UNIVERSITY of BAYREUTH
Department of Micrometeorology

The Arctic Turbulence Experiment 2006

Direct measurements of turbulent fluxes in the near surface environment at high latitudes applying the eddy-covariance method

PART 1

Technical documentation of the ARCTEX 2006 campaign

May, 2nd to May, 20th 2006

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Contents

1 Introduction

Abstract

Accurate quantification of turbulent fluxes between the surface and the atmospheric boundary layer in polar environments, characterized by frequent stable to very stable stratified conditions, is a fundamental problem in soil-snow-ice-vegetation-atmosphere interaction studies. The observed rapid climate warming in the Arctic requires improvements in the monitoring of energy and matter exchange; accomplished by setting up appropriate (adapted to polar conditions) observation sites to measure turbulent fluxes. To address these problems, it is essential to improve the databases with high-quality in-situ measurements of turbulent fluxes near the surface applying the Eddy-Covariance method.

These direct measurement data (CSAT3 sonic anemometer, KH20 krypton hygrometer, and laser scintillometer) obtained during the first Arctic Turbulence Experiment (ARCTEX-2006) in May 2006 at the French-German Arctic Research Base in Ny-Ålesund (AWI/IPEV) on Spitsbergen (Svalbard) allowed a comparison with simulated results from simple flux gradient-parameterizations used today to force atmosphere-ocean-ice models. In addition, the results of this pilot study shows the problem of direct measurements (e.g. snow drift through the sensor path ways) under rough weather conditions as well as they reveal that the misestimating of sensible heat fluxes can result from inaccurate measurements or calculation of the surface temperature and inappropriate treatment of the neutral and stable conditions (e.g. intermittency, gravity waves) in the bulk parameterization.

The primary goals of the ARCTEX-campaign were:

1. continuous measurements of high-resolution (20 Hz) turbulent heat fluxes near the tundra surface using a ultra sonic anemometer (eddy-covariance method) and an ultraviolet krypton hygrometer,
2. continuous measurements of the turbulent sensible heat flux near the tundra surface using the Laser-scintillometry,
3. measurements of standard meteorological data sampled at 1s intervals using a meteorological gradient tower (6 m and 10 m),
4. pre- and post- processing of high-quality data sets of turbulent fluxes using state of the art flux data quality assessment techniques,
5. understanding of exchange processes and their parameterization for neutral and stable conditions,
6. validation of commonly used sensible and latent heat flux parameterizations (aerodynamic approach, bulk and gradient method).

2 General Information

2.1 Location

Detailed geographic locations of the "Arctic Turbulence Experiment 2006" (ARCTEX-2006) at Ny-Ålesund (Svalbard, Kongsfjorden), May 2006, Universities of Bayreuth and Trier, Germany:

General location	Svalbard, Kongsfjorden, Ny-Ålesund, Position (Center of settlement): 078° 55' 24'' N, 011° 55' 15'' E	
Eddy-Flux complex UBT (EF):	Coordinates:	078° 55' 02'' N, 011° 55' 52'' E
	Altitude:	13 m a. s. l.
	Land use:	snow covered tundra
Meteorological tower AWI (MT1):	Coordinates:	078° 55' 04'' N, 011° 55' 26'' E
	Altitude:	14 m a. s. l.
	Land use:	snow covered tundra
Meteorological tower UBT (MT2):	Coordinates:	078° 55' 03'' N, 011° 55' 34'' E
	Altitude:	14 m a. s. l.
	Land use:	snow covered tundra
Scintillometer UBT (SLS):	Coordinates:	078° 55' 00'' N, 011° 56' 00'' E
	Altitude:	13.5 m a. s. l.
	Land use:	snow covered tundra
Tethered balloon AWI (TB1):	Coordinates:	078° 55' 06'' N, 011° 55' 23'' E
	Altitude:	11 m a. s. l.
	Land use:	snow covered tundra
Tethered balloon AWI (TB2):	Coordinates:	078° 55' 27'' N, 011° 56' 07'' E
	Altitude:	3 m a. s. l.
	Land use:	Harbor (concrete), fjord (water)
Radiosonde AWI (RS):	Coordinates:	078° 55' 06'' N, 011° 55' 23'' E
	Altitude:	11 m a. s. l.
	Land use:	snow covered tundra
BSRN AWI (BSRN):	Coordinates:	078° 56' 05'' N, 011° 56' E
	Altitude:	11 m a. s. l.
	Land use:	snow covered tundra
Time zone		Central European Time: CET = GMT + 1 h (winter) CEST = GMT + 2 h (summer). Given times and filenames reflect starting time of intervals

UBT=Univ. of Bayreuth; AWI= Alfred Wegener Institute for Polar- and Marine Research; BSRN= Baseline Surface Radiation Network

2.2 Surface and weather conditions

Table 2.1 lists the surface and weather conditions during the ARCTEX-2006 campaign. Noteworthy, is the extreme warm period until evening May 7 and the heavy snow-storm at night, May 7 to May 8.

Table 2.1: Surface and weather conditions during the ARCTEX-2006 campaign.

May 3 to May 5	wet melting snow over ice, larger snow free spots (bare soil, tundra), surface melt water, some rain fall and partly cloudy, Arctic Haze event, extremely warm, temperature range: +3 °C to +8 °C
May 6 to May 8	1st storm and heavy snowfall, heavy snowdrift; overcast weather, extremely warm (+8 °C) until beginning of the 2nd storm on May 7, 19 h CET and temperature drop of more than 16 K (–10 °C)
May 9 to May 11	fresh snow cover, predominantly sunny weather, temperature range: –5 °C to –2 °C
May 12 to May 14	ongoing snowdrift, snow cover depleting, at 13th pm temperature around 0 °C, predominantly overcast or partly cloudy weather, temperature range: –4 °C to 0 °C
May 15 to May 16	ongoing snowdrift, some snow free spots, at ground refrozen and compacted thin ice layers, predominantly sunny or partly cloudy weather, temperature range: –4 °C to –1 °C
May 17 to May 19	melting snow over ice, some snow free spots (bare soil, tundra), light to moderate rain and/or snowfall (17th and 18th, temperature range: –2 °C to +1 °C)

3 Overview of measurement sites

3.1 Maps and photographs

The Digital Elevation model (DEM) of the whole Kongsfjord area together with a simple land use classification was produced by the ARCTEX-Team, namely Univ. of Trier, derived from the official topographic maps of the Norwegian Polar Institute Tromsø (Figure 3.1) as background information to interpret e.g. the local mesoscale wind field and (in future) to force Footprint or SVAT-models.

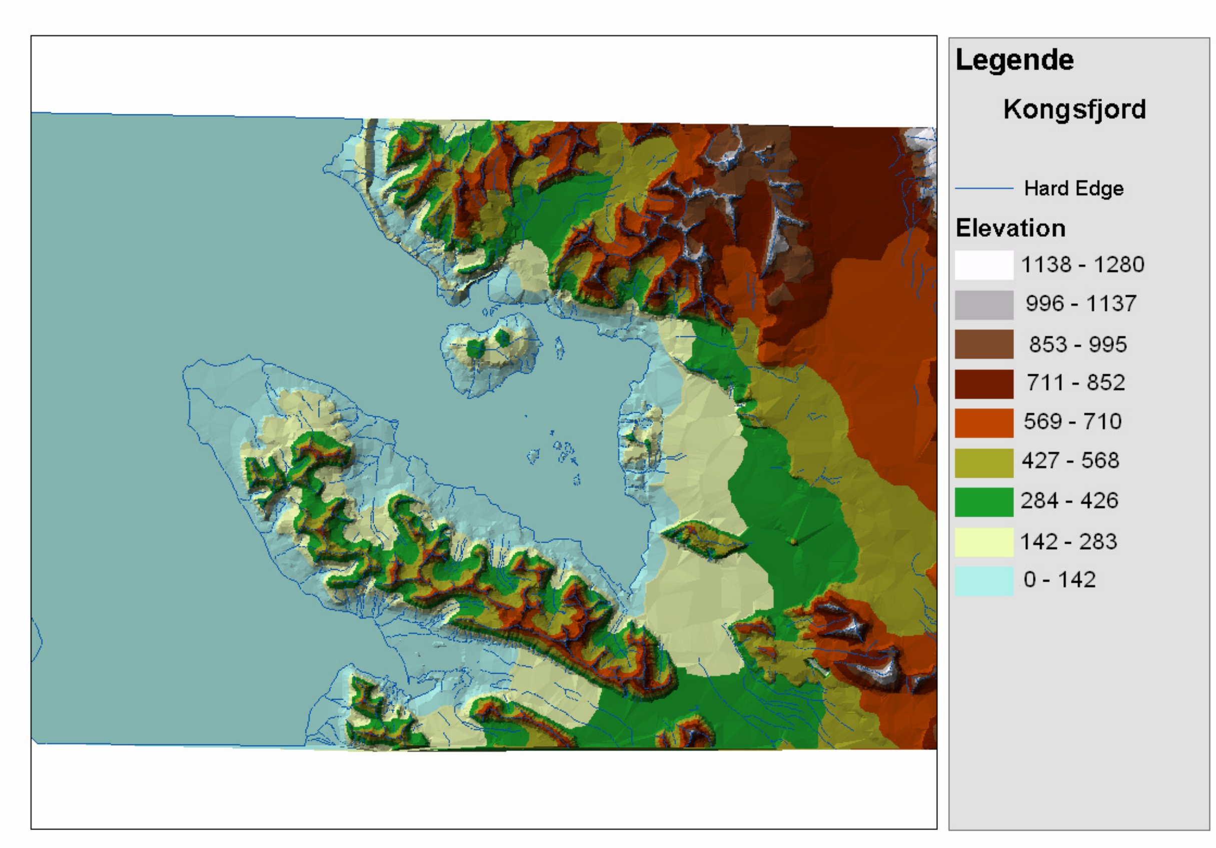

Figure 3.1: High resolution Digital Elevation Model of the Kongsfjord area, Svalbard, produced by the ARCTEX-Team and derived from the topographic map of Svalbard, parts A6, A7, B6 and B7 - 1:100 000 (S100), Norwegian Polar Institute Tromsø, ARCTEX-2006 campaign.

