



available at www.sciencedirect.com



journal homepage: www.elsevier.com/locate/agwat



Energy budget and actual evapotranspiration of an arid oasis ecosystem: Palmyra (Syria)

Jean-Pierre Brunel^{a,b,*}, Jnad Ihab^a, Abdallah M. Droubi^a, Samar Samaan^a

^a ACSAD, P.O. Box 2440 – Damascus, Syria

^b IRD, UMR LISAH, 2 Place Viala, 34 060 Montpellier Cedex 01, France

ARTICLE INFO

Article history:

Accepted 23 February 2006

Published on line 12 June 2006

Keywords:

Evapotranspiration

Oasis

Palmyra

ABSTRACT

Continuous measurements of evapotranspiration (LE) using eddy covariance method and energy budget were performed over more than 1 year above the heterogeneous canopy of an arid oasis ecosystem in the central Syrian desert. Irrigation practice was traditional flooding with a 28-day turn of water delivery. The work focused on seasonal variations of energy budget over a 2-year period with emphasis on effects of rainfall, wind speed and radiative budget and irrigation practice on evapotranspiration. A time lag of 3 days was observed between irrigation and transpiration response from the vegetation and maximum evapotranspiration was only 5 mm/day. Even with water input from irrigation, winter rainfall seems to have an important impact on LE: comparisons of two situations in June 2002 and June 2003 showed an increase of 13% in values of $LE/R_n - G$. In many situations averaged hourly values of evapotranspiration increased with wind speed up to 3 m/s, then decreased suggesting strong evaporative control from the vegetation. Results from the energy balance closure showed significant differences in the slope of $H + LE$ against $R_n - G$ relationships between cold and hot month which was explained by specific radiative budget of desert areas.

© 2006 Elsevier B.V. All rights reserved.

1. Introduction

For many centuries, in the whole Arabic world, oasis have played a major role in every country history. For long time they were unavoidable passages for caravans, vehicles of commercial as well as cultural exchanges. Oasis are an important source of income and a ‘way of life’ for ethnic population, the *Bedouins*, ancestrally and deeply rooted to these arid regions. Oasis are also used by governments to stabilize traditional pastoral nomads in areas where water is available for cattle consumption and pasture irrigation. At last but not the least oasis are becoming increasingly popular as tourist destinations (“green tourism”), particularly if they display a unique world cultural heritage as Palmyra does. As a result of the multi-use of oasis, these very fragile ecosystems are becoming under tremendous anthropogenic pressures.

Furthermore, very little is known about these ecosystems functioning.

With an averaged annual rainfall of 120 mm, the whole region of our study entirely relies on non-renewable groundwater resources.

Human pressures on these resources take place not only within the oasis cultivated area itself but also in the peripheral steppe region, they are mainly:

1. irrigation of the present cultivated areas of the oasis and extension of irrigated areas;
2. increasing of water extraction in the steppe area for cattle consumption, especially sheep (exportation in many Arab countries of the highly appreciated, Syrian sheep original breed) and also more and more frequently for pasture irrigation;

* Corresponding author.

E-mail address: brunel@scs-net.org (J.-P. Brunel).

0378-3774/\$ – see front matter © 2006 Elsevier B.V. All rights reserved.

doi:10.1016/j.agwat.2006.02.005

3. tourism development linked to the famous archaeological site;
4. phosphate ore treatment and fertilizer plant projects, 30 km from the oasis, that will use the same regional aquifer.

The competing demand for water resources is visible within the irrigated area of the oasis where there is a scarcity of good quality water and spatial and temporal variability of water distribution to the farmers have led to soil and water resources degradation (salinization) and decreasing of both productivity and biodiversity.

A change of irrigation practice was planned by 2006 to increase the water use efficiency by both reducing the amount of water delivered to the farmers and by extending the irrigated surfaces. The traditional way of irrigation by flooding should be replaced by a dripping irrigation network. The research presented here focused on surface–atmosphere interaction studies but is a part of a wider investigation activity aiming to understand and to analyze causes and effects of the degradation of oasis resources, water, soil, natural vegetation, crop production and biodiversity.

