SNS COLLEGE OF TECHNOLOGY

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DEPARTMENT CIVIL ENGINEERING

19CEE303 – REMOTE SENSING and GIS

III YEAR / V SEMESTER

Unit 2 : Features of the Remote Sensing Satellites

Digital Image Processing
-Image Restoration

(iii) Atmospheric Corrections

Objectives

- Introduction
- Radiometric Errors
- Atmospheric correction
- Sun Illumination correction

Introduction

- Energy registered by sensor

Emitted Energy + Reflected Energy + Radiometric Error + Geometric Error

➢ Radiometric errors can be sensor driven or due to atmospheric attenuation

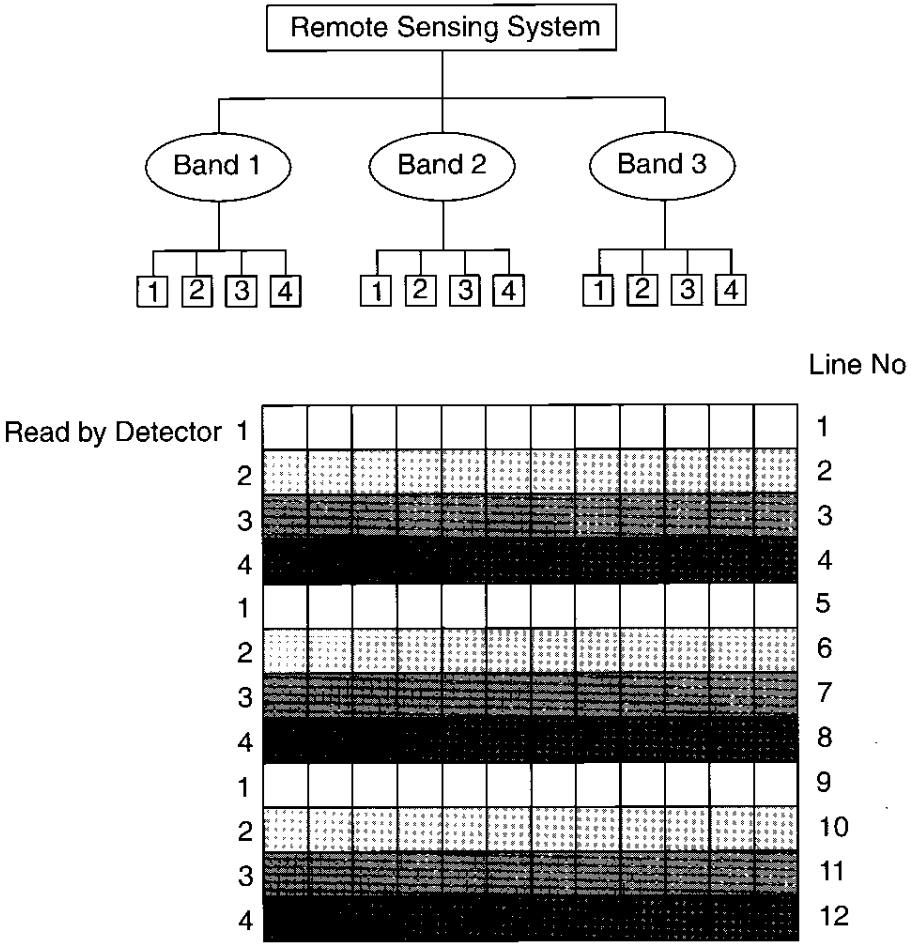
Radiometric Errors- Sensor driven

- Occurs due to improper functioning of the sensor system
  a. Line Banding
  b. Line Dropout

