

Index

Index | Key

- An asterisk (*) indicates the term also appears in the Glossary.
- Page numbers in bold indicate page spans for entire chapters.
- Page numbers in italics denote figures, tables, boxed material.

A

Abrupt climate change*, 15, 63, 64, 67, 276
paleontological records, 421-423

Acclimatization*, 49, 287, 426, 427

Acidification. See Ocean acidification

Active transport, 714, 742

Adaptation*, 14-28, 39, 59-84, **833-977**, **1101-1131**
about: relationship between adaptation chapters, 838, 1115-1117

actors and roles in, 836

adaptation as development, 816

ancillary benefits of, 910-911, 948

assessment* (See Adaptation assessment)

autonomous*, 321-324, 815, 1284-1286, 1472-1473, 1531, 1538-1539

barriers to, 233, 906, 1476

climate change magnitude and rate and, 1121

climate policies, 89-90, 171, 909, 922, 948-949

community-based* (See Community-based adaptation)

Copenhagen Accord, pledges, 1115

core concepts and entry points, 26, 85

costs and benefits (See Adaptation costs and benefits)

decision making and governance, 9-11, 54-56, 85-87, 388-390, 389, 638, 836, 1118

definition of, 40, 853

development and, 816, 882, 948, 954, 1473

disagreements about, 180-182

disaster risk management and, 836

as dynamic issue, 951

early, 878

economics of (See Adaptation economics)

ecosystem-based* (See Ecosystem-based adaptation)

emergent risks and, 1060-1061

ethical dimensions, 903, 925-927, 926

evolutionary*, 322-323, 415, 426

experience, 8-9, 51-55, 52-55

facilitating, 888, 908, 948, 965

feedbacks in, 9

first step as vulnerability reduction in present, 25-26, 85, 1502, 1531, 1545

framing and focus of, 836, 838-839, 874, 948

funding gap, 28, 87, 844, 953

genetic and evolutionary responses, 322-323, 426, 1709

global, costs and benefits, 392-393

goals, 836

human-assisted, 324-326, 325, 328

incremental*, 733, 1121, 1445

indigenous knowledge in, 87, 758, 766

inter-relationship with mitigation (See Adaptation and mitigation inter-relationships)

in IPCC assessment reports, 180-182

limits to (See Adaptation limits)

local government and, 836, 842-843, 849

mainstreaming, 87, 948, 1351-1352

maladaptation*, 87, 254, 518, 837, 857-859, 1476

management decisions, 324-325

measuring, 853-857, 855

metrics, 853-857

micro-finance for, 584

mitigation and (See Adaptation and mitigation inter-relationships)

National Adaptation Programmes of Action (NAPAs), 215, 816, 836, 852, 873, 880, 1111

needs and options (See Adaptation needs and options)

opportunities, constraints, and limits (See Adaptation opportunities, constraints, and limits)

pathways, 1116-1117, 1386-1387

planning and implementation (See Adaptation planning and implementation)

principles for, 25-28, 85-87

private sector engagement, 843-844, 876, 876, 880-881, 886

regional, 8-9, 21-25, 90-91, 1145-1148, 1152-1157

risk management and, 56, 253-258, 1104-1105, 1117-1118

sectoral synthesis, 14-20, 922

synergies, 28, 87

technology and, 885

trans-generational, 415

transformational* (See Transformational adaptation)

transitional, 733

unintended consequences of, 277, 327-328

See also *specific systems and regions*

Adaptation and mitigation inter-relationships, 26, 28, 180-181, 1080-1083

in Asia, 1352-1353

co-benefits, 89-91, 1104, 1118

decision processes, 216-218, 217

examples, 90-91

integration of adaptation and mitigation, 1104, 1117-1118

sustainable development and, 216-217, 217, 1109-1110

synergies and trade-offs, 89-91, 216, 217, 394, 925, 1104

Adaptation assessment*, 51, 837, 850-853, 1176-1184

analysis and reliability of, 1176-1184

first-generation, 851

national assessments, 852-853

purpose of, 850

regional, 1176-1184

scale in, 1149

scenario-based, 213, 851

second-generation, 851

istandard approach to, 850-851

top-down and bottom-up, 851, 1144, 1144

trends in, 850-851

Adaptation constraints*, 87, 902, 906, 911-919

adaptation needs and, 844-845

assessing, 901

biological, 902, 913-914, 922

in coastal areas, 393-394

competing values, 917

cross-scale dynamics, 912, 918-919

cultural factors, 902

definition of, 907

differences from barriers, obstacles, and limits, 906

economic, 914, 922

ethical dimensions, 903, 925-927, 926

financial, 914-915

governance and institutional, 916-917, 922

hard and soft limits, 89, 903, 907, 919-921

human resource, 915, 922

institutional factors, 902

knowledge, awareness, and technology, 911-913, 922

overcoming, 927

physical, 913, 922

risk-based framework, 902, 905-908, 906

in rural areas, 617, 642-643

sectoral and regional synthesis, 922-924, 922

social and cultural, 902, 915-916, 922

in urban areas, 540

See also Adaptation opportunities, constraints, and limits

Adaptation costs and benefits, 392-393, 948, 952-953, 953, 958-963

ancillary benefits, 948

broad categorization of, 952

in coastal systems, 364, 392-393, 395

cost-benefit analysis, 948, 956-957, 963

in freshwater resources, 256

global adaptation costs, 392-393, 949, 959-960, 959, 960

new thinking on, 948

socioeconomics and, 959

See also Adaptation economics; Trade-offs

Adaptation deficit*, 210, 214, 839

Adaptation economics, 26, 945-977

adaptation as dynamic issue, 951

adaptation benefits and costs, residual damage, and projects, 952-953, 953

adaptation costs, 952-953, 953

adaptation limits and, 951-952, 952

adjustment costs, 955

ancillary benefits/effects, 948, 951

behavior, role of, 966

bias in (potential), 967

biophysical limits to adaptation, 948

broad-based approach, 948, 949, 951-954, 967, 963

broad categorization of adaptation strategies, 950

broad categorization of benefits and costs, 952 charges, 965-966

co-benefits, 948, 951, 952, 960

competitive adaptation, 948, 954

complementary adaptation, 948, 954

consistency between localized and global analyses, 960

coordination, government failures, and political economy, 956

cost-benefit analysis, 948, 956-957, 963

costing adaptation, 958-963

coverage of adaptation costs and benefits, 960

decision making, 954-958, 954, 963

decision making, economic barriers to, 955-956

decision making support, 948

decision making with uncertainty, 9, 956-958

development and adaptation, 948, 954

differences between adaptation potential and achievement, 948

- discount rates, 959
 disincentives, 949, 964
 economic analyses, desired characteristics of, 949
 economic aspects of adaptation, 950-954
 economic instruments, 26, 87, 948-949, 963-966, 965
 education, 948, 950, 963
 eligibility for adaptation funds, 952, 952
 environmental regulation, 948, 950
 equity and, 948, 955-956
 ethics and distributional issues, 955-956
 facilitating adaptation, 948, 965
 financing, 948-949, 952
 global adaptation costs, 949, 959-960, 959, 960
 incentives, 949, 963-966
 innovation, 966
 insurance, 949, 964
 intellectual property rights, 966
 mainstreaming, 87, 948, 1351-1352
 market-based instruments, 965-966
 market failures, 955
 missing markets, 955
 moral hazard, 964
 multi-metric decision making, 957, 957
 multi-metric evaluations, 948
 narrow economic approach, 961
 narrowing of adaptation, 951-952, 952
 non-market factors, 948, 951, 956, 958, 960, 961, 962, 963
 non-monetary considerations, 948-949, 951, 961, 963
 non-probabilistic methodologies, 949, 957-958
 Paris agglomeration, 957, 957
 payment for ecosystem services (PES), 964, 965, 1523, 1540-1541, 1541
 practical adaptation strategy, 951-952, 952
 private and public sectors, 948, 950
 regional and sectoral studies, 949
 research & development funding, 948, 966
 residual cost, 952-953, 953
 resource pricing, 964-965
 risk financing, 949
 risk pools, 949, 964
 risk sharing and transfer, 949, 964
 robustness, 949, 957-958, 958
 sectoral and regional studies, 960-963, 960, 962-963
 subsidies, 949, 965-966
 taxes, 949, 965-966
 technology transfer, 966
 theoretical basis, 948
 trade-offs, 948
 transaction costs, 955
 uncertainty and, 949, 954, 956-958
 valuation of ecosystem services, 956-957
 water markets, 964-965
- Adaptation limits***, 9, 89, 902-903, 906, 919-922, 1085
 assessing, 902
 avoiding, 920, 927
 biophysical, 922, 948
 change and, 902-903, 912
 in coastal areas, 393-394
 definition of, 907
 differences from constraints, barriers, and obstacles, 906
 economic, 922
 ethical dimensions, 903, 925-927, 926
 exceedance of, 28, 87, 924
 factors influencing, 951-952, 952
 hard and soft limits, 89, 903, 907, 919-921
 historical perspectives, 920
 interacting systems, 903-904
 mitigation and, 903, 924-925, 924
 in ocean systems, 416
 overview, 902-903
 risk-based framework, 902, 905-908, 906
 in rural areas, 617, 642-643
 scale-dependent properties, 921
 sectoral and regional synthesis, 922-924, 922
 social/cultural, 922
 transformational adaptation and, 89, 921-922, 1121
 See also Adaptation opportunities, constraints, and limits
- Adaptation needs and options***, 833-868
 actors and roles, 836, 841-844
 adaptation assessments*, 837, 840, 850-853
 adaptation constraints and limits*, 844-845
 adaptation needs*, 839-844
 adaptation options*, 844-850, 845
 awareness of, 837, 845, 848
 behavioral measures, 845, 847
 biophysical and environmental needs, 840-841
 broad categorization of adaptation strategies, 950
 categories of needs and options, 840, 845
 cost and, 948
 ecosystem-based adaptation, 845, 846-847
 engineering and built environment, 845, 846
 ethics and, 903
 finance and, 392, 843-844, 845, 848-849
 freshwater resource management, 254, 255
 governments and, 836, 842-843, 845, 849
 information, capacity, and resource needs, 844, 845, 848
 institutional needs*, 842-843
 institutional options*, 836, 845, 848-849
 local government involvement, 836, 842-843, 849
 maladaptation*, 836, 857-859
 measuring adaptation, 837, 853-857, 855
 metrics, 837, 853-857
 migration as an option, 770-771, 770
 options in coastal systems, 365
 policy actions, 948-949
 private sector engagement, 836, 843-844
 research and data gaps, 859-860
 safety nets, 836, 845
 selection of options, 836, 849-850, 850, 903
 service provision, 845, 847
 social needs, 841-842
 social options, 845, 847-848
 structural and physical options, 845-847, 845
 summary of AR4 findings, 839
 technological options*, 836, 845, 846
 trade-offs, 918
 transformative adaptation, 836
 vulnerability and, 836, 839-840
- Adaptation opportunities, constraints, and limits***, 14-28, 59-84, 899-943
 adaptation constraints*, 902, 906, 911-919
 adaptation limits*, 902-903, 906, 919-922
 adaptation opportunities*, 902, 908-911, 909
 assessing, 902
 awareness raising, 845, 909, 922
 capacity building, 902, 909, 922
 case study of opportunities (Bangladesh), 910
 changes and, 902-903, 912
 cross-chapter box, 101-103
 cross-scale dynamics, 912, 918-919
 decision support tools, 902
 definitions, 907
 ethical dimensions, 903, 925-927, 926
 facilitating adaptation, 908, 948
 hard and soft limits, 89, 903, 907, 919-921
 innovation, 909, 922
 learning, 902, 909, 922
 mitigation and, 903, 924-925, 924
 policy, 909, 922
 risk-based framework, 902, 905-908, 906
 sectoral and regional synthesis, 14-25, 62-73, 922-924, 922
 seizing opportunities, overcoming constraints, and avoiding limits, 927
 selection and implementation of options, 903
 summary of AR4 findings, 904-905
 summary of SREX findings, 905
 sustainable development and, 909-910
 tools, 902, 909, 922
 trade-offs, 918, 925
 transformational adaptation, 89, 921-922
 See also Adaptation constraints; Adaptation limits
- Adaptation options.** See Adaptation needs and options
- Adaptation planning and implementation**, 8, 25-26, 51, 85-87, 869-898
 in Australasia, 1374-1375, 1389-1390
 in Central and South America, 1531, 1538-1539
 common recognition, 873-874
 communication tools, 883
 decision support tools, 883, 902
 development and, 882
 disaster risk management, 871, 881-882
 early adaptation, 878
 early warning systems, 872, 877, 878, 883-885
 in Europe, 1297
 examples, 875, 875, 879-880, 880, 1355
 facilitating, 888
 factors constraining, 902
 financing, 878-881, 902
 governance, 25, 85-87, 887-889
 horizontal interplay, 871
 impacts-led approaches, 872
 implementation, 390-392, 877-878, 879-880
 implementation tools, 838
 increasing capabilities, 888-889
 indigenous communities, 876
 information and communication technologies, 884
 institutional dimensions, 871, 886-888
 insurance, 872, 884, 885-886
 international mechanisms, 873-874
 learning processes, 871
 levels of, 873-877
 livelihoods and poverty and, 815-816
 local governments, 871, 876
 local knowledge, 875
 mixed-portfolio approaches, 883
 monitoring, modeling, and spatially integrated tools, 872, 883
 multidisciplinary efforts, 872
 multiple approaches to, 871-872

- multiple stresses and, 871
national initiatives, 85, 871, 874-875
planning tools, 883-885
political dimensions, 887-888
present status, global, 876
private sector, 8, 871, 876, 876, 880-881, 886, 948, 950
public sector, 8, 948, 950
research needs, 889-890
return on investment, 880-881
status and progress, 871, 873-881, 876
strategies and approaches, 871-872, 883-884
subnational initiatives, 85, 871, 875-877, 875, 881
technology development, 885
in terrestrial and inland water systems, 324-326
tools, 872, 883-886, 884
top-down and bottom-up approaches, 871-872
transboundary, Mekong River Basin, 1355
types of approaches, 871-872, 878
in urban areas, 539-540, 876-877
- Adaptation potentials.** *See* Adaptation opportunities, constraints, and limits
- Adaptive capacity***, 838, 875, 1176-1178
assessment of, 214
building, 909, 1115-1116
in China, 1116
development and, 1111
exceedance of, 87
in food systems, 513-514
of indigenous peoples, 765, 766
limits to, 426
of ocean systems, 416
poverty and, 816
regional context, 1142-1144
resilience and, 217
in rural areas, 617
in small islands, 1617, 1636-1637
of societal actors and natural systems, 902
in urban areas, 179-180, 539
See also specific systems and regions
- Aeroallergens**, 729, 1043
- Afforestation**, 233, 257, 284, 317, 321
- Africa, 1199-1265**
access to resources/technology, 1204
adaptation, 8, 51, 487, 1203-1204, 1225-1238, 1237-1238, 1240
adaptation and development linkages, 1203-1204
adaptation barriers, 1236-1238
adaptation deficit, 1203
adaptation experiences and lessons learned, 54, 1229-1236
adaptation limits, 1204, 1236-1238
adaptation opportunities, constraints, and limits, 21, 922
adaptive capacity, 1204, 1226
agricultural pests, diseases, and weeds, 1220
agriculture, 54, 519, 1203, 1212-1213, 1218-1221, 1223, 1231
air quality, 1224
biodiversity, 1231-1232
biofuels, 1240-1241
biome change, 1215
Botswana, 804
climate finance and management, 1241-1242, 1241
climate forecasts, 643
coastal and ocean systems, 388, 1216
communication, 1233
community-based adaptation, 1229
conclusions from previous assessments, 1205-1206, 1205
costs of climate impacts, 631
crop insurance, 1147
crop yields, 510, 1218-1219, 1219
Darfur, conflict in, 773
deserts/desertification, 1205, 1209, 1210, 1213, 1214, 1215, 1234
detection and attribution, 44, 1003-1009, 1005-1006, 1212
development pathways, 1203-1204
diseases, 1222-1224
droughts, 42
East Africa coast and Madagascar, 1688
ecosystem services, 1231-1232
ecosystems, 1202, 1213-1216, 1214
education, 1213, 1233
emerging issues, 1238-1242
environmental context, 1211-1212
equity, 1226, 1227
extreme temperature and rainfall, 1210-1211
extreme weather and climate events, 42
fisheries, 1220-1221
floods, 42, 804, 805
food insecurity, 512, 1203
food production, 1202, 1212-1213
food security, 1202, 1212-1213, 1218-1221, 1221
freshwater ecosystems, 1215-1216
governance, 1203, 1227-1229
hantavirus, 1224
health, 1221-1224
human health, 715, 1203
human population, 1203
human security, 1204, 1238-1239
ICPAC, 1157
impacts, 1211-1225
infrastructure, 1234-1235
insurance, 54, 1231
integrated adaptation/mitigation, 91, 1240
Intergovernmental Authority on Development (IGAD), 1157
key risks, 21, 76, 117, 1204, 1237-1238, 1238
Lagos flooding, 804
land use, 1240-1241
leishmaniasis, 1223
Limpopo River, 803
livelihoods, 1155, 1230-1231
livestock, 511, 1219-1220
maladaptation risks, 1203-1204, 1235-1236
malaria, 722-723, 723, 1222-1223
malnutrition, 1222
meningococcal meningitis, 1224
migration, 1239-1240
mitigation, 1237-1238, 1240
mixed farming in Tanzania, 519
monsoons, 1161-1162
multiple stressors, 1202
Nairobi Work Programme, 583
natural resource management, 1231-1232
observed changes, 30, 82, 848, 1206-1211, 1207, 1208
observed climate trends, 1206-1211
observed impacts, 44, 1003-1009, 1005-1006, 1202
perennial crops, 1202, 1219, 1219
policies and access to information, 635
poverty, 801, 1211-1212
poverty indicators, 624
precipitation, 82, 1202, 1207, 1208, 1209-1210
projected changes, 82, 1206-1211, 1207, 1208
projected impacts, 796, 1202, 1204
regions within, 1205
research gaps, 1204, 1242-1243, 1242
resilience in, 1204
Rift Valley fever, 1223
risk management/reduction, 1202, 1204, 1230-1231, 1237-1238
risks, 21, 73-75, 76, 117, 1204, 1237-1238, 1238
river flow, 143-144
Sahel region, 519, 777
schistosomiasis, 1223-1224
social justice, 1227, 1227
socioeconomic context, 1211-1212
sub-Saharan, 796, 801
sustainable development, 1226-1227
technology, 1204, 1234-1235
temperature, 82, 1202, 1204, 1206-1209, 1207, 1208, 1224
terrestrial ecosystems, 1213-1215, 1214
trees, integrating into cropping systems, 1231
tropical beverage crops, 626, 641
undernourishment, 1213, 1213
urbanization, 1224-1225
violent conflict, 1239, 1239
vulnerability, 1202-1203, 1211-1225
water resources, 73-74, 250, 250, 625, 1203, 1213, 1216-1218
water stress, 73-74, 1202, 1217, 1237, 1237
- Aggregate impacts***, 690, 690
risks associated with, 12, 61, 1015, 1016, 1044, 1077-1078
- Agricultural droughts**, 232, 247-248, 247
- Agricultural productivity**, 60, 810-812
- Agriculture**
adaptation, 215, 277, 489, 514-516, 515, 516, 638, 639-640
adaptation options, economic evaluation of, 962
adaptation trade-offs, 918
in coastal systems, 384
conservation agriculture, 638
crop insurance, 54, 685, 1147
diversification of, 516, 638
economic dependence on, 616, 617
extreme events and, 503
high-value food crops, 625
human security and, 761, 762, 763, 766, 768-769
irrigation, 233, 241, 251, 257
land conversion for, 67
observed impacts, 996-997
post-harvest aspects, 623-625
projected changes, 488-489, 623-625, 810-812
rainfed, 251-252, 498, 499, 514, 616, 624, 634
in rural areas, 616, 617, 621-625
smallholder and subsistence, 503, 616, 623, 627, 634, 638, 797
soil erosion and, 233, 237-239, 246
temperature effects, 110
trade and, 617, 628-629
tropical beverage crops, 625, 626-627, 641, 1528
under-investment in, 616

- in urban areas, 539
valuation of changes, 617, 631-632, 632
water demand, 251-252, 625
See also Crop yields; Food production systems
- Air pollution**, 713, 727-730, 728
acute episodes, 729
biomass burning, 739
black carbon, 716, 739
climate-altering pollutants, 713, 714, 715, 716, 728, 728
forest fires and, 721, 729
fuel combustion, 738-739
household sources, 738-739
human health and, 727-730, 737-738
outdoor sources, 738, 739
ozone, 728-729, 728
particulate, 728, 728
primary co-pollutants, 739
reducing, 737-740
secondary co-pollutants, 739-740
temperature and, 729-730
transboundary pollution, 1353
- Air quality**, 189, 727-730
fires and, 721, 729
human health and, 727-730
near-term future, 729-730
ozone and, 1171, 1172
projected changes, 729-730, 1171, 1172
regional projections, 1171, 1172
in urban areas, 556
- Air transportation**, 676
- Albedo**, 274
green and white roofs, 90, 574-575
- Algal blooms**, 253, 257, 454-455
dissolved inorganic carbon and, 287
harmful (HAB), 439-440, 454-455, 465, 726, 1582
toxins produced by, 251, 252
- Alien species**. See Invasive species and invasive alien species
- Allergens**, 1000, 1043, 1056, 1064-1065, 1465
- Alpine ecosystems**, 314-317, 1274, 1274, 1301
- Alternative development pathways**, 1044, 1052, 1072-1073
- Amazon region**, 64, 67, 1502, 1507, 1509-1510, 1518, 1519, 1542
abrupt and irreversible changes (potential), 64, 67, 276, 309-310, 1016
Amazon river, 1518, 1519, 1521, 1543
biomass in, 308, 989
deforestation, 276, 284, 310, 1502, 1503, 1509-1510, 1514-1515, 1514, 1522-1523, 1535
forests, 64, 67, 276, 284, 310, 982, 990-991, 1016, 1503, 1512, 1514, 1522-1523
observed impacts, 83, 982, 990-991
projected changes, 83
tipping point (potential), 64, 309-310, 1016
- Amphibians**, 275, 300, 989
- Anaerobic organisms**, 415, 443
- Andes region**, 1502, 1507, 1508, 1510, 1519, 1521, 1522
- Animals**
Arctic, 317, 990, 1016, 1570, 1575-1576, 1588, 1596
hypoxia and, 443
life cycles, 441
marine, 414, 429-430, 440-441, 443, 449-450, 457, 1575-1576, 1588-1589
multiple drivers, responses to, 447
phenology, 292
in polar regions, 317, 414
temperature and, 49, 447
thermal sensitivity/windows, 48, 49, 427-428, 427, 428, 429-430
- Annex 1 and 2 countries**, 1115
- Anoxia**, 415-416, 443-445
- Antarctic Circumpolar Current**, 1671
- Antarctica**
freshwater systems, 1573, 1586-1587
key risks and adaptation, 1594
ocean acidification, 1587
productivity and species, 1576-1577
Southern Ocean, 1585-1586, 1589
terrestrial ecosystems, 1581, 1590
tourism, 1595
See also Polar regions
- Anthropogenic* climate change**, 26, 982
DAI (See Dangerous anthropogenic interference)
drivers of, 1502
See also Detection and attribution
- Aquaculture**, 452, 488, 676, 1701-1704
adaptation, 489, 516
in coastal systems, 366, 384
impacts, 366, 384, 500-501, 508, 676
ocean acidification and, 452
vulnerabilities, 500-501
- Aquifers**, 364, 379, 991
See also Groundwater
- Arabian Gulf**, 1683
- Arabian Sea**, 1687-1688
- Aragonite**, 423, 1673, 1674, 1675, 1683
- Arctic region**, 1570, 1572
abrupt and irreversible changes (potential), 276, 1017
adaptation limits, 1570
animal populations, 1580-1581
cascading impacts, 1015-1016
compound risk, 1058, 1059
economic sectors, 1584-1595
economy, 1585
extreme weather events, 42
fisheries, 1584
freshwater ecosystems, 1572-1573, 1586, 1594
health impacts, 42, 1581-1583, 1594
hydrology, 1572-1573, 1586
indigenous peoples, 51, 983, 1016, 1581-1583, 1593-1595
infrastructure, 1584-1585, 1594
key risks and adaptation, 8, 1594
krill, 1577
livelihoods, 51, 983
marine mammals and seabirds, 1588-1589
marine transport, 1584
multiple stressors, 1572-1586
navigation and shipping, 559, 776, 776, 1173, 1174, 1584, 1591-1593, 1591, 1592, 1705
observed changes, 1572-1586
observed impacts, 232, 314, 982, 983, 990, 1017
ocean acidification, 1587
phenology, 1578, 1578, 1588-1589
as potential carbon source, 315
projected changes, 314-317
projected impacts, 1586-1593
rapid rate of change in, 1570
regime shift in, 1015-1016
resource exploration, 1585, 1593
river ice, 232
sea ice losses, 60, 623, 776, 982, 987, 987, 1015-1016, 1071, 1570, 1591, 1595, 1705, 1712
sea ice projections, 1136, 1591-1593
security and geopolitical issues, 776
socioeconomic impacts, 1595
terrestrial ecosystems, 1577-1581, 1589-1590
tipping elements, 276, 1015-1016, 1017
traditional knowledge, 8, 54, 1583-1584
trans-Arctic shipping, 453, 1584, 1705
transportation infrastructure, 628
as unique and threatened system, 1013, 1014
vegetation, 1578-1580, 1579
vulnerability, 1572-1593
warming in, 190, 776
See also Polar regions
- Armed conflict**, 771-775, 772, 773
- Asia**, 75-76, 1327-1370
about: countries and regions included, 1332
adaptation, 8, 22, 51, 922, 1334-1352, 1336-1337, 1355
adaptation and mitigation interactions, 1352-1353
adaptation, mainstreaming and institutional barriers, 1351-1352
adaptation, valuation of, 1350-1351
agriculture, 75
biodiversity, 1342
case studies, 1355-1356
caste system, 799, 807, 808
coastal systems, 1341-1343, 1347, 1351, 1354
conclusions from previous assessments, 1332
conservation, 1351
coral reefs, 1342
crop areas, 1344-1345
crop failure, 1336, 1352
crop yields, 509, 1349
dams, 1342, 1345, 1353, 1355
deserts/desertification, 1330, 1339, 1344
detection and attribution, 45, 1003-1009, 1006
development, 1330, 1351
disaster preparedness, 148, 1350
diseases, 723, 723, 1348-1349
droughts, 1341, 1348
economic development, 1330, 1351
economic growth, 1351
economy, 1353
education, higher, 1352
equitable development, 1351
extreme weather events, 1330, 1331
fisheries and aquaculture, 1345
floods, 1348, 1351
food production and security, 1330, 1343-1346, 1344, 1349, 1354
forests/forestry, 1340
freshwater resources, 1334-1338, 1338, 1354
glaciers, 242, 243, 1337, 1356, 1357
human health, 715, 1331, 1347, 1348-1350, 1354
human population, 1332, 1347
human security, 1331, 1348-1350, 1354
human settlements, 1346-1348, 1354
hydropower, 1355
income inequality, 802
industry, 1330, 1346-1348
infrastructure, 1346-1348

