

¹ **Supplementary 3: Sequential Monte Carlo**

² **methods for data assimilation problems**

³ Kwaku Peprah Adjei¹²³ Robert B. O'Hara⁴ Nick Isaac⁵³

⁴ Daina Bowler²³ Rob Cooke²³

⁵ Invalid Date

⁶ **1 Example 1 : Linear Gaussian State Space Models**

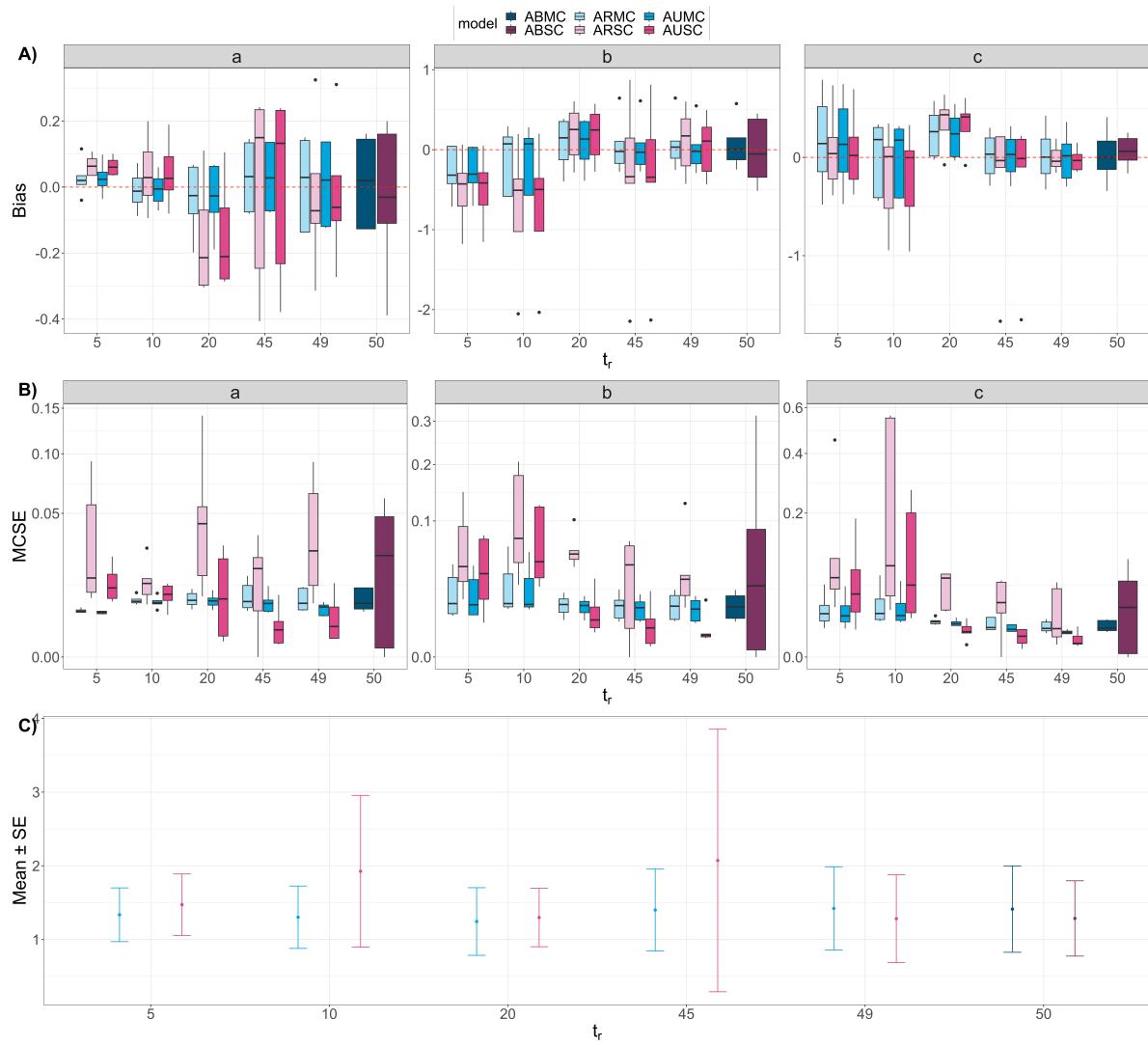


Figure 1: Mean bias and Monte Carlo standard error of model parameters and the mean root mean square error of the latent states estimated from the study models that use auxiliary particle filter.

