

INTRODUCTION

1.0 Preamble

Changes in the urban environment are generally found to take place through modifications in the urban spatial structure. Relationships between the built forms, including land cover and thermal comfort have been researched and established by researchers in the context of tropical cities (Emmanuel, 2003, Emmanuel, 2005, Santamouris and Assimakopoulos, 1996 and Santamouris et al.1999). Modifications, in the urban spatial structure bring about changes in the urban thermal environment. Changes in thermal environment especially in Indian cities, quite often lead to significant deterioration of comfort conditions of the urbanites. Urban thermal environment is a function of geographic location and its spatial structure. Urban Heat Island (UHI) refers to elevation of urban temperatures over those in surrounding rural areas, the difference generally being greater at night than during the day. For people living and working in cities, both day time and night time air temperatures are important, particularly in tropical and sub-tropical cities, where the climate may often exceed the threshold of human comfort for major periods of the year.

One important objective of physical planning is to optimize the distribution of land use, as lack of proper land use control results in poor land use compatibility. The developmental activities in India quite often, being haphazard and uncontrolled, are leading to over use, congestion, incompatible

land use and poor living conditions. Sustainability has been the recent concern of urban and regional planning including planning for conservation, protection and appropriate use of land and natural resources.

Zoning regulations and building byelaws of an urban area while specifying the FAR, consider the infrastructural capacity, the extent of sunlight penetration and the wind flow. The thermal effect of built form, and irradiation, to a great extent, has an influence on the micro climate, which is not effectively considered in the zoning regulations and building byelaws in India. Therefore, there is a need to understand the thermal effects of built forms and land cover of urban areas.

Thus, it is imperative to analyze the urban spatial structure by characterizing various surface components. This is important as the urban spatial structure has a direct bearing on the intensity of Urban Heat Island effect. Characterization of the area fraction of various surface type especially vegetative cover and water body are of particular importance.

Remotely Sensed Imagery acquired from space is an important tool for urban planners. Conventional techniques of recording land use and land resource information are capital and time intensive. Recent technological developments provide recourse to data creation using remote sensing methods that are cheaper and faster. Land cover information derived from aerial photographs or satellite imageries can be superimposed on other demographic or geographic information to provide insights to the human settlement patterns and their characteristics. Normally the images used to create such databases are panchromatic aerial photographs or panchromatic and multi-spectral imageries from satellite sensors such as IRS (Indian Remote Sensing Satellite) LISS 3 & 4, LANDSAT, SPOT, ASTER, METEOSAT, MODIS, etc. High resolution

imaging satellite sensors like RESOURCESAT, IKONOS, QUICKBIRD and CARTOSAT-1& 2, have given impetus to the use of remote sensing imageries as resource for urban mapping. Apart from land cover mapping, a number of satellite-based studies using thermal infra-red imagery (Nichol et al. 2002, Xue and Guo, 2000, Arita et al., 1999, Narongrit et al., 2002) have been carried out. Satellite data provides a dense grid of almost instantaneous temperature measurements over a city and can permit visualization of spatial relationships between temperature patterns and urban spatial structure. Satellite-based studies can therefore provide recommendations for building design and landscaping, that aims to minimize heat accumulation and retention by urban surfaces. So far there is no detailed study in the context of Indian cities to assess the impact of changes in the built forms on the thermal environment, hence this research.

1.1 Aim

The aim of this research is to develop a model for assessing the thermal response of urban land cover and built form based on satellite imagery and climatic data of metropolitan city of Kolkata.

1.2 Scope

The research aims at exploring the following aspects:

1. Evaluation of land cover and urban form of Kolkata using GIS and landscape metrics as tools.
2. Estimation of thermal fluxes.
3. Study of thermal response with respect to different land cover composition and built forms at Kolkata.