- intra-regional and inter-regional issues, 1353
 key risks, 22, 77, 118
 livelihoods, 1331, 1348-1350, 1354
 malaria, 723, 723
 marine systems, 1330
 migration, 1353
 monsoons, 1333, 1334
 multiple stresses, 1330
 new coverage in AR5, 1333
 observed climate change, 83, 1333-1334
 observed impacts, 31, 45, 1003-1009, 1006, 1334-1351, 1336-1337, 1354
 oceans, 1334
 peatland, 258, 1341, 1350, 1352, 1353
 permafrost, 1330, 1340, 1341, 1342
 phenology, 1339, 1340
 poverty, 624, 1331, 1348-1350, 1354
 precipitation, 83, 1333, 1335
 projected changes, 83, 796, 1330-1331, 1334
 projected impacts, 74-75, 1334-1351, 1336-1337, 1354
 research and data gaps, 1331, 1353-1354, 1354
 rice, 41, 1330, 1343-1345, 1344, 1347, 1349, 1354, 1354, 1355
 rice landscapes, 318
 risk, 22, 77, 118, 1336-1337, 1347
 risk management, 1351-1352
 runoff, 1337-1338
 sea level rise, 1342
 species and biome distributions, 1339-1340
 storm damages, exposure, and economic impacts, 147-148, 148, 1333-1334, 1638
 surface wind speeds, 1334
 sustainable cities, 91
 temperature, 83, 1330, 1333, 1335, 1348
 terrestrial and inland water systems, 1330, 1339-1341, 1354
 trade, 1353
 transboundary adaptation planning, 1355
 transboundary pollution, 1353
 tropical and extratropical cyclones, 147-148, 148, 1333-1334
 urbanization, 1330
 valuation of impacts and adaptation, 1350-1351
 vulnerability, 1334-1351, 1336-1337
 water resources, 250, 250, 1330, 1337-1338, 1346
 water-saving irrigation, 1116
 water scarcity, 1330, 1337-1338, 1338
 water stress, 1338
See also specific countries
- Assessment**, 3, 3-4, 37, 184, 198, 199, 213-214
 of adaptation (*See* Adaptation assessment)
 context for, 4, 38-39
 of impacts (*See* Impact assessment)
 stakeholder participation in, 837
 of vulnerabilities (*See* Vulnerability assessment)
See also Decision making; IPCC Assessment Reports
- Assessment methods**
 downscaling, 211-212, 1137-1138, 1159-1162
 risk assessment, 922
 stakeholder involvement, 837
 thresholds and risk criteria, 855, 1051-1052
 top-down vs. bottom-up approaches, 851, 1144, 1144
- Atlantic Multi-decadal Oscillation/Variability (AMO/AMV)***, 63, 420, 422, 433, 993, 1671
- Atlantic Ocean**
 chlorophyll concentrations, 1660
 North Atlantic, 621, 1678-1679
 responses to temperature, 434-435
 sea surface temperature (SST), 1658, 1665
 subtropical gyres, 1695-1696
- Atmospheric circulation**, 190
- Atolls**, 775, 1616, 1618, 1619-1622, 1619, 1623, 1634
See also Small islands
- Attribution**. *See* Detection and attribution
- Australasia**, 76, 1371-1438
 adaptation, 51-54, 1374-1375, 1382-1387, 1410-1411
 adaptation challenges, 1374, 1406-1407, 1412-1413
 adaptation decision making, 1386-1387
 adaptation examples, 8, 55, 1148, 1157, 1398-1399
 adaptation-mitigation interactions, 1406-1410, 1408
 adaptation opportunities, constraints, and limits, 23, 922, 1382-1385, 1383, 1406-1407, 1412-1413
 adaptation options, 389, 391-392
 adaptation planning, 51-54, 1374-1375, 1389-1390
 adaptation, transformational, 1375, 1412-1413
 adaptation, uncertainties and, 1386-1387
 adaptive capacity, 1375
 agriculture, 1157, 1374, 1376, 1396-1399
 Australia, 1377, 1413
 biodiversity, 1391, 1408
 biosecurity, 1397
 carbon sequestration/storage, 1409
 climate change, 1374
 coastal adaptation, 365, 389, 1384-1385
 coastal and low-lying areas, 1374, 1375-1376, 1413
 coastal ecosystems, 1392-1393
 conclusions from previous assessments, 1377
 coral reefs, 431, 1374, 1375, 1392-1393, 1395, 1413
 crop yields, 511
 cyclones, 1374, 1377, 1381
 detection and attribution, 45, 1003-1009, 1006-1008
 droughts, 721, 807, 1380, 1389, 1389, 1395
 economy, 1374, 1379-1382, 1410, 1410-1411
 ecosystems, 1374, 1375-1376, 1390-1393
 El Niño Southern Oscillation (ENSO), 632, 1377
 emerging risk, 1412
 energy supply, transmission, and demand, 1374, 1400-1401, 1408
 extreme heat, 721
 extreme weather events, 721, 1374, 1380-1381
 fires/wildfires, 721, 1374, 1375, 1381, 1400, 1408, 1413
 fisheries, 1393
 floods, 721-722, 1374, 1375, 1404
 flow-on effects, 1408-1410
 forestry, 1393-1396
 freshwater resources, 1374, 1387-1390, 1388
 gender impacts, 807
 Great Barrier Reef, 431, 1393
 heat waves, 1374, 1375, 1380, 1401, 1402, 1405, 1407, 1411, 1413
 heat waves, Victorian, 42, 1374, 1400, 1401, 1402
 human health, 1374, 1402-1405, 1408, 1413
 human population, 1379
 human systems/society, 1374, 1375, 1380-1381, 1402-1406, 1412
 indigenous peoples, 1375, 1405-1406, 1408
 industries, 1393-1401
 industries, relocation of, 55
 infrastructure, 1375, 1408, 1413
 insurance, 1403
 invasive species, 1397
 Kakadu National Park, 1391
 key risks, 23, 78, 118, 1375-1376, 1410-1413, 1410-1411, 1413
 knowledge gaps, 1376, 1413-1414
 land-based interactions, 1409
 livelihoods, 1408
 livestock, 511, 1396-1397
 Maori (New Zealand), 1395-1396
 marine ecosystems, 1392-1393
 migration, human, 1375-1376, 1410
 mining, 1399, 1408
 mortality from drought, fires, and heat waves, 42, 721
 mountains/montane ecosystems, 1375, 1381, 1401, 1411, 1413
 Murray-Darling Basin, 807, 843, 1374, 1376, 1379, 1389, 1410
 native species, 1375
 natural systems/ecosystems, 1375, 1390-1393, 1394-1395, 1412
 New Zealand, 1377, 1413
 observed climate change, 83-84, 1374, 1377-1379, 1378-1381
 observed impacts, 31, 45, 1003-1009, 1006-1008, 1385-1387, 1394-1395
 ocean acidification, 1374, 1379, 1393, 1413
 poverty, 1379-1382
 precipitation, 83-84, 1374, 1377-1379, 1378, 1380
 productivity (vegetative), 1374, 1376
 projected climate change, 83-84, 1374, 1377-1379, 1378-1381
 projected impacts, 76, 1375-1376
 relocation of agricultural industries, 1148
 risk management/reduction, 1403, 1410-1411, 1412-1413
 rural areas, 1398-1399, 1408
 sea level, 1374, 1376, 1381, 1384, 1413
 snow and ice, 1381
 sociocultural factors, 1376, 1379-1382
 socioeconomic scenarios, 1382
 species distribution and viability, 1390-1392, 1394-1395, 1397
 synergies and trade-offs, 1376, 1409
 temperature, 83-84, 1006-1008, 1374, 1377, 1378-1380, 1402-1403, 1402, 1410-1411
 terrestrial ecosystems, 1390-1392
 tourism, 1401, 1408
 transboundary effects, 91
 urban adaptation, 1406-1407
 vulnerability/risk, 76, 1374, 1375-1376, 1385, 1391, 1393, 1410-1413, 1410-1411, 1413
 water conservation, 1374, 1389-1390
 water management, 1389-1390, 1408

- water resources, 1374, 1374-1375, 1387-1390, 1388, 1399
- Autonomous adaptation***, 321-324, 815
in Central and South America, 1531, 1538-1539
in Europe, 1284-1286
in North America, 1472-1473
- Avalanches**, 989, 1280
- Avoided impacts**, 1045, 1081-1083, 1081
- B**
- Bacterial pathogens**, 726
- Baltic Sea**, 80, 1684
- Bangladesh**
adaptation and disaster risk reduction, 148, 910
coastal regions, 804
cyclone impacts, 148
exposure to storm damages, 1638
flood protection costs, 673
floods, 105, 1346
gender roles in, 105
human population, 373
rice prices, 568
See also Asia
- Barents Sea**, 1678
- Baseline/reference***, 138, 1179-1181
- Beaches**, 375-376
erosion, 1524, 1525, 1620, 1624
recreational value, 663, 679
See also Coastal systems and low-lying areas
- Benguela Current**, 1691-1692
- Benthic habitats and ecosystems**, 125, 150, 422, 424, 443-444, 448, 449
- Bering Sea**, 1576
- Biodiversity***
adaptation, 640-642
adaptation trade-offs, 918
adaptive management, 101, 640-642
in Africa, 1231-1232
in Australasia, 1391, 1408
in Central and South America, 1502, 1522, 1535, 1542
in coastal systems, 376-377
coral reefs, 1016
in Europe, 1289, 1294-1295, 1297, 1299-1300, 1300, 1304
forest dieback and, 276
habitat for, 319-320
hotspots, 1177
invasive species and, 289
key risks, 1042, 1058, 1071
mitigation and, 1043, 1061-1062
nitrogen deposition and, 286
in North America, 1446, 1458-1462, 1460, 1475
observed impacts, 990
in ocean systems, 416, 451, 453, 461
in small islands, 1622
in terrestrial and freshwater ecosystems, 274, 277
vulnerability/risk, 60-62, 63, 274
See also Extinction; Range shifts
- Bioenergy***, 318
unintended consequences of, 277, 327
- Bioenergy crops**, 320
land use for, 277
water needs, 233, 257
- Biofuel production**, 320, 617, 1043, 1409
in Central and South America, 1515, 1533-1534, 1535, 1544-1545
- impacts of, 630
land use and, 630, 797, 806-807, 814-815
palm oil, 1515, 1533
risk and emergent risks, 1055-1056, 1056, 1118
water for, 163, 630
- Biological systems**. *See* Ecosystems
- Biomass***
biomass stove programs, 739, 1353
combustion fuels, 738-739
observed impacts, 989-990
phytoplankton, 434-435, 445
- Biomass burning**, 739
- Biomass-derived energy**, 320
- Biomes***, 446
biome changes (Africa), 1215
biome shifts, 274, 278-279, 279, 280, 281, 316-317
See also Ecosystems; Range shifts
- Biophysical adaptation needs**, 840-841
- Biophysical processes**, 278, 283-285, 1043
- Birds**
phenology and, 321-322
seabirds, 414, 449-450, 457, 1575, 1577, 1588-1589
- Black carbon**, 716, 739
- Black Sea**, 80, 1684
- Blue Carbon**, 394, 1699-1701
- Body size**, 414, 428, 429, 430, 458, 459
- Bogs**, 313
- Bohai Sea**, 1686-1687
- Boreal forests**, 303-305, 317, 982, 1016, 1589
- Boreal-tundra Arctic systems**, 67, 1589-1590
biome shift, 316-317
productivity in, 990
spring advancement, 292
tipping point (potential), 64, 276, 316-317, 1016
vulnerability of, 303-305
- Bottom-up approaches**, 851, 871-872, 1144, 1144
- Boundary organization***, 207, 392
- Brazil**
agriculture, 1503, 1527
allocating tax shares, 589
deforestation, reduction in, 1522-1523
energy production, 1533-1534, 1540
fisheries, 1503
observed and projected changes, 83
payment for ecosystem services (PES), 1541
precipitation, 83, 1502, 1503
rainfall, 1502
renewable energy production, 1533-1534
S„o Paulo, 1532
species changes, 1502
temperature, 83
See also Central and South America
- Breeding programs**, 326
- Brundtland Report**, 1118
- Bryozoans**, 442
- Built environment***, 27, 538, 559-560
adaptation options, 845, 846
- C**
- C₃ plants**, 288, 310-311, 500
- C₄ plants**, 287, 288, 311, 500, 505
- Calcifiers**, 17, 64, 364, 366, 372, 374, 436-437, 436, 441, 447, 452, 464-465, 1064
See also Ocean acidification
- California Current**, 1692
- Campylobacter**, 726
- Canada**, 1446-1447
adaptation, 1474, 1475
adaptation constraints, 1445, 1448
agriculture and food security, 1462
climate projections, 1455-1456
climate trends, 1453-1454
detection and attribution, 1447
extreme events and vulnerabilities, 1450, 1470
forests, 294, 320
GDP, 1451
human health, 1464-1466
human population, 1448-1449, 1451, 1452
mining, 1467-1468
NAFTA, 1448, 1450
precipitation, 81
snowpack and snowmelt, 81, 1443, 1470
socioeconomic indicators, 1451
temperature, 81
tourism and recreation, 678
transportation infrastructure, 628
tree mortality, 1459
Vancouver, climate responses, 1474
water resources, 1443-1444, 1456-1457
wildfires, 1460-1461, 1473
winter precipitation, 1454
See also North America
- Canary Current**, 1690-1691
- Cancun Agreements (2010)**, 814, 853
- Capacity building***, 909, 1115-1116
See also Adaptive capacity
- Capacity needs***, 838-839, 844
- Carbon**
Blue Carbon, 394, 1699-1701
dissolved organic (DOC), 287, 313
social cost of (SCC), 690-691, 691
storage (*See* carbon sequestration; carbon sinks)
voluntary carbon offsets, 814
- Carbon capture and storage (CCS)**
deep sea, 1705-1706
effects on freshwater resources, 233, 258
transport of CO₂, 668
- Carbon cycle***, 287, 293
- Carbon dioxide (CO₂)***
carbon dioxide fertilization*, 286, 293, 328
effects on ecosystems, 287
effects on human health, 1043, 1064-1065
effects on ocean systems, 415, 418, 432-443, 450
effects on plant growth, 157, 159, 293, 303, 308
FACE (Free Air CO₂ Enrichment) studies, 287, 495, 499
flux, in oceans, 420, 993, 1660
freshwater resources and, 251
plant productivity and, 276, 292-293
pollen production and, 1043
rise in, 287-288
rising concentrations of, 287-288
transfer from atmosphere to land, 276
- Carbon dioxide fertilization***, 286, 293, 328
- Carbon Dioxide Removal (CDR)**, 454
- Carbon monoxide**, 739
- Carbon sequestration**
climate change effects on, 276
by forests, 90, 276
by mangrove forests, 90, 1155
mitigation efforts by planting trees, 277

- by terrestrial and freshwater ecosystems, 275-276, 277
 See also Carbon capture and storage; Carbon sinks
- Carbon sinks**, 15, 64, 67
 in the Arctic
 global carbon stores, 313-314
 loss of, 1054
 peatland changes and, 313-314
 reversal to carbon source (potential), 67, 276, 313-314, 315
 terrestrial ecosystems, 64, 275-276, 293-294, 989
- Carbon stocks**, 293-294, 394, 1016
- Carbonate chemistry**, 130, 414, 436, 436, 464, 1658, 1673-1675
- Carbonate neutralization**, 454, 455
- Caribbean region**
 Caribbean Catastrophic Risk Insurance Facility, 886, 1638
 Caribbean Sea, 1688
 climate projections, 1628
 dengue fever, 724
 ocean swells, 1631
 sea urchin (*Diadema*) in, 1633-1634
 See also Small islands
- Caribou**, 1580
- Cascading impacts**, 64, 983, 1012, 1013, 1015-1016
- Caste system**, 799, 807, 808
- Cattle**. See Livestock
- CDM**. See Clean Development Mechanism
- Central and South America**, 78-80, 1499-1566
 adaptation, 8, 91, 1516-1537, 1545
 adaptation, autonomous and planned, 1531, 1538-1539
 adaptation, barriers to, 1539
 adaptation, ecosystem-based, 54, 1502, 1542
 adaptation experiences, 1538-1539
 adaptation, first step in, 1502, 1531, 1545
 adaptation interactions with mitigation, 1539-1540
 adaptation opportunities, constraints, and limits, 24, 922, 1537-1539
 adaptive capacity, 1508, 1531, 1537
 agricultural productivity, 1503, 1528-1529, 1543
 agriculture, 1502, 1503, 1504, 1514-1515, 1527-1531, 1528-1529, 1543
 air quality, 1536-1537
 Amazon forest, 276, 284, 310, 1502, 1503, 1509-1510, 1512, 1514-1515, 1514, 1522-1523, 1535
 Amazon region, 83, 1502, 1507, 1509-1510, 1518, 1519, 1542
 amphibians, 275
 Andean cryosphere, 1502, 1517-1518, 1522
 Andes region, 1502, 1507, 1508, 1510, 1519, 1521, 1522
 beach erosion, 1524, 1525, 1541
 biodiesel, 1533
 biodiversity, 1502, 1522, 1535, 1542
 biofuel production, 1515, 1533-1534, 1535, 1544-1545
 case studies, 1540-1541
 Central America, 1504
 Chagas disease, 1536
 cholera, 1536
 climate change perceptions, 1508
 climate extremes, 1505-1507, 1508
 climate trends, 1502, 1506-1516, 1545
 climate variability, 1502, 1506-1510, 1508, 1542
 climatic stressors, 1506-1513
 coastal systems, 1503, 1524-1527, 1525, 1541, 1543
 coffee, 1528
 community cooperatives, 1539
 conclusions, 1542-1545, 1545
 conservation, 1523-1524, 1526-1527
 coral reefs, 1503, 1525, 1527, 1543, 1545
 costs of extreme events, 805
 crop yields, 510, 1504, 1527-1530, 1528-1529, 1543
 cutaneous leishmaniasis, 1536
 data and research gaps, 1541-1542
 deforestation, 276, 284, 310, 1502, 1503, 1509-1510, 1514-1515, 1514, 1522-1523, 1535, 1540
 dengue fever, 1535-1536
 detection and attribution, 46, 1003-1009, 1544
 diseases and vectors, 1503, 1532, 1532, 1535-1536, 1536, 1543, 1545
 droughts, 247, 1545
 early warning systems, 1538, 1545
 economy, 1504, 1516, 1516
 ecosystem loss, 1502, 1522
 ecosystems, 1502, 1503, 1525-1527, 1542
 El Niño Southern Oscillation (ENSO), 632
 extreme events, 805, 1502, 1504-1505
 fisheries, 1503, 1526
 fishing agreements, 1542
 floods, 1524, 1525, 1525, 1532, 1532, 1545
 food production, 1503, 1527-1531, 1528-1529, 1544, 1545
 food security, 1503, 1530, 1541, 1544-1545
 freshwater resources, 1516-1522, 1517-1518, 1519-1520
 glaciers, 623, 1518-1520, 1519, 1521, 1522, 1543, 1543
 hantaviruses, 1536
 heat waves, 1536, 1537
 hotspots, 1530
 human health, 1503, 1535-1537, 1536, 1545
 human settlements, 1531-1533
 hurricanes, 1508, 1535, 1542
 hydropower, 1519-1520, 1540-1541, 1544
 insurance, 1531
 key risks, 24, 79, 119, 1545
 La Plata River basin, 1502, 1507-1508, 1521, 1525, 1543
 land management, 1527
 land use/land use change, 1502, 1503, 1509-1510, 1513-1516, 1522-1523, 1534-1535, 1542, 1543
 leptospirosis, 1532, 1536
 livestock/cattle, 512, 1515, 1528, 1530
 local and indigenous knowledge, 1531
 low-lying areas, 1504-1527
 malaria, 1535
 mangroves, 1503, 1525-1526, 1527
 manufacturing, 1532-1533
 marine ecosystems, 1503, 1525-1527
 marine protected areas, 1526
 megacities, 1532, 1537
 monsoons, 1506, 1509, 1511
 mortality from extreme events, 805
 non-climatic stressors, 1513-1516
 observed changes, 82-83, 1502, 1505-1507, 1506-1510, 1543
 observed impacts, 32, 46, 1003-1009, 1505-1507, 1516-1537
 palm oil, 1515, 1533
 payment for ecosystem services (PES), 1523, 1540-1541, 1541
 phenology, 1523
 plant pests and diseases, 1504
 poverty, 1502-1503, 1515-1516, 1516, 1533
 poverty indicators, 624
 precipitation, 82-83, 1502, 1504, 1505-1507, 1509-1513, 1527, 1543, 1545
 precipitation extremes, 1505-1507, 1545
 previous assessments, 1502, 1504-1506, 1542
 projected changes, 82-83, 1502, 1509-1513, 1510-1513
 projected impacts, 1516-1537, 1519-1520
 protected areas, 1524, 1526
 recent changes and projections, 1506-1516
 reforestation, 1540
 regional and international partnerships, 1542
 regional observed changes, 1505-1507, 1543
 regional projected changes, 1509-1512, 1519-1520
 regions within, 1505-1507
 renewable energy, 91, 1503, 1533-1535, 1534, 1544-1545
 risk, compound, 1532
 risk reduction, 1531, 1538-1539
 S.,o Paulo, 1532
 schistosomiasis, 1536
 sea level rise, 1503, 1504, 1541, 1543-1544
 sea ports, 1524, 1525
 socioeconomic conditions, 1502-1503, 1515-1516, 1516
 South America, 1504
 soy, 1503, 1504, 1515, 1527, 1528, 1535
 species viability and range shifts, 1502, 1504, 1523
 streamflow, 1502
 sugarcane, 1503, 1528, 1533, 1534, 1540, 1544
 temperature, 82-83, 1502, 1504-1505, 1505-1507, 1509-1513, 1543, 1545
 temperature extremes, 1505-1507, 1545
 terrestrial systems, 1522-1524
 urban heat islands, 1532, 1533
 urban settlements, 1531-1533, 1532, 1544
 vulnerability, reducing in present, 1503
 vulnerability/risk, 1502-1503, 1504, 1508, 1516-1537, 1532, 1537, 1545, 1545
 water-borne diseases, 1532, 1532
 water management, 1530-1532
 water resources, 1502, 1516-1522, 1517-1518, 1519-1520, 1543, 1545
 water supply, 1502, 1516, 1521-1522, 1543, 1544
 yellow fever, 1536
- Cereals and grains**, 488, 491, 492, 497-499, 498
 in Central and South America, 1527-1530, 1528-1529
 in Europe, 1271, 1284, 1300
- Certainty**, 6, 7, 41
- Chagas disease**, 1536
- Change**
 abrupt changes, 16, 63, 64, 67, 276, 421-423
 institutional change, 1114
 irreversible (See tipping points)
 land use (See Land use change)

- Chikungunya fever**, 385, 723, 725, 736
- Child mortality**, 688
- Childhood undernutrition**, 731
- China**, 1332
- adaptive capacity in, 1116
 - coastal areas, 373
 - droughts, 1350
 - economic impacts, 1350-1351
 - exposure to storm damages, 1638
 - flood risk/adaptation, 24, 1346
 - forests, 1340
 - human health, 1347, 1349, 1353
 - income inequality, 802
 - precipitation, 1333
 - rice yields, 1343-1344
 - schistosomiasis, 727, 727
 - surface wind speeds, 1334
 - temperature, 1332, 1339
 - trade, 1353
 - transboundary pollution, 1353
 - typhoon-related losses, 682
 - water resources, 1337-1338
 - water-saving irrigation, 1116
 - See also Asia
- Cholera**, 415, 455, 726, 1536
- health care costs, 689
 - shellfish and, 726
 - in small islands, 1624
 - Vibrio cholerae*, 455, 726
- Ciguatera fish poisoning**, 455, 1624-1625, 1634
- Circulation**
- atmospheric, 190
 - oceanic, 1658, 1671
 - regional, 1162
- Cities**. See Urban areas
- Clean Development Mechanism (CDM)***, 797, 813-814, 1111
- afforestation/reforestation, 257
 - developing countries, 848-849
- Climate-altering pollutants (CAPs)***, 713, 714, 715, 716, 728, 728
- Climate change***, 3
- amplification of risks, 1057
 - commitment, 179
 - communication of understanding and risks, 171
 - core concepts and definitions, 3, 3-4, 5, 37-40, 85
 - detection and attribution of, 42, 979-1037
 - as driver of ecosystem changes, 256
 - impacts (See Impacts)
 - inaction, consequences and costs of, 326-327, 326
 - land use change and, 282
 - literature authorship, 38, 171
 - literature on, amount of, 38, 171, 172
 - magnitude and rate, adaptation and, 1121
 - observed impacts, 979-1037
 - perceptions of, 764, 1505-1507
 - Reasons for Concern, 12, 61, 983, 1013-1016, 1073-1080
 - as threat to sustainable development, 816, 1104, 1108-1113
 - uncertainty and, 254-255
 - See also Climate velocity; specific regions and systems
- Climate change scenarios**. See Scenarios
- Climate extremes**. See Extreme weather events
- Climate forecasting**, 643
- Climate models***
- CMIP3 and CMIP5*, 137-138, 178, 179, 240, 1143, 1454
 - downscaling, 1137-1138, 1159-1162
 - Earth System Models (ESMs)*, 282, 456
 - Global Climate Model (GCM), 370
 - ocean systems, 456-460, 457
 - regional, 1136, 1137-1138
 - Regional Climate Model (RCM), 370, 1162
- Climate policy**, 89-90, 171, 909, 922, 948-949
- culture and, 764
 - information for decision making, 171, 210-213
 - mainstreaming, 948
 - See also Adaptation; Governance/government; Mitigation
- Climate regulation**, 453, 456
- Climate-resilient pathways**. See Resilience: Climate-resilient pathways
- Climate scenarios***. See Scenarios
- Climate sensitivity***, 423-424, 450, 997
- Climate system***
- dangerous anthropogenic interference with, 11, 1043-1044, 1047, 1049, 1073
 - human interference with, 3, 12, 37, 61-62
- Climate variability***, 414, 419, 450
- human health and, 717-720
 - impacts of, 6
 - modes of*, 1162, 1180
 - net primary production and, 133
 - Ocean (region), 1658-1659, 1713
 - violence/conflict and, 1001-1002
- Climate velocity***, 15, 62, 67, 125, 126, 274, 296, 297
- Climatic drivers***, 240, 256
- in coastal systems, 364, 367, 368, 370-372
 - land use change, 274
- CMIP3 and CMIP5***, 178, 179, 1143, 1454
- regional assessments (CMIP5), 1143
 - regional projections (CMIP5), 137-138, 1159, 1159
 - See also Climate models
- Coastal squeeze***, 375, 376, 378, 1623
- Coastal systems and low-lying areas**, 17, 69, 361-409
- adaptation and risk management, 365, 386-396
 - adaptation costs and benefits, 17, 364
 - adaptation decision making and governance, 388-390, 389
 - adaptation implementation and practice, 390-392
 - adaptation measures, 387-388
 - adaptation opportunities, constraints, and limits, 922
 - adaptation options, economic evaluation of, 962
 - adaptation planning, 387
 - adaptation, successful projects, 365
 - adaptation trade-offs, 918
 - adaptive capacity, 373
 - agriculture, 384
 - aquaculture, 366, 384, 500-501
 - aquifers, 364, 379, 991
 - beaches, barriers, and sand dunes, 375-376
 - biodiversity, 376-377
 - carbon stocks, 394
 - climate change and, 374, 376
 - climate-related drivers, 364, 367, 368, 370-372
 - community-based adaptation, 390, 391
 - coral reefs, 378-379, 378
 - costs and socioeconomic aspects, 373, 382, 383
 - decision making for, 211
 - definition, 366-367
 - deltas, 147-148, 369, 380-381
 - detection and attribution, 386, 386, 989-991, 1007-1008
 - developed vs. developing countries, 364-365
 - drivers of change, 364, 367-374, 367, 368
 - erosion, 7, 17, 44-46, 69, 364, 376, 381, 386, 991
 - estuaries and lagoons, 379-380, 991
 - eutrophication, 364, 373, 380, 420, 465
 - exposure, 364, 372-373, 381
 - extreme events, 385
 - fisheries, 384
 - global mean sea level rise, 364, 366
 - groundwater, 246
 - habitat destruction, 375, 1707
 - human health, 385-386
 - human impacts, 364, 366, 375
 - human migration to, 373, 805
 - human population in, 17, 364, 372-373, 381, 386
 - human-related drivers, 372-374
 - human settlements and infrastructure, 364, 381-383, 382, 993
 - human systems, 381-386
 - hypoxia, 373, 420
 - impact and risk assessment approaches, 374-375
 - impacts, 364, 374-386, 375, 982, 991-993
 - industry, infrastructure, transport, and network industries, 383-384
 - information gaps, data gaps, and research needs, 363-366
 - infrastructure, 364, 383-384, 993
 - Integrated Coastal Zone Management (ICZM), 365, 366, 878
 - inundation, 374, 1707, 1712
 - invasive species, 364
 - key risks and vulnerabilities, 59, 1070
 - local sea level, 364
 - Low Elevation Coastal Zone (LECZ), 372
 - natural systems, 375-381
 - nutrients, 364, 373, 380
 - observed impacts, 7, 30-32, 48, 991-993, 1007-1008
 - ocean acidity and, 364, 368, 370, 372, 374
 - ocean temperature and, 364, 371-372, 379
 - planned retreat, 387, 389, 1375-1376
 - progress since AR4, 366, 368
 - protection, 364, 371, 387, 395
 - regional differences, 382
 - regional sea level, 364, 369
 - rocky coasts, 376-377, 992
 - runoff changes and, 364, 368, 372
 - salinity levels, 370, 379, 993
 - scenarios and models, 367
 - sea level extremes, 370, 991, 993
 - sea level rise, 7, 17, 364, 366, 367-370, 368, 374, 375, 379, 381, 385, 1669-1670, 1707
 - sea level rise, long-term commitment to, 394-395
 - sea surface temperature, 368, 371-372, 431
 - sediment amounts and distribution, 364, 369, 373-374, 379, 380
 - socioeconomic development, 372-373

