

## Supplementary Material for Impact of climate and mosquito vector abundance on sylvatic arbovirus circulation dynamics in Senegal

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### Additional Cross-Correlations

Figure S1 shows cross-correlations between *Ae. fuscifer* and *Ae. taylori* since 1990 are only significant up to one year lag. Figures S2-S5 show cross-correlations between DENV, YFV, CHIKV, and ZIKAV each with *Ae. fuscifer* and *Ae. taylori* and with *Ae. luteocephalus*. We see little statistically significant cross-correlations.

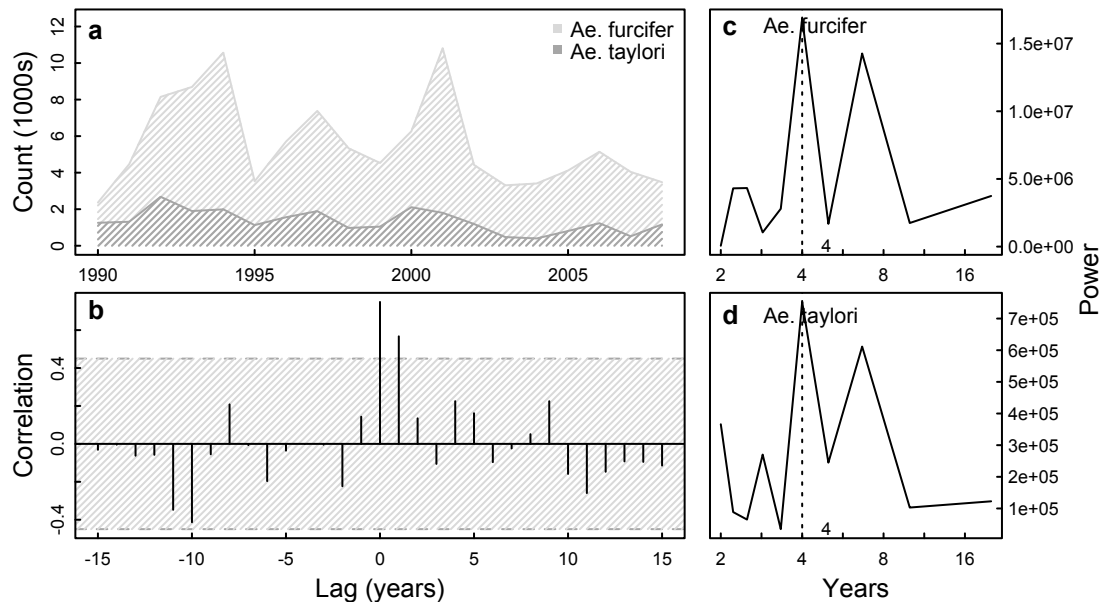


Figure S1: **Cross-Correlation of YFV Isolates and Other Virus Isolates** Figure shows time series of YFV isolates compared to the other virus isolates over time (panels a, c, e) with corresponding cross-correlation plots (panels b, d, e). Hatched area in panels b, d, e indicate 95% confidence interval for correlation, assuming an underlying white noise process [1]. We see significant cross-correlation between YFV and CHIKV at 1 year and 8 year lags, and at 2 and - 5 year lags for ZIKAV.

