International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 7 No. 1 Aug. 2014, pp. 5-10

http://www.ijisr.issr-journals.org/

MAPPING OF IRON MININGS OF NOAMUNDI AREAS, JHARKHAND BY USING THE IMAGE BASED NDII AND GEOSPATIAL TECHNOLOGY

Surajit Panda[1], Krishnendu Banerjee[1], Dr. Manish Kumar Jain[2], Dr. A.T Jeyaseelan[3], and Ratnesh Kr. Sharma[1]

[1]Jharkhand Space Applications Center,
Dept. of Information Technology, Govt. of Jharkhand,
Ranchi- 834004, Jharkhand, India

[2]Dept. of Environmental Science & Engineering,
Indian School of Mines (ISM),
Dhanbad-826004, Jharkhand, India

[3]Regional Remote Sensing Centre West,
NRSC, ISRO,
Jodhpur - 342003 Rajasthan, India

ABSTRACT: This paper present the mapping of active Iron ore mines of Noamundi areas of Jharkhand.It was observed that the spectral characteristic of iron ore lie in the NIR and SWIR region. The Iron ore absorbs the0.85-0.9µm, and shows strong reflectance at 0.7-0.75µm region of Electromagnetic Radiation (EMR).The study involves hyperspectral image data, preprocessing like Noises are fixing bad and outlier pixels, local de-striping, atmospheric correction etc. and mines map generation by using NDII (Normalized Difference Iron ore Index) from the image. Atmospheric correction was carried out by using FLAASH algorithms applied on Hyperion image using the Hyperion tools available from ENVI 4.7 [2]. The Iron ore mines are full of Iron ore or Fe dust material. So Iron ore has spectral signature due to own chemical component. In the case of Iron ores, the maximum reflectance Hematite shows near 0.7µm and maximum absorption shows near 0.85µm range of EMR [7]. By using this importance character of Iron ore, Iron ore mines are mapped with the help of NDI Index which shows a reasonable match with known mining locations.

KEYWORDS: Atmospheric Correction, FLAASH, NDII, EMR, EO-1Hyperionetc.

1 INTRODUCTION

Land and water are the two basic natural resources which are being exploited for various developmental activities. For example mineral resources play very important role to back up or support the economy of country. Now a day the Iron ore resource takes very important role to support the economy of under developing country like India. But sometimes mining activities are cross the lease areas know as Illegal mining. So the active mining areas mapping are very important. The field survey technique, which is the more costly and time consuming technique to mapping the mining areas. The recent advancement technology of remote sensing is provide a powerful tool to mapping the mineral distribution, different activities, different features and natural resources mapping on earth surface etc. Hyperspectral images can provide valuable information of mining areas of earth surface as a form of aerial mapping.

Noamundi of Jharkhand is an active Iron ore mining areas according to Geological survey of India (GSI 2006). So by using this geospatial technique we can show, this technique can provide the information and mapped the mining areas of earth surface.

2 Objectives

The main objectives of the present study is mapping and locating the iron mines of Noamundi areas, Jharkhand through a simple ratio technique of multispectral imagery.

3 About Study Areas

This Iron ore mining are situated at Noamundi of Jharkhand state in India. The geographical location of theses mining fall between 22°04'14”N to 22°10'41”N latitude, and 85°27'09E to 85°30'06E longitude which is shows in Fig 1. The deposit is now being mined by TATA Steel. As the mining progresses, the benches are exposed and samples location collected from these exposed mining areas and faces.

