



Temperature Modeling of Indus Basin Using Landsat Data

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Abstract: The anthropogenic association contribute towards depletion of natural resource and transforms to transform the natural covers into land use; the result of this modification has significant effects on regional weather and climate. The deforestation and urbanization directly impact on atmosphere and surface heat fluxes; the major fundamental factors are modification in the physical property of the surface and the natural vegetation such as forest, grassing land and natural cover; these changes continuously reduce surface moisture which was available in atmosphere and this refers especially to distinct difference of temperature between natural and non- natural landscape. This extensive research has been carried out using remotely sensed information to detect thermal characteristics and measurements of temperature of Indus basin surfaces and impact on regional climate. The satellite borne instruments can provide quantitative and quality physical data at high spatial, temporal resolutions and repetitive coverage, capability of measurements of earth surface conditions.

Keywords: Land surface temperatures (LSTs); Land use/Land cover remote sensing; classification method.

1. INTRODUCTION

The surface temperature is an important variable, essential for a huge range of application such as climatologically, hydrological, agricultural, and biogeochemical and change detection studies (Wubet, 2003 and Dash 2005). Land surface temperature gives significant sequence regarding the surface physical possessions and climate which play a key role in several environmental methods (Doussat *el at.*, 2003; Weng, *el at.*, 2004). Different studies have been carried-out to predict comparative warmness by determining the land surface temperature, using land based observation stations. (Yamashita 1996). The stations based observation method is costly, time consuming and direct to troubles in spatial interpolation. Remote sensing (RS) power is tool and superior a better alternative. The remotely sensed images are the accessibility of high resolution, repetitive coverage and capability of measurements of earth surface environment (Owen, *el at.*, 1998). In RS, Thermal infrared (TIR) sensors are capable to acquire quantitative, quality information of surface temperature about the Land use/ land cover classes.

The several thermal infrared sensors have been used in land surface temperatures studies;

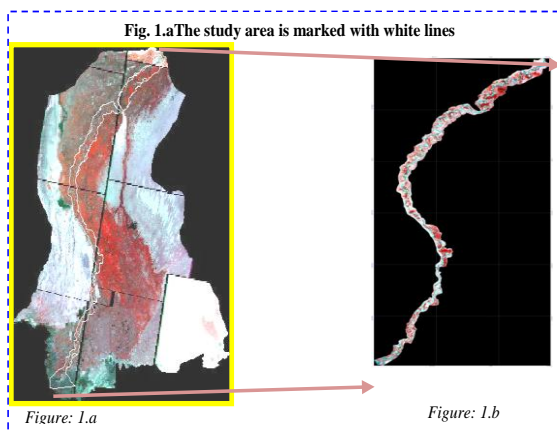
in land surface temperatures studies; the Thematic Mapper (TM) has a 60-m resolution in thermal region. Some studies used measurements of temperature and general environmental problems of the 21st century (Weng, 2001), reported that uncontrolled land development and its alteration lead to loss of natural vegetation, forests; Amazon has been generally decline in the quantity. Therefore, only satellite based radiance capacity to provide the temporal coverage and spatial resolution to analyze the LST. This work is to contribute in the field of temperature modeling and regain climatic changes of Indus basin surface (Mallick. *el at.*, July 2008 and Abbasi *el at.*, August, 2011).

Introduction of Study Area

The Indus basin being narrow belt is comprised of the total area of 1,861,571 Acres - * - in Sindh province with a width of 4 to 6 km width and length is too long about 855 kilometers, (Fig. 1). It starts form Guddu barrage to Arabian Sea (Abbasi *el at.*, July, 2011). The study area is shown in (Fig.1).

- * - This area of Indus basin has been drive from satellite images during image analysis of Indus basin

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2.1. Species

The main species of Indus basin are *Acacia nilotica* (local name Babul), *Prosopis cineraria* (local name Kandi), *Tamarix aphylla* (local name Lawa), *Tamarix dioca* (local name Lai), *Populus euphratica* (local name Bahan), *Prosopis juliflora* (local name Mesquit) (Bhatti, et al., 2000, and Abbasi et al., 2011).

2.2. Habitat for Wildlife

The Indus basin have been a significant sanctuaries for a variety of mammals and reptiles especially hog, deer and other animals like partridges wild boars, jackals, sand grouse, wolves, porcupines etc. (Fund 2008).

