

## Index

If a keyword appears followed by ++ in this index, it indicates that the pages covered are only representative, and many other occurrences may exist. The following keywords particularly will be especially under-represented (or may not exist at all) due to the great frequency of their occurrence, although they will occur selectively with additional descriptors: Backscatter, Correlation, Data, Doppler, Echo, Echoes, Energy, Frequency, Height, Layer, MST, MST radar, Phase, Pulse, Radar, Reflection, Scattering, Spectra, Spectrum, Structure, Temperature, Transmitter, Turbulence, Velocity, VHF, Wavelength, Waves, Spectral.

- A/D (Analog to digital) conversion, 312, 343, 443
  - converter, 300, 313, 314, 353
- Absorption, 14, 18, 59, 153, 159, 207, 416, 439, 589
  - bound electrons, 207
  - Chapman layer, 15
  - coefficient, 153
  - and communication, 12
  - D-region, 59, 65, 335
  - DAE, 59, 62, 549
  - dispersion, 236
  - electromagnetic, 159
  - electrons, 137
  - EM spectrum, 14
  - gravity waves, 33, 636
  - greenhouse, 18
  - heat, 711
  - imaginary refractive index component, 207
  - infrared, 19
  - ionosphere, 59, 61, 267, 335, 336, 590
  - K-band, 207
  - MF to VHF, 207
  - molecules, 207
  - neutral atmosphere, 208
  - O and X modes, 59, 153, 589
  - oxygen, 14
  - radiative transfer, 18
  - radio-communication, 59
  - radiowaves, 145, 158, 159, 205, 236, 590
  - and refraction, 159
  - solar radiation, 16
  - of solar radiation, 14
  - sunspots, 59
  - troposphere, 14, 18
  - UV, 15
  - by UV, 14
  - water vapor, 5, 207
- ACF (+ see Autocorrelation function), 249
- Acoustic, 116, 117, 203, 572, 606, 674
  - cutoff frequency, 606
  - wave, 105, 116, 117, 201, 606, 607, 674
- Adaptive filter, 490
- Adiabatic, 18, 20, 31, 37–40, 42, 43, 45, 115, 569,
  - 586, 602, 604, 634, 635, 653, 657, 663, 711, 712, 716, 717, 719, 721, 722, 741
  - lapse rate, 18, 35, 38, 40, 41, 209, 604, 605, 678, 705, 716, 717, 722, 723, 741
  - dry, 710, 711, 715–718, 720–722
  - moist, 40, 46, 710, 712, 714–717
  - process, 18, 38, 44, 718, 719
- Advective derivative, 606
- AGC, automatic gain control, 347, 444
- AIM, Angular imaging (also see CRI), 111, 112,
  - 538, 539, 542, 543
- Albedo, 16, 19, 20
- Aliasing
  - severe, 263
  - spectral line displacement, 259
- Aliasing frequency, incorrect interpretation, 262
- Alwin radar, 429
- Ambiguities in phase, 241, 561
- Ambiguities in range and velocity, 517
- Ambiguities, angular, 561, 578
- Ambiguity and Nyquist sampling theorem, 264
- Ambiguity function, 264
- Ambiguity in range, 265
- Ambiguity in range and second-trip echoes, 265
- Ambiguity in velocity, 264
- Ambiguity, range vs. velocity dilemma, 265
- Ambipolar diffusion, 561–563
- Ambipolar diffusion and temperature, 561
- Anelastic, 628
- Angel, 48, 49

- Antenna
- adaptive design, 301
  - effective area, 276, 277
  - fan-beam, 273
  - height above ground, 360
  - phased array, 290, 352
  - reflector-type, 288
  - Yagi, half-power full-width, 375
- Antenna beam
- half-power full-width, 102, 281, 284, 287
  - half-power half-width, 63, 86, 233, 280, 281, 283, 284, 316, 319, 320, 353, 404
  - half-power half-width, two-way, 316, 388, 390, 395, 403, 420
  - main lobe, 223, 287, 291, 299, 305, 348, 349, 355, 356, 377, 432, 575
  - one-way, 320, 323, 332
  - tilted, 68, 255, 348
  - two-way, 285, 323, 360, 377, 442
- Antenna beam bore, tilted, 305
- Antenna beam gain
- one-way, 285, 316, 320
  - two-way, 285, 360
- Antenna beam pairs, tilted, 387
- Antenna beam-width, 276
- Antenna coupling, 366
- interference, 365
  - mutual, 290, 293, 294, 296–298, 308, 561, 578
- Antenna directivity, 275
- Antenna element spacing, 342
- Antenna feed, 300, 308, 321, 333, 349, 352–355, 358, 361, 363, 364, 380
- Antenna gain, 96, 274, 294, 314, 324, 332, 334, 742
- Antenna grating lobes, 223, 291–293, 377
- Antenna side-lobes, 72, 106, 108, 110, 223, 224, 233, 275, 276, 280, 287, 291, 292, 299, 300, 302, 317, 323, 348, 349, 355, 356, 360, 377, 378, 512, 577
- suppression, 348
  - tapering, 287, 291, 349
- Antenna weighting, spatial, 349
- Antenna–antenna interference, 361
- Antennas, helical, 295
- Arecibo Observatory, 85
- Aspect sensitivity, 84, 96, 379, 390, 393, 424, 427, 430, 438, 576, 673, 676
- Atmospheric refractive index, 48, 119, 324, 519
- Atmospheric regions, temperature classification, 8
- Atmospheric stability, 20, 566, 614, 705, 723
- Atmospheric temperature, 72, 116, 439, 588, 674, 716
- Atmospheric tides, 23, 31
- Attenuation, 234
- in correlation function, 477
  - in DAE, 590
  - due to atmosphere, 49
  - radiowaves, 145
  - in sampling, 347
  - sampling transmitter, 326
  - solar radiation, 14
- Aurora, 6
- Auroral oval, 552, 553
- Autocorrelation, 519
- function, 108, 187, 257, 273, 274, 393, 414, 430, 434, 452, 478, 515, 525, 527–529
  - spatial, relation to polar diagram, 430
- Autocovariance, 105, 183–185, 187, 188, 254, 257, 282, 283, 338, 385, 424, 466, 467, 471, 497, 540, 546
- function, 498, 515
  - matrix, 485, 490
  - sequence, 467
- Available potential energy, 45
- Aviation flight planning, 688, 731
- Aviation passenger safety, 49, 731, 732
- Aviation travel, 731
- Backscatter cross-section, 93, 159, 171, 175, 176, 196, 198, 209, 210, 242, 243, 272, 314, 315, 317, 318, 335, 419, 420, 552, 567, 590, 686
- Backscatter reflectivity, 445
- Backscatter theory, 451
- Backscatter++, 47
- Backscattered power, dependence on refractive index spectrum, 175
- Backscattered power, radar volume dependence, 173
- Barker code, 248, 250, 328, 582
- Baroclinic instability, 23
- Beam broadening, 394, 494
- Beam tilts, 396
- Beam-broadening and tilted beams, 397
- Beam-width, 322
- Biological targets, birds, 48, 113, 217, 506, 729
- Biological targets, insects, 48, 49, 217, 506
- Bistatic radar, 268, 270–272, 391
- Bore-sight, 275
- Boundary layer, 6, 252, 426, 505, 506, 542, 544–547, 639, 644, 655, 728
- turbulence, 639
- Boussinesq, 609, 610, 628
- approximation, 610
- Bragg, 73, 169
- condition, 73, 168, 201, 202
  - reflection, 116, 165–169
  - reflections vs. scatter, 168
  - scale, 73, 76, 85, 86, 88, 166, 168, 169, 172, 175, 176, 193–195, 198, 212, 215, 218, 408, 442, 550, 557, 558, 642, 650, 655, 673, 674
  - scale vs. Buoyancy scale, 408
  - scatter, 85, 168, 169, 218, 519, 530–532, 542, 673, 674
  - scatterer++, 168
  - vector, 194, 195

- wavenumber, 180, 195, 204, 556
- Brewer–Dobson circulation, 29–31
- Brunt–Väisälä frequency, 36, 40, 45, 115, 210, 569, 609, 610, 614–616, 626, 657, 668, 697, 718–720, 740
- Brunt–Väisälä period, 605
- Buckland Park, 62, 68, 405, 435
- Buoyancy waves + see Gravity waves, 393, 597
- Calibration, 268, 419, 595
  - by artificial satellites, 324
  - compensation for coding, 328
  - constants and impact of receiver noise, 328
  - constants using E-region, 335
  - constants using noise, 326–330
  - and digital receivers, 238
  - efficiency, 330
  - efficiency and losses, 330
  - importance of, 267
  - and measurement of turbulence, 324, 416, 422
  - noise and sampling rate, 263
  - of phases, 335
  - of polar diagram/radiation pattern, 322
  - for power, 117, 118, 242, 324
  - radar equation, 324
  - and rainfall, 118, 334
  - of range, 321, 322
  - receiver, 325
  - by skynoise, 330
  - by sniffer, 326
  - turbulence vs. aircraft, 666
  - using galactic noise, 331
  - verification of winds, 322
- Capon's method, 111, 484
- Carbon dioxide and infrared radiation, 16, 18
- Cartesian coordinates, 509, 607
- CCF (see Cross-correlation), 468
- CCF, engineer vs. statistician, 468, 514
- Chapman layer, 16
  - cause, 15
- Chinook winds and gravity waves, 699
- Circuit, 32, 51, 125, 230, 259, 276–278, 295, 308, 309, 311, 354, 356, 358, 366, 368, 370, 441, 444
  - control, 238
- Circulation, 29, 32
  - and angular momentum, 28
  - atmosphere, causes, 34
  - BDC (Brewer–Dobson), 29
  - BDC, lower branch, 31
  - cells, 26, 661
  - extratropical, 26
  - Ferrel cell, 22
  - forcing, parameterization, 639
  - global mean, 34
  - gravity waves and mean winds, 96
  - Hadley cell, 21
  - mean winds and gravity waves, 599, 622, 627, 633, 635, 638
  - meridional, 28, 31
  - mesoscale, 596, 680
  - mesosphere, 31, 101
  - orographic forcing, 700
  - stratosphere, 33, 700
  - stratosphere and mesosphere, 29
  - TEM, models, 22
  - and wave forcing, 27
  - waves, 29
  - winds, 20
- Classifications, radio bands, 5
- Clear-air radar, 48–50, 531
- Clear-air turbulence, 49, 113, 477, 495, 542, 732
- CLOVAR++, 359
- Clutter, 85, 113, 301–303, 445
  - fading, 85
  - from the sea, 85
  - ground, 85
  - suppression, 300
- Coaxial-collinear antenna, 288, 294, 341
- Coding, 76
  - programming, 65
- Coherence time, 250, 257, 343, 452
- Coherent integration, 68, 76, 77, 81, 250, 251, 253, 255, 257–263, 266, 299, 308, 314, 323, 328, 330, 337, 342, 347, 367, 370–372, 418, 443, 501–503, 574, 578, 681, 692
- Collision frequency, 143, 146, 157, 158, 206, 591
- Collision frequency of electron, 143
- Collisionless plasma, 139, 197
- Collisions, 128–130, 146, 156, 554, 555, 571, 646, 648
  - molecular, 646
  - plasma, 204
- Complementary code, 250–252, 328, 340, 504
- Compression, 20, 247, 248, 270, 273, 274, 353, 464, 504, 505, 544, 653, 725
- Consensus filter, 682
- Continuity equation, 606, 609
- Continuous-wave radar, 240
- Controller, master, 238
- Convection, 18, 23, 49, 437, 570, 605, 624, 627, 669, 675, 680, 700, 703, 705, 711, 717, 719, 721, 725–727
  - instability, 46, 721, 722
  - and lapse rate, 716
- Convergence, 460
- Coordinates, 108, 147, 150, 179, 191, 195, 235, 522, 589, 655, 743
- Coriolis parameter, 27, 608, 609, 634
- Corona, 571
- Correlation function, for FCA, 524
- Cosmic noise, 85, 333, 341, 420
- Coupling