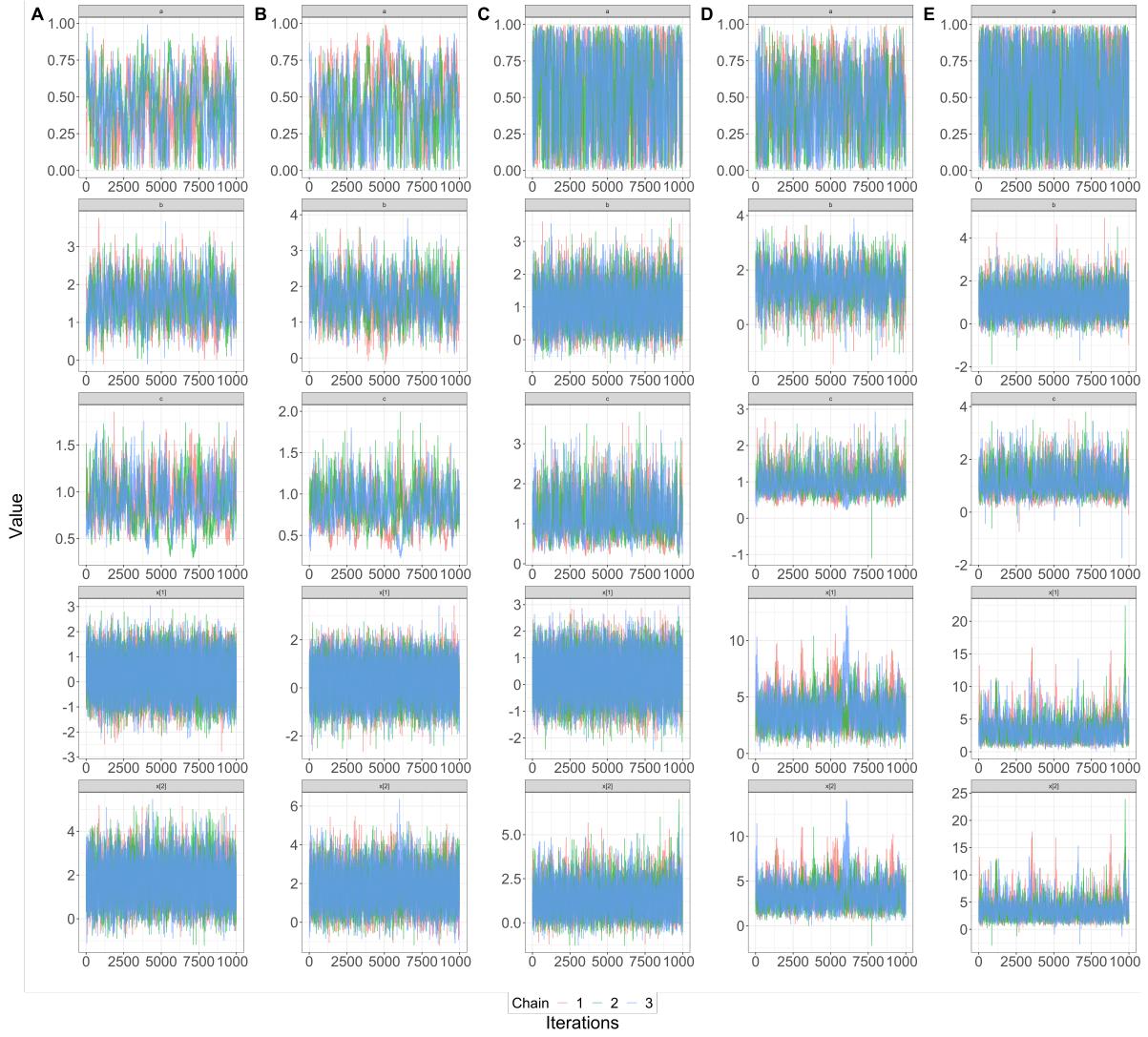


Figure 2: Convergence of model parameters estimated from the study models that employ the auxiliary particle filter approach, with the reduced model fitted with MCMC. Each column corresponds to a particular study model: A) Baseline model with MCMC B) ARMC with $t_r = 10$, C) ARMC with $t_r = 45$, D) AUMC with $t_r = 10$ and E) AUMC with $t_r = 45$

