Twenty First Indian Expedition to Antarctica, Scientific Report, 2007
Ministry of Earth Sciences, Technical Publication No. 19, pp 215-223

Report of Tasks Completed By Snow and Avalanche Study Establishment (S.A.S.E.) during Summer (Jan-Feb 2002)- XXI IAE

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Objective 1: Microstructural Studies

The SASE team of Sh. Rajiv K Das and Sh. Sudesh Jamwal carried out microstructural studies by making thin section of ice sample of the continental ice using microtome machine and hot plate. Sh Sudesh Jamwal took extensive training on microstructural studies before going to Antarctica.

Work done

A cold laboratory was established at Maitri Station. Dr.P.C. Pandey, DIRECTOR NCAOR, inaugurated it on 27th Jan. 2002. The laboratory consists of one Microtome machine for making samples of ice to be observed under the magnifying microscope. The microscope is fitted with a high-resolution camera arrangement for taking pictures of the samples. This work is under the project for microstructure analyses of ice.

Methodology

The ice samples were collected from the ice cap near Sankalp point, which is about 5 km from the Maitri station. Initially the chain saw was used to cut out ice blocks of 60cm thickness, but due to failure of the machine, later ice axe and iron rods were used. As a result the team could not collect sample from more depth. The samples were brought to Maitri station in plastic bags and kept in the deep freezer.

Ice samples were then cut into small blocks of 2-3 cm with microtome machine. After flattening the surfaces, the sample was put on the hot plate for smoothening the surfaces through melting. The same

then bonded to a clean glass slide. A thin sample of 0.5mm (approx.) was prepared by melting the opposite surface. The melted water was removed from the sample surface, dyed with proper solution and then observed under the microscope.

Results

As the team couldnot take ice samples from much depth, not much variation in ice grain structure was observed. The grains were of bigger size and significant amount of air bubbles was also observed in the surface. These air bubbles were trapped into the ice layer during the glaciating period.

Remarks

The experiments will continue during the winter period as well. Samples will be collected whenever the convoy moves.

Fig. 1: SASE cold lab at Maitri

Fig. 2: Microscope and camera arrangement in the cold lab

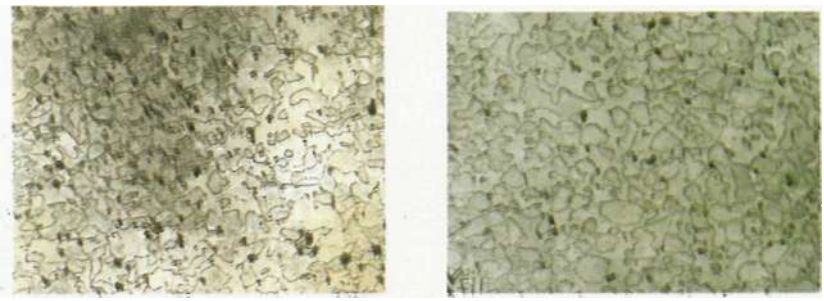

Fig. 3: Thin ice section of samples taken from Sankalp point as observed under microscope in the cold lab

Objective 2: Energy Budget Model based on reflectance and Glacio-meteorological parameters of Antarctic Ice through ground based observations

The SASE team worked throughout the summer for collection of glacio-met data for the simulation of Energy Budget Model. The objective was to set up an Automatic Weather Station to collect Snow-met data and albedo values over Antarctic ice. Sh Rajiv K Das had gone extensive training for the installation and upgradation of Automaic Weather Stations before leaving for Antarctica. In addition to the AWS the team also installed an Albedometer near Maitri station and integrated it with an EPR recorder for recording albedo variations near Maitri.

Work done

Automatic Weather Station: One Automatic Weather station was installed at Sankalp point on continental ice on 2nd Feb 2002. Wind Speed, Wind Direction, Relative Humidity, Atmospheric Temperature, Atmospheric Pressure, Snow Depth sensors and Albedometer were integrated with the Weather Station. The sensors are programmed so as to log data hourly. Charging of the battery of the Weather Station is through solar panel. The whole system is functioning properly.

Wind Electric Generator: One Wind Electric Generator was also installed at Sankalp point near the automatic weather station as an alternate source for charging the battery during polar night. The Wind Electric Generator was integrated with the automatic weather station on 9th Feb 2002.

AWS on shelf ice at Dakshin Gangotri could not be installed as the instrument was found to be non-operational. The instrument requires repair and hence backloaded.

Albedometer: One Albedometer was also installed near Maitri. The Albedometer was integrated with an EPR recorder. The EPR recorder is placed inside Maitri.

