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## **Temporal and Spatial Variations of Energy Fluxes of Different Snow and Ice Media in Antarctica Using Radio Based Remote Telemetry System Data**

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### **ABSTRACT**

Ice Sheet Met parameters for the year 2008 have been collected using two Automatic Weather Stations. Net Radiation, Heat Flux and Energy Balance have been calculated from these observations.

**Keywords:** Antarctica, AWS, Net Radiation, Energy Balance.

### **1.0 INTRODUCTION**

**1.1** Measurement of the following snow-meteorological parameters using Automatic Weather Station (AWS) over the continental ice sheet:

- a) Ambient temperature
- b) Maximum temperature
- c) Minimum temperature
- d) Snow/ice surface temperature
- e) Incoming radiation
- f) Outgoing radiation
- g) Wind speed
- h) Wind direction
- i) Atmospheric pressure
- j) Relative humidity

**1.2** Estimation of Albedo and its temporal variation.

**1.3** Estimation of the various energy fluxes over different snow/ice media e.g. short wave radiation flux, long wave radiation flux, latent heat flux and sensible heat flux. Estimation of the hourly, weekly, monthly, seasonal and yearly Net Energy Budget of the Antarctic ice sheet and its temporal variation.

## 2.0 INTRODUCTION

The project work was initiated in 25<sup>th</sup> Indian Antarctic Expedition. Two Automatic Weather Stations were installed over continental ice sheet for the energy balance study, at S 70°47'40.9", E 11°41'43.1" (04 km from Maitri, having 75 to 80 meters thick ice sheet) and at S 70° 46' 05.1", E 11° 42' 12.2" (1.5 km from Maitri near starting zone of glacier) during 25<sup>th</sup> and 26<sup>th</sup> expeditions, respectively. All the electronic components of both the AWS are capable of operating up to -40°C under extreme weather conditions. Power is supplied by a solar panel, combined with heavy-duty low temperature batteries.

### 2.1 Field Work

Hourly observations of various snow-meteorological parameters (Incoming Solar Radiation, Outgoing Solar Radiation, Sun Shine duration, Net Radiation, Average Ambient Temperature, Maximum Temperature, Minimum Temperature, Instantaneous Temperature, Relative humidity, Wind Speed, Wind Direction, Atmospheric Pressure, Snow Surface Temperature, Snow Depth) have been taken over the continental ice sheet (*Sankalp location*) as well as starting zone of the glacier (*Dozer Point location*). Cloud measurements were taken by visual inspection.

## 3.0 OBSERVATIONS

The collected data have been presented in **Table-1 and Table-2**. The analysis of the data is given in **Figs 1 to 9**.

**Table 1— Meteorological Parameters of Continental ice Year 2008 (January to December)**

Highest Instantaneous Temperature (°C)	7.2
Lowest Instantaneous Temperature (°C)	-35.2
Highest Maximum Temperature (°C)	7.3
Lowest Maximum Temperature (°C)	-35.1
Highest Minimum Temperature (°C)	1.4
Lowest Minimum Temperature (°C)	-35.3
Highest Relative Humidity (%)	87
Lowest Relative Humidity (%)	34
Highest Atmospheric Pressure (mB)	963
Lowest Atmospheric Pressure (mB)	906
Highest Wind speed (m/sec)	31.7
Lowest Wind speed (m/sec)	1
Highest Sun duration (Hrs)	17.9
Lowest Sun duration (Hrs)	0.3
Highest Albedo (%)	91.2