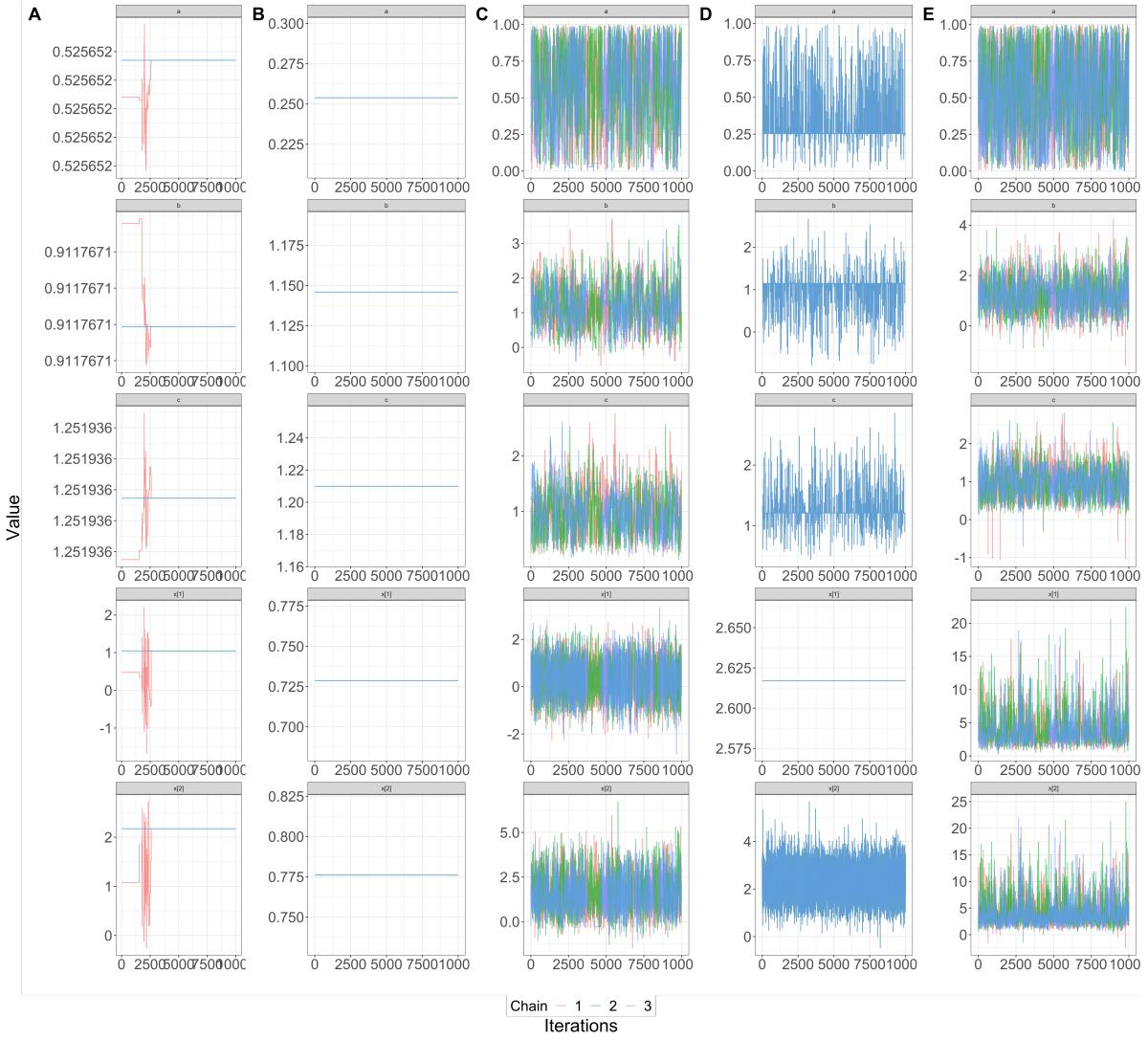


Figure 3: Convergence of model parameters estimated from the study models that employ the auxiliary particle filter approach, with the reduced model fitted with SMC. Each column corresponds to a particular study model: A) Baseline model with SMC B) ARSC with $t_r = 10\$$, C) ARSC with $t_r = 45\$$, D) AUSC with $t_r = 10\$$ and E) AUSC with $t_r = 45\$$

