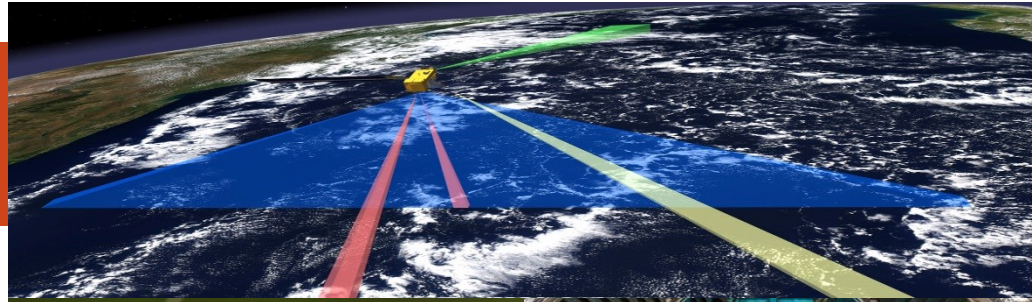
NASA's Use of Remote Sensing to Predict Zika Spread

Dr. J.D. Polk
NASA Chief Health and Medical Officer

UNITED NATIONS
Committee on the Peaceful Uses of Outer Space



Overview

- Remote Sensing scientists from NASA's Marshall Spaceflight Center worked along with colleagues from the National Center for Atmospheric Research (NCAR) to create a map to anticipate and predict the spread of Zika in the United States based on satellite imagery data and predictive modeling programs.

- The predictive models and map had a high correlation to the female Aedes aegypti mosquito population sampling.

- This map helps identify at risk areas, where limited resources might be deployed early or concentrated by public health officials.

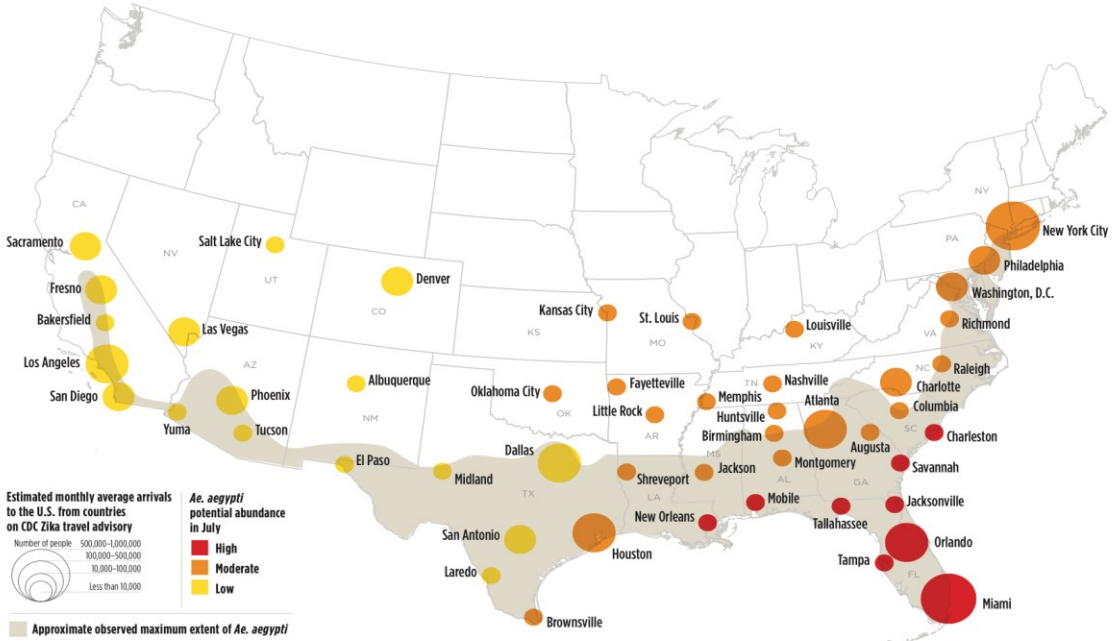
Process Used

NASA and NCAR scientists used meteorologically driven models for 2006-2015 to simulate the potential seasonal abundance of adult Aedes aegypti for fifty cities within or near the margins of its known U.S. range. Mosquito abundance results were analyzed alongside travel and socioeconomic factors that are proxies of viral introduction and vulnerability to human-vector contact.

To estimate the seasonal abundance of adult Ae. aegypti we employed two life cycle models, Skeeter Buster32 and DyMSiM33. Both models simulate the egg, larval, pupal and adult life stages as a function of daily meteorological inputs and user specified information about container habitats. Using two models enabled the quantification and reduction of model uncertainty; previous studies have shown that model ensembles provide a more accurate result than those from individual models.