- Line Banding: Transverse scanning systems – Multiple detectors

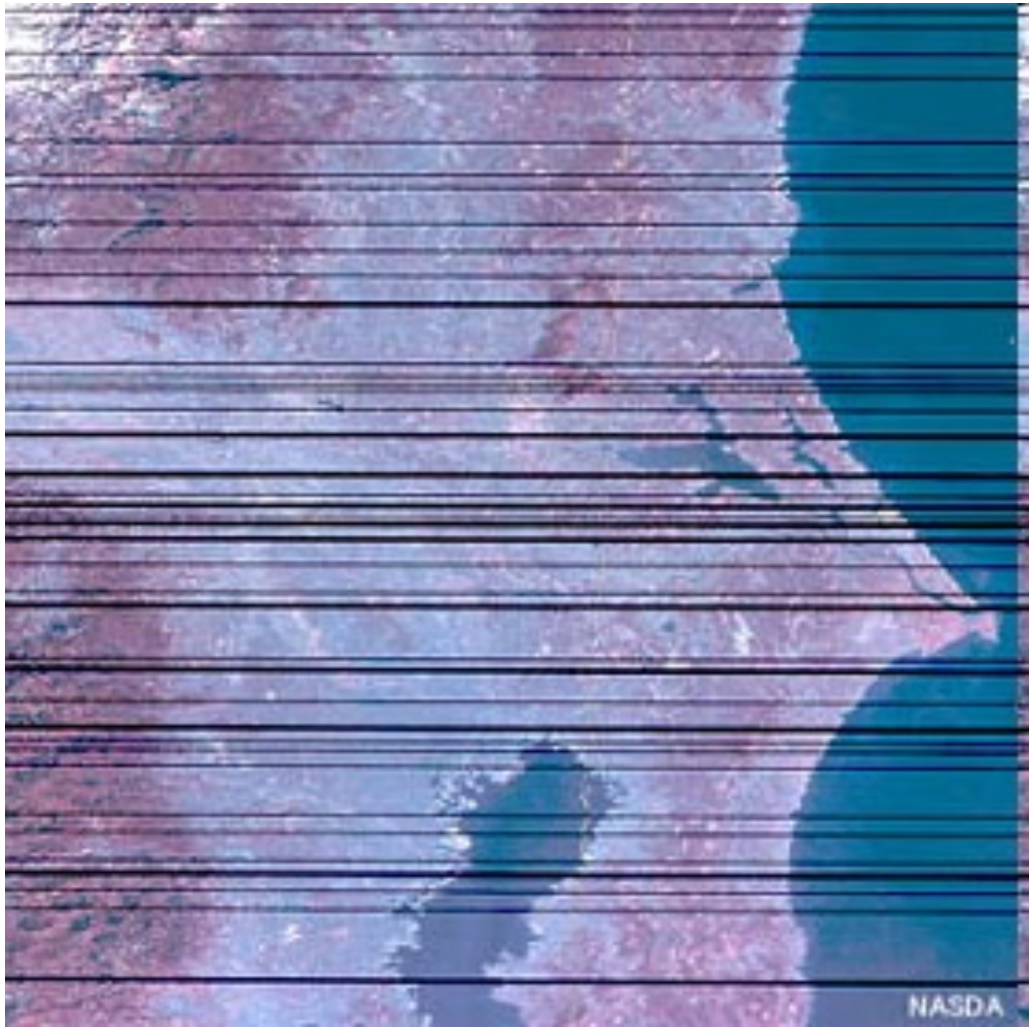
- Life of individual detectors

Radiometric Errors- Sensor driven

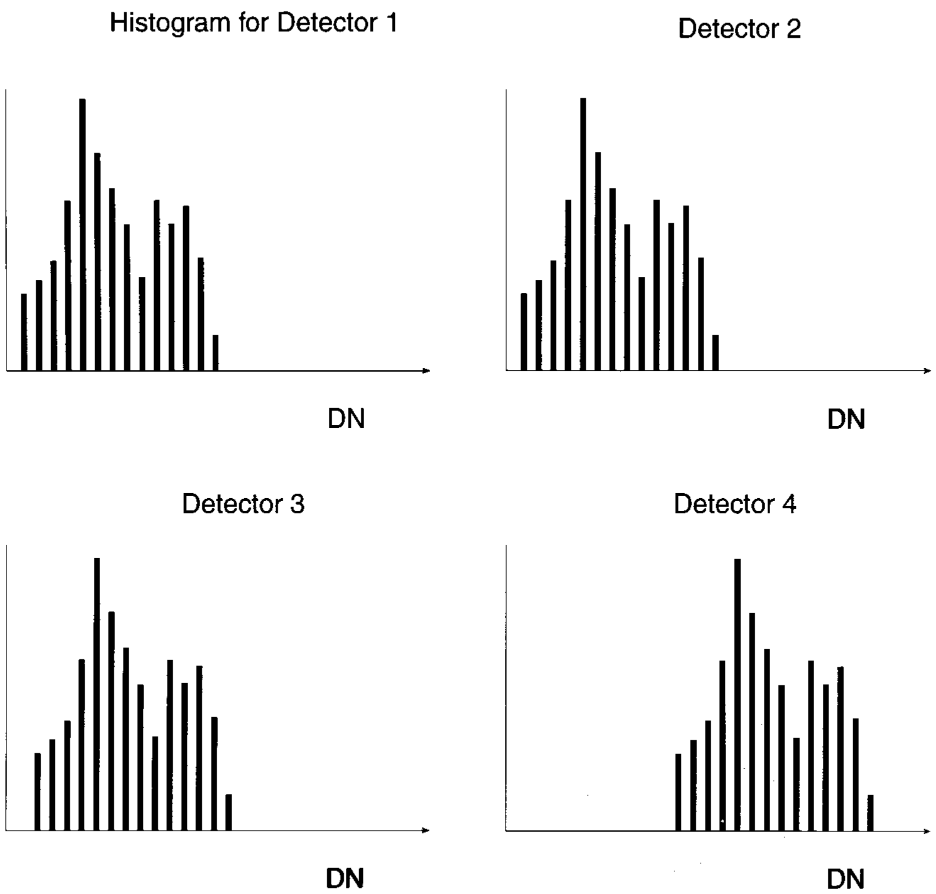


Sequence of lines read by detectors in in Transverse scanning system

Line Banding in Landsat-5 TM Image



Line Banding Correction

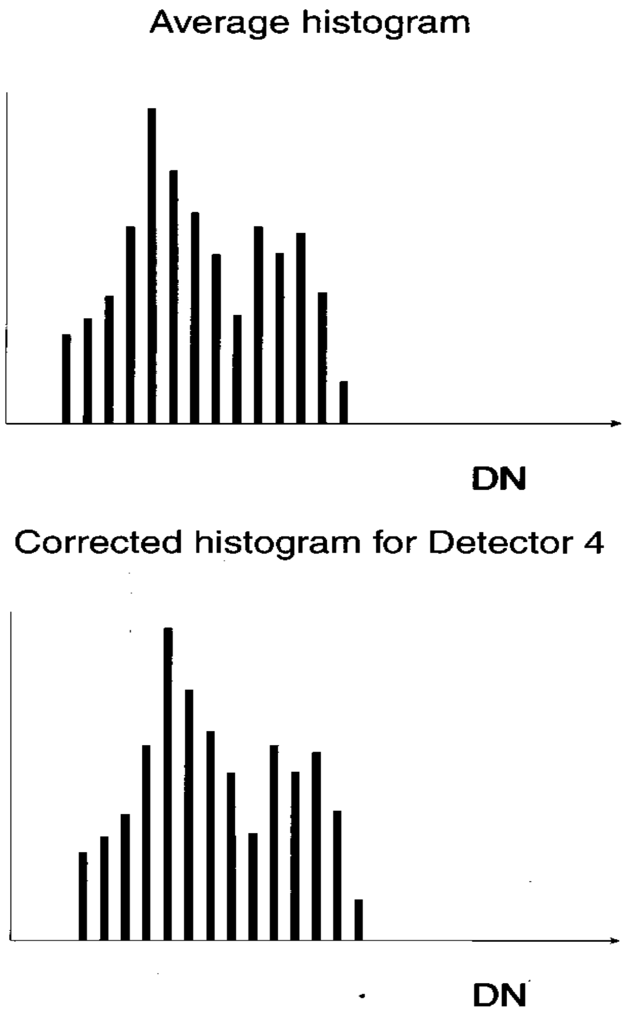


Histogram for each detector of Band 1 (say)

- A histogram for each detector in each band is produced.