The map (Figure 3.2) of Ny-Ålesund (Svalbard) shows the measurement sites during the ARCTEX-2006 campaign. The permanent AWI/IPEV sites used for this study are the 10 m meteorological tower of the Alfred Wegener Institute for Polar and Marine Research (MT1), the international standardized radiation measurements of the Baseline Surface Radiation Network (BSRN), the WMO 1004 radiosonde launch site (RS) and the temporary AWI tethered balloon launch sites TB1 and TB2. The temporary sites - build up by the Universities of Bayreuth and Trier - are the 6 m meteorological tower (MT2), the eddy-flux measurement complex with sonic anemometer (EF), and the Laser-scintillometer pathway (SLS).

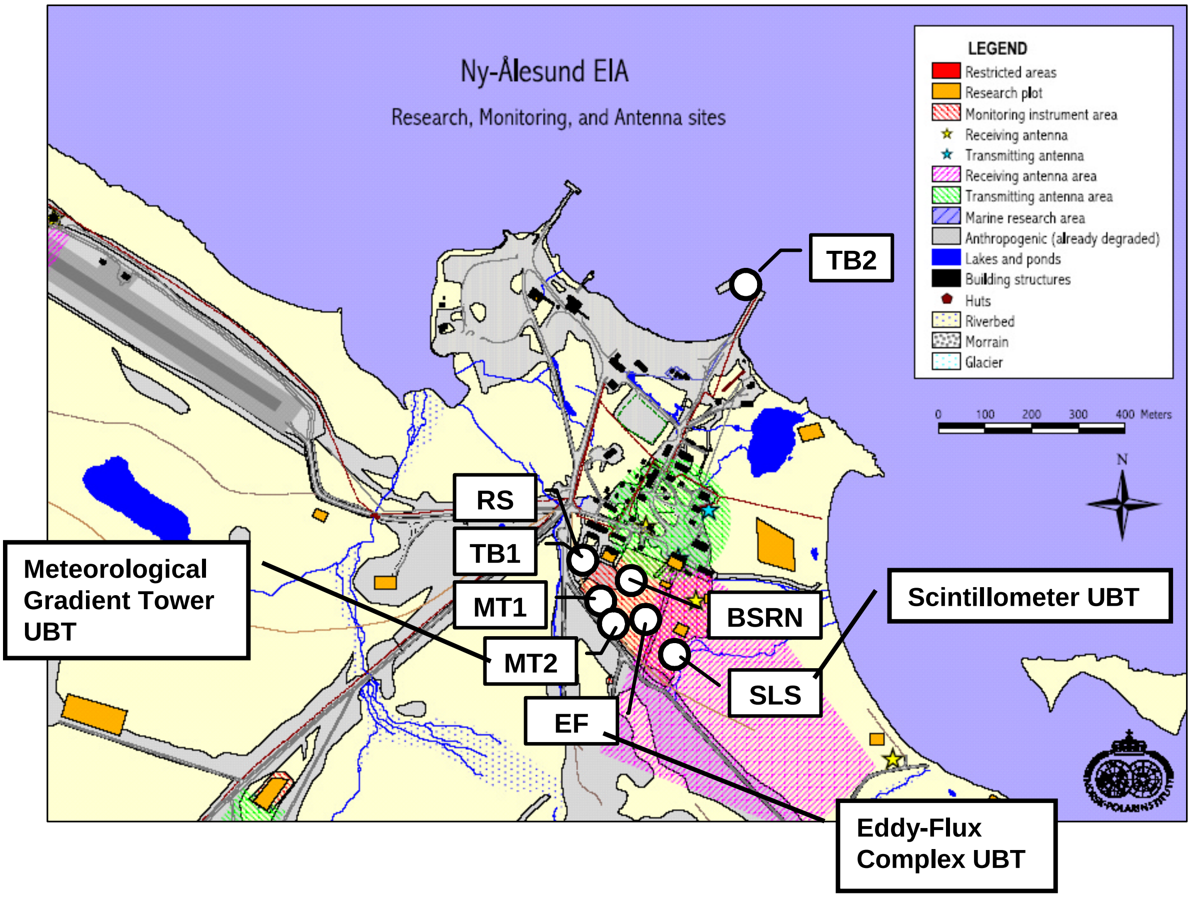

Figure 3.2: Map of Ny-Ålesund (Svalbard, Kongsfjorden) showing the measurement sites during the ARCTEX-2006 campaign: MT1 (10 m meteorological tower of the Alfred Wegener Institute for Polar and Marine Research), MT2 (6 m meteorological tower of the University of Bayreuth), EF (eddy-flux measurement complex), SLS (site for scintillometer measurements), BSRN (radiation measurements of the Baseline Surface Radiation Network), RS (radiosonde launch site), TB1 and TB2 (tethered balloon launch sites). The base map was kindly provided by the Norwegian Polar Institute.

3.1.1 AWI Meteorological Tower (MT1)

The permanent 10 m tall meteorological tower (MT1) of the Alfred-Wegener-Institute (Figure 3.3) is located about 100 m south-east of the atmospheric observatory (AWI-OBS) south of Ny-Ålesund in the protected monitoring instrument area five meter away from the driveway to the Corbel-Station. The measurements of this site are part of the routine meteorological observation program (surface radiation and mast measurements) operating since 1994 and headed by the AWI (http://www.awi-potsdam.de/MET/NyAlesund/wettertab.html).

Figure 3.3: Ten meter tall meteorological tower (MT1) of the Alfred Wegener Institute south of the AWI Scientific Observatory. Routine meteorological measurements AWI/IPEV station Ny-Ålesund (Svalbard), ARCTEX-2006 campaign.

Table 3.1: Ten meter tall meteorological tower (MT1) of the Alfred Wegener Institute south of the AWI Scientific Observatory. Routine meteorological measurements AWI/IPEV station Ny-Ålesund (Svalbard), ARCTEX-2006 campaign.

Meteorological element	Sensor type
air temperature 2 m and 10 m (°C)	ventilated thermometer
relative humidity 2 m (%)	capacitive humidity sensor
wind speed 2 m and 10 m (m s^{-1}	cup anemometer
wind direction 2 m and 10 m (Grad)	wind vane
surface pressure 11 m a.s.l. (hPa)	piezoelectric pressure sensor

3.1.2 Univ. of Bayreuth Gradient Tower (MT2)

To compare the direct measurements of turbulent heat fluxes applying the eddy-covariance method (EF) and laser scintillometry (SLS) with calculated results from simple flux gradient-parameterizations additional micrometeorological measurements were necessary. Figure 3.4 shows the installed instrumentation of a micrometeorological gradient tower provided by the Univ. of Bayreuth (MT2) as used during the ARCTEX 2006 campaign. The tower was used to measure the near surface vertical gradients of air temperature and wind speed and additionally all components of the radiation balance.

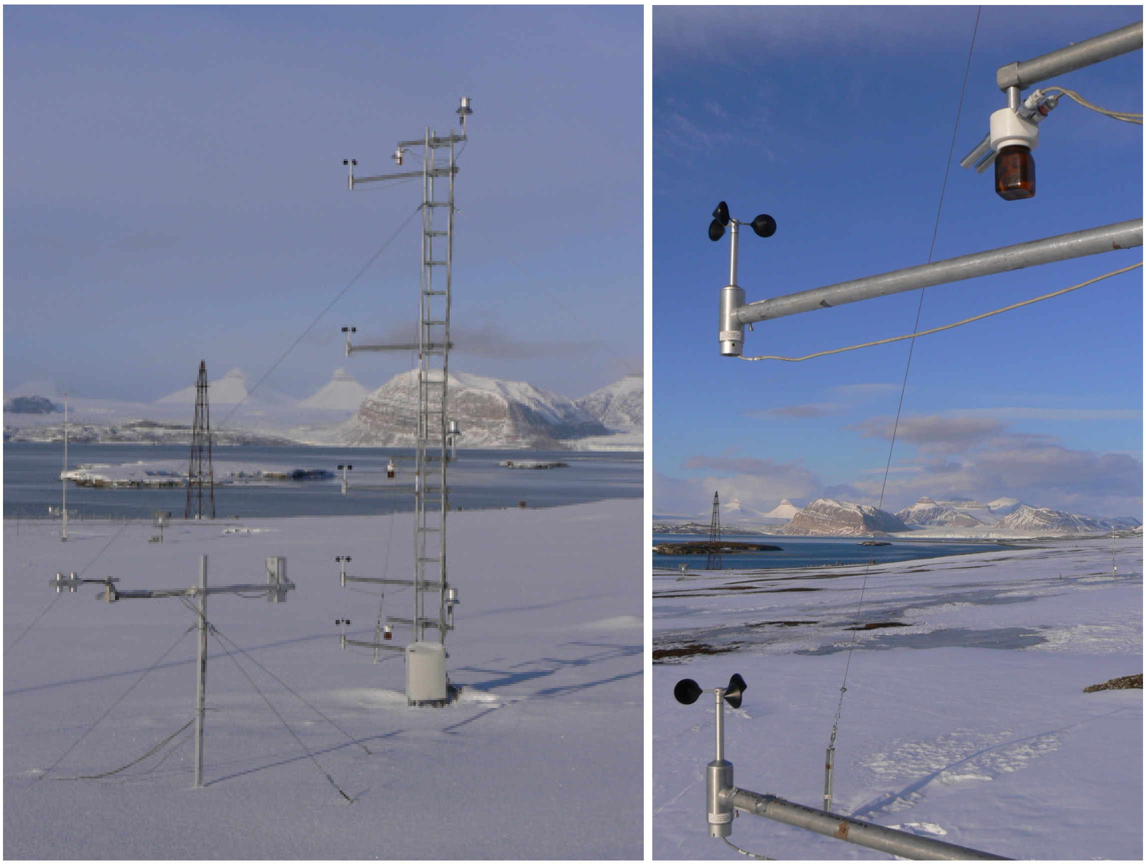

Figure 3.4: Six meter tall micrometeorological gradient tower of the Univ. of Bayreuth 200 m south of Ny-Ålesund (Svalbard). Measurements of vertical air temperature and wind speed and all components of the radiation balance, ARCTEX-2006 campaign.