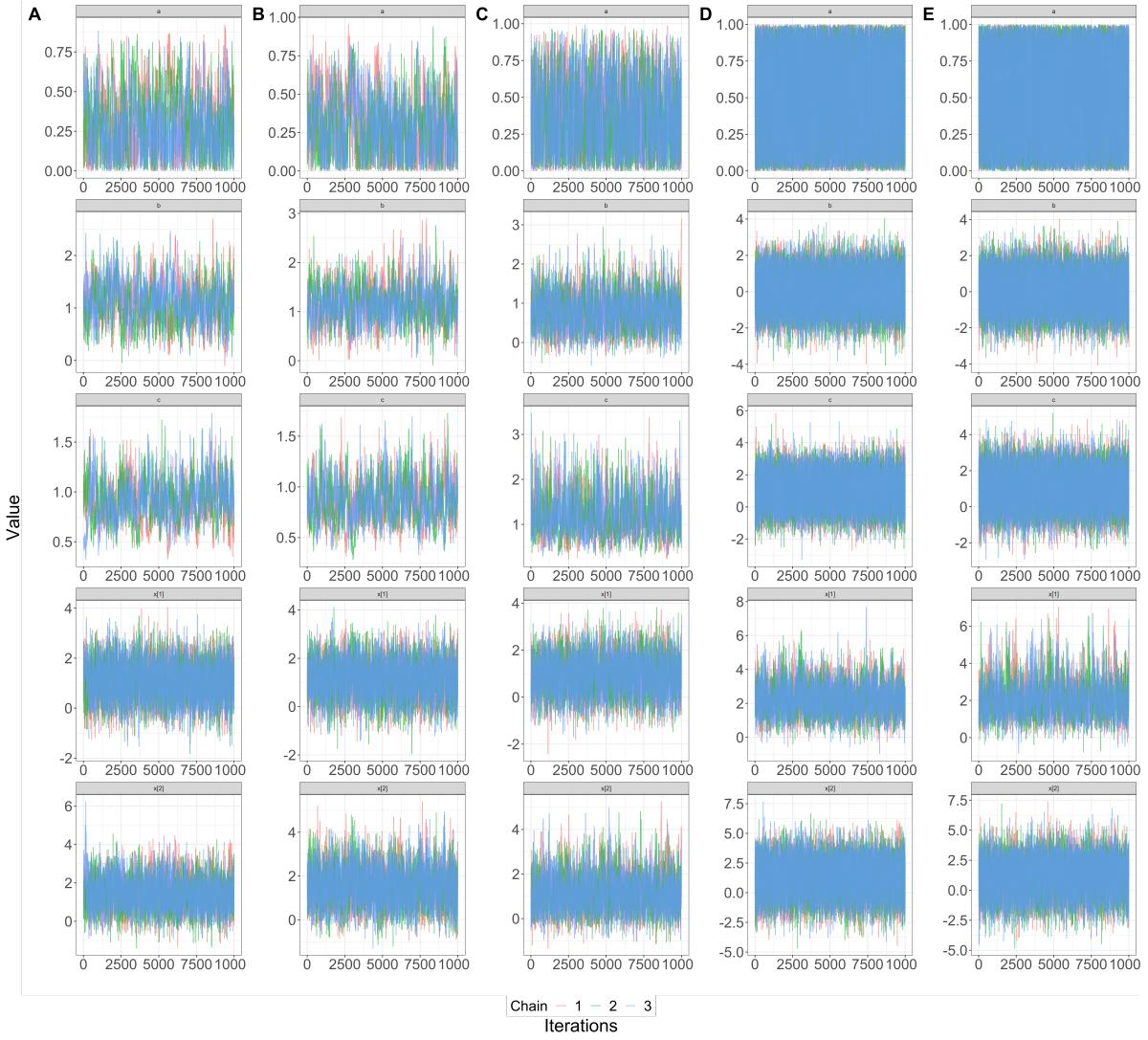


Figure 4: Convergence of model parameters estimated from the study models that employ the auxiliary particle filter approach, with the reduced model fitted with MCMC. Each column corresponds to a particular study model: A) Baseline model with MCMC B) BRMC with $\$t_r = 10\$$, C) BRMC with $\$t_r = 45\$$, D) BUMC with $\$t_r = 10\$$ and E) BUMC with $\$t_r = 45\$$

