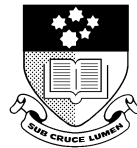


**Three-Dimensional
Tide and Surge Modelling and
Layered Particle Tracking Techniques
Applied to
Southern Australian Coastal Seas**

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Contents

List of Tables	vi
List of Figures	vii
Abstract	xiii
Signed Statement	xv
Acknowledgements	xvii
1 Introduction	1
2 Tide and Storm Surge Models	5
2.1 Introduction	5
2.2 Governing Equations	5
2.2.1 Cartesian equations (ted)	5
2.2.2 Three-dimensional spherical tidal equations (tsoc)	9
2.3 The Boundary and Initial Conditions	12
2.3.1 Cartesian co-ordinate zig-zag boundary (ted)	12
2.3.2 Spherical co-ordinate oblique boundary conditions (tsoc)	14
2.4 Discussion of Open Boundary Methods	17
2.4.1 Height specified conditions	17
2.4.2 Sommerfeld radiation condition	17
2.4.3 Meteorological inputs (BST, IBP)	18
2.4.4 Other radiation condition	18
2.4.5 Comparison testing	19
2.4.6 Conclusions	19
2.5 Numerical Model	20
2.5.1 Horizontal grid (ted)	20
2.5.2 Horizontal grid (tsoc)	20
2.5.3 Vertical grid	21
2.5.4 Finite-difference scheme	22
2.5.5 Cartesian co-ordinate horizontal eddy viscosity formulation (ted)	22
2.5.6 Spherical co-ordinate horizontal eddy viscosity formulation (tsoc)	23
2.5.7 Tidal flat scheme (ted)	24
2.5.8 Computational procedure (ted and tsoc)	25
2.5.9 Grid element classification scheme (ted and tsoc)	26
2.6 Model Calibration (ted and tsoc)	26
2.6.1 Tidal analysis methods	26
2.6.2 Error measures for simulation comparisons	27
2.7 Grid Specification (ted and tsoc)	29
2.7.1 Specifying the horizontal grid	29
2.7.2 Specifying the vertical grid	29

2.7.3	Determining the optimal time step	30
2.8	Summary	30
3	Three Dimensional Modelling of Tides in Gulf St. Vincent, South Australia	31
3.1	Introduction	31
3.2	Tidal Observations in Gulf St. Vincent	31
3.3	The Model Set-Up and Run	34
3.4	Open Boundary Formulation	37
3.5	Optimising Model Parameters	38
3.6	Open Boundary Adjustments	38
3.6.1	Use of the three-dimensional model (adjustment 1)	41
3.6.2	Use of the depth-averaged model (adjustment 2)	42
3.7	Model Results	47
3.7.1	The sea surface elevations	47
3.7.2	Tidal ellipses in Gulf St. Vincent	50
3.7.3	Tidal circulation in Gulf St. Vincent	50
3.8	Conclusion	54
4	Hindcasting Surges in Gulf St. Vincent	55
4.1	Introduction	55
4.2	Modelling the Surge of June 1999	55
4.2.1	Tidal forcing	55
4.2.2	Meteorological forcing	56
4.2.3	External surges	60
4.2.4	Determining the surge	62
4.2.5	The final 1999 storm-surge model	63
4.2.6	Conclusions	63
4.3	Sub-Model of GSV	64
4.3.1	Modelling tides	65
4.3.2	Wind and pressure	67
4.3.3	Surge times in N-GSV	68
4.3.4	Open boundary formulations for N-GSV	68
4.4	Consideration of Open Boundary Behaviour	70
4.4.1	Time series of N-GSV and GSV currents	70
4.4.2	Errors due to open boundaries	76
4.4.3	Conclusions	78
4.5	Factors Determining Currents in Gulf St. Vincent	80
4.5.1	Current time series in GSV	80
4.5.2	GSV current fields	83
4.5.3	Conclusions about currents in GSV	91
4.6	Summary and Conclusions	91
5	Modelling Tides and Storm Surges in the Great Australian Bight	93
5.1	Introduction	93
5.2	Tidal Observations	94
5.3	The Model	95
5.4	Tides of the Great Australian Bight	95
5.4.1	Open boundary formulation	95
5.4.2	Tide height predictions	98
5.4.3	Modelled co-amplitudes and co-phase diagrams	98
5.4.4	Tidal current ellipses	98
5.4.5	Tidal residual circulation	99
5.4.6	Tidal velocity fields	104

