



Swiss Tropical Institute  
Institut Tropical Suisse  
Schweizerisches Tropeninstitut



# **malariacontrol.net**

Nicolas Maire

On behalf of the Malaria Modeling Team

Swiss Tropical Institute, Basel





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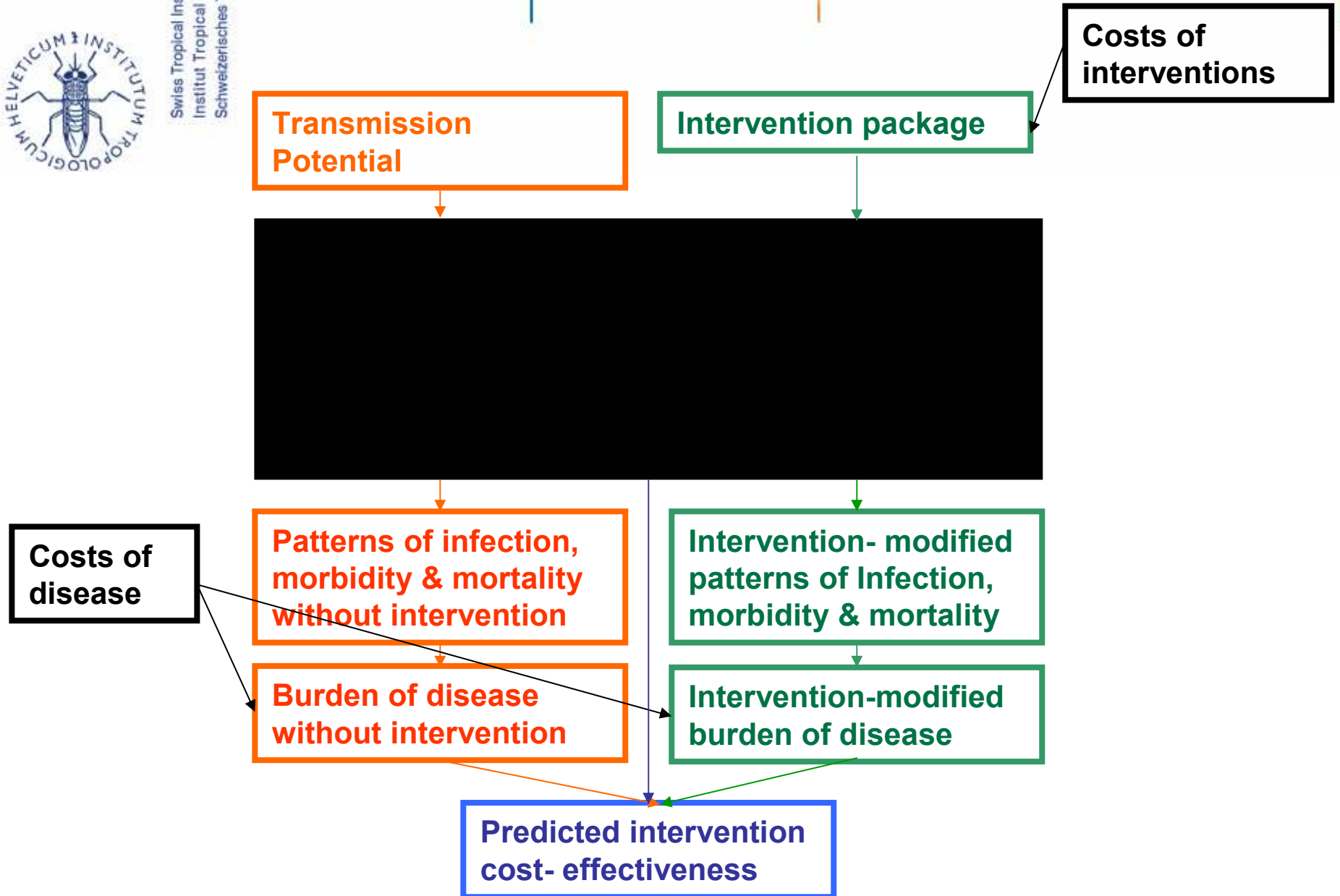
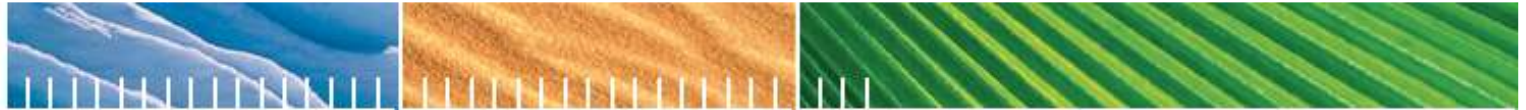


