LIVERPOOL SCHOOL OF TROPICAL MEDICINE

and the

malaria atlas project

Spatiotemporal Patterns of Insecticide Resistance

Mike Coleman

Insecticide Resistance

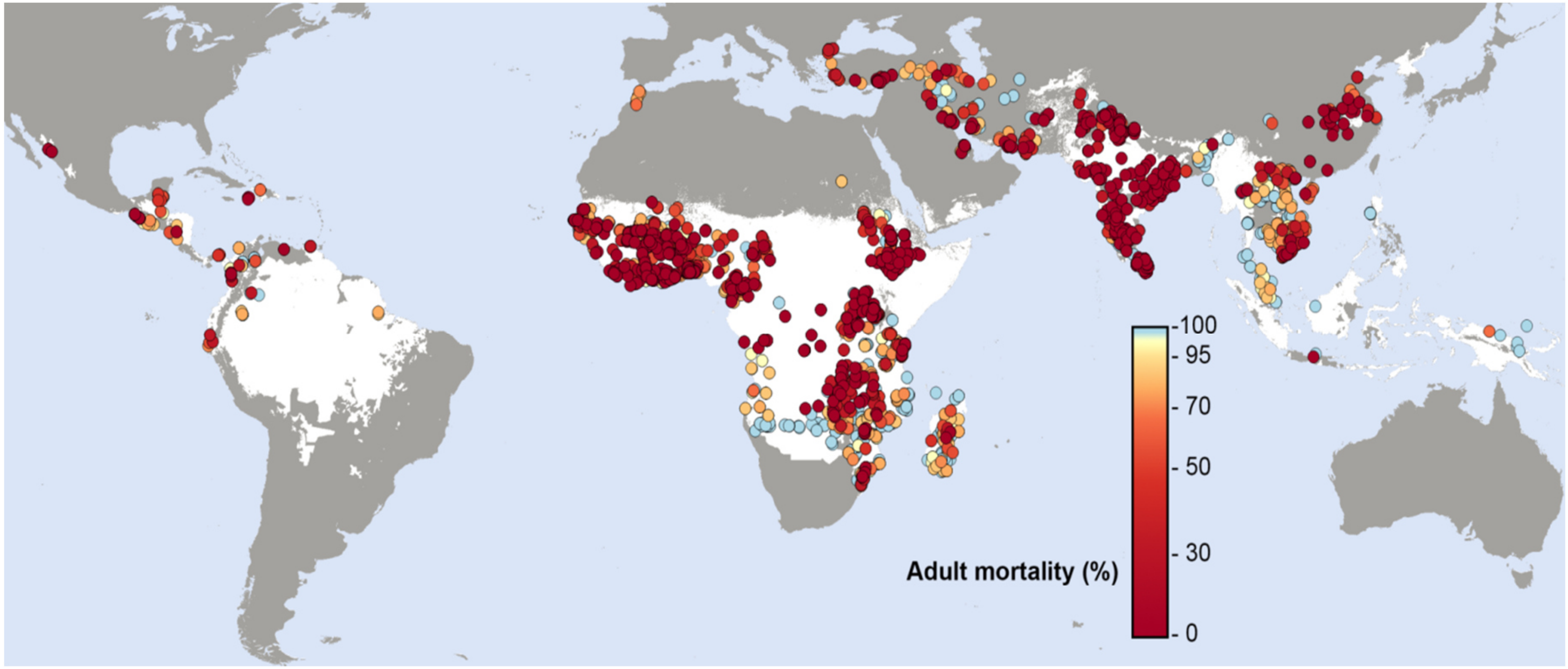
Insecticide resistance amongst vector species is currently threatening vector control, by reducing the efficacy of the limited number of insecticides available to control the vectors.

How do we deal with this?

A key question is “What is the scale of the problem?”

