



Tarfala Research Station automatic weather station, 2006

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1 Instrumentation

The TRS met station consisted of the following instruments during 2006

Sensor	Serial number	Remark
Pt100		in Stevenson screen
Pt100		in Young screen
Young Wind Monitor		at 3 m
LiCor Li-200SB pyranometer		at 2 m
Tipping bucket precipitation gauge		at 2 m
Vent HygroClip T/Rh		at 2 m
CR10X-2M data logger		

2 Notes on the station data

- Ventilated Rh is malfunctioning until late March for unknown reasons.
- No changes to or breaks in data.

3 Data coverage

- Data coverage complete

4 Notes on data storage

Example of hourly data:

101,2006,185,1300,5.27,5.538,4.441,69.99,7.44,312.4,.028,416.2,.16,0,0,15.74,1242,
5.112,5.342,4.193,68.89,5.033,1213,4.007,1259

Column	Example data	Description
01:	101	ID
02:	2006	Year
03:	191	Day of Year
04:	1600	hour-minute (hhmm)
05:	5.27	2 Pt100 T in Stevenson screen
06:	5.538	3 Pt100 in new Young screen
07:	4.441	4 Ventilated T
08:	69.99	5 Ventilated T
09:	7.44	6 Mean horizontal wind speed
10:	312.4	7 resultant mean wind direction
11:	.028	8 Standard deviation of wind direction
12:	416.2	9 Global radiation
13:	.16	10 Precipitation/SR50
14:	0	11 Not used
15:	0	12 Not used
16:	15.74	13 hourly max wind speed
17:	1242	14 time for max wind speed
18:	5.112	15 Sample T Stevenson
19:	5.342	16 Sample T Young
20:	4.193	17 Sample ventilated T
21:	68.89	18 Sample ventilated Rh
22:	5.033	19 Max T
23:	1213	20 time for max T
24:	4.007	21 Min T
25:	1259	22 time for min T

Example of daily data summaries:
124,2006,185,2400,4.875,5.252,4.232,71.7,9.66,40,2.509,2339,21.79,522,7.08,314.4,
155.7,6.08,13.9,0,0

Column	Example data	Description
01:	124	ID
02:	2006	Year
03:	185	Day of Year
04:	2400	hour-minute (hhmm)
05:	4.875	2 Daily average T in Stevenson screen)
06:	5.252	3 Daily T from T/Rh in Young screen
07:	4.232	4 Daily T from ventilated T/Rh
08:	71.7	5 daily average Rh from ventilated T/Rh
08:	9.66	6 Daily maximum temperature in Young screen
10:	40	7 hhmm for maximum daily temperature
11:	2.509	8 Daily minimum temperature in Young screen
12:	2339	9 hhmm for minimum daily temperature
13:	21.79	10 Maximum wind speed
14:	522	11 hhmm for maximum wind speed
15:	7.08	12 Average wind speed
16:	314.4	13 Average wind direction
17:	155.7	14 Incoming radiation
18:	6.08	15 Totalized precipitation
19:	13.9	16 Battery voltage
20:	0	17 Not used
21:	0	18 Not used

Example of 'Synoptic' output:
103,2006,185,1300,5.342

Column	Example data	Description
01:	103	ID
02:	2006	Year
03:	185	Day of Year
04:	1300	hour-minute (hhmm)
05:	5.342	Pt100 in Young screen

5 Data files and content

TRSmnet2006.csv Raw data file

TRS_met_2006_Precipitation.csv

Date-time, Precipitation

2006-01-01 01:00:00,0.00

TRS_met_2006_Radiation.csv

Date-time, Global radiation

2006-01-01 01:00:00,-0.10

TRS_met_2006_Relative_humidity.csv

Date-time, Vented Rh, ssample ventilated Rh

2006-01-01 01:00:00,9.0,8.9

TRS_met_2006_Temperature.csv

Date-time, hourly average T (Stevenson), hourly average T (Young), hourly average vented T/Rh, sample T (Stevenson), Sample T (Young), sample T vent, max T vent, time for max T vent, min T vent, time for min T vent

2006-01-01 01:00:00,-13.17,-11.34,-12.22,-12.42,-11.04,-12.20,-10.19,9,-14.81,40

TRS_met_2006_Wind.csv

Date-time, Mean horizontal wind speed, resultant mean wind direction, hourly max wind speed, time of max wind
spd

2006-01-01 01:00:00,2.5,334.5,0.0300,4.31,25

TRS_met_2006_Daily_data.csv

Data columns follows description above except last two columns (not used)

2006-01-02 00:00:00,-10.99,-10.02,-10.88,9.3,-5.50,227,-14.93,714,5.2,1156,1.7,350.5,
0.2,0.0,13.91

TRS_met_2006_Synop_data.csv

Date-time, sample temperature

2006-01-01 01:00:00,-11.04

The data collected during 2006 is summarized the figure 1 and Table 1.