- receiver/transmitter, 729
- in receivers, 309
- wave-wave, 605
- Covariance function, various forms, 515
- Covariance matrix, Hermitian, Toeplitz, 468
- CRI, coherent radar imaging (also called AIM), 111, 538
- Criteria, optimization for interferometry, 111
- Critical level, 31, 33, 57, 142, 211, 621, 626, 629–632, 636
- critical layer, 621
- Cross-correlation, 96, 97, 106, 241, 248, 264, 392, 393, 450, 468, 520, 523, 524, 528, 529
  - and ambiguity function, 264
  - and autocorrelation in spaced antenna method, 527
  - c.f. convolution, 485
  - engineering definition, 468
  - and passive radar, 733
  - properties, 468
  - vs. spectral width, 393
- Cross-covariance, 241, 466, 515
- Cross-section, 25, 32, 48, 73, 84, 88, 108, 159, 164, 180, 188, 210, 242, 267, 288, 314, 317, 318, 322, 324, 381, 384, 416, 420, 522, 555, 577, 623, 625, 642, 657
  - of special satellites, 324
- Current
  - antenna, 286
  - electrical, 125, 160–162, 274–278, 285, 290, 296–298, 307, 344, 368
  - fair-weather, 571
  - lightning, 572
  - linear antenna, 285
  - radiating element, 298
  - transistor, 307
  - unbalanced, 353
- Current density, 123, 160, 162, 178, 180, 278
- Current distribution, 275, 278, 286, 291
  - main lobe, 286
- Current elements, 285
- Current source, 286, 291
- CW radar (also see FM-CW), 54
- CWINDE, 687, 688
- D-region, 10, 12, 13, 55, 57–62, 66, 67, 69, 70, 74, 76, 77, 84, 88, 89, 94, 96, 98, 199, 205, 335, 336, 418, 439, 559, 581, 588, 589, 591, 593
  - DAE, 59
  - winds++, 59, 62
- DAE, 59, 62, 153, 589, 590, 592, 594
  - differential absorption experiment, 59
- Damped wave, 586
- Damping, 59, 127, 156, 206, 585, 588, 653
  - Landau, 203
- Data, operational, 687
- Data, quality control++, 683
- DBF, digital beam forming, 299
- DCMP, directionally constrained minimization of power, 302
- DDS, direct digital synthesis, 238
- Debye length, 200, 203, 209
- Densities of ions, 13
- Densities, neutral atmosphere++, 11
- Derivative, 215, 247, 389, 418, 526, 529, 591, 611, 622, 623, 636, 640, 713, 740
- Detectability, 76, 77, 255, 261, 262, 314, 370, 371, 418, 496, 502, 504, 733
- DFT, discrete Fourier transform, 447, 455–458, 471, 473
- Diabatic, 18, 23, 30
- Differential phase, 537
- Differentiation, 24, 45, 129, 606
- Diffraction screen, 519
- Diffusion, 586, 636, 637, 639, 646–649, 651, 659, 661, 662, 667, 670
  - ambipolar, 561–563
  - coefficient, 439, 646–648, 651, 652, 659, 661, 667
    - electron, 554
    - electron-ion pair, 555
    - heat, 647
    - large scale, 646
    - molecular, 648, 670
    - molecular, in PMSE, 554
    - momentum, 660
    - neutral, 554
    - scatter vs. height, 563
    - thermal, 45
    - vs. height, 562
  - dependence on layer lifetimes, 649
  - different forms, 439
  - equation, 586, 650
  - equations and wave-like solutions, 427
  - expansion, 586
  - of heat, 45, 606
  - and intermittency, 98
  - km-scale, 637
  - large scale, 637, 661
  - mechanisms in air, 98
  - of meteor trails, dependence on magnetic field, 589
  - molecular, 8, 89, 100, 646, 647, 650
  - of momentum, 23
  - momentum and heat, 640
  - multipolar theory, 555
  - nett, 637
  - neutrals, 647
  - parameter-dependent, 643
  - particles and heating, 660
  - plasma, 204
  - Prandtl number, 422, 658
  - rates, meteor trails, 589
  - in Richardson number, 660

- salt and momentum, 557
- scale-dependent, 439, 649
- scales > buoyancy scale, 651
- Schmidt number, 101
- Stokes, 439, 636, 637, 649, 661
- theory, 150 km echoes, 585
- time scale, 554
- turbulence vs. molecular, 98
- waves (also see Viscosity waves)++, 211
  - with charged aerosols, 101
- Diffusive balance, 675
- Digital levels, 65
- Digital processing, 79, 441, 445
- Digital radar, 441
- Directivity, 275
- Dispersion relation, 585, 609, 610, 626
- Divergence, 23, 24, 31, 387, 494
- Doppler dilemma, 265
- Doppler measurements, 54, 69, 264, 347, 382, 618
- Doppler processing, 54
- Doppler radar, 1, 54, 233, 244, 249, 372, 374, 386, 395, 441, 445, 447–449, 451, 452, 455, 465, 467, 469, 470, 472, 475, 491, 681, 683, 684
- Doppler shift, 53–55, 67, 70, 71, 80, 95, 116, 199, 202, 227, 228, 242, 264, 270, 271, 305, 306, 382, 386, 394, 442, 497, 510, 513, 584
  - plasma waves, 202
- Doppler shifting, 238, 438, 588, 615
- Doppler spectrum, 201, 442, 443, 452, 469, 475, 477, 489–496, 499–502, 569
- Doppler technique, 55, 386
- Drag, 632, 633
  - due to momentum fluxes, 611, 632
  - due to momentum forcing, 646
  - forces due to gravity waves, 634
  - and friction, in cloud-charging, 571
  - gravity waves, 34
  - at ground compared to upper atmosphere, 639
  - ions and dressed ions, 203
  - neutral and charged, 589
  - neutrals, 589
  - orographic, 613
  - PMSE, dressed aerosols, 555
  - Rayleigh, 609
  - Reynold's stresses, 646
  - viscous, 646
- Drift velocity, 96
- Drifts, 60–63, 65, 67, 68, 446
  - Stokes, 637
- Drop-size distribution, 117, 495, 567
- Drop-size spectra, 117
- Dry adiabatic lapse rate, 710, 715–718, 720–722
- DTFT, Discrete-time Fourier transform, 453, 455, 456, 460, 469, 471, 474, 477, 485, 496, 497
- Dual wavelength calibration method, 334
- Duration, meteor and lightning echoes, 446
- Duration, transmitter pulse, 47
- Dynamic instability, 46, 724
- Dynamic range, 323, 343, 345, 347, 353, 444
- E-layer, 57, 335, 336
- E-region, 4, 8, 15, 56, 57, 60–62, 104, 105, 335, 336, 393, 420, 553, 582, 588
- Echo, range dependence, 679
- Eddy diffusion, 638, 639
- Effective area, 276
  - and gain, 280
- Electric fair-weather field, 571
- Electric field, 105, 107, 121, 123–127, 130–132, 134, 138, 143, 146–153, 157, 159, 161, 162, 176, 178–180, 225, 229, 242, 246, 274, 276, 277, 280, 285, 286, 310, 421, 430, 519, 521, 570, 571, 589, 590, 742, 743
- Electrojet, 581, 582
- Electromagnetic theory, 280
- Electromagnetic waves, 123, 165, 274, 278, 427, 671
- Electron collision frequency, 740
- Electron density, 8, 12, 13, 15, 16, 56–59, 63, 65–67, 73, 74, 77, 85, 86, 88, 90, 120, 138–142, 153, 155, 156, 159, 173, 174, 176, 197–200, 315, 317, 319, 419, 439, 505, 553, 554, 559, 565, 581, 588–591, 593, 594, 642, 657, 658, 663, 740, 741
- Eliassen–Palm flux, 23, 700
- EM
  - electromagnetic radiation, 3
  - electromagnetic radiation, ordinary and extraordinary modes, 153
- Entrainment, 544
- Environment
  - Antarctica, 375
  - atmospheric, 47
  - experienced by air parcel, 41, 604, 611, 719–722, 741
  - for ducted waves, 626
  - for lightning, echo decay, 577
  - for radiowaves, 381
  - mesopause, 555
  - mountain waves, 697
  - nonlinear, 666
  - space, 74
  - stratified, 422
  - of turbulence, 639, 640
- Environment related to static stability, 676
- Errors
  - antenna array amplitudes, 299
  - antenna array phases, 298, 299
  - antenna array positions, 299
  - beam direction and winds, 322
  - beam pointing, 322
  - digital phases, 301
  - digitization, 250

