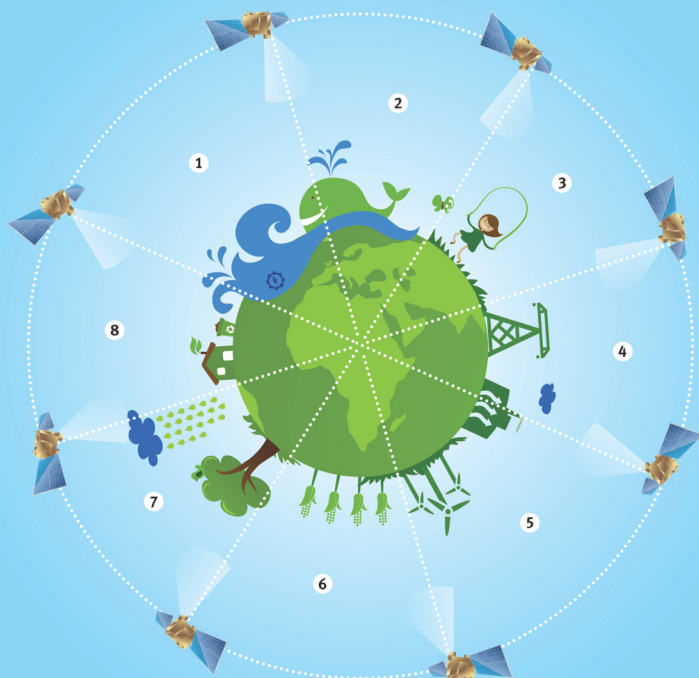


Remote Sensing

Principles and Applications



A.N. Patel
Surendra Singh

REMOTE SENSING

PRINCIPLES AND APPLICATIONS

2nd Revised Edition

**A.N. PATEL
and
SURENDRA SINGH**



Published by:

Scientific Publishers (India)
5 A, New Pali Road, P.O. Box 91
Jodhpur - 342 001 (India)

E-mail: info@scientificpub.com
Website: www.scientificpub.com

Dr. A.N. PATEL
INDORE - 452 008

Dr. SURENDRA SINGH
JODHPUR - 342 011

© Patel & Singh

Print: 2018

ISBN: 978-81-7233-590-8 (HB)
978-81-7233-591-5 (PB)
eISBN: 978-93-8786-900-4

Second Revised Edition, 1999

Laser typeset: Rajesh Ojha
Printed in India

PREFACE

It is an established fact that for proper application of remote sensing techniques in the identification and mapping of natural resources, wastelands, temporal environmental changes, sand dunes, present and palaeo drainage systems and desertification, the knowledge of the basic principles of remote sensing is of paramount importance. Accordingly, an attempt has been made in this book to discuss the basic principles and applications of remote sensing.

In all, there are fourteen chapters, first eight chapters deal with basic principles of remote sensing and remaining three chapters highlights applications of remote sensing. In the chapters one and two (Introduction and Signatures in Remote Sensing), necessity, importance, scope and basis of remote sensing techniques have been highlighted.

The third chapter (Electromagnetic Radiation) deals with radiant energy from the sun, the electro-magnetic spectrum, atmospheric effects of radiation, absorpition, transmission, reflection, atmospheric windows and black body radiation. The basis of signatures such as spectral, spatial, polarisation and temporal variations and methods for obtaining signatures based on laboratory, airborne and spaceborne sensors have been discussed in chapter four (Interaction of Electromagnetic Radiation with Matter).

Inchapterfive(SensorsUsedinRemoteSensing),spectral bands for sensors, classification of sensors and types of sensors needed for different spectral bands ranging from ultraviolet to visible, infrared, thermal infrared and microwave regions have been highlighted.

The types of platforms such as balloons, aircrafts, rockets and satellites for the sensors to record the images of terrain features have been dealt with in chapter six (Remote Sensing Platforms).

In chapter seven (Data Product), the type of remotely sensed data in the form of photographs, paper prints, satellite imagery, Computer Compatible Tapes (CCT's) 'multi' concept in acquiring remote sensing data, advantages of Landsat imagery and conversion of data into information have been highlighted.

The chapter eight (Analysis and Interpretation Techniques)

deals with the image processing and enhancement of remotely sensed data for visual and digital analysis.

In chapter nine (Application of Remote Sensing in the Appraisal and Management of Natural Resources), the physical potentials and limitations of the natural resources such as landforms, soils, vegetation, landuse and water resources for regional planning have been discussed.

The chapter ten (Role of Remote Sensing in the Detection of Temporal Changes) highlights the temporal changes in saline areas, morphology of landforms, drainage systems, water bodies, grazing lands and forest cover. The types, extent and distribution of wastelands in India and Jodhpur district of Rajasthan and their management have been discussed in chapter eleven (Application of Remote Sensing in Wastelands Mapping).

In chapter twelve (Distribution and Management of Sand Dunes Using Remote Sensing Techniques), distribution and morphology of sand dunes, digital Landsat spectral characteristics of sand dunes, management and stabilisation of sand dunes have been discussed.

The chapter thirteen (Impact of Present and Palaeo Drainage Systems on Geoenvironment using Remote Sensing Techniques) highlights the positive and negative impact of present and palaeo drainage systems on Geoenvironment.

