by the sum), maps of the basin were derived in a near real-time mode every 6 days from SMMR observations. The sequential Gr maps showed anomalously low values in the Wyoming snow-pack when compared to the other states. This near real-time information then directed the field teams to Wyoming to carry out an extensive survey, which showed that these values were due to the presence of depth hoar; the average crystal sizes were more than twice as large as in the other areas. SMMR can be used to monitor the spatial distribution and temporal evolution of crystal size in snow-packs. Also, scatter diagrams of snow–water-equivalents from the combined snow-pit and SNOTEL observations versus Gr from the Wyoming part, and the Colorado and Utah part, of the basin can be used to estimate snow–water equivalents for various parts of the basin.

COMPARISON OF LANDSAT MULTISPECTRAL SCANNER AND THEMATIC MAPPER RADIOMETRIC AND SPATIAL CHARACTERISTICS OVER GLACIERS

(Abstract)

by

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ABSTRACT

For more than 10 years, images obtained from the four Landsat Multispectral Scanner (MSS) bands have provided important data for mapping and glaciological studies in the inaccessible polar regions. During this period, the specifications of the MSS have remained little altered, to allow data comparability. More recently, satellites 4 and 5 of the Landsat series have been equipped additionally with Thematic Mapper (TM) sensors. The TM has 7 bands in the visible, near infra-red, mid infra-red, and thermal infra-red, together with a larger dynamic range and improved spatial resolution relative to the MSS. The aim of this paper is to compare MSS and TM computer-compatible tapes (CCTs) from a glacierized area in order to demonstrate the advantages of using TM data in glaciological applications.

The digital MSS and TM scenes compared were imaged simultaneously from Landsat 5 on 5 May 1984 over the north-west part of Spitsbergen, Svalbard (path 218, row 3). This location was selected because of the range of glaciological features present: numerous valley glaciers, the ice field of Holtedahlfonna, fast ice, and ice floes. Partially cloud-covered imagery was preferred, to allow comparison of the two sensors in terms of their ability to distinguish between clouds and snow. The time of year is also advantageous, in that Sun elevation (27°) is high enough for detector saturation to occur in MSS band 2 (Dowdeswell and McIntyre 1986). Surface-elevation data from airborne radio echo-sounding, and other ancilliary glaciological information, are also available for this part of Svalbard.

Differences in the dynamic range and the wavelengths over which TM and MSS data are collected have two main implications for glaciological studies. First, snow and snow-covered ice masses can be distinguished easily from cloud cover in TM band 5 (1.57 to 1.78 μm). Snow appears dark whereas clouds are light at this wavelength. For example, thin clouds over part of Oscar II Land in Spitsbergen became apparent. In many MSS scenes of the Antarctic, the cloud-free ice-sheet surface has been misidentified as cloud-covered during quality-control analysis. Secondly, the wider dynamic range of the TM sensors means that saturation occurs less frequently over snow than was the case with MSS imagery. Digital analysis of MSS and TM scene radiance over Spitsbergen demonstrates this fact and implies that ice-surface topographic information will only rarely be degraded in TM imagery, although TM band 1 (0.45 to 0.52 μm) is most often saturated.

The nominal spatial resolution of TM sensors is 30 m, except for the thermal infra-red band. This is a significant improvement over the 79 m by 56 m resolution of the MSS. A major advantage of this is that ice margins and ice-surface features can be more precisely identified. More accurate glacier maps can be made, and smaller variations in termini positions of outlet glaciers can be monitored. Ice-surface features, such as crevasses, are more likely to be recorded on TM imagery, and examples are shown from Spitsbergen glaciers. The identification of such features is of major importance in studies of ice-surface velocities from Landsat imagery. For sea-ice applications, the ability to identify smaller floes is also important; for example, in the analysis of floe-size distributions.

The only significant drawbacks to the use of Landsat TM data in glaciological studies are the expense, particularly in the more useful digital format, and the small amount of coverage yet available for the polar regions.

REFERENCE

Dowdeswell J A, McIntyre N F 1986 The saturation of Landsat MSS detectors over large ice masses. *International Journal of Remote Sensing* 7: 151–164

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