



# Tarfala Research Station automatic weather station, 2010

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# 1 Instrumentation

The TRS met station consisted of the following instruments during 2010

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

- The wind sensor failed in mid-November (apparently at 2010-11-17 17:00:00) affecting both speed and direction

## 3 Data coverage

- General data gap:  
2009-01-07 17:00:00 to 2009-03-27 10:00:00
- Relative humidity data missing from  
2010-08-10 10:00:00 to 2010-08-11 16:00:00 (ventilated Rh)
- Temperature data missing from  
2010-06-29 07:00:00 to 2010-07-03 15:00:00 (Pt100 in Stevenson screen)  
2010-08-10 10:00:00 to 2010-08-11 16:00:00 (ventilated T)
- Wind data missing from  
From 2010-11-17 17:00:00 to end of year
- Daily data missing from  
2010-06-30 00:00:00 to 2010-07-03 00:00:00 (Pt100 T)  
2010-08-11 00:00:00  
2010-11-17 17:00:00 to end of year

## 4 Notes on data storage

Example of hourly data:

101,2010,185,1300,8.6616,8.7393,8.1231,92.025,0.97303,193.45,0.04069,52.022,1.76,0,0,2.5774,1234,8.6406,9.0077,8.0758,95.046,8.3521,1201,7.8451,1245,886.55

Column	Example data	Description
01:	101	ID
02:	2010	Year
03:	191	Day of Year
04:	1600	hour-minute (hhmm)
05:	8.6616	2 Pt100 T in Stevenson screen)
06:	8.7393	3 Pt100 in new Young screen
07:	8.1231	4 Ventilated T
08:	92.025	5 Ventilated T
09:	0.97303	6 Mean horizontal wind speed
10:	193.45	7 resultant mean wind direction
11:	0.04069	8 Standard deviation of wind direction
12:	52.022	9 Global radiation
13:	1.76	10 Precipitation
14:	0	11 Not used
15:	0	12 Not used
16:	2.577	13 hourly max wind speed
17:	1234	14 time for max wind speed
18:	8.6406	15 Sample T Stevenson
19:	8.0077	16 Sample T Young
20:	8.0758	17 Sample ventilated T
21:	95.046	18 Sample ventilated Rh
22:	8.3521	19 Max T
23:	1201	20 time for max T
24:	7.8451	21 Min T
25:	1245	22 time for min T
26:	886.55	23 Barometric pressure

Example of daily data summaries:  
124,2010,185,2400,8.8723,9.2171,8.5587,79.773,11.411,1507,6.8495,2317,4.3512,1923,  
1.5568,102.36,61.231,3.84,13.899,0,0,886.34

Column	Example data	Description
01:	124	ID
02:	2010	Year
03:	185	Day of Year
04:	2400	hour-minute (hhmm)
05:	8.8723	2 Daily average T in Stevenson screen)
06:	9.2171	3 Daily T from T/Rh in Young screen
07:	8.5587	4 Daily T from ventilated T/Rh
08:	79.773	5 daily average Rh from ventilated T/Rh
08:	11.411	6 Daily maximum temperature in Young screen
10:	1507	7 hhmm for maximum daily temperature
11:	6.8495	8 Daily minimum temperature in Young screen
12:	2317	9 hhmm for minimum daily temperature
13:	4.3512	10 Maximum wind speed
14:	1923	11 hhmm for maximum wind speed
15:	1.5568	12 Average wind speed
16:	102.36	13 Average wind direction
17:	61.231	14 Incoming radiation
18:	3.84	15 Totalized precipitation
19:	13.899	16 Battery voltage
20:	0	17 Not used
21:	0	18 Not used
21:	886.34	18 Average barometric pressure

Example of 'Synoptic' output:

103,2010,185,1300,9.0077

Column	Example data	Description
01:	103	ID
02:	2010	Year
03:	185	Day of Year
04:	1300	hour-minute (hhmm)
05:	9.0077	Pt100 in Young screen