- For a four detector system, histogram 1 is formed from data in lines 1, 5, 9 ... etc., histogram 2 from lines 2, 6, 10 ..., histogram 3 from lines 3,7, 11 ... and histogram 4 from lines 4, 8, 12 ...etc.
- Assuming each detector has sensed a representative sample of all the surface classes within the scene, each of the histograms will be similar (i.e. have the same mean and standard deviation) if the detectors are matched and calibrated

Line Banding Correction



- However, if one detector is no longer producing data readings consistent with the other detectors, its histogram will be different. Detector 4 in the figure is producing higher digital numbers than the other detectors.

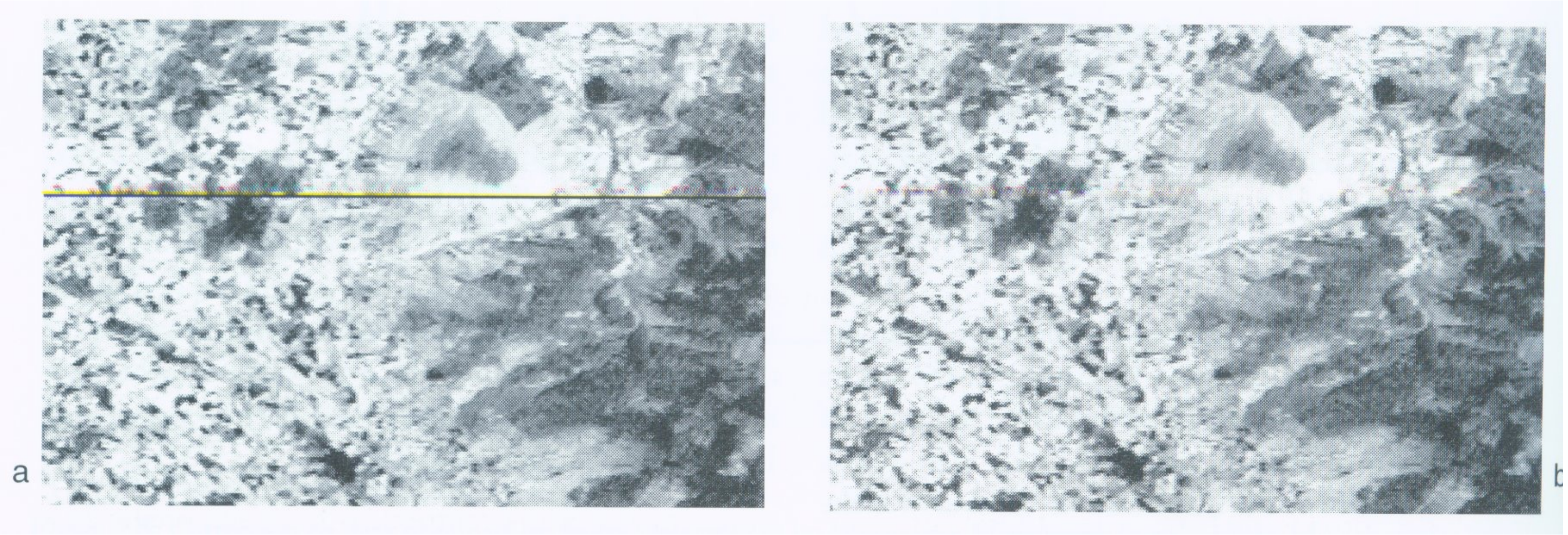
- An average histogram is produced by using the digital number from all the detectors (excepting the defective detector)

- The DNs produced by all the detectors are altered so that their histograms are then made to match the average one.

