



Tarfala Research Station automatic weather station, 2002

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1 Instrumentation

The TRS met station consisted of the following instruments during 2002

Sensor	Serial number	Remark
Pt100		in Stevenson screen
Pt100		in Young screen
T/Rh		at 2 m (Young screen)
Young Wind Monitor		at 3 m
LiCor Li-200SB pyranometer		at 2 m
Tipping bucket precipitation gauge		at 2 m
Ventilated T/Rh		at 2 m
CR10 data logger		

2 Notes on the station data

- Problems with ventilated T/Rh throughout the year Although less NaN values in ventilated Rh many unrealistic values exist in the series.
- Problems (unknown) with Pt100 sensors in Young and Stevenson screens in the period 2002-09-11 17:00:00 to 2002-11-23 15:00:00. Bad data (but not NaN exist beyond the period.
- Based on the graph, it is evident that the Young shield Pt100 is not working well in December. This can be a program constants, reference resistor or zero offset calibration issue.

3 Data coverage

- Relative humidity (ventilated) data missing from
2002-01-13 21:00:00 to 2002-01-14 07:00:00
2002-01-14 09:00:00 to 2002-01-14 13:00:00
2002-01-14 16:00:00 to 2002-01-14 20:00:00
2002-04-22 22:00:00 to 2002-04-23 01:00:00
2002-04-23 14:00:00 to 2002-04-24 01:00:00
2002-04-24 08:00:00 to 2002-04-24 18:00:00
2002-05-13 02:00:00
- Temperature (ventilated unless stated otherwise) data missing from
2002-01-05 15:00:00
2002-01-05 23:00:00 to 2002-01-06 00:00:00
2002-01-06 10:00:00 to 2002-01-08 04:00:00
2002-01-10 11:00:00 to 2002-02-12 02:00:00
2002-02-12 04:00:00 to 2002-02-24 16:00:00
2002-02-24 19:00:00 to 2002-02-25 15:00:00
2002-02-25 17:00:00
2002-02-25 19:00:00 to 2002-02-26 04:00:00
2002-02-28 12:00:00 to 2002-03-01 22:00:00
2002-03-02 16:00:00 to 2002-03-02 18:00:00
2002-03-03 09:00:00 to 2002-03-03 10:00:00
2002-03-03 12:00:00 to 2002-03-03 15:00:00
2002-03-04 04:00:00
2002-03-04 06:00:00 to 2002-03-04 19:00:00
2002-03-08 09:00:00 to 2002-03-08 19:00:00
2002-03-13 11:00:00 to 2002-03-13 15:00:00
2002-03-13 17:00:00
2002-03-13 19:00:00
2002-03-13 22:00:00 to 2002-03-13 23:00:00

2002-03-14 11:00:00 to 2002-03-22 16:00:00
 2002-03-22 18:00:00
 2002-03-22 21:00:00 to 2002-03-23 00:00:00
 2002-03-23 02:00:00
 2002-03-23 04:00:00 to 2002-03-24 16:00:00
 2002-03-24 18:00:00 to 2002-03-24 19:00:00
 2002-03-24 23:00:00 to 2002-03-25 00:00:00
 2002-03-25 05:00:00 to 2002-03-28 02:00:00
 2002-03-28 04:00:00 to 2002-03-28 08:00:00
 2002-03-28 11:00:00 to 2002-03-28 13:00:00
 2002-03-29 09:00:00 to 2002-03-29 11:00:00
 2002-03-29 14:00:00
 2002-03-31 12:00:00 to 2002-03-31 14:00:00
 2002-04-21 13:00:00 to 2002-04-28 22:00:00
 2002-04-29 10:00:00 to 2002-04-29 20:00:00
 2002-04-30 07:00:00 to 2002-04-30 18:00:00
 2002-05-04 14:00:00 to 2002-05-04 20:00:00
 2002-05-05 11:00:00
 2002-05-05 14:00:00 to 2002-05-06 00:00:00
 2002-05-06 09:00:00 to 2002-05-06 17:00:00
 2002-05-07 09:00:00 to 2002-05-07 10:00:00
 2002-09-11 17:00:00 to 2002-11-23 15:00:00 (Pt100 Young)
 2002-09-12 20:00:00 to 2002-11-22 14:00:00 (Pt100 Stevenson)
 2002-11-22 14:00:00

- Daily data missing from
2002-09-12 00:00:00 to 2002-11-24 00:00:00
- ‘Synoptic’ data missing from:
2002-09-11 19:00:00 to 2002-11-23 13:00:00

