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A STUDY ON THE MICROCLIMATE IN A MOSSY AREA OF KING GEORGE ISLAND, ANTARCTIC*

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Abstract: By using the micrometeorological observation data in a mossy area and the daily meteorological data of Great Wall Station (GWS) in the Antarctic, two microclimate features are revealed in this study. First, the amplitude of diurnal variation of temperature in the lower layer above the ground in the mossy area is decreasing rapidly with altitude under any kind of weather conditions; Second, the difference between the diurnal mean surface (0 cm height) temperature and mean surface air (150 cm height) temperature in the mossy area is much smaller than in GWS. The aforesaid difference is probably due to the difference between the moss cushion in the microclimatic observation field and the bare sandy soil in GWS, that may have an important influence on the microclimate features of those areas.

1. Introduction

The study of the moss microclimate is part of moss research program of the Chinese Fifth Antarctic Expedition.

The growing of moss vegetation requires suitable environment conditions. The study of the microclimate influence on the vegetation and the relation between the environmental factors and the moss vegetation in different areas of the Antarctic have been investigated by many authors, *e.g.*, KAPPEN and REDON (1984), KANDA (1986, 1987), etc. On the other hand, the moss associations also have an important effect on the environment and the study of the moss microclimate in the Antarctic is an interesting subject for meteorologists. Unfortunately, the research works in this field are comparatively less due to the lack of observational data. Our present work is a primary study on the influence of moss vegetation on the microclimate in the Antarctic.

From the point of view of meteorology, there are two important aspects in such a study, one is the investigation of the moss microclimate, and the other is the determination of a certain kind of parameters which are useful for the climate modeling. In this paper, the authors put emphasis on the moss microclimate itself. Based on the basic analysis of the data set collected in the Antarctic by ourselves, some of features of the microclimate in the Antarctic were obtained. This data set will be of benefit to the second apsect mentioned above in the future time.

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2. The Micrometeorological Observations in the Mossy Area

2.1. Time and place

The micrometeorological observation field is shown in Fig. 1a. The authors defined the observational field in a mossy area of the Antarctic, which is from nearby 400–600 m on the southeastern side of Great Wall Station (GWS) in the Fildes Peninsula of King George Island and did the observations six times a day (7, 10, 13, 16, 19 and 22 o'clock by local time) during Feb. 2–10, 1989.

2.2. Weather processes and large scale circulation background

A brief description of the weather conditions during Feb. 1–10, 1989, such as weather process, synoptic system and large scale circulation background, is given in Table 1. According to the table the weather conditions can be divided into three types, *i.e.* overcase/lightly cloudy, fine day, and rainy.

2.3. Micrometeorological observation

The authors also defined the micrometeorological observation levels (see Fig. 1b) in the observation field of the mossy area as follows:

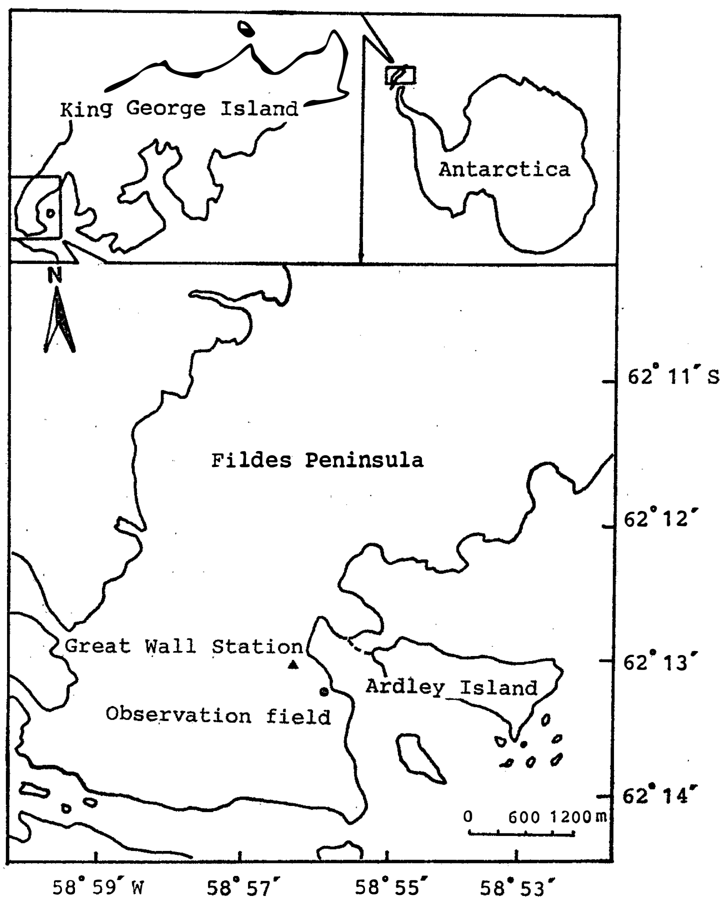

Fig. 1a. Observation field in King George Island.

