

# Index

- APAR *see* absorbed PAR
- absolute radiometer 116
- absorbed PAR, APAR 125
- AC power *see* alternating current power
- aerial photography 2
- AGC *see* automatic gain control
- albedo 119
- meter 119
- alternating current power, AC power 13, 105, 106, 107
- analog 30, 34, 46, 77, 81, 82, 103, 104, 105, 108, 132
- analog-digital resolution 104
- anemometer 98, 104, 130, 131, 132, 133, 134
- applied voltage 104, 166, 167
- arrester 15, 16, 17, 119
- atmospheric pressure 21, 23, 65, 139, 142, 145, 161, 162
- attenuation (of CO<sub>2</sub> concentration fluctuation) 67, 79, 83
- automated calibration 41, 67, 72
- automatic gain control, AGC 46, 51, 52
- automatic solar tracker 117
- average wind direction 134
- average wind velocity 130
- Avogadro's number 129
- back-up power supply 11
- balance gas 50, 81
- Bernoulli's law 133
- binary format 105
- black body 116
- BNC connector 126
- boardwalk 7, 19
- calibration 18, 41, 42, 45, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 63, 67, 71, 72, 80, 81, 87, 116, 119, 121, 124, 127, 132, 133, 135, 140, 142, 144, 155, 158, 159, 160, 162, 163, 165
- calibration frequency 135
- calibration gas 41, 51, 52, 53, 54, 71, 72, 78, 88, 91, 93, 99
- canister 92, 98, 100
- capacitive water level meter 161, 164
- cavity ring down spectroscopy, CRDS 102
- channel 53, 82, 160, 164, 165, 166
- charge controller 13
- chemiluminescence 102
- closed-path CO<sub>2</sub> analyzer 55
- closed-path gas analyzer 41, 57, 67, 68, 69, 70, 74, 78, 83, 84, 87
- CO<sub>2</sub> concentration 18, 41, 50, 57, 58, 65, 67, 68, 70, 72, 78, 79, 80, 81, 82, 83, 84, 86, 87, 88, 90, 94, 95
- measurement 50, 67
- CO<sub>2</sub> molecule 41, 56
- CO<sub>2</sub> storage change 22, 86, 87, 94, 95
- coaxial cable 126
- cold junction 137, 138
- circuit 147
- cold trap 100
- comma separated value format, CSV 103, 105
- commercial power 3, 11, 12
- compensation lead wire 138, 147
- correcting flux loss 44, 47, 64
- CRDS *see* cavity ring down spectroscopy
- cross sensitivity 41, 42, 58
- cryofocus 100
- CSV *see* comma separated value format
- culmination time 128
- cup anemometer 130, 131

- data logger 18, 34, 35, 40, 72, 78, 79, 88, 94, 98, 103, 104, 105, 108, 136, 137, 138, 147, 149, 166, 167, 168
- DEC technique  
*see* disjunct eddy covariance technique
- dehumidification 88
- dehumidifier 78, 90
- detection area 162
- dew-point generator 51, 53, 81
- dew-point hygrometer 142
- diaphragm 72, 73, 74, 161, 162  
  - pump 72, 73, 74
- diffuse radiation 116
- digital 30, 34, 46, 77, 79, 81, 82, 102, 103, 104, 105, 108, 119, 124, 132, 166
- digital multimeter, tester 107, 119
- direct radiation 116
- disjunct eddy covariance technique, DEC technique 101
- dome coefficient 120
- dryer (air -) 69, 77, 78
- dry-bulb thermocouple 58, 59
- dry-bulb thermometer 138, 143
- eddy accumulation method 96
- eddy covariance method 2, 28, 35, 67, 77, 78, 83, 96, 97, 101, 102, 103
- electromagnetic noise 106
- electromagnetic wave 106, 107, 116, 152
- equation of time 128
- fine-wire thermocouple, fine-wire thermometer 58, 61
- flow distortion 30, 32, 37
- flow meter 50, 51, 68, 69, 74, 76, 77, 88, 89, 164
- flux averaging period 94, 95
- footprint 3, 7
- forest management map 2
- four-component radiometer 122, 123
- fragmentation 101
- gas chromatograph  
  - electron capture detector, GC-ECD 100  
  - flame ionization detector, GC-FID 99, 101  
  - mass spectrometer, GC-MS 100, 101
- global solar radiation 116, 119, 124
- groundwater level 23
- harmonic current 106
- heat-sink type (of radiometer) 116, 119
- hemispherical image 24
- high frequency fluctuation correction 83
- high frequency flux loss 44, 45, 46, 61, 64
- high voltage electric power line 12
- horizontal/vertical advection 86
- hot-wire anemometer 131
- hour angle 128
- hydrostatic water depth meter 162
- IMR-MS  
*see* ion molecule reaction mass spectrometer
- influence of heating (by open-path gas analyzer) 59, 64, 66
- infrared absorption 41, 56
- infrared gas analyzer 56, 57
- infrared radiation 41, 50, 56, 57, 70, 119, 120
- instantaneous power failure 106, 107
- instantaneous wind velocity 134
- insulation resistance 106, 107
- International Organization for Standardization, ISO 76, 116, 117  
  - first class pyranometer 117  
  - second class pyranometer 117  
  - secondary standard pyranometer 117
- ion molecule reaction mass spectrometer, IMR-MS 101

