


[Home](#) > [Journal](#) > [Earth & Environmental Sciences](#) > [JGIS](#)
[Indexing](#) | [View Papers](#) | [Aims & Scope](#) | [Editorial Board](#) | [Guideline](#) | [Article Processing Charges](#)
[JGIS](#) > Vol.3 No.3, July 2011



## Characterisation of Landscape with Forest Fragmentation Dynamics

PDF (Size: 1440KB) PP. 242-253 DOI: 10.4236/jgis.2011.33021

### Author(s)

T. V. Ramachandra, Uttam Kumar

### ABSTRACT

Land cover (LC) and land use (LU) dynamics induced by human and natural processes play a major role in global as well as regional patterns of landscapes influencing biodiversity, hydrology, ecology and climate. Changes in LC features resulting in forest fragmentations have posed direct threats to biodiversity, endangering the sustainability of ecological goods and services. Habitat fragmentation is of added concern as the residual spatial patterns mitigate or exacerbate edge effects. LU dynamics are obtained by classifying temporal remotely sensed satellite imagery of different spatial and spectral resolutions. This paper reviews five different image classification algorithms using spatio-temporal data of a temperate watershed in Himachal Pradesh, India. Gaussian Maximum Likelihood classifier was found to be apt for analysing spatial pattern at regional scale based on accuracy assessment through error matrix and ROC (receiver operating characteristic) curves. The LU information thus derived was then used to assess spatial changes from temporal data using principal component analysis and correspondence analysis based image differencing. The forest area dynamics was further studied by analysing the different types of fragmentation through forest fragmentation models. The computed forest fragmentation and landscape metrics show a decline of interior intact forests with a substantial increase in patch forest during 1972-2007.

### KEYWORDS

Land Cover, Algorithms, ROC Curve, Spatial Change, Correspondence Analysis, Forest Fragmentation

### Cite this paper

 T. Ramachandra and U. Kumar, "Characterisation of Landscape with Forest Fragmentation Dynamics," *Journal of Geographic Information System*, Vol. 3 No. 3, 2011, pp. 242-253. doi: 10.4236/jgis.2011.33021.

### References

- [1] R. O. Duda, P. E. Hart and D. G. Stork, "Pattern Classification," 2nd Edition, A Wiley-Interscience Publication, Hoboken, 2000.
- [2] M. K. Arora and S. Mathur, "Multi-Source Classification Using Artificial Neural Network in Rugged Terrain," *Geocarto International*, Vol. 16, No. 3, 2001, pp. 37-44. doi:10.1080/10106040108542202
- [3] R. M. Rao and M. K. Arora, "Overview of Image Processing," In: P. K. Varshney and M. K. Arora, Ed., *Advanced Image Processing Techniques for Remotely Sensed Hyperspectral Data*, Springer-Verlag, Berlin, 2004, pp. 51-85.
- [4] G. Simone, A. Farina, F. C. Morabito, S. B. Serpico and L. Bruzzone, "Image Fusion Techniques for Remote Sensing Applications," *Information Fusion*, Vol. 3, No. 1, 2002, pp. 3-15. doi:10.1016/S1566-2535(01)00056-2
- [5] J. D. Hurd, E. H. Wilson, S. G. Lammey and D. L. Civco, "Characterization of Forest Fragmentation and Urban Sprawl Using Time Sequential Landsat Imagery," *ASPRS 2001 Annual Convention*, St. Louis, 23-27 April 2001.
- [6] M. G. Turner, "Landscape Ecology: The Effect of Pattern on Process," *Annual Review of Ecology and Systematics*, Vol. 20, 1989, pp. 171-197. doi:10.1109/TGRS.2005.846874
- [7] Z. Wang, D. Ziou, C. Armenakis, D. Li and Q. Li, "A Comparative Analysis of Image Fusion Methods,"

[JGIS Subscription](#)
[Most popular papers in JGIS](#)
[About JGIS News](#)
[Frequently Asked Questions](#)
[Recommend to Peers](#)
[Recommend to Library](#)
[Contact Us](#)

Downloads:	128,265
------------	---------

Visits:	273,053
---------	---------

[Sponsors, Associates, and Links >>](#)

IEEE Transactions on Geoscience and Remote Sensing, Vol. 43, No. 6, 2005, pp. 1391-1402. doi:10.1109/TGRS.2005.846874