Table 1. Weather processes and large scale circulation background.

Data	Weather process	Synoptic system on surface level	Large scale circulation background on 500 MB level
Feb. 1	snow/overcast	col	before the trough
2	overcast	south western side of the low/col	after the trough
3	overcast	ridge line	after the trough
4	overcast/cloudy	ridge line/col	after the trough
5	cloudy/lightly cloudy	col	after the trough
6	few clouds	col	before the ridge
7	clear, few clouds	ridge/col	before the ridge
8	cloudy/overcast	ridge line	ridge/after ridge
9	rainy	after the ridge line /before the trough	after the ridge line /before the trough
10	rainy	before the low	trough

Southern Hemisphere Weather Maps from Japan Meteorological Agency.

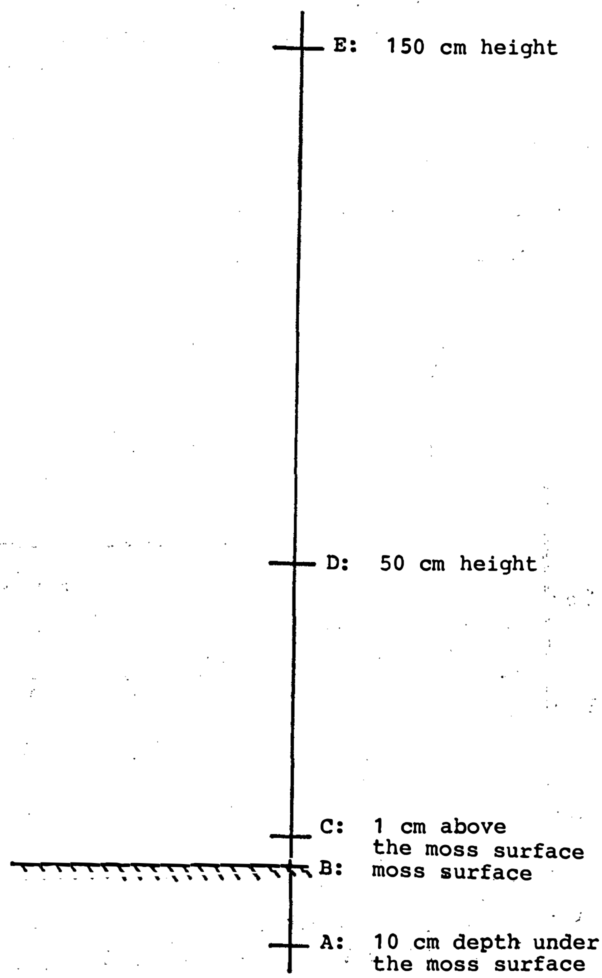

Fig. 1b. Vertical arrangement of observation levels.

level A: 10 cm depth under the moss surface;
level B: moss surface;
level C: 1 cm above the moss surface;
level D: 50 cm height;
level E: 150 cm height.

The micrometeorological elements of the observation at each level are shown in Table 2.

Table 2. Observed element.

Content	Dry-bulb temperature	Wet-bulb temperature	Wind direction	Wind speed
level				
A	yes	no	no	no
B	yes	no	no	no
C	yes	yes	no	no
D	yes	yes	no	yes
E	yes	yes	yes	yes

Meteorological instruments: Assmann psychrometer, soil thermometer and hand anemometer; a thermograph and a hygrograph in the Stevenson screen at level E.