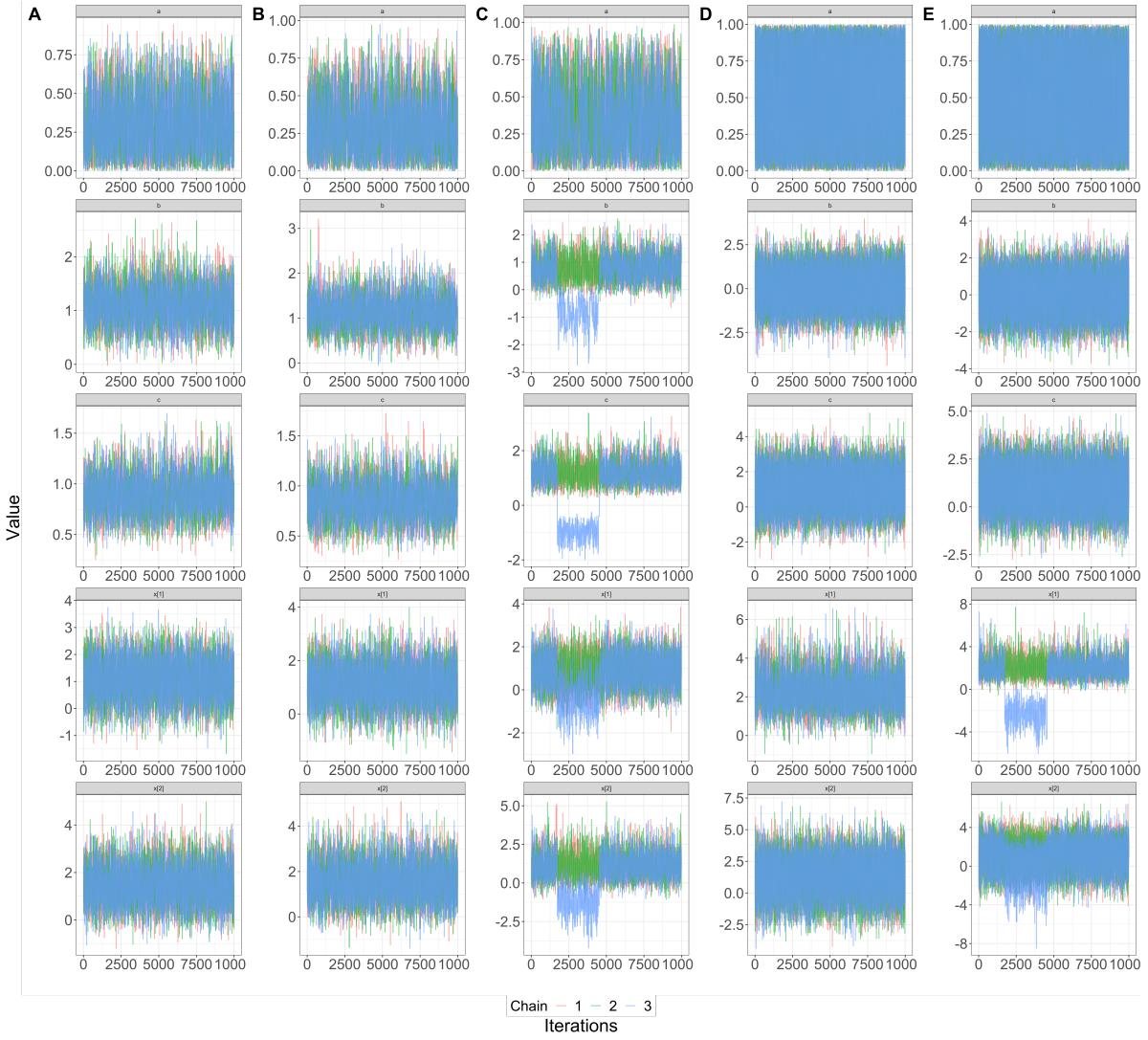


Figure 5: Convergence of model parameters estimated from the study models that employ the bootstrap particle filter approach, with the reduced model fitted with SMC. Each column corresponds to a particular study model: A) Baseline model with SMC B) BRSC with $t_r = 10$, C) BRSC with $t_r = 45$, D) BUSC with $t_r = 10$ and E) BUSC with $t_r = 45$