- irrigation planning 160
- ISO  
    *see* International Organization for Standardization
- Krypton hygrometer 57
- ladder tower 8, 9
- LAI *see* leaf area index
- land consolidation 160
- land improvement organization 5
- land use map 2
- leaf area index, LAI 24
- LI-6262 (LI-COR, Inc.) 61, 68, 69, 70, 71, 81, 82, 88
- LI-7000 (LI-COR, Inc.) 68, 69, 70, 71, 82, 88
- lightning shielding transformer 15, 107
- litterfall 24
- logger 16, 18, 124, 126, 138, 148, 149, 166, 167
- logging interval 104
- longwave radiation 119, 121, 122, 124, 148
- low-pass filter 107
- Lyman-alpha hygrometer 57
- magnesium perchlorate 50, 52, 70, 71
- mass flow controller 68, 73, 76, 77, 88, 89, 91, 97, 102
- measurement box 19
- measurement range 82, 103, 104, 135, 161, 167
- memory media 103
- micrometeorological method 2
- mixing ratio 21, 41, 48, 49, 55, 65, 84, 145
- National Forest 6
- net ecosystem CO<sub>2</sub> exchange, NEE 21, 22, 86
- net radiation 21, 22, 122, 123, 124
- noise 3, 12, 16, 34, 46, 73, 105, 106, 107, 108, 119, 121, 136, 138, 158
- cut transformer 107, 108
- offset 35, 36, 48, 49, 52, 53, 54, 55, 56, 65, 80, 117, 120
- open-path CO<sub>2</sub> gas analyzer 41, 42, 67
- oscilloscope 106, 107
- paddy 160, 162, 163
- PAR *see* photosynthetically active radiation
- parshall flume 164, 165
- PC *see* personal computer
- permeation 160
- permittivity (of soil) 152, 153
- personal computer, PC 48, 51, 52, 53, 63, 72, 79, 97, 103, 105, 124, 166, 167
- photodiode 116
- photosynthetic photon flux density, PPFD 124
- photosynthetically active radiation, PAR 21, 22, 124, 125, 129, 167
- photovoltaic cell 13
- Pitot tube 132, 133
- Planck's constant 129
- platinum resistance 143, 147
- thermometer 61, 135, 137, 142, 162
- polymeric humidity sensor 142, 143
- power generation system 12
- power restoration 11
- power supply line 12, 106
- PPFD *see* photosynthetic photon flux density
- precipitation (rainfall / snowfall) 22, 23, 156
- preheat 167
- pressure regulator 50, 91
- prevailing wind direction 2, 32, 43, 44, 46, 131, 134
- programmable relay 79, 98
- protected forest 6
- protective tube 12
- proton transfer reaction mass spectrometer, PTR-MS 101

