Abstract View

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A Study of Tides, Setup and Bottom Friction in a Shallow Semi-Enclosed Basin. Part II: Tidal Model and Comparison with Data

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ABSTRACT

This is the second in a series of papers reporting the results of a study of tides, setup and bottom friction in the Bight of Abace, Bahamas. The extensive field data reported in Part I of the series (Filloux and Snyder, 1979) are compared with tidal computations using a modified elliptic model first developed by Sidjabat (1970). This model, a multiconstituent generalization of the “hamonic method” of Dronkers (1964), is based on a polynomial representation for the magnitude of the current which provides a tractable resolution of bottom friction, resulting in a coupled set of time-independent equations governing the individual constituents. This resolution naturally spots the bottom friction into a part which can be absorbed on the left-hand (operator) side of the constituent equations and a part which can be treated as multilinear source terms on the right-hand side. The contribution to the left-hand side is large enough that the resulting coupled set may be solved iteratively, converging rapidly. The method provides an efficient and physically transparent alternative to time-stepping methods, particularly for parameter studies such as that described in the paper.

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Comparison of model computations with the Bight field data supports the following conclusions:

1) Bottom friction is important to the dynamics of all tidal constituents; it is the source of the M6 overtide. 2) The M4 and M6 overtides are locally generated.

3) While it is possible to fit the principal tides and the M4 overtide with quadratic bottom friction (using a constant drag coefficient and neglecting the contribution of non-tidal motions to the rms current), it is not possible to simultaneously fit the M6 overtide. The resulting frictional interaction is too strong a source of the overtide (by about a factor of 2).

4) The addition of linear bottom friction (and corresponding reduction of the quadratic friction) allows an acceptable fit to both the principal tides and the M4 and M6 overtides.

5) Inclusion of a non-tidal contribution to the rms current also allows an acceptable fit to both the principal tides and the M4 and M6 overtides. The necessary rms non-tidal current (~ 0.28 m s^{-1}) is, however, somewhat larger than seems reasonable.

6) In either case the implied bottom stress is significantly larger than reported by other investigators.

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