Utilization of ERA5 Data for Agriculture Evaporation Spatial Analysis in East Seram Area

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ABSTRACT

Evaporation is the process of water from the earth's surface into the atmosphere. Reference of evaporation is *the most important outlay of water balance in the specific area. This reference accurate to monitoring and estimate in the field of agricultural, especially for provide theoretical basis of irrigation. Therefore, the use of model data can be carried out to estimate the evaporation value so that for more efficient measurement. Evaporation characteristics of certain land cover can also be analyzed by using model data. Based on the latest global ERA5 dataset of ECMWF for 2019–2021 and Observation data from Geser Meteorological Station, Evaporationis calculated by using the Penman-Monteith method recommended by FAO. By using GrAds spatial analysis function, the maps of evaporation can be described and evaluated the accuracy of the model data and observation with RMSE and correlation. the results showed that the evaporation in the center part of East Seram in 2021 was dominated by area near the bay and mountain with the accuracy of RMSE 0.352 and correlation of 0.916.*

Keywords: *evaporation, era5 data, agricultural*

INTRODUCTION

Evaporation is a physical process that occurs on the surface where water is converted into water vapor and transferred to the atmosphere at a rate determined by weather factors. A similar physical process occurs in vegetation which is largely determined by the physiological factors of the vegetation (1). Spatial evaporation analysis is a meteorological analysis which expresses atmosphere evaporation capacity, and basic data of designing and researching irrigation and water conservancy.

The distribution characteristics of reference crop (2) evapotranspiration of Hangjiahu area studied under climate change has an important guiding significance to estimate crop water requirement of coastal plains, to research the rule of water cycle, to evaluate water resources, and irrigation planning and management (2).

Several research are available to calculated and analysis the spatial evaporation. Penman-Montieth formula recommended by FAO-56 is more accurate and most used (3). For spatial analysis, Geostatistical interpolation techniques is the first utilize the statistical properties of the measured data to produce the raster maps. This technique creates not only prediction maps but also error or uncertainty maps and implies how good the predictions are (4). In East Seram, the Evaporation just get from one point observation. So, Empirical approach to estimating the evaporation value is used to avoid the difficulties encountered in conducting observations so that the estimation of evaporation becomes more efficient. Several empirical approaches that can be used include: water balance approach, Penman method or combination method, mass transfer, eddy correlation, and energy balance (5). ERA5 model used for this research because this data is reanalysis going from downward fluxes energy balance. Before this research, Spatial distribution evaporation in Iraq

with ERA5 model data (6) studied shows the interaction between evaporation and climatic parameters in whole Iraq, except in the east and southeast (6). Previous studies spatial analyzed just with geostatistical method, interpolation from observation data in-depth, but few people used model data to estimate the evaporation, even though model data with high resolution may be more accurate. This paper uses ERA5 data to analyze spatial distribution of Evaporation in East Seram and validation with meteorological station data.

MATERIAL AND METHODS

East Seram area is located in the easthern part of Maluku Province. Its geographical location is very special. Close to the Bula territory, many developed river systems. North is a part of sea and bay area, center is the mountainous terrain. It has dry and humid climate, adequate light, and is a tropical Australian monsoon climate zone. Figure 1, East Seram are selected for the study.

Figure 1. Location of East Seram area

Several sources are ERA5 monthly averaged data reanalysis data with case study during 2021, developed by the European Centre for Medium-Range Weather Forecasts (ECMWF). It is a global dataset of many land and atmospheric parameters at a high resolution (spatial grid of 0.25°). The dataset of ERA5 consists observation data with advanced numerical prediction models. Parameters of ERA5 to used is Evaporation and low vegetation cover for know the fraction of the grid that is covered with low vegetation consist of crops mixed farming and irrigated crops for agriculture purposed.

Evaporation total mm (daily) during 2021 from Geser Meteorological for validation one point observation data who represented the east seram area.

For basic math calculations the evaporation estimating methods with the amount of heat required to vaporize one kilogram of water (L) is used in converting latent heat value to daily evaporation value. The following equation for latent heat vaporization (7).

$$L = 2.5x10^6 - 2400xTs \qquad [1]$$

Furthermore, the daily evaporation value can be estimated using the following equation.

$$E = \frac{LE}{\rho L} x1000x86400 \qquad [2]$$

where E is daily evaporation (mm day^{-1}), ρ is the density of water of 1000 kgm^{-3}, and L is latent heat vaporization (J kg^{-1}).