- PTFE (polytetrafluoroethylene) 74, 75, 76, 89, 98, 99  
 - membrane filter 70  
 - tubing 74, 75
- PTR-MS  
*see* proton transfer reaction mass spectrometer
- pump 62, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 82, 83, 87, 88, 89, 90, 93, 94, 97, 98, 101, 102, 106
- pyranometer 116, 117, 118, 119, 123, 124, 167
- pyrheliometer 117, 118
- pyradiometer 122, 123, 124
- quantum sensor 124, 125, 129, 167
- radiation thermometer 135, 139, 148
- rain gauge 156, 157, 159
- rainfall interception 23
- range of data logging 103
- REA method  
*see* relaxed eddy accumulation method
- rectangular weir 164
- reference cell 69, 70, 71, 88
- reference junction 137
- regulator 88, 91
- relaxed eddy accumulation method, REA method 96, 97, 98, 99, 100, 101, 102
- relay 79, 80, 102, 166
- resolution 57, 98, 104, 106, 119, 131, 162, 167
- RS-232C 34, 81, 82, 104, 105, 166
- RS-422 104
- runoff 23
- sample air 62, 67, 69, 71, 73, 76, 77, 88, 93, 94
- sample cell 49, 68, 69, 70, 80, 82, 88, 89, 90, 91
- sampling rate 28, 96, 97, 103, 106
- sap flow velocity 23
- SAT *see* ultrasonic anemometer thermometer
- satellite image 2
- scaffolding tower 8, 9
- SDI *see* serial data interface
- SDM *see* synchronous device for measurement
- Seebeck effect 137
- sensitivity constant 149
- sensor separation 44, 45, 47, 61, 64
- serial data interface, SDI 104
- shadow band, shadow ball, shadow plate 118
- sheath 135
- shelter 62, 135, 138, 139, 140, 142, 143
- shield, shielding 14, 106, 107
- shortwave radiation 22, 61, 116, 124
- signal cable 33, 34, 106, 107, 108
- signal wire 47, 48, 119
- silencer 88, 89, 92
- silver brazing, silver soldering 138, 139, 147
- snow depth 23, 156, 158, 159
- snow survey 158
- snow water equivalent, SWE 23, 159
- snow weight 156, 158, 159
- soda lime 50, 52, 70, 71
- soft ionization mass spectrometer 101
- soil heat flux 11, 23, 149, 150, 151
- solar altitude 128
- solar radiation 13, 22, 46, 56, 63, 64, 116, 117, 118, 119, 120, 121, 122, 124, 139, 147, 149, 150, 162
- solar zenith angle 128
- solenoid valve 69, 71, 72, 78, 79, 80, 82, 87, 88, 89, 90, 91, 93, 94, 97, 98, 99, 102
- sonic virtual temperature 21, 28, 29, 30, 35, 37, 38, 39, 59
- span calibration 53
- span gas 52, 53, 71, 80, 88
- spectroradiation 22
- spectroradiometer 21, 124

- spectrum analyzer 106
- standard gas 50, 67, 71, 80, 81
- static capacitors 152
- Stefan-Boltzmann Law 116, 120
- stemflow 23
- subsampling 68, 78, 79
- suction flow rate 68, 89
- super-fine thermocouple 138
- SWE *see* snow water equivalent
- switching power supply 105, 107
- synchronous device for measurement, SDM 34, 35, 42, 46, 47, 48
- TDLS *see* tunable diode laser spectroscopy
- tedler bag 98
- temperature dependence 161
- tester *see* digital multimeter
- thermal desorption unit 100
- thermistor 49, 54, 59, 136, 137, 147, 148, 162  
- thermometer 136, 147
- thermocouple 54, 56, 57, 58, 59, 61, 135, 137, 138, 139, 142, 147, 162  
- thermometer 135, 137, 138, 142, 148
- thermopile 116, 119, 120, 121, 122
- three-cup anemometer 132
- throughfall 23
- tilt check 33, 35
- time constant 135, 147
- time lag (of the signal output) 42, 46, 47, 63, 68
- tipping bucket rain gauge 156, 157
- topographic map 2
- transducer 28, 30, 104, 131  
- shadow 37
- triangular weir 164
- true solar time 128
- tube 12, 42, 49, 50, 51, 52, 53, 54, 57, 62, 68, 70, 74, 77, 91, 97, 98, 99, 100, 132, 133, 144, 149, 155, 162
- connector, tubing connector 75, 76, 82
- tunable diode laser spectrometer, TDLS 101
- ultrasonic anemometer thermometer, SAT 28, 29, 31, 32, 33, 34, 35, 36, 37, 38, 39, 43, 44, 45, 46, 47, 58, 59, 60, 61, 64, 67, 96, 97, 98, 99, 102, 135  
- probe 29, 30, 32, 33, 36, 37  
slanted path - 29, 30, 31, 36, 37, 38  
vertical path - 29, 30, 31, 37, 38
- ultraviolet gas analyzer 56, 57, 58
- underdrain 160
- uninterruptible power supply, UPS 107, 108
- vegetation map 2
- velocity of light 129
- volatile organic compound, VOC 96, 98, 99, 100, 101
- voltage drop 13, 106
- voltage fluctuation 107
- water bath 140, 163
- water meter 164, 165
- water-level-discharge curve 165
- wavelength 22, 56, 57, 116, 119, 122, 124, 127, 129
- wet-bulb thermocouple 58, 59
- wet-bulb thermometer 138
- wind direction 22, 43, 44, 45, 47, 130, 132, 134
- wind tunnel 37, 131, 132, 133
- wind vane 130, 132
- wind velocity 21, 22, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 44, 58, 61, 64, 67, 86, 96, 97, 98, 102, 130, 131, 132, 133, 134, 158
- windmill anemometer 130, 131
- World Radiation Center 116, 118
- World Radiometric Reference, WRR 118, 124
- zero calibration 53
- zero gas 49, 50, 52, 53, 71, 80, 81