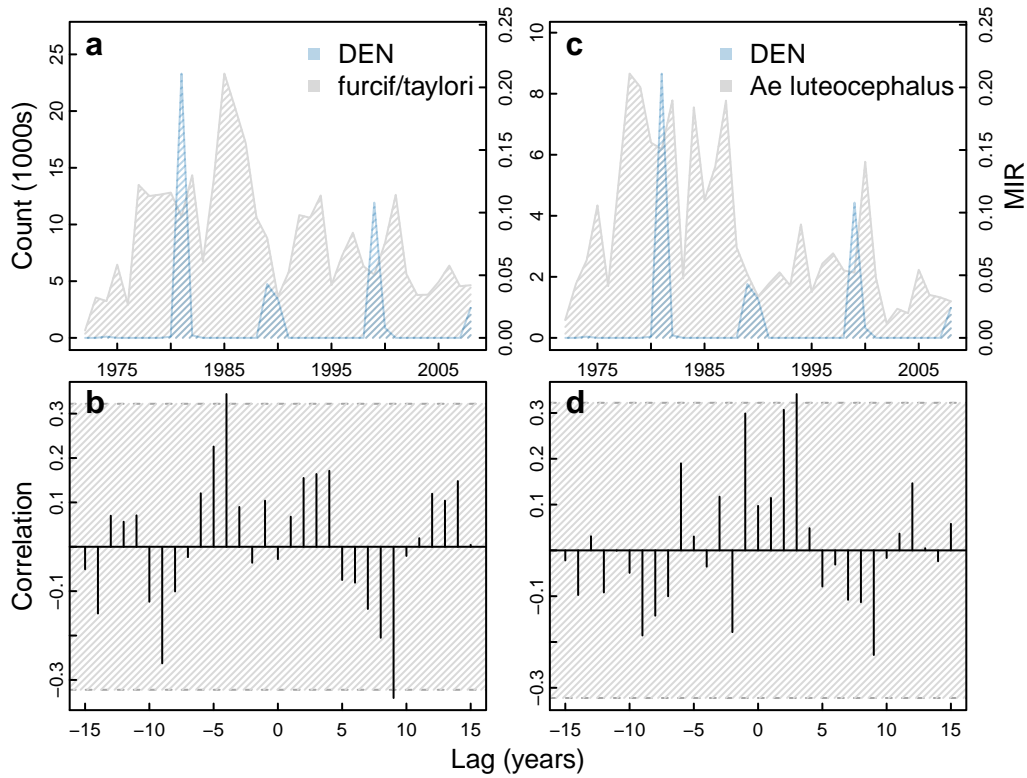


Figure S2: **Cross-Correlation of DENV Isolates with Virus Isolates** Figure shows time series of DENV isolates compared to abundances of *Ae. furcifer* and *Ae. taylori* (panel a) and *Ae. luteocephalus* (panel c) with corresponding cross-correlation plots (panels b, d). Hatched area in panels b and d indicate 95% confidence interval for correlation, assuming an underlying white noise process [1].

