Global Journal of human-social science: B
Geography, Geo-Sciences, Environmental Science & Disaster Management
Volume 16 Issue 4 Version 1.0 Year 2016
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Cross Validation can Cause a Difference of Misinterpretation to Valid Interpretation

By Vipin Upadhyay & B. S. Adhikari
Wildlife Institute of India

Abstract- Easy availability of remote sensing dataset increases its importance and use by multiple folds, especially in areas of rough and difficult terrain like snow bound mountains. But at the same chances of misinterpretations will also be increased in the same proportion, when dealing with high altitude mountains in remote sensing. Seasonal variation within single year time framework and temporal changes in long time are more important to understand separately. Verification of the imagery selection, operations and findings is the key of analysis. This paper focused upon misinterpretation often occurs in the geospatial domain by shifting the focus, when observations transforming to information. A negligible error in selection of imagery, operation or perception make it possible to misinterpret the findings. In this study we are try to withdrawing kind attention of users toward small-small negligence, that cost a lot. In this study we take area under Nanda Devi national Park as an example to highlight such errors.

Keywords: accuracy assessment, cross validation, land use land cover, change detection, remote sensing and misinterpretation.

GJHSS-B Classification : FOR Code: 969999

Cross Validation can Cause a Difference of Misinterpretation to Valid Interpretation

Vipin Upadhyay [α] & B. S. Adhikari [σ]

Abstract- Easy availability of remote sensing dataset increases its importance and use by multiple folds, especially in areas of rough and difficult terrain like snow bound mountains. But at the same chances of misinterpretations will also be increased in the same proportion, when dealing with high altitude mountains in remote sensing. Seasonal variation within single year time framework and temporal changes in long time are more important to understand separately. Verification of the imagery selection, operations and findings is the key of analysis. This paper focused upon misinterpretation often occurs in the geospatial domain by shifting the focus, when observations transforming to information. A negligible error in selection of imagery, operation or perception make it possible to misinterpret the findings. In this study we are try to withdrawing kind attention of users toward small-small negligence, that cost a lot. In this study we take area under Nanda Devi national Park as an example to highlight such errors. As we observed a clearly change in vegetation cover as well as in snow cover on direct compression of satellite images from two different time frame in first operation. While in reality the change in snow cover is just because of seasonal snow fall is only become known after second operation. Such kind of misinterpretations are often in studies using geo-spatial technologies and remote sensing. Therefore, it must be required to validates and examine observations every time whenever reporting, our findings. And also requires to understanding about concepts properly prier interpret results and observation of any findings. Article like this useful to manager's researcher and other remote sensing users in assessment, clarification and validations of their findings.

Keywords: accuracy assessment, cross validation, land use land cover, change detection, remote sensing and misinterpretation.

I. Introduction

Remote sensing' refers as detection of electromagnetic energy from aircraft or satellites, which was reflected back from earth surface and entities on earth. Remote sensing Data are often distributed in a matrix of square picture elements called pixels (Turner *et al,* 2003). Remote sensing is the technique of deriving information about objects on the surface of the earth without physically coming into contact with them. This process involves making observations using sensors (cameras, scanners, radiometer, radar etc.) mounted on platforms like aircraft and satellites (Lillesand & Kiefer, 1987). Measurement of reflected energy under visible, near- and middle-infrared, and thermal-infrared range of electromagnetic radiation is commonly used for land-use land cover monitoring via passive remote sensing technique (Turner *et al*, 2003). Satellite remote sensing found to be useful in estimating the diversity, richness and extent of land cover throughout the different landscapes, meeting a fundamental need that is common to many ecological applications (Kerr & Ostrovsky, 2003). Satellite imageries obtained from various satellites are increasingly being used for various purposes including land use mapping, change detection and other geographic information system (lee, 1991). Geospatial information about land-use land cover and its patterns having important applicability for development and conservation planning/management. Data for Land-cover and land-use are necessary for various different purposes like environmental monitoring, change detection, as well as development schemes (Mumby & Harborne, 1999 and Mumby & Edwards, 2002).

Snow bound mountains are sensitive to climate and also act as best indicators for change. Therefore, monitoring of these mountains thus subject to monitoring of environmental and climate changes (Oerlemans, 1994). Information about changes or change detection on the earth's surface is becoming more and more important in monitoring of resources and environment at the local, regional as well as global scale. Remote sensing techniques are best suited and easily applicable way to analyze and to monitor these remote snow bound mountains (Bolch & Kamp, 2008). The easily availability of remote sensing imagery of present as well as past makes it possible to analyze spatio-temporal pattern of environmental elements, changes throughout the time interval and impact of human activities in past decades (Jianyaa *et al,* 2008). Change detection plays a very important role for development, conservation, economic construction and national defense as well. Change detection and its accuracy is a main issue for resource and environmental monitoring, disaster monitoring, city expansion, geographic information update and military defense (Li, 2010).