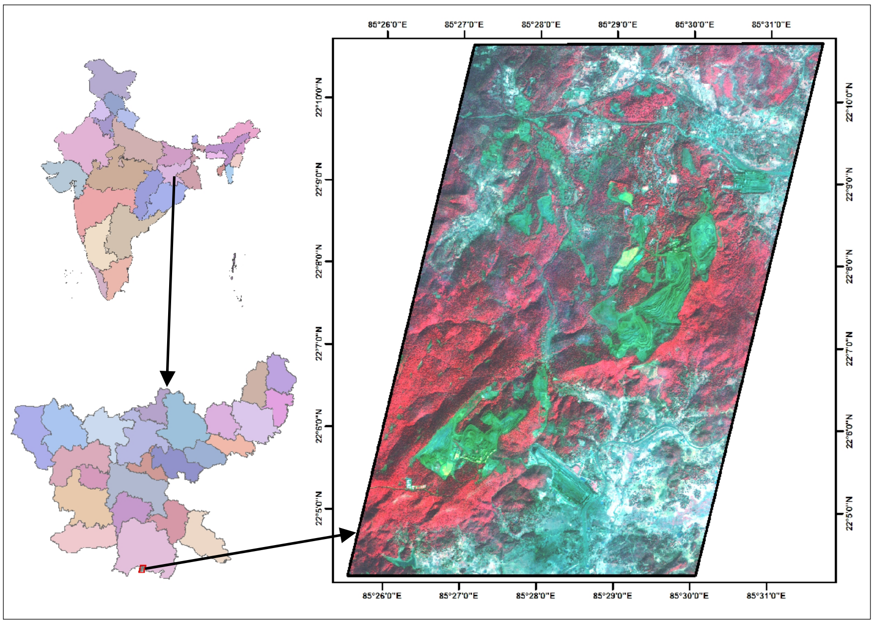

Fig. 1. Location map of the study area.

4 Data Used And Methodoligy

The EO-1Hyperion sensor data on 16th April 2011 has been used for this present study (Noamundi mining areas of Jharkhand state, India) which acquired from USGS glovis data center. The image has 242 unique spectral channels range of 400-2500 nm with 10 nm band width. But only 196 of 242 bands are calibrated. The bands 8 to 57 for visible-to-near-infrared (VNIR) and bands 77 to 224 in the shortwave-infrared (SWIR) regions are used. The details of data specification of Hyperion image are given bellow:

Table 1. Details of EO-1 Hyperiondata specification

Sensor	Hyperion
Type	Pushbroom grating spectrometer (VNIR-SWIR)
Path, Row	P-140, R-45
Date of acquisition	16/04/2011
Spectral range	400-2500 nm
Spectral coverage	Contiguous
Spectral resolution	10nm
Spatial resolution	30m
Radiometric resolution	16 bit
Temporal resolution	200 days
Number of bands	242 but Calibrated: 196 of 242
Swath width	70km
Sensor altitude	705km

Before using this imagery, some pre-processing operation needs to be done in this image to reduce the image Noise like fixing the bad and outlier pixels, local de-striping it is necessary to correct the atmospheric noise [4] etc. by using the Hyperion tools available from ENVI 4.7 [2].

The Hyperion image is acquired as level 1B data in scaled radiance units to fulfill the requirement of different indices and measurements. These values are to be digitally converted from raw radiance into apparent reflectance using Fast Line-of-sight Atmospheric Analysis of Spectral Hyper cubes (FLAASH) atmospheric correction model [3]. Hyperion raw data is corrected using FLAASH from ENVI includes atmospheric rectification, geometric correction of the image. The FLAASH algorithm along with the field data calibration can thus be used for conversion of Hyperion data from radiance to reflectance values [6].The used FLAASH parameter of the atmospheric correction is presented in bellow table 2.

Table 2. Details of FLAASH parameter using for atmospheric correction

Scene canter location	22 13 50.653 85 30 09.312	**Initial visibility**	40km
Sensor Altitude	705km	**Spectral Polishing**	Yes
Ground elevation	0.75	**Width of bands**	9
Pixel size9(m)	30	**Wave length calibration**	No
Flight date	April 16 2011	**Aerosol scale height(km)**	2
Flight ime(HH:MM:SS)	4:33:00	**Co_2 mixing ratio(ppm)**	390
Atmospheric Model	Tropical	**Use adjacency correction**	No
Water retrieval	No	**Modtran Resolution**	15 cm-1
Water absorption features	1	**Modtran multi scatter Model**	Scaled DISORT
Aerosol model	Rural	**No of Disort streams**	8
Aerosol Retrieval	2-Band(K-T)	**Output reflectance scale factor**	10000
Azimuth Angle	111.872439	**Title Size**	600

The overview methodology of the study is presented through a schematic diagram or flow chart shown in below Fig 2.

