

1. Record Nr.	UNINA9910633914703321
Titolo	The mathematics of marine modelling : water, solute and particle dynamics in estuaries and shallow seas / / Henk Schuttelaars, Arnold Heemink, Eric Deleersnijder, editors
Pubbl/distr/stampa	Cham, Switzerland : , : Springer, , [2022] ©2022
ISBN	3-031-09559-6
Descrizione fisica	1 online resource (324 pages)
Collana	Mathematics of Planet Earth ; ; v.9
Disciplina	551.460015118
Soggetti	Oceanography - Mathematical models Approximation theory Mathematical analysis Oceanografia Models matemàtics Teoria de l'aproximació Anàlisi matemàtica Llibres electrònics
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Intro -- Preface -- Contents -- Contributors -- 1 Basic Equations of Marine Flows -- 1.1 Mathematical Description of Fluids -- 1.1.1 Fluids as Continuous Media -- 1.1.2 Integral and Differential Formulations -- 1.1.3 Averaging of Turbulent Flows -- 1.2 Governing Equations -- 1.2.1 Volume Conservation -- 1.2.2 Salt Conservation -- 1.2.3 Heat Balance -- 1.2.4 Momentum Balance -- 1.2.5 Common Formulations and Closures -- 1.3 Summary -- References -- 2 Water Waves in Isotropic and Anisotropic Media: A comparison -- 2.1 Introduction -- 2.2 Gravity Waves -- 2.2.1 Surface Gravity Waves in Homogeneous Fluids -- 2.2.2 Gravity Waves in Heterogeneous Media -- 2.3 Inertial Waves -- 2.3.1 Waves in Shear Flows -- 2.3.2 Waves in Rotating Basins -- 2.3.3 Three-dimensional Effects -- 2.4 Discussion -- 2.4.1 The Linear Shear Flow as 'Problematic' Equilibrium -- 2.4.2 Waves in Anisotropic Media -- 2.4.3 Mixing Due to Wave Focusing and Mean

Flows -- 2.5 Conclusion -- References -- 3 A Review of Nonlinear Boussinesq-Type Models for Coastal Ocean Modeling -- 3.1 Introduction -- 3.2 The Water Wave Problem -- 3.2.1 Dispersive Properties of the Linear Waves -- 3.2.2 Scaling of Variables and Operators -- 3.2.3 Nondimensionalization of Equations -- 3.2.4 Green-Naghdi Equation -- 3.3 A Finite Element Discretization of the Green-Naghdi Equation -- 3.3.1 Notation -- 3.3.2 Functional Setting -- 3.3.3 Variational Formulation and Solution Procedure -- 3.4 Numerical Results -- 3.5 Conclusions -- References -- 4 Tides in Coastal Seas. Influence of Topography and Bottom Friction -- 4.1 Introduction -- 4.2 Model Formulation -- 4.3 Fundamental Wave Solutions -- 4.3.1 Derivation with Klein-Gordon Equation -- 4.3.2 Kelvin Wave -- 4.3.3 Poincaré Waves -- 4.3.4 Wave Solutions with a Transverse Topographic Step -- 4.4 Amphidromic Patterns in Semi-enclosed Basins.