Accurate and timely information about land use and land coverof a landscape or landforms and its changes over the time plays a crucial role for land management, decision-making, ecosystem monitoring, conservation, urban planningand development (Zhou *et. al*, 2008). There are two types of information-processing system: the type that is capable of converting the

Author α σ: Wildlife Institute of India, Dehradun.
e-mail: vipinupadhaya@gmail.com

information it receives into knowledge and the type that is not (Dretske, 1981). There are surprising number of things that we cannot know (or questions we cannot answer) that are not the result of imperfect information. Forms of not knowing are pervasive in domains as diverse as mathematics, logic, physics, and linguistics, and are apparently irreducible (Couclelis, 2003). In applications of GIS and other geo-spatial technologies, being right (accurate, correct, precise) is considered of paramount importance and may be sometimes mean the difference between life and death (Couclelis, 1992).

Error associated with data acquisition, processing, analysis and interpretation can have significant impact on management planning and conservation efforts (lunette *et al* 1991). Although the use of advance techniques is increasing rapidly our understanding about data processing, integration and especially result interpretation, leg far behind. Performing geospatial operations using satellite imageries especially in high mountain regions with low accuracy and narrow range of operations without actual verification will produce product of low confidence (Veregin, 1989). Therefore, it must be needed to clearly identify the types of errors that may occur, proper understand of concepts and how these errors propagate and how to remove them or avoid them (Marin,1989). Main objective of this article is to highlighting one of the basic conceptual errors occurring during use of remotely sensed imaginary for high mountain regions studies and its resolution.

a) *Background*

Snow bound mountains and their surrounding regions like Nanda Devi National Park in India is best areas to study the climate change impact on glaciers and its outcomes on life forms (Bolch, 2006, Gong, 2008 and Oerlemans, 1994). Without using advance geospatial techniques like remote sensing and GIS Studying such rough terrain is not an easy task (Kerr, 2003). Easily availability of remotely sensed imagery for high range of temporal resolution make it easier to analyze change over the time period (Rees, 2002). But due to seasonal variation within year time framework, it is more important to understand and carefully selection of imagery and operations should be clearly analyzed and verified. A negligible error in selection without verifications make it possible to misinterpret the findings. This paper focused upon misinterpretation often occurs in the geospatial domain by shifting the focus from observations to information, as well as on the schemes applicable for validation of results.

II. Material and Methods

Satellite remote sensing had been used for meeting a fundamental need that is common to many geospatial applications (Lu *et al.,* 2004, Manonmani 2010 and Stacy, 2002). Satellite images for year 2003, 2004, 2014 and 2015 were acquired from earth USGS explorer (http://earthexplorer.usgs.gov/). Lands at 8 satellite image of the study area (Row: 39, Path: 145) for April 2014 &2015 and October 2014 & 2015 and Landsat 4-5 TM (Row: 39, Path: 145) image for October 2002 and April 2003 were used. Sun Elevationangle54.33, 63.25, 59.22, 46.13, 47.17, and 43.57 for images April 2003, 2014, 2015, and October 2002, 2014 and 2015 respectively. And Sun Azimuth angle of 131.46, 126.55, 131.84, 150.52, 152.62 and 153.42 for images April 2003, 2014, 2015, and October 2002, 2014 and 2015 respectively.

Lands at remote sensing datasets were acquired with initial geo-rectification completed. After acquiring the satellite images of the study areas Atmospheric and radiometric corrections (Leonardo *et al.* 2006) was performed where ever needed. And then False Color Composite (FCC) map was developed using layer stack function in EARDAS Imagine software by taking four band Red (wave length of 0.636-0.673), Blue (wave length of 0.412-0.512), Green (wave length of 0.533-0.590) and Infrared (wave length of 0.851-0.876) each with spatial resolution of 30m and radiometric resolution of 8 bit and 16 bit for Lands at 4/5 and Landsat 8 respectively. The software packages used for assessment were ERDAS IMAGINE 13 and ArcGIS 10.2.Change detection analysis on the seasonal basis (April to April and October to October) was carried out by visual interpretation of FCC created using four different band i.e. Red, Blue, Green and infrared band and further verified by NDVI calculations (Ichii, 2002, John, 1998, Paruelo, 1998 and Ricotta, 2000).

