

## Index

- Aarhus Convention  
 access to environmental information, 95  
 access to justice, 96  
 background to, 95  
 commitments, 14, 95  
 guarantee of rights, 95  
 Kiev Protocol on Pollutant Release and Transfer Registers, 96  
 public participation in decision-making, 95  
 absolute state liability, *see* liability and compensation  
 access to environmental information, 95  
 access to justice, 96  
 acid deposition, US regulation of, 178  
 adaptation to climate change  
 compensation, 8  
 Framework Convention on Climate Change, 68  
 limitations, 7  
 need for, 7  
 Paris Agreement, 69  
 aerosol sulfate injection project (Russia), 272  
 affluence as factor for GHG production, 6  
 Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs), 108, 281  
 agriculture  
 biochar production from agricultural waste, 48  
 as factor for GHG production, 7  
 air capture devices, US zoning requirements, 199  
 aircraft emissions, 103  
 airspace, US regulation of, 191  
 albedo modification, *see* solar radiation management  
 Antarctica Treaty System  
 Antarctic Treaty, 100  
 background to, 100  
 climate engineering aspects, 101  
 commitments, 100  
 liability and compensation, 232  
 Madrid Protocol, 100  
 research governance, 14, 101  
 anthropocentrism  
 Framework Convention on Climate Change, 66  
 international environmental law, 63  
 Arrhenius, Svante, 4  
 Asilomar International Conference on Climate Intervention Technologies, 283  
 Asilomar International Conference on Recombinant DNA Molecules, 285  
 Asilomar Principles of climate engineering research governance, 283  
 atmosphere, enhanced weathering, 50  
 Aurora Flight Science Corporation, 31  
 authorization of projects, *see* projects  
 authorization of research, 285  
 aviation law, *see* civil aviation law  
 Ban Ki-Moon, 331  
 biochar, 48  
 bio-energy plus carbon capture and storage (BECCS)  
 application, 45  
 IPCC, 8, 326  
 recommendations, 326  
 UNCLOS, 84  
 bioengineering, 38  
 biological diversity  
 climate engineering principles, 16

- Convention, *see* Convention on Biological Diversity
- Bodansky, Daniel, 283
- Boysen, Lena, 327
- brightness of sky, impact of SAAM, 32
- Broecker, Wally, 325
- Budyko, Mikhail, 4, 29
- Buesseler, Ken, 47
- building standards (USA), 198
- Burns, Wil, 332
- CAA (Clean Air Act) (USA), *see* United States
- Canada
  - Haida Salmon Restoration Corporation, 273
  - tortious liability, 240
- carbon capture and storage (CCS)
  - BECCS, *see* bio-energy plus carbon capture and storage
  - capture and storage
  - carbon dioxide removal contrasted, 3
  - CO<sub>2</sub> storage or use, 46
  - direct air capture and storage, *see* direct air capture and storage
- carbon dioxide removal (CDR)
  - advantages, 4
  - application, 3, 41
  - biochar, 48
  - bio-energy plus carbon capture and storage (BECCS), 8
  - carbon capture and sequestration contrasted with, 3
  - category of research, 276
  - direct air capture and storage, *see* direct air capture and storage
  - disadvantages, 4
  - enhanced weathering, 50
  - Framework Convention on Climate Change, 12, 65, 67
  - IPCC, 114
  - Kyoto Protocol, 68
  - liability, 253
  - liability and compensation, 226
  - need for, 9
  - objectives and projections, 8
  - ocean fertilization, 47
  - Paris Agreement, 8, 9, 12, 69
  - prospects for, 10
  - recommendations for, 324, 325
  - representative concentration pathways (RCPs), 8
  - research, 22
  - research governance, 24
  - technologies, 3
  - trespass, liability for, 242
  - UNCLOS, 13, 76, 78, 84
  - Vienna Convention for the Protection of the Ozone Layer, 71
- Carnegie Climate Geoengineering Governance Initiative, 331
- Carnegie Council for Ethics in International Affairs, 331
- CBD, *see* Convention on Biological Diversity
- CCS, *see* carbon capture and storage
- CDR, *see* carbon dioxide removal
- Center for Carbon Removal (USA), 44
- CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) (USA), 188
- Chavez, Anthony, 332
- Chevron–Ecuador dispute, 247
- Chicago Convention on International Civil Aviation, 103
- cirrus cloud seeding, 37
- cirrus cloud thinning, liability for, 228
- civil aviation law
  - aircraft emissions, 103
  - Convention on International Civil Aviation (Chicago Convention), 103
  - International Civil Aviation Organization (ICAO) guidelines, 103
  - noncompliance procedures, 104
  - relevance to climate engineering, 17, 103
  - sovereignty and jurisdiction over airspace, 14
