Abstract View

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Effect of Sampling Rate and Random Position Error on Analysis of Drifter Data

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ABSTRACT

The central question discussed here is how the rate at which drifter positions are determined and the position errors affect the calculation of velocity, acceleration and velocity gradients such as divergence and vorticity. The analysis shows that the mean-square velocity and acceleration errors each are composed of two terms. One arises from the position uncertainty and the discrete sampling rate. The other term is an alias resulting from sampling a continuous velocity or acceleration spectrum discretely. Effects at low and high frequencies and sampling intervals are examined by asymptotic expansions of the spectra. Then optimum smoothing and derivative filters are obtained for the velocity and accelerations, respectively. The efficiency of these filters is determined by comparison with the errors previously established.

The calculation of divergence and vorticity from drifter clusters typically neglects the position error, in which case the errors in the velocity gradients are proportional to the velocity errors. Our analysis shows that this procedure produces estimates of the velocity gradients whose magnitudes are less than the true values. This bias is easily removed. The analysis is concluded with a derivation of formulas for unbiased estimates of the variance and covariance of the velocity gradients.