Monaghan AJ, Morin CW, Steinhoff DF, Wilhelmi O, Hayden M, Quattrochi DA, Reiskind M, Lloyd AL, Smith K, Schmidt CA, Scalf PE, Ernst K. On the Seasonal Occurrence and Abundance of the Zika Virus Vector Mosquito Aedes Aegypti in the Contiguous United States. PLOS Currents Outbreaks. 2016 Mar 16

Risk Mapping



Temperature, precipitation and humidity data used to drive two process-based life cycle models and simulate the daily potential abundance of Ae.

Overlay of other data known to impact public health and mosquito populations used to create a Risk Map.

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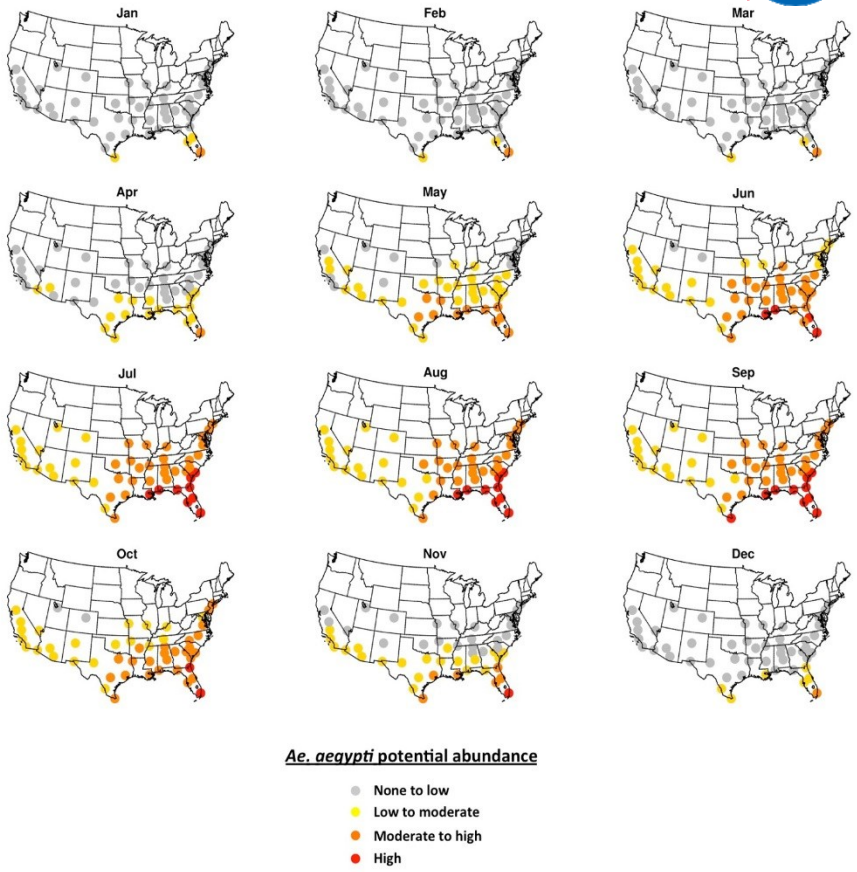
Models and Predictions

Using both remote sensing to determine water, soil moisture and temperature and overlaying that with data on the two months with the highest estimated number of travelers returning by air from countries on the Centers for Disease Control and Prevention's Zika travel advisory showed peaks in July and August, which corresponds with the summer months when mosquito populations would be highest.