- species abundance, distribution, and range shifts, 364, 376, 377, 378, 982
- storm surge, 147, 148, 364, 370, 381, 453
- storms, 364, 368, 370
- submergence/subsidence, 364, 368, 369, 374
- tourism and recreation, 364, 384-385
- upwelling, 149-152, 150, 364, 373, 994
- urban flooding in, 722
- vulnerabilities and risks, 60-62, 69, 364, 372-386, 453, 462-463, 1347
- wetlands and seagrass beds, 373, 377-378, 992, 1330
- winds and waves, 368, 371
- See also specific regions and countries*
- Co-benefits***, 28, 89-91, 180, 737-741, 742
- of adaptation, 89-91, 538, 578-579, 948, 1118
- coastal areas, 393
- of development, 948
- human health, 714, 737-741, 737, 738
- of integration of adaptation and mitigation, 1104
- of mitigation, 714, 737-741, 737, 738, 742
- trade-offs and, 1119
- in urban areas, 538, 578-579
- Coccolithophores***, 428, 440, 1681
- See also* Phytoplankton
- Cocoa**, 626-627
- Cod**, 461
- Coffee growing/production**, 506, 625, 626-627, 1528
- Cold-related mortality**, 721, 983
- Commercial sectors**, 662, 671
- Communicable diseases***. *See* Infectious diseases
- Communication tools**, 883
- Community-based adaptation***, 390, 391, 580-582, 582, 641, 1157
- adaptation experience, 53
- in small islands, 1146
- Compound risk**, 1042, 1057-1059, 1058, 1412
- Computable general equilibrium (CGE) model**, 671, 689, 1059
- Confidence***, 7, 177, 184-185, 186
- degree of certainty, 6, 7, 41
- See also* Uncertainty; *specific topics and executive summaries*
- Conflict**. *See* Violence and conflict
- Conservation**, 674, 1176
- conservation agriculture, 638
- ex situ*, 326
- Construction**, 27, 677
- traditional methods, 1637
- Copenhagen Accord**, 1115
- Coral bleaching***, 80, 98, 364, 378, 1621, 1689
- detection and attribution, 982, 992, 1014, 1014
- observed impacts, 378, 378, 414, 982, 992, 1014, 1014
- projections, 457, 465, 1628, 1659
- temperature and, 379, 457, 1689
- Coral reefs**, 97-100, 378-379, 431
- adaptation potential, 431
- in Asia, 1342
- in Australasia, 431, 1374, 1375, 1392-1393, 1395, 1413
- biodiversity, 1016
- in Central and South America, 1503, 1525, 1527, 1543, 1545
- compound risk, 1058, 1059
- Coral Reef Provinces (of Ocean), 1667, 1669
- cross-chapter box, 97-100
- degradation of, 1690
- economic impacts, 131
- emergent risks, 1054, 1058
- food production, 493, 1690
- geographic locations, worldwide, 1689
- Great Barrier Reef, 431, 1393
- habitat loss, 414
- interactive effects on, 416
- Mesoamerican Coral Reef, 1503, 1525
- observed impacts, 378, 982, 992, 992, 1014, 1014
- ocean acidification and, 16, 17, 98, 129, 131, 364, 368, 415, 436, 438, 1064, 1065
- potentially irreversible changes, 1017
- projected impacts, 16, 379, 457, 1659
- recreation and tourism value, 384
- responses to climate change, 414
- sea level rise and, 378
- services provided by, 99
- small islands and, 1616, 1621, 1628, 1635
- thermal stress, 63, 110, 1669
- vulnerability/risk, 63, 97, 364, 415, 1064, 1065, 1075
- See also* Coral bleaching
- Corals**
- calcification of, 99, 436, 441, 1042, 1064, 1065
- coral regions, 1689
- ocean acidification and, 364
- temperature and, 431, 457
- vulnerability/risk, 64, 1016
- warm- and cold-water corals, 16, 68, 431, 438, 441, 465, 1014
- Core concepts and entry points**, 3, 3-4, 85
- Corporations**, 566, 836
- Cost-benefit analysis**, 948, 956-957, 963
- See also* Adaptation costs and benefits
- Cost of Policy Inaction (COPI) Projects**, 326-327
- Costs**
- adaptation (*See* Adaptation economics)
- coastal systems, impacts, 382, 383
- computable general equilibrium (CGE) model, 671, 689
- extreme weather events, 633, 805, 982, 998, 1016
- freshwater resources/management, 233
- global adaptation costs, 949, 959-960, 959, 960
- health care, 687-689, 737
- residual cost, 952-953, 953
- social cost of carbon, 690-691, 691
- valuation of impacts, 617, 630-633, 632
- Crop insurance**, 54, 685, 1147
- Crop production**, 488-489, 491-493
- adaptation, 514-516, 514
- carbon dioxide effects, 487, 488, 507
- detection and attribution, 996-997
- emergent risks, 1059-1060
- models, 496
- observed impacts, 996-997
- ozone effects, 488, 493
- risks and vulnerabilities, 494-505
- See also* Food production systems
- Crop yields**, 17-18, 18, 65, 488-489, 491-493, 492, 997
- adaptation and, 514-516, 515, 516, 519
- aggregate impacts, 1016
- carbon dioxide effects on, 487, 488, 493, 494, 499, 506
- cereals and grains, 488, 491, 492, 497-499, 498, 621
- climate extremes and, 796
- emergent risks, 1054
- observed impacts, 4-6, 7, 491-493, 492, 616, 982
- ozone effects on, 488, 493
- pests, weeds, and diseases, 500, 506-507
- projected impacts, 17-18, 18, 69-70, 70, 505-507, 505, 506, 509-511, 623-624
- rural areas, 616, 629
- sensitivity to climate and weather, 497-502, 504-505, 504
- temperature and, 488, 492-493, 492, 497-499, 498, 516
- trade and, 629
- See also* Agriculture; Food production systems; *specific regions*
- Cross-chapter boxes**, 97-166
- coral reefs, 97-100
- ecosystem-based adaptation, 101-103
- gender and climate change, 105-107
- heat stress and heat waves, 109-111
- key risks and vulnerabilities, emergent risks, and hazards, 113, 114-121
- long-term resilience, 147-148
- marine biogeography, abundance, and phenology, 123-127
- net primary production in the ocean, 133-136
- ocean acidification, 129-131
- regional climate summary figures, 137-141, 138-140
- river flow regimes, 143-146
- tropical cyclones, 147-148
- upwelling ecosystems, 149-152
- urban-rural interactions, 153-155
- vegetation and water flows, 157-161
- water-energy/feed/fiber nexus, 163-166
- Crustaceans**, 16, 68, 415, 438, 465
- Cryosphere***
- Andean, 1502, 1517-1518, 1522
- detection and attribution, 982, 986-989, 987
- observed impacts, 982, 986-989, 987, 1003
- regional impacts, 1003
- See also* Polar regions
- Cultural and organizational theory**, 198, 204, 272
- Culture**
- adaptation and, 762-765, 764
- climate impacts and, 762-765, 764
- climate policy and, 764
- cultural constraints to adaptation, 915-916
- cultural landscapes, 318
- cultural services, oceans, 453
- cultural values, 71-72, 203-204
- human security and, 71-72, 758, 762-766, 764
- Cyanobacteria**, 439-440, 726
- Cyclones**. *See* Extratropical cyclones; Tropical cyclones
- D**
- Dams**, 275, 327, 1061-1062
- in Asia, 1110-1111, 1342, 1345, 1353, 1355
- in Egypt (Aswan High Dam), 252
- in USA, 1458
- in Vietnam, 1110-1111, 1355
- Dangerous anthropogenic interference (DAI)**, 11, 1043-1044, 1047
- Article 2 (UNFCCC), 1047
- definition of, 1049, 1073

- Dansgaard-Oeschger (DO) events**, 421-423
- Dar es Salaam**, 591-592
- Darfur, conflict in**, 773
- Dead zones***, 17, 373, 415, 420, 1676, 1693, 1709-1710
- Deaths**. See Mortality
- Decision making**, 9-11, 54-56, 195-228
- adaptation, mitigation, and sustainable development—linkage of, 216-218, 217, 388-390, 638, 1118
 - approaches, 199-200
 - assess-risk-of-policy framing, 208
 - assessment of impact, adaptation, and vulnerability, 213-214, 213, 837
 - behavioral sciences, 198, 199, 204
 - climate and climate change decisions, 200, 210, 214-216, 216
 - climate impacts, adaptation, and vulnerability, 204-214, 213
 - complexity in, 200-201
 - context for, 9-11, 54-56, 203-207
 - cultural and organizational theory, 198, 204, 272
 - cultural values, 199, 202, 203-204
 - decision analysis, 212
 - decision implementation, 212
 - decision review, 212
 - decision scoping, 212
 - downscaling, 211-212
 - economic barriers to, 955-956
 - in economic context of adaptation, 954-958, 954
 - economic evaluations as support for, 948
 - ethics, 198, 205-206
 - four-stage process of, 212
 - frameworks for, in ocean regions, 1661, 1711-1713, 1711-1712
 - geo-political dimension, 212-213
 - indigenous, local, and traditional knowledge, 758, 765-766
 - information for, 171, 210-213
 - institutional context, 206-207
 - key concepts, 199-203
 - knowledge transfer, 198, 213
 - language and meaning, 204-205
 - learning, review, and reframing, 209-210
 - methods, tools, and processes, 207-210, 922
 - multi-attribute decision theory, 209
 - multi-metric, 957, 957
 - opportunity space for, 181-182, 182
 - psychology and, 204
 - in regional context, 1136, 1139, 1140
 - resilience and, 182, 198, 216-217
 - risk/risk management and, 198, 199-202, 201, 202, 215
 - scale issues, 1118
 - scenario-based projections, 213
 - scenarios and, 198, 208
 - social context, 203-206
 - stakeholder involvement in, 199, 209, 254, 837
 - sustainability and, 198, 216-218, 217
 - trade-offs, 208-209, 216, 217
 - transformational adaptation, 198, 217-218
 - uncertainties and, 56, 198, 207-208, 1386-1387
 - with uncertainty, 9, 956-958
 - wicked problems, 200-201, 208, 211
- Decision support**, 26, 87, 198, 202-203, 210-216
- climate information and services, 210-213
 - tools, 883, 902
 - in water resources, 255
- Deforestation***, 283, 284, 1016
- in Amazon basin, 276, 284, 310, 1502, 1503, 1509-1510, 1514-1515, 1514, 1522-1523, 1535
 - avoided, 1540
 - carbon release by, 276
 - in Central and South America, 276, 284, 310, 1502, 1503, 1509-1510, 1514-1515, 1514, 1522-1523, 1535, 1540
 - REDD payments, 617, 630, 641, 797, 814, 965, 1111, 1119
 - reduction in, 276, 302, 1522-1523
- Delta Programme**, 391
- Delta Works**, 365
- Deltas**, 369, 380-381
- cities in, compound risk, 1058, 1059
 - tropical cyclones and, 147-148, 148
- Dengue fever**, 385, 723-725, 723, 731
- in Asia, 723, 723, 1348
 - in Caribbean, 724
 - climate-related factors and, 723
 - in Europe, 723
 - intervention to control, 724
 - near-term future, 725-726
 - in small islands, 1624
 - thermal tolerance of vectors, 736
 - vectors, 725, 736
- Deserts/desertification***, 312
- in Africa, 1205, 1209, 1210, 1213, 1214, 1215, 1234
 - in Asia, 1330, 1339, 1344
 - in Europe, 1275
- Detection and attribution***, 7, 42, 979-1037
- aggregate impacts, 1015, 1016
 - anthropogenic climate change, 982, 1502
 - assessing all climate change aspects, 1017
 - attribution, 986
 - attribution, challenges of, 1018
 - attribution of a single event, 1018
 - attribution to climate change, 7, 42
 - attribution to precipitation changes, 982
 - attribution to warming, 982
 - biological systems, 1015
 - cascading impacts, 983, 1012, 1013
 - challenges, 986, 1018
 - coastal systems, 991-993, 1007-1008
 - conclusions, 188-189, 1016-1017
 - confidence, 7, 184-185
 - coral bleaching, 992, 992
 - crop production, 996-997
 - cryosphere, 986-989, 987
 - definitions, 985-986
 - detection, 985-986
 - differences in land and ocean systems, 995
 - economic impacts, 997-998
 - extreme weather events, 998-1000, 999, 1014, 1014
 - food production systems, 996-997, 1017
 - freshwater resources, 986-989, 987
 - gaps, research needs, and emerging issues, 983, 1017
 - human and managed systems, 996-1003, 1009-1010, 1015, 1017
 - human interference with climate system, 3, 12, 37, 61-62
 - hydrological systems, 986-989, 987, 1013, 1015, 1016
 - impacts attributed to climate change, 30-32
 - importance of, 1017
 - indigenous people, 983, 1001, 1002, 1003, 1014
 - methodological concepts, 984-986, 985
 - natural systems, 986-996, 1014, 1015
 - new evidence, 982
 - ocean ecosystems, 993-996, 993, 994, 995, 1007-1008
 - phenology, 989
 - physical systems, 982, 984, 994, 1011, 1012
 - quantitative synthesis assessment, 986
 - Reasons for Concern, 983, 1013-1016
 - regional impacts, 30-32, 1001-1030, 1003-1010
 - of single weather events, 998-1000, 1018
 - terrestrial and inland water systems, 989-991
 - terrestrial ecosystems, 982, 983, 989-990, 1005-1006, 1017
 - traditional ecological knowledge and, 1001
 - water resources, 982, 986-989, 987
- Developed countries***, 181
- adaptation experience, 51
 - poverty in, 796
- Developing countries**, 181
- adaptation experience, 51
 - adaptation in context of development path, 948
 - coastal area impacts/costs, 364
 - ocean systems and, 416
 - poverty in, 616, 623, 796, 797
 - rural poverty, 616, 623
 - sea-level rise, costs of, 364
- Development**
- adaptation and, 816, 882, 948, 954
 - adaptive capacity and, 1111
 - alternative development pathways, 1044, 1052, 1072-1073
 - ancillary or co-benefits, 948
 - Clean Development Mechanism (CDM), 797, 813-814, 848-849, 1111
 - climate-resilient development pathways, 818
 - of coastal areas, 364
 - country development terminology, 181
 - economic (See Economic development)
 - equity issues, 1351
 - greener, 180-181
 - Human Development Index (HDI), 720
 - inequalities and, 40
 - integrating with climate policies, 1111-1112
 - mitigation and, 1109, 1114-1115
 - pathways, 563-566, 1052, 1109
 - pathways of countries, 948
 - policy, climate change and, 1110
 - transformative, 538
 - See also Sustainable development
- Diarrheal diseases**, 689, 726, 727
- Diatoms**, 726
- Dinoflagellates**, 439, 726
- Disadvantaged populations***, 796, 798, 799, 801-802, 806, 808
- Disaster risk management (DRM)***, 27, 881-882
- adaptation and, 836, 871
 - community-based programs, 734
 - early warning systems, 734, 872, 877, 878, 883-885, 1145
 - insurance and, 686, 797
 - lessons from, 817
- Disaster risk reduction (DRR)***, 91, 148, 390, 565-566, 565, 1296
- Hyogo Framework for Action, 14, 217

Disasters*

- education on, 733
- health care treatment during, 687-688
- preparedness programs, 714, 733
- SREX report, 680
- See also Extreme weather events; *specific disasters*

Discount rates, 959**Diseases**, 19-20, 713, 717-720

- age and gender and, 717-718
- air quality and, 727-730
- in Central and South America, 1503, 1532, 1532, 1535-1536, 1536, 1543, 1545
- cholera, 415, 455, 726, 1536
- climate change variability and, 717-720
- in coastal regions, 385
- current status, 717
- diarrheal, 726, 727
- early warning systems, 734
- floods and windstorms and, 722
- food production and, 500, 506-507
- mosquito-borne, 722-726, 723
- near-term future, 725, 727
- ocean systems and, 415, 431
- parasites, bacteria, and viruses, 726-727
- projected changes, 713, 725, 727
- rodent-borne diseases, 725, 1000
- in small islands, 1624-1625
- spatial distribution of, 713
- tick-borne, 722, 723, 725
- in urban areas, 556
- vector-borne, 713, 722-726, 723
- vulnerability to, 717-720
- water-borne, 713, 726-727
- zoonotic, 725, 726
- See also Human health; Infectious diseases; *specific diseases*

Displacement, 72

- forced, 736, 1175-1176
- health risks, 736
- numbers of people displaced, 768
- permanent, sea level rise and, 770, 770
- See also Migration, human

Distribution of benefits (of mitigation), 1111**Distribution of impacts**, 12, 61, 241, 254, 1015, 1044, 1045, 1077

- ethical issues, 955-956

Distribution of species. See Species distribution**Disturbance regimes***, 276, 277, 290

- abrupt changes and, 276
- fire, 290, 314, 317
- observed changes, 276, 290
- projected changes, 276
- See also Fires; Insect pests

Downscaling*, 211-212, 241, 1137-1138**Droughts***, 232, 247-248

- agricultural, 232, 247-248, 247
- conclusions of AR4, 189
- detection and attribution, 44-46
- dryness, 81-84
- extreme events, 247-248, 248
- frequency and severity, 247-248, 247
- impacts, 248
- meteorological, 232, 247-248, 247
- migration and mobility outcomes, 769-770
- observed and projected changes, 1165-1170
- observed impacts, 7, 30-32, 44-46, 239-240, 620
- projected changes, 232

- rural areas, 616, 620-621
- urban areas, 538, 552, 555
- vulnerability/risk, 60, 63, 1070-1071
- wildfires and, 721
- See also *specific regions*

Dryland ecosystems, 308-312**Dryness**, 81-84**Durban, adaptation in**, 573, 592-593**Dust, airborne transcontinental**, 1616, 1633**Dynamic Global Vegetation Models (DGVMs)***, 305**E****Early warning systems***, 734, 872, 876, 878, 883-885, 1145, 1448, 1466, 1538

- adaptation experience, 52

Earth system, 985, 986, 1084

- Earth System Models (ESMs)*, 282, 456
- large-scale interventions, 1114, 1121
- potential tipping points in, 1016

East China Sea, 1686-1687**Echinoderms**, 415, 438, 439, 465, 1633-1634**Ecological sustainability***, 552**Economic costs of climate change**, 326-327, 326

- valuation of impacts, 617, 630-633, 632

Economic development, 662, 679, 688

- human health and, 713, 720

Economic goals, trade-offs with environmental goals, 1118-1119**Economic growth**, 663, 691-692, 997

- climate-resilient pathways and, 1114-1115
- conflict with environmental management, 1118
- human health and, 713
- Malthusian ideas, 1118

Economic instruments, 26, 87, 948-949, 963-966**Economic sectors and services**, 19-20, 50, 70-71, 659-708

- adaptation potential, 62-73
- aggregate impacts, 690, 690
- aquaculture, 676
- charges, 965-966
- climate change impacts on, 662, 690, 690, 997-998
- commercial sectors, 662, 671
- construction and housing, 677
- crop and animal production, 676
- detection and attribution, 997-998
- economic development, 662, 679, 688
- economic growth and productivity, 663, 691-692
- economic impact estimates, global, 663
- economic welfare, 662, 664
- electricity grids, 669, 669
- energy, 664-672, 693
- extreme weather events and, 50
- financial services, 680, 686-687
- fisheries, 676
- forestry and logging, 676
- health and health care, 663, 687-689, 693
- impacts on markets and development, 689-693
- insurance, 663, 680-687, 693
- key risks, 59-60, 59-62, 64-65
- macroeconomic impacts, 669-672, 670-671
- manufacturing, 677
- markets, 663, 688, 689-690, 690
- mining and quarrying, 676
- pipelines, 71, 668, 669, 675
- poverty traps, 692

- projected impacts, 70-71
- public-private partnerships, 686, 686
- recreation, 677-678
- research needs and priorities, 663, 693-694
- residential sectors, 662, 671, 676
- social cost of carbon, 690-691, 691
- summary, 692-693, 693
- supply and demand, 662, 664, 679
- tourism, 663, 677-679, 693
- transport, 662, 674-676, 693
- transport infrastructure, 662
- vulnerability, 664, 688
- water infrastructure, 662, 672, 693
- water services, 672-674, 693
- water supply, 662

Economic welfare, 662, 664**Economics**, 27, 945-977

- of adaptation (See Adaptation economics)
- analysis in face of uncertainty, 949
- economic analyses, desirable characteristics in, 949, 963
- economic instruments, 26, 87, 948-949, 963-966, 965
- global economic risk and impacts, 63, 71
- green fiscal policies, 90
- incentives, 949, 963-966
- macroeconomic analysis, 963
- multi-metric evaluations, 948, 957, 957
- PESETA project, 1059
- REDD payments, 965
- See also Markets; Socioeconomic impacts; *specific systems and regions*

Ecosystem-based adaptation*, 101-103, 836, 846-847

- adaptation options, 845
- in coastal systems, 388
- costs of, 393
- cross-chapter box, 101-103
- in Durban, 573, 592-593
- payment for ecosystem services (PES), 641-642, 964, 1523, 1540-1541, 1541
- processes in, 102
- in rural areas, 641-642
- in urban areas, 539

Ecosystem degradation, 276**Ecosystem services***, 319-321, 319, 659-708

- degradation of, 276
- economic costs related to, 326-327, 326
- emergent risks, 1042, 1053-1054, 1054
- ocean systems, 414, 452-453, 461-465
- payment for (PES), 641-642, 949, 964, 1523, 1540-1541, 1541
- projected changes, 274
- risks from large temperature increase, 63
- species composition and seasonal changes and, 274
- in urban areas, 538, 572-575
- valuation of, 956-957
- See also Economic sectors and services

Ecosystems*, 271-359

- abrupt changes in, 276
- adaptation and thresholds, 278-279, 321-328
- adaptation capacity, 277
- boundaries of, 278
- carbon dioxide effects on, 287
- climate change, effects of, 319
- degradation, 276
- detection and attribution, 42
- drivers of change, 274

- dynamic and inclusive view of, 278-290
 economic costs of climate change, 326-327, 326
 emerging issues, 328
 GHG and climate change impacts on, 249
 human influence on, 278
 impacts/risks for major systems, 301-319, 302
 key issues risks, 1058, 1071
 management, 27, 453-454, 456
 multiple stressors, 276, 283-290
 observed impacts, 7, 30-32, 42-43, 982
 paleoecological evidence, 279-282
 projected impacts, 274-277
 properties of, 278
 protected areas, 324
 regime shifts, 454
 restoration of, 324
 services (See ecosystem services)
 thermal tolerance, 432
 thresholds, 278-279
 tipping points, 276, 278-279, 309-310, 316-317
 uncertainties, 328
 vulnerability/risk, 274-277, 290-321, 302, 1071
 See also Biodiversity; Freshwater ecosystems; Marine ecosystems; Terrestrial ecosystems
- Education**, 720, 731
 access to, 19, 27, 70, 73, 154, 625
 disaster education, 733
 gender and, 39, 73, 105, 106
 health education, 734
 higher education, 1352
 long-term resilience and, 148
 options in, 27, 52
 in rural areas, 70, 618, 625
- Egypt, Aswan High Dam**, 252
- El Niño Southern Oscillation (ENSO)***, 1162
 agriculture effects, 632
 in Australasia, 632, 1377
 conclusions of AR4, 191
 droughts, correlation with, 239-240
 economic impacts, 632
 marine ecosystems and, 421
 projected changes, 1162
- Elderly populations**
 disproportionate impacts on, 47-48
 health and, 717-718, 719, 720
 in North America, 1451, 1452
 vulnerability of, 47-48, 717-718, 809
- Electric power**, 566, 571, 671-672
 brownouts and blackouts, 558
 decarbonization of, 1353
 outages, 737
 prices of, 671-672
- Electricity grid**, 71, 669, 669
- Emergent risks***, 59-60, 117, 1039-1099
 alternative development pathways and, 1044, 1052, 1072-1073
 assessing, 1052-1053
 biofuel production, 1055-1056, 1056
 biophysical impacts, 1043, 1072
 carbon dioxide health effects, 1064-1065
 climate change amplification of risks, 1057
 compound risk, 1042, 1057-1059, 1058
 conflict and insecurity, 1042, 1060-1061
 criteria for identifying, 1052
 crop production, prices, and food insecurity, 1059-1060
 cross-chapter box, 113, 114-121
 definition of, 1049
 ecosystem services, 1042, 1053-1054, 1054
 examples of, 1053-1059, 1054, 1070-1071
 framework for, 1050-1053
 geoengineering, 1043, 1065-1066
 hazards, vulnerabilities and, 1070-1071
 health effects, 1056-1057, 1064-1065
 human migration, 1042, 1060
 impacts of adaptation, 1060-1061
 indirect, trans-boundary, and long-distance impacts, 1042-1043, 1059-1062, 1062
 interactions of systems, 1042, 1046
 management of water, land, and energy, 1042, 1054-1056, 1056
 mitigation for risk management, 1080-1085, 1081
 mitigation, unintended consequences of, 1042-1043, 1059, 1060, 1061-1062
 multiple interacting systems and stresses, 1053-1059
 new developments, 1049-1050
 newly assessed risks, 1062-1066
 ocean acidification, 1043, 1064, 1064, 1065, 1071
 previous assessments, 1046-1047, 1053
 Reasons for Concern, 1049, 1073-1080
 species range shifts, 1042, 1061
 summaries, 1042-1045
 temperature rise beyond 4°C above preindustrial, 1062-1064
- Emissions reduction, co-benefits**, 714, 737-740
- Endemic species**. See Biodiversity
- Energy**, 664-672, 666
 adaptation, 571
 adaptation options, economic evaluation of, 962
 efficiency, 91
 electricity grid, 71, 669, 669
 macroeconomic impacts, 669-672, 670-671
 pipelines, 71, 668, 669
 transport and transmission of, 668-669, 671
 water-energy/feed/fiber nexus, 92-93, 163-166
- Energy access**, 817
- Energy supply**, 665-668, 666, 693
 adaptation options, 665-667, 666, 737
 biofuels (See Biofuel production)
 biomass, 320
 brownouts and blackouts, 558
 climate impacts, 997-998
 coal fuel, 668
 detection and attribution, 997-998
 electric power, 566, 571, 669, 669, 671-672
 emergent risks, 1042, 1054-1056, 1056
 extreme weather events and, 666, 671
 hydropower, 252, 257-258, 666, 667
 impacts on sources and technologies, 662
 nuclear power, 662, 666, 667
 in Ocean regions, 1660, 1705
 offshore, 1660, 1705
 oil and gas, 668
 possible impacts, 666
 renewable energy (See Renewable energy)
 in rural areas, 617
 solar power, 327, 666, 667-668
 thermal power, 252, 662, 665-667, 666
 tidal power, 1660
 in urban areas, 558, 571
 water for, 92-93, 163, 164, 252, 662
 wind power, 327, 630, 666, 668
- Energy use/demand**, 664-665, 672, 693
 for cooling and heating, 662, 693
 demographics and, 662
 economic impacts, 669-672, 670-671
 governance of, 630
 temperature and, 665, 672
- Engineered adaptation options**, 836, 845, 846
 See also Geoengineering
- Engineering and built environment***, 845, 846
- ENSO**. See El Niño Southern Oscillation (ENSO)
- Enterovirus infection**, 726
- Environmental adaptation needs**, 840-841
- Environmental goals, trade-offs with economic goals**, 1118-1119
- Environmental vulnerability**, 1068
- Equity**, 926, 1119
 in adaptation choices and decisions, 948
 in adaptation economics, 955-956
 equitable development, 1351
 equity weighting, 926
 See also Inequality
- Erosion**
 beaches, 1524, 1525, 1620, 1624
 in coastal systems, 17, 44-46, 69, 364, 376, 381, 386, 991
 observed impacts, 988-989
 soil, 233, 237-239, 246
- Estuaries**, 379-380
- Ethanol/bioethanol**, 1110, 1533, 1534
- Ethics**, 180, 925-927, 926
 adaptation and, 903, 925-927, 926
 in decision making, 198, 205-206
 and distributional issues in adaptation economics, 955-956
 equity concept, 926
 equity weighting, 926
 moral hazard, 964
- Europe**, 74, 1267-1326
 adaptation, 8, 22, 51, 53, 1270, 1271, 1273, 1295-1298, 1295, 1297, 1302
 adaptation costs, 1271, 1273, 1297-1298, 1297
 adaptation limits, 922, 1270, 1298, 1298
 adaptation, unintended consequences, 1273, 1298-1300
 adaptive capacity, 1273
 agriculture, 1271, 1284-1286, 1285, 1286, 1299, 1302-1303, 1304
 air quality, 1272, 1293-1294
 alpine region, 1274, 1274, 1301
 Atlantic region, 1274, 1274, 1301
 avalanches, 1281
 banking, 1283
 biodiversity, 1289, 1294-1295, 1297, 1299-1300, 1300, 1304
 bioenergy production, 1288-1290, 1299, 1304
 biological conservation, 1299-1300
 built environment, 1281, 1303
 cereal, 1271, 1284, 1300
 coastal regions, 1270, 1279-1280, 1294-1295, 1305
 coastal zone management, 1296
 co-benefits of adaptation and mitigation, 1298-1300
 conclusions from previous assessments, 1274-1275
 continental region, 1274, 1274, 1301
 crop yields, 510, 1270, 1271, 1302-1303
 cultural heritage, 1272, 1292-1293, 1301, 1303
 current and future trends, 1275-1279

- detection and attribution, 44, 1003-1009, 1006, 1303, 1304
- disaster risk reduction, 1296
- diseases and vectors, 723, 1272, 1288, 1303, 1305
- droughts and dry spells, 247, 625, 1278, 1279, 1280
- economy/economic impacts, 1270, 1271, 1297-1298, 1297
- ecosystem impacts, 1294-1295
- ecosystem services, 1270, 1288-1289
- energy, 1271, 1282-1283, 1282, 1301, 1303
- environmental quality, 1293-1295, 1299-1300, 1301, 1304
- EuroHEAT project, 734
- European Climate Change Oscillation (ECO), 1159-1161
- extreme events, 42, 1270, 1276-1279, 1280, 1301-1302
- fires, 999, 1287-1288, 1287
- fisheries and aquaculture, 1290, 1304
- flood damages, 633, 673, 1270-1272, 1280, 1304
- flood defenses, 53, 1146, 1157
- flooding, 239, 1270-1271, 1279-1281
- food production, 1284-1286, 1285, 1305
- forestry, 1287-1288, 1299
- forests, 311, 1270, 1272, 1287-1288
- glaciers, 243, 988, 1304
- grasslands, 318
- heat waves, 720, 721, 729, 999, 1278, 1280, 1290-1291
- human health, 1270, 1272, 1293, 1299
- impacts by sector, 1270-1272, 1279-1295, 1301
- impacts by sub-region, 1301
- infrastructure, 1270, 1291, 1302
- insurance, 1283
- integrated water resource management, 1296
- inter-regional implications, 1303-1304
- intra-regional disparity, 1270, 1303
- irrigation, 1271, 1275, 1284, 1286
- key risks, 22, 77, 118
- knowledge gaps and research needs, 1304-1305
- lakes, 313
- land degradation, 1293
- land use planning, 1296-1297
- livestock, 511, 1286
- manufacturing and industry, 1283
- marine ecosystems and species, 1272
- mitigation policy, 1298-1299
- non-climate trends, 1275
- Northern region, 1274, 1274, 1301
- observed changes, 81-82, 1270, 1275-1277, 1303, 1304
- observed impacts, 30, 44, 1003-1009, 1006
- ozone, 1272
- phenology, 1270
- plant pests, 1272
- policy frameworks, 1274
- precipitation, 81-82, 1276, 1277, 1279
- projected changes, 74, 81-82, 1270
- projected climate change, 1276-1279, 1277-1278
- protected areas, 324
- range shifts, 1272
- risk management, 1296
- rural development, 1297, 1302
- sea level rise, 1270-1271, 1272, 1279
- settlements, 1279-1281, 1301
- shrublands and grasslands, 311
- social welfare, 1290-1293, 1299, 1301
- soil quality, 1293
- Southern region, 1274, 1274, 1301
- sub-regions, 1274, 1274, 1301
- synthesis of key findings, 1300-1306
- temperature, 81-82, 1271, 1275-1276, 1278, 1280
- terrestrial and freshwater ecosystems, 1294, 1303
- tourism, 253, 384-385, 679, 1271, 1283
- transport, 1271, 1281-1282, 1301
- vulnerabilities, 1300-1303, 1301
- water quality, 1294
- water resources, 250, 250, 1286, 1296, 1302
- windstorms/wind speed, 1279, 1281
- wine production, 1271-1272, 1292
- Eutrophication***, 257, 313, 415, 420
- in coastal areas, 364, 373, 380, 465
- Evapotranspiration**, 157-161, 257
- CO₂ effects on, 307
- drivers of change, 240-241
- feedbacks, 274
- observed impacts, 236, 294
- projected changes, 241-243
- Evolutionary adaptation***, 322-323, 415, 426
- Ex situ conservation**, 326
- Exposure***, 3, 26, 1043, 1051, 1074
- adaptation examples, 1145-1148
- climate change and, 1042, 1074
- in coastal systems, 364, 372-373, 381
- definition of, 39, 1049
- differential, 1066-1067
- interactions of, 1046
- observed impacts, 40-51
- trends in, 1067
- in urban areas, 556-560
- Externalities***, 1119
- Extinction**
- climate change and, 295
- extinction debt, 301
- global, 299-300
- keystone species, 295
- in marine ecosystems, 451
- mass, 427
- observed impacts, 295, 299-300, 982
- in ocean systems, 451, 456
- projected changes, 14-15, 275, 300-301
- regional, 451
- risk, 14-15, 63, 64, 67, 275
- Extratropical cyclones***, 368, 1333-1334, 1447, 1454, 1459
- effects on small islands, 1632
- Extreme climate events**. See Extreme weather events
- Extreme sea level**. See Sea level change; Storm surge
- Extreme weather events***
- in Australasia, 721, 1374, 1380-1381
- climate extremes, adaptation to, 91
- conclusions of AR4, 189-190
- costs of, 633, 805, 982, 998, 1016
- detection and attribution, 620-621, 998-1000, 1014, 1014
- detection and attribution of single events, 998-1000, 1018
- in Europe, 1276-1279, 1280
- floods, 236, 247-248, 248
- heat waves and temperature extremes, 189, 720-721
- human health and, 663
- hydrological events, 236
- importance of understanding, 84
- insurance and, 663
- in North America, 1443-1445, 1447, 1450, 1470, 1472, 1478
- observed impacts, 6, 40-42, 998-1000, 999, 1014, 1014
- in ocean systems, 453
- poverty and, 802
- precipitation, 1162-1163, 1163-1170
- projected changes, 1162-1171, 1163-1170
- psychological effects, 805
- Reasons for Concern, 12, 61, 1014, 1014, 1044, 1076
- recent disasters, 999
- regional projections, 1162-1171, 1163-1170
- risks associated with, 1014, 1014, 1045, 1058, 1069
- in rural areas, 616, 620-621, 623, 633
- SREX report, 187-188, 247, 620, 680, 1047-1049, 1163-1164
- temperature, 60, 1070-1071, 1162, 1163-1170
- in urban areas, 548, 559, 568
- vulnerability/risk, 59, 1070
- See also Droughts; Floods; Heat waves; Hurricanes; and specific systems and regions
- Extremes, climate, adaptation to, 91**
- F**
- FACE (Free Air CO₂ Enrichment) studies**, 287, 288, 495, 499
- Family planning services**, 740-741, 742
- Farming**. See Agriculture; Crop yields
- Fifth Assessment Report**, 175, 176-182, 176-177
- context for, 4, 38-39
- core concepts, 3, 3-4, 85
- literature and authorship, 38, 171
- Financial flows**, 1171-1172
- Financial markets**. See Markets
- Financial services**, 680, 686-687
- adaptation constraints, 914-915
- adaptation finance, 392, 843-844, 845, 848-849, 878-881
- adaptation finance, distribution of responsibilities, 952, 952
- adaptation finance, eligibility for, 952, 952
- climate change impacts on, 680, 687
- risk-based capital, 684
- risk financing, 686, 949
- weather risks, products responding to, 684-686, 685
- See also Insurance
- Fire disturbance regime**, 290, 314, 317
- Fires**
- in Australasia, 721, 1374, 1375, 1381, 1400, 1408, 1413
- carbon emission from, 276
- in Europe, 1287-1288, 1287
- in North America, 1460-1461, 1477
- observed changes, 7, 276, 304
- projected changes, 303, 304
- smoke-related health effects, 721, 729
- wildfire management, 276
- See also Forest fires

