EVAPOTRANSPIRATION CALCULATIONS WITH NOAA-AVHRR AND ASTER DATAS, AFŞİN-HURMAN STREAM EXAMPLE

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Water and water resources get highly important effective utilization in recent years therefore it is very important that they must be continually and hydrological budget must have been calculated in very short frequences especially in some countries suffered from droughty. There are lots of parameters necessary to calculate hydrological budget. Evapotranspiration that together is one of the leader part of these parameteres. Technically evaporation is the process of a liquid or solid especially icy water converting to the gaseous state and diffused to the environment from free water resources or land surface. Transpiration is the evaporation of water coming from the roots of the plants, diffused to the athmosphere from the aerial parts of plants, especially occurs through stomata cells that have tiny opening or pore, found mostly on the underside of a plant leaf and used for gas exchange. These two hydrological parts have been detecting with the local meterological measurement. Especially measurement with simple lisimeters have given some informations about evapotranspiration but some of reasons that, datas reflect very small areas and renovation is too hard and also in-stu measurements are not healthy so the researcher are looking for different methods in recent years. Some developments and new techniques in GIS and Remote Sensing enable evapotranspiration gain different dimension. Especially like NOAA and MODIS satellites and radar datas are so helpfull to calculate these two parameters. Like these datas other Remote Sensing Satellite images like ASTER, Landsat are helpfull for detecting evapotranspiration in small basins especially.

NOAA, AVHRR sensors images are not directly used in evapotranspiration calculations. They must have been processed with appropriate programs. Because their reflectance from their bands are not supposed to used in direct applications. NOAA-AVHRR satellite system datas gives five band images and last band gives thermal image, reflectance parameters must be calculated from first three bands. For that reason reflectance is calculated with the help of some calibrations and brightness temperature must be calculated with some algorithms in last two bands. With the help of these datas detected parameters like NDVI, Net Radiation, Latent Heat Flux and Soil Heat Flux are helpfull to determine the evapotranspiration capacity. ASTER datas give evaporation capacity. First of all, Non evaporited part of the field must have been calculated from ASTER datas. Non-Evaporited part of the field is calculated with the help of Net Radiation, Heat flux and NDVI and also they are derived from ASTER datas. Calculating net radiation from ASTER datas there are both Shortwave and longvawe radiation are needed. When detecting shortvawe radiation first of all Albedo of the field must have been calculated in every period of the year according to the Equation 1.

Equation 1: $P1 \cdot 0.484 + P3 \cdot 0.335 + P6 \cdot 0.551 + P8 \cdot 0.305 - P5 \cdot 0.324 - P9 \cdot 0.367 - 0.0015$ (Liang S. L., 2001),
P1, P3, P6, P8, P5 and P9 are the calibrated value of 1, 3, 6, 8, 5 ve 9. bands from ASTER Datas.

Albedo values in same basins are very changable in every season of the year for example, snow covered parts of the basins in the first months of the year give albedo value closed to 1, but in sumer season canopy parts of the basins are emerged therefore albedo value closed to 0. July, 6, 2006 ASTER datas albedo value of the basin is given Figure 1.

Figure 1. Albedo values of Hurman Stream, Afşin, Kahramanmaras ,Turkey (July, 6 2006)

After all of these albedo values net radiation value of the field are higher in summer season than winter season according to the Equation 2.

Equation 2: $(Rns)=(1-\alpha)\cdot 0.75\cdot Ra$ (Allen, 1998)
(α: albedo values of basin) (Rns: shortvawe net radiation)

Here Ra means Area solar Radiation is detected from DEM models from the some GIS techniques. Merging topographical elevations create DEM models and so helpfull to create Area Solar Radiation. ASR extensions are present in diffrent GIS programs.

