Space as a tool to foster climate mitigation and adaptation

By Komal Sajwan

Abstract

Climate change is emerging as one of the greatest long-term challenges that society faces today. It is very important and urgent to tackle some major problems posed by climate change. Taking examples from case studies, based on land surface temperature monitoring, flood hazard and risk assessment and vegetation cover, helps us understand the need for developing satellite systems that can measure and monitor climate change, help us to plan our action and mitigate its consequences. The essay underlines the importance of satellites as critical communication and information-based infrastructure for modern societies.

Introduction

Today climate change is an important issue that needs to be tackled urgently. Global warming is often correlated as a consequence of human activities and not to natural causes. This inference is concluded due to the abrupt climate change recorded over the past 200 years as compared to the time period usually accompanied by natural climate change. There are many factors that account for these anomalies like increase in the use of fossil fuels causing the release of greenhouse gases to a large extent, rapid urbanization and degradation of vegetation cover.

The climate change problem must be addressed globally by collecting data related to the same. In recent times many space missions have been carried out to assist in climate monitoring through space at local, national and global level. These studies can successfully support in implementing various protocols to mitigate climate change and pre-plan our actions for a sustainable future.

Case studies

1. **Land surface temperature monitoring**

   Urbanization has led to various environmental problems, like global warming, air and water pollution, which negatively affect quality and comfort of urban livelihood. In this study, a wide analysis was done to find out the changes in land temperature in NCR[1] (Delhi) region with the variety in vegetative cover.

This region has experienced rapid spatial changes in its landscape pattern. These changes, whether conversion of agricultural land to industry and civic facilities, or sparse built-up areas to dense built-up areas, have impacted the residential patterns, agricultural practices, urban thermal environment and urban forest distribution in the city (Hang et al., 2017).

To investigate the current condition, Landsat 8 datasets of May 2014 were acquired and the land use/land cover classification was performed using the satellite images.

The results displayed that the suburban and the city area showed higher temperature due to scarcity of vegetation, fallow land and industrial/commercial land use. Whereas the agricultural cropland, dense vegetation area, water bodies and marshy land showed lower surface temperature. Refer Fig. A.