First Assessment Report (FAR), 174, 175**Fish**

- biomass reduction, 416
 - body size, 414, 458, 459
 - carbon dioxide effects on, 441
 - distribution and range shifts, 295, 384, 414, 451
 - extinctions, 300
 - habitat fragmentation, 327
 - ocean acidification and, 415, 438, 676
 - projected impacts, 415-416, 507-508, 507
 - thermal windows for, 427-428, 427
 - tuna, 507, 1629
 - upwelling and, 149
 - water temperature and, 295, 429-430
- Fisheries**, 68-69, 69, 452-453, 676, 1681
- adaptation, 489, 516-517, 519-520, 642
 - artisanal, 637, 644
 - catch potential, changes in, 124, 414-415, 459, 461
 - coastal area impacts, 380, 384
 - detection and attribution, 997
 - exploitation and overfishing, 69, 452, 456
 - food security and, 414-415
 - high-latitude, 414, 508
 - management, 456, 516
 - marine, 16, 18, 68-69, 69, 1659-1660, 1663, 1699, 1701-1704, 1707-1708, 1708
 - marine capture, 1701
 - observed changes, 384, 493, 997
 - pelagic, 150, 384, 435, 1016, 1702, 1708
 - in polar regions, 1584, 1590-1591
 - production by, 150, 416, 489, 493
 - projected impacts, 16, 68-69, 69, 384, 452-453, 457-459, 458, 465, 507-508, 507
 - in rural areas, 627-628, 632-633, 637, 642, 644
 - shellfish, 64, 1701
 - in small islands, 1616, 1621, 1629
 - small-scale, 1702-1703
 - spatial shifts in species, 414-415, 493, 994
 - tuna, 507, 1629
 - UN Straddling Fish Stocks Agreement (UNSFSA), 1713
 - valuation of, 452, 632-633
 - vulnerability/risk, 68-69, 416, 452, 500-501, 516, 1699

Floods*

- adaptation, 52, 962, 1146
- conclusions of AR4, 189
- costs, 633
- detection and attribution, 44-46
- economic impacts, 673
- extreme events, 234, 247-248, 248
- flash floods, 805
- flood defenses, 1146, 1157, 1181, 1297
- frequency and severity, 66, 232, 239, 247-248, 247, 248, 722
- hazards of, 232, 240, 242, 247, 247, 1070
- health impacts, 721-722
- impacts, 59, 248
- inland, 59
- insurance, 885
- mental health impacts, 722
- migration and mobility outcomes, 769-770
- observed changes, 7, 30-32, 44-46, 232
- projected changes, 247
- projected frequency of 100-year floods, 248
- projected impacts and interactions, 232, 247, 248

- risk reduction, 1145
- river floods, 721
- in urban areas, 319, 538, 555-556, 557-558, 804, 962
- vulnerability/risk, 1070
- See also *specific regions*

Flows

- flow-on effects, 1408-1410
- river flow regimes, 143-146
- water flows, vegetation and, 157-161
- See also *Streamflow*

Food access, 488, 502-503, 503, 763**Food aid**, 734**Food-borne infections**, 726-727**Food crops**, 616, 623-625

- See also *Agriculture; Crop yields*

Food/feed/fiber, energy and water for, 92-93, 163-166**Food prices**, 491, 494, 495, 568

- biofuel production and, 815
- emergent risks, 1059-1060
- food-price shocks, 763
- health impacts, 730
- increases in, 6-8, 796, 797, 802, 812
- links to climate, 763
- poverty and, 796, 797, 802
- projected impacts, 512-513, 623, 625

Food production systems, 17-18, 30-32, 49-50, 485-533

- adaptation, 489, 513-520, 922
- adaptation barriers and limits, 518
- adaptation case studies, 518-519
- adaptation, facilitating, 518
- adaptation, key findings and confidence levels, 519-520
- aquaculture, 488, 500-501, 508, 516
- assessment methods, 494-497
- carbon dioxide effects on, 251, 488, 493, 494, 495, 499, 506
- in Central and South America, 1503, 1527-1531, 1528-1529, 1544, 1545
- coral reef ecosystems, 493
- crop models, 496
- crop production, 488, 491-493, 505-507, 505, 519, 982
- crop yields (See *Crop yields*)
- detection and attribution, 44-46, 491-494, 996-997, 1017
- diversification of, 515
- drivers, 490
- extreme events and, 503, 507
- fisheries, 452-453, 489, 493, 500-501, 507-508, 507, 516-517, 519-520
- food processing, 489
- food quality, 501-502
- food security and, 494
- food systems, 490, 490
- high-latitude regions, 488, 508
- human health and, 501-502
- impact assessment, 494-505
- indigenous knowledge, 517, 520
- key risks, 114, 1058, 1069-1070
- land use and, 504-505, 504, 507
- limits to food production, 736
- livestock, 494, 502, 508-512, 517, 519-520
- observed impacts, 7, 30-32, 44-46, 49-50, 488-489, 491-494, 982, 996-997, 1017
- ocean acidification and, 507

- oceans and marine ecosystems, 452-453, 456
- ozone effects on, 488, 493, 499
- phenology, 499
- precipitation and, 488, 489
- projected impacts, 17-18, 18, 488-489, 505-513, 509-512
- sensitivity to weather and climate, 497-502, 504-505, 504
- smallholders, 503
- summary from AR4, 491
- temperature and, 488, 489, 492-493, 492, 516
- trade-offs, 489
- tropical bearing crops, 625, 626-627, 641, 1528
- vulnerabilities and risks, 494-505
- water-energy/feed/fiber nexus, 92-93, 163-166
- water use, 251-252, 516-517
- weeds, pests, and disease, 488, 500, 506-507
- See also *Agriculture; Crop yields*

Food security*, 18, 49-50, 69-70, 485-533

- adaptation and, 514-516, 514, 519
 - adaptation case studies, 518-519
 - in Asia, 1343-1346, 1344, 1354
 - current state of, 490-491
 - drivers and responses, 490
 - droughts and, 494, 515
 - emergent risks, 1059-1060
 - extreme events and, 503
 - fisheries and, 414-415, 493, 507-508, 507
 - food access, 488, 502-503, 503
 - food availability, 763
 - food deficits, 629
 - food demand, 489
 - food insecurity, 490-491
 - food prices and, 491, 494, 495, 512-513, 568, 623, 625, 763
 - food production and, 494
 - food quality and, 501-502
 - health vulnerabilities, 713
 - impacts on, 488-489
 - indigenous knowledge, 517, 520
 - key risks, 114, 519, 1058, 1069-1070
 - links to climate, 763
 - nutrition/nutrients, 488, 490, 501-502, 507
 - poverty and, 491, 797
 - price stability, 488
 - price volatility, 491, 495, 513
 - projected impacts, 18, 69-70, 488-489, 512-513
 - research and data gaps, 520
 - in rural areas, 616, 623-625, 628-630
 - sensitivity to weather and climate, 502-504
 - stability, 503
 - temperature increase and, 63, 489, 736
 - undernutrition and, 713
 - in urban areas, 539
 - utilization, 503-504
 - vulnerability/risks, 60
 - water resources and, 232
- Food webs**, 448, 449
- in coastal areas, 380
 - marine, 424, 448, 449, 459-460
 - ocean acidification and, 131
 - phytoplankton and, 424, 448, 451
 - tundra, 1016
- Foraminifera**, 415, 440
- Forest fires**, 1016
- air pollutants from, 721, 729
 - in Europe, 1287-1288, 1287
 - health effects of, 721, 729

- in North America, 1460-1461
 observed changes, 304
 projected changes, 304
 in Russia (2010), 305, 729, 999
 See also Fires
- Forestry**, 320, 325, 676
 adaptation, 962
 in Asia, 1340
 in Australasia, 1393-1396
 in Europe, 1287-1288, 1299
 FACE studies, 287, 288, 495, 499
 management and adaptation, 640-642
 in North America, 1460, 1471, 1472, 1477
- Forests**, 301-307
 afforestation, 233, 257, 284, 317, 321
 Amazon, 276, 284, 310, 982, 990-991
 biomass, 989-990
 boreal, 303-305
 as carbon sink/source, 301, 305, 320
 carbon stocks, 293-294
 conversion to non-forest, 283
 deforestation (See Deforestation)
 dieback, 15, 66, 276, 306-307, 1016
 insect infestations/damage, 289-290, 1016, 1443, 1447, 1458, 1459
 management, 640-642
 mangrove, 992, 1145, 1155
 in North America, 1459, 1460-1461
 pest species, 289-290, 1459
 plantation forestry, 317-318
 planting of fast-growing trees, 277
 rainforests, 276
 range/biome shifts, 307
 REDD payments, 617, 630, 641, 797, 814, 965, 1111, 1119
 reforestation, 277, 317, 321, 1062
 temperate, 305-307
 tree mortality, 15, 110, 276, 306-307, 308
 tropical, 158, 284, 307-308, 990-991
 See also Amazon region; Deforestation; Forest fires; Forestry
- Fourth Assessment Report (AR4)**, 175, 176, 182-184
- Fracking (hydraulic fracturing)**, water use for, 258
- France, climate extremes and heat waves**, 720, 721, 999, 1280
- Freshwater ecosystems**, 14-16, 143-146, 249, 253, 271-359
 adaptation, 277, 321-328
 biodiversity, 274
 carbon sequestration, 275
 carbon stocks, 294
 climate change and, 232
 cross-chapter box, 143-146
 land use and, 274
 management actions, 277, 324-325, 325
 nitrogen deposition, 286
 observed impacts, 44-46, 44-48
 river flow regimes, 143-146
 species distribution, 274, 991
 species invasions, 990
 stressors and threats, 312
 vulnerability and risks, 274-277, 290-321, 302
- Freshwater-related risks**, 66, 232-233, 248-253, 249
- Freshwater resources**, 229-269
 adaptation and risk management, 14, 234, 253-258
 adaptation barriers, 233, 254
- adaptation, mitigation, and sustainable development, 233
 adaptation opportunities, constraints, and limits, 922
 climate change and, 232, 234, 251, 257, 274
 climate change mitigation and, 257-258
 climatic drivers, 240, 256
 costs and socioeconomic aspects, 233
 detection and attribution of impacts, 234-236, 235, 986-989, 987
 droughts, 232, 239-240, 247-248, 247
 ecosystems, 249
 energy production, 252
 erosion and sediment load, 237-239, 246-247
 evapotranspiration, 236, 240, 241-243
 extreme hydrological events, 236, 239-240
 flood frequency and severity, 232, 239, 247-248, 247, 248
 flood hazards, 232, 240, 242, 247, 247
 framework and linkages, 234
 glaciers, 233, 242, 243
 greenhouse gas concentrations and, 232
 groundwater, 14, 237, 238, 243-246, 250, 250
 hydrological changes, 234-240
 hydropower generation, 233, 252, 257-258
 impact assessment methods, 241
 impacts, 234, 241-248, 982, 986-989, 987
 impacts of adaptation in other sectors, 257
 Integrated Water Resources Management (IWRM), 254
 key risks, 66, 232-233, 256
 land use and, 240-241
 linkages with other sectors and services, 257-258
 municipal services, 252-253
 negative impacts on, 234
 nonclimatic drivers, 240-241
 observed changes, 44, 234-240
 permafrost, 236, 243
 precipitation, 236
 projected changes, 14, 234, 241-248
 projected extremes, 247-248, 248
 projected impacts, vulnerabilities, and risks, 248-253
 renewable water, decreases in, 232
 research and data gaps, 258-259
 risks, 232-233
 runoff, 237, 243, 245
 sea-level rise and, 253
 soil erosion, 233, 237-239, 246
 soil moisture, 232, 236, 239, 241-243, 247, 249
 streamflow, 236-237, 243, 244
 surface water, 232, 233, 250-251
 vulnerability/risk, 248-253, 250
 water availability, 248-251, 251
 water management, 215, 233, 253, 254-256, 255, 258
 water quality, 237, 238, 246, 251, 252
 water temperature, 232, 234, 235, 237, 238, 252, 253, 274, 295
 water uses, 251-253
 See also specific regions
- Frogs**. See Amphibians
- Funding gap**, 28, 87, 844, 953
- G**
- GDP**. See Gross Domestic Product
- Gender**, 105-107
- access to land, 635
 adaptation options and, 617
 caste system and, 799, 807, 808
 climate change impacts and, 796, 807-808
 cross-chapter box, 105-107
 education and, 39, 73, 105, 106
 emotional and psychological distress, 808
 entrepreneurship and financing, 106, 635
 feminization of responsibilities, 808
 gender roles, 105-106, 799, 1002
 gendered climate experiences, 807
 health and, 718
 inequalities, 19, 47-48, 796, 806-807
 livelihood impacts, 807
 male out-migration, 808
 mortality, 808
 occupational hazards, 808
 rural areas, issues in, 617, 635
 vulnerability and, 105-106, 635, 644, 718
- Gene banks**, 326
- Genetic responses to climate change**, 322-323, 426, 1709
- Geoengineering***, 91, 1114
 Carbon Dioxide Removal (CDR), 454
 conflict over, 776-777
 crops with reflective leaves, 321
 examples of, 1114
 large-scale interventions, 1114
 in oceans, 416, 454, 455
 risks of, 454, 455, 1065-1066
 solar radiation management (SRM), 416, 454, 455, 776, 1065-1066
 sustainable development and, 1114
 techniques, 455
- Geopolitical issues**, 775-777
- Germany**, insurance losses, 682
- Giorgi-Francisco regimes**, 1160
- Glacial lakes**, 242
- Glacial rivers**, 239
- Glacier lake outburst floods (GLOFs)**, 988, 1000, 1002
- Glaciers**, 233
 aggregate impacts, 1016
 in Asia, 242, 243, 1337, 1356, 1357
 average rate of ice loss (1993-2009), 1136
 in Central and South America, 623, 1518-1520, 1519, 1521, 1522, 1543, 1543
 committed changes, 233
 conclusions of AR4, 190
 in Europe, 243, 988, 1304
 Himalayan glaciers, 242
 meltwater from, 233, 239
 observed changes, 7, 236, 982, 987, 987, 1075, 1136
 projected changes, 233, 242, 243, 253, 312
 runoff from, 145, 987, 987, 1075-1076
 vulnerability/risk, 1075-1076
- Global Environmental Facility (GEF)**, 874
- Global sea level**. See Sea level; Sea level change
- Global temperatures**. See Temperature
- Global warming**. See Climate change; Temperature; Temperature impacts; Temperature projections
- Globalization**, 616, 1303
- Governance/government**, 26, 207
 adaptation and, 842-843, 845, 849, 1475-1476
 adaptation planning and implementation, 25, 85-87, 388-390, 874-875, 886-889
 government failures, 956
 insurance and, 686, 686

- leadership, 540, 589-590
 local, 566, 577-578, 836, 842-843, 876
 national adaptation responses, 871
 national governments, 25, 27, 85, 842, 1475
 policy on environmental migrants, 771, 771
 rural areas, 617
 security and national security challenges, 758
 stakeholder participation, 540, 1473-1475
 state integrity and geopolitical rivalry, 72-73, 775-777
 subnational level adaptation, 85, 1475-1476
 urban governance, 538-540, 566, 575-578, 578
- Grain crops**, 488, 491-493, 492
 projected impacts, 488-489
 sensitivity to climate change, 497-499, 498
 temperature and, 488, 498
See also Agriculture; Crop yields; *specific regions*
- Grapes**, 499, 506, 625
- Grasslands**, 311, 311-312, 637
- Great Barrier Reef**, 431, 1393
- Green and white roofs**, 90, 574-575
- Green economy**, 567
- Green fiscal policies**, 90
- Green infrastructure**, 90, 560, 572-575, 847, 884
- Greener development**, 180-181
- Greenhouse gases (GHGs)***, 50, 171, 188-189, 249
 feedbacks, 274
 mitigation, 903, 1045
 release from permafrost, 67
 vulnerability/risk and, 66, 852
 water resources and, 15, 66
See also Carbon dioxide
- Greenland ice sheet**, 63
- Gross Domestic Product (GDP)**, 811-812
 impacts computed as a percent of, 364, 631
- Groundwater**, 66, 243-246
 attribution of changes, 237
 coastal groundwater, 246, 364, 379
 observed changes, 237, 238
 pollutants in, 252
 projected changes, 14, 243-246, 250, 625
 salinization, 633, 991
 vulnerabilities, 250-251, 250
- Groundwater recharge***, 158, 244-246, 250
- Growing season**. *See* Phenology
- Gulf of Mexico**, 1678
- H**
- Habitat**
 destruction, 375, 414, 1707
 fragmentation, 275, 327-328
See also Biodiversity; Ecosystems
- Hailstorms**, 683
- Hantavirus**, 725, 1224, 1536
- Hard and soft limits**, 89, 903, 907, 919-921
- Harmful algal blooms (HABs)**, 439-440, 454-455, 465, 726, 1582, 1709, 1712
- Hazards**, 37, 113, 114-121, 1042, 1070-1071
 definition of, 39
 novel, 59
- Health**. *See* Human health
- Health care**, 663, 687-689, 693, 733
 costs, 687-689, 737
- Heat islands**. *See* Urban heat islands
- Heat-related deaths**, 42, 60, 720-721, 736, 983, 1058, 1069, 1374
 in Australasia, 1375, 1402-1403, 1411
 in Europe, 1280, 1290-1291, 1307
 in North America, 1470, 1477
- Heat strain/exhaustion**, 731, 733
- Heat stress**, 109-111
 effect on livestock, 517, 627
 gender and, 106
 in urban areas, 538, 556
See also Thermal stress
- Heat stroke**, 731
- Heat waves***, 109-111, 558, 720-721
 in Australasia, 42, 1374, 1375, 1380, 1400, 1401, 1402, 1405, 1407, 1411, 1413
 brownouts and blackouts, 558
 cross-chapter box, 109-111
 disproportionate impacts, 109
 early warning systems, 883-885, 1145
 in Europe, 720, 721, 729, 999, 1278, 1280, 1290-1291
 frequency and intensity of, 721
 mortality from, 42, 60, 110, 720-721, 736, 983, 1058, 1069, 1374
 in North America, 721, 1444, 1470, 1477
 observed and projected changes, 1165-1170
 in Russia, 503, 729, 999
 violence and, 109
- Hemorrhagic fever with renal syndrome (HFRS)**, 725
- Herbicides**, 500
- Heritage benefits**, 453
- Heritage sites**, 560, 1272, 1292-1293, 1301, 1303
- High-altitude ecosystems**, 17, 274, 312, 995
 responses to climate change, 317
 species distribution, 274
 species range shifts toward, 274, 278-279, 279
 tourism increases, 678
See also Mountain regions
- High-latitude ecosystems**, 124, 274, 312
 deforestation, 283
 fisheries, 414, 508
 food production, 488
 impacts/risks, 301, 1010
 primary productivity in, 293, 415
 tourism increases, 678
 water resources, 251
- Honeybees**, 320-321
- Hotspots***, 20, 1137, 1177-1178, 1463
- Housing**, 538, 539, 559-560, 568-570, 676
- Human-assisted adaptation***, 324-326, 325, 328
- Human capital**, 761, 762, 774
- Human Development Index (HDI)**, 720
- Human health**, 19-20, 50, 71, 709-754
 adaptation, 712, 733-737, 735, 742, 922
 adaptation options, economic evaluation of, 962
 adaptation policies, 733-734
 adaptation under high levels of warming, 735-737
 aeroallergens, 729, 1043
 air pollution, 713, 716, 727-730
 air quality, 721, 727-730
 carbon dioxide effects on, 1043, 1064-1065
 child health services, 714
 childhood mortality, 688
 climate-altering pollutants (CAPs), 713, 714, 715, 716, 728, 728
 climate change and, 713, 716-717, 716, 735, 741
 climate change benefits for, 742
 climate change variability and, 717-720
 co-benefits, 714
 in coastal areas, 385-386
 co-benefits, 714, 737-741, 737, 738, 753
 costs, 687-689, 737
 dengue fever, 723-725
 detection and attribution, 1000
 direct impacts of climate and weather, 720-722, 741
 disaster preparedness, 714
 disease distributions, 713
 diseases, 713, 722-730
 diseases, vulnerability to, 717-720
 drought and, 721
 early warning systems, 734, 1466, 1538
 economic development and, 713, 720
 elderly people, 717-718, 719, 720
 emergent risks, 1042, 1056-1057, 1064-1065
 extreme events and, 663, 721
 fires and smoke, 721, 729
 floods and, 721-722
 food-borne infections, 726-727
 food production and, 713
 food quality and, 501-502
 food security, 736
 health adaptation policies, 733-734
 health care costs, 687-689, 737
 health care services, 663, 687-689, 693, 733
 heat- and cold-related impacts, 713, 720-721, 731, 983
 heat-related deaths, 110, 713, 720-721, 736, 983
 heat tolerance, limits to, 736
 heat waves and, 110, 720-721
 impacts, direct, 50, 720-722, 741
 impacts, ecosystem-mediated, 722-730
 impacts, human system-mediated, 730-733
 impacts, mechanisms of, 713
 infectious diseases, 663, 722-726
 injuries and drowning, 713, 717, 721, 731
 key risks, 116
 knowledge gaps, 714
 malaria, 722-723
 malnutrition, 688, 730-731, 1530, 1537
 meat consumption, 714, 742
 mental health, 722, 732, 1404
 nutrition, 730-731, 730
 observed impacts, 1000
 occupational health, 731-732
 ocean systems and, 415, 431-432, 454-455
 ozone and, 716
 physical infrastructure and, 718, 736-737
 population growth and, 718
 populations most affected, 742
 present state of global health, 715-716, 720
 projected changes, 71, 713
 projections under RCP scenarios, 713
 protecting, 733-734, 735
 public financing of, 688
 public health, 714, 718, 733, 738
 reproductive health services, 740-741, 742
 research gaps, 714
 rodent-borne diseases, 725, 1000
 in rural areas, 623
 socioeconomic status and, 718
 storms and, 721-722
 temperature and precipitation and, 713, 1000
 thermal thresholds, 713
 thermoregulation, 713, 720-721
 tick-borne diseases, 722, 723, 725, 1000

- ultraviolet radiation and, 722
 uncertainties and knowledge gaps, 714, 741
 in urban areas, 556, 560
 vaccinations, 21, 714, 733
 vector-borne diseases, 722-726
 violence and conflict, 732-733
 vulnerability mapping, 733-734
 vulnerability projections, 718-720, 719
 vulnerability reduction, 714
 vulnerability/risk, 60, 72, 717-720, 1042, 1058, 1069
 water-borne infections, 726-727
 weather and, 713, 715
 weather shifts and, 713
 work capacity, temperature and, 19, 71, 713, 731, 732
See also Diseases; specific diseases
- Human migration.** *See* Migration, human
- Human-modified land systems,** 317-319
- Human population**
 in Asia, 1332, 1347
 in coastal areas, 364, 372-373, 381, 386
 growth, health and, 718, 740
 in North America, 1450-1452, 1451
 in rural areas, 616, 618, 618, 622
 slowing growth through fertility, 740-741
 in urban areas, 50, 538, 541-547, 544, 553, 554, 622
 water availability and, 250
- Human rights,** 759
- Human security*,** 20, 50, 71-73, 73, 755-792
 adaptation, 762, 766, 778-779
 adaptation opportunities, constraints, and limits, 922
 agriculture, 761, 762, 763, 766, 768-769
 armed conflict, 758, 771-775, 772, 773
 basic needs, 761
 climate change and, 759, 760, 1001-1002
 culture and, 71-72, 758, 762-766, 764
 definition and scope, 759-761
 economic dimensions, 761-762, 761
 food prices and insecurity, 763
 geopolitical issues, 775-777
 human capital, 761, 762, 774
 human rights, 759
 indigenous, local, and traditional knowledge, 758, 765-766, 766
 key risks, 39, 778
 livelihood security, 758, 761-762, 761
 migration, 758, 766-771, 769-770, 777
 mobility, 758, 766-770, 769-770
 multiple factors in, 758
 national security policies, 758
 observed changes, 50, 1001-1002
 projected changes, 71-72
 property, 761, 762, 773-774, 779
 scales of, 73
 state integrity, 72-73, 775-777
 states, challenges to, 758, 760
 synthesis, 777-779, 777, 778
 threats to, 758, 762
 vulnerabilities, 758, 761, 778
 vulnerable populations, 758, 761
 water scarcity, 761-762, 761
- Human settlements**
 in coastal areas, 364, 381-383, 382, 993
 informal settlements*, 538, 583, 805-806
See also Rural areas; Urban areas
- Human systems***
 in coastal areas, 381-386
 detection and attribution, 42, 982, 996-1003, 1009-1010, 1015
 factors affecting, 982
 observed impacts, 4-8, 7, 40, 42-43, 44-46, 49-51, 982, 996-1003, 1009-1010, 1015, 1017
- Human thermoregulation,** 713, 720-721
- Humboldt Current,** 1692-1693
- Hunger,** 796, 805
- Hurricanes**
 in Central and South America, 1508, 1535, 1542
 economic damages of, 383
 Hurricane Katrina, 211, 381, 383, 810, 1002
 Hurricane Mitch, 1535
 Hurricane Rita, 381
 Hurricane Stan, 621
 Hurricane (Superstorm) Sandy, 383, 810, 1470, 1473
 Hurricane Wilma, 1470
 in North America, 1445, 1460, 1470
See also Tropical cyclones
- Hydrological cycle*,** 234, 249, 253
- Hydrological impact assessment,** 241
- Hydrological systems**
 detection and attribution of impacts, 234-236, 235
 extreme events, 236, 239-240
 observed changes, 4, 7, 232, 234-240, 982
 projected changes, 241-248, 253
 projected extremes, 247-248, 248
- Hydropower,** 666, 667
 in Asia, 1355
 in Central and South America, 1519-1520, 1540-1541, 1544
 in Europe, 1282
 extreme events and, 666
 freshwater resources and, 233, 252, 257-258
 in North America, 1458, 1467
- Hyogo Framework for Action,** 217
- Hypoxia,** 150, 418-420, 443-445, 444
 in coastal areas, 373
 dead zones, 17, 373, 415, 420, 1676, 1693, 1709-1710
 hypoxic effects, 464
 hypoxic zones, 420, 464
 in ocean systems, 415-416, 418-420, 443-445, 444, 464, 993, 1675-1676
 tolerance, 415, 464
- Hypoxic events*.** *See* Eutrophication
- I**
- Ice caps*,** 987, 987
- Ice sheets*,** 63, 190
- Impact assessment*,** 213-214, 213, 1176-1184
 baseline and scenario information, 1179-1184
 climate model projections and, 171
 delta method, 241
 downscaling, 211-212, 1137-1138, 1159-1162
 impact analyses, 1178-1179
 methods, 241, 631
 probability distributions, 241
 scale in, 1149
 top-down and bottom-up approaches, 1144, 1144
- Impacts*,** 4-8, 7, 37-58
 aggregate (*See* Aggregate impacts)
 attributed to climate change, 30-32
 avoided impacts, 1045, 1081-1083, 1081
 cascading, 983, 1012, 1013, 1015-1016
 of climate-related extremes, 40-42
 definition of, 39, 1048
 detection and attribution of, 7, 979-1037
 direct and indirect, 720-722, 741
 distribution of, 12, 61, 241, 254, 955-956, 1015, 1044, 1077
 on ecosystem services, 319-321, 319
 global pattern of regional impacts, 1010-1013, 1011
 global patterns of, 43
 interactions of, 1046
 local, 1151
 non-climate factors and, 40
 observed (*See* Observed impacts)
 regional, 7, 1001-1030, 1003-1010, 1147-1152, 1150, 1151
 regional vs. other scales, 1150, 1151-1152, 1151
 residual, 1080-1083
 transboundary, 1042-1043, 1059-1062, 1062
 valuation of, 617, 630-633, 632
See also Observed impacts; Projections; *specific systems and regions*
- Incentives,** 949, 963-966
- Income inequality, global,** 802
- Incremental responses*,** 733, 1106, 1121, 1445
- INDEPTH Network,** 715
- India**
 agriculture, 1343-1344, 1351
 air quality, 1353
 caste system, 799, 807, 808
 coastal population, 373
 electricity production, 1353
 exposure to storm damages, 1638
 flood risk, 1346, 1347
 forests, 1340
 Ganges river runoff, 1337-1338
 gender inequalities, 807
 human health, 1347, 1348-1349, 1353
 malaria, 1347
 monsoons, 1333, 1334
 trade, 1353
 water resources, 1337-1338, 1344
See also Asia
- Indian Ocean**
 chlorophyll concentrations, 1660
 climate projections, 1628-1629
 sea surface temperature (SST), 1658, 1665
 subtropical gyre, 1695
- Indigenous knowledge,** 182, 517, 520, 758, 765-766, 1001
 adaptation and, 87, 765-766, 766
 in Central and South America, 1531
 in climate forecasting, 643
 threats to, 766
- Indigenous peoples*,** 758, 765
 adaptation, 758, 765, 766
 adaptation planning, 876
 adaptive capacity, 765, 766
 in Arctic region, 51, 983, 1016, 1581-1582, 1593-1595
 in Australasia, 1375, 1405-1406, 1408
 decision making, lack of inclusion in, 758, 765
 detection and attribution, 983, 1001, 1002, 1003, 1014
 health and well-being, 1581-1583, 1594, 1595
 knowledge systems of, 213, 765-766