According to (8), quantitatively the reliability of the model in reproducing events nature was assessed statistically by various parameters. One or more objective functions generally used to quantitatively measure the error rate between measured data and modeled. The following equation for validation with objective functions in this research (8).

$$RMSE = \sqrt{\frac{\sum_{I=1}^{N}(P_i - Q_i)^2}{N}} \qquad [3]$$

Where P_i is observation data (actual data), Q_i is model data (estimation from numerical prediction), N is amount of data.

RESULT

Land cover classification was carried out in this study. The classification results can be represented spatially using ERA5 data with low vegetation cover parameter, which is the crops and mixed farming, and irrigated crops. Figure 2 is the classification agricultural land cover in the East Seram region in 2021.

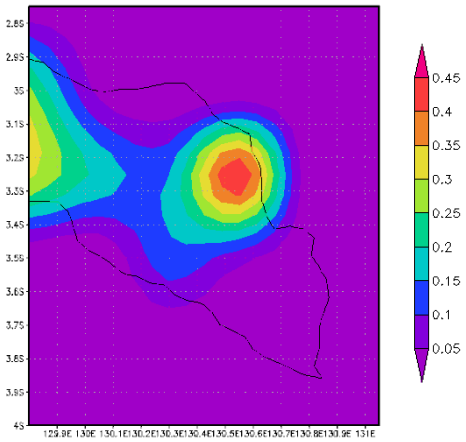

Figure 2. Vegetation cover in East Seram

The scale in the low vegetation cover parameter is 0 to 1, where the closer to 1, this is agricultural land cover. In figure 2, it can be seen that the scale is 0.05 to 0.45, this is in accordance with the red pattern precisely located in the Bula area, Waru Bay and a little area of Werinama, where there is a lot of agriculture and plantations, this shows that the ERA5 data can very well represented the vegetation of certain area because high resolution (0.25 to 0.25) grid according observation data.

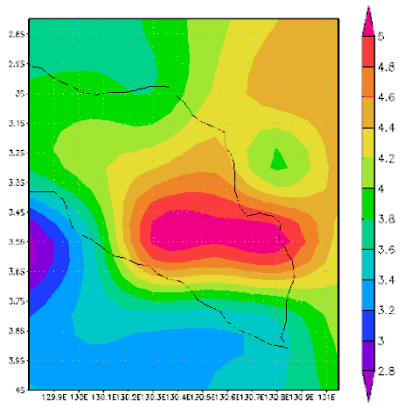

Figure 3. Spatial Evaporation Monthly Average During 2021

In figure 3 shows the spatial distribution of monthly average evaporation during 2021, it can be seen that evaporation occurs mostly in the Werinama and Kilmury areas which are dominated by mountains near the coast, then the bay area, namely Waru, which makes large evaporation occur with evaporation values reaching 4.2 to 5.0 mm/day. It can be concluded that through 2021, the water that evaporates is mostly in the highlands and bays around the town of Bula, which has a lot of agriculture and plantations (Figure 2) forms rain around Bula, making agriculture obtain adequate irrigation in 2021.

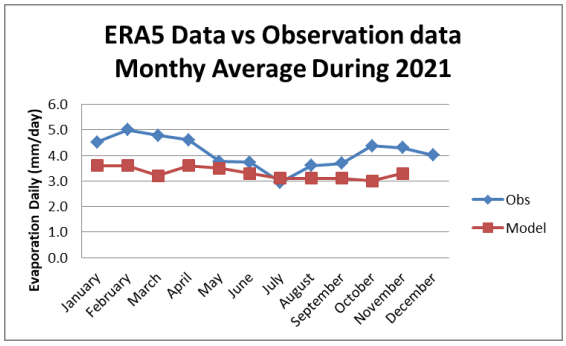

Figure 4. Monthly average between ERA5 and Observation

In Figure 4 shows the comparison between the era5 data and the observation data, which results are underestimated with an RMSE accuracy of 0.352 and a correlation of 0.916. This happens because the points on the grid in the model only read near the observation point but still represented evaporation in that area.

DISCUSSION

ERA5 data can represented vegetation cover in the eastern part of seram area. Spatial analysis of land cover clearly describes the agricultural and plantation areas where evaporation data are needed. Then, evaporation during 2021 with a monthly average spatially distributed occurs in mountainous and bay areas. For accuracy, It's still underestimated because the observation points and the available points on the grid do not match but still represented close to the observation area.

CONCLUSION

The conclusion ERA5 data is still good in terms of the need for analysis of spatial maps of land cover and evaporation which is very useful for agriculture and plantations in the East Seram region. During 2021, evaporation will mostly occur in mountainous and bay areas. The water vapor forms rain in which means irrigation during 2021 is going very well.

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