MODELLING AND CLIMATOLOGICAL ASPECTS OF CONVECTIVE BOUNDARY LAYER*

By Chong Bum LEE**

(received February 27, 1985)

ABSTRACT

A model which estimates the parameters in the convective boundary layer using routine meteorological observation data is developed. The data required are net radiation, air temperature, wind speed, and radiosonde sounding. The model includes the estimation schemes of surface heat flux and friction velocity, and a mixed layer height model modified from the jump model.

The jump model is modified for mechanical convection and large scale vertical motion. A sensitivity test shows the importance of mechanical convection and large scale vertical motion.

The field observation of the boundary layer was carried out at Tsukuba. The field observation data are used to determine empirical equation of the surface heat flux and to evaluate the model. Estimated values of the surface heat flux using the empirical equation fit well with observed values. Evaluation of the scheme, which estimates the friction velocity and the Monin-Obukhov length, shows that the scheme can be adopted for the purpose of the present study. From the results of evaluation using the data set of the Wangara experiment and the field observation at Tsukuba, it has been shown that the modification of the jump model improves results.

Seasonal and diural variations of the convective boundary layer are obtained using the model for data over a period of three years at Tsukuba.

Stability of the surface layer is most unstable in autumn. However, in the boundary layer, the stability is most unstable in spring. Convection is most intensive in spring. There are two peaks in the seasonal variation pattern of the mixed layer height occurring in spring and autumn. Notably, it is not so high in summer in spite of strong solar radiation.

It is known that the potential temperature gradient is large in summer and small in winter, with this feature being related to air mass types. The potential temperature gradient of continental air mass is small and that of maritime air mass is large. The development of the mixed layer is closely related to the potential temperature gradient, and is surpressed by a strong inversion layer, especially in summer. Thus together with the surface heat flux, the occurence frequency of types of air mass is one of the important factors in explaining seasonal variation of the structure of the convective boundary layer.

* A dissertation submitted for the degree of Doctor of Science in the University of Tsukuba.

** Address: Department of Environmental Science, Kangwon National University, Chuncheon 200, Korea.