Methodology

To estimate the energy budget of continental ice the SASE team installed one AWS near Sankalp point, approximately 5 kms from Maitri. Though SASE installed one AWS in the XlXth Expedition, it couldn't log data during the polar nights, as battery charging was not possible during absolute darkness. Moreover, the tower would tilt / fall during summer

because the metallic tower got heated up and as a result the ice at the base of the tower melted.

Taking into consideration these problems, the SASE team designed the tower with special consideration. The tower was fitted onto a wooden box filled with concrete. The box had holes at specific positions for inserting in ice pickets. The tower was then put into a two feet deep foundation and the ice pickets hammered into the ice. The foundation was then covered with ice and some salt water was put for strengthening the foundation. The salt water would also act for grounding of elctric charges. Three guy ropes were then tied to the triangular tower and anchored to the surronding ice with ice pickets. A diagram of the modified tower is shown below.

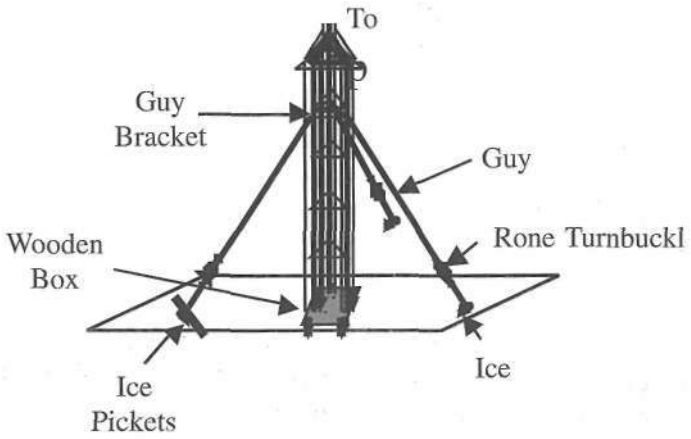

Fig. 4: Specially assembled Tower for AWS

The team assembled and installed a Wind Electric Generator near the AWS to overcome the problem of data loss during polar nights. During polar nights, due to absence of sunlight, the battery of the AWS discharges out and so the AWS is unable to log data during that period. We installed the Windmill near the AWS and provided an alternative source for charging the battery apart from the regular solar panels. The wind electric generator was erected on a separate tower 5m away from the AWS. This tower was also fabricated on similar guidelines as the AWS tower. The connection was then made to the charger unit of the Data logger.

The Albedometer, Wind speed sensor, Wind direction sensor, Temperature seneor, Relative Humidity sensor, Snow depth sensor Pressure sensors were integrated to the Automatic Weather Stations.

Measurements of snow-met data for estimation of surface energy budget includes net radiation, wind speed/direction, air temperature, and

pressure. All the snow-met data were collected on hourly basis. The net radiation is sum of net short wave radiation and net longwave radiation. The net short wave radiation is the difference between the measured incoming solar radiation and the measured reflected solar radiation. The incoming and the reflected solar radiations were measured by the albedometer, which basically comprises two Pyranometers, one facing upward and the other facing downward. This sensor has a nominal sensitivity of 7-lO^VAV-m^2. It has excellent transmission characteristic for solar radiation in the wavelength range 0.3-3(xm.

Fig. 5: AWS installed near Sankalp Point

Fig. 6: The AWS with the Wind Electric Generator

An albedometer arrangement was also installed near Maitri station. An EPR recorder was used to record incoming and outgoing radiation on a thermal chart.

Fig. 7: EPR integrated with Albedometer near Maitri

Results

Data from the automatic weather station has been downloaded from 4th Feb 2002 .All the sensors are functioning satisfactorily. The data from the above-mentioned sensors is brought back to India for further processing. The feasibility of sending data through e-mail has also been tested and it has been found that data can be sent through e-mail to RDC SASE at regular intervals. In winter, data will be sent through mail to R.D.C, SASE, Chandigarh.

The graphs showing diurnal variation of (a) temperature and (b) albedo on a clear day (13 Feb. 02) and on an overcast day (18 Feb. 02) are shown in Fig. 8. Detailed analysis and comparision of this year's data with past data is going on at SASE.

