# Optimal Parameter Selection in GWCE-based Shallow Water Models

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ABSTRACT

One strategy for solving the shallow water equations in the finite element community is to reformulate the primitive continuity equation into the generalized wave continuity equation (GWCE). The GWCE contains a parameter, "G," as well as the second derivatives in space and time that are generally associated with the classic wave equation, hence its name. G is a numerical parameter: as G goes to zero, the equation reduces to the form of a pure wave equation, and as G goes to infinity, the equation takes the form of the primitive continuity equation. Atkinson et al.[i] found that the GWCE formulation is equivalent to the quasi-bubble discretization (as applied to the linearized shallow water equations) for a specific value of G, which depends on the wave frequency and the bottom friction parameter. Additionally, they theorize that this relationship for G that makes them equivalent also yields optimal dispersion properties; linearized analysis bears this out. The spatially and temporally-variable G parameter, based on the quasi-bubble/GWCE comparison, yielded favorable results for problems dominated by tidal forcing, with decreases in wave constituent and mass balance errors for highly non-linear cases. While this method of selecting G works well for problems with periodic forcing, it appears to be sub-optimal for non-periodic problems, like hurricane storm surge. Thus, through analyses and numerical experiments, we are trying to identify an algorithm for G that accurately describes surge and wave run-up in shallow coastal regions. Selected results from a variety of idealized and real basins will be presented, including hindcasts of Hurricane Katrina and comparisons to measured high-water marks.

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i.J.H. Atkinson, J.J. Westerink, and J.M. Hervouet. Similarities between the Quasi-Bubble and the Generalized Wave Continuity Equation solutions to the Shallow Water Equations. *International Journal for Numerical Methods in Fluids*, 45, 2004; 689-714.