

Interactive comment on “Multifractal analysis of oceanic chlorophyll maps remotely sensed from space” by L. de Montera et al.

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While I am fairly satisfied with the overall response of the authors to my suggestions, I still feel that the issue of active versus passive scalars has not been resolved. Even if we agree that the zooplankton dominated scales are < 1 km (see however [Behrenfeld, 2010] for new evidence on the importance of grazing), we remark that growth rates as high as $r = 0.5 \text{ day}^{-1}$ are not unusual and values of the order of $r = 0.1 \text{ day}^{-1}$ are common (e.g. [Smith et al., 1999]). At these rates, growth could easily dominate the turbulence patch decay rate as we show below. Therefore, unless there is a “joint” nonlinear growth turbulence mechanism of the sort proposed by [Lovejoy et al., 2000] with $0 < H < 1/3$, there will be a critical scale L_c beyond which growth (with $H = 0$) will dominate turbulence ($H = 1/3$), and this transition should be visible in the data.

To see this, recall that in a turbulence dominated regime, the patch lifetime is expected to vary as $T \approx \varepsilon^{**(-1/3)}L^{**(2/3)}$ where L is the patch size, and ε is the turbulent energy flux. For a given patch size, the growth mechanism will dominate when $r > 1/T$ i.e. whenever $L_c > \approx \varepsilon^{**(1/2)}r^{**(-3/2)}$ where L_c is the critical patch size. This critical patch size should be visible as a spectral break at the corresponding wavenumber. In order for the authors to see the break with their imagery (which covers roughly 4 – 100 km in scale), we would need roughly $50 \text{ km} < L_c < 10 \text{ km}$. Due to the intermittency, ε is highly variable, although drifter studies [Niiler, 2001] can be used to infer [Lovejoy and Schertzer, 2011] that it is often the range $10^{**(-7)}$ to $10^{**(-9)} \text{ m}^{**2}\text{s}^{**(-3)}$, and SST spectra can be used to infer that a global mean is around $10^{**(-8)} \text{ m}^{**2}\text{s}^{**(-3)}$ (implying that planetary scale surface structures - eddies, gyres - live about 1 year, [Lovejoy and Schertzer, 2011]). In this case, we find that with weak turbulence and high growth rates ($\varepsilon = 10^{**(-9)} \text{ m}^{**2}\text{s}^{**(-3)}$, $r = 0.5 \text{ day}^{**(-1)}$) that $L_c \approx 2 \text{ km}$ and at the opposite extreme, of strong turbulence and weak growth ($\varepsilon = 10^{**(-7)} \text{ m}^{**2}\text{s}^{**(-3)}$, $r = 0.1 \text{ day}^{**(-1)}$) that $L_c \approx 250 \text{ km}$. In other words, either we should see scaling with a nonstandard H , or we should see a transition from a turbulent to a growth dominated regime. In order to partially address this problem, the authors could break up their spectral range into two parts one smaller, one larger than $\approx 20 \text{ km}$. They could then compare the histograms of the spectral exponents of the two.

A last comment: I noticed that the new fig. 5 indicates an outer scale of the order of 2000 km whereas I would have expected something a bit closer to planetary scales (as in the atmosphere and in analyses of in situ SST temperatures in [Lovejoy and Schertzer, 2011]). I suspect that the sample used by the authors is not fully representative of the dynamical variability; this would require data sampled more or less uniformly over a period of the order of a year, (the lifetime of the largest near-surface eddies).

-Shaun Lovejoy

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