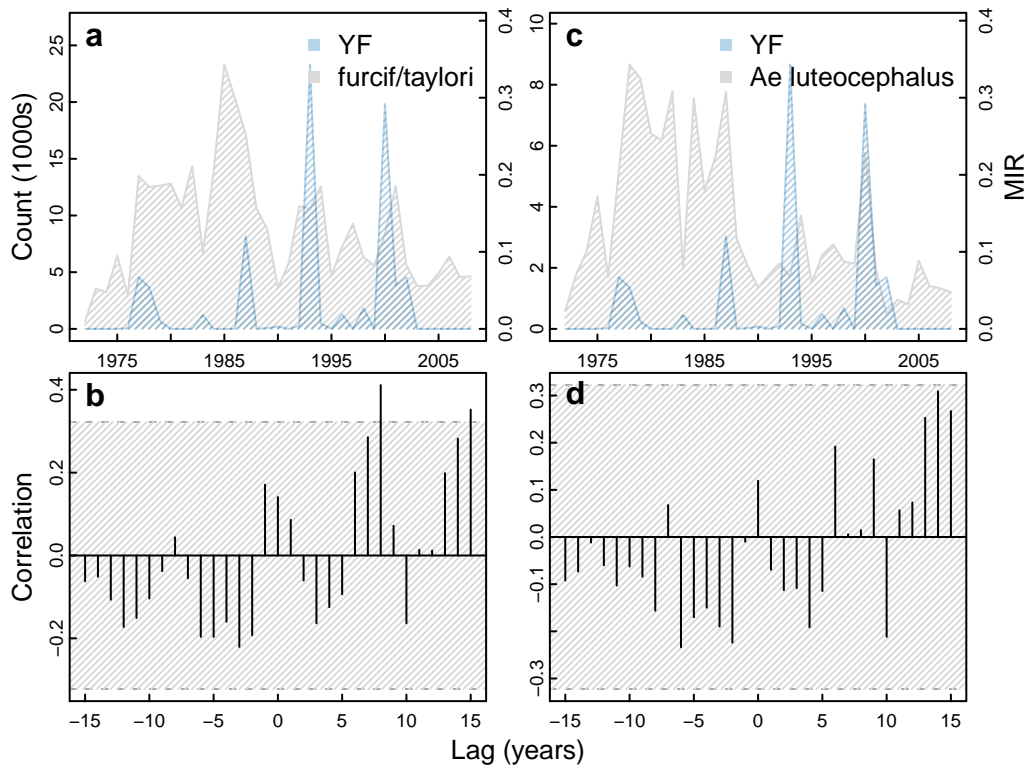


Figure S3: **Cross-Correlation of YFV Isolates with Virus Isolates** Figure shows time series of YFV isolates compared to abundances of *Ae. furcif* and *Ae. taylori* (panel **a**) and *Ae. luteocephalus* (panel **c**) with corresponding cross-correlation plots (panels **b**, **d**). Hatched area in panels **b** and **d** indicate 95% confidence interval for correlation, assuming an underlying white noise process [1].

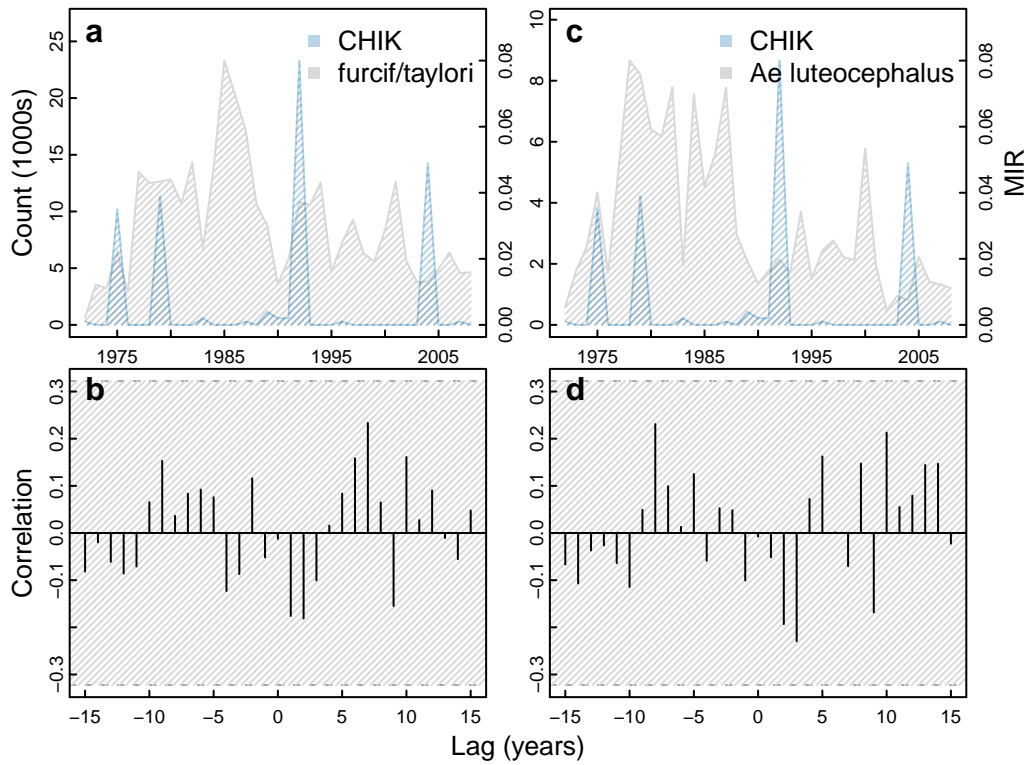


Figure S4: **Cross-Correlation of CHIKV Isolates with Virus Isolates** Figure shows time series of CHIKV isolates compared to abundances of *Ae. furcifer* and *Ae. taylori* (panel **a**) and *Ae. luteocephalus* (panel **c**) with corresponding cross-correlation plots (panels **b**, **d**). Hatched area in panels **b** and **d** indicate 95% confidence interval for correlation, assuming an underlying white noise process [1].