3. Some Facts of Micrometeorological Observation

Descriptions of the micrometeorology under the three types of weather conditions on each level including the diurnal variation of temperature, the amplitude of temper-

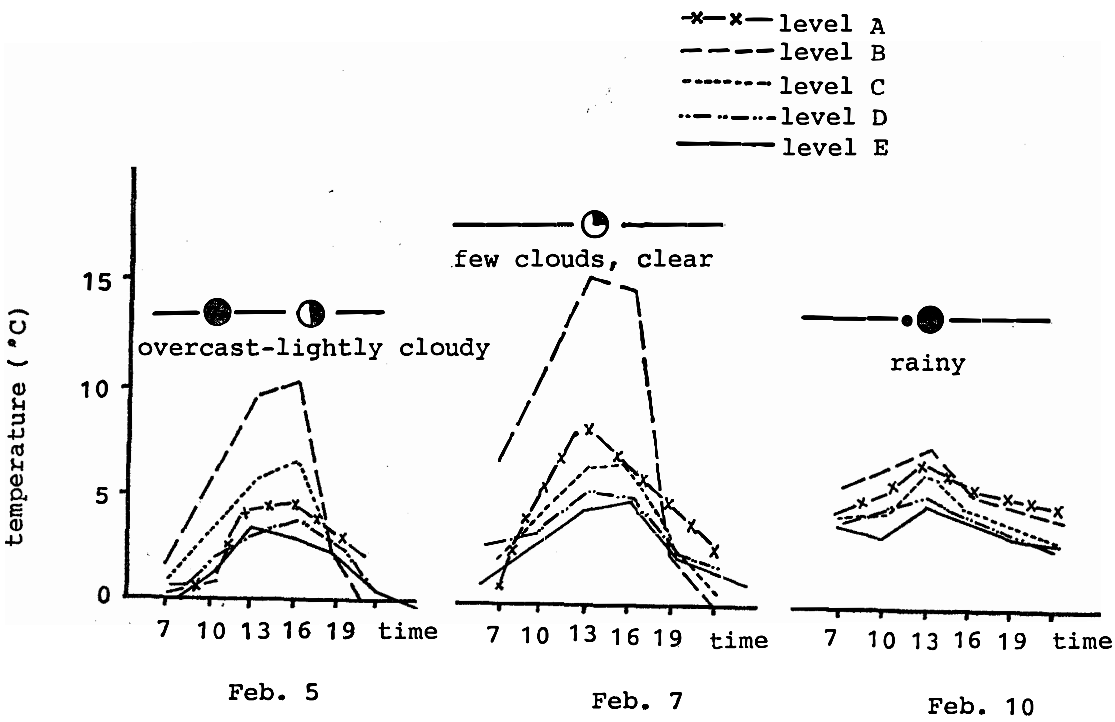

Fig. 2. Diurnal variation of temperature under three kinds of weather conditions.