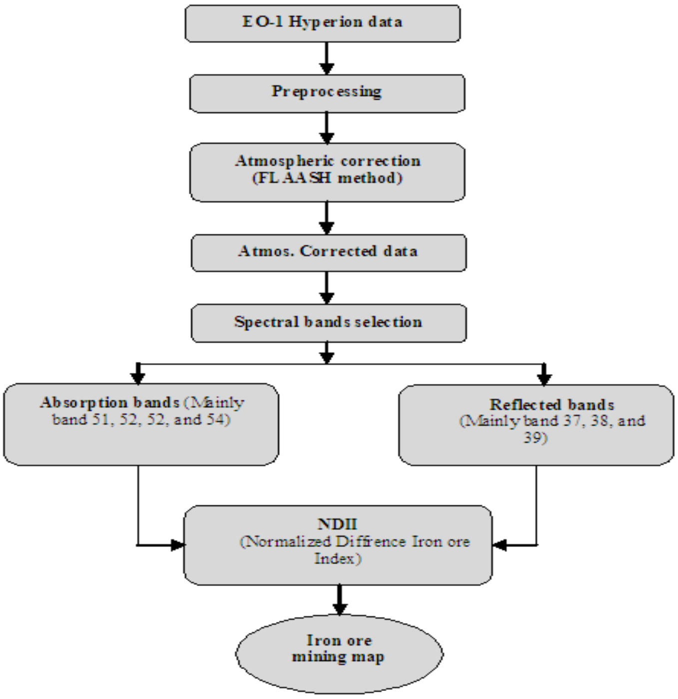

Fig. 2. Flow Diagram showing the methodology adopted in the study

5 RESULT AND DISCUSSION

In this present study, atmospheric correction was carried out and result is shown in Fig 2, the raw Hyperion image (Fig 3a) and the respective spectral plots for Iron ore of known mines [1]. From these spectral plots, it is observed that the reflectance of iron ore is obtained from the radiance image on the Hyperion image (Fig 3b). It is observed that very strong absorption of iron ore at 840-890nm and strong reflectance at 720-755nm region.