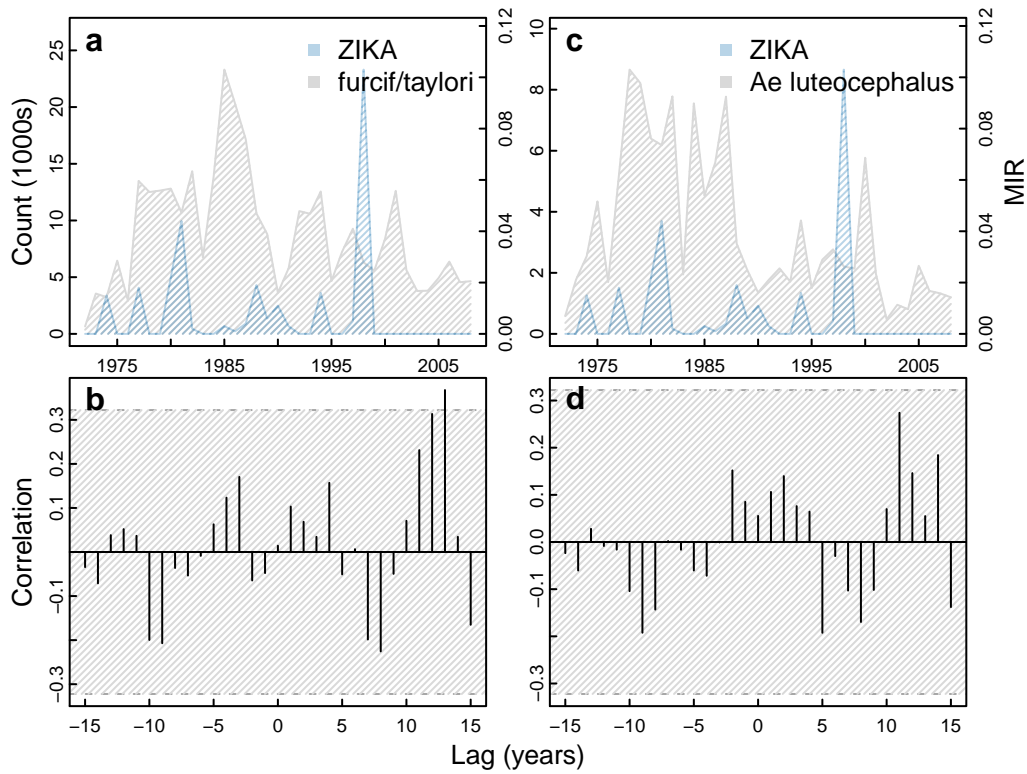


Figure S5: **Cross-Correlation of ZIKAV Isolates with Virus Isolates** Figure shows time series of ZIKAV isolates compared to abundances of *Ae. furcif* and *Ae. taylori* (panel **a**) and *Ae. luteocephalus* (panel **c**) with corresponding cross-correlation plots (panels **b**, **d**). Hatched area in panels **b** and **d** indicate 95% confidence interval for correlation, assuming an underlying white noise process [1].

## Associations in Wet and Dry Seasons

Tables 1– 4 present the results of regressions identical to those presented in the main text but with climate variables summarized over the wet (June through October) and dry (November through May) seasons. Little difference is seen between the regressions in the main text and those split into seasons due to the mosquito counts and viral isolations are aggregated at the yearly level.

	<i>Ae. furcifer</i> & <i>taylori</i>		<i>Ae. luteocephalus</i>	
	Estimate	95% CI	Estimate	95% CI
Intercept	4576.186	(3129.061, 6607.123)	1570.945	(1072.768, 2299.942)
Lag Count (per 1000)	<b>1.063</b>	<b>(1.027, 1.103)</b>	<b>1.165</b>	<b>(1.067, 1.272)</b>
Sum Rain (In.)	1.008	(0.992, 1.025)	1.009	(0.987, 1.031)
Relative humidity	0.958	(0.905, 1.016)	<b>0.911</b>	<b>(0.843, 0.986)</b>
Mean Temp (C°)	0.893	(0.703, 1.139)	<b>0.708</b>	<b>(0.526, 0.966)</b>

Table 1: **Drivers of Mosquito Abundance in the Wet Season** The results of a Bayesian hierarchical over-dispersed Poisson regression with *Ae. furcifer/taylori* and *Ae. luteocephalus* mosquito abundance as the count, the mosquito count from the previous year (lag, in 1000s), total rainfall, the mean temperature, and relative humidity over the wet season (June–October). Data were mean-centered to aid interpretation. The intercept corresponds to the expected number of *Ae. furcifer/taylori* or *Ae. luteocephalus* in a year with mean counts of mosquitoes in the previous wet season, mean amounts of rain, temperature, and relative humidity. Statistically significant coefficients are denoted in bold face.