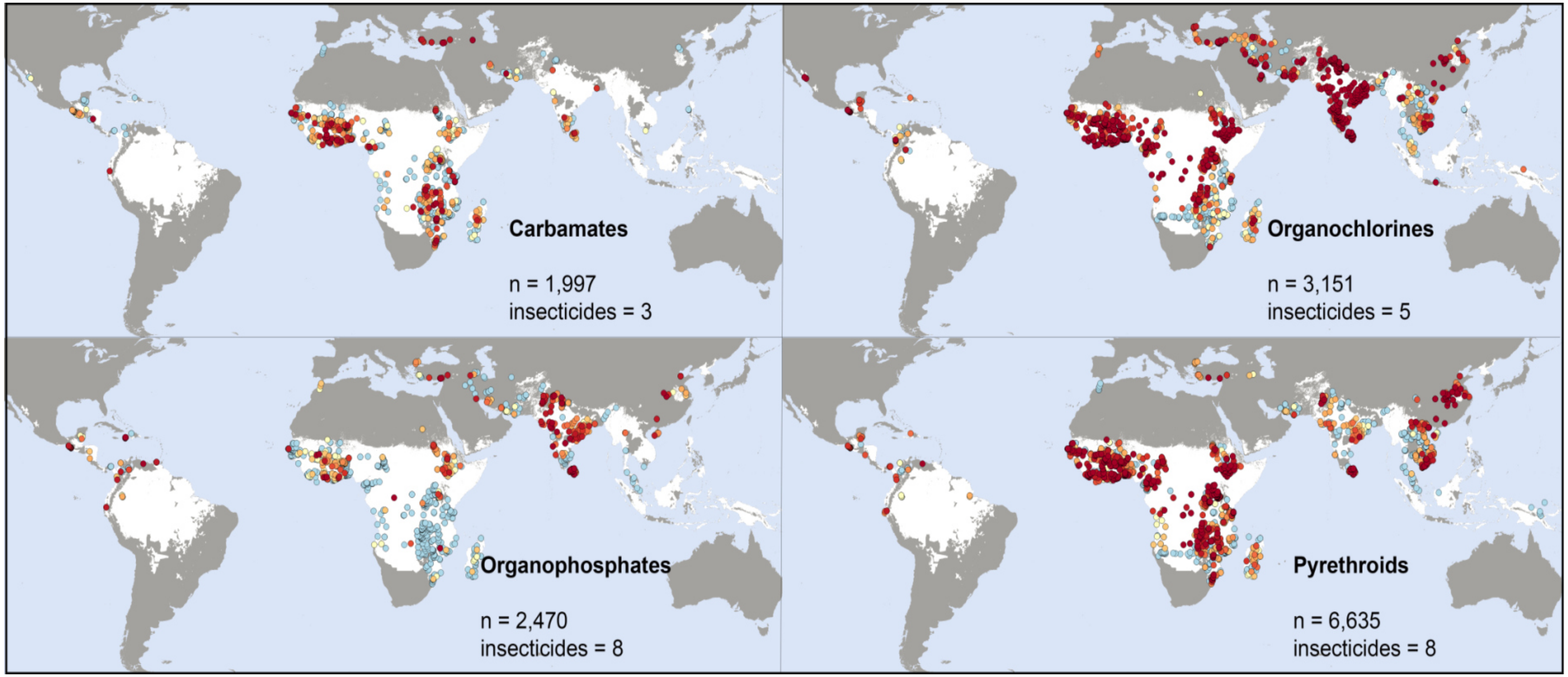
Global Maps

Substantial data requirements

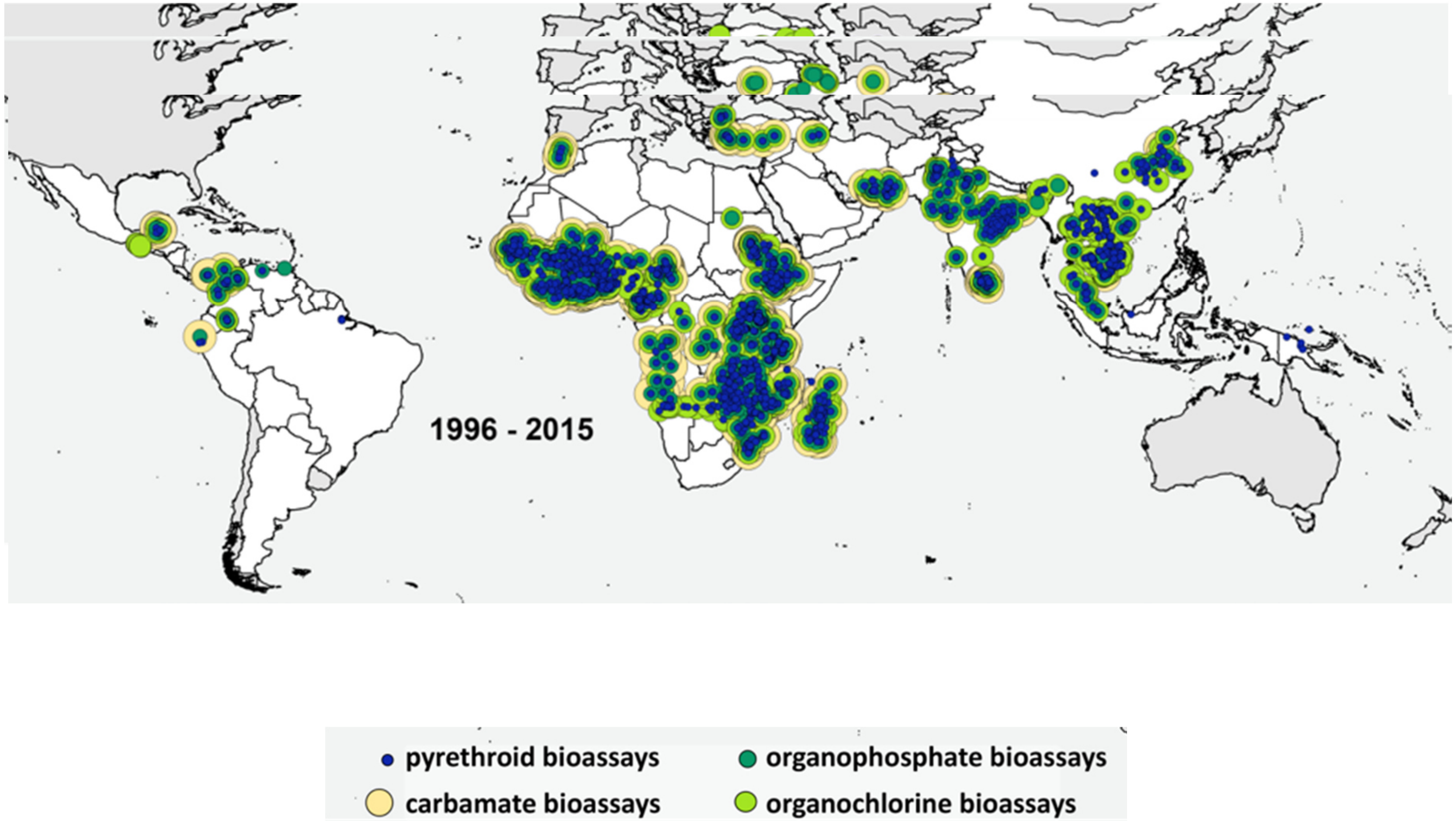


n = 14,473

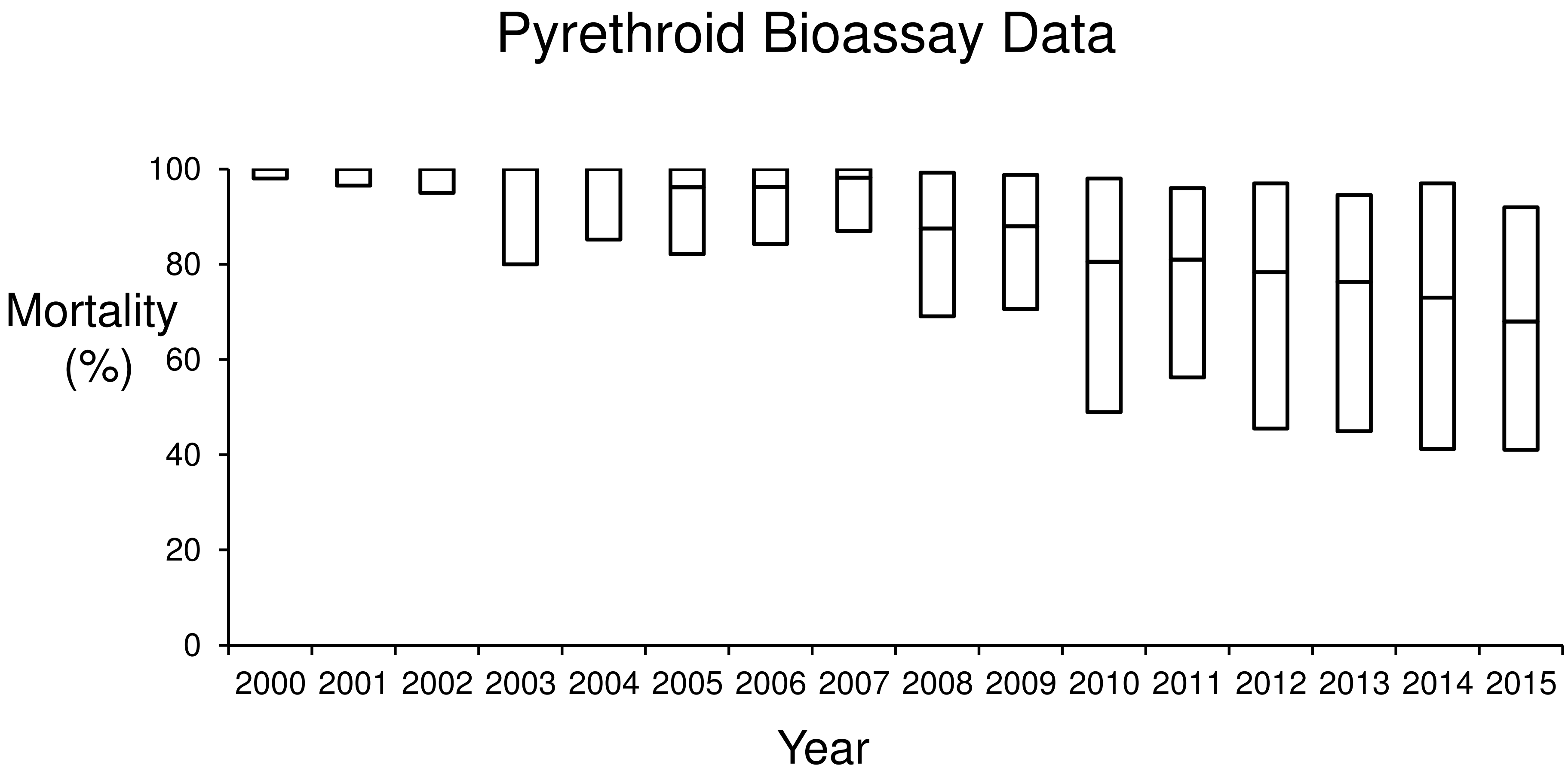
Data by class



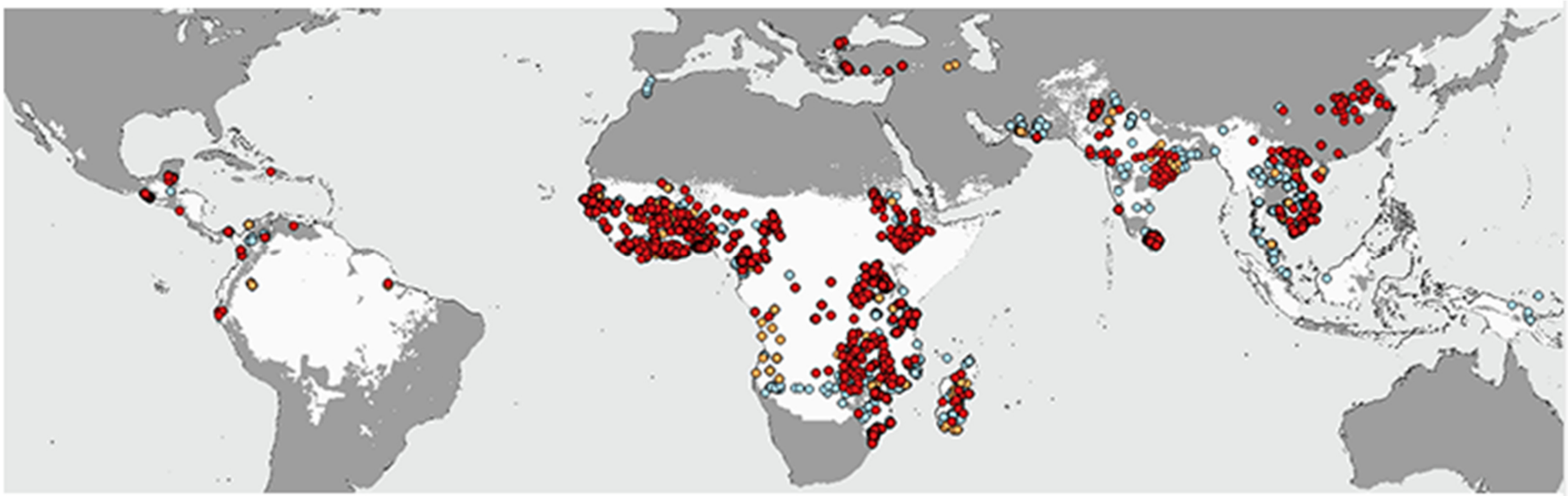