4 Notes on data storage

Example of hourly data:

101,2002,185,1300,10.03,9.85,9.93,50.89,4.208,277.4,.164,472.5,0,10.77,61.98,7.1,1224

Column	Example data	Description
01:	101	ID
02:	2002	Year
03:	185	Day of Year
04:	1300	hour-minute (hhmm)
05:	10.03	2 Pt100 T in Stevenson screen)
06:	9.85	3 T in Young screen
07:	9.93	4 Pt100 in new Young screen
08:	50.89	5 Rh in Young screen
09:	4.208	6 Mean horizontal wind speed
10:	277.4	7 resultant mean wind direction
11:	.164	8 Standard deviation of wind direction
12:	472.5	9 Global radiation
13:	0	10 Precipitation/SR50
14:	10.77	11 ventilated T
15:	61.98	12 ventilated Rh
16:	7.1	13 hourly max wind speed
17:	1224	14 time for max wind speed

Example of daily data summaries:
124,2002,185,2400,8.84,8.78,8.9,60.56,11.38,1520,6.605,2342,12.5,503,3.517,306.5,
148.8,0,13.9,9.61,70.4

Column	Example data	Description
01:	124	ID
02:	2002	Year
03:	185	Day of Year
04:	2400	hour-minute (hhmm)
05:	8.84	2 Daily average T in Stevenson screen)
06:	8.78	3 Daily T from T/Rh in Young screen
07:	8.9	4 Daily T from T/Rh in Young screen
08:	60.56	5 daily average humidity in Young screen
08:	11.38	6 Daily maximum temperature in Young screen
10:	1520	7 hhmm for maximum daily temperature
11:	6.605	8 Daily minimum temperature in Young screen
12:	2342	9 hhmm for minimum daily temperature
13:	12.5	10 Maximum wind speed
14:	503	11 hhmm for maximum wind speed
15:	3.517	12 Average wind speed
16:	306.5	13 Average wind direction
17:	148.8	14 Incoming radiation
18:	0	15 Totalized precipitation
19:	13.9	16 Battery voltage
20:	9.61	17 Average ventilated temperature
21:	70.4	18 Average ventilated relative humidity

Example of 'Synoptic' output:
103,2002,185,1300,10.04

Column	Example data	Description
01:	103	ID
02:	2002	Year
03:	185	Day of Year
04:	1300	hour-minute (hhmm)
05:	10.04	Pt100 in Young screen

5 Data files and content

TRSmnet2002.csv Raw data file

TRS_met_2002_Precipitation.csv

Date-time, Precipitation

2002-01-01 01:00:00,0.00

TRS_met_2002_Radiation.csv

Date-time, Global radiation

2002-01-01 01:00:00,-0.21

TRS_met_2002_Relative_humidity.csv

Date-time, hourly average Rh, ventilated Rh

2002-01-01 01:00:00,55.8,73.0

TRS_met_2002_Temperature.csv

Date-time, hourly average T (Stevenson), hourly average T (Young), hourly average T/Rh (Young), ventilated (T/Rh)

2002-01-01 01:00:00,-12.61,-12.67,-11.84,-11.87

TRS_met_2002_Wind.csv

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

2002-01-01 01:00:00,3.5,301.5,0.1550,9.66,2

TRS_met_2002_Daily_data.csv

Data columns follows description above

2002-01-02 00:00:00,-14.54,-14.19,-13.66,41.4,-9.82,557,-18.87,2240,9.7,
2,2.3,342.1,0.4,0.0,13.93

TRS_met_2002_Synop_data.csv

Date-time, sample temperature

2002-01-01 01:00:00,-13.86

The data collected during 2002 is summarized the figure 1 and Table 1.

