



Swiss Tropical Institute
Institut Tropical Suisse
Schweizerisches Tropeninstitut



Citizen Cyberscience for Africa

Tom Smith
Swiss Tropical Institute

Citizen Cyberscience in a Global Context
26 October 2009





Swiss Tropical Institute
Institut Tropical Suisse
Schweizerisches Tropeninstitut



Citizen Cyberscience and Africa

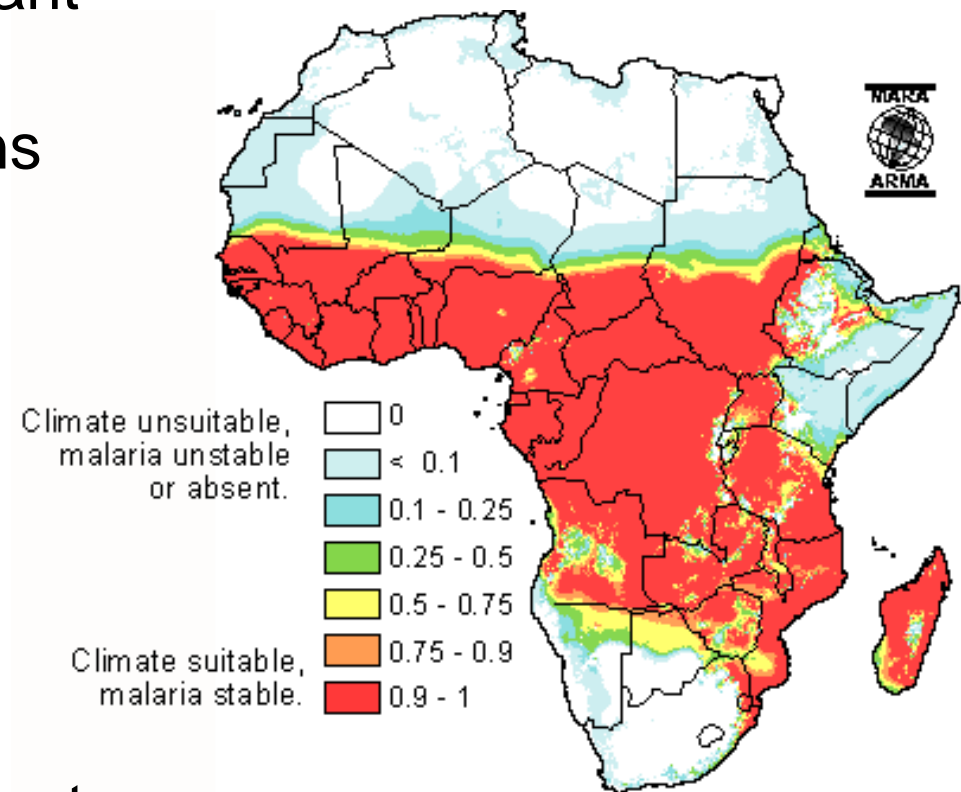
Tom Smith
Swiss Tropical Institute

Citizen Cyberscience in a Global Context
26 October 2009



Importance of malaria in Africa

- Along with HIV/AIDS, malaria one of the two most important health problems in Africa
- Causes hundreds of millions of episodes of illness each year, and around 1 million deaths
- Up to 40% of health expenditure
- Most of the world's malaria burden is in Africa
- Resource constrained context



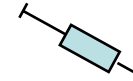
Malaria interventions

- Many possible interventions, none of them perfect

❖ Case management



❖ Vaccines



❖ Intermittent Preventive Treatment



❖ Insecticide Treated Nets

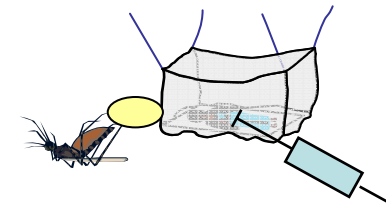


❖ Indoor Residual Spraying



❖ Larval control (source reduction or larviciding)

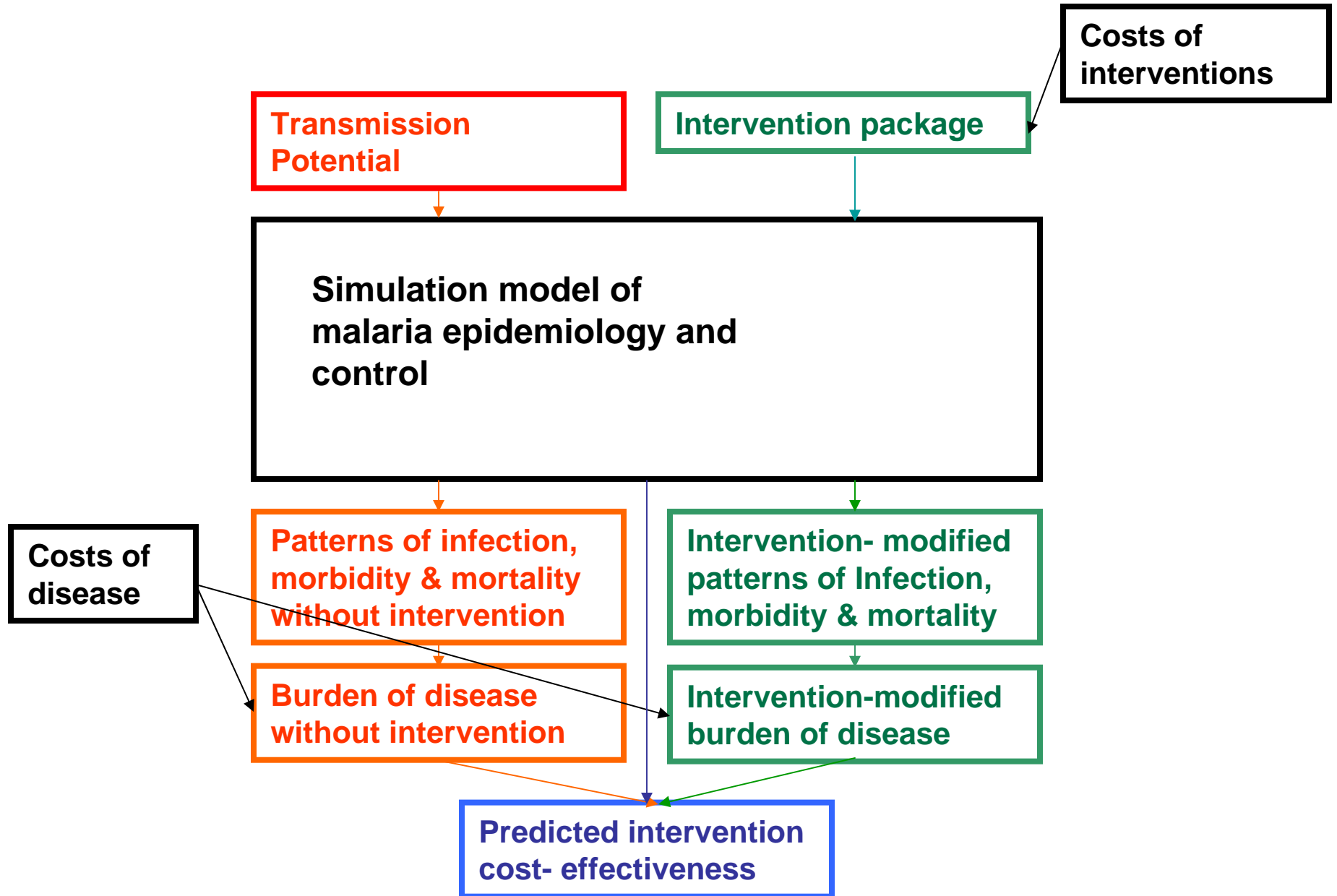
❖ Integrated control (combinations)



