Figure S1. Tests of SEIRX-EAKF state variable and parameter estimation using synthetic times series. Plots show ensemble mean estimates using the SEIRX model as described in Equations 1-6, synthetic observations of incidence, mortality and case fatality rate, and the EAKF. 8 different estimates are shown in which the 'true' parameter values for *Z, D,* and *M* are either treated as a free parameter and estimated during data assimilation ('free') or fixed with the true value provided up front ('fixed'). Shown are the estimates of cumulative incidence, cumulative deaths, weekly number of exposed ('E'), weekly number of infected ('I'), R_{0Mean}, *Z, D, M,* R_{0Amp}, and η. The black 'x' indicate the target true values of each variable and parameter from the free run of the SEIRX model. The dashed line shows $R_0(t) = R_{0Mean} + \kappa R_{0Amp}$.

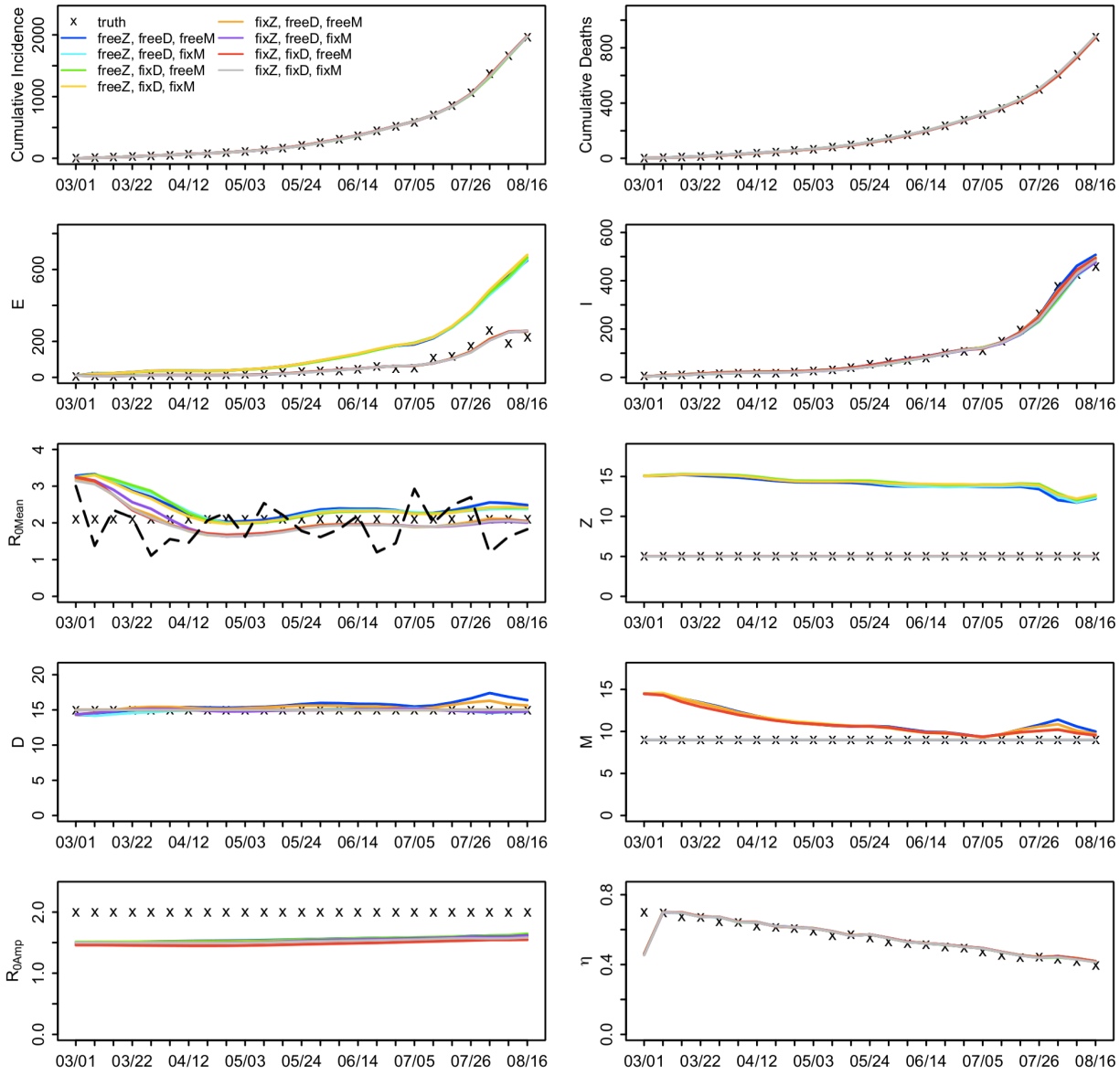


Figure S2. Parameter estimates of $R_{0\,Mean}$ through time for Guinea, Liberia, and Sierra Leone as generated using the ensemble model-EAKF framework. Four model structures are presented: 1) Equations 1-5, $R_0(t) = R_{0\,Mean}$ and fixed η = X [amplitude (amp) off; case fatality rate (cfr) off]; 2) Equations 1-5, $R_0(t) = R_{0\,Mean}$ and η treated as a free parameter estimated by the EAKF [amplitude (amp) off; case fatality rate (cfr) on]; 3) the core SEIRX model (Equations 1-6) as presented in the main results [amplitude (amp) on; case fatality rate (cfr) off]; and 4) Equations 1-6, $R_0(t) = R_{0\,Mean} + \kappa R_{0\,Amp}$ and η treated as a free parameter estimated by the EAKF [amplitude (amp) on; case fatality rate (cfr) on]. The box and whiskers show the median (black horizontal line), 25th and 75th percentiles (box boundaries), 95% credible interval (whiskers) and outliers (dots).

