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Determination of evapotranspiration on Dicle Basin

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Abstract

The use of water in agriculture is a necessity for plant production, and it is necessary to determine the water consumption of the plant to meet the water needs of the plant in a sufficient and efficient way. Water consumption by plants varies not only with weather conditions, but also with plant variety. The use of suitable methods for calculating the water consumption of plants in the planning of irrigation systems at the basin level facilitates operations. Today, as a result of population growth, industrialization and especially climate change, the importance of water has increased as a result of global warming, use efficiency and performance criteria have gained importance. In this study, we intend to determine important parameters such as water consumption and plant biomass in large areas with satellite technology, which is one of the most important application areas of remote sensing. Evapotranspiration; It is the transfer of water from the soil to the atmosphere by evaporation and from plants to the atmosphere by transpiration. For this purpose, the SEBAL model was used, which is the Surface Energy Balance Algorithm for Land, which is one of the most preferred methods in the literature for mapping true evapotranspiration. With the execution of the model, data on reference evapotranspiration, plant coefficient, true evapotranspiration, indices of plant vegetation and biomass production were obtained. These values were compared with climatic data and results obtained at field level. It is thought that remote sensing techniques, which produce much faster and less expensive results than climate data and calculation methods, will be used more in the near future.

1. Introduction

In recent years, the importance of water has increased due to the increasing impact of climate change. Evaporation-transpiration is an important parameter affecting the water balance in the water cycle. Accurate determination of the evaporation-transpiration amount is also important in determining the plant water requirement.

In our country, unconscious or wrong irrigation is applied in more than one agricultural area. The aim of this project is to know and calculate the actual plant water consumption (ETo), which is the amount of water needed by plants in order to increase the product obtained in an irrigation system and to achieve maximum efficiency.

Effective water management and planning is very important in important agricultural lands such as the Dicle Basin. Evapotranspiration calculations and measurements, which were made as point until recently, can be calculated more quickly and accurately as a result of the developments in the discipline of remote sensing and optical satellite systems.

Evapotranspiration; Remote sensing-based evaporation-transpiration methods rely on surface energy balance and often provide accurate evaporation-sweat predictions (Allen et al.2011).

Due to the increase in water consumption, effective use of water has become a much more important process than in the past. For this reason, it is very important to calculate the water budget as accurately as possible and to make water management effectively (Goyal et al.2013).

Water loss from evapotranspiration is one of the most important components of a region's water budget. Evapotranspiration means the sum of water loss from evaporation and perspiration (Allen et al.2011).

Geographical information system (GIS) and Remote Sensing techniques, which are used in many areas today and can be combined with earth data, are very effective

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tools in evaluating ETp and ETo in large-scale irrigated areas.

In the literature review, it was seen that this study was carried out in important water areas in the world. Although most of the studies have been used with satellite images such as Landsat 5, Landsat 7, Aster, MODIS, AVHRR, it has not been used with Landsat 8 (LDCM). Therefore, with this method, which will be applied for the first time in the Diyarbakir Basin, a current and high-accuracy study has been revealed.

2. Method

The study area is the Devegeçidi Irrigation Area connected to the Dicle-Fırat Basin (Figure 1).

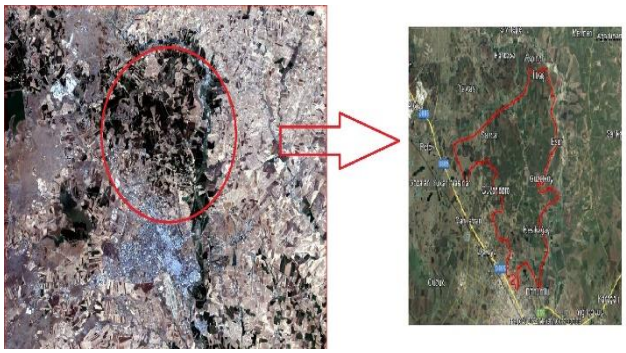

Figure 1. Study Area

It is located between 38°05'-38°57' North parallels and 40°13'-40°12' East meridians in the Upper Mesopotamian region. It was opened for irrigation in 1972 and later included in the Southeastern Anatolia irrigation project. In the Devegeçidi irrigation basin, an irrigation system has been established on an area of 5800 hectares.

The continental climate of the Diyarbakir basin is dominated by a desert-like air current, which is mostly tropical in origin and enters the region through the Arabian Peninsula. Winters are cold and rainy; summers are very hot and dry. Winters are cold and rainy; summers are very hot and dry. Annual precipitation is 473.6 mm, annual evaporation is 1775 mm, evaporation amount in summer is 1036 mm, annual average temperature is 15.6 °C.

