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Surface Temperature variation for Large Scale windfarm area in Tamil Nadu

Kavi Nandhini M*, Geetha P
Center for Excellence in Computational Engineering and Networking, Amrita Vishwa Vidyapeetham, Coimbatore.
***Corresponding author: E-Mail: kavinandhini.m@gmail.com**

ABSTRACT

A standout amongst the most renewable sources is wind energy they create a clean energy utilizing windfarms. Windfarms is introduced in huge numbers and worked to supplant other fossil powers power plants. Wind energy in Tamil Nadu has an exceptional development moving the state to the most obvious position in renewable vitality source in India. Any enormous development will have an effect on ecological element. The effect of substantial scale windfarm on surface temperature is dissected for different years in Southwest monsoon district of Tamil Nadu. Satellite remote sensing discernments from Landsat7 pictures are used to study temperature changes. For the study area the shape file (.kml format) is created for large wind farm area using the Google earth. The shape file (.kml format) is imported to the Landsat images and the surface temperature is analyzed using the ArcGIS software.

KEY WORDS: Temperature, windfarm, South-West Monsoon, Google Earth, ArcGIS.

1. INTRODUCTION

Wind energy being a renewable source provides an alternative for the energy generation. This renewable energy occupies a large area for its establishment. This establishment literally may provide clean energy but, this energy also generates a considerable amount of pollution. The term pollution here attribute to the change in temperature and related atmospheric quantities. This quantity creates a threat to mankind in turn.

This paper employs the use of satellite image for the estimation of change in temperature above the Earth surface. The satellite images are the record of reflectance of re-radiated radiation from the Earth surface. These images are used for the estimation change in temperature in the study area.

As wind power dominatingly turns into the renewable vitality source decision, it is progressively imperative to focus and comprehend the ecological effects on such establishments and operations. With any new innovation, it is key to recognize the expenses and advantages and make certain surveyed legitimately to guarantee.

Wind force is the privilege and really most feasible and option vitality source. Numerous methodologies can be taken to successfully fulfill such assessment. Satellites and other remote sensing procedures including those that are ground based assume a crucial part in this evaluation process. A customary method for assessing surface temperature is by utilizing weather station based meteorological perceptions.

This framework is not a conceivable response for a wide blended sack of topographic conditions. Notwithstanding, remote recognizing technique is important in any topographic and climatic condition of the district. Warm infrared remote seeing gave an opportunity to gauge zone surface temperature from warm band pictures [2]. Estimation of surface temperature from satellite infrared radiometers has been exhibited essential. Most studies have focused on the use of polar circling satellite systems in light of their high spatial determination. This estimation in surface temperature gives the information about the variation of temperature after the installation of wind mill in an area. This study was carried out over a wide latitude and longitude of Tamil Nadu.

This paper is organized as follows, description about the data is provided at the section 2 followed by the explanation about the study area is given in section 3. Later sections of the paper gives the information about the methodology used and the conclusion.

Data Description: Landsat 7 photographs contain eight repulsive social occasions with a spatial determination of 30 meters for Bands 1 to 7. The determination for Band 8 is a panchromatic images and it is of 15 meters [2]. All social affairs can gather one of two form settings is of high or low for intensified radiometric affectability and part accomplish, while Band 6 gathers both high and low get for all scenes. Incorrect scene size is 170 km north-south by 183 km east-west. Landsat-7 ETM+ has a high spatial determination precision isolated from other warm sensors on specific satellites, moreover the warm imaging in this sensor is controlled by two parties, one band is 6-1 where the securing the low get, while the second band is 6-2, the procurement will be high get. Landsat 7 information has been downloaded from general region spread office (GLCF). Similarly, Google Earth has been utilized to make a shape file (.kml format) for the windfarm zone.

Study Area: Climatic effect on windfarms examination is on the south west monsoon area. The monsoon begins toward the end of April and toward the end of September in a year. Month of July and August are the crest season for the winds. First and foremost is palghat pass, the areas are Coimbatore and dissolve. Second is of Shencottah pass, the areas are Tirunelveli and Tuticorin, third is of Aralvoimozhi pass regions is Aralvoimozhi in Kanyakumari locale and the latter is Cumbam pass locales is of Dindigul locale. Amid southwest monsoon these four passes blessed

with substantial wind stream. For the above location the large windfarm area is created as shape file (.kml format) in google earth.

2. METHODOLOGY

The strategy in this study has been partitioned into six stage (A) Data Training, (B) Change over across Digital Numbers (DN) to Spectral Radiance (L), (C) Change over across Spectral Radiance to Temperature in kelvin, (D) Conversion of Kelvin to Celsius (E) Satellite Temperature to the Surface Temperature Value (F) Importing the shape file to the map.

