

Index

Page numbers in *italics* refer to Figures. Page numbers in **bold** refer to Tables.

- à trous* algorithm 82, 83, 85, 87, 90
- 'a'a lava 426
 - Hawai'i 500
 - rheology 253, 320–321
- ABI **162**, 169
- Afar Rift, SO₂ emission 278–279
- AHI (Advanced Himawari Imager) 160, **162**, 169, 170, 225
- alerting 559–562
 - Fogo 2014 eruption 561–562
 - GDACS 562–564
 - levels 560, 562
 - thresholds, timing and reliability 560–561
 - see also* volcano warning systems
- algorithms
 - hotspot detection 56, 597–606
 - ASE 137–138, 140–143, 602–603
 - ASTER URP 119–133, 601–602
 - AVHotRR 73, 74–91, 225, 574, 575, 601
 - HOTSAT 208–210, 211, 603–604, 612–614
 - HOTVOLC 223, 225–233, 235, 237, 604–605
 - Kalman filter 103–105, 605–606, 623–624
 - MIROVA 182–202, 604, 615–616
 - MODVOLC 24–52, 224, 599–600, 615–622
 - OKMOK 88, 182, 225, 465, 575, 598–599
 - RAT 224
 - RST_{VOLC} 56–69, 600–601
 - RED SEED recommendations 574–578
 - THERMAL_CLASSIFIER 141, 142, *143*, **144**
 - types 224
 - VAST 224, 597
 - hybrid 182
 - lava flow 606–611
- ALI (Advanced Land Imager) 138, 140, 142, **144**, *146*, 148, 149, *153*, 572
 - Hawai'i 492, 493, 495, 496, 498
- ALICE (Absolutely Local Index of Change of the Environment) 57, 59, 66, 68, 465
- ALTAMIRA INFORMATION 513
- Ambrym lava lake, thermal emission 2000-14 35–38, 39, 51
- Anak Krakatau, thermal emission 2000-14 35–38, 39
- Anatahan, thermal emission 2000-14 35–38, 39
- anisotropy, SCIARA-fv2 model 347
- Aqua MODIS images 23, 24, 26, 27, 33
- ArcMap 657
- Arenal, thermal emission 2000-14 35–38, 39
- Asamayama
 - 2004 eruption, RST_{VOLC} application **60**, 61, 62
 - thermal emission 2000-14 35–38, 39
- ASE (Autonomous Sciencecraft Experiment) software 137–138, 140–143, 602–603
 - products 141–143, **144**
 - THERMAL_CLASSIFIER 141, 142, *143*, **144**, **145**
- ash clouds 554, 555, 557, 558
 - ASTER URP detection 127, 129
 - Eyjafjallajökul 148–149
- ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) *31*, 116–133, **161**
- AESICS (Emergency Scheduling Interface and Control System) 120, 121, *122*, 123
- EDS (Expedited Data System) 117, 119
 - Hawai'i 491, 492, 493, 495
 - STAR (Science Team Acquisition Requests) 116, 117
 - URP (Urgent Request Protocol) Program 116, 117, 119–133, 575, 576, 601–602
 - data integration 120–123, *124*
 - expansion 120
 - lava-flow volumes 129, 131–132
 - mapping flow-deposit temperature 127–129
 - monitoring effusive eruptions 125–127
 - operation 119–120
 - plume composition analysis 129
- atmosphere
 - source of uncertainty 96, 97, 98–99, 101, 197, 523–524
 - see also* clouds
- ATSR (Along Track Scanning Radiometer) 23, 115, 159
- Augustine
 - 2006 eruption, MODVOLC observation 30–31
 - thermal emission 2000-14 35–38, 39
- automation, multispectral image processing 166–171
- Autonomous Sciencecraft Experiment *see* ASE
- AVHotRR algorithm
 - CheckBack test 86, 87, 88
 - hot spot detection 73, 74–91, 225, 574, 575, 601
 - accuracy assessment 76–80
 - accuracy improvement 82, 84, 85, 88
 - comparison with other methods 88–90
 - MSG data 85, 87
 - operational flow chart *84*
- AVHRR (Advanced Very High Resolution Radiometer) 23, 26, 33, 115, 159, 225, 463–484
- ASTER 119, 120, 128
- AVHotRR algorithm *84*, 87
 - fire detection 463, **464**, 465, **466–467**
 - HOTSAT 217
 - NEODAAS service 465–484
 - NEODAAS-Dundee 465, 467–468, 469
 - NEODAAS-Plymouth 465, 468, 471–472
 - RST_{VOLC} 57, 58, **60**, 61, 62, 64–66, 68
- axisymmetric cooling and spreading benchmark 433–434
- Bagana, thermal emission 2000-14 35–38, 39, 51
- Barren Island, thermal emission 2000-14 35–38, 39
- Batu Tara, thermal emission 2000-14 35–38, 40
- benchmarking
 - lava flow models 425–440, 579
 - axisymmetric cooling and spreading 433–434
 - comparison with natural 434–435, 436–437
 - dam-break flow 431, 432, 435–436
 - fundamentals 431–435
 - Newtonian fluid spreading 431, 433
 - split flow experiment 434, **435**
- Bezymianny
 - ASTER data 117
 - MIROVA algorithm *198*
 - thermal emission 2000-14 35–38, 40

