Supporting Information: S2 Text

Detecting the impact of temperature on transmission of Zika, dengue and chikungunya using mechanistic models

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Tables A-D

Table A. Data used in the *Ae. albopictus* R_0 model. Each trait parameter symbol, definition, data sources, and thermal response function (Quad = quadratic) are shown on the left. Mean and 95% credible interval (95% HPD interval) for the critical thermal minimum (T_0), maximum, (T_m), and a rate constant (c) are given for each trait in the three right sections. * indicates unpublished data provided by Francis Ezeakacha.

Trait	Definition	Refs	Function	T_0			T_m			c		
				Mean	95% CI		Mean	95% CI		Mean	95% CI	
a	biting rate, calculated as reciprocal of oviposition cycle length (1/days)	(8)	Brière	10.25	5.84	14.82	38.32	36.60	40.51	1.93E-04	1.27E-04	2.61E-04
TFD	eggs laid per female per gonotrophic cycle (number/female)	(8,9)	Brière	8.02	3.18	13.08	35.65	35.00	36.51	4.88E-02	3.21E-02	6.72E-02
pEA	mosquito egg-to-adult survival probability	(8,10–13)	Quad	9.04	6.37	11.67	39.33	37.17	41.62	-3.61E-03	-4.74E-03	-2.59E-03
MDR	mosquito egg-to-adult development rate (1/days)	(8–11,13–17)*	Brière	8.60	4.43	12.29	39.66	37.78	41.70	6.38E-05	4.67E-05	8.23E-05
lf	mosquito adult lifespan (days)	(9,14,18)	Quad	13.41	10.53	16.11	31.51	29.14	33.57	-1.43E+00	-2.16E+00	-6.89E-01
b	probability that a mosquito infected with DENV becomes infectious (has virus in the salivary glands)	(19)	Brière	15.84	11.42	19.87	36.40	36.00	36.93	7.35E-04	4.36E-04	1.04E-03
c	probability that a mosquito fed on DENV-infected blood becomes infected	(19)	Brière	3.62	0.00	9.90	36.82	36.00	37.88	4.39E-04	3.29E-04	5.66E-04
PDR	DENV extrinsic incubation rate (reciprocal of the extrinsic incubation period: the time required	(19)	Brière	10.39	2.82	17.60	43.05	37.54	49.56	1.09E-04	5.45E-05	1.76E-04

for an exposed mosquito to become infectious; 1/days)			

Table B.

Data used in the *Ae. aegypti* R_0 model. Each trait parameter symbol, definition, data sources, and thermal response function (Quad = quadratic) are shown on the left. Mean and 95% credible interval (95% HPD interval) for the critical thermal minimum (T_0), maximum, (T_m), and a rate constant (c) are given for each trait in the three right sections.

Trait	Definition	Refs	Function	T_0			T_m			c		
				Mean	95% CI		Mean	95% CI		Mean	95% CI	
a	biting rate, calculated as reciprocal of oviposition cycle length (1/days)	(1,20)	Brière	13.35	8.27	17.41	40.08	40.00	40.28	2.02E-04	1.20E-04	2.80E-04
EFD	eggs laid per female per day (number/female/day)	(21,22)	Brière	14.58	8.08	20.60	34.61	34.00	35.77	8.56E-03	3.78E-03	1.41E-02
pEA	mosquito egg-to-adult survival probability	(10,23–26)	Quad	13.56	12.56	14.51	38.29	37.54	39.02	-5.99E-03	-6.82E-03	-5.13E-03
MDR	mosquito egg-to-adult development rate (1/days)	(10,23–27)	Brière	11.36	7.19	15.03	39.17	39.00	39.54	7.86E-05	5.75E-05	9.93E-05
lf	mosquito adult lifespan (days)	(21,22)	Quad	9.16	6.69	12.33	37.73	35.68	39.89	-1.48E-01	-2.06E-01	-9.77E-02
b	probability that a mosquito infected with DENV becomes infectious (has virus in the salivary glands)	(28–30)	Brière	17.05	12.56	21.26	35.83	35.06	36.69	8.49E-04	5.07E-04	1.20E-03
c	probability that a mosquito fed on DENV-infected blood becomes infected	(28,30)	Brière	12.22	5.61	17.76	37.46	35.70	39.29	4.91E-04	3.33E-04	6.41E-04
PDR	DENV extrinsic incubation rate (reciprocal of the extrinsic incubation period: the time required for an exposed mosquito to become infectious; 1/days)	(28,30–34)	Brière	10.68	3.86	18.33	45.90	39.73	52.92	6.65E-05	3.60E-05	1.09E-04

Table C.

Aedes spp. trait thermal response data used to generate informative priors for the main *Ae. albopictus* and *Ae. aegypti* R_0 models. Mean and 95% credible interval (95% HPD interval) for the critical thermal minimum (T_0), maximum, (T_m), and a rate constant (c) are given for each trait in the three right sections.