5.5	The Surge of April 1996	104
5.5.1	Atmospheric pressure and wind fields April 11–12, 1996	107
5.5.2	Modelling the coastal surge	111
5.5.3	Comparison of modelled and recorded surge	111
5.5.4	Currents	112
5.6	Discussion	116
5.7	Summary	116
6	Lagrangian–Stochastic Particle Tracking	117
6.1	Introduction	117
6.2	Oceanographic Modelling of Advection and Diffusion	117
6.2.1	Oil spills	117
6.2.2	Larval transport	118
6.2.3	Sediment and other transport	118
6.2.4	Why the Lagrangian method?	118
6.3	Advection	118
6.4	Spatial Interpolation	119
6.5	Temporal Interpolation	120
6.6	Grid Types	120
6.7	Testing Advection in the Model Regions	120
6.7.1	Calculation of errors	122
6.7.2	Interior behaviour	122
6.7.3	Coastal boundary behaviour	124
6.7.4	Open boundary behaviour	124
6.8	Tidal Flat Wetting and Drying	127
6.9	Comparison of Grid Types	127
6.10	Diffusion	128
6.10.1	Analytic solution	128
6.10.2	Easton, Steiner and Zhang	128
6.10.3	Prickett, Naymic and Lonquist	128
6.10.4	Lewis, Noye and Evans	130
6.10.5	Diffusion comparison	130
6.11	Summary	130
7	Prawn Larvae Dispersal Modelling in Gulf St. Vincent, South Australia	131
7.1	Introduction	131
7.2	Prawn Biology	131
7.3	Prawn Larvae Modelling and Vertical Migration	132
7.3.1	Nixon	132
7.3.2	Grzechnik and Noye	133
7.3.3	Rothlisberg	134
7.3.4	Conclusion	134
7.4	Spawning and Settlement	134
7.4.1	Settlement	134
7.4.2	Processing spawning data	135
7.5	Development of Surge Model and Current Data	136
7.5.1	Wind and pressure fields	136
7.5.2	Comparison of elevation	137
7.5.3	Consequences when applied to particle tracking	137
7.6	The Particle Tracking Technique	137
7.6.1	The surface–bottom algorithm	137
7.6.2	Pre-settlement duration	139
7.6.3	Incorporation of life stages	139

7.6.4	Boundary treatment	139
7.6.5	Diffusion	140
7.7	Prawn Larvae Dispersal with the Single Life Stage	140
7.7.1	Run 1 – settlement in 1990	140
7.7.2	Run 2 – settlement in 1991	142
7.8	Prawn Larvae Dispersion with Dual Life Stages	145
7.8.1	Run 1 – settlement in 1990	145
7.8.2	Run 2 – settlement 1991	149
7.9	Boundary Settlement	149
7.10	Discussion	153
7.11	Conclusions	154
8	Suspended Particle Dispersion in Boston Bay, South Australia	155
8.1	Introduction	155
8.2	Biology of Southern Bluefin Tuna	155
8.3	The Boston Bay Model	156
8.4	Modelling Tides in Boston Bay	157
8.5	Determining Vertical Eddy Viscosity Parameters for Storm Surge Modelling . . .	159
8.6	The Disaster of April 1996	164
8.6.1	The tuna mortalities	164
8.6.2	Storm surge model	166
8.7	Storm Induced Currents In Boston Bay	170
8.7.1	Current fields caused by surges and winds	170
8.7.2	Time series of surface and bottom currents caused by tide alone and by tide plus storm	174
8.8	Simulation of Particle Dispersion in Boston Bay	179
8.8.1	Boundary conditions	179
8.8.2	Advection of individual particles	180
8.8.3	Multiple particle tracking	182
8.8.4	Concentrations of particles at tuna farms	185
8.8.5	Discussion	187
8.9	Summary	189
9	Conclusions	191
	Bibliography	197
	Glossary	207

