Problem-Solving with Remote Sensing: An Update

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INTRODUCTION

IN A PAPER written in 1979, Philipson (1980) outlined a framework of questions and significant points to aid in deciding if and how a particular problem should be approached with remote sensing. While that discussion focused on aspects of remote sensing that should not have changed substantially over the past six years, it is of interest to examine how the advances in computer technology and satellite sensors have affected approaches to problem-solving with remote sensing.

BACKGROUND

Philipson (1980) recommended that, once it is decided that useful information toward solving a specific problem might be derived through remote sensing, the remote sensing analyst should define the problem by responding to the following interdependent questions: What are the targets? What level of interpretation is needed? How can the targets be sensed? What are the available resources and required data?

Given the responses, the analyst might then develop the "best" approach to completing the remote sensing task, with due consideration of the following points:

1. The need for a human interpreter increases as the required level of interpretation increases.
2. Spectral and computer approaches are valuable when seeking surface information, but they are often of little or no real value when seeking subsurface information, the latter being more dependent on human interpretation.
3. As the required spatial resolution and spectral sensitivity approach the limits of the sensor, the need for applying the original remotely sensed data increases.
4. A remote sensing approach cannot produce results of some specified reliability and geometric accuracy unless all input data are of that reliability and accuracy.
5. The costs for data and analysis should be justified and minimized.

IMPACT OF COMPUTER TECHNOLOGY

The greatest impact of the tremendous advances in computer technology is the increased availability of powerful microcomputers and microcomputer-based image processing and information systems. This is not to overlook the cost reductions and computational improvements in minicomputers or mainframe computers, nor is it meant to downplay the expectations for the supercomputers, such as that being developed at the author's institution. It is only to emphasize that, because of the revolution in microcomputers, virtually any group can now afford to apply digital image processing.

Referring to the points listed previously, one finds that the widespread availability of microcomputers does not decrease the need for a human interpreter and thus has no effect on the first two points. It relates to the third point insofar as remotely sensed digital data can be analyzed by microcomputer. It increases the importance of the fourth point insofar as there is a greater likelihood that incompatible data will be overlaid and misinterpreted in a microcomputer-based geographic information system. And regarding the last point, where one would expect the greatest effect, one finds that, as the costs for computers and computing have plummeted, the costs for digital data have skyrocketed. The cost for a single Landsat thematic mapper scene in digital form now exceeds the basic cost for a microcomputer. This does not address the requirement of having the data on disks suitable for microcomputer (floppy disks), nor does it address the limitations and costs of the alternative approach of digitizing the photographic product.

IMPACT OF IMPROVED SENSORS

The advances in satellite sensors include higher

PHOTOGRAMMETRIC ENGINEERING AND REMOTE SENSING,
Vol. 52, No. 1, January 1986, pp. 109–110.

0099-1112/86/5201-0109$02.25/0

spatial resolution, more spectral bands, and increased radiometric quantization. For example, where the Landsat multispectral scanners have acquired 6- or 7-bit image data in four spectral bands with a nominal spatial resolution of 79 metres since 1972, the Landsat thematic mappers now acquire 8-bit image data in seven bands with a nominal resolution as high as 30 metres (USGS and NOAA, 1984). In the near future, the SPOT satellite's pointable, linear array sensors are expected to acquire 8-bit image data in only three spectral bands, but their spatial resolution is designed to be 10 and 20 metres, with the capacity for stereoscopic images (Chevrel *et al.*, 1981).

Referring again to the points listed previously, one finds that the resolution and radiometric improvements relate mostly to the last point, the cost for data and analysis. In essence, the availability of higher resolution satellite data and data in different spectral bands means that more can be accomplished with the photographic products through non-computer approaches to image analysis. In fact, the cost for the satellite data in digital form may force the analyst to accomplish more with non-computer approaches. Regarding the potential availability of stereoscopic satellite images, the greatest impacts should be in cartographic applications and in the capacity for landform analysis. Notably, obtaining subsurface information through landform analysis is done best by a human interpreter (points 1 and 2).

SUMMARY AND CONCLUSIONS

Advances in computer technology and satellite sensing systems during the first half of the 1980s have had relatively little effect on approaches to problem-solving with remote sensing. Increased access to computer image processing has been offset by increased cost for image data in digital form. Fortunately, the remotely sensed digital data are being acquired by higher resolution sensors, whose less expensive photographic product can be analyzed effectively with non-computer approaches.

To take maximum advantage of the improved computer technology, including the improvements in digital enhancements and classification algorithms, the digital data will have to be made available at lower cost and, for the immediate future, on floppy disks. Allowing that this may not occur, the emphasis of problem-solving with remote sensing—at least, satellite remote sensing—will have to be placed on determining whether non-computer image analysis methods will suffice for specific problems. This is completely in line with the questions and points outlined previously.

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(Received 17 July 1985; accepted 6 August 1985)