- drop-size distribution, 567
- due to noise, 393
- due to scatterer anisotropy, 692
- due to spectral frequency resolution, 403
- need for calibration, 321
- phase, due to antenna coupling, 578
- phases, 195, 196
- radiosondes, 686
- refractive index expression, 158
- spaced antenna method, 61, 72
- in turbulence due to strong winds, 404
- turbulence strengths, 412
- vertical winds, 95, 693
- Errors due to spatial variability of winds, 403
- Errors in spectral width for turbulence, 403
- Errors in turbulent Prandtl number, 647
- Eulerian mean, 22
- Eulerian vs. Lagrangian averaging, 22
- Eulerian-mean wind, dangers in using, 22
- Evanescent wave, 142, 697, 699
- Evaporation, 709, 710, 716
- F-region, 12, 16, 56, 73, 75, 582
- Faraday, 2
  - rotation, 153, 154, 207, 208, 295, 565, 593
- Fast Fourier transform, 55, 187, 338, 367, 447, 455, 457, 471
- FCA, full correlation analysis, 60, 111, 114, 392, 393, 523, 524, 527, 530
- FDI, frequency domain interferometry, 106, 111
- Ferrite, 301, 310, 365, 366, 371
- FFT, 55, 184, 305, 338, 371, 447, 457–459, 471, 478, 500
- Fick's law, 606
- Field-aligned irregularities, E- and F-region, 582
- FII, Frequency-domain radar interferometric imaging, 111
- Filter, 53, 229, 232, 238, 244–247, 252, 262–264, 266, 267, 309, 314, 325, 328, 329, 347, 441, 460–464, 474, 482–490, 495, 512, 574, 619
  - adaptive, 486
  - band-pass, 53, 308, 313, 358
  - bank, 482, 483
  - biased, 262
  - boxcar, 245, 329
  - Capon, 487
  - CIC (cascaded integrator-comb), 314
    - coefficients, 462, 482
    - design, 461
    - digital, 459, 461
    - final stage, 53, 263, 329
  - FIR (finite impulse response), 314, 463
  - Gaussian, 246
  - IF (intermediate frequency), 262
  - impulse response, 244
  - low pass, 51, 52, 226, 228, 232, 244, 245, 248, 263, 452
  - matched, 243, 245, 248–250, 264, 451, 512
  - narrow band, 229
  - and noise, 244
  - phase variation, 452
  - and pulse length, 245
  - and resolution, 245
  - response, 463
  - stable, 461
  - wide band, 573
  - width, 53, 232, 263, 326, 329
- Finite impulse response, 462
- Fluid equations, 607
- Flux Richardson number, 46, 423, 658, 660
- FMCW, 49, 116, 268–271, 672
- Folding frequency, incorrect interpretation, 262
- Forecasting, 100, 140, 568, 569, 639, 680, 684, 688, 689, 691, 716, 731
- Fossil turbulence, 557
- Fourier transform, 105, 106, 108–110, 172–175, 182, 184–187, 191–193, 196, 215, 226, 229, 246, 262, 280–283, 286, 287, 385, 393, 409, 414, 417, 430, 447–457, 459, 460, 469, 471, 474, 478, 481, 482, 484, 492, 538, 540, 541, 546, 674, 737, 742
  - 3-D, 168
- Free oscillations, 23
- Frequency agility, 543, 546
- Frequency aliasing
  - Nyquist frequency++, 259
  - Nyquist frequency, PRF, 329
- Frequency allocations, 728
- Frequency band, 1, 5, 341, 487, 506, 624
- Frequency diversity, 543
- Frequency domain interferometry, 106, 113, 505, 535, 537
- Frequency spectrum, 231
- Fresnel, 68, 88, 89, 92, 94, 96, 113, 115, 212, 508, 673, 677, 678, 728
  - radius, 89
  - reflection, 92, 93
  - scatter, 92, 93, 168, 234, 418, 519, 677
  - zone, 89
- Frontal system, 23, 35, 100, 339, 570, 596, 605, 627, 639, 676, 680, 681, 692, 695, 700–702
- Fronts and gravity waves, 605, 627, 700
- Frozen-in hypothesis, 520, 521, 524
- FSA, full spectral analysis, 111
- Gain, 272, 275, 279, 280, 285, 307, 309, 322, 324, 326, 328–330, 347, 353, 380, 399, 487
  - absolute, 276, 322
  - AGC, 444
  - along bore-sight, 275
  - amplifier, 309
  - antenna, 79, 97, 216, 274, 284, 302, 332, 334, 342, 348, 399, 420, 512, 742–744
  - antenna and side-lobes, 348

- at arbitrary angle, 319
- area dependence, 349
- array vs. element, 294
- and beam-width, 284, 355
- bore-sight, 319, 348, 349
- calibration, 326, 327
- Capon, 487
- combined transmitter and receiver antennas, 285
- control, 347
- dB, dBi, 274
- DBF c.f. DB, 300
- digital acquisition, 325
- digital receiver, 441
- dipole over ground, 294
- directional, 275, 322, 323
- and effective area, 276, 278, 283, 294
- and efficiency, 325
- element, 294
- filter, 486
- frequency dependence, 318, 342
- fully digital receiver, 314
- half-wave dipole, 294
- infinitesimal dipole, 276
- instability, 309
- isotropic, 280
- low pass filter, 461
- measurement, 326
- MST and non-AGC, 444
- MST transmitter antenna, 272
- narrow beam, 284
- and noise, 326
- over isotropic, 275
- PA, power amplifier, 358
- quadrature channels, 312
- radar, 316
- and radiated power, 421
- receiver, 209, 308, 313, 325, 328, 347
- receiver, frequency response, 464
- receiver to digitizer, 326, 420
- relative to dipole, 275
- signal, 79
- signal and noise, 347
- stable receiver, 309
- system, 322, 328
- three, four element Yagis, 294, 349, 355
- transmitter, 272
- transmitter amplifier, 306
- transmitter antenna, 104, 272, 274
- volts to digital, 326
- Yagi, isotropic, 375
- Galactic noise, 308, 309, 331, 332, 552
- Gaussian, 108–110, 190, 191, 199, 200, 231, 233, 245, 246, 256, 257, 284, 316–320, 385, 388, 390, 394, 405, 409, 414, 417, 428, 432, 477, 481, 490, 495–498, 500, 528, 530, 535, 536, 642, 681, 693, 694
- Geopotential height, 376
- Geostrophic, 23, 605, 627, 703
- Gradient Richardson number, 46, 423, 658, 660
- Gravity wave
  - convective breakdown and intrinsic phase speed, 621
  - group velocity, 626
  - intrinsic frequency, 609, 619
  - intrinsic period/frequency, 605
  - intrinsic phase speed, 605, 610
  - intrinsic phase speed and critical levels, 621
  - propagation, 605, 611, 629
  - propagation, direction, 606
  - reverse ray-tracing, 628
- Gravity wave generation, convection, 726
- Gravity waves, 23, 30–32, 34, 35, 61, 62, 78, 95, 96, 98, 115, 339, 348, 372, 393, 404–406, 410–412, 415, 426, 429, 435, 438, 506, 549, 557, 581, 582, 584, 586–588, 596–600, 604–607, 611, 612, 617, 622, 625–627, 629–632, 634, 636–640, 644, 648, 671, 675, 681, 691, 693, 694, 697–703, 719–721, 725, 728, 733
  - amplitude vs. height, 597, 600, 613, 632
  - anelastic, 609
  - Boussinesq, 609
  - breakdown modes, various, 631
  - breaking, 31, 614, 621
  - breaking, slant-wise, 631, 724
  - catastrophic collapse, 631
  - compressible, 609
  - convective adjustment, 614, 615, 630, 631
  - convective instability, 621, 630, 632, 692
  - critical level++, 621
  - and diffusion, 636
  - diffusion effects, 587
  - dispersion relation, 609
  - drag, 34, 636, 638
  - ducted, bias in measurements, 626
  - effect of variability of mean state on propagation, 628
  - energy propagation, 602
  - first order perturbations, 608
  - fluid equations, 607
  - fronts, propagation, 602
  - Garrett–Munk universal spectrum, 612
  - generation, 605
  - generation, orographic, 627
  - generation and simple picture, 597
  - global distribution, 624
  - ground to tropopause standing waves, 699
  - hydrostatic, 609
  - inertial frequency, 609
  - and lee-waves, 696
  - linearization, 607–609
  - and mean-flow reversal, 638

- mean state interaction, 625  
 modeling, 671  
 non-hydrostatic, 608, 609  
 number of, 613  
 phase and group velocities, 597  
 polarization relations, 609  
 propagation, 603, 625, 629  
 propagation, direction, 605, 625, 629  
 quasi-monochromatic, 611  
 ray-tracing, 628  
 Rayleigh drag, 638  
 refraction, 625  
 saturation, 613  
 shear excitation, 605  
 shedding, 614  
 sources, 605, 627  
 sources, ducts, 700  
 sources, eclipse, 625  
 sources, frontal systems, 627  
 spectra, 615  
 Stokes parameter, 629  
 stratospheric propagation directions, 630  
 and tilting of reflectors, 435  
 trapped, 625, 626, 697, 699  
 tropospheric forcing, 605, 620  
 universal spectrum, 612, 614, 615  
 universal spectrum and catastrophic wave  
 collapse, 615, 616  
 up/down propagation ratio, 629  
 vertical velocity spectra, 615  
 Greenhouse effect, 18  
 Ground clutter, 303–305, 348, 386, 477, 482, 490  
 Group velocity, 122, 128–130, 142, 585, 597, 621,  
 622, 626  
 Gyrofrequency, 147  
 Hadley circulation, 633  
 Heating, 16, 18–20, 30, 31, 35, 217, 437, 559, 632,  
 633, 640, 645, 646, 659–662, 692, 711, 712,  
 727  
 frictional, 645  
 radiative, 10  
 troposphere, 18, 19  
 by turbulence, 640  
 UV, 15, 16  
 Height distribution, 10  
 Hermitian adjoint, 467  
 Hermitian adjoint, transpose, conjugate, 467  
 Hermitian matrix, 303  
 Hermitian operator, 467  
 Hertz, 2, 80, 448  
 HF radar, 58, 68  
 History, 2, 6, 47, 48, 53–55, 57, 70, 75, 118, 337,  
 346, 349, 350, 560, 567, 589, 672, 680  
 Hodograph, 629  
 Homosphere and Heterosphere, 10  
 Horizontal velocity, 521, 603, 609, 622  
 Horizontal wind, 80, 81, 84, 95, 96, 255, 386, 387,  
 389, 391, 403, 404, 450, 522, 528–530, 615,  
 692, 694  
 Horizontally stratified, 416, 425  
 Hurricane, 35, 119, 596, 681, 682  
 Hydrogen, 11, 14  
 Hydrometeor, 567, 570–572, 674, 729  
 Hydrostatic, 628  
 balance, 46, 706  
 equation, 41  
 Ice, 16, 49, 50, 374, 543, 551, 555, 557, 567, 570,  
 571, 700, 710, 711, 716, 728  
 IDI, imaging Doppler interferometry, 111  
 In-phase/quadrature and coherent integration, 257  
 In-phase/quadrature and phase lead, 238  
 In-phase/quadrature signals, 68, 220, 225, 227,  
 229–231, 233, 236, 260, 312, 314, 326–328,  
 441, 445, 446, 692–694  
 complex representation, 125, 228  
 sample data, 234  
 In-phase/quadrature when sampling the RF, 238  
 In-phase/quadrature, and superheterodyne, 238  
 In-phase/quadrature, conversion to digital, 238  
 In-situ, 1, 555, 596, 661, 662  
 aircraft, 696  
 balloon, 90, 91, 387, 663, 676, 696  
 balloons, rockets, aircraft, 617  
 radiosondes++, 84  
 rocket, 12, 31, 60, 64, 65, 555, 559, 593, 617,  
 622, 623, 630, 644, 647, 652, 653, 665, 728  
 gravity waves, 617  
 Incoherent averaging, 481  
 Incoherent integration, 255, 481  
 Incoherent scatter, 73–76, 168, 169, 218, 288, 305,  
 337, 372, 550, 582, 588  
 Infinite impulse response, 462  
 Infrared cooling to space in stratosphere,  
 mesosphere, 16  
 Infrared radiation and greenhouse, 18  
 Infrared radiation and tropospheric temperature  
 profile, 18  
 Infrared radiation from ground, 18  
 Infrasound, 557, 607  
 Instability, 210, 309, 439, 584, 614, 621, 630, 660,  
 705, 716, 717, 721, 724  
 Interferometer, 69, 392, 393, 560, 561, 578, 619  
 lobes, 578  
 Interferometric techniques, different names, 111  
 Interferometry, 98, 102–104, 106, 111–113, 224,  
 240, 241, 360, 365, 374, 380, 506–508, 510,  
 511, 530–533, 537, 557, 573, 578, 581, 582,  
 594, 696, 725  
 angle of arrival, 111  
 range, 111  
 Internal energy, 35, 712



