Appendix A: List of Selected Notation. The following list includes variables that are common, that require special explanation, or that have multiple usages; is not exhaustive.

$(\ )^*$	The asterisk always denotes the dimensional version of a variable The star is omitted for common parameters such as g or f, or for scales such as D and L that do not have not have dimensionless versions
$(\ )^T$	matrix transpose
$(\ )_c$	a quantity evaluated at a section of critical flow
$(\ )_R$, $(\ )_L$	quantities measured along the right and left sides (facing downstream) of a channel
$(\ )_s$	usually a quantity evaluated at a topographic sill
$[AB]$	$=A_1B_2- A_2B_1$ in Appendix B
a	usually denotes the amplitude of a wave, initial condition or topographic amplitude. It can also be also the position (x=-a) of the left edge of a current (Sec. 2.9), the potential vorticity gradient (Sec 2.9), the basin radius (Sec. 2.13), or a background potential vorticity (Sec. 6.4)
A	cross-sectional area of flow (Secs. 2.12, 5.8); Mach angle (Secs. 4.3, 4.4, and Appendices A and B); coefficient in depth profile (Sec. 5.8)
A'	angle of characteristic curve in hodograph plane (Appendix B)
$\mathcal{A}$	cross-sectional area of background flow (Sec. 3.9)
A_C	area enclosed within a contour C
b	$x=b$ generally denotes the position of the free edge, or grounding point of a current. In Sec. 6.4 b is the background potential vorticity in Region II
B	Bernoulli function
$\overline{B}$	average of the two side-wall values of B (Sec 2.2)
B_o	surface Buoyancy flux (Sec 5.6)
B_f	Buoyancy flux (Sec. 2.12)
ΔB	internal Bernoulli function (Sec. 5.2.)
c	generally a wave speed. Also the background potential vorticity in Region III in Sec. 6.4
$c_\pm$	characteristic wave speeds
$c^{(n)}$	the propagation velocity of a shock normal to itself (Sec. 3.5)
c_b	speed of gravity current nose (Sec. 4.4)
c_{sep}	speed of left-wall separation point in a gravity current (Sec. 4.4)
C	a contour such as a potential vorticity front (Sec. 3.2), shock (Sec. 3.5), or a contour of depth discontinuity (Sec. 6.2); a coefficient in the depth and velocity profiles (Sec. 5.8)
C_+,C_-	denote characteristic curves (Sec. 4.3, 4.4 and Appendix B and C)
C_d	dimensionless drag coefficient (Sec. 1.9)
d, d_n	layer thickness, thickness of layer n (Chapter 5)

$d_{1\infty}, d_{2\infty}$ constant thickness of layer 1 or layer 2 in a hypothetical reservoir of infinite width (Chapter 5). Used in systems with no background rotation

$\bar{d}, \hat{d}$ average of, and one-half the difference between, the wall depths in a rotating channel (Ch. 2)

$\bar{d}_1, \bar{d}_2$ mid-channel (x=0) values of the layer depths (Sec. 5.7)

d_b wall depth of a gravity current just to the rear (upstream) of the head (Sec. 4.5)

d_o This initial depth in Long's towing experiment (Sec. 1.7); the layer thickness along a channel wall (Secs. 2.3, 5.7); the nondimensional basin depth below sill level (Sec. 2.13)

d_S the depth (below the rigid lid) at which the plume is introduced. Mixing presumably increases as does d_S (Sec. 5.5)

d_u upper layer thickness in laboratory estuary basin (Sec. 5.5)

$(d\gamma_1, d\gamma_2, \ldots)$ The displacement or displacement vector associated with a small change in a steady flow due to a stationary wave. The displacement vector determines the structure of the wave (Section 1.5)

D background current depth (Sec. 1.3) or depth scale (elsewhere)

$\hat{D}_f$ form drag (Section 1.6)

D_s in a two-layer system with a rigid lid, the depth over the sill (Ch. 5)

D_∞, $D_{n\infty}$ potential depth (Sec. 2.1) or potential depth within layer n (Chapter 5)

$D_{-\infty}$ In submerged weir flow (end of Sec. 2.4) the depth measured in a quiescent region of the downstream basin

$\hat{D}_r$ nondimensional Bernoulli function along the coast in Sec. 4.1

$\mathcal{D}(x)$ depth of background flow (Sec. 2.9)

e_n enstrophy (Sec. 2.9)

e_w density of wave energy (Sec. 3.9)

E volume entrainment rate (Sec. 1.6); the maximum energy or Bernoulli function (Sec. 2.10); the total energy (Sec. 3.9); the evaporation rate (Chapter 5)

$\dot{E}$ time rate of change of energy (negative for energy dissipation).

