# S3 Appendix: Age-year-space covariance

The simulation applied in this paper was set-up to control covariance across ages, years and space. To do this we used a combination of Matérn covariance, to control the level of spatial aggregation, and the age-year covariance described in Cadigan [16], to control the level of similarity in distributions across ages and years. As described in Appendix A in Cadigan [16], the age-year covariance can be broken down into a series of AR(1) processes. We integrate Matérn covariance into this series of equations:

Where indicates the multivariate normal distribution, controls the variance of the process, and control correlation in the age and year dimension and is defined by Matérn correlation:

where is the Euclidean distance between two locations, is the gamma function, denotes the modified Bessel function of the second kind, and and control the smoothness and scale of the spatial process [18]. With this structure, simulated error is correlated across ages, years and space.