- Bingham fluid model 346–347, 358, 389–390, 395–401, 402–404, 410
- BIRD (Bi-spectral InfraRed Detection) 96, 571
- BIROS (Bi-spectral Infrared Optical System) 571
- Bory crater 509, 515, 534, 535
- bottom-up methods 430
- ‘bow-tie’ effect 176, 546
- Cameroon
1986 eruption, CO₂ 1
DOWNFLOW simulation 296, 298
thermal emission 2000-14 35–38, 40
- CASOAR database 506, 507
- cellular automata lava flow modelling 346–354, 357, 358, 360, 375, 410, 428–429
- Central Cone 534, 535
- Cerro Azul
1998 eruption, SO₂ emissions 285–288
thermal emission 2000-14 35–38, 40
- Chaîne des Puys 14, 15, 650, 652–653
lava flow simulation 626–635, 650–670
comparison of simulations 660
effusion rates 652, 655, 656
GDACS GIS 655–657, 670
v. local GIS 666–667
hazard mapping 661–666
local GIS 657–659, 668, 669, 670
evacuation needs 667–668
source term preparation 651–652, **654**, 668
- Chaiten, thermal emission 2000-14 35–38, 40, 51
channelled models 428, **439**
FLOWGO 313–333
- Château Fort crater 535, 538
- chemical monitoring 558
- Chirinkotan, thermal emission 2000-14 35–38, 40
- Chirpoi, thermal emission 2000-14 35–38, 40
- Choungou Chagnoumeni crater 508, 509
- Choungou Chahalé crater 508, 509
- civil defence, SCIARA-fv2 model 350–352
- Cleveland, thermal emission 2000-14 35–38, 40
- cloud masking 98–99
AVHotRR 77, 84
HOTSAT Satellite Monitoring System 209–210
MyMET 169
RST_{VOLC} 58
- clouds
and hot spot detection 58, 69, 76–77, 84, 98–99, 101
MIROVA 197, 198–202
- CO₂ release 1
- coherence 506, 536–537, 538
Piton de la Fournaise 513–524, 527, 539–540, 548
- Colima, thermal emission 2000-14 35–38, 41
- Colombia 1985 eruption, mud flows 1
- communications 590–594
- computational fluid dynamics codes 429–430
- Congo, Democratic Republic of
see Goma; Nyamuragira; Nyiragongo
- convolution model 259, 260
- cooling curve 262
HOTVOLC 230–231, 235
- Copahue, thermal emission 2000-14 35–38, 41
- Cordon Caulle 2000-14 eruption 35–38, 41, 51
- CORFLOW code 429
- corium spreading 429
- COSMO-SkyMed data 534, 537, 538, 540–544, 548–549
- crisis management
data speed and accuracy 588
education, outreach and presentation 590, 593–594
event magnitude 583
format and standards 588–589
global services 590
hazard response 594–596, 595
RED SEED recommendations 583, 588–590, 593–594
- CROCO code 429
- Cubesat format 578
- CUDA (Compute Unified Device Architecture) 211, 365, 371, 388
- D8 (Deterministic Eight neighbour) method 318
- Dalla Filla, thermal emission 2000-14 35–38, 41
- dam-break flow benchmark 431, 432, 435–436
- deflection barriers, Etna 2, 449–450, 456, 457, 458
- depth-averaged models 429
- deterministic models 293, 305, 307–308, 375, 409, 427–428, 578
pros and cons 431
see also LavaSIM model; MAGFLOW model; SCIARA model; VolcFlow code
- DIAPASON software 507, 513, 537
- digital elevation models (DEMs) 533, 573–574, 579
ASTER 116, 131
Chaîne des Puys lava flow simulation 651, **655**, 668
DOWNFLOW 300, 301, 303–304
drones 579, 581–582
FLOWGO 318, 326, 330
GPU SPH 396–397
Karthala 513, 517
La Réunion 537
MAGFLOW 360
Piton de la Fournaise 417–418, 419, 513, 534, 537
and stochastic models 430–431
VolcFlow 340–342
- Dirac comb 261
- diversion and containment, Etna 449–450, 456, 457
- Dolomieu crater 509, 515, 517, 520, 521, 528, 534, 535, 538, 591
- DOWNFLOW code **9**, **10**, 294–305, 409, 578, 608
benchmarking 430–431, 435, 437, 440
Chaîne des Puys lava flow simulation 628, 634, 651, 660–662, **663**, **664**, 666
comparison with deterministic codes 305, 307–308
comparison with real lava flows 305, 437
efficiency 438
pros and cons **428**
- drones, DEM updating 579, 581–582
- DISCOVR (Deep Space Climate Observatory) 289
- dual-band technique 74–76, 78, 79, 80, 94, 97, 102, 244
- Dubbi, MIROVA algorithm 200
- Dukono, thermal emission 2000-14 35–38, 41
- dykes
Etna 2002-3 eruption 450–452, 455
InSAR 536, 548
- dynamic thermal proxy 245–246
comparison with field observations 250
experiments 246–250, 251
precautions 250, 252–253

- earthquakes, precursors to eruption 557
- East Rift Zone, Kilauea, lava flow 490, 491, 493–500
- ECHO, disaster bulletins 6, 554–555
- Ecuador 1, 35–38, 47, 50, 153, 338–342
 - see also* Reventador; Tungurahua
- education 590, 593–594
- effusion rate *see* lava flow, effusion rate
- effusive trend detection, MIROVA 191, 193–194
- Eldfell, population at risk **3**
- ELFM code 409, 430
- EMCT camera, Etna 212–215
- emissivity 244
 - source of uncertainty 96
- Enclos Fouqué 508, 509, 515, 534, 535, 540
- Enclos-Grand-Brulé 508, 509, 512, 528, 534, 535, 540
- Enhanced Thematic Mapper Plus 23, 98, 101, **161**
 - Popocatepetl 29
- Enhanced Thermal Index (ETI)
 - MIROVA 185, 187
 - dETI matrix 185, 186–187, 188, 189
- EO (Earth Observing)-1 spacecraft 116, 137, 138
 - ALI 138, 140, 142, **144**, 146, 148, 149, 153, 572
 - Hawai'i 492, 493, 495, 496, 498
 - Hyperion imaging spectrometer 23, 51, 138, 140, 141, 142, **144**, 149, 150, 151, 182
- EOS project 23
 - Aqua 23, 24
 - Terra 23, 24, 26
- EOSDIS (Earth Observation Data Information System) 23, 24
- EPIC (Earth Polychromatic Imaging Camera) 289
- Erebus lava lake
 - ASE THERMAL_CLASSIFIER 141, 143
 - thermal emission 2000-14 35–38, 41, 51
 - thermal remote sensing 11
- Erebus Volcano Observatory, VSW 152
- ERS-1 Along-Track Scanning Radiometer (ATSR) 23, 115, 159
- Erta Ale lava lake
 - MIROVA algorithm 199
 - radiant flux 165
 - thermal emission 2000-14 35–38, 41, 51
 - thermal remote sensing 11
- eruptions
 - event magnitude 583
 - intensity 2, 30, 32, 51
 - international humanitarian concern 553–555
 - thermal emissions 2000-14 32–34, 35–38, 39–50, 51–52
- Etna
 - 1983 eruption, deflection barriers 2
 - 2001 eruption 447–448
 - lava flow benchmarking 434–435, 436–437
 - LavaSIM model 380–381
 - 2002-3 eruption
 - chronology 450–452
 - hazard mitigation 253, 254, 453, 455–458
 - monitoring 452–454
 - RST_{VOLC} application **60**, 62, 63
 - 2006 eruption, MAGFLOW simulation 366, 367
 - 2008-09 eruption, RP monitoring 94–96, 99, 101, 103, 105, 106, 107, 108–109, 110
 - 2011 eruption, HOTVOLC monitoring 229, 231–233, 235
 - 2011-2013 paroxysmal eruptions 73
 - AVHotRR application 76–90
 - 2014 eruption, RST_{VOLC} application 63–66, 68
 - AVHRR data 472–477, **478–479**, 479, **480**, 481
 - basaltic flow fields 294, 295
 - DOWNFLOW simulation 296–300, 302, 303–305, 307
 - EMCT camera 212–215
 - EO-1 VSW 153
 - ETI 187
 - GPUSPH model 400–404
 - hazard mapping, SCIARA 346, 348–350
 - HOTSAT/MAGFLOW 217–219
 - hotspot detection exercise 611–626
 - lava flows 447–448
 - MAGFLOW
 - hazard mapping 358, 366–370
 - lava flow path simulation 365–371
 - MIROVA 184, 186, 187, 202
 - effusive trend detection 191, 193–194
 - lava flow cooling 194
 - lava flow monitoring 191, 192
 - radiative power 189–194
 - TADR 195
 - MODVOLC observation 33
 - NEODAAS data, TADR tracking 479–484
 - NEODAAS hot spot tool 471–472, 473, 474, 477
 - NTI 94–96, 186, 187
 - population at risk 2, 3, 345, 348–354, 447, 450–458
 - SCIARA-fv2 model 346, 348–354
 - thermal emission 2000-14 35–38, 42, 50, 51
 - thermal remote sensing 11, 94–96, 99, 101
 - VAST-II data 472–473
 - conversion to TADR 473–479
- EUMETSAT 168, 169, 226
- European Union
 - DG ECHO 6, 554–555
 - Joint Research Centre 3
 - GDACS 6
 - humanitarian service 6
- evacuation 1–2
 - Chaîne des Puys simulation 667–668
- EOVSS 167, 576
- Excel, FLOWGO model 314, 322–331, 333
- exposure, definition 556
- Eyjafjallajökull
 - 2010 eruption
 - MIROVA algorithm 199
 - multipayload observation 173, 175
 - plume composition, ASTER URP 129, 130
 - VSW 147–150, 151, 154
 - thermal emission 2000-14 35–38, 41
- Eyjafjöll, RST_{VOLC} applications **60**
- false alerts, MIROVA 196–197
- FCI **162**, 169
- Fernandina, thermal emission 2000-14 35–38, 42
- Fimmvörðuháls
 - EO-1 observation 148, 149, 151
 - plume composition, ASTER URP data 129
- Fine Quad Polarization 511–512, 512, **513**, 514, 516, 517, 527
- finite element method (FEM) 388
- fire detection, AVHRR 463, **464**, 465, **466–467**