₇ **2 Example 2 : Dynamic Occupancy Models**

₈ **3 References**

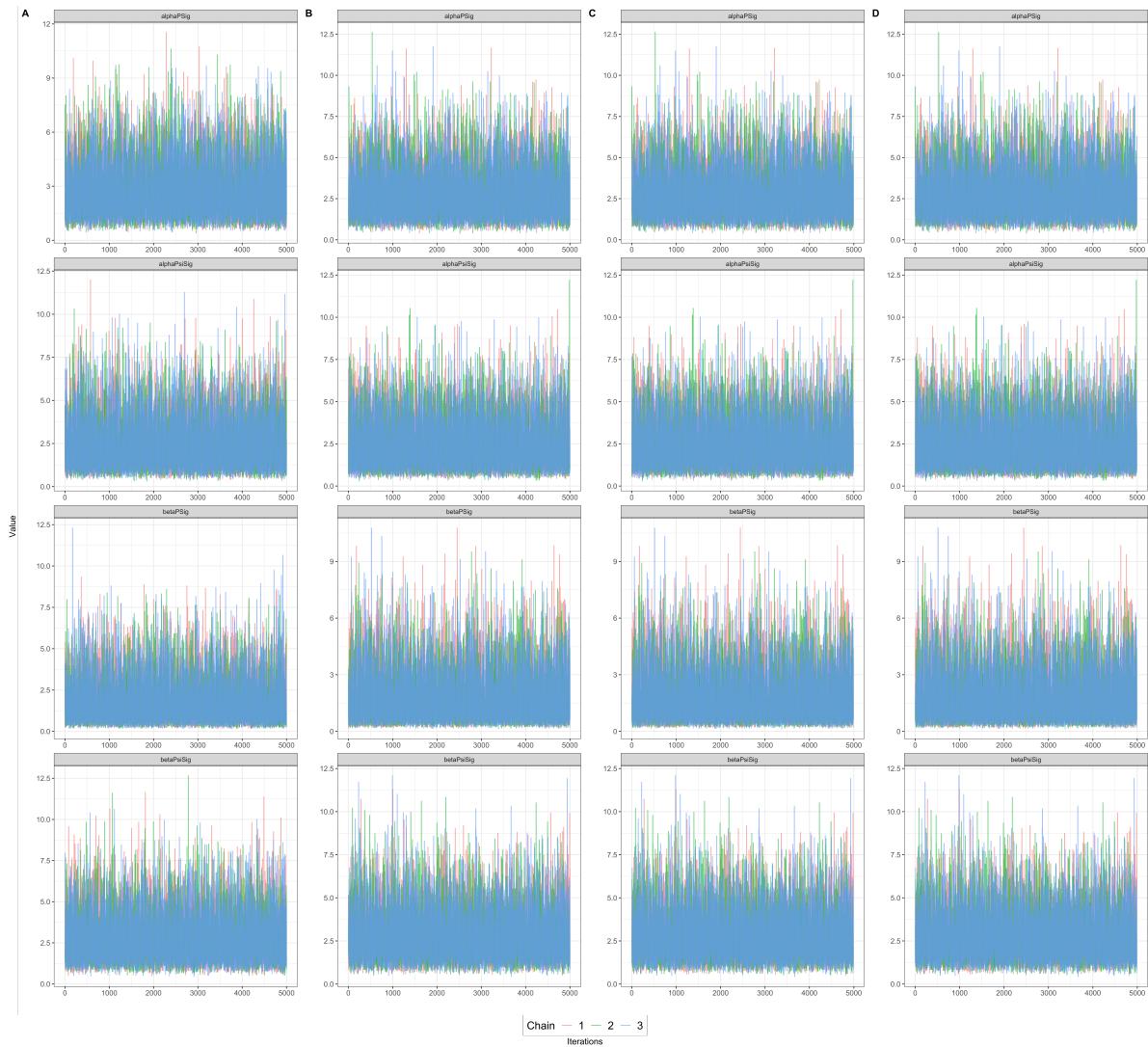


Figure 6: Converge of model parameters estimated from A) BBMC, B) BRMC, C) BUMC and D) AUMC. The model parameters presented here are: alphaphi (α^ϕ), alphaPsig (σ_{α^ϕ}), betaphi (β^ϕ), betaPsig (σ_{β^ϕ})

