Table S1 Chicken housing data used for simulations. 2 houses are from each site. * data were used for deriving indoor conditions only.

Site name	Location	Production system	Monitored period
CA1B*	San Joaquin, California	Broiler (barn)	Sep 01, 2007 to Oct 31, 2009
IN2B*	Wabash, Indiana	Layer (barn)	May 15, 2008 to Mar 15, 2009
NC2B	Nash, North Carolina	Layer (barn)	Mar 15, 2008 to Mar 15, 2009

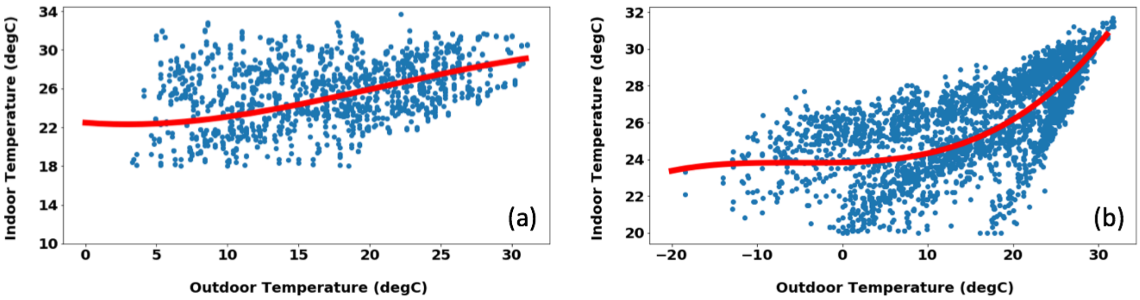


Figure S1 Modelled stable temperature in a) broiler house ($T_B = 0.00020T^3 + 0.0010T^2 + 0.024T + 22.1$), b) layer house ($T_L = 0.00014T^3 + 0.0023T^2 + 0.011T + 23.8$). The relationship for the broiler house is for data where bird bodyweight is >0.5 kg, as explained in the main text.

