

## Appendix S2 for

"Ebola virus" evolution and emergence are associated with land use change"

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**Appendix S2: Table S1. Model selection and regression results.** "Working correlation structure" selection with the Correlation Information Criterion (CIC) selected for a first-order autoregressive model. Covariates selection using the Extended Quasi-Likelihood Information Criterion (EQIC) selected the preferred model that controlled for percentage anthropogenic land use and dispersal speed (Models 1-6, each evaluating the different land use change scenarios described in Table 1). A large decadal change in CV is consistently significantly associated with a faster rate of EBOV evolution.  $\beta$  coefficients have been converted to incidence rate ratios. See Methods for details.

Model	Preferred Model by Information Criteria					
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Residential Semi-Natural	Populated Semi-Natural	Remote Semi-Natural	Residential WR	Populated WR	Remote WR
SUDV (Dummy Variable)	0.213 (0.174)	0.163 (0.307)	1.522 (0.834)	0.871 (0.900)	0.735 (0.769)	11.38 (0.106)
Decadal Change in CV	30.18*** (8.89e-05)	15.49*** (2.48e-05)	14.26*** (0)	15.03* (0.0896)	4.240* (0.0620)	21.48*** (1.61e-06)
SUDV#Decadal Change in CV (Intxn)	0.00113*** (3.45e-08)	0.00871*** (0.00280)	0.00788*** (0.000990)	0.169 (0.372)	0.611 (0.746)	0.0760*** (0.00440)
Dispersal Speed (km/yr)	1.054*** (4.62e-09)	1.056*** (8.63e-07)	1.058*** (9.97e-07)	1.059*** (0.00354)	1.055* (0.0716)	1.065*** (2.01e-09)
SUDV#Dispersal Speed (Intxn)	1.109*** (9.89e-09)	1.087*** (3.72e-05)	1.084*** (0.000271)	1.075*** (0.00260)	1.080** (0.0130)	1.069*** (2.66e-05)
Decadal Change in CV#Dispersal Speed (Intxn)	0.854** (0.0130)	0.929** (0.0112)	0.965*** (2.11e-06)	0.936** (0.0137)	0.939 (0.345)	0.957*** (1.87e-06)
SUDV#Decadal Change in CV#Dispersal Speed (Intxn)	3.575** (0.0271)	1.130* (0.0917)	1.102 (0.289)	0.953 (0.816)	0.990 (0.918)	1.013 (0.772)
Percentage Anthropogenic Land	0.894*** (2.03e-06)	0.911*** (1.77e-05)	1.007 (0.612)	0.784* (0.0925)	0.949 (0.309)	1.031* (0.0680)
SUDV#Percentage Anthropogenic Land (Intxn)	1.130*** (2.65e-06)	1.116*** (5.39e-05)	1.014 (0.497)	1.277* (0.0941)	1.055 (0.313)	0.983 (0.378)
Time (Decades)	1.021* (0.0675)	1.029*** (0.00770)	1.044** (0.0109)	1.031** (0.0112)	1.018** (0.0248)	1.027** (0.0366)
SUDV#Time (Intxn)	0.964*** (0.00959)	0.961** (0.0108)	0.946*** (0.00933)	0.967** (0.0157)	0.979** (0.0244)	0.962** (0.0158)
Decadal Change in Percentage Anthropogenic Land						
SUDV#Decadal Change in Pct. Anthropogenic Land (Intxn)						
Constant	0.796 (0.576)	0.779 (0.463)	0.0592*** (0.00672)	0.430 (0.144)	0.491 (0.226)	0.0163*** (0.00119)
Correlation Structure	AR 1	AR 1	AR 1	AR 1	AR 1	AR 1
Correlation Information Criterion (CIC)	<b>35.71195</b>	32.85946	<b>32.02777</b>	<b>48.09691</b>	66.81321	<b>32.06041</b>
Quasi-Likelihood Information Criterion (QIC)	3.94E+08	3302.13	5964.49	6430.682	3134.842	4720.115
Extended Quasi-Likelihood Information Criterion (EQIC)	<b>386.2661</b>	<b>393.2319</b>	<b>370.7583</b>	<b>431.8244</b>	<b>502.3672</b>	<b>387.9876</b>
Observations	106	106	106	106	106	106
Number of clusters	16	16	16	16	16	16

Beta coefficients shown for each variable in each model

Robust pval in parentheses

\*p<0.1, \*\*p<0.05, \*\*\*p<0.01

**Bold** indicates preferred by information criterion

AR = Autoregressive order, CV = Coefficient of Variation, Intxn = Interaction, WR = Woodlands and Rangelands

Land use change Scenarios defined per Table 1

**Appendix S2: Table S1 (ctd.)** for "*Ebolavirus* evolution and emergence are associated with land use change" by Christian E. Lange et al.

