

Spatial patterns and climate drivers of malaria in three border areas of Brazil, Venezuela and Guyana, 2016-2018

Kinley Wangdi^{1*‡}, Erica Wetzler^{2‡}, Horace Cox³, Paola Marchesini⁴, Leopoldo Villegas^{5,6}, Sara Canavati²

¹Department of Global Health, Research School of Population Health, ANU College of Health and Medicine, The Australian National University, Canberra, ACT 2601, Australia

²World Vision US, 34834 Weyerhaeuser Way South, Federal Way, Washington, USA

³Vector Borne Diseases Unit, Guyana Ministry of Health, Georgetown, Guyana

⁴Department of Surveillance for Zoonotic and Vector Borne Diseases, Malaria Technical Group, Ministry of Health, Brasilia, Federal District, Brazil

⁵Global Development One, Silver Spring, Maryland, USA

⁶Asociación Civil Impacto Social (ASOCIS), Tumeremo, Bolívar, Venezuela

*Corresponding author

‡Contributed equally

Email:

KW: kinley.wangdi@anu.edu.au

EW: ewetzler@worldvision.org

HC: horacecox17@yahoo.com

PM: paola.b.marchesini@gmail.com

LV: leopoldovillegas2@gmail.com

SC: saracनावati@yahoo.com

Table S1 Climatic variable selection for *Plasmodium falciparum*

Variables	IRR	p value	AIC	BIC
No lag				
Precipitation	0.998	<0.0001	674515.8	674525.8
Max Temperature	1.54	<0.0001	623912.600	623922.600
Min Temperature	1.295899	<0.0001	660840.000*	660850.000
One month lag				
Rainfall	0.998	<0.0001	671545.300	671555.300
Max Temperature	1.555015	<0.0001	622373.400*	622383.400
Min Temperature	1.290	<0.0001	661860.900	661870.900
Two months lag				
precipitation	0.998	<0.0001	668456.400	668466.300
Max Temperature	1.540	<0.0001	624538.300	624548.300
Min Temperature	1.260	<0.0001	664491.100	664501.100
Three months lag				
Precipitation	0.997	<0.0001	665186.600	665196.600
Max Temperature	1.480	<0.0001	634759.200	634769.200
Min Temperature	1.200	<0.0001	670260.600	670270.500
Four Months lag				
Precipitation	0.997	<0.0001	662514.8	662524.7
Max Temperature	1.45	<0.0001	640588.2	640598.1
Min Temperature	1.17	<0.0001	672939.7	672949.7
Five Months lag				
Precipitation	0.997	<0.0001	659744.1	659754.1
Max Temperature	1.38	<0.0001	648039.2	648049.2
Min Temperature	1.13	<0.0001	675413	675423
Six Months lag				
Precipitation	0.997	<0.0001	659353.8*	659363.7
Max Temperature	1.37	<0.0001	649486.3	649496.2
Min Temperature	1.11	<0.0001	676688.1	676698
Seven Months lag				
Precipitation	0.997	<0.0001	662459.3	662469.3
Max Temperature	1.3	<0.0001	658377.5	658387.4
Min Temperature	1.07	<0.0001	678341	678350.9
Eight Months lag				
Precipitation	0.997	<0.0001	670093.6	670103.5
Max Temperature	1.23	<0.0001	665825.3	665835.3
Min Temperature	1.03	<0.0001	679248.2	679258.2

*selected

Table S2 Climatic variable selection for *Plasmodium vivax*

Variables	IRR	p value	AIC	BIC
No lag				
Precipitation	0.99998	0.124	1467283	1467293
Max Temperature	0.89	<0.0001	1454771	1454781
Min Temperature	0.78	<0.0001	1394461	1394471
One month lag				
Precipitation	0.99997	<0.0001	1466769	1466779
Max Temperature	0.87	<0.0001	1448302*	1448312
Min Temperature	0.77	<0.0001	1390713	1390723
Two months lag				
Precipitation	0.9997	<0.0001	1465688	1465697
Max Temperature	0.87	<0.0001	1447754	1447764
Min Temperature	0.78	<0.0001	1393519	1393529
Three months lag				
Precipitation	0.9993	<0.0001	1462814	1462824
Max Temperature	0.88	<0.0001	1450183	1450193
Min Temperature	0.78	<0.0001	1394141	1394151
Four months lag				
Precipitation	0.9988	<0.0001	1457381	1457391
Max Temperature	0.89	<0.0001	1452784	1452794
Min Temperature	0.76	<0.0001	1392708	1392718
Five Months lag				
Precipitation	0.999	<0.0001	1453769	1453779
Max Temperature	0.7	<0.0001	1453275	1453285
Min Temperature	0.77	<0.0001	1389959	1389969
Six Months lag				
Precipitation	0.998	<0.0001	1449901*	1449910
Max Temperature	0.9	<0.0001	1453505	1453515
Min Temperature	0.77	<0.0001	1388966*	1388976
Seven Months lag				
Precipitation	0.999	<0.0001	1454306	1454316
Max Temperature	0.89	<0.0001	1451233	1451243
Min Temperature	0.78	<0.0001	1393242	1393252

*Selected variable

Table S3 Collinearity assessment of selected variables for *P. falciparum*

VIF		
Maximum Temperature lagged one month	2.17	0.461
Minimum Temperature lagged six months	2.04	0.491
Precipitation lagged six months	1.17	0.857
Mean VIF	2	

Table S4 Collinearity assessment of selected variables for *P. vivax*

VIF		
Maximum Temperature lagged one month	1.66	0.603752
Minimum Temperature lagged six months	1.55	0.644147
Precipitation lagged six months	1.1	0.906167
Mean VIF	1.44	

Table S5 Summary table of climatic variables

Climatic variable	Mean	Standard deviation	Minimum	Maximum
Precipitation	150.5	107.6	1.1	413.6
Minimum temperature	21.9	1.4	16.9	24.6
Maximum temperature	31.1	1.3	26.8	35.2