Low-frequency array technologies
SHOW PROMISE AS ENVIRONMENTAL MONITORS

Someday, farmers will be able to electronically monitor the development of their crops with high precision, permitting them to quickly take steps to improve problem areas.

Someday, environmentalists will be able to precisely predict ground movements caused by extraction of natural gas.

That day is nearly here. A technology called low-frequency arrays (LOFAR), originally developed for radio astronomy, holds great promise for making such measurements possible.

LOFAR started as an innovative effort to improve sensitivity for astronomical observations at radio frequencies below 250 MHz. Constructing larger and larger mechanical dish antennas to improve sensitivity has become impractical and prohibitively expensive. Scientists have been seeking new technology to take the next step in achieving the sensitivity needed to unravel pressing astronomical secrets.

LOFAR emulates a conventional dish antenna, but instead uses a large array of simple omni-directional antennas. Digitized signals from these antennas feed a central digital processor and processing software. Since the cost of electronics decreases with time, increasingly large LOFAR telescopes can be built with economy. Essentially, LOFAR is an IT-telescope.

The antennas are simple, but a full LOFAR design requires a lot of them—typically many tens of thousands. To capture the stars and galaxies with adequate sharpness, these antennas will be spread out over an area 70 miles in diameter.

Scientists in the Netherlands realized that by adding various kinds of sensors to a LOFAR antenna array, they could extend its purpose to measuring earthbound environmental parameters. Such environmental data will help governments and companies take the proper steps to effectively manage and maintain environmental conditions.

Towards this end, two clusters of companies and institutions in the Netherlands have joined forces to permit complete information services for managing the environment. Phase 1, currently funded, involves 34,000 ground-based antennas installed within an area having a diameter of more than 60 miles.

In the case of precision farming, the combination of satellite and ground-based information would help to monitor crop conditions on a large farm. LOFAR measuring points on the ground would supply online data relating to such environmental parameters as atmospheric humidity, temperature, and microclimate. By integrating this data with satellite-based information, specific advice on fertilizer and crop protection chemicals could be provided to the farms for each plot section. The farm maximizes its harvest while minimizing costs for materials.

In the case of monitoring ground movements caused by gas extraction, LOFAR point sensors such as seismological geophones could “listen” for ground abnormalities.

Two agencies—the Northern Regional Development Agency and the Flevoland Development Agency—are planning to bring these information services to the attention of other countries, especially in North America.