- fires/anthropogenic heat sources, MIROVA 197
 FLOP efficiency 437–438
 Flow3D code **428**, 430, 436, 440
 FLOWFRONT model **8**, 428
 FLOWGO model **9**, 286, 313–333, 409, 428, 578, 607–608
 benchmarking 435, 437, 440
 Chaîne des Puys lava flow simulation 631, 633, 651, 660, 661
 in Excel 314, 322–331, 333
 GoogleTM Earth slope profile 330–331
 limitations 332–333, **428**, 438
 operation 315–318, **319**, 320
 fluid dynamics
 3D computational codes 429–430
 lava effusion rate 244–254
 FOAMS software 321
 Fogo 2014 eruption, alerting 561–562
 Fuego, thermal emission 2000-14 35–38, 42

 Galeras, thermal emission 2000-14 35–38, 42
 Gamkonora, thermal emission 2000-14 35–38, 42
 Gaea, thermal emission 2000-14 35–38, 42
 GDACS (Global Disaster Alert and Coordination System)
 alerting 6, 562–564, 650, 655, 666–670
 Chaîne des Puys simulation GIS 655–657
 GEO satellites 225
 GEOnet Names Server (GNS) 657
 GIS (Geographical Information System)
 evacuation needs 667–668
 GDACS 655–657, 666–670
 layers 656–657
 LAV@HAZARD 208, 215
 local system 666–670
 layers 657–659, 669
 RED SEED recommendations 583, 588, 650
 Global Human Settlements Layer 657
 Global Volcanism Program 34, 51, 61, 63, 127, 555, 556
 Global Volcano Monitoring 176
 GlobVolcano project 167
 glucose syrup experiment 247
 GOES (Geostationary Operational Environmental Satellite) 33, 115, 160, **162**, 225, 226, 598
 fire detection **467**
 Hawai'i 491–492, 495, 500–501
 SO₂ plumes 285–288
 Goma 553, 576
 see also Nyamuragira; Nyiragongo
 GoogleTM Earth, FLOWGO model slope profile 330–331
 GPU implementation
 GPUSPH 388, 406
 HOTSAT 211–212
 MAGFLOW model 365
 SCIARA-fv2 model 346
 GPUSPH model 388–406, 440, 578
 boundary conditions for ground 396–398
 Etna 400–404
 free surface 398
 GPU implementation 388, 406
 mass conservation 393, 395
 momentum equation 392
 numerical integration 405
 particle surface computation 406
 physical basis 389–390
 pros and cons **428**
 solidification 400
 source term 400
 thermal model 395–396
 weak compressibility and equation of state 392–393
 Grandes Pentes 508, 509, 517
 Grave Noire 14, 15, 650, 652–653
 lava flow simulation exercise 626–635, 660
 gravity currents 245–246
 Grímsvötn 2011, VSW operation 150, 152
 ground surface displacement 533–534, 536–537, 538–539
 InSAR 548
 volcano warning systems 557–558
 ground-based camera data, comparison with HOTSAT 212–215

 Hawai'i 490
 MODIS data 24, 25, 26
 population at risk 2, 494, 495, 499–500
 see also Kilauea; Mauna Loa
 Hawai'i Institute of Geophysics and Planetology (HIGP) hotspot tracking 159, 471, 479
 Hawaiian Volcano Observatory
 lava flow monitoring 489–501
 GOES data 491–492
 VSW 152
 hazard
 volcanic 1–3, 553–555
 warning systems 555–556
 humanitarian-oriented 6, 556–562
 hazard assessment 332, 337, 588
 Kahauale'a 2 lava flow 499–500
 hazard mapping 348–350, 558, 582–583
 MAGFLOW, Etna 358, 366–370
 SCIARA, Etna 346, 348–350
 hazard mitigation 588
 Etna 2002-3 eruption 253, 254, 455–458
 hazard modelling 558–559, 562–563
 hazard response 1, 594–596, 595
 Heard Island, thermal emission 2000-14 35–38, 42, 51
 heat budget method, HOTVOLC 229, 233, 235
 Hekla, thermal emission 2000-14 35–38, 42
 Herschel-Bulkley fluid model 389, 396–401, 402–404, 410
 constitutive equation 411
 Himawari-8 sensor *see* AHI
 Holuhraun 2014 eruption, HOTVOLC monitoring 233, 235, 237
 HOTSAT Satellite Monitoring System 88, 207–220, 225, 574, 575, 603–604, 612–614
 cloud mask algorithm 209–210
 comparison with ground-based thermal camera data 212–215
 GPUs 211–212
 hotspot detection 210
 integration with MAGFLOW model 215–217
 Etna 217–219
 OpenCL 211–212
 radiant flux and discharge rate estimation 210–211
 hotspot detection 6–7, 55–56
 algorithms 56, 597–606
 ASTER 115–133

