

The WinBugs program for the best selected model (ZIP model with hyper-g prior, SM-OU specification, exponential kernel (C))

```

model
{

for (j in 1:9){ gb[j] <- b[j]*gamma1[j] }
for (j in 1:9){ gc[j] <- c[j]*gamma2[j] }

O[1] ~ dpois(lambda[1])
u[1] ~ dbern(p[1])
lambda[1] <- (1 - u[1]) * mu[1]
log(mu[1]) <- mu1[1]
mu1[1] ~ dnorm(M[1],U)
C[1]<- s + gb[1]*x1[1] +gb[2]*x2[1] +gb[3]*x3[1] +gb[4]*x4[1] +gb[5]*x5[1] +gb[6]*x6[1]
+gb[7]*sp[1] + gb[8]*su[1] +gb[9]*fa[1] + alphab*exp(-alphab*x7[1])+ random[y[1]]

M[1]<-C[1] + (log(mu[1])- C[1])*exp(-phi)

logit(p[1]) <-s + gc[1]*x1[1] +gc[2]*x2[1] +gc[3]*x3[1] +gc[4]*x4[1] +gc[5]*x5[1] +gc[6]*x6[1]
+gc[7]*sp[1] + gc[8]*su[1] +gc[9]*fa[1] + alphac*exp(-alphac*x7[1])

```

```

for(k in 2:2208) {
D1[k]<-alphab*exp(-alphab*x7[k])
D2[k]<-alphac*exp(-alphac*x7[k])
}

for(i in 2:n){
V1[i]<-mean(D1[startinds[i]:endinds[i]])
V2[i]<-mean(D2[startinds[i]:endinds[i]])

```

Incorporation of spatial kernel

```

O[i] ~ dpois(lambda[i])
u[i] ~ dbern(p[i])
lambda[i] <- (1-u[i]) * (mu[i]+mu[i-1])*0.5
log(mu[i]) <- mu1[i]
mu1[i] ~ dnorm(M[i],U)

C[i]<- s + gb[1]*x1[i] + gb[2]*x2[i] +gb[3]*x3[i] +gb[4]*x4[i] +gb[5]*x5[i] +gb[6]*x6[i]
+gb[7]*sp[i] + gb[8]*su[i] +gb[9]*fa[i] + V1[i]+ random[y[i]]

M[i]<-C[i] + (log(mu[i-1])- C[i])*exp(-phi)

```

Ornstein-Uhlenbeck process

```

logit(p[i]) <-s + gc[1]*x1[i] + gc[2]*x2[i] +gc[3]*x3[i] +gc[4]*x4[i] +gc[5]*x5[i] +gc[6]*x6[i]
+gc[7]*sp[i] + gc[8]*su[i] +gc[9]*fa[i] + V2[i]

```

```
}
```

```
U<-(2*phi)/(1-exp(-2*phi))
```

Ornstein-Uhlenbeck process

```
lamda<-exp(s)
```

```
for (m in 1:5) {random[m] ~ dnorm(0, tau.btw)}
```

```
for (j in 1:9){ gamma1[j]~dbern(0.5) }
```

```
for (j in 1:9){ gamma2[j]~dbern(0.5) }
```

```
for (i in 1:10)
```

```
{
```

```
for (j in 1:10)
```

```
  {
```

```
  inverse.V[i , j]<-inprod(x[ , i] , x[ , j])
```

```
  }
```

```
}
```

```
for (i in 1:9)
```

```
{
```

```
for (j in 1:9)
```

```
  {
```

```
  prior.T[i , j]<-inverse.V[i , j]*lamda/(K/(1-K))
```

```
  }
```

```
}
```

```
b[1:9] ~ dnorm( mu.beta[ ], prior.T[ , ])
```

```
for (j in 1:9)
```

```
{mu.beta[j]<-0.0}
```

```
c[1:9] ~ dnorm( mu.c[ ], prior.T[ , ])
```

```
for (j in 1:9)
```

```
{mu.c[j]<-0.0}
```

```
alphab~dnorm( 0, 0.01)I(0,)
```

```
alphac~dnorm( 0, 0.01)I(0,)
```

```
phi ~ dnorm( 0, 0.1)I(0.31, )
```

```
s ~ dnorm( 0, 0.001)
```

```
K~dbeta(1,1)
```