- livelihoods, 51, 765, 805, 983, 1003, 1010
mitigation actions and, 797
in North America, 1444, 1460, 1461, 1462, 1470, 1471-1472, 1478
observed impacts, 983, 1001, 1002, 1003, 1014
in polar regions, 983, 1016, 1571, 1581-1583, 1593-1595
poverty and, 797, 805-806
vulnerability/risk, 876
- Indonesian Throughflow**, 1671
- Industrialized countries***, 181
- Industry**
coastal industries, 383-384
water supply for, 673
See also specific regions and countries
- Inequality**, 6, 47-48
disadvantaged people, 796, 798, 799, 801-802, 806, 808
disproportionate climate impacts and, 797
equity and equity weighting, 926
exacerbation by climate impacts, 796
gender, 807-808
global income inequality, 802
high-income countries and, 802
livelihoods and, 799, 802
multidimensional, 6, 40, 47-48, 809-810, 809
multiple stressors and, 799
poverty and, 796, 802-803, 816, 1002
structural, 796, 802, 819
unequal distribution of mitigation benefits, 1111
See also Equity; Marginalization
- Infectious diseases**, 663, 722-727
climate-related factors and, 723
floods and windstorms and, 722
thermal tolerance of vectors, 736
See also Diseases; Human health; Vector-borne diseases; Water-borne diseases; specific diseases
- Informal settlements**, 538, 583, 805-806
- Information and communication technologies**, 884
- Information needs and options***, 844, 845, 848
- Infrastructure**
adaptation, 847
in coastal areas, 364, 383-384, 993
costs of climate change, 383
costs of repairing, 628
critical, 72-73, 775
deterioration/damage of, 628
green, 90, 560, 572-575, 847, 884
human health and, 718, 736-737
in rural areas, 616, 628
state capacity and, 775
transportation, 628, 662, 674
in urban areas, 538, 539, 557, 560, 572-575
vulnerability/risk, 628
vulnerability to failure of, 737
water supply, 662, 672, 693
See also specific regions, sectors, and systems
- Innovation**, 27, 909, 922, 966
climate resilience and, 1120-1121
- Insect pests**, 289-290, 320-321
forest infestations, 289-290, 1016, 1443, 1447, 1458, 1459
mountain pine and spruce beetles, 289-290
spread of, 303
- Insolation**, 1671
- Institutional capacity**, 1473
- Institutional change**, 1114
- Institutional learning**, 635
- Institutional needs***, 843-844
- Institutional options***, 836, 845, 848-849
- Institutional vulnerability**, 1068
- Institutions**, 27
adaptation constraints, 916-917, 922
adaptation options, 836, 845, 848-849
adaptation planning and implementation, 388-390, 389, 886-888
adaptation support, 1119-1120
barriers, 871, 886-888, 1351-1352
decision making and, 206-207, 1139
problems with, 1120
regional decision making and policies, 1139, 1140
See also Governance/government
- Insurance***, 680-687, 693, 949
adaptation and, 680, 872, 884, 885-886, 949, 964
adverse selection, 684
building standards for high-risk sites, 685
covering weather hazards, 680
crop insurance, 54, 685, 1147
diversification of large losses, 684, 685
flood insurance, 885
governance, public-private partnerships, and insurance market regulation, 686, 686
government, 663
impacts on insurance systems, 663, 680
index-based, 964, 1147, 1231
insurance systems, 663
microinsurance, 684, 816, 949
moral hazard, 964
observed and projected losses from weather hazards, 680-683, 681, 682
poor people and, 797, 816
prices, 682, 685
public-private risk prevention, 663
public sector as insurer of last resort, 949
reinsurance*, 663, 684, 949
risk-adjusted premiums, 685, 886
risk financing, 686
risk-linked securitization, 663
risk management, 1403
risk transfer, 886
sovereign insurance, 685-686, 685
supply-side challenges and sensitivities, 683-684, 683
urban areas, 582-584
very large loss events, 684
weather disasters and, 663
weather risks, products responding to, 684-686, 685
- Integrated Assessment Models (IAMs)**, 925, 1148
- Integrated Coastal Zone Management (ICZM)***, 365, 366
- Integrated Water Resource Management (IWRM)**, 254
- Intellectual property rights**, 966
- International trade**, 617, 629, 1171
sensitivity to climate, 1173-1175
- Invasive species and invasive alien species (IAS)***, 15, 67, 275, 288-290, 289
in Australasia, 1397
observed changes, 275, 288-289, 990
projected changes, 275, 289-290, 289
in small islands, 1616, 1633
- IPCC Assessment Reports**, 4, 38, 169-126, 175
First Assessment Report (FAR), 174, 175
Second Assessment Report (SAR), 174-176, 175
Third Assessment Report (TAR), 175, 176
Fourth Assessment Report (AR4), 175, 176, 182-184
Fifth Assessment Report (AR5), 4, 38, 175, 176-182, 176-177
AR5 Guidance Note, 176, 176-177
certainty and uncertainty treatment in, 6, 7, 41, 176, 176-177
context for, 4, 38-39
evolution of WG II Assessments, 174-176, 175
information this report is based on, 174
literature, amount and authorship of, 38, 171, 172-174, 173, 174
major conclusions of AR4, 182-184
major conclusions of more recent reports, 184-192
science basis for, 172-174, 173
Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX), 187-188, 247, 620, 643, 680, 720, 1047-1049, 1163-1164
Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN), 165, 186, 187
Working Group I Fifth Assessment Report, 188-191
Working Group III Fifth Assessment Report, 191-192
See also specific reports
- IPCC Working Groups**. *See* Working Group I; Working Group II; Working Group III
- Iron, in ocean fertilization**, 455
- Irreversible changes**. *See* Tipping points
- Irrigation**, 673-674
projections, 241
water demand for, 159, 251
water-saving, 1116
water use efficiency, 157-158
water use for, 233, 257
- Islands**. *See* Small islands
- J**
- Japan**
2011 Tohoku Earthquake Tsunami, 390
aging population in, 1332
coastal systems, 390, 1342
exposure to storm damages, 1638
food production, 1343-1344, 1345
rice production, 1343, 1344-1345
trade, 1353
transboundary pollution, 1353
See also Asia
- Japanese encephalitis**, 725, 1348-1349
- Justice**, 180
- K**
- Kelp**, 364, 377-378, 992
- Key risks***, 11-20, 21-25, 59-60, 114-121, 1069-1073
adaptation and, 1072-1073, 1080-1083
alternative development pathways and, 1044, 1052, 1072-1073
assessing, 1069-1071
assessment of response strategies, 1080-1085
criteria for identifying, 1051-1052
cross-chapter box, 113, 114-121

- dangerous anthropogenic interference, 11, 1043-1044, 1047, 1073
- definition of, 11-12, 1048-1049
- economic sectors, 59-60, 59-62, 64-65
- examples of, 1058, 1069-1071, 1070-1071
- food production and security, 114, 1058, 1069-1070
- freshwater resources, 232-233, 256
- global perspective on, 13
- human health, 116
- human security, 778
- livelihoods and poverty, 116-117, 811, 1058, 1070-1071
- mitigation and, 1080-1083, 1081
- ocean acidification, 60, 74-75, 1042, 1064, 1064, 1065, 1071, 1707-1708
- ocean systems, 114, 461-465, 462-463
- for poor people, 811
- Reasons for Concern, 1049, 1073-1080
- regional, 20, 21-25, 59-62, 76-80, 117-121
- rural areas, 115-116, 633-637
- terrestrial and inland water systems, 114
- urban areas, 114-115, 561-562, 591-596
- See also Emergent risks
- Key vulnerabilities***, 59-60, 113, 117, 1039-1099
- assessing, 1052-1053
- criteria for identifying, 1051
- cross-chapter box, 113, 114-121
- definition of, 1048-1049
- differential vulnerability and exposure, 1066-1067
- environmental vulnerability, 1068
- factors in, 1065-1069
- framework for, 1050-1053
- historical development, 1046-1047
- institutional vulnerability, 1068
- new developments, 1049-1050
- previous assessment findings, 1046-1049
- Reasons for Concern, 1049, 1073-1080
- rural areas, 633-637
- socioeconomic vulnerability, 1067-1068
- SREX findings, 1047-1049
- trends in, 1067
- See also Key risks
- Knowledge**, 576, 576, 765-766
- access to, 629, 635
- adaptation and, 766
- adaptation constraints, 911-913
- indigenous, 182, 517, 520, 643, 765-766, 766, 1001
- local, adaptation and, 875
- traditional and local, 8, 629, 758, 765-766, 766
- traditional ecological (TEK), 1001
- Knowledge gap**, 565
- Knowledge transfer**, 198, 635
- Krill**, 1577, 1589, 1596
- Kyoto Protocol**, 257
- L**
- Lakes**
- eutrophication, 313
- glacial lakes, 242, 988, 1000, 1002
- lake ice, 987, 987
- observed impacts, 7, 30-32, 313, 1004
- See also Freshwater resources
- Land acquisitions, large scale (LSLA)**, 814-815, 1175
- Land degradation**, migration and mobility outcomes, 769-770
- Land-grabbing**, 73, 180, 630, 814-815, 1175
- Land use***, 27
- for biofuel production, 630, 806-807, 814-815
- food production, 504-505, 504, 507
- human-modified systems, 317-319
- influence on climate change, 282
- land tenure systems, traditional, 635
- in rural areas, 616, 635, 637
- scenarios, 285
- Land use and cover change (LUCC)**, 274, 282, 283-285, 284-285
- Land use change***, 66, 274, 284-285, 1502
- biofuel production and, 630, 797, 806-807, 814-815, 1055-1056, 1056
- carbon release by, 276
- in Central and South America, 1502, 1503, 1509-1510, 1513-1516, 1522-1523, 1534-1535, 1542, 1543
- in coastal areas, 372-373
- as driver of ecosystem change, 274, 1513
- effects on ecosystems, 277
- effects on terrestrial and freshwater ecosystems, 274, 277, 283-285, 284-285
- emergent risks, 1042, 1054, 1055, 1056
- freshwater resources and, 240-241
- privatization, 637
- summary of effects, 284-285
- Landslides**, 805, 987-988
- Large-scale interventions**, 1114
- See also Geoengineering
- Large-scale land acquisitions**, 814-815, 1175
- Large-scale processes and feedbacks**, 415
- Large-scale singular events**, 12, 61, 1015-1016, 1044, 1078-1080
- avoiding, 1084
- temperature and, 63
- Least Developed Countries (LDCs)**, 852, 874
- Leishmaniasis**, 385, 1223, 1536
- Leptospirosis**, 1532, 1536
- Likelihood***, 6, 41, 177
- See also Confidence; Uncertainty
- Livelihoods***, 20, 30-32, 39, 50-51, 73, 793-832
- adaptation actions, 762
- agricultural, 621-623
- agricultural productivity and, 810-812
- assessment of climate change impacts, 803-813
- assessment of climate change responses and mitigation, 813-816
- assets, 803-805, 812
- biofuel production and, 814-815
- climate-resilient development pathways, 818
- climate stressors and, 796
- critical thresholds, 798, 804
- definitions and scope, 798-799
- detection and attribution, 44-46
- dynamics, 805
- farming, 803
- financial assets, losses of, 805
- future impacts and risks, 810-813, 811
- gender and, 807
- impacts of adaptation responses, 815-816
- impacts of climate, weather, and climate-related hazards, 796
- indigenous peoples, 51, 765, 805, 983, 1003, 1010, 1595
- inequalities and, 799, 802
- insurance and, 797
- interactions with poverty, inequality, and climate change, 802-803, 804
- key risks, 116-117, 1058, 1070-1071
- land issues, 803
- mitigation policies and, 797
- mobility and, 758
- multiple stressors and, 50-51, 798-799, 799
- observed impacts, 6-8, 7, 30-32, 44-46, 803-810, 983, 1002-1003, 1002
- poverty and, 796, 1002
- projected impacts, 73
- REDD and, 797
- research gaps, 818-819
- resilience, 797, 818
- rural areas, 60, 616, 617, 623-628, 644, 796
- seasonal sensitivity, 806
- security, 27, 758, 761-762, 761
- shifts in, 796, 805, 812
- synthesis, 818-819
- trajectories, 796, 798, 799, 803, 805, 806, 812
- weather events and, 803-805
- Livestock**, 494, 502
- adaptation, 489, 517, 519-520
- adaptation options, economic evaluation of, 962
- in Central and South America, 512, 1515, 1528, 1530
- heat stress, 110, 517, 627
- observed impacts, 502
- projected impacts, 508-512, 625-627, 633
- temperature and, 502, 517
- water stress, 502
- Low regrets policies and actions***, 66, 188, 233, 254, 637, 644-645
- Lyme disease**, 723, 725, 736
- M**
- Macroalgae**, 429, 440, 450
- Macroeconomic analysis**, 963
- Macroeconomic impacts**, 669-672, 670-671
- Madagascar**, 1688
- Mainstreaming**, 87, 948, 1351-1352, 1640
- barriers to, 1351-1352
- Maize**, 491, 492, 493, 1016
- observed changes, 7, 621, 982
- projected crop yields, 5, 17, 69, 505, 509-510
- sensitivity to climate change, 505
- temperature and, 498
- Maladaptation***, 87, 837, 857-859
- adaptation planning and, 837
- avoiding, 254, 518
- causes of, 858-859
- definition of, 837
- examples and experiences, 858, 859, 1476
- screening for, 858-859
- Malaria**, 385, 722-723, 731
- in Africa, 722-723, 723, 1222-1223
- in Asia, 1349
- climatic drivers and, 723, 723
- future risks, 688
- geographic distribution, 722-723, 723
- health care costs, 689
- near-term future, 725
- observed changes, 1000
- in small islands, 1624
- thermal tolerance of vectors, 736
- transmission and vectors, 722-723, 1625
- Malnutrition**, 688, 689, 1530, 1537
- Managed systems**, 277, 324-325, 325
- detection and attribution, 996-1003, 1009-1010, 1015, 1017

- managing for resilience, 325
 marine ecosystems, 453-456
 observed impacts, 7, 996-1003, *1009-1010*, 1015, 1017
- Mangrove forests**, 992, *1145*, 1330, 1503, 1525-1526, 1527, 1621
 adaptation experience, 52
 carbon sequestration by, 90, 1155
- Manufacturing**, 677, 1283, 1468, 1532-1533
- Marginalization**, 6, 47-48, 154, 180, 796-797, 799, 799, 802, *802*, *809*
- Marine biogeography**, 123-127
- Marine ecosystems**, 414-415, 423-424, 441-443, 1658-1660, 1677-1701, 1706, *1711*
 adaptation, 451-456
 adaptation limits, 416
 biodiversity, 64, 416, 453
 changes due to climate change, *451*
 climate change impacts, 424-451
 climate change sensitivity, 423-424
 coastal, 453
 cumulative impacts of multiple drivers, 448
 detection and attribution, 44-46, 459-460, *460*, 993-996, *993*, *994*, *1007-1008*
 ecosystem-level processes, 441-443
 ecosystem services, 414, 452-453, 461
 ecosystem structure, 7, *433*, 461-464
 extinctions, *451*
 human activities, 451-456
 importance of, *417*
 large-scale processes and feedbacks, 415
 multiple drivers, responses to, 445-448, *446*
 observed changes, 7, 30-32, 44-46, 48, 414-416, 993-996, *993*, *994*, *1007-1008*
 ocean acidification impacts, 17, 415
 Oxygen Minimum Zones, 48, 415-416, 418-420, *426*, *443-444*, 451
 in polar regions, *451*, *1594*
 projected changes, 17, 69, 414-416, 457-459, *458*
 temperature effects, 110, 427-432, *427*
 upwelling, 149-152
 vulnerability/risk, 60-62, 415, 453, 1043
 See also Coastal systems; Fisheries; Ocean systems
- Marine exclusive environmental zones**, *1174*
- Marine fisheries**. See Fisheries
- Marine mammals**, 414, 449-450, 457, 1575-1576, 1588-1589
- Marine protected areas**, 99, 1526
- Markets**, 663, *688*
 adaptation and, 663
 computable general equilibrium (CGE) model, 689
 impacts on, 689-690, *690*
 insurance market regulation, 686, *686*
 market-based instruments, 180-181, 965-966
 market failures and missing markets, 955
 non-market factors, 948, 951, 956, 958, 960, *961*, *962*, *963*
 transmission of impacts across locations, *688*, 690
- Meat consumption**, 714, *742*
- Mediterranean region**. See Europe
- Mediterranean Sea**, 1684-1685
- Mediterranean-type ecosystems**, 312
- Mekong River/delta**, 803
 dams, 1355
 iliving with floods*i* program, 640
- transboundary adaptation planning and management, 1355
- Mental health**, 722, 732, 1405
 extreme events and, 805, 1537
- Methane**, 63, 739
- Metrics**, 631, 632-633, 853-857
 for adaptation, 837, 853-857
 criteria and indicators, *855*
 established, 855-856
 monetary and non-monetary, 631
 monitoring and evaluation, 856
 multi-metric decision making, *957*, *957*
 multi-metric evaluations, *957*, *957*, 1118-1119
 resource allocation, 855-856
 validation of, 856-857
 vulnerability, 854-855
- Mexico**, 1463
 adaptation, *1448-1449*, *1474*
 agriculture, 1463
 extreme events and vulnerabilities, *1450*
 GDP, *1451*
 human population, 1448-1449
 Mexico City, climate responses, *1474*
 Mexico-USA border region, *1448-1449*, 1470
 migration, 1449-1450
 NAFTA, *1448*, 1450
 observed and projected changes, 82
 poverty, 1452
 precipitation, 82
 socioeconomic indicators, *1451*
 temperature, 82
 See also North America
- Microbes**, 415, 424, 428-429, 436
 hypoxia and, 443
 ocean acidification and, 439-440, 442
 productivity, 447
- Micro-finance**, *584*
- Microinsurance**, 684, 816
- Middle East and North Africa (MENA)**, 803
- Migration**
 assisted, 325-326, *325*, 328
 migration corridors, 325-326, *325*
 of natural systems, 1176
 of species, 15, 69, 324
 See also Range shifts
- Migration, human**, 65, 72, 758, 766-771, *769-770*, 1175-1176
 ability to move, *768*
 as adaptation strategy, *770-771*, *770*
 climate change and, *766-767*, *768*
 to coastal areas, 373, 805
 definition of, *767*
 environmental degradation and, 616, 628
 environmental migrants, *771*
 extreme events and, 65, 623
 forced migration, 746, 1175-1176
 health risks of, 736
 human security and, 39, 758, 766-771, *769-770*, *777*
 international policy and, *771*, *771*
 multiple drivers of, 617, 621, 628
 numbers of people displaced, *768*
 pathways to, *767-768*, *768*
 planned retreat, 39, 387, 389, 1375-1376
 regional context, 1175-1176
 risks, 1060
 rural areas, 616, 617, 628, 635
 rural-to-urban, *568*
 sea level rise and, *770*, *770*
- small islands and, 1625, 1639-1640
 trends and long-term climate change, 768-770
 urban adaptation and, 563
 vulnerability/risk, 1042, 1060
- Migration of natural ecosystems**, 1176
- Millennium Development Goals (MDGs)**, 800-801, 818, 1211
- Millennium Ecosystem Assessment**, 283, 300, 312, 319, 956-957
- Mining**, 163, 633, 676, 1399, 1467-1468
- Mitigation***, 26, 1101-1131
 adaptation and, 180-181, 216-218, *217*, 1080-1083, 1104, 1109-1110
 adaptation limits and, 903
 avoided impacts, 1045, 1081-1083, *1081*
 biodiversity and, 1061-1062
 Clean Development Mechanism (CDM), 813-814, 848-849, 1111
 climate-resilient pathways and, 1104
 co-benefits, 714, 737-741
 consequences and costs of inaction, 326-327, *326*
 decision processes, 216-218, *217*
 development processes and, 1109
 early, rapid, *1081*
 geoengineering (See Geoengineering)
 impacts on freshwater resources, 257-258
 integration with adaptation, 1104, 1117-1118
 limits to, 1083-1084
 poverty and livelihoods and, 797, 813-815
 REDD payments, 617, 630, 641, 797, 814, *965*
 resilience and, 1113-1115
 responses not compatible with sustainable development, 1110-1111
 risk management through, 1080-1085, *1081*, 1104-1105
 risks associated with, 1042-1043, 1059, 1060, 1061-1062
 risks of delay in, 1105
 scenarios, 1080-1083, *1081*, *1083*
 scenarios, stringent, 1045, 1055, *1081*
 terrestrial and inland water systems, 321
 trade-offs, 216, 217, 925, 1104
 unequal distribution of benefits, 1111
 unintended consequences of, 277, 327-328, 1042-1043, 1059, 1060, 1061-1062
 voluntary carbon offset (VCO), 814
 win-win/triple-win approaches, 24, 27, 1111, 1117, 1118
 Working Group III Fifth Assessment Report, 191-192
 See also Adaptation; Adaptation and mitigation inter-relationships
- Mobility**, 758, 766-770, *769-770*
 ability to move, *768*
 See also Migration, human
- Models**. See Climate models
- Modes of climate variability***, 1162, *1180*
- Molluscs**, 16, 68, 415, *438*, *452*, 465
 extinctions, 300
- Monsoons***
 in Africa, 1161-1162
 in Asia, 1333, 1334
 in Central and South America, 1506, 1509, 1511
 North American Monsoon System, 1506
 projected changes, 1162, 1334
- Montane ecosystems**. See Mountain regions
- Moral hazard**, 964

Mortality

- child mortality, 688
- cold-related (winter), 721, 983
- drought-related, 721
- extreme weather events and, 42, 720-722, 805
- gender and, 808
- heat-related, 42, 60, 110, 720-721, 736, 983, 1058, 1069, 1374

Mosquito-borne diseases, 722-726

See also Dengue fever; Malaria

Mosquitoes, 718, 722, 725, 726, 736

- Aedes* spp., 718, 725, 736
- Anopheles* spp., 722, 723, 1625

Mountain regions

- high mountain states, 797
- impacts and critical thresholds, 804
- montane ecosystems, 1375, 1381, 1401, 1411, 1413
- mountain farmers, 637
- observed impacts, 982, 987, 987, 989, 1000, 1003
- poverty in, 797
- regional impacts, 1003
- slope instability, 987, 987, 989
- vulnerability/risk, 298-299

See also High-altitude ecosystems

Multi-metric decision making, 957, 957**Multi-metric evaluations, 957, 957, 1118-1119****Multinational corporations, 566****Multiple stressors, 6-8, 50-51, 276, 283-290**

- climate change adaptation and, 871
- regional context, 1138, 1181-1182
- scenarios and, 172
- vulnerability and, 179-180

Musk oxen, 1581**Mussels, 415****Myanmar, cyclone impacts, 148****N****National Adaptation Programmes of Action**

(NAPAs), 180, 816, 836, 852, 873, 880, 1111

National security policies, 758**Natural resources**

- conflict over, 617
- economic dependence on, 617, 623

Natural systems

- in coastal areas, 375-381
 - detection and attribution in, 986-996, 1015
 - migration, 1176
 - observed impacts, 40-50, 44-46, 986-996, 1014, 1015
 - trends in impacts, 1014, 1014
- See also Observed impacts; *specific systems and regions*

Nature conservation, 674**Nature tourism, 663, 679****Navigation**

- inland navigation, 675-676
- in polar regions, 1173, 1174, 1584, 1591-1593, 1591, 1592, 1705

Nepal, 799, 807**Net primary production (NPP), 133-136, 134**

- aggregate impacts, 1016
- boreal-tundra systems, 316
- carbon dioxide effects on, 292-293
- cross-chapter box, 133-136
- global, 133, 135, 460, 1714
- model projections, 134, 135

- ocean systems, 17, 35, 133-136, 415, 421, 424, 424, 425, 434, 443, 444-445, 456, 457, 458, 461, 462, 1659, 1697, 1699, 1707, 1714

ozone and, 286

- phytoplankton, 421, 1714
 - spatial trends in, 133-135
 - terrestrial systems, 276, 286, 292-293
- See also Primary production

Netherlands

- adaptation, 391
- coastal adaptation, 365, 391, 395
- government policies, 1157
- green infrastructure, 884

New York City, 555, 595-596

- climate responses, 1474
- extreme precipitation days, 1472
- green infrastructure, 884

New Zealand. See Australasia**Nitrogen**

- deposition, 285-286, 989
- low availability of, 276
- negative effects on productivity, 286
- removal of fixed (denitrification), 416

Nitrogen fixation, 447, 1065**Nitrogen oxides (NO_x), 739****Nitrous oxide, 453****Non-climate stressors, 616, 1053, 1054, 1066-1067, 1070, 1513-1516****Non-climatic drivers of change*, 240-241****Non-climatic factors, 40, 1050**

- use of (in oceans), 80, 1710

Non-governmental organizations, 180, 617, 836**Nonlinear effects, 735-736****North America, 76-78, 1439-1498**

- adaptation, 23, 54, 91, 1445, 1472-1476, 1477, 1478

adaptation challenges, 1443

- adaptation, evidence of, 1472-1473
- adaptation examples, 8, 1460-1462, 1474
- adaptation, federal and subnational, 1475-1476

adaptation in ecosystems, 1460-1462

- adaptation opportunities, constraints, and limits, 922, 1443-1444, 1449, 1473-1475, 1476

adaptation planning, 1445, 1473, 1476, 1478**adaptation, transboundary context, 1448-1449****adaptive capacity, 1448-1456, 1478****agriculture, 1443, 1444, 1446-1447, 1462-1464****air quality, 1464, 1465****biodiversity, 1446, 1458-1462, 1460, 1475****climate stressors, 1478****climate trends, 1447, 1452-1456****coastal areas/ecosystems, 1443, 1444, 1459-1460, 1470, 1477****conclusions of AR4, 1446-1448****construction and housing, 1468-1469****crop yields, 510, 1444, 1462-1463****cyclones, 1447, 1452-1454, 1459, 1460, 1477****demographic and socioeconomic trends, 1448-1452****detection and attribution, 45, 1003-1010, 1443, 1444, 1447****droughts, 63, 247, 999, 1444, 1455, 1456, 1461, 1470, 1477****early warning and response systems, 1466****economic sectors and services, 1466-1469****economy, 1444, 1445, 1451, 1471-1472****ecosystems, 1443, 1446, 1458-1462, 1470, 1476, 1477, 1478****elderly population, 1451, 1452****energy, 1466-1467****extreme weather events, 42, 1443-1445, 1447, 1450, 1470, 1472, 1478****federal level adaptation, 1475****fires/wildfires, 1460-1461, 1477****fisheries, 1470****floods, 673, 721-722, 1444, 1445, 1456, 1457, 1476****food security, 1462-1464****forest infestation, 1443, 1447, 1458, 1459****forestry, 1460, 1471, 1472, 1477****heat waves, 721, 1444, 1470, 1477****high-resolution climate change projections, 1162****human health, 1444, 1447, 1464-1466, 1477****human population, 1450-1452, 1451****human settlements, 1469-1475****hurricanes, 1445, 1460, 1470****indigenous peoples, 1444, 1460, 1461, 1462, 1470, 1471-1472, 1478****infrastructure, 1443, 1444, 1445, 1472, 1478****institutional capacity, 1473-1475****insurance, 1469****key risks, 23, 78, 118-119, 1476-1477, 1477****livelihoods, 1444, 1472, 1476****livestock, 512****locally novel temperature regime, 1443****maladaptation, 1463, 1476****manufacturing, 1468****Mexico-USA border region, 1448-1449****migration, 1449-1450****mining, 1467-1468****multi-sectorial risks, 1476-1477, 1477****NAFTA, 1448, 1450****New York City, 555, 595-596****observed climate change, 81, 1443, 1452-1454, 1453****observed impacts, 31, 42, 45, 1003-1010, 1443-1445, 1447, 1459-1460, 1478****pollen, 1465-1466****poverty, 1451****precipitation, 81, 1443-1445, 1452, 1453, 1462, 1477****precipitation extremes, 1455, 1456, 1470, 1472, 1477****projected climate change, 81, 1443-1444, 1453, 1454-1456, 1455****projected impacts, 76-78****risk management, 1445****risks, 1443-1444, 1448-1456, 1472, 1476-1477, 1477****rural settlements, 1443, 1469-1475****sea level rise, 1443, 1444, 1454, 1477****slow-onset perils, 1445****snow/snowpack, 1443, 1452, 1454-1456, 1455, 1462-1463****snowmelt, 1443, 1456, 1462-1463****socioeconomic indicators, 1451****spring advancement (phenology), 291-292****storms and related impacts, 1443, 1444, 1452-1454, 1460, 1463, 1464, 1470****streamflow, 1443, 1456****subnational adaptation, 1475-1476****temperature, 81, 999, 1443, 1444, 1452, 1453, 1472, 1477****temperature extremes, 1444, 1452, 1455, 1456, 1463, 1464, 1477**