- [8] T. M. Lillesand and R. W. Kiefer, "Remote Sensing and Image Interpretation," 4th Edition, John Wiley and Sons, New York, 2002.
- [9] M. E. Hodgson, "Reducing the Computational Requirements of the Minimum-Distance Classifier," Remote Sensing of Environment, Vol. 25, No. 1, 1998, pp. 117-128. doi:10.1016/0034-4257(88)90045-4
- [10] M. W?lfel and H. K. Ekenel, "Feature Weighted Mahalanobis Distance: Improved Robustness for Gaussian Classifiers," 13th European Signal Processing Conference, September 2005, Turkey. <http://www.eurasip.org/Proceedings/Eusipco/Eusipco2005/defevent/papers/cr1853.pdf>.
- [11] C.-C. Hung and B.-C. Kuo, "Multispectral Image Classification Using Rough Set Theory and the Comparison with Parallelepiped Classifier," IEEE International Geoscience and Remote Sensing Symposium, 6-11 July 2008, Boston, pp. 2052-2055.
- [12] R. A. Schowengerdt, "Remote Sensing: Models and Methods for Image Processing," 2nd Edition, Academic Press, San Diego, 1997.
- [13] A. S. Mazer, M. Martin, M. Lee and J. E. Solomon, "Image Processing Software for Imaging Spectrometry Data Analysis," Remote Sensing of Environment, Vol. 24, No. 1, 1988, pp. 201-210. doi:10.1016/0034-4257(88)90012-0
- [14] D. R. Scott, "Effects of Binary Encoding on Pattern Recognition and Library Matching of Spectral Data, Chemometrics and Intelligent Laboratory Systems, Vol. 4, No. 1, 1998, pp. 47-63. doi:10.1016/0169-7439(88)80012-1
- [15] D. Lu, P. Mausel, E. Brondizio and E. Moran, "Change Detection Techniques," International Journal of Remote Sensing, Vol. 25, No. 12, 2004, pp. 2365-2407. doi:10.1080/0143116031000139863
- [16] T. Fung and E. LeDrew, "Application of Principal Component Analysis for Change Detection," Photogrammetric Engineering and Remote Sensing, Vol. 53, No. 12, 1987, pp. 1649-1658.
- [17] R. D. Macleod and R. G. Congalton, "A Quantitative Comparison of Change-Detection Algorithms for Monitoring Eelgrass from Remotely Sensed Data," Photogrammetric Engineering and Remote Sensing, Vol. 64, No. 3, 1998, pp. 207-216.
- [18] H. I. Cakir, K. Khorrarn, S. A. C. Nelson, "Correspondence Analysis for Detecting Land Cover Change," Remote Sensing of Environment, Vol. 102, No. 3-4, 2006, pp. 306-317. doi:10.1016/j.rse.2006.02.023
- [19] J. G. Lyon, D. Yuan, R. S. Lunetta and C. D. Elvidge, "A Change Detection Experiment Using Vegetation Indices," Photogrammetric Engineering and Remote Sensing, Vol. 64, No. 2, 1998, pp. 143-150.
- [20] J. R. Jensen, "Introductory Digital Image Processing: A Remote Sensing Perspective," Prentice-Hall, Upper Saddle River, 2004, pp. 467-494.
- [21] K. J. Riitters, R. O' Neill, J. D. Wickham, B. Jones and E. Smith, "Global-Scale Patterns of Forest Fragmentation," Conservation Ecology, Vol. 4, No. 2, 2000.
- [22] J. E. Vogelmann, "Assessment of Forest Fragmentation in Southern New England Using Remote Sensing and Geographic Information System Technology," Conservation Biology, Vol. 9, No. 2, pp. 439-449. doi:10.1046/j.1523-1739.1995.9020439.x
- [23] J. D. Wickham and K. B. Jones, K. H. Riitters, T. G. Wade and R. V. O' Neill, "Transition in Forest Fragmentation: Implications for Restoration Opportunities at Regional Scales," Landscape Ecology, Vol. 14, No. 2, 1999, pp. 137-145. doi:10.1023/A:1008026129712
- [24] A. K. Jain and R. C. Dubes, "Algorithms for Clustering Data," Prentice Hall, Englewood Cliffs, 1988.
- [25] PCI Geomatics Corporation, ISOCLUS-Isodata Clustering Program. <http://www.pcigeomatics.com/cgi-bin/pcihip/ISOCLUS>
- [26] J. A. Richards, "Remote Sensing Digital Image Analysis," Springer-Verlag, Berlin, 1986, pp. 206-225.
- [27] J. B. Campbell, "Introduction to Remote Sensing," Taylor and Francis, New York, 2002.
- [28] T. Fawcett, "An Introduction to ROC Analysis," Pattern Recognition Letters, Vol. 27, No. 8, 2006, pp.

- [29] A. P. Bradley, " The Use of the Area under the ROC Curve in the Evaluation of Machine Learning Algorithms," *Pattern Recognition*, Vol. 30, No. 7, 1997, pp. 1145-1159. doi:10.1016/S0031-3203(96)00142-2
- [30] J. Gao, H. F. Chen, Y. Zhang and Y. Zha, " Knowledge-Based Approaches to Accurate Mapping of Mangroves from Satellite Data," *Photogrammetric Engineering & Remote Sensing*, Vol. 70, No. 12, 2004, pp. 1241-1248.
- [31] D. B. Hester, H. I. Cakir, S. A. C. Nelson and S. Khorram, " Per-pixel Classification of High Spatial Resolution Satellite Imagery for Urban Land-cover Mapping," *Photogrammetric Engineering & Remote Sensing*, Vol. 74, No. 4, 2008, pp. 463-471.
- [32] M. Song, D. L. Civco and J. D. Hurd, " A Competitive Pixel-Object Approach for Land Cover Classification," *International Journal of Remote Sensing*, Vol. 26, No. 22, 2005, pp. 4981-4997. doi:10.1080/01431160500213912
- [33] K. McGarigal, S. A. Cushman, M. C. Neel and E. Ene, " FRAGSTATS: Spatial Pattern Analysis Program for Categorical Maps," 2002. <http://www.umass.edu/landeco/research/fragstats/fragstats.html>