Simulation of malaria epidemiology

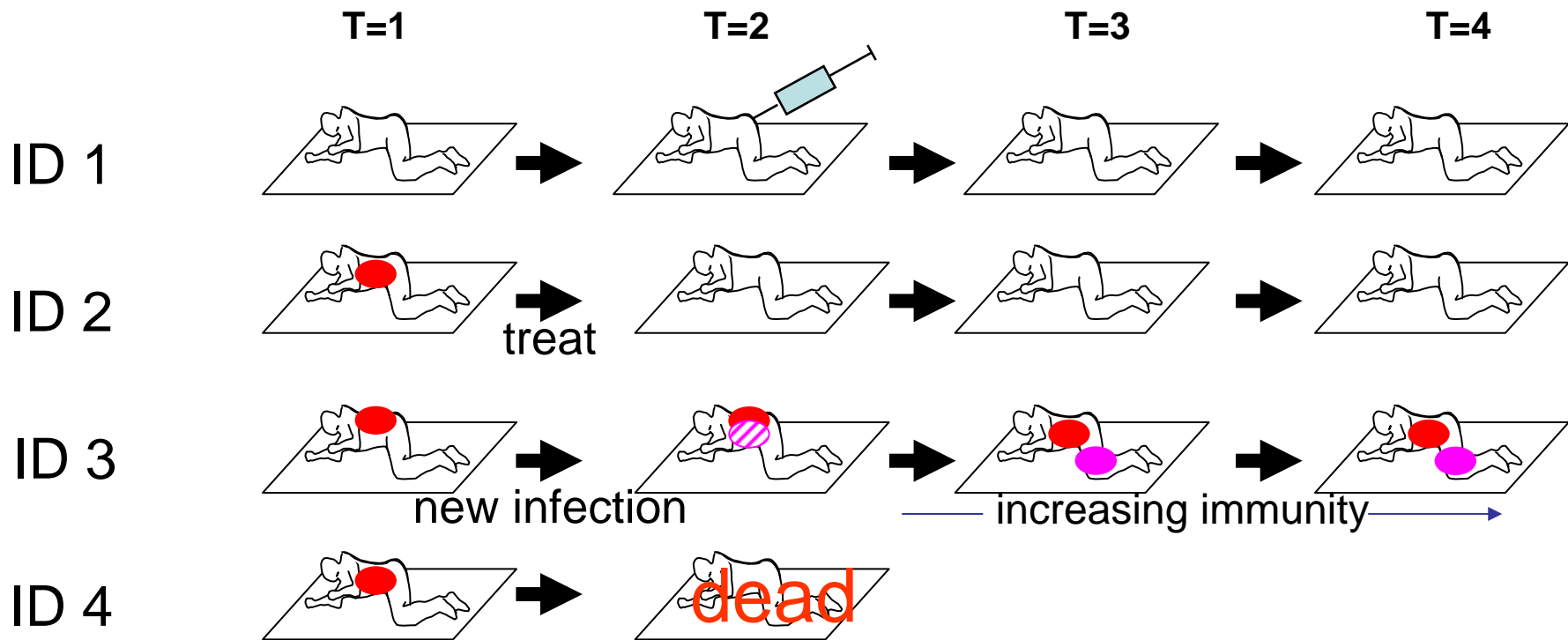
- **Simulation models** of transmission dynamics and health effects of malaria are an important tool for malaria control.
- Models are needed to help develop **target product profiles** for new interventions
- Models are needed to develop **optimal delivery strategies** for existing interventions.





