ESTIMATE OF THE NET RADIATION ON THE CROP OF THE COTTON, IN LUBBOCK, TEXAS – USA, WITH TECHNIQUES OF REMOTE SENSING

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ABSTRACT: The net radiation (Rn) it is a key amount in the computation of losses of water for irrigated cultures. In that way, the use of the remote sensing is shown useful, because it is capable to present your variability space-time. In that context, this work presents the estimate of Rn obtained starting from images Landsat 5-TM and through SEBAL in areas of cotton cultivation irrigated in Lubbock, Texas, USA. The estimates of Rn with SEBAL presented values varying of approximately 480 Wm^{-2} for areas without irrigation even values about 540 Wm^{-2} for the irrigated areas, what evidencing the good application of SEBAL in semi-arid areas.
KEYWORDS: net radiation, SEBAL, cotton

ESTIMATIVA DO SALDO DE RADIAÇÃO SOBRE A CULTURA DO ALGODÃO, EM LUBBOCK, TEXAS – USA, COM TÉCNICAS DE SENSORIAMENTO REMOTO

RESUMO: O saldo de radiação (Rn) é uma quantia chave no cômputo de perdas de água por culturas irrigadas. Dessa forma, a utilização do sensoriamento remoto orbital se mostra útil, pois é capaz de apresentar sua variabilidade espaço-temporal. Nesse contexto, o presente trabalho apresenta a estimativa do Rn obtida a partir de imagens Landsat 5-TM e através do SEBAL em áreas de cultivo de algodão irrigado em Lubbock, Texas, USA. As estimativas de Rn com o SEBAL apresentou valores variando de aproximadamente 480 Wm^{-2} para áreas sem irrigação até valores de cerca de 540 Wm^{-2} para as áreas irrigadas, o que evidenciando a aplicabilidade do SEBAL em regiões semi-áridas.
PALAVRAS-CHAVES: saldo de radiação, SEBAL, Algodão.

INTRODUCTION: The density of flux of radiation balance (Rn) it is a key variable in the computation of the evapotranspiration. According to Bisht et al. (2005) Rn is also used in several applications including climatic monitoring, weather forecast and agricultural meteorology. The technique of remote sensing, through images of satellites, is capable to do estimates of Rn presenting your variability space-time.

In that way, the algorithm SEBAL (Surface Energy Balance Algorithm for Land) (Bastiaanssen, 1995) and/or METRIC™ (Mapping Evapotranspiration at High Resolution and

with Internalized Calibration) (Allen et al., 2005) they have been showing if quite useful according to studies of Lopes (2003), Di Pace (2004) and Folhes et al. (2006).
The SEBAL calculates Rn through eleven steps computationaly that involve the correction radiometric, the calculations of the albedo, of the emissivity of the surface and thermal, of the temperature of the surface, of the vegetation indexes and of the emitted thermal radiation, all pixel by pixel. Estimates of the radiation of waves short incident are still used, done with base in the solar constant, in the angle of solar incidence, in the it distances average Earth-sun and in the atmospheric transmissivity, and of the radiation of incident long wave that is done through the equation of Stefan-Boltzman.
The central idea of this research was to estimate Rn on an experimental area of cotton, using the algorithm SEBAL and images of the satellite Landsat 5-TM, to analyze the behavior of Rn not on irrigated areas and areas irrigated.

MATERIALS AND METHODS: The study was accomplished on an experimental field of cotton, in Lubbock, located in the state of Texas - USA (**Figure 1**).

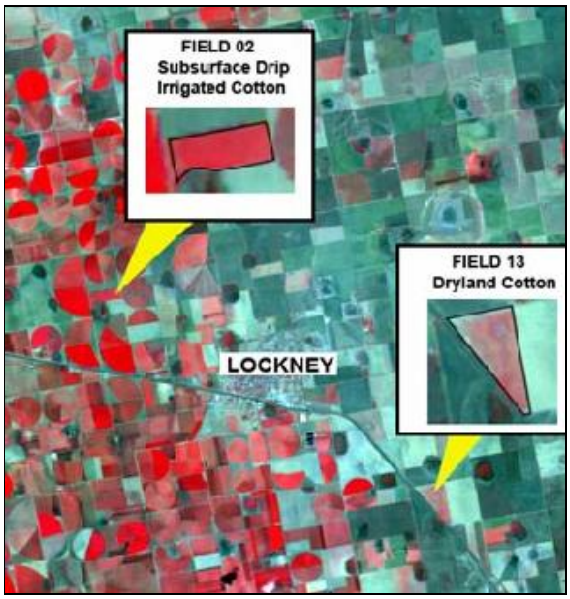

Figure 1: Image Landsat 5 - TM, with prominence for the experimental areas in Lubbock, Texas – USA.

