

Index

- absolute vorticity 99
- active layer 200
- adaptation 201, 202
- adiabatic 78
- aerosol effects 19–20
- aerosol optical depth 20
- aerosols 19
- African Easterly Jet stream (AEJ) 152
- agriculture and climate 212–14
- air masses 59
- air–sea interaction 135–8
- aircraft operations 219
- airflow types over the British Isles 119
- albedo 18
- albedo values for natural surfaces 19
- Alert 167
- Altiplano 155–7
- Amazon River basin 157–9
- anabatic winds 76
- anemometer 50
- angular momentum 92–3
- Angström, A. 105
- Antarctic Circumpolar Current (ACC) 134
- Antarctic ice sheet 168
- Antarctica 169
- Anthropocene 186–91
- applied climatology 206–22
- Arctic frontal zone 61–2
- Arctic haze 45
- Arctic Ocean, 132–4; ice-free 200
- Arctic sea ice extent 187
- Argo floats 129
- arithmetic mean 4
- Arrhenius, Svante 187, 188
- Asian brown cloud 45
- astronomical variations 181
- Atlantic Meridional Overturning Circulation (AMOC) 128
- Atlantic Multidecadal Oscillation (AMO) 111, 160
- atmospheric chemistry 22–3
- atmospheric pressure (see pressure)
- atmospheric structure 16
- axial tilt (obliquity of the ecliptic) 179, 180
- baroclinic zones 62
- barotropic 62
- basal metabolic rate 87
- Baur, Franz 122
- Bergen 164
- Bergeron, Tor 35, 59
- Berlin 163
- Bjerknes, J. 105
- black body 16
- blocking pattern 99
- blowing sand 45
- blowing snow 45
- Bolivian high 155
- bora 78
- Boreal Ecosystem-Atmosphere Study (BOREAS) 167
- boreal forest 165–7
- Bowen ratio 25
- Brezowsky, H. 122
- Budyko, M.I. 44
- Callendar, George S. 187, 188
- carbon dioxide 22; concentrations 187; removal 203; sequestration 203
- Cenozoic era 175–6
- Central England Temperatures (CET) 187
- Chaco low 154
- chemical proxies 176
- China, southeast 161
- China monsoon 152
- chinook 78
- chlorofluorocarbons (CFCs) 3
- Christchurch 163
- circulation modes 103–14
- cities, moisture effects 84–5
- classifying climate 146
- climate 2
- climate – elements 14; why it matters 3–4
- climate change 173; effects on water resources 215–16
- climate classification 8–9, 41
- climate effects on transportation 219–20
- Climate Extremes Index (CEI) 207
- climate forecasts 221–2
- climate of land areas 138
- climate sensitivity 196
- climate services 221, 222
- climate statistics 4–6
- climate variability 173
- climatic aspects of vegetation and soils 209–12
- climatic extremes 207–8, 209
- climatic types on land 145–69
- climatology 7
- clothing insulation 87
- cloud cover 32
- cloud effects 18
- cloud formation 32
- cloud liquid water content 31
- clouds 31–2
- coastal desert 147
- coefficient of variation 4
- cold front 66
- cold island 84
- cold spells 191
- conceptual models of the general circulation 95
- conduction 25
- Congo River basin 159–60
- conservation of angular momentum 93
- conservation of potential vorticity 98
- continental drift 173
- continental Polar air 59
- continental synoptic classifications 122
- continental Tropical air 59, 213
- continentality 141
- Coriolis force 53
- Coupled Model Intercomparison Project (CMIP) 196
- crop growth 212
- crops – suitable conditions 213
- cut-off low 100
- cyclone tracks 70
- daily maximum urban heat island intensities 83
- Dansgaard-Oeschger oscillations 182
- dating the past 184

- day-length 138
 deaths from heat and cold 88
 Defant, A. 94
 degree-day index 27
 dendrochronology 178
 dendroclimatology 178
 derecho 72
 desertification 149
 deserts 146–9
 dew 85
 dew point temperature 29
 disasters 220–1
 distance from the ocean 141
 disturbance lines 153
 diurnal character of tropical rainfall 159
 diurnal range of temperature 27
 dry adiabatic lapse rate 56, 78
 drought 208–9; drought areas 42–4, 191
 Dust Bowl 166
 dust devils 148
 dust storm 148