4.4.1 Superposition of Two Kelvin Waves -- 4.4.2 Solution to Extended Taylor Problem -- 4.4.3 Application to Basins Around the World -- 4.5 Discussion -- 4.6 Conclusions -- References -- 5 Variational Water-Wave Modeling: From Deep Water to Beaches -- 5.1 Introduction -- 5.2 Derivation of Luke's Variational Principle -- 5.3 Transformed Luke's/Miles' Variational Principles with Wavemaker -- 5.3.1 FEM and Mesh Motion -- 5.3.2 Numerical Results: Comparison with Wave-Tank Experiments -- 5.4 Coupling Water Waves to Shallow-Water Beach Hydraulics -- 5.4.1 Numerical Results: Damping of Waves on the Beach -- 5.5 Summary and Conclusions -- References -- 6 Quasi-2D Turbulence in Shallow Fluid Layers -- 6.1 Introduction -- 6.2 Two-Dimensional Turbulence -- 6.2.1 Inertial Ranges in 2D Turbulence -- 6.2.2 2D Turbulence: The Early Years -- 6.2.3 Coherent Structures and 2D Turbulence -- 6.3 2D Turbulence in Square, Rectangular and Circular Domains -- 6.3.1 Simulations of 2D Turbulence in Domains with No-Slip Walls -- 6.3.2 Quasi-Steady Final States: Laboratory Experiments -- 6.3.3 Forced 2D Turbulence on Confined Domains -- 6.4 Interaction of Vortices with Walls -- 6.4.1 No-Slip Walls as Vorticity Sources -- 6.4.2 Vorticity Production by Dipole-Wall Collisions -- 6.5 Review of 2D Turbulence Experiments in Shallow Fluids -- 6.5.1 Laboratory Experiments in Shallow Fluid Layers -- 6.5.2 2D Turbulence with Rayleigh Friction -- 6.5.3 Secondary Flows in Quasi-2D Turbulence in Thin Fluid Layers -- 6.5.4 Concluding Remarks -- 6.6 Summary -- References -- 7 Turbulent Dispersion -- 7.1 Introduction -- 7.2 Model Requirements -- 7.3 Model Development -- 7.4 Reduction to One Dimension with Boundaries -- 7.5 Application to Dispersion in Turbulent Jets -- 7.5.1 Turbulent Round Jet -- 7.5.2 Turbulent Planar Jet -- 7.6 Turbulent Flow along a Wall-The Logarithmic Velocity Profile.

7.7 Application to the Marine Ekman Layer -- 7.7.1 Surface Ekman Layer -- 7.7.2 Bottom Ekman Layer -- 7.8 Conclusions -- References -- 8 Spreading and Mixing in Near-Field River Plumes -- 8.1 Introduction -- 8.2 Dynamical Regions -- 8.3 A Simple Near-Field Plume Model -- 8.4 Complications to The Simple Plume Model -- 8.4.1 Local Mixing Parameterization -- 8.4.2 Plume Frontal Mixing -- 8.4.3 Rotation and Return to Geostrophy -- 8.5 Conclusions -- References -- 9 Lagrangian Modelling of Transport Phenomena Using Stochastic Differential Equations -- 9.1 Introduction -- 9.2 Stochastic Differential Equations -- 9.2.1 Introduction -- 9.2.2 Itô Stochastic Integrals -- 9.2.3 Itô Stochastic Differential Equations -- 9.2.4 Itô's Differentiation Rule -- 9.2.5 Stratonovich Stochastic Differential Equations -- 9.2.6 Fokker-Planck Equation -- 9.3 Particle Models for Marine Transport Problems -- 9.4 Numerical Approximation of Stochastic Differential

Equations -- 9.5 Test Cases for Marine Transport Problems -- 9.5.1
Simple Vertical Diffusion -- 9.5.2 One Dimensional Water Column Including a Pycnocline -- 9.5.3 Multidimensional Diffusion in an Unbounded Domain -- 9.6 Conclusion -- References -- 10
Morphodynamic Modelling in Marine Environments: Model Formulation and Solution Techniques -- 10.1 Introduction -- 10.2 Morphodynamic Modelling Approaches -- 10.3 Process-Based Models -- 10.3.1 Mathematical Formulation of Simulation Models -- 10.3.2 Mathematical Formulation of Exploratory Models -- 10.4 Solution Procedure -- 10.4.1 Initial Value Approach -- 10.4.2 Bifurcation Approach -- 10.5 Example: Morphodynamics of Tidal Inlet Systems -- 10.5.1 Introduction -- 10.5.2 Cross-Sectionally Averaged Morphodynamic Equilibria -- 10.5.3 Depth-Averaged Morphodynamic Equilibria -- 10.6 Summary and Conclusions -- References.
11 Wetting and Drying Procedures for Shallow Water Simulations -- 11.1 Introduction -- 11.2 Governing Equations -- 11.3 Space Discretization -- 11.3.1 Finite Volume Methods -- 11.3.2 Discontinuous Galerkin Schemes -- 11.4 Time Discretization -- 11.4.1 Explicit Time Integration -- 11.4.2 Implicit Time Integration -- 11.5 Concluding Remarks -- References -- Appendix Index -- Index.