- tourism, 636, 1471-1472
 transportation, 1467
 tree mortality and forest infestation, 1443, 1447, 1459
 uncertainties, knowledge gaps, and research needs, 1477-1478
 urban settlements, 1443, 1469-1475, 1476
 vector-borne diseases, 1465
 vulnerabilities, 1443, 1444, 1448-1456, 1470-1472
 vulnerability hotspots, 1463
 water-borne diseases, 1465
 water management, 1456-1458
 water quality, 1444, 1457, 1466, 1477
 water resources, 1443-1444, 1446, 1456-1458
 water supply, 1443-1444, 1456-1457
 wildfires, 1460-1461
See also Canada; Mexico; United States
- North American Free Trade Agreement (NAFTA)**, 1448, 1450
- North Atlantic**, 621, 1678-1679
- North Atlantic Oscillation (NAO)***, 1162, 1180
 marine ecosystems and, 420, 434
 projected changes, 1162
- North Pacific**, HLSBS in, 1679-1680
- Northern Hemisphere**
 spring advancement, 291-292
 temperature, 434
- Norwegian Sea**, 1678-1679
- Nuclear power**, 662, 666, 667
- Nutrients**, 257, 286
 in coastal systems, 364, 373, 380
 interactive effects, 286
 in ocean systems, 415-416, 420
- Nutrition**, 488, 730-731, 730
 calorie intake/availability, 730-731
 climate change impacts on, 730-731
 effects on children (stunting and underweight), 731
 healthy diets, 714
 limits in, 736
 malnutrition, 688, 689, 1530, 1537
 meat consumption, 714, 742
 near-term future, 730-731
 nutrients, 488, 490, 501-502, 507
See also Undernutrition
- O**
- Observed impacts**, 4-8, 7, 30-32, 37-58, 40-42, 44-46
 aggregate impacts, 1015, 1016
 all continents and zones affected by, 4, 40, 982, 1017
 assessing all climate change aspects, 1017
 biodiversity, 990
 biological systems, 1015
 cascading impacts, 983, 1012, 1013, 1015-1016
 climate and non-climate drivers, 240-241
 coastal systems and low-lying areas, 7, 991-993, 1007-1008
 conclusions of AR4, 182-184, 984
 confidence in, 184-185, 186
 cryosphere, 982, 986-989, 987
 detection and attribution (*See* Detection and attribution)
 deviation from historical conditions, 982
 emerging patterns, 1010-1017
 extreme weather events, 998-1000, 999, 1014, 1014
 floods, 7, 59, 232, 248
 food production systems, 7, 996-997, 1017
 freshwater resources, 7, 234-240, 986-989, 987
 gaps in knowledge and research needs, 983, 1017
 global pattern of regional impacts, 1010-1013, 1011
 human and managed systems, 7, 996-1003, 1009-1010, 1017
 human health, 50, 720-722, 741, 1000
 hydrological systems, 7, 986-989, 987, 1013, 1015, 1016
 indigenous people, 983, 1001, 1002, 1003, 1014
 livelihoods, 7, 983, 1002-1003, 1002
 major systems, 7, 990-991
 natural systems, 7, 986-996, 1014, 1015
 ocean acidification, 982
 Ocean region, 1658-1660, 1664-1677, 1706
 ocean systems, 7, 993-996, 993, 994, 1007-1008
 physical systems, 7, 982, 984, 994, 1011, 1012
 productivity and biomass, 7, 989-990
 regional impacts, 7, 1001-1030, 1003-1010, 1147-1148
 regional water balance, 988
 sensitivity to climate and adaptation, 997
 species distribution, 990
 synthesis, 1010-1017
 terrestrial ecosystems, 7, 982, 983, 989-991, 1005-1006, 1017
 water resources, 982, 986-989, 987
See also specific regions and countries
- Occupational health**, 731-732
- Ocean acidification***, 74-75, 129-131, 374, 426, 464-465, 1658-1659, 1673-1675, 1673, 1707-1708, 1710, 1714
 acclimation and gene regulation, 439
 analogues of, 129
 in Australasia, 1374, 1379, 1393, 1413
 biotic responses to, 415
 calcifiers and, 129, 364, 368, 464-465, 1042
 cause of, 74
 chemistry of, 129
 coastal impacts, 364, 368, 370, 372
 conclusions of AR4, 190
 coral bleaching and, 80, 98, 364, 1689
 cross-chapter box, 129-131
 detection and attribution, 1662
 economic impacts and costs, 129
 fisheries, impact on, 507, 676
 impacts of, 129-131, 415, 436, 437, 439, 993, 1064, 1064
 interactive effects, 416
 Ocean Acidification Effects (OAEs), 464-465
 overview, 74-75, 130
 pathways of impacts, 74-75, 1064, 1064
 policy options for action, 130
 projections, 69, 129-131, 368, 379, 415, 416, 450, 1673
 responses to, 131, 437-439, 438-439
 risks from, 60, 74-75, 1042, 1064, 1064, 1065, 1071, 1707-1708
 tolerances to, 437
 variability in, 418
See also Coral bleaching; Coral reefs
- Ocean fertilization**, 454, 455
- Ocean (region)**, 80-84, 1655-1731
 adaptation, 8, 1660, 1698-1706
 adaptation options, 25, 1703, 1703, 1707-1708, 1711-1712
 aquaculture, 1701-1704
 Basin Scale, 1667
 biodiversity, 1707
 biological systems, 1699, 1711-1712
 Blue Carbon, 1660, 1699-1701
 carbon absorption and storage, 1658, 1697-1698, 1705-1706
 carbon dioxide flux, 420, 993, 1660
 carbonate chemistry, 1658, 1673-1675, 1682-1683
 chemical changes, 1673-1677
 chemical systems, 1699
 chlorophyll concentrations, 1660
 circulation and currents, 1658, 1671
 climate variability, 1658-1659, 1713
 Coastal Boundary Systems (CBS), 1663, 1666, 1686-1690
 conclusions from previous assessments, 1662-1664
 Coral Reef Provinces, 1667, 1669
 coral reefs, 80, 1659, 1682, 1689, 1707
 dead zones, 1676, 1693, 1709-1710
 Deep Sea, 1660, 1663, 1697-1698, 1705-1706
 detection and attribution, 1662, 1698, 1699
 Eastern Boundary Upwelling Ecosystems (EBUE), 149, 1659, 1663, 1666
 economic sectors, 1701-1705
 emerging issues, data gaps, and research needs, 1713-1715
 energy industry, 80, 1660, 1705
 Equatorial Upwelling Systems (EUS), 149, 1659, 1663, 1666, 1681-1683
 extreme events, 1659
 fisheries, 1659-1660, 1663, 1699, 1701-1704, 1707-1708, 1708
 food webs, 1714-1715
 frameworks for decision making, 1661, 1711-1713, 1711-1712
 Global Partnership for Oceans, 1713
 global patterns of marine organism responses, 1677
 heat content and temperature, 1664-1668, 1665-1667
 High-Latitude Spring Bloom Systems (HLSBS), 1659, 1666, 1677-1681, 1703-1704
 human health, 1705
 impacts, potential to reverse, 1675
 industries, 1660
 international frameworks and agreements, 8, 54, 1661
 key risks, 25, 80, 121, 1707-1709, 1708-1711, 1711-1712
 livelihoods, 1659-1660, 1709
 marine ecosystems, 7, 1658-1660, 1677-1701, 1706, 1711, 1714-1715
 marine organisms, distribution and abundance, 48, 1658, 1677-1698, 1707, 1708, 1711-1712, 1714
 marine spatial planning, 8, 1660, 1708
 maritime security, 54, 1706
 mitigation, 1705-1706
 multiple stressors, 1658-1659
 natural ecosystems, 1699-1701
 net primary productivity, 133-136
 non-climate factors, use of, 80, 1710
 observed changes, 1658-1660, 1664-1677, 1706
 ocean acidification, 1658-1659, 1673-1675, 1673, 1707-1708, 1710, 1714

- ocean circulation, 1658, 1671
 offshore energy and mineral extraction, 1660, 1705
 oxygen concentration, 1675-1677, 1676, 1697-1698, 1707, 1709-1710, 1714
 pH, 68, 993, 1658, 1673-1675, 1673
 physical changes, 1664-1672
 physical systems, 1699
 precipitation, 1707-1708, 1712
 productivity/NPP, 17, 35, 133-136, 1659, 1660, 1672, 1677-1698, 1682, 1714
 projected changes, 1658-1660, 1664-1677
 projected impacts (examples of), 1700
 regional changes and projections, 1664-1677
 regional impacts, risks, and vulnerabilities, 1658, 1677-1698
 renewable energy, offshore, 1660, 1706
 resilience, 1715
 role in Earth's climate, 1658
 sea level, 1660, 1668-1670, 1707-1708
 sea surface temperature (SST), 1658, 1664, 1665-1668
 sectoral impacts, adaptation, and mitigation, 1698-1706
 Semi-Enclosed Seas (SES), 1659, 1663, 1666, 1683-1686
 shipping, 80, 1660, 1705, 1709
 solar insolation, 1671
 storm systems, 1660, 1671, 1710, 1712, 1713-1714
 sub-regions, 1658, 1662, 1663, 1677-1698
 Subtropical Gyres, 1663, 1666, 1693-1697
 surface salinity, 1658, 1672, 1673
 surface wind, 1660, 1671, 1706, 1710
 synthesis and conclusions, 1706-1715
 temperature, 60, 1658-1659, 1664-1668, 1665-1669, 1707-1708, 1708
 temperature extremes, 110, 1707-1708, 1708-1709
 thermal stratification, 80, 1658, 1672, 1710
 thermal stress, 1669
 tourism, 1704-1705
 UN Straddling Fish Stocks Agreement (UNSFSA), 1713
 United Nations Convention on the Law of the Sea (UNCLOS), 1661, 1711-1713
 vulnerabilities, 1677-1698, 1700
 waves, 1660, 1671
 winds, 1658, 1659, 1660, 1671, 1713-1714
- Ocean systems, 411-484**
 adaptation capacity/limits, 414, 415, 416
 adaptation, human activities and, 451-456
 adaptation, local, 430-431
 adaptation, management-related, 453-456
 adaptation opportunities, constraints, and limits, 922
 adaptation responses, 415, 451-456
 animals, 427-428, 427, 428, 429-430, 440-441, 443, 447
 anoxia, 415-416, 443-445
 benthic habitats and ecosystems, 125, 150, 422, 424, 443-444, 448, 449
 biodiversity, 64, 416, 451, 453
 biogeochemistry, 417, 420-421, 424, 424, 436, 451, 459
 biological pump, 424
 biota, 415, 416, 456
 birds, 414
 body size, 414, 429, 430, 458, 459
 carbon dioxide effects on, 415, 418, 432-443, 450
 carbon dioxide flux, 420, 993, 1660
 carbon storage in, 454, 455
 circulation, 1671
 climate change impacts, 417-418, 417, 424-451, 426
 climate regulation, 453, 456
 climate variability, 414, 419
 conclusions, 461-465
 conclusions of AR4, 190
 coral communities, 431
 cross-chapter box, 123-127
 cultural services, 453
 detection and attribution, 459-460, 460, 994-996, 995
 ecosystem projections, 457-459, 458
 ecosystem services, 414, 452-453, 461
 ecosystems, 414-415, 431-432, 433, 441-444, 448, 451
 extinctions, 451, 456
 extreme events, 453
 fisheries, 414-416, 435, 452-453
 food production, 452-453, 456
 food web, 424, 448, 449, 459-460
 freshwater input, 426, 435, 442
 geoen지니어ing, 416, 454, 455
 health and diseases, 415, 431-432, 454-455
 historical and paleo-records, 420-423, 422
 human systems/activities and, 416, 451-456
 hypoxia, 150, 415-416, 418-420, 443-445, 444, 447, 464, 993
 key risks, 114, 461-465, 462-463
 key uncertainties, 465
 large-scale processes and feedbacks, 415
 light and, 420, 444-445
 macroalgae, 429, 440, 450
 macrophytes and macrofauna, 442
 marine biogeography, abundance, and phenology, 123-127
 marine mammals, 414, 449-450, 457
 microbes, 415, 424, 428-429, 436, 439-440, 442, 447
 mixed layer depth, 444-445, 444
 modelling approaches, 456-460, 457
 multiple drivers, responses to, 416, 445-448, 446, 459, 465
 nutrients, 415-416, 420, 442
 observed impacts, 414-416, 417-423, 982, 993-996, 993
 Oxygen Minimum Zones*, 48, 415-416, 418-420, 426, 443-444, 451
 paleoclimate (fossil) evidence, 414
 pelagic biomes and ecosystems, 150, 424, 434-435, 993, 1016
 pH, 68, 993, 1658, 1673-1675, 1673
 phenology, 123-124, 430, 431, 432
 physical, chemical, and biological properties, 414, 418-420, 419, 982, 994, 994
 plants, 427-428, 427, 428, 447
 predator-prey dynamics, 48, 414, 431, 432, 450
 production/productivity, 133-136, 415, 416, 423, 429, 444-445, 450, 451, 453, 456, 457, 459, 461, 993
 projected changes and impacts, 414-416, 417-418, 456-460
 reptiles, 414, 448-449
 salinity, 414, 418, 431, 435, 1658, 1672
 sea surface temperature, 433
 seabirds, 414, 449-450, 457
 seagrasses, 415, 429, 440, 442, 450
 socioeconomic impacts, 414, 416, 459
 species abundance, distribution, and migration, 7, 48, 49, 123-125, 414-415, 416, 430, 431, 448, 451, 456, 459, 461-464, 982, 994, 994
 species interactions, 414, 431, 432, 450, 459
 species responses to changing variables, 430, 450
 species-specific responses to warming, 415, 430, 450
 supporting services and transport, 453
 temperature effects, 414-416, 418, 419, 427-432, 427, 1071
 temperature, responses to, 49, 434-435
 thermal sensitivity, 48, 60, 414, 415, 416, 431-432, 432, 446
 thermal windows/ranges, 427-428, 427, 428, 450
 trophic levels, higher, 456-457
 trophic mechanisms, bottom-up, 149
 upwelling, 149-152, 416, 442, 465, 995-996
 vulnerability, 414-416
 See also Marine ecosystems; Ocean acidification
- Opportunity space**, 88, 181-182, 182
- Oxygen**
 concentration (in oceans), 1675-1677, 1676
 critical threshold, 443
 dissolved oxygen, 1675-1677, 1676
- Oxygen deficiency**. See Hypoxia
- Oxygen Minimum Zones***, 48, 415-416, 418-420, 426, 443-444, 451
- Oysters**, 415, 464
- Ozone***, 286-287, 728-729
 air quality and, 1171, 1172
 effects on crop yields, 488, 493, 499
 ground-level, 729
 human health and, 716, 728-729, 728
 methane and, 739
 negative effects of current levels, 286-287
 stratospheric, 499
 trends, 739
 tropospheric, 286-287, 488, 493, 716, 728-729
- P**
- Pacific Decadal Oscillation (PDO)***, 421, 993
- Pacific North American (PNA) pattern**, 1180
- Pacific Ocean**
 chlorophyll concentrations, 1660
 North Pacific, HLSBS in, 1678-1679
 sea surface temperature (SST), 1658, 1665
 subtropical gyres, 1694-1695
- Pacific Walker Circulation**, 1180, 1671
- Pakistan**, 503
 See also Asia; Bangladesh
- Paleoecological evidence**, 274, 279-282
 abrupt climate change, 421-423
 ocean systems, 421-423, 422
 Paleocene-Eocene Thermal Maximum, 422, 423
- Palm oil**, 1515, 1533
- Parasites**, 726-727
- Paris agglomeration**, 957, 957
- Particulates***, 728, 728
- Pastoralism***, 625, 644, 766
 coping/adaptation strategies, 636-637
 poverty and, 806-807

- Payment for ecosystem services (PES)**, 90, 641-642, 964, 965, 1523, 1540-1541, 1541
- Peat/peatlands***, 258, 313-314
in Asia, 258, 1341, 1350, 1352, 1353
carbon stocks in, 313-314
- Pelagic biomes and ecosystems**, 150, 424, 434-435, 993, 1016
- Pelagic communities**, 1016
range shifts in, 435
- Pelagic fisheries**, 150, 384, 1016, 1702
- Penguins**, 457
- Permafrost***, 314-315, 315
aggregate impacts, 1016
carbon stocks, 63, 314-315
conclusions of AR4, 190
degradation of, 314-315, 315, 1016
detection and attribution, 982, 987-988, 987, 1016
infrastructure and, 662
observed changes, 7, 236, 982, 987-988, 987
in polar regions, 1570, 1594, 1595
projected changes, 243, 314-315, 315
thawing, 63, 64, 304
vulnerability, 305
- Pests**, 289-290, 320-321, 1459
effects on carbon cycle, 276
food production and, 500, 506-507
forest insect infestations/damage, 289-290, 1016, 1443, 1447, 1458, 1459
- pH, oceanic**, 68, 993, 1658, 1673-1675, 1673
See also Ocean acidification
- Phenology***, 123-124, 274, 291-292
adaptation and, 321-322
drivers of change, 292
freshwater resources and, 232
observed changes, 291-292, 322, 982, 989, 1000
in ocean systems, 123-124, 430, 431, 432
projected changes, 274, 322
- Philanthropic engagement**, 584-585
- Photosynthesis**, 133, 276, 288, 424, 429, 1409
CO₂ effects on, 307, 415, 494
- Physical systems**, 982, 984, 994, 1011, 1012
detection and attribution, 42
observed impacts, 7, 42-43
- Phytoplankton**, 417, 431, 438-439, 453, 1596
adaptation in, 75, 130
biomass, 434-435, 445
blooms, 291, 444, 445, 455, 455, 1681
carbon sequestration and, 425, 1699
chlorophyll concentrations, 421, 424, 457
community structure, 423, 424, 442, 1711
distribution changes, 43, 69, 428, 431, 434, 447
fisheries and, 456-457
food webs and, 424, 448, 451
in freshwater systems, 286, 287, 291, 313
global NPP percentage due to, 1714
light and nutrients, 286, 420, 444-445, 455, 1681
observed impacts, 7, 46
ocean acidification and, 69, 74, 130, 439, 439, 442, 1696-1697
ocean upwelling and, 1710
paleo-records, 423
in polar regions, 32, 445, 1678, 1681
productivity, 32, 46, 421, 431, 435, 444-445, 451, 457, 1680-1681, 1682, 1714
projected impacts, 17, 69, 457, 457
season peaks, 1680-1681
temperature and, 427, 428, 435, 455
See also Algal blooms; Zooplankton
- Pilot Program on Climate Resilience**, 844, 879
- Pine and spruce beetles**, 289-290
- Pipelines**, 71, 668, 669, 675
- Plague**, 723, 725, 1000
- Planetary boundaries**, 902
- Plankton**, 414, 415, 435
ocean acidification and, 69, 74
See also Phytoplankton; Zooplankton
- Planned adaptation**. See Adaptation planning and implementation
- Plants**
anthropogenic climate change and, 288
C₃ and C₄ plants, 287-288, 310-311, 500, 505
carbon dioxide effects on, 157, 159, 293, 303, 308
diseases, 500
hypoxia and, 443, 447
multiple drivers, responses to, 447
oceanic, thermal windows for, 427-428, 427, 428
ozone and, 286-287
primary production by, 276, 286, 292-293
range shifts, 274, 279
spring advancement (phenology), 291-292
- Plasmodium spp.**, 722
- Polar bears**, 317, 990, 1016, 1570, 1575-1576, 1588, 1596
- Polar regions**, 80, 1567-1612
adaptation, 8, 24, 1570-1571, 1594
adaptation opportunities, constraints, and limits, 922, 1570
animal populations, 1580-1581
Arctic (See Arctic region)
biomass production, 1571
climate change impacts, 1570
detection and attribution, 46, 1003-1010
economic sectors, 1584-1586, 1590-1593
economy, 1585
ecosystem shift, 1576
ecosystems, 1570
fish/fisheries, 1584, 1590-1591
forestry and farming, 1591
freshwater ecosystems, 234, 1570, 1572-1573, 1586-1587, 1594
human adaptation, 1593-1595
human health, 1581-1583, 1594, 1595
hydrology, 1572-1573, 1586-1587
indigenous peoples, 1571, 1581-1584, 1593-1595
infrastructure, 1570, 1584-1585, 1591, 1594
interconnected factors, 1570
key risks, 24, 79, 119-120, 1594
krill, 1577, 1589, 1596
livelihoods, 1595
map of, 1572
marine ecosystems and services, 451, 1594
marine mammals and seabirds, 1575-1576, 1588-1589
marine transport, 1584
multiple stressors, 1572-1586
new evidence on, 1570-1571
observed changes, 314, 1572-1586
observed impacts, 32, 46, 1003-1010, 1570
ocean acidification, 17, 69, 1571, 1587
oceanography, 1574-1577, 1587-1589
permafrost, 1570, 1594, 1595
- phenology, 1571, 1574, 1578, 1578, 1588-1589
phytoplankton, 32, 445, 1570, 1596, 1678, 1681
polar bears, 1570, 1575-1576, 1588, 1596
production, 1574-1575, 1596
projected changes, 314
projected impacts, 1571, 1586-1593
rapid rate of change, 1570
research and data gaps, 1595-1596
resource exploration, 1585, 1593
sea ice, 1570, 1591-1593, 1591, 1594, 1595, 1596, 1681
socioeconomic impacts, 1595
Southern Ocean, 1585-1586, 1589
species shifts, 1570, 1571, 1574
temperature, 1573
terrestrial ecosystems, 1570, 1577-1581, 1589-1593
traditional knowledge, 1583-1584
transportation/navigation, 1173, 1174, 1584, 1591-1593, 1591, 1592, 1705
upwelling, 1576
vegetation, 1578-1580, 1579
vulnerabilities/risks, 276, 414, 1572-1586, 1586-1593
See also Antarctica; Arctic region
- Policy decisions**
for adaptation, 89-90, 171, 909, 922, 948-949
information for, 171
low regrets, 188, 233, 254, 637, 644-645
in regional context, 1139, 1140
Shared Policy Assumptions (SPAs), 1143
- Pollen**, 1000, 1043, 1056, 1064, 1465
- Pollination/pollinators**, 320-321, 1054
- Pollution**
climate-altering pollutants, 713, 714, 715, 716, 728, 728
transboundary, 1353
See also Air pollution
- Population**. See Human population
- Ports**, 557, 558, 572, 675-676
in Central and South America, 1524, 1525
- Poverty***, 50-51, 793-832
adaptive capacity and, 816
agricultural impacts and, 810-812
assessment of climate change responses and mitigation, 813-816, 813
assessment of impacts, 803-813
chronic, 796, 801, 803, 805-806, 812-813
Clean Development Mechanism (CDM) and, 797, 813-814
climate-resilient development pathways, 818
climate-resilient pathways, 797
critical thresholds, 807-809
definitions and scope, 798, 799-801
densely-populated coastal cities, 803
differences in impacts on, 796
dimensions of, 799-801
disproportionate impacts associated with, 796, 802-803, 816, 1002
dynamics, 805-806, 812, 818
extreme event impacts, 802
financial assets, losses of, 805
food insecurity and, 491, 797, 806
food price increases and, 796, 802, 812
future impacts and risks, 810-813, 811
geographic distribution, 801
human health and, 805

- impacts of adaptation responses, 815-816
 impacts of climate, weather, and climate-related hazards, 796, 802-803, 802, 983
 indigenous peoples, 797, 805-806
 inequalities and, 802
 informal settlements, 805-806
 insurance and, 797, 816
 interactions with livelihoods, inequality, and climate change, 802-803
 International Poverty Line, 800
 key risks, 116-117, 811
 land use and, 797, 806-807, 814-815
 lessons from climate-development efforts, 816-818, 817
 measuring, 799-801, 800
 middle-income countries, 801, 819
 mitigation policies and, 797
 multidimensional, 797, 800-801, 800
 multiple deprivations and, 796
 net buyers of food, 797, 802
 new poor, 796, 803
 new vulnerabilities, 796
 observed evidence, 796, 1002-1003, 1002
 pastoralism and, 806-807
 pockets of, 797
 positive climate change impacts, 796
 poverty indicators, 623, 624
 projections, 801, 810-813, 811
 REDD and, 797, 814
 research gaps, 818-819
 risk-prone locations, 803-805
 in rural areas, 616, 618, 618, 621, 623, 806
 spatial and temporal scales, 801
 sustainable development and, 796, 816
 synthesis, 818-819
 transient, 805-806, 812-813
 trends, 801
 vulnerability and, 796, 797, 802
- Poverty reduction**, 27, 89-90, 796, 800-801, 815, 819
 adaptation and, 948
 implications of climate change for, 816-818
- Poverty traps***, 20, 692, 796, 806-809, 812-813
 critical thresholds, 807-809, 812-813
 debt load, 807
 minimum asset threshold, 801
 new, 796
- Precipitation**
 conclusions of AR4, 189
 drivers of change, 240-241
 extremes, 59, 239-240, 1070, 1162-1163, 1163-1170
 Giorgi-Francisco regimes, 1160
 heavy precipitation events, 81-84, 1136
 observed changes, 57-58, 140, 236, 1136, 1153, 1165-1170
 projected changes, 57-58, 81-84, 140, 307-308, 1136-1137, 1152-1154, 1158-1159, 1159-1160, 1162-1163, 1163-1170
 projected extremes, 240, 246, 1162-1171, 1163-1170
 projected impacts and interactions, 240-241
 projections, regional, 1159, 1160
 RCP projections, 140
 regional impacts, 1153, 1154, 1158-1159, 1160-1161
 variability, 60, 1070
 See also Droughts; Floods; specific regions and countries
- Predator-prey dynamics**, 48, 414, 431, 432, 450
- Pregnancy**, 718, 740-741
- Pre-industrial temperatures**, 735
 warming to 2°C above, 735
 warming to beyond 2°C above, 735, 735, 736
- Price rises**, 568, 623, 625, 730, 796, 1059-1060
 See also Food prices
- Price stability**, 488, 628
- Price volatility**, 491, 495, 513, 628
- Primary production**, 286, 292-293
 carbon dioxide effects on, 276, 287, 292-293
 fisheries, 150, 416, 489, 493
 in freshwater ecosystems, 286, 293, 493
 nitrogen/nutrients and, 286
 observed changes, 286, 982, 989-990
 ocean acidification and, 129
 in oceans, 17, 133-136, 415-416, 423-424, 424-425, 431, 434, 440, 443, 444-445, 447, 448, 449, 450, 451, 452, 455, 456-459, 457, 461, 508, 1658-1660, 1663, 1671, 1672, 1677, 1680-1697, 1682
 by phytoplankton, 32, 46, 421, 431, 435, 444-445, 451, 457, 1680-1681, 1682, 1714
 by plants, 276, 292-293
 in terrestrial systems, 292-293, 294, 311, 319
 upwelling ecosystems, 149-150
 See also Net primary production (NPP)
- Private sector engagement**, 539-540, 582-584, 836, 843-844
 in adaptation, 8, 871, 876, 876, 880-881, 886, 948, 950
- Probability distributions (of future impacts)**, 241, 254
- Productivity/production**. See Net primary production (NPP); Primary production
- Projections***, 11-25, 21-25, 59-60, 59-84, 63-65, 76-84
 Arctic sea ice, 60, 623, 776, 987, 987, 1015-1016, 1071, 1591-1593, 1591, 1595, 1712
 downscaled, 1159-1162
 global, 1136-1137
 high-resolution projections, 1162, 1181-1182, 1182
 impact models, 1148
 regional, 81-84, 1136-1137, 1148-1152, 1152-1154, 1158-1171, 1159-1160, 1163-1170
 regional summary figures, 137-141, 138-140
 scenario-based, 213
 sea level rise, 366, 368-369, 369, 633, 1137, 1171, 1669-1670
 sea level rise, global, 1137
 temperature and precipitation, global, 10, 1137
 temperature and precipitation, regionally, 1153, 1154
 temperature, projected changes, 10, 57-58, 81-84, 182, 1153, 1154
 uncertainties, 1138
 See also Key risks; Temperature projections; specific sectors, regions, and systems
- Property and property rights**, 761, 762, 773-774, 779
- Protected areas**, 324, 1524, 1526
 marine protected areas, 99, 1526
- Psychological effects**. See Mental health
- Pteropods**, 415, 440-441
- Public health**, 714, 718, 733, 738
- Public-private partnerships**, 686, 686, 949
- Public sector**, 8, 948, 950
 as insurer of last resort, 949
- Public services**, 575
- R**
- Radiation**, 288, 722
- Radiative forcing***, 178, 179, 188-189
- Rail transportation**, 572, 675
- Rainfall**. See Precipitation
- Rainfed agriculture**, 251-252, 498, 499, 514, 616, 624, 634
- Range shifts**, 4, 44, 69, 274, 294-296, 1176
 in Asia, 1339-1340
 climate velocity and, 15, 125, 126
 coastal areas, 364, 376, 377, 378, 992
 observed changes, 294-296
 in oceans, 124-125, 414-416, 430, 431, 450, 451, 456, 994, 1677-1698, 1707, 1708, 1711-1712, 1714
 projected changes, 296-299, 297
 risks associated with, 1042, 1061, 1075
- Reasons for Concern***, 12, 61, 1013-1016, 1073-1080
 aggregate impacts, 12, 61, 1015, 1016, 1044, 1077-1078
 climate change and exposure, 13, 1074
 conclusions of AR4, 182-184
 dangerous anthropogenic interference, 11, 1049, 1073
 definition, 1049
 distribution of impacts, 12, 61, 1015, 1044, 1045, 1077
 extreme weather events, 12, 61, 1014, 1014, 1044, 1045, 1076
 large-scale singular events, 12, 61, 1015-1016, 1044, 1078-1080
 mitigation scenarios and, 1083
 socioeconomic pathways and, 1074-1075
 summary of, 983, 1044, 1049
 temperature and, 1073, 1074
 unique and threatened systems, 12, 61, 1013-1014, 1013, 1044, 1045, 1075-1076
 updating, 1044, 1073-1080
 warming beyond 2°C, 924
- Recreation**, 677-678, 679
 in coastal areas, 384-385
 urban areas, 560
 See also Tourism
- Red Sea**, 1683-1684
- REDD (Reducing Emissions from Deforestation and Degradation)**, 617, 630, 641, 797, 814, 965, 1111, 1119
- Reforestation***, 277, 317, 321, 1062
- Regime shifts**, 454, 1015-1016, 1079
- Regional context**, 137-141, 1133-1197
 about: regions, with chapter numbers and map, 1142
 abrupt and irreversible changes, 276
 adaptation, 73-84, 1152-1157
 adaptation assessment, 1176-1184
 adaptation examples, 8-9, 90-91, 1145-1148, 1155-1156
 adaptation studies, variations in, 1137
 air quality projections, 1171, 1172
 baseline information, 138, 1179-1181