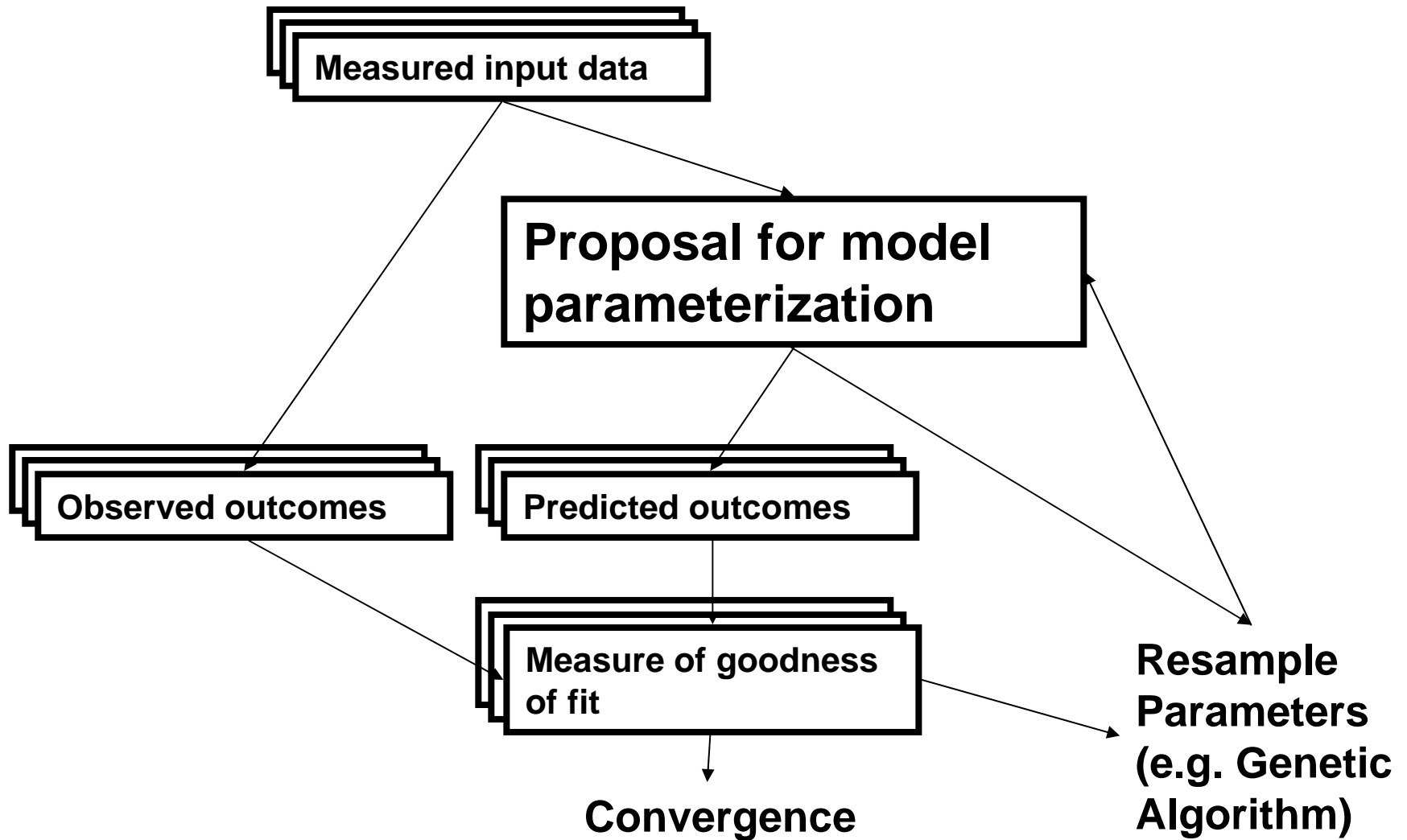
Approach

- ❖ Discrete time stochastic individual-based simulations (5-day or 1-day time step)