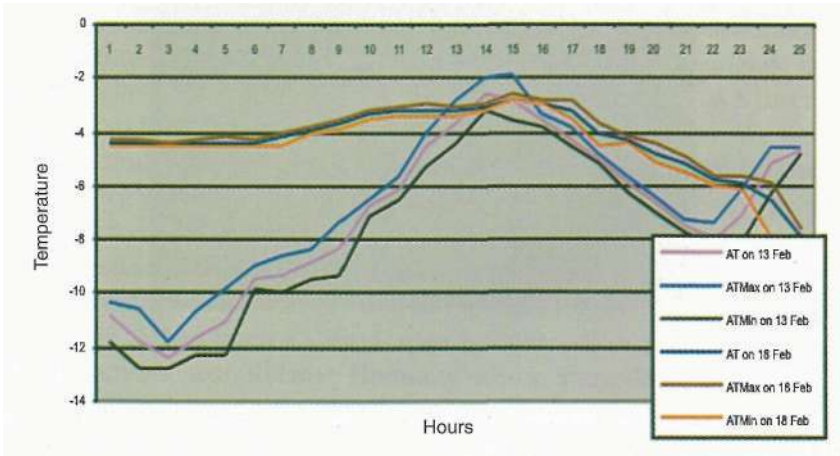

Fig. 8 (a): Diurnal Variation of Temp on Clear and Cloudy Days

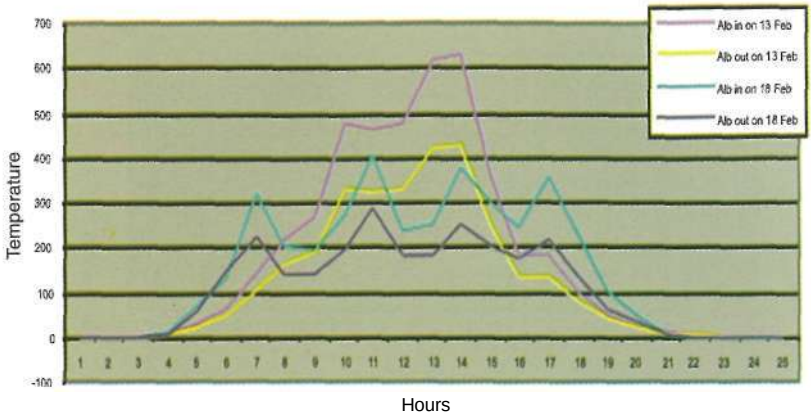

Fig. 8: (b) Variation of Alb in/Alb out in Clear and Cloudy Days

The solar radiation is the main component in the surface energy budget during summer, but as the winter falls the effect of solar radiation keeps on decreasing. The graph in Fig. 8 (a) shows that on a cloudy day the variation in air temperature is least as compared to a clear sky day. The albedo variation is also shown in Fig. 8 (b). The net short wave variation was also calculated ($Sw_{net} = Sw_r Sw_0$) and plotted (Fig. 9) for clear and cloudy day. The values were found much higher for clear day.

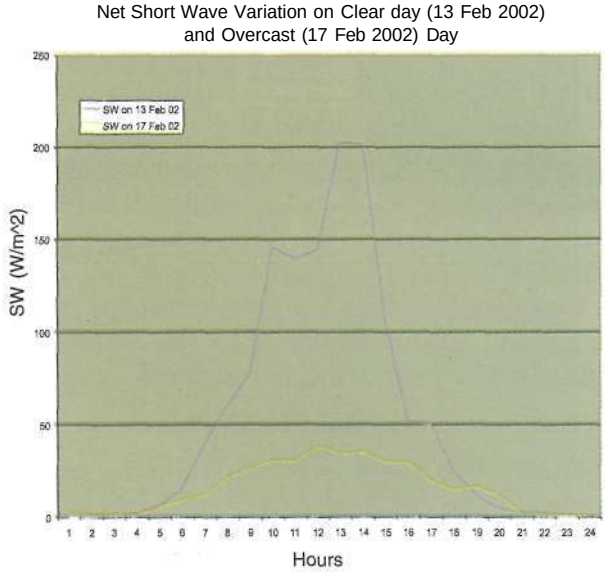

Fig. 9: Short Wave Variation on 13 Feb 02 and 17 Feb 02

The wind direction was observed (Fig. 10) and the trend line showed that most of the time the wind was blowing 150-200 degrees from north.

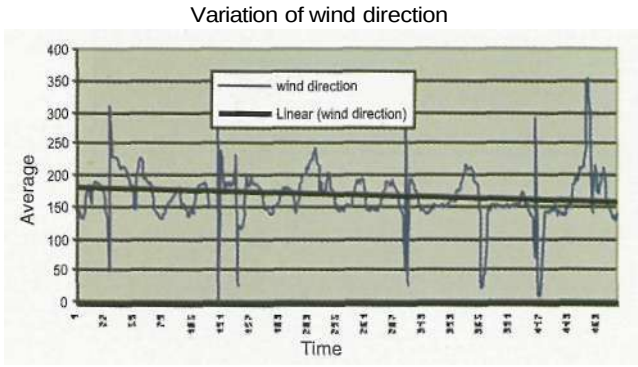

Fig. 10: Wind Direction Variation and Trend Line

This observation may be helpful in deducing the probable direction of blizzards. The mean velocity of wind in this direction was found to be 5.2 m/s during February.