- climate change impacts perspective, *1144*
 climate information for political and economic regions, *1157*
 climate models, *1136, 1137-1138*
 climate summary figures, *137-141, 138-140*
 climate system, *1158-1162*
 context, *1139-1144*
 cross-chapter box, *137-141, 138-140*
 cross-regional phenomena, *1137, 1171-1176*
 decision-making context, *1136, 1139, 1140*
 defining, *1140-1143, 1141-1142*
 detection and attribution, *7, 30-32, 42, 44-46, 1001-1030, 1003-1010*
 distribution of impacts, *1015, 1015*
 downscaling, *1137-1138, 1159-1162*
 extreme climate events, *1162-1171, 1163-1170*
 extreme hydrological events, *247-248, 248*
 financial flows, *1171-1172*
 global context, *1158-1159*
 global pattern of regional impacts, *1010-1013, 1011*
 global scenarios, new framework for, *1143*
 globally averaged observed and projected changes, *1136-1137*
 hotspots, *1137, 1177-1178*
 human migration, *1175-1176*
 hydroclimatic regimes, *1162*
 impacts, *7, 30-32, 1137, 1147-1152, 1151*
 impacts assessment, *1149*
 indicators, *1177*
 information available, *1136-1137, 1144*
 institutions and actors, *1139*
 key risks, *20, 21-25, 59-62, 76-80*
 knowledge gaps and research needs, *1183, 1184*
 main topics, *1142-1143*
 methods, *1144*
 migration of natural ecosystems, *1176*
 modes of variability, *1162, 1180*
 multiple stressors, *1138, 1181-1182*
 observed changes, *81-84, 1136-1137, 1158-1171*
 observed impacts, *7, 44-46, 1001-1030, 1003-1010*
 previous assessments, *1136*
 previous assessments, and current report, *1150*
 projected changes, *81-84, 137-141, 138-140, 1136-1137, 1152-1154, 1158-1171, 1159-1160, 1163-1170*
 projected impacts, *1138, 1148-1152*
 projections, models and information for, *1136-1137*
 projections, variation in, *1137*
 regional assessment, scenarios for, *1143*
 regional circulation, *1162*
 regional variation, *1137*
 reliability of approaches, *1176-1184*
 reliability of information, *1147, 1150*
 resilience, enhancing, *1145-1148*
 resolution of models, scenarios, and projections, *1137-1138, 1162, 1181-1182, 1182*
 risk management on 20-year time horizon, *1156*
 risks, *73-84, 1136*
 scale issues, *1149, 1151-1152*
 scenario information, *1137-1138*
 sea level, *369, 1171*
 seasonal and annual changes, *1152, 1154*
 similarities and differences in regions, *1155*
 summary figures, *137-141, 138-140*
 synthesis of key issues, *1144-1151*
 synthesis of projected changes in extremes, *1163-1170*
 temperature and precipitation, *138, 1153, 1154, 1158-1159, 1160-1161*
 trade, *1171-1175*
 uncertainty, *1138*
 vulnerabilities, *1136, 1144, 1144, 1147-1152*
 vulnerability assessment, *1149, 1176-1184*
 vulnerability indicators, *1137, 1177*
 vulnerability mapping, *1151, 1152*
 vulnerability perspective, *1144*
 vulnerability reduction, examples, *1145-1148*
- Regional chapters**
 Africa, **1199-1265**
 Asia, **1327-1370**
 Australasia, **1371-1438**
 Central and South America, **1499-1566**
 Europe, **1267-1326**
 map of regions, *1142*
 North America, **1439-1498**
 Ocean, **1655-1731**
 Polar Regions, **1567-1612**
 Small Islands, **1613-1654**
See also specific regions
- Reindeer**, *1580, 1594-1595*
Reinsurance*, *663, 684, 949*
See also Insurance
- Relative sea level**. *See Sea level*
- Renewable energy**, *91, 617, 629-630, 1503, 1533-1535, 1534, 1544-1545*
 IPCC Special Report on (SRREN), *165, 186, 187*
 in small islands, *1641-1642*
- Representative Concentration Pathways (RCPs)***, *139-140, 171, 178, 179*
 coastal systems, *367*
 human health projections, *713*
 land use scenarios, *285*
 projections for small islands, *1629, 1630-1631*
 regional assessments, *1143*
- Reproductive health services**, *740-741, 742*
Reptiles, marine, *414, 448-449*
Research & development funding, *948, 966*
Reservoirs, sedimentation of, *373-374*
Residential sectors, *662, 671, 676*
Residual cost, *952-953, 953*
Residual impacts, *1080-1083, 1204*
Resilience*, *28-29, 85-93, 1101-1131*
 boundaries of the envelope of, *1123*
 building, *85-93*
 climate change responses and, *1113-1118*
 climate velocity and, *62, 87-88, 1121*
 in coastal systems, *365*
 co-benefits, *1104, 1118*
 concepts in, *1104, 1106, 1121*
 decision making and, *182, 198, 216-217, 1118*
 definition of, *40*
 determinants of, *1121-1123*
 economic growth and, *1114-1115*
 enhancing, *1110*
 in face of serious threats, *1121-1122*
 incremental responses, *1106, 1121*
 innovation and, *1120-1121*
 long-term, *147-148*
 mitigation and, *1104, 1113-1115, 1117-1118*
 political transformation, *1121-1122, 1122*
- range of options, *1120-1121*
 regional examples, *1145-1148*
 research and knowledge gaps, *1105, 1124-1125*
 risk management and, *1104-1105, 1117-1118*
 socio-technical transformation, *1105, 1120-1121*
 sustainable development and, *198, 216-217, 1104, 1118-1121*
 trade-offs, *1104, 1118-1119*
 transformation change and, *2-16, 1107, 1121-1122*
 from tropical cyclone disasters, *147-148*
 in urban areas, *18, 538, 539, 548-549, 550, 560-563*
 urban-rural interactions and, *154*
 window of opportunity, *1124*
- Resilience: Climate-resilient pathways***, *28-29, 87-93, 1101-1131*
 adaptation and, *1104, 1115-1117*
 alternative pathways, *1122-1123*
 case study (China), *1116*
 categories of response, *1106*
 co-benefits, *1104*
 decisions and, *1118*
 definitions, *1104, 1106, 1106, 1107*
 delayed action, results of, *1105, 1123-1124*
 elements of, *1104, 1112-1113, 1113, 1121-1122, 1122*
 framing, *1112*
 goals for, *1107*
 innovation and, *1120-1121*
 institutions and, *1119-1120*
 mitigation and, *1104*
 moving toward, *1105, 1122-1124*
 now as the time for, *1105, 1123*
 opportunity space, *88*
 political transformations and, *1105, 1121-1122, 1122*
 range of options, *1104, 1120-1121*
 research needs, *1105, 1124-1125*
 risk management and, *1104*
 sustainable development and, *28, 87, 1104, 1108-1113, 1110, 1118-1121*
 technology and, *1114, 1120-1121*
 transformations and, *29, 88, 1105, 1119-1120*
- Resource pricing**, *964-965*
- Rice**, *5, 17, 49, 1330-1331, 1343-1345, 1344, 1347, 1349, 1354, 1354, 1355, 1528-1529*
 observed crop yields, *7, 491, 492*
 prices, *568*
 projected crop yields, *5, 17, 49, 75, 488-489, 505, 509-510, 1330-1331, 1343-1345, 1344, 1504*
 temperature and, *498, 1330, 1344-1345*
- Rice landscapes**, *318*
Rift Valley Fever, *1223*
Rio+20 (2012), *818*
Risk*, *3, 26*
 acceptable, *1047*
 amplification by climate change, *63, 1057*
 assessment (*See Risk assessment*)
 climate change pathways and, *9*
 compound risk, *1042, 1057-1059, 1058, 1412*
 conclusions of AR4, *182-184*
 core concepts, *3, 37, 85*
 definitions of, *40, 199, 1048-1049*
 drivers of, *633-634*
 emergent risks*, *59-60, 117, 1039-1099*

- exposure (See Exposure)
 financing, 686, 949
 freshwater-related, 248-253, 249
 geoengineering, 454, 455, 1043
 governance and, 538-539
 hierarchy of, 202
 interactions of, 3, 1046
 key risks*, 11-20, 21-25, 59-60, 114-121, 1069-1073
 methodologies, 199-200
 new, creation of, 63
 newly assessed, 1062-1066
 perceptions of*, 28, 1068-1069
 projected, 59-60, 59-84
 Reasons for Concern, 12, 61, 983, 1013-1016, 1073-1080
 risk-based framework for adaptation, 902, 905-908, 906
 risk pools and sharing, 949, 964
 in rural areas, 633-637
 systemic, 59, 60, 1070
 temperature (See Key risks)
 tolerable and intolerable, 88, 906, 906
 transboundary, 1042-1043, 1059-1062, 1062
 types of, 201
 in urban areas, 538-540, 547-549, 549, 550-563
 vulnerability and, 1050
 See also Emergent risks; Key risks; Vulnerabilities
- Risk assessment***, 3, 3-4, 55-56, 684, 983, 1052
 evidence for, 11
 Reasons for Concern*, 983, 1013-1016
 scenarios and, 254-255
 tools, 922
- Risk financing**, 686, 949
- Risk-linked securitization**, 663
- Risk management***, 25-29, 26, 27, 56, 85-93, 86, 680
 climate forecasts and, 643
 climate-resilient pathways and, 1104, 1106
 coastal systems, 365, 386-396
 decision making and, 198, 199-202, 201
 disaster risk reduction, 217, 390, 565-566, 565
 feedbacks in, 9
 freshwater resources, 253-258
 in Ho Chi Minh City, 958
 iterative process of, 56, 183, 198, 200-202, 201
 mitigation and, 14
 overlapping approaches, 86
 regional, on 20-year time horizon, 1156
 resilience and, 1104-1106, 1117-1118
 sustainable development and, 1117-1118
 See also Disaster risk management
- Risk prevention**, 663
- Risk transfer***, 886, 949, 964
- River discharge***, 625
 See also Runoff
- River flow regimes**, 143-146, 144
- Rivers**, 274, 312-313
 air temperature impacts, 144
 cross-chapter box (flow regimes), 143-146
 dams on (See Dams)
 floods, 66, 721
 flow regimes, 143-146, 144
 impacts and vulnerability, 143-146, 312-313
 mean annual flow, 144
 observed impacts, 7, 30-32, 44-46, 1004
 projected changes, 313
 river basins, transboundary, 776
 river ice, 232, 987, 987
- water temperature, 144-145, 313
 See also Freshwater resources; Runoff; *specific rivers*
- Roads**, 572, 674-675, 1467
- Robustness**, 949, 957-958, 958
- Rodent-borne diseases**, 725, 1000
- Rooftops, green and white**, 90, 574-575
- Rotavirus infection**, 726
- Runoff***, 143-146, 243
 climate variability and, 158
 coastal systems impacts, 364, 368, 372
 from glaciers, 242
 nutrients in, 257
 observed changes, 237, 313, 987, 987
 projected changes, 243, 245, 257, 372
 river flow regimes and, 143-146
 species richness and, 145
- Rural areas**, 19, 50, 70, 613-657
 access to credit, 617, 642, 643
 access to knowledge, 629, 635, 643
 access to resources, 635, 642
 access to water, 634
 adaptation, 617, 637-643, 642, 644-645, 922
 adaptation, decision making for, 638
 adaptation experience and examples, 638-642, 639-640
 adaptation limits and constraints, 617, 642-643
 adaptation planning, 215-216
 adaptive capacity, 617
 agricultural adaptation, 638, 639-640
 agricultural impacts, 616, 623-625, 631-632, 632
 agriculture, 616, 617, 621-625
 climate forecasts, 643
 climate policies, 617, 629-630
 conservation agriculture, 638
 context of climate change, 616
 cross-chapter box, 153-155
 definition of, 616, 618-619, 619, 644
 detection and attribution of impacts, 616, 619-621
 distinctive characteristics of, 618
 droughts, 616, 620-621
 economic base, 616, 617, 623-628
 economic transformation, 616
 extreme weather events, 616, 620-621, 623, 633
 farm households and communities, 616
 fisheries, 627-628, 632-633, 637, 642, 644
 food crops, 616, 623-625
 food security, 616, 623-625, 628-630
 forestry and biodiversity, 640-642
 gender and, 617, 635, 644
 governance and, 617
 high-value food crops, 625
 human health, 623
 human population in, 616, 618, 618, 622
 impact assessment, 619-637
 incomes, 616
 infrastructure, 616, 627
 investment, 629
 key conclusions, 643-645
 key vulnerabilities and risks, 115-116, 633-637
 knowledge and traditional knowledge, 629, 635
 land tenure systems, traditional, 635
 land use, 616, 635, 637
 livelihood shifts, 796
 livelihoods, 50, 60, 616, 617, 623-628, 644
- livestock, 625-627, 633
 major impacts, 616, 619-637, 644
 marginalization of, 154
 market orientation, 634
 migration, 616, 617, 623, 628, 635
 mining, 633
 multiple non-climate stressors, 616
 natural resources and, 617, 623
 non-food crops, 625
 observed impacts, 50, 616, 619-623
 pastoralists, 625, 636-637, 644
 poverty in, 616, 618, 618, 621, 806
 poverty indicators, 623, 624
 projected impacts, 19, 70, 623-633, 796
 recreation and tourism, 633, 636
 REDD, 630, 641
 research gaps, 645
 resilience, 50, 616, 630, 634, 637, 638, 644
 rural-urban migration, 568
 salinity and saltwater intrusion, 633
 scale of farms, 617, 623, 634
 smallholder and subsistence farmers, 617, 623, 627, 634, 638
 spatial and regional interconnections, 628-630, 644
 storms, 616
 summary of previous assessments, 619, 620
 trade and, 70, 616, 617, 623, 628-629
 transportation, 628
 tropical beverage crops, 625, 626-627, 641
 under-investment, 616
 urban-rural interactions, 153-155
 valuation of impacts, 617, 630-633, 632
 vulnerabilities and risks, 616, 619-637
 vulnerability outcomes, 635
 water-dependent activities, 616, 625, 638-640
 water supply and resources, 19, 65, 616, 625, 632-633, 638-640, 640
- Russia**
 forest fires, 305, 729, 999
 heat wave of 2010, 503, 729, 999
- S**
- Safety nets**, 27, 539, 836, 845
- Salinity (of oceans)**, 414, 418, 431, 435, 1658, 1672, 1673
- Salinization**
 in coastal regions, 370, 379, 991
 of groundwater, 633, 991
- Salmonella**, 726
- Salmonellosis**, 688
- Saltmarshes**, 377
- Sanitation and sewage**, 252-253
 health aspects, 714
 in urban areas, 538, 557-558
- São Paulo, Brazil**, 1532
- Savannas**, 308-311
- Scenarios***, 56, 176-179, 179, 1179-1184
 baseline, 138, 1179-1181
 comparison of SRES and RCP, 178, 179
 credibility of, 1181-1184
 downscaling, 241
 evolution of, 172
 mitigation, 1080-1083, 1081, 1083
 mitigation, stringent, 1045, 1055, 1081
 regional assessment, 1143, 1179-1184
 Representative Concentration Pathways (RCPs), 139-140, 171, 178, 179, 285, 367, 1143

- Shared Socioeconomic Pathways (SSPs), 171, 178-179, 367, 1143
- socioeconomic elements, 1183-1184
- SRES, 171, 367
- SRES CMIP3, 178, 179, 1143
- Schistosomiasis**, 727, 727, 1223-1224, 1536
- Scopus bibliographic database**, 173, 174
- Sea ice**
- Arctic, 60, 623, 776, 987, 987, 1015-1016, 1071, 1136, 1570, 1591-1593, 1591, 1595, 1712
 - conclusions of AR4, 190
 - importance of changes in, 1596
 - in polar regions, 1570, 1591-1593, 1591, 1594, 1595, 1596, 1681, 1712
 - risks and vulnerabilities, 1071
- Sea level**, 1660, 1668-1670, 1707-1708
- extremes, 191, 368, 370, 991
 - global mean sea level*, 364, 368-369, 369, 1137, 1668-1669
 - local, 369-370, 991
 - regional, 369, 1171
 - relative sea level*, 364, 367-370, 375
- Sea level change***, 59, 63, 1668-1670
- adaptation options, economic evaluation of, 962
 - coastal area impacts, 364, 366, 367-370, 368, 374, 375, 379, 381, 385
 - commitment to, 1376
 - conclusions of AR4, 190-191
 - global mean sea level rise, 364, 368-369, 369
 - key risks and vulnerabilities, 1070, 1075, 1707-1708
 - large temperature increase, effect of, 63
 - long-term commitment to, 394-395
 - migration and mobility outcomes, 769-770, 770
 - observed changes and impacts, 7, 367, 368, 375
 - projected changes and impacts, 366, 368-369, 369, 633, 1137, 1171, 1669-1670
 - rate of rise, 1668-1669
 - regional impacts, 7
 - regional variations in, 364, 369
 - relative sea level rise, 367-370, 375
 - sanitation facilities and, 253
 - scenarios, 369
 - urban areas and, 538, 555
 - See also specific regions and countries*
- Sea surface temperature (SST)***, 1658, 1664, 1665-1668
- climate velocity and, 126
 - coastal systems and, 368, 371-372
 - extremes, 371-372
 - observed changes, 371
 - ocean systems and, 418, 419, 433
 - projected changes, 372, 418
 - regional changes, 1666-1667
 - velocity of isotherm shifts, 1668
- Sea urchin (*Diadema*)**, 1633-1634
- Seabirds**, 414, 448-450, 457, 1577
- in polar regions, 1575, 1588-1589
- Seagrasses**, 415, 429, 440, 442, 450, 992, 1330
- in coastal areas, 377-378
 - in small islands, 1621-1622
- Seals**, 1016, 1596
- Seasonality**
- animal and plant species, 274, 291-292
 - climate indices and, 1180
 - freshwater resources, 232
 - See also* Phenology
- Second Assessment Report**, 174-176, 175
- Sectors**. *See* Economic sectors and services
- Sediment delivery**, 364, 369, 373-374, 982
- Sediment load**, 233, 237-239, 379, 380
- projected changes, 246-247
- Seed banks**, 326
- Sensitivity***
- climate sensitivity, 423-424, 450, 997
 - thermal sensitivity, 48, 49, 431-432, 432, 446
- Sequestration**. *See* Carbon sequestration
- Services**
- adaptation options, 845, 847
 - ecosystem (*See* Ecosystem services)
- Settlements**. *See* Human settlements
- Shared Policy Assumptions (SPAs)**, 1143
- Shared Socioeconomic Pathways (SSPs)**, 171, 178-179, 367, 1143
- Shellfish**, 64, 1701
- cholera and, 726
- Shipping**, 80, 1173, 1174, 1584, 1591-1593, 1591, 1592, 1705
- trans-Arctic, 453, 1584, 1705
- Shrublands**, 4, 20, 279, 311-312
- Single weather events, attribution of**, 998-1000, 1018
- Sinks***. *See* Carbon sinks
- Ski industry**, 71, 636, 663, 678, 679, 693, 998
- adaptation, 636
 - snow-making, 636
- Small islands**, 80, 1613-1654
- adaptation, 8, 24, 1616-1617, 1634-1640, 1635, 1636
 - adaptation and mitigation interactions, 1616-1617, 1641-1642
 - adaptation barriers and limits, 922, 1640
 - adaptation costs, 1626, 1639, 1644
 - adaptation experience, 53, 1636-1640
 - adaptation, facilitating, 1642-1643
 - adaptation financing, 1617
 - adaptation options, 1703
 - adaptation risks, 1634-1640
 - adaptation support, 1703
 - adaptation, transfer of lessons learned, 1642
 - adaptive capacity, 1617, 1636-1637
 - aquatic pathogens, 1616, 1624-1625, 1633-1634
 - atolls, 1616, 1618, 1619-1622, 1619, 1623, 1634
 - beach erosion, 1620, 1624
 - biodiversity, 1622
 - ciguatera fish poisoning, 1624-1625, 1634
 - coastal areas, 1616, 1619-1622, 1627, 1635
 - coastal squeeze, 1623
 - coastal wetlands, 91, 1616, 1621-1622
 - collective and cooperative action, 1638-1639, 1642
 - community-based adaptation, 54, 1146
 - conclusions from previous assessments, 1618-1619
 - coral reefs, 1616, 1621, 1628, 1635
 - detection and attribution, 46, 1004-1010, 1620, 1626, 1627, 1644
 - diseases, 1624-1625
 - dust, airborne transcontinental, 1616, 1633
 - economic development, 1703
 - economies, 1625-1626, 1626, 1628, 1635
 - ecosystems, 1621-1622, 1635
 - energy, 91, 1641-1642
 - erosion, 1620-1621
 - extreme events, 1635
 - fisheries, 1616, 1621, 1629
 - food security, 1703
 - freshwater lens, 1623
 - freshwater supply, 1622-1623
 - human health, 1624-1625, 1634
 - human settlements, 1620, 1623
 - human systems, 1623-1626, 1627
 - hydro-meteorological hazards, 1634, 1637, 1638
 - inundation, 1620
 - invasive species, 1616, 1633
 - island coasts, 1619-1622
 - key risks, 24, 79, 120, 1635
 - livelihoods, 1616, 1632, 1635, 1703
 - loss of land, 803
 - mainstreaming, 1640
 - maladaptation, avoiding, 1642-1643
 - management risks, 1634-1640
 - marine biophysical systems, 1619-1622
 - migration, 1625, 1639-1640
 - multiple stressors, 1616
 - observed impacts, 32, 46, 1004-1010, 1616, 1619-1626
 - ocean acidification, 1621, 1634, 1635
 - ocean waves, distant-source, 1616, 1630-1632
 - precipitation, 1616, 1622-1623, 1627, 1630-1631, 1635
 - projected impacts, 17, 1004-1010, 1626-1629
 - projection methods, 1626-1627, 1643-1644
 - RCP projections, 1629, 1630-1631
 - relocation, 1625, 1639-1640
 - renewable energy resources, 1641-1642
 - research and data gaps, 1643-1644
 - risk avoidance, 1638
 - risks, 24, 79, 120, 1616, 1635
 - risks, addressing, 1616, 1635, 1637-1638
 - saline intrusion of groundwater, 1623
 - scenario-based projections, 1626-1629, 1628, 1643-1644
 - sea level rise, 364, 775, 1616, 1619-1620, 1621-1622, 1627, 1634, 1635, 1639
 - sea surface temperature, 1616, 1635
 - shoreline change, 1619-1621
 - socioeconomic stressors, adaptation and, 1636
 - temperature, 1616, 1622, 1627-1629, 1630-1631, 1635
 - terrestrial systems, 1622-1623, 1627
 - tourism, 91, 1623-1624, 1627, 1638
 - trade-offs, 1616, 1618, 1641
 - traditional knowledge, 53, 1146, 1636-1637
 - transboundary impacts, 1616, 1629-1634
 - tropical and extra-tropical cyclones, 1616, 1632, 1635
 - tuna fisheries, 1629
 - Tuvalu, 777
 - types and characteristics of, 1616, 1619, 1634, 1644
 - vulnerabilities, 1616, 1618, 1625, 1635-1636
 - water resources, 1622-1623
 - waves, 1616, 1630-1632
- Small to medium enterprises (SMEs)**, 836, 843
- Snow cover**, 4, 7, 30-32, 190, 232, 315, 1003
- in North America, 1443, 1452, 1454-1456, 1455, 1462-1463
 - observed impacts attributed to climate change, 44-46

- Social capital**, 1473
- Social cost of carbon (SCC)***, 690-691, 691
- Social needs**, 841-842
- Social options (for adaptation)**, 836, 845, 847-848
- Social protection***, 797, 817
- Social safety nets**, 539, 836, 845
- Socio-ecological systems**, 278
- Socio-technical transformation**, 1105, 1120-1121
- Socioeconomic change**, 912
- Socioeconomic factors, interactions with risk and vulnerability**, 11, 26, 1046
- Socioeconomic impacts**
in coastal systems, 372-373, 382, 383
floods, 239
of geoengineering, 416
human health, 718
in ocean systems, 414, 416, 459
- Socioeconomic pathways**, 26, 171, 178-179, 367, 1074-1075, 1143
- Socioeconomic scenarios***, 171, 178-179, 367, 1143, 1183-1184
- Socioeconomic vulnerability**, 1067-1068
- Soil erosion**, 233, 237-239, 246
- Soil moisture**, 236, 239, 241-243
observed changes, 236
projected changes, 232, 247, 249
- Solar insolation**, 1671
- Solar power**, 327, 666, 667-668
- Solar radiation management (SRM)**, 416, 454, 455, 776
risks of, 1043, 1065-1066
- Solution space**, 85
- Somali Current**, 1687-1688
- South America**. See Central and South America
- South China Sea**, 1687
- Southeast Asian Seas**, 1687
- Southern Ocean**, 1585-1586, 1589
mammals and seabirds, 1577
sea ice extent, 1596
temperature, 421
wind stress, 1671
See also Polar regions
- Sovereign insurance**, 685-686, 685
- Soy/soybeans**, 7, 491, 492, 493, 500, 1503, 1504, 1515, 1527, 1528, 1535
projected impacts, 5, 17
- Spatially restricted populations**, 275
- Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation**. See SREX
- Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN)**, 165, 186, 187
- Species community composition**, 67, 274, 415, 451, 465, 994
- Species distribution**, 123-125, 124, 125
coastal areas, 376, 377, 982
human activities and, 298
observed changes, 274, 294-296, 990
ocean systems, 4, 7, 48, 124-125, 414-415, 416, 430, 431, 448-450, 456, 459, 461-464, 994
projected changes, 274, 296-299, 297
spatially restricted populations, 275
- Species extinctions**. See Extinction
- Species interactions**, 414, 459
predator-prey dynamics, 48, 414, 431, 432, 450
- Species movements**, 274, 275, 324
anthropogenic transport, 275
limits to, 275
ocean systems, 414-415, 416
- Species range shifts**, 44, 69, 124-125, 125, 274, 294-296, 1176
climate velocity and, 15, 125, 126
coastal areas, 364, 376, 377, 378, 992
observed changes, 294-296
oceans, 124-125, 414-416, 430, 431, 450, 451, 456, 994, 1677-1698, 1707, 1708, 1711-1712, 1714
projected changes, 296-299, 297
risks associated with, 1042, 1061, 1075
- Species responses, constraints on**, 48, 275
- Species thermal sensitivity**, 48, 49
- Sphagnum moss**, 313
- Spring advancement**. See Phenology
- SRES scenarios***, 171, 367
CMIP3, 178, 179, 1143
compared with RCP, 178, 179
- SREX (Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation)**, 187-188, 247, 620, 643, 680, 720, 1047-1049
summary of findings, 1163-1164
- SRREN (Special Report on Renewable Energy Sources and Climate Change Mitigation)**, 165, 186, 187
- Stakeholders**, 182, 837, 842
involvement in decision making, 199, 209, 254, 580
participation, 540, 837, 1473-1475
- States, integrity of**, 72-73, 775-777
- Storm surges***, 364, 368, 370, 381, 453, 1070
in Asia, 147, 148
projected changes, 364, 370
projected impacts, 370
regional variability, 370
- Storms**
coastal systems and, 364, 368, 370
conclusions of AR4, 190
frequency and intensity of, 1669-1670, 1710
health impacts, 721-722
impacts on water resources, 257
in Ocean regions, 1660, 1671, 1710, 1712, 1713-1714
Superstorm Sandy, 383, 810, 1470, 1473
See also Hurricanes; Tropical and extratropical cyclones
- Storylines**, 176
- Strategic Environmental Assessment**, 254
- Strategic Programmes for Climate Resilience**, 1111
- Streamflow**, 243
climate change impacts on, 232
observed changes, 232, 236-237, 239-240
projected changes, 243, 244
seasonal changes in, 232, 243, 244
- Stressors***. See Multiple stressors; Non-climate stressors
- Stunting**, 731
- Subsidies**, 949, 965-966
- Subsistence agriculture***, 503, 616, 623, 627, 634, 638, 797
- Sugarcane**, 1503, 1528, 1533, 1534, 1540, 1544
byproducts, 163
- Sulfur (as air pollutant)**, 739-740
- Sulfur dioxide**, 739-740
- Supply and demand**, 662, 664, 679
- Supply-side challenges and sensitivities**, 683-684, 683
- Surface temperature**. See Temperature
- Surface water**, 66, 232, 233, 250-251
- Sustainable development***, 1101-1131
adaptation and, 1109-1110
adaptation and mitigation links, 216-217, 217, 1109-1110
climate change as threat to, 816, 1104, 1108-1113
climate change effects and reasons for concern, 1109
climate change interactions with other factors, 1109-1110
climate change, links to, 1108-1112
climate change response/decision making, 198
climate-resilient pathways and, 28, 1104, 1108-1113, 1110, 1118-1121
current, threats to, 1104
economic growth, tensions with, 1118
freshwater resources, 233
future, threats to, 1104
goals and objectives of, 1108-1109, 1111
institutions and, 1119-1120
interactions with CCAV, 179-182
local institutions, 1120
mitigation responses not always compatible with, 1110-1111
resilience and, 216-217, 1108-1113, 1118-1121
risk management, 1117-1118
strategies and choices, 1118-1121, 1123-1124
Sustainable Development Goals, 818
temperature rises and, 1123
threats to, 816, 1104, 1108-1113
trade-offs, 1118-1119
transformative action, 1119-1120
in urban areas, 18, 538-539, 560-563
See also Resilience
- Synergies**, 28, 87, 89-91, 394, 948
- T**
- Taxes**, 949, 965-966
- Tea**, 626-627
- Technology**, 27
access to, 1204
adaptation and, 885, 911-913, 922
adaptation options, 836, 845, 846
change, 1114
climate-resilient pathways and, 1114, 1120-1121
development, transfer, and diffusion, 885
information and communication technologies, 884
socio-technical transformation, 1105, 1120-1121
transfer, 966
- Telecommunication**, 538, 558-559, 571, 572
- Temperature**
annual averaged surface temperature, 139
conclusions of AR4, 189
early warning systems, 52, 734, 872, 876, 878, 883-885, 1145, 1466, 1538
extremes, 189, 720, 1162, 1165-1170
Giorgi-Francisco regimes, 1160
global averaged (1880-2012), 1137
global mean surface, 4, 178, 179
hottest months (1980-2009), 732
human thermoregulation, 713, 720-721