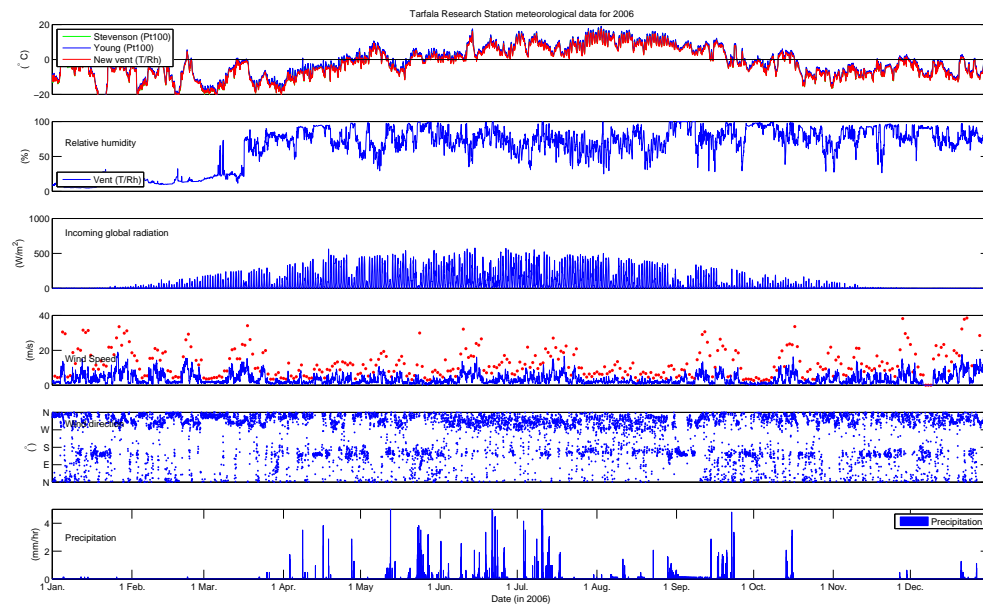


Figure. 1. Summary of meteorological data from Tarfala Research Station automatic weather station 2006.

Table. 1. Monthly averages of meteorological parameters from the Tarfala Research Station automatic weather station 2006.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average air temperature (Stevenson)												
(°C)	−7.4	−9.3	−11.8	−5.7	0.7	4.9	8.7	11.1	3.8	−4.4	−6.2	−5.7
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767
Average air temperature (Young)												
(°C)	−6.8	−8.7	−11.1	−5.1	1.3	5.3	9.1	11.5	4.3	−3.8	−5.6	−5.2
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767
Average air temperature												
(°C)	−7.6	−9.6	−12.3	−6.5	−0.2	4.1	8.0	10.3	3.1	−4.9	−6.6	−6.1
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767
Positive degree sum												
(°C)	48	38	0	54	1168	3150	5929	7914	3075	341	22	32
<i>n</i>	25	17	0	55	405	651	743	767	512	148	39	32
Average relative humidity												
(%)	—	—	—	80.1	76.2	74.4	67.1	69.9	82.5	82.2	79.4	79.1
<i>n</i>	—	—	—	743	743	743	743	767	743	767	743	767
Average incoming global radiation												
(W m ^{−2})	1.2	12.4	47.7	97.0	138.1	139.8	135.8	104.3	40.7	18.4	3.0	0.2
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767
Global incoming energy sum												
(W m ^{−2})	924	8356	36587	72088	102622	103885	100934	80006	30236	14124	2286	188
<i>n</i>	572	502	560	681	740	743	743	761	592	399	293	338
Totalized precipitation												
(mm)	1.12	0.32	1.76	32.48	107.20	102.24	116.16	43.84	77.92	25.44	2.40	9.76
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767
Average wind speed												
(m s ^{−1})	4.9	4.6	3.7	2.6	2.6	3.6	3.9	2.1	3.3	2.9	3.6	5.1
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767