- Internal gravity wave (+ see Gravity waves), 597, 607, 612
- Ion temperature, 9, 204
- Ionization, 553, 572, 580, 588
- Ionogram, 56, 57
- Ionosonde, 56–58, 73, 139, 141, 142, 561
- Ionosphere, 1, 2, 4–6, 8, 47, 56, 57, 61, 73–75, 77, 79, 87, 111, 120, 126, 129, 130, 137–142, 146, 147, 153, 156–158, 199, 201, 205, 211, 216, 218, 315, 419, 505, 571, 572, 582, 583, 588, 589, 594, 658, 740
- variability, 4
- Ionospheric echoes, 59, 73, 75, 76, 582
- Ionospheric echoes, 150 km, 583
- Ionospheric radar, 55
- Ionospheric radio propagation, critical frequency, 56
- Ions, 6, 11–13, 16, 73, 101, 126, 158, 176, 199, 200, 203, 554, 555, 571, 665
- IPP, 264–266, 352, 353, 469, 504
- IPP, inter-pulse period, 253
- Isolation, 273, 300, 310, 358, 364
- ITCZ, inter-tropical convergence zone, 20
- Johnson noise, 329
- Kelvin–Helmholtz, 49, 50, 103, 631, 637, 699, 725
- billows, 506, 725
- instability, 631, 724
- Kirchoff integral, 133, 212
- Kolmogoroff microscale, 642
- Lagrangian vs. Eulerian averaging, 22
- Langmuir probe, 90
- Lapse rates, stable, labile, marginal, unstable, 716
- Latent heat, 35, 40, 116, 703, 710–713, 715, 718
- Clausius–Clapeyron equation, 714
- Lee-wave train, 696
- Lee-waves, 602, 637, 692, 693, 696, 697
- c.f. inertial waves, 698
- height variation, 697
- and radar, 696
- stationary, 697
- Lenticular clouds, 637
- Lidar, 170, 567, 614, 617, 731, 732
- winds, 561
- Light, 16, 47, 128, 130, 139, 142, 146, 155, 159, 161, 211, 223, 224, 236, 243, 420, 517
- internal reflection, 142
- polarized, 125
- visible, 18, 19
- winds and BV frequency, 695
- Lightning, 263, 335, 341, 446, 447, 572–577, 580, 681, 704
- active detection, 574
- calibration, phase, 578
- channel, 100, 572, 573, 576, 577, 580
- characteristics, 570, 572, 574, 576
- dart leader, 572
- echo, characteristics, 574–577
- duration, 576, 577
- as interference, 446
- interferometry, locating, 576–580
- main stroke, 572
- mechanism, 570, 572
- passive detection, 572
- polar plots, 579
- power and reflectivity, 572, 575, 576
- radial velocity, 577
- by radio methods, 572
- reflected echo plus sferics, 574
- RF interference, 446
- sferics, 572, 576
- time-series analysis, 446, 576
- VHF radar and radio, 572
- with VHF/MST radar, 549, 570, 574, 578
- LMA, lightning mapping array, 573
- LNA, low noise amplifier, 313
- Lower stratosphere, 84, 88, 99, 116, 359, 403, 428, 563, 596, 635, 703
- MAARSY, 372, 581
- Magnetic field, 3, 121, 123, 126, 127, 129, 130, 143, 146–148, 152–154, 156, 157, 160–162, 177, 197, 206–208, 278, 286, 295, 301, 310, 582, 589, 741
- Magnetosphere, 7
- Maxwell, 2, 123
- Maxwell's equations, 123
- Mean free path, 8, 648
- Mean meridional circulation, 23
- Median, 664, 665, 667
- Mesopause, 2, 34, 251, 253, 542, 552, 555, 562, 599, 635, 661
- temperatures, 555, 561, 562
- Mesoscale, 100, 119, 596, 680
- breezes (sea, land, lake), 681
- city-sized, 35
- production of gravity waves, 35
- studies by radar, 681
- vs. microscale, 35
- vs. synoptic, 34, 35
- Mesosphere, 1, 29
- circulation, 29
- and CO<sub>2</sub> cooling, 19
- gravity wave spectra, 617, 619
- orographic forcing, 700
- radar studies++, 58
- spaced antenna winds++, 59, 62
- turbulence and waves, 639
- wave amplitudes, 600
- winds++, 59, 62, 69, 624
- Mesosphere, gravity wave spectra, 615
- Meteor, 1, 5, 54, 60, 70–73, 78, 86, 224, 231, 240, 253, 263, 266, 328, 370–372, 439, 446, 447,

- 552, 553, 555, 560–565, 579, 582, 594, 595, 681, 732, 733
- diffusion and radar wavelength, 562
- drifts, 54
- duration, 446
- entrance speeds, 565
- height-dependent temperatures, 563
- lidar winds, 561
- radar and momentum fluxes, 561
- studies, 549
- temperatures, 72, 561
- trail, 560
  - alignment and electric fields, 589
  - plasma, 589
- trails, 54, 72, 86, 114, 446, 560–562, 564, 581, 589
  - long duration, 565
- winds, 561
- Meteorology, 47, 703
- Methane, 551
- Methods for wind measurements, 97, 531
- MF frequencies, signal time scales, 406
- MF radar, 62, 67, 68, 114, 335, 405, 418, 434, 435, 563, 630, 732
- MF, medium frequency++, 559
- Microscale vs. mesoscale, 35
- Middle and upper atmosphere radar++ (also see MU radar), 86
- Middle atmosphere, defined, 1
- Mie, 49, 567
  - scattering, 324
- Miller planes, 166
- Millibar, 209, 591, 673, 740
- Minimum variance method, 111, 482, 491
- Minor constituents, atmosphere, 10, 11
- Mixing
  - organized, 673
  - and ozone hole, 700
  - production of  $i/q$ , 229
  - production of refractive index variability, 88, 211
  - receiver, baseband, 228
- Mixing of IF with LO, 312
- Mixing ratio, 209, 706, 708, 709, 715, 741
- Mobility, 309
- Modeling, 46, 100, 631, 661, 671, 700, 703
- Modeling, global field, 30, 636, 639
- Moist adiabatic lapse rate, 40, 46, 710, 712, 714–717
- Moments, 255, 338, 360, 371, 402, 495–497, 499, 666, 681, 694
  - estimation of, 385, 452
- Momentum equation, 27, 609
- Momentum flux, 23–25, 31, 98, 438, 563, 597, 598, 607, 618, 632, 635, 639, 646, 700, 702, 731
  - dual-beam, 563, 564
  - by meteor radars, 73
- Momentum fluxes
  - dual beam as subset of meteor method, 564
  - meteor radar and dual beam, 564
  - reliability, 563
- Moon as a target, 322
- Morphology of turbulent layers, 49, 59, 93, 639, 644
- MPAE, Max Planck Institut für Aeronomie, 337, 349
- MST radar, 1, 47, 48, 348, 350, 352, 439, 468, 542, 549, 581, 596, 660, 666, 672, 732, 733
  - ACF, 469
  - antenna gain, 272
  - astronomy, 594
  - backscatter, 171
  - beam directions, 79
  - c.f. Meteorological radars, 1, 47
  - calibration vs. relative power, 497
  - Chung-Li, 726
  - clear air scatter, 117, 120
  - coherence time, 250
  - convection, 725
  - D-region, 70
  - data sampling, 452
  - digital filters, 260
  - Doppler, 1
  - early highlights, 76
  - FFT, 458
  - first complementary codes, 341
  - funding, 99
  - gravity waves, 34
  - head echoes, 565
  - imaging, 105
  - ionosphere, 559, 581, 582
  - ionospheric history, 55, 57
  - KHi, 725
  - matched filters, 462, 463
  - meteors, 72
  - more than just VHF, 78
  - multistatic, 240
  - narrow beam, 239
  - networks, 99
  - origin of name, 78
  - passive TR switch, 312
  - periodogram, 470, 473
  - Poker Flat, 86
  - precipitation, 117, 549
  - pulse, 231
  - RASS, 117
  - refractive index, 120
  - scatterers, 211
  - spectra, 442
  - tropopause, 569
  - truncated codes, 252
  - turbulence, 210, 211
  - workshops, 100
- MST radars at 400 MHz, 99

- MST studies at Arecibo, 85  
MST/VHF, lightning, 570  
MU radar, 87, 91, 117, 118, 322, 323, 332, 337, 338,  
350–357, 359–361, 364, 366, 370, 372–374,  
380, 533, 534, 562, 581, 582, 595, 663, 668,  
669, 676, 686, 688, 732  
Multi-frequency, 505, 508, 538, 543, 553, 555
- Navier–Stokes, 24, 606, 645  
Negative ions, 12, 204, 571  
Networks, 337, 565, 687, 688, 691, 731  
countries, 99  
ionosondes, 56  
ionosphere, 5  
local, 100  
mesosphere, global, 100  
radar, 55  
of windprofilers, 99, 118, 681  
of windprofilers, meteorologists, 99  
Neutral atmosphere, 6, 77, 130, 139, 197, 199, 205,  
208, 210, 211, 315, 318, 319, 582, 724  
Neutral gases in atmosphere, 11  
Neutral wind, 60, 61  
Nitrogen, 329, 708  
NOAA, 337, 339, 372, 687–689, 729  
Noise  
aliased, 262, 263  
amplification, 308  
antennas, feeds, 308, 333  
in autocorrelation function, 393, 497, 499  
background, 575, 576  
in calibration, 326, 327  
and coherent integration, 255, 258, 259  
cosmic, 85, 244, 267, 331  
cosmic, discrete source, 334  
in deconvolution, 103  
detectability, 261  
and digitization, 327  
electronic, 244, 308, 326, 327  
from sky, 309  
gain, 330, 420  
geophysical, 638  
geophysical, and resonance, 700  
and IF bandwidth, 262, 329  
integrated power in spectrum, 261, 328, 496  
ionospheric absorption, 267  
ionospheric scintillation, 323  
Johnson, 329  
lightning, sferics, 576, 580  
man-made, 335, 341  
moments, 255  
Nyquist, 329  
and PRF, 266  
and pulse coding, 248  
Rayleigh distribution, 259  
receiver, 309, 314, 327–330, 345  
and receiver gain, 328  
RF, internal leakage, 236, 270  
RF, radiofrequency, 52, 242  
scatterer c.f. skynoise, 318  
sensitivity of moment methods to, 681  
severe, 681  
shot, 344, 347  
skynoise, 267, 308, 318, 327, 332, 333, 679  
skynoise, beam, 332  
skynoise, frequency dependence, 318  
skynoise, map, 333  
and SNR, 261, 342  
SNR, beam direction, 91  
in spectra, 262, 329, 385, 386, 402, 403, 475, 482,  
496, 500  
spectral moments, 666  
temporal fluctuations, 262  
TR switch, 311  
various sources, 331, 333, 372, 383, 442, 445, 452  
white, 116, 244, 257, 260, 328, 330, 475, 496  
Noise and radar optimization, 243, 308  
Noise figure, 308, 309  
Noise pollution, 695, 730  
Noise source, for calibration, 267, 326, 328, 329,  
552  
Noise spectrum, 328  
Noise temperature, 309, 329, 334, 345  
Non-hydrostatic, 608  
Nonlinear, 23, 463  
Nowcasting, 100, 688
- Operational, 84, 353, 506, 549, 695, 728, 732, 733  
Optics, 138, 212, 223  
Orbit, 224, 324, 565, 595  
Orography, 23, 26, 34, 639, 644, 683, 698, 700, 701  
as wave sources, 627  
Oxygen, 14, 15, 661, 708  
Ozone, 10, 15, 30, 93, 676, 678, 695, 700, 732  
absorption of UV, 14  
layer, 15, 16  
stratosphere–troposphere exchange, 570  
transport, 437, 732  
and tropopause jumps, 570  
Ozone-defined tropopause, 678
- PANSY, 372, 581  
Parcel, 18, 22, 26, 30, 35–45, 115, 209, 600,  
602–606, 609–611, 649–651, 653, 663,  
710–714, 716, 718–722, 740, 741  
displacement, 741  
Partial reflection, 57, 60, 65, 88, 166, 559, 576, 590  
Periodogram, 442, 470–482, 487, 490, 491  
vs. power spectrum, 442  
Perturbation, 25, 65, 167, 196, 197, 199–201, 213,  
214, 218, 324, 550, 557, 586, 603, 608, 609,  
617, 618, 621, 642, 645, 663, 733  
Phase calibration, 335  
Phase codes, 248