## STI Malaria Modeling

- Initial project: Mathematical modeling of the impact of malaria vaccines on the clinical epidemiology and natural history of *P.falciparum* malaria (supported by Malaria Vaccine Initiative & GSK from 2003-2005)
- Current extension to evaluate the likely impact of different control strategies singly and combined (supported by Bill & Melinda Gates foundation):
  - Vector control, intermittent preventive treatment, different kinds of vaccines



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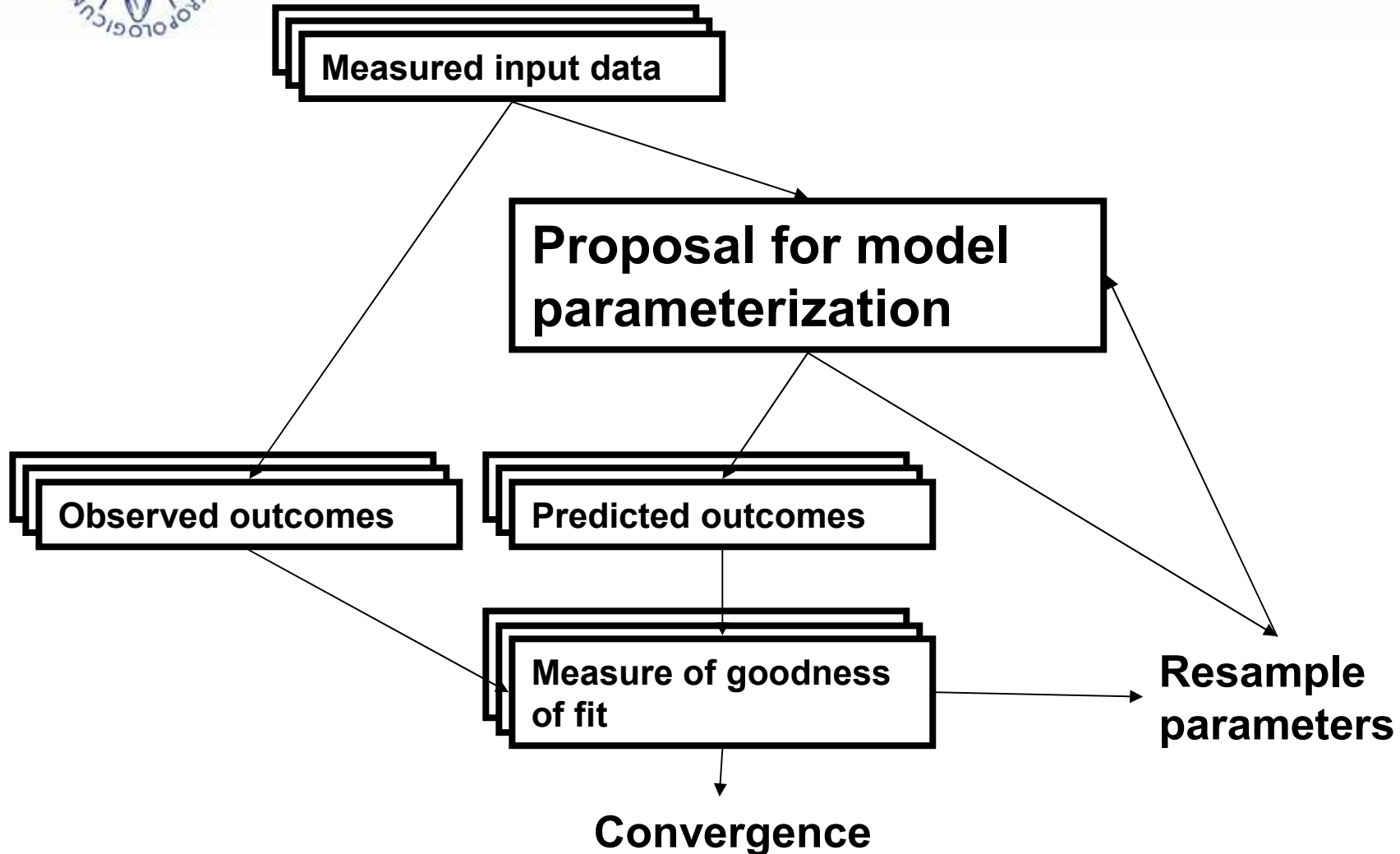