 Dzerdzevski, B.L. 123
- earliest meteorological network 7
 Earth's axis 15
 Earth's energy balance 92
 Earth's orbit 179
 East Antarctica, land ice 175
 East Asia–West Pacific monsoon 161
 East Greenland Current 131
 easterly waves 137
 eccentricity of Earth's orbit 180
 economic and socio-political issues 202–4
 eddy correlation 41
 Eemian interglacial 181
 elementary circulation mechanisms 123
 elements of climate 14
 El Niño 106–8
 Empirical Orthogonal Functions 117
 energy 15–25
 energy balance; of Earth 92; of a human, 86–7
 ENSO outlook 222
 environmental lapse rate 29
 European Project for Ice Coring in Antarctica (EPICA) 181
 evaporation 40–2
 evaporation pans 41
 evapotranspiration 41
 extratropical cyclones 64
- Fenno-Scandinavian ice sheet 184
 Ferrel, William 94
 Ferrel cells 94
 Flohn, Herman 189
 flooding, in Colorado 153; the Indus basin 208; the Mississippi River 208
 foehn 78
 fog 45
 fog drip 36
 forest climate 79–80
 Forks, WA 164
 Franklin, Benjamin 130
 freeze events in Florida 209
 frequency distribution 5
 frequency of circulation patterns 189
 frequency of extreme warm events 201
 frequency of hot days 191
 frontal zones 61–3
 frostbite 87
 future climate 194–204
- general circulation, 91–101; factors 125
 general circulation models (GCMs) 125
 geoengineering 203
 geological timeline 173–5
 geomorphological methods 178
 geopotential height 49
 geostrophic wind 52
 Girs, A.A. 122
 glacial cycles 154–7, 176
 glacial Lake Agassiz 183
 global brightening 190
 global climate models 195–6
 global conveyor belt 128
 global dimming 190
 global monsoons 154
 global warming 201; history of research 188
 Gobi 147
 gradient wind 53
 Great Lakes, effects 80
 greenhouse effect 187
 greenhouse gases, 21, 22, 183; history of research on 188
 Greenland 168
 Greenland ice sheet 168
 Grosswetterlagen 122
 ground-based remote sensing 12
 ground water 217
 growth rings in trees and corals 177
- Gulf Stream 130–1
 gusts 51
- Hadley, George 94, 95
 Hadley cell 94
 hail 36–8
 Halley, Edmond 95
 harmattan 149
 haze 45
 health hazards 88
 heat capacity 27; of water 135
 heat fluxes 23
 heat index 29, 88
 heat island intensity 83
 heat low 149
 heat stress in cattle 213
 heat wave 29, 207–8; in Europe, 207; in Russia 207
 heavy precipitation events 191
 hemispheric synoptic classifications 122–3
 Hess, P. 122
 high altitude 88, 150
 high plateaus 154–7, 176
 high pressure cell over northeast Siberia 48
 Himalaya 149
 history of world climatology 6–9
 hoar frost 85
 Holocene, 184; “optimum” 184
 horizontal moisture flux 57–9
 Hotan 147
 hot days, frequency 191
 human bioclimatology 86–8
 humid subtropical climate 160–1
 Humboldt Current 134
 Hurricane Sandy 194, 221
 hurricanes 138
 hydrological cycle 214–15
 hydrostatic equilibrium 49
 hyperthermal (heat) stress 86
 hypothermal (cold) stress 86
 hypothermia 87
 hypoxia 88
 Hypsithermal 184
- ice-albedo feedback 188
 ice-free Arctic Ocean 200
 ice plateaus 168–9
 ice roads 219
 impacts 199–201

- incoming solar radiation 18, 183
 infrared radiation 21–3
 instability lines 158
 insurance and climate disasters 220–1
 interception of rainfall 79
 interglacials 183
 Intergovernmental Panel on Climate Change (IPCC), 187; Fifth Assessment Report 205; Fourth Assessment Report 197
 Inter-Ocean Convergence Zone (IOCZ) 159
 Intertropical Convergence Zone (ITCZ) 36, 63
 Inversion 29, 169
- jet stream, 54–5; low-level, 55; polar front jet stream 54; subtropical jet stream 54; tropical easterly jet stream 55
- Juliaca 156
- Karaganda 165
 katabatic winds 76
 Keeling, C.D 188
 Kelvin scale 16
 Kinshasa 159
 Köppen, Vladimir 8–9
 Kuroshio 132
 Kyoto Protocol 202
- Labrador Current 131
 La Niña 106–8
 Lake Baikal 80