E_b, E_m, E_w background, mean and wave energies (Sec. 3.9)

E_n the entrainment rate (Secs. 1.6 and 2.12)

f Coriolis parameter, $2\Omega\sin(latitude)$, where Ω is Earth's angular rotation rate.

$f_\pm(x - c_\pm t)$ linear wave solutions

F or $\mathbf{F}$ a scalar or vector force in the horizontal momentum equation (Sec 2.1).

F_1, F_2 layer Froude numbers (Chapter 5)

F_β Beta plane Froude number (Eq. 6.4.13).

F_d The Froude number based on the local values of velocity and layer thickness (Sec 1.2). In Chapters 2-6, F_d can denote various generalized versions of the Froude number for rotating flow.

F_o The Froude number of the initial flow in an initial-value problem. (e.g. Secs. 1.7, 3.8, and 6.2)

F_p Froude number for rotating flow in a parabolic channel (Sec. 2.8)
F_S Froude number defined using Stern's criterion (Eq. 3.4.12)
F_τ bottom drag (Sec. 2.12)
F_w Froude number based on side-wall velocities (Sec. 3.5)
$\bar{F}_n$ Pseudo Froude number for layer n of a rotating exchange flow (Sec. 5.7)
g, g' the first can represent either the normal ($9.8 m/s^2$) or reduced gravitational acceleration depending on whether the equation in question applies to a free-surface flow or an equivalent barotropic (1.5-layer) model. The second always represents reduced gravity.
$\mathcal{G}$, $\mathcal{G}_n$ hydraulic function, or one of n such functions in n variables (Sec 1.5).
G composite Froude number for two-layer flow (Chapter 5), also a Greens function (Sec. 3.2).
G_r composite Froude number for rotating, exchange flow with zero potential vorticity (Sec 5.7)
h topographic elevation, usually referenced to the elevation of a source basin
δh height of topographic step or shelf (Sec. 6.2)
h_c the minimum sill height required for upstream influence (Sec. 3.4); more generally, the bottom elevation at critical section usually the sill elevation.
h_m sill elevation
$H(y)$ step function (Sec. 6.2)
$\mathbf{J_n}^*$ the contribution to the vorticity flux from dissipation (Sec 2.1)
k wave number in the cross-channel direction (Sec. 2.1) or in along-channel direction in a zonal channel (Sec. 6.2)
$K(y)$ topographic function defined by Equation (6.4.6).
$K_o(y)$ modified Bessel function of zero order.
$K_{m,n}$ Helmholtz point vortex (Sec. 2.1).
l wave number in the along-channel or along-coast direction (Sec 2.1); also the width of a control volume (Sec. 3.5.1).
L generally the dimensional scale of variation in the primary direction of the current; a differential operator in Appendices B and C.
L_d $=(gD_\infty)^{1/2}/f$, the Rossby radius of deformation based on the potential depth.
ΔL distance L_1-L_2 between potential vorticity fronts in Sec. 6.4.
M total momentum (Sec. 3.9 and 6.2).
M_b,M_m,M_w background, mean and wave momentum (Sec. 3.9)
m_w density of wave momentum
n in curvilinear (s,n) direction, n is normal to the current axis (Sec. 2.12) or isobath (Sec. 2.13), or coastline (Sec. 4.1)
$N(x)$ cross-channel structure function for wave mode (Sec. 2.1). N is also used as a scale for the interface displacement η (Sec. 2.13).
$\mathcal{N}(x)$ x-varying component of topographic height $h=\mathcal{N}(x)H(y)$ (Sec. 6.4)
p,p_n fluid pressure, pressure in layer n
p_o external pressure field (Sec. 3.8).
p_T* rigid lid pressure
P precipitation rate (Sec. 5.5)

q potential vorticity

q_2 in the Chapter 5 Froude number diagrams, q_2 is a proxy for the topographic height or channel width. See equation following 5.3.2.

