REMOTE SENSING SYSTEMS

Frans J.M. van der Wel
KNMI, Royal Netherlands Meteorological Institute, the Netherlands

Keywords: electromagnetic energy and spectrum, sensors, satellites, remote sensing systems, pixels, spatial resolution, temporal resolution

Contents

Summary

This chapter describes the meaning of remote sensing techniques as part of “Life Support Systems” by touching upon a number of applications that illustrate their contribution to the well-being of our planet. In addition to paying attention to the technical background of remote sensing systems, a number of satellite missions is briefly introduced, ranging from the well-known Landsat, NOAA and SPOT series to the new generation of satellites to be launched in the framework of NASA's Earth Observing System (EOS).

Remote sensing technology used to be bound up with military applications – and of course, it still is. Reconnaissance and monitoring are, however, also useful in civil fields of interest such as mapping natural resources and environmental risks, and atmospheric sciences, meteorology and climate studies. Using air- and space-borne instruments to contribute to the fosterage of our planet is becoming common practice nowadays.

Remote sensing data are widely distributed through infrastructures based on the Internet where the only impediment seems to come from heterogeneous data policies. In this way people all over the world benefit from huge amounts of data that help them to better understand their surroundings, hopefully resulting in an everlasting brotherhood between mankind and planet Earth.

1. Introduction

Where does the history of remote sensing start? This will probably depend on the definition of remote sensing, but an important starting point could be October 4, 1957. On this day, the then Soviet Union succeeded in launching the first man-made satellite,

Sputnik. A few months later, the USA followed with Explorer and from here on competitive efforts would further shift the boundaries of our knowledge. Systematic earth observation began with the American Tiros-1 weather satellite in 1960, quickly followed by generations of photo-reconnaissance satellites in the 1960s. As with more technological advancements, the achievements in the field of satellite technology would eventually come within the reach of civil applications.

An alternative starting point could be as far back as 1858 when Gaspard-Félix Tournachon ("Nadar") shot the first aerial photograph. This certainly ushered in a new era of data acquisition for topographic mapping. A milestone within the context of "life support systems", however, is without doubt the launch of ERTS-1 by NASA at July 23, 1972. This Earth Resources Technology Satellite (ERTS) was the first of a series of LANDSAT satellites that aimed at the systematic observation of the Earth's surface in order to retrieve information on geology, hydrology, geography and cartography. Nowadays Landsat-7 continues this task together with a number of other satellites. The observation from air and space has become an essential source of information for the sustainable development of our environment.

This chapter describes the meaning of remote sensing techniques as part of "Life Support Systems" by touching upon a number of applications that illustrate their contribution to the well-being of our planet. But first, attention is paid to the technical background of remote sensing systems, thereby discussing some of the major satellite systems in greater detail.

-
-
-

Bibliography

Abkar, A.A. (1999): *Likelihood-based segmentation and classification of remotely sensed images. A Bayesian optimization approach for combining rs and gis*. PhD thesis. University of Twente, Enschede / itc, Enschede. 132 pp. [PhD thesis emphasizing statistics to deal with uncertainty in classifications based on remotely sensed data]

Curran, P.J. (1985): *Principles of remote sensing*. Longman, London. 282 pp. [although a bit old, this book is still of use because of its clear drawings explaining the basics of remote sensing]

Fussell, J., D. Rundquist & J.A. Harrington Jr. (1986): On defining remote sensing. *Photogrammetric Engineering & Remote Sensing*, vol. 52, no. 9. pp. 1507 - 1511. [paper dealing with the fundamental question "what is remote sensing?"-- a question that needs an extended answer]

Gonzalez, R.C. & R.E. Woods (1992): *Digital image processing*. Addison-Wesley, Reading. 716 pp. [Excellent and comprehensive textbook introducing digital image processing techniques: not restricted to

earth observation data. An extended discussion on remote sensing techniques can be found here, providing an introduction to the concepts and methodologies to process the image data that are acquired by remote sensing techniques.

Lillesand, T.M. & R.W. Kiefer (1994): *Remote sensing and image interpretation*. (third edition) Wiley & Sons, New York. [good and comprehensive introductory textbook on the general topic of remote sensing and image processing]

Mather, P.M. (1987): *Computer processing of remotely sensed images. An introduction*. Wiley & Sons, Chichester. 352 pp. [complete treatment of processing methods such as classification approaches]

Rees, W.G. (1990): Physical principles of remote sensing. *Topics in remote sensing 1*. Cambridge University Press, Cambridge. 247 pp. [a more exact approach to remote sensing: could be considered complementary to general textbooks]

Richards, J.A. (1999): *Remote sensing digital image analysis. An introduction*. (Third revised and enlarged edition) Springer Verlag, Heidelberg. [excellent introductory textbook on the subject: well-suited for educational use]

Strain, P. & F. Engle (1992): *Looking at earth*. Turner Publishing Inc., Atlanta. 304 pp. [nice collection of satellite images providing a visual snapshot of the potential of remote sensing technology]

Biographical Sketch

Frans van der Wel (Utrecht, 1965) was educated in Physical Geography at Utrecht University. During his studies he focused on ways to process and present spatial data and their metadata: Hence his interest in cartography, image processing and geographical information systems (GIS). In 1990 he graduated as a cartographer and started his research activities at the Cartography Section of Utrecht University. In this period, integration of remotely sensed data with GIS data gained much attention within the scientific community. The role of GIS ("mapping") data related to the reduction of uncertainties in remote sensing land cover classifications was the subject of his PhD study. In addition to the assessment and reduction of uncertainty, progress was made in the field of cartographic visualization of spatial metadata, resulting in the thesis *Assessment and Visualization of Uncertainty in Remote Sensing Land Cover Classifications* (2000). Currently, Dr van der Wel is working at the Royal Netherlands Meteorological Institute (KNMI) where he is responsible for the use of GIS in climatological and meteorological applications. Moreover, he is involved in data infrastructure issues, concentrating on the accessibility of data through the Internet via web applications.