Cambridge University Press 978-0-521-84086-6 - Human Impacts on Weather and Climate, Second Edition William R. Cotton and Roger A. Pielke Index More information

# Index

ABLE see Amazon Boundary Layer Experiment ABRACOS see Anglo-Brazilian Amazonian Climate Observation Study abrupt climate change 240-241, 245-256 absorption and scattering by aerosols 158-159 by clouds 159-160 by gases 156-158 absorption bands defined 156 discussed 156-160 aerosols anthropogenic, discussed 187-202 effect on clouds discussed 75-82 illustrated 77, 80-81 formation mechanisms 188 impact on absorption 190 on albedo 190 on clouds 192 on conductivity of air 188-189 regional radiative influences 86 as source of CCN see cloud condensation nuclei afforestration, defined 230 aggregates, defined 58 as hailstone embryos 58 aircraft contrails, discussed 82-85 albedo change of global surface albedo over time 240 of cities 94 of deserts 131-132 effect of clouds, discussed 192-198 Amazon Boundary Layer Experiment, discussed 137 Anglo-Brazilian Amazonian Climate Observation Study, discussed 137 atmosphere-vegetation interactions 237-240 atmospheric radiation, basic concepts discussed 155-160 atmospheric window, defined 156

Bergeron-Findeisen process discussed 10 illustrated 11 biogenic ice nuclei, as contamiant of cloud seeding experiements 71 biogeochemical forcing, defined 238-239 biogeographic forcing, defined 239 biophysical forcing, defined 238 blackbody radiation, defined 155 "black rains" 209 boundary-layer effects 108-111 bounded weak echo region defined 47 illustrated 48-49 Bowen ratio, defined 103 BWER see bounded weak echo region CAPE see convective available potential energy capricious administration of science and technology 247-248 carbon-14, discussed 162 carbon dioxide, impact on global climate 157, 160 Carnot engine, as a model of tropical cyclone engine 64 CCN see cloud condensation nuclei CFCs see chlorofluorocarbons chain reaction theory, defined 7 chlorofluorocarbons, defined 158 climate feedbacks 174-181 climate forcing, defined 153 climate system defined 153 illustrated 154 cloud condensation nuclei anthropogenic sources 75-82 associated with nuclear winter hypothesis 208-209 defined 11 effect on clouds, discussed 10-12, 75-82, 87-89, 136-142 effect on seeding 11 impact on climate 192 influence on urban areas 90-92 as mechanism for smoke removal 208-209

Cambridge University Press 978-0-521-84086-6 - Human Impacts on Weather and Climate, Second Edition William R. Cotton and Roger A. Pielke Index

More information

# 306

## Index

cloud condensation nuclei - cont. natural cloud droplet sources 10 urban sources 75 cloud feedbacks to global climate, discussed 176-179 cloud seeding development of concept 3-6 definition of static and dynamic seeding 9 visual evidence of 7 collision-coalescence discussed 33-35 illustrated 11 comets, effect on climate 165 computer models of clouds, discussed 24-25 contrails, modification of cloud cover 82-85 convective available potential energy, discussed 43 CRYSTAL-FACE (Cirrus Regional Study of Tropical Anvils and Cirrus Layers-Florida Area Cumulus Experiment), described 88 cumulus congestus, defined 22 deforestation, discussed 135-138 Africa 137, 142 Amazon 135, 141 influence on global climate 221 desert dust regional impacts 87-89 global impacts 202 desertification 131-135 impact on global climate 131-133 impact on regional climate 220-221 Middle East 133-135 North Africa 132, 240-241 Western Australia 132-133 dimethylsulfide, as source of CCN 195 direct climate forcing, defined 153 DMS see dimethylsulfide dry static energy 106 dryland agriculture, effect on climate 131 dynamic mode of cloud seeding application to rainfall enhancement 20 application to hurricanes 65 defined 18 discussed 18-26 Earth orbital parameter, discussed 163-164 embryo competition 58 embryo curtain, defined 53 energy budget of Earth's surface, discussed 102

