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Simple determination of evaporation using a new technique

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INTRODUCTION

The simple and accurate determination of the evaporation or the evapo-transpiration from the ground surface is very important to estimate precisely the ground water flow that is passing near the ground surface and also important for controlling the moisture condition near the ground surface. A new technique for measuring the evaporation has been developed. In situ and laboratory tests have been successfully carried out to examine the accuracy and the applicability of these measurements.

1.MEASURING EQUIPMENT

The measuring equipment has been presented by Watanabe and Tsutsui (1). The basic idea of this equipment is essentially identical to the ventilation test that has been used for measuring the small inflow rate in a tunnel. Figure (1) schematically shows the measuring equipment. The interstices between the side wall of this ventilation box and the ground surface must be completely sealed to avoid the leakage of air through these interstices.

2.ACCURACY OF THE EQUIPMENT.

The accuracy of the equipment has been examined using some laboratory tests. The evaporation rate was affected by many factors such as wind velocity near the ground surface, change of the temperature and the net-radiation. Blower and dryer systems have been used to inject the air in the ventilation box. The maximum wind velocity was injected by the blower system was 230 l/min. and by the dryer system was 130 l/min. Figure (2) and Figure (3) show the measured evaporation rate and the true evaporation rate for two samples of water at different wind velocities in case of blower and dryer systems respectively. The true evaporation rate was measured from the weigh change of these water samples. The maximum difference between the true and the measured values is less than ±10%.

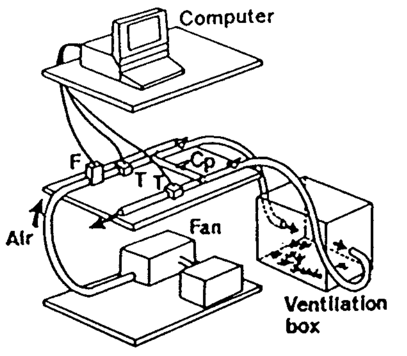

Figure (1). The Equipment. F: Flowmeter, T: A copule of the thermistor and a humidity sensor and Cp: short- cut pipe.

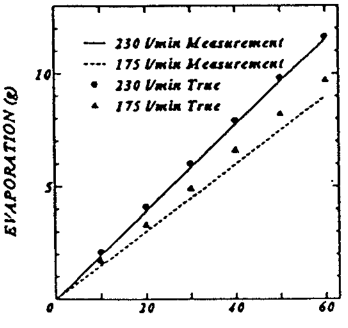

Figure (2)

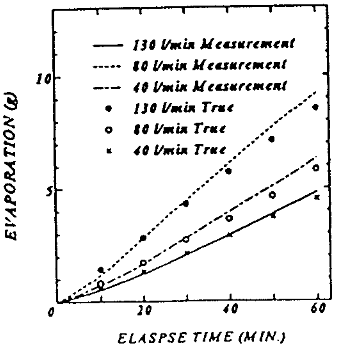

Figure (3)

3.INFLUENCE OF TEMPERATURE CHANGE ON THE EVAPORATION RATE.

To study the effect of temperature change on the evaporation rate four samples have been prepared to measure the changes of the evaporation rate with the temperature. These samples are Water, Sandy Soil, Vegetation 2 (Azalea) and Vegetation 3 (Adiantum).
The temperature rate was changed between 8°C to 25°C. Figure (4) shows the relation between the evaporation rate with temperature change for these samples. The increasing of evaporation rate from the vegetation samples due to temperature rise was smaller than the evaporation from the water.

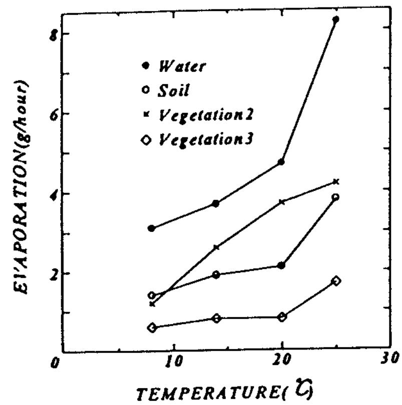

Figure (4)

4.APPLICABILITY OF THE EQUIPMENT AND FIELD MEASUREMENTS.

Field tests were performed to examine the applicability of the equipment. The transient change of the evaporation rate from a grass field at Saitama University Campus was measured on February 2, 1995. The evaporation rate was measured at two different places, the first was covered by vegetation (grass) and the second had no vegetation (very little grass). The measurements have been done at the same time and the air flow discharge was fixed as 230l/min. Figure (5) presents the comparison between the evaporation rate in case of vegetation field and no vegetation field at the same condition with the measured net-radiation. This figure shows clearly that the transient change of the evaporation rates was almost parallel to the net-radiation. Also the evaporation rate is larger in case of vegetation than the case of no vegetation at the day time. Another field measurement was performed on July 6,1994 to study the effect of the net-radiation on the evaporation rate . The ventilation box was covered for one hour to prevent the net-radiation to reach to the grass, the evapotranspiration decreased rapidly during this period as shown in figure (6).

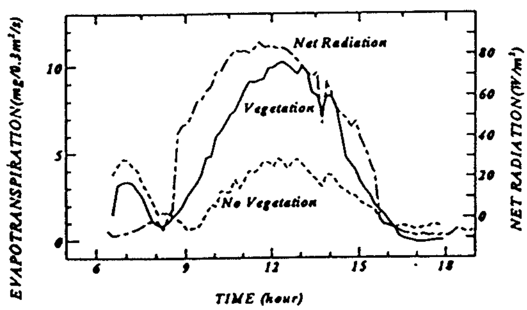

Figure (5)

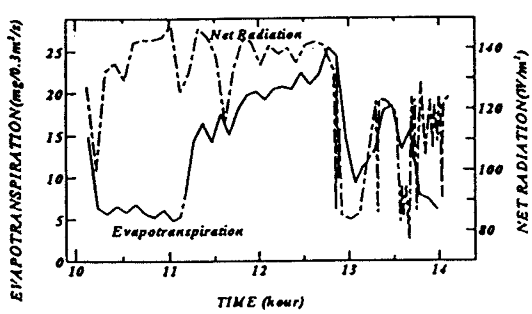

Figure (6)

CONCLUSIONS:

A new technique for measuring evaporation has been developed. The accuracy of the evaporation measurements has been examined. This technique can be applied to measure the evaporation or the evapotranspiration in the field with good accuracy. The transient change of the measured evaporation rate was almost parallel to the change of net-radiation.

REFERENCES:

1) K. Watanabe and Y. Tsutsui, 1994. A new equipment used for measuring evaporation in the field, Proc.7th Congress IAEG.
2)K. Watanabe, T. sakai, Y. Hoshino & S. Hamada,1995. In-situ and laboratory tests for estimating the hydraulic properties of unsaturated rock, Proc.8th Congress ISRM.