	<i>Ae. furcifer</i> & <i>taylori</i>		<i>Ae. luteocephalus</i>	
	Estimate	95% CI	Estimate	95% CI
Intercept	4602.889	(3206.310, 6672.129)	1483.877	(1031.101, 2123.198)
Lag Count (per 1000)	<b>1.063</b>	<b>(1.026, 1.099)</b>	<b>1.187</b>	<b>(1.088, 1.288)</b>
Sum Rain (In.)	1.026	(0.986, 1.068)	1.053	(0.999, 1.109)
Relative humidity	0.954	(0.900, 1.013)	<b>0.901</b>	<b>(0.836, 0.971)</b>
Mean Temp (C°)	0.885	(0.701, 1.118)	<b>0.680</b>	<b>(0.511, 0.903)</b>

Table 2: **Drivers of Mosquito Abundance in the Dry Season** The results of a Bayesian hierarchical over-dispersed Poisson regression with *Ae. furcifer/taylori* and *Ae. luteocephalus* mosquito abundance as the count, the mosquito count from the previous year (lag, in 1000s), total rainfall, the mean temperature, and relative humidity over the dry season (November–May). Data were mean-centered to aid interpretation. The intercept corresponds to the expected number of *Ae. furcifer/taylori* or *Ae. luteocephalus* in a year with mean counts of mosquitoes in the previous dry season, mean amounts of rain, temperature, and relative humidity. Statistically significant coefficients are denoted in bold face.

	DENV		YFV	
	Estimate	95% CI	Estimate	95% CI
Intercept	1.88e-05	(3.96e-06, 6.08e-05)	9.20e-05	(3.34e-05, 0.000215)
Ae. furcifer	0.217	(0.00783, 5.84)	0.220	(0.00807, 5.93)
Ae. furcifer & Ae. taylori	<b>0.181</b>	<b>(0.0401, 0.541)</b>	<b>0.295</b>	<b>(0.107, 1.00)</b>
Ae. taylori	0.219	(0.0109, 5.94)	0.214	(0.00711, 6.20)
Pre 1990	1.77	(0.337, 9.19)	0.748	(0.207, 2.62)
Sum Rain (In.)	<b>0.892</b>	<b>(0.815, 0.968)</b>	1.00	(0.938, 1.07)
Relative humidity	<b>0.734</b>	<b>(0.521, 0.962)</b>	0.988	(0.830, 1.19)
Mean Temp (C°)	0.359	(0.112, 1.01)	1.38	(0.608, 3.68)
DENV	–	–	<b>0.944</b>	<b>(0.865, 0.998)</b>
YFV	1.00	(0.973, 1.03)	–	–
CHIKV	<b>0.862</b>	<b>(0.682, 0.995)</b>	1.00	(0.925, 1.09)
ZIKAV	0.876	(0.721, 1.03)	1.05	(0.971, 1.13)
	CHIKV		ZIKAV	
	Estimate	95% CI	Estimate	95% CI
Intercept	1.92e-05	(5.26e-06, 5.97e-05)	2.04e-05	(5.26e-06, 6.20e-05)
Ae. furcifer	0.216	(0.00998, 6.50)	0.215	(0.00784, 6.70)
Ae. furcifer & Ae. taylori	<b>0.185</b>	<b>(0.0419, 0.576)</b>	<b>0.223</b>	<b>(0.0711, 0.708)</b>
Ae. taylori	0.216	(0.00842, 6.72)	0.217	(0.00883, 5.33)
Pre 1990	2.53	(0.469, 14.9)	<b>6.49</b>	<b>(1.58, 30.3)</b>
Sum Rain (In.)	1.06	(0.976, 1.15)	<b>1.15</b>	<b>(1.04, 1.29)</b>
Relative humidity	0.974	(0.779, 1.27)	0.880	(0.674, 1.10)
Mean Temp (C°)	1.03	(0.379, 3.46)	0.914	(0.324, 2.57)
DENV	0.992	(0.921, 1.05)	0.981	(0.948, 1.01)
YFV	<b>0.931</b>	<b>(0.849, 0.987)</b>	<b>0.960</b>	<b>(0.918, 0.992)</b>
CHIKV	–	–	0.866	(0.666, 1.00)
ZIKAV	0.859	(0.680, 1.01)	–	–