3.1.3 Univ. of Bayreuth Eddy-Flux measurement complex (EF)

The Eddy-Covariance Flux measurement complex (UBT EF), build up at May 6 and May 7, 2006 at the monitoring instrument area south-east of the Ny-Ålesund research facilities, consists of a CSAT3 ultra sonic anemometer (Campbell Scientific) to measure the turbulent variation of all three wind vectors as well as the sonic temperature and a KH20 ultraviolet krypton hygrometer (Campbell Scientific) to measure the turbulent variation of water vapor (Figure 3.5). Due to a malfunction of the CR23X data logging system (Campbell Scientific), caused by electrostatic discharge during shipping, we were not able to run the KH20 hygrometer.

Consequently, we were unable to obtain any latent heat fluxes directly during the ARCTEX-2006 campaign. As a backup an in-house development of a data receiving system (Mini-ITX hardware) was used to receive the ultrasonic data during the entire field campaign.

Figure 3.5: Eddy-Flux measurement complex (EF) of the Univ. of Bayreuth, monitoring area south-east of Ny-Ålesund (Svalbard), ARCTEX-2006 campaign.

3.1.4 Univ. of Bayreuth Laser Scintillometer (SLS)

In addition to the Eddy-Flux measurement complex, the displaced laser beam Scintillometer SLS20 (Scintec A.G.) was installed at May 9, 2006 (Figure 3.6). The path length across the monitoring area was 104 m in a height of around 1.5 m above the ground.

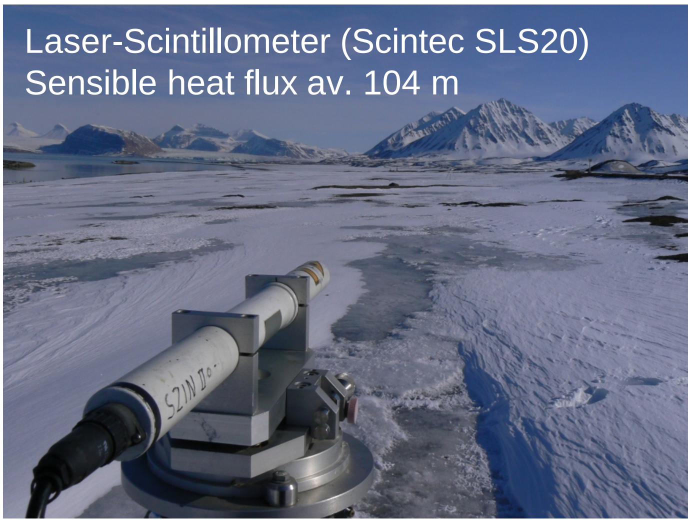

Figure 3.6: Laser Scintillometer, Scintec SLS20 (SLS) of the Univ. of Bayreuth, monitoring area south-east of Ny-Ålesund (Svalbard), ARCTEX-2006 campaign.

Along the laser path the surface condition changed during the whole campaign from a completely snow covered surface over refrozen and compacted ice-layers to a partly snow free tundra.

4 Detailed description of instrumentation

4.1 Eddy-flux measurements (EF)

No.	Name	Position	Instrument	Period
1	3D ultrasonic system	UBT EF	Campbell Scientific (U.S.A.) CSAT3, S/N: 0322	2006 May 07, 2006, 12 CET – May 19, 2006, 07 CET
2	Ultraviolet krypton hygrometer	UBT EF	Campbell Scientific (U.S.A.) KH20, S/N: 1462	2006 N/A
3	Logger Unit	UBT EF	Campbell Scientific (U.S.A.) Logger CR23X, S/N: 1113	
4	PC control system	UBT EF	Mini ITX Main board VIA + TFT 7 inch touch screen Monitor	

4.2 Laser Scintillometer (SLS)

No.	Name	Position	Instrument	Period
1	Displaced Beam Scintillometer	UBT SLS	Scintec A.G. (GER) SLS20, S/N: 010-A-00010 Sensor separation (path length) 104 m, measurement height 1.5 m a. g. l (height of laser beam)	2006 May 10, 2006, 00 CET – May 18, 2006, 15 CET
2	PC control system	UBT SLS	Desktop-PC with Scintec standard software	
3	Data cable	UBT SLS	200 m RS-485 serial connection	
4				

4.3 Meteorological measurements (MT2)

No.	Name	Position	Instrument	Period
1	Temperature profile	UBT MT2	electric ventilated Psychrometer (PT100), Th. Friedrichs: 0.73 m, 2.37 m, 5.63 m a. g. l.	2006 May 04, 2006, 21 CET – May 19, 2006, 10 CET
2	Wind profile	UBT MT2	3-cup wind speed anemometer, F460 (Lexan-cups) Climatronics: Cup transfer function: Freq(Hz)=(mph–0.3)*9.511 or mph=(Freq/9.511)+0.3 Conversion in m/s: m/s=mph/2.237 Measurement heights: 0.73 m, 1.42 m, 2.37 m, 3.85 m, 5.63 m a. g. l.	2006 May 04, 2006, 21 CET – May 19, 2006, 10 CET
3	Radiation	UBT MT2	CNR1 Net radiation, Kipp&Zonen, S/N 970059, calibrated Feb 24, 2004 sensitivity: CM3 up: 09.90 µV / Wm^{-2} CM3 down: 09.86 µV / Wm^{-2} CG1 up: 09.12 µV / Wm^{-2} CG1 down: 09.33 µV / Wm^{-2} KT 15.82 D, S/N: 2244, Infrared Thermometer, Heitronics	2006 May 06, 2006, 12 CET – May 19, 2006, 10 CET

5 Data acquisition and recording

5.1 Eddy-flux measurements (EF)

Due to a malfunction of the CR23X data logging system (Campbell Scientific), caused by electrostatic discharge during shipping, we were not able to use the especially for the ARCTEX campaign pre-configured Campbell logger (CSAT3_37.dld) to receive the turbulent raw data from the Campbell CSAT3 ultrasonic and the KH20 hygrometer. As a backup an in-house development of a data receiving system, a 12 Volt Mini-ITX motherboard with a passive cooled CPU-unit, was used instead. A direct connection between the sonic CSAT3 and the Mini-ITX was achieved with use of the Campbell PC Monitor program CSAT32.exe (Campbell PC-support software 32 bit Version 2.0, March 1998). The binary raw files collected with the CSAT3 pc monitor were converted into ASCII text format using the CSAT_B2A.exe routine.