**Table 2— Monthly Temperature Pressure, Relative Humidity, Wind and Sunshine Data Year 2008 (January to December)**

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Highest Max Temp ( in °C )</b>	7.3	6.0	-2.0	-1.5	-7.9	-5.4	-9.1	-12.3	-5.0	-6.4	-0.3	6.3
<b>Lowest Min. Temp (in °C)</b>	-8.2	-12.5	-14.6	-26.2	-25.8	-35.3	-31.2	-32.8	-28.6	-23.8	-5.9	-5.0
<b>Highest Atm Pressure (in mb)</b>	946	948	951	963	962	951	950	954	941	950	953	954
<b>Lowest atm. Pressure (in mb)</b>	930	923	914	908	920	906	914	924	924	922	923	920
<b>Highest Rh (in %)</b>	60	59.2	56.5	57.2	55	57	56.6	58.4	58	55	46	87
<b>Lowest Rh (in %)</b>	53	51.5	50.0	49.2	48	44.4	46	47.1	46	47	34	45
<b>Peak Wind speed (in meter/sec)</b>	19.0	18.2	27.9	28.6	27.4	29.1	31.7	25.4	31.4	27.0	18.8	15.0
<b>Av Sunshine (in Hrs)</b>	14.2	11.2	4.3	0.3	Nil	Nil	Nil	Nil	3.4	9.9	16.4	17.9