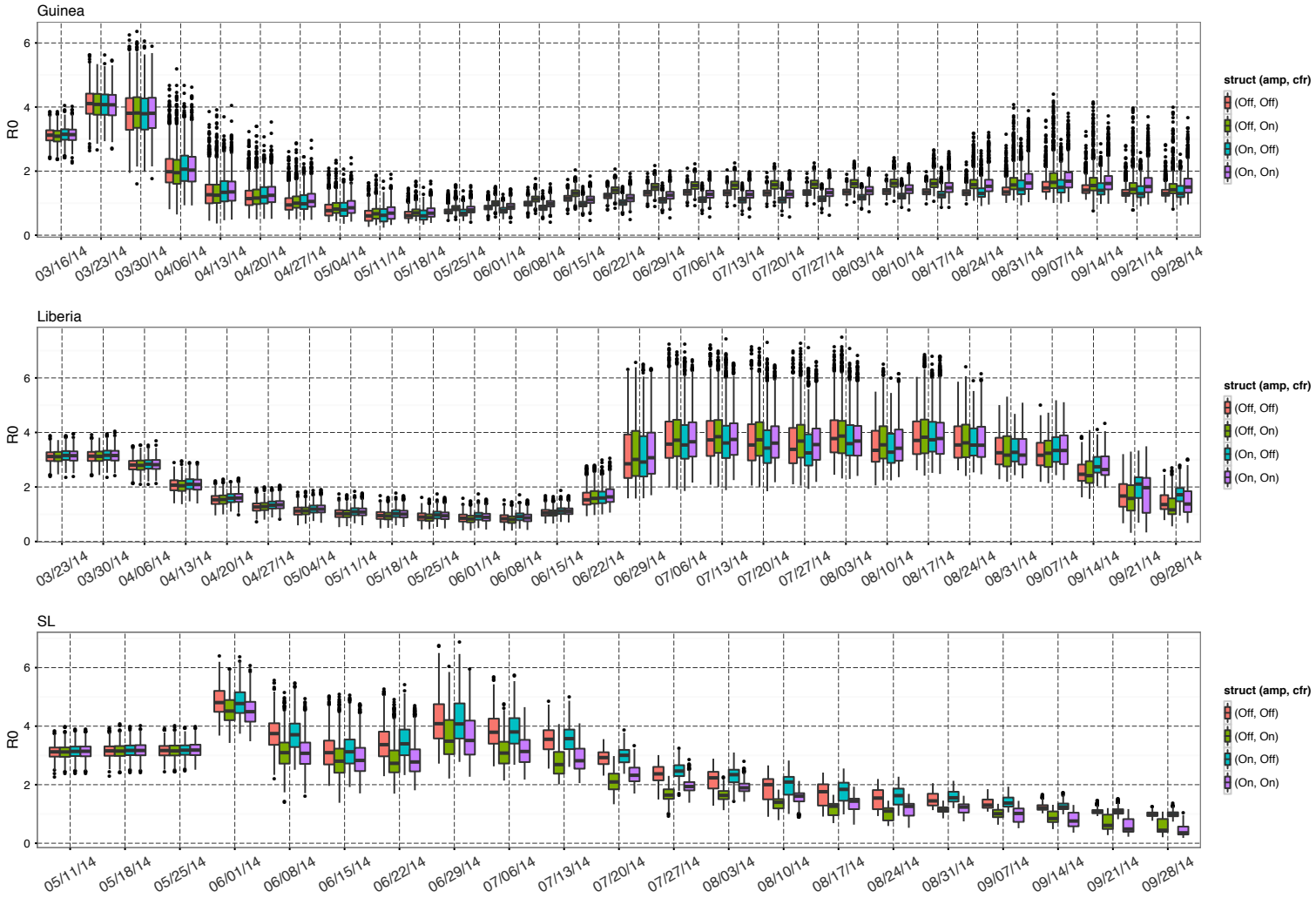

Guinea
Liberia
SL
R0
0
2
4
6
03/16/14
03/23/14
03/30/14
04/06/14
04/13/14
04/20/14
04/27/14
05/04/14
05/11/14
05/18/14
05/25/14
06/01/14
06/08/14
06/15/14
06/22/14
06/29/14
07/06/14
07/13/14
07/20/14
07/27/14
08/03/14
08/10/14
08/17/14
08/24/14
08/31/14
09/07/14
09/14/14
09/21/14
09/28/14
struct (amp, cfr)
(Off, Off)
(Off, On)
(On, Off)
(On, On)

Figure S3. Same as Figure S2, but for *Z*.

