

Caratteristiche della struttura dello Strato Limite Atmosferico a Concordia durante STABLEDC

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Abstract

A large atmospheric field experiment STABLEDC (Study of the STABLE Boundary Layer Environmental at Dome C) was held at the French-Italian station of Concordia located on the Antarctic plateau at Dome C (Lat 75° 06.06' S, Long 123° 20.74' E, 3233 m a.s.l.) during 2004-2005. During the same period the RMO (Routine Measurements Observations) programme was also started. This was the first overwintering at Concordia. In the frame of this experiment *in situ* and ground based *remote sensing* sensors were used to monitor the variation of the meteorological parameters.

In the first part of this thesis a brief illustration of the field experiment and the instrumentation is given and the methods utilised for the measurements validation are described.

In the second part the characteristics of the main atmospheric parameters has been investigated. The behaviour of the temperature, the wind velocity and the ground based inversion is illustrated. The near surface air temperature shows a seasonal cycle with the lowest temperatures occurring in April and mid-August. Warming events are observed periodically. These events have a duration and a periodicity of 3-5 days and 15 days, respectively. In correspondence of these events the wind direction changes, the wind velocity tends to increase, the intensity of the surface based inversion decreases. These events are generally accompanied by an increase of the cloudiness.

The wind speed reaches extreme values during the winter. All the year the prevailing wind direction is from the angular sector 180°-210°, that is from the continent. In this sector the strongest winds are also observed. A second mode has been found in the sector 270°-300°. Both temperature and wind speed shown a diurnal cycle during the summer which is absent during the winter.

Uninterrupted temperature profiles were obtained with a Microwave Temperature Profiler (MTP-5P). These high resolution spatial-temporal profiles allowed to monitor the strength of the surface inversion. The response of the atmospheric boundary layer to the diurnally varying forcing differs significantly during the summer and the winter. During the austral winter a long-lived stable boundary layer characterizes the thermal condition of the low troposphere. The strength of the surface inversion increasing with the decreasing of the temperature and wind velocity. The depth of the inversion layer ranges between 100-200 m. During the summer the layer interested by the strength of temperature inversion is more shallow. An unstable profile is observed during the warmer hours of the day when the sun elevation reaches its maximum.

The new parameterization proposed by Zilitinkevich (2007) for the long-lived stable atmospheric boundary layer height was tested using Concordia's data. The comparison between model and observations shows a good correlation although the model on average underestimates the observed values.

The Surface Energy Balance (SEB) has been calculated and the cloudiness estimated. The Net Radiation, is negative during the winter with a peak during the summer. During the summer the sensible heat flux is direct towards the atmosphere and allows the formation of a mixing layer. As expected, an annual variation and a diurnal variability are present. Using the Crank-Nicholson scheme the ground flux has been computed.

The cloudiness has been derived as function of the temperature and the Net Longwave radiation following the method proposed by van den Broeke (2004). At Concordia clear sky conditions prevail.

Finally a comparison of the wintertime SEB between two Antarctic sites at the same latitude has been done. The data for the coastal site of Halley and the continental station of Concordia are compared. The differences in fluxes occurrence distribution observed overall in Net Radiation is probably related to the type and amount of clouds at the two stations.