List of Tables

2.1	Synodic periods for selected tidal constituents.	28
3.1	Observed amplitudes and phases for Gulf St. Vincent (GSV).	34
3.2	The initial open boundary data for Investigator Strait to be input into the GSV model.	39
3.3	The initial open boundary data for Backstairs passage to be input into the GSV model.	39
3.4	Observed and predicted amplitudes and phases for initially forced GSV 3D model.	40
3.5	Observed and predicted amplitudes and phases for internally forced GSV 2D model.	43
3.6	The modified open boundary data for Investigator Strait to be input into the GSV model.	44
3.7	The modified open boundary data for Backstairs passage to be input into the GSV model.	44
3.8	Observed and predicted amplitudes and phases for optimal 3D GSV model. . . .	46
4.1	Summary of boundary effects upon test pulse in GSV model.	62
4.2	The open boundary tidal data to be input into the GSV sub-model.	66
4.3	Ranges for tides and storm surges in Gulf St. Vincent.	77
5.1	Amplitudes and phases for the western GAB open boundary.	96
5.2	Selected amplitudes and phases for the southern GAB open boundary.	97
5.3	Calibration table for GAB model for comparison with observed tidal constants for O_1 , K_1 , M_2 and S_2	99
7.1	The settlement data for Gulf St. Vincent.	135
7.2	Spawning dates in GSV.	136
7.3	Sunrise and sunset times for model runs in Gulf St. Vincent.	139
7.4	A summary of modelled settlement for Gulf St. Vincent.	153
8.1	Port Lincoln jetty tidal constituents and model verification.	158
8.2	Percentages of tuna cumulative deaths observed after 5 days and at the end of the month of April	166
8.3	Ratings of tuna farm deaths according to predictions of particle dispersal. . . .	188

List of Figures

1.1	A map of southern Australia showing the location of the Great Australian Bight (GAB), Spencer Gulf and Gulf St. Vincent (GSV).	1
2.1	Cartesian ($z-x$) and transformed ($\eta-x$) coordinate system cross-sections.	7
2.2	Symbols used in the tsoc coastal boundary condition computation.	15
2.3	Comparison of oblique and stepped boundaries.	15
2.4	A grid element plan view, indicating elevation and horizontal velocity grid-points.	21
2.5	An η -section of the transformed vertical coordinate system.	22
2.6	Schematic of the tidal model finite-difference scheme.	23
2.7	Grid element plan view, indicating the immediate neighbour indexing scheme.	23
2.8	Testing for wetting and drying events in the ted model.	24
2.9	Coordinate grids generated using different vertical grid-spacing parameter values.	29
3.1	The location of Gulf St. Vincent (GSV), South Australia.	32
3.2	The location of tidal stations used in the GSV model.	33
3.3	The observed Crossover of M_2 and S_2 in GSV.	35
3.4	The bathymetry (m below MSL) and boundaries of the GSV model.	36
3.5	The GSV Investigator Strait open boundary element numbering scheme.	37
3.6	The GSV Backstairs Passage open boundary element numbering scheme.	38
3.7	The predicted crossover of M_2 and S_2 for the initial 3D model.	41
3.8	The predicted crossover of M_2 and S_2 for the 3D model using adjustment 1.	41
3.9	The final predicted Crossover of M_2 and S_2 in 2D model.	45
3.10	The predicted crossover of M_2 and S_2 for the final 3D model adjusted according to 2D model.	45
3.11	Amplitude and phase contours for GSV model diurnal constituents.	48
3.12	Amplitude and phase contours for GSV model semi-diurnal constituents.	49
3.13	Tidal ellipses near the surface for Gulf St. Vincent, O_1 , K_1 , M_2 , S_2	51
3.14	Tidal ellipses near the sea floor for Gulf St. Vincent, O_1 , K_1 , M_2 , S_2	52
3.15	Monthly mean residual calculations for Gulf St. Vincent.	53
4.1	Observed sea level residuals in Gulf St. Vincent, 1999.	56
4.2	The location of meteorological stations used in the study of storm surges in GSV.	57
4.3	Winds over Gulf St. Vincent, June 1999.	58
4.4	Observed pressure levels in GSV, May 1999.	59
4.5	Effect of wind and pressure at Outer Harbor, 1999.	60
4.6	Test pulses in GSV.	61
4.7	The outside surge and its effects included in the model of Gulf St. Vincent, 1999.	63
4.8	Modelled meteorological and storm effects in Gulf St. Vincent in 1999.	64
4.9	The Gulf St. Vincent sub-model, N-GSV.	65
4.10	The N-GSV model open boundary element numbering scheme.	65
4.11	Output elevations for the N-GSV model at Outer Harbor for various scenarios.	67
4.12	Residual storm surge sea levels in the GSV sub-model for various boundary formulations.	69

