Appendix B

Acronyms, Symbols, and Constant Values

Commented [01]: Missing the many acronyms from the reanalysis data sources. See those tables in chapter 2. Such as AIREP, ACARS, AMDAR, ASDAR, TAO, TRITON, PAOBs, beta, cap U, k_sub beta, GPS/MET, LIMS, TCPW, RMS, See website list at bottom of table 2.1, WMO, more in Table 2.3 and 2.4

Purpose: Defines acronyms and symbols used throughout the book. Where relevant, the value of the constant is provided

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A	available potential energy
A_{lbd}	planetary albedo
A_{lbd_c}	planetary albedo (cloudy)
A_{lbd_nc}	planetary albedo (clear, no cloud)
AEF	atmospheric total energy flux
AMIP	Atmospheric model intercomparison project
ASHF	atmospheric sensible heat flux
amc	angular momentum conserving
a_{Λ}	absorptivity at electromagnetic wavelength Λ
a_{SA}	shortwave absorptivity of 'glass' atmosphere
a_{SG}	shortwave absorptivity of ground
a_{LA}	longwave absorptivity of 'glass' atmosphere
a_{LG}	longwave absorptivity of ground
BEBVE	baroclinic equivalent barotropic vorticity equation
C_{Ev}	bulk transfer coefficient for evaporation (similar magnitude as C_{Ht})
C_{Ht}	bulk transfer coefficient for heat ($1x10^{-3}$ to $5x10^{-3}$, unitless)
C_p	specific heat of dry air at constant pressure, = 1004 J K^{-1} kg^{-1}
C_{sd}	specific heat estimate for dry soil, ~800 J K^{-1} kg^{-1}
C_{sw}	specific heat estimate for wet soil, ~1500 J/(kgK)
C_v	specific heat of dry air at constant volume, = 717 J K^{-1} kg^{-1}
C_w	specific heat for water, ~4200 J K^{-1} kg^{-1} varies with temperature. This value for T~280K
CTW	cloud-track winds
c	speed of light (3 x 10^8 m/s)
c_B	Boltzmann constant (1.38 x 10^{-23} J/K)
c_d	drag coefficient ($3x10^{-3}$ over land, 10^{-3} over ocean; see surface stress, τ)
c_h	Planck constant (6.625 x 10^{-34} Js)
D	divergence
D_T	total diabatic heating rate per unit mass, = D_J / C_p (units K/s)
D_J	total diabatic heating rate in units J s^{-1} kg^{-1} (see C.3)
D_{NM}	diabatic heating rate from processes other than net changes of water state (K/s units)
DOE	(U.S.) Department of Energy
DSE	dry static energy (per unit mass), = $C_pT+\Phi$

Commented [RG2]: Consider using D instead of Q

dX	distance (path length) increment
dω	solid angle incrementω
ECMWF	European Centre for Medium-range Weather Forecasts
ERA-40	ECMWF 40 year reanalysis datasets
ERA-Interim	ECMWF reanalysis dataset successor to ERA-40
E_w	evaporation of liquid water
E	radiance
E_{ei}	diffuse radiance emitted by a layer, also E_e
E_I	incident irradiance
E_I^{ω}	average intensity that reaches an atmospheric layer
E_i	radiance from layer i
E_Λ	radiance (at wavelength Λ)
ENSO	el Niño – Southern Oscillation
e	vapor pressure
e_s	saturation vapor pressure
F	friction
F_{cld}	fraction of sky covered by cloud
Fr	Froude number, = (U_s typical value)/(gH)
f	Coriolis parameter, = 2Ωsinφ
f_o	constant value of Coriolis parameter at latitude φ_o, = $2\Omega\sin\varphi_o$
g	acceleration of gravity, = 9.81 m s^{-2}
h	elevation, Montgomery Stream function, geopotential (See appendix C)
H	scale height, = RT/g where T has usually been averaged in some way
HCBE	hypothetical boundary between atmospheric regions where Hadley Cells dominate versus baroclinic eddies.
H_L	Sunrise or sunset (in radians) relative to local noon, such that $2H_L$ = the length of daylight (in radians)
i	square root of -1
i	(bold) unit vector pointing eastwards
I	irradiance (over all wavelengths)
I_A	irradiance from atmosphere in glass slab model
I_F	net vertical flux of radiant energy
I_G	irradiance from ground in radiative models
I_i	irradiance from layer i
I_{IN}	irradiance input into glass slab model
I_0	incident solar radiation at the TOA
I_S	annual and global average solar radiation spread over the Earth (=I_{Sol}/4)
I_{Sol}	solar constant (1356-1370 Wm^{-2}, 1365 generally used here)
I_sol	solar radiation at the TOA incident upon a latitude averaged over a day
I_Λ	irradiance (at wavelength Λ)
ISCCP	International Satellite Cloud Climatology Project
ICZ	intertropical convergence zone
K	kinetic energy
j	layer index
j	(bold) unit vector pointing northwards
k	(bold) unit vector pointing locally outwards (i.e. 'upwards')