- AVHotRR algorithm 74–91
 AVHRR 463, 468–484
 quick-look tool 471–472
 direct broadcast receiving stations 577, 578
 end-users and formats 577
 exercise, Etna eruptions 611–626
 geolocation 577
 HOTSAT Satellite Monitoring System 210
 HOTVOLC monitoring system 226, 228, 231–238
 quantification 228–231, 233, 235
 infrared satellite measurements 224–225
 MODVOLC algorithm 26–52
 Augustine 30
 Karymsky 28
 Lascar 31
 Popocatepetl 29
 multispectral image analysis 159–176
 quality index 80
 RED SEED recommendations 569–578
 RST_{VOLC} algorithm 56–69
 satellite monitoring 23–52, 94–96
 simulation at different resolutions 97–98, 100
 uncertainty 96–103
 volcano warning systems 557
 HOTSPOTS, Hawai'i Institute of Geophysics and
 Planetology 159
 HOTVOLC monitoring system 223, 225–231, 227
 Etna 2011 eruption 229, 231–233, 235
 Holuhraun 2014 eruption 233, 235, 237
 hotspot detection 226, 228–238
 Kelut 2014 eruption 234, 237
 NTI 226, 228, 230, 231, 234, 604–605
 Piton de la Fournaise 2015 eruption 235, 236, 237
 Stromboli 2010 eruption 232, 235
 HRIT (High Rate Information Transmission)
 data 226
 Hualālai, lava flows 490–491
 humanitarian crises, volcanic eruptions 2–3,
 6, 553–555
 Humanitarian Early Warning Service 556
 Hyperion imaging spectrometer 23, 51, 138, 140, 141,
 142, 144, 149, 150, 151, 182
HyspIRI 133, 155–156
 Ibu, thermal emission 2000-14 35–38, 43
 image processing, multispectral
 automated procedures 161, 162, 166–171
 conversion to mass flux 165–166
 multiple components 160, 161, 163–164, 166
 radiant flux 163–165
 single component 164–165
 thermally anomalous pixels 160, 166
 impact assessment 559, 563
 Indian Ocean InSAR Observatory (OI2) 506, 507, 511
 Indonesia 1982 eruption 1
 see also Kelut; Merapi; Semeru; Talang
 InfoRM Risk Index 554, 559
 infrared satellite measurements, hotspot detection 12, 23,
 33, 55–56, 224–225, 583, 588
 InSAR monitoring 505–529, 534
 Karthala 506, 509–510, 512, 517, 519, 520, 529
 limitations 506, 521, 523–524, 527
 near-real-time 527–528
 OI2 506, 507, 511
 Piton de la Fournaise
 2010 eruption 535, 537–549
 2014 eruption 506, 507–509, 512, 513–517, 518,
 520–529
 technique 536–537
 instantaneous radiance model 257
 interferograms, InSAR 536–549, 538
 Piton de la Fournaise 506, 507, 510–529
 interferometry *see* InSAR monitoring
 international aid 563
 inverse blackbody problem 258
 IPM (Intelligent Payload Module) 155–156
 isoviscous fluid 246
 isoviscous theory 245
 Izu-Oshima 1986 eruption, LavaSIM model
 379–380
 JAMI (Japanese Advanced Meteorological Imager)
 160, 161, 164
 MyMET 169, 174, 175
 Jebel al Tair
 RST_{VOLC} applications 60
 thermal emission 2000-14 35–38, 43
 Jeffreys equation 313, 315, 425–426
 Kahauale'a 2 lava flow 493–495
 hazard assessment 499–500
 satellite monitoring 495–499
 Kalman filter 93, 103–105, 106, 107, 109–111, 571, 574,
 575, 605–606, 623–624
 Kamchatka
 ASTER URP data 117, 118, 119, 127, 129
 see also Bezymianny; Karymsky; Kliuchevskoi;
 Shiveluch; Tolbachik
 Karangatang, thermal emission 2000-14 35–38, 43
 Karthala 508, 509–510
 Choungou Chagnoumeni crater 508, 509
 Choungou Chahalé crater 508, 509
 InSAR monitoring 506, 509–510, 512, 517,
 519, 520, 529
 thermal emission 2000-14 35–38, 43
 Karymsky
 MODVOLC detection 28
 thermal emission 2000-14 35–38, 43
 Kavachi, thermal emission 2000-14 35–38, 43
 Kelut (Kelud)
 2010-2014 eruptions, thermal emission 35–38, 43
 2014 eruption, HOTVOLC monitoring 234, 237
 population at risk 553, 554–555
 Kilauea
 ASTER URP data 123
 lava flows 490, 580–581
 remote sensing 489, 491, 492
 MODVOLC observations 24, 25, 30
 population at risk 2, 3, 580–581
 SO₂ emissions 152–153, 285
 thermal emission 2000-14 35–38, 43, 50, 51
 VSW 152–153
 Kirishima, thermal emission 2000-14 35–38, 44
 Kizimen, thermal emission 2000-14 35–38, 44
 Kliuchevskoi, thermal emission 2000-14 35–38, 44
 Krafla fissure eruption, sources of SO₂ 281–283
 Krieger-Dougherty (KD) equation 378, 380,
 381, 382, 385

