

# Internal waves generated by turbulent convection

“making waves in a stratified fluid”

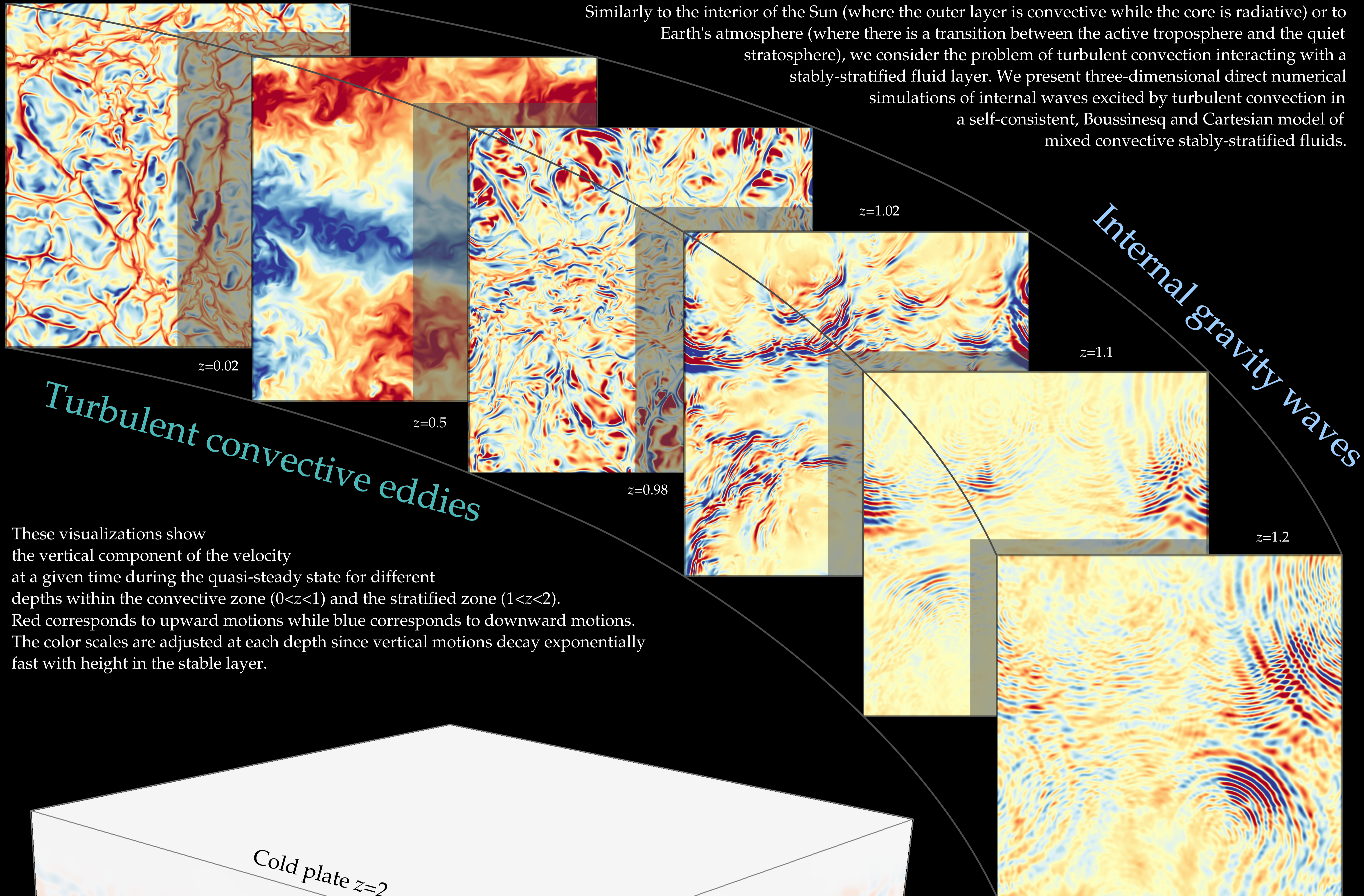
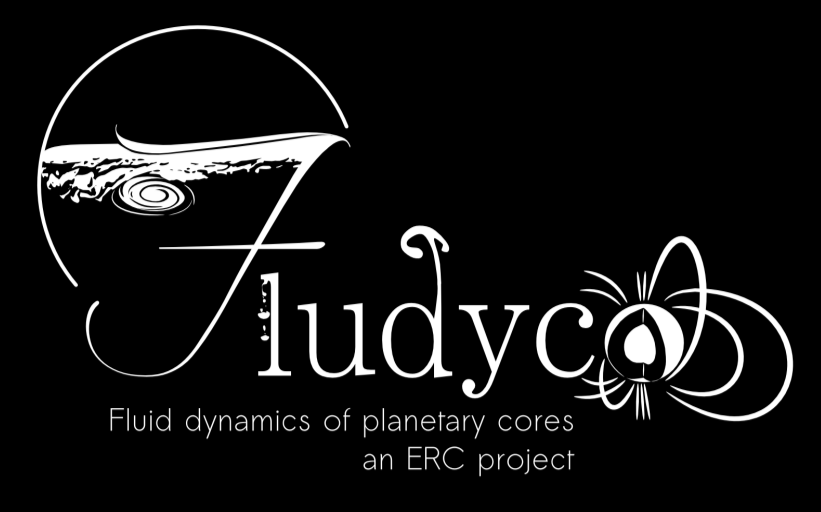
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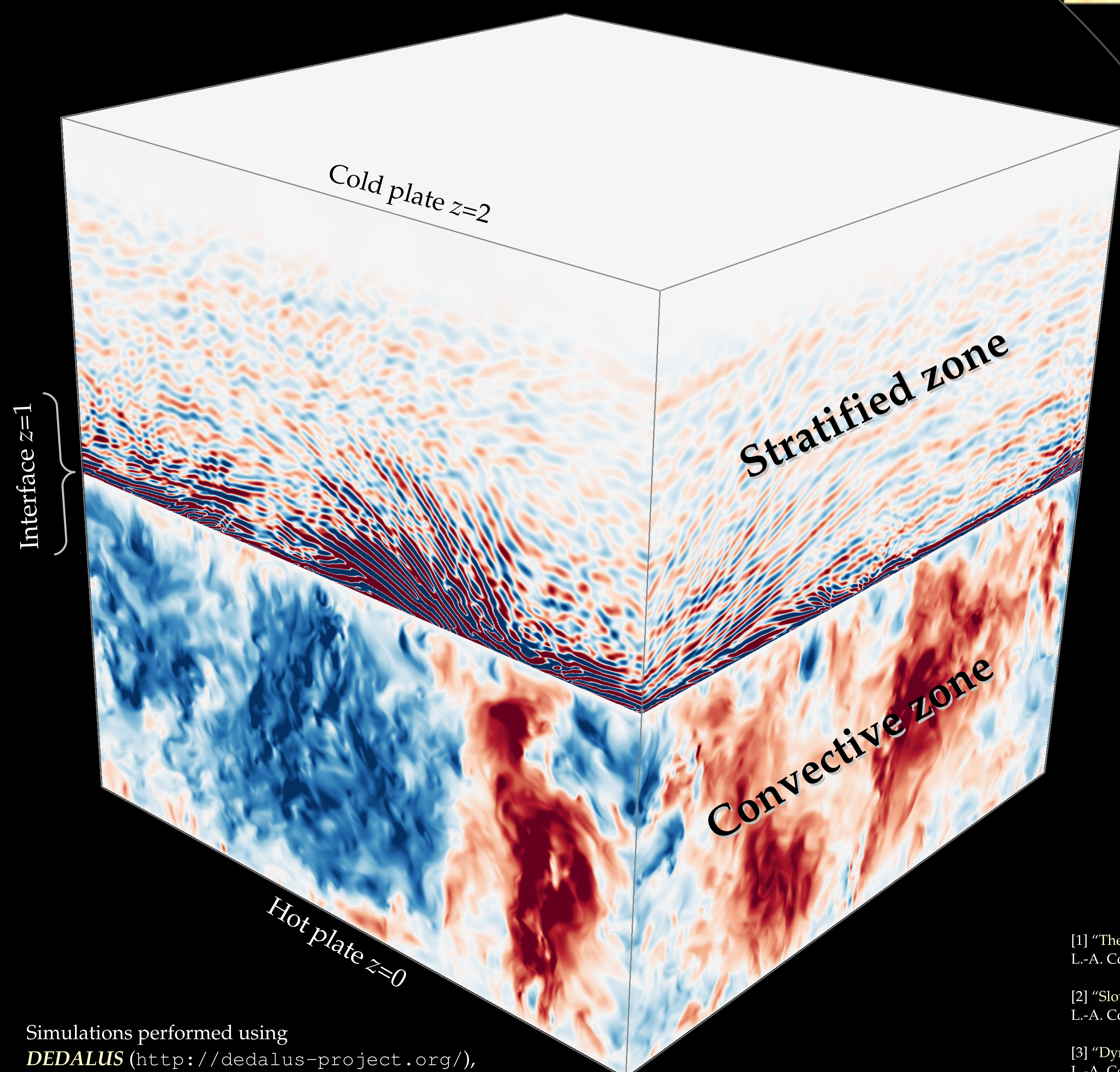
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Turbulent convective eddies

