INTERNAL DYNAMICS OF THE SALTON SEA

Wind Field Analysis in Support of Hydrodynamic Modeling

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CENTER FOR ENVIRONMENTAL AND WATER RESOURCES ENGINEERING
UNIVERSITY OF CALIFORNIA, DAVIS

REPORT 00-4

PREPARED FOR
SALTON SEA AUTHORITY

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Increases in salinity and water levels in the Salton Sea are threatening its aquatic and avian ecology. In response to these threats, the Salton Sea Authority is exploring alternative management options to control salinity and water levels. One such scenario may involve the physical modification of the Sea's current incarnation. To assist understanding of the potential effects of bathymetric alterations on present water circulation processes, the Modeling Group of the Center for Water Resources and Environmental Engineering at the University of California at Davis entered into an agreement with the Salton Sea Authority to provide three-dimensional mathematical models of water circulation within the Sea.

Since the Salton Sea is a wind-driven system, characterizing basin-wide wind patterns could provide an understanding of how wind circulation affects water circulation. In addition, wind data are required as boundary condition inputs for calculation of sea-surface wind shear stresses in the momentum equations within the hydrodynamic model. Past methods of applying wind inputs for dynamic simulations of water circulation were cumbersome. Thus, this thesis focuses on wind field characterization in the Salton Sea Basin and the development and use of a spatial interpolation scheme to create dynamic wind boundary-condition input files for use in the hydrodynamic model RMA-10.

Analysis of data from eight meteorological stations in close proximity to the Salton Sea revealed local-scale phenomena, such as land-sea breezes, that may influence mean

diurnal wind conditions along the entire shoreline of the Sea, but that are most prevalent along northern shorelines near CIMIS station 141 and SSN. Mountain-valley breezes may be persistent along the western shoreline near CIMIS station 127. Extreme wind events, which seem to obliterate such local-scale phenomena, mostly tend to occur in the southern basin, as observed in the meteorological records of CIMIS station 128 in the southeast and the Safety Clean station in the southwest. Cyclonic wind gyres observed in the southern basin of the Sea tend to occur late at night, persisting into early morning and dissipating by mid-morning. A good correlation exists between this characteristic wind gyre pattern and persistent counter-clockwise water circulation gyres that have been hydrodynamically simulated and confirmed by field observations using Acoustic Doppler Current Profilers (ADCPs).

Prior to work presented in this thesis, hydrodynamic model results were found to be extremely sensitive to wind boundary conditions (Cook, 2000). To improve model performance a quick and efficient method, adopted from a technique originally developed by Stanley Barnes (1964), was created for spatial interpolation of wind data observed at land-based meteorological stations. Using the interpolation scheme, sea-surface winds were computed for finite element node points throughout the model grid. Application of the hydrodynamic model was greatly facilitated and circulation results, compared to field observations, were determined to be more realistic.

Recommendations are made to extend time series of wind data for use in the model. To improve the database, gaps in the meteorological station network may need to be addressed, especially along the eastern shoreline of the Sea. *In-situ* buoyed-meteorological stations could be located to provide better information on the wind field structure at the sea surface. Additionally, the wind field model could be extended to account for mass conservation. Improved representation of topographical effects on the wind field could provide even more realistic boundary conditions and thereby improve hydrodynamic simulations of the Salton Sea.