## Modeling Approach

- Discrete time stochastic individual-based simulations
- Fit model to data from field studies
- Predict impact of control strategies by comparing simulated interventions with baseline scenarios



# Estimating model parameters from field data

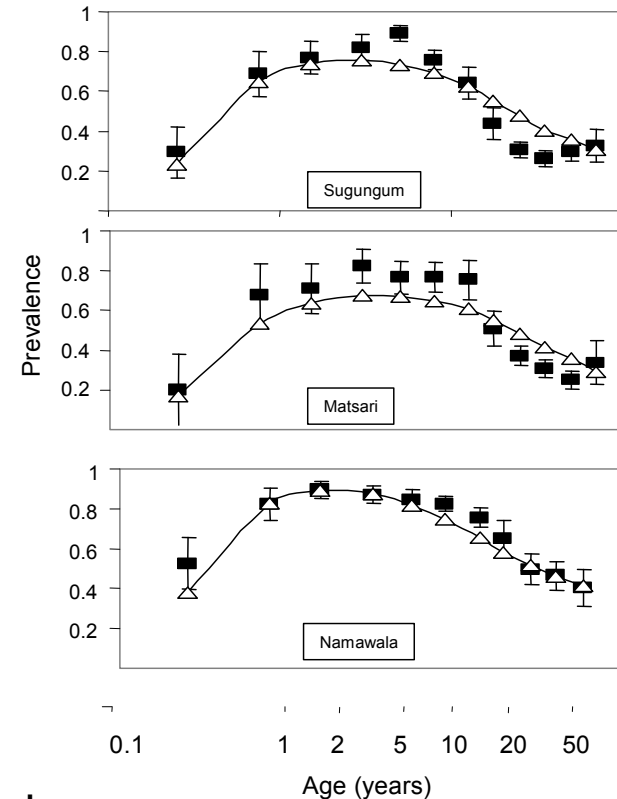




# Optimization

- 61 datasets from field studies, different objectives\*
  - Incidence of infection
  - Age-prevalence of parasitemia
  - Seasonality of parasitemia
  - Age-density of parasites
  - Age-incidence of clinical disease, hospitalisation and mortality

## Age-prevalence of infection



\*all related to seasonal patterns of transmission



# Optimization

- Stochastic, non-differentiable objective function
- Single iterations partially parallelizable (simultaneous fitting of several scenarios per parameterization)
- First phase of project
  - Moderately parallel environment (Dektop grid with 40-50 nodes max)
  - Simulated annealing approach



## BOINC environment and optimization

- Highly parallel
  - 15'000 to 20'000 results in progress
  - 10'000-15'000 workunits in progress
  - 500-800 parameterizations in progress
- Need to find a good parallel optimization algorithm



