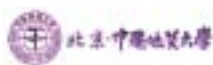


Research on Evaporation of Taiyuan Basin Area by Using Remote Sensing*



X. M. Jin(1), L. Wan(1), Z. Su(2)

(1) School of Water Resources and Environment, China University of Geosciences, Beijing, China, jinxm@cugb.edu.cn

(2) Wageningen University and Research Centre, ALTErrA Green World Research, The Netherlands, Bob.Su@WUR.NL



Introduction

Taiyuan basin of China, with abundant mineral resources and semiarid climate, is an area of shortage of water resources. In this paper, the Surface Energy Balance System (SEBS) was used to estimate spatial distribution of actual evaporation over the basin. It will help to understand the distribution of shallow groundwater resources over the basin area.

Study area

Taiyuan basin, surrounded by hills and mountains, is located in the middle of Shanxi province, China, with longitude/ latitude between 111°30'-113°00'E and 37°00'-38°20'N. The alluvial plain lies in middle of the basin composed of large areas of croplands. The strip-shaped loess mesa distributes around the basin with different width. The basin is typical semiarid area with annual average precipitation of 433-528mm.

Methodology and Data

The Surface Energy Balance is commonly written as

$$R_n = G_0 + H + \lambda E \quad (1)$$

where R_n is the net radiation, G_0 is the soil heat flux, H is the sensible heat flux, and λE is the latent heat flux. On the basis of energy balance and energy partitioning under dry and wet limit conditions, SEBS estimates the evaporative fraction EV as

$$EV = 1 - \frac{H - H_{wet}}{H_{dry} - H_{wet}} \quad (2)$$

and the daily evaporation E_{daily} is expressed as

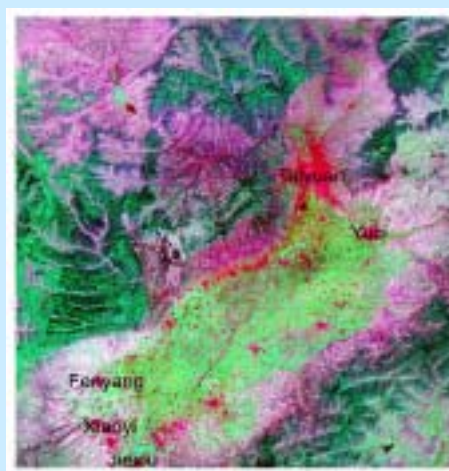
$$E_{daily} = 8.64 \times 10^7 \times \frac{24}{\lambda \rho_w} \times \frac{R_n - G_0}{\lambda \rho_w} \quad (3)$$

where H_{dry} is the sensible heat flux at the dry limit, H_{wet} is the sensible heat flux at the wet limit, $\frac{24}{\lambda}$ is the daily evaporative fraction, ρ_w is the density of water. Land surface parameters used in this study are albedo, NDVI and surface temperature which were derived from NOAA-AVHRR data in visible, infrared and thermal infrared spectral domain respectively. The meteorological variables were obtained by interpolating observations collected in the meteorological stations over the concerned area.

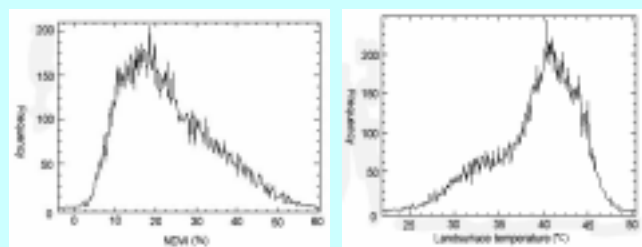
Evaporative fraction and daily evaporation were finally calculated using Eq.(2) and Eq.(3) and the data described above. The results are shown in the Figures below.

Results

A case study was carried out using NOAA-AVHRR data on 1, July, 2003. Taiyuan basin has a large range of NDVI and surface temperature distribution with peak values around 0.2 and 40 °C. Accordingly, the evaporation over the basin shows relatively large range but it apparently has two dominated categories: higher values of EV(>0.5) and E_{daily} (>4.2mm) corresponds to the croplands area, while lower values of EV and E_{daily} are related to the loess area with much less vegetation covering. During the crop growth season, the higher evaporation from the croplands attributes to the irrigation. On the contrary, with relatively less precipitation, the loess area shows the natural climate characteristics of semiarid region.

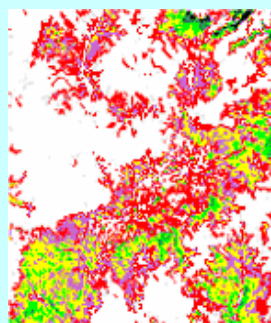


Landsat ETM image (1 July 2003) showing the landuse classification of the study area (Taiyuan basin)

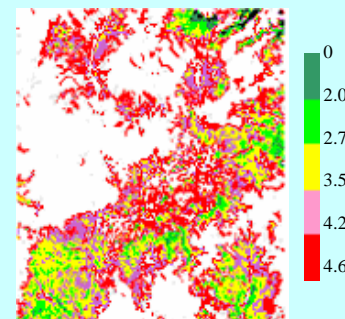


Conclusions

The study shows that the Taiyuan basin area has a semiarid characteristics with less evaporation over the loess area, while the high evaporation corresponds to the irrigated croplands.



Evaporative fraction (EV)



Daily evaporation

* This work was partly supported by the project EAGLE funded by EU (EU FP6-2002-SPACE-1).