 lake climate 80–1
 lake effect snow 80
 Lake Titicaca 157
 Lake Victoria 80
 Lamb, Hubert 117, 118
 Lamb's "weather types" – characteristics 119
 land breeze 76
 Landsberg, Helmut 82
 land and sea effects 127–42
 large-scale shelter 75
 Last Glacial Maximum 181
 latent heat 25
 latitude, effects on incoming solar radiation 138
 Laurentide ice sheet 181, 184
 Lhasa 155
 lidar 12
- lightning 32–3
 Lincoln 165
 Little Ice Age (LIA) 185
 local climate 75–8
 local winds 76
 London's climate 81
 Los Angeles 162
 low-level jet 55
 lysimeter 41
- Madden-Julian Oscillation 112–14
 major crops – suitable conditions 213
 Manaus 157
 Manley, Gordon 189
 Marine Isotope Stages (MIS) 183
 marine stratocumulus 137
 maritime Polar air 59
 maritime Tropical air 59
 maritime west coasts 164
 Medieval Warm Period 185
 Mediterranean climates 161–2
 mega-droughts 185
 mercury barometer 48
 meridional cells 94
 meridional southerly components 51
 mesoscale convective systems 71–2
 methane 22, 201
 Mexican monsoon 153
 microclimate 85–6
 mid-Cretaceous period 175
 mid-latitude steppe and prairie 165–6
 Milanković, Milutin 181
 milibar 48
 Miocene Climatic Optimum 176
 Mitchell, Murray 189
 mitigation 202–3
 moisture 29–46
 monsoon depressions 150
 monsoons 149–54
 Montreal Protocol 3
 mountain sickness 88
 mountain wind 77
 Mt. Rainier snowfall 164
 multicell clusters 71
- Namias, Jerome 48, 136
 Namib Desert 147
 natural climate variability 190
 net radiation 23
 Normalized Difference Vegetation Index (NDVI) 209
- normal distribution 5
 normals 2
 North American monsoon 153
 North Atlantic Oscillation 109
 North Pacific Oscillation 110
 Northern Annular Mode 109
 Northern Australia 153
 Northern Eurasian Earth Science Partnership Initiative (NEESPI) 167
 Northern Hemisphere currents 129–32
- obliquity (axial tilt) 179, 180
 occluded front 66
 occlusion 66
 oceans 128–35
 ocean characteristics 128–9
 orbital eccentricity 179
 optical depth 20
 oxygen isotope record 176
 ozone, 22; hole 3, 22
- Pacific Decadal Oscillation 111
 Pacific/North America (PNA) pattern 108
 Palmén, Erik 96
 Palmer Drought Severity Index (PDSI) 43, 213
 Pampas grassland 161
 Panama seaway 176
 Pascal 48
 past climates 172–91
 permafrost, 166, 168, 200–1; degradation 219
 Permo-Carboniferous period 175
 planetary waves 98
 plant hardiness zones 201
 plate tectonics 173
 polar amplification 190–1
 polar deserts 147
 polar front 61
 polar front jet stream 54
 polar low 136
 polar vortex 97
 poleward energy transport 92
 pollen 177
 pollutants, in urban areas 82
 pollution 82–2
 polynya 133
 positive feedback 188
 precession of the spring equinox 179

- precipitable water content 30–1
 precipitation 34–9
 precipitation efficiency 42–2
 precipitation gauge 35
 present weather 67
 pressure 48–50
 projected changes 196–9
 Proterozoic 173
 proxy records 176
 pyranometer 18
- Quaternary Period 176–86
- radiation 16
 radiational index of dryness 44
 radiative cooling 75
 radiative forcing 189–90
 raindrops 34–5
 rainfall, 35; intensity 35
 rain shadow 141
 range 4
 RAWINSONDE 151
 reanalysis 118
 regional classifications of synoptic
 circulation types 117–22
 relative angular momentum 93
 relative humidity 30
 renewable energy 217–19
 return period 214
 Riehl, Herbert 137
 Representative Concentration Pathways
 (RCPs) 197, 205
 Roaring Forties 135
 Rome 161
 Rossby, C-G 95, 99
- Sahara 147, 149
 Sahel 160; shift of rainfall regime 208
 Sargasso Sea 132
 saturated adiabatic lapse rate 56, 78
 saturation vapor pressure 30
 scenarios, used in the Fourth
 Assessment Report of the IPCC 197
 scirocco 149
 sea ice 132
 sea and land breezes 76, 134
 seacoast zones of convergence or
 divergence 76
 seasonal outlooks 222