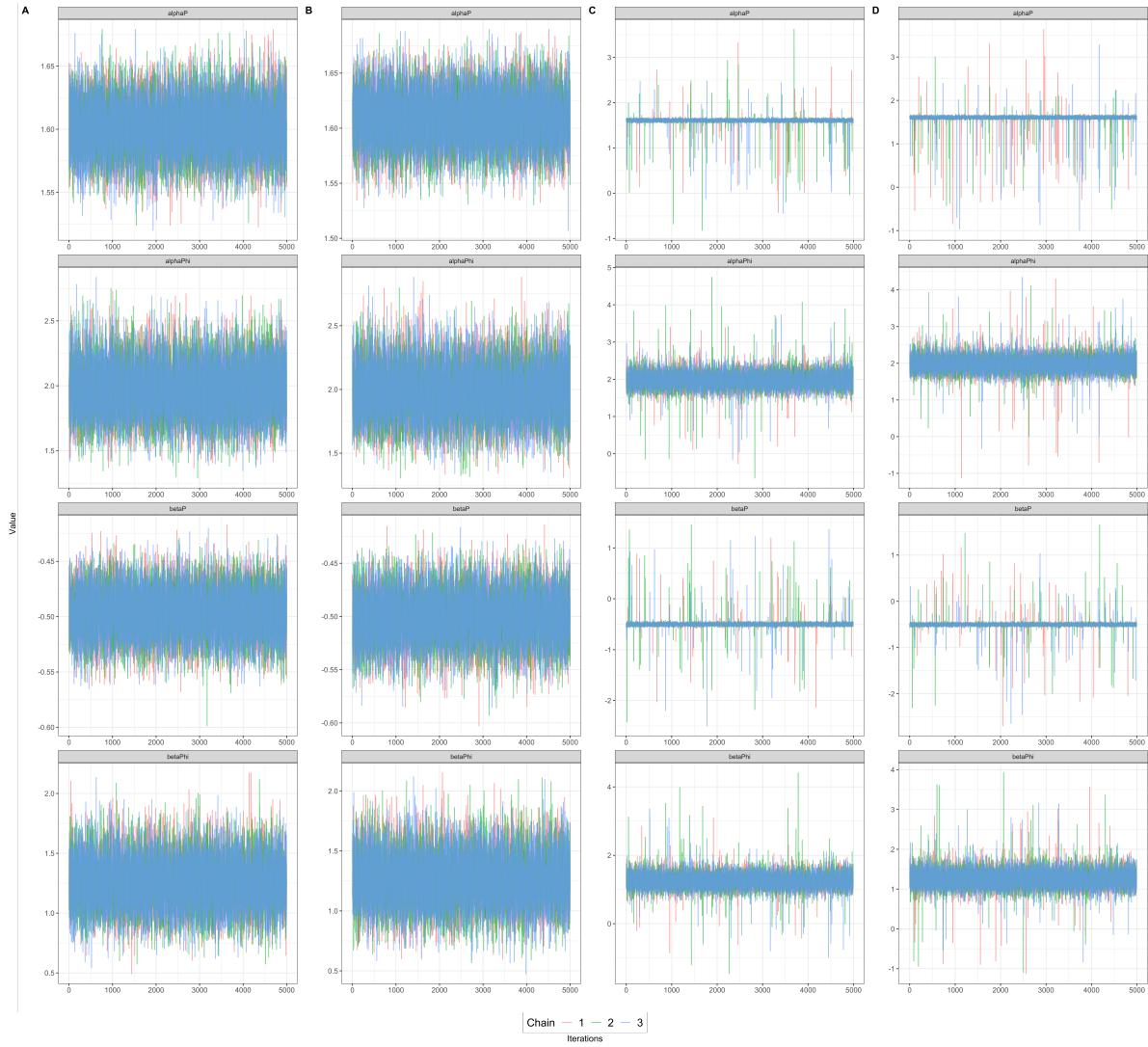


Figure 7: Convergence of model parameters estimated from A) BBMC, B) BRMC, C) BUMC and D) AUMC. The model parameters presented here are: alphaP ($\$\\alpha\\hat{p}$), alphaPsig ($\$\\sigma_{\\alpha\\hat{p}}$), betaphi ($\$\\beta\\hat{\\phi}$), betaPsig ($\$\\sigma_{\\beta\\hat{\\phi}}$)