$\tilde{q}$ potential vorticity anomaly (Sec. 3.2)

q_o* average potential vorticity (Sec. 2.8)

Δq $|a|Q^*/2q_o^*$ (see Sec. 2.8)

Q, Q_n volume transport (flux) or volume transport within layer n. In Section 2.14, Q_0* and Q_1* denote the dimensional flux for a flow with potential vorticity q=0 and q=1. In Section (5.2) Q denotes the net flux over two layers.

Q_b volume flux in a gravity current

Q_r ratio of top to bottom volume fluxes in a two-layer system (Sec. 5.2)

Q_R volume flux due to river runoff or other source of fresh water (Sec. 5.5)

$Q(x)$ potential vorticity of background flow (Sec. 3.9)

r part of the Riemann function (see Eq. 2.2.24); the ratio of width to deformation radius for a parabolic channel (Sec. 2.8, 2.13); the radial coordinate (Sec. 2.12).

r_f,R_f dimensional and nondimensional versions of a linear drag coefficient (Sec. 2.13).

r_o radius of downwelling patch (Sec 2.13)

R a region of the flow field

∂R the boundary of region R

$R_\pm$ Riemann invariant functions (e.g. Secs. 1.3 and 2.2).

R_b bulk Richardson number

R_i Richardson number (Sec. 1.10)

R_c reflection coefficient (Sec. 1.8)

R_o Rossby number (Sec. 6.1)

s in a curvilinear (s,n) coordinate system, s is tangent to the axis of the current (Sec. 2.12), isobath (Sec. 2.13), or coastline (Sec. 4.1). In Sec. 6.4, s is the topographic slope.

$s_\pm$ see Eq. (5.9.12)

Δs nondimensional salinity difference between layers (Eq. 5.5.8)

S bottom slope (Secs. 1.9 and 2.12); ratio of horizontal length scale to Rossby radius (Secs. 6.1-6.4)

S_n salinity in layer n

r part of the Riemann function (see Eq. 2.2.24); the ratio of width to deformation radius for a parabolic channel (Sec. 2.8); width parameter for separated shock (Eq. 3.7.1).

t time

$\tilde{t}$ slow time variable (Sec. 6.2)

T tanh(qw/2) over most of the book. T is also used to denote the volume transport of a basin source (Sec. 2.13) and a time scale (Sec. 6.1).

T_e tanh(qw_e/2)

(u,v) x- and y-velocity components in most of the book. In Section 2.13, u and v are radial and azimuthal velocities. In Section 4.1, they are the off-shore and along-shore velocities along a curvy coast line.

$u^{(n)}, u^{(s)}$ normal and tangential velocity components to a shock (Sec. 3.5)

u_o westward velocity of far field flow (Sec. 6.4)

U_o maximum velocity in zonal jet (Sec. 6.2)

$\bar{v}, \hat{v}$ average of, and one-half difference between, the wall velocities in a rotating channel.

$\bar{v}_1, \bar{v}_2$ layer velocities at mid-channel (Sec. 5.7).

v_o initial velocity in Long's towing experiment (Sec. 1.7); the layer velocity along a channel wall (Secs. 2.3 and 5.7);

v_e velocity on free edge of stream (Sec. 2.3)

V scale for v and (in Section 1.3) the velocity of the background current. V is also used to denote a control volume (Sec. 1.6) and the along-axis velocity of a plume (Sec. 2.12).

$V(x)$ the mean barotropic velocity in a two-layer system (Sec. 5.9)

$\mathcal{V}(x)$ velocity of background flow (Sec. 3.9)

(x,y,z) cross channel, along channel, and upward coordinates. For coastal flows, y is aligned along the coast, or in its predominant direction.

w channel or shelf width or, in Section 1.1, the vertical velocity

w_b width of a gravity current just to the rear of the head (Sec. 4.4)

w_B variable basin width upstream of channel mouth (Sec. 5.7)

w_e width of separated channel flow (Secs. 2.3, 5.7, 5.8); the current width (Section 4.1); the (positive downwards) entrainment velocity (Secs. 1.10, 2.13)

W width scale

x,y in rotating channels or coastal applications, x generally denotes the cross-channel or offshore coordinate. and y the longitudinal coordinate. In Chapter 6, where the currents are aligned east-west, this convention is reversed.

$\tilde{x}$ scaled version of x used to capture gradual variations (Sec. 6.2).

x_c the midpoint of a separated current (Sec. 2.3).

