The Detection of Jets in the High Resolution Simulations of the Southern Ocean Using Wavelets and Higher Order Statistics

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Abstract

This paper presents a novel method (the WHOSE method) for the identification of oceanic jets in the Southern Ocean based on mature techniques used in signal and image processing. The WHOSE method is designed for application in high-resolution datasets, where both jets and eddies are present. The method relies on a denoising process involving the wavelet decomposition of sea–surface height, or a similar variable and the higher statistical moments of those coefficients. The kurtosis of a signal can be used as a test of whether that signal follows a Gaussian distribution. Since steps and jumps are highly non–Gaussian, using kurtosis allows for a discrimination between the step and non-step like components of a signal. The method is compared to three other techniques used for detecting oceanic jets: basic gradient thresholding, the contour method of Sokolov and Rintoul (2007) and the probability density function (PDF) method of Thompson et. al (2010). Quantitative comparison is undertaken using synthetically generated sea–surface height fields. The WHOSE method and the contour method are found to perform well even in the presence of a strong eddy field. In contrast the standard gradient thresholding and PDF methods only perform well in high signal-to-noise ratio situations.
Qualitative comparisons are undertaken using output from the eddy–resolving Ocean General Circulation Model for the Earth Simulator (OFES). While the methods are in broad agreement on the location of the main ACC jets, the nature of the jet fields they produce differ. In particular, the WHOSE method reveals a fine scale jet field with complex braiding behaviour. It is argued that this fine scale jet field may affect the calculation of eddy diffusivities.

Keywords: Southern Ocean, jets, wavelets, high resolution modelling.

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