Data Training: Making a mosaic obliges some arranging as their order can help to choose which pictures ought to overlay others. Data management tool in ArcGIS software are utilized to make a mosaic data set to cover study region.

Change over across Digital Numbers (DN) to Spectral radiance: The data were converted of digital numbers to spectral radiance. The Spectral radiance equation is given below.

L= ((LMAX - LMIN)/(QCALMAX-QCALMIN)) * (QCAL-QCALMIN) + LMIN

Where, L is the Spectral Radiance at the sensor's aperture in watts/ (meter squared*ster*am) QCAL is the quantized calibrated pixel value in Digital number. LMIN is the spectral radiance that is scaled to QCALMIN in watts/ (meter squared*ster*am), LMAX is the spectral radiance that is scaled to QCALMAX in watts/ (meter squared *ster*am). QCALMIN is the minimum quantized calibrated pixel value (corresponding to LMIN) in Digital number. QCALMAX is the maximum quantized calibrated pixel value (corresponding to LMAX) in Digital Number.

Change over across Spectral Radiance to Temperature in kelvin: From the below equation the radiance value is converted to satellite temperature value.

$$T = \frac{K_2}{\ln\left(\frac{K_1}{L} + 1\right)}$$

Where, K1 is the Calibration Constant 1, K2 is the Calibration Constant 2, T is the Satellite brightness Temperature.

Conversion of Kelvin to Celsius: $T = T - 273$

This equation converts the temperature value from kelvin to Celsius.

Satellite temperature to the surface temperature value: $\left(\frac{BT}{1}\right) + W * \left(\frac{BT}{P}\right) * \ln(e)$.

Where BT is the Satellite Temperature, W is the Wavelength of Emitted radiance and P is defined by the below equation.

$$P = h * \left(\frac{c}{s}\right).$$

From the above equation the surface temperature is identified. Where h is the Planck's constant. S is the Boltzmann constant. C is the velocity of light.

Importing the shape file to the map: After the surface temperature has been found out for the particular region finally the shape file (.kml format) is imported to the surface temperature map and Surface temperature map has been arranged by selecting a fitting shading incline in symbology to recognize the variety of evaluated surface temperature.

3. RESULTS AND DISCUSSION

Evaluated surface temperature from a thermal band of Landsat 7 ETM+ is as indicated in underneath fig.1-7. The examination of images demonstrates that neighborhoods, industrial regions and infertile sandy territory are the spots with most noteworthy surface temperature. Woods regions, water logging regions are the spots with the most reduced temperature. The outcomes are contrasted and the National Centers for Environmental Prediction (NCEP) and watched temperatures demonstrated a good correlation.

Impact of wind farm on climate: Surface temperature controls the surface warmth and water exchange with the atmosphere which effecting climatic change in the locale. Ground surface temperature above the Earth level at the study area is characterized across the latitude and longitude of the area. Land surface temperature is the temperature discharged by the surface and measured in kelvin. It was significantly influenced by expanding greenhouse gasses in the air. In this way it prompts surge and ocean level ascent. Increment in surface temperature additionally influences the climatic state of the monsoon place. As its esteem changes the nearby atmosphere of the region additionally changes.

The analysis is conducted for different year's images. Fig.2-6 is an example of temperature variation in the region of interest during various years. The legend includes ten natural breaks of temperature range of the entire image is calculated using the ArcMap.

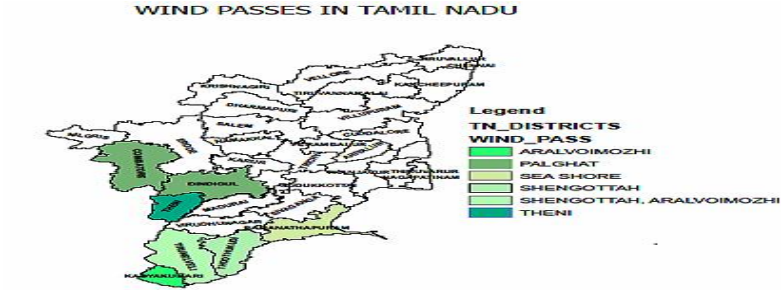

Figure.1.South West Monsoon Region of Tamil Nadu

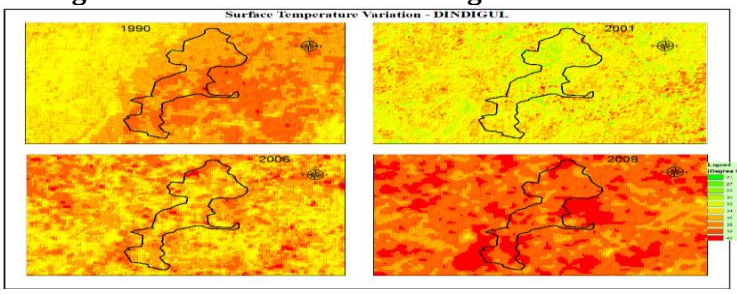

Figure.2.Surface Temperature variation of large windfarm area of Dindigul district for various years