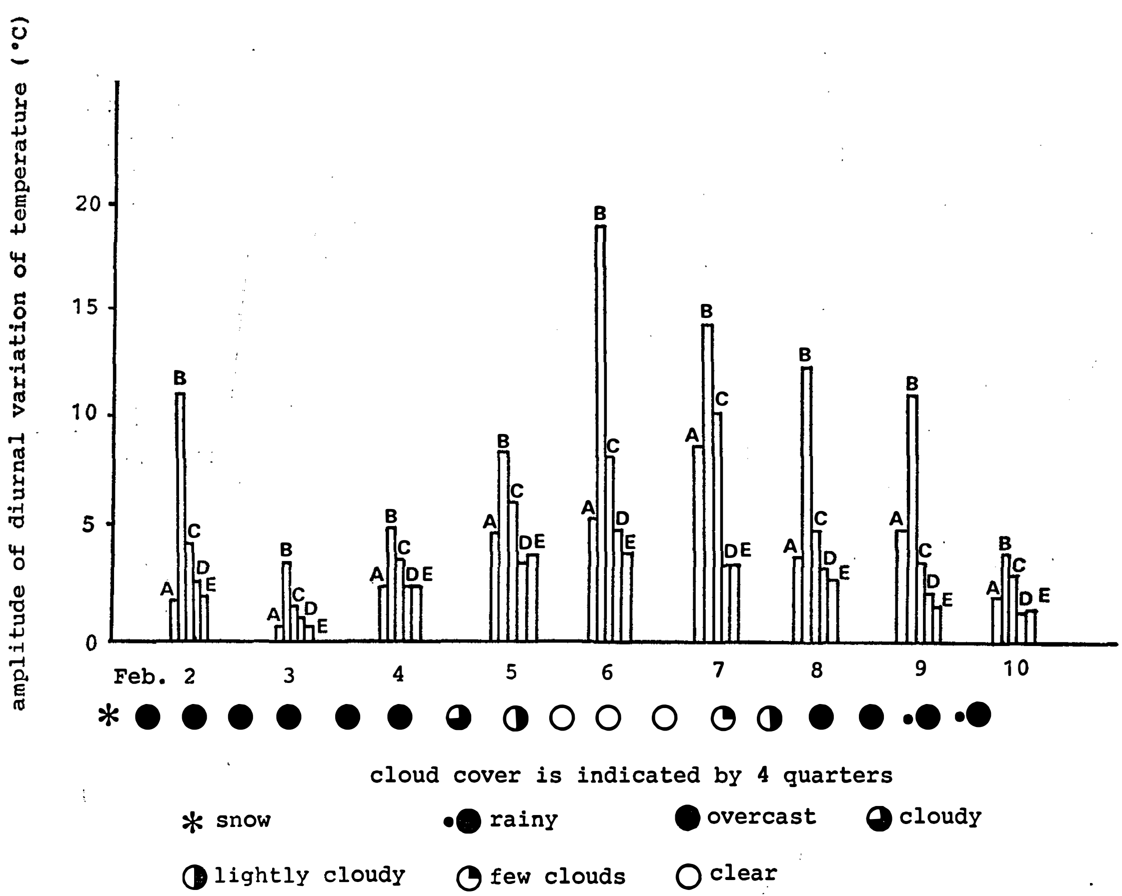

Fig. 3. Amplitude of diurnal variation of temperature at all the levels.

ature variation, the vertical distribution of temperature, the relative humidity and so forth are given in Figs. 2–4. From these figures we found the following characteristics:

1) The diurnal variation of temperatures on each level is different dramatically under all the three kinds of weather conditions (see Fig. 2);

2) Above the moss surface the amplitude of diurnal variation of temperature in the mossy area is decreasing rapidly with height under any kind of weather conditions (see Fig. 3);

3) The difference of temperature between level B and level C is larger than other layers (among any two levels) especially during the clear days (see Fig. 4, the upper). In fact, the difference of daily mean temperature between level B and level C is 5°C, and those between level C and level D, and between level D and level E are all about 0.5°C during the clear days. The maxima of the temperature difference between level B and level C is about 10°C, and those between level C and level D, and between level D and level E are only 2°C and 1°C respectively at midday on clear days.

Furthermore we speculate that the difference of the relative humidity between level B and level C is also larger than other layers (Fig. 4, the lower), because the relative humidity at level B which is covered by moss vegetation (as a moss cushion) is much larger than that at other levels (though no humidity observation has been made for level B).

