

Index

- a**
- advanced doubling-adding (ADA) method 95
 - advanced microwave scanning
 - radiometer-EOS (AMSR-E) 151–153, 155, 162–163, 166, 167, 169, 170, 173, 175, 177, 183, 186–190
 - advanced microwave sounding unit (AMSU-A)
 - 11, 12, 28, 99–101, 125, 148, 212–222, 224, 226–227, 230, 232, 235, 237, 239, 241–242, 248–249, 257, 261, 291, 293–297, 299–300, 320–328, 330–334, 337–339
 - Advanced Technology Microwave Sounder (ATMS)
 - 8–10, 12–13, 19, 21, 28, 92, 96–97, 99–102, 104–118, 123–149, 224, 232, 237, 239–242, 244, 257, 260, 262–282, 296
 - Allan deviation method 123, 139–143, 148
 - antenna emission, two-point calibration 123, 133, 287
 - data assimilation, forecast tracks 272–282
 - data, background and analysis 272
 - GSI QC procedure 267, 269
 - instrument description 123–128
 - NEDT 138–143, 148
 - radiometric calibration 128–133, 322
 - reflector emissivity 124, 135–138, 286
 - requirements and characteristics 97, 125
 - advanced very high resolution radiometer (AVHRR) 221–222, 269
 - Airborne Rain Mapping Radar (ARMAR) 214
 - Allan deviation method 123, 139–143, 148
 - AMSR-2 153, 161, 175
 - AMSU-A data assimilation 293–296
 - atmospheric absorption and scattering models
 - absorption line and shape 16–17
 - Benchmark tests 55–60
 - energy transition 19, 25
 - first-order approximation, radiative transfer solution 62
 - GEISA 15
 - HG and Rayleigh phase function 42, 43
 - HITRAN 15, 24
 - LBLRTM 15, 23–24
 - nitrogen and ozone absorption 23
 - oxygen absorption 18–22, 24, 28, 92, 224, 225, 227, 234, 236, 238, 326
 - parameterized transmittance model 28–32
 - particle size distribution 34–38
 - radiance gradient/Jacobians 53–55
 - Rayleigh approximation 38–42, 81, 211
 - scattering parameter 32–34, 37, 112, 217, 218, 219, 220, 222, 248
 - water vapor absorption 22–24, 117, 192, 198, 202, 238
 - Zeeman splitting absorption 24–28
 - Zeeman splitting effect 26, 28, 93
 - zeroth-order approximation, radiative transfer solution 60–61
 - atmospheric profiles
 - microwave sounding principle 236–239
 - NWP models 45, 121, 149, 207, 235, 259–298
 - one dimension variation retrieval (1dvar) theory
 - AMSU-A channel 244–249, 253, 257, 330–339
 - cloud and precipitation scattering 94, 114, 251, 329
 - cloudy and precipitation conditions 1, 15, 41, 163, 166, 225–226, 230, 234, 249, 253, 300, 324, 326
 - cost function 245–247, 254, 260–261, 272, 289, 330
 - covariance matrix 155, 164, 166, 168–169, 246–247, 253, 255, 260, 330,