In this study three different operations were performed. In the first operation, direct comparison (Singh, 1989 and Deer, 1999) of FCC created from images of two different time frame 2002/3 and 2014 for pre as well as post monsoon season separately. In the second operation, compression of FCC produced from images of two successive years 2014 and 2015 with 2003 image similarly for both seasons. And in third operation compression of NDVI of pre and post monsoon season (vegetation cover) for two successive years 2014 and 2015 with 2002-2003 images.

III. Results

In the first operation visual interpretation of FCC produced from pre-monsoon images acquired on April 2003(figure 1a) and 2014 (figure 1b) and post monsoon images acquired on October 2002 (Figure 1c) and 2014 (Figure 1d) were compared. In this operation there was an increment in vegetation cover and snow cover (only in post monsoon image) and decrement in thickness of snow in latter images (2014-15).

While in the second operation (which was performed to check the validity of the first one) visual interpretation of FCC produced from pre-monsoon images acquired on April 2003, 2014, 2015 and pre-

Global Journal of Human-Social Science (B) Volume XVI Issue IV Version I Year 2016

monsoon images acquired on October 2002, 2014 and 2015(figure 2) all together were compared. Results of this operation were contradictory to the first operation results, i.e. no change in snow cover. This clearly indicates that the increment in snow cover in first operation was observed only because of early snow fall for that year at the time of image acquisition. This change is not land cover change but it is an artifact of technology.

But at the same time increment in vegetation cover was observed in both (first and second) the operations indicates an actual increment (more in pre monsoon images i.e. April). This increment in vegetation cover was also supported by NDVI calculations (figure 3) of imagery collected for both operations in entire time frame from 2002 to 2015.

As the interpretation about decrement of snow thickness produced by first operation was also not clearly validated here, therefore it requires a more focused study on it with some more clear and precise methodology.

IV. Conclusion

As reported in the results of first operation there was an increment in snow cover is an example of over dependency on technology without knowing about facts. Take it as an example, in such cases technology without knowing about facts sometimes gives false information. Therefore, it must be required to validates and examine (using like in second operation of successive years' imagery compression) findings every time whenever reporting, our findings. And also requires to understanding about concepts properly prier interpret results and observation of any findings.

Similarly, in case of interpretation about increment in vegetation cover was cross checked and validated by second (i.e. Compression of imagery of successive years) and third (i.e. NDVI assessment of Vegetation) operations. This increment in vegetation cover was found in both successive years from 2003 to 2014 and 2015 and also using NDVI results validate each other. In this case one can says that if results of two different operations was found to be same then there are high chances of valid and error-less interpretations. The changes in vegetation cover (increased) can be result of conservation efforts during the time frame also validated by this study.

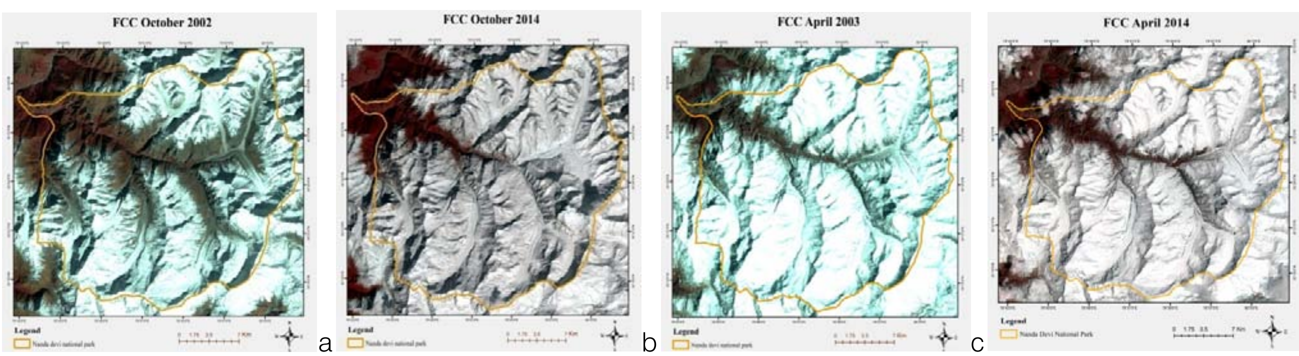

Figure 1 (a and b); Preliminary assessment of land cover change using FCC (False color composite) clearly indicates an increment in vegetation cover, increment in area under snow cover and decrease in thickness of snow was visualized since last 12 years in post monsoon images. *(c and d);* Preliminary assessment of land cover change using FCC clearly indicates an increment in vegetation cover, no or very less change in area under snow cover and decreases in thickness of snow since last 12 years in pre-monsoon images.