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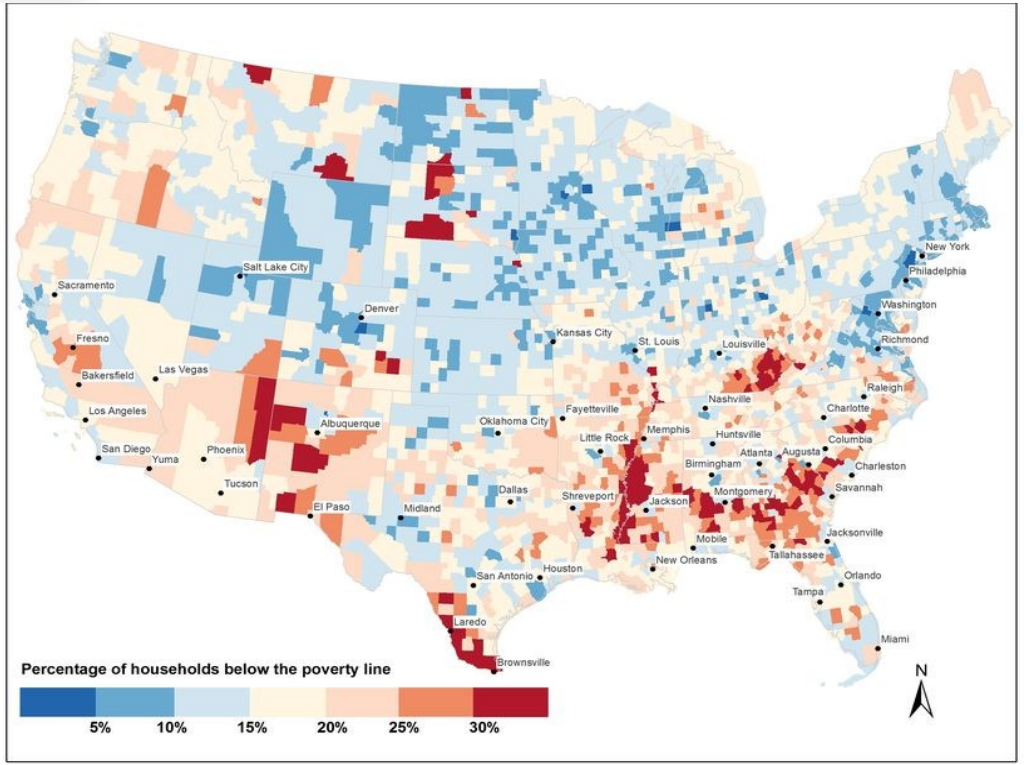
Using Population Statistics Overlay

Using poverty rates, especially in urban areas (a favorite haunt of the Aedes aegypti) as an overlay on top of satellite data. Low income correlates with a lack of prevention measures such air conditioning and screens on windows, which are extremely effective methods in preventing Zika transmission.



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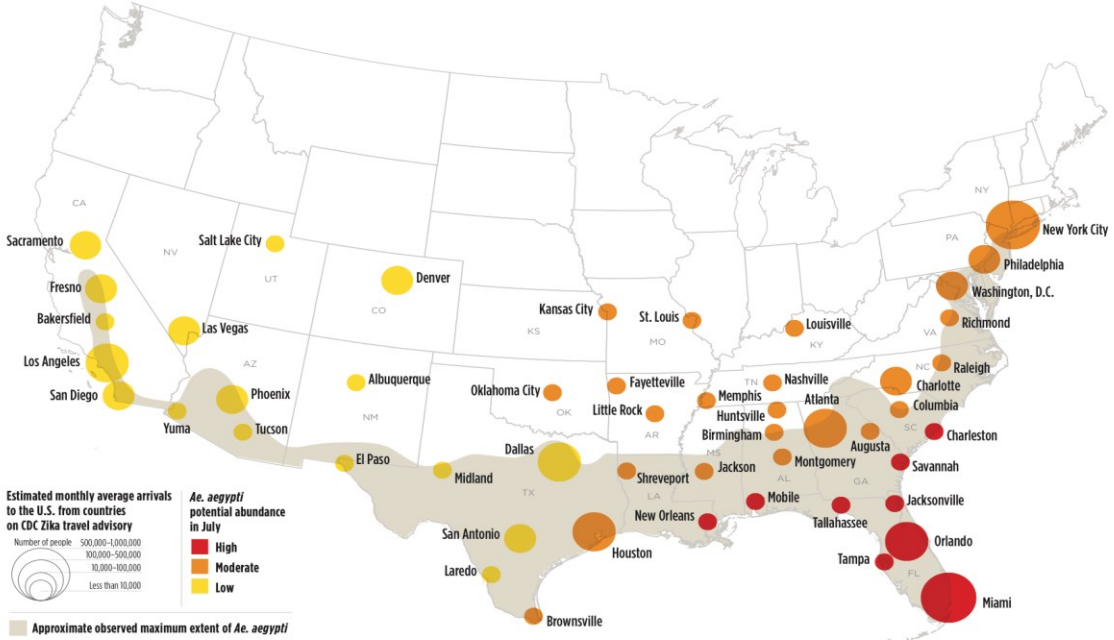

The Risk mapping showed the Miami area to the be the highest risk area, with particular neighborhoods standing out. This correlated well to the actual Zika cases.

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Potential Impacts

In times of constrained resources, modeling and risk mapping can allow public health officials to concentrate on the highest risk areas first.

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Over the past 30 years, NASA has worked with numerous world health organizations using both remote sensing and data modeling to look at the possible spread of such diseases as malaria, plague, yellow fever, West Nile virus, Lyme disease, Rift Valley fever and Onchocerciasis, also known as river blindness.