- When this procedure is completed, the imbalance between the detectors is eliminated and the image is said to have been de-striped.

Line Dropout Correction

- This error results in transverse scanning systems when out of the multiple detectors used, 1 or 2 fails to function properly.



Line Dropout Correction

Computed / Actual

TM1

74	74	74	73	75	81
73 / 74	73 / 74	74 / 74	73 / 74	74 / 74	78 / 80
73	73	75	74	74	75

TM2

32	32	31	32	33	36
31 / 32	32 / 32	32 / 33	32 / 33	32 / 32	34 / 35
30	32	33	33	32	32

TM3

28	29	29	29	31	37
26 / 25	28 / 27	28 / 29	29 / 29	29 / 29	33 / 37
25	28	28	29	28	29

TM4

122	105	88	90	87	82
123 / 132	107 / 113	98 / 94	103 / 100	98 / 93	90 / 88
125	109	108	116	109	98

TM5

77	74	72	67	75	83
71 / 71	70 / 67	72 / 67	72 / 72	75 / 77	77 / 81
66	66	72	78	75	71

TM7

22	23	24	23	28	38
21 / 19	21 / 21	23 / 22	23 / 23	25 / 26	31 / 33
20	20	22	23	23	25

- Comparison of actual and computed line dropout values.
- Taking the average of the line above and below shows little divergence from the actual vales for most bands

