

Report for 2002TX51B: Higher-Order Statistics in Transport and Evolution of Algae Blooms

- unclassified:
 - Furnans, Jordan, David Maidment, and Ben Hodges. An Integrated Geospatial Database for Total Maximum Daily Load Modeling of the Lavaca Bay - Matagorda Bay Coastal Area. Texas Water Resources Institute SR 2002-018.

Report Follows:

Higher-Order Statistics in Transport and Evolution of Algae Blooms

By Jordan Furnans

The purpose of this project was to determine the capacity of numerical models for transporting distributive information needed for accurate modeling of algal blooms. The first phase of this project involved a numerical analysis of the feasibility of modifying the standard transport equation for quantities more accurately described by higher order statistics rather than just by mean values. This numerical exercise demonstrated reasonable results are obtainable as by applying the transport equation to local mean values across the distribution of the quantity transported by the flow. It also demonstrated the need to develop “particle tracking” capabilities in the numerical models in order to accurately describe the energy flux path the particles & transported objects follow in the flow. This path determines the environmental conditions to which the transported substance is subjected, and therefore aides in determining the affects of the conditions on the time history of the transported substance. In reference to algal blooms, the energy flux path is vital in determining the life history of the algae particles contributing to a bloom.

The second phase of this project involved the development of sub-grid scale particle tracking capabilities within the 3D hydrodynamic model ELCOM. This work was conducted while I was researching at the University of Western Australia on a US Fulbright Fellowship. The particle tracking model that was developed has been checked for accuracy against field measurements of drifter movement in Lake Kinneret (Israel) as well as in the Marmion Marine Park in Western Australia. Further analysis is being conducted, but the preliminary results are that the particle tracking model follows directly from the results of the hydrodynamic model, and variations between field and numerical drifter results are predominantly indicators of the overall inaccuracy of the hydrodynamic model given the boundary conditions imposed.

The third phase of this work will involve the quantification of horizontal dispersion/diffusion coefficients detemined from field and numerical drifters. This work will form the final portion of my Ph.D. research, which will be completed by May, 2004.

The papers that are currently under development as a result of the TWRI grant are:

1. On Horizontal Dispersion in the Coastal Boundary Layer
2. Numerical Modeling of Lagrangian Drifters

These working titles are likely to be changed. The first paper focuses on the calculation of horizontal dispersion coefficients in the costal zone using field and numerical drifters in Marmion Marine Park. The second paper details the working numerics and the accuracy of the particle tracking routine within the ELCOM model, as verified against an analytically derived velocity field. Each of these topics will be addressed in the final report submitted to TWRI in June, 2003.