2.3. Goods

The Indus basin is a good source of several goods like agriculture, fishing, livestock grazing, fodder, medicinal plants, fuel wood and timber, seed and wildlife hunting to meet the needs of local, provincial and national utilization (Fund 2008).

2.4. Soil

The province of Sindh is a part of lower Indus plain; the soils productive in nature esp. in central plains have been formed by action of the Indus River by depositing silt cover along both the sides. These soils of alluvium nature have fine texture having more ratios of silt, clay and equal lime – magnesium and low quantity of sodium carbonate. These sediments of alluvial texture have variable thickness i.e. several meters at Guddu and Sukkur to less than 30 meters at down stream at Kotri. The soils do not reflect any development especially after floods but are in the form of stratified sand, silty clays and silt, loam (Bhatti, et al., 2000). The soils are of very fertile in nature and are uneven due to seasonal and annual deposition of silt providing the Riverine belt a special topography (Sheikh, 2000).

2.5. Climate

The climate of the area under study is sub-tropical and continental type, which consists of hot summers and clement dry winter lasting from December to February. The annual mean rainfall in the northern part is about **100 mm** whereas in the south it is **175mm**. July and August are the months of rainfall .The temperature in the extreme north (i.e. up stream Sukkur and Shikarpur) is in between 40° - 50° C where as in the south (i.e. down stream Kotri and Thatta) is up to 35° C. The humidity in the above regions is 30% and 61 % respectively. The evapo-transpiration has been observed to be more than the precipitation (Fund, 2008).

2. MATERIAL AND METHODS

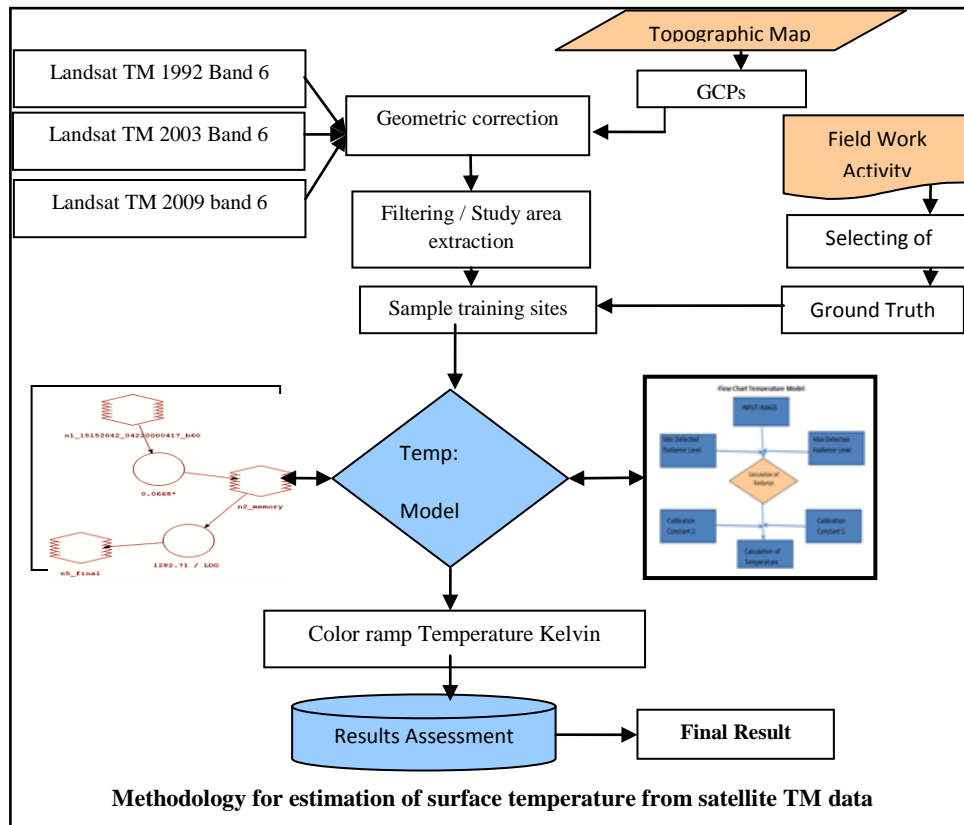
The Landsat TM image, dated 16th May 1992, 15th May 2003 and 15th May 2009 were used effectively for identification of the spatial distribution characteristics of surface temperature of Indus basin. Band 6 of TM respectively were analyzed for the determination of the surface temperatures, images were compared with each other for understanding the relationship between the land cover types and different types of temperature in the Indus basin. *Temperature Model* was developed in the ERDAS Imagine for the calculation of the surface Temperature and when ERDAS imagine processing has completed, finally the images open in Arc Map software and color ramp scheme were applied, reflecting water bodies low temperature, dry land/ barren land in high temperature the image; The temperature values image are shown in Kelvin (Abbasi et al., July, 2011).