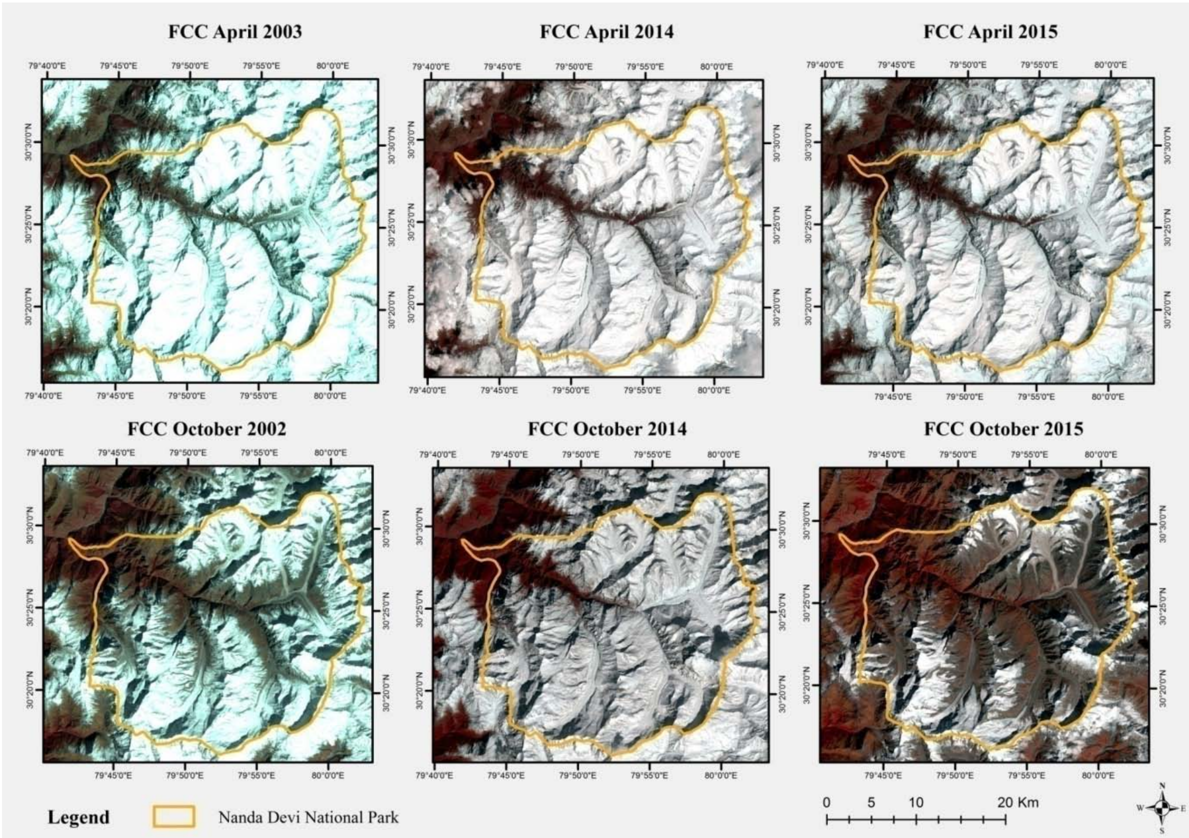

Figure 2 : Compression of successive year satellite imagery FCC of pre and post monsoon timeframe

