Remote Sensing Solutions to Monitor Water Pollution and Energy Distribution System Security. R.L Kremens[1], G. E. Bove[2], R. Drake[3] and D. E. Shields[4]. [1]Rochster Institute of Technology, Center for Imaging Science, 54 Lomb Memorial Drive, Rochester, NY 14623 email: kremens@cis.rit.edu; [2]State University of New York at Buffalo, Dept. of Geography, Buffalo, NY 14426; [3]Buffalo-Niagara Riverkeepers, 1250 Niagara St., Buffalo, NY 14213; [4]Rochester Gas and Electric, 89 East Avenue, Rochester, NY 14649.

Introduction: Remote sensing solutions have often been touted as a panacea for environmental and emergency monitoring problems. In practice, however, remotely sensed data, whether acquired by satellite or aircraft, often falls short of satisfying monitoring needs for one of several reasons:

1. The data was acquired at the wrong time
2. The data was not processed in a time frame consistent with the monitoring goals (usually the data processing took too long)
3. Spatial or spectral resolution of the data was not consistent with monitoring goals (usually, resolution is too coarse or there is not enough spectral resolution -- too few bands)
4. Ground truth measures are insufficient or absent
5. Complicated or poorly-behaving algorithms and methods to reduce the data require expert interaction and complex interpretation.
6. In the case of some rapid-turnaround systems like directly observing from a helicopter, poor or no geospatial data is obtained with the data (a map product was not produced).

We have investigated several applications of remote sensing where we endeavored to minimize the above problems. We have attempted to provide practical solutions to the difficulties of water pollution monitoring and verification of electric and gas distribution system integrity especially during natural disasters. In general, our methods use rapid turnaround airborne camera platforms, multi-spectral information (including several visible channels in addition to RGB/color-IR and long-wave infrared) and ground based auxiliary systems that are used as multi-level 'triggers' for timely airborne and ground sensing.

Method: A major difficulty with remote sensing methods for disaster remediation or environmental monitoring is the unavailability of data during or immediately after the 'event'. In the case of water pollution monitoring, this means during a high-water runoff event or an industrial release. In the case of power and gas distribution systems, this means immediately following a high-wind, rain, or flood event that could cause catastrophic failure of the system.

Energy distribution systems can be monitored at the 'input' or supply end, but it is difficult to know where a failure is located. It is of course very easy to know that a catastrophic weather event (flood, wind or ice) has occurred, and it is a simple matter to fly the remote sensing mission on the next good weather day (usually the next day after a weather event) to obtain the data set. For this application we use the WASP camera system (developed at Rochester Institute of Technology for wildland fire and disaster monitoring) which has in-flight data geo- ortho- rectification, providing immediate turn-around of the map data to the power company's disaster managers. The data is produced in a format that can be overlaid with the company's geospatial data sets containing the location of transmission lines and other infrastructure. The WASP system has three infrared bands and a high-resolution RGB/color-NIR camera. The combination of infrared (which is very good at locating cool water from floods) and high resolution visible bands (to located downed trees and poles) produces a simple data product that is exceptional at locating power distribution problems. Since the data sets are usually over a relatively small area, the data 'analysis' can be done manually or with the aid of simple, proven data processing. (E.g. gross change detection)

Water quality problems may or may not be correlated with weather data, and in any case, there may be some lag time from the weather event (e.g. a heavy rainstorm) and the first appearance of pollution in a river system. We use a very inexpensive moored buoy that monitors sediment loading (via a turbidity sensor) and temperature at several depths to act as a trigger both for a remote sensing airborne data set and further ground sampling of e river system. The remote sensing mission again uses the WASP system, and, using thermal infrared images, can locate runoff that might be the cause of pollution. Ground based data collection can then be undertaken to isolate the particular nature of the pollution using the synoptic view obtained from remote sensing.

Results: We will show the construction and performance of both in-scene (ground truth) buys and other equipment, and overhead sensing equipment.

Data from overhead sampling of several lakes and rivers in the Rochester, NY area will show the influx of sediments (and thus possible contaminates) during rain events and periodic runoff events, and how this information might be used to trigger ground sampling. While we have no actual disaster data for power distribution, we will show a typical data product simulation that represents what could be obtained (complete with a GIS – layer indicating distribution infrastructure) using this system during a flood event.