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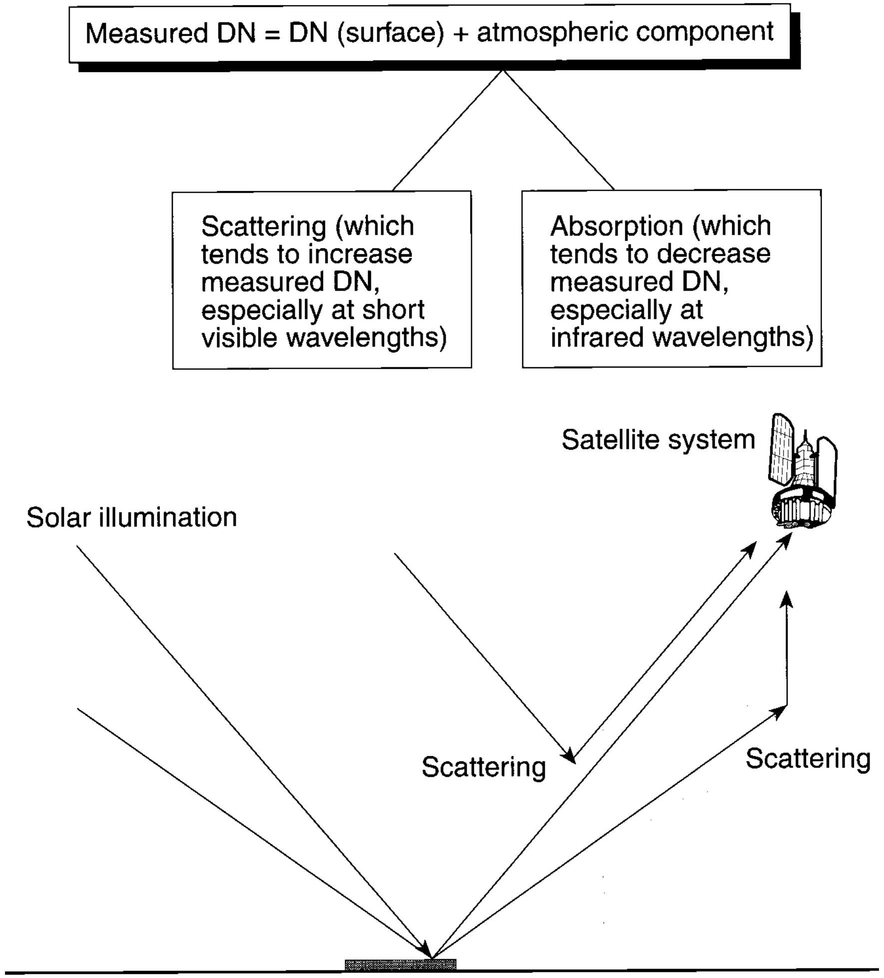
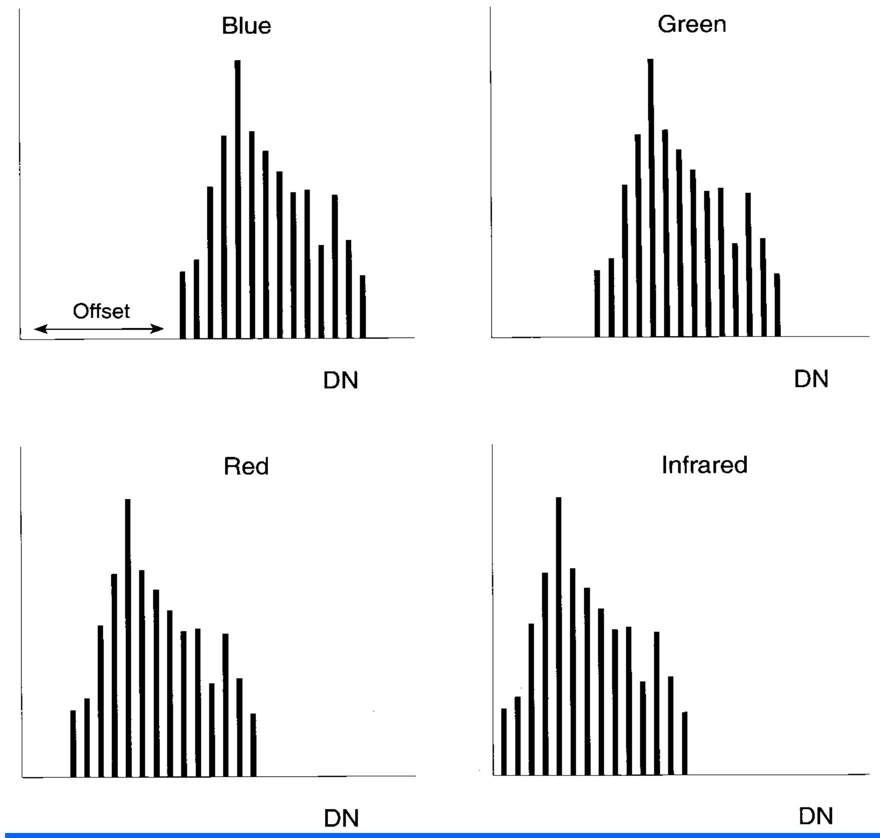
Radiometric Correction-Atmospheric Attenuation



- When a detector on a remote sensing system measures the radiance of a pixel and assigns it a DN, the DN is formed of two components.
  - ✓One is the actual radiance of the pixel which we wish to record, but added to it is an atmospheric component.
  - ✓The atmospheric component has a scattering effect which tends to increase the DN that is assigned to the pixel and also an absorption effect which may reduce the assigned DN.

Atmospheric Corrections



DN offsets in DN histograms resulting from atmospheric scattering.
Offsets tend to be greater for lower wavelengths bands.