4.13	Surface current predictions near the N-GSV open boundary using different open boundary conditions.	72
4.14	Bottom current predictions near the N-GSV open boundary using different open boundary conditions.	73
4.15	Surface current predictions at Outer Harbor using different open boundary conditions.	74
4.16	Bottom current predictions at Outer Harbor using different open boundary conditions.	75
4.17	The location of points used for the open boundary test in Gulf St. Vincent.	76
4.18	The errors in sea level obtained at various distances from the GSV sub-model open boundary.	78
4.19	The errors in currents obtained at various distances from the GSV sub-model open boundary.	79
4.20	Surface current predictions due to various factors at Outer Harbor during the 1999 storm surge.	81
4.21	Bottom current predictions due to various factors at Outer Harbor during the 1999 storm surge.	82
4.22	Surface current predictions due to various factors at Long Spit Beacon during the 1999 storm surge.	84
4.23	Bottom current predictions due to various factors at Long Spit Beacon during the 1999 storm surge.	85
4.24	Tidal currents simulated during 1999 storm in GSV.	86
4.25	Meteorological currents simulated during 1999 storm in GSV.	87
4.26	External surge currents simulated during 1999 storm in GSV.	89
4.27	Currents simulated during 1999 storm in GSV.	90
5.1	A map of southern Australia showing the location of the Great Australian Bight (GAB).	93
5.2	Positions of historical sea level and current recording stations in the GAB.	94
5.3	The computational coastline and bathymetry for the GAB model.	95
5.4	The GAB open boundary element numbering scheme.	96
5.5	Tide-height amplitude calculated using the 3D GAB tidal model.	100
5.6	Tide-height phase computed using the 3D GAB tidal model.	101
5.7	Tidal current ellipses near the sea surface for the GAB model.	102
5.8	Tidal current ellipses near the sea floor for the GAB model.	103
5.9	Tidal current residuals for the GAB model.	104
5.10	Tidal current fields near the sea surface computed in the GAB model.	105
5.11	Tidal current fields near the sea floor computed in the GAB model.	106
5.12	Observed sea level residuals at Esperance, Thevenard and Port Lincoln.	108
5.13	Atmospheric pressure contours during the April 1996 storm over the GAB.	109
5.14	Wind velocity field in the Great Australian Bight for the storm considered.	110
5.15	Sea level residuals at Thevenard with and without meteorological effects.	112
5.16	Sea level residuals at Thevenard using either pressure or wind effects.	113
5.17	Near surface storm induced currents in the GAB.	114
5.18	Near bottom storm induced currents in the GAB.	115
6.1	The position of a particle relative to velocity gridpoints in the bilinear interpolation.	120
6.2	Four element blocks for each of the two grid types showing the relative positions of the ζ , u and v gridpoints and the horizontal step sizes.	121
6.3	The domain for the test grid for particle tracking.	122
6.4	The results from the test of grid influence in the model interior with $\Delta t = 300$ s.	123