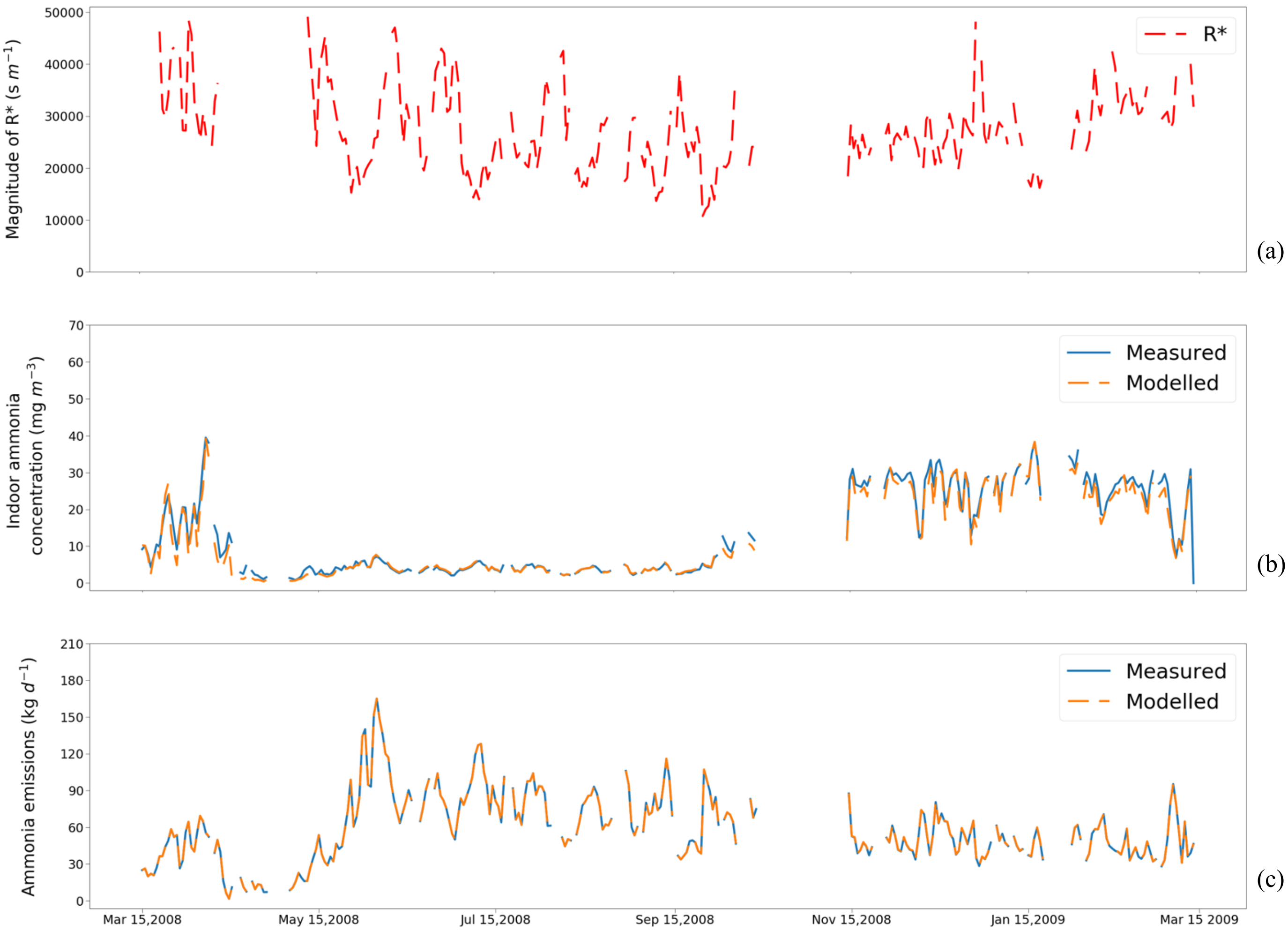


Figure S2 Site simulations using the new UA hydrolysis parameterisation for House A at site NC2B, Nash, North Carolina from March 15 to March 15, 2009. a): Inversion derived resistance values (R*). b): Comparison between measured and modelled indoor NH_3 concentrations of the house. c) Comparison between modelled NH_3 emissions and calculated NH_3 emissions from measured indoor concentrations. The comparisons demonstrate the ability of the model to reproduce measured NH_3 concentrations and emissions given the use of the fitted values of R*.