embryo curtain, defined 53 energy budget of Earth's surface, discussed 102 entrainment, illustrated 25 evaporation, defined 102–103 evaporative fraction, defined 103 evapotranspiration, defined 103

federal spending on weather modification discussed 67–71 illustrated 68 feeder cells, defined 56 firestorms, defined 208 free convection, level of, defined 19

giant cloud condensation nuclei defined 76 effects on global climate 194 effects on precipitation 76-77, 88-89 glaciated cloud, defined 37 glaciation dynamic seeding 27 hail suppression 57 mechanism in an urban area 92-93 glaciers, effect on global climate 166 global assessments of land-use/land cover effect on weather and climate 224-232 Table 231 Global energy balance and the greenhouse effect 160-161 illustrated 161 global warming potential, defined 232 graupel, defined 49 greenhouse effect defined 160-161 radiative effects of H2O and CO2 166-176 greenhouse theory 157 basic concepts 157-158, 160-161 cloud feedbacks 176-179 ocean feedbacks 180-181 surface albedo feedbacks 179-180 vegetation feedbacks, 179-180 water vapor feedbacks 174-176 GWP see global warming potential hail formation, discussed 41-50 hail suppression discussed 56-63 embryo competition concept 58-59 glaciation concent 57-58 liquid water depletion by salt seeding 59-60 Soviet hail suppression scheme 56-57 hailstone trajectories, illustrated 55 hailswath, discussed 40 Hallett-Mossop rime-splinter processes 13 hard scientific evidence, should society wait for 250-251 haze defined 86 regional impacts 86 HIPLEX-1 experiment 15 hot towers, defined 224 hurricanes, discussed 63-65 hygroscopic seeding, discussed 36-40 ice albedo, defined 179 ice crystals, rimed defined 12 illustrated 12 ice fog, defined 87 ice nuclei anthropogenic sources 85-86

defined 19 dust 88-89

effect on clouds discussed 12-14, 85-86

Cambridge University Press 978-0-521-84086-6 - Human Impacts on Weather and Climate, Second Edition William R. Cotton and Roger A. Pielke Index

More information

formed by seeding 4 influence of an urban area 90-91 Indian Ocean Experiment (INDEX) 86 indirect climate forcings, summarized 183-184 Intergovernmental Panel on Climate Change (IPCC), discussion on climate forcings 181-185 IPCC see Intergovernmental Panel on Climate Change iris effect, defined 177 irrigation, effect on climate 118-131 Colorado 118-121 influence of regional climate 118-120 Nebraska 121-131 Israeli experiments 17-18 LAI see leaf area index Land Ecosystem-Atmosphere Feedback Model Version 2 126 landscape effects 102-118 global impacts 220-240 land-use/land-cover changes 102-149, 220-242 boundary-layer effects 108-111 defined 102 deforestation 135-138 desertification 131-135 global impacts 220-240 historical 221-223 influence of irrigation 118-131 local wind circulations 111–112 mesoscale and regional perspective 112-118 quantify effect on global climate 232-237 regional impacts 102-117 assessment of, table 144-147 surface 102-108 Langmuir seeding hypothesis 4-5 latent heat of fusion, value of 18 of sublimation, value of 18 transfer, defined 83 in urban surface 95 of vaporization, value of 18 LCL see lifting condensation level LEAF-2 see Land Ecosystem-Atmosphere Feedback Model Version 2 leaf area index 225 lifting condensation level 19 lightning, global distribution of 224 liquid water path, defined 159 local wind circulation 111-112 longwave radiation, defined 155 merger of clouds, discussed 27 mesiscape, defined 101 mesoscale and regional landscape effects 112 methane as a greenhouse gas 158 METROMEX, discussed 90-97

National Hail Research Experiment, discussed 41 National Research Council, climate forcing 182–185