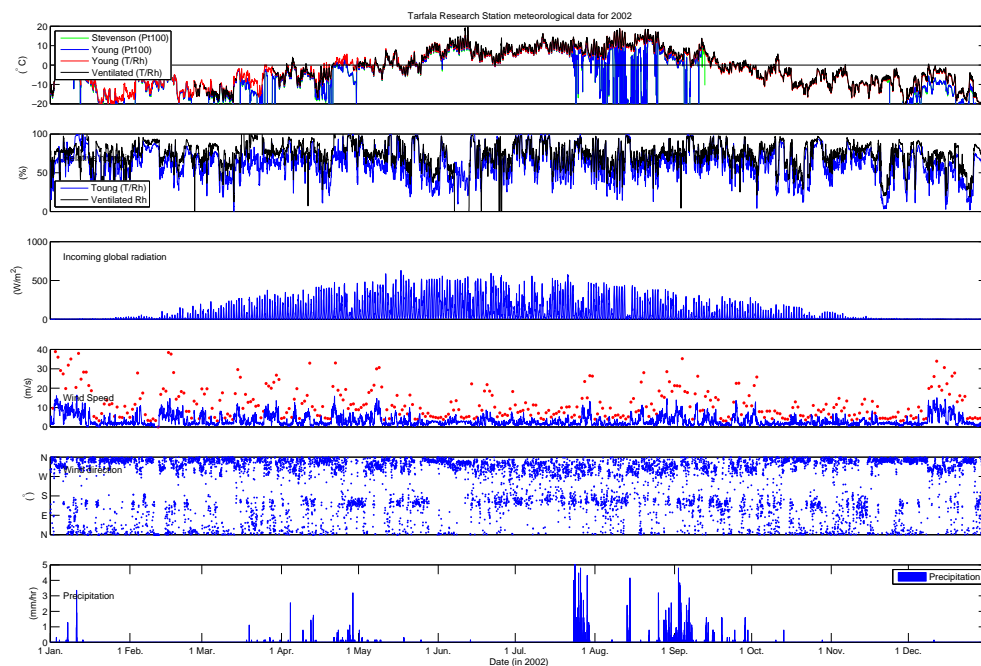


Figure. 1. Summary of meteorological data from Tarfala Research Station automatic weather station 2002.

Table. 1. Monthly averages of meteorological parameters from the Tarfala Research Station automatic weather station 2002.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average air temperature (Stevenson)												
(°C)	−17.3	−35.7	−61.7	−6.8	1.0	6.7	7.4	−15.4	—	—	—	−19.1
<i>n</i>	743	671	767	743	743	743	743	767	—	—	—	767
Average air temperature (Young)												
(°C)	−17.0	−35.6	−61.5	−6.6	1.1	6.7	7.3	−15.4	—	—	—	−18.8
<i>n</i>	743	671	767	743	743	743	743	767	—	—	—	767
Average air temperature												
(°C)	−9.2	−10.2	−9.3	−3.1	1.5	7.1	8.7	10.4	2.1	−6.4	−9.4	−10.7
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767
Positive degree sum												
(°C)	89	0	0	384	1700	5293	6453	7946	2036	78	0	0
<i>n</i>	117	0	2	211	437	738	743	767	471	30	0	0
Average relative humidity												
(%)	62.5	67.2	58.4	67.7	62.3	57.4	70.6	60.1	69.5	59.7	57.6	51.6
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767
Average incoming global radiation												
(W m ^{−2})	2.4	11.5	50.7	97.2	158.0	158.3	117.4	108.8	52.3	28.7	5.5	2.6
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767
Global incoming energy sum												
(W m ^{−2})	1805	7706	38927	72230	117415	117614	87216	83490	38862	21976	4065	1984
<i>n</i>	714	643	589	651	740	743	743	678	731	767	702	765
Totalized precipitation												
(mm)	13.28	0.00	3.04	33.92	3.36	0.32	95.20	58.08	134.88	1.12	0.00	0.16
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767
Average wind speed												
(m s ^{−1})	4.5	3.6	3.7	3.0	3.2	2.6	2.6	2.8	3.5	2.3	2.1	4.0
<i>n</i>	743	671	767	743	743	743	743	767	743	767	743	767

Logger program

5.1 Program valid for the year (copy from 2001)

```
;{CR10}
;=====
; TARFALA MET STATION
; based on program tarm0898 from 6. August 1998
; NEW: output hourly max wind
; Regine Hock, 5 May 2001
;=====
;{CR10}
```

*Table 1 Program

01: 10.0000 Execution Interval (seconds)

1: Batt Voltage (P10)

1: 10 Loc [Batteri_V]

2: IF (X<=>F) (P89)

1: 10 X Loc [Batteri_V]

2: 4 <

3: 9.7 F

4: 0 Go to end of Program Table

;===== TEMPERATURE 1 - PT100 in weather hut =====

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 [Rs_Ro_T1]

7: 100 Mult

8: 0.0000 Offset

;===== TEMPERATURE 2 - PT100 in radiation shield =====

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 [Rs_Ro_T2]

7: 100.00 Mult

8: 0.0000 Offset

;=== calculate Temp 1 and Temp 2 from Rs/Ro =====

5: Temperature RTD (P16)