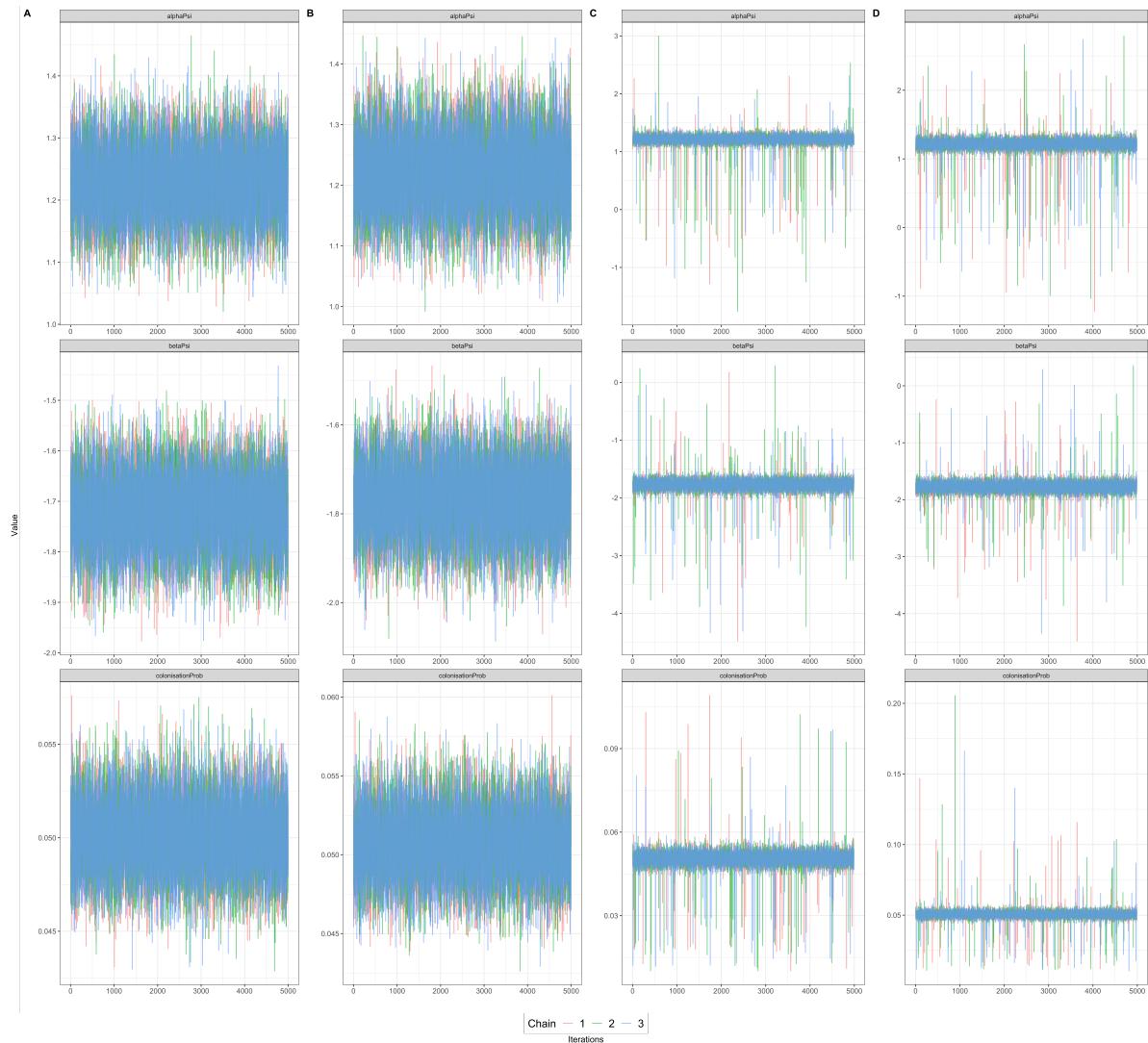


Figure 8: Mean bias and Monte Carlo standard error of model parameters and the mean root mean square error of the latent states estimated from the study models that use auxiliary particle filter.

Parameter	Truth	BBSC		BMMC		BRMC		BUMC		ABSC		AUMC
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
σ_{α^p}	2	0.497	1.95×10^{-12}	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	1.4832
σ_{β^p}	3	0.497	1.95×10^{-12}	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	1.4832
σ_{α^ψ}	4	2.2393	1.95×10^{-12}	2.355	1.4803	2.3462	1.4673	2.3467	1.4673	1.8579	10.02038	2.3467
σ_{β^ψ}	2	4.3329	1.95×10^{-12}	2.6840	1.496	2.7186	1.49	2.7185	1.49	1.4285	0.013	2.7185
α_p	1.6	1.217	1.95×10^{-12}	1.6009	0.0213	1.608	0.0233	1.603	0.101	-0.088	0.005	1.6002
β_p	3	0.497	1.95×10^{-12}	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992
α_ϕ	3	0.497	1.95×10^{-12}	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992
β_ϕ	3	0.497	1.95×10^{-12}	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992
α_ψ	3	0.497	1.95×10^{-12}	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992
β_ψ	3	0.497	1.95×10^{-12}	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992
γ	3	0.497	1.95×10^{-12}	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992	1.4834	2.5992

Table 1: A caption