Milankovitch theory, discussed 163-164

moisture budget surface, defined 100

moist enthalpy, defined 106

#### Index

307

natural variability, importance and underappreciation of 243-244 natural variations in aerosols and dust 165 net radiation, defined 102 NHRE see National Hail Research Experiment non-radiative forcing 153 nuclear fall, defined 215 nuclear winter acute phase 213-216 biological effects 216-218 chronic phase 216 defined 203 global responses 213-216 hypothesis chain 205 mesoscale responses 210-213 nucleation, defined 4 nucleation scavenging, defined 208 ocean feedbacks, discussed 180-181 orbital parameters of Earth 161-165 illustrated 164 overseeding defined 14 inadvertent 85 overselling of science, discussed 244-247 paper pulp mills, effect on CCN and precipitation 76 politics and science 251-252 pollution tracks, defined 195 population growth, global 250 potential temperature, defined 104 precipitation efficiency 209 prediction, classes of defined 184-185 illustrated 185 Project Cirrus 6-8 radiative effects of carbon dioxide and water vapor, relative 166-174 radiative forcing, defined 153 IPCC view, illustrated 182 NRC view, illustrated 154 rainout, early 59 RCCP see regional climate change potential refineries as urban moisture sources 97 regional climate change potential, defined 234 Saharan dust layer regional impacts 87-89 salt seeding, described 36-40 scientific credibility and advocacy 248-250 sea ice feedbacks to climate, discussed 179 secondary ice particle production defined 13 discussed 12-14 illustrated 13 seedability defined 25 dynamic seedability 25 illustrated 26 static seedability 10 seeder-feeder precipitation process, discussed 84 sensible heat transfer

# 308

### Index

defined 83 of urban surface 95, 99 ship track trails effect on CCN and albedo, discussed 195 evidence of impacts of anthropogenic CCN 77-80 relationship to CCN-albedo hypothesis 195 shortwave radiation absorption 156 absorption and scattering by aerosols 158-159 by clouds 159-160 defined 155 illustrated 155 smoke production by nuclear bombs 206-207 smokeosphere, defined 216 solar climate forcing 161-165 solar luminosity, discussed 161-165 solar radiation defined 83 of urban area 94 soviet hail model discussed 51-52 illustrated 51 soviet hail program, discussed 56-57 static cloud seeding, defined 10-17 St. Louis study see METROMEX STORMFURY discussed 63, 65, 138 seeding hypothesis 65 sulfur, effect on climate, discussed 188 sunspot activity, discussed 162 Supercooled droplets, defined 3 Supersaturation defined 33 with respect to ice for a water saturated cloud 5 Surface air moist enthalpy 106–108 surface albedo feedbacks 165, 179-180 surface energy budget impact of contrails 68 of urban areas 94 surface properties, effect on global energy balance 165-166 surface roughness urban changes 93 Swiss hail program, discussed 61-62 telecommunication, defined 224 terrestrial radiation, defined 83

terrestrial radiation, defined 83 thermohaline circulations, defined 181 thermostat hypothesis, defined 178 thunderstorm multicell defined 45

discussed 46 illustrated 46 organized 56 ordinary defined 41-42 life cycle of, illustrated 43 supercell defined 45 discussed 45-56 illustrated 46 weakly evolving, defined 56 trajectory lowering technique of hail suppression 59-60 transpiration, defined 102 tropical cyclone conceptual model 63 tropical forest extent and loss, summarized 223 TTAPS, defined 203 Twomey effect defined 192 discussed 192-198 ultra-giant particles defined 76 effects on precipitation 76-77, 88-89 urban areas influence on airflow, illustrated 94, 96 on climate 194 on clouds, precipitation, and weather 90-97 urban sources 91-92 urban heat island, defined 95-97 vegetation effect on global climate 237-239 regional effects 138-144 visibility affected by pollution 86 volcano, effect on climate 165 vulnerability 250-251 warm cloud precipitation discussed 33-35 modification of, discussed 36-40 water drop seeding 36 water vapor feedbacks 174-176

as greenhouse gas 156–158 weak echo region 45 WER *see* weak echo region wind shear, defined 41

xeriscape, defined 101

zeroscape, defined 101