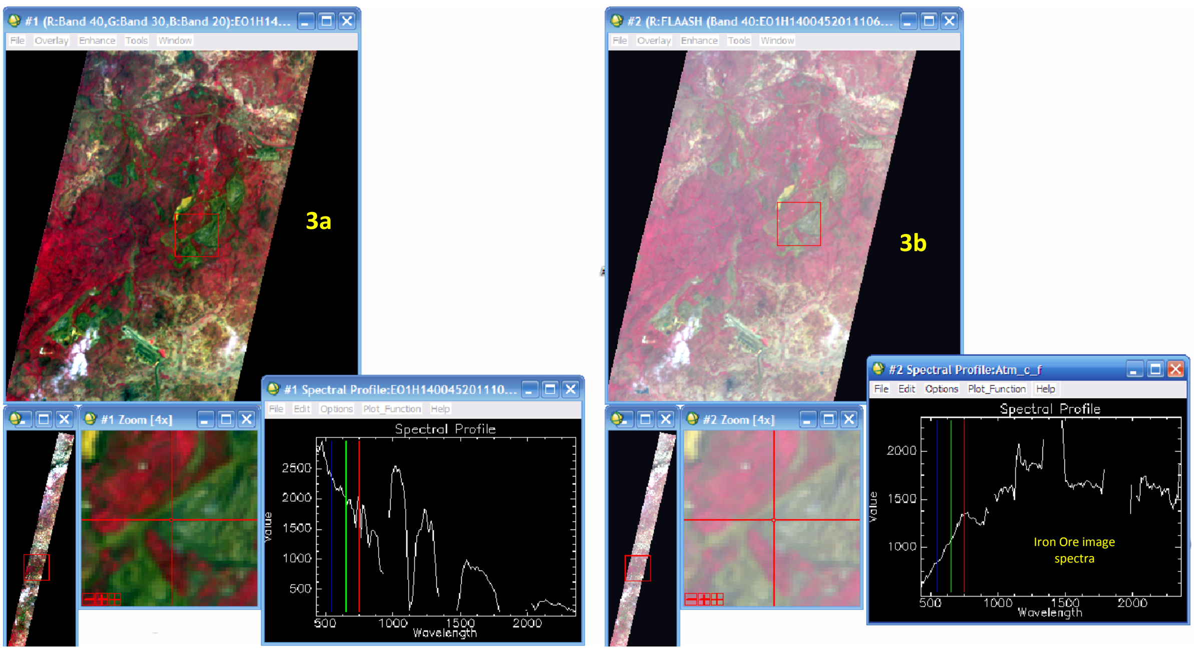

Fig. 3. Showing the spectral profile of Iron ore mining areas of before and after atmospheric correction. 3a: Before atmospheric Correction and 3b: after atmospheric Correction

The 840nm to 890nm region of EMR of atmospheric corrected image indicate the band no. 51, 52, and 53. On the other hand 720nm to 755nm region of EMR of atmospheric corrected image indicate the band no. 37, 38, 39 and 40. The group of high reflectance and group of strong absorption bands are average individually. After that NDI Index calculated using the eq. No 1. This index is the modified form of Normalized Diffrence Vegetation Index (Edward P.et.al 2008).The NDII algorithm subtracts the absorption bands from the reflectance bands and divides it by the sum of absorption and reflectance bands. The result of this NDII is varies between -1 to 1. The positive values near 0 indicate the Iron ore mine areas which are middle of this range. So the -1 is multiply with that index to sifting that range towards a side of range. Now the all positive values are converted into negative values and vice versa. Finally the negative values are indicate the Iron ore mining areas which is shows in Fig 4 with two test site (Red 1 and Yellow 2) in a certain zoom label to see better.

$$\text{NDII} = \left(\frac{((B37+B38+B39+B40)/4)-((B51+B52+B53)/3)}{((B37+B38+B39+B40)/4)+((B51+B52+B53)/3)}\right) (1)$$

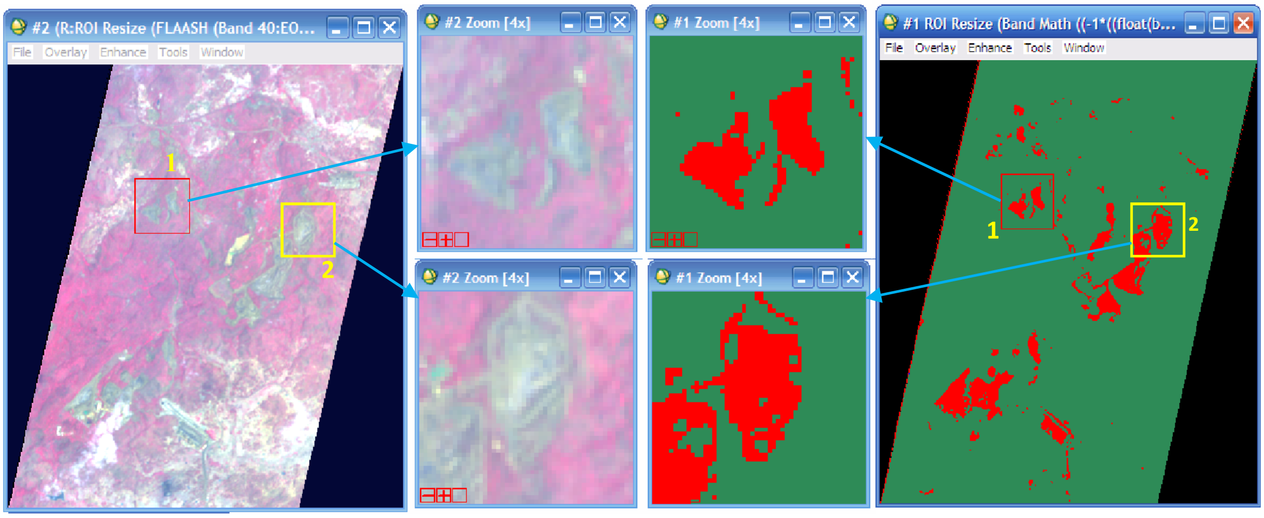

Fig. 4. Fig 4: Showing the final result of Iron ore mines of Noamundi areas. Hyperion Image (Left) and comparative mine areas (Right)