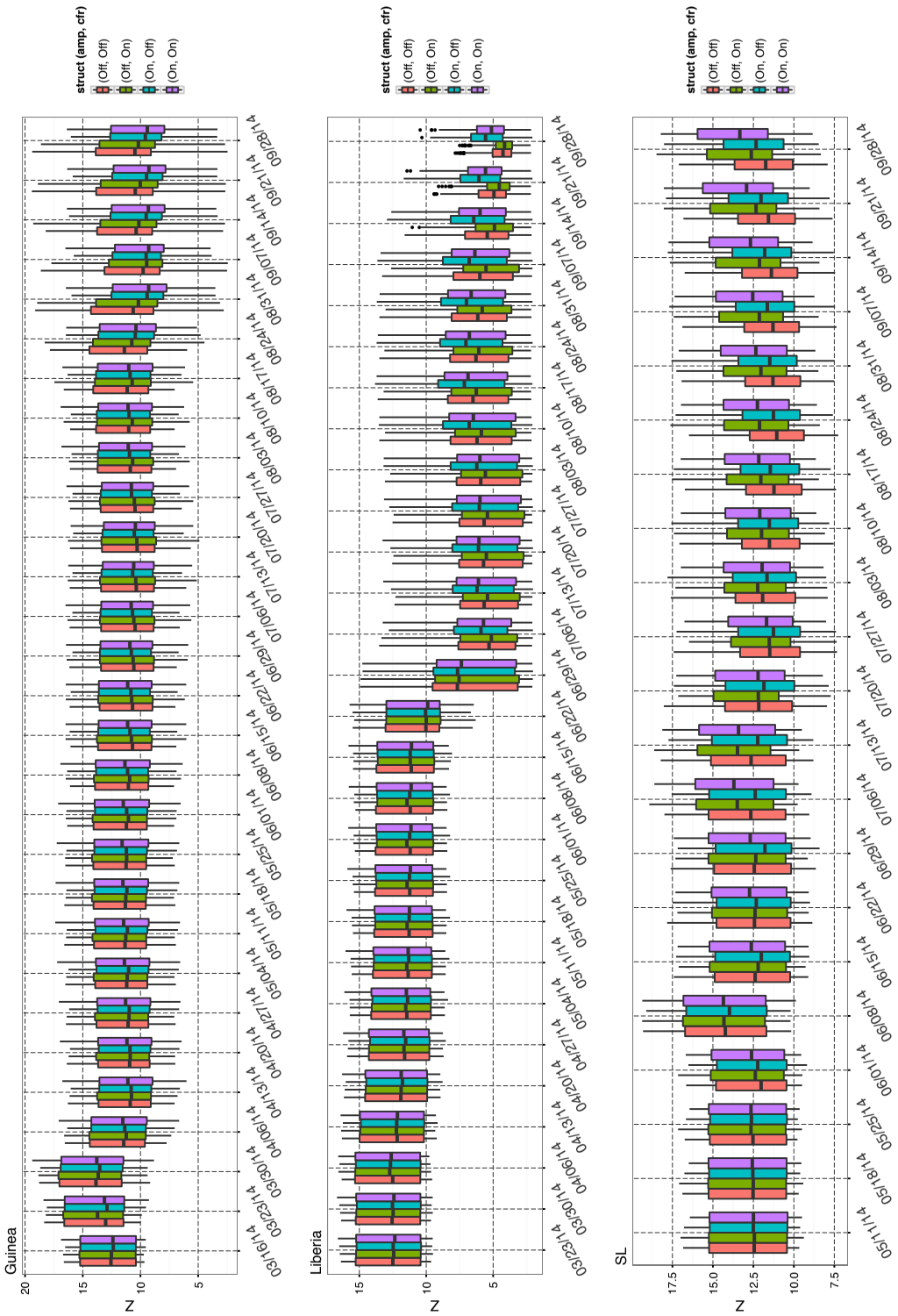


Figure S4. Same as Figure S2, but for *D*.