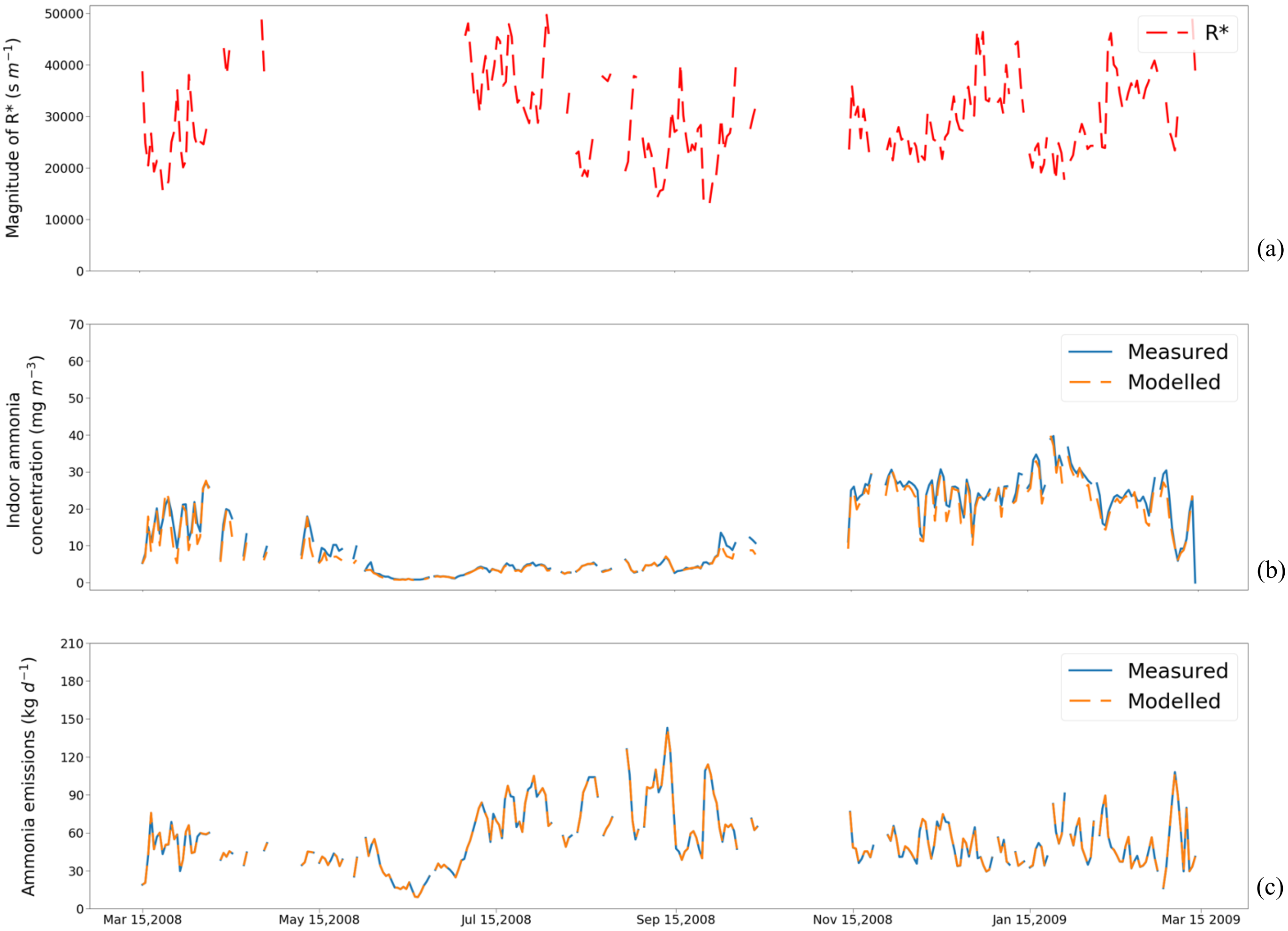


Figure S3 Site simulations using the new UA hydrolysis parameterisation for House B at site NC2B, Nash, North Carolina from March 15 to March 15, 2009. a): Inversion derived resistance values (R*). b): Comparison between measured and modelled indoor NH_3 concentrations of the house. c) Comparison between modelled NH_3 emissions and calculated NH_3 emissions from measured indoor concentrations. The comparisons demonstrate the ability of the model to reproduce measured NH_3 concentrations and emissions given the use of the fitted values of R*.