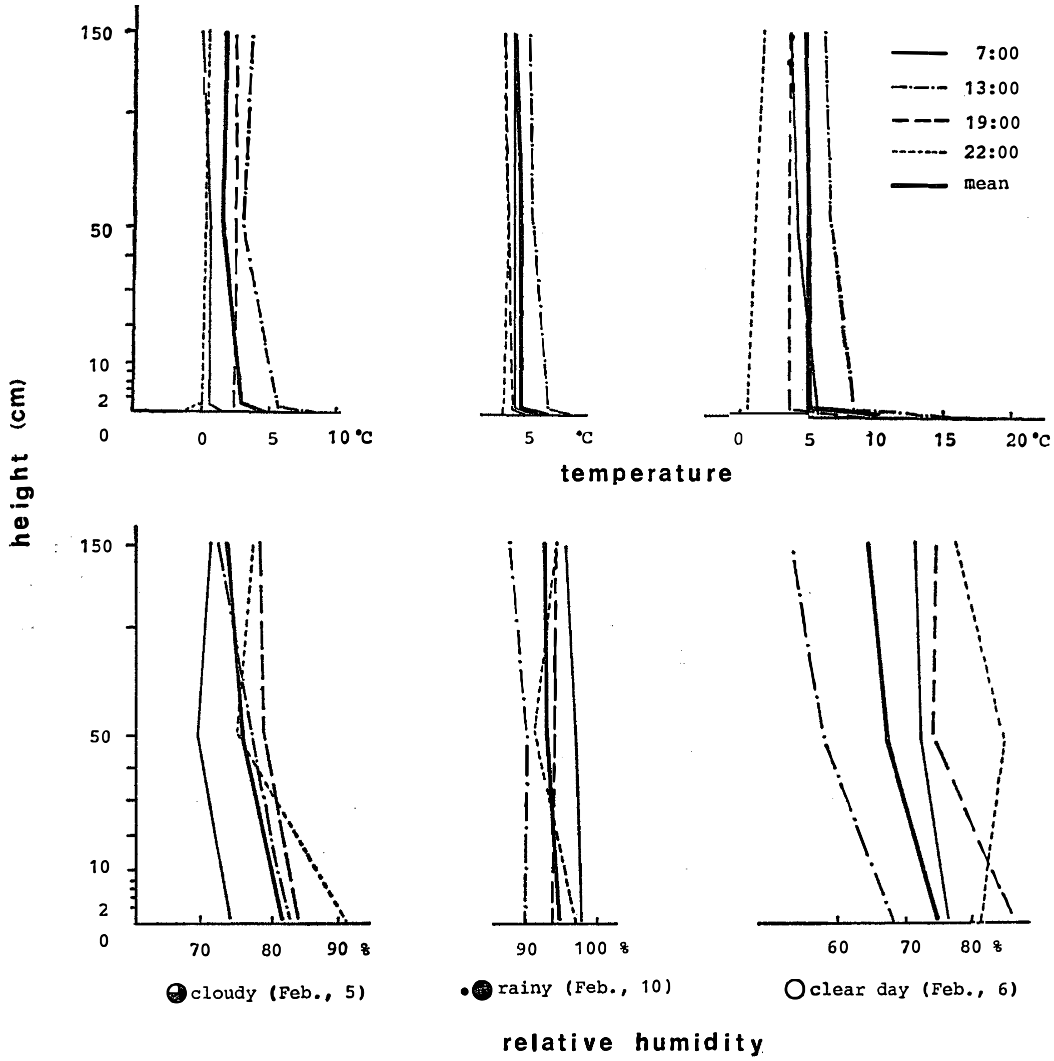

Fig. 4. Vertical distribution of temperature and relative humidity.

4. Features of Moss Microclimate

It should be noted that the distance between the mossy area (our observation field) and GWS is only 400–600 m, thus the two places are almost under the same environmental conditions and just in the same synoptic weather system background. The main difference between the mossy area and GWS is in their ground vegetation conditions: the moss vegetation is growing well as a moss cushion around the observation field, whereas it is a bare sandy soil around GWS. Therefore, the microclimatic differences between the two fields may reflect the effect of the ground vegetation on microclimate.

Figure 5 shows the two sets of surface tempreature profiles for the two fields. It is very clear that during daytime the ground surface temperature in GWS is much greater than in the mossy area under all of the weather conditions, and the maximum difference is over 8°C.

The differences between the diurnal mean surface (0 cm height) temperature and the diurnal mean surface air (150 cm height) temperature in two fields are shown in

