THE STABILITY OF THE AIR LAYER NEAR THE SNOW SURFACE AT MIZUHO STATION, ANTARCTICA (EXTENDED ABSTRACT)

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Observations of the air layer near the snow surface at Mizuho Station, East Antarctica (70°42′S, 44°20′E, 2230 m a.s.l.) have been taken since 1979 for three years, on a 30 m observation tower. The observation system on the tower is described in MAE *et al.* (1981). A few results derived on the stability of the air layer near the surface will be shown.

The Richardson number,

$$Ri=\frac{g\cdot\Delta\theta\cdot\Delta z}{\theta_0(\Delta u)^2},$$

was calculated to examine the seasonal trend of the dynamic stability of the air layer. The difference Δ adopted in the present paper was that between the 2 and 30 m

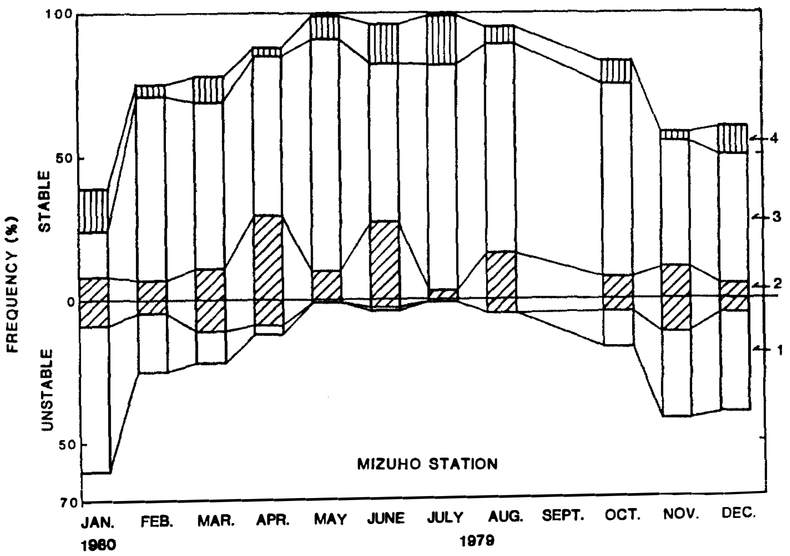

Fig. 1. The frequency distribution of Ri between 2–30 m for the period of February 1979 to January 1980 at Mizuho Station. The numbers at the right end correspond to the range of Ri shown in the text.

levels. The symbol g is the gravitational acceleration force, Δu and $\Delta\theta$ are the difference of wind speed and potential temperature, θ is the average potential temperature of the air layer and Δz is 28 m in this case. The frequency of Ri is shown in Fig. 1 by classifying Ri into the following four grades.

(1)	$Ri < -0.01$	(unstable)
(2)	$-0.01 < Ri < 0.01$	(neutral)
(3)	$0.01 < Ri < 0.1$	(stable)
(4)	$0.1 < Ri$	(very stable)

The division at $Ri=0.1$ was made due to the fact that above this value the log-linear profile for wind speed does not fit. This probably occurs because the local Ri of the upper part of the 2–30 m layer will be near $Ri=0.25$, which is said to be the critical value for the occurrence of the turbulence. In the summer season (November-January) the frequencies of unstable and stable cases are about the same. In the winter season (May-August) 97% of the cases are stable. This is due to low or no incoming solar radiation, resulting in negative radiation balance in this period (YAMANOUCHI *et al.*, 1981). There is not much seasonal difference in the frequency of neutral cases. The very stable cases do not show much annual variation. It is generally considered that the air layer near the surface will be more stable when there is a strong deficit of net radiation at the surface, which is realized in the winter season. However, as Mizuho Station is located on an inclined surface,

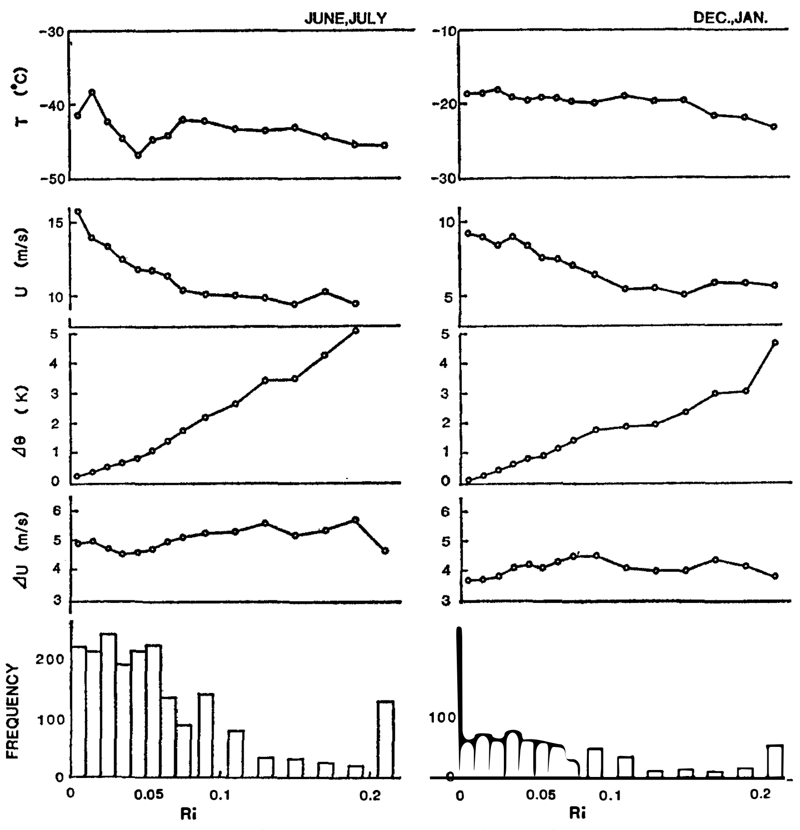

Fig. 2. The frequency distribution of Ri for the stable case, and the average values of T, u Δθ, Δu for the corresponding Ri range. The left case is for winter (June, July) and the right is for summer (December, January).

a strong temperature inversion in the lowest few 100 m of the atmosphere produces a strong katabatic wind which induces strong mixing near the surface. The effect of katabatic wind mixing is considered to suppress the occurrence of a very stable layer against the effect of the radiative cooling.

In Fig. 2, the frequency of Ri and the average of the four values Δu, $\Delta\theta$, u and T was obtained for each Ri range for the winter (June, July) and summer (December, January) periods. u and T are the wind speed and air temperature at 8 m level, respectively. From this figure, it can be said that dynamical stability at Mizuho Station depends mainly on $\Delta\theta$, not on Δu. One interesting tendency can be seen in T. In the summer season, T gradually decreases as Ri increases. However in the winter season, there is a local maximum at $0.01<Ri<0.02$, and local minimum at $0.04<Ri<0.05$, the difference being 9°C. The former corresponds to a situation under the influence of the passage of a low pressure system which accompanies clouds and warm air, and the latter to a situation under the influence of strong katabatic wind which occurs when the air layer near the surface is cooled intensely. It can be said from these results that the dynamical stability of the air layer near the surface is influenced by the larger atmospheric circulation.

The eddy diffusion coefficient was calculated for 8 days in winter and summer. It was deduced by postulating the log-linear profile. The variation in the eddy diffusion coefficient mainly corresponded to the variation of the wind speed, but when the wind speed was low, it showed a tendency to be small in the cooling period and high in the warming period.

References

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