

REMOTE SENSING OF NEW YORK LAKES

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Abstract.—Reverse flow through the outlet of Onondaga Lake and thermal activity associated with the spring mixing of Cayuga Lake were discerned on thermal-infrared imagery. Thermal radiances of natural and artificial discharges into Lake Ontario were measured, delineating the thermally pulsating nature of discharges into the open lake and thermal relationships between water masses. Quantitative imagery (radiometry) will become most useful in defining energy exchanges at the air-water interface.

This report is part of a 2-year investigation of the application of remote sensing for acquisition and communication of information about lake processes.

Three different New York lake environments were studied:

1. Lake Ontario (shoreline): very large, one of the Great Lakes, rural and urban areas, nearshore ice cover.
2. Cayuga Lake: moderate size, deep, one of the Finger Lakes, predominantly rural, little ice cover.
3. Onondaga Lake: small, relatively shallow, in an urban setting, subject to major ice cover.

For each lake, aerial visible photography and thermal-infrared imagery were provided by the U.S. Air Force Rome Air Development Center, and calibrated thermal-infrared imagery was contracted commercially as part of a Geological Survey cooperative program with the New York State Department of Environmental Conservation. Imagery was correlated with available water and weather data.

For guidelines to remote sensing in hydrology, see Robinove and Anderson (1969), and for information on infrared photography and imagery, see Robinove (1965).

LAKE ONTARIO

Figure 1 is a reduced-scale print of infrared imagery of Lake Ontario, N.Y., at Oswego Harbor on the night of June 9, 1971. Quantitative imagery is shown as the bottom data strip of three on original 9-inch film; lighter tones represent greater thermal radiances corresponding to higher temperatures. In

quantitative imagery, gray shades are related to radiance in a constant, linear fashion through controllable d-c amplifying circuits and are referenced to scanner blackbody radiators with calibrated radiances. In this image, the radiators are set at temperatures 4°C apart, and the corresponding gray shades are shown along the edges of the image (bottom) strip. Qualitative imagery is printed in the top data strip for locating the line of sight of the separate radiometer. This imagery has no blackbody references, uses an a-c amplifier, and is sometimes subjected to automatic gain control. It is printed here in negative format.

The radiometer and scanner blackbody reference temperatures are available but are not shown here. The radiometer trace is printed so that radiance values increase upward. The imagery is not corrected for geometric scanner distortion; therefore, the transverse scale decreases from center to edge, as shown in the bottom strip (fig. 1), where h = flying height above ground level. General information on line scanners and infrared systems is given by Lowe (1968) and Parker (1968). For a description of data-collection equipment and operation, see Whipple (1971).

Imagery of the Lake Ontario shoreline, acquired at several times throughout the year, showed thermal contrasts between natural discharges of the tributary streams, artificial discharges, and the lake proper. In July 1970 and June 1971 the apparent thermal radiance of the Oswego River at Oswego Harbor was greater than that of the adjacent discharge of heated water from a generating plant at the west end of the harbor enclosure; both discharges were warmer than the ambient nearshore lake surface (fig. 1). The fact that streams respond more quickly than large lakes to rising air temperatures in spring contributes to this situation. During November and April, however, the river is cooler than the plant discharge, and in November the river appears to be cooler than the lake.

Conditions similar to those at Oswego also occurred near Rochester on the night of June 9, 1971 (fig. 2). Nearshore water (bottom of image) of Lake Ontario is generally warmer