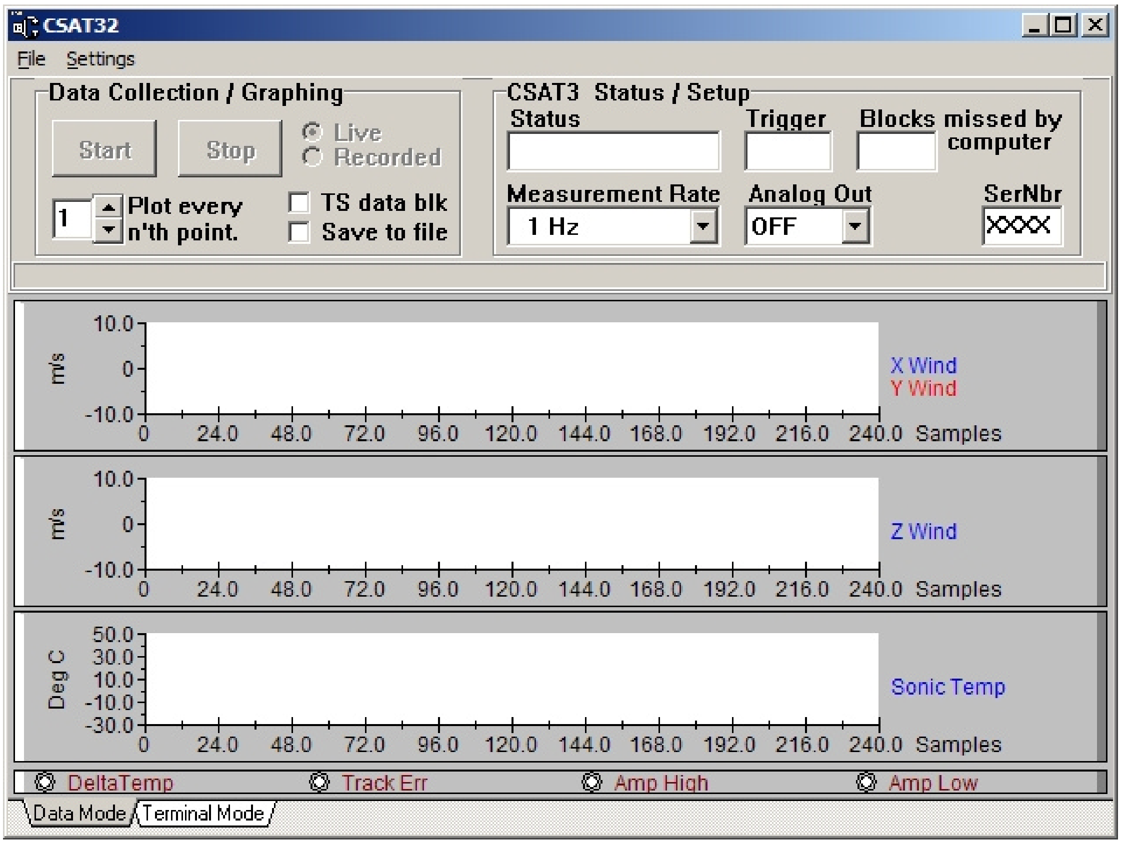

Figure 5.1: Example of the Campbell PC Monitor program to receive the CSAT3 ultrasonic raw data, ARCTEX-2006 campaign.

Finally, to process the turbulent fluxes with the internationally standardized QA/QC software package TK2, the raw data were transformed in the TK2 HIRATE-input-format. TK2, developed by the Department of Micrometeorology, University of Bayreuth (Mauder and Foken, 2004), is based on 15 years of experience.

It was developed to calculate turbulent fluxes automatically for several international micrometeorological experiments since 1989. TK2 is capable of performing all of the post processing of turbulence measurements producing quality assured turbulent fluxes for a station automatically in one single run. It includes all corrections and tests, which are state-of-the-art (i.e. detection of spikes, application of Planar Fit method for coordinate transformation, determination of the time delay between sensors) and a quality assessment.

CR23X-Campbell logger configuration (CSAT3_37.dld)

```
;{CR23X}
*Table 1 Program
  01: 0.05      Execution Interval (seconds)

1:  Batt Voltage (P10)
 1: 6        Loc [ Batt_____ ]

;Measure KH20
2:  Volt (Diff) (P2)
 1: 1        Reps
 2: 15       5000 mV, Fast Range
 3: 3        DIFF Channel
 4: 8        Loc [ H2O       ]
 5: 1.0      Mult
 6: 0.0      Offset

;Measure CSAT3
3:  SDM-CSAT3 (P107)
 1: 1        Reps
 2: 3        SDM Address
 3: 91       Trigger and Get wind & Ts data
 4: 1        Ux Input Location [ Ux_in     ]

4:  If (X<=>F) (P89)
 1: 5        X Loc [ diag      ]
 2: 1        =
 3: 61440    F
 4: 21       Set Flag 1 Low

5:  If Flag/Port (P91)
 1: 21       Do if Flag 1 is Low
 2: 30       Then Do

6:  If (X<=>F) (P89)
 1: 5        X Loc [ diag      ]
 2: 3        >=
 3: 0        F
 4: 30       Then Do

7:  If (X<=>F) (P89)
 1: 5        X Loc [ diag      ]
 2: 2        <>
 3: 61503    F
 4: 30       Then Do

8:  Do (P86)
 1: 11       Set Flag 1 High

9:  SDM-CSAT3 (P107)
 1: 1        Reps
 2: 3        SDM Address
 3: 62       Set Execution Parameter
 4: 1        Ux Input Location [ Ux_in     ]
```

```
10:  End (P95)

11:  End (P95)

12:  End (P95)

13:  Do (P86)
 1: 10       Set Output Flag High (Flag 0)

14:  Set Active Storage Area (P80)
 1: 1        Final Storage Area 1
 2: 37       Array ID

15:  Real Time (P77)
 1: 0111     Day,Hour/Minute,Seconds (midnight = 0000)

16:  Resolution (P78)
 1: 1        High Resolution

17:  Sample (P70)
 1: 5        Reps
 2: 1        Loc [ Ux_in     ]

18:  Sample (P70)
 1: 1        Reps
 2: 8        Loc [ H2O       ]

*Table 2 Program
  02: 0.0000    Execution Interval (seconds)

*Table 3 Subroutines

End Program

-Input Locations-
1 Ux_in     5 1 2
2 Uy_in     9 1 2
3 Uz_in     9 1 2
4 Ts_in     9 1 2
5 diag      17 4 2
6 Batt_____ 1 0 1
7 _________ 1 0 0
8 H2O       1 1 1
9 _________ 1 0 0
10 _________ 0 0 0
11 _________ 0 0 0
12 _________ 0 0 0
13 _________ 0 0 0
14 _________ 0 0 0
15 _________ 0 0 0
16 _________ 0 0 0
17 _________ 0 0 0
18 _________ 0 0 0
19 _________ 0 0 0
20 _________ 0 0 0
21 _________ 0 0 0
22 _________ 0 0 0
23 _________ 0 0 0
24 _________ 0 0 0
25 _________ 0 0 0
26 _________ 0 0 0
27 _________ 0 0 0
28 _________ 0 0 0
```

```
-Program Security-
0000
0000
0000
-Mode 4-
-Final Storage Area 2-
0
-CR10X ID-
0
-CR10X Power Up-
3
-CR10X Compile Setting-
3
-CR10X RS-232 Setting-
-1
```

5.2 Laser Scintillometer (SLS)

The SLS20 Scintillometer was operated using the Scintec DOS-based software SLSRUN.exe version 2.10 (Figure 5.2). Path length and height were set as described before; average air temperature and pressure were adjusted for every measurement period (usually one day). Before any measurement period an automatic Background Alignment test was executed to eliminate signal noise and to handle the channel crosstalk. To recalculate the turbulent fluxes the required representative temperature values were calculated as the mean of the measurement heights of 0.7 m and 2.4 m a. g. l. The representative air pressure at station height was taken from the AWI meteorological routine measurement observation.

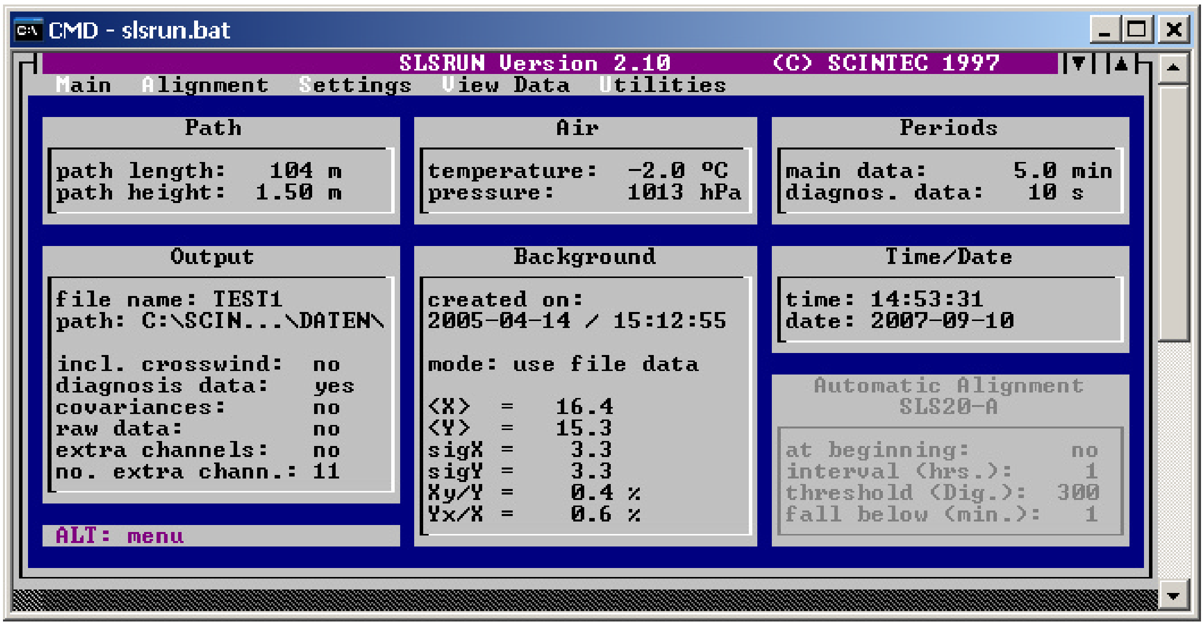

Figure 5.2: Example of the Scintec DOS-based SLSRUN software to receive the scintillometer raw data, ARCTEX-2006 campaign.

5.3 Meteorological measurements (MT2)

The data recording used for the meteorological gradient tower was performed by a Vaisala-logger-system, Two QLC50 units with a motherboard and CPU (S/N: S06208) and one external QLI501 unit to connect additional physical sensors (v.1.03).

The used Vaisala QSP-configuration files were:

ArctexQ1.qsp (temperature, radiation, wind) and

ArctexQ2.qsp (temperature and wind).

The used sensors for ARCTEX-2006 campaign were: 5 x cup anemometers, 3 x ventilated thermometers, 1 x net radiation CNR1 and 1 x infrared thermometer KT15IR; optional: 4 x soil temperature and 2 x soil heat flux (not used 2006).