Temporal Trends in Reporting



Temporal Trends

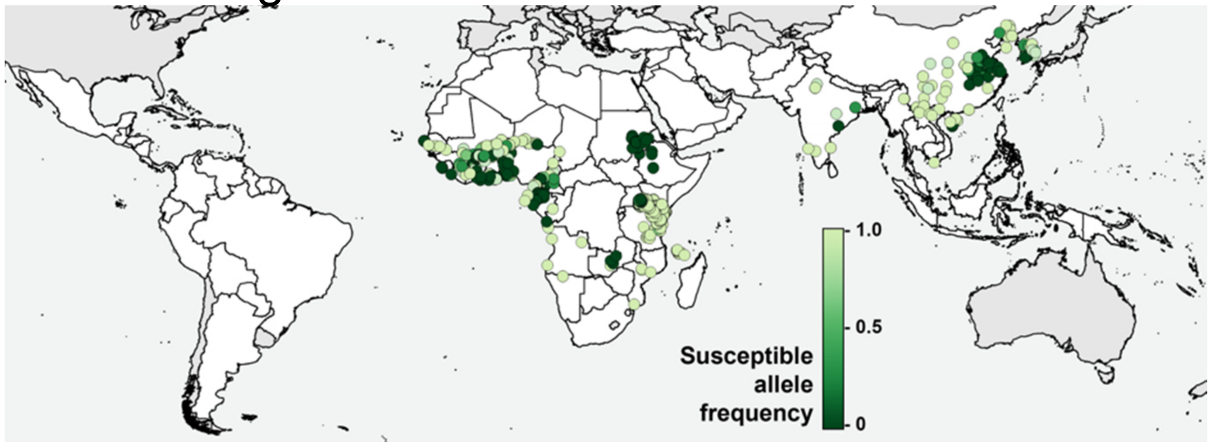


Pyrethroid Resistance

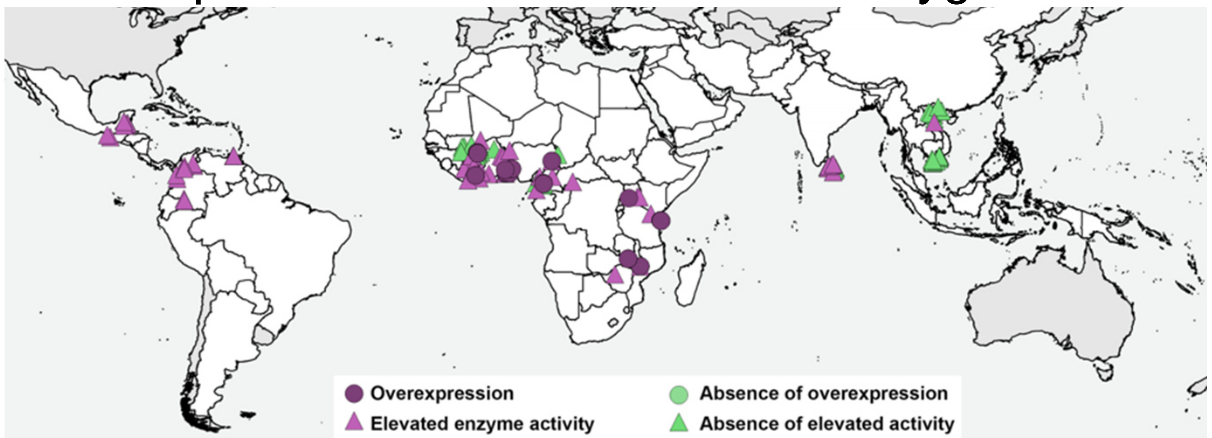


Pyrethroid resistance mechanisms

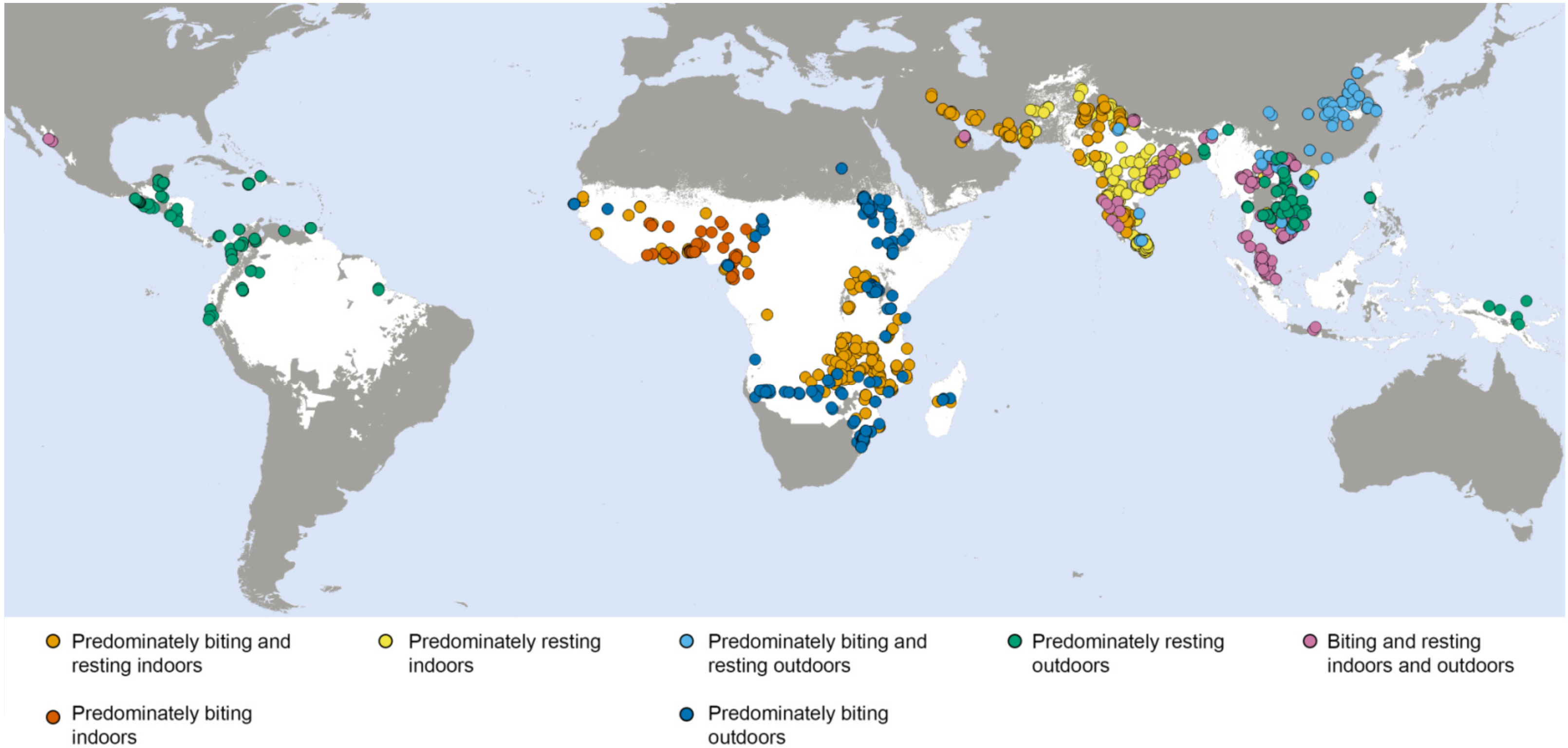
Altered target site



