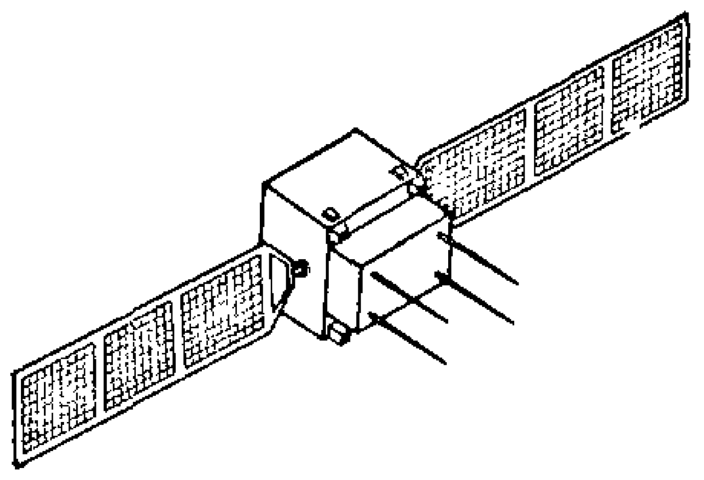

Special Issue on:
Remote Sensing for National Development

BOOK REVIEW

Remote Sensing of Biosphere Functioning

Edited by R. J. HOBBS and H. A. MOONEY, Springer-Verlag, New York, 1990 (Ecological Studies: Vol. 79) Pages 312; Price: Rs. 2423.50.

While enormous concern is expressed about the changes occurring on earth's surface and atmosphere, and the virtues of using Remote Sensing data for monitoring the global changes are stressed, many technical and conceptual issues remain to be resolved. It is more pertinent in the case of biosphere, wherein the effects of global change cover all spatial scales. The book under review, which is a compilation of various technical papers, addresses different aspects of metabolic processes, factors driving the changes in the global metabolism, as well as the remote sensing of changes in the biosphere structure. The book is organised with the initial chapters centering on the use of remote sensing to estimate the rates at the metabolic level and the later chapters dealing with the structural changes detection.

The global phenomena like green house effect, El Nino and acid rain jostle for attention alongwith the local problems of deforestation, soil erosion, etc. which in aggregate have global consequences/ramifications. The chapter on terrestrial ecosystem structure stresses that global understanding of ecosystem problems is required to act rationally at local levels, which is not possible without the use of remote sensing. An ability to forecast the interaction of climatic change with biosphere functioning in general and terrestrial vegetation in particular, using remote sensing data and realistic models, is an immediate and major objective of the field ecologists.

The chapter on surface soil moisture and temperature measurements dwells on the data remote sensing could provide through thermal IR and microwave sensors for estimating surface parameters (soil/vegetation system such as vegetation indices and surface soil features) and components of radiation forcing (solar insolation, surface albedo and the effect on surface temperature).

Different biomes have different canopy structures and reflectance properties and so can produce different Normalised Difference Vegetation Index (NDVI) while having identical Leaf Area Index(LAI). Also, NDVI at the most represents ecophysiological processes in only a simple empirical way. Prior knowledge of the biome type is essential for using an appropriate relationship between the biophysical variables for estimating terrestrial primary productivity using remote sensing. Satellite estimation of LAI by correlating spectral reflectances with direct measurement and integrating LAI into suitable ecosystem models to estimate the Net Primary Productivity has been suggested. The major hurdle seems to be development of the ecosystem model itself.

Litter and soil organic matter decomposition is the complementary process to primary production, which could play a role in the long term ecosystem function through the regulation of nutrient availability. It is brought out that while remote sensing of important chemical features is feasible, predicting the rates of ecosystem processes is less certain, as the dynamics is not well known to the field scientists themselves. However, for organic matter decay, a generalised predictive ability is possible considering the tight coupling of canopy chemistry and nitrogen mineralisation. On the remote sensing of water and energy exchange,which is fundamental to biosphere functioning as well as to land climate processes and regional hydrology, approaches for combining appropriate modelling with observations are discussed.

Mass and energy exchanges within an ecosystem ultimately define the efficiency of photosynthetic processes and system productivity, primarily determined by plant canopy. The capability of remote sensing techniques to detect changes in the canopy biochemistry, discussed in the book, provides a means of assessing the spatial content and variation of carbon/nutrient sources and sinks crucial to understanding the gas exchange between vegetation and atmosphere. Fluxes of trace gases like methane, carbon monoxide, nitrous oxide, etc. are spatially and temporally variable and arise from well defined biological processes within the terrestrial ecosystem. While remote sensing cannot be directly used for measuring the trace gases, remote classification of ecosystems and measurements of the flux on the ground for each classified type and estimation of the driving variables for models of trace gas flux could be the approach.

The chapter on spatial and temporal dynamics of vegetation examines the role of remote sensing in the study of vegetation dynamics. The short term phenological and inter- annual changes on the plant growth and reproductive patterns have to be taken into account before addressing the long term changes like vegetation cover, soil moisture, biome extent, productivity, nutrient cycling, etc.

Remote sensing could provide useful surrogate information on both landscape properties and processes. Deriving these surrogates may call for spatial and temporal data availability rather than the single scene approach practised commonly. The chapter on landscape processes describes the models of change which are equilibrium based and addresses the relationship between land forms and fluctuating climatic conditions that control their properties.

Remote sensing of marine photosynthesis is another chapter wherein the importance of remote sensing in resolving the spatial and temporal variation of ocean dynamics is highlighted. Simple models that link parameters observed by remote sensing (mostly surface pigment concentration) to *in situ* photosynthetic rates and finally, the link between photosynthesis, other flux estimates and climate change are discussed.

The effect of climatic changes on the global metabolism and the biosphere structure cannot be modelled simultaneously because of time scale differences. However, both are needed as structural changes will feedback into metabolic process. A clear shift in domain from the plant protection to population and community dynamics is seen as one attempts to interlink the two levels. Modelling of metabolic responses assumes that climatic conditions do not affect the vegetation boundaries, whereas the structural models assume that there will be boundary shift. When dealing with the Global Circulation Modes (GCM) on vegetation, the limitations of the estimates of global metabolism are highlighted and the role remote sensing could play in realistically estimating the same and in aiding the prediction of future changes is pointed out.

The authors feel that in developing remote sensing techniques to evaluate biosphere function, extensive experimental techniques have not been used. Long term consistent data collection using compatible successive generation of sensors matched with continued ground truthing should enable monitoring biosphere changes. Although new technologies, more sophisticated, may be available in the future, authors point out, the main problems not really lie with data acquisition but in the ability of data analysis and interpretation.

The book, thus, covers various aspects of biosphere functioning and the role remote sensing could play in measuring the parameters of importance to biosphere. However, it would have been better if the various interlinkages between different processes involved in biosphere functioning were covered in detail, probably in an overview chapter, before dwelling on each of the processes in subsequent chapters. It would have helped in maintaining a continuity and coherence between the chapters, which, at present, seems to be lacking. This book is a must, both for serious practitioners of remote sensing as well as the students of remote sensing, as it scans a wide spectrum of topics concerning biosphere.

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