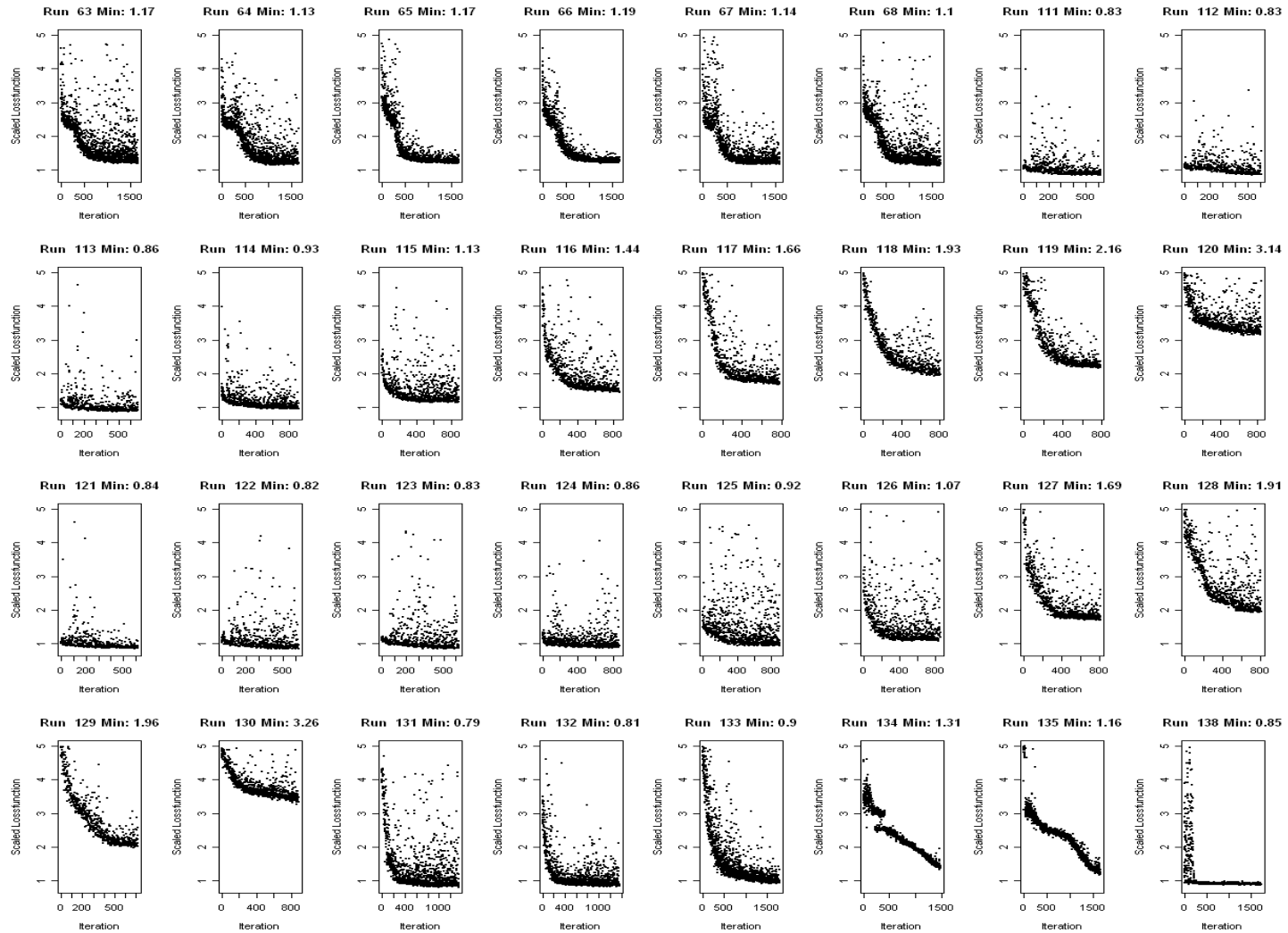


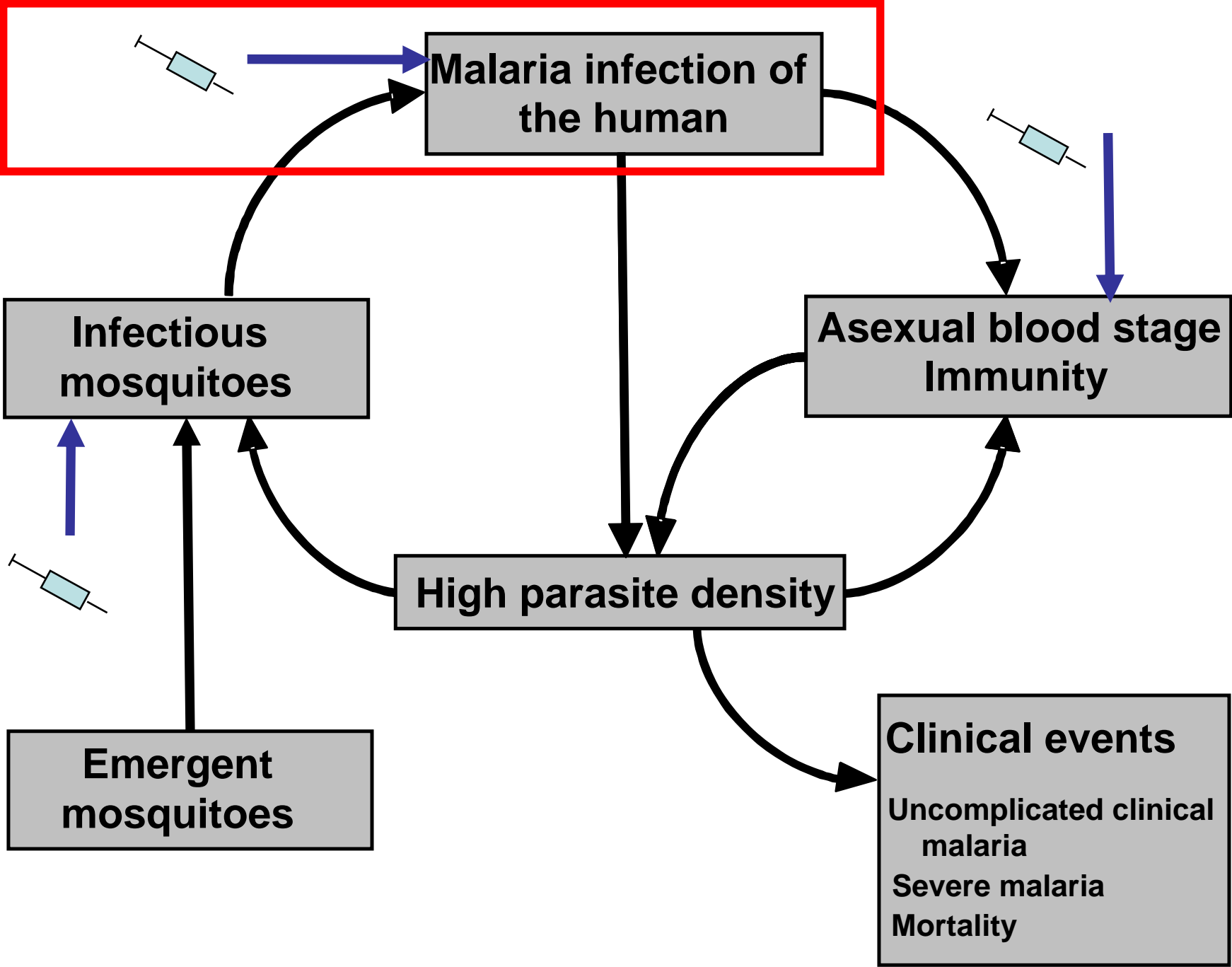
Agent-based model, microsimulation.....