 seasons 15–17
 sea-level rise 199–200
- secondary air mass 59
 seeder-feeder mechanism 35
 self-organizing maps (SOMs) 120
 semi-annual oscillations 110
 sequestration of carbon dioxide 203
 sensible heat 24
 shift of plant species 201
 slope orientation and angle 75
 snow accumulation, in a forest 79
 snow cover 38–9; effects on climate 142
 Snowball Earth 173
 snowfall 35
 sodar 12
 soil 209–10; classification 210–12;
 moisture 210; pH 210; temperature
 210; type 85–6; soil type global
 distribution 212
 solar constant 15
 solar cycle 186
 solar energy 217
 solar radiation 15–21; management 203
 South American monsoon 153
 South Asian monsoon 149–50
 South Atlantic convergence zone
 (SACZ) 136, 159
 South Pacific convergence zone
 (SPCZ) 136
 South Pole station 169
 Southern Annular Mode 110
 Southern Hemisphere currents 134
 Southern Hemisphere three wave
 pattern 112
 Southern Ocean 134–5
 Southern Oscillation 104–6
 Spatial Synoptic Classification (SSC)
 120–2
 specific humidity 30
 speleothems 177
 spring snowmelt 200
 squall line 71
 squalls 51
 standard atmosphere 50
 standard deviation 4
 Starr, V. P. 94
 stationary longwaves 96
 stationary planetary waves 96
 Stevenson screen (weather shelter)
 27, 85
 storm frequency 57–9
 storm tracks 199
 stratosphere 16
- sublimation 80, 142
 subtropical anticyclone 48
 subtropical jet stream 54
 Summit station 168
 sunshine duration 18
 sunshine recorder 18
 sunspots 15
 supercell storms 71
 surface boundary layer 85
 surface energy balance 25
 surface receipt of solar radiation 20–1
 surface roughness 141
 surface skin temperature 86
 synoptic circulation types 117–22
 synoptic climatology, 116–25; modern
 applications, 125
 synoptic weather map 67
- taiga 165–7
 Taklamakan 147
 Tamanrasset 147
 Teleconnections 105; patterns, 125
 temperate lowlands 162–3
 temperature 25–9
 temperature lapse rate 27
 terrestrial boreholes 177
 thermal belt 76
 thermal wind relationship 53
 thickness 53
 thickness lows 66
 “Third Pole” 155
 Thornthwaite, C.W. 41
 thunderstorms 71
 Tibet (Qinghai-Xizang) plateau 154–5
 topoclimate 75
 tornadoes 160
 total freshwater reserves 214
 trace gases 22
 trade winds 51
 transient eddies 96
 Transpolar Drift Stream 132
 trend in ice area 133
 tropical cyclones, 70–1, 138, 161
 Tropical Easterly Jet stream 55
 tropical Pacific, warm and cold
 events 108
 tropical and subtropical steppe 160
 troposphere 16
 tropospheric rivers 57–8
 tundra 167–8
 typhoons 138

- United States, central 120; southeast 160
 urban climate, 81–5; moisture effects
 84–5
 urban heat island 82–4
- valley wind 77
 Vangengeim, G. Ya. 122
 Vangengeim–Girs classification 122–3
 vapor content 29
 vapor pressure 30
 vasoconstriction 86
 vasodilation 86
 vegetation cover effect on climate 141
 vertical air motion 56
 visibility 45
 volcanic eruptions 186
 vorticity 98; absolute 99; relative,
 98; conservation of potential, 98
 Vostok station, 169; ice core record 188
- Walker circulation 100
 Walker, Sir Gilbert 100, 103
 warm and cold events in the tropical
 Pacific 108
 warm conveyor belt 66
 warm front 66
 water balance 42
 water resources 214–17; effects of
 climate change 215–16
 water vapor 30
 weather 2, 3
 weather analysis 68
 weather radar 12
 weather satellites 11–12
 Wegener, A. 173
 West Africa monsoon 152–3
 westerlies 51, 93, 96–9
 Westerly Wind Bursts (WWBs) 106
 wet lowlands 157–60
- White, R. M. 94
 why climate matters 3–4
 why is the sky blue? 18
 Wien's Law 16
 wind chill index 29, 87
 wind power 217–18
 wind rose 51
 wind speeds inside a
 forest 79
 wind velocity 50
 winds 50–6
- Yakutsk 166
 Younger Dryas 183
- zonal circulations 100–1
 zonal westerly components 51
 zonal wind belts 96–100
 zonal winds 94