Commented [RG3]: Reserve 'E' for radiance instead of 'e'

Commented [RG4]: This might be the same as Q_{Sol}

Commented [RG5]: Try I for irradiance instead of 'E'

k_a	mass extinction coefficient for absorber a
k_H	horizontal viscosity coefficient for second order friction
k_R	viscosity coefficient for Rayleigh friction
k_z	vertical viscosity coefficient for second order friction
k_β	transitional wavenumber for jets versus eddies
L	latent heat of vaporization, = 2.5×10^6 J kg^{-1} at 0 C.
LE	latent heat energy
LH	latent heating (from any phase change of water)
LHF	latent heat flux
LHS	left hand side (of an equation)
lw	longwave (radiation) (~5 to 200 μm wavelength)
lw_t	total longwave radiation from the Earth (atmosphere + surface contributions)
M	angular momentum per unit mass, $=R_c (R_c \Omega + u)$
$\dot{M}$	angular momentum, $=\rho R_c (R_c \Omega + u)$
MMC	zonal and time mean meridional cell(s)
MSE	moist static energy (per unit mass), $= C_pT+\Phi+Lq$
N	north
N^2	Brunt-Väisälä frequency (squared), $= \frac{g}{\theta_s}\left(\frac{\partial \theta_s}{\partial z}\right)$ in height coordinates for an ideal gas
NCEP	(U.S.) National Centers for Environmental Prediction
NDRA2	NCEP-DOE (AMIP-II) reanalysis datasets
NHem	Northern Hemisphere
NRC	Net radiative cooling
nr_t	TOA net radiation (sw_t – lw_t)
O_a	optical depth of absorber a
O_{ab}	optical depth of absorber a through whole depth of the atmosphere
OHF	oceanic heat flux
p	pressure
p_{oo}	reference pressure, typically set to 10^5 Pa
PDO	Pacific Decadal Oscillation
PGF	pressure gradient force
p_{sfc}	surface pressure
P_w	precipitation of any solid or liquid form of water
Q_E	potential vorticity in isentropic coordinates (see C.49)
Q_{QG}	quasi-geostrophic potential vorticity (see C.47)
Q_{QGy}	meridional gradient of quasi-geostrophic potential vorticity
Q_{SWE}	shallow water equations potential vorticity, $= \frac{\tilde{\zeta}_g + f}{\tilde{h}}$
QG	quasi-geostrophic
Q_{sol}	daily total solar insolation
q	specific humidity
$q_{sat}(T_G)$	saturation specific humidity for temperature T_G
q_{sfc}	specific humidity measured at surface instrument height
R	gas constant for dry air, = 287 J K^{-1} kg^{-1}
R_v	gas constant for water vapor, = 461 J K^{-1} kg^{-1}
R_c	$r \cos(\varphi)$