ArctexQ1.qsp

Configured variable list DVRX.bin:

```
GROUP 0 ;
0,fuenfmin,INTEGER,,-1 ;Log Task

GROUP 1 ;
1,m_CNR_T,    REAL,,-1 ;Mittel CNR1 Temperatur (°C)
1,m_CNR_Glb,  REAL,,-1 ;Mittel CNR1 Globalstrahlung (Wm-2)
1,m_CNR_Ref,  REAL,,-1 ;Mittel CNR1 Reflexstrahlung (Wm-2)
1,m_CNR_Geg,  REAL,,-1 ;Mittel CNR1 Gegenstrahlung (Wm-2)
1,m_CNR_Aus,  REAL,,-1 ;Mittel CNR1 Ausstrahlung (Wm-2)
1,m_ru01,     REAL,,-1 ;Mittel Wind (1. height) [m/s]
1,m_ru02,     REAL,,-1 ;Mittel Wind (2. height) [m/s]
1,m_ru03,     REAL,,-1 ;Mittel Wind (3. height) [m/s]
1,m_ru04,     REAL,,-1 ;Mittel Wind (4. height) [m/s]
1,m_KT15IR,   REAL,,-1 ;Mittel KT15 Infrared (K)
1,m_Psy01Tr,  REAL,,-1 ;Mittel Psy01 Trocken [°C]
1,m_Psy01Fe,  REAL,,-1 ;Mittel Psy01 Feucht [°C]
1,m_Psy02Tr,  REAL,,-1 ;Mittel Psy02 Trocken [°C]
1,m_Psy02Fe,  REAL,,-1 ;Mittel Psy02 Feucht [°C]
1,m_Psy03Tr,  REAL,,-1 ;Mittel Psy03 Trocken [°C]
1,m_Psy03Fe,  REAL,,-1 ;Mittel Psy03 Feucht [°C]

GROUP 2 ;
2,ru01,       REAL,,-1 ;Wind speed 1. height
2,ru02,       REAL,,-1 ;Wind speed 2. height
2,ru03,       REAL,,-1 ;Wind speed 3. height
2,ru04,       REAL,,-1 ;Wind speed 4. height
2,Psy01Tr,    REAL,,-1 ;Psychrometer 01 Trocken
2,Psy01Fe,    REAL,,-1 ;Psychrometer 01 Feucht
2,Psy02Tr,    REAL,,-1 ;Psychrometer 02 Trocken
2,Psy03Fe,    REAL,,-1 ;Psychrometer 03 Feucht
2,Psy03Tr,    REAL,,-1 ;Psychrometer 03 Trocken
2,Psy03Fe,    REAL,,-1 ;Psychrometer 03 Feucht
2,CNR_T,      REAL,,-1 ;CNR1 Temperatur
2,CNR_Glb,    REAL,,-1 ;CNR1 Globalstrahlung
2,CNR_Ref,    REAL,,-1 ;CNR1 Reflexstrahlung
2,CNR_Geg,    REAL,,-1 ;CNR1 Gegenstrahlung
2,CNR_Aus,    REAL,,-1 ;CNR1 Ausstrahlung
2,KT15IR,     REAL,,-1 ;Infrared KT15.82D
```

Configured mathematical calculation MATH.bin:

```
00:00:00,0
300,(fuenfmin) ;Mittelung alle 5 Minuten
[1,m_ST01]= AVG([2,SoilTemp01], 300)
[1,m_ST02]= AVG([2,SoilTemp02], 300)
[1,m_ST03]= AVG([2,SoilTemp03], 300)
[1,m_ST04]= AVG([2,SoilTemp04], 300)

[1,m_Psy01Tr]= AVG([2,Psy01Tr], 300)
[1,m_Psy01Fe]= AVG([2,Psy01Fe], 300)
[1,m_Psy02Tr]= AVG([2,Psy02Tr], 300)
[1,m_Psy02Fe]= AVG([2,Psy02Fe], 300)
[1,m_Psy03Tr]= AVG([2,Psy03Tr], 300)
[1,m_Psy03Fe]= AVG([2,Psy03Fe], 300)

[1,m_SHF01]= AVG([2,SoilHF01], 300) * 1000000 / 44.0
[1,m_SHF02]= AVG([2,SoilHF02], 300) * 1000000 / 45.5
[1,m_SHF03]= AVG([2,SoilHF03], 300) * 1000000 / 15.3

[1,m_ru01]= (AVG([2,ru01], 300) / 9.511 + 0.3) / 2.237
[1,m_ru02]= (AVG([2,ru02], 300) / 9.511 + 0.3) / 2.237
[1,m_ru03]= (AVG([2,ru03], 300) / 9.511 + 0.3) / 2.237
[1,m_ru04]= (AVG([2,ru04], 300) / 9.511 + 0.3) / 2.237

[1,m_KT15IR]= (AVG([2,KT15IR], 300) * 50) - 50
[1,m_CNR_T]= AVG([2,CNR_T], 300)
[1,m_CNR_Geg]= AVG([2,CNR_Geg], 300) / 0.00000826
[1,m_CNR_Aus]= AVG([2,CNR_Aus], 300) / 0.00000841
[1,m_CNR_Glb]= AVG([2,CNR_Glb], 300) / 0.00000941
[1,m_CNR_Ref]= AVG([2,CNR_Ref], 300) / 0.00000950

[0,fuenfmin]=1
```

Configured sensor channels, internal QLI, MPX1.bin:

```
=B38400
=X0
=L3
=P3
=F5
=U1
=S1,00:00:00,100,60
:r,2,RTC_TEMP;0,0,1 TIN
:r,2,SoilHF02;0,0,1 6V
:r,2,ru01;0,0,1 F1
:r,2,ru02;0,0,1 F2
:r,2,SoilTemp01;0,0,1,-50.0000,160.0000,50.0000 1PT100
:r,2,SoilTemp02;0,0,1,-50.0000,160.0000,50.0000 2PT100
:r,2,SoilTemp03;0,0,1,-50.0000,160.0000,50.0000 3PT100
:r,2,SoilTemp04;0,0,1,-50.0000,160.0000,50.0000 4PT100
:r,2,Psy01Tr;0,0,1,-50.0000,160.0000,50.0000 8PT100
:r,2,Psy01Fe;0,0,1,-50.0000,160.0000,50.0000 9PT100
:r,2,Wdir;0,0,1 0RPE
:r,2,SoilHF01;0,0,1 5V
:r,2,SoilHF03;0,0,1 7V
=END
```

Configured sensor channels, external QLI, MPX2.bin:

```
=B19200
=X0
=L3
=P3
=F5
=U2
=S1,00:00:00,100,60
:r,2,CNR_Geg;0,0,1 4V
:r,2,CNR_Aus;0,0,1 5V
:r,2,CNR_Ref;0,0,1 3V
:r,2,Psy02Tr;0,0,1,-50.0000,160.0000,50.0000 6PT100
:r,2,Psy02Fe;0,0,1,-50.0000,160.0000,50.0000 7PT100
:r,2,ru03;0,0,1 F1
:r,2,Psy03Tr;0,0,1,-50.0000,160.0000,50.0000 8PT100
:r,2,Psy03Fe;0,0,1,-50.0000,160.0000,50.0000 9PT100
:r,2,CNR_T;0,0,1,-50.0000,160.0000,50.0000 1PT100
:r,2,CNR_Glb;0,0,1 2V
:r,2,ru04;0,0,1 F2
:r,2,KT15IR;0,0,1 0V
=END
```

Configured log task, QLCLOG.bin:

```
;
= FROUND
fuenfmin r 0 m m0
[0,fuenfmin]
[1,m_Psy01Tr]
[1,m_Psy01Fe]
[1,m_Psy02Tr]
[1,m_Psy02Fe]
[1,m_Psy03Tr]
[1,m_Psy03Fe]
[1,m_ru01]
[1,m_ru02]
[1,m_ru03]
[1,m_ru04]
[1,m_SHF01]
[1,m_SHF02]
[1,m_SHF03]
[1,m_ST01]
[1,m_ST02]
[1,m_ST03]
[1,m_ST04]
[1,m_Wdir]
[1,m_KT15IR]
[1,m_CNR_Geg]
[1,m_CNR_Aus]
[1,m_CNR_Glb]
[1,m_CNR_Ref]
[1,m_CNR_T]
```

ArctexQ2.qsp

Configured variable list DVRX.bin:

```
GROUP 0 ;
0,fuenfmin,INTEGER,,-1 ;Log Task

GROUP 1 ;
1,m_ST02,REAL,,-1 ;Mittel SoilTemp 2.Tiefe [°C]
1,m_ST03,REAL,,-1 ;Mittel SoilTemp 3.Tiefe [°C]
1,m_ST04,REAL,,-1 ;Mittel SoilTemp 4.Tiefe [°C]
1,m_ST01,REAL,,-1 ;Mittel SoilTemp 1.Tiefe [°C]
1,m_ru05,REAL,,-1 ;Mittel Wind (5. height) [m/s]
1,m_ru06,REAL,,-1 ;Mittel Wind (6. height) [m/s]
1,m_Psy04Tr,REAL,,-1 ;Mittel Psy04 Trocken [°C]
1,m_Psy04Fe,REAL,,-1 ;Mittel Psy04 Feucht [°C]

GROUP 2 ;
2,SoilTemp01,REAL,,-1 ;Bodentemperatur 1. Tiefe
2,SoilTemp02,REAL,,-1 ;Bodentemperatur 2. Tiefe
2,SoilTemp03,REAL,,-1 ;Bodentemperatur 3. Tiefe
2,SoilTemp04,REAL,,-1 ;Bodentemperatur 4. Tiefe
2,ru05,REAL,,-1 ;Wind speed 5. height
2,ru06,REAL,,-1 ;Wind speed 6. height
2,Psy04Tr,REAL,,-1 ;Psychrometer 04 Trocken
2,Psy04Fe,REAL,,-1 ;Psychrometer 04 Freucht
```