6 CONCLUSION

Integrated Remote sensing and GIS is a powerful tool to mapping the land surface feature and activities. In the present study it is possible to identify the Iron ore mining areas by visual interpretation and digital mapping. For digital mapping some noise and error corrections are required. It true's that the standard and advanced atmospheric correction method of FLAASH is very useful to normalizations the atmospheric noise of the satellite data. From this work reported it is clear that to using the band selection and band ratio technique the Iron ore mines of Noamundi areas it is possible to demarcate the mining distribution mapping. The Fig 4 (Right) shows the Iron ore mining's of Noamundi Iron ore belt. The red patches of the image (Fig 4 Right) represent the Iron ore mines and green are represent vegetation and other features. The result of Iron ore mines of noamundi is verified with the GSI located mines and field survey data of T. Magendran and S. Sanjeevi [8].

ACKNOWLEDGMENT

The authors are grateful to Dr. Jatisankar Bandyopadhyay, Lecturer, Department of Remote Sensing & GIS, Vidyasagar University, West Bengal, India, for giving valuable suggestions during this study. Our thanks are also due to colleagues of Jharkhand Space Applications Center, Ranchi of Jharkhand who have helped at various stages and provide their laboratory to process the satellite image of this study. As well as our thanks to USGS data center to free available the data of this areas.

REFERENCES

[1] Babu K. Raghu, 2012: Spectral analysis of IRS P6 LISS III image for gold associated minerals in Veligallu Schist Belt, Kadapa district, A.P, Int. Journal of Advances in Remote Sensing and GIS, Vol. 1, No. 1, 2012

[2] Brando, V.E., and Dekker, A. 2003. Site Report for Moreton Bay in the evaluation of Hyperion performance at Australian hyperspectral calibration and validation sites (NRA-99-OES-01). (D. Jupp), Canberra, ACT, Australia: CSIRO Earth Observation Centre.

[3] Cooley, T.; Anderson, G.P.; Felde, G.W.; Hoke, M.L.; Ratkowski, A.J.; Chetwynd, J.H.; Gardner, J.A.; Adler-Golden, S.M.; Matthew, M.W.; Berk, A.; Bernstein, L.S.; Acharya, P.K.; Miller, D.; Lewis, P.(2002). FLAASH, a MODTRAN4-based atmospheric correction algorithm, its application and validation Geoscience and Remote Sensing Symposium, IGARSS 02. 2002 vol.3 IEEE International, November 2002 pp 1414-1418.

[4] Dobhal Shashi, 2008 : Performance analysis of high-resolution and hyperspectral data fusion for classification and linear feature extraction, January, 2008, pp. 07-10.

[5] Edward P. Glenn, Alfredo R. Huete, Pamela L. Nagler and Stephen G. Nelson, 2008: Relationship Between Remotely-sensed Vegetation Indices, Canopy Attributes and Plant Physiological Processes: What Vegetation Indices Can and Cannot Tell Us about the Landscape, Sensors 2008, 8, 2136-2160.

[6] Kawishwar Prashant, 2007 : Atmospheric Correction Models for Retrievals of Calibrated Spectral Profiles from Hyperion EO-1 Data, January, 2007, pp. 17-19

[7] T. Magendran and S. Sanjeevi, 2011: Assessing the Grades of Iron Ores of Noamundi, India by Ground Based Hyperspectral Remote Sensing, International Journal of Earth Sciences and Engineering ISSN 0974-5904, Vol. 04, No 08 - Spl issue, December 2011, pp. 07-16

[8] T. Magendran and S. Sanjeevi, 2013: A Study on the Potential of Satellite Image-derived Hyperspectral Signatures to Assess the Grades of Iron ore Deposits, JOURNAL GEOLOGICAL SOCIETY OF INDIA Vol.82, September 2013, pp.227-235.