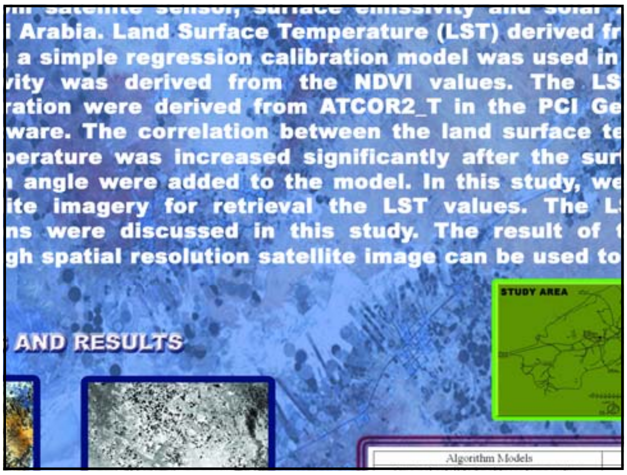

An algorithm for land surface temperature analysis of remote sensing image coverage over AlQassim, Saudi Arabia

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Presentation Outline

Objective
Introduction
Study Areas And Data Acquisition
Algorithm Model
Data Analysis and Results
Conclusion

Objective

- To propose a mono window technique for retrieving the LST from Landsat TM with combined surface emissivity and the solar angle, θ. The emissivity values used in this study were calculated based on the NDVI values.

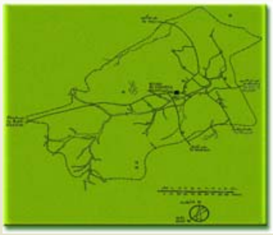
Introduction

- Estimation of LST from remotely sensed data is nowadays usual. LST is a key parameter in the physics of land surface processes because it is involved in the energy balance as well as in the evapotranspiration and desertification processes.
- The extensive requirement of land surface temperature (LST) for environmental studies and management activities of the Earth’s resources has made the remote sensing of LST an important academic topic during the last two decades.
- In the literature review, normally researchers using split window methods for retrieving the LST values.

Introduction

- But Landsat TM only has one thermal band which it makes the use of split window impossible.
- The correlation coefficient (R) values were increasing after surface emmisivity and solar angle were added to the algorithm model.

Study Areas And Data Acquisition



The study area in the Arabian Peninsula, located between latitude of 12ºN and 32ºN and between longitude of 20ºE and 35ºE

Study Areas And Data Acquisition

- This particular geographical position gives the area of the great bioclimatic diversity.
- The desert of the Arabian Peninsular is located as a part of the hot desert, which extends from the Sahara in Africa in the west to the Thar Desert in Indo-Pakistan sub-continent in the east.

Algorithm Model

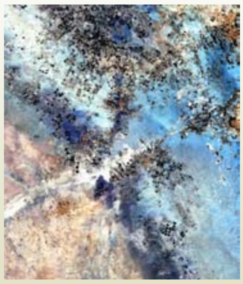
Regression Algorithm

$$T_G = a0 + a_1 T_B^2 + a_2 T_B + a_3\varepsilon + a_4\theta$$

where

- T_G = ground truth temperature
- T_B= brightness temperatures
- ε = emissivity
- θ = solar zenith angles
- a_j= algorithm coefficient, j = 0, 1, 2, … is then empirically determined.

Raw Satellite Image



18-08-1998

Raw Satellite Image

22-01-1998

Data Analysis and Results

- Surface emissivity and incoming solar radiation was considered in the proposed algorithm.
- The solar zenith angle was used to replace the incoming solar radiation in analysis is because they are highly correlated but solar zenith angle can be calculated easily.
- The land surface emissivity (LSE) values were needed in this proposed model. An easy procedure to apply for retrieving the LSE was based on the NDVI.

Data Analysis and Results

- The method proposed obtains the emissivity values from the NDVI considering different cases:
- (a) NDVI < 0.2

  In this case, the pixel is considered as bare soil and the mean emissivity value used in this study was 0.97 (Sobrino, et al., 2004).
- (b) NDVI>0.5

  Pixels with NDVI values higher than 0.5 are considered as fully vegetated, and then a constant value for the emissivity is assumed, typically of 0.99. It should be noted that the samples considered in the paper are not included in cases (a) or (b).

Data Analysis and Results

- (c) 0.2<NDVI<0.5
- In this case, a mixture of the bare soil and vegetation composes the pixel, and the emissivity is calculated according to the following equation:

$$\varepsilon = \varepsilon_v P_v + \varepsilon_s (1 - P_v) + d\varepsilon \quad (1)$$

- where is the vegetation of the emissivity and is the soil emissivity, is the vegetation proportion obtained according to (Sobrino, et al., 2004):

$$P_v = \left[\frac{NDVI - NDVI_{min}}{NDVI_{max} - NDVI_{min}} \right]^2$$

$NDVI_{max}$ =0.5

$NDVI_{min}$ =0.2

Data Analysis and Results

- The term in Equation (1) includes the effect of the geometrical distribution of the natural surfaces and also the internal reflections. For plain surfaces, this term is negligible, but for heterogeneous and rough surfaces, as forest, this term can reach a value of 2%. A good approximation for this term can be given by

$$d\varepsilon = (1 - \varepsilon_s)(1 - P_v) F \varepsilon_v \quad (2)$$

  where F is a shape factor (Sobrino, et al., 1990) whose mean value, assuming different geometrical distributions, is 0.55. The proposed algorithm model was shown in the Equation (2).

Data Analysis and Results

- A set of 30 location over AlQassim, Saudi Arabia were selected randomly and then the surface emissivity and solar zenith angle was calculated for algorithm regression analysis.
- Comparison between the used of original satellite brightness temperature and the proposed algorithm with added surface emissivity and solar angle were shown in Table 1 and Table 2 for the two different date of satellite imagery.

Table 1: Model to estimate LST using original satellite brightness temperature, quadratic algorithm and proposed algorithm with added surface emissivity and solar angle (18-08-1998)

Algorithm Models	R	RMS
Original satellite brightness temperature	0.1241	5.2154
Proposed algorithm with added surface emissivity and solar angle	0.7915	2.0159

Table 2: Model to estimate LST using original satellite brightness temperature, quadratic algorithm and proposed algorithm with added surface emissivity and solar angle (22-01-1998)

Algorithm Models	R	RMS
Original satellite brightness temperature	0.0512	8.2159
Proposed algorithm with added surface emissivity and solar angle	0.8102	1.9215

Conclusion

- In this study, we present an algorithm to retrieve LST by using mono window from Landsat TM data.
- The algorithm accuracy has been found improved with considered the surface emissivity and incoming solar radiation.
- The RMS value was increased from 5.2154 K to 2.0159 K using the proposed mono algorithm.

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THANK YOU