Trait	Definition	Refs	Function	T_0			T_m			c		
				Mean	95% CI		Mean	95% CI		Mean	95% CI	
a	biting rate, calculated as reciprocal of oviposition cycle length (1/days)	(18)	Brière	14.67	10.67	18.34	41.00	37.56	44.99	2.71E-04	1.59E-04	4.09E-04
EFD	eggs laid per female per day (number/female/day)	(35)	Brière	14.06	11.32	16.60	32.03	30.95	33.35	2.08E-02	1.36E-02	2.89E-02
pEA	mosquito egg-to-adult survival probability	(36)	Quad	7.68	6.48	8.90	38.31	36.99	39.57	-3.36E-03	-4.02E-03	-2.72E-03
MDR	mosquito egg-to-adult development rate (1/days)	(35, 36)	Brière	15.12	9.56	19.93	37.67	36.54	38.45	1.49E-04	8.59E-05	2.17E-04
lf	mosquito adult lifespan (days)	(35)	Quad	16.63	15.93	17.25	31.85	31.16	32.64	-1.24E+00	-1.50E+00	-9.76E-01
b	probability that a mosquito infected with flavivirus becomes infectious (has virus in the salivary glands)	(37)	Brière	12.05	8.18	15.09	32.79	32.02	34.32	9.86E-04	5.97E-04	1.34E-03
c	probability that a mosquito fed on flavivirus-infected blood becomes infected	(37)	Brière	1.51	0.00	4.11	34.74	32.87	37.18	5.23E-04	4.10E-04	6.32E-04
PDR	WNV, SLEV, WEEV extrinsic incubation rate (reciprocal of the extrinsic incubation period: the time required for an exposed mosquito to become infectious; 1/days)	(38)	Brière	11.50	3.43	18.55	38.97	33.08	45.00	1.04E-04	3.79E-05	1.93E-04

Table D.

Generalized linear models used to validate the $R_0(T)$ model. Presence/absence models used a Binomial distribution and incidence models used a Gamma distribution. "- DEN" indicates that separate y-intercepts were not fit for DENV versus CHIKV/ZIKV (only interaction terms). Abbreviations used in the table are listed below.

Presence/Absence Models

model	formula	BIC	Model prob.	D^2	OOS model prob.	OOS classification error (DENV)	OOS classification error (CHIKV & ZIKV)
PA1	pa ~ lpop*DEN - DEN	1444	0	0.382	0	0.224	0.309
PA2	pa ~ (propTGDP + lGDP +lpop)*DEN - DEN	1644	0	0.469	0	0.142	0.434
PA3	pa ~ (R0.GR0+lpop)*DEN - DEN	1465	0	0.461	0	0.093	0.338
PA4	pa ~ (R0.GR0 + propTGDP+ lGDP+lpop)*DEN - DEN	1375	0.008	0.505	0.01	0.118	0.342
PA5	pa ~ R0.GR0 + propTGDP + (lGDP+lpop)*DEN - DEN	1365	0.992	0.503	0.99	0.12	0.351
PA6	pa ~ R0.GR0.alt*DEN - DEN	1455	0	0.432	0	0.096	0.337

Incidence Models

model	formula	BIC	Model prob.	D^2	OOS model prob.	OOS mean absolute percentage error
IM1	l.inc ~ lpop*DEN-DEN	2593	0	0.465	0	0.169
IM2	l.inc ~ (propTGDP + lGDP +lpop)*DEN-DEN	2559	0	0.506	0	0.169
IM3	l.inc ~ (R0 +lpop)*DEN-DEN	2484	0	0.55	0	0.148
IM4	l.inc ~ (lR0.alt)*DEN-DEN	2433	0.052	0.595	0.058	0.14
IM5	l.inc ~ (R0 + propTGDP + lGDP + lpop)*DEN-DEN	2427	0.948	0.595	0.942	0.14
IM6	l.inc ~ (R0 + propTGDP + lpop)*DEN + lGDP -DEN	2501	0	0.531	0	0.153

Model terms and abbreviations

OOS = out-of-sample

BIC = Bayesian Information Criterion

Model prob. = model probability based on BIC

D^2 = deviance explained

pa = presence-absence

lpop = log(population size)

DEN = indicator of DENV (DEN = 1) or CHIKV or ZIKV (DEN = 0); -DEN indicates that the main effect for this term was not included

lGDP = log(gross domestic product)

propTGDP = proportion of GDP in tourism

R0.GR0 = Prob($R_0(T) > 0$)

R0.GR0.alt = Prob($R_0(T) > 0$) * log(population size)

l.inc = log(incidence) for incidence > 0

R0 = $R_0(T)$

lR0.alt = log($R_0(T)$ * population size)