$y_\pm(t)$ along-channel position along a characteristic curve

$Y(x,t)$ position of Kelvin bore (Sec. 3.6); position of potential vorticity front (Sec. 6.2)

$Y(x)$ position of topographic step or shelf (Sec. 6.2).

z vertical coordinate

Δz difference between reservoir surface or interface elevation and sill elevation

Δz_E an upstream surface or interface, measured relative to deepest part of the sill, equivalent to E/g', where E is the maximum energy over the streamlines passing across the sill (Sec 2.10).

z_R the source elevation above the bottom in a Sec. 5.5 experiment.

z_s elevation of source of plume (Sec. 5.5)

z_T in a two-layer system, the elevation of the bounding rigid lid.

Greek

- α — a multiplying factor (Sec. 1.3); bottom curvature (Sec. 2.8); the parameter $|a|^{1/2} d*$ (Sec. 2.9); cross-axis bottom slope (Sec. 2.12); bottom slope parameter (Sec. 2.13); composite variable for the position of the edge of a coastal current (Sec. 4.2); coastline angle (Sec. 4.3); the initial velocity of the channel flow (Sec. 6.2); $(\beta/u_o)^{1/2}$ in Sec. 6.4.
- β — a measure of the potential vorticity gradient either due to bottom topography (Sec 2.9,) or due to variations in the Coriolis parameter (Sec. 6.1.); the angle of the plume axis (Sec. 2.12) or an oblique shock (Sec. 4.3); coefficient in the expression for the speed of the nose of a gravity current (Sec. 4.5); coefficient of expansion of water due to salinity (Sec. 5.5).
- β_w — coefficient in the expression for the neck width of a gravity current (Sec. 4.4)
- δ — horizontal aspect ratio (e.g Sec 2.1); boundary layer thickness (Sec. 2.13)
- $\hat{\delta}$ — ratio of potential layer depths (Sec. 5.9)
- $\delta(x)$ — the Dirac delta function (Secs. 2.13 and 3.2)
- δ_b — boundary layer thickness (Sec. 2.13)
- δ_E — Ekman layer thickness
- Δ — the change in interface elevation across the flow (Sec. 2.11); the ratio of total depth to the sum of potential layer depths (Sec. 5.9)
- ε — a generic small dimensionless parameter, also the length of a control volume (Sec. 3.5)
- $\phi(\tilde{x}, y, \tilde{t})$ — perturbation stream function (Sec. 6.2)
- γ or γ_n — a generic dependent flow variable used in a hydraulic funcion (e.g. Sec. 1.5) Also $\gamma = \frac{1}{2} w * |a|^{1/2} D$ in Sec. 2.9
- $\Gamma_\pm$ — hodograph images of characteristics
- η — displacement of surface or interface above some reference level
- $\eta_\pm$ — interface displacement along right and left walls (Sec. 5.9)
- η_e — interface elevation, relative to sill, at a channel entrance (Sec. 2.13)
- κ — drag coefficient used in plume model (Sec. 2.12); turbulent diffusivity (Sec. 5.6)
- λ — wave length
- λ_n — multiplying factor in derivation of hyperbolic forms (Appendix B)
- μ — artificial 'viscosity' used in numerical code (Sec. 3.4)
- $\mu_\pm$ — defined by expression following Eq. (5.9.11)
- θ — azimuthal coordinate (Sec. 2.13); angle of inclination of a shock (Sec. 3.5); angle of velocity vector (Sec. 4.4).
- ρ, ρ_n — density, density of layer *n*. In Section 4.1, ρ is the radius of curvature of the coastline

$\Delta\rho$ difference in layer densities

τ slow time variable (Sec. 3.2)

τ_B, τ_I bottom or interfacial stress (Sec. 2.12)

ν kinematic viscosity

ω wave frequency; also the angle of a characteristic curve in the hodograph (Sec. 4.4)

σ, $\sigma_\pm$ parameter for characteristic curve (Appendix B)

σ_θ potential density referenced to the surface

σ_4 potential density referenced to 4000db.

ξ boundary layer coordinate (Sec. 2.13); x-coordinate of point vortex (Sec. 3.2)

ψ transport streamfunction, but occasionally also the velocity streamfunction

ψ_i value of ψ in quiescent interior region of the reservoir of Gill's (1977) model

ψ_o the value of the streamfunction corresponding to the potential vorticity front in a steady flow (Sec. 6.2)

ζ generally the relative vorticity; a similarity variable (Sec. 6.3)

ζ_a absolute vorticity ($f+\zeta$) (Sec. 2.1)