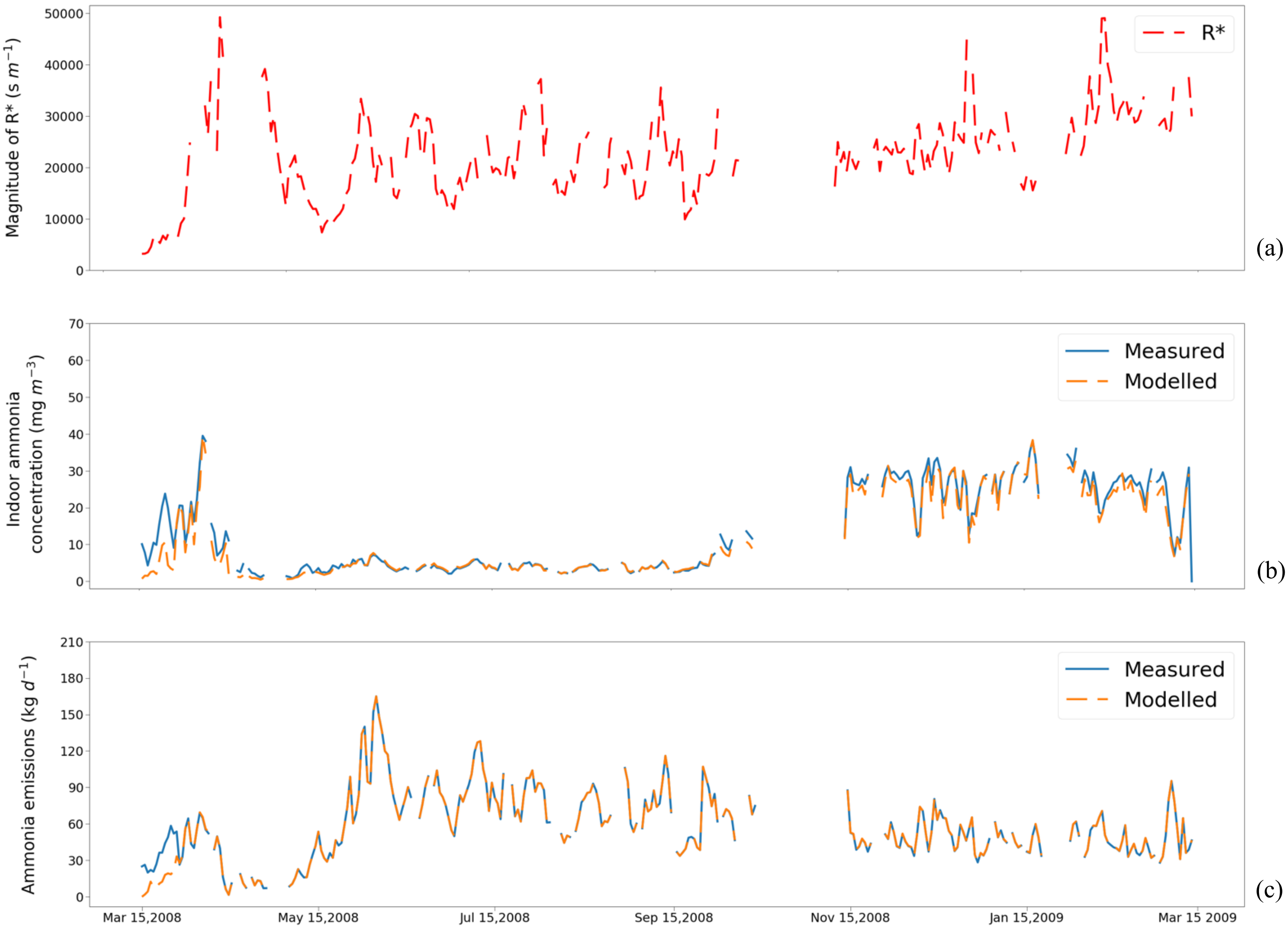


Figure S4 Site simulations using the UA hydrolysis parameterisation from the Elliot and Collins (1982) for House A at site NC2B, Nash, North Carolina from March 15 to March 15, 2009. a): Inversion derived resistance values (R*). b): Comparison between measured and modelled indoor NH_3 concentrations of the house. c) Comparison between modelled NH_3 emissions and calculated NH_3 emissions from measured indoor concentrations. The comparisons demonstrate the ability of the model to reproduce measured NH_3 concentrations and emissions given the use of the fitted values of R*.

Figure S5 Site simulations using the UA hydrolysis parameterisation from the Elliot and Collins (1982) for House B at site NC2B, Nash, North Carolina from March 15 to March 15, 2009. a): Inversion derived resistance values (R*). b): Comparison between measured and modelled indoor NH_3 concentrations of the house. c) Comparison between modelled NH_3 emissions and calculated NH_3 emissions from measured indoor concentrations. The comparisons demonstrate the ability of the model to reproduce measured NH_3 concentrations and emissions given the use of the fitted values of R*.