Model	Second-order autoregressive correlation structure					
	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	Residential Semi-Natural	Populated Semi-Natural	Remote Semi-Natural	Residential WR	Populated WR	Remote WR
SUDV (Dummy Variable)	0.202 (0.163)	0.145 (0.269)	1.477 (0.844)	0.859 (0.889)	0.645 (0.663)	11.18* (0.0941)
Decadal Change in CV	31.27*** (3.18e-05)	15.41*** (3.11e-06)	14.15*** (0)	13.87 (0.104)	3.812* (0.0649)	20.58*** (2.02e-06)
SUDV#Decadal Change in CV (Intxn)	0.00119*** (6.76e-08)	0.00824*** (0.00428)	0.00739*** (0.00127)	0.186 (0.403)	0.715 (0.820)	0.0761*** (0.00547)
Dispersal Speed (km/yr)	1.053*** (5.56e-09)	1.054*** (8.38e-07)	1.058*** (1.63e-06)	1.059*** (0.00378)	1.052* (0.0906)	1.065*** (4.56e-09)
SUDV#Dispersal Speed (Intxn)	1.110*** (3.07e-08)	1.088*** (4.28e-05)	1.084*** (0.000365)	1.075*** (0.00242)	1.082** (0.0138)	1.069*** (3.11e-05)
Decadal Change in CV#Dispersal Speed (Intxn)	0.857** (0.0160)	0.930** (0.0113)	0.965*** (2.66e-06)	0.937** (0.0154)	0.942 (0.370)	0.957*** (3.26e-06)
SUDV#Decadal Change in CV#Dispersal Speed (Intxn)	3.423** (0.0456)	1.145* (0.0713)	1.129 (0.188)	0.953 (0.813)	0.992 (0.931)	1.019 (0.674)
Percentage Anthropogenic Land	0.897*** (1.02e-06)	0.913*** (2.83e-06)	1.007 (0.619)	0.787* (0.0998)	0.954 (0.292)	1.030* (0.0756)
SUDV#Percentage Anthropogenic Land (Intxn)	1.126*** (1.71e-06)	1.114*** (1.87e-05)	1.014 (0.498)	1.270 (0.102)	1.050 (0.295)	0.984 (0.379)
Time (Decades)	1.019* (0.0731)	1.028*** (0.00632)	1.045*** (0.00902)	1.030** (0.0129)	1.015* (0.0712)	1.028** (0.0319)
SUDV#Time (Intxn)	0.965** (0.0125)	0.964** (0.0201)	0.947** (0.0115)	0.968** (0.0175)	0.982* (0.0570)	0.961** (0.0152)
Decadal Change in Percentage Anthropogenic Land						
SUDV#Decadal Change in Pct. Anthropogenic Land (Intxn)						
Constant	0.817 (0.602)	0.795 (0.460)	0.0588*** (0.00602)	0.436 (0.134)	0.546 (0.288)	0.0175*** (0.00108)
Correlation Structure	AR 2	AR 2	AR 2	AR 2	AR 2	AR 2
Correlation Information Criterion (CIC)	36.14946	<b>31.6138</b>	32.59423	48.28012	<b>64.61072</b>	32.07395
Quasi-Likelihood Information Criterion (QIC)	2.27E+08	3131.22	5690.458	6329.531	2895.579	4600.696
Extended Quasi-Likelihood Information Criterion (EQIC)	388.4539	392.9454	371.858	432.3245	501.2065	387.9298
Observations	106	106	106	106	106	106
Number of clusters	16	16	16	16	16	16

Beta coefficients shown for each variable in each model

Robust pval in parentheses

\*p&lt;0.1, \*\*p&lt;0.05, \*\*\*p&lt;0.01

**Bold** indicates preferred by information criterion

AR = Autoregressive order, CV = Coefficient of Variation, Intxn = Interaction, WR = Woodlands and Rangelands

LUC Scenarios defined per Table 1

**Appendix S2: Table S1 (ctd.)** for "*Ebolavirus* evolution and emergence are associated with land use change" by Christian E. Lange et al.