R_o	Rossby number, $=U/f_oL_s$, where U and L_s are speed and horizontal length scales.
r	mean radius of the solid earth, 6370 km
RCE	radiative convective equilibrium
RHS	right hand side (of an equation)
RMS	root mean square
S	south
S_a	enthalpy, $= C_p T$
S_o	entropy, $dS_o = C_p \, d\ln(\theta)$
S_R	Rossby wave source
SH	heating by sensible heat flux
SHem	Southern Hemisphere
SHF	sensible heat flux
SLHF	surface latent heat flux
SLP	sea level pressure
SPCZ	South Pacific convergence zone
SSHF	surface sensible heat flux
sw	shortwave (radiation) (~0.4 to 5 μm wavelength)
sw_a	shortwave radiation absorbed by the atmosphere
sw_s	shortwave radiation absorbed by the Earth's surface
sw_t	shortwave radiation absorbed by atmosphere and surface
SWE	shallow water equations
T	temperature
T_A	atmospheric temperature
T_G	surface temperature
T_{sa}	skin temperature of atmosphere (radiative models)
T_{sfc}	'surface' air temperature (at surface instrument height of 2m or 10m)
TE	total energy (per unit mass) = MSE+K
Th	thickness (between two isobaric surfaces)
THC	global, oceanic thermohaline circulation
TOA	top of atmosphere
t	time
U_{amc}	a zonal wind component conserving angular momentum
U_s	wind speed
u	zonal component of the wind
u_{ag}	zonal component of the ageostrophic wind, $= u - u_g$
u_g	zonal component of the geostrophic wind, $= -\frac{1}{f}\frac{\partial Z}{\partial y}$ in pressure coordinates
V	vector wind, 3 dimensional unless otherwise stated
$\mathbf{V_g}$	geostrophic wind vector, 2 dimensional
$\mathbf{V_{gm}}$	vertical (pressure) average geostrophic wind vector, 2 dimensional
v	meridional component of the wind
v_{ag}	meridional component of the ageostrophic wind, $= v - v_g$
v_g	meridional component of the geostrophic wind, $= \frac{1}{f}\frac{\partial Z}{\partial x}$ in pressure coordinates
$[v_R]$	meridional component of the zonal average residual circulation
w	vertical velocity in height coordinates

w_c, w_s	vertical velocity in cloudy, sinking regions (of tropics)
w_d	mixing ratio, equivalent to saturation mixing ratio at dewpoint temperature
WBC	western boundary current
X	distance
x	longitudinal distance (depends on coordinate system)
Z	geopotential height
z	elevation independent variable
z_a	length
α	specific volume, = $1/\rho$
α_v	specific volume for water vapor, = 1/e
β	meridional derivative of the Coriolis parameter
Γ	lapse rate (= $-\partial T/\partial z$)
Γ_d	dry adiabatic lapse rate (= g/C_p)
Γ_m	moist (or saturation) adiabatic lapse rate
δ	solar declination angle (Chap 3 homework)
ε_Λ	emissivity?
ε_f	efficiency factor?
ζ	vertical component of relative vorticity, = $\vec{k} \bullet \vec{\nabla} \times \vec{V} = \frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}$
ζ_a	vertical component of absolute vorticity, = $\zeta + f$
ζ_{ay}	meridional gradient of vertical component of absolute vorticity
$\vec{\zeta}$	three dimensional vorticity, $= \vec{\nabla} \times \vec{V}$
θ	potential temperature
θ_e	equivalent potential temperature
Λ	wavelength of electromagnetic radiation
λ	longitude or azimuth based on context
μ	$=\sin(\varphi)$
ρ	density
ρ_a	density of absorber
ρ_w	density of fresh water. = 10^3 kg/m^3
σ	Stefan-Boltzmann constant, = $(2\pi^5 c_B{}^4)/(15 c^2 c_h{}^3) = 5.67 \times 10^{-8}\, W\, m^{-2}\, K^{-4}$
τ	surface stress by wind
τ_λ	surface stress in zonal direction (=$\rho\, c_d\, \lvert V \rvert\, u$)
υ_Λ	electromagnetic frequency at wavelength Λ
Ω	angular rotation rate of the earth, 7.292 x 10^{-5} rad/sec
Ω, $\vec{\Omega}$	(bold or with arrow) angular rotation vector for the earth, = (0 **i**, $\Omega \cos(\varphi)$ **j**, $\Omega \sin(\varphi)$ **k**)
ω	(vertical) pressure velocity. $\omega = dP/dt$
ω_D	diabatic pressure velocity from vertical advection balancing diabatic processes
$[\omega_R]$	(vertical) pressure component of the zonal average residual circulation
Φ	geopotential, $d\Phi = g\, dz = -RT dp/p$ (for hydrostatic balance)
φ	latitude or zenith angle based on context
χ	velocity potential (in two dimensions)
Ψ or ψ	stream function (in two dimensions)

Commented [RG6]: What to do about absorptivity versus specific volume?

Commented [RG7]: Emissivity versus efficiency factor?