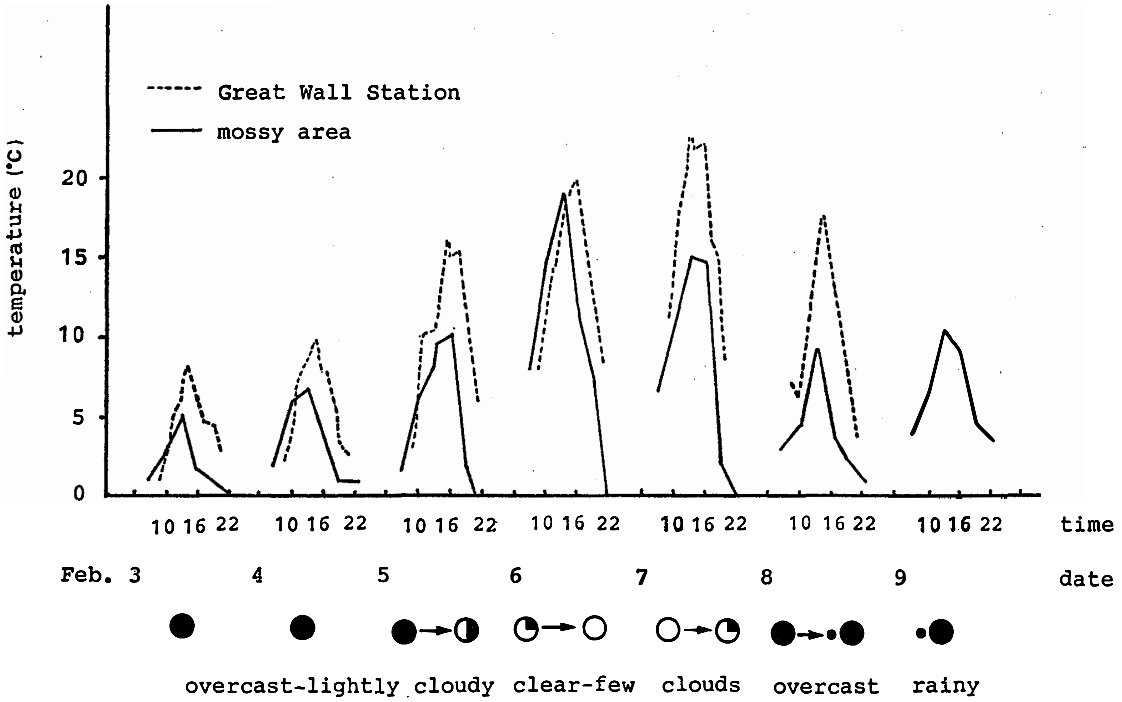

Fig. 5. Diurnal variation of surface temperature.

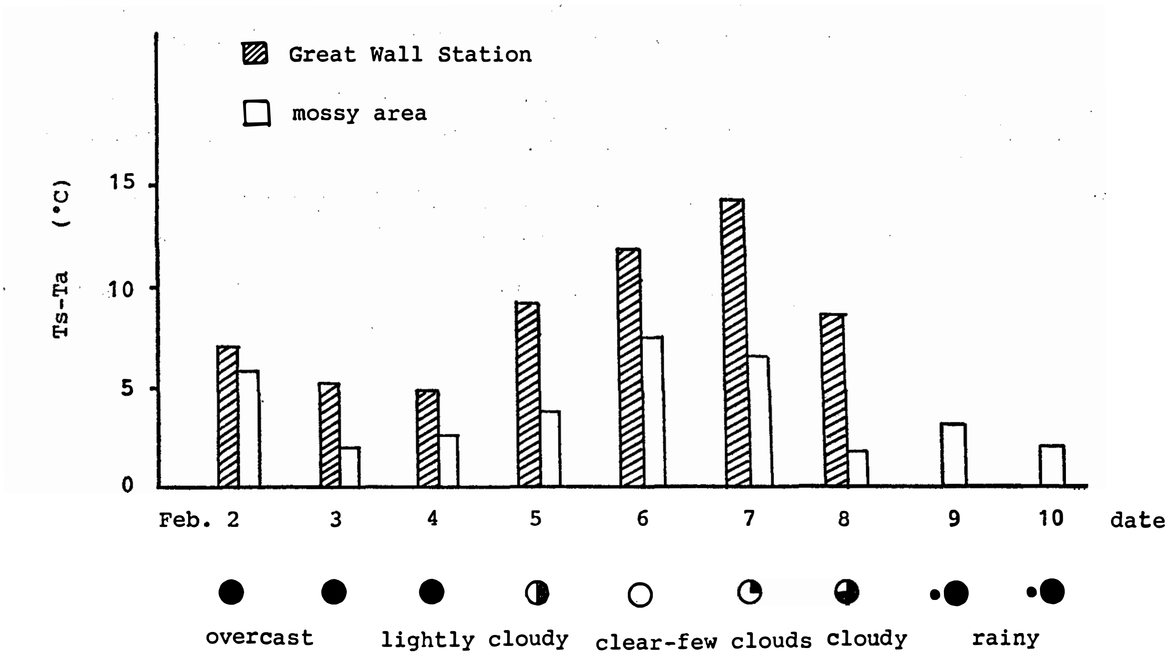

Fig. 6. The difference between the diurnal mean surface temperature (T_s) and the diurnal mean surface air temperature (T_a).

Fig. 6. From Fig. 6 we find that the difference between the mean surface temperature and the mean surface air temperature in the mossy area (blank square) is much lower than that in GWS (covered square), and the maximum difference between the two places is also over 8°C.

The difference of surface air temperature between the two places is always quite small because the micrometeorological observation field is quite close to GWS. As a matter of fact, Fig. 5 and Fig. 6 show clearly the synchronous variation of the surface temperature for the two places. Therefore, the different results shown in Fig. 6 can be understood easily: they are mainly due to the difference of the surface temperature between the two places.

Although the observation field is not far from GWS and the mossy area is not big enough as Ardley Island, we did find some of moss microclimate features from the present preliminary study. In addition, the data set obtained from the observation will be very useful for the future studies.

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