S3 Appendix: Description of spatial covariates used in simulation study

In this supplement we describe how the values of the two spatial covariates used in the simulation study were computed.

Spatial covariate $v(s)$ of individual density

We computed $v(s)$ using the probability density function of a finite mixture of four normal (Gaussian) distributions as follows:

$$ v(s) = \sum_{i=1}^{4} p_i f(s|\mu_i, \Sigma_i) $$

where the mixing proportions were $p_1 = 0.25$, $p_2 = 0.45$, $p_3 = 0.15$, and $p_4 = 0.15$. The means and covariance matrices for the four normal distributions were as follows:

- $\mu_1 = \begin{pmatrix} 0.75 \\ -0.2 \end{pmatrix}$, $\Sigma_1 = \begin{pmatrix} 0.25 & 0.25 \\ 0.25 & 1.00 \end{pmatrix}$
- $\mu_2 = \begin{pmatrix} -0.7 \\ 0.6 \end{pmatrix}$, $\Sigma_2 = \begin{pmatrix} 1.00 & -0.2 \\ -0.2 & 0.25 \end{pmatrix}$
- $\mu_3 = \begin{pmatrix} -1.5 \\ -1.0 \end{pmatrix}$, $\Sigma_3 = \begin{pmatrix} 0.15 & 0.1 \\ 0.1 & 0.25 \end{pmatrix}$
- $\mu_4 = \begin{pmatrix} 1.75 \\ 1.75 \end{pmatrix}$, $\Sigma_4 = \begin{pmatrix} 0.15 & -0.1 \\ -0.1 & 0.25 \end{pmatrix}$

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After $v(s)$ was computed for all locations $s \in B$, the values of $v(s)$ were centered and scaled to have zero mean and unit variance.

**Spatial covariate $w(s)$ of baseline detection rate**

We computed $w(s)$ as a spatial trend (decline) in the northeast direction as follows:

$$w(s) = -0.1s_1 - 0.1s_2 + 0.01s_1s_2$$

where $s_1 =$ easting of location $s$ and $s_2 =$ northing of location $s$. After $w(s)$ was computed for all $K$ trap locations (i.e., where $s = x_k$), the values of $w(s)$ were centered and scaled to have zero mean and unit variance.