1: 2 Reps

2: 21 R/R0 Loc [Rs_Ro_T1]

3: 1 Loc [T1_bur__C]

4: 1 Mult

5: 0.0000 Offset

6: Do (P86)

1: 41 Set Port 1 High


```

;===== Temperature Rotronic =====

7: Volt (Diff) (P2)
  1: 1      Repts
  2: 35     2500 mV 50 Hz Rejection Range
  3: 3      DIFF Channel
  4: 3      Loc [ T3_Rot__C ]
  5: 0.1    Mult
  6: 0.0000 Offset

;===== RELATIVE HUMIDITY Rotronic =====

8: Volts (SE) (P1)
  1: 1      Repts
  2: 35     2500 mV 50 Hz Rejection Range
  3: 7      SE Channel
  4: 4      Loc [ rH_Rot___ ]
  5: 0.1    Mult
  6: 0.0    Offset

;===== VENTILATED TEMPERATURE SENSOR (Vaisala PT100) =====

9: 3W Half Bridge (P7)
  1: 1      Repts
  2: 33     25 mV 50 Hz Rejection Range
  3: 11     SE Channel
  4: 3      Excite all reps w/Exchan 3
  5: 2100   mV Excitation
  6: 23     Loc [ Rs_Ro_ven ]
  7: 100    Mult
  8: 0.0000 Offset

10: Temperature RTD (P16)
  1: 1      Repts
  2: 23     R/R0 Loc [ Rs_Ro_ven ]
  3: 11     Loc [ TempVent ]
  4: 1      Mult
  5: 0.0000 Offset

;===== RELATIVE HUMITY (VENTILATED SENSOR) =====

11: Volts (SE) (P1)
  1: 1      Repts
  2: 35     2500 mV 50 Hz Rejection Range
  3: 8      SE Channel
  4: 12     Loc [ HumVent ]
  5: 0.1    Mult
  6: 0.0    Offset

;===== WIND SPEED =====

12: Pulse (P3)
  1: 1      Repts
  2: 1      Pulse Input Channel
  3: 21     Low Level AC, Output Hz
  4: 5      Loc [ Vhast_m_s ]
  5: 0.098  Mult
  6: 0      Offset

```

```

;===== WIND DIRECTION =====
13: 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 (units 0.01 sec)
  6: 2500   mV Excitation
  7: 6      Loc [ Vrikt____ ]
  8: 0.142  Mult
  9: -135   Offset

14: IF (X<=>F) (P89)
  1: 6      X Loc [ Vrikt____ ]
  2: 4      <
  3: 0      F
  4: 30     Then Do

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

16: End (P95)

;===== GLOBAL RADIATION =====
17: Volts (SE) (P1)
  1: 1      Reps
  2: 33     25 mV 50 Hz Rejection Range
  3: 10     SE Channel
  4: 7      Loc [ Sol__W_m_ ]
  5: 116.55 Mult
  6: 0.0000 Offset

;===== PRECIPITATION =====
18: Pulse (P3)
  1: 1      Reps
  2: 2      Pulse Input Channel
  3: 2      Switch Closure, All Counts
  4: 8      Loc [ Nederb_mm ]
  5: 0.16   Mult
  6: 0.0    Offset

19: Internal Temperature (P17)
  1: 9      Loc [ Logtemp_C ]

; ===== OUTPUT =====

20: If time is (P92)
  1: 0      Minutes (Seconds --) into a
  2: 60     Interval (same units as above)
  3: 10     Set Output Flag High

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

22: Real Time (P77)

```

```

1: 1220      Year,Day,Hour/Minute (midnight = 2400)

23: Average (P71)
1: 4        Reps
2: 1        Loc [ T1_bur__C ]

24: Wind Vector (P69)
1: 1        Reps
2: 1        Samples per Sub-Interval
3: 0        S, é1, & â(é1) Polar
4: 5        Wind Speed/East Loc [ Vhast_m_s ]
5: 6        Wind Direction/North Loc [ Vrikt____ ]

25: Average (P71)
1: 1        Reps
2: 7        Loc [ Sol__W_m_ ]

26: Totalize (P72)
1: 1        Reps
2: 8        Loc [ Nederb_mm ]

27: Average (P71)
1: 2        Reps
2: 11       Loc [ TempVent  ]

28: Maximize (P73)
1: 1        Reps
2: 10       Value with Hr-Min
3: 5        Loc [ Vhast_m_s ]

29: Serial Out (P96)
1: 71       SM192/SM716/CSM1

; ===== STORAGE DAILY MEANS AT MIDNIGHT =====

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

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

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

33: Average (P71)
1: 4        Reps
2: 1        Loc [ T1_bur__C ]

34: Maximize (P73)
1: 1        Reps
2: 10       Value with Hr-Min
3: 2        Loc [ T2_skyd_C ]

35: Minimize (P74)
1: 1        Reps

