



**US Army Corps  
of Engineers®**

Engineer Research and  
Development Center

# Navigation Systems Research Program

## Improved Numerical Modeling of Vessel Hydrodynamics and Sediment Transport

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**Problem** The Corps is charged with assessing environmental quality on its navigation projects. The effects of moving vessels must be quantified and mitigated. Corps investigators presently calculate the effects of a vessel sailing through a waterway using a numerical program developed by Berger and Stockstill, HIVEL2D. While this model has proven to be successful in addressing many vessel effects issues, it is computationally limited due to longer setup and computing times than are necessary. Also, the numerical program does not directly include sedimentation effects. This effort will move the concept of a moving pressure field that currently exists in HIVEL into the new modern ADH (Adaptive Hydraulic) program. Furthermore it will make the vessel movement algorithm available to all shallow water models.

**Research Approach** Training the adaption routines for this problem, adding entrainment routines, and thorough testing will be performed. The details are as follows: 1) Transfer the moving pressure field mechanics into ADH. This includes the movement of multiple vessels. 2) Train the adaption routines to resolve the vessels and hydrodynamics near the vessel. The model will adapt around the vessel based upon information from the hydrodynamic model as it is running. This particular information is called "error indicators." These will need to be tested and refined to insure they are general. 3) Test cases of projects previously studied using the existing program will be run to quantify improvements of the new code in efficiency and accuracy. 4) The multiple processor features will be evaluated to insure they function properly with the moving vessel mechanics. 5) Entrainment mechanics gained from the Upper MS studies will be added. Tests will then be conducted using the new features with sediment entrainment.

**Labs/others involved** Coastal and Hydraulics Laboratory

**Final Products** A vessel movement library that can track several vessels within a numerical water body has been developed. This library can be used with many other shallow water models. This vessel library has been combined with the ADaptive Hydraulics shallow water model, thus allowing accurate grids to be automatically produced as vessels move along a waterway. Since the ADH code refines the mesh near the vessel (and unrefines when the vessel effects have passed) the setup time for the user is a minimum. Entrainment regions around the vessel and the propeller are delineated in the vessel library. These entrainment conditions then feed the sediment calculations within ADH to predict scour and deposition effects from the vessel.

**Point of Contact** Dr. Charlie Berger, US Army Engineer Research and Development Center, 3909 Halls Ferry Road, Vicksburg, MS 39180, 601-634-2570, email: [Charlie.R.Berger@erdc.usace.army.mil](mailto:Charlie.R.Berger@erdc.usace.army.mil)