Review

- Linear: $\nu = 0$ has $S_{px}(z) = S_{px,0}$ great prediction. Fit $\vec{u}$ for $\nu \neq 0$ as well, though not $S_{px}(z)$ yet (**Updated!**).
- In nonlinear, review: expect deposited flux $\Delta S_{px} = S_{px,0}$ incident/generated flux.
- Instead, observe $\Delta S_{px} < S_{px,0}$, and moreover S_{px} far from critical layer changing over time!
- Last week: defined some

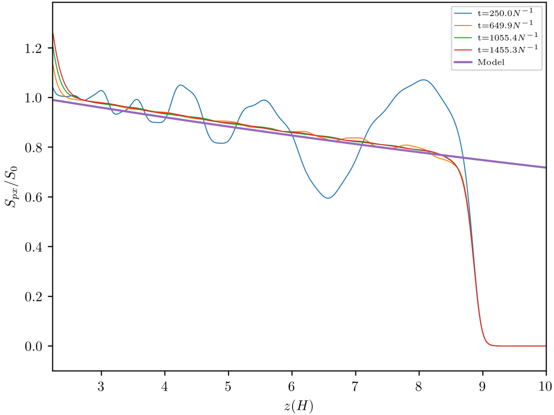
$$\delta u_z = \frac{u_z - u_{z,0} - \langle u_z \rangle_x}{\left| u_{z,0} \right|}, \qquad (1)$$

  deviation (new: subtracting mean flow too), computed RMS. Found higher RMS for lower ν.
- Could it be $\langle \ldots \rangle_x$ vs $\langle \ldots \rangle_t$?
- Objective: understand "reflection"?

Overview

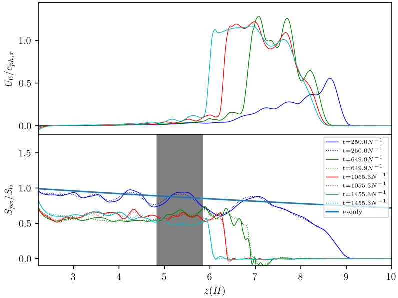
- Understand exactly how much flux is being absorbed at the critical layer:
  - Can the decreased flux absorption be explained by viscous dissipation before the critical alyer alone?
  - Compare predictions of $\frac{\partial z_c}{\partial t}$ to the observed ΔS_{px} at the critical layer.
- Understand nature of "reflection", why cannot see in certain simulations.

Had great u_z fits including viscosity (error $\sim 3-5\%$), but did not show great $S_{px}(z;\nu)$ fits last week. Here they are!



Results

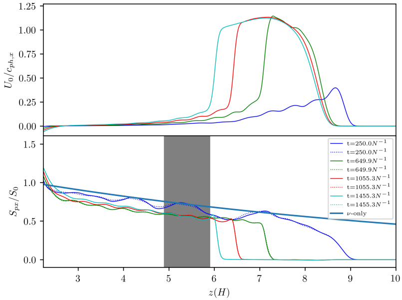
Mean Flow and Flux



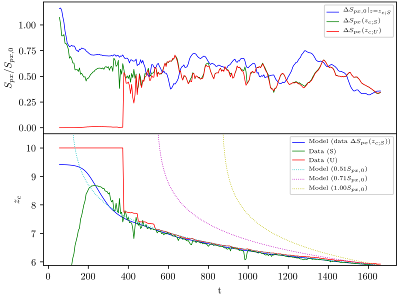
- Last week: Evolution of $\langle u_x \rangle_x(t), \langle S_{px} \rangle_x(t)$ at different times. Note flux seems to decrease over time throughout domain.
- Bottom panel, solid lines are time slices, dotted lines indicate averaging over $\sim \frac{2\pi}{\omega}$ one period (6 times), thick line is linear viscous prediction.
- Shaded grey indicates one vertical wavelength.

Results

Mean Flow and Flux



- More damped for comparison ($\nu \to 7\nu/3$).
- Note that S_{px} does not change much over time, general trend matches viscous linear decrease.



