Hydro-meteorological Environment at Tonle Sap Lake and its Environs: As a Case Study of Lake Basins in the Tropical Humid Region

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1. INTRODUCTION: STUDY NEEDS AT TONLE SAP & OTHER TROPICAL HUMID REGIONS

Tonle Sap Lake is located in the Lower Mekong, an international river basin, and recently there has been an increasing concern on the effects of water resources development in the Upper Mekong. However, in Cambodia, where Tonle Sap Lake is located, hydro-meteorological monitoring has not been actively performed due to the shortage of observation stations, engineers and researchers, and funds after the political confusions during the civil war. Consequently, even the present conditions, without saying of the future prospects, of its hydro-meteorological environments are unclear. In addition, most of the studies on evaporation have been done at mid-latitude and/or semi-arid regions and the applicability of the knowledge gained at those regions to low-latitude tropical humid regions has not been fully discussed yet. In this study, hydro-meteorological environment of Tonle Sap Lake and its environs were examined by analyzing the on-site observation data and the points at issue were distilled.

2. STUDY SITE AND ON-SITE HYDRO-METEOROLOGICAL OBSERVATION

Compared with other lake basins, the unique characteristics of Tonle Sap Lake and its environs in considering the heat budget and evapotranspiration were summarized as follows: i) high surface water temperature (24-34°C) and high air humidity (vapor pressure deficit: 9-14hPa) throughout the year; ii) dynamic seasonal change in lake water depth (1-9m) and surface area (1,500-12,000km^2) following the inflow from and the outflow to surrounding rivers; iii) shallow and large lake; iv) location on flat land without surrounding mountains which prevent vapor/ heat transportation; v) high turbidity of lake water; vi) land use of inundation area as paddy land and rice cultivation with rainfall and/or inundation water there. In this study, on-site hydro-meteorological data* which were observed over 2 years at Phnom Penh, at paddy area, and on the lake were analyzed.

3. RESULTS: UNIQUE DIURNAL CYCLE / EVAPOTRANSPIRATION UNDER HUMID AIR

Our results showed that, contrary to common expectations, rainy and dry seasons had nearly the same amount of solar radiation and the amount of solar radiation on rainy days reached 88% of that on nonrainy days. This rainfall–radiation relationship meant that the rainy season had a larger amount of net radiation due to the low reduction ratio of solar radiation and an increase in atmospheric radiation. Accordingly, the rainy season had a high evaporation potential and provided great advantage for rice growing in rain-fed paddy lands which prevail in this area. Other diurnal variations to be noted were as follows. Air temperature on the lake took its maximum around sunset under the effect of the heat storage of lake water. Evapotranspiration rate was highest around noon in paddy whereas it was highest at evening on the lake, resulted from the heat releasing of water and the higher wind speed at evening. The higher wind speed at nighttime is attributed to the radiative cooling on the lake. During the dry season, land-lake breeze was detected.

The point at issue in discussing evapotranspiration in the tropical humid region would be whether the atmospheric demand of vapor is more decisive to actual evapotranspiration than the energy supply by net radiation. For potential evapotranspiration, net radiation was shown to be more critical. Neglecting advection, lake evaporation was calculated by the bulk method, resulting in almost the same value as its potential (2-7mm d^{-1} with Bowen ratio of 0.0824). However, if advection occurs as in the tropical ocean, actual evaporation should be smaller. On the other hand, actual evapotranspiration in paddy lands was larger than its potential and vertical one-dimensional heat balance was not satisfied. This is due to the physiological and morphological characteristics of rice plant.

4. FOR FUTURE WORKS

These results would be suggesting the existence of diurnal local circulation between lake water and the upper air and between lake and its environs, which works for heat and vapor transportations. Intensive observation of atmosphere and model construction would be needed for further consideration. Advection through river should be also investigated to examine lake evaporation.

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