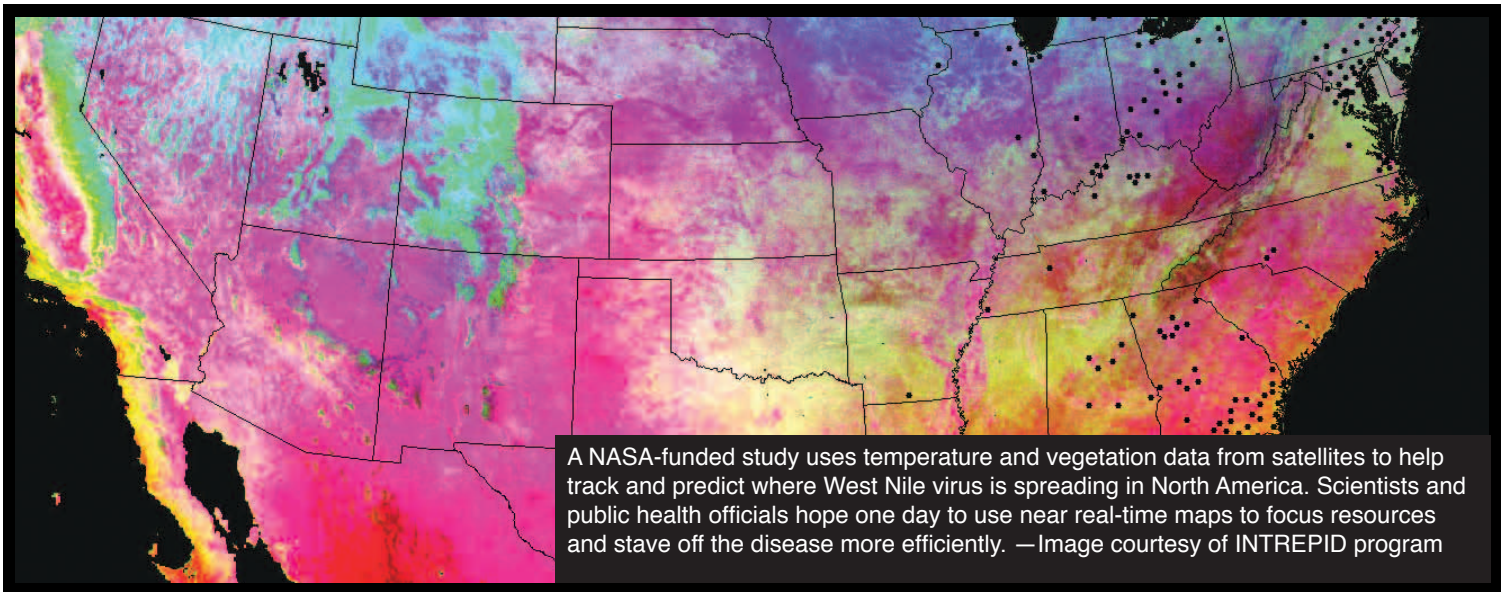
National Aeronautics and Space Administration

Tracking and Predicting the Spread of Mosquito-borne Encephalitis Using NASA Data



A NASA-funded study uses temperature and vegetation data from satellites to help track and predict where West Nile virus is spreading in North America. Scientists and public health officials hope one day to use near real-time maps to focus resources and stave off the disease more efficiently. —Image courtesy of INTREPID program

Students research mosquito-borne viruses and develop new tools and strategies for their surveillance and control.

Pesticides are sprayed over New Orleans to prevent West Nile after Hurricane Katrina.

Project Goals:

Provide advanced data management, visualization, analysis, and reporting tools for epidemiological surveillance data to provide rapid turn-around of surveillance information

Integrate remotely sensed climate variation and epidemiological surveillance data into forecasts and nowcasts of encephalitis risk

Develop a climate-based risk assessment model that can be exported to public health planners at the national and local levels

Project Impacts:

Provided a permanent georeferenced data set describing arboviral activity in California

Enhanced data access and utility among public health partners

Improved human, veterinary, and wildlife health through focused and scientifically directed intervention

Effectively managed insecticide use to minimize environmental impact

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Summary

Mosquitoes obtain encephalitis virus from infected birds and pass it on to humans. NASA's goal is to provide people on the front lines of public health with innovative technologies and satellite data which are tailored into useful tools for combating this deadly disease.

The population dynamics of mosquitoes and other disease carriers, and therefore the escalation of disease transmission to humans, are closely linked to climate. Mosquito population control is presently the only method of coordinated public health intervention. In order to confront disease transmission among human and animal populations, a statewide decision support system has been developed in California. Climate measures are downloaded daily from the NASA Terrestrial Observation and Prediction System (TOPS). TOPS is a NASA system that combines weather and climate forecasting, ecosystem modeling, and satellite remote sensing into one model in order to enhance management decisions related to floods, droughts, forest fires, and human health. These data are scored on an escalating risk basis correlated with the science of virus replication within the primary mosquito host. Risk scores for temperature and surveillance measures of virus transmission are averaged to produce an overall risk score or nowcast of viral amplification. The California Mosquito-Borne Virus Surveillance and Response Plan aligns appropriate intervention and public health response strategies with escalating risk, allowing public health officials to initiate mosquito population control methods when necessary.

Project Details

This project has enhanced California decision support by developing a web-based data management system, called the Surveillance Gateway. Local mosquito control and related health agencies input data through web-based forms and, in turn, laboratories testing mosquitoes or bird samples access these data and electronically input related test results. Submission of completed test results produces instantaneous reports of laboratory results to the submitting agency, refreshes interactive maps, and archives data into historical systems retrievable by both clients and approved researchers. At weekly intervals, summary reports are sent automatically to the California Department of Public Health. Human risk of infection in urban and rural areas is summarized for each participating agency and sent automatically via email as color coded time-series graphics for each surveillance factor. These surveillance factors include temperature partitioned based on virus replication models, mosquito abundance as a percent anomaly of the previous five years of data, mosquito infection incidence per 1,000 calculated using CDC maximum likelihood methods, and chicken seroconversions and number of positive dead birds grouped by occurrence within spatial and temporal scales.

The ongoing West Nile virus epidemic in California continues to provide challenges for mosquito control intervention at varying temporal and spatial scales. Enhanced surveillance and decision support systems can be used to direct control efforts and limit the incidence of disease in California. Future plans include production of a revised version of the Surveillance Gateway that is exportable to other state or federal agencies with computing capacity and access to NASA products.

For more information about this project

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NASA APPLIED SCIENCES PROGRAM & PUBLIC HEALTH

This program focuses on the use of NASA assets to support planning and decision making for the public health, medical, and environmental health sectors. The application includes epidemiologic surveillance of infectious disease, environmental health, and emergency response and preparedness. Public Health also explores issues of toxic and pathogenic exposure, natural and man-made hazards for risk characterization and mitigation, and improvements to health and safety.