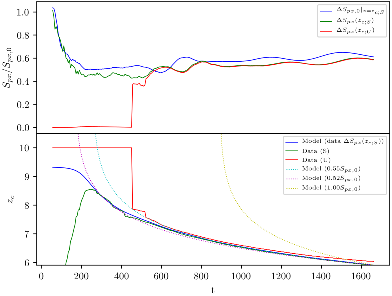
- Three different ΔS_{px}:
  - LinVisc extrapolate $S_{px,0}$.
  - $\Delta S_{px;S}$ (z-avg).
  - $\Delta S_{px;U}$ (z-avg too).

- **FIXED** $z_c(t)$ for different incident fluxes, even more models:
  - Solid lines are three ways of extracting from data.
  - Dotted lines use $\frac{\partial z_c}{\partial t}(\Delta S_{px})$ model for three values of S_{px}:
    - Average ΔS_{px}.
    - ν-extrapolated $S_{px,0}$.
    - Full $S_{px,0}$.

Takeaway: strongly inconsistent with $S_{px,0}$ being completly absorbed! In fact, most are $\sim 0.5 S_{px}$ being absorbed.

Results

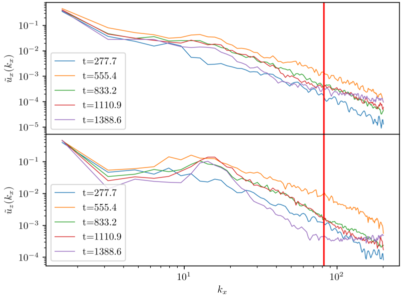
Absorbed Flux and Front Propagation



- Overdamped for comparison.
- Absorbed flux is in good agreement w/ linear viscous extrapolation of $S_{px,0}$, seems to imply full absorption.

v	$\Delta S_{px;S}$	LinVisc Extrapolation
$0.7v_0$	0.55	0.52
$0.4v_0$	0.54	0.66
$0.4v_0$ (double strength)	0.42	0.56
$0.3v_0$	0.51	0.71
$0.2v_0$	0.47	0.76
$0.1v_0$	0.45	0.82

Table: Fluxes in units of $S_{px,0}$ excited flux. For linear viscous extrapolation, I took a slightly earlier (but not immediate) flux and extrapolated to an average z_c, so rather approximate.



- FT of $\delta\vec{u}$ slightly below the critical layer. Red line denotes where $2\nu k_x^2 = \omega$, "viscous wavenumber"?
- Note that we've chosen $\nu k_x^2 \lesssim u_x k_x \sim \frac{\omega}{k_{0x}} k_x$, our previous viscous wavenumber already.

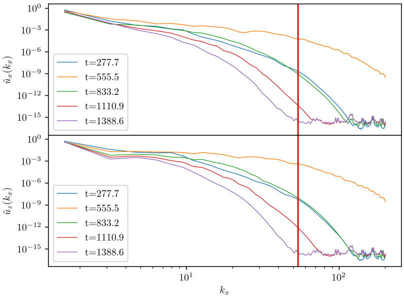


Figure: Overdamped for comparison, not power law!

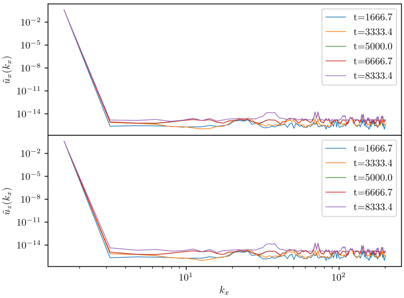


Figure: Linear for comparison; taken just below damping zone.

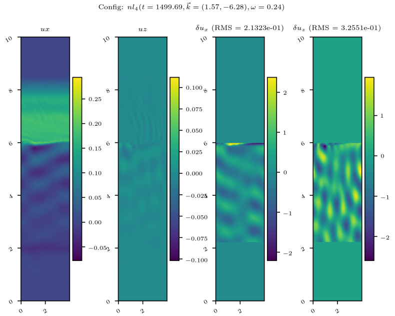


Figure: Residuals for not overdamped.

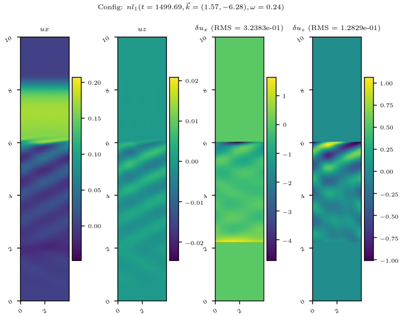


Figure: Residuals for overdamped.