

## Index

### A

absolute vorticity 50, 51, 57, 151  
active radar 10  
active-break cycle 61, 135  
adiabatic heating 104, 106  
advection 57, 104, 106, 108, 151, 170, 211  
  cold air —— 106  
  horizontal —— 105, 108, 209  
  vertical —— 104, 108, 210  
  warm air —— 106  
air mass modification 162  
air-sea coupled wave 34, 60  
albedo effect 140  
Aleutian low 93, 157, 173, 174  
American monsoon 20, 130  
anomaly 11  
anvil 19, 196  
aphelion 180, 181, 183  
Arafura Sea 92  
Arctic oscillation (AO) 165  
atmospheric window 18  
Australian monsoon 143  
autonomous telemetering line acquisition system  
  (ATLAS) 6  
autumnal equinox 182

### B

Baiu 117, 118, 122  
baroclinic structure 91, 157  
barotropic 17, 45, 57, 91, 157  
barotropic instability 123  
Bay of Bengal 91  
 $\beta$ -plain approximation 207  
Bjerknes feedback 28, 34, 76, 141  
Bonin high 157, 160  
bulk method 65  
bulk transfer coefficient 65

### C

capacitor effect 80  
carbon cycle 2, 178  
Central Asia 102, 144, 146-148, 164, 198  
Changma 122  
Clausius-Clapeyron equation 191  
climatic precession 179, 184  
climatology v, vi, 1, 4, 172, 205  
cloud cluster 61  
cloud shielding effect 26, 65  
coastal Kelvin wave 51-53, 59  
coastal upwelling 23, 40, 41, 78  
cold air 72, 81, 93, 162  
cold air advection 106  
composite anomaly 25  
condensation heating 91, 94, 102, 104, 107, 110,  
  130, 172, 190  
continental monsoon 117  
convection jump 118, 122, 124, 138, 167  
COP 176  
Coriolis force 38, 39, 44, 51-55, 58, 67, 89-91, 93,  
  99, 207  
cumulus convection 19, 29, 105, 107-109, 111,  
  114-116, 130, 135, 192  
cut-off low 162

### D

Darwin 30-32  
deep ocean circulation 2  
delayed oscillator vi, 4, 34-37, 42, 47, 58-60, 78,  
  81, 84, 85, 143  
diabatic heating 21, 93, 101, 102, 104, 107, 130,  
  160, 198  
dispersion relationship 85  
diurnal variation 21, 192, 193, 195-198  
divergence 13-16, 19, 21, 28, 41, 42, 54, 78, 91,  
  194, 195, 198, 211  
divergent circulation 12, 15, 79, 89, 130