- La Réunion 508, 535
 DEM 537
 population at risk 2
see also Piton de la Fournaise
- lahars 1, 127, 559
- LANCE data 195–196, 493
- land use, SCIARA-fv2 model 350–352
- Landsat Thematic Mapper 23, **161**
see also Enhanced Thematic Mapper Plus
- LandScan data 559
 population at risk from volcanic hazard 554, **555**
- Langila, thermal emission 2000-14 35–38, *44*
- Lascar
 MODVOLC observation 31
 thermal emission 2000-14 35–38, *44*
 thermal remote sensing *11*
- Lattice Boltzmann methods 430
- LAV@HAZARD 208, 215
- LAVA code 429
- lava discharge rate 224
 time-averaged *see* TADR
- lava domes 34, 38, 51, 127, 160
- lava emplacement models **8–10**, 257–274, 340–342,
 357, 426–431, 606–611
 derivation 259–260
 influence of rheology 400–404
 MAGFLOW 357–371, 428–429
 VolcFLOW 340–342
- lava flow
 active flow area 257
 advancement monitoring 190–191, *192*, 533
 Hawai'ian Volcano Observatory 489–501
 shallow-depth approximation model 409–419
 area simulation, DOWNFLOW code 294–305
 basaltic volcano fields
 channels and bifurcations 294, 295
 FLOWGO model 313–333
 cellular automata modelling 346–354
 channelized 313–333, 428, **439**
 cooling 194, 230–231, 235, 262
 cooling rate 313–314
 crystallization 318, **319**, 325, 326, 328, *329*, 378
 discharge rate 96
 and volume, thermal remote sensing *11*
 effusion rate 80–81, 165–166, 169, 243, 253, 426, 533
 dynamic thermal proxy 245–246
 comparison with field observations 250
 experiments 246–250, *251*
 precautions 250, 252–253
 Etna 2002-3 eruption 454–455, 457
 FLOWGO 315, 320, 327, 328, 331
 from SO₂ measurement 283, 285–288
 and lava flow length 425
 LavaSIM 382, 384
 static thermal proxy 244
 tests, MAGFLOW 361–365
- hazard mapping 348–350, 558, 582–583
- hazard mitigation, Etna 2002-3 eruption 253, 254,
 455–458
- heat loss, FLOWGO 317–318, 324–325
- humanitarian crises 2–3, 6, 553–555
- mass flux 165–166
- mean velocity 425–426
- modelling **4–5**, 6–7, **8–10**, 558, 578–583, 606–611
- benchmarking 425–440
 GPUSPH 392–400, **428**
 LavaSIM 375–385, **428**
 MAGFLOW 365–371, 428–429
 numerical methods 387–388, 427–431
 physical parameters 7, 16
 RED SEED recommendations 573
see also deterministic models; probabilistic codes
- processes and dynamics 426, 427
- risk assessment 409
- simulation exercise, Grave Noire and Petit Puy de
 Dôme 626–635
- spaceborne observation 160
- spectral radiance 24–26
- surface temperature distribution 257–258
- thermo-rheological evolution 314
 GPUSPH 388–406
- thermo-rheologically based models **4–5**, 6–7, **8–10**,
584–587
- viscosity 313, 375, 389
see also deflection barriers; diversion and containment;
 viscosity
- lava lakes
 thermal emission *11*, 34, 38, 50, 51, 160
 ASE THERMAL_CLASSIFIER 141, *143*
- lava lobes 430
- lava pancake formation 381–382, 383, 384–385
- LAVA project 88
- lava shed model 573
- lava tubes 426
 cooling rate 425
 Hawai'i 491, 496, *498*
 spaceborne observation 160
- LavaSIM model **9**, 243, 375–385, 429, *440*, 578,
 608–609
 Chaîne des Puys lava flow simulation 629, 651
 Etna 2001 eruption 380–381
 Izu-Oshima 1986 eruption 379–380
 lava properties 378–379
 procedures 376–378
 pros and cons **428**
 Shinmoe-dake 2011 eruption 381–382, 383, 384–385
- LAZSLO code 430
- Least Squares Spectral Analysis (LSSA) 109
- Lennard-Jones repulsive force 391–392
- LEO (Low Earth Orbiting) satellites 159, 224–225, 577
- LiDAR
 FLOWGO slope profile 330–331
 Piton de la Fournaise 513, 521, 537
 TADR 571
- Limagne Fault 650, 652
- Llaima, thermal emission 2000-14 35–38, *44*
- Lopevi, thermal emission 2000-14 35–38, *44*
- MAGFLOW model **9**, 208, 243, 357–371, 410, 578, 610,
 635, 660, 661–666
 benchmarking 428–429, 435, 437, *440*
 Chaîne des Puys lava flow simulation 629, 632, 651
 effusion rate tests 361–365
 GPU implementation 365
 integration with HOTSAT data 215–217
 Etna 217–219
 lava flow path simulation, Etna 365–371
 physical basis 358–360

- sensitivity analysis 360–365
- magma ascent, Stromboli 189–190
- Manam, thermal emission 2000-14 35–38, 44
- Manda Hararo
 - 2007-14 eruptions, radiant flux 172–173
 - thermal emission 2000-14 35–38, 45
- mass flux 7, 10
- Mauna Loa
 - lava flows 490
 - monitoring 489
 - future work 500–501
 - MODVOLC observations 24, 25, 26
 - population at risk 2, 3
 - VSW 152
- Mayon, thermal emission 2000-14 35–38, 45
- media, role in volcano warning system 555
- MELTSPREAD code 429
- MEOS 73
- Merapi
 - 2006 ASTER URP monitoring 125–127
 - 2010 eruption, lack of public warning 555
 - RST_{VOLC} applications 60
 - thermal emission 2000-14 35–38, 45
- meshless methods 388, 430
- MIAVITA project, risk from volcanic hazard 554, 557, 560, 561
- Michael, thermal emission 2000-14 35–38, 45
- Mihara 1950-1952 eruption, thermal remote sensing 11
- MIR (Middle InfraRed) data 56, 58, 94–97, 169, 182, 188–189, 194, 463, 465, 468, 470, 472
 - HOTSAT 210
- MIROVA (Middle InfraRed Observation of Volcanic Activity) algorithm 182–202, 225, 574, 575, 604, 615–616
 - Etna 184
 - TADR 195
 - hot spot detection
 - dNTI and dETI 185, 186–187, 188, 189
 - ETI 185
 - NTI 184–185, 186
 - performance and exportability 189
 - radiative power 188–189
 - Stromboli and Etna 2000-13 189–194
 - spatial analysis 185
 - spectral analysis 184–185
 - limits and uncertainty 196–197
 - MODIS granules 183, 184
 - near-real-time implementation 195–196
 - regions of interest 183–184, 187
 - Stromboli 184
- modelling *see* lava flow, modelling
- MODIS (Moderate Resolution Imaging Spectroradiometer) 23, 24, 27, 33, 52, 73, 115, 161, 164, 225
 - AVHotRR algorithm 84, 85, 87
 - Etna 99, 101, 103, 105, 106, 107, 108–109, 110
 - Hawai'i 24, 25, 26, 491, 492, 493, 495, 500, 501
 - MIROVA 182, 183, 184
 - Piton de la Fournaise 538, 545–547
 - RST_{VOLC} 60, 61, 64–66, 68
- MODLEN 182, 575
- MODTRAN model 230
- MODVOLC algorithm 23, 24–52, 88, 94, 225, 465, 574, 575, 599–600, 617–622
 - false positives 27, 31, 32
 - flow chart 27, 28
 - Kilauea 491
 - limitations 30–31, 32, 51–52, 182, 577
 - NTI thresholds 27
 - operation 27–29
 - physical principles 24–27
 - volcanic thermal emissions 2000-14 32–34, 35–38, 39–50, 51
- Montagu, thermal emission 2000-14 35–38, 45
- MOR (Mean Output Rate) 534
- Moving Averages (MA) 109, 110
- MSG (Meteosat Second Generation)-RSS (Rapid Scan Service) 225–226
- MSG (Meteosat Second Generation)-SEVIRI (Spinning Enhanced Visible InfraRed Imager) 73, 74, 94, 159, 161, 162, 164
 - AVHotRR algorithm 84, 85, 86, 87
 - HOTSAT 207–210, 212, 215, 217
 - HOTVOLC 228, 231–233
 - multiScales algorithm 84, 86, 87–88, 90
 - MyMET 169
 - RST_{VOLC} 58, 60, 61
- MTSAT-1R/2, RSTVOLC 61
- MTSAT-2, HOTVOLC 226
- mudflows *see* lahars
- multiScales algorithm 84, 86, 87–88, 90
- MyMET 161, 162, 167, 168–171, 574, 625–626
 - JAMI and SEVIRI 169, 174, 175
 - rapid scan 169–171
- MyMOD 161, 162, 167, 168, 574
- MyVOL 161, 162, 167, 575
- Nabro, thermal emission 2000-14 35–38, 45
- NASA *see* EO (Earth Observing)-1 spacecraft; LANCE data; SRTM; Volcano Sensor Web
- Navier-Stokes equation 358, 359, 375, 389, 390, 409
- NB3D code 428, 430, 436, 440
- NEODAAS, near-real-time service 465–484
- NEODAAS-Dundee, AVHRR 465, 467–468, 469
- NEODAAS-Plymouth
 - AVHRR 465, 468, 471, 473
 - TADR tracking
 - Etna 479–484
 - Stromboli 481–484
 - VAST-II 472–473
- NEST (Next Esa SAR Toolbox) 513
- net area emplacement surface 258, 259–274
- Nevado de la Huilla, thermal emission 2000-14 35–38, 45
- New South-East Crater, Mt Etna, lava flow 63, 65
- Newtonian flow
 - simulation 394, 395, 398, 399, 400, 401–404, 410, 415
 - velocity 425–426
 - viscous isothermal spreading benchmark 431, 433, 439
- Nicaragua 1992 eruption 1
- Nicolosi, SCiARA-fv2 model 350–352
- Nimbus 1 satellite 55
- NIR (Near InfraRed) data 470
- Nishinoshima, thermal emission 2000-14 35–38, 45
- NOAA NESDIS 470
- non-isothermal flow benchmark 433–434
- non-Newtonian fluid 410