- atmospheric profiles (*contd.*)
 - – Hurricane Isabel 182–184, 249–250
 - – multiple scattering effects 246
 - – satellite measurements and radiosonde data 249
 - – scattering model 15, 85, 246, 251
 - – temperature profiles 201, 235, 237, 239, 247, 339
 - regression algorithms 235, 239–244, 247–248, 257
 - – AMSU-A temperature retrieval 239
 - – ATMS retrieval algorithm 241
 - – Hurricane Sandy 224, 242–244, 264–266, 269, 275–276, 278–281
 - TC maximum sustained wind (MSW) 235, 241–242, 244
- ATMS data quality control
 - GSI system 235, 260–262, 266–272, 288–289, 296
- b**
- bearing and power transfer assembly (BAPTA) 197
- bias correction radiance measurements 269
- blackbody emission 3–4
- c**
- Chinese FengYun-3C satellite 21, 224–228, 230–231, 233–234
- climate study
 - atmospheric temperature trend 299, 323, 330–337
 - – climate applications 330–331
 - – cloud detection algorithm 123, 304, 320, 330–334
 - – MSU and AMSU-A cross calibration 331
 - – temperature trend 301, 320, 323, 328–330, 334, 337–339
 - climate trend 300–303, 313, 320, 323, 337–338
 - – measurement precision 140, 148, 302–303
 - long term climate data record, from MSU/AMSU 320–330
 - – brightness temperature trend 326–330
 - – emission and scattering effect 323, 326
 - SSM/I 74, 152, 177–178, 192–194, 196–200, 203–204, 207, 232, 257, 285, 287–289, 296, 303–319
 - – bias characterization 132, 261–262, 269–271, 288–294, 296–297, 307, 309–313, 331
 - – cross calibration, on SSM/I SDR 307, 310–313
 - – intersensor bias correction 310–313
 - – RADCAL beacon interference, with F15 SSM/I 308–310
 - – satellite intersensor calibrations 304
 - – SCO method 304–307
 - – TPW 310, 315–319, 338
 - cloud absorption and scattering 32–44
 - cloud and precipitation 1, 15, 41, 163, 166, 225–226, 230, 234, 253, 300, 324, 326
 - AMSU-A sounding channels 224, 226–227, 320, 323
 - Bayesian retrieval algorithm 225
 - CESI 226–227, 230–234
 - FY-3 satellite series 224
 - FY-3C microwave sounding instruments, channel pairing 225–227
 - MWTS 225–234
 - oxygen absorption band 224
 - Typhoon Neoguri, MWHS and MWTS observations 227–230
 - cloud emission and scattering index (CESI) 226, 230–232
 - cloud icewater, remote sensing 213–223
 - AMSU-A frequencies 222
 - AVHRR and surface temperature 221
 - IWP algorithm 216
 - microwave scattering 213–216
 - Mie theory 32, 44, 51, 94, 112, 181, 208, 219
 - scattering parameter ratio 208–223
 - cloud liquid water, remote sensing
 - algorithm 210–223
 - atmospheric temperature and water vapor profiles 24, 208
 - low emissivity condition 61, 191, 208
 - physical principle 61, 208
 - vector RTM 181, 208
 - Coastal-Marine Automated Network (C-MAN) sites 188
 - Coherent Electromagnetic Tomography (CERTO) experiment 308
 - Community Radiative Transfer Model (CRTM), 9, 15–16, 92–95, 99, 103, 107–109, 111–112, 120–121, 226, 246, 230–231, 252, 257, 260, 266, 323–324, 330, 336–337, 339
 - advanced doubling-adding (ADA) method 95
 - cloud hydrometeor size and bulk volume density 112
 - cloud types 112

- discrete dipole approximation (DDA) 37, 94, 112, 114–118
 - fast emissivity model (FASTEM) 63, 64, 66, 74, 94
 - gaseous absorption module 92
 - limb effect 103, 229, 269
 - COSMIC satellite system 106
 - CRTM simulations 108–109, 112
- d**
- data assimilation system 15, 28, 88–89, 92, 195, 208, 235, 254, 259–261, 270, 285
 - Debye approximation 65
 - Debye formula 65
 - dense media radiative transfer (DMRT) theory 85
 - Dicke radiometer 2
 - dielectric soil-water mixing model 86
 - discrete dipole approximation (DDA) 37, 94, 112, 114–118
 - discrete-ordinate method 45, 47–53, 88
 - discrete-ordinate radiative transfer (DISORT) method 52
 - Doppler broadening 17, 27
 - double principal component analysis (DPCA) 151, 155–160, 163, 168–170, 175
 - doubling-adding method 47, 95, 323
 - DV2 spectrum model 70
- e**
- Earth's magnetic field 18, 31, 93
 - environmental data records (EDRs) 305–306, 310, 313, 315, 319
 - European geostationary television (TV) satellites 173, 175
- f**
- fast emissivity model (FASTEM) 74, 94
 - fast Fourier transform (FFT) analysis 286
 - fast microwave emissivity model (FASTEM) model 63–64, 66, 74, 94
 - fast Zeeman splitting models 33
 - field-of-view (FOV) 11–13, 41, 99, 101–102, 106–108, 111, 124, 127, 137, 173, 225–226, 244, 269–274, 327–328, 331
 - finite differential method (FDM) 54–58
 - frequency location 20–21, 234
 - Fresnel reflection coefficients 64, 86
- g**
- geometric optics (GO) theory 63, 94
 - geostationary satellites 162, 173
 - Global Change Observation Mission 1st Water (GCOM-W1) satellite 153
 - gridpoint statistical interpolation (GSI) analysis system 260–262
 - GSI bias correction 270
- h**
- Henyey–Greenstein (HG) phase function 42–43
 - heterodyne principle 1
 - heterodyne radiometer 1
 - heterodyne receiver 1
 - high resolution transmission (HITRAN) 15, 24
 - Hurricane Weather Research and Forecast (HWRF) System 224, 260, 262–264, 275–276, 278–280, 288–289, 296
 - ATMS data on forecasting track and intensity 272–282
 - Hurricane Events, in 2012, 264–266
 - O–B and O–A Statistics 272
 - vortex initialization 11, 153, 166, 182, 188, 197, 264
- i**
- infrared split window technique 178
 - instantaneous field of view (IFOV) 11, 153, 166, 182, 188, 197
 - integrated predictors 30–31
- k**
- K-bands 7, 31, 151, 154, 162–163, 173, 175
- l**
- land emissivity model 45, 78–88, 95, 96
 - optical parameters of snow 83–85
 - simulated surface emissivity spectra 87–88
 - soil dielectric constant 78, 87
 - surface reflection, at layer interfaces 85–87
 - theoretical approach 78–80
 - vegetation canopy, optical parameters of 81–83
 - land surface parameters 190–205
 - error sensitivity 198–202
 - land surface emissivity 160, 178, 195–198, 202, 205
 - land surface emissivity algorithm 202
 - land surface temperature 79, 178, 190–195, 205
 - microwave split window algorithm 205
 - polarizations 10, 11, 13, 43, 54–56, 63–65, 73, 75, 77–80, 82, 83, 85–86, 88–89, 95–98, 111–112, 121, 124–125, 128, 133–135, 137–138, 144–147, 149,