- Phase coding, 265, 353
- Phase, cross-spectrum, 534
- Phased array, 74, 290, 292, 294, 297, 300, 301, 308, 309, 334, 349, 352, 353, 372, 380, 539, 595
- Photochemistry, 14
- Physics, 2, 24, 27, 70, 99, 159, 162, 318, 429, 436, 549, 550, 552, 560, 571, 606, 607, 705
- radiation, 14
- Pixies, 48, 49
- Planetary boundary layer, 242
- Planetary wave propagation, 700
- Planetary waves, 22, 31, 32, 607, 700
- Plasma, 4, 5, 10, 56, 57, 60, 61, 70, 74, 104, 120, 124, 138, 143, 157, 159, 160, 168, 197, 199, 201, 204, 205, 209, 217, 218, 295, 315, 439, 446, 555–557, 559, 572, 581–583, 589, 594, 731
- anisotropic, 146
- Debye length, 200
- dielectric constant, relative permittivity, 124
- Doppler spectrum, 201
- electron cross-section, 159
- electron line, ion line, plasma lines, 204
- frequency, 128, 143, 159
- ionosphere, 157
- lens, 138
- in magnetic field, 146
- many electrons, 165
- propagation of EM wave, 120
- radial drift, 199
- radiowaves, 6
- random electrons, 168
- realistic collision rates, 158
- realistic spectrum, 204
- refraction, 139
- refractive index, 120, 130, 159
- refractive index < 1, 128
- relative permittivity, 124
- scattering, 159
- spectrum, 203
- waves, 203
- different types, 201
- waves embedded in, 201
- with collisions, 128
- PMC, polar mesospheric clouds, 372
- PMSE, 101, 106, 199, 359, 372, 414, 542, 549, 550, 599, 637, 729, 731
- anomalous diffusion, 556
- data, 543
- diffusion, electron c.f. neutrals, 554
- diffusion, ice particles, 555
- diffusion coefficient, dressed aerosols, 555
- diffusion time-scales, 557
- polar mesosphere summer echoes, 100
- slow diffusion, temperature, 555
- VHF c.f. MF, 558
- PMWE, polar mesosphere winter echoes, 379, 558
- Poker Flat, 86, 100, 101, 337, 346, 552, 582
- Polar
- PMSE, 81
- summer-to-winter flow, 30
- Polar circulation, 635
- Polar coordinates, 164, 195, 743
- Polar diagram, 108, 222–224, 241–243, 251, 266, 275, 278, 280, 282, 284–286, 314, 316, 319, 320, 322, 324, 332, 348, 355, 360, 361, 377, 387–391, 395, 396, 399, 415, 420, 425, 428, 430, 431, 573, 743, 744
- calibration, 322
- calibration by galactic sources, 595
- combined, 430
- effective, 431
- gain, 420
- Gaussian, 317, 318, 390
- HPHW, 401
- one-way, 320, 332
- radar and scatterers, 390
- radiation pattern, 224, 362
- scatterers, 388, 402
- spaced antennas, 392
- transmission vs. reception, 275
- two-way, 388, 395, 404
- wind corrections, 392
- Yagi, 355
- Polar jet, 27, 28, 35
- Polar latitudes, 28, 101, 372
- cell, 26
- cooling, 31
- pressure, 28
- temperatures, 101
- vertical motion, 29
- Polar mesopause, 34, 599
- Polar MST/ST radars, 553
- Polar plot, lightning, 579, 580
- Polar radar sites, 552
- Polar region
- echoes, 557
- meteor fluxes, 565
- temperature tides, 563
- Polar regions, 542, 552, 553, 559, 700, 729
- Polar stratosphere, 700
- Polar vortex, 700, 703
- Polarization, 150, 151
- angle, 162
- antenna, 242, 288, 295, 353
- circular, 295
- bound electrons, 146
- circular, 349, 592
- circular, O and X, 592
- circular and linear, SOUSY, 358
- DAE, 58, 439
- elliptical, 150

- EM, characteristic modes, 150, 152
- EM radiation, 57, 225, 243, 288, 295, 592
- Faraday rotation, 295
- gravity wave, 605, 610, 629
- induced, 124, 126, 144, 150, 151, 157, 177, 178
- linear, 352
- linear characteristic modes at equator, 592
- magnetic field, 177
- plasma, 124, 128
- ratio, 152
- refractive index, 125
- rotation, 593
- in scatter, 132, 243, 576
- Stokes, 592
- switch, 358
- Potential
  - electric, 572
  - electrostatic, 163
  - grounded, 300
  - vector, 160, 161, 178, 180
  - voltage, 298
- Potential refractive index, 674
  - gradient, 209, 210, 419, 544, 553, 554, 567, 568, 588, 657, 678, 695, 706, 740
- Potential temperature, 44, 45, 544, 606, 609–611, 657, 658, 692, 709, 718, 719, 740, 741
- Power spectrum, 182, 184, 187, 192, 193, 260, 270, 481, 492
  - discrete time series, 442
  - measured by radar, 229, 230, 254, 260, 385, 390
  - vs. periodogram, 442
- Power, pulse-length dependence, 174
- Poynting flux, 174, 277, 295, 421
- Poynting vector, 162, 175, 181, 182, 209, 272, 274, 743
- Prandtl number, 557, 659
  - molecular, 647
  - turbulent, 647
- Precipitation, 1, 5, 20, 100, 113, 117, 118, 243, 437, 495, 542, 549, 552–554, 567, 568, 570, 592, 670, 674, 675, 703, 728, 729
  - echoes, 477, 495
  - measurements, 117, 118, 567, 672, 686
  - radar, 1, 55, 100, 682
- PRF for lightning, 574
- PRF, pulse repetition frequency, 259–263, 266, 329, 549, 574
- Primitive, 4, 54, 86, 431, 681
- Propagation, 131, 145, 152, 156, 157, 159, 178, 207, 219, 243, 629, 636
  - conducting media, 427
  - diffraction pattern, 522
  - direction, 222
  - direction c.f. E-, B-field, 124, 132, 148
  - EM, characteristic modes, 157
  - EM, quasi-transverse, 157
  - EM, speed, 176, 227
  - of gravity wave, 604, 633
  - neutral gas, 146
  - phase speed > c, 130
  - quasi-transverse, 157
  - radiowaves, 65, 120, 126
  - through a plasma, 120
  - VHF, limited refraction < 100 km, 120, 138, 159
- PSC, polar stratospheric clouds, 372, 700
- Pulse
  - half-power full-width, 246
  - side-lobes, 248, 250
- Pulse compression (coding), 76, 248, 251, 307, 328, 380, 504
- Pulse compression, complementary, 250, 251, 339
- Pulse pair, 497, 498
- Pulse shaping, 238
- Pulse side-lobes, 61, 250
- Pulse transmission, 47, 56, 75, 142, 179, 221, 222, 233, 273, 330, 349, 352, 358, 374, 377, 573
  - harmonics, 358
  - time delay, 142
- Pulsed Doppler radar, 516, 518, 543
- Pulsed transmitter, class-E, 378
- Quadrature/In-phase: see In-phase/quadrature, 228
- Quasi-specular, 554, 674
  - echoes, 64
- Radar applications, 5, 102, 233, 296, 300, 302, 479, 490
- Radar beam, tilting for phased array, 289
- Radar design, 61, 218, 243, 342, 560
- Radar echoes as a convolution, 215, 234
- Radar echoes, range dependence, 214
- Radar equation, 164, 165, 240, 243, 247, 272, 324, 420, 509
- Radar ground plane, 365
- Radar images, three-dimensional, 113
- Radar range resolution, 232, 233, 243, 245, 248, 504, 538, 543
- Radar range resolution and coding, 248
- Radar tree, history, meteorological radar, 48
- Radar volume, 93, 95, 98, 106, 172–174, 180, 193, 195, 210, 254, 315, 318, 319, 383, 406, 407, 409, 420, 423, 432, 434, 517, 568, 569, 657, 677, 740
  - and fraction of turbulence, 423
- Radial component, 200, 383, 385, 386, 404
- Radial distance and polar diagram, 223
- Radial motion, single scatterer, 445
- Radial vector in structure function, 654
- Radial vector vs. Bragg vector, 194
- Radial velocity with meteor radars, 564
- Radial velocity++, 50, 54, 69, 76, 105, 200, 242, 253–255, 257, 267, 323, 338, 360, 371, 383, 385–387, 390, 394, 397, 441, 442, 447, 449,