Estimating model parameters from field data



Parameter estimation for a series of alternative models



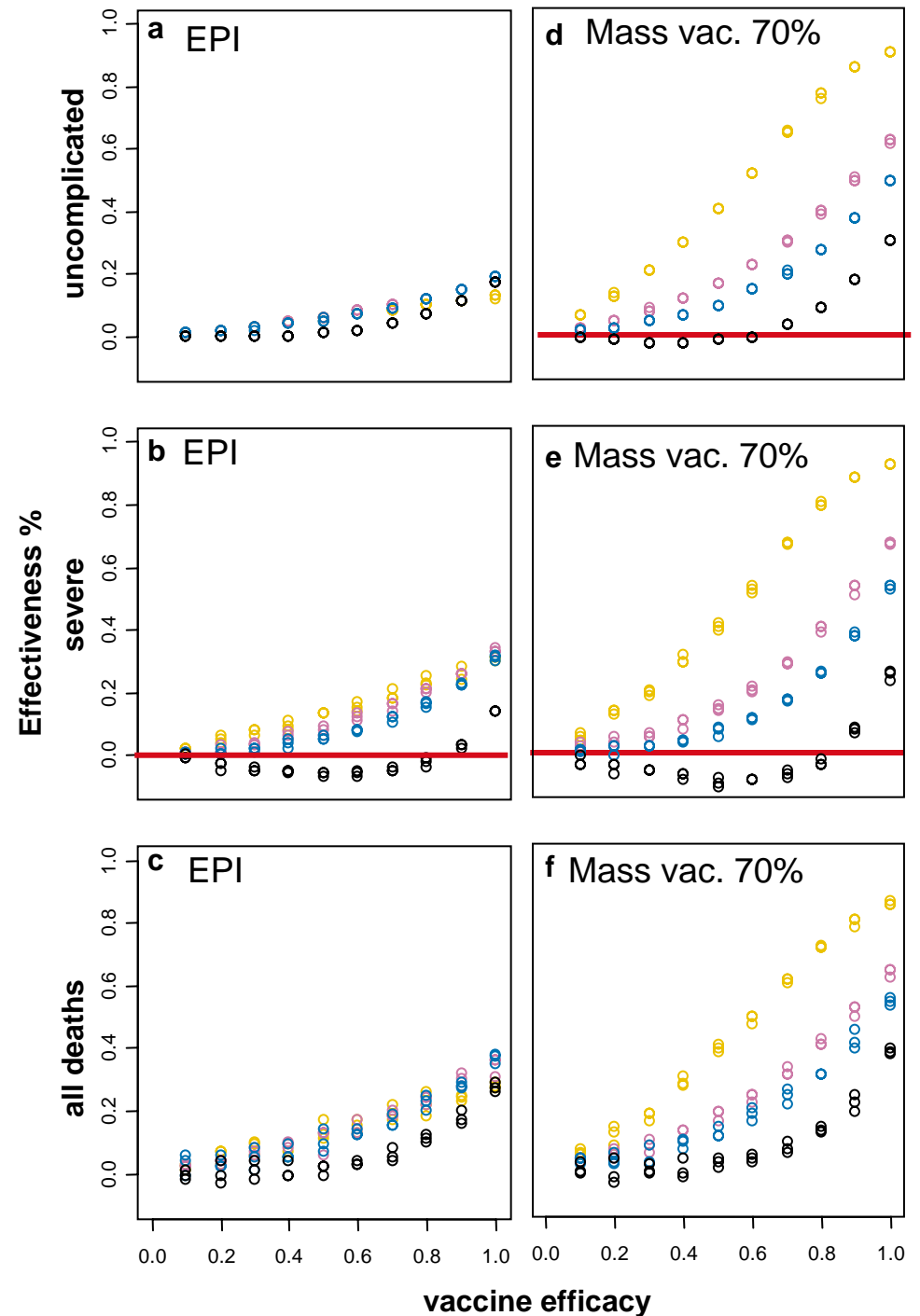


Key Results for this vaccine

- We consider EPI (vaccination of infants only); mass vaccination (vaccinating everyone)
- Vaccine is more effective in low transmission settings
- In high transmission settings may lead to more severe cases
- Can achieve local elimination in low transmission settings in some conditions

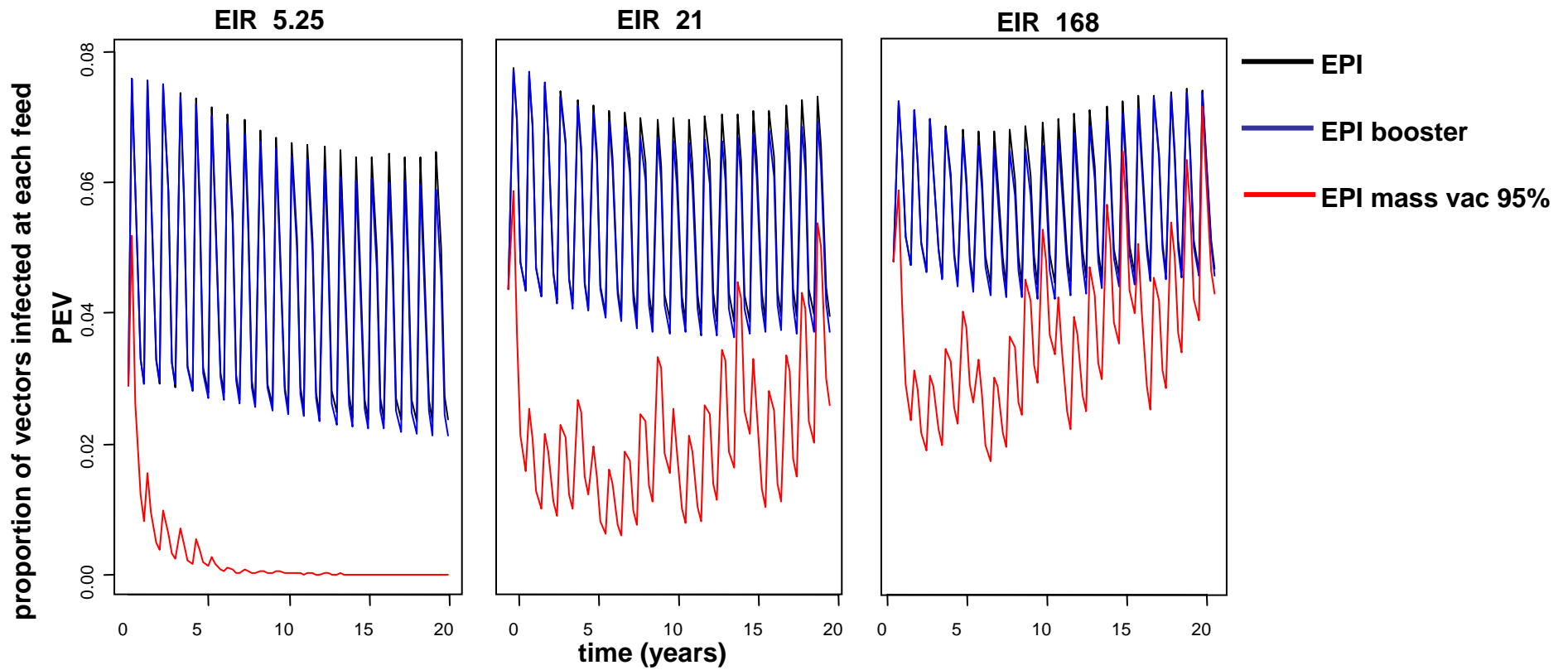
Initial Transmission intensity
(infectious bites per annum)