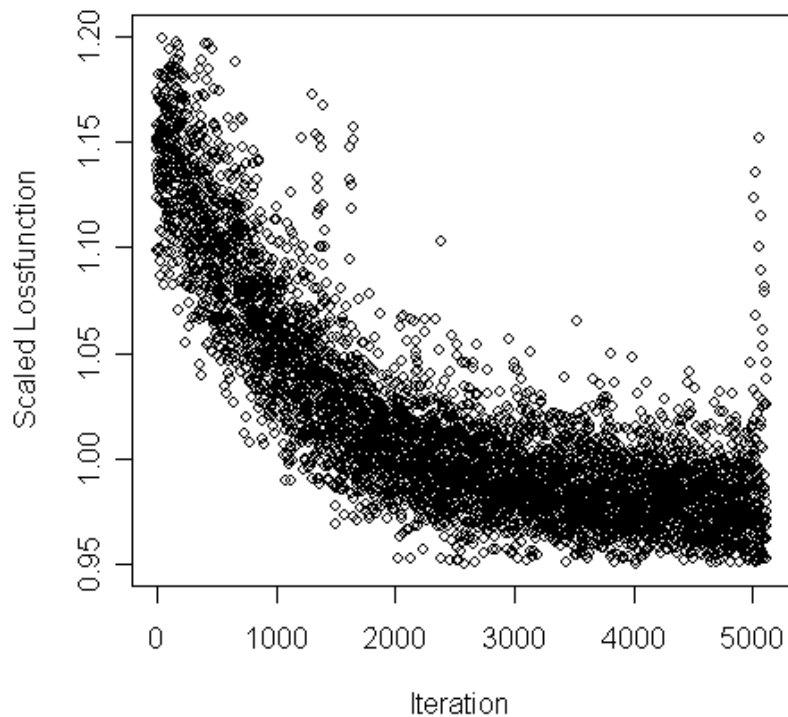
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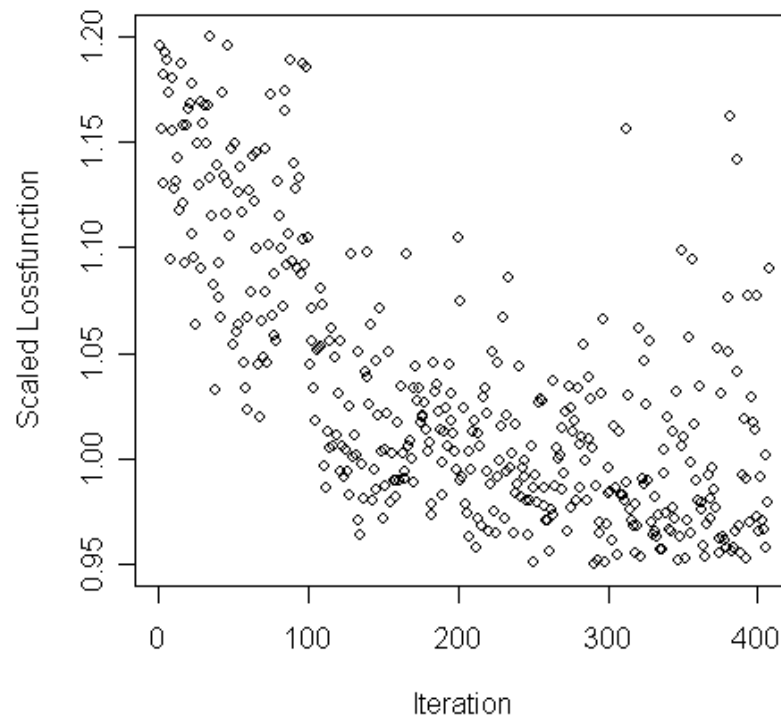
# Fitting of models via genetic algorithm

- Highly parallel environment

Run 17



Run 19





## Science application II: Malaria risk mapping

- Data on populations at risk is important for planning of malaria control
- Risk maps can be based on available malariological data and environmental predictors
- STI: Bayesian geospatial model
- Implementation in Fortran, BOINC-wrapper approach
- Opt-out via project-preferences



## Science application III: Dynamics of malaria infections

- Aimed at understanding some more specific aspects of malaria transmission (infection and clearance rates).
- Parameter estimates by fitting to field data
- Wrapper application, java app using JSmooth, workunits last from 10mins to 1h



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## STI project team

- **Matthias Bischof** (probabilistic sensitivity analysis)
- **Nakul Chitnis** (vector control, modelling)
- **Lesong Conteh** (economics)
- **Christian Lengeler** (vector control interventions)
- **Don de Savigny** (health systems)
- **Nicolas Maire** (modelling, computing)
- **Melissa Penny** (within-host modelling)
- **Amanda Ross** (IPTi, modelling)
- **Fabrizio Tediosi** (economics)
- **Alain Studer** (computing)
- **Tom Smith** (project leader)
- **Marcel Tanner** (policy)
- **Penelope Vounatsou** (geo-statistics)
- **Margrith Slaoui** (support staff)
- **Allan Saul** (NIH)
- **Ian Hastings** (LSTM) drug resistance modeling
- **Allan Schapira** (policy etc.)
- **Michael Bretscher** (modelling)
- **Blaise Genton** (Clinical Epi.)
- **Financial support**
  - Bill & Melinda Gates Foundation, Swiss National Science Foundation