- 468, 469, 480, 492, 493, 495, 497–502, 510, 517, 530, 532, 533, 542, 564, 574, 577, 618, 619, 692, 704
- Radiation  
  longwave, 19  
  shortwave, 19
- Radiation pattern (+ see polar diagram), 285, 286
- Radiative, 107, 201, 366, 599, 638
- Radiative damping, 33
- Radiative equilibrium, 632, 634, 635, 638, 700
- Radiative heating, 10, 18
- Radiative transfer, 16, 18
- Radio acoustic sounding system, 439, 566, 689, 695, 710
- Radiosonde, 84, 118, 373, 379, 430, 566–569, 677, 679, 682–686, 688, 697, 700, 701
- Radiosonde winds, 322
- Radiowave propagation, 48, 129, 130, 157, 159, 206, 223, 285, 593
- Radiowaves, 2–4, 12, 48, 55–59, 66, 70, 85, 97, 100, 224, 268, 274, 335, 381, 382, 388, 419, 446, 505, 507–509, 512, 519, 521, 531, 544, 557, 617, 663, 673, 734
- Rain  
  drop-size distribution, 495, 567  
  drop-size spectra, 117
- RAM, random access memory, 352, 367
- Random processes, 241, 448, 465, 467, 468, 513, 514
- Range ambiguities, 517
- Range gate, 47, 48, 83, 84, 92, 222, 233, 251, 252, 445, 517, 536, 537, 543, 544, 576, 577
- Range imaging, 111, 112, 505, 543, 544, 546
- Range interferometry, 111
- Range side-lobes, 110
- RASS, radio acoustic sounding system, 115–118, 439, 566–569, 674, 689, 695, 710, 730
- Ray tracing, 628, 702
- Rayleigh, Rice distribution, 66, 95, 434
- Rayleigh damping (friction), 609
- Rayleigh distribution, 66, 67, 94, 95, 169, 170, 172, 174, 433–435
- Rayleigh drag, 609
- Rayleigh scatter, 170, 207, 218, 674
- Rayleigh scatter vs. Bragg scatter, 218
- Rayleigh–Taylor, 631, 724
- Receiver  
  IF, intermediate frequency, 237  
  LO, local oscillator, 237  
  mixers, 237, 238  
  noise, 329  
  superheterodyne, 236, 309
- Receivers, 69, 97, 103, 111–113, 120, 125, 171, 178, 217, 229, 237, 240–242, 268, 272, 273, 300, 305, 312–314, 335, 338, 339, 370, 375, 504, 509, 511, 516, 529, 533, 538, 541, 560, 573, 578, 580, 582  
  for lightning, 572
- Reception, efficiency, 330
- Recombination, 16
- Reflected from antenna surface, 287
- Reflected from wall, 303
- Reflected light  
  by clouds, 16  
  by ground, 17
- Reflected signal, 57, 70, 120, 165, 166, 172, 211, 214, 215, 225, 303, 311, 573
- Reflected, from ionosphere, 4
- Reflected, lee waves, 699
- Reflection coefficient, 58, 61, 176, 210, 212, 213, 219, 234, 235, 242, 267, 335, 336, 415–417, 419–421, 425, 677
- Reflection, Fresnel (+ see Fresnel scatter), 92
- Reflections, multiple, 220
- Reflectivity, 118, 176, 198, 210, 232, 242, 243, 251, 265, 296, 314, 317, 318, 322, 324, 421, 505, 507, 533, 535, 537–539, 544, 547, 555, 575, 577, 704
- Refraction, 120, 138, 139, 153, 159, 205, 211, 217, 622, 625  
  in a plasma, 138
- Refractive index, 48, 77, 85, 88–90, 92, 96, 103, 116, 120, 121, 124–126, 129, 130, 137–140, 143, 144, 146, 148, 153–161, 167, 168, 172–174, 176, 196–199, 205, 206, 208, 209, 211, 212, 214–218, 242, 319, 416–419, 425, 426, 436, 519, 520, 530, 536, 568, 575, 590, 592, 626, 653, 657, 658, 663, 673, 674, 704, 739–741  
  potential, 567  
  stratified, 88, 168, 211, 214, 704
- Remote methods, 1
- Reynolds' number, 652
- Reynolds' stresses, 24–26, 645, 646
- RF mixing in transmitter, 306
- RI, radar interferometry, 111
- Rice, 66, 67, 94, 95, 433–436
- Rice distribution, 66, 94, 433, 434
- Richardson number, 45, 46, 210, 423, 614, 630, 631, 659, 660, 669, 721, 723, 724  
  flux, 46, 423, 658, 660  
  gradient, 46, 423, 658, 660  
  potential and kinetic energy, 45
- RIM, range imaging, 111, 112, 538, 543–547
- Rosby waves, 22, 23, 31, 33, 35
- Rutherford, DSIR/Radio Research Board, 55
- SA, spaced antenna, 111
- SAD, spaced antenna drift, 111
- Sampling, 268, 269, 273, 313  
  bias for vertical velocities, 694  
  decimation, FFT, 458

- digital, 47, 453
- discrete-time series, 443
- errors, 446
- finite frequencies, 500
- Fourier transform, 454
- gates, 233
- interval, 443
- meteor entrance speeds, 565
- noise and filter, 263
- Nyquist, 259
- Nyquist theorem, 264, 453
- pulse resolution, 232
  - and quantization, 445
- rate, 230, 259–261, 263, 402
- time, 259, 262, 383, 406, 407, 454, 493
- time delay and range, 221
- trigger, 238
- uniform, 455
  - and zero-padding, 457
- Satellite, 1, 5, 17, 19, 31, 93, 118, 139, 156, 207, 288, 322–324, 355, 437, 569, 570, 596, 623, 627, 644, 695, 731, 733
- Saturated, 614, 708, 709, 711, 713–715, 722
- Saturation, 576, 577, 613, 614, 713, 715
- Scatter
  - anisotropic, 84, 92, 96, 387, 388, 392, 556, 692
    - tilted, 692
  - tropopause, 428
  - anisotropy in lower stratosphere, 428
  - Fresnel (+ see Fresnel scatter), 92
  - isotropic, 62, 67, 89, 255, 388, 392, 395
    - vs. anisotropic, 62, 401, 425
  - isotropic/anisotropic vs. specular, 425
  - mesosphere, specular vs. isotropic, 432
  - mixed isotropic, anisotropic and specular, 391
  - mixed specular and quasi-isotropic, 64
  - quasi-isotropic, 64, 66, 92, 703
  - tropopause, isotropic cases, 437
- Scatterers, three-dimensional vs. specular, 62
- Scattering cross-section, rain and hail, 49
- Scattering mechanisms, 381, 673, 674
- Schmidt number, 101, 554–557, 559
- SDI, SI, spatial domain interferometry, 106, 111, 114, 508
- Sea breezes, 35, 596
- Sensible heat vs. virtual heat, 711
- Severe turbulence, 732
- Severe weather, 35, 732
- Sferics, 572, 576
- Shear instability, 721
- Shear interface, 637
- Shear, wind, 397
- Shear-instability, 630
- Shears, rotational, 699
- Short-wave and long-wave radiation, 19
- Side-lobe, cosmic radio source, 267
- Side-lobes
  - angular, 223
  - antenna, 223
  - Capon, 487, 490
  - complementary codes, 250
  - current source distribution, 287
  - linear current distribution, 286
  - pulse, 248
  - range, 110, 111, 250–252, 504
- Signal strength, 63, 115, 221, 223, 234, 235, 324, 492, 513, 568
- Signal, in-phase/quadrature + see In-phase, 227
- Signal-to-noise, 68, 72, 76, 79, 101, 104, 244, 245, 247, 259, 267, 270, 308, 314, 322, 325, 341, 342, 344, 347, 370, 371, 393, 420, 502, 504, 512, 561, 679
- Signal-to-noise ratio, SNR, 318
- Signatures, 629, 636
- Sinc function, main lobe, 190
- Skynoise, 267, 309
  - for calibration, 330
- SNR, 244, 248, 250, 255, 257–259, 261, 300, 305, 393, 501, 504
- Solar, 17, 18, 20, 31, 70, 99, 147, 552, 559, 593, 594, 662, 702
  - black-body, 14
  - eclipse, and gravity waves, 605
  - radiation, 13, 14
- Soliton, 626, 732
- Sounding, 78, 344, 672, 674
- Sources, 31, 35, 48, 108, 110, 116, 117, 133, 267, 303, 322, 323, 331, 335, 495, 544, 595, 605, 620, 627–629, 639, 644, 667, 701, 703
  - gravity waves, 620
  - noise, 329, 331
- SOUSY, 75, 78–81, 86, 325, 338, 339, 341, 342, 344–346, 348–350, 358, 361, 370, 672
- SOUSY radar, 81, 82, 95, 337, 338, 340–343, 346, 347, 350, 355, 366, 396, 428, 434, 436, 672, 704
- SOUSY VHF, 84, 85, 704, 720
- Space debris, 733
- Space Shuttle Columbia, 733
- Space travel, 732
- Spaced antenna, 60–63, 65, 68, 69, 96, 97, 112–114, 240, 380, 382, 392, 393, 415, 468, 505, 506, 519, 520, 529–531, 557, 560, 563, 618, 732
  - method, 61, 69, 72, 96, 97, 241, 268, 349, 350, 382, 392, 393, 403, 450, 519, 732
- Spaced receiver, 60, 63, 68, 241, 450
- Spatial resolution, 102, 507
- Spectra, weak lines, 490
- Spectral, 737
  - amplitudes for pulse, 174
  - analysis and coherent integration, 76, 261
  - analysis and detectability, 76, 261, 262, 496

- analysis of velocities, 115
- analysis vs. autocorrelative approach, 187
- analysis vs. time-series analysis, 445, 446, 576
- averaging, running means, 481, 482
- band, integrated power, 172, 175, 496
- beam-broadening, 360, 404, 405, 415
- broadening, 394, 395
  - due to turbulence, 394
  - plasma, 203
- density, 255, 256, 383, 386, 469, 489, 490, 496, 613, 620, 656, 737, 738
  - BV peak, 615, 616
  - noise, 244
- determination, mixed radix, Singleton, 472
- estimation, 385, 445, 459, 467, 469–471, 474, 475, 478, 479, 491, 499, 500
  - adaptive, 482, 483, 487
  - Blackman–Tukey, 477
  - and periodogram, 474
  - random processes, 448
  - with window, 476
  - zero padding, 472
- estimator, 480
- fitting, 257, 367, 371, 372, 402, 404, 500, 502, 694
- form, gravity waves, 410, 438, 599, 611, 614, 615, 620
- form, turbulence, 318, 409, 639, 640, 643, 656, 668, 735, 737, 738
- form vs. structure function, 737
- interference, 262
- leakage, 452, 474, 487
- line, FOOR, 487, 488
- line, offset, 202, 242, 254, 387, 694
- line and scatterer, 69, 230, 383, 493
- lines, chi-squared distribution, 693
- lines, cross-spectrum, 104
- lines, dominant, 484
- lines, effect of diffusion, 204
- lines, ion waves, 203
- lines, ionosphere, 203
- lines and Bragg scales, 73, 176
- lines near 0 Hz, 85
- model, 496
- moments, 255, 402, 452, 495–497, 503, 681
- peaks, 446
- peaks and aliasing, 263
- processing, 55, 342, 446, 681
  - alternatives to Fourier, 490
- resolution, 402, 403, 474, 477, 693
- shape, 445, 497
- side-lobes, 372, 474, 477, 478
- sorting, 113
- summation, coherent vs. incoherent, 255
- version of FCA, 114
- width, 55, 69, 175, 242, 255, 267, 338, 360, 386, 393–398, 400–405, 414, 431, 451, 481, 495–497, 499, 502, 551, 569, 582, 660, 665, 666, 704, 725
  - radar, 255
  - window, main lobe, 474
- Spectrum
  - half-power half-width, 397
  - main lobe, 477
  - side-lobes, 386
- Spectrum width, 242, 499
- Specular reflection, 72, 92, 93, 95, 214, 236, 341, 421, 554, 556, 557, 559, 560, 592, 663
- Sporadic E, 335, 582
- SSW, sudden stratospheric warmings, 31
- ST radars, 87, 99, 728
- Stability, troposphere vs. stratosphere, 89
- Stable, 17, 36, 40, 42, 68, 94, 238, 266, 272, 306, 309, 335, 425, 437, 569, 604, 631, 675, 679, 694, 716, 717, 719, 721–724, 727
  - lapse rate, 716
  - layer, 341
  - spectrum, 631
- Stable regions, 677
- Stably stratified atmosphere, 720
- Stably stratified flows, 506
- Static, 8, 20, 36, 40, 603, 722
  - stability, 46, 615, 676
- Statistical, 65, 66, 69, 434, 448, 452, 473, 474, 497, 503, 564, 582, 622, 667
- STE, stratosphere–troposphere exchange, 93, 437, 570, 676
- Stokes, 23
- Stokes'
  - diffusion, 439, 636, 637, 661
  - drift and diffusion, 636
  - parameters, 592
  - parameters, EM radiation, 592
- Stratifications with wrinkles, 425
- Stratified reflectors, 62, 88, 391, 416
- Stratified refractive index, 168
- Stratified steps and sheets, 77
- Stratified steps in electron density, 63
- Stratopause, 16
- Stratosphere, 1, 18, 76, 78, 419, 423, 424, 428, 434, 439, 677, 700, 720, 740
  - balloons, 617, 662
  - BV frequency, 605
  - circulation, 29
  - and CO<sub>2</sub> cooling, 19
  - diffusion processes, 98
  - gravity wave spectra, 615, 617, 619
  - gravity waves, 599, 622
    - directions, 629, 630
  - humidity, 90
  - jetstream, 703