● 5.25 ● 21 ● 42 ● 168



Transmission effects

Initial transmission intensity (infectious bites per annum)



malariaccontrol.net: A volunteer computing project

- 2003-2005: simulations on STI Desktop Grid
- Several hours to run a single simulation
- Large number of simulation runs
 - 1,000s of iterations necessary to fit parameters to field data
 - 10,000s to 100,000s of simulations for predictive runs and sensitivity analysis
 - Ensemble modeling adds another dimension
- **Millions of simulation runs, need for High Performance Computing**
- Science application suitable for Volunteer computing



AFRICA@home:
Volunteer computing for health





AFRICA@home: Volunteer computing for Africa

What is AFRICA@home?

- **Huge potential** for volunteer computing to contribute to solving pressing **health and environmental issues** facing developing world.
- AFRICA@home tackles such issues by providing a **common framework** for volunteer computing projects that address **African needs**.
- An important goal of AFRICA@home is to involve **African students, scientists and institutions** in the development and running of these volunteer computing projects.

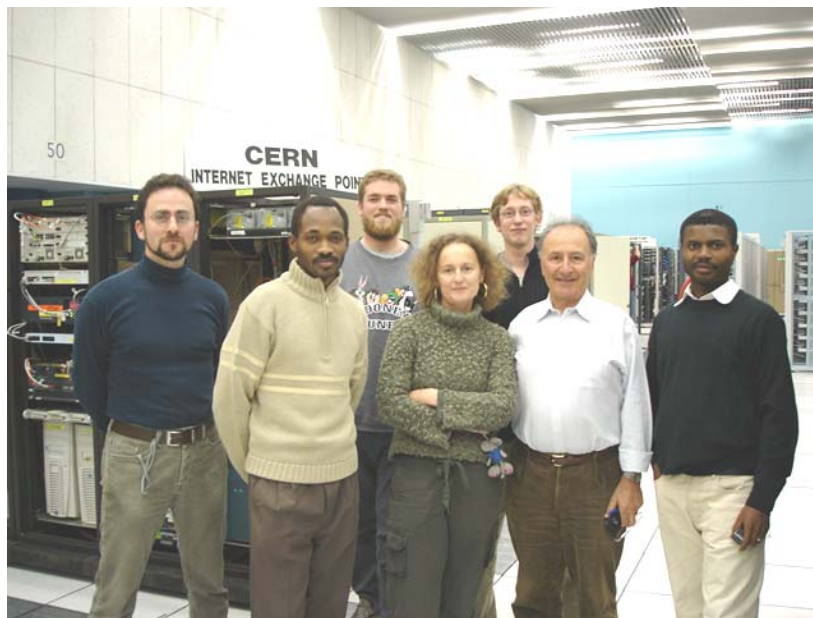




AFRICA@home: first project

Porting of MalariaControl.net to BOINC platform

- Project team involves 3 students from **Geneva, Bamako and Yaoundé**
- Funded by **Geneva International Academic Network**, hosted at **CERN**
- Port takes 3 months, beta-test February 2006, **open to public July 2006**
- Server at **University Geneva**, African students recruited by **ICVolunteers**



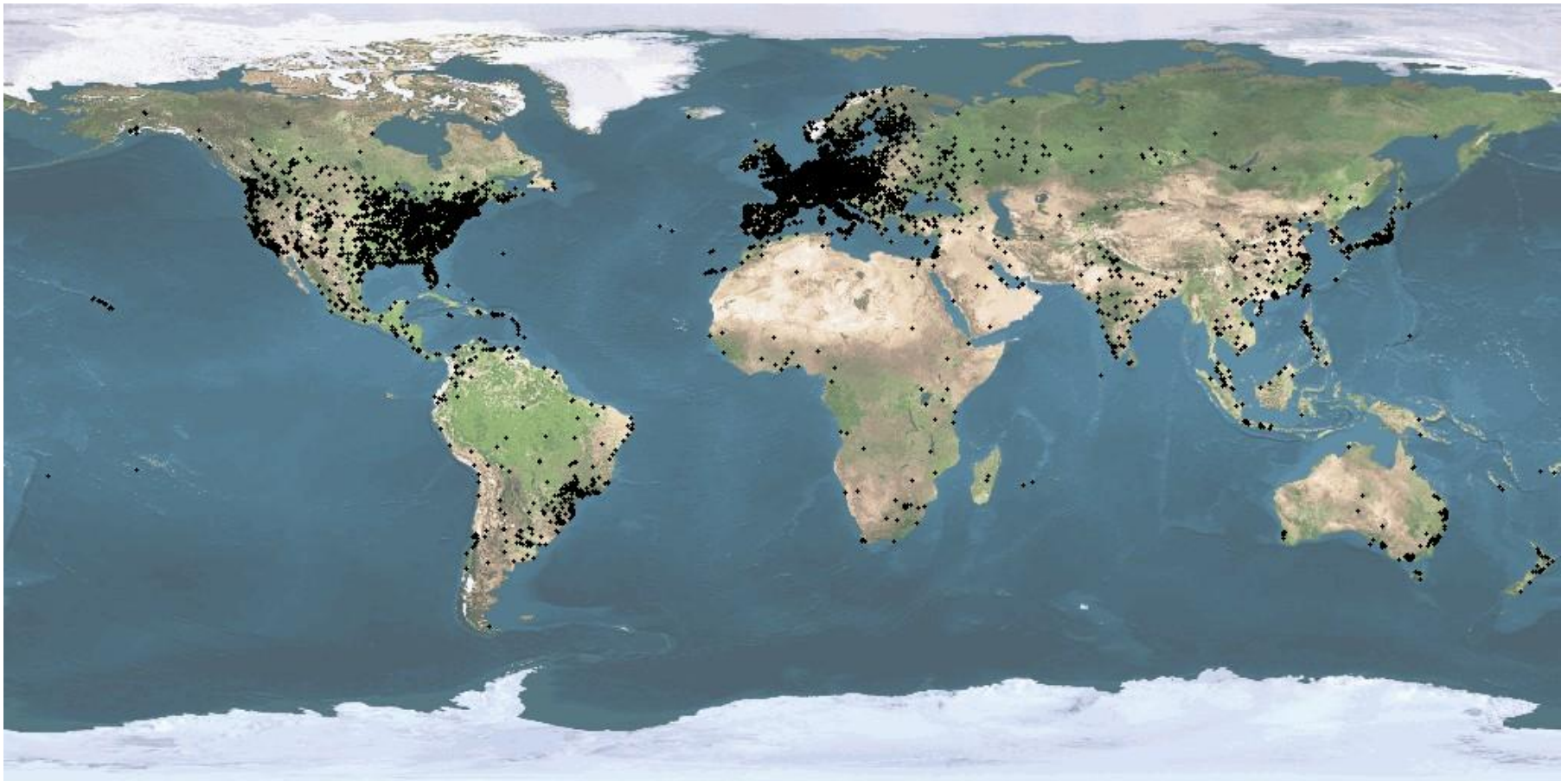
A screenshot of the AFRICA@home website. The page features a navigation menu with links like 'What is AFRICA@home?', 'Join MalariaControl.net', and 'Links'. There are several small images, including a group of people and a person using a microscope. The main content area has the heading 'Volunteer computing for African humanitarian causes' and a paragraph of text. A 'News' section at the bottom mentions '13 July 2006 - Africa@home goes public!'. The website has a dark orange and white color scheme with binary code accents.