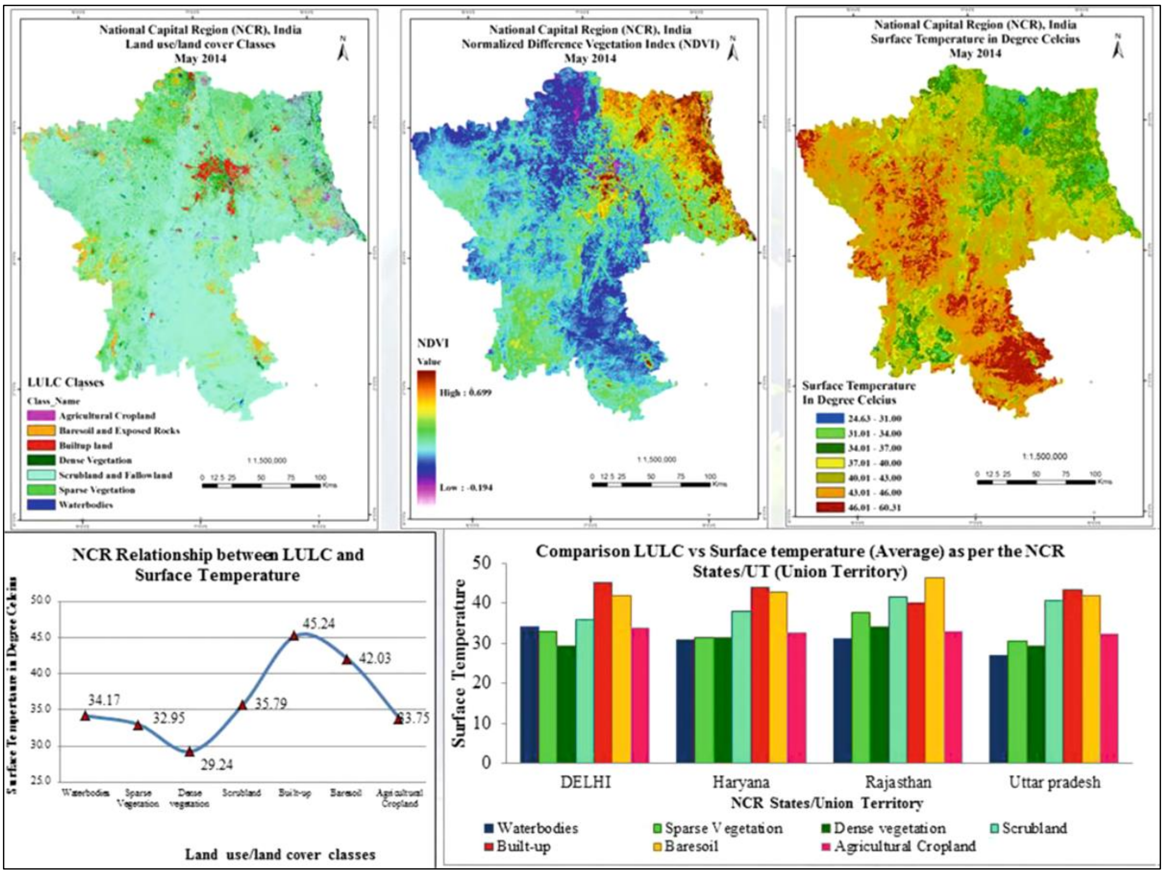

Fig. A. Geospatial environmental analysis (Hang et al., 2017).
This image shows various observations made in the NCR region while analysing the land surface temperature.

[1]National Capital Region (NCR) in India is the designation for the conurbation or metropolitan area which encompasses the entire National Capital Territory of Delhi, which includes New Delhi, as well as urban areas surrounding it in neighbouring states of Haryana, Uttar Pradesh and Rajasthan (Hang et al., 2017).

2. Flood hazard and risk assessment

Flooding is a major environmental problem in India due to unexpected heavy rainfall and a plethora of rivers located geographically in the peninsula prone to surge. Therefore, it is critical to analyze the danger zones, hence help in mitigation of losses to lives and property.

The objective of present study is to delineate and identify flood hazard and risk assessment at landscape level using Landsat satellite data from 1974-2013 in Chamoli District, Uttarakhand, India covering total geographical area of 8030 km2. The multi-flood time series dataset was used for preparation of Digital Elevation Model. Geographical Information System was used for identification of flood prone areas which were classified with zone-wise. A flood frequency map was developed using the multi-date Landsat satellite imagery. The classified vegetation type/land use map from 1974-2013 was overlaid to find out the frequency of the flood. Flood affected areas were classified into very low, low, medium, high, very high and extremely high based on vulnerability to the potential of flood hazard. Refer Fig. C. (Bhatt et al., 2014).

This study demonstrates that preplanning using flood and risk assessment can help with flood management and emergency response more efficiently and thus reduce the impact of such natural disaster.