- civil liability, *see* liability and compensation
- Clean Air Act (CAA) (USA), *see* United States
- Clean Power Plan (USA), 327
- Clean Water Act (CWA) (USA), *see* United States
- climate change, *see* adaptation to climate change
- Climate Change Convention (UNFCCC), *see* Framework Convention on Climate Change
- climate engineering
  - climate policy in relation, 5
  - conclusions and recommendations, 324, 335
  - definition, 2
  - discussions, 4
  - elements of, 2
  - ‘geoengineering’ definition, 2
  - geoengineering origins, 4

- climate engineering (*cont.*)
  - governance regime
    - elements of, 331
    - recommendations for, 330
  - introduction to, 1
  - law, *see* international law; United States
  - legal scholarship, 128
  - liability and compensation, *see* liability and compensation
  - methodologies, 2
  - projects, *see* projects
  - prospective uses, 1, 2
  - research, *see* research governance
  - technologies, *see* technologies
- Climate Engineering Fund for damages
  - payments, 334
- climate policy
  - adaptation strategy, 7
  - carbon dioxide removal, 8
  - climate engineering in relation, 5
  - components, 5
  - mitigation strategy, 5
  - principal objective, 5
  - solar radiation management, 10
  - technology breakthrough, likelihood of, 10
- Climeworks (firm), 43
- cloud brightening, *see* Marine Cloud Brightening
- CLRTAP, *see* Convention on Long-Range Transboundary Air Pollution
- Collinridge Dilemma, 276, 279
- common but differentiated responsibilities
  - principle, 16, 124
- common concern of humankind,
  - environment as, 16, 123
- compensation, *see* liability and compensation
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (USA), 188
- conflict identification and resolution, 285
- Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, *see* Aarhus Convention
- Convention on Biological Diversity (CBD)
  - background to, 96
  - climate engineering aspects, 14, 97
  - COP decisions concerning climate engineering, 97
  - 'geoengineering' definition, 98
  - liability, 253
  - liability and compensation, 231
  - ocean fertilization, 98, 99
  - technology reports, 100
- Convention on Environmental Impact Assessment in a Transboundary Context, *see* Espoo Convention
- Convention on International Civil Aviation (Chicago Convention), 103
- Convention on Long-Range Transboundary Air Pollution (CLRTAP)
  - 'air pollution' definition, 73
  - climate engineering aspects, 73
  - as framework agreement, 13, 72
  - governance gap, 298
  - liability and compensation, 230
  - noncompliance procedure, 74
  - parties, 72
  - principles, 72
  - protocols, 13, 74
  - as regional agreement, 13, 72
- cooperation principle, 17, 127
- Coordinated Framework for the Regulation of Biotechnology, 329
- countermeasures, transboundary
  - environmental harm, 121
- crop albedo bioengineering, 38
- Crutzen, Paul, 5, 29
- customary international law
  - bindingness, 62, 115
  - Framework Convention on Climate Change, 66
  - liability and compensation, 233
  - relevance to climate engineering, 15, 115
  - sense of legal obligation (*opinio juris*), 15, 62, 115
- CWA (Clean Water Act) (USA), *see* United States
- damages, *see* liability and compensation
- decision-making, public participation in, 95
- Declaration of the UN Conference on the Human Environment, 110
- deforestation as factor for GHG production, 7
- Deich, Noah, 44
- direct air capture and storage
  - application, 42
  - CDR, *see* carbon dioxide removal
  - first commercial scale plant, 43
  - implementation techniques, 43
  - UNCLOS, 84
- direct removal of carbon dioxide, liability for, 226
- Disaster Relief and Emergency Assistance Act, 168

- disclosure requirements for research, 286  
 dispute resolution for climate engineering projects, 335  
 domestic law of liability, *see* liability and compensation  
 Draft Articles, *see* International Law Commission  
 due diligence, Framework Convention on Climate Change, 67  
 dumping at sea, control of, 85
- Earth's surface, solar radiation management, 38, 39  
 Eastern Pacific Emitted Aerosol Cloud Experiment (E-PEACE) project (USA), 273  
 economic orientation of Framework Convention on Climate Change, 66  
 Ecuador–Chevron dispute, 247  
 EIA, *see* environmental impact assessment  
 emergency powers in US law, 168  
 Endangered Species Act (ESA) (USA), 162  
 energy use as factor for GHG production, 7  
 enforcement of international law, 62  
 enhanced weathering, 50  
 ENMOD Convention  
   background to, 101  
   commitments, 102  
