

Rotating Hydraulics

by

L. J. Pratt and J. Whitehead
(Woods Hole Oceanographic Institution)

Preface

Introduction

Chapter 1 The hydraulics of non-rotating, homogeneous flows.

- 1.1 The approximations of hydraulics.**
- 1.2 The shallow water equations and linear waves.**
- 1.3 Nonlinear steepening and rarefaction.**
- 1.4 The hydraulics of steady, homogeneous flow over an obstacle.**
- 1.5 A general formulation for inviscid hydraulics problems.**
- 1.6 Hydraulic Jumps, Bores, Rarefaction Waves and Long's Experiment.**
- 1.7 Solution to the initial value problem.**
- 1.8 Wave reflections and time dependence.**
- 1.9 Friction and bottom drag.**
- 1.10 Entrainment.**
- 1.11 Other topics (dispersion, ???).**

Chapter 2 The hydraulics of homogeneous flow in a rotating channel.

- 2.1 The Semigeostrophic Approximation in a Rotating Channel.**
- 2.2 Uniform Potential Vorticity: Boundary Layers and Kelvin waves.**
- 2.3 Flow Separation and Frontal waves.**
- 2.4 Steady flow from a deep basin: the WLK model.**
- 2.5 Steady flow emanating from a wide basin: Gill's model.**
- 2.6 Uniform Potential Vorticity Flow Revisited.**
- 2.7 Flow reversals and recirculations.**
- 2.8 Non-rectangular cross-sections**
- 2.9 Non-uniform potential vorticity.**
- 2.10 Transport bounds.**
- 2.11 Anatomy of an overflow: The Faroese Channels**
- 2.12 Outflow Plumes**
- 2.13 Applications to Deep Overflows**
- 2.14 Closed upstream basins with forcing and dissipation.**

Chapter 3 Time-dependence and Shocks

- 3.1 Linear Rossby adjustment in a channel.**
- 3.2 Weakly Nonlinear Behavior (advanced topic)**
- 3.3 Rossby Adjustment in a channel: Fully Nonlinear Case (advanced topic)**
- 3.4 Long's problem in a rotating channel**
- 3.5 Shock joining**
- 3.6 The Kelvin Bore**
- 3.7 Shocks in separated flows.**
- 3.8 Hydraulic control in a dispersive system: flow over an infinite ridge.**

Chapter 4 Coastal Applications

- 4.1 Curvature effects and flow separation.**
- 4.2 Coastal Jets and Upwelling Fronts**
- 4.3 The Coastal Marine Layer.**
- 4.4 Expansion fans and oblique shocks: formal theory.**
- 4.5 Gravity Currents.**

Chapter 5 Stratified Systems

- 5.1 Formulation of two-layer, semigeostrophic models.**
- 5.2 Review of the theory for a nonrotating channel.**
- 5.3 Flow over a sill.**
- 5.4 Flow through a pure contraction.**
- 5.5 Overmixing and maximal vs. submaximal exchange: estuaries.**
- 5.6 Overmixing in inverse estuaries.**
- 5.7 Exchange between two deep basins.**
- 5.8 Rotating lock exchange between shallow basins.**
- 5.9 Systems with net barotropic flow.**

Chapter 6 Potential Vorticity Hydraulics

- 6.1 Potential vorticity hydraulics. Should be renamed 'Introduction'.**
- 6.2 Potential vorticity jump in a channel.**
- 6.3 Equatorial jets.**
- 6.4 A mid-latitude jet.**

Appendices

- A. List of Notation**
- B. The method of characteristics in two dimensions.**
- C. The method of characteristics for 2-d, shallow flow with rotation.**
- D. ? Numerical method.**