6.5	The different deformations of trajectories at the closed boundary using the Arakawa A and C grid types with a constant velocity value.	125
6.6	The replacement of velocities in the bilinear interpolation for a particle approaching the open boundary for the Arakawa A and C grids.	126
6.7	Trajectories followed by particles that cross the open boundary for each grid type.	126
6.8	The dispersal of particles using various diffusion schemes.	129
7.1	Schematic of a typical penaeid prawn life cycle.	132
7.2	Nursery areas in South Australia for <i>P. latisulcatus</i> juvenile prawns.	133
7.3	The locations of recorded nursery areas in northern Gulf St. Vincent and points where prawn concentration is considered.	135
7.4	Processed spawning data for January and November 1990 in Gulf St. Vincent. .	136
7.5	Predictions of sea level at Outer Harbor, 1990–1991.	138
7.6	Particle dispersal and density for spawning on 20 December 1989 with single life stage, using currents from tides and meteorological effects.	141
7.7	Particle dispersal and density for spawning on 20 December 1989 with single life stage, using currents from the full storm effect.	143
7.8	Particle dispersal and density for spawning on 15 January 1990 with single life stage, using currents from tides and meteorological effects.	144
7.9	Particle dispersal and density for spawning on 15 January 1990 with single life stage, using currents from the storm model.	146
7.10	Particle dispersal and density for spawning on 20 December 1989 with dual life stage, using currents from tides and meteorological effects.	147
7.11	Particle dispersal and density for spawning on 20 December 1989 with dual life stage, using currents from the storm model.	148
7.12	Particle dispersal and density for spawning on 15 January 1990 with dual life stage, using currents from tides and meteorological effects.	150
7.13	Particle dispersal and density for spawning on 15 January 1990 with dual life stage, using currents from the storm model.	151
7.14	Particle density near the boundary for runs 1 and 2.	152
8.1	The location of Boston Bay, South Australia.	156
8.2	The bathymetry of the Boston Bay model region.	157
8.3	The location of current meters in Boston Bay.	159
8.4	Current time series at PL1 in Boston Bay.	160
8.5	Current time series at PL2 in Boston Bay.	161
8.6	Current time series at PL3 in Boston Bay.	162
8.7	Time series of observed winds at Port Lincoln Airport.	165
8.8	Locations of various tuna farms in the Boston Bay region.	166
8.9	Daily tuna mortalities as a percentage of stock in the Boston Bay region. . . .	167
8.10	Cumulative tuna mortalities as a percentage of stock in the Boston Bay region.	168
8.11	Plots of modelled and recorded tide heights in Boston Bay.	169
8.12	Comparison of modelled tide heights with and without wind effects in Boston Bay model.	171
8.13	Surface velocities at 12:00 hr 12/4/1996 CST for each component of the storm. .	172
8.14	Bottom velocities at 12:00 hr 12/4/1996 CST for each component of the storm. .	173
8.15	Positions of time series outputs around Boston Island.	174
8.16	Time series of velocities at point A north of Boston Island.	175
8.17	Time series of velocities at point B south of Boston Island.	176
8.18	Time series of velocities at point C west of Boston Island.	177
8.19	Time series of velocities at point D east of Boston Island.	178
8.20	Possible sources of suspended particles in Boston Bay model.	180
8.21	Tracks of centroids due to storm and tide conditions.	181

8.22	Simulated sediment movements for 0:00 hr 12/4/1996 to 13/4/1996 CST.	183
8.23	Simulated sediment movements for 0:00 hr 14/4/1996 to 15/4/1996 CST.	184
8.24	Number of particles simulated in farms A–H.	185
8.25	Cumulative number of particles simulated in farms A–H.	186

Abstract

Three-Dimensional Tide and Surge Modelling and Layered Particle Tracking Techniques Applied to Southern Australian Coastal Seas

This thesis reports the development, testing, and application of computer programs for simulating Lagrangian–Stochastic particle dispersion in coastal seas, with particular application to tide and storm induced dispersion in South Australian seas.

The three-dimensional tidal equations are briefly discussed for the two types of surge models used, and finite-difference methods for numerically solving these equations are considered. Different methods of simulating flows at open sea boundaries are investigated. The method of particle tracking and the development of the particle tracking model is also described. Various tests are conducted to investigate both the advective and diffusive aspects of dispersion, and a number of scenarios for the simulation of open (ocean) and closed (coastal) boundaries are considered. Various aspects of the particle tracking routine are given specific characteristics according to the nature of the particle being considered.

Application of the tide and storm surge model to the Great Australian Bight is described. This uses spherical polar co-ordinates to account for the curvature of the earth, and an oblique boundary element to increase accuracy of the coastline representation. The effect of a low pressure system moving from west to east across the Bight and the resulting significant observed surge at Thevenard during the storm of April 1996 is simulated.

This storm resulted in a significant number of deaths in aquaculture farms containing southern bluefin tuna (*Thunnus maccoyii*) within the Boston Bay region to the extreme east of the Bight due to the agitation of almost neutrally buoyant organic sediments at the sea floor. The effects of this storm are further considered using a Cartesian co-ordinate fine-grid local model of Boston Bay, in Spencer Gulf, South Australia, where both tidal and storm (wind and outside surge) induced flows are simulated. The dispersion of suspended neutrally buoyant sediment throughout the region is considered, and compared with the mortalities of tuna at various farms within the region.

Tidal and storm induced currents in the Gulf St. Vincent region, South Australia, have also been modelled using Cartesian co-ordinates. Detailed consideration has been given to the modelling of tides, winds, atmospheric pressures and outside surges from the two open boundaries in Investigator Strait and Backstairs Passage. The information obtained has enabled the modelling of a number of storm surge scenarios. Further to this, various simulations of the dispersion of the larvae of the western king prawn (*Penaeus latisulcatus*) have been driven using the storm surge model developed. These incorporate currents near the surface and the sea floor, as well as the consideration of changes in behaviour during the life history of the larvae.

Signed Statement

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

SIGNED: DATE:

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