- land surface parameters (*contd.*)
 - 153–155, 157–161, 165–166, 168,
 - 170–175, 182, 186–187, 192, 198, 200,
 - 204–205, 208, 283, 285, 287, 290,
 - 304–305, 307, 320
 - L-band technology 7
 - line by line radiative transfer model (LBLRTM)
 - 15, 23–24
 - local oscillator (LO) frequencies 1
 - m**
 - magnetic dipole quantum number 20
 - matrix operator method 47
 - 5th generation mesoscale model (MM5)
 - simulations 57, 247
 - microwave bands 7
 - microwave calibration 7, 123–124
 - microwave gaseous absorption
 - absorption line and shape 16–32
 - parameterized transmittance model 28–32
 - microwave humidity sounder (MHS) 12, 95, 125, 148, 225–226, 230, 232, 237, 254–257, 296
 - microwave integrated retrieval system (MIRS)
 - 251–256
 - convergence of variational methods 254
 - EOF space 251, 253
 - microwave imaging and sounding data 254
 - microwave measurements 99, 177–178, 191, 208, 213, 230, 239, 251, 257, 303, 315, 319, 328
 - retrieval system 93, 251–252, 254
 - microwave radiance simulations 91–122
 - advanced radiative transfer simulations 92, 117–120
 - Advanced Technology Microwave Sounder
 - global forecast model outputs 92, 99–105
 - GPS RO 105–108, 110, 120, 149, 334
 - GPS RO Data 92, 107–108
 - single polarization state 96
 - TRMM data 109–111
 - TRMM derived simulations 112–117
 - cloud and aerosol optical properties 94
 - cloud and precipitation scattering and absorption 94
 - CO₂ cell pressure 93
 - infrared sea surface emissivity model 95
 - snow and sea ice emissivities 95
 - microwave radiometer system 1–3, 10–11
 - antenna gain/efficiency and distribution function 10–11
 - blackbody emission 3–4
 - internal amplifier noise 2
 - linearized Planck function 4–5
 - microwave data records and their terminology 13
 - microwave instrument scan geometry 11–13
 - microwave spectrum 7–10, 18
 - radio-frequency 1, 151–152, 154
 - spectral response function 8–10
 - stokes vector and its transformation 5–7
 - microwave radiometers 1, 151–152, 230–231
 - microwave sounding unit (MSU) 123, 224–225, 299–300, 304, 320–334, 337, 339
 - cloud detection algorithm 331–334
 - microwave spectrum 7–8
 - Monte Carlo emissivity model 68
 - Monte-Carlo radiative transfer model 118
 - n**
 - NCEP 15, 99, 123, 208, 231, 248, 254, 256, 259–261, 263, 279–280, 285
 - Nimbus-6 scanning microwave spectrometer 207
 - the NPOESS Aircraft Sounder
 - Testbed-Microwave (NAST-M) 225
 - ATMS data assimilation, forecast tracks 272–282
 - ATMS data, background and analysis 272
 - GSI bias correction 270
 - NCEP 15, 99, 123, 208, 231, 248, 254, 256, 259–261, 263, 279–280, 285
 - SSMIS data assimilation, instrument 282–287
 - tangent-linear and adjoint technique 68, 246, 261
- Nyquist theorem 2
- o**
- ocean emissivity model 62–78
 - foam coverage 73
 - ocean roughness heights and spectrum 67–73
 - ocean roughness phenomena 62–64
 - surface emissivity vector 74–78
 - water dielectric constant 40, 63–67, 89
- 1DVar method 339
 - climate application 123, 304, 320, 330
- overlapping Allan deviation 139–140, 148
- p**
- Planck's law 3
- platinum resistance thermometers (PRTs) 131–133, 286
- polychromatic gas absorption model 29