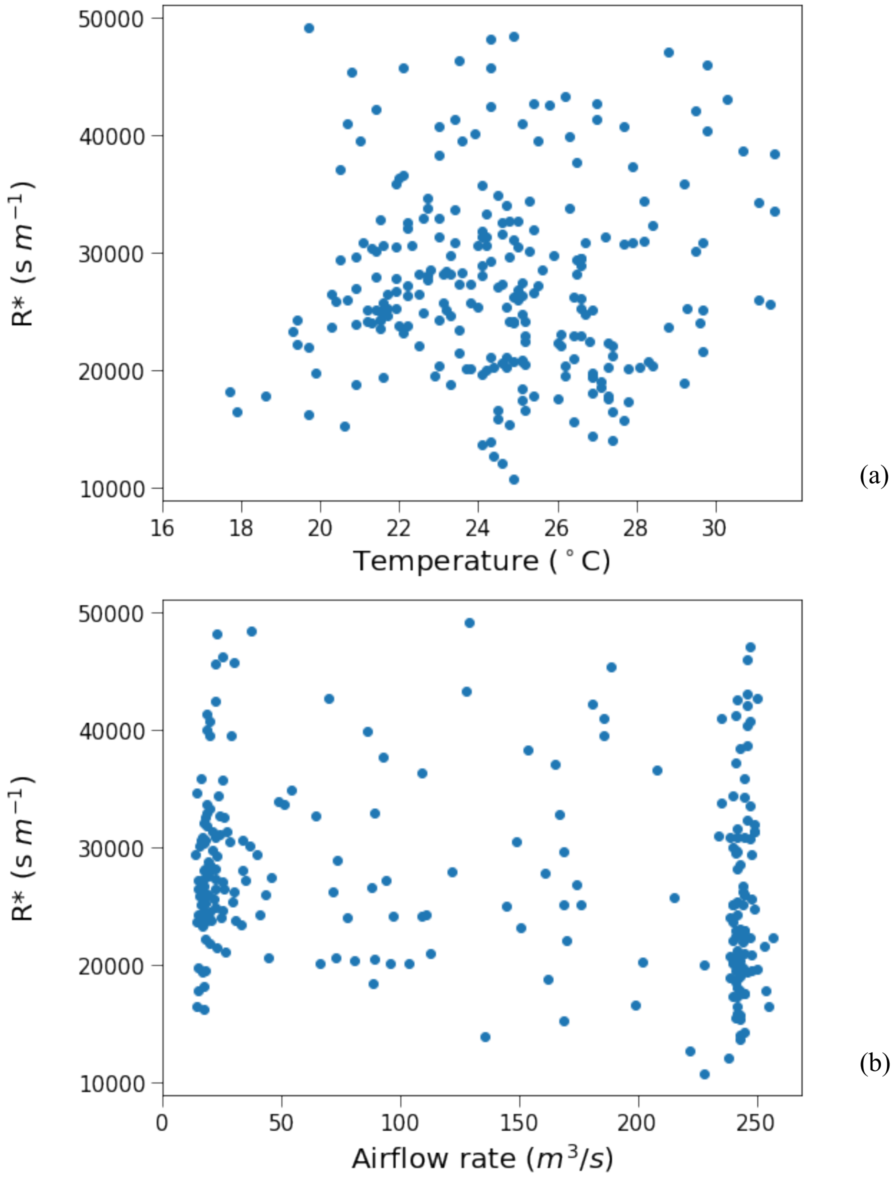


Figure S6 Consideration of possible relationships between a) temperature and b) ventilation rate with the inversion derived R* values for House A at NC2B.

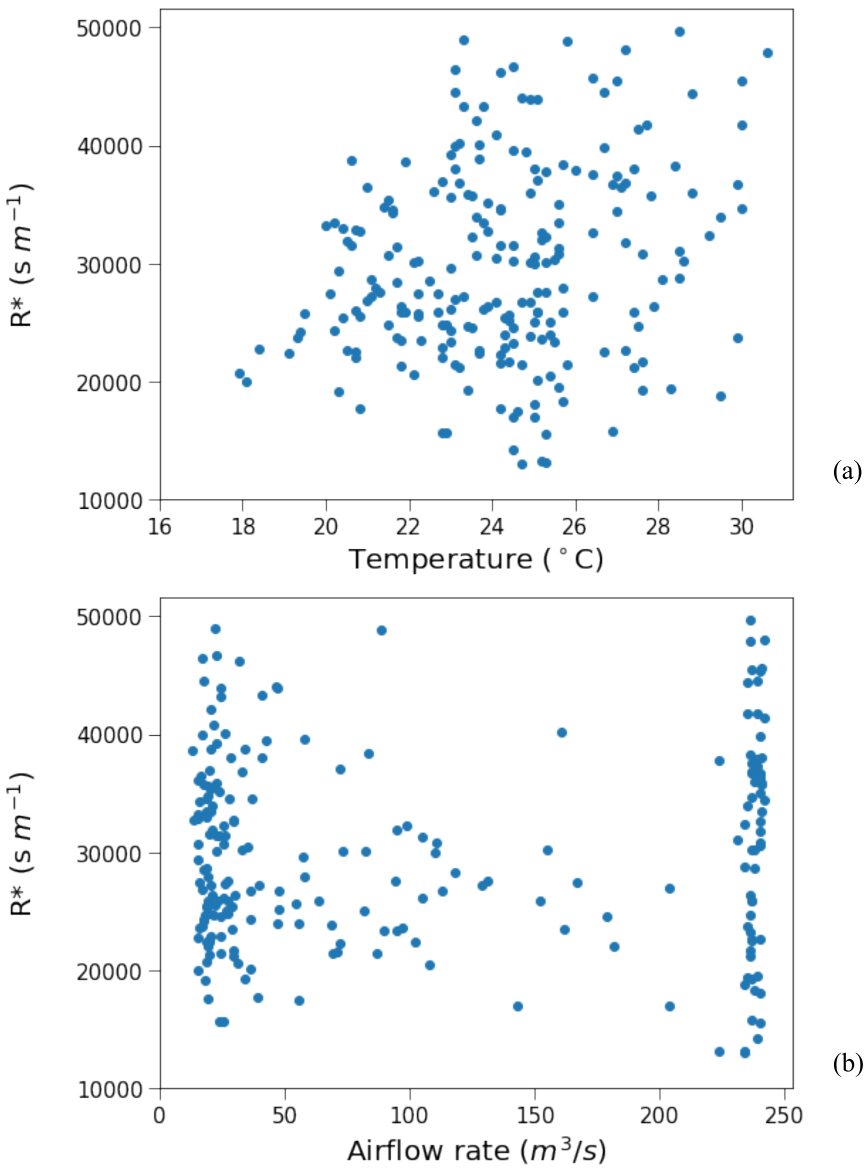


Figure S7 Consideration of possible relationships between a) temperature and b) ventilation rate compared to the inversion derived R* values for House B at NC2B.

