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Comments on the "Spatial Variability of Coastal Surface Water Temperature during Upwelling"

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In a recent paper, Scarpace and Green (1979) presented a study on the spatial variability of surface water temperature. The temperature density variance $E(k)$ is computed as a function of the wavenumber k from airborne thermal scanner data, and is found to follow a k^{-p} power law with $p = 3$ for the wavenumber range from 1 to 25 km^{-1} (wavelength from 40 to 1000 m) and $p = 5/3$ at wavenumbers > 25 km^{-1}. Nevertheless, these conclusions are rather risky and may be subject to several criticisms.

The first criticism is that the paper refers to two-dimensional turbulence theories (Kraichnan, 1967; Charney, 1971) which imply homogeneity and isotropy of the horizontal variability of temperature. This does not apply for the given example of a coastal upwelling for the studied scales. We must also notice that if the velocity spectrum for a homogeneous, isotropic, bidimensional flow predicted by Kraichnan (1967) follows a k^{-3} law, the temperature variance spectrum is a k^{-1} power law (Kraichnan, 1974).

Second, error sources like instrumental noise and cloud cover should have been mentioned and discussed.

Figs. 4–9 of Scarpace and Green (1979) may be understood despite the lack of units. The computed spectra could also be explained by the sums of the actual k^{-3} power laws of the water surface temperature variations and of the 10^{-4} (°C)^2 variance of a typical instrumental noise of an airborne thermal scanner which is assumed to be 0.01°C. In this case, the observation of $p = 5/3$ at larger wavenumbers would only be an artifact, and would only mean the joining up of the k^{-3} and the noise spectra. A final resolution is possible only if the noise-equivalent temperature spectrum of the thermal scanner is known.

Because emissivity of water is not exactly 1, small variations of a few tenths of a °C of the observed radiometer temperature may occur, associated with changes in the cloud coverage (Saunders, 1967), so that the observed density variances could be due, at least partially, to other than water surface temperature variations. It may not be the case, but this point should have been cleared up, either by restricting the flights only to clear-sky conditions or by giving at least a rough estimate of a possible cloud-cover effect on the observed density variances.

The conclusions of the paper are not as well established as they could have been. The observed k^{-3} law may be an effect of the cloud cover, and the $5/3$ power law may be due to the intrumental noise as well as the actual turbulence spectra of the water surface temperature.

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