2. Objectives

Objectives were two-fold, at first to provide water resources managers with accurate and reliable measurements of water used by the oasis vegetation.

When changing the irrigation practices, the existing vegetation of the oasis will have to adapt to the new way of water distribution and availability for the root system. As it is an old vegetation, mainly olive trees and date palm trees (some of them more than 100 years old), changes in the ecosystem functioning that will affect the energy budget as well as geochemical and water budgets could almost certainly be expected. The second objective was to document the current energy and water budget of this ecosystem to show the impact of traditional irrigation.

3. Site description

The study area is located near to the town of Palmyra in the centre of the “Syrian Desert” (Fig. 1). It belongs hydrographically to the Tudmor basin (4860 km²) and geographically includes three units: the oasis, the hydrological discharge area (sebkha Al Mouh) and the steppe. Geological formations are mainly cretaceous Calcareous rocks with some Jurassic dolomite rocks in the centre and Quaternary deposits. The basin shows a gently undulated landscape with the lower altitude at the centre of the sebkha (370 m) but limited to the north by the Palmyrides chain (900–1400 m). Except for the irrigated area and the partially inundated sebkha, the natural steppe vegetation is very ephemeral and scarce and for most of the year the soil surface is a sandy and stony desert.

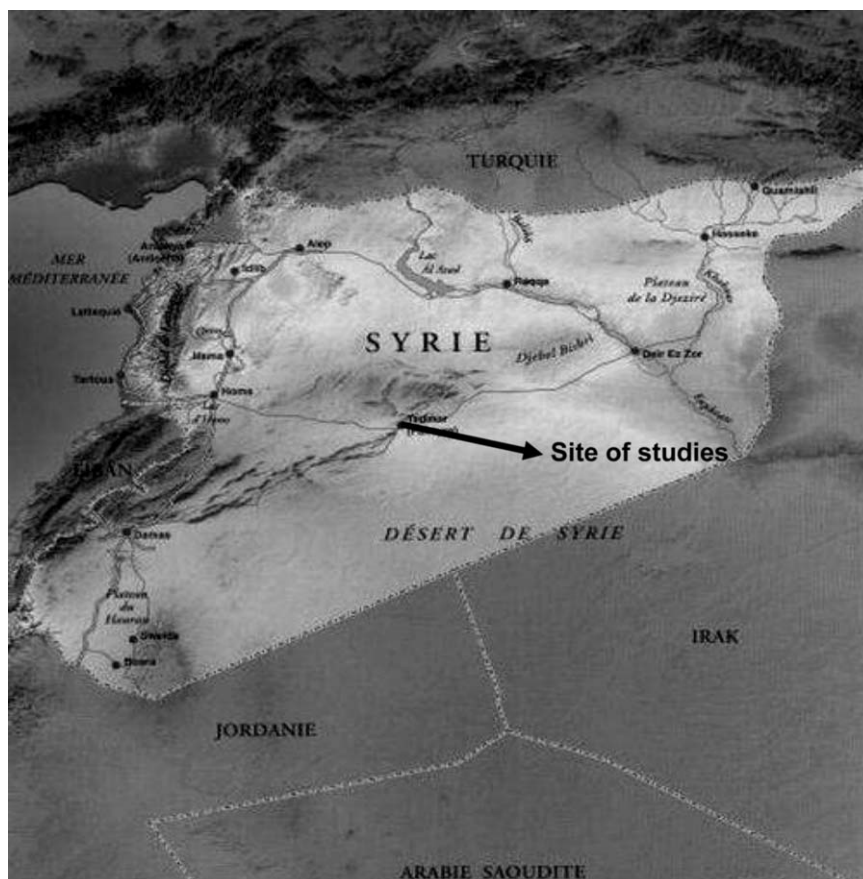


Fig. 1 – Geographical location of the area of study.

Download English Version:

<https://daneshyari.com/en/article/4480538>

Download Persian Version:

<https://daneshyari.com/article/4480538>

[Daneshyari.com](https://daneshyari.com)