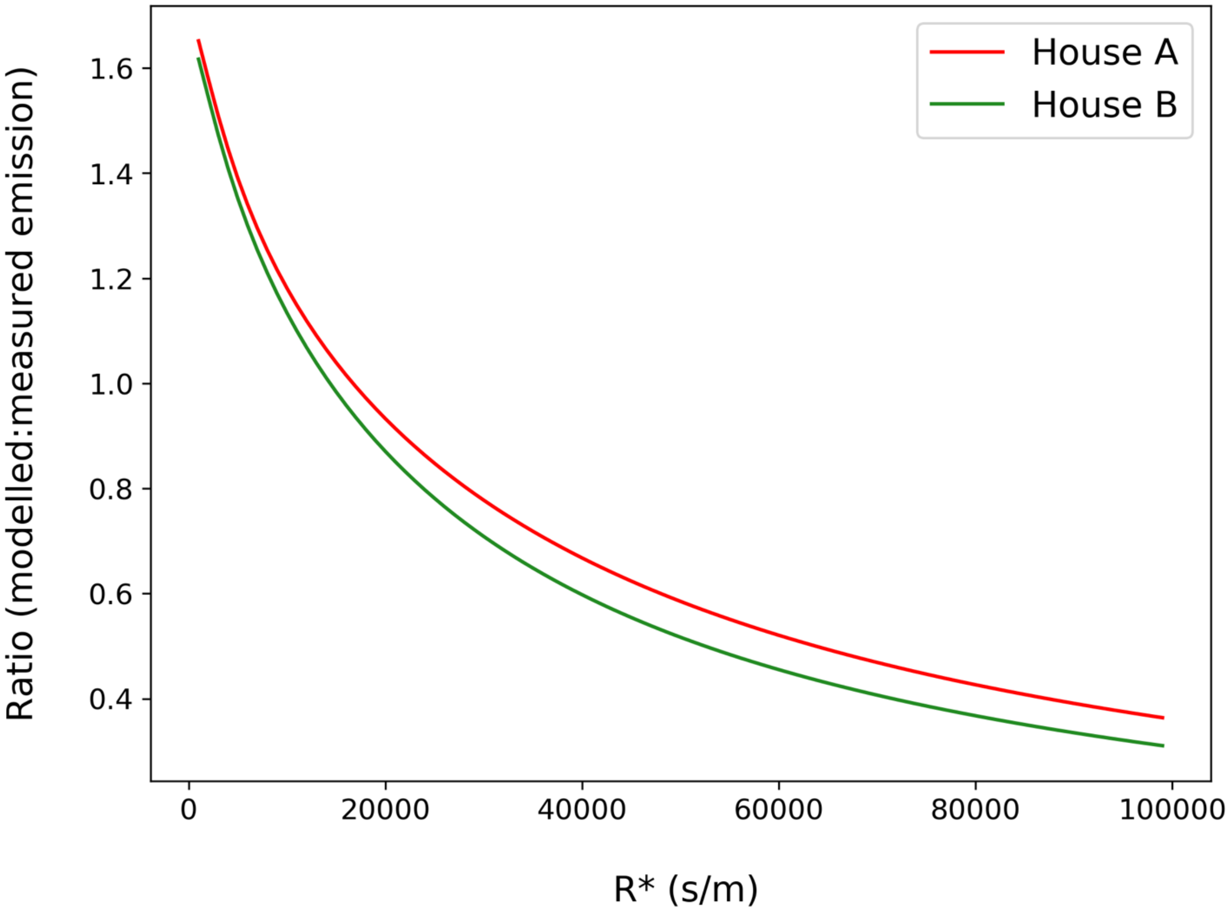
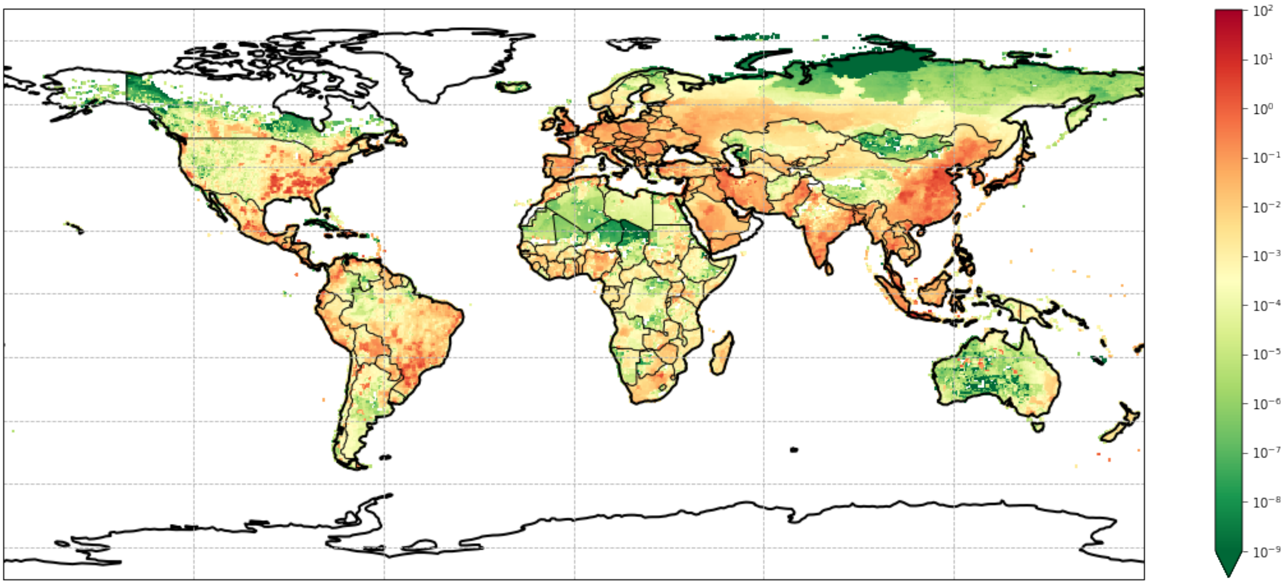