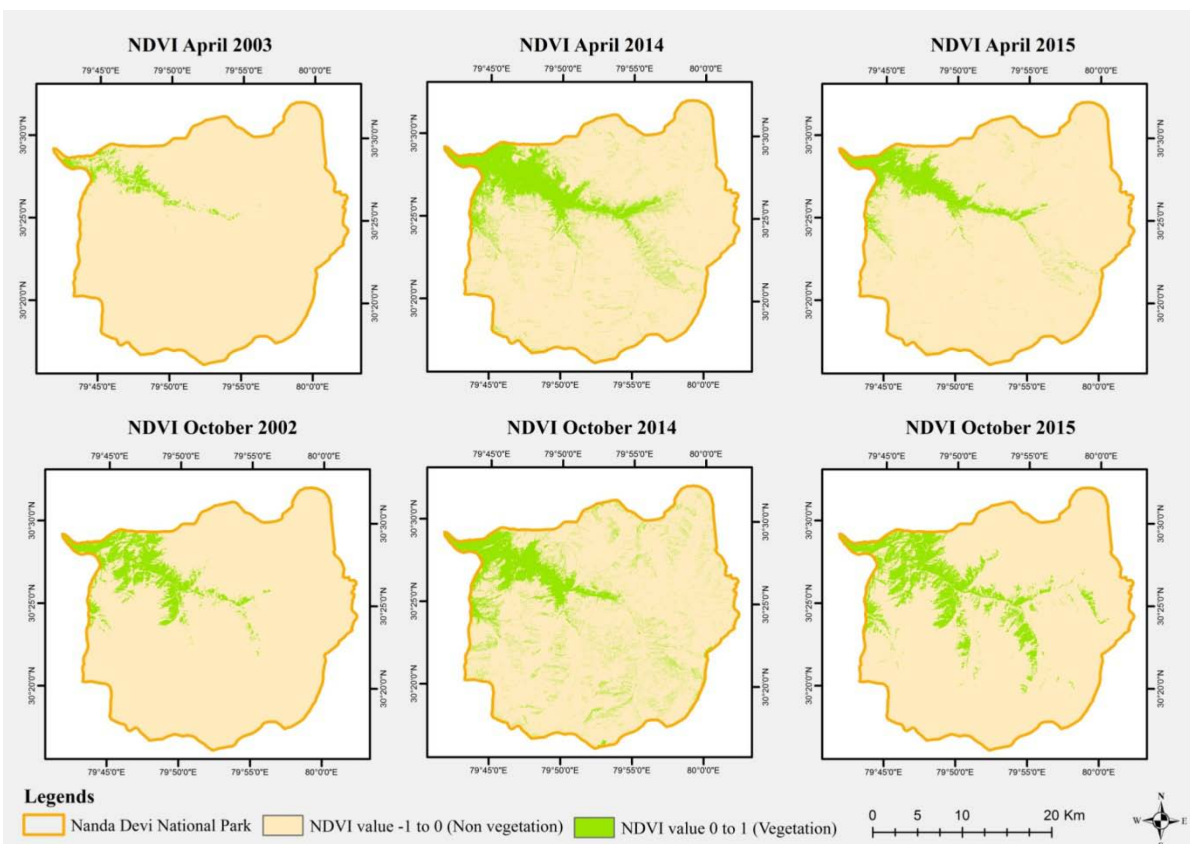

Figure 3 : Compression of successive year satellite imagery NDVI of pre and post monsoon timeframe.

V. Acknowledgement

The study is conducted under a research project funded by ICIMOD with collaboration of Wildlife Institute of India (WII). First of all, we are thanking to director WII, ICIMOD of allowing me to do this study. We are also thankful to Dr. G S Rawat Scientist WII for their timely guidance support. We don't forget to thanks Dr. Panalal and our Lab mates GIS Lab WII, Dehradun for shearing their GIS knowledge and moral support whenever we needed. And in last we also thanking our friends, parents and almighty god.