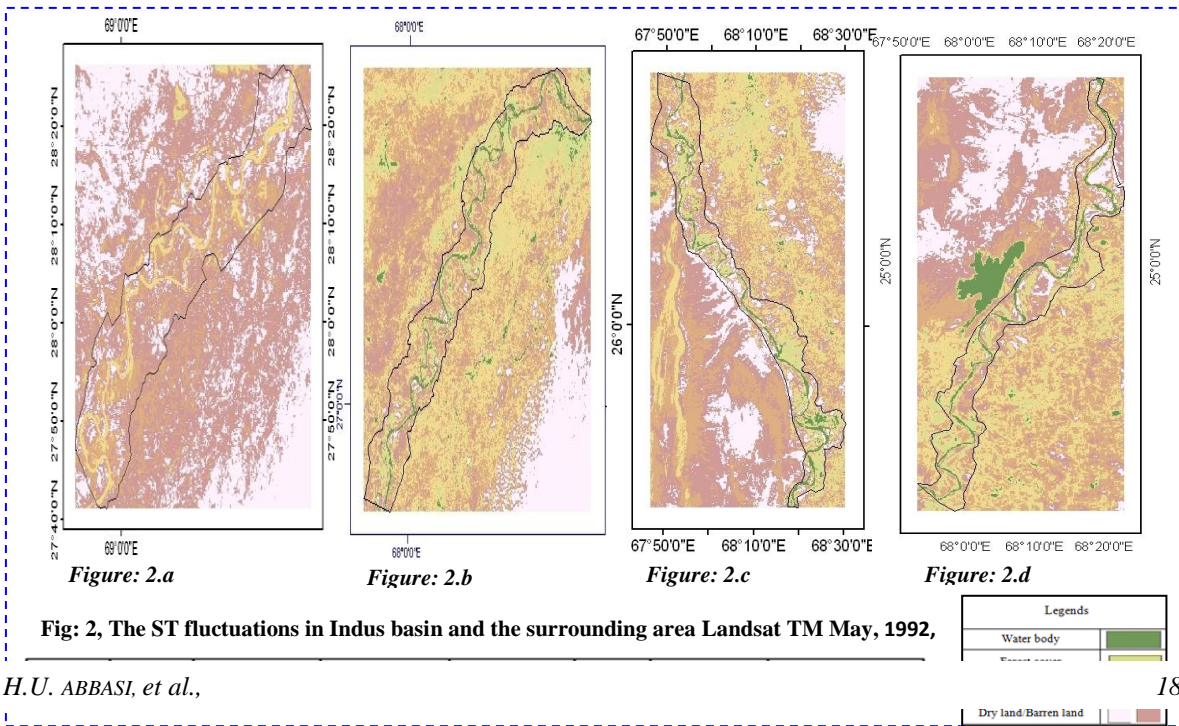
3. RESULTS AND DISCUSSION

The Indus basin was divided into four regions, region first starts from Guddu to Sukkur as shown in (Fig. 2a,) second region begins form Sukkur to Nawabshah shown in (Fig. 2b), third region from Nawabshah to Kotri barrage shown in (Fig. 2c) and fourth region establishes from Kotri barrage to Arabian Sea as shown in (Fig. 2d) because the area was large in length and the other reason different climatic conditions after 100 kilometers in Indus basin. The analysis of surface temperature using thermal infrared band 6, was carried out. The analysis showed significant change in temperature, in 1992 the temperature was 38.76°C and in 2009 the temperature was 43.1°C which increased by about 4.38°C in 16 years. In May 1992, May 2003 to May 2009, the total difference of in the temperature was found to be increased 4.38°C . The results show the increase in average temperatures due to