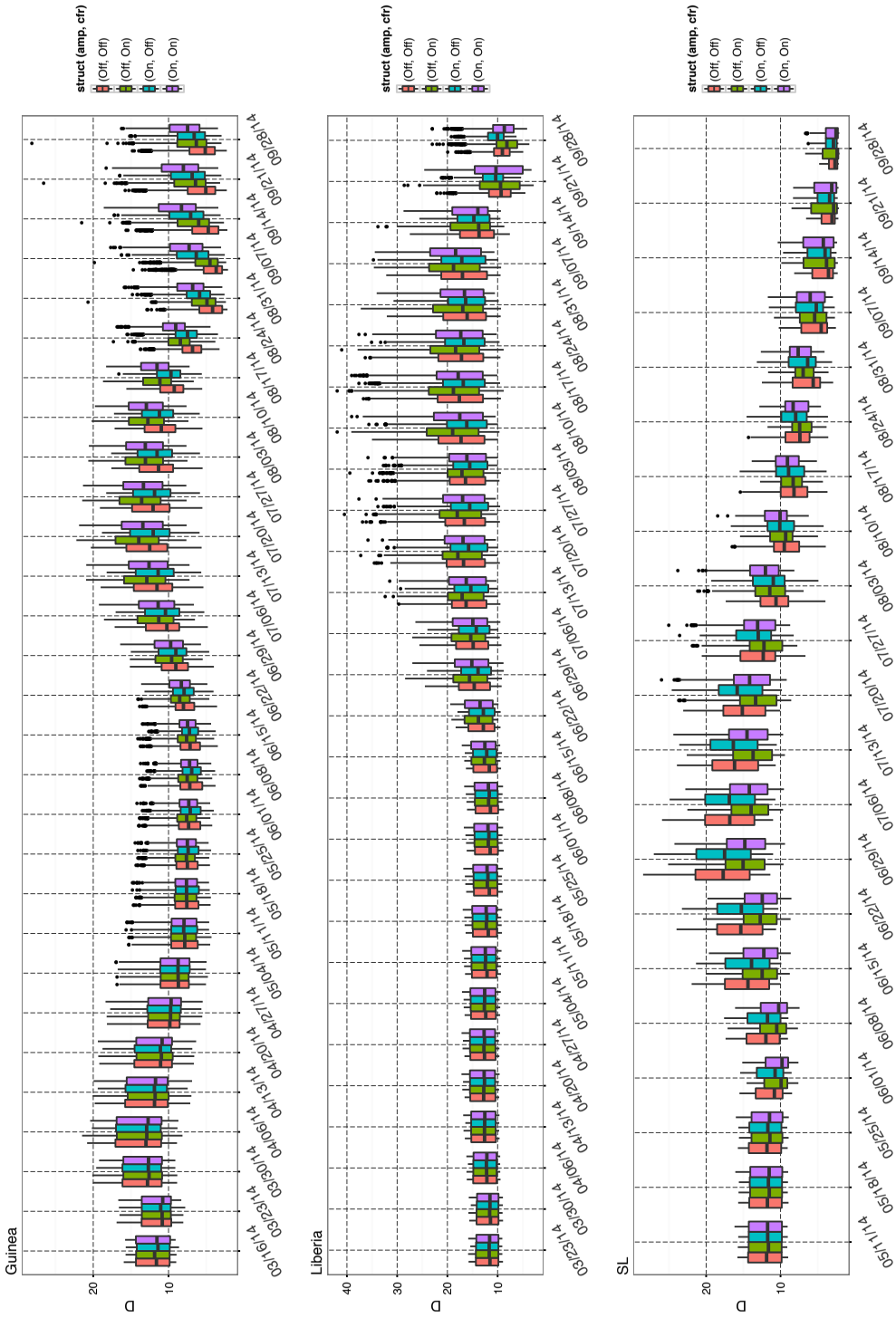


Figure S5. Same as Figure S2, but for *M*.