- Normalized Thermal Index (NTI) 25, 27, 28, 94, 160, 168, 225
- Etna 2011 94–96, 229, 230, 231–233
 adaptive threshold 94–96, 97–98, 102
 cloud coverage 98–99, 101
 HOTVOLC 226, 228, 230, 231–233, 604–605
 MIROVA 184–185, 186
 dNTI matrix 185, 186–187, 188, 189
 MODVOLC 27
 MyMET 169
 Piton de la Fournaise 545–546
- Nornahraun, EO-1 observation 154, 155
- nuclear-based models 429
- numerical methods 387–388, 427–431
 particle 388
- Nyamuragira
 2006 eruption, VSW 143, 145–147, 154
 MODVOLC observation 34
 SO₂ emission 278, 284
 thermal emission 2000-14 35–38, 46, 50, 51
- Nyiragongo
 2002 eruption
 DOWNFLOW simulation 305, 306
 population at risk 2–3, 3, 553, 576
 lava lake, thermal remote sensing 11, 34
 thermal emission 2000-14 35–38, 46, 50, 51
- Observatoire de Physique du Globe de Clermont Ferrand,
 HOTVOLC 223–224, 225
- Observatoire Volcanologique du Piton de la Fournaise
 506, 509, 520, 534
 lava flow emplacement 417, 418
- OCA (One-channel Cloud-detection Approach) 58
- OKMOK algorithm 88, 182, 225, 465, 575, 598–599
- Oldoinyo Lengai
 RST_{VOLC} applications 60
 thermal emission 2000-14 35–38, 46
- OMI 277, 278, 279, 280, 281, 289
- OMPS (Ozone Mapping and Profiler Suite) 277, 289
- OpenCL 211–212
- OpenFOAM toolbox 428, 429–430, 435–436, 440
- OpenStreetMap (OSM) 657
- OurAirports database 657
- outlier detection 105, 109, 110
- OVG (Goma Volcanic Observatory) 576
- Pacaya, thermal emission 2000-14 35–38, 46
- Pacific Disaster Centre 556
- Pagan, thermal emission 2000-14 35–38, 46
- Pago, thermal emission 2000-14 35–38, 46
- pāhoehoe lava 426
 Kilauea 26, 496, 497, 499, 500
 rheology 253
 temperature distribution 258
- Paluweh, thermal emission 2000-14 35–38, 46
- parallelization 392
- Paricutin 1943-1952 eruption
 lava flow 426
 population at risk 3
 thermal remote sensing 11
- particle grounding 394, 400, 401
- Pavlof, thermal emission 2000-14 35–38, 46
- PCE (Polynomial Chaos Expansion) 360–361
- Petit Puy de Dôme 14, 15, 650, 652–653
- lava flow simulation exercise 626–635, 659–660
 effusion rate 656
- Philippines 1991 eruption 1
see also Mayon
- Pinatubo, SO₂ emission 278
- Piton de la Fournaise 507, 508, 509, 534–535
 2007-14 eruptions
 population at risk 2, 3
 radiant flux 171–172
 thermal emission 35–38, 47, 50
 2010 eruption 416–417
 flow simulation 416, 417–419
 InSAR monitoring 535–536
 2014 eruption, InSAR monitoring 520–521, 524–527
 2015 eruption, HOTVOLC monitoring 235, 236, 237
 Bory crater 509, 515, 534, 535
 Central Cone 534, 535
 Château Fort crater 535, 538
 DEM 417–418, 419, 513, 537
 Dolomieu crater 509, 515, 517, 520, 521, 528, 534, 535, 538, 591
 Enclos Fouqué 508, 509, 515, 534, 535, 540
 Enclos-Grand-Brulé 508, 509, 512, 528, 534, 535, 540
 FLOWGO model 319, 320–322, 333
 Grandes Pentes 508, 509, 517
 InSAR monitoring 506, 507–509, 511, 512, 513–517, 518, 520–529, 535–549
 lava flow emplacement 413, 414
 NTI 545–546
 simulation 591, 592–593
 SO₂ emissions 280
- pixels
 hot 463
 Etna 76, 78, 79, 82, 465, 472–473, 476, 572
 Kilauea 24–26, 27
 MIROVA 185–189
 MODVOLC 24–26, 27, 28, 33
 Piton de la Fournaise 545–547
 RST_{VOLC} 58
 THERMAL_CLASSIFIER 141–142, 143
 multiple thermal components 161, 163–164, 166, 168
 single thermal component 164–165
 sunglint 29
 thermally anomalous 160, 166, 167
- Planck's Blackbody Radiation Law 24, 25, 26, 210, 224, 244
- polyethylene glycol (PEG), flow and solidification
 experiments 248, 249, 250, 253
- Popocatepetl
 Enhanced Thematic Mapper Plus image 29
 thermal emission 2000-14 35–38, 47, 51
- population at risk 1–3, 6
 Etna 2, 3, 345, 348–354, 447, 450–458
 global 2, 3, 553–554
 Hawai'i 494, 495, 499–500
 Kilauea 2, 3, 580–581
 La Réunion 2
 Nyiragongo 553, 576
- probabilistic codes
 lava flow 293, 375
 DOWNFLOW code 294–305, 578
- PSInSAR 523
- Pu'u 'Ō'ō lava flows 490, 491, 492, 494–499
 SO₂ monitoring 152–153

