Malaria Modeling and Surveillance In Thailand and Indonesia

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Meteorological & Climatological Parameters

NASA’s Earth Observing System

THE PROBLEM

- 40% of the world’s populations at risk
- 300-500 million cases per year
- 1-3 million deaths per year
- Highest risks for children, pregnant women, and people with depressed immunoresponse
- One death every 30 seconds
- Counterfeit and substandard antimalarial drugs abound.
- ACT is becoming less sensitive.
- Previously unaffected regions may have outbreaks due to climate change.

OBJECTIVES

Risk detection
Detection of larval habitats
Textural-contextual classification

Risk prediction
Prediction of current and future endemicity
Neural network methods

Risk reduction
Identification of key factors that sustain or promote transmissions
Agent-based discrete event simulation

BENEFITS

Applying larval control as a preventive measure

Strengthening and mobilizing public health support

Cost-effectively curtailing malaria transmission
Malaria incidence in Aceh increased significantly after the Tsunami Disaster in December 2004.
Classification Accuracy using Pan-Sharpened Ikonos Data (1 meter resolution)

Satellite-Observed Meteorological & Environmental Parameters For Four Thailand Seasons

Surface Temperature MODIS Measurements

Vegetation Index AVHRR & MODIS Measurements

Rainfall TRMM Measurements

Actual Malaria Incidence Hindcast Incidence

Satellite-Observed Meteorological & Environmental Parameters

Dynamic Transmission Modeling Framework

Kong Mong Tia Test Site, Kanchanaburi, Thailand

In Collaboration with AFRIMS and WRAIR

Actual Malaria Incidence Hindcast Incidence
Example: A Small Hamlet

- 23 houses
- 2 cattle sheds
- 24 clusters of larval habitats
- 8 cows
- 69 adults
- 23 childrens
- 2 cattle sheds

Modeled and Observed Prevalence

Modeled and Observed Sporozoite Rates

Modeled and Observed Entomological Inoculation Rates

Sensitivity Studies and Simulations Performed

- Abundance of larval habitats
- Access to health care and appropriate treatment
- Asymptomatic cases
- Acquired immunity
- Active and passive case detections
- Bednets or personal protections
- Improved dwelling construction
- Parasite infectivity in mosquitoes
- Zoonotic prophylaxis
- Arrival of non-immune populations (such as migrant workers, refugees, foreign military forces)

Well Placed Farm Animal Sheds and Zoonotic Prophylaxis

May Significantly Reduce Malaria Transmission
With over 18,000 islands and a decentralized government, it is challenging to implement malaria control policy.

Rainfall Pattern, Which Drives Malaria Transmission, Varies Significantly from Island to Island
Average Monthly Precipitation for the Major Cities on the 8 Islands 2000-2005

Precipitation Based on TRMM Measurements

Hindcasting Malaria Cases in Jawa Tengah, Indonesia
Actual (red), Modeled (blue), and Hindcast (green) Malaria Cases

Districts Involved in Menoreh Hills Project
- A MOH-WHO-NAMRU2-USAID Collaboration

Comparison of Kulong Progo and Purworejo ACD Cases (blue) with Jawa Tengah PCD Cases (red)
Thank you!

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