References Références Referencias

1. Couclelis, H. (1992). Geographic knowledge production through GIS: Towards a model for quality monitoring. In Couclelis, H. Beard, K. and Mackaness, W. (ed) *Two Perspectives on Data Quality*. Santa Barbara, CA, University of California, National Center for Geographic Information and Analysis Technical Report No 92-12: 1539.
2. Couclelis, H. (2003). The Certainty of Uncertainty: GIS and the Limits of Geographic Knowledge. *Transactions in GIS* Blackwell Publishing Ltd, 7(2): 165-175.
3. Deer, P. (1999). Digital Change Detection Techniques: Civilian and Military Application Published in the UK. Taylar & Francis Ltd, London.
4. Dretske, F. I. (1981). Knowledge and the Flow of Information. Cambridge, MA, MIT Press.
5. Gareth, R., Brown I. Kari, M., Tarmo, V., Ben W. (2002). How Can the Dynamics of the Tundra-Taiga Boundary Be Remotely Monitored? Ambio Special Report 12, Tundra-Taiga Treeline Research, Royal Swedish Academy of Sciences.
6. Gong, J., Sui, H., Guoruia, M., and Zhou, Q. (2008). A Review of Multi-Temporal Remote Sensing Data Change Detection Algorithms. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol. XXXVII. Part B7.
7. Ichii, K. (2002). Global correlation analysis for NDVI and climatic variables and NDVI trends: 1982-1990. Int. J. Remote Sens, 23, 3873–3878.
8. Jeremy T. Kerr and Marsha Ostrovsky (2003). From space to species: ecological applications for remote sensing. TRENDS in Ecology and Evolution, Vol.18 No.6.
9. Kerr, J. T. and Ostrovsky, M. (2003). From space to species: ecological applications for remote sensing. TRENDS in Ecology and Evolution, Vol.18 No.6.
10. Lee, K. H. (1991). Wetlands Change Detection methods investigation. EPA Environmental Moni-toring Systems laboratory, Las Vegas, Nevada, 42p.
11. Leonardo, P., Franceisco, G., Jose, A., Sobrino, Juan, C., Jimenez, M. and Haydee, K. (2006). Radiometric correction effects in lands at multi-date/multi-sensor change detection studies. International Journal of Remote Sensing, 2, pp 685-704.
12. Li Deren. (2010). Remotely sensed images and GIS data fusion for automatic change detection International Journal of Image and Data Fusion. Vol. 1, No. 1, pp99–108.
13. Lillesand. T.M. and Kiefer, R.W. (1987). Remote Sensing and Image Interpretation. John Wiley & Sons.
14. Lu, D., Mausel, P., Brondizio, E. and Moran, E. (2004). Change detection techniques. International Journal of Remote Sensing, 25(12), pp 2365-2407.
15. Lunette, R. S., Congalton R. G., Lynn F. K., John, R J., Mcgwire K. C., and Tinnery, L. R. (1991). Remote sensing and geographic information systems: Error sources and research issues. American Society for Photogrammetry and Remote Sensing, Vol 57, No. 6, pp 677-687.
16. Lyon, J. G., Yuan, D., Lunetta, R. S. and Elvidge, C. D. (1998). A Change Detection Experiment Using Vegetation Indices. Photogrammetric engineering and remote sensing.
17. Manonmani R., Mary G., Suganya D. (2010). Remote Sensing and GIS Application in Change Detection Study in Urban Zone Using Multi Temporal Satellite, international journal of geomatics and geosciences Volume 1, No 1.
18. Marin, L. R. G. (1989). Accuracy assessment of landsat-Based Visual Change Detection Methods Applied to the Rural-Urban Fringe. Photogrammetric Engineering and Remote sensing, Vol 55, No. 2, pp 209-215.
19. Mumby, P.J., Edwards, A.J. (2002). Mapping marine environments with IKONOS imagery: enhanced spatial resolution can deliver greater thematic accuracy. Remote Sensing of Environment, 82, 248–257.
20. Mumby, P.J., Harborne, A.R. (1999). Development of a systematic classification scheme of marine habitats to facilitate regional management and mapping of Caribbean coral reefs. Biological Conservation, 88, 155–163.
21. Oerlemans, J. (1994). Quantifying global warming from the retreat of glaciers. Science 264, 243-245.
22. Ozesmi S. L. and Bauer, M. E. (2002). Satellite remote sensing of wetlands. Wetlands Ecology and Management10: 381–402, 2002.
23. Paruelo, J. M. and Lauenroth, W. K. (1998) Interannual variability of NDVI and its relationship to climate for North American shrub lands and grasslands. J. Biogeogr. 25, 721–733.
24. Ricotta, C. & Avena, G.C. (2000). The remote sensing approach in broad-scale phonological studies. Applied Vegetation Science, 3: 117-122.

25. Singh, A. (1989). Digital change detection techniques using remotely-sensed data. International Journal of Remote Sensing, 10(6), pp.989-1003.
26. Tobias B. and Kamp U. (2008).Glacier Mapping in High Mountains Using DEMs Landsat and ASTER Data. 8th International Symposium on High Mountain Remote Sensing Cartography, pp 37-48.
27. Turner, W., Spector, S., Gardiner, N., Matthew, F., Sterling, E. and Steininger, M. (2003). Remote sensing for biodiversity science and conservation, TRENDS in Ecology and Evolution Vol.18 No.6.
28. Veregin, H. (1989). Accuracy of spatial Databases: Annotated Bibliography. National Center for geographic information and Analysis, Technical paper 89-9, 54pp.
29. Zhou, W., Austin, T. and Morgan, G.(2008). Object-based Land Cover Classification and Change Analysis in the Baltimore Metropolitan Area Using Multitemporal High Resolution Remote Sensing Data. *Sensors*, *8* pp1613-1636.