## 5 Data files and content

TRSmnet2010.csv Raw data file

TRS\_met\_2010\_Barometric\_pressure.csv

2010-01-01 01:00:00,878.9

TRS\_met\_2010\_Precipitation.csv

Date-time, Precipitation

2010-01-01 01:00:00,0.00

TRS\_met\_2010\_Radiation.csv

Date-time, Global radiation

2010-01-01 01:00:00,-4.48

TRS\_met\_2010\_Relative\_humidity.csv

Date-time, Vented Rh, ssample ventilated Rh

2010-01-01 01:00:00,82.0,80.7

TRS\_met\_2010\_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

2010-01-01 01:00:00,-17.74,-17.49,-18.24,-18.88,-18.94,-19.47,-16.28,0,-19.85,52

TRS\_met\_2010\_Wind.csv

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

2010-01-01 01:00:00,0.3,338.3,0.0354,0.85,23

TRS\_met\_2010\_Daily\_data.csv

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

2010-01-02 00:00:00,-15.90,-15.27,-16.03,83.4,-12.05,906,-19.98,129,3.1,114,1.3,89.1,-4.3,0.0,13.99

TRS\_met\_2010\_Synop\_data.csv

Date-time, sample temperature

2010-01-01 01:00:00,-18.94

The data collected during 2010 is summarized the figure 1 and Table 1.

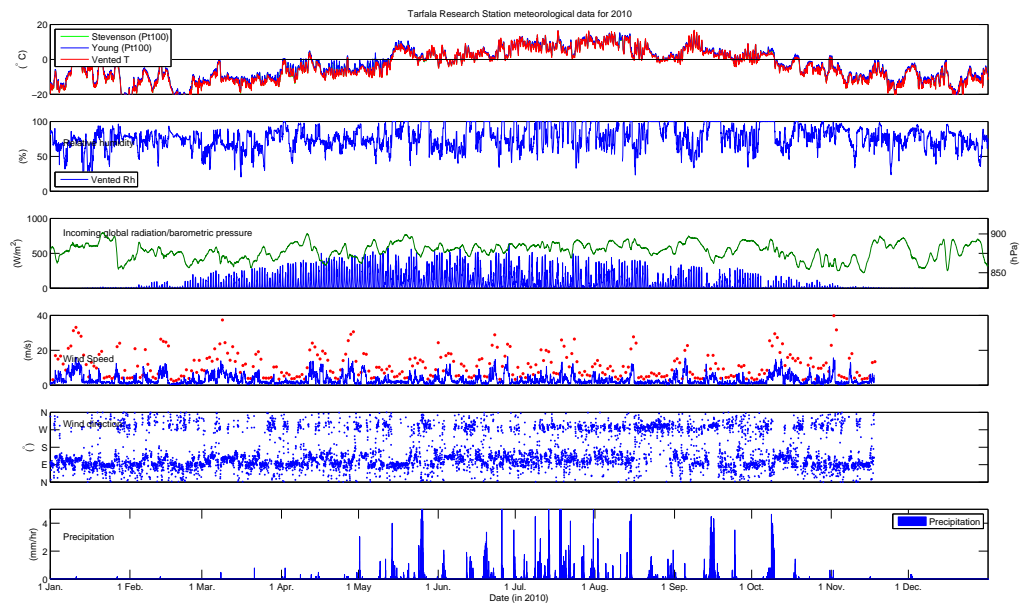


Figure. 1. Summary of meteorological data from Tarfala Research Station automatic weather station 2010.

Table. 1. Monthly averages of meteorological parameters from the Tarfala Research Station automatic weather station 2010.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average air temperature (Stevenson)												
(°C)	−9.9	−15.1	−11.3	−5.6	0.4	2.3	8.2	6.4	3.8	−2.1	−9.7	−11.0
<i>n</i>	743	671	767	743	743	702	680	767	743	767	743	767
Average air temperature (Young)												
(°C)	−9.2	−14.5	−10.7	−5.0	1.0	3.0	8.7	6.7	4.3	−1.6	−9.0	−10.2
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767
Average air temperature												
(°C)	−10.2	−15.5	−11.9	−6.4	−0.3	2.5	7.8	5.8	3.3	−2.7	−10.2	−11.5
<i>n</i>	743	671	767	743	743	743	743	736	743	767	743	767
Positive degree sum												
(°C)	6	0	0	53	1479	2169	5825	—	2633	545	9	0
<i>n</i>	7	0	0	33	389	570	743	—	619	224	13	0
Average relative humidity												
(%)	68.4	73.9	67.7	75.5	79.0	76.1	83.5	84.2	79.1	83.1	76.6	73.3
<i>n</i>	743	671	767	743	743	743	743	736	743	767	743	767
Average incoming global radiation												
(W m <sup>−2</sup> )	−2.9	6.4	46.1	105.4	131.0	135.2	95.6	75.8	48.8	15.3	−1.8	−4.2
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767
Global incoming energy sum												
(W m <sup>−2</sup> )	474	6319	37049	79380	97722	100530	71308	58986	37649	13777	1298	17
<i>n</i>	78	195	362	474	605	706	638	521	385	271	129	14
Totalized precipitation												
(mm)	0.32	0.16	1.28	5.60	128.00	101.92	192.16	95.04	99.84	70.08	2.40	1.44
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767
Average wind speed												
(m s <sup>−1</sup> )	3.8	2.7	3.8	3.5	2.6	3.6	2.9	2.4	2.7	3.6	—	—
<i>n</i>	743	671	767	743	743	743	743	767	743	767	—	—
Average barometric pressure												
(hPa)	880.8	872.8	869.9	878.6	883.2	880.6	884.0	882.5	882.8	873.7	874.4	875.7
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767

