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Obvservation and Analysis of Free Water Surface Evaporation in the Yongdam Dam Experimental Basin

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I. Introduction

Today so many sensors are developed for easy measuring electric signal and logging by using data loggers. Many meteorological elements can be measured by this kind of new technology but still remained manual observation in the Class A Evaporation Pan because of water level measurements is not easy. World Meteorological Organization recommended the observation of Class A Evaporation Pan with resolution of 0.1 mm. Traditional manual observation method is reading hook gauge scale once a day. It is used for the estimation of water resources on free water evaporation by multiple certain constant. Because observation of free water evaporation on dam is nearly impossible. But there is theoretically model methods offered by several researchers. So there needs the real observation data for the purpose of the model outputs calibration of free water evaporation.

This study carried out observation of free water surface in the Yongdam dam. We observed meteorological elements and water level to checked the possibility of evaporation observation on the platform in the dam.

II. Materials and Methods

Fig. 1 shows the survey site Muju which locate middle of Korea Peninsula. For Automatic observation of meteorological sensors applied CR10X data logger. We measured wind, temp., humid, surface water temperature and water level.

The model of the level sensor is BYL-EV250 which applied buoyance force measurement principle. This principle does not effect any frictional force and measure very high accuracy and reliability for the observation of water level.

Fig. 1. Location of study site (Muju).

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Observation started from 26 May 2013 and now goes on. This study focused on short term analysis and long term analysis. The first short term analysis period was 15-20 July 2013. We analyzed the evaporation and compared Dalton's equation form the observation data.

Fig. 2 shows the observation platform which was made of all stainless steel because long term observation on free water surface in the dam. Each side of platform installed the buoyance materials for stable on the water. Wind sensor is 1.5 m, temp. and humidity sensor 1.0 m and other measured inside and out side of pan water temperature at 10 cm depth. Water level sensor installed middle of pan (see Fig. 3). The pan diameter is 1.2 m and depth is 1.0 m.

Fig. 2. Observation platform.

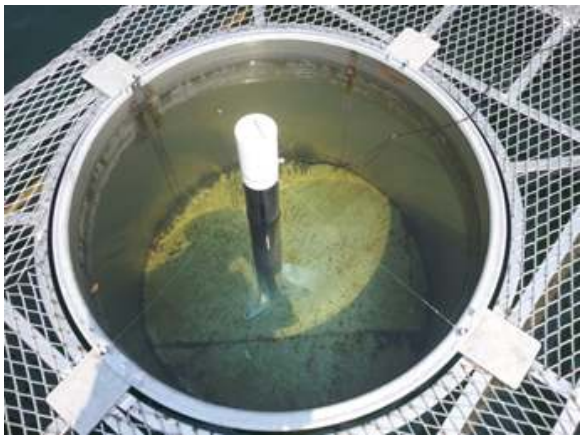

Fig. 3. Observation instrument.

Straingauge load cell was applied for measuring buoyance force generated from buoyance bar which diameter 6 cm and 24 cm long. Observation was carried out every 10 second and averaged every 10 minute 60 samples data and saved to data logger.

III. Results

Fig. 4 shows the observation of surface water temperature inside and out side of pan. The temperature between inside and outside is below then around 0.5 C. It is very meaningful result. If there occurs much high temperature difference between two point then observation data can not apply estimation of free water surface evaporation in the dam. Usually clear day is more high water temperature variation compare than cloudy day. It recorded maximum 3 C daily variations given period.

Fig. 5 shows the observation and model result. The data was calculated following process. Measured every 10 minute data was averaged by running mean method. And hourly evaporation was derived from extract data from 1 hour interval term. The first 3 days observation result was

very good but the next 3 day was high oscillation not much good. There is still unknown why there occurs sometimes good and sometimes bad. There may be some kind of nose which may be human activity or others.

During observation period there recorded 0.45 mm/h around. At that time there was 5 m/s wind speed recorded and also recorded 18 hPa water vapor difference between water surface and air. This kind of condition derived high evaporation rate. It is well know by Dalton's equation which equation consist of wind speed and vapor difference between water and air. The model result in Fig. 5 was drawn from the Dalton's equation. From the observation data can calculate the vapor pressure difference between water and air and combined wind speed term (Eq. 1).

