

# Contents

<b>1</b>	<b>Formulation of the Problem, Transformation of Equations and Elaboration of Ocean Circulation Models . . . . .</b>	<b>1</b>
1.1	Initial Equations, Their Simplification and Transformations . . . . .	1
1.1.1	Initial Equations and Boundary Conditions . . . .	1
1.1.2	Simplification of Equations and Boundary Conditions for Large-Scale Flows . . . . .	3
1.1.3	Velocity in the Quasi-Geostrophic Model: Calculation Formulas . . . . .	9
1.1.4	Equations for Integral Functions in Off-Equatorial Current Models . . . . .	11
1.1.5	Evaluation of the Order of Magnitude of the Quantities in the Equations for Integral Functions .	15
1.1.6	Equations for the Calculation of Sea-Surface Topography at the Basin Boundary in an Off-Equatorial Currents Model . . . . .	18
1.2	Diagnostic Sea Current Models . . . . .	19
1.2.1	Quasi-Geostrophic Model for the Calculation of Sea-Surface Topography and Flow Velocity . . . .	19
1.2.2	Quasi-Geostrophic Model for the Calculation of the Total Mass Transport Stream Function and Flow Velocity . . . . .	24
1.2.3	A Non-Linear Model for the Calculation of Sea-Surface Topography and Flow Velocity . . . . .	30
1.2.4	The List of the Main Correlations in the Spherical System of Coordinates and for the Southern Hemisphere . . . . .	36
1.3	Some Numerical Methods of Solving Simplified Equations of Hydrodynamics . . . . .	40

<b>2</b>	<b>The Simplest Methods of Difference Approximation and Constructed Equations Solution . . . . .</b>	<b>53</b>
2.1	The Construction of Difference Grids . . . . .	53
2.2	The Methods of Approximation and Equation Solutions . . . . .	55
2.2.1	The Methods of Calculating the Sea-Surface Topography (SST) at the Basin Boundary . . . . .	55
2.2.2	Methods of Difference Approximation and Solutions of the Equations-of Quasi-Geostrophic Models . . . . .	58
2.2.3	The Methods of Difference Approximation and Solutions of the Equations of a Non-Linear Model . . . . .	67
<b>3</b>	<b>Numerical Methods of Solving Ocean Dynamics Problems . . . . .</b>	<b>75</b>
3.1	The Construction and Methods of Solving Simplified Problems of Ocean Dynamics . . . . .	75
3.2	The Operator Representation of the Problem and the Principal Algorithm of the Splitting . . . . .	82
3.3	The Evolutional Statement of the Problem . . . . .	93
3.4	The Difference Schemes for the Equations of Motion . . . . .	98
3.5	The Approximation of Adaptation Equations by Spatial Variables . . . . .	101
3.6	The Approximation of the Adaptation Equations by Time . . . . .	109
3.7	The Choice of the Parameters for Approximation in the Simplest Model . . . . .	116
3.8	The Organization of the Numerical Algorithm . . . . .	121
<b>4</b>	<b>The Stationary Problems of Ocean Dynamics . . . . .</b>	<b>123</b>
4.1	The Statement of the Linearized Problem of the Ocean Climatic Condition . . . . .	123
4.2	The Simplest Model of the Stationary Ocean Currents . . . . .	124
4.3	The Ocean Dynamics Model, Taking into Account the Wind-Driven Currents . . . . .	130
4.4	The Difference Operators of the Ocean Dynamics Problem and the Methods of Approximation . . . . .	134
4.5	The Iterative Processes for Solving the Ocean Dynamics Difference Equations for the Barotropic Component . . . . .	139
4.6	The Solution of the Difference Equations of the Ocean Dynamics Baroclinic Component . . . . .	143

4.7	The Modified Iterative Process . . . . .	144
4.8	The Simplest Model of Ocean Dynamics, Taking into Account the Non-Linear Turbulent Exchange .	151
4.9	The Statement of Several Non-Linear Problems . .	152
4.10	The Problem of Non-Stationary Adjustment of Flow Fields to Atmospheric Disturbances . . . . .	154
4.11	The Formation of the Thermocline in the Ocean .	156
<b>5</b>	<b>The Analysis of the Results of Calculations . . . . .</b>	<b>162</b>
5.1	On the Results of Diagnostic Calculations of the Currents in Different Oceanic Basins . . . . .	162
5.2	The World Ocean Surface Topography and the Surface Gradient Currents . . . . .	167
5.2.1	Density and Wind Fields for Diagnostic Calculations. Filtration of the Fields . . . . .	167
5.2.2	Specified Data and Peculiarities of Calculating World Ocean Currents . . . . .	169
5.2.3	The Peculiarities of the World Ocean Surface Topography and the Surface Gradient Currents for the Summer Season . . . . .	184
5.3	The Large-Scale Circulation and Seasonal Variation of the World Ocean Waters . . . . .	189
5.3.1	The Circulation in the World Ocean Surface and Intermediate Layers in the Summer Season . . . .	189
5.3.2	The World Ocean Deep and Bottom Layer Water Circulation . . . . .	205
5.3.3	The Vertical Structure of the World Ocean Currents . . . . .	214
5.3.4	Seasonal Variations of the World Ocean Surface Topography and the Surface Gradient Currents . .	216
5.3.5	Seasonal Variations of the Upper Layer Water Circulation of the World Ocean . . . . .	220
5.3.6	The Structure and Seasonal Variations of the Vertical Circulation of the World Ocean Waters .	233
5.4	The Hydrodynamic Adjustment of the Ocean Temperature, Salinity, Density and Flow Fields . .	236
5.5	The Diagnostic Calculations of Flows and the Adjustment of the Hydrological Elements of the North Atlantic . . . . .	241
5.5.1	The Diagnostic Calculations of Flows by the Quasi-Geostrophic Model . . . . .	241
5.5.2	The Diagnostic Calculations of Flows by the Non- Linear Model . . . . .	244
5.5.3	The Adjustment of the Temperature, Salinity, Density and Flow Fields by the Quasi-Geostrophic Model . . . . .	245

5.5.4	The Adjustment of the Temperature and Flow Fields by the Non-Linear Model . . . . .	248
5.6	The Diagnostic Calculations of Flow in the Equatorial Belt of the Ocean . . . . .	252
5.6.1	The Equatorial Atlantic Flow Calculations by the Quasi-Geostrophic Model: the Assessment of the Validity Limits of the Models . . . . .	253
5.6.2	The Calculations of Flows of the Equatorial Belts in the Atlantic and Indian Oceans by the Non-Linear Model . . . . .	257
5.7	The Calculation of Flows in the Black Sea Offshore Zone . . . . .	266
5.7.1	The Diagnostic Calculations of Flows for the Summer and Fall Seasons . . . . .	267
5.7.2	Numerical Experiments on the Calculation of the Vertical Velocity Component . . . . .	274
5.7.3	The Adjustment of the Density and Flow Fields . . . . .	279
	<b>References . . . . .</b>	<b>285</b>
	<b>Subject Index . . . . .</b>	<b>291</b>