Logger program

5.1 Program for 2006 (same as for end of 2005)

```
;{CR10X}
*Table 1 Program
  01: 10.0000   Execution Interval (seconds)

;-----
; Check battery voltage
; and stop execution if lower than 9.7V
1:  Batt Voltage (P10)
  1: 10        Loc [ Battery   ]

2:  If (X<=>F) (P89)
  1: 10        X Loc [ Battery   ]
  2: 4         <
  3: 9.7       F
  4: 0         Go to end of Program Table

;-----
; A I R   T E M P E R A T U R E
; Measure R/R0 for old met cage Rt100
3:  3W Half Bridge (P7)
  1: 1         Reps
  2: 33        25 mV 50 Hz Rejection Range
  3: 1         SE Channel
  4: 2         Excite all reps w/Exchan 2
  5: 2100      mV Excitation
  6: 21        Loc [ R_R0_T_1   ]
  7: 100.1     Mult
  8: 0         Offset

; Meaasure R/R0 for Young screen Rt100
4:  3W Half Bridge (P7)
  1: 1         Reps
  2: 33        25 mV 50 Hz Rejection Range
  3: 3         SE Channel
  4: 2         Excite all reps w/Exchan 2
  5: 2100      mV Excitation
  6: 22        Loc [ R_R0_T_2   ]
  7: 100.2     Mult
  8: 0         Offset

; Calculate T for both Rt100
5:  Temperature RTD (P16)
  1: 2         Reps
  2: 21        R/R0 Loc [ R_R0_T_1 ]
  3: 1         Loc [ T_1        ]
  4: 1         Mult
  5: 0         Offset

;-----
; V E N T I L A T E D   T & Rh
; Measure temperature from ventilated
; HygroClip sensor
6:  Volt (Diff) (P2)
  1: 1         Reps
  2: 35        2500 mV 50 Hz Rejection Range
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3: 3      DIFF Channel
4: 3      Loc [ T_vent   ]
5: .1     Mult
6: -40    Offset

; Measure humidity from ventilated
; HygroClip sensor
7: Volt (Diff) (P2)
  1: 1      Reps
  2: 35     2500 mV 50 Hz Rejection Range
  3: 4      DIFF Channel
  4: 4      Loc [ rH_vent ]
  5: .1     Mult
  6: 0.0    Offset

;-----
; W I N D
; Measure wind speed on Young Wind Monitor
8: Pulse (P3)
  1: 1      Reps
  2: 1      Pulse Channel 1
  3: 21     Low Level AC, Output Hz
  4: 5      Loc [ Wind_spd ]
  5: .098   Mult
  6: 0      Offset

; Measure wind direction on Young Wind Monitor
9: Excite-Delay (SE) (P4)
  1: 1      Reps
  2: 5      2500 mV Slow Range
  3: 9      SE Channel
  4: 1      Excite all reps w/Exchan 1
  5: 2      Delay (0.01 sec units)
  6: 2500   mV Excitation
  7: 6      Loc [ Wind_dir ]
  8: .142   Mult
  9: -135   Offset

; Make corrections to wind direction
10: If (X<=>F) (P89)
  1: 6      X Loc [ Wind_dir ]
  2: 4      <
  3: 0      F
  4: 30     Then Do

11: Z=X+F (P34)
  1: 6      X Loc [ Wind_dir ]
  2: 360    F
  3: 6      Z Loc [ Wind_dir ]

12: End (P95)

;-----
; G L O B A L   R A D I A T I O N
; Measure Li200s Pyranometer
13: Volt (SE) (P1)
  1: 1      Reps
  2: 33     25 mV 50 Hz Rejection Range

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```

3: 10      SE Channel
4: 7       Loc [ Li200S   ]
5: 116.55  Mult
6: 0       Offset

;-----
; P R E C I P I T A T I O N
; Measure tipping bucket rain gauge
14: Pulse (P3)
  1: 1      Reps
  2: 2      Pulse Channel 2
  3: 2      Switch Closure, All Counts
  4: 8      Loc [ Precip   ]
  5: .16    Mult
  6: 0      Offset

;-----
; I N T E R N A L   T E M P E R A T U R E
15: Internal Temperature (P17)
  1: 9      Loc [ T_int    ]

;-----
; H O U R L Y   O U T P U T
16: If time is (P92)
  1: 0      Minutes (Seconds --) into a
  2: 60     Interval (same units as above)
  3: 10     Set Output Flag High (Flag 0)

17: Set Active Storage Area (P80)
  1: 1      Final Storage Area 1
  2: 101    Array ID

18: Real Time (P77)
  1: 1220   Year,Day,Hour/Minute (midnight = 2400)

; Store average unvent and vent T and Rh
19: Average (P71)
  1: 4      Reps
  2: 1      Loc [ T_1      ]

; Store wind speed, dir and std dev
20: Wind Vector (P69)
  1: 1      Reps
  2: 1      Samples per Sub-Interval
  3: 0      S, theta(1), sigma(theta(1)) with polar sensor
  4: 5      Wind Speed/East Loc [ Wind_spd  ]
  5: 6      Wind Direction/North Loc [ Wind_dir ]

; Store average global rad
21: Average (P71)
  1: 1      Reps
  2: 7      Loc [ Li200S   ]

; Store hourly precipitation
22: Totalize (P72)
  1: 1      Reps
  2: 8      Loc [ Precip   ]

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```

; no data
23: Average (P71)
  1: 2      Reps
  2: 11     Loc [ _____ ]

; Store maximum wind speed during last hour
24: Maximum (P73)
  1: 1      Reps
  2: 10     Value with Hr-Min
  3: 5      Loc [ Wind_spd  ]

; Store transient unvent and vent T and Rh
25: Sample (P70)
  1: 4      Reps
  2: 1      Loc [ T_1      ]

; Store max vent T
26: Maximum (P73)
  1: 1      Reps
  2: 10     Value with Hr-Min
  3: 3      Loc [ T_vent   ]

; Store min vent T
27: Minimum (P74)
  1: 1      Reps
  2: 10     Value with Hr-Min
  3: 3      Loc [ T_vent   ]

; Write to card
28: Serial Out (P96)
  1: 71     Storage Module

;-----
; D A I L Y   O U T P U T
29: If time is (P92)
  1: 0      Minutes (Seconds --) into a
  2: 1440   Interval (same units as above)
  3: 10     Set Output Flag High (Flag 0)

30: Set Active Storage Area (P80)
  1: 1      Final Storage Area 1
  2: 124    Array ID

31: Real Time (P77)
  1: 1220   Year,Day,Hour/Minute (midnight = 2400)

; Store daily average unvent and vent T & Rh
32: Average (P71)
  1: 4      Reps
  2: 1      Loc [ T_1      ]

; Store daily max unvent T
33: Maximum (P73)
  1: 1      Reps
  2: 10     Value with Hr-Min
  3: 2      Loc [ T_2      ]

; Store daily min unvent T