Internal gravity waves

These visualizations show the vertical component of the velocity at a given time during the quasi-steady state for different depths within the convective zone ( $0 < z < 1$ ) and the stratified zone ( $1 < z < 2$ ). Red corresponds to upward motions while blue corresponds to downward motions. The color scales are adjusted at each depth since vertical motions decay exponentially fast with height in the stable layer.



We demonstrate that in the limit of large Rayleigh number and large stratification, simulations are in good agreement with a theory that assumes waves are generated by Reynolds stresses due to eddies in the turbulent region (Lecoanet & Quataert, *M.N.R.A.S.* **430** (3) 2363-2376).

Our results have implications for the generation of internal waves in stellar interiors and for the generation of mean flows by non-linearly interacting internal waves, a mechanism at the origin of the Quasi-Biennial Oscillation observed in the Earth's stratosphere.

Simulations performed using **DEDALUS** (<http://dedalus-project.org/>), an open-source pseudo-spectral solver.

- [1] “The energy flux spectrum of internal waves generated by turbulent convection” L.-A. Couston, D. Lecoanet, B. Favier and M. Le Bars, *J. Fluid Mech.* **854** (2018).
- [2] “Slowly-reversing mean flows emerge from turbulently-generated internal waves” L.-A. Couston, D. Lecoanet, B. Favier and M. Le Bars, *Phys. Rev. Lett.* **120** (2018).
- [3] “Dynamics of mixed convective–stably-stratified fluids” L.-A. Couston, D. Lecoanet, B. Favier and M. Le Bars, *Phys. Rev. Fluids* **2**, 094804 (2017).