A new tool to eradicate malaria

by Marsha Freeman

If the United States does not succeed in destroying its Earth remote sensing technology system (Landsat), the world will soon have a powerful new weapon in the fight against insect-borne diseases.

A team of specialists in remote sensing at the NASA Ames Research Center, led by project chief Paul Sebesta, is developing a model to track the migration of malaria-carrying mosquitos, using satellite data from Earth orbit. By knowing in detail the ecological niche of many of the more than 85 species of mosquitos that carry malaria, scientists will be able to predict the likely path of spread of the disease, and begin pesticide, water drainage, and other eradication programs before the insects arrive.

According to the World Health Organization, malaria afflicts more than 250 million people wordwide. According to Sebesta, Ames became involved in this project when people there looked at the increase in malaria cases, and found them "alarming." "Many governments have dropped their malaria control programs," he said, "because of limited incomes, and other priorities. It's all political."

Remote sensing data have already been demonstrated to be useful for mapping the areas in Africa where the spread of locusts could be determined by water availability. The National Oceanographic and Atmospheric Administration (NOAA) data show where the locusts are likely to hatch, and where they will go next to find food. Knowing the precise requirements of the insects can lead to preventive measures, and the saving of crops, livestock, and lives.

In addition, scientists have used data from U.S. meteorological satellites to conduct surveillance activities in Kenya for Rift Valley Fever. A 31-month study in 1982 provided data which correlated rainfall followed by flooding, with the proliferation of breeding habitats for Rift Valley Fever-carrying mosquitos.

Developing the model

The Landsat system of remote sensing satellites can not see the insects, but can monitor the key environmental factors which trigger the breeding of malaria-carrying mosquitos. Taking measurements of reflected wavelengths in visible light and the infrared, the satellite can provide data on rainfall patterns, areas with standing water, irrigation, drainage, temperature, soil characteristics, and general topology. The goal of the program is to ultimately monitor thousands of square miles on a weekly basis, and deliver data within 24-48 hours.

During the first phase of the project, now under way, researchers are studying mosquito breeding patterns in the Sacramento Valley rice fields of California. The insects there do not carry malaria, but are similar to the ones in Mexico, for example, that do. This summer, during the mosquito-breeding season from May to August, Landsat data of California will be analyzed to see how closely the predictive model corresponds to what actually happens on the ground.

From there, the researchers will move to the southwestern oceanic plain of Mexico, near Tapachula in 1988, to test out the remote sensing-based predictive model they have developed. NASA is also considering Costa Rica, Turkey, Pakistan, and China as prime targets for this technology's application.

Next-generation technologies

One of the problems in the quality of Landsat data stems from the fact that neither optical wavelengths nor infrared penetrates clouds. A large portion of Landsat imagery is cloud cover, not the land features the investigator is trying to see.

New wavelengths in the remote sensing field are being developed, however, to overcome this difficulty. This is crucial in the tropics, where clouds and mosquitos are common. New radar instruments, particularly under development for the NASA Magellan mission to Venus (which is always under cloud cover), scheduled for launch in 1989, will be very useful for Earth remote sensing.

Experiments on the Space Shuttle have tested techniques for on-board processing of data, so the pictures of cloud cover could be eliminated on the Landsat satellite itself, and not uselessly transmitted back to Earth.

As well, the space station that NASA and its international partners are trying to have operational by the mid-1990s, will orbit the Earth between 28° North and South latitude, which is precisely the tropical zone with the worst insect-borne diseases. New experimental instruments, as well as operational systems, could be placed on or near the space station, to push forward this vital technology.

Sebesta and the Ames team hope to be able to expand their project geographically, technologically, and also to other insect-borne diseases. These include yellow fever and schistosomiasis, and could also include AIDS, if the insect transmission route is mapped out precisely.

This project should clearly be a top-priority item in the United States and among all other nations, with the timetable accelerated as quickly as the technique can move ahead. But currently the Landsat remote sensing system is in such a state of disarray, it is questionable whether or not it will even exist

over the next few years.

In 1979, the Carter administration made the decision to pull the Landsat system out of the space agency, and put it into the Commerce Department, under the National Oceanographic and Atmospheric Administration. The agency was then ordered to make the operational system "pay for itself" through sale of the data. To attempt to do that, NOAA tripled the price of the satellite data. Sales of the data fell by the same proportion, so the revenue has remained the same.

Closing down Landsat?

To make matters worse, in 1984 President Reagan signed into law the Land Remote-Sensing Commercialization Act. This turned the operating Landsat system over to the private sector, with the promise that the government would continue to fund research and development into new remote sensing technologies, and pay for the construction of two new satellites, which are badly needed.

Every year since then, the portion of the promised $250 million needed to build Landsat 6 and 7 has been cut out of the budget and put back in, in a tug-of-war between the Office of Management and Budget, and the Congress. Similar penny-pinching has led to cutbacks in NOAA's weather satellite program.

In a 1985 report titled, "Remote Sensing of the Earth from Space: A Program in Crisis," the National Research Council sounded the alarm, stating that the program was "foundering because of limitations placed on federal support."

Earth remote sensing, they stated, is "analogous to census data. The U.S. Census cannot be justified by looking at the revenues generated from the sale of census tapes to the general public," the report states. "It is justified because census data have thousands of uses, permeating all branches of industry, academia, and government, and making definite but unquantifiable contributions to all."

Likewise, the Landsat data are used by industry to find new mineral reserves; by government to plan for economic growth, transportation systems, water development, and other infrastructure; by scientists to study the basic geology, topology and features of the Earth; and now the potential exists to assist medical professionals in eradicating insect-borne diseases, which may include AIDS, according to growing evidence in Africa.

The National Research Council report states that the "value of the program cannot be equated to the revenues derived from direct sales or the fees paid by foreign ground receiving station operators," and that "a private sector operator cannot be relied on to fund and conduct the necessary research."

The March 23 issue of *Aviation Week & Space Technology* quotes Congressman Bill Nelson (D-Fla.), that "Landsat is in its death throes," and recommends that it be "resuscitated by the CIA." A proposal to transfer all weather satellites to the military, to make room in the NOAA budget for the two needed Landsat satellites, is being argued against by the owner of Landsat, Eosat, which insists that if $62 million is put back into the FY88 budget for the follow-on satellites, the program can continue.

At the present time, Landsat 5 is the only functioning U.S. remote sensing satellite, and its projected operational lifetime will not carry it to the end of this decade. No user is going to purchase Landsat data, especially when French SPOT remote sensing data are also available, if there is no plan to continue the program, and provide a continuity of information.

The United States pioneered Earth remote sensing technology, starting with the photographs of the planet taken by the astronauts on the Gemini flights of the 1960s, which had agricultural and geological significance. Between 1966 and 1967, five NASA unmanned spacecraft orbited the Moon, to pick out a landing site for the Apollo crews.

The NRC report states, "the instruments used in the Lunar Orbiter were first tested over terrestrial sites that simulated the lunar landscape, and the photographs thus obtained were compared with actual measurements on the ground." Now the United States has competition in the field of remote sensing.

Though the planetary space science program has continued to push the state-of-the-art in sensing technology, the United States is standing at the edge of closing down its operational land remote sensing system.