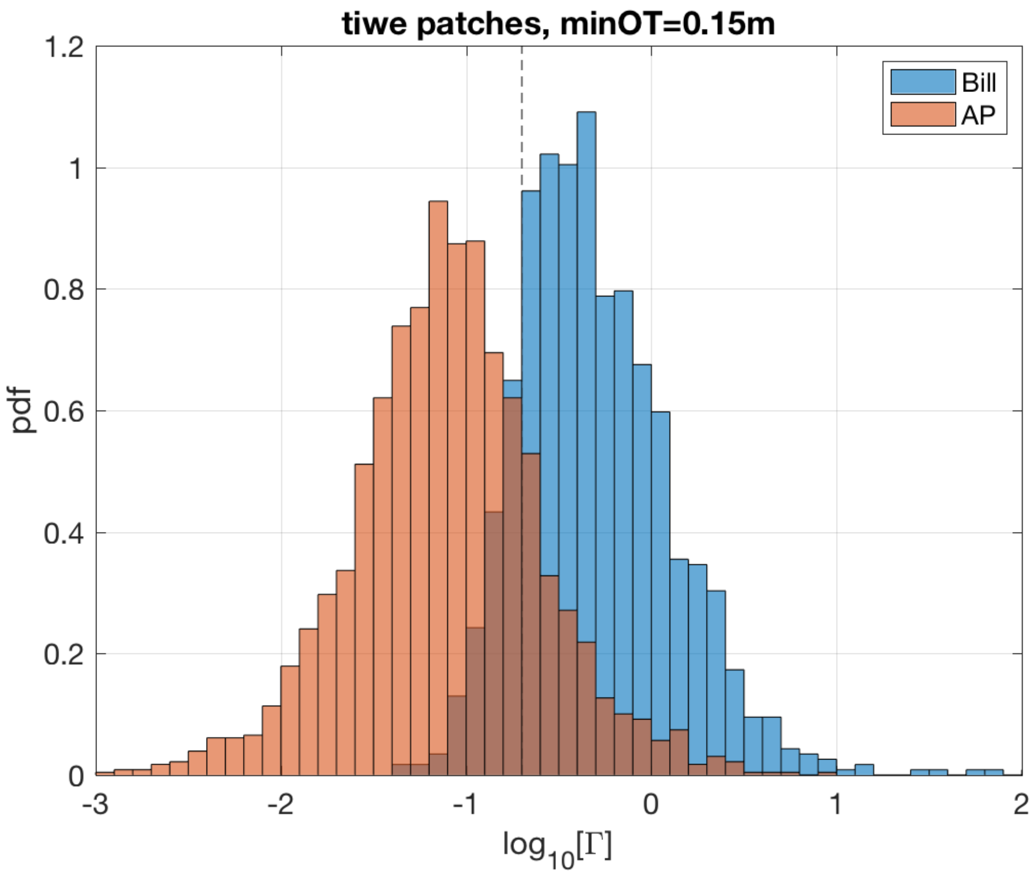

Figure 5: Histograms of Γ for patches analyzed by myself and Bill.