In chapter fourteen (Remote Sensing in Monitoring and Combating Desertification), the status of desertification, digital analysis of Landsat data for assessment of land vulnerability to desertification and measures for combating desertification have been highlighted.

It is hoped that this book will help the academicians, scientists, students, planners and policy makers in understanding the basic principles and applications of remote sensing for rational regional development planning.

The authors wish to express their sincere thanks to Prof. Alam Singh for providing an opportunity to write this book. The sincere thanks are due to the Director and Head, Division of Resource Survey and Monitoring, Central Arid Zone Research Institute, Jodhpur for granting permission to the second author to write the book. The help rendered by the colleagues in writing, typing, tabulation, drawing and photography is thankfully acknowledged.

A.N. PATEL
SURENDRA SINGH

CONTENTS

Preface

iii

1.	INTRODUCTION	1
	Introduction to Remote Sensing	1
	Necessity and Importance	2
	Applications and Scope	3
2.	SIGNATURES IN REMOTE SENSING	5
	Basis of Remote Sensing Techniques	5
3.	ELECTROMAGNETIC RADIATION	7
	Introduction	7
	Radiant Energy from the Sun	8
	The Electromagnetic Spectrum	9
	Atmospheric Effects on Radiation	11
	Absorption, Transmission and Reflection	12
	Atmospheric Windows	14
	Black Body Radiation	15
	Specular and Diffuse Surfaces	17
4.	INTERACTION OF ELECTROMAGNETIC RADIATION WITH MATTER	21
	Introduction	21
	Basis for Signature	22
	Methods of Obtaining Signatures	24
5.	SENSORS USED IN REMOTE SENSING	27
	Introduction	27
	Spectral Bands for Sensors	27
	Resolving Power	28

	Classification of Sensors	28
	Sensors for Ultra-violet Region	29
	Sensors for Visible Region	30
	Sensors for Infra-red Region	32
	Sensors for Microwave Region	33
	Multispectral Scanners (MSS)	34
	Photometer, Radiometer, Spectrometer etc.	34
	Return Beam Vidicon (RBV) Camera	35
	Thematic Mapper (TM)	36
6.	REMOTE SENSING PLATFORMS	37
	Introduction	37
	Air Borne Platforms	37
	Rockets	39
	Satellites	39
7.	DATA PRODUCTS	40
	Introduction	40
	Aerial Photographs	40
	Orthophotography	46
	Aerial Photogrammetry	47
	Digital Image	51
	Multi Concept in Acquiring Remote Sensing Data	52
	Advantages and Limitations of Landsat Imagery	54
	Reference Data or Ground Truth	55
	Conversion of Data into Information	56
8.	ANALYSIS AND INTERPRETATION TECHNIQUES	57
	Introduction	57
	Visual Interpretation	57
	Image Processing	68
9.	APPLICATION OF REMOTE SENSING IN THE APPRAISAL AND MANAGEMENT OF NATURAL RESOURCES	75
	Introduction	75

	Digital Analysis of Landsat Data for Classification of Landforms	80
	Digital Analysis of Soils Classification	88
	Forest and Vegetation	92
	Digital Analysis of Landsat Data for Forest and Vegetation Classification and Range Biomass Estimation	98
	Land Use	100
	Digital Analysis of Landsat Data for Land Use Classification	107
	Water Resources	107
	Digital Analysis of Landsat Data for Water Resources Evaluation	117
	Integration, Assessment and Management of Natural Resources	118
	Suggested Landuse Planning	129
10.	ROLE OF REMOTE SENSING IN THE DETECTION OF TEMPORAL CHANGES	132
	Introduction	132
	Changes in Saline Areas	132
	Changes in the Morphology of Landforms	134
	Changes in Drainage Systems	135
	Changes in Water Bodies	136
	Changes in Land Use	138
	Changes in Grazing Lands and Forest Cover	139
11.	APPLICATION OF REMOTE SENSING IN WASTELANDS MAPPING	142
	Introduction	142
	Type, Extent and Distribution of Wastelands in India	142
	Type, Extent and Distribution of Wastelands in Jodhpur District	145
	Development of Wastelands	153
12.	DISTRIBUTION AND MANAGEMENT OF SAND DUNES USING REMOTE SENSING TECHNIQUES	156
	Introduction	156
	Distribution and Morphology of Sand Dunes	156

	Digital Landsat Spectral Characteristics of Sand Dunes	162
	Management and Stabilisation of land Dunes	163
13.	IMPACT OF PRESENT AND PALAEO DRAINAGE SYSTEMS ON GEOENVIRONMENT USING REMOTE SENSING TECHNIQUES	167
	Introduction	167
	Positive Impact of Present and Palaeo Drainage Systems on Geoenvironment	168
	Negative Impact of Present and Palaeo Drainage Systems on Geoenvironment	173
14.	REMOTE SENSING IN MONITORING AND COMBATING DESERTIFICATION	176
	Introduction	176
	Status of Desertification	176
	Digital Analysis of Landsat Data for Assessment of Land Vulnerability to Desertification	182
	Measures for Combating Desertification	182
	REFERENCES	185