Model	Independent correlation structure					
	(13)	(14)	(15)	(16)	(17)	(18)
	Residential Semi-Natural	Populated Semi-Natural	Remote Semi-Natural	Residential WR	Populated WR	Remote WR
VARIABLES						
SUDV (Dummy Variable)	0.199 (0.164)	0.174 (0.350)	1.175 (0.937)	0.887 (0.913)	0.835 (0.856)	9.971 (0.144)
Decadal Change in CV	5.944 (0.126)	10.57*** (0.00138)	12.73*** (0)	15.28* (0.0928)	4.264* (0.0733)	21.48*** (9.38e-07)
SUDV#Decadal Change in CV (Intxn)	0.00548*** (0.000232)	0.0132*** (0.00273)	0.00996*** (0.00109)	0.147 (0.336)	0.473 (0.617)	0.0629*** (0.00130)
Dispersal Speed (km/yr)	1.053*** (2.62e-08)	1.056*** (7.41e-06)	1.058*** (9.53e-07)	1.061*** (0.00315)	1.056* (0.0577)	1.066*** (5.87e-10)
SUDV#Dispersal Speed (Intxn)	1.108*** (2.56e-09)	1.085*** (0.000122)	1.082*** (0.000483)	1.072*** (0.00447)	1.078** (0.0133)	1.068*** (7.09e-05)
Decadal Change in CV#Dispersal Speed (Intxn)	0.869** (0.0295)	0.933** (0.0297)	0.965*** (4.36e-06)	0.936** (0.0144)	0.940 (0.339)	0.957*** (9.43e-07)
SUDV#Decadal Change in CV#Dispersal Speed (Intxn)	3.690*** (0.00935)	1.101 (0.161)	1.038 (0.669)	0.950 (0.801)	0.983 (0.853)	0.993 (0.873)
Percentage Anthropogenic Land	0.893*** (2.81e-06)	0.909*** (5.97e-05)	1.003 (0.834)	0.773* (0.0736)	0.938 (0.301)	1.031* (0.0760)
SUDV#Percentage Anthropogenic Land (Intxn)	1.133*** (3.24e-06)	1.118*** (0.000159)	1.019 (0.389)	1.295* (0.0749)	1.067 (0.309)	0.985 (0.463)
Time (Decades)	1.020 (0.120)	1.029** (0.0159)	1.043** (0.0196)	1.031** (0.0118)	1.022*** (0.00430)	1.025* (0.0559)
SUDV#Time (Intxn)	0.963** (0.0141)	0.961*** (0.00840)	0.947** (0.0101)	0.967** (0.0159)	0.976*** (0.00619)	0.963** (0.0209)
Decadal Change in Percentage Anthropogenic Land						
SUDV#Decadal Change in Pct. Anthropogenic Land (Intxn)						
Constant	0.871 (0.768)	0.848 (0.692)	0.0816** (0.0145)	0.430 (0.182)	0.474 (0.202)	0.0178*** (0.00153)
Correlation Structure	Independent	Independent	Independent	Independent	Independent	Independent
Correlation Information Criterion (CIC)	36.85355	37.27041	31.87747	47.30454	67.64358	32.13201
Quasi-Likelihood Information Criterion (QIC)	7.61E+08	3373.426	7039.865	6721.559	3268.522	5036.893
Extended Quasi-Likelihood Information Criterion (EQIC)	385.6417	401.1208	371.1786	429.5851	501.2727	388.4913
Observations	106	106	106	106	106	106
Number of clusters	16	16	16	16	16	16

Beta coefficients shown for each variable in each model

Robust pval in parentheses

\*p&lt;0.1, \*\*p&lt;0.05, \*\*\*p&lt;0.01

**Bold** indicates preferred by information criterion

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Model	Different percentage anthropogenic land use variable					
	(19)	(20)	(21)	(22)	(23)	(24)
VARIABLES	Residential Semi-Natural	Populated Semi-Natural	Remote Semi-Natural	Residential WR	Populated WR	Remote WR
SUDV (Dummy Variable)	0.691 (0.549)	0.828 (0.834)	4.016 (0.215)	0.284 (0.144)	0.430 (0.283)	1.222 (0.854)
Decadal Change in CV	0.725 (0.852)	2.349 (0.370)	36.50** (0.0297)	4.255 (0.290)	3.074** (0.0333)	8.894*** (0.00591)
SUDV#Decadal Change in CV (Intxn)	0.284 (0.472)	0.244 (0.153)	0.0162** (0.0161)	1.033 (0.981)	1.118 (0.872)	0.185 (0.104)
Dispersal Speed (km/yr)	1.034*** (0)	1.045*** (3.31e-06)	1.076*** (0.00605)	1.033*** (0.00206)	1.063* (0.0784)	1.055*** (0.00134)
SUDV#Dispersal Speed (Intxn)	1.120*** (6.29e-11)	1.088*** (8.46e-10)	1.053* (0.0711)	1.112*** (1.77e-06)	1.083** (0.0336)	1.075*** (0.000346)
Decadal Change in CV#Dispersal Speed (Intxn)	0.920** (0.0457)	0.947* (0.0519)	0.951** (0.0300)	0.967 (0.406)	0.921 (0.275)	0.966** (0.0248)
SUDV#Decadal Change in CV#Dispersal Speed (Intxn)	3.126*** (0.00826)	1.047 (0.234)	1.056 (0.416)	0.872 (0.231)	0.949 (0.552)	1.004 (0.938)
Percentage Anthropogenic Land						
SUDV#Percentage Anthropogenic Land (Intxn)						
Time (Decades)	1.012 (0.326)	1.003 (0.843)	1.061** (0.0107)	1.015 (0.259)	0.997 (0.781)	1.028* (0.0522)
SUDV#Time (Intxn)	0.987 (0.555)	1.005 (0.855)	0.953 (0.115)	0.990 (0.550)	1.007 (0.668)	0.993 (0.798)
Decadal Change in Percentage Anthropogenic Land	1.558* (0.0725)	1.170 (0.140)	0.837 (0.467)	0.622 (0.720)	1.133 (0.193)	0.997 (0.976)
SUDV#Decadal Change in Pct. Anthropogenic Land (Intxn)	0.689 (0.133)	0.907 (0.380)	1.274 (0.324)	1.906 (0.627)	1.062 (0.661)	1.122 (0.309)
Constant	0.369*** (0.00528)	0.325*** (0.000219)	0.0622*** (0.000257)	0.598 (0.416)	0.383* (0.0592)	0.137*** (3.64e-08)
Correlation Structure	AR 1	AR 1	AR 1	AR 1	AR 1	AR 1
Correlation Information Criterion (CIC)	41.47174	49.0244	33.88673	73.76906	66.4847	38.04353
Quasi-Likelihood Information Criterion (QIC)	3.14E+08	2026.289	60525.7	2541.985	5047.88	4596.831
Extended Quasi-Likelihood Information Criterion (EQIC)	447.2806	465.8643	371.9746	538.4746	504.2476	403.645
Observations	106	106	106	106	106	106
Number of clusters	16	16	16	16	16	16