2.1. Evapotranspiration Calculation with CROPWAT

CROPWAT 8.0 software developed by FAO Water Resources Development and Management Service (int.link1) was used. The climate data required for the Cropwat ET calculation were obtained with the Climwat plugin, which includes long-term data. Climate data was entered into the cropwat screen, and ETo values were calculated according to the Penman-Monteith method.

2.2. SEBAL (Surface Energy Balance Algorithm For Land) Model

Multi-channel satellite images are used in the SEBAL technique. In this study, data from Landsat-8 (OLI/TIRS) satellite with 11 bands were used. The meteorological data required to run the model were obtained from the Kayapınar/Devegeçidi station operating in the research area. ETo calculations to be obtained with climate data were made using Cropwat software (FAO Penman Technique).

The model is able to estimate plant water parameters from the surface energy balance by using satellite images, digital elevation model (DEM), soil moisture properties, instant-daily average air temperature, wind speed, relative humidity and solar radiation climate data.

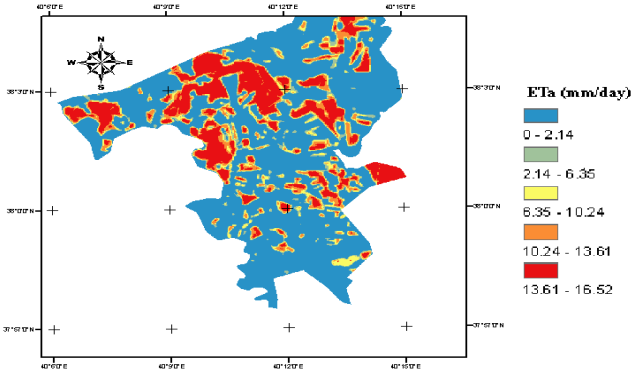

Figure 2. ETo map obtained from sebal bu using satellite ımage dated 21 july 2020

The SEBAL model, which is used to determine plant water consumption, and open source QGIS software and GRASS GIS plug-in were used. The Eto maps obtained with the SEBAL model were analyzed in QGIS software and compared with the Eto values obtained from the Cropwat program.

3. Results

Evapotranspiration values were calculated using the Penman-Monteith method with the data obtained from the Meteorology Observation Stations of the Diyarbakir Regional Directorate of Meteorology. Pixels belonging to the study area were selected from the thematic maps obtained with the SEBAL model and their controls were provided.

Table 1. CropWat program camelgate station penman-monteith ETo values

Month	Humidity %	Wind Speed km/day	Eto mm/day
January	82	216	1.78
March	77	185	3.5
May	60	135	8.32
July	28	190	15.08
September	30	154	10.78
November	59	254	5.12

SEBAL Model can process more than one type and number of data sets at the same time in its Findings. The outputs are in.ovr extension and can be taken in the desired format in GrassGIS program.

As output data, pixel-based selection can be made as ETo, NVDI (Normalized Difference Vegetation Index), SAVI (Soil Adjusted Vegetation Index), RGB, PHOT, PCOLD and the values are reported. In the calculation

made with CropWat (Penman-Monteith) for the day the satellite image was taken on July 21, 2020, the ETo for the month of July was found as 15.08 mm/day (Table 1).

The values obtained with the SEBAL model are between 13.61 – 16.52 mm/day (Figure 2).

4. Discussion

ET, irrigation time planning in crop production; In other words, it is considered as the most important input in determining when and how much water will be applied to the area to be irrigated. Calculations made with climate data include some assumptions compared to the net result, and spatial differences are ignored.

ET calculations made by sampling in the fields, on the other hand, involve some assumptions since the sample amount remains within a certain limit, although it takes time and expense. However, with the SEBAL methods, an example of which was carried out in this study, a more precise and accurate calculation, as well as a cost-free calculation with a number of operational processes, was carried out in a short time.

Due to these benefits, the agricultural use of Remote Sensing has become a subject that needs to be researched in a way that cannot be ignored.

5. Conclusion

One of the most important components of water management is true evapotranspiration. This parameter, which has been calculated as a point in many scientific studies or projects carried out in our country so far; It can be calculated as a fully spatial thematic map with the help of satellite images.

SEBAL is one of the most preferred methods for calculating true evapotranspiration. In this study, real evapotranspiration mapping was applied in the important agricultural area of Diyarbakır using the SEBAL technique.

In this way, the applicability of the said technique within the borders of Diyarbakır with the Landsat 8 satellite was examined and demonstrated. The obtained areal ETo map can be used in water management studies on a basin basis. These maps can be prepared on a weekly, 15-day, monthly or quarterly basis and can be made available to decision makers.

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