The average variation in Albedo and Net short wave radiations is shown in Fig. 11 (a) and Fig. 11(b) respectively. The trend line shows that albedo decreases as winter approaches.

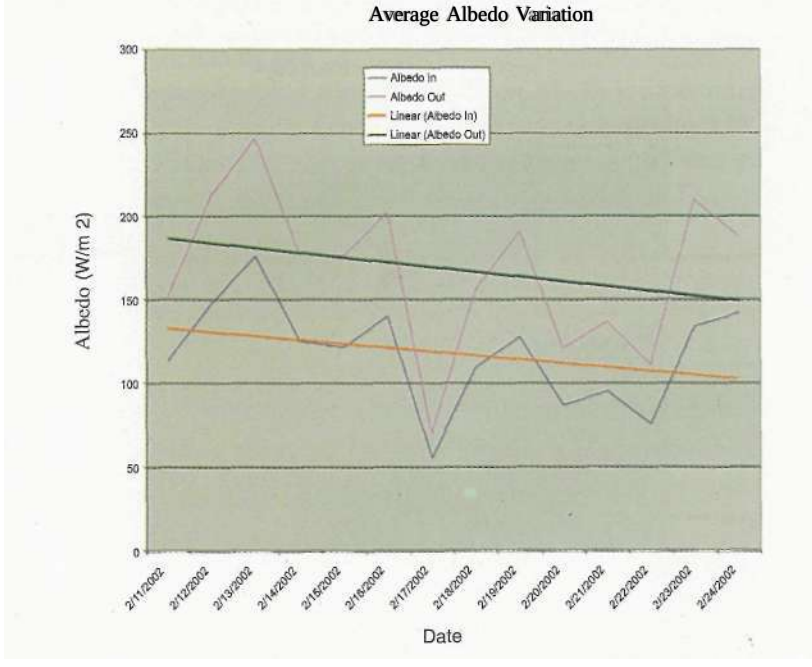

Fig. 11 (a): Average albedo variation during February

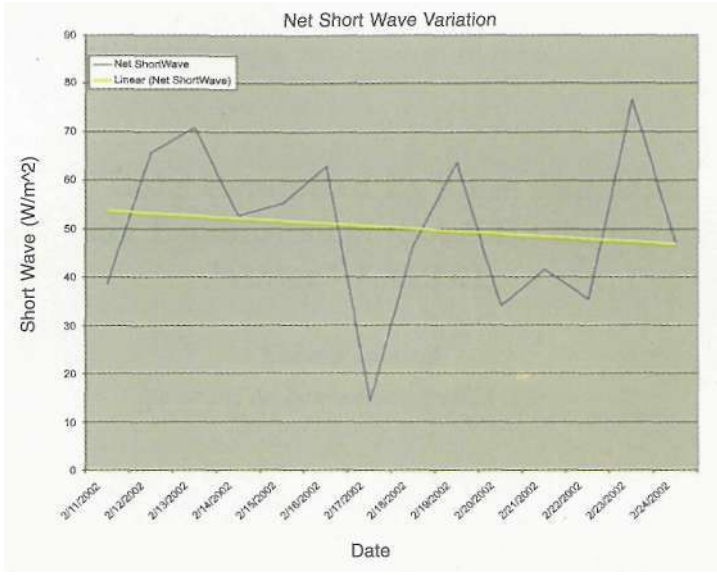

Fig. 11 (b): Net Short Wave variation during February

From the aggregate of snow-met data it is evident that the summer at observation site is relatively warm with high air temperature, low wind speed, low pressure and high solar radiation.the trend in micro-climatological elements changes as winter approaches. The air temperature and solar radiation show a decreasing trend whereas the wind speed and the pressure show an increasing trend.

Remarks

The Weather station will continue to function during winter and the data will be downloaded whenever the convoy moves. The snow surface temperature is an important factor in calculating energy budget. SASE plans to integrate one IR Snow Surface Sensor to the Automatic Weather Station in the next Expedition.

Objective 3: Study of Crack Propagation On Ice Shelf Using GPS

Work done

One crack was observed over ice shelf near Indian Bay by helicopter. Detailed observations could not be made as no camp could be organized due to bad weather.

Miscellaneous Activities

Helped DEAL Dehradun members in establishing VHF repeater at Vetiah top. Also helped NAL members to install WindMill at Vetiah.