   ‘environmental modification’ definition, 14, 102  
   institutional structure, 102  
   peaceful environmental modification, 14, 102  
 environment as common concern of humankind, 16, 123  
 environmental agreements, *see* multilateral environmental agreements  
 Environmental Defense Fund (USA), 283, 298  
 environmental harm, *see* transboundary environmental harm  
 environmental impact assessment (EIA)  
   Espoo Convention, *see* Espoo Convention  
   London Convention and Protocol, 90  
   research governance, 287, 333  
   USA, *see* United States, National Environmental Policy Act  
 environmental information, access to, 95  
 environmental law principles, 16  
 environmental modification techniques, *see* ENMOD Convention  
 E-PEACE (Eastern Pacific Emitted Aerosol Cloud Experiment) project (USA), 273  
 equity principle, 17, 127
- Espoo Convention  
   background to, 93  
   climate engineering aspects, 94  
   commitments, 14, 93  
   Protocol on Strategic Environmental Assessment, 94  
 Espy, James, 4  
 exclusive economic zones (EEZ), 80
- Federal Advisory Committee Act (USA), 285  
 financial assurance mechanisms, 250  
 flexibility mechanisms (Kyoto Protocol), 68  
 Food and Agriculture Organization (FAO) (UN), Code of Conduct for Responsible Fisheries, 295  
 forum shopping, 278  
 Framework Convention on Climate Change (UNFCCC)  
   adaptation to climate change, 68  
   anthropocentricism, 66  
   carbon dioxide removal, 12, 65, 67  
   climate engineering aspects, 67  
   commitments, 67  
   customary international law, 66  
   due diligence commitment, 67  
   economic orientation, 66  
   as framework agreement, 64  
   goal of, 1  
   governance gap, 298  
   governance system, 12  
   institutional structure, 70  
   Kyoto Protocol, *see* Kyoto Protocol  
   liability, 253  
   liability and compensation, 230  
   objectives and projections, 65  
   Paris Agreement, *see* Paris Agreement  
   parties, 65  
   as platform for management and governance, 330  
   principles of international environmental law, 66  
   research governance, 25, 67  
   solar radiation management, 13, 65  
   technologies, 67  
   Technology Mechanism, 67  
 fund for climate engineering damages payments, 334  
 funding of research, 285
- Gates, Bill, 325  
 general principles of international law, 62

- genetically modified organisms (GMOs), US  
regulation of, *see* United States
- geoengineering, *see* climate engineering
- Germany  
Institute for Advanced Sustainability  
Studies, 326  
LOHAFEX project (with India), 271  
Max Planck Institute for Meteorology, 327
- global greenhouse gas (GHG) emissions  
factors for production of, 6  
global spread, 6  
levels, 1, 6  
mitigation, 5  
persistence, 6  
reduction, 2
- Global Thermostat (firm), 44
- Haida Salmon Restoration Corporation  
(Canada), 48, 273
- Hansen, James, 5
- harm to environment, *see* transboundary  
environmental harm
- hazardous substances and hazardous waste  
regulation (USA), 185
- human rights  
application to climate engineering, 105  
benefits of scientific research, enjoyment  
of, 107  
as category of rights, 105  
liability and compensation, 234  
private actor involvement in research  
governance, 108  
procedural rights, 107  
relevance to climate engineering, 18, 105  
research governance, 106
- human-centredness, *see* anthropocentrism
- ICAO, *see* International Civil Aviation  
Organization
- Iceland, CO<sub>2</sub> geologic storage project, 46
- ILC, *see* International Law Commission
- India, LOHAFEX project (with  
Germany), 271
- information, access to, 95
- Institute for Advanced Sustainability Studies  
(Germany), 326
- Institute of Biological & Environmental  
Sciences (UK), 327
- intellectual property law  
governance gap, 280  
patents, 108  
relevance to climate engineering, 18, 108  
research governance, 289  
TRIPS Agreement, 108, 281
- Intergovernmental Panel on Climate Change  
(IPCC)  
BECCS, 45  
carbon dioxide removal, 114  
establishment, 5, 114  
reports, 5, 45, 114  
representative concentration pathways  
(RCPs), 8, 65  
solar radiation management, 114
- International Civil Aviation Organization  
(ICAO) guidelines, 103
- international dispute resolution, 18, 108
- international environmental law  
anthropocentrism, 63  
legal scholarship, 128  
multilateral environmental  
agreements  
binding, 12, 63  
nonbinding, 15  
principles, 16, 66, 123
- international law  
agreements between states, 61  
boundaries, 63  