## List of authors

1.1 The Observation site .....	NAKAI Yuichiro, FFPRI MIYATA Akira, NIAES
1.2 Building infrastructure	
1.2.1 Obtaining Land-use Permission.....	KOMINAMI Yuji, FFPRI MIYATA Akira, NIAES
1.2.2 Tower construction and maintenance.....	SHIMIZU Takanori, FFPRI MIYATA Akira, NIAES
1.2.3 Electric power supply .....	KOMINAMI Yuji, FFPRI NAKAI Yuichiro, FFPRI
1.2.4 Lightning Surge Countermeasures.....	YAMANOI Katsumi, FFPRI
1.2.5 Observation hut .....	NAKAI Yuichiro, FFPRI
1.2.6 Other.....	NAKAI Yuichiro, FFPRI MIYATA Akira, NIAES
1.3 Measurement variables .....	NAKAI Yuichiro, FFPRI MIYATA Akira, NIAES
2.1 Ultrasonic anemo-thermometers, SATs.....	SHIMIZU Takanori, FFPRI
2.2 Open-path CO <sub>2</sub> /H <sub>2</sub> O analyzers.....	MANO Masayoshi, NIAES
2.3 Closed-path CO <sub>2</sub> analyzers.....	YASUDA Yukio, FFPRI
2.4 CO <sub>2</sub> Storage Change.....	KITAMURA Kenzo, FFPRI
2.5 Relaxed Eddy Accumulation, REA Method .....	MIYAMA Takafumi, FFPRI
2.6 Data Logger .....	TAKANASHI Satoru, FFPRI
2.7 Detection and Reduction of Noise .....	YAMANOI Katsumi, FFPRI
3.1 Radiation.....	MIZOGUCHI Yasuko, FFPRI
Appendix 3.1-1 .....	MIZOGUCHI Yasuko, FFPRI OHTANI Yoshikazu, FFPRI
Appendix 3.1-2 .....	MIZOGUCHI Yasuko, FFPRI
3.2 Wind direction / Wind velocity .....	TAKANASHI Satoru, FFPRI
3.3 Air temperature .....	MIYAMA Takafumi, FFPRI
3.4 Humidity .....	MIYAMA Takafumi, FFPRI
3.5 Soil temperature and soil heat flux .....	TAMAI Koji, FFPRI
3.6 Soil moisture.....	TAMAI Koji, FFPRI
3.7 Precipitation / Snow Water Equivalent, Snow survey.....	KOMINAMI Yuji, FFPRI
3.8 Water level, Water temperature, Irrigation and Drainage.....	ONO Keisuke, NIAES
3.9 Data logger .....	MIZOGUCHI Yasuko, FFPRI TAKANASHI Satoru, FFPRI

Authors used the following figures and photographs by courtesy of researchers and sensor manufacturers.

Photo 1.2-3 .....	SHIMIZU Akira, FFPRI
Photo 2.1-1 (a) .....	KOMINAMI Yuji, FFPRI
Fig. 2.3-1 .....	OHTANI Yoshikazu, FFPRI
Photo 2.4-1, 2.4-2 right, 3.5-7.....	MIZOGUCHI Yasuko, FFPRI
Photo 2.4-2 left .....	YUTA Satoko, FFPRI
Photo 2.4-3 .....	TAKAHASHI Yoshiyuki, NIES
Photo 3.1-1 left, 3.1-2, 3.1-3 right, 3.1-5 right, 3.1-6 right, 3.5-6.....	EKO INSTRUMENTS CO., LTD.
Photo 3.1-1 right, 3.1-3 left, 3.1-5 left, 3.1-6 left .....	Kipp & Zonen B.V.
Photo 3.5-1, 3.5-2 .....	CLIMATEC, Inc.
Photo 3.5-3 .....	CHINO CORPORATION
Photo 3.5-5 .....	PREDE CO. LTD.
Fig. 3.6-1 .....	CAMPBELL SCIENTIFIC, INC.
Photo 3.6-1 .....	Decagon Devices, Inc.
Photo 3.6-2 .....	Daiki Rika Kogyo Co., Ltd.
Photo 3.6-3 .....	IIDA Shinichi, FFPRI
Photo 3.8-3 .....	Senecom, Inc

All trademarks are the property of their respective owners.