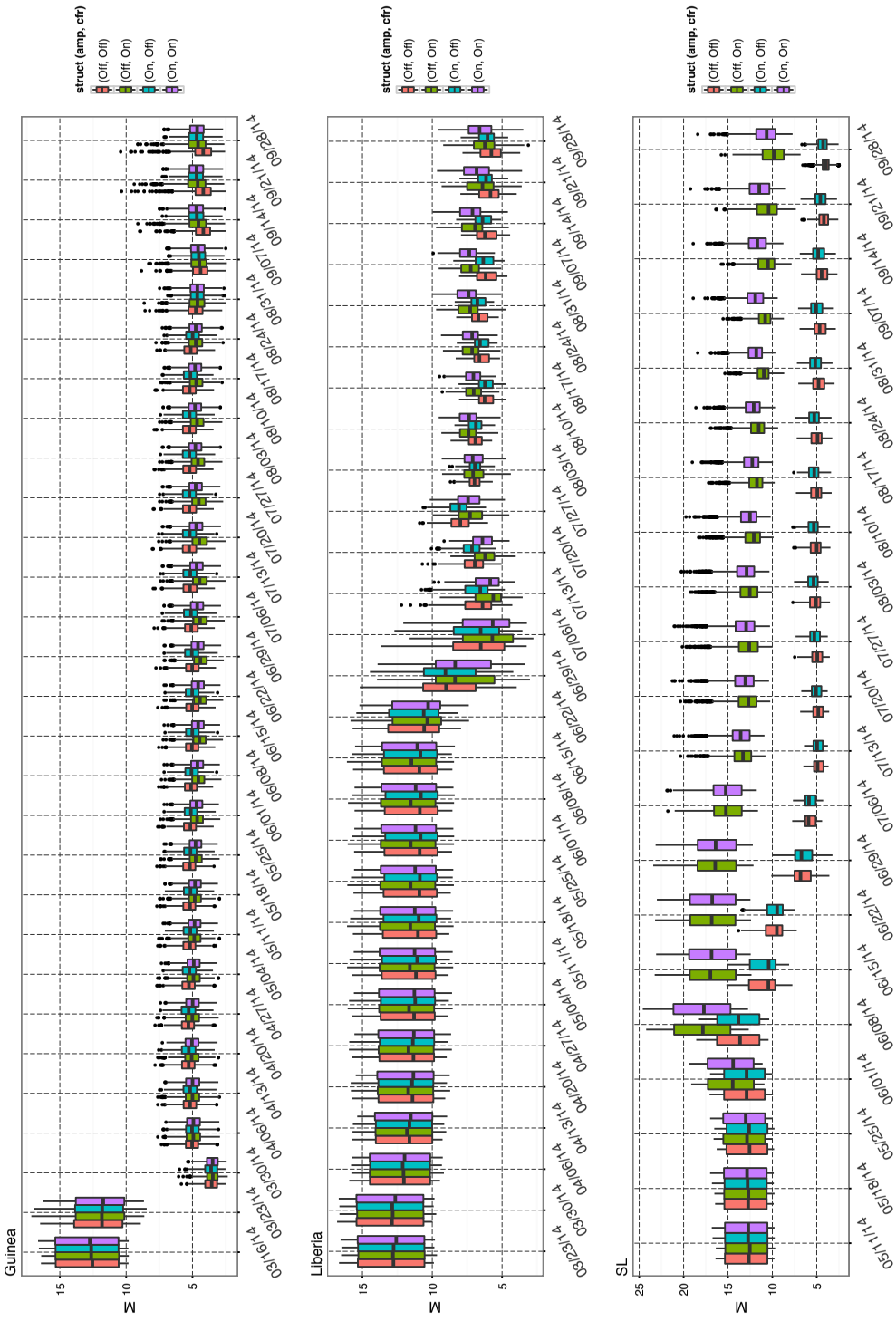


Figure S6. Parameter estimates $R_{0\,Mean}$ through time for Guinea, Liberia, and Sierra Leone as generated using the ensemble model-EAKF framework. Eight combinations of initial parameter ranges for Z, D and M are shown, each either drawn from a uniform distribution range of [4, 14] or [4, 21]. The box and whiskers show the median (black horizontal line), 25th and 75th percentiles (box boundaries), 95% credible interval (whiskers) and outliers (dots).

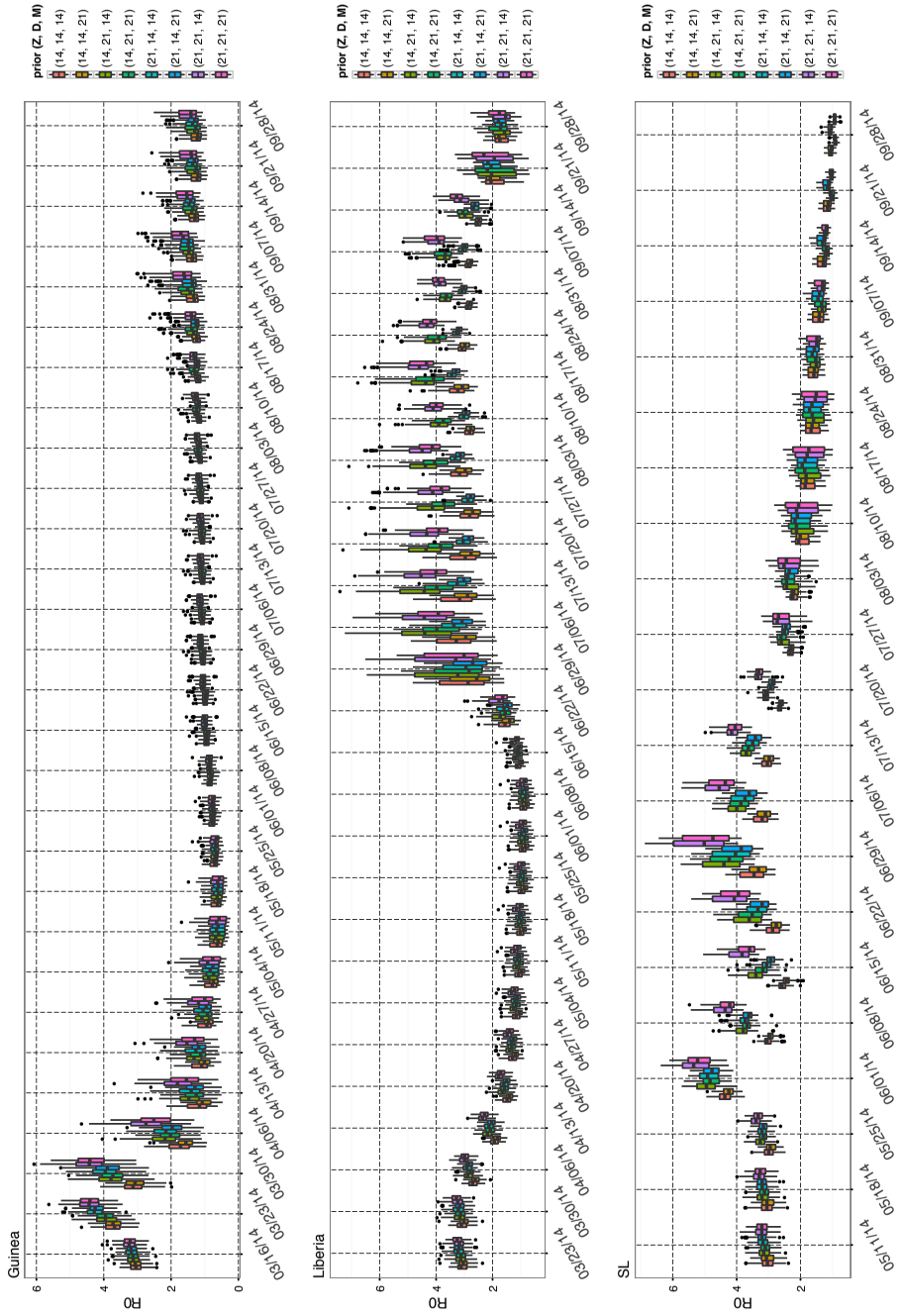


Figure S7. Same as Figure S6, but for *Z*.