```

```

2: 10      Value with Hr-Min
3: 2       Loc [ T2_skyd_C ]

36: Maximize (P73)
1: 1       Reps
2: 10      Value with Hr-Min
3: 5       Loc [ Vhast_m_s ]

37: Wind Vector (P69)
1: 1       Reps
2: 1       Samples per Sub-Interval
3: 1       S, é1 Polar
4: 5       Wind Speed/East Loc [ Vhast_m_s ]
5: 6       Wind Direction/North Loc [ Vrikt_---- ]

38: Average (P71)
1: 1       Reps
2: 7       Loc [ Sol__W_m_ ]

39: Totalize (P72)
1: 1       Reps
2: 8       Loc [ Nederb_mm ]

40: Sample (P70)
1: 1       Reps
2: 10      Loc [ Batteri_V ]

41: Average (P71)
1: 2       Reps
2: 11      Loc [ TempVent  ]

42: Serial Out (P96)
1: 71      SM192/SM716/CSM1

43: If time is (P92)
1: 60      Minutes (Seconds --) into a
2: 1440     Interval (same units as above)
3: 10      Set Output Flag High

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

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

; SAMPLE TEMP FOR COMPARISON WITH 3-HOURLY DATA OF OTHER STATIONS =====

46: Sample (P70)
1: 1       Reps
2: 2       Loc [ T2_skyd_C ]

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

48: Set Active Storage Area (P80)

```

```

1: 1      Final Storage Area 1
2: 103     Array ID

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

50: Sample (P70)
1: 1      Reps
2: 2      Loc [ T2_skyd_C ]

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

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

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

54: Sample (P70)
1: 1      Reps
2: 2      Loc [ T2_skyd_C ]

; 3-HOURLY TEMP VALUES TO FILE =====0

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

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

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

58: Sample (P70)
1: 1      Reps
2: 2      Loc [ T2_skyd_C ]

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

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

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

62: Sample (P70)
1: 1      Reps

```

```

2: 2          Loc [ T2_skyd_C ]

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

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

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

66:  Sample (P70)
1:  1         Reps
2:  2         Loc [ T2_skyd_C ]

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

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

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

70:  Sample (P70)
1:  1         Reps
2:  2         Loc [ T2_skyd_C ]

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

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

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

74:  Sample (P70)
1:  1         Reps
2:  2         Loc [ T2_skyd_C ]

*Table 2 Program
01: 0.0000    Execution Interval (seconds)

*Table 3 Subroutines

End Program

```

1	[T1_bur__C]	RW--	2	1	Start	-----	---
2	[T2_skyd_C]	RW--	12	1	-----	-----	End
3	[T3_Rot__C]	RW--	2	1	Start	-----	---
4	[rH_Rot___]	RW--	2	1	-----	-----	---
5	[Vhast_m_s]	RW--	4	1	-----	-----	---
6	[Vrikt_____]	RW--	4	2	-----	-----	---
7	[Sol__W_m_]	RW--	2	1	-----	-----	---
8	[Nederb_mm]	RW--	2	1	-----	-----	---
9	[Logtemp_C]	-W--	0	1	-----	-----	---
10	[Batteri_V]	RW--	2	1	-----	-----	---
11	[TempVent]	RW--	2	1	-----	-----	---
12	[HumVent]	RW--	2	1	-----	-----	---
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	[Rs_Ro_T1]	RW--	1	1	-----	-----	---
22	[Rs_Ro_T2]	RW--	1	1	-----	-----	---
23	[Rs_Ro_ven]	RW--	1	1	-----	-----	---
24	[_____]	----	0	0	-----	-----	---
25	[_____]	----	0	0	-----	-----	---
26	[_]	----	0	0	-----	-----	---
27	[Rs_lo2]	----	0	0	-----	-----	---
28	[Temp2m]	----	0	0	-----	-----	---
29	[RelHum2m]	----	0	0	-----	-----	---
101	[_____]	----	0	0	-----	-----	---
103	[_____]	----	0	0	-----	-----	---
124	[_____]	----	0	0	-----	-----	---