Table 3: **Drivers of Viral Isolations in the Wet Season** Table reports the results of a Bayesian hierarchical over-dispersed Poisson regression of viral isolations with mosquito abundance as the offset, species of mosquito as a categorical variable, total rainfall, mean temperature, and relative humidity in the wet season (June-October), and isolations of the other three viruses. Data were mean-centered to aid interpretation. The model intercepts correspond to the expected MIR of DENV, YFV, CHIKV, and ZIKAV, in *Ae. luteocephalus* over a wet season with average amounts of rain, temperature, and relative humidity, and no concurrent isolation of other viruses. Statistically significant coefficients are denoted in bold face.

	DENV		YFV	
	Estimate	95% CI	Estimate	95% CI
Intercept	1.21e-07	(3.33e-09, 3.07e-06)	0.000109	(4.23e-05, 0.000253)
Ae. furcifer	0.172	(0.00204, 10.3)	0.175	(0.00208, 9.64)
Ae. furcifer & Ae. taylori	<b>0.113</b>	<b>(0.0175, 0.372)</b>	<b>0.279</b>	<b>(0.0988, 0.963)</b>
Ae. taylori	0.176	(0.00315, 13.3)	0.174	(0.00191, 9.07)
Pre 1990	2.57	(0.462, 14.7)	0.646	(0.189, 2.19)
Sum Rain (In.)	<b>0.0649</b>	<b>(0.0169, 0.233)</b>	<b>0.868</b>	<b>(0.756, 0.989)</b>
Relative humidity	0.800	(0.576, 1.04)	1.02	(0.871, 1.22)
Mean Temp (C°)	0.361	(0.100, 1.07)	1.49	(0.682, 3.57)
DENV	–	–	<b>0.944</b>	<b>(0.865, 0.998)</b>
YFV	1.01	(0.979, 1.04)	–	–
CHIKV	0.896	(0.664, 1.06)	1.01	(0.931, 1.08)
ZIKAV	0.888	(0.739, 1.01)	1.05	(0.981, 1.12)

	CHIKV		ZIKAV	
	Estimate	95% CI	Estimate	95% CI
Intercept	2.37e-05	(6.47e-06, 6.79e-05)	1.57e-05	(3.95e-06, 4.97e-05)
Ae. furcifer	0.173	(0.00234, 7.13)	0.179	(0.00257, 15.9)
Ae. furcifer & Ae. taylori	<b>0.156</b>	<b>(0.0362, 0.503)</b>	<b>0.180</b>	<b>(0.0548, 0.533)</b>
Ae. taylori	0.176	(0.00210, 9.51)	0.174	(0.00212, 14.7)
Pre 1990	1.84	(0.364, 10.2)	<b>10.2</b>	<b>(2.44, 46.4)</b>
Sum Rain (In.)	0.887	(0.657, 1.08)	<b>1.17</b>	<b>(1.05, 1.33)</b>
Relative humidity	1.04	(0.848, 1.35)	0.865	(0.647, 1.08)
Mean Temp (C°)	1.28	(0.495, 3.96)	0.877	(0.290, 2.23)
DENV	0.998	(0.928, 1.05)	0.982	(0.953, 1.01)
YFV	<b>0.930</b>	<b>(0.852, 0.990)</b>	0.974	(0.932, 1.01)
CHIKV	–	–	0.869	(0.665, 1.01)
ZIKAV	0.893	(0.711, 1.03)	–	–

Table 4: **Drivers of Viral Isolations in the Dry Season** Table reports the results of a Bayesian hierarchical over-dispersed Poisson regression of viral isolations with mosquito abundance as the offset, species of mosquito as a categorical variable, total rainfall, mean temperature, and relative humidity in the dry season (November–May), and isolations of the other three viruses. Data were mean-centered to aid interpretation. The model intercepts correspond to the expected MIR of DENV, YFV, CHIKV, and ZIKAV, in *Ae. luteocephalus* over a dry season with average amounts of rain, temperature, and relative humidity, and no concurrent isolation of other viruses. Statistically significant coefficients are denoted in bold face.



## References

- [1] C. Chatfield, *The analysis of time series: an introduction*. Boca Raton, FL: Chapman & Hall/CRC, 6th ed ed., 2004.