Over expression / elevation of monooxygenase



Species class



n = 14,473

no. species/complexes = 74

no. data points for species with behaviour data = 6,421

AIM of MAP-IR

Aim is to characterise spatiotemporal patterns of resistance in different regions of the world using a Bayesian geostatistical approach:

- produce regional maps of insecticide resistance for malaria vectors;
- investigate the drivers of selection, such as insecticide and pesticide coverage and environmental factors, using a cartographic approach;
- generate estimates for variation in resistance, bounded by a measure of uncertainty, that can be combined with estimates of the impact of insecticide resistance.

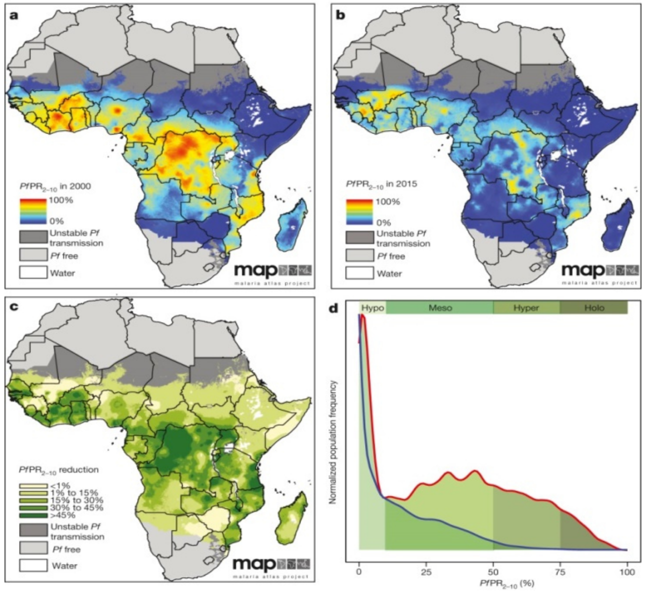
And we will release the data that goes into these models and the predictions produced by them.

Filling in gaps

A Bayesian geostatistical model

Our <u>starting point </u>is a Bayesian geostatistical model previously used to analyse *Plasmodium falciparum* prevalence.