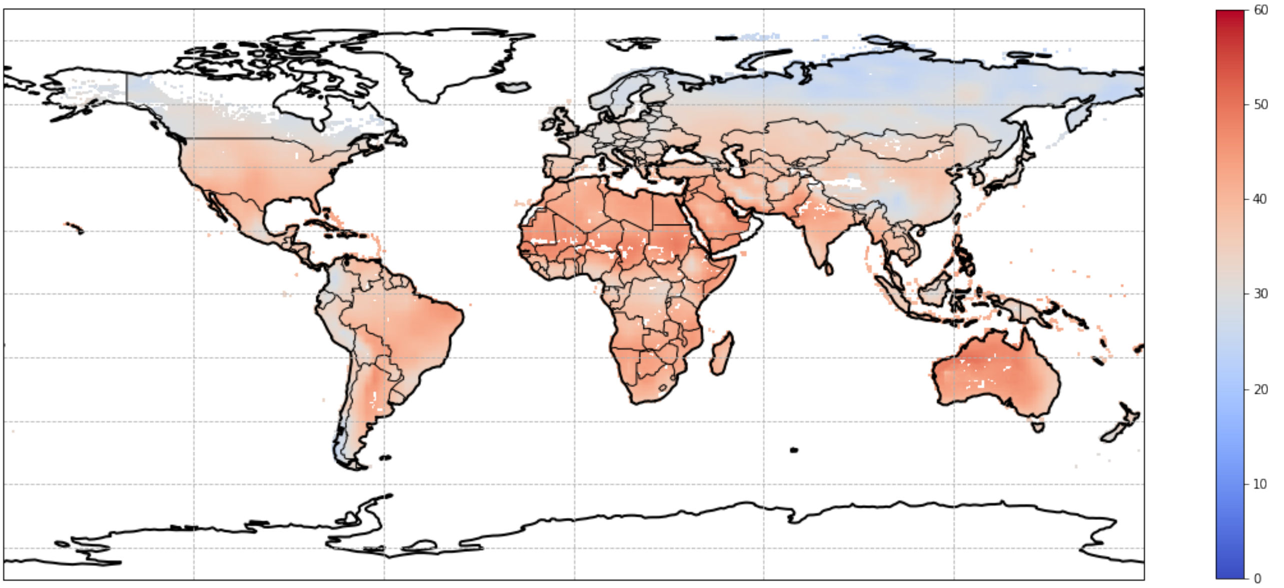