```

```

34: Minimum (P74)
  1: 1      Reps
  2: 10     Value with Hr-Min
  3: 2      Loc [ T_2      ]

; Store daily max wind speed
35: Maximum (P73)
  1: 1      Reps
  2: 10     Value with Hr-Min
  3: 5      Loc [ Wind_spd  ]

; Store average wind vector
36: Wind Vector (P69)
  1: 1      Reps
  2: 1      Samples per Sub-Interval
  3: 1      S, theta(1) with polar sensor
  4: 5      Wind Speed/East Loc [ Wind_spd  ]
  5: 6      Wind Direction/North Loc [ Wind_dir ]

; Store daily avg global radioation
37: Average (P71)
  1: 1      Reps
  2: 7      Loc [ Li200S    ]

; Store daily precipitation
38: Totalize (P72)
  1: 1      Reps
  2: 8      Loc [ Precip    ]

; Store sample of battery voltage
39: Sample (P70)
  1: 1      Reps
  2: 10     Loc [ Battery   ]

; no data
40: Average (P71)
  1: 2      Reps
  2: 11     Loc [ _____ ]

; Write to card
41: Serial Out (P96)
  1: 71     Storage Module

;-----
; S Y N O P T I C O U T P U T
; transient T data is stored every 3 hrs
; according to synoptic standards.
42: If time is (P92)
  1: 60     Minutes (Seconds --) into a
  2: 1440   Interval (same units as above)
  3: 10     Set Output Flag High (Flag 0)

43: Set Active Storage Area (P80)
  1: 1      Final Storage Area 1
  2: 103    Array ID

44: Real Time (P77)
  1: 1220   Year,Day,Hour/Minute (midnight = 2400)

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```

45: Sample (P70)
   1: 1      Reps
   2: 2      Loc [ T_2      ]

46: If time is (P92)
   1: 240    Minutes (Seconds --) into a
   2: 1440   Interval (same units as above)
   3: 10     Set Output Flag High (Flag 0)

47: Set Active Storage Area (P80)
   1: 1      Final Storage Area 1
   2: 103    Array ID

48: Real Time (P77)
   1: 1220   Year,Day,Hour/Minute (midnight = 2400)

49: Sample (P70)
   1: 1      Reps
   2: 2      Loc [ T_2      ]

50: If time is (P92)
   1: 420    Minutes (Seconds --) into a
   2: 1440   Interval (same units as above)
   3: 10     Set Output Flag High (Flag 0)

51: Set Active Storage Area (P80)
   1: 1      Final Storage Area 1
   2: 103    Array ID

52: Real Time (P77)
   1: 1220   Year,Day,Hour/Minute (midnight = 2400)

53: Sample (P70)
   1: 1      Reps
   2: 2      Loc [ T_2      ]

54: If time is (P92)
   1: 600    Minutes (Seconds --) into a
   2: 1440   Interval (same units as above)
   3: 10     Set Output Flag High (Flag 0)

55: Set Active Storage Area (P80)
   1: 1      Final Storage Area 1
   2: 103    Array ID

56: Real Time (P77)
   1: 1220   Year,Day,Hour/Minute (midnight = 2400)

57: Sample (P70)
   1: 1      Reps
   2: 2      Loc [ T_2      ]

58: If time is (P92)
   1: 780    Minutes (Seconds --) into a
   2: 1440   Interval (same units as above)
   3: 10     Set Output Flag High (Flag 0)