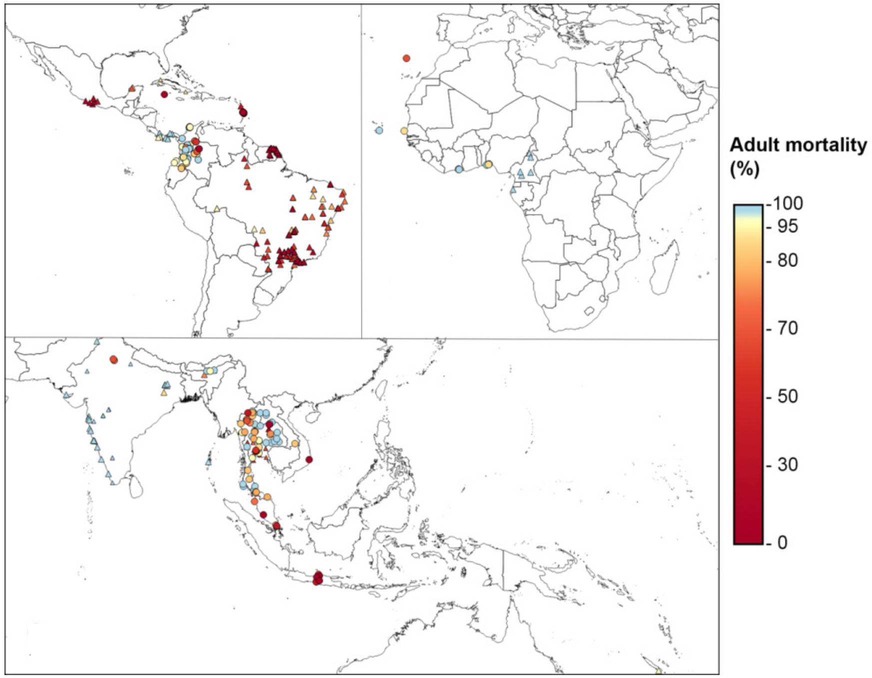
This model and large volumes of parasite prevalence data were used to estimate variation in space and time.



Bhatt S, Weiss DJ, Mappin B, Dalrymple U, Cameron E, Bisanzio D, Smith DL, Moyes CL, Tatem AJ, Lynch M, Fergus CA, Yukich J, Bennett A, Eisele TP, Kolaczinski J, Cibulskis RE, Hay SI and Gething PW (2015) **Coverage and system efficiencies of insecticide-treated nets in Africa from 2000 to 2017**. *eLife*, e09672.

Insecticide resistance in other vectors

Deltamethrin resistance in adult *Aedes aegypti.*



Many to thank

Funded by the Wellcome Trust

The core team: Penelope Hancock, Antoinette Wiebe, Katherine Gleave, Janet Hemingway, Michael Coleman, Peter Gething, Catherine Moyes and colleagues

The data contributors: Mustafa Akiner; Lai Yee Ho; Lorenzo Caceres; Sylvie Manguin; Katrijn Verhaeghen; Anges Yadouleton, Vincent Corbel, Darjaniva Molina, Halil Kasap, Hafiz Tahir, Qi Gao, Bilali Kabula, Manisha Kulkarni, Arthur Sovi, Dawn Wesson, Basil Brooke, Martin Donnelly, Si Hyeock Lee, Chris Drakeley, Theeraphap Chareonviriyaphap, Caterina Fanello, Fiacre Agossa, Sovannaroth Siv, Axel Kroeger, Abdoulaye Diabate, Rosa Patricia Penilla, Pradya Somboon, Peter Rawlings, Michael Bangs, Nicolas Pocquet, Richard Reithinger, Jocelyn Ratovonjato, Ashwani Kumar, Christophe Antonio-Nkondjio, Gil Germain Padonou, Eliningaya Kweka, Hitoshi Kawada, Alessandra della Torre, Nora Besansky, Narumon Komalamisra, Maureen Coetzee, Innocent Djegbe, Kamaraju Raghavendra, Marc Coosemans, Mouhamadou Chouaibou, Roch Dabire, Hilary Ranson, Sara Abuelmaali, Manisha Kulkarni, Lizette Koekemoer, Frederic Simard, Chafika Faraj, Devika Perera, Danial Boakye, Kwadwo Kyereme Frempong, Saleem Rana, Craig Wilding, David Weetman, Eric Ochomo, Jacob Riveron, Christen Fornadel, Charles Wondji, Americo Rodriguez, Geraldine Foster, Laura Norris, Charles Mbogo, Dereje Dengela, Aklilu Seyoum **and everyone who has published their data**.