civil aviation, 17  
current state, 11  
customary international law, 15, 62  
enforcement, 62  
general principles, 62  
human rights, 18  
intellectual property, 18  
international dispute resolution, 18  
*introduction to*, 57  
multilateral agreements  
binding, 12, 63  
nonbinding, 15  
necessity defense for contrary acts, 120  
nonstate actors, 63  
peremptory norm (*jus cogens*), 119  
principles of international environmental  
law, 16  
relations between states, 61  
sources, 61  
sovereignty principle, 60  
space, 17
- International Law Commission (ILC)  
Draft Articles on Responsibility of States for  
Internationally Wrongful Acts, 118  
Draft Articles on the Prevention of  
Transboundary Harm from Hazardous  
Activities, 116

- Draft Articles on the Protection of the Atmosphere, 123
- international relations, disruption of, 281
- Israel, Yuri, 272
- Johannesburg Declaration, 111
- jus cogens*, 119
- justice, access to, 96
- Keith, David, 29
- Kyoto Protocol
  - carbon dioxide removal, 68
  - emissions reduction targets, 12, 68
  - flexibility mechanisms, 68
  - ratification, 68
  - solar radiation management, 68
  - successor, *see* Paris Agreement
- land use planning (USA), 198
- large-scale projects, *see* projects
- Latham, Jonathan, 273
- legal scholarship, 128
- liability and compensation
  - absolute state liability (Space Liability Convention), 249
  - actions that violate domestic environmental laws, 237
  - adaptation strategy, 8
  - Antarctica Treaty System, 232
  - carbon dioxide removal, 226
  - Chevron–Ecuador dispute, 247
  - cirrus cloud thinning, 228
  - civil liability for private party pollution under polluter pays principles, 249
  - climate engineering, 224
  - Climate Engineering Fund for damages payments, 334
  - Convention on Biological Diversity, 231, 253
  - Convention on Long-Range Transboundary Air Pollution (CLRTAP), 230
  - customary international law, 233
  - direct removal of carbon dioxide, 226
  - domestic law
    - actions that violate domestic environmental laws, 237
    - failure to take required actions, 239
    - introduction to*, 236
    - negligence, 242
    - nuisance actions, 240
    - obstacles to climate engineering liability actions, 243
    - strict liability, 243
    - tortious conduct, 239
    - trespass, 241
  - establishment of compensation systems, 21
  - failure to take required actions under domestic law, 239
  - financial assurance mechanisms, 250
  - form of reparations, 119
  - Framework Convention on Climate Change, 230, 253
  - future directions, 252
  - future liability, 225
  - human rights violations, 234
  - London Convention and London Protocol, 253
  - mandatory compensation funds, 250
  - marine cloud brightening, 228
  - model strategies
    - absolute state liability (Space Liability Convention), 249
    - civil liability for private party pollution under polluter pays principles, 249
    - financial assurance mechanisms, 250
    - introduction to*, 248
    - mandatory compensation funds, 250
  - Montreal Protocol, 230
  - negligence, 242
  - nuisance actions, 240
  - Ocean Iron Fertilization (OIF), 227
  - Outer Space Treaty, 232
  - Paris Agreement, 230, 231
  - research governance, 290, 333
  - solar radiation management, *see* solar radiation management
  - space law, 104
  - Space Liability Convention, 232, 249
  - state liability
    - absolute state liability (Space Liability Convention), 249
    - application to climate engineering, 230
    - claims framework, 229
    - customary international law, 233
    - definition, 229
    - human rights violations, 234
    - introduction to*, 228
    - treaty and IEA provisions, 229
  - strict liability, 243
  - tortious conduct, 239, 243
  - transboundary environmental harm, 118, 121
  - transnational law, 246
  - trespass, 241
  - UNCLOS, 82, 230, 232

- LOHAFEX project (Germany/India), 271
- London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter
- application, 88
  - background to, 88
  - climate engineering aspects, 89
  - commitments, 89
  - environmental impact assessment, 90
  - liability, 253
  - London Protocol, *see* London Protocol
  - objectives, 88
  - ocean fertilization, 89
  - parties, 88
  - UNCLOS in relation, 88
- London Protocol
- amendment of 2013, 90
  - application, 88
  - assessment framework for marine geoengineering activities, 91
  - background to, 88
  - carbon dioxide capture, 92
  - climate engineering aspects, 89
  - commitments, 88
  - environmental impact assessment, 90