Beta coefficients shown for each variable in each model

Robust pval in parentheses

\*p&lt;0.1, \*\*p&lt;0.05, \*\*\*p&lt;0.01

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Model	No dispersal speed variable					
	(25)	(26)	(27)	(28)	(29)	(30)
VARIABLES	Residential Semi-Natural	Populated Semi-Natural	Remote Semi-Natural	Residential WR	Populated WR	Remote WR
SUDV (Dummy Variable)	3.261 (0.340)	2.722 (0.309)	6.825 (0.186)	3.920* (0.1000)	3.423 (0.138)	17.13** (0.0408)
Decadal Change in CV	0.268 (0.640)	1.576 (0.117)	5.308*** (0)	2.903 (0.239)	1.959 (0.122)	6.779*** (0)
SUDV#Decadal Change in CV (Intxn)	1.455 (0.894)	0.896 (0.878)	0.132*** (0.00941)	0.448 (0.395)	0.755 (0.573)	0.225*** (0.00255)
Dispersal Speed (km/yr)						
SUDV#Dispersal Speed (Intxn)						
Decadal Change in CV#Dispersal Speed (Intxn)						
SUDV#Decadal Change in CV#Dispersal Speed (Intxn)						
Percentage Anthropogenic Land	0.979 (0.171)	0.962** (0.0269)	1.000 (0.972)	0.970 (0.594)	0.969 (0.309)	1.013 (0.288)
SUDV#Percentage Anthropogenic Land (Intxn)	0.999 (0.975)	1.018 (0.413)	0.984 (0.377)	1.007 (0.910)	1.008 (0.799)	0.968* (0.0721)
Time (Decades)	1.012 (0.248)	1.022** (0.0456)	1.017* (0.0997)	1.018 (0.114)	1.020* (0.0689)	1.013 (0.153)
SUDV#Time (Intxn)	1.007 (0.554)	0.999 (0.950)	1.000 (0.984)	1.005 (0.661)	1.004 (0.737)	1.007 (0.456)
Decadal Change in Percentage Anthropogenic Land						
SUDV#Decadal Change in Pct. Anthropogenic Land (Intxn)						
Constant	1.655 (0.307)	1.781 (0.145)	0.634 (0.612)	1.054 (0.899)	1.152 (0.705)	0.255* (0.0952)
Correlation Structure	AR 1	AR 1	AR 1	AR 1	AR 1	AR 1
Correlation Information Criterion (CIC)	48.58588	40.43182	44.58294	47.27916	40.76993	42.49568
Quasi-Likelihood Information Criterion (QIC)	3453.613	2798.631	2732.236	3240.847	3246.567	3284.544
Extended Quasi-Likelihood Information Criterion (EQIC)	661.2515	645.8472	615.3583	654.7056	640.2031	607.4359
Observations	106	106	106	106	106	106
Number of clusters	16	16	16	16	16	16

Beta coefficients shown for each variable in each model

Robust pval in parentheses

\*p&lt;0.1, \*\*p&lt;0.05, \*\*\*p&lt;0.01

**Bold** indicates preferred by information criterion

AR = Autoregressive order, CV = Coefficient of Variation, Intxn = Interaction, WR = Woodlands and Rangelands

LUC Scenarios defined per Table 1