Malaria Modeling and Surveillance
In Thailand and Indonesia

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Meteorological & Climatological Parameters

Vector Ecology
Predator Ecology
Local Environment

Anthropogenic Factors

AGRICULTURAL PRACTICE
ROAD BUILDING
DEFORESTATION
MILITARY CONFLICT
REFUGEE
ECONOMIC CRISIS
MEDICAL CARE

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 Models
- Local Habitat Detection
- Larval habitats estimation: Species specific
- Larval habitats suitability
- Larval habitats resources
- Larval habitats diversity

Value & Benefits
- Reduced morbidity & mortality for US Forces
- Improved public health for local populations
- Reduced damage to the environment
- Reduced likelihood of larvicide, insecticide & antimalarial resistance

Decisions
- Preventive measures
- Countermeasures

Earth Obs. Model
- Climate Prediction
- Earth Sci. Model
- Earth Observation

Research Partners
- Kari, Traptop, & Bingham, data
- Satellite/remote data

Earth Observation
- NACER
- MODIS
- Landsat
- AVHRR

Some text and images are not clearly visible due to the quality of the images.
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

1.00 0.95 0.90 0.85 0.80 0.75 0.70 0.65 0.60

Effective Malaria Incidence
Hindcast Incidence

Kong Mong Tla Test Site, Kanchanaburi, Thailand

In Collaboration with AFRIMS and WRAIR

Kong Mong Tla Test Site, Kanchanaburi, Thailand

Malaria Surveillance Study (Jun 99 – Jan 04)

Blood films from ~450 persons/month

Microscopy and Polymerase Chain Reaction

Larval and adult mosquito collection

In Collaboration with AFRIMS and WRAIR

A. dirus
A. minimus
A. maculatus
A. barbirostris
A. campestris
A. sawadwongpori
A. maculatus
Example: A Small Hamlet

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

Modeled and Observed Prevalence

Modeled and Observed Sporozoite Rates

Modeled and Observed Entomological Inoculation Rates

Well Placed Farm Animal Sheds and Zoonotic Prophylaxis May Significantly Reduce Malaria Transmission

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)
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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