divergent wind 13-16, 74, 79

downwelling Rossby wave 35, 78, 79

drag coefficient 38, 40, 171

dry season 66, 117

dry static energy 109, 209

dynamical effect 94, 96

## E

Earth Summit 176

easterlies 27-30, 40, 68-70, 91, 92, 100, 123, 127

easterly jet 28, 91, 129

easterly wave 120, 135

eccentricity 179-181, 184

eddy heat flux 111, 174

eddy viscosity 38

Ekman dump 41, 58

Ekman flow 35, 38, 42

Ekman pumping 35, 41, 45

Ekman pumping velocity 42, 45

Ekman spiral 38

Ekman transport 26, 38-42, 44, 58, 70, 79, 209

El Niño 7, 23-25, 58-61, 71, 75, 80-83, 149

transition from —— to La Niña 84, 144

El Niño/southern oscillation ENSO 32

equation of motion 3, 7, 54

equation of state 3, 103, 133, 210

equatorial Kelvin wave 10, 24, 34, 51, 52, 55, 59,  
60, 79

equatorial monsoon 69, 71, 73, 80, 84

equatorial upwelling 40, 80, 84

equatorial wave 1, 6, 10, 34, 37, 47, 57, 93, 97, 99

equatorial wave guide 52

equivalent black body temperature ( $T_{\text{BB}}$ ) 20, 124,  
193, 196

Euler's formula 85

evaporative cooling 26, 36, 72, 75, 78, 82, 91, 171,  
172

explosive low 162

## F

feedback v, 1, 2, 26, 37, 63, 140, 169-171, 178

Bjerknes —— 28, 34, 76, 141

ice-albedo —— 186

ocean —— 127

wind-evaporation —— 36, 140

wind-evaporation-SST —— 68, 129, 144

first law of thermodynamics 3, 103

forced Rossby wave 149

free Rossby wave 3, 58, 59, 151

frequency 25, 56, 60, 85, 116, 132, 152-154

frontal monsoon 122

## G

geostationary satellite 21

geostrophic balance 53, 54

geostrophic wind 97, 98, 129

great circle 149, 150

greenhouse gas 165, 176-178

group velocity 154

## H

Hadley circulation 101, 159, 172

Halley 89, 93

heat storage anomaly 53

heating 90, 93, 96-101, 103

adiabatic —— 21, 104, 106

condensation —— 91, 94, 104, 107, 130, 190

diabatic —— 93, 101, 104, 107, 130, 160, 198

latent —— 104

sensible —— 91, 104, 108, 114, 116, 130, 131

heat source 3, 4

heavy snowfall 162

Helmholtz's theorem 57

horizontal advection 106, 108, 209, 210

horizontal wind shear 35, 42

horseshoe shape 34

hydrostatic equilibrium 8, 9

hypsithermal 186

## I

ice core 177

ice sheet 2, 178, 186, 191

ice-albedo feedback 186

Indian monsoon 30, 84, 140-143, 160

Indian Ocean basin-wide warming 80  
 Indian Ocean dipole mode 69, 204  
 insolation 179-181, 184-186, 199  
 Intergovernmental Panel on Climate Change (IPCC) 165, 172, 175, 176, 199, 205  
 internal energy 103  
 international date line 25, 91, 157  
 intraseasonal oscillation 60  
 intraseasonal variation (ISV) 61  
 inversion layer 114  
 isotherm 7, 49, 169

**K**

Kelvin wave 3, 34, 51-57, 76, 84, 97-100, 153  
 coastal —— 51-53, 59  
 equatorial —— 10, 24, 34, 51, 55, 59, 79  
 Keplerian orbital elements 179  
 Köppen climate classification 100, 116  
 Kuroshio 3, 49, 66

**L**

La Niña 10, 29, 34, 48, 60, 81, 141, 144, 147, 165  
 transition from El Niño to —— 60, 83  
 land breeze 193  
 land-sea breeze 89, 93, 193  
 land-sea configuration 93  
 Laplacian 14  
 last glacial maximum (LGM) 186, 188, 191  
 latent heat flux 64-66  
 latent heating 104  
 Laurentide ice sheet 188, 191  
 law of conservation of mass 3  
 law of conservation of water vapor 4, 103, 110, 112, 115  
 linearization 156  
 long-wave radiation 18-20  
 low frequency 60

**M**

Madden and Julian oscillation (MJO) 61, 63  
 main thermocline 5-7  
 maritime continent 19, 27, 30, 32, 74, 78, 92, 146,

193  
 Matsuno-Gill pattern 3, 97, 99  
 mausim 89  
 mechanical mixing 5  
 Meiyu 170, 171  
 meridional temperature gradient (MTG) 134  
 mesoscale convective system (MCS) 196  
 meteorological radar 124  
 Mexican monsoon 20, 160  
 mid-Holocene 170, 186, 191  
 Mid-Pacific trough 15, 91, 157  
 Milankovitch cycle 178

Milankovitch forcing 178

mirror image 93  
 moist static energy 111  
 monsoon v, 2, 89-91  
 American —— 20, 130  
 Australian —— 143  
 continental —— 117, 122  
 ENSO- —— study 81, 138, 141, 144  
 equatorial —— 69, 71, 73, 76, 80, 84  
 frontal —— 122  
 Indian —— 30, 84, 141-143  
 Mexican —— 20, 160  
 ocean —— 122  
 planetary-scale —— 120  
 South East Asian —— 117  
 western North Pacific —— 107, 117, 146,  
 160, 167, 171, 172  
 winter —— 72, 73, 93, 164, 172-175

monsoon circulation 17, 26, 28, 91-94, 103, 108,  
 190

monsoon trough 100, 157

monsoon-desert mechanism 102

**N**

Nobel Peace Prize 176, 205  
 North Atlantic oscillation (NAO) 165

**O**

ocean feedback 127  
 ocean monsoon 122

Okhotsk high 162, 169  
 onset 117, 119, 125, 128-131, 135, 168  
 outgoing long-wave radiation (OLR) 18-21, 25,  
 63, 67, 107, 117, 125, 146, 161, 164

**P**

Pacific high 17, 45, 69, 91, 127, 151, 157, 159,  
 160, 169  
 Pacific North American (PNA) pattern 33, 150  
 Paleoclimate Modelling Intercomparison Project  
 (PMIP) 178, 186  
 perihelion 180  
 phase velocity 53, 56, 99, 153, 156, 197  
 phytoplankton 23  
 pile up 28  
 planetary vorticity 46, 50, 57, 133, 151  
 planetary wave 160  
 planetary-scale monsoon 120  
 Poisson equation 14  
 pollen analysis 186  
 positive feedback 28, 67, 68, 79, 140, 170, 198  
 precession 179, 181-184  
 climatic —— 179, 184, 185  
 pressure gradient force 51-54, 59  
 prevailing wind 70, 89, 93, 116, 117  
 primitive equation 101  
 proxy data 178, 186, 188, 190