Configured mathematical calculation MATH.bin:

```
00:00:00,0
300,(fuenfmin) ;Mittelung alle 5 Minuten
[1,m_ST01]= AVG([2,SoilTemp01], 300)
[1,m_ST02]= AVG([2,SoilTemp02], 300)
[1,m_ST03]= AVG([2,SoilTemp03], 300)
[1,m_ST04]= AVG([2,SoilTemp04], 300)

[1,m_Psy04Tr]= AVG([2,Psy04Tr], 300)
[1,m_Psy04Fe]= AVG([2,Psy04Fe], 300)

[1,m_ru05]= (AVG([2,ru05], 300) / 9.511 + 0.3) / 2.237
[1,m_ru06]= (AVG([2,ru06], 300) / 9.511 + 0.3) / 2.237

[0,fuenfmin]=1
```

Configured sensor channels, internal QLI, MPX1.bin:

```
=B38400
=X0
=L3
=P3
=F5
=U1
=S1,00:00:00,100,60
:r,2,RTC_TEMP;0,0,1 TIN
:r,2,ru05;0,0,1 F1
:r,2,ru06;0,0,1 F2
:r,2,Psy04Tr;0,0,1,-50.0000,160.0000,50.0000 1PT100
:r,2,Psy04Fe;0,0,1,-50.0000,160.0000,50.0000 0PT100
:r,2,SoilTemp01;0,0,1,-50.0000,160.0000,50.0000 5PT100
:r,2,SoilTemp02;0,0,1,-50.0000,160.0000,50.0000 6PT100
:r,2,SoilTemp03;0,0,1,-50.0000,160.0000,50.0000 7PT100
:r,2,SoilTemp04;0,0,1,-50.0000,160.0000,50.0000 8PT100
=END
```

Configured log task, QLCLOG.bin:

```
;
= FROUND
fuenfmin r 0 m m0
[0,fuenfmin]
[1,m_Psy04Tr]
[1,m_Psy04Fe]
[1,m_ru05]
[1,m_ru06]
[1,m_ST01]
[1,m_ST02]
[1,m_ST03]
[1,m_ST04]
```

Table 5.1: Detailed sensor wiring (**ArctexQ1.qsp**), ARCTEX-2006 campaign:

Logger QLC 1 internal QLI 1	**Type**	**Variable Name**	**Signal**	**Channel**	**E**	**H**	**L**	**C**	**Power / Calibration**
Intern QLI 1	Sensor real	Wdir Wind Direction Top	Potentio-meter with V (RPE)	Ch 00	X	X brown	X green	X yellow	E and H with Bridge
Intern QLI 1	Sensor real	SoilTemp01 Soil temperature 1. Depth	PT100 4 wire	Ch 01	X black	X brown	X red	X orange	
Intern QLI 1	Sensor real	SoilTemp02 Soil temperature 2. Depth	PT100 4 wire	Ch 02	X black	X brown	X red	X orange	
Intern QLI 1	Sensor real	SoilTemp03 Soil temperature 3. Depth	PT100 4 wire	Ch 03	X black	X brown	X red	X orange	
Intern QLI 1	Sensor real	SoilTemp04 Soil temperature 4. Depth	PT100 4 wire	Ch 04	X black	X brown	X red	X orange	
Intern QLI 1	Sensor real	SoilHF01 Campbell Heat Flux H943242	Voltage diff (V)	Ch 05		X	X		* 1000000 / 44.0 Wm-2 / mV
Intern QLI 1	Sensor real	SoilHF02 Campbell Heat Flux H943243	Voltage diff (V)	Ch 06		X	X		45.5 Wm-2 / mV
Intern QLI 1	Sensor real	SoilHF03 CN3 Heat Flux Plate G428	Voltage diff (V)	Ch 07		X white	X white-brown		15.3 Wm-2 /mV
Intern QLI 1	Sensor real	Psy01Tr (white) Psychrometer dry 1. height	PT100 4 wire	Ch 08	X yellow	X green	X brown	X white	
Intern QLI 1	Sensor real	Psy01Fe (91311 red) Psychrometer wet 1. height	PT100 4 wire	Ch 09	X black	X green / yellow	X brown	X blue	
Intern QLI 1	Sensor real	ru01 (4713) Anemometer 1. height	Fre-quency 1	F1 (57) yellow					GND(59)=green, Bridge to DC- (68), DC+(67)=red [ru01 / 9.511+0.3) / 2.237]
Intern QLI 1	Sensor real	ru02 (4522) Anemometer 2. height	Fre-quency 2	F2 (58) yellow					GND(59)=green, Bridge to DC- (68), DC+(67)=red [ru02 / 9.511+0.3) / 2.237]

Table 5.2: Detailed sensor wiring (**ArctexQ1.qsp**), ARCTEX-2006 campaign:

Logger QLC 1 external QLI 2	Type	Variable Name	Signal	Channel	E	H	L	C	Power / Calibration
Extern QLI 2	Sensor real	KT15IR (IR Temperature KT15.82D)	Voltage diff (V)	Ch 00		X yellow	X green		white (-) and brown (+) 24 V, [KT15IR * 55 – 50]
Extern QLI 2	Sensor real	CNR_T CNR1 970059 Temperature	PT100 4 wire	Ch 01	X yellow	X red	X green	X blue	
Extern QLI 2	Sensor real	CNR_Glb CNR1 970059 Global radiation	Voltage diff (V)	Ch 02		X red	X blue		/ 0.00000941
Extern QLI 2	Sensor real	CNR_Ref CNR1 970059 Reflected radiation	Voltage diff (V)	Ch 03		X white	X black		/ 0.00000950
Extern QLI 2	Sensor real	CNR_Geg CNR1 970059 incoming long wave radiation	Voltage diff (V)	Ch 04		X grey	X yellow		/ 0.00000826
Extern QLI 2	Sensor real	CNR_Aus CNR1 970059 outgoing long wave radiation	Voltage diff (V)	Ch 05		X brown	X green		/ 0.00000841
Extern QLI 2	Sensor real	Psy02Tr (0095 new) Psychrometer dry 2. height	PT100 4 wire	Ch 06	X yellow	X green	X brown	X white	
Extern QLI 2	Sensor real	Psy02Fe (0085 new) Psychrometer wet 2. height	PT100 4 wire	Ch 07	X yellow	X green	X brown	X white	
Extern QLI 2	Sensor real	Psy03Tr (9028 white) Psychrometer dry 3. height	PT100 4 wire	Ch 08	X yellow	X green	X brown	X white	
Extern QLI 2	Sensor real	Psy03Fe (8839 red) Psychrometer wet 3. height	PT100 4 wire	Ch 09	X yellow	X green	X brown	X white	
Extern QLI 2	Sensor real	ru03 (4524) Anemometer 3. height	Fre-quency 1	F1 (57) yellow					GND(59)=green, Bridge to DC- (68), DC+(67)=red [ru03 / 9.511+0.3) / 2.237]
Extern QLI 2	Sensor real	ru04 (4719) Anemometer 4. height	Fre-quency 2	F2 (58) yellow					GND(59)=green, Bridge to DC- (68), DC+(67)=red [ru04 / 9.511+0.3) / 2.237]

Table 5.3: Detailed sensor wiring (**ArctexQ2.qsp**), ARCTEX-2006 campaign:

Logger QLC 2 internal QLI 1	**Type**	**Variable Name**	**signal**	**Channel**	**E**	**H**	**L**	**C**	**Power**
Extern QLI 3	Sensor real	Psy04Tr (not used) Psychrometer dry 4. height	PT100 4 wire	Ch 00					
Extern QLI 3	Sensor real	Psy04Fe (not used) Psychrometer wet 4. height	PT100 4 wire	Ch 01					
Extern QLI 3	Sensor real	not used							
Extern QLI 3	Sensor real	not used							
Extern QLI 3	Sensor real	not used							
Extern QLI 3	Sensor real	not used							
Extern QLI 3	Sensor real	not used							
Extern QLI 3	Sensor real	not used							
Extern QLI 3	Sensor real	not used							
Extern QLI 3	Sensor real	not used							
Extern QLI 3	Sensor real	ru05 (4505) Anemometer 5. height	Frequency 1	F1 (57) yellow					GND(59)=green, Bridge to DC- (68), DC+(67)=red [ru05 / 9.511+0.3) / 2.237]
Extern QLI 3	Sensor real	Ru06 (not used) Anemometer 6. height	Frequency 2	F2 (58) yellow					GND(59)=green, Bridge to DC- (68), DC+(67)=brown [ru06 / 9.511+0.3) / 2.237]

6 Field protocol and data archiving

6.1 Field protocol

ARCTEX 2006 campaign at Ny-Ålesund (Svalbard) May 2006, Universities of Bayreuth and Trier, Germany

May, 1, 2006 Monday

Arrival: Nürnberg – Frankfurt; Frankfurt – Oslo

May, 2, 2006 Tuesday

Arrival: Oslo – Longyearbyen; Longyearbyen – Ny-Ålesund (app. 16 CEST)
Reception by the AWI-Crew and Kings-Bay
Short introduction: Ny-Ålesund facilities, Station regulations

May, 3, 2006 Wednesday Ny-Ålesund

Start of installation Turbulence Complex:
-- choosing of the right measurement plot together with Anne Hormes,
-- installation of mast Turbulence Complex and power supply,
-- installation of CSAT3 and KH20,
-- installation of Campbell CR23X Logger-system and Mini-ITX.