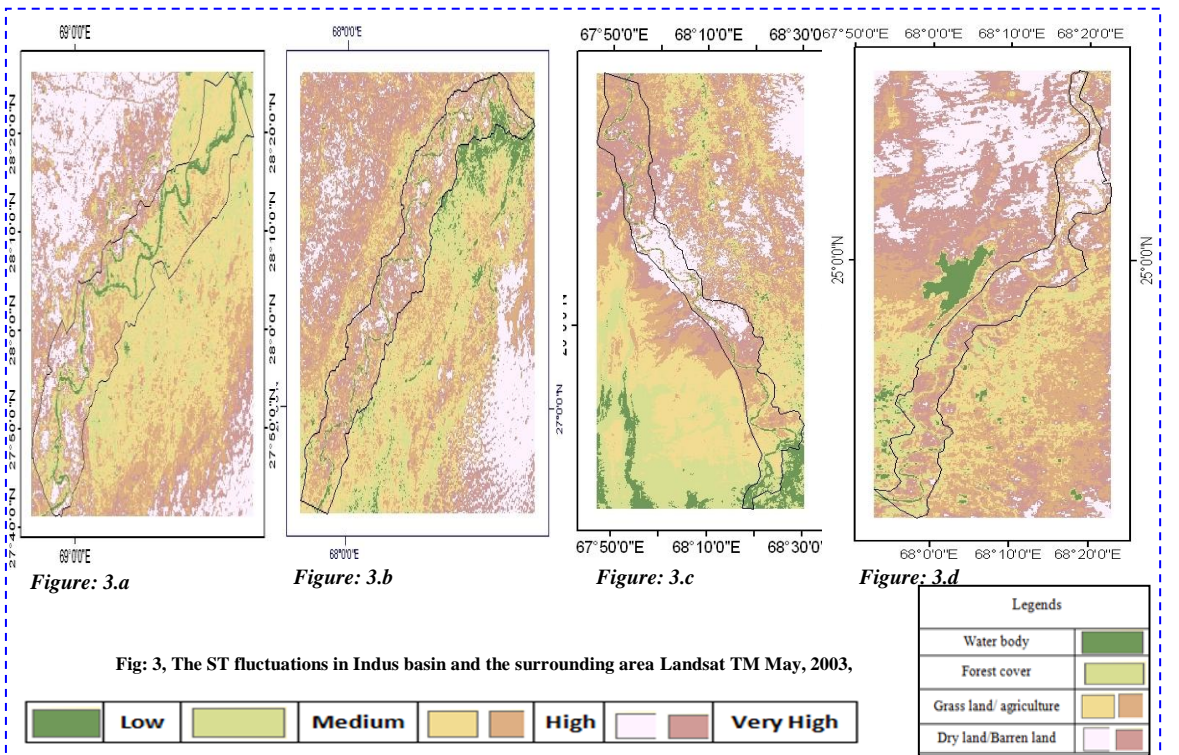
anthropogenic activities and major factor is deforestation in the Indus basin; the LST calculated from the satellite data which indicates a large

difference in surface temperature shown in images (Fig: 2,3,4 a, b, c, d and Fig: 5).