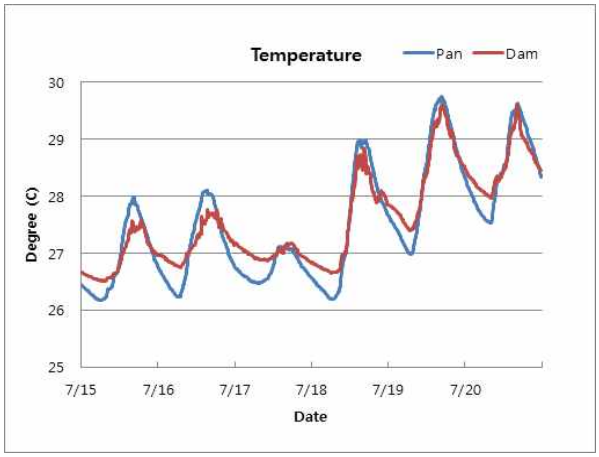

Fig. 4. Water temperature in side and out side of pan.

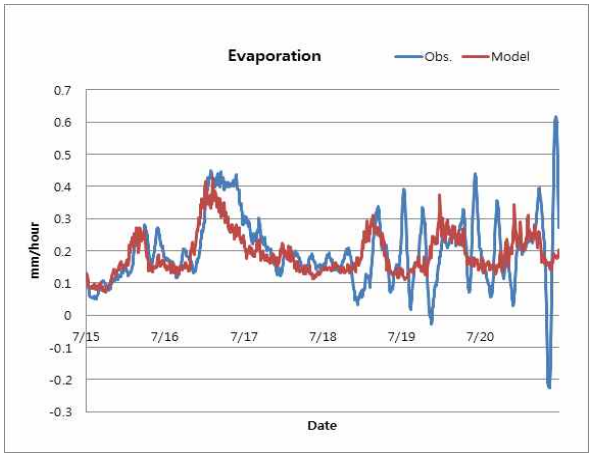

Fig. 5. Observation and model result.

$$\text{Evap. (mm/h)} = (0.01 + 0.003\ V) \times (Ew - Ea) \qquad (1)$$

V : wind speed (m/s), Es : water vapor pressure (hPa), Ea : air vapor pressure (hPa)

From the Eq. 1 we can draw Fig. 5. model result line. During 15-17 July it matches very well with each other but next 3 days is not much well match. We can find out the possibility of direct observation on free water surface evaporation using platform system in the dam.

Fig. 6 show the evaporation during 2015. It was corrected rainfall amount about evaporation data. In the winter time there occurs evaporation around 1-2 mm/day. Middle of summer there decreased relatively near the season because of many rainy days.

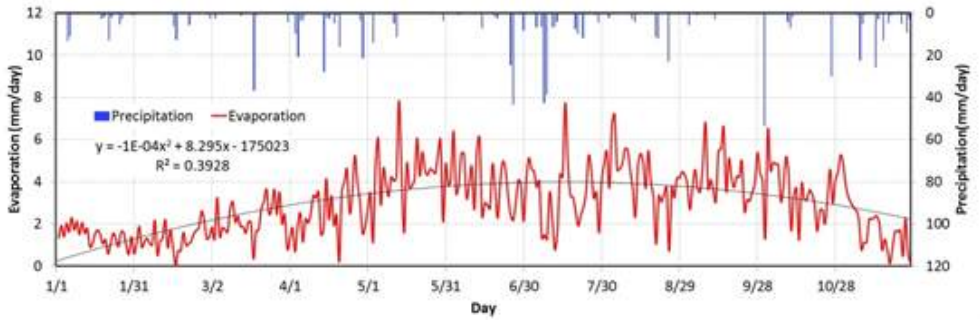

Fig. 6. Daily evaporation data corrected daily rainfall amount.

From the observation results we can find out the possibility observation of free water surface evaporation on the platform system in the dam. And it gives a chance to certify the many model results.

It is easily explained by using Dalton's equation at evaporation phenomenon according to direct observation of evaporation.

There needs more development for the good quality data of evaporation on the platform observation.

Acknowledgements

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