- pyroclastic density currents 127, 558–559
- Rabaul, thermal emission 2000-14 35–38, 47
- RADAR, synthetic aperture interferometry (InSAR) 505–529
- RADARSAT-2 data
Karthala 517
Piton de la Fournaise 506–507, 510–511, 522, 528, 529
- radiance **570**
lava flows 24–27, 30–34, 74–75, 163
 emplacement models 259
 analysis 262–264
 cooling curve 262
 discretization 260–262
 test models 264–265
 see also instantaneous radiance model; spectral radiance; temperature distribution model
- radiant density 195
- radiant energy **570**
- radiant flux 80, 163–165, 166, 169, 171–176, **570**
HOTSAT 210
MODVOLC 32–33, 39–50, 51
- radiant flux density **570**
- radiant power (RP) 244, 245
 estimation 96, 99, 102–105
 MIROVA 197
 Stromboli and Etna 189–194
 uncertainty 93, 96–103
 Etna 105, 106, 107, 108–109, 110
 Kalman filter 103–105, 106, 107, 109–111
- rapid scan, and MyMET 169–171
- RASPLAV code 429
- RAT (Robust AVHRR Techniques) algorithm 56, 57, 61, 182, 224
see also RST_{VOLC}
- Raung, thermal emission 2000-14 35–38, 47
- RED SEED (Risk Evaluation, Detection and Simulation during Effusive Eruption Disasters) working group 3, 6, 12, **13**, 14–16
 recommendations and findings 569–596
 crisis management 583, 588–590, 593–594
 hotspot detection 569–574
 algorithms 574–578
 lava flow modelling 578–583, 668, 670
- Redoubt, thermal emission 2000-14 35–38, 47
- remote sensing
Hawai'i Volcano Observatory 489–501
 thermal 6–7, 10, 11, 159–176, 207–220, 244
 effusive eruptions 253, 537, 538
 RED SEED recommendations 571, 573–578, 583
- resolution
 high-spatial 167–168, 176
 hot spot analysis 167–168
 hot spot selection 167
 high-temporal 168–171, 175, 176
 moderate 168
- Reventador
 EO-1 observation 153
 thermal emission 2000-14 35–38, 47
- RHEOLEF **428**, 429, 440
- rheology
 influence on flow emplacement 400–404
 lava flow modelling **4–5**
- Rinjani, thermal emission 2000-14 35–38, 47
- risk, definition 556
- risk assessment 409, 588
 global 554
- risk management index 554
- RSAM (Real-time Seismic Amplitude Measurement) 30
- RST (Robust Satellite Techniques) algorithm 56, 88, 225
- RST_{VOLC} algorithm 56–69, 574, 575, 600–601
 applications 59–67
 capabilities 57–59, 69
 operational flow chart 58, 59
- St Helens, thermal emission 2000-14 35–38, 49, 145
- St Vincent lava dome, isoviscous theory 245
- Saint-Venant shallow water model 410, 429
- Sakurajima, thermal emission 2000-14 35–38, 47
- SAMPSON code 429
- Sangay, thermal emission 2000-14 35–38, 48
- Santa Maria, emission 2000-14 35–38, 48, 51
- SAR (synthetic aperture RADAR) 505–506
see also InSAR
- Sarychev Peak, thermal emission 2000-14 35–38, 48
- satellite monitoring
 Hawai'i Volcano Observatory 489–501
 HOTVOLC 223
 MODIS 23, 24, 27, 33, 52
 thermal anomalies 6, 23–52, 55–56, 94–96
 instrument uncertainty 96–97, 103
see also remote sensing
- satellite viewing geometry, MIROVA 197
- Sciara del Fuoco, hot spot detection 62, 63
- SCIARA model **8**, 345–354, 410, 428–429, 578, 606–607
 Chaîne des Puys lava flow simulation 630, 635, 651, 660, 661–666
 pros and cons **428**
- SCIARA-fv2 cellular automata model 346–348
 civil defence and land use 350–352
 hazard mapping 346, 348–350
- SEAS-OI (Survey of Environment Assisted by Satellite in Indian Ocean) 506–507, 510–511, 520, 521, 525–526
- seismic amplitude measurement v. MODVOLC 30
- seismicity, Etna 2002-3 eruption 451
- Semeru, thermal emission 2000-14 35–38, 48, 51
- SEVIRI *see* MSG-SEVIRI
- shallow-depth approximation model 409–419
 comparison with Piton de la Fournaise lava flow 415–419
 physical parameters **411**
 reduction model 419–421
 silicone oil pancake experiment 413, 415
 three-dimensional formulation 411–413
- shear-thinning 410
- Shinmoe-dake
 2011 eruption, LavaSIM model 381–382, 383, 384–385
 RST_{VOLC} applications **60**
- Shishaldin, thermal emission 2000-14 35–38, 48
- Shiveluch
 2004 ASTER URP flow-deposit temperature mapping 127–128
 thermal emission 2000-14 35–38, 48, 51
- SI and SI-based units **7**, **570**, 588, **589**, **590**