- methane, 551
- momentum fluxes, 563
- neutral air, 205
- orographic forcing, 700
- ozone, 10, 15, 676
  - heating, 15
  - pollution, 695
- radiowave, 159
- scattering from bound electrons, 130
- specular reflections, 92
- ST radar, 87
- temperature from space, 17
- turbulence and waves, 639
- VHF scatter, 77
- water, 567
- Stratospheric, 26, 29, 31, 34, 83, 85, 89, 90, 93, 99, 337, 341, 359, 372, 406, 623, 624, 628, 648, 651, 665, 672, 695, 700, 732
  - circulation, 29
  - cooling, 19
  - mean state, 31
  - VHF echoes, 76
- Structure constant, 88, 656, 674
  - refractive index, 422, 657, 739
- Sublimation, 711, 717
- Subsidence, 635
- Sunset radar, 78–80, 83, 84, 325, 339, 341, 342, 672
- Superadiabatic, 716
- Supercooled, 570, 571
- Switches, 224, 238–240, 301, 311, 347, 358, 367, 370, 582, 729
- Synoptic vs. mesoscale, 34
- Synoptic, size of frontal systems, 34
- Target, 3, 4, 47, 48, 69, 107, 108, 110, 119, 165, 217, 219–222, 224, 226–228, 233, 235, 241–243, 245, 246, 264, 268–272, 274, 275, 288, 302, 303, 305, 320–323, 355, 393, 396, 422, 437–440, 492, 508, 576, 578, 729
  - reflection, 4
- TEM, 23
  - transformed Eulerian mean, 22
- Temperature gradient, stable, 89
- Temperature inversion, 716, 733
- Temperature profile, 9, 18, 90, 93, 94, 115, 117, 438, 566–568, 614, 626, 628, 663, 672, 679, 716, 717, 719–721
  - and radiative transfer, 18
  - stratified, 89
- Temperature, stably stratified, 720
- Temperatures, by meteor radar, 72, 86
- Temporal resolution, coherent integration, 259
- Tensor, 126
- Thermal, 10, 33, 45, 203, 307, 329
  - diffusivity, 647
  - ion velocities, 204
- Thermodynamics, 2, 8, 35, 63, 116, 143, 715
  - first law, 18, 37–39, 606, 609, 712
- Thermosphere, 2, 8, 99, 242, 505, 551, 581, 589, 596, 731
  - gravity wave spectra, 615
- Thorpe sorting, minimization of potential energy, 663
- Thunder, 574
- Thunderstorm, 35, 100, 571, 574, 579, 596, 605, 627, 680, 704, 732
- Tides, 31, 71, 563, 564, 588, 596, 607, 636, 644
  - in temperature, 673
- Tilted beam, 618
  - mathematical representation, 389
- Tilted beams and momentum flux, 618
- Tilted beams and spectral width, 395
- Tilted isopleths and fronts, 692
- Tilted isotherms, 692, 693
- Tilted layers, 114, 693
  - AOA (angle of arrival) corrections, 105
- Tilted scatterers, 537, 692
- Tilted specular reflectors, 92, 95, 105, 435
- Tilting and Rice parameters, 436
- Tilting of layers near mountains, 692
- Time domain interferometry, 111
- Time-domain signal processing, 445–447
- Topography, 23, 33, 375, 376
- Tornado, 732
- TR switch, 219, 237, 239, 309–312, 347, 358
- Tracer, 217, 738
- Trail
  - meteor (+ see meteor trails), 54, 70, 217, 218, 439, 446, 560, 564
    - alignment, 72
    - diffraction, 565
    - locating, 70, 104, 560, 564
    - plasma, 218
    - rocket release, 652
    - smoke, TMA, 617
    - vapor, 652, 653
- Transformed Eulerian mean, 22, 24
- Transmission, 243, 245, 273, 279, 330, 421, 533, 742
  - absorption in communications, 12
  - antenna, 274, 275, 341, 370, 578
  - CW, 230, 270
  - DBF compared with DB, 300
  - efficiency, 330, 334
  - feed (+ see Antenna feed), 300
  - fundamentals, 5
  - gate, 358
  - ionosphere, 12
  - Lecher wire, 301
  - line, 279, 294, 296, 298, 300, 310, 311, 361, 366
  - losses, 274, 275, 278, 300, 420, 422
  - monostatic, 239, 269, 320
  - polar diagram, 223, 275, 276, 278

- port, 368
- pulse, 219
- radiowaves, 2, 3, 58, 193
  - BBC, 4
  - K-band, 207
  - Marconi, 4
  - water vapor, 5
- reception same, 324
- refraction, 48
- side-lobes, 348
- time delay, 235
- TR switch, 347
- troposphere, 14
- variation within aperture, 280
- vs. reception, 324
- Transmit-receive switch, 219, 237, 238, 344, 347, 348, 358, 370
- Transmitted waveform, 307
  - digitization, 306
- Transmitter types, 306
- Transmitters and phased array antennas, 307
- Transmitters, different types, 307
- Transmitters, solid-state/magnetron/klystron, 307
- Transport, 8, 23, 99, 604, 606, 627, 631, 640, 645, 646, 650, 658, 659, 695, 703
- Transverse, 407, 409, 653, 655, 671, 735
- TRMM, tropical rainfall monitoring mission, 118
- Tropical, 20, 33, 559, 726
- Tropopause, 8, 14, 15, 26–29, 32, 89, 93–95, 99, 341, 379, 381, 428, 429, 434, 437, 438, 568–570, 672, 676–680, 695, 699, 727, 732
  - detection, 676, 695
  - fold, 695
  - formal definition of, 679
  - jumps, 570
  - seen by ozone gradient, 676
  - seen by radar, 678
  - turbulence above, 644
- Troposphere, 1, 566, 582, 596, 672, 699, 740
  - anisotropic scatter, 428
  - balloons, 662
  - basics, 2
  - BV frequency, 605
  - circulation, 21, 638
  - dry, 424
  - dynamics, 20
  - early VHF studies, 84, 337
  - equator, 20
  - Fresnel scatter, 88
  - global warming, 551
  - gravity wave energy, 636
  - gravity wave source, 607, 620, 627
  - gravity wave spectra, 613, 615
  - gravity waves vs. 2-D turbulence, 617
  - heating, 17, 19
  - humidity, 118, 567
  - idealized temperature profiles, 719
  - interferometry, 112
  - jetstream, 703
  - lapse rate, 720
  - low power radars, 99
  - mesoscales, 596
  - methane, 551
  - momentum fluxes, 563
  - PRF, 266
  - radiation balance, 19
  - radiative transfer, 14, 16, 17
  - radiowave, 159
  - radiowave scattering, 77, 205
  - RASS, 116, 566
  - refractive index, 130, 673
  - RF interference, 729
  - short-wave radiation, 19
  - solitons, 626
  - source of waves, 31, 33
  - specular reflections, 89
  - standing waves, 699
  - temperature distribution, 27
  - temperature profiles, 695
  - turbulence, 98, 402, 598, 644, 667, 674, 728
  - turbulence and momentum flux, 98, 563
  - upper, turbulence and waves, 639
  - vertical velocities, 725
  - VHF and dynamics, 78
  - VHF studies, 76
  - virtual temperature, 116
  - water, 567
  - water, change of phase, 717
  - wave amplitudes, 600
  - waves over mountains, 613
  - whitecaps, 614, 631
  - wind vectors by Doppler, errors, 403
- Troposphere-stratosphere, 378
- Tropospheric, 16, 29, 48, 60, 83, 85, 89, 98, 99, 138, 266, 328, 337, 359, 406, 411, 436, 438, 530, 613, 627, 639, 665, 672, 674, 693, 695, 700, 731
  - heating, 18
  - waves, forcing, mean flow, 23
- TSE, troposphere–stratosphere exchange, 437, 570
- Turbopause, 8–10, 644, 650, 652, 653
- Turbulence
  - 3-D cross-spectrum, 736
  - 3-D spectrum, 735
  - 3-D vs. 2-D, 598
  - anisotropic, 92, 93, 96, 214, 424, 494, 668
    - tilted, 692
  - anisotropy, mesosphere, 430
  - buoyancy scale, 55, 69, 640, 651
  - convective instability, 630, 632
  - diffusion, meteorology, 727
  - diffusion in presence of layers, 98

- diffusion of momentum, 23
- dynamic instability, 46, 724
- horizontally stratified, 644
- inertial range, 342, 407, 409, 558, 640, 642, 643, 645, 650, 652, 654, 655, 659, 668, 735, 738, 739
  - energy cascade, 640
- inner scale, 85, 86, 341, 409, 550, 558, 639, 640, 642, 643, 650, 670
- intense mixing, adiabatic profile produced?, 663
- isotropic, 426, 494, 654, 655, 735, 736, 738
  - and precipitation, 674
  - vs. anisotropic, 670, 673
- kinetic and potential energy dissipation, 640, 643, 658, 674
- kinetic energy, 640
- Kolmogoroff, 3-D, 655
- Kolmogoroff laws, 735
- Kolmogoroff microscale, 583, 649, 650
- Kolmogoroff spectrum, 643
- layer, distribution of anisotropy, 425
- layer thickness, 644
- mesosphere, 439, 644, 665
- mixing, 211, 627, 637, 647, 673, 674
- mixing of electrons, 77
- outer scale (+ see buoyancy scale), 55
- parallel vs. transverse structure function, 735
- potential energy, 640
  - storage, 721
- quasi-isotropic, 640, 675
- refractive index structure constant,  $C_n^2$ , 210, 320, 335, 342, 568, 656, 657, 672, 674, 739
- scatter and spectra++, 210
- shears and viscous heating, 645
- spectra and structure functions, 653
- spectral density function, 738
- stratified layers, 98, 412, 704
- stratosphere, layers, 644
- theory, 88, 185, 550, 559, 642, 646, 649, 653, 654, 734
- three-dimensional, 598, 653
- time to destroy a layer, 89
- tropopause, isotropy, 680
- two-dimensional, 598
- unstratified, 412
- viscous energy dissipation, 640
- viscous range, 641
- wavelength, Fourier scale, 641
- wind-shear, 699
- Turbulence
  - diffusion in presence of layers, 415
  - due to nonlinear breaking, 644
  - energy fluxes, 46
  - inertial range, 409
  - inner scale, 652
  - isotropic, 418, 641
  - Kolmogoroff microscale, 35, 642
  - layer thickness, 644
  - potential energy, 640
  - refractive index structure constant,  $C_n^2$ , 118
  - theory, 734
  - three-dimensional, 494
- Turbulence and radar echo intensity++, 118, 210, 320, 342, 568, 656, 657, 673
- Turbulence strength and radar volume, 423
- Turbulent diffusion, 89
  - asymmetries, 646
  - layers, 98, 648
- Turbulent diffusion coefficient, 89, 415, 645, 646, 661, 667, 668, 674
- Turbulent diffusion vs. molecular, 647, 648
- Turbulent eddy diffusion, 638
- Turbulent energy dissipation rate, 67, 70, 118, 210, 334, 401, 402, 404, 406, 408, 411–413, 422–424, 429, 559, 568, 569, 598, 640, 644, 650, 657, 659, 663–667, 739
  - incorrect interpretation, 645
- Turbulent layer, 49, 93, 98, 115, 388, 415, 425, 426, 439, 536, 648, 649, 663, 675, 721
  - anisotropic at edges, 425
- Turbulent layers, edges, 675
- Turbulent Prandtl number, 422, 423, 647, 658
- Turbulent scatter, 81, 88, 93, 114, 205, 209, 218, 318, 341, 395, 421, 434, 445, 557, 559, 592, 674
- Turbulent structures, 3-D, 673
- Turbulent vs. specular scatter, 235
- Typhoon, 100, 681, 682, 686
- UHF, 1, 5, 73, 78, 208, 296, 300, 301, 309, 335, 437, 506, 542, 546, 547, 550, 551, 672, 687, 729
  - calibration satellite, 324
  - precipitation, 100
  - radar, 687
  - refractive index vs. frequency, 208
- Uncertainties, 569
  - turbulence, 643
- Unstable lapse rate, 716
- Updrafts, 726
- UV, visible and IR, 14
- Väisälä–Brunt frequency, 36
- VAD, velocity azimuth display, 505
- Van Allen belts, 7
- Variance, 69, 185, 255, 258, 299, 328, 329, 334, 402, 407, 444, 471, 473–479, 482, 485, 489–491, 499, 613, 618, 636, 667
- Velocity ambiguities, 264
- Velocity field, 405, 419, 667, 668
- Velocity shear, 598
- Velocity spectrum, 656