Princeton Ocean Model (POM) 263
 principal component analysis (PCA) 151,
 155–157, 159, 160, 163, 165, 175

q

quality control (QC) procedures 289
 quasicrystalline approximation (QCA) 85

r

Radar backscatter measurements 214
 radiative transfer model 15, 22, 45–89,
 91–92, 99, 104, 117, 201, 203, 220, 224, 232,
 250, 269–270, 304, 308–309
 – radiative transfer equation 45–47, 50, 62,
 78, 178, 181, 197, 236, 323
 – vector discrete-ordinate method 47–53
 radio-frequency interference (RFI) 8, 108,
 151–175
 – brightness temperature spectrum 154
 – C-band channels 175
 – land surface 79, 88, 95, 155, 159–162, 178,
 190–205, 263
 – ocean surface 162–163, 166, 173, 178–190
 – – Chi-square probability method 163
 – – cloud and precipitation 163
 – – cloud scattering 166
 – – distribution, in US coast 38, 43, 166,
 171, 173, 214, 217
 – – eigenvalues and eigenvectors, covariance
 matrix 156, 164, 168
 – – 1st PC coefficient 159, 166, 169–170
 – – principal component analysis (PCA)
 technique 165
 – – regression method 163, 301, 338
 – – RFI intensity maps 170, 172–174
 – – satellite glint angle 166, 168, 173
 – – spatial distribution, brightness
 temperatures 117, 158, 172–173,
 227–228, 270
 – – spectral difference method 151, 170, 175
 – – spectral difference vectors 165
 – satellite missions 152
 Radio Society of Great Britain (RSGB) 7
 Rayleigh–Jeans approximation 4, 61, 129
 Rayleigh's phase function 43
 Rosenkranz's models 31

s

satellite microwave measurements 177, 213,
 303
 sea surface temperature (SST) 76, 177, 179,
 181, 183, 185–189, 205, 208, 212, 330–331

– AMSR-E's calibration system 188
 – *in-situ* sensors 177
 – scattering and emission 45–46, 63, 91, 95,
 183, 252, 326, 338
 sea surface wind (SSW) 177, 189, 208, 330
 – Stokes vector 5–7, 43, 49, 50, 55–56,
 77–78, 94, 96, 120, 134, 153, 180
 – two scale emissivity model 77, 180
 – WindSat data 181
 simultaneous conical overpassing (SCO)
 method 304–307, 310–313, 337
 simultaneous nadir overpass (SNO) technique
 304
 special sensor microwave imager sounder
 (SSMIS) 28, 31, 32, 33, 93, 95, 232,
 282–297, 303, 304
 – antenna and calibration subsystem 286
 – FFT analysis 286
 – polarization channels 133, 135, 137, 155,
 165–166, 168, 170, 175, 285
 – receiver subsystem 286
 – SSMIS bias correction 288–293
 – data assimilation, instrument 282–287
 – SSMIS data quality control 287–288
 – SSMIS LAS data 293–294, 296–297
 – SSMIS TDR data 285
 – Zeeman splitting channels 31
 standard predictors 30–31
 Suomi National Polar-orbiting Partnership
 (SNPP) 19, 123, 125, 131, 138,
 142

t

tangent-linear and adjoint technique 68, 246,
 261
 3-dimensional numerical cloud models 91,
 92, 109, 111, 113, 177
 TRMM Microwave Imager (TMI) 109
 Tropical Rainfall Measuring Mission (TRMM)
 2A12 products 111–112

v

V-band 7, 138
 VDISORT Jacobian model 57–58

w

WindSat/Coriolis mission 181
 WindSat data 181
 WindSat radiometer 152

z

Zeeman splitting absorption 24–28