Height of CSAT above ground:	2.23 to 2.25 cm
Orientation against North:	128° to 130 ° (SE)
Height a.s.l.:	app. 18 m

Surface conditions: wet, melting snow over ice, some snow free spots (black soil, tundra).
First try to communicate with CR23X.
No communication with CR23X possible! Intensive error search without success!

May, 4, 2006 Thursday Ny-Ålesund

Further error check to solve communication problem with CR23X!
Successful parallel installation Gradient tower:
Heights of installed instruments:

1. Height: 073 cm above ground (snow) (Cup anemometer + Psychrometer)
2. Height: 142 cm a. g. (Cup anemometer)
3. Height: 237 cm a. g. (Cup anemometer + Psychrometer)
4. Height: 385 cm a. g. (Cup anemometer)
5. Height: 563 cm a. g. (Cup anemometer + Psychrometer)

Start of measurements gradient tower at May 4, 21:10 CET
(Start of Cup anemometer at height of 563 cm at May 05, 19:20 CET!)

May, 5, 2006 Friday Ny-Ålesund

Further error check to solve communication problem with CR23X!

May, 6, 2006 Saturday Ny-Ålesund

Further error check to solve communication problem with CR23X!
Installation of radiation mast: Start of measurements radiation at 12:40 CET
Heavy snowfall and wind.

May, 7, 2006 Sunday Ny-Ålesund

Further error check to solve communication problem with CR23X!
New plan: Direct connection of sonic CSAT3 to the Mini-IPX with help of the Campbell monitor program CSAT32.exe. Successful installation (new serial cable) and start of flux measurements at 12:54 CEST!
Heavy snowfall and storm!

May, 8, 2006 Monday, Ny-Ålesund

Departure of Jo Olesch back to Germany
Arrival of Alfred Helbig (former Univ. of Trier)
Surface condition: fresh snow (5 cm to 10 cm).
No further problem with Eddy-Flux-Complex.
Partly cloudy or sunny weather after Sunday night's snowstorm.
During whole day relatively high wind speed.

May, 9, 2006 Tuesday, Ny-Ålesund

Installation and test of Scintillometer
Mostly cloudless weather, low wind speed!

May, 10, 2006 Wednesday, Ny-Ålesund

All systems running well.
Sunny weather but relatively windy!

May, 11, 2006 Thursday, Ny-Ålesund

All systems running well.
Partly cloudy or sunny weather, at noon relatively windy!

May, 12, 2006 Friday, Ny-Ålesund

At May 12, 08:25 CET: Short power cutoff (for app. 5 minutes).
Cloudy (morning to noon), partly cloudy or sunny at afternoon.

May, 13 and 14 2006 Weekend, Ny-Ålesund

All systems running well.
At Saturday noon: Change to cloudy weather (temperature reaches 0 °C) then more or less overcast skies (during whole Sunday).
May, 15. 2006, Monday, Ny-Ålesund
Cup-Anemometer at 5.63 m defect ball bearing at May 15, 08:40 CET.
Cloudy (morning to noon), partly cloudy or sunny at afternoon.

May, 16, 2006, Tuesday, Ny-Ålesund

Day starts sunny, at late afternoon getting cloudy (Cumuls, Cumuls stratus).
Power-point presentation to AWI-Crew at 17:30 CEST.
Cup-Anemometer at 5.63 m is not running (observed at 21:30 CEST).
Defect ball bearing! Not able to fix problem. After data check: time of malfunction at May 15, 08:50 CET.
Start of snowfall at May, 17, around 02:00 CEST.

May, 17, 2006, Wednesday, Ny-Ålesund

Partly cloudy (4/8).
Routine check of Scintillometer at 10 CEST: Snow inside receiver window. After cleaning, still no signal! Seems same problem like in the beginning (May, 9, defect cable, loose connection). Late afternoon: Scintillometer running, loose contact in plug of the connection cable junction box to PC (serial cable)!
Check of psychrometer, wet thermometer, socks are dry -- ca. 21:30 CEST (wiederbefeuchtet).

May, 18, 2006, Thursday, Ny-Ålesund

Light rain and snow fall during second part of “night” until 11 CEST, overcast.

May, 19, 2006, Friday, Ny-Ålesund

End of measurement Eddy flux complex at May, 19, 2006, 08:12 CEST.
Deconstruction of turbulence mast.
End of measurements gradient tower at 10:25 CET.
Deconstruction of gradient tower.
Packing of all equipment into transport boxes, prepared for ship transport back to AWI Hafenlager, Harbor Bremerhaven.

May, 20, 2006, Saturday, Ny-Ålesund

Saving and backup of all measurement data.

6.2 Data archived at Ny-Ålesund (CDs)

CD-Nummer		**CD-Inhalt**
CD1		Rohdaten CSAT3, ARCTEX-Gradientmast und Strahlungsbock, AWI-Met-Turm, Radiosonden
CD2		CSAT3-Originale und ausgelesene Dateien mit CSAT_B2A.EXE (Teil 1), 07.05.2006 bis 10.05.2006
CD3		CSAT3 ausgelesene Dateien mit CSAT_B2A.EXE (Teil 2), 11.05.2006 bis 15.05.2006
CD4		CSAT3 ausgelesene Dateien mit CSAT_B2A.EXE (Teil 3), 16.05.2006 bis 19.05.2006
CD5		TK 2 Eingabe- und Ausgabedateien (Teil 1), AT_0001.dat bis AT_0006.dat
CD6		TK 2 Eingabe- und Ausgabedateien (Teil 2), AT_0007.dat bis AT_0011.dat
CD7		TK 2 Eingabe- und Ausgabedateien (Teil 3), AT_0010.dat bis AT_0013.dat + Fesselballondaten + Scintillometer

7 Appendix

Later I became a workshop and storage place for the Norsk Polarinstitutt and subsequently a scooter garage for Kings Bay employees.
My floor is made of wood and my gate big enough to pass a boat on a trailer through it. You can't heat me but I provide space of about 200 squaremeter. Last winter during a big storm I lost some panels of my roof, but Kings Bay, my owner, is in the process of fixing this.


Old Hospital from south-east
(Photograph: Rainer Vockenroth)

Since May 1st, half of my space has been rented by the AWIPEV research base. They use me as a garage for boats. Their staff has already started to fill the space with buoys, ropes, engines and boats. My big floor helped the biologists to assemble their underwater experimental frame, and a group called ARCTEX was happy to use the space to store away its equipment in a sheltered room.


The new storage room
(Photograph: Rainer Vockenroth)

I feel very proud to be part of the scientific community in the village. When you are in town, come by and take a look - I would be pleased to meet you.

Rainer Vockenroth

ARCTEX

Bodennahe Turbulenzmessungen in der Arktis – aber wo ist der Schnee geblieben?

Bereits seit Frühjahr 2005 laufen unsere Vorbereitungen der dreiwöchigen Meßkampagne „ARCTEX“ (Arctic Turbulence Experiment). Wir sind Johannes Lüers und Jo Olesch von der Universität Bayreuth sowie Jörg Bareiss und Alfred Helbig von der Universität Trier. Klingt eigentlich recht lange, aber die 800 kg Ausrüstung musste bereits im Oktober 2005 mit dem AWI-Container per Schiff nach Ny-Ålesund verschifft werden. Ziel von ARCTEX ist die direkte Messung turbulenter Energieflüsse (Wärmestrom und Verdunstung) in der bodennahen Luftschicht über polaren Eis- und Schneelandschaften unter Anwendung der Eddy-Kovarianz-Methode und mit einem Laser-Szintillometer. Hochgenaue Messungen dieser Energieflüsse, die den Energiehaushaushalt und damit das Gefrieren bzw. Abschmelzen polaren Eises oder Schnees steuern, liegen bisher nur sehr spärlich vor. Die ARCTEX-Messkampagne soll zunächst im Mai 2006 als Pilotstudie diese Lücke schließen und durch präzise direkte Messungen die bisherigen empirischen Parametrisierungen in den numerischen Wetter- und Klimamodellen verbessern oder ersetzen helfen. Ok, soweit – sogut!

Mit dem Blick auf den Kongsfjord während des Landeanflugs auf Ny-Ålesund wurden unsere schlimmsten Befürchtungen bestätigt: kein Meereis im Fjord und nur noch Schneereste auf dem Küstenstreifen – halt Gummistiefelwetter.

Der Januar war fast 10 Grad Celcius wärmer als normal, der April sogar ganze 12 Grad Celcius. Zum Glück waren wir die ersten Tage erst einmal mit Auspacken der Kisten und dem Aufbauen der Messkomplexe beschäftigt. Stündlich haben wir uns die neuesten Wetter-vorhersagen angeschaut. Allerdings bestand keine Hoffnung auf die Rückkehr des Winters. Wir machten uns Mut, in dem wir übereinstimmend festellten, daß auch die Synoptiker der Wetterdienste irren können – v.a. in den Polarregionen. Zu allem Unglück began es auch noch in Strömen zu regnen. Nichts konnte uns aber vom Aufbau der Messgeräte in dieser ungemütlichen Umgebung abhalten! Auf dem Weg in das Messfeld südlich des Dorfes mussten wir zuerst einen kleinen Canyon vor dem Observatorium über-queren, dann kamen uns auch noch Schmelzwasserbäche am Hang entgegen. Oh je, was wird wohl aus unseren Messungen werden? Nach drei Tagen hatten wir es dann endlich geschafft, die Masten mit den Messgeräten im Schneematsch zu errichten - sozusagen unser Richtfest. Da steht er nun der Turbulenzkomplex mit dem Ultraschall-anemometer und dem Kryptonhygrometer (Abb. 1).