Figure S8 Ratio of total modelled and measured NH_3 emissions over the simulation period (when measurements were available) as a function of R* value for House A and House B at NC2B. The modelled values were derived by using constant R* throughout the simulation period under the same environmental conditions as chicken houses at NC2B.



(a)



(b)

Figure S9 Simulated a) annual global NH_3 emissions (Gg yr^{-1}) from chicken housing in 2010. b) Percentage of excreted N that volatilizes (P_v, %) as NH_3 from chicken housing in 2010. In both cases, these estimates show the effect of using the new parameterisations derived from the AFO's data for UA hydrolysis (Figure 3). The resolution is 0.5°×0.5°.

Table S2 Total N application, NH_3 emission from chicken manure applications and percentage of volatilization (Pv, %) for six major crops and other crops. NH_3 emission from other crops (*) was obtained from an average Pv (**) of the six major crops' at local area.

Crop	N application (Gg)	NH_3 emission (Gg)	P_V (%)
Barley	269.6	93.0	34.5
Maize	1617.9	643.4	39.8
Potato	239.9	94.2	39.3
Rice	1432.7	601.4	42.0
Sugar beet	62.7	21.7	34.6
Wheat	1364.2	520.3	38.1
Other	1840.0	608.3 *	33.1 **
Total	6827.0	2582.3	37.8

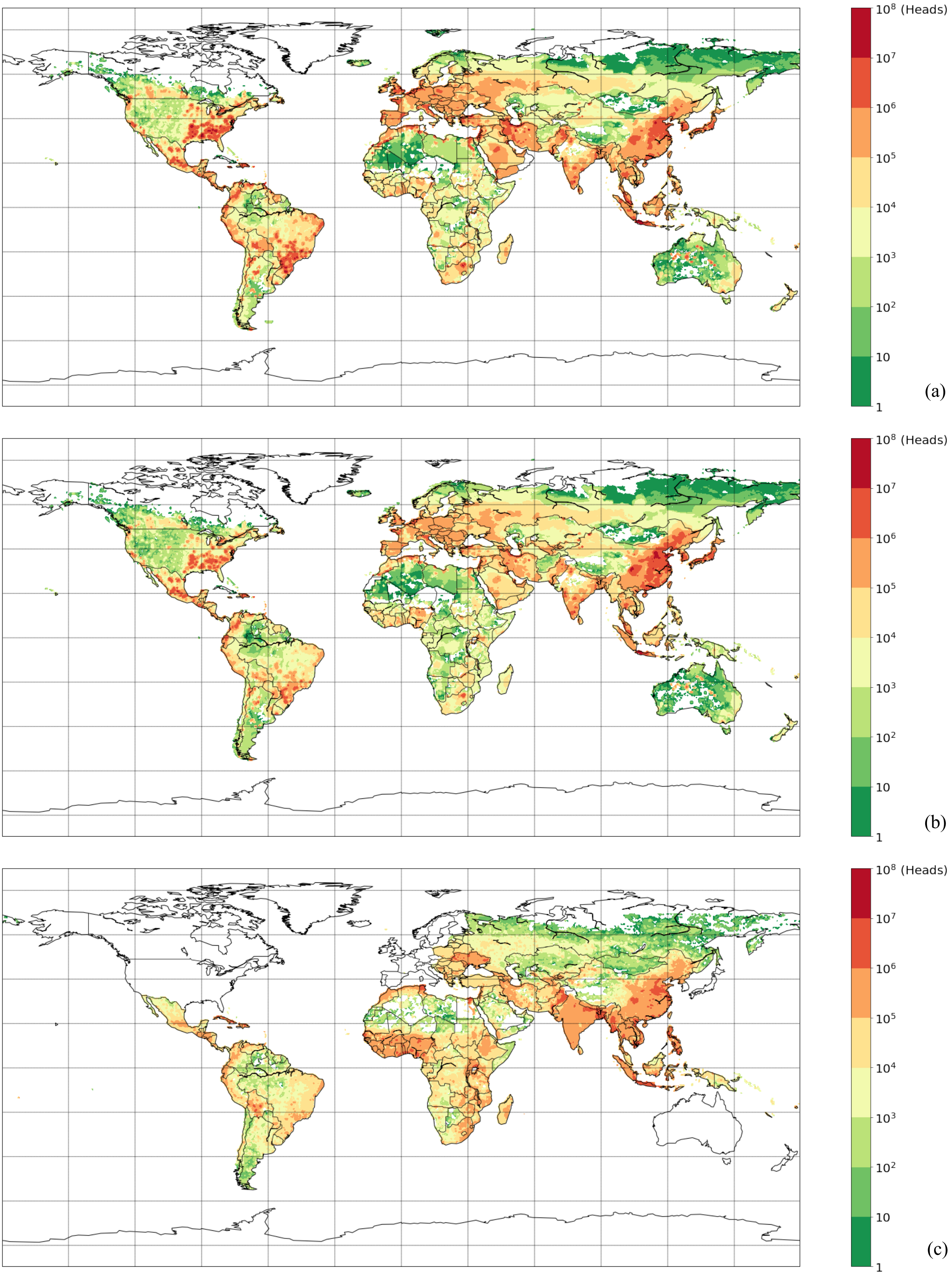


Figure S10 Global density distribution of a) broilers, b) layers, c) backyard chicken in 2010, based on FAO (2018) in a resolution of 0.083° × 0.083°.The total head is approximately 9.63×10^9 for broilers, 6.83×10^9 for layers and 3.73×10^9 for backyard chicken.