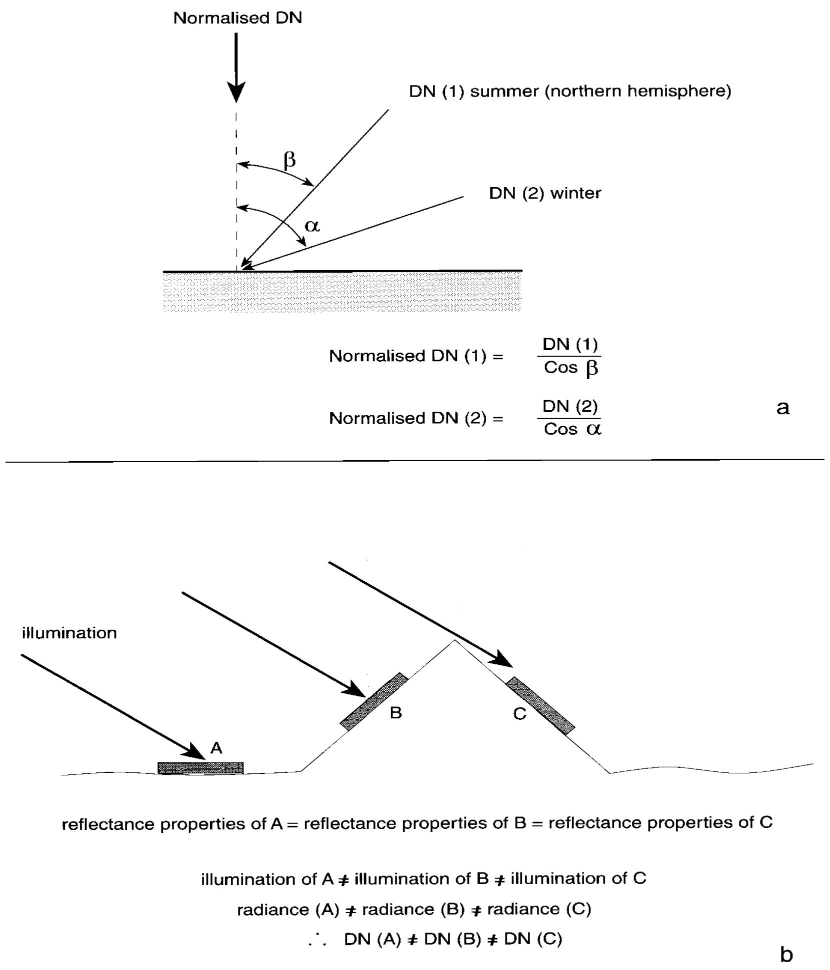
- The extent to which the atmosphere alters the true DN is best seen by an examination of the DN histograms for different bands.

- Many scenes contain very dark pixels (such as those in deep shadow) and it might be assumed that they should have a DN of zero. However, when the histograms for different bands are examined, some are seen to be offset from zero.

- Scattering is inversely proportional to wavelength. Thus shorter wavelength bands have a greater offset from the origin

- The degree of offset is dependent on the atmospheric conditions that change laterally a and temporally. It is therefore not possible to give absolute offsets which are applicable in all situations.

Solar Illumination Correction



- Images obtained at different times of the year are acquired under different illumination conditions

- Solar illumination angle, as measured from the horizontal, is greater in the summer than in the winter

- In change detection images, if two images of the same area, taken on different dates, are compared, they will not be similar even if there has been no change in the spectral characteristics of the elements within the scene because of the different illumination angles

Solar Illumination Correction

- In order to ascertain whether any changes have occurred in a region, it is necessary to remove the effects of the differing solar illumination. One method of doing this is to normalize the data by calculating for each pixel (based on the actual DN) the DN that a pixel would be expected to have at a particular illumination angle

Bibliography

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2. Lillesand T. M. & Kiefer R. W., 2000. *Remote Sensing and Image Interpretation, 4th ed.* Wiley & Sons.
3. John R. Jensen, 1996, Introductory Digital Image Processing, Prentice Hall

THANK YOU