```

```

59: Set Active Storage Area (P80)
   1: 1      Final Storage Area 1
   2: 103    Array ID

60: Real Time (P77)
   1: 1220   Year,Day,Hour/Minute (midnight = 2400)

61: Sample (P70)
   1: 1      Reps
   2: 2      Loc [ T_2      ]

62: If time is (P92)
   1: 960    Minutes (Seconds --) into a
   2: 1440   Interval (same units as above)
   3: 10     Set Output Flag High (Flag 0)

63: Set Active Storage Area (P80)
   1: 1      Final Storage Area 1
   2: 103    Array ID

64: Real Time (P77)
   1: 1220   Year,Day,Hour/Minute (midnight = 2400)

65: Sample (P70)
   1: 1      Reps
   2: 2      Loc [ T_2      ]

66: If time is (P92)
   1: 1140   Minutes (Seconds --) into a
   2: 1440   Interval (same units as above)
   3: 10     Set Output Flag High (Flag 0)

67: Set Active Storage Area (P80)
   1: 1      Final Storage Area 1
   2: 103    Array ID

68: Real Time (P77)
   1: 1220   Year,Day,Hour/Minute (midnight = 2400)

69: Sample (P70)
   1: 1      Reps
   2: 2      Loc [ T_2      ]

70: If time is (P92)
   1: 1320   Minutes (Seconds --) into a
   2: 1440   Interval (same units as above)
   3: 10     Set Output Flag High (Flag 0)

71: Set Active Storage Area (P80)
   1: 1      Final Storage Area 1
   2: 103    Array ID

72: Real Time (P77)
   1: 1220   Year,Day,Hour/Minute (midnight = 2400)

73: Sample (P70)
   1: 1      Reps
   2: 2      Loc [ T_2      ]

```

*Table 2 Program

01: 0.0000 Execution Interval (seconds)

*Table 3 Subroutines

End Program

1	[T_1]	RW--	3	1	Start ----- ---
2	[T_2]	RW--	13	1	----- ----- End
3	[T_vent]	RW--	5	1	----- ----- ---
4	[rH_vent]	RW--	3	1	----- ----- ---
5	[Wind_spd]	RW--	4	1	----- ----- ---
6	[Wind_dir]	RW--	4	2	----- ----- ---
7	[Li200S]	RW--	2	1	----- ----- ---
8	[Precip]	RW--	2	1	----- ----- ---
9	[T_int]	-W--	0	1	----- ----- ---
10	[Battery]	RW--	2	1	----- ----- ---
11	[-----]	R---	2	0	----- ----- ---
12	[-----]	R---	2	0	----- ----- ---
13	[-----]	----	0	0	----- ----- ---
14	[-----]	----	0	0	----- ----- ---
15	[-----]	----	0	0	----- ----- ---
16	[-----]	----	0	0	----- ----- ---
17	[-----]	----	0	0	----- ----- ---
18	[-----]	----	0	0	----- ----- ---
19	[-----]	----	0	0	----- ----- ---
20	[-----]	----	0	0	----- ----- ---
21	[R_R0_T_1]	RW--	1	1	----- ----- ---
22	[R_R0_T_2]	RW--	1	1	----- ----- ---