**Q**

$Q_1, Q_2$  method 4, 113, 116  
 quasi-biennial oscillation (QBO) 60

**R**

radiative cooling 65, 195, 198  
 Rayleigh friction 98  
 recharge-discharge oscillator 3, 34, 37, 42, 47, 48,  
 85  
 regional climate model 174, 175  
 release of latent heat 96  
 remote forcing 69  
 restoring force 6, 35, 52, 59  
 ridge 143

Rossby radius of deformation 53, 54  
 Rossby wave 35-37, 42, 57, 69, 77, 97, 99-101,  
 144, 146, 149, 151, 153, 165  
 downwelling —— 35, 78, 79  
 forced —— 149  
 free —— 3, 58, 59, 151  
 symmetric —— 63, 97-99  
 rotational circulation 12  
 rotational wind 13, 18

**S**

salinity 5, 6  
 sea surface height 6, 10-12, 28, 54, 58, 65, 77  
 seasonal forecast 80  
 seasonal mixed layer 5  
 seasonal thermocline 5  
 seasonal wind 66, 89, 93, 162, 174, 193  
 semi-arid region 101  
 sensible heat 64-66, 91, 96, 104, 108, 111, 112,  
 114, 116, 130, 131  
 sensible heat flux 64-66, 111, 116  
 sensible heating 91, 104, 108, 114, 116, 130, 131  
 shallow water equation 3, 42, 54, 85, 97, 156  
 shortwave radiation 64, 140  
 Siberian high 93, 107, 162, 174  
 Silkroad pattern 161  
 singularity 132, 135  
 Somali jet 72, 74, 96  
 South East Asian monsoon (SEAM) 117-119  
 South Pacific convergence zone (SPCZ) 15, 19,  
 92, 107  
 southern oscillation (SO) 30, 32, 182, 183  
 southern oscillation index (SOI) 32, 33  
 specific humidity 65, 103-105, 108, 210  
 static stability 192  
 stationary Rossby wave 4, 132, 134, 146, 151,  
 153-155, 161, 164  
 Stefan-Boltzmann law 18  
 stream function 12-14, 17, 147, 152, 157-159  
 structure function 56  
 summer solstice 182-186  
 super cluster 61

Sverdrup balance 3  
 Sverdrup relation 47, 208  
 Sverdrup transport 3, 34, 37, 45-51, 85, 209  
 symmetric Rossby wave 97-99

**T**

Tahiti 30-32  
 Taylor-Proudman theorem 45  
 teleconnection pattern 4, 33, 149, 161  
 temperature lapse rate 19, 21, 93  
 terrestrial radiation 18  
 the first transition 119, 127, 167  
 the Gulf stream 66  
 thermal convection 5  
 thermal expansion 9, 10, 52  
 thermal wind 129  
 thermodynamic equation 4, 103, 111, 115, 198, 209  
 thermostat hypothesis 26  
 thickness 133, 166  
 Tibetan high 17, 91, 157, 198  
 time-slice experiment 178  
 TOPEX/POSEIDON 10  
 trade wind → easterlies  
 trapped wave 52, 97  
 Tropic of Cancer 180  
 Tropic of Capricorn 180  
 tropical easterly jet 28, 91  
 Tropical Ocean and Global Atmosphere (TOGA) 124  
 tropical rainfall measuring mission (TRMM) 21, 126, 195-197  
 tropospheric biennial oscillation (TBO) 140, 142, 143  
 turbulent mixing 26, 36, 91, 125, 128  
 typhoon 120

**U**

upwelling 29, 37, 38, 41, 44, 59, 78-80

**V**

velocity potential 12-16, 19

vernal equinox 181-184  
 vertical advection 104, 108, 210  
 vertical eddy heat transport 107-109, 198  
 vertical velocity 7, 47, 69, 98, 104, 151, 152  
 vorticity 13, 14, 18, 21, 45, 48-51, 57-59, 97, 131, 149  
 absolute ——— 50, 57, 151  
 planetary ——— 46, 50, 57, 151  
 vorticity conservation law 3, 50  
 vorticity equation 151  
 vorticity forcing 46

**W**

Walker circulation 28, 30, 32, 74-76, 141-143  
 warm air advection 106  
 warm pool 24, 28, 29, 67, 91  
 water vapor flux 135, 166, 210  
 water vapor transport 131, 166, 169, 171, 211  
 wave guide 51  
 equatorial ——— 52  
 wave source 132  
 wave train 33, 161  
 westerly jet 28, 129, 174  
 Western Atlantic pattern 150  
 western boundary current 3, 49  
 western North Pacific monsoon (WNPM) 107, 117-121, 138, 146, 160, 167, 171  
 western Pacific oscillator 34, 36, 37  
 Western Pacific pattern 150  
 wind stress 3, 5, 26, 37-40, 43, 45, 47-49, 67  
 wind-driven circulation 38  
 wind-evaporation feedback 36, 37, 140  
 winter monsoon 72, 81, 93, 134, 164, 172-175, 192  
 winter solstice 182-184, 186  
 Wyrtki jet 41, 72, 75, 78