  - liability, 253
  - 'marine geoengineering' definition, 90
  - objectives, 88
  - ocean fertilization, 89
  - parties, 88
  - 'pollution' definition, 88
  - research governance, 91
  - UNCLOS in relation, 88, 92
- Low, Sean, 326
- lower atmosphere, solar radiation management, 34
- LRTAP Convention, *see* Convention on Long-Range Transboundary Air Pollution (CLRTAP)
- Marchetti, Cesare, 4
- Marine Cloud Brightening (MCB)
- description, 34
  - E-PEACE project (USA), 272
  - liability and compensation, 228
  - National Research Council study, 40
  - UNCLOS, 86
- marine environment, *see* oceans and seas
- Marine Mammal Protection Act (MMPA) (USA), 166
- Max Planck Institute for Meteorology (Germany), 327
- Migratory Bird Treaty Act (MBTA) (USA), 166
- mitigation strategy, difficulties for, 5
- Montreal Protocol
- commitments, 71
  - goal of, 13
  - governance gap, 280, 298
  - liability and compensation, 230
- moral hazard, 278
- moratoria on research, 293
- multilateral environmental agreements
- binding
    - atmospheric agreements, 12, 64
    - category of, 12, 63
    - marine agreements, 13, 75
    - procedural agreements, 14, 93
    - specific agreements in other categories, 14, 96
  - liability under, *see* liability and compensation
  - nonbinding, 15, 109
- Myrvold, Nathan, 30
- National Emergencies Act (NEA) (USA), 169
- National Environmental Policy Act (NEPA), *see* United States
- National Research Council, geoengineering report, 5, 28, 40, 41, 45
- National Science Foundation (USA), 4
- Natural Environment Research Council (UK), 326
- natural resources, sovereign right to exploit, 16, 115
- necessity defense for acts contrary to international law, 120
- negligence, liability for, 242
- nonstate actors in international law, 63
- nuisance, liability for, 240
- Ocean Dumping Act (USA), 183
- ocean fertilization
- Convention on Biological Diversity, 98, 99
  - description, 47
  - liability and compensation, 227
  - LOHAFEX project, 271
  - London Convention and London Protocol, 89
  - nuisance, liability for, 241
  - phases of research, 291
  - UNESCO oversight, proposal for, 297
- oceans and seas
- marine agreements, 13, 75

- UNCLOS, *see* United Nations Convention on the Law of the Sea
- OIF (Ocean Iron Fertilization), *see* ocean fertilization
- outer space, *see* space law
- Outer Space Treaty, 104, 232
- Oxford Principles of climate engineering
  - research governance, 283, 289
- ozone depleting substances, US regulation of, 179
- ozone, impact of SAAM, 32
- Paris Agreement
  - adaptation to climate change, 69
  - carbon dioxide removal, 8, 9, 12, 69
  - emissions reduction targets, 69
  - entry into force, 69
  - human rights, 234
  - liability and compensation, 230, 231
  - solar radiation management, 69
  - US withdrawal, 12, 327
  - voluntary pledges, 1, 12, 69
- Pasztor, Janos, 331
- patents, 108
- penalties for unauthorized research
  - activities, 334
- peremptory norm (*jus cogens*), 119
- Philippines, Mount Pinatubo eruption, 3, 32, 270
- photosynthesis, impact of SAAM, 31
- Planktos (firm), 296
- polar regions, *see* Antarctic and Arctic
- pollutant release and transfer registers, Kiev Protocol, 96
- polluter pays principle, 17, 126, 249
- 'pollution' definition, 88
- population as factor for GHG production, 6
- precautionary principle, 16, 125
- principles of international environmental law, 16, 66, 123
- principles of international law, 62
- private actors in research governance, 108
- procedural agreements, 14, 93
- procedural rights, 107
- projects
  - authorization of large-scale projects, 332
  - authorization principles, 332
  - authorization process, 332
  - Climate Engineering Fund for damages payments, 334
  - compensation, 333
  - dispute resolution, 335
  - eligible applicants, 332
  - environmental impact assessment, 333
  - liability, 333
  - monitoring, reporting and verification, 332
  - penalties for unauthorized activities, 334
  - public deliberation, 333
  - transparency, 333
- projects, 331
- public engagement with research, 288, 333
- public participation in decision-making, 95
- RCRA (Resource Conservation and Recovery Act) (USA), 187
- REDD program, 7
- reparations, *see* liability and compensation
- representative concentration pathways (RCPs), 8, 65
- research governance
  - by adapted institutions, 296
  - aerosol sulfate injection project (Russia), 272
  - approaches to, 282
  - Asilomar Principles, 283
  - authorization, 285
  - benefits of scientific research, enjoyment of, 107
