

Supporting Information

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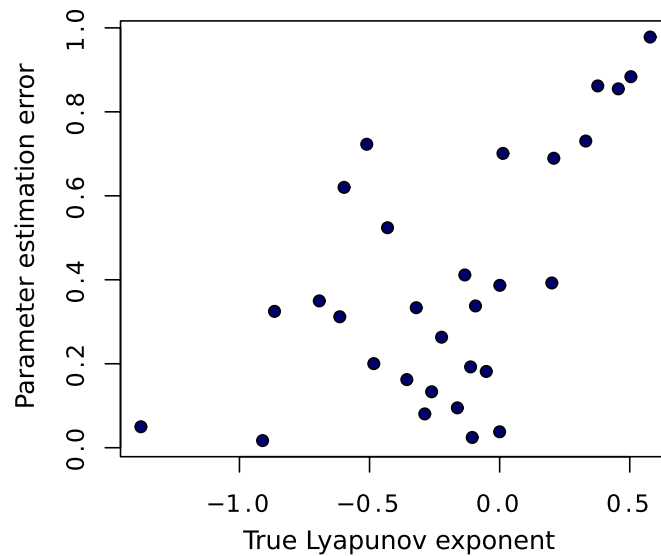


Fig. S1. The logistic model was fit with values for parameter r ranging from 2.5 to 3.9. For each value of r , we generated a 50-y time series using the observation and process noise levels described in the main text. The Markov chain Monte Carlo procedure was performed in JAGS (1) via R (2). Convergence was checked using batch-mean plots and the Gelman–Rubin statistic ($\hat{R} < 1.2$). As the true model becomes more unstable (represented by a higher Lyapunov exponent), the estimation error increases. Estimation error for parameter r is defined as $|r_{\text{fit}} - r_{\text{true}}|$.

1. Plummer M (2003) JAGS: A program for analysis of Bayesian graphical models using Gibbs sampling. *Proceedings of the Third International Workshop on Distributed Statistical Computing*. Available at www.r-project.org/conferences/DSC-2003/Proceedings/index.html.
2. R Development Core Team (2011) *R: A Language and Environment for Statistical Computing* (R Foundation for Statistical Computing, Vienna).

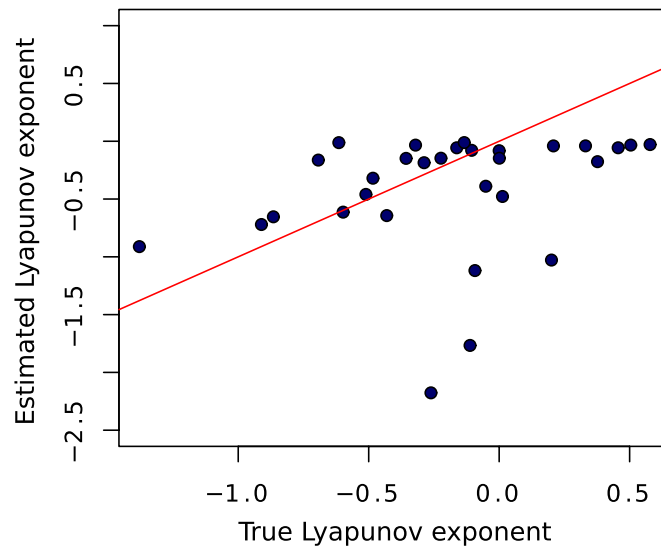


Fig. S2. Estimated Lyapunov exponent vs. true Lyapunov exponent for the logistic model fit with parameter r ranging from 2.5 to 3.9. For each value of r , we generated 50 points using the observation and process noise levels described in the main text. The red line is one to one. The failure of the Bayesian fitting routine is demonstrated for unstable values of r . The estimated model is always stable despite the true model being unstable. The Lyapunov exponent is always poorly estimated when the true Lyapunov exponent is positive.

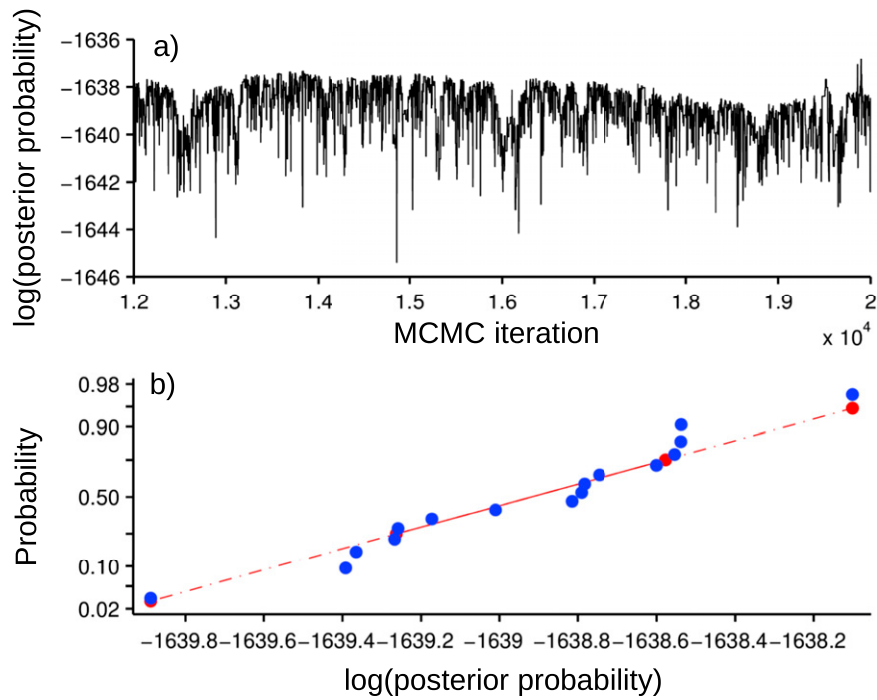


Fig. S3. Example trace plot (A) and normal-normal plot (B) of 500-point batch means for the LPA model illustrating that the Markov chain Monte Carlo routine converged. The red points denote the range of the data and the end of the first and third quartiles.

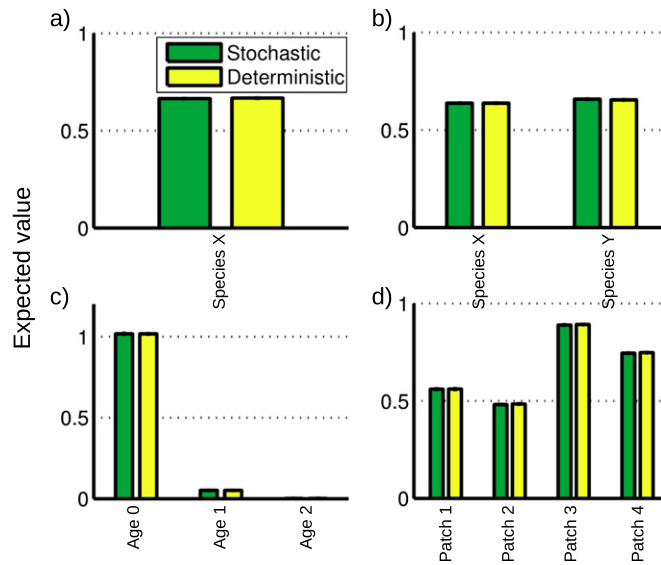


Fig. S4. Time series expected values (100 y, 100 replicates) for the stochastic vs. deterministic version of each model illustrating the similarity between the expected value of the stochastic model and deterministic models. A–D show results for the logistic, two-species, age-structured, and spatial models, respectively.