- Sierra Negra
 2005 SO₂ emissions 279
 thermal emission 2000-14 35–38, 48
- silicone oil experiments 246, 413, 415
- simulation codes
 benchmark efficiency 437–438
 benchmarking facility 438–439
 pros and cons 431
- Single Look Complex 511
- SLAG 609–610
- Slamet, thermal emission 2000-14 35–38, 48
- slope profile, FLOWGO model 330–331
- SO₂
 monitoring 152–153, 558
 satellite measurement 277–289
 and lava effusion rate 283, 285–288
 sources of gas 281–283
 sensors 152–153
- solar reflection 94
- solidification 248, 253, 360, 378, 400, 404
- Soputan, thermal emission 2000-14 35–38, 49
- Soufrière Hills, thermal emission 2000-14 35–38, 49, 51
- source terms 7, 16, 651–652, **654**
 Chaîne des Puys 651–652, **654**, 668
 FLOWGO 315, 316, 318, **319**, 320, **654**, 668
 GPUSPH **394**, 400
 lava flow advance **411**
 LavaSIM 382, **654**
- spectral radiance 24–27, 30, 32–33, 570
- SPH (Smoothed Particle Hydrodynamics) method
9, 388, 430
 GPUSPH model 388–406
 mathematics 390–392
 boundary conditions 391–392
 discretization of gradients 391
 discretization of scalar fields 390–391
- split flow experiment 434
- SPOT (Satellite Pour l'Observation de la Terre) 116
 SPOT 5 imagery 506, 520, 521, 525–526
- spreading benchmarks 432–433, 435
- SRTM DEM
 FLOWGO slope profile 330–331
 Karthala 513, 517
- SRV (Sistema Rischio Vulcanico) project 73, 84
- static thermal proxy 244
- steepest descent paths 294–295, 297
- Stefan-Boltzmann Law 32, 33, 80, 96, 210, 244
- stochastic models 430–431
- Stromboli
 2002 eruption, RST_{VOLC} application **60**, 62, 63
 2010 eruption, HOTVOLC monitoring 232, 235
 2014 eruption, RST_{VOLC} application 63–66, 67
 AVHRR data 481–484
 magma ascent 189–190
 MIROVA 184, 202
 effusive trend detection 193–194
 radiative power 189–194
 thermal emission 2000-14 34, 35–38, 49
- sub-pixel temperature-retrieval 74–76, 463
- sub-resolution 163, 175
- sunlint 29, 169
- Surtsey 1967 eruption, thermal remote sensing 11
- Suwanosejima, thermal emission 2000-14 35–38, 49
- SWIR (Short Wave InfraRed) data 94, 137, 169, **470**
 ASTER 116, 125, 127
- TADR (Time-Averaged lava Discharge Rate) 80, 89, 90,
 224–225, 257, 570
 Chaîne des Puys lava flow simulation 652, 655
 Etna 218–219, 224, 473, 475–479
 NEODAAS data 479–481
 HOTSAT 211
 HOTVOLC 229–231
 MIROVA 194–195, 197
 Piton de la Fournaise 545–547
 RED SEED recommendations 571, 573–574
 Stromboli, NEODAAS data 481–484
- Talang, VSW 145, 154
- TanDEM-X data 534, 537–538, 540–541, 544–545,
 548–549
- temperature distribution model 257–258
- tephra *see* ash clouds
- Terra ASTER 23, 51, 116
see also ASTER
- Terra MODIS images 23, 24, 26, 27, 33
 Etna and Stromboli 62, 63
- TerraSAR-X data 537–538, 539, 547–548
- TET-1 (Technology Experiment Carrier-1) 571
- THEMA code 429, 440
- Thematic Mapper *see* Landsat Thematic Mapper
- thermal anomalies *see* hotspots
- THERMAL_CLASSIFIER 141, 142, 143, **144**, 145
- thermal components
 multiple 160, 161, 163, 166
 single 164–165
- THERMAL_SUMMARY 142, **145**, 146
- tilt variation, Etna 2002-3 eruption 450, 451, 455
- Tinakula, thermal emission 2000-14 35–38, 49
- TIR (Thermal InfraRed) data 57–58, 94–96, 115, 116,
 132, 133, 159, 169, 463, 465, 468, **470**, 472
 AVHRR 74–75
- TIROS (Television InfraRed Observation
 Satellite) 159
- TIROS-2 radiometer 6–7
- TIROS-N, NEODAAS data 468
- Tofua, thermal emission 2000-14 35–38, 49
- Tolbachik
 2012 eruption, radiant flux 174, 175
 ASTER data 118
 lava-flow volume 129, 131–132
 MIROVA algorithm 201
 thermal emission 2000-14 35–38, 49, 51
- TOMS (Total Ozone Mapping Spectrometer) 277, 278,
 283, 284, 285, 287–288, 289
- topography, source of uncertainty 96, 101–102,
 103, 108–109
- total area emplacement 260, 266, 268–269, 274
- Traversin vent 650
- triangular irregular network (TIN) 295, 297
- tsunamis 559
- Tungurahua 339
 2010 eruption, VolcFlow code 338–342
 EO-1 observation 153
 thermal emission 2000-14 35–38, 50
- Ubinas, MIROVA algorithm 200
- Ulawun, thermal emission 2000-14 35–38, 50

- URP *see* ASTER, URP Program
 USGS-Hawai'ian Volcano Observatory, VSW 152
- Valle del Bove
 hotspots 63, 67
 lava flow fields 194, 302, 449
- VAST algorithm 182, 224, 465, 575, 597
 VAST-II 472–473
 Veniaminoff, thermal emission 2000-14 35–38, 50
- Vesuvius
 population at risk 2, 3
 RST_{VOLC} applications 60
- VHUB 583
- Villarricca lava lake
 MIROVA algorithm 201
 thermal emission 2000-14 35–38, 50, 51
- viscoplastic flow
 shallow-depth approximation 409–419
 reduction model 419–421
- viscosity 245–246, 375
 and lava flow velocity 313, 317, 326
 non-Newtonian fluid 389, 392
 temperature-dependent 247–248, 317, 326–327, 329, 332, 378–382
- VNIR (Visible/Near InfraRed) data 116, 131–132, 133
- Volcanic Ash Advisory Centre 6, 146, 595
- volcanic eruptions, international humanitarian concern 553–555
see also eruptions
- Volcano Sensor Web 137, 138–156
 ASE software 137–138, 140–143
 data flow 140
 Eyjafjallajökull 2010 147–150, 151
 future plans 155–156
 Grímsvötn 2011 150, 152
 Nyamulagira 2006 143, 145–147
 SO₂ monitoring 152–153
- triggers 138, 139, 140, 143, 145, 152, 153
- volcano warning systems 555–556
 humanitarian-oriented 556–562
 alerting 559–562
 GDACS implementation 562–564
 hazard modelling 558–559, 562–563
 impact assessment 559, 563
 international aid 563
 monitoring 557–558, 562
 multi-hazard 555–556
- volcanoes
 basaltic, lava flow fields 294
 global risk 2, 3, 554
 strombolian, spaceborne observation 160
 thermal emissions 2000-14 32–34, 35–38, 39–50, 51
- VolcFlow code 337–342, 428, 429, 435–436, 437, 440, 578, 611
 Chaîne des Puys lava flow simulation 630, 635, 651, 660–666
 Tungurahua volcano 338–342
- VTF (Vogel-Tammann-Fulcher) viscosity relationship 326, 378
- Vulcano, MODVOLC observation 31
- vulnerability 556, 559
- warning systems *see* volcano warning systems
- wavelet transform, à trous algorithm 82, 83, 85, 87, 90
- Wien's displacement law 94, 468
- Wooster's coefficient 96, 97, 102, 108, 109
- WOVODAT 583
- WV-3 162
- Yasur, thermal emission 2000-14 35–38, 50
 yield strength 317
 yield stress 425, 426
- Zubair Group, 2011 SO₂ emissions 279, 281