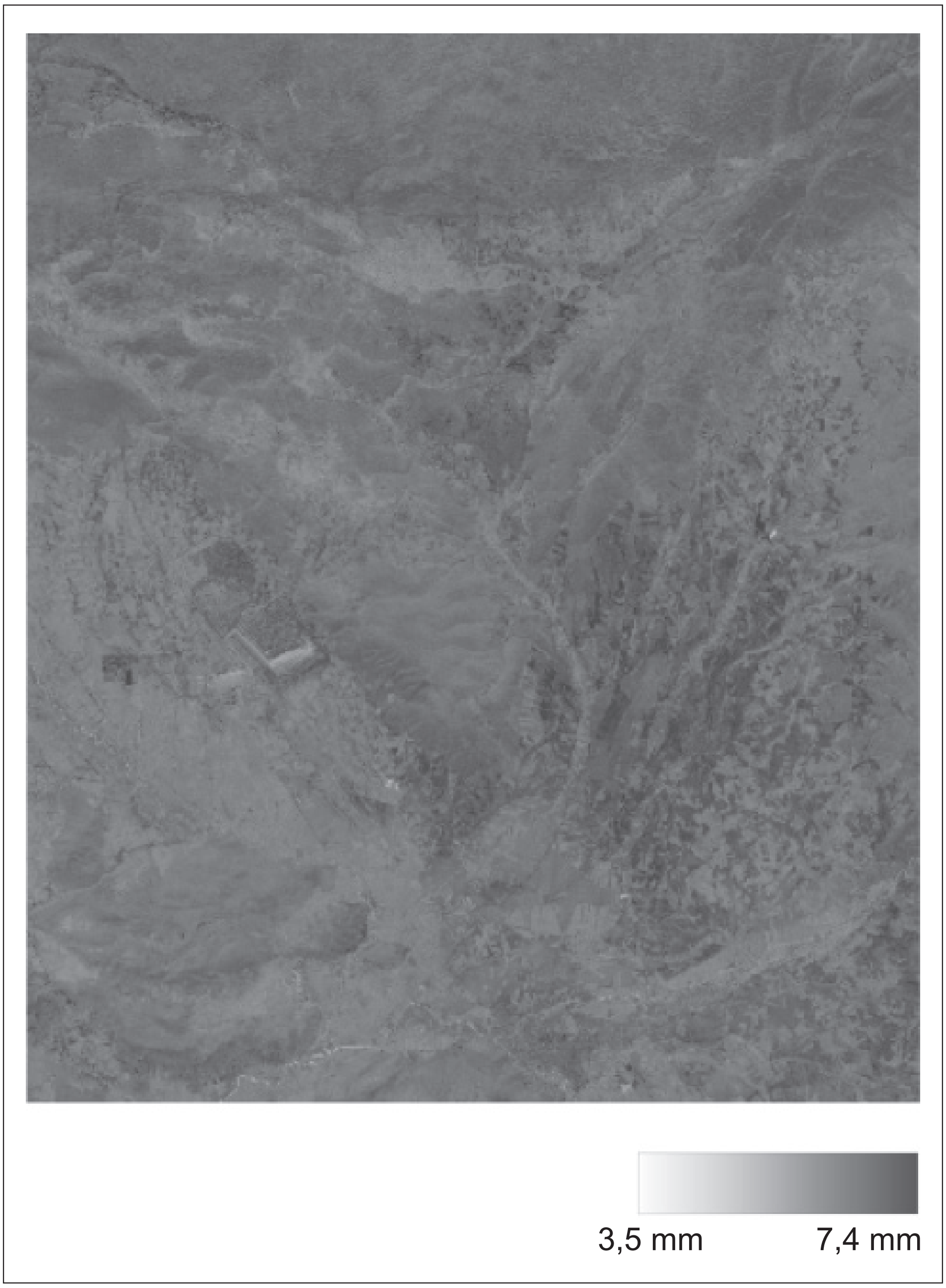

Figure 2. Evaporation values of the basin, dark parts are heavily evaporated rather than white parts, (ASTER July, 6, 2006)

After calculating shortvawe net radiation with Equation 2, longwave radiation value is necessarily calculated according to the Equation 3.

Equation 3: Rnl= -4.25-0.25·Rs. (Allen *et al.*1998)

Rs:Shortvawe net radiation.

After calculating net radiation of the field that given above steps, Latent heat fluxes of the basin are necessary to calculate evaporation. LHF must have been calculated with the thermal bands of ASTER like 12,13,14, LST(Land Surface Temperature) is calculated from 12, 13 and 14. bands of ASTER datas and NOAA-AVHRR 4 and 5.bands. In ASTER system LHF could be calculated with Equation 4.

Equation 4: $LHF=p \cdot Cp \cdot (Ts-Tair)/rh$

Ts: surface temperature

Tair: air temperature

Cp: the specific heat capacity of weather in constant pressure ($MJ \cdot kg^{-1} \cdot {}^{o}C^{-1}$)

Rh: aerodinamic resistance ($s \cdot m^{-1}$)

LHF and Net radiation give non-evaporited part of the field, LHF divided by Net radiation so non-evaporited fraction minus from 1, gives evaporited parts of the field. Figure 2 gives the evaporited parts of Afşin-Hurman Stream.

There are lots of plants specimens in Afşin, Hurman Stream fields. Transpiration occurs especially summer season with evaporation cause very important reduced in water level. Calculating transpiration capacity from NOAA and ASTER datas LAI (Leaf Area Index) represents whole biomass must be calculated. LAI calculating explains whole trnaspiration capacity of the field and Net Radiation, Heat Flux, Reflectance parameters are helpfull to detect transpiration. These datas are derived from SAVI ındex (Soil Adjusted Vegetation Index) that calculated from the processing of 1 and 2 bands of NOAA images after some athmospheric corrections.

Evapotranspiration values are calculated with the day, month and year period. According to the these barren parts of the field, cultivated and plenty leaves parts of the field are calculated evapotranspiration one by one. After these values are correlated with the meteorological datas. As a result of the fact that whole values are closed to each other but there is some discrepancies in ASTER datas. But especially NOAA-AVHRR datas results are so closed to meteorological datas because of frequency time of NOAA-AVHRR is 2 days on the contrary to the fact that, ASTER frequency times 14 days approximately, so some results may not have reflect meteorological correlations.

References

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