  - carbon dioxide removal, 24
  - categories of climate engineering research, 276
  - choice of rules, 23
  - Collinridge Dilemma, 276, 279
  - commencement of oversight, 290
  - concerns and issues, 277
  - conflict identification and resolution, 285
  - current state of climate engineering research, 22
  - definition, 283
  - disclosure requirements, 286
  - disruption of international relations, 281
  - Eastern Pacific Emitted Aerosol Cloud Experiment (E-PEACE) project (USA), 273
  - elements of, 25
  - environmental impact assessment (EIA), 287
  - evolutionary approach, 24
  - examples, 271
  - by existing institutions, 296
  - forum shopping, 278
  - Framework Convention on Climate Change, 25, 67
  - functions, 283



- research governance (*cont.*)  
 funding, 285  
 gaps, 297  
 Haida Salmon Restoration Corporation (Canada), 273  
 human rights, 106  
 institutional structure, 23  
 institutional structures, 295  
 intellectual property, *see* intellectual property law  
 intellectual property rights  
 management, 289  
*introduction to*, 269  
 liability, 290  
 LOHAFEX project (Germany/India), 271  
 moral hazard, 278  
 moratoria, 293  
 by new institutions, 297  
 obstacles to research, 22  
 Oxford Principles, 283, 289  
 phases of geoengineering research  
 generally, 292  
 phases of SRM and OIF research, 291  
 principles, 23, 24, 283  
 private actor involvement, 108  
 public engagement, 288  
 solar radiation management, 24  
 space law, 104  
 Stratospheric Particle Injection for Climate Engineering (SPICE) project (UK), 272  
 summary overview, 299  
 supervisory structures, 295  
 thresholds, 292  
 transboundary environmental harm, 118  
 UNCLOS, 79  
 Vienna Convention for the Protection of the Ozone Layer, 72  
 research governance, 270, 274, 279, 280, 293  
 Resource Conservation and Recovery Act (RCRA) (USA), 187  
 responsibility of states, *see* states  
 rights, *see* human rights  
 Rio Declaration on Environment and Development, 111  
 Rivers and Harbors Act (USA), 183  
 Robert T. Stafford Disaster Relief and Emergency Assistance Act, 168  
 Royal Society (UK), 283, 298  
 definition of 'geoengineering', 2, 274  
 geoengineering studies, 5, 34, 43  
 SRM Governance Initiative, 283, 298  
 Russia, aerosol sulfate injection project, 272  
 SAAM, *see* Stratospheric Aerosol Albedo Modification  
 scientific research, *see* research governance  
 sky brightness, impact of SAAM on, 32  
 Smith, Pete, 327  
 solar radiation management (SRM)  
 abrupt termination, 117  
 advantages, 2  
 application, 2, 28  
 Arctic ice and snow albedo  
 enhancement, 39  
 category of research, 276  
 cirrus cloud seeding, 37  
 cloud brightening, *see* Marine Cloud Brightening  
 comparative efficacy and costs, 40  
 crop albedo bioengineering, 38  
 disadvantages, 3  
 disclosure requirements, 286  
 Earth's surface, 38, 39  
 Framework Convention on Climate Change, 13, 65  
 IPCC, 114  
 Kyoto Protocol, 68  
 legal scholarship, 130  
 liability  
 future, 225, 228, 252  
 nuisance, 241  
 potential, 20  
 trespass, 242  
 lower atmosphere, 34, 37  
 moral hazard, 11  
 nuisance, liability for, 241  
 Paris Agreement, 69  
 phases of research, 291  
 potential effects, 11  
 recommendations for, 324, 327  
 research, 22  
 research governance, 24  
 SAAM, *see* Stratospheric Aerosol Albedo Modification  
 science of, 28  
 solar sunshades in space, 33  
 SRM Governance Initiative (SRMGI), 283, 298  
 sulphate injection, *see* sulphate injection  
 trespass, liability for, 242  
 UNCLOS, 76, 78, 85  
 upper atmosphere, 29

- US regulation, 198
- Vienna Convention for the Protection of the Ozone Layer, 71
- solar sunshades in space, 33
- sovereign right to exploit own natural resources, 16, 115
- sovereignty principle, 60
- space law
  - liability and compensation, 104
  - Outer Space Treaty, 104
  - relevance to climate engineering, 17, 104
  - research governance, 104
  - solar sunshades, relevant laws, 33
  - Space Liability Convention, 249
- Space Liability Convention, 232, 249
- SPICE (Stratospheric Particle Injection for Climate Engineering) project (UK), 272
- SRM, *see* solar radiation management
- SRMGI, *see* solar radiation management states, 119
  - agreements between, 61
  - enforcement of international law, 62
  - liability, *see* liability and compensation
  - relations between, 61
  - responsibility of, 16, 118
  - sovereignty, 60
  - transboundary environmental harm, *see* transboundary environmental harm
