Ocean Sci. Discuss., 9, C1448–C1451, 2013
www.ocean-sci-discuss.net/9/C1448/2013/

Ocean Science Discussions

OSD

9, C1448–C1451, 2013

Interactive Comment

Interactive comment on "Measurement of turbulence in the oceanic mixed layer using Synthetic Aperture Radar (SAR)" *by* S. G. George and A. R. L. Tatnall

S. G. George and A. R. L. Tatnall

sgg303@soton.ac.uk

Received and published: 4 January 2013

Firstly, many thanks to the anonymous reviewer for the constructive comments. These comments are addressed in this discussion response, but also reflected in a modified version of the Ocean Science paper which contains amendments based on the helpful comments provided.

Of course, because of the high-resolution nature of the DNS (Direct Numerical Simulation) data acquired, concerns about the appropriateness and validity of the theoretical (ocean/radar) models are justified, and it is right that there is open debate on this issue: in the literature, little evidence was discovered regarding firm limits of a "slowly-varying"

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

current, and so some assumptions have been made when applying currents with strong variations in this study. The focus of this paper lies in presenting evidence that small current variations and flow structure in a surface wake can generate strong radar signatures, and thus it was necessary to examine the small-scale limits of hydrodynamic wave-current approximations. The concerns lie in the accuracy of wave modulations computed in the presence of strong currents over short spatial scales.

To consider the effects of current variations, some additional test cases were considered. The current fields presented in the paper were upscaled (by various factors, up to a factor 8, relaxing current gradients by around a factor 8) and processed in M4S to compare the observed radar signatures. Although some departure was observed between the values of Bragg NRCS observed in the computed signatures (NRCS modulation was lower in the case of increased scale, as would be expected), these deviations were small compared to the absolute NRCS values observed in both cases. There is also little visual difference in the pattern of the signature itself, which suggested that the computed wave modulation was convincing in both cases and indicated that the computed modulations at the original scale were reasonable. As discussed previously, it is primarily the deviation from mean value of NRCS which is of interest in M4S signatures. Although deviations from the mean value were higher in the original case, these did not appear to be higher than would be expected from applying stronger gradients in current alone.

More variation between the two cases is visible in the composite surface NRCS signatures, where effects of the directional resolution of the model begin to produce artefacts in the signature, since the 15 degree wavenumber grid may be slightly undersampled for the complex current field which is applied. This is a concern for presenting valid, and valuable, results in terms of the composite surface signature, so to alleviate these concerns, the modified paper now focuses only on presenting results in Bragg NRCS, for which confidence in the results may be more adequately gauged. Of course, this means that comparisons with real imagery is more limited, since the effects of the

OSD

9, C1448–C1451, 2013

Interactive Comment

composite wave spectrum and contributions from longer waves are not reflected in our results (but are observed in real conditions), and this should unquestionably be a goal for future work to accommodate these effects so comparison with real conditions may be drawn. For the current work, however, we feel that the influence of the wake currents on the Bragg scattering response is of value for displaying the effects of small-scale turbulent/current fluctuations, with the aim that it will drive further simulation and development of wave-current interaction/radar scattering theory.

Overall, the results of this comparison study did not indicate that significant inaccuracy in the calculation wave modulation at the original scale of the presented results was present. Perhaps the current fields operated in the original study approach the limits of the accepted theory for hydrodynamic wave-current interactions and application of strong surface currents, but no major errors arising from incorrect wave modulation were observed, leading the authors to assume that the output M4S presented here were correct. A slight error was discovered in the original translation of the wake from DNS to M4S, however, and hence modifications have been made to the scale of the original current field which have further alleviated slightly some of the strong current variations and wave modulation concerns.

Surface slopes from the wake (DNS) data are not currently included in the M4S computation through a surface elevation input file. Elevation can be calculated using the DNS output for pressure at the surface (in the vertical direction) and the hydrostatic equation to provide an approximate elevation field. Preliminary testing regarding the impact of surface slopes was pursued, but the slopes observed when this process was applied did not show significant variation which would be expected to major impact on the radar signature (at least, not at incidence angles on the order of 20-30°). However, further computations will reflect the inclusion of surface slope effects and potential impacts on the composite spectrum signature.

In response to the smaller issues, the reviewers' comments have been addressed and reflected in the updated version of the paper: NRCS results (now restricted to only

OSD

9, C1448–C1451, 2013

Bragg NRCS signatures) are presented as deviations from the 'background' value of NRCS present in the ambient water outside the wake. In the particular cases raised, these have been modified to present sub-figures on the same colour axis. Other figures noted in the original comment have been amended to reflect the suggested changes. Likewise, minor corrections and grammatical errors that were pointed out have been amended.

Interactive comment on Ocean Sci. Discuss., 9, 2851, 2012.

OSD

9, C1448–C1451, 2013

Interactive Comment