An image was used Landsat 5-TM of the 18/09/2006.
The calculation of Rn was made through the algorithm SEBAL for the following equation:

$$Rn = (1-\alpha)R_{S\downarrow} + R_{L\downarrow} - R_{L\uparrow} - (1-\varepsilon_0)R_{L\downarrow} \quad (1)$$

Where α it is albedo of the surface, it is the radiation of long wave (thermal) emitted by the surface, ε_0 are the emissivity of the surface, all obtained starting from the images Landsat 5-TM, it is the radiation of incident short wave and it is the radiation of incident long wave, dear for the equation of Stefan-Boltzmam with base in the temperature of the air in the instant of the passage of the satellite (to see Allen et al. , 2002, Trezza, 2002, for details).

RESULTS: It can be observed of the **Figure 2**, that Rn on the experimental area, on the 18/09/2006, varied about 420 W m^{-2} to you value superior to 500 W m^{-2}. Could be clearly identified in the scene, the distinction among the irrigated areas (larger values of Rn) and the not irrigated (smaller values of Rn). It is evidenced of the **Table 1**, the differences among the

key parameters for the computation of dear Rn for SEBAL, for the irrigated areas and the not irrigated. Could also identify a difference of approximately 3ºC among the two areas. The algorithm SEBAL presented good estimates in the computation of Rn for the experimental area and adjacent areas.

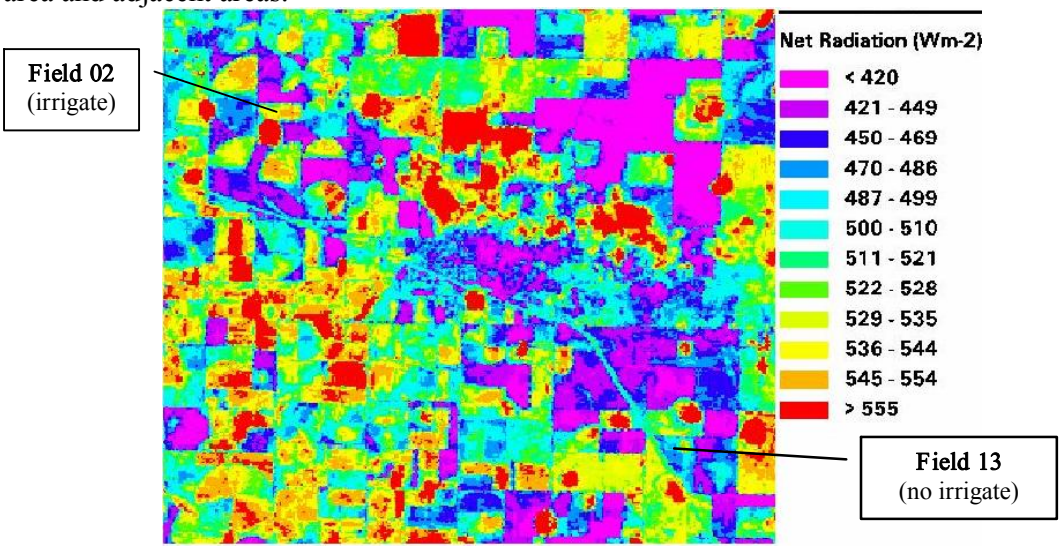

Figure 2: Distribution space of Rn on the experimental field and adjacent areas in W m^{-2}.

Table 1: Estimates of the basic components for the computation of the radiation balance.

Parameters	Cotton Field 1 (no irrigate)	Cotton Field 2 (irrigate)
Albedo of the surface	0,21	0,17
Emissivity of the surface	0,95	0,96
Emissivity thermal of the atmosfhere	0,97	0,97
NDVI	0,30	0,75
LAI	0,20	1,43
SAVI	0,22	0,53
Temperature of the surface (K)	298,6	295,7
Net Radiation (Wm^{-2})	**480**	**540**

CONCLUSIONS: The algorithm SEBAL comes as an important tool for the obtaining of the distribution space-time in the computation of Rn. Evidencing that the same can be applied in an operational way, for great areas, using images of low resolution. Once, the only information of necessary surface for the calculation of Rn is the close temperature the surface, however, studies have been showing that the temperature of the cold pixel can be used as a good approach.

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