- storage of CO<sub>2</sub>, *see* carbon capture and storage (CCS)
- strategic environmental assessment, Protocol on, 94
- Stratospheric Aerosol Albedo Modification (SAAM)
  - costs, 31
  - environmental impacts
    - brightness of sky, 32
    - National Research Council study, 40
    - photosynthesis, 31
    - stratospheric ozone layer, 32
    - sudden halt of SAAM, 33
  - implementation techniques, 30
  - science of, 29
  - sudden halt, 33
- stratospheric aerosol schemes, US regulation of, 175
- stratospheric ozone layer, impact of SAAM, 32
- Stratospheric Particle Injection for Climate Engineering (SPICE) project (UK), 272
- strict liability, *see* liability and compensation
- sulphate injection
  - Clean Air Act (USA), 177, 178
  - CLRTAP, 74
  - nuisance actions, 241
  - Russian project, 241
  - SPICE project (UK), 272
  - state liability, 230
  - Vienna Convention for the Protection of the Ozone Layer, 71
- surface environment, *see* Earth's surface
- Sustainable Development Goals, 111
- technologies
  - carbon dioxide removal, *see* carbon dioxide removal
  - change to cleaner types, 6
  - description, 28
  - as factor for GHG production, 6
  - Framework Convention on Climate Change, 67
  - international conference, 23
  - research, *see* research governance
  - solar radiation management, *see* solar radiation management
  - technology breakthrough, likelihood of, 10
  - Technology Mechanism, 67
  - UNCLOS, 83
- terrestrial environment, *see* Earth's surface
- The Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD), *see* ENMOD Convention
- thresholds for research, 292
- tortious conduct, liability for, 239, 240, 243
- Toxic Substances Control Act (TSCA) (USA), 186
- transboundary environmental harm
  - abrupt termination of SRM, 117
  - compensation, 121
  - countermeasures, 121
  - disruption of international relations, 281
  - from climate engineering, 120
  - from climate engineering research, 281
  - ILC Draft Articles on prevention, 116
  - necessity defense, 120
  - obligations of state of origin, 122
  - prevention of, 16, 116
  - research governance, 118
  - state responsibility and liability, 118
  - ultrahazardous activities, 122
- transnational law of liability, 246
- transparency in climate engineering projects, 333

- trespass, liability for, 241  
 TRIPS, *see* Agreement on Trade-Related  
 Aspects of Intellectual Property Rights  
 Trump, Donald  
 climate policy, 7  
 election, 1  
 withdrawal from Paris Agreement, 12, 327  
 TSCA (Toxic Substances Control Act)  
 (USA), 186
- UN Environment Programme (UNEP)  
 Provisions for Co-operation between States  
 in Weather Modification, 15, 112  
 recent activity, 113  
 role, 112
- UNESCO, 113, 297
- United Kingdom  
 climate engineering research  
 definition, 274  
 geoengineering initiatives, 5  
 Institute of Biological & Environmental  
 Sciences, 327  
 Natural Environment Research  
 Council, 326  
 Oxford Principles of climate engineering  
 research governance, 283, 289  
 Royal Society, 2, 5, 34, 43, 274, 283, 298, *see*  
 Royal Society  
 SRM Governance Initiative (SRMGI),  
 283, 298  
 Stratospheric Particle Injection for Climate  
 Engineering (SPICE) project, 272
- United Nations  
 Education, Social and Cultural  
 Organization (UNESCO), 113, 297  
 Environment Programme (UNEP), 15, 112  
 Food and Agriculture Organization  
 (FAO), 295  
 Framework Convention (UNFCCC),  
*see* Framework Convention on  
 Climate Change  
 General Assembly Resolution on Oceans  
 and the Law of the Sea, 115  
 international environmental summits,  
 15, 110  
 International Law Commission, *see*  
 International Law Commission  
 IPCC, *see* Intergovernmental Panel on  
 Climate Change  
 multilateral environmental  
 agreements, 12, 63  
 World Meteorological Organization, 114
- United Nations Convention on the Law of the  
 Sea (UNCLOS)  
 background to, 75  
 carbon dioxide removal, 13, 76, 78, 84  
 climate engineering aspects, 76, 77  
 climate engineering installations  
 at sea, 86  
 climate engineering methods, 84  
 cloud brightening, 86  
 coastal state jurisdictional zones, 80  
 commitments, 76  
 dumping at sea, 85  
 efficacy for climate engineering  
 governance, 87  
 exclusive economic zones (EEZ), 80  
 high seas, 81  
 institutional structure, 76  
 liability and compensation, 82, 230, 232  
 London Convention and London Protocol  
 in relation, 88, 92  
 ‘marine environment’ definition, 76  
 marine technology development and  