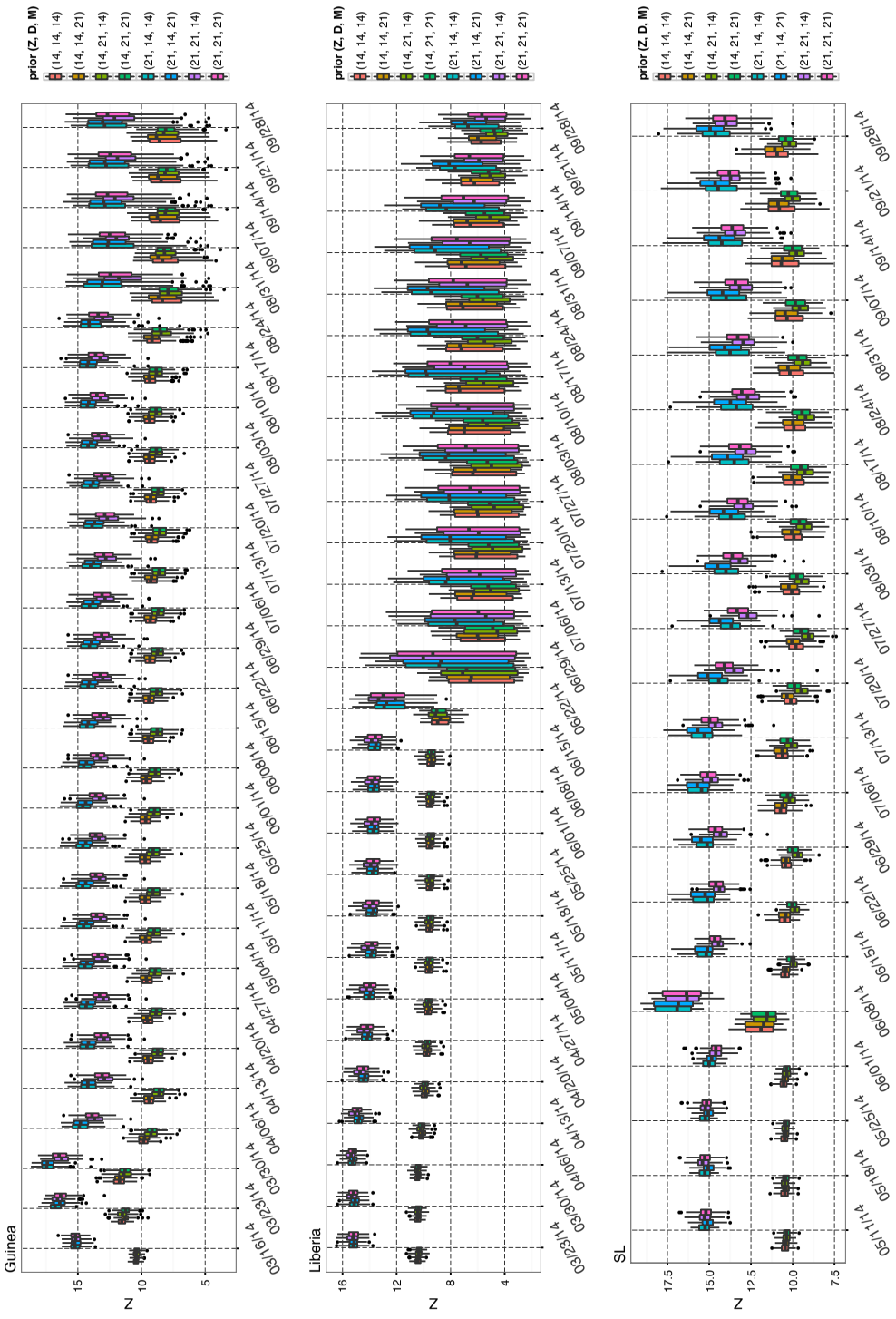


Figure S8. Same as Figure S6, but for *D*.

