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Ocean Science
Discussions

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 day** (-1) are not unusual and values of the order of r = 0.1 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 Lc 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 $\approx$ ε**(-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 Lc>$\approx$ ε**(1/2)r**(-3/2) where Lc 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 km< Lc <10 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 m**2s**-3, and SST spectra can be used to infer that a global mean is around 10** -8 m**2s**-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 (ε =10**-9 m**2s**-3, r = 0.5 day**(-1) that Lc $\approx$ 2 km and at the opposite extreme, of strong turbulence and weak growth (ε =10**-7 m**2s**-3, r = 0.1 day**(-1)) that Lc $\approx$ 250 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 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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