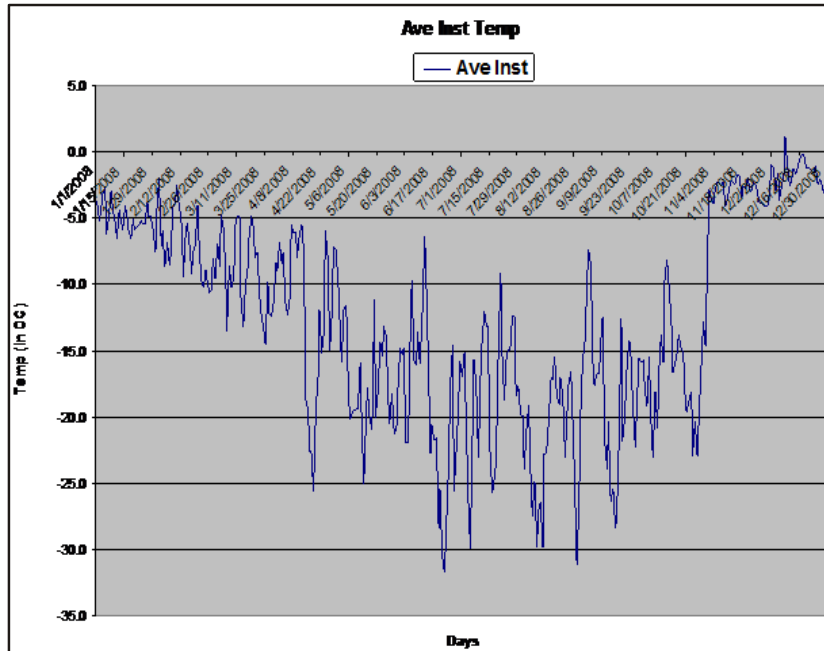


Fig. 1

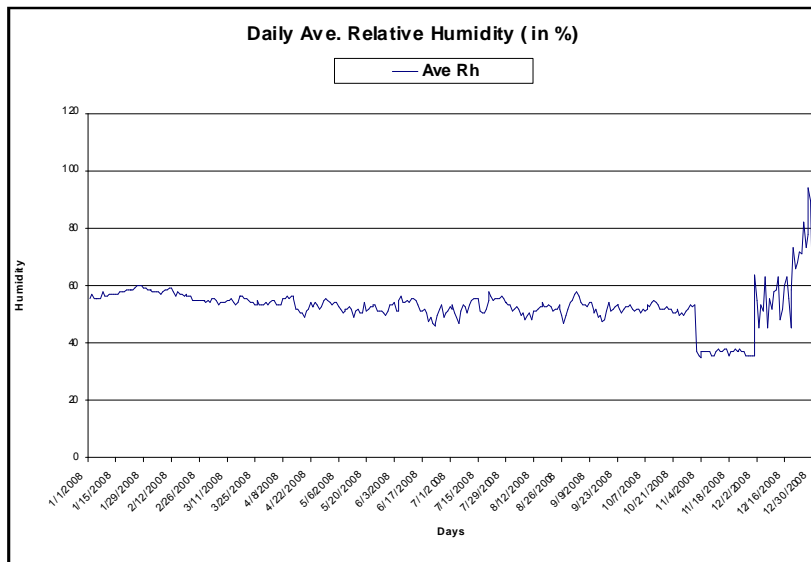


Fig. 2

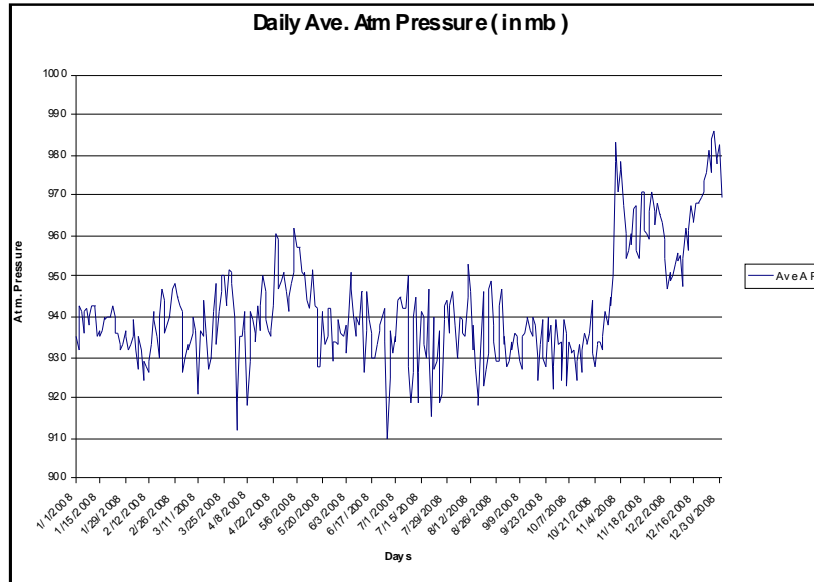


Fig. 3

