



Introduction

Accurate observations of the energy balance were carried out by the Swiss Federal Institute of Technology at the Greenland Summit Environmental Observatory (72.58°N, 34.46°W; 3203 m asl), starting in 2001. Knowledge of the energy and mass balance is necessary for understanding the links between climate and the Greenland ice sheet. This poster presents the ETH Summit campaign including all the measurements and instruments.

Investigations of the Atmospheric Boundary Layer

The structure of and the energy exchange in the atmospheric boundary layer was investigated at high vertical (0.5, 1, 2, 5, 10, 20, 35 and 50 m) and temporal resolution (1 to 10 min) with a series of instruments mounted on a 50 m tower:

- **Temperature and relative humidity:** Vaisala HMP35A.
- **Wind speed:** cups, Aanderaa 2740; **wind direction:** Aanderaa 2750
- **Turbulence:** ultrasonic anemometers (20Hz), Gill R2A (2, 5, 10, 50 m); & Krypton hygrometers (10Hz), KH2O (2, 10, 50 m).
- **Radiation:** Longwave incoming and outgoing (2 and 50 m): Eppley PIR pyrometers; Shortwave incoming and reflected (2 and 50 m): Kipp and Zonen CM21/11 pyranometers.
- **Longwave radiation divergence:** mobile boom on a elevator equipped with Eppley PIR pyrometers facing up and down.

The data coverage is given in the table on the bottom of the poster.

Upper Air Soundings

An extensive upper air sounding program was carried out to obtain atmospheric profiles up to the lower stratosphere. The program lasted for 14 months. Radiosondes were usually released twice a day, but every three hours during intensive campaigns.

The sounding system utilized was a Vaisala Marwin12 with sondes of the RS80 and RS90 type. Overall, 660 profiles were collected.

Available Datasets:	2000	2001	2002	2003	2004
Solar Tracker:	SW direct, global, diffuse, reflected, LW in/out Spectral 305,311,318,332,368,412,500,863	=====	=====	=====	=====
50 Meter Tower:	Temperature 0.5,1,2,5,(10,20,35,50)m Relative Humidity 0.5,1,2,5,(10,20,35,50)m Windspeed/direction 0.5,1,2,5,(10,20,35,50)m Turbulence: Ultrasonic anemometers 20Hz, Gill 2,5,10,50m Hygrometers 10Hz, Krypton 2,10,50m Radiation: SW in/out, LW in/out 2m and 50m Longwave radiation profiles 2m – 50m	=====	=====	=====	=====

Upper Air Sounding
Snow Temperature Profiles – 15m to 0m

Radiation Balance

Radiation measurements (1 min. resolution) started in July 2000 and have been continuously running until present, with a gap in winter 2002/3. A state-of-the-art construction was designed to measure all components of the radiation balance according to BSRN standards [1]:

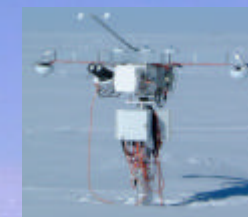
- **Shortwave: direct, diffuse, global, reflected** (Kipp and Zonen CH1, CM11, CM21)
- **Longwave: incoming and outgoing** (Eppley PIR)
- **Spectral radiation:** Two Precision Filter Radiometers, 305, 311, 318, 332 nm and 368, 412, 500, 863 nm, developed at the World Radiation Center (PMOD/WRC) for the investigation of aerosol optical depth and total column ozone.

The hemispheric instruments are ventilated with slightly heated air to prevent riming. All instruments are mounted on a semi-intelligent solar tracker (BRUSAG INTRA) allowing direct solar measurements and precise shading of the diffuse and longwave incoming instruments. Shortwave measurements have been compared to a travelling standard (absolute cavity pyrheliometer PMO-6). The longwave instrumentation was recalibrated by comparison to a travelling standard pyrometer of PMOD/WRC.

Snow Temperatures / Snow Profiles

The **thermal conditions of the snow cover** are continuously monitored since June 2001 with thermocouples (0, 5, 10, 30, 50, 100 cm depth) and with a thermistor chain (0.3, 0.5, 1, 2, 3, 5, 10, 15 m). Detailed studies of the solar **radiation extinction in the uppermost snow layers** were carried out in 2001 with photovoltaic cells (400-700nm) and with a spectrometer (350-2500nm).

The **structure and texture of the snow cover** were investigated in 2003 with a SnowMicroPen and with a NIR camera. Changes in the height of the surface (relative accumulation) were measured until 2002 with a IR-sensor mounted on the 50 m tower.



Solar Tracker



Vane and Windcup



Ultrasonic anemometer, Hygrometer



Upper Air Sounding

50 Meter Meteorological Tower

