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Ocean Science
Discussions

Interactive comment on "Typhoon effect on Kuroshio and Green Island wake: a modelling study" *by* T.-W. Hsu et al.

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General Comments

The paper is a study of the effect of one real typhoon and four simulated typhoons on the ocean currents near Green Island. The study region lies in the path of the Kuroshio with depths extending down to 5000m. The study makes use of a finite element model based on the shallow water equations. It reads as a reasonable paper but the description of the model is poor and the paper make a basic error in using a barotropic model for a region of ocean where baroclinic effects are likely to be important.

The paper is not acceptable in it present form. More importantly the use of a barotropic model means that even if other parts of the paper were considerably improved the

paper would still not be acceptable for Ocean Science

Main points

1. The Shallow Water Equations

1.1 The first paragraph talks about the 'non-conservative' form of the shallow water equations, without stating what is not conserved and why that is better than the normal form which conserves volume and momentum.

1.2 The viscosity term in the du/dt and dv/dt equations depends only on the gradient of the velocity fields, not their second order derivative. This is unphysical.

1.3 The equations contain a term which depends on the bottom slope which is not balanced by any other term. This is unphysical.

1.4 The variables H and Zb in the equations refer to the same quantity.

1.5 The term Wg is described as a "gradient of wind speed". It is then defined as having no dimensions and then used as if it is a wind speed.

2. The Finite Element Method

2.1 The equations involving du/dt and dv/dt in equation (7) do not match the corresponding terms in equation (1).

2.2 The model (equations 7) appears to have no Coriolis term. This is unphysical. It also has the unphysical bottom slope terms.

2.2 In equation (9) the definition of the variables is not explicit enough. Are they point values or terms in a local polynomial expansion within each grid cell. Are the grids or points the same for all three sets of variables?

2.3 What is the definition of the functions M(x,y)?

2.4 At this stage the residuals R have not been defined so substituting (9) into (8) does not result in equation (10).

2.5 The paper does not explain what boundary conditions were used or how they were introduced into the finite element equations.

3. Use of the model

3.1 The Kuroshio is a strong baroclinic ocean current. The region of research includes large regions of stratified ocean. As a result the ocean's response to any forcing is expected to contain both baroclinic and barotropic components.

3.2 The model used is purely barotropic. In addition in a region where the strong baroclinic Kuroshio extends to much deeper levels the model depth field is limited to 360m.

3.3 The bottom friction terms appear to be used, with the assumption of a sold bottom and a water depth of 360m, even when the water depth is far in excess of 360m.

3.4 According to figure 1, the ridge between Green Island and Taiwan has depths of between 250m and 500m. It is just possible that the flow across the ridge is predominantly barotropic so that locally a barotropic model may be acceptable. This needs to be demonstrated. However even if demonstrated it is very unlikely that a barotropic model will give satisfactory results over the whole domain.

4. Figures

4.1 Figures 1, 5, 6 to 8 and 10 to 16 were much too small.

4.2 Figure 1. Green island appears to be much further from the coast of Taiwan in (b) than it does in (a).

4.3 Figure 2. This shows stream lines not contours of flow speed.

Interactive comment on Ocean Sci. Discuss., 12, 3199, 2015.