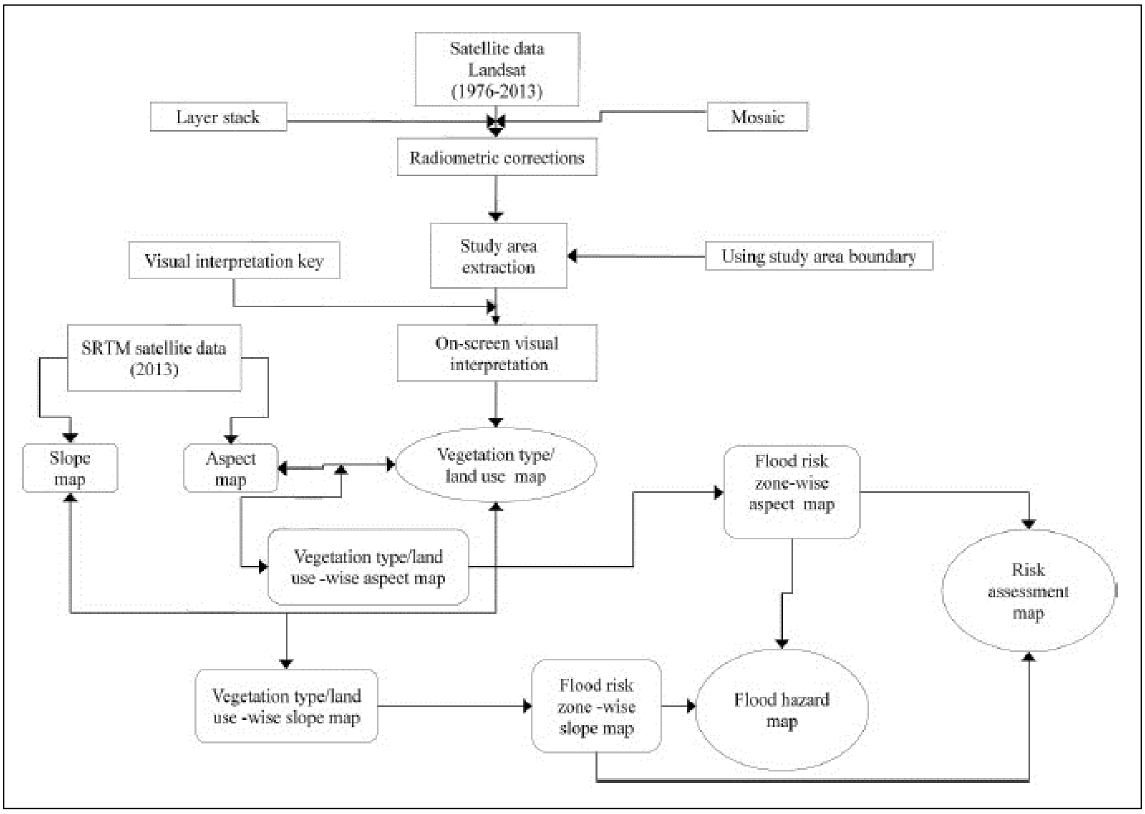

Fig. B. Methodology for flood hazard and risk assessment using satellite remote sensing and GIS (Bhatt et al., 2014).

