

Reply

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Comprehensive complexity is no virtue in modeling, but rather, an admission of failure.—Ian James¹

In his comments on Baumert and Peters (2004, henceforth BP04), Kantha (2005, henceforth K05) claims that a better fit to laboratory data of turbulent length scales than that found in BP04 can be achieved either with a “traditional model” or with a modification of the BP04 closure, and he finally argues that there is no need for BP04’s explicit term of energy transfer from turbulence to internal waves. (The notation herein is that of K05 and BP04 and needs no specific definitions.)

BP04 deliberately refrained from tuning and optimizing parameters. This closure is not tunable; its body and its parameter values form a unity. Thus the variety of models attributed to BP04 in K05 are not our product. Remaining deviations between our model and laboratory data in Fig. 3 of BP04 are not important. What is important is the general behavior of the BP04 closure that captures both the $L_E/L_O \approx R_g^{3/4}$ behavior at small and moderate R_g as well as a cap, $L_E/L_O \leq 2$, at $R_g \geq 1/2$. The implicit limitation of the length-scale ratio through the primary process of energy absorption by internal waves is a most important and physically consistent part of BP04. It is ignored in K05.

K05 fails to explore the full range of consequences of the variations of closure parameters he proposes. To be specific, he fails to show that his “optimized” models

exhibit a steady state with a realistic value R_g , a topic explored by Baumert and Peters (2000, henceforth BP00). For example, the empirically sound steady-state value $\sigma = 1$ —together with Eq. (14) of K05 and with $c = 3$ and $C_{\varepsilon 3} = -0.5$ proposed there—leads to a steady state R_g of 0.4, far above the inviscid upper limit of 0.25.

K05 characterizes the representation of the energy loss of turbulence to internal waves in BP04 as “arbitrary” and “ad hoc.” This wave term represents the only degree of freedom in the BP04 closure. We accept the label ad hoc and invite suggestions for improvement. As laid out in BP04, our choice was not arbitrary. The topic is discussed further in Baumert and Peters (2005).

We note that K05 does not question the reality of the turbulence energy loss to internal waves. BP04 chose to represent this process explicitly. In contrast, K05 offers a parameter tuning exercise designed to avoid the necessity of having to represent explicitly the energy loss to waves. K05 thus ignores the root of the problems discussed herein, in BP04, and in BP00: the fundamental coexistence of waves and turbulence in stratified fluids.

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¹ (James 1994, p. 93)

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