New Frontiers: Remote Sensing in Social Science Research

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An expedition is planned for highly detailed remote sensing of the physical and environmental aspects of planet Earth. However, the possibilities of such remote sensing for social and political research have been largely overlooked by sociologists. Remote sensing is a potentially revolutionary instrument with significant methodological and theoretical implications. Changes in the Earth’s environment and surface features will be monitored continuously in an objective way. Some of these changes could be used by social scientists as indicators of social and political changes.

Introduction

An international effort to monitor Earth from space has begun. Placement in orbit of several satellites by the National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA) are precursors to the launch of the Earth Observation System (EOS) planned for the turn of the millennium. EOS is designed to generate highly detailed maps of Earth’s surface to an extent hitherto not possible. Although its primary mission is to map the physical, geological, and environmental surface of Earth, it holds exceptional promise for social science research as well. EOS does not concern social science methodology or theory per se, but it does provide us with a new instrument, potentially a very significant instrument, for social scientific study. EOS is all the more important for social scientists in an age where borders are becoming less salient. We briefly describe here the technical aspects of present and forthcoming remote sensing technology relevant to social scientists, the possibilities that infor-
Information gathered from space provide the social researcher, and, finally, the kinds of issues and theories that can be studied with EOS.

EOS is an intricate form of "remote sensing." Remote sensing is the art and science of data collection and analysis without coming in direct contact with the object being studied. Many things we do in our day to day lives can be regarded as remote sensing. The use of television or radio as a means for gathering information is remote sensing. More commonly remote sensing is associated with the collection of spatial information about objects using airborne and orbiting systems. These systems collect data on levels of the energy emitted or reflected by an object. Each system can obtain data within a specific portion of the electromagnetic spectrum (often referred to as a bandwidth). For instance, most aerial photographs are traditionally in the portion of the electromagnetic spectrum that can be seen by the human eye. Thermal infrared systems are a representation of surface temperatures. Radar images are obtained by actively illuminating a surface with energy of a centimeter to one meter long wavelength, and then measuring the energy reflected back to the antenna. Radar systems respond primarily to surface roughness, slope and dielectric constant—which is advantageous to earth scientists. However, another advantage of radar is its ability to see through cloud cover. Hence, the use of radar imaging techniques can provide views of areas that are cloud covered year-long, many of which are also hard to access and for which census tract data are non-existent or unreliable—such as rain forest areas in Brazil. Village encroachment can be tracked in these regions by radar and phenomena that are indicative of population activity, such as clear-cutting, can be mapped by radar. Extinct civilizations can be detected by the use of radar in regions where thin layers of sand have hidden the evidence of the civilization—such as dwellings or transport routes. (Radar was used, for example, in the STS-59 space shuttle mission to discover buried archeological sites and previously in the SIR-A mission to study buried channels [McCauley et al., 1982].) Generally, it is possible to filter portions of the electromagnetic spectrum and to design instruments to measure specific portions of the spectrum (such as infrared, near-infrared, gamma ray, and so on).

The advent of satellite and orbiting systems has raised the science of remote sensing to a higher level. Data can now be obtained on a global scale at relatively high spectral resolutions. Commercial data available to the public have resolutions of 20 meters or less depending on the system and the spectral ranges. Table 1 shows some of the readily available data sources and platforms used for gathering data from space. The Landsat 1, 2, and 3 with a 79 x 79 meter picture element on the multispectral scanner (MSS) provide too low a resolution for many of the Earth scientists but may provide advantages to social scientists. The images are affordable at a cost of $200 per scene, are available from 1972, and they provide a temporal coverage that documents physical changes to an extent unavailable elsewhere. The higher resolution thematic mapper (TM) and SPOT IMAGE data are more costly ($4,400 per scene which includes 7 bands) but will provide data for finer spatial scale studies. (A scene is 34,225 km² for Landsat data and 3,600 km² for SPOT IMAGE data.) TM and SPOT IMAGE data will be more useful for the study of transport route evolution than MSS because it will