 transfer, 83  
 non-transfer of pollution hazards, 78  
 parties, 75  
 pollution control, 13  
 ‘pollution of the marine environment’  
 definition, 76  
 protect and preservation of marine  
 environment, 76  
 research governance, 79  
 ships, jurisdiction over, 80, 81  
 solar radiation management, 76, 78, 85  
 supplementary agreements, 84  
 territorial waters, 80
- United States  
 air capture devices, zoning requirements  
 for, 199  
 airspace, regulation of  
 airplanes, 194  
 amateur rockets, balloons, and  
 kites, 191  
 large ground structures interfering with  
 airspace, 195  
 other rockets, 193  
 albedo modification techniques, regulations  
 and standards applicable to, 198  
 building standards, state and local, 198  
 categories of climate engineering  
 research, 276  
 Center for Carbon Removal (USA), 44  
 Chevron–Ecuador dispute, 247

- Clean Air Act (CAA)
  - acid deposition, regulation of, 178
  - mobile sources, regulation of, 177
  - ozone depleting substances, regulation of, 179
  - stationary sources, regulation of, 176
  - stratospheric aerosol schemes, 175
- Clean Power Plan, 327
- Clean Water Act (CWA)
  - National Pollutant Discharge Elimination System (NPDES)
    - permits, 179
  - other permissions and requirements, 182
  - relevance to climate engineering, 179
- climate engineering law
  - application, 201
  - current state, 18
  - federal laws applicable to specific techniques, 19, 175
  - generally applicable laws, 18, 154
  - introduction to*, 154
  - procedural statutes, 154
  - state and local laws applicable to specific techniques, 198
- climate policy inertia, 7
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 188
- Disaster Relief and Emergency Assistance Act, 168
- Eastern Pacific Emitted Aerosol Cloud Experiment (E-PEACE) project, 273
- emergency powers
  - constitutional sources of emergency
    - federal executive authority, 170
  - environmental statutes, 168
  - federal authorities, 167
  - geoengineering and federal emergency authorities, 171
  - National Emergencies Act (NEA), 169
  - state and local authorities, 173
- Endangered Species Act (ESA), 162
- Environmental Defense Fund, 283, 298
- environmental impact assessment, 287
- Federal Advisory Committee Act, 285
- genetically modified organisms
  - federal regulation, 195
  - state and local regulation, 200
- geoengineering initiatives, 4, 5
- governance gap, 280
- hazardous substances and hazardous waste,
  - regulation of, 185
- incorporation of international laws, 236
- intellectual property, 280
- land use planning, state and local
  - regulation of, 198
- liability
  - actions that violate domestic
    - environmental laws, 237
  - Chevron–Ecuador dispute, 247
  - failure to take actions required by
    - regulations, 239
  - negligence, 245
  - nuisance, 245
  - tortious conduct, 240, 243
  - trespass, 242
- Marine Mammal Protection Act (MMPA), 166
- Migratory Bird Treaty Act (MBTA), 166
- National Environmental Policy Act (NEPA)
  - description, 155
  - relevance to climate engineering, 157
- National Science Foundation (USA), 4
- Ocean Dumping Act, 183
- Paris Agreement, withdrawal
  - from, 12, 327
- proposed state and local initiatives, 162
- public trust doctrine, 173
- research governance, 269
- Resource Conservation and Recovery Act (RCRA), 187
- Rivers and Harbors Act, 183
- state endangered species acts, 165
- state environmental policy acts (SEPA), 158
- state weather modification laws, 161
- tortious liability, 240, 243
- Toxic Substances Control Act (TSCA), 186
- trespass, liability for, 242
- Trump Administration, *see* Trump, Donald
- UNCLOS, 75
- Weather Modification Reporting Act (WMRA), 160
- White House Office of Science and Technology, 329
- white roofs, regulations and standards, 198
- wildlife laws, 162
- upper atmosphere, solar radiation
  - management, 29

- Vienna Convention for the Protection of the Ozone Layer  
background to, 70  
carbon dioxide removal, 71  
climate engineering implementation, 71  
climate engineering research, 72  
as framework agreement, 70  
goal of, 13  
governance gap, 298  
Montreal Protocol, 13, 71  
solar radiation management, 71
- weather, *see* atmosphere  
Weather Modification Reporting Act (WMRA) (USA), 160  
White House Office of Science and Technology, 329  
white roofs, US regulations and standards, 198  
wildlife laws (USA), relevance to climate engineering, 162  
Williamson, Phil, 326  
World Meteorological Organization (WMO), 114