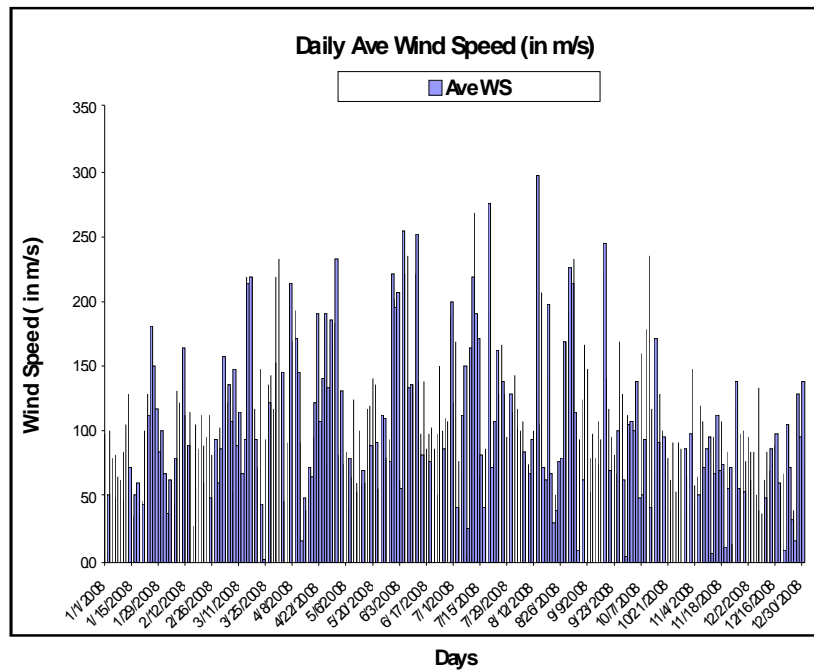


Fig. 4

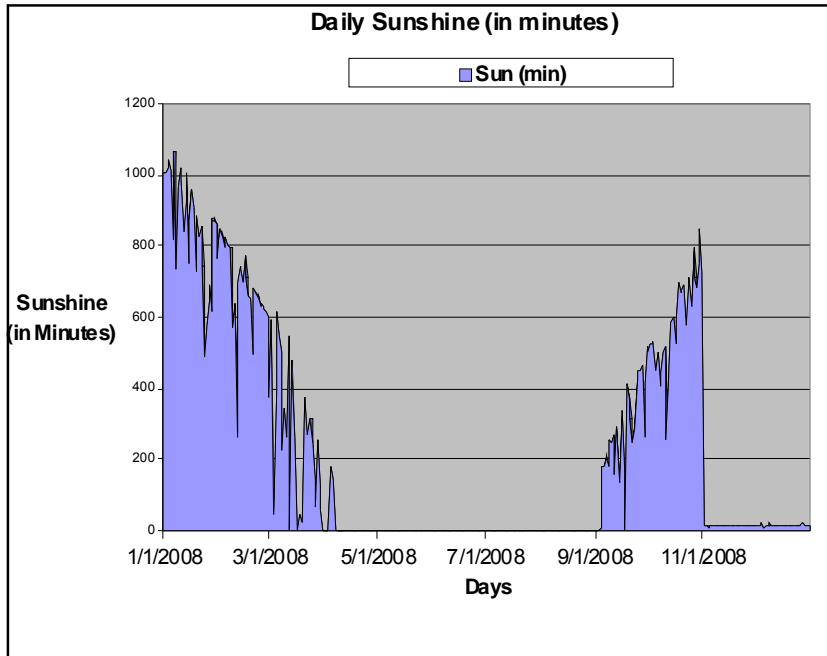


Fig. 5

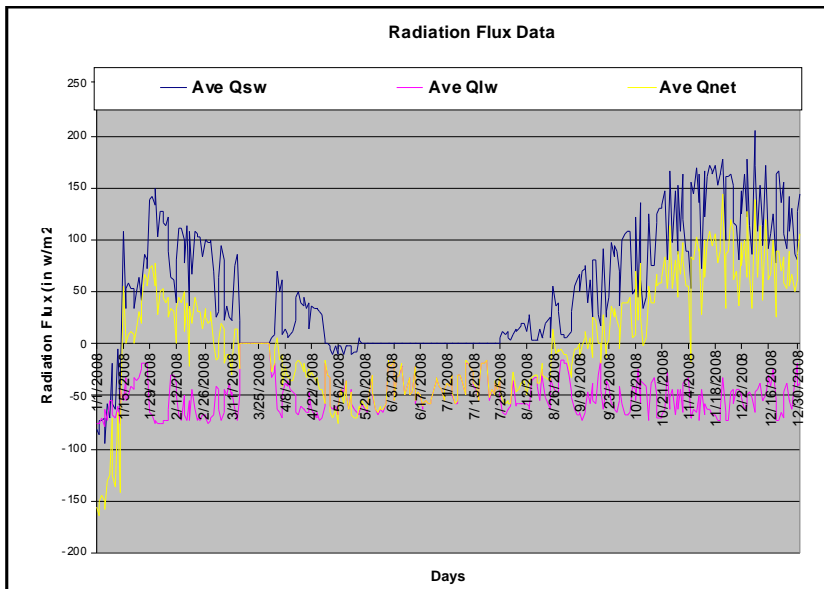
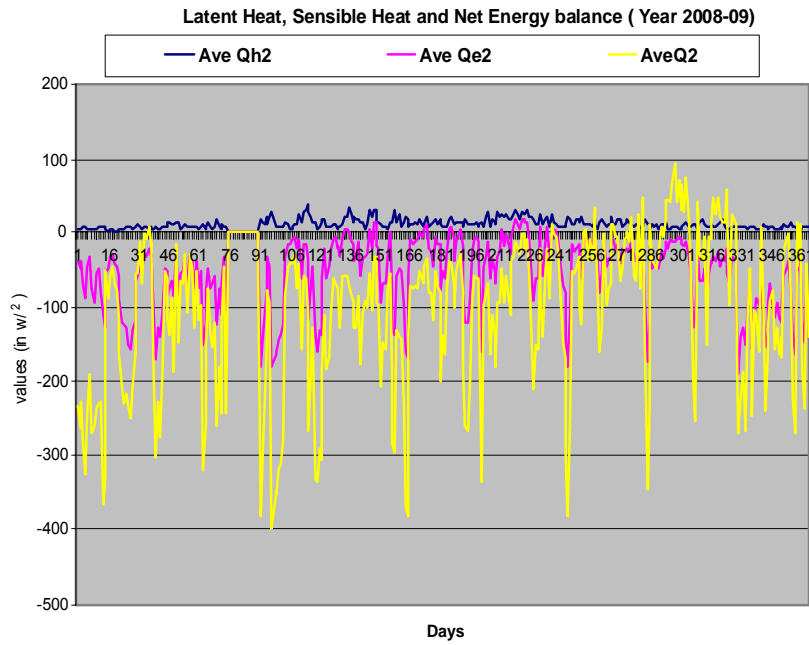