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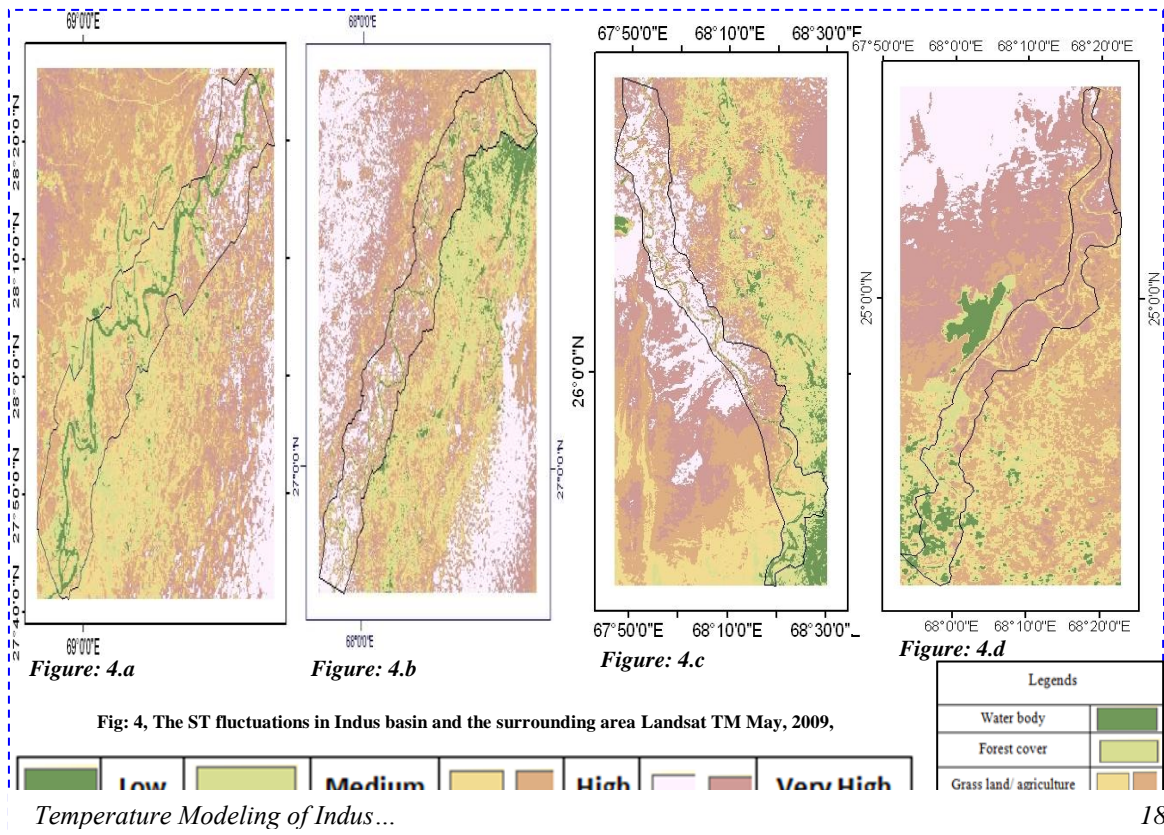


Table: 1, Spatial Distribution of Land Surface Temperature of Landsat TM

<i>Legends</i>		<i>Average Temperature in Celsius</i>		
		1992	2003	2009
Water body		26.5 ⁰	30.35 ⁰	33.85 ⁰
Forest cover		34.85 ⁰	36.35 ⁰	39.85 ⁰
Grass land/ agriculture		38.85 ⁰	39.35 ⁰	43.35 ⁰
Dry land/Barren land		54.85 ⁰	53.35 ⁰	55.35 ⁰

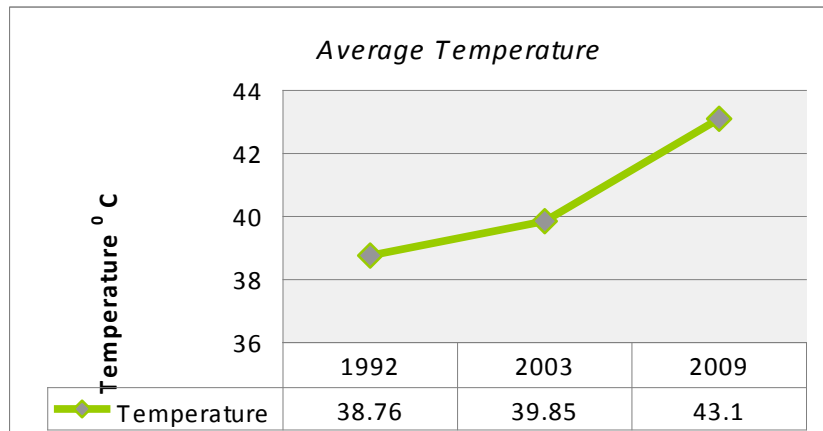


Fig. 5, the temperature fluctuations in Indus and the surrounding area

4. CONCLUSION

The analysis of surface temperature using thermal infrared band 6, was also carried out to find out the significant change in temperature, the results have shown that from May 1992, May 2003 to May, 2009, the total increase in temperature is 4.58°C. This is very significant increase in average temperatures of the surface due to Deforestation in River Forests, other natural resource depletion and anthropogenic activities.

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