malariacontrol.net

- Volunteers: 30'000 total, 10'000 active
 - Sign up rate: up to 2000 new users per day
- Host PCs: 15,000 active,
 - 85% Windows, 15% Linux, Mac
- CPU power:10(5) TeraFLOPS
 - Delivered to date 15,000 CPU years (Oct 09)
- Up to 50'000 simulation runs per day
- Outreach
 - Huge public/press interest (Economist, Nature news, National Geographic, New Scientist, BBC, Wall Street Journal...)

malariaccontrol.net volunteers





empowering African scientists

- **Africa@home projects:** MalariaControl.net, HIVMM, AfricaMap, Autodock (w. HealthGrid)
- **Africa@home workshops:** >50 African scientists from 20 countries (South Africa, Mali)
- **Africa@home servers:** Uni. Cape Town, Uni. Geneva



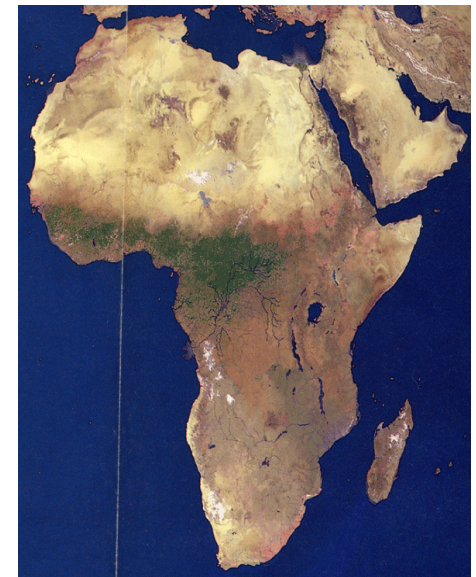


Perspectives in empowering African scientists

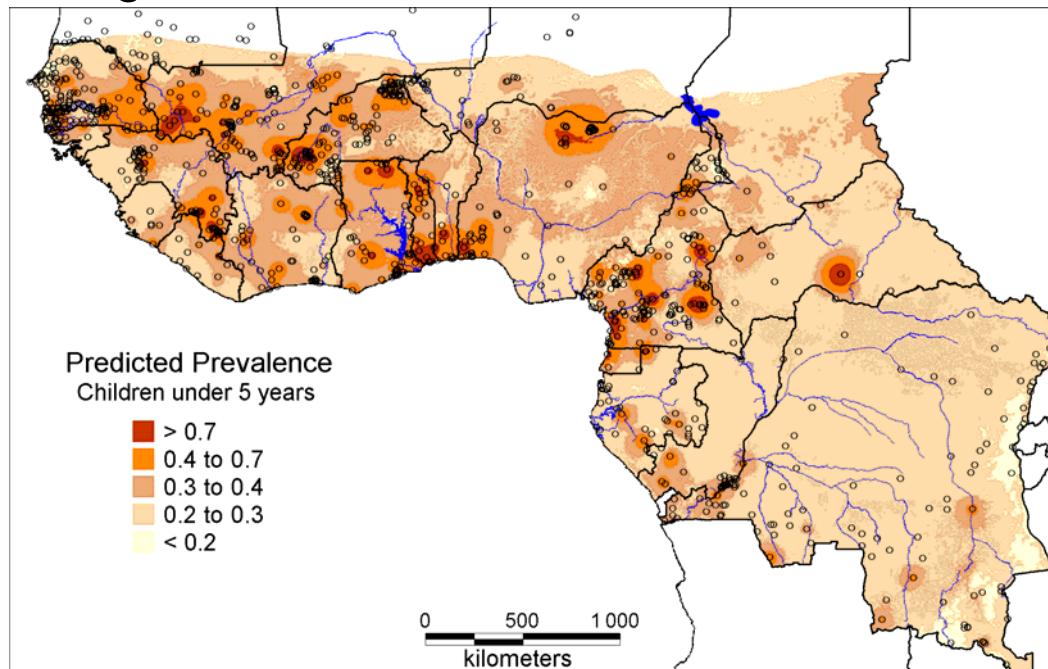
- Mobile phones in Africa
 - Lack of functional fixed telephone networks:
 - High mobile coverage in urban populations
 - Rapid development of innovative mobile phone applications
- Internet applications in Africa
 - Made international communication possible for African scientists
 - Bandwidth issues/Poor connectivity
 - May soon be history
 - Adaptation of applications to BOINC still too expensive/time consuming/difficult
 - May soon be history
 - CCC could make an important contribution

Where next?