Fig. 6

$Q_{sw}$  = Short Wave Radiation Flux;  $Q_{lw}$  = Long Wave Radiation Flux



$Q_2 = \text{Total Net Energy Budget for the year 2008} = -55 \text{ w/m}^2$   
 Note:- Net Energy Budget for Last 10 Years :  $-70 \text{ w/m}^2$

Fig. 7

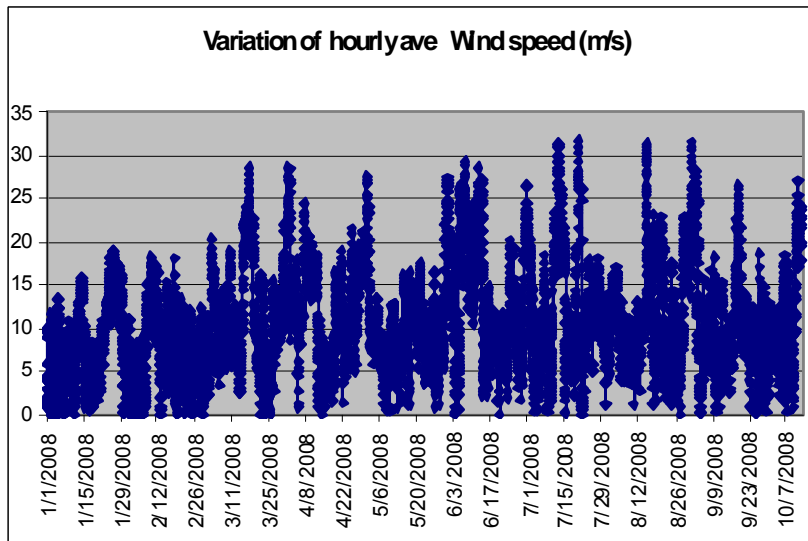


Fig. 8

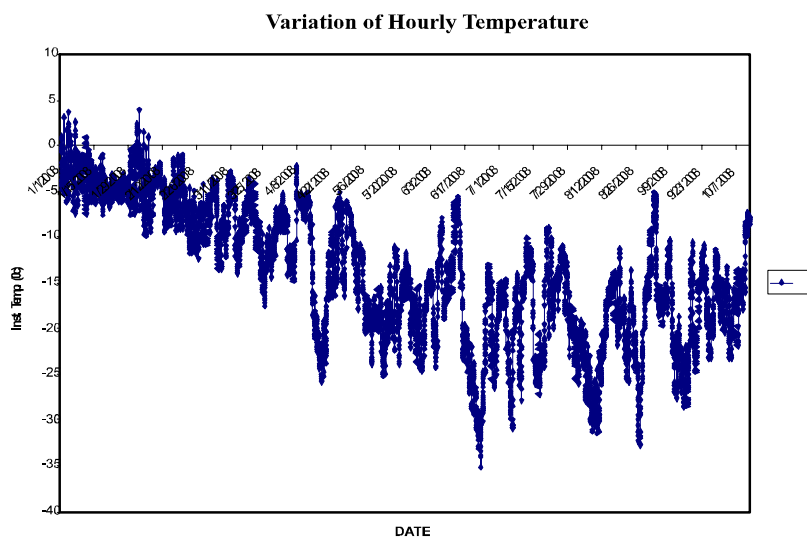


Fig. 9

#### 4.0 CONCLUSIONS

Maximum and minimum temperatures recorded near the Ice Sheet margin were 6.0°C and -35.3°C, respectively. Maximum hourly averaged wind speed observed was 114 km/hr (31.7 m/sec) and the relative humidity varied from 44% to 59 % during year 2008.

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