- Vertical velocity, 81, 104, 105, 112, 255, 386, 387, 391, 442, 597, 603, 611, 616, 618, 619, 694, 695, 697, 720
- Vertical winds, 392, 603, 634, 661, 691–693, 725  
tilted reflectors, 391
- Vertically pointing, 83, 349, 394, 405, 494  
radar, 331, 388, 442, 544
- VHF, 1, 76, 78, 105, 300, 406, 542, 546, 559, 729  
advantages, 99  
amplitude distributions, 94  
at Arecibo, 75  
array sizes, 79  
band, 1, 78  
calibration satellite, 324  
and coherent integration, 259, 260, 418, 672  
DBS, 68  
dispersion, 416  
echoes, from mesosphere, 78, 85, 90  
echoes, temporal variations, 78  
Eiscat, 106, 251, 253  
F-region, 73  
first D-region echoes, 75, 77, 87, 559  
first meteorological radars, 337, 339, 676  
first stratospheric echoes, 76, 90  
Fresnel zone, 89  
height coverage, 99  
humidity, 118  
ionospheric, 588  
for ionospheric scatter, 73  
lightning, Chung-Li, 574, 578  
lower power, 99  
meteors, 266, 565  
meter-scale turbulence simulations, 671  
networks, 688  
partial reflection, 88  
PMSE, 550, 551  
precipitation, 100, 117, 437, 495, 567, 728  
radar, 687  
    anisotropic scatter, 63, 64, 387, 428, 430, 674  
    Chung-Li, 725  
    Eureka, 552  
    first windprofilers, 728  
    McGill, efficiency, 334  
    Resolute Bay, 552  
    specular scatter, 676  
    transmitter powers, 79  
    wind velocities, 84  
radars, boundary layer, 570, 729  
radars, vertical winds, 694  
refractive index, 85, 419  
    vs. frequency, 207, 208, 319  
relative to specular reflector depths, 418  
RF digital sampling, 313  
skynoise, 85, 267, 309  
skynoise source, Cassiopeia A, 334  
spatial scales, 407  
spectral beam-broadening, 394, 396  
stacked spectra, 256  
time scales, 230, 406  
tropopause detection, 93, 437, 695  
troposphere, stratosphere, 138  
turbulence, 644  
UHF co-located, 569  
viscous range, 81  
VHF/MST, pre-history, 672  
VHF/MST frontal studies, 100  
VHF/MST networks, 99  
VHF/MST radar and lightning, 570  
Virtual, 116, 142, 235, 710  
    heat vs. sensible heat, 710  
    temperature, 46, 116, 117, 695, 709, 710  
Viscosity, 24, 81, 550, 554, 557, 581, 584, 585, 588, 608, 644, 645  
    coefficient, 554  
    eddy, 651, 652  
    kinematic, 341, 606, 641, 645–647, 650, 652  
    molecular, 606  
    turbulent, 646, 647  
    waves, 211, 388, 426, 557, 559, 673, 675  
Viscous, 81, 85, 100, 143, 409, 583, 588, 641, 642, 646, 650, 652, 654, 659, 660  
    dissipation, 643, 670  
Vortices, 555, 668, 703  
VSWR, voltage standing wave ratio, 296, 344, 355, 358, 366, 375
- Water vapor, 10, 18, 35, 40, 116, 207, 209, 551, 555, 569, 673, 678, 706–715, 741
- Water/ice/vapor phase changes, adiabatic processes, 711
- Water/ice/vapor phase diagram, 709
- Waves++, 23, 33, 597, 600, 602, 700
- Wave breaking, condition, 622
- Wave energy, 166, 612, 620, 622, 636  
flux, 636
- Wave forcing, 29
- Wave-induced, 636
- Wave reflection, smoothness and roughness, 215
- Wave source, 617, 622, 628, 629, 639, 700, 702
- Wave spectrum, 614, 638
- Wave–wave interaction, 605, 616
- Waveform, 121, 225, 264, 306–308, 374, 482, 483  
design, 308  
digital, 238
- Wavefront, tilted, 289
- Wavelength  
10 cm radar, 506  
and aliasing, 254  
atmospheric  
    horizontal, 602  
    vertical, 602  
Bragg scale, 73, 218, 673  
defined, 122

- EM, at critical reflection in ionosphere, 142
- EM, radar choice, 341, 342
- evanescent, 697
- for boundary layer radar, 252
- Fourier scale, 641
- Fresnel zones, 134
- gravity wave, described, 602
- horizontal
  - gravity wave, resolving, 348
  - measurement by radar, 618, 619
  - optical, 619
- infrared, 16
- interferometer spacing and grating lobes, 291
- long vertical, 699
- maximum gravity wave energy, 620
- and Mie scatter, 50
- radio-bands, 3
- relative to antenna size, 79
- short-wave, 14
- signal path integral number of, 226
- trapped, 697
  - vertical, 697
  - measurement by radar, 619
- UV, 15
  - visible, IR, 15
- Wavelength dependence, skynoise, 318
- Wavelength++, 1, 253, 495, 655
- Wavelengths
  - 1000s km, 33
  - EM, and far-field, 252
  - gravity to planetary waves, 23
  - upper air research, 5
  - visible and infrared, 14
- Wavenumber, 276, 408
- Waves
  - acoustic, 43, 121, 201, 572, 606, 607
    - RASS, 674
  - amplitude variation with height, 597
  - amplitudes, 597, 600
  - atmospheric, 22, 23, 26, 27, 32
    - forcing, 28
    - free or forced, 23
  - BD circulation, 31
  - boundary layer, 506
  - breaking, 33
  - damped, 203, 588
  - diffusion effects, 586, 587
  - dispersion and polarization relations, 609
  - ducted, 95
  - electron waves, 201
  - EM, characteristic modes, 150, 152, 154, 156
  - EM, damping, 59
  - EM, electromagnetic, 132, 302
  - EM, evanescence in ionosphere, 142
  - EM, planar, 212
  - EM, plane, 290, 508, 510, 512
    - superposition, 512
  - EM, polarization, 295
  - EM, reflected, 287
  - EM, scattering, 120
  - EM, spherically radiated, 223
  - EM, Stokes' parameters, 592
  - focusing, 625
  - forced, 23, 31
  - free, 626, 699
  - frontal generation, 701
  - generation, 23
  - generation by mountain flow, 695
  - gravity (+ see Gravity waves), 23, 600
  - gravity, transverse, 607
  - group velocity, 123
  - in stratosphere++, 31
  - incident, reflected, transmitted, 211
  - inertial, 699
  - interference, 167
  - internal, 597
  - ion-acoustic, 203, 557
  - ion waves, 203
  - ionospheric, km-scale, 582
  - jet stream, 703
  - Landau damped, 203
  - Langmuir, 201
  - lee, 696
  - lee vs. inertial, 698
  - momentum flux, 607, 639
  - monochromatic, 620, 628, 629
    - vs. spectra, 620
  - mountain flow as sources, 697
  - nonlinear, 33, 616, 637, 697
  - optical, 138
  - parameterization, 638
  - parametric instabilities, 631
  - parent, 700
  - planetary, 23, 564, 581, 596
  - plasma, 201, 203, 315
    - free, 201
  - radiowaves, 4
  - Rossby, 33
  - secondary, 616
  - secondary generation, 700
  - sferics, 572
  - small scale, 35
  - solar heating, 31
  - solitons, 732
  - source, 703
  - spectrum, 122, 697
  - standing, 699
  - in stratosphere++, 31
  - superposition, 133, 146
    - characteristic modes, 150
  - turbulent scales, 737
  - ubiquitous, 606

- upgoing vs downgoing, 620
  - viewed optically, 617
  - viscosity waves, 675
- Weather, 20, 54, 84, 243, 373, 380, 503, 569, 639, 680, 684, 687–689, 702, 732
- Weighting, 110, 111, 190, 193, 194, 261, 262, 302, 303, 349, 402, 442, 487, 512, 513, 540, 541, 546
  - function, 190–192, 263, 512, 513, 544
- Wind vector, three-dimensional, 81, 242
- Wind-shear, 69, 242, 254, 391, 395, 397, 398, 400, 437, 493, 494, 557, 627, 630, 641, 643, 645, 660, 668, 669, 703, 721–724, 726
  - broadening/thinning, 431
  - in cloud, 570
  - instabilities, 644
  - and kinetic energy, 722
  - spectral broadening/thinning, 397
- Windows, spectral analysis, 454, 473, 474, 477–479, 481
- Windprofiler, 100, 117, 324, 337, 437, 567, 569, 596, 597, 617, 672, 674, 676, 680–683, 686–691, 693, 695, 700, 701, 703, 728–731
  - (also wind-profiling Doppler radar), 99
- Windprofilers, allocated frequencies, 687
- Winds, meteors, 86, 561
- X-band, 4, 5, 682
- X-rays, 14, 73, 165
- Yagi (Yagi–Uda) antennas, 75, 79, 80, 86, 156, 222, 288, 294–297, 304, 339, 341, 342, 349, 350, 353–355, 360, 362, 370, 372, 374–376, 380, 542, 574, 578, 729
- z-transform, 459
- Zonal, 22, 28–30, 32, 33, 493, 526, 599, 632–634, 700, 702
  - mean, 22, 26, 27