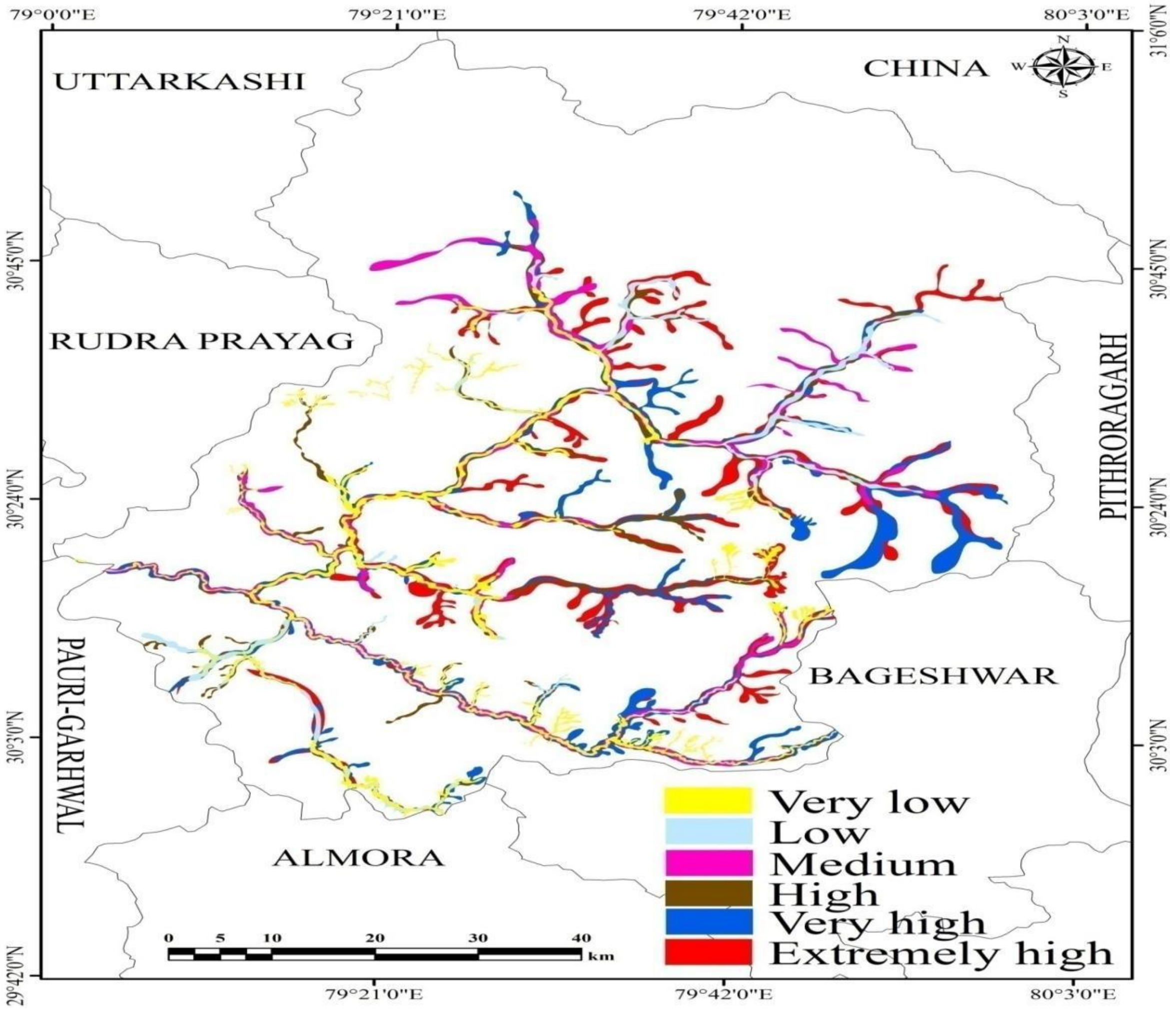

Fig. C. Flood hazard and risk assessment map (Bhatt et al., 2014).

3. Vegetation management

In India, land usage for human activities is changing the functioning and extent of ecosystems. In a workshop organized by Indo-UK Terrestrial Carbon Group comprising both Indian and UK scientists, funded jointly by the Department of Science and Technology (DST), India and the Department of Business, Innovation and Skills (BIS) to explore ways in which Earth observation data can be effectively utilised in vegetation carbon modelling and how field measurements can be incorporated to improve estimation of the regional carbon budget (Behera and Dash 2013) it was discussed a need to establish following actions:

- Long-term and regular measurement of gas and energy fluxes, various properties of vegetation and ecosystem using some low-cost developed initiatives.
- An Indian Phenological Network (IPN) facilitating the long-term collection of existing and new observations done at local scale, and further up-scaling to the national level.

- Modify existing Dynamic Vegetation Model (DGVM) or develop new model to be integrated with a land surface–atmospheric–ocean model; and thus, allowing actual and potential carbon sequestration to be mapped under future land use and climate change scenarios.
- A policy to allow use of time-series comparison of satellite data for identifying degraded land or harmed ecosystems that can be restored by vegetation management

In order to achieve the ideal environment goal, research which spans in many scientific fields including biology, ecology and space science, is necessary (Dash et al., 2020).

Conclusion

Earth based observation using satellites offers a unique, fact-based perspective that can help us tackle climate change. Studies based on data provided by space tools can help us improve our vegetation cover, and encourage the use of renewable energy sources in place of fossil fuels to reduce global warming. These technologies remain key to fighting climate change and support the policies to be laid out for a sustainable future. Today they are helping us connect the world through the internet and communication and in the future are bound to offer much more.

Bibliography

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