- Simulation modeling of other diseases
 - HIV/AIDS
- Drug-docking for neglected diseases
 - (Software licensing issues)
- Constructing databases of geographical information:
 - Computer intensive estimation where data are limited
 - Interpretation/annotation of images
 - Satellite images
 - Photographs

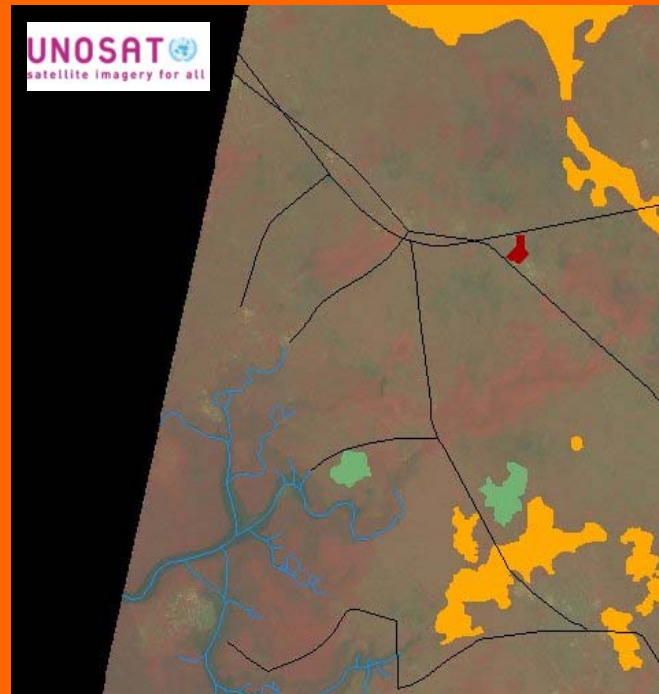
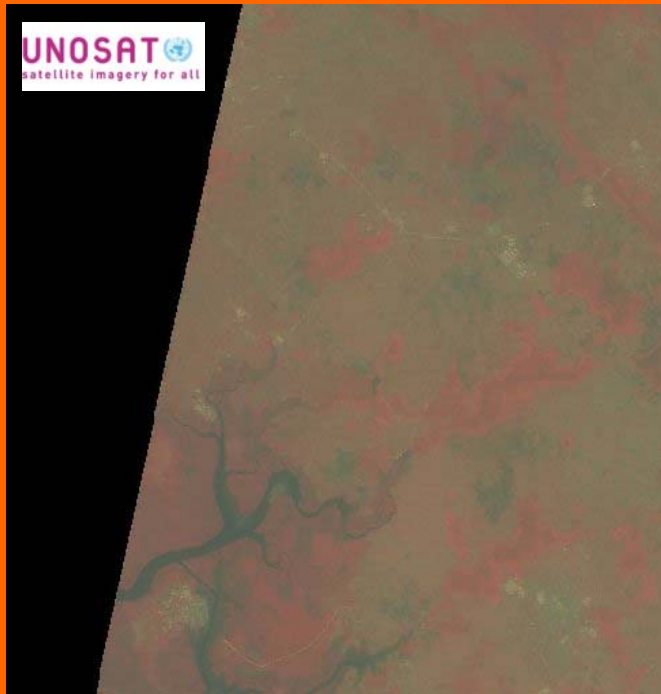


- Mapping of malaria risk in West Africa via computer intensive algorithms



Predicted prevalence in
children under 5 yrs

AfricaMap: cartography from satellite images



BOSSA: open-source software platform for volunteer thinking projects
BOLT: toolkit for web-based training and education



Outlook: Data acquisition and validation using volunteer thinking

- An example: The MARA Project
- Mapping Malaria Risk in Africa (MARA) is a comprehensive collection of malaria prevalence data for Africa
- Contains data from 45 African countries from early 20th century to present
- Open access: www.mara-database.org

- Geolocation of datapoints is important
 - Is currently incomplete, and existing data is not completely validated
 - Is a very time-consuming process
- A volunteer thinking project?
- Proposal: Use BOSSA to have volunteers geolocate data, by providing them with relevant data from MARA records

Enter coordinates


Title	Country	Fourth level	Community name	Year	Lookup on GNS search
Influence of Consecutive-Day Blood Sampling on Polymerase Chain Reaction - Adjusted Parasitological Cure Rates in an Antimalarial-Drug Trial Conducted in Tanzania	Tanzania		FUKAYOSI	2007	Lookup on GNS search

Enter the coordinates in text field, search name on map, point to the location on map, or leave empty if there is not enough information.

Lat: -2.4
Long: 38.66667

Confirm

FUKAYOSI



Map Satellite Hybrid Terrain

Map ©2008 Google Technology - Terms of Use

- Annotation of images-
 - Extensive applications in health
 - ..agriculture
 - ..transport
 - etc.



Acknowledgements

- STI malaria modeling team
- Bill & Melinda Gates Foundation
- Africa@home partners

Core Partners

European Organization for Nuclear Research (CERN)
International Conference Volunteers (ICV)
Informaticiens sans Frontières (ISF)
Swiss Tropical Institute (STI)
University of Geneva, Computer Science Dept.
World Health Organisation (WHO)

Associated Partners

Agence Universitaire de la Francophonie (AUF)
Erasmus University Medical Center, The Netherlands
SACEMA, Stellenbosch University, South Africa
African Institute for Mathematical Sciences, Muisenberg, South Africa
University of Bamako, Mali
University of Dakar, Senegal
University of Yaoundé, Cameroon

Sponsor

Geneva International Academic Network (GIAN)