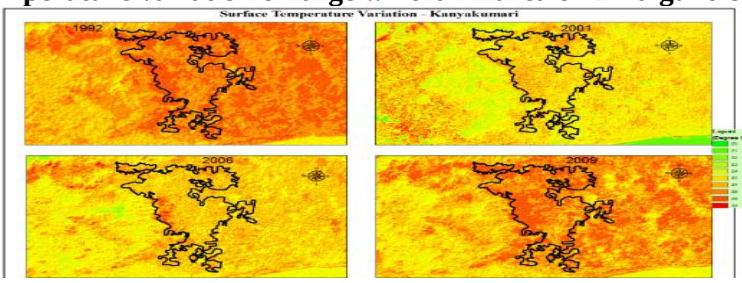

Figure.3.Surface Temperature variation of large windfarm area of Kanyakumari district for various years

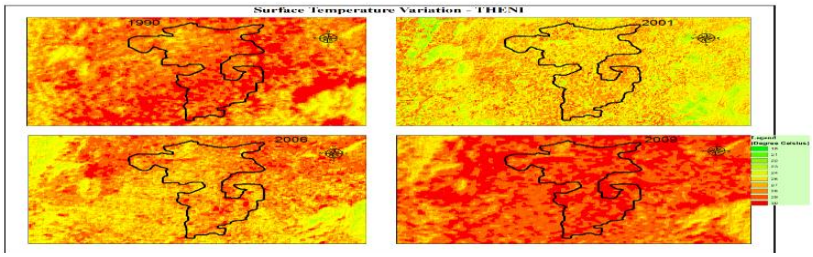

Figure.4.Surface Temperature variation of large windfarm area of Theni district for various years

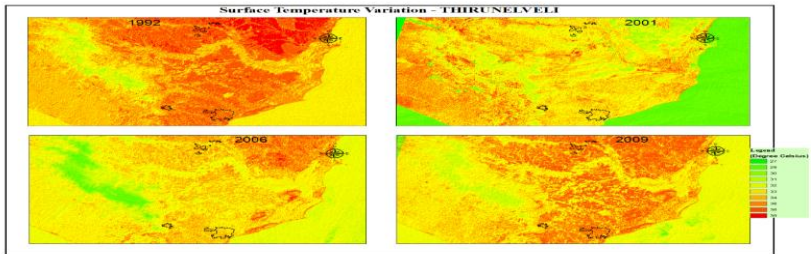

Figure.5.Surface Temperature variation of large windfarm area of Thirunelveli district for various years

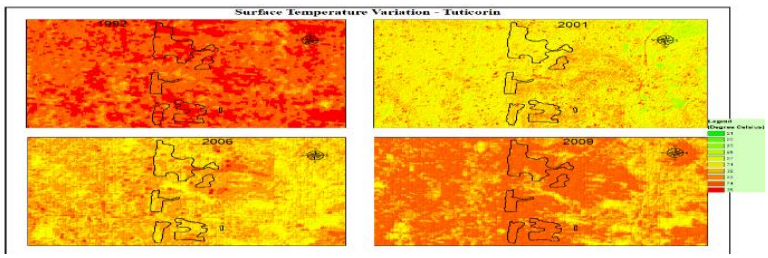

Figure.6.Surface Temperature variation of large windfarm area of Tuticorin district for various years

4. CONCLUSION

Paper reveals the application of satellite image into the application of standalone ground station process. Perceived analysis of the satellite image is carried out with the quantification in the principle of predefined mathematical involved in the software used. This analysis provides an information about the change in temperature at the level of Earth surface. This surface change in temperature is attributed to the presence of wind farms in a study area.

A standout amongst the most massive parts of this study was that it shows help that remote recognizing symbolism can be suitably utilized as a bit of aggregation with simple to use, off the rack programming to discrete and investigate the effects of a significant scale windfarm on the near to atmosphere, all the more particularly to the degree surface temperature. Uninhibitedly accessible Landsat7 scenes were picked and dealt with utilizing a perceived model based procedure for picking surface temperature values in the area including and within a considerable scale windfarm.

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