Abb. 1: Turbulenzmesskomplex (Johannes Lüers)

Es scheinen noch Wunder zu passieren. Am Wochenende war es soweit. Unser tägliches Flehen und Jammern wurde erhöht, denn der Himmel schickte in Form eines kräftigen Sturmtiefs endlich den lange ersehnten Schneefall. In kurzer Zeit sanken die Lufttemperaturen immer weiter ab und Zentimeter für Zentimeter erhöhte sich die Schneedecke. Und da war er wieder – der arktische Winter, wie wir ihn für einen typischen Mai-Anfang in Erinnerung hatten. Es bereitete uns ein wahres Vergnügen zuzusehen, wie unser sechs Meter hohe Gradientmast mit den Schalensternanemometern und Aspira-tionspsychrometern für die Messung der Vertikalprofile von Windgeschwindigkeit, Lufttemperatur und Luftfeuchte von Stunde zu Stunde immer mehr einschneite (Abb. 2).

Abb. 2: Klassischer meteorologischer Gradientmast (Johannes Lüers)

Der Montag Morgen offenbarte ein Winterzauber in Ny-Ålesund. Die Luft war glasklar, das Himmelsblau schien gefroren und der frisch gefallene Schnee verzauberte das Tal im Kongsfjord – selbstverständlich auch unser Messfeld. Man kann es nicht anders sagen: Schnee – der Stoff aus dem die Wintermärchen sind! In diesem Zustand sieht unser Messfeld mit dem Strahlungsbock, Gradientmast und der Turbulenzmessgeräten genau so aus, wie wir es noch vor Tagen herbeigesehnt hatten (Abb. 3). Für mehr als eine Woche herrschten perfekte Bedingungen zum Messen.

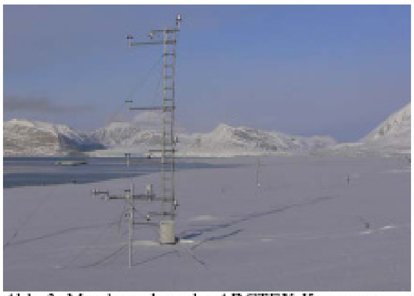

Abb. 3: Messkomplexe der ARCTEX-Kampagne am 8. Mai 2006 (Jörg Bareiss)

Den turbulenten Wärmefluss kann auch mit einem Szintillometer erfasst werden. Dabei misst man die Lageänderungen und Intensitätsschwankungen von Lichtstrahlen infolge der Dichteänderungen, die die Turbulenzelemente längs des Lichtweges erzeugen. Über einer erhitzten Wiesnfläche kann man diesen Effekt als „Flimmern" beobachten. Wir nutzen mit unserem Szintillometer zwei Laserstrahlen mit rotem Licht, die auf einer Strecke von 104 m diese turbulente Luftschicht in ca. 1,5 m Höhe über der Schneedecke durchqueren und im Strahlungsempfänger in elektrische Signale umgewandelt werden. Nach Verarbeitung in einem speziellen Computerprogramm erhalten wir turbulente Wärmeflüsse, die nun die mittleren Verhältnisse über der Schneedecke beschreiben. Auch bei diesen Messungen waren wir froh über die vielen Tage mit geringer Bewölkung und guter Sicht.

Abb. 4: Sendeeinheit der Laser-Szintillometer-Anlage am Anfang der Messstrecke

Nicht nur die Gigabyte an neu gewonnenen Daten haben uns Freude und Arbeit beschert. Genauso bedeutsam ist das Kennelernen und die hervorragende Zusammenarbeit mit der Aerosolgruppe (Andreas, Treffi), der Sondierungsgruppe („Egon", Anne und Miss Piggy) sowie dem Permafrostteam (Julia und Conni).
Unser Dank für den interessanten und schönen Aufenthalt an der AWIPEV Station gelten Rainer, Cedric, Kai und Anne.
Für die hervorragende Verpflegung danken wird den Kings Bay Mitarbeitern in der Messe.

Johannes Lüers, Jo Olesch (Universität Bayreuth)
Jörg Bareiss, Alfred Helbig (Universität Trier)

End of an era

Yesterday, an era in the Blue House came to an end. Since August 1992 it had been a source of memories, good wishes, tears and farewells: the black leather-bound book that was lying in the living room. The first guestbook of the Blue House received its last entry on May 29th, 2006 from Markus Molis, closing this part of 14 years of collective base history.
However, the new guestbook has already its place. I hope it will testify to another 14 years of memories that will be stored here.

Rainer Vockenroth

Riddle May - June/ Rätsel

In Longyearbyen gibt es eine Universität, mit der die AWIPEV base auch hin- und wieder zusammenarbeitet.

Wie heißt die Universität? Wer besuchte sie während der letzten Monate? Welchen Anlaß (-lässe) hatte der Besuch?

Bisher erschienene Arbeiten der Reihe “Arbeitsergebnisse Universität Bayreuth, Abteilung Mikrometeorologie”:

Nr	Author(s)	Title	Year
01	Foken	Der Bayreuther Turbulenzknecht	01/1999
02	Foken	Methode zur Bestimmung der trockenen Deposition von Bor	02/1999
03	Liu	Error analysis of the modified Bowen ratio method	02/1999
04	Foken et al.	Nachfrostgefährdung des ÖBG	03/1999
05	Hierteis	Dokumentation des Experimentes Dlouhá Louka	03/1999
06	Mangold	Dokumentation des Experimentes am Standort Weidenbrunnen, Juli/August 1998	07/1999
07	Heinz et al.	Strukturanalyse der atmosphärischen Turbulenz mittels Wavelet-Verfahren zur Bestimmung von Austauschprozessen über dem antarktischen Schelfeis	07/1999
08	Foken	Comparison of the sonic anomometer Young Model 81000 during VOITEX-99	10/1999
09	Foken et al.	Lufthygienisch-bioklimatische Kennzeichnung des oberen Egertales, Zwischenbericht 1999	11/1999
10	Sodemann	Stationsdatenbank zum BStMLU-Projekt Lufthygienisch-bioklimatische Kennzeichnung des oberen Egertales	03/2000
11	Neuner	Dokumentation zur Erstellung der meteorologischen Eingabedaten für das Modell BEKLIMA	10/2000
12	Foken et al.	Dokumentation des Experimentes VOITEX-99	10/2000
13	Bruckmeier et al.	Documenation of the experiment EBEX-2000, July 20 to August 24, 2000	01/2001
14	Foken et al.	Lufthygienisch-bioklimatische Kennzeichnung des oberen Egertales	02/2001
15	Göckede	Die Verwendung des Footprint-Modells nach Schmid (1997) zur stabilitätsabhängigen Bestimmung der Rauhigkeitslänge	03/2001
16	Neuner	Berechnung der Evaporation im ÖBG (Universität Bayreuth) mit dem SVAT-Modell BEKLIMA	05/2001
17	Sodemann	Dokumentation der Software zur Bearbeitung der FINTUREX-Daten	08/2002
18	Göckede et al.	Dokumentation des Experiments STINHO-1	08/2002
19	Göckede et al.	Dokumentation des Experiments STINHO-2	12/2002
20	Göckede et al	Characterisation of a complex measuring site for flux measurements	12/2002
21	Liebethal	Strahlungsmessgerätevergleich während des Experiments STINHO-1	01/2003
22	Mauder et al.	Dokumentation des Experiments EVA_GRIPS	03/2003
23	Mauder et al.	Dokumentation des Experimentes LITFASS-2003, Dokumentation des Experimentes GRASATEM-2003	12/2003
24	Thomas et al.	Documentation of the WALDATEM-2003 Experiment	05/2004
25	Göckede et al.	Qualitätsbegutachtung komplexer mikrometeorologischer Messstationen im Rahmen des VERTIKO-Projekts	11/2004
26	Mauder & Foken	Documentation and instruction manual of the eddy covariance software package TK2	12/2004
27	Herold et al.	The OP-2 open path infrared gas analyser for $CO_2$and H_2O	01/2005
28	Ruppert	ATEM software for atmospheric turbulent exchange measurements using eddy covariance and relaxed eddy accumulation systems and Bayreuth whole-air REA system setup	04/2005
29	Foken (Ed.)	Klimatologische und mikrometeorologische Forschungen im Rahmen des Bayreuther Institutes für Terrestrische Ökosystemforschung (BITÖK), 1989-2004	06/2005
30	Siebeke & Serafimovich	Ultraschallanemometer-Überprüfung im Windkanal der TU Dresden 2007	04/2007
31	Lüers & Bareiss	The Arctic Turbulence Experiment 2006 PART 1: Technical documentation of the ARCTEX 2006 campaign, May, 2nd to May, 20th 2006	08/2007
32	Lüers & Bareiss	The Arctic Turbulence Experiment 2006 PART 2: Near surface measurements during the ARCTEX 2006 campaign, May, 2nd to May, 20th 2006	08/2007
33	Bareiss & Lüers	The Arctic Turbulence Experiment 2006 PART 3: Aerological measurements during the ARCTEX 2006 campaign, May, 2nd to May, 20th 2006	08/2007