- interactive effects, 416
 nonlinear and threshold effects, 735-736
 observed changes, 10, 57-58, 81-84, 138, 139, 1153
 projected changes, 10, 57-58, 81-84, 138, 139, 182, 1153, 1154
 projected impacts (See Temperature impacts)
 ranges for plants and animals, 427-428, 427, 428, 429-431, 430
 RCP projections, 139
 regional observed and projected changes, 81-84
 scenarios compared, 178, 179
 sea surface (SST) (See Sea surface temperature)
 temperature range for animals, 49
 thresholds, 63, 713, 735-736
 tolerance and its limits, 432, 736
 warm days/nights, 318-319, 554-555, 720, 1163, 1165-1170
 web bulb global temperature (WBGT), 732, 736
 See also Heat waves; Temperature impacts; Temperature projections; *specific regions and countries*
- Temperature impacts**, 63, 713, 720-721, 731
 global/aggregate impacts, 13, 14
 heat-related deaths, 110, 713, 720-721, 736, 983, 1058, 1069, 1374
 irreversible impacts, 13, 14, 62
 key risks and vulnerabilities, 13, 59-60, 1070, 1073, 1074
 projected impacts of 2-3°C rise, 69-70, 796, 1121
 projected impacts of 4°C rise, 63, 924, 1123
 projected impacts of greater than 4°C rise, 1062-1064
 regional impacts, 1153, 1154, 1158-1159, 1160-1161
- Temperature projections**, 10, 57-58, 1162, 1163-1170
 extremes, 1162, 1163-1170
 regional, 1158-1159, 1159, 1160
 warming to 2°C above pre-industrial, 62, 735
 warming to beyond 2°C above pre-industrial, 735, 735, 736
- Terrestrial and inland water systems**, 271-359
 abrupt and irreversible regional-scale changes, 276
 adaptation and its limits, 277, 321-328
 adaptation capacity, 277
 adaptation opportunities, constraints, and limits, 922
 alien and invasive species, 275, 288-290, 289
 Amazon basin, 276, 309-310
 animals, 274, 292, 317
 biome shifts, 274, 278-279, 279, 280, 281, 316-317
 boreal-tundra Arctic systems, 276, 292, 303-305, 316-317
 carbon dioxide and, 287-288, 287
 carbon sequestration/sink, 15, 64, 67, 275-276, 276, 277, 313-314, 315, 989
 carbon source, potential to become, 276, 313-314, 315
 climate change impacts on, 274-277, 301-319, 302
 detection and attribution, 44-46, 290-291, 291, 989-991
 disturbance regime, 276, 290, 314, 317
 dryland ecosystems, 308-312
 dynamic and inclusive view of, 278-290
 economic costs of climate change, 326-327, 326
 emerging issues, 328
 extinctions, 275, 295, 295, 299-300
 feedbacks*, 274, 278, 303-305, 309-310, 315-317, 328
 forests and woodlands, 301-303
 freshwater ecosystems, 274-277, 290-321
 high-altitude ecosystems, 274, 278-279, 279, 312, 317
 high-latitude ecosystems, 274, 283, 293, 301, 312
 human-modified systems, 317-319, 364
 impacts/risks for major systems, 301-319, 302, 1058, 1071
 key risks, 114
 land use and cover change, 274, 282, 283-285, 284-285
 management actions, 277, 324-325, 325
 methods and models, 279
 mitigation options, 321
 multiple stressors, 276, 283-290
 nitrogen, 276, 285-286
 observed impacts, 30-32, 44-46, 44-48, 274-277, 290-321, 989-991
 ozone, 286-287
 paleoecological evidence, 279-282
 past assessments, 278
 permafrost, 304, 314-315, 315
 phenology, 291-292, 321-322, 989
 plants, 291-292
 productivity, 276, 286, 292-293
 projected changes, 274-277, 290-321
 radiation, 14-16, 288
 spatially restricted populations, 275
 species distribution and movements, 274-275, 294-299
 tipping points, 276, 278-279, 301, 309-310, 316-317
 tree mortality, 15, 276, 306-307, 308
 uncertainties, 278, 279, 328
 vulnerability/risk, 274-277, 290-321, 302
- Terrestrial ecosystems**, 271-359
 adaptation, 277, 321-328
 biodiversity, 274
 carbon sequestration/sink, 15, 64, 67, 275-276, 277, 313-314, 315, 989
 carbon source, potential to become, 276, 313-314, 315
 carbon stocks, 293-294
 detection and attribution, 982, 983, 989-990, 1005-1006, 1017
 extinctions and invasions, 14-15, 275, 288-290, 289, 295, 295, 299-300
 feedbacks, 274
 forest dieback, 15, 66, 276, 306-307, 1016
 genetic and evolutionary responses, 322-323
 land use and land use change, 274, 276, 282, 283-285, 284-285
 management of, 277, 324-325, 325
 observed changes, 7, 30-32, 274-277, 982, 983, 989-990, 1005-1006, 1017
 phenology, 274, 291-292, 321-322
 in polar regions, 314-317
 projected changes, 14-16, 274-277
 species community changes, 274
 species distribution/abundance, 4, 274, 293-299, 297
 vulnerability/risk, 274-277, 290-321, 302, 1071
- Thames Estuary 2100 plan**, 365, 389
- Thermal power**, 665-667, 1282
 extreme events and, 666
 water resources and, 252, 662, 665
- Thermal sensitivity**, 48, 49
 in oceans, 48, 414, 431-432, 432, 446
- Thermal stratification**, 80, 1672, 1710
- Thermal stress**
 hypoxia and, 447
 in Ocean regions, 1669
 See also Heat stress
- Thermal tolerance**, 432
 human limits to, 736
- Thermal windows/ranges**, 49, 427-428, 427, 428
 upper limits of, 450
- Thermokarst**, 305, 317, 988
- Thermoregulation, human**, 713, 720-721
- Third Assessment Report**, 175, 176
- Thresholds**, 63, 278-279, 1078-1080
 avoiding, 1084
 climate, 736
 critical, 1045
 critical, livelihoods and, 798, 804
 critical, poverty and, 807-809, 812-813
 critical, risk of crossing, 1045
 detection and prediction of, 278
 ecosystems, 278-279
 temperature, 63, 713, 735-736
 types of, 278
 See also Tipping points
- Tick-borne diseases**, 722, 723, 725
 Lyme disease, 723, 725, 736
 observed changes, 1000
 tick-borne encephalitis (TBE), 723, 725, 736, 1000
- Ticks**
Ixodes spp., 725
 thermal tolerance of, 736
- Tidal power**, 1660
- Tipping points***, 15, 67, 276, 278-279, 301, 902, 1045, 1078-1080
 Amazon basin, 64, 276, 309-310, 1016
 Arctic region, 276, 1015-1016
 avoiding, 1045, 1084, 1085
 boreal-tundra Arctic systems, 64, 276, 316-317, 1016
 mitigation and adaptation and, 925
 risk of crossing, 1045
 temperature impacts, irreversible, 13, 14, 63
 temperature impacts, irreversible, 13, 14, 63
- Top-down approaches**, 851, 871-872, 1144, 1144
- Tourism**, 71, 678-679, 693
 beach tourism, 71, 663, 679
 climate sensitivity of, 998
 coastal area impacts, 364, 384-385, 663
 demand for, 677-679
 in Europe, 253, 384-385, 679, 1271, 1283
 global GDP, 1704
 higher altitudes and latitudes, 663, 678
 impacts on, 662, 678-679
 marine, 1704-1705
 market impacts, 679, 689
 nature tourism, 663, 679
 in North America, 636, 1471-1472
 observed changes, 253, 998
 planned adaptation, 636
 projected changes, 71, 253, 633
 in rural areas, 633, 636
 ski resorts, 71, 636, 663, 678, 679, 693, 998
 in small islands, 1623-1624, 1627, 1638
 summer, 693

- supply, 679
valuation of, 633
winter, 636, 693, 998
- Trade**, 70, 1171-1175
adaptation and, 629
agreements, 1353, 1448, 1450
agricultural products, 617, 628-629
international, 617, 629, 1171, 1173-1175
regional information, 1171-1175
rural areas and, 70, 616, 617, 623, 628-629
sensitivity to climate, 1173-1175
volumes, 617, 629
- Trade-offs**, 208-209, 216, 217, 394, 925, 1118-1119
adaptation, 948, 1104
adaptation and mitigation, 1104
in adaptation of food production systems, 489
adaptation options, 918
costs of, 327
between economic and environmental goals, 1118-1119
frameworks for addressing, 1118-1119
multi-metric valuation and, 1118-1119
in terrestrial ecosystem management, 325, 327
- Traditional ecological knowledge (TEK)**, 1001
- Traditional knowledge***, 629, 758, 765-766, 766, 1001
adaptation experience, 53
in polar regions, 8, 1583-1584
- Transaction costs**, 955
- Transboundary adaptation**, 1355, 1448-1449
- Transboundary impacts and risks**, 1042-1043, 1059-1062, 1062
in Australasia, 91
for small islands, 1616, 1629-1634
- Transboundary pollution**, 1353
- Transboundary water basins**, 776
- Transformation***, 29, 86, 88, 181, 1105
definition of, 40, 1122
spheres of, 86, 1122, 1122
transformational changes, 1107, 1116, 1121-1122
in urban areas, 538
- Transformational adaptation**, 89, 181, 513, 1121-1122
decision making and, 198, 217-218
definition of, 733
elements and potentials, 1121-1122
incremental adaptation vs., 1121
limits and, 89, 921-922
need for, 836, 839, 1105, 1106, 1116, 1374
policy, 1116
resilience and, 88, 1105
risk reduction, 1121-1122
transformative responses, 1106, 1119-1120
in urban areas, 539
- Transpiration**. See Evapotranspiration
- Transportation**, 674-676, 693
active transport, 714, 742
adaptation, 571-572
air, 676
Arctic sea ice loss and, 559, 776
bridges, 675
coastal areas, 383-384
disaster response, 559
of energy, 668-669
extreme weather events and, 559
geographic zones for impacts, 674
infrastructure, 628, 662, 674
inland navigation, 675-676
navigation and shipping, 559, 776, 776, 1173, 1174, 1584, 1591-1593, 1591, 1592, 1705
ocean systems and, 453
pipelines, 675
in polar regions, 1173, 1174, 1584, 1591-1593, 1591, 1592
ports, 557, 558, 572, 675-676
rail, 572, 675
roads, 572, 674-675, 1467
in rural areas, 628
in urban areas, 538, 558-559, 571-572
vulnerability, 383
- Tree growth**, 293, 303, 308
- Tree line***, 317
- Tree mortality**, 15, 110, 276, 306-307
in North America, 1443, 1447, 1459
observed changes, 276, 308, 991
- Tree rings**, 293
- Triple-win approaches**, 24, 27, 1111, 1117
- Tropical beverage crops**, 625, 626-627, 641, 1528
- Tropical cyclones***, 147-148, 190, 368, 1707-1708
in Asia, 147-148, 148, 1333-1334
in Australasia, 1374, 1377, 1381
cross-chapter box, 147-148
impacts, 147-148
in North America, 1452-1454, 1460, 1477
observed changes, 621
projected changes, 147, 370
in small islands, 1616, 1632
See also Extra-tropical cyclones
- Tropical forests**, 284, 307-308
See also Amazon region
- Troposphere***, **ozone in**, 286-287, 488, 493, 728-729
health effects, 716, 728-729
- Tsunamis***, 390
- Tundra***, 314-317
biome shift, 316-317
fire disturbance, 314, 317
food webs, 1016
livelihoods, 1349
permafrost degradation, 314, 1016
projected changes, 314, 316-317
shrub encroachment, 290, 1016
- Turtles, marine**, 414, 448-450, 457
- U**
- Ultraviolet radiation**, 722
- UN Straddling Fish Stocks Agreement (UNSFSA)**, 1713
- Uncertainty***, 6, 11, 56, 174-176, 175
communication of, 6, 41, 171
dealing with in future climate change, 11, 254-255
decision making and, 9, 56, 198, 207-208, 956-958, 1386-1387
deep, 254
risk and, 199
treatment in this Report, 6, 41, 174-176, 176-177
- Undernutrition**, 490, 713, 805, 810
- Unique and threatened systems**, 12, 61, 983, 1013-1014, 1013, 1044, 1045, 1075-1076
- United Kingdom (UK)**
adaptation, 1295, 1296
adaptation costs, 1297
climate projections, 1276
coastal policies and adaptation, 365, 388, 389, 395, 1296
coastal retreat, 389
critical infrastructure, 1291
flood defenses, 1157, 1181, 1297
flood insurance, 885
floods, 633, 1279, 1280-1281, 1291
human health, 1291
insurance, 1283
London, adaptation risks and potentials, 593-595
National Adaptation Programme, 880
river flow, 1279
sea level, 1276, 1451
storm surges, 1279
Thames Estuary 2100 plan, 365, 389
transportation, 1281-1282
water quality, 1294
- United Nations Convention on the Law of the Sea (UNCLOS)**, 1661, 1711-1713
- United Nations Framework Convention on Climate Change (UNFCCC)***, 1042
Article 2, 1042, 1043, 1047, 1107
disaster risk management and, 686
Global Environmental Facility (GEF), 874
vulnerability assessment, 852
- United States**
adaptation, 1445, 1446, 1448, 1458, 1466, 1468, 1473-1476
agriculture, 1446-1447, 1462-1463, 1470
climate trends, 1443, 1452, 1478
coastal areas, 1444
coastal storms, 1444, 1467
droughts, 999, 1459, 1460-1461, 1470, 1478
elderly population, 1449, 1451, 1452
ethanol industry, 1110
extreme events, 1450, 1470
fires/wildfires, 1446, 1460-1461
floods, 1457, 1470
forest insects, 1446, 1459
GDP, 1451
green infrastructure, 884
human health, 1444, 1447-1448, 1464-1466
human population, 1448-1449, 1451
Hurricane Katrina, 211, 381, 383, 810, 1002
Hurricane Rita, 381
Hurricane (Superstorm) Sandy, 383, 810, 1466, 1470, 1473
insurance, 1469
Mexico-USA border region, 1448-1449, 1470
migration, 1449-1450
NAFTA, 1448, 1450
New York City, 555, 595-596, 884, 1472, 1474
precipitation, 1443, 1452, 1454, 1456, 1467, 1470
runoff and streamflow, 1443, 1456
snow, 1443, 1454, 1456
socioeconomic indicators, 1451
temperature, 1443, 1452, 1454, 1456
temperature extremes, 999, 1443, 1452, 1456, 1464, 1478
tourism and recreation, 636
transboundary adaptation, 1448-1449
transportation infrastructure, 1467
vulnerability, 1470-1472, 1478
water resources, 1444, 1446, 1456-1457
See also North America
- Upwelling**, 149-152
artificial, for geoengineering, 455
coastal systems and, 364, 373
cross-chapter box, 149-152

- definition of, 149
 Eastern Boundary Upwelling Ecosystems, 149, 1659, 1663, 1666
 Equatorial Upwelling Systems, 149, 1659, 1663, 1666, 1681-1683
 mechanisms of increasing, 150
 in ocean systems, 415, 416, 442, 465, 995-996
 trends in, 149-152
- Urban areas**, 18, 50, 70, 535-612
 adaptation, 51, 277, 538-540, 563-575, 564
 adaptation co-benefits, 538, 578-579
 adaptation constraints, 540, 564-565
 adaptation context, 549-550
 adaptation examples, 591-596, 1474
 adaptation implementation, 539-540, 575-590
 adaptation opportunities, constraints, and limits, 922
 adaptation options, economic evaluation of, 962
 adaptation pathways, 563-566
 adaptation planning, 215-216, 563-566, 578, 876-877
 adaptation potentials, 561-562, 591-596
 adaptation resources, 585-590, 586
 adaptation support, 539-540
 adaptive capacity, 179-180, 539, 545, 546
 agriculture, 539
 air quality, 556
 allocating tax shares, 587, 589
 built environment, 538, 559-560
 city networks and learning partnerships, 585
 climate change and variability impacts, 553-556
 climate-related drivers of impacts, 561-562
 complexity of, 577
 conclusions from AR4, 549-550
 context, 541-547
 cross-chapter box, 153-155
 dense nature of, 551
 development pathways, 563-566
 differences in, 545
 direct and indirect impacts, 553-556
 disaster management assistance, 587-588
 disaster preparedness, 569
 disaster risk management, 539
 disaster risk reduction, 565-566, 565, 588
 droughts, 538, 552, 555
 ecological sustainability, 552
 economic base, 566-568
 economic development, 567
 ecosystem-based adaptation, 539
 ecosystem services, 538, 572-575
 electric power, 566, 571
 energy supply, 558, 571
 as essential to global climate change
 adaptation, 538
 extreme heat, 569
 extreme precipitation, 538
 extreme weather events, 548, 559, 568
 financing, 538-539, 540, 586-589, 586
 flooding, 319, 538, 555-556, 557-558, 804, 962
 food and biomass, 568
 food security, 539
 government/governance, 538-540, 566, 575-578, 576
 green and white roofs, 574-575
 green economy, 567
 green infrastructure, 560, 572-575
 green spaces, 573-574, 734
 health and social services, 560
 heat islands, 59, 551, 554-555, 1070, 1532
 heat stress, 538, 556
 heat waves, 558, 575, 1470
 heritage sites, 560
 household and community-based adaptation, 580-582, 581, 582
 housing, 538, 539, 559-560, 568-570
 human health and disease, 556
 human population in, 50, 538, 541-547, 544, 553, 554, 622
 informal settlements, 538, 583
 infrastructure, 18, 538, 539, 557, 572-575
 insurance sector, 582-584
 inter-dependent systems, 538, 549, 556
 key issues, 541
 key risks, 114-115, 561-562, 591-596
 key uncertainties, 550
 large cities, 541, 542-543
 leadership, 540, 589-590
 local government, 566, 577-578
 low-income groups, 540
 megacities, 551
 micro-climate, 538
 micro-finance for adaptation, 584
 migration, 563
 migration from rural areas to, 568
 peri-urban areas, 153-155, 616
 philanthropic engagement, 584-585
 ports, 557, 558, 572
 private sector engagement, 539-540, 582-584
 public services, 575
 railways, 572
 recreational sites, 560
 regional differences, 552
 resilience, 18, 70, 538, 539, 548-549, 550, 560-563
 risk reduction, 539
 risks and impacts, 114-115, 550-563, 561-562, 591-596
 roads, 572
 sanitation, 538, 557-558
 scientific evidence base, 540
 sea level rise and, 538, 555
 sectors: adaptation, 566-575
 sectors: exposure and sensitivity, 556-560
 severity of projected impacts, 796
 social safety nets, 539
 spatial and temporal dimensions, 551-552
 stakeholder involvement, 580-585
 storm surges, 538, 555
 stormwater costs, 673
 sustainability, 560-563
 sustainable development, 70, 538-539
 telecommunications, 538, 558-559, 571, 572
 temperature, 552-555, 553-554
 transformative adaptation, 539
 transformative development, 538
 transportation, 538, 558-559, 571-572
 uncertainties in climate projections, 540, 563, 580
 urban effect, 551
 urban processes, 550-563
 urban-rural interactions, 153-155
 vulnerabilities and risks, 65, 538-540, 547-549, 549
 vulnerability and risk assessment, 579-580
 warm days/nights, 318-319, 554-555
 waste economy, 567
 wastewater, 557-558, 570, 571, 673
 water-related services, 252-253, 570, 673
 water supply, 65, 557-558, 570, 673
- Urban ecosystems**, 318-319, 538-539
Urban governance, 538-539, 538-540, 566, 575-578, 576
Urban heat islands*, 59, 551, 554-555, 1070, 1532
Urban-rural interactions, 153-155
Urbanization, 50, 542, 551-552, 1470-1471
 in Africa, 1224-1225
 in Asia, 1330
- V**
- Vaccinations**, 21, 714, 733
Valuation of impacts, 617, 630-633, 632
Variability, modes of, 1162, 1180
Vector-borne diseases, 385, 713, 722-726
 chikungunya fever, 723, 725
 dengue fever, 723-725, 723, 724
 early warning systems, 734
 hemorrhagic fever with renal syndrome (HFRS), 725
 Japanese encephalitis, 725
 Lyme disease, 723, 725
 malaria, 722-723, 723, 1000
 near-term future, 725-726
 plague, 723, 725, 1000
 thermal tolerance of vectors, 736
 tick-borne encephalitis (TBE), 723, 725
 See also Diseases; specific diseases
- Vegetation**, 157-161
 active role in water flows, 157-161
 Arctic region, 1578-1580, 1579
 carbon dioxide effects on, 276, 292-293, 303, 308
 models, 282
 Normalized Difference Vegetation Index (NDVI), 293, 1578, 1579
 See also Plants; specific systems and regions
- Venice Lagoon project**, 365
- Vibrios**, 726
Vibrio cholerae, 455, 726
- Vietnam**, 1355
 adaptation in, 1110-1111
 coastal population, 373
 dams in, 1110-1111, 1355
 exposure to storm damages, 1638
 gender and inequalities, 809
 iliving with floods program, 640
 Mekong River/delta, 640, 803, 1355
 risk management in Ho Chi Minh City, 958
 transboundary adaptation planning, 1355
- Violence and conflict**, 8, 20, 39, 50, 65, 72, 732-733, 771-775
 armed conflict, 771-773, 772
 climate change as cause of, 771-773, 772, 773
 climate policies and, 617
 climate variability and, 1001-1002
 conflict over resources, 617
 in Darfur, 773
 geoengineering and, 776-777
 geopolitical rivalry, 775-777
 human health effects, 732-733
 human security and, 758, 771-775, 772, 773
 peace-building activities, 775
 risks of, 1042, 1060-1061
 sensitivity to climate change, 758
 vulnerabilities for human populations, 758
 water scarcity and, 253
- Vitamin D**, 722
Voluntary carbon offset (VCO), 814

- Vulnerabilities***, 3, 4-8, 26
 assessment (See Vulnerability assessment)
 coastal systems, 364, 372-386, 462-463
 conclusions of AR4, 182-184
 definition of, 39, 839-840, 1048-1049
 drivers of, 633-634
 ecosystems, 274
 exposure (See Exposure)
 freshwater resources, 248-253, 250, 274
 gender and, 635, 644, 718
 human health, 717-720, 733-734
 indicators, 1137, 1177
 induced vulnerability, 637
 interactions, 3, 37, 1046
 key*, 1039-1099
 measurement and metrics, 854-855
 multidimensional, 47-48, 809-810, 809
 multiple stressors and, 179-180
 ocean systems, 414-416, 461-465, 462-463
 reducing, 1045
 reduction in present, as first step to adaptation, 25-26, 85
 regional context, 1147-1152
 risk and, 1050
 rural areas, 633-637
 terrestrial and freshwater ecosystems, 274-277, 290-321, 302
 trade and financial flows and, 1173
 urban areas, 538-540, 547-549
 violence and, 733, 758
 vulnerability mapping, 733-734, 1151, 1152
 See also Key vulnerabilities; Risk; *specific systems and countries*
- Vulnerability assessment**, 1144, 1144, 1176-1184
 analysis and reliability of, 1176-1184
 baseline and scenario information, 1179-1184
 comprehensive, 840
 methods, 1144
 Reasons for Concern, 12, 61, 983, 1013-1016, 1073-1080
 regional, 1176-1184
 in rural areas, 619-637
 scale in, 1149, 1151-1152
 top-down and bottom-up approaches, 1144, 1144
 in urban areas, 579-580
- Vulnerability hotspots**, 20, 1137, 1177-1178, 1463
- W**
- Walker Circulation**, 1180, 1671
- Warming**. See *Temperature entries*
- Waste economy**, 567
- Wastewater**, 673
 adaptation, 570
 management, 571
 sanitation and urban drainage, 252-253, 538, 557-558
 treatment, 257
 in urban areas, 557-558, 570, 571
- Water**, 672-674
 adaptation options, economic evaluation of, 962
 competition for, 232
 cross-chapter boxes, 157-166
 groundwater (See Groundwater)
 surface water, 66, 232, 233, 250-251
 water-energy/feed/fiber nexus, 92-93, 163-166
 water-saving techniques, 27, 1116
 water services sector, 672-674
- See also Freshwater resources; Hydrological systems
- Water-borne diseases**, 713, 726-727
- Water cycle***, 157-161
 climate models of, 235-236
- Water demand/use**, 251-253, 312
 for biofuel production, 630
- Water flows, vegetation and**, 157-161
- Water infrastructure**, 672-673, 693
- Water management**, 66, 90, 674
 adaptation, 254, 255, 256
 adaptation trade-offs, 918
 adaptive approaches to, 215, 233, 254-255, 255
 climate change impacts on, 234
 emergent risks, 1042, 1054-1056, 1056
 impact on mitigation, 258
 Integrated Water Resource Management, 254, 877
 modification of, 253
 water allocation, 674
- Water quality**, 232, 251, 714
 drinking water, 232
 observed changes, 237, 238
 projected changes, 246, 252, 319
- Water resources**
 adaptation costs, 256
 adaptation options, economic evaluation of, 962
 adaptation potential, 14, 256
 adaptation trade-offs, 918
 availability of, 248-251, 251
 climate change and, 232, 234, 257
 competition for, 630
 conservation of, 91
 detection and attribution, 982, 986-989, 987
 economic impacts of climate change, 672-673
 observed impacts, 4, 7, 982, 987-988
 projected impacts, 14
 regional water balance, 988
 resource pricing, 964-965
 in rural areas, 616, 625, 632-633
 vulnerability/risk, 248-253, 250
 See also Freshwater resources; Runoff
- Water scarcity**, 248, 249, 253
 in Asia, 1330, 1337-1338, 1338
 human security and, 761-762, 761
 in urban areas, 555
- Water security**, 248-251
- Water services**, 672-674
 infrastructure and economy-wide impacts, 672-673
 inland navigation, 675-676
 irrigation, 673-674
 municipal and industrial water supply, 673
 nature conservation, 674
 recreation and tourism, 674
 wastewater and urban stormwater, 673
 water management and allocation, 674
- Water stress**
 in Africa, 73-74, 1202, 1217, 1237, 1237
 in Asia, 1338
 livestock and, 502
 projections, 312-313
- Water supply**, 65, 662
 adaptation, 570, 638-640, 640
 for energy production, 92-93, 163, 164, 252, 662
 future impacts and vulnerabilities, 248-251, 251
- infrastructure, 662, 672
 municipal and industrial, 673
 reliability of, 233
 rural areas, 19, 65, 70, 616, 625, 632-633
 urban areas, 65, 557-558, 570
- Water use efficiency (WUE)***, 157-158, 294
- Waves**, 1660, 1671
 coastal systems, 368, 371
 conclusions of AR4, 190
 deep ocean swells, 1616, 1630-1632
 impact on small islands, 1616, 1630-1632
 significant wave height*, 190
 See also Storm surges
- Web bulb global temperature (WBGt)**, 732, 736
- Weeds**, 488, 500, 506-507
- Welfare**
 economic welfare, 662, 664
 ocean ecosystems and, 1698
 social welfare, 1290-1293, 1299, 1301
- Wetlands**, 312, 992
 coastal, 91, 373, 377-378
 projected changes, 313, 314
- Wheat**, 488, 489, 1527, 1528-1529
 observed impacts, 7, 491, 492, 982
 projected impacts, 5, 17, 69, 488-489, 505, 509-511, 1285
 sensitivity to climate change, 505
 temperature and, 498
- White band disease**, 1634
- Wicked problems**, 200-201, 208, 211, 387
- Wildfires**. See *Fires; Forest fires*
- Win-win approaches**, 1111, 1117, 1118
- Wind**, 371
 coastal systems, 368, 371
 in Ocean regions, 1658, 1659, 1660, 1671, 1713-1714
 projects changes, 371
 surface wind (oceans), 1660, 1671, 1706, 1710
 wind speeds, 1334
 wind storms, 276, 1281, 1283
- Wind power**, 327, 630, 666, 668, 1282, 1283, 1660
- Wind turbines**, 327, 668
- Wine production**, 506, 625, 1271-1272, 1292
- Winter mortality**, 721
- Winter tourism and sports**, 636, 693, 998
- Women**. See *Gender*
- Work capacity, heat effects on**, 19, 71, 731, 732
- Working Group I**, 188-191
- Working Group II**
 core concepts, 3, 3-4, 85
 Fifth Assessment report (AR5), 3, 3-4, 85, 176-182, 176-177
 scenarios, 178-179, 179
 uncertainty, treatment of, 6, 41, 176, 176-177
 See also IPCC assessment reports
- Working Group III**, 191-192
- World Bank**
 country development terminology, 181
 economic estimates, 960
 Pilot Program on Climate Resilience, 844, 879
- World Economic Forum**, 843
- Y**
- Yellow Sea**, 1686-1687
- Z**
- Zoonoses (zoonotic diseases)**, 725, 726
- Zooplankton**, 431, 440-441, 455
- Zoos**, 326