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Scaling analysis of ocean surface turbulent heterogeneities from satellite remote sensing: a methodological study.

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Satellite remote sensing observation allow the ocean surface to be sampled synoptically over large spatio-temporal scales. The images provided by ocean colour satellites are widely used in physical, biological and ecological oceanography. The present work proposes a method for understanding the multi-scaling properties of satellite ocean colour products such as Chlorophyll-a (Chl-a) Sea Surface Temperature (SST), rarely studied. The specific objectives of this study are to show how the small scale heterogeneities of satellite images can be characterized using tools borrowed from the fields of turbulence, and how these patterns are related to environmental conditions. For that purpose, we show how the structure function, which is classical for scaling time series analysis, can be used also in 2D. The main advantage of this method is that it can be used for images which have missing data. We show, using a simulation and two real images taken as examples that coarse-graining (CG) of a gradient modulus transform of the original image does not provide correct scaling exponents. We show, using a fractional Brownian simulation in 2D, that the structure function (SF) can be used with randomly sampled couple of points, and verify that 1 million of couple of points provides enough statistics. We illustrate this methodology using two satellite images chosen as examples.