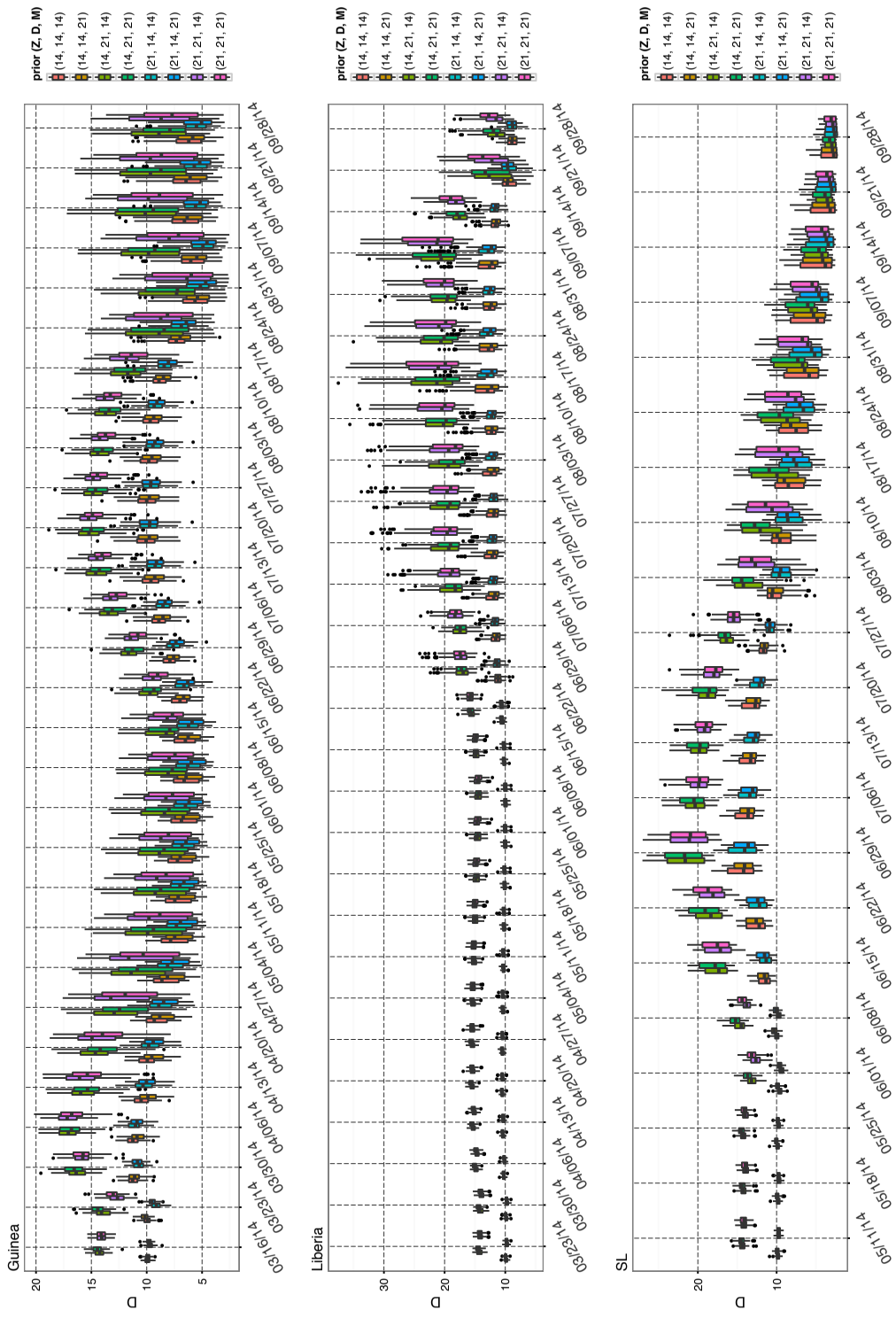


Figure S9. Same as Figure S6, but for *M.*

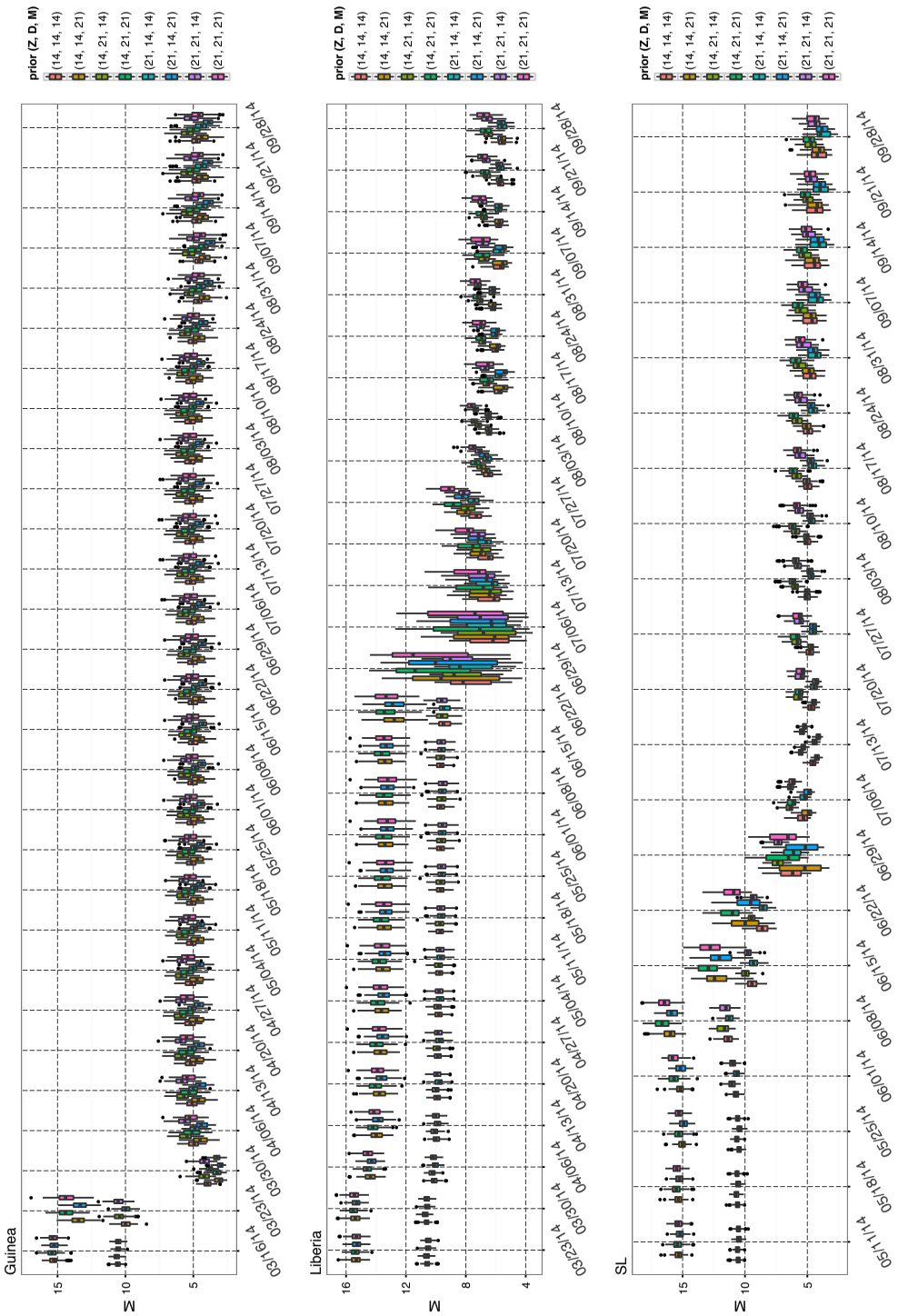
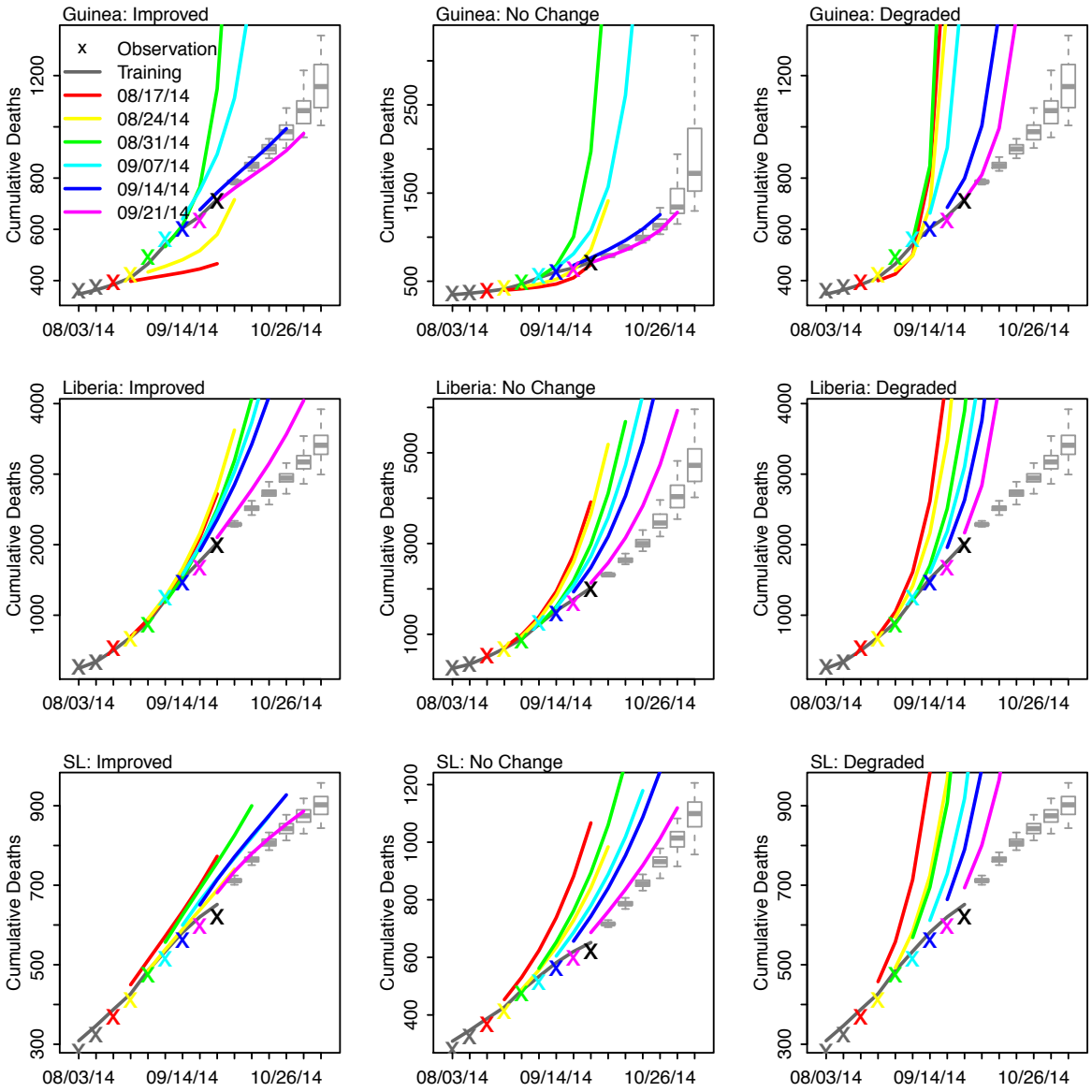


Figure S10. No change, improved, and degraded scenario forecasts of cumulative mortality for Guinea, Liberia, and Sierra Leone. Observations (x), mean ensemble trajectory during training with observations (solid dark grey line), mean ensemble trajectory of prior weekly forecasts (colored lines), and the current forecast begun September 28, 2014 (boxes and whiskers) are shown. The colored 'x' shown the corresponding final observation assimilated prior to generating a given weekly ensemble forecast. The box and whiskers show the median (thick grey horizontal line), 25^{th} and 75^{th} percentiles (box boundaries), and 95% credible interval (whiskers).


Guinea: Improved
Guinea: No Change
Guinea: Degraded
Liberia: Improved
Liberia: No Change
Liberia: Degraded
SL: Improved
SL: No Change
SL: Degraded
Cumulative Deaths
x Observation
Training
08/17/14
08/24/14
08/31/14
09/07/14
09/14/14
09/21/14
08/03/14
09/14/14
10/26/14