# Logger program

## 5.1 Program for 2010 (same as for 2009)

```
{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: 22 Loc [ R_R0_T_1 ]
7: 95.969 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: 23 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: 22 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
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
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 ]

;-----
; B A R O M E T R I C   P R E S S U R E
16: If time is (P92)
1: 59     Minutes (Seconds --) into a
2: 60     Interval (same units as above)
3: 48     Set Port 8 High

17: If time is (P92)
1: 0      Minutes (Seconds --) into a
2: 60     Interval (same units as above)
3: 30     Then Do

18: Volt (SE) (P1)
1: 1      Reps
2: 15     2500 mV Fast Range
3: 11     SE Channel
4: 11     Loc [ P_mb ]
5: 0.2    Mult
6: 600    Offset

19: Do (P86)
1: 58     Set Port 8 Low

20: End (P95)

;-----
; H O U R L Y   O U T P U T
21: 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)

22: Set Active Storage Area (P80)
1: 1      Final Storage Area 1

```

```

2: 101      Array ID

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

24: Resolution (P78)
1: 1      High Resolution

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

26: Resolution (P78)
1: 1      High Resolution

; Store wind speed, dir and std dev
27: 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  ]

28: Resolution (P78)
1: 1      High Resolution

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

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

; no data
31: Average (P71)
1: 2      Reps
2: 12     Loc [ _____ ]

32: Resolution (P78)
1: 1      High Resolution

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

34: Resolution (P78)
1: 1      High Resolution

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

36: Resolution (P78)
1: 1      High Resolution

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

38: Resolution (P78)
1: 1      High Resolution

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

40: Resolution (P78)
1: 1      High Resolution

41: Sample (P70)
1: 1      Reps
2: 11     Loc [ P_mb      ]

;-----
; D A I L Y   O U T P U T
42: 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)

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

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

45: Resolution (P78)
1: 1      High Resolution

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

47: Resolution (P78)
1: 1      High Resolution

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

49: Resolution (P78)
1: 1      High Resolution

; Store daily min unvent T
50: Minimum (P74)
1: 1      Reps
2: 10     Value with Hr-Min
3: 2      Loc [ T_2      ]

51: Resolution (P78)
1: 1      High Resolution

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

53: Resolution (P78)
1: 1      High Resolution

; Store average wind vector
54: 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 ]

55: Resolution (P78)
1: 1      High Resolution

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

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

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

; no data
59: Average (P71)
1: 2      Reps
2: 12     Loc [ ----- ]

60: Resolution (P78)
1: 1      High Resolution

61: Average (P71)
1: 1      Reps
2: 11     Loc [ P_mb      ]

```

```

;-----
; 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.
62: If time is (P92)
1: 60      Minutes (Seconds --) into a
2: 180     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: Resolution (P78)
1: 1       High Resolution

66: 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--  6      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 [ P_mb     ] RW--  2      1      -----
12 [ ----- ] R---  2      0      -----
13 [ ----- ] R---  2      0      -----
14 [ ----- ] ----  0      0      -----
15 [ ----- ] ----  0      0      -----
16 [ ----- ] ----  0      0      -----
17 [ ----- ] ----  0      0      -----
18 [ ----- ] ----  0      0      -----
19 [ ----- ] ----  0      0      -----
20 [ ----- ] ----  0      0      -----
21 [ ----- ] ----  0      0      -----
22 [ R_RO_T_1 ] RW--  1      1      -----
23 [ R_RO_T_2 ] RW--  1      1      -----

```