Incorporation of g-prior distribution

1, 0, 9.43, 23.571, 29.857, 16.114, 84.33, 0, 0, 1, 1, 0, 2.26, 20.457, 25.657, 15, 82.33, 0, 0, 1, 1, 0,
0.6285714, 16.721, 20.029, 13.171, 71.76, 0, 0, 1, 1, 0, 0.56, 15.179, 17.943, 12.571, 77.67, 0, 0, 1, 1,
0, 0, 15.686, 20.257, 10.571, 75, 0, 0, 1, 1, 0, 3.942857, 14.443, 19.371, 8.714, 76, 0, 0, 1, 1, 1, 4.73,
11.186, 14.371, 6.486, 67, 0, 0, 1, 1, 0, 0, 8.779, 13.057, 4.971, 58.67, 0, 0, 1, 1, 0, 0, 7.286, 12.2, 2.743,
68.67, 0, 0, 1, 1, 0, 0, 2.914, 8.571, -2.743, 70.67, 0, 0, 1, 1, 0, 1.36, 6.743, 11.429, -0.486, 70.52571, 0, 0,
0, 1, 0, 9.228571, 6.636, 12.257, 1.686, 67, 0, 0, 0, 1, 0, 11.8, 4.607, 6.829, 1.486, 66, 0, 0, 0, 1, 0,
12.07143, 7.514, 10.686, 5.657, 54.67, 0, 0, 0, 1, 0, 0.8714286, 3.793, 6, 2.4, 56.67, 0, 0, 0, 1, 0, 0, 0.471,
2.4, -1.943, 62.67, 0, 0, 0, 1, 0, 0.2857143, 7.657, 12.543, 2.943, 68.67, 0, 0, 0, 1, 0, 6.4, 6.357, 11.143,
2.543, 70.33, 0, 0, 0, 1, 0, 0.6857143, 7.686, 11.571, 3.029, 63.71571, 0, 0, 0, 1, 0, 0, 8.171, 11.571, 4.229,
87, 0, 0, 0, 1, 0, 0.5, 10.364, 15.057, 5.543, 83, 0, 0, 0, 1, 0, 3.728571, 11.486, 15.8, 7.571, 74, 0, 0, 0, 1, 0,
1.86, 10.479, 14, 7.143, 77.33, 1, 0, 0, 1, 0, 1.13, 6.55, 10.057, 2.343, 82.33, 1, 0, 0, 1, 0, 0.1, 8.95, 13.114,
4.2, 90.67, 1, 0, 0, 1, 0, 14, 9.529, 13.314, 5.571, 79.33, 1, 0, 0, 1, 0, 0, 12.95, 16.857, 6.571, 81.95143, 1,
0, 0, 1, 0, 4.73, 8.15, 12.8, 3.571, 77, 1, 0, 0, 1, 0, 1.16, 13.607, 17.514, 6.686, 85.67, 1, 0, 0, 1, 0, 1.46,
16.1, 20.257, 9.629, 85.67, 1, 0, 0, 1, 0, 0.8571429, 14.414, 18.886, 8.6, 80.33, 1, 0, 0, 1, 0, 0, 18.736, 21.8,
11.2, 83.67, 1, 0, 0, 1, 0, 0, 17.843, 21.857, 10.257, 52.67, 1, 0, 0, 1, 0, 0.4, 21.2, 25.371, 12.514, 51.67,
1, 0, 0, 1, 0, 0, 23.743, 29, 13.229, 73.81143, 0, 1, 0, 1, 0, 0.04, 23.826, 28.029, 16.143, 70.33, 0, 1, 0, 1, 0,
0.1, 26.736, 30.371, 17.429, 78.33, 0, 1, 0, 1, 0, 1.74, 25.107, 29.943, 16.6, 85, 0, 1, 0, 1, 0, 0.1, 24.857,
28.314, 17.657, 73.33, 0, 1, 0, 1, 0, 1.34, 26.093, 30.429, 17.343, 63.33, 0, 1, 0, 1, 0, 2.07, 24.707, 29.457,
17.714, 62, 0, 1, 0, 1, 0, 0.09, 27.171, 31.314, 20.2, 50.67, 0, 1, 0, 1, 0, 0, 27.829, 32.143, 19.086,
68.99857, 0, 1, 0, 1, 0, 0, 26.193, 29.886, 18.657, 73.33, 0, 1, 0, 1, 0, 0.76, 24.843, 29.657, 16.857, 75,
0, 1, 0, 1, 0, 0, 25.329, 29.4, 17.343, 88.33, 0, 1, 0, 1, 0, 1.31, 25.157, 29.4, 17.2, 85.67, 0, 1, 0, 1, 1, 4.27,
22.943, 27.157, 15.457, 80.66, 0, 1, 0, 1, 0, 0.6, 22.343, 26.114, 15.286, 69.33, 0, 1, 0, 1, 0, 0, 22.6, 27.229,
16.086, 76.80857, 0, 0, 1, 1, 0, 0, 20.436, 24.686, 14.914, 71.67, 0, 0, 1, 1, 0, 7.54, 17.6, 22.571, 11.2,
79.33, 0, 0, 1, 1, 0, 0, 15.15, 20.114, 8, 69, 0, 0, 1, 1, 0, 0, 17.293, 22.2, 11.714, 65.33, 0, 0, 1, 1, 0, 0,
15.557, 20.6, 9.057, 61.67, 0, 0, 1, 1, 2, 0.1, 11.943, 15, 9.371, 84.33, 0, 0, 1, 1, 1, 18.42857, 12.907,
17.943, 7.143, 79.33, 0, 0, 1, 1, 1, 3.41, 4.786, 9.829, 0.686, 72.95143, 0, 0, 1, 1, 1, 4.314286, 13.871,
17.086, 9.514, 78.67, 0, 0, 1, 1, 0, 0.6, 2.714, 7.6, -0.971, 84, 0, 0, 1, 1, 0, 2.37, 8.907, 11.514, 5.486, 57.33,
0, 0, 1, 1, 0, 0.57, 6.921, 8.857, 4.571, 55.33, 0, 0, 1, 1, 0, 0, 4.6, 7.771, 0.4, 64.67, 0, 0, 0, 1, 0, 1.8, 6.364,
9.971, 1.714, 72.67, 0, 0, 0, 1, 0, 4.585714, 11.757, 14.429, 9.8, 78.33, 0, 0, 0, 1, 0, 1.816667, 5.767, 8.6,
2.9, 70.14286, 0, 0, 0, 1, 0, 0, 6.129, 8.2, 2.743, 82, 0, 0, 0, 1, 0, 0, 1.764, 5.314, -0.971, 64, 0, 0, 0, 1, 0,
0.8857143, 3.007, 6.143, -0.457, 69.33, 0, 0, 0, 1, 0, 0.27, 2.136, 5.2, -0.857, 87.33, 0, 0, 0, 1, 0, 2.03,
3.193, 6.743, 0.457, 73.33, 0, 0, 0, 1, 0, 0.24, 4.471, 7.286, 0.914, 72.33, 0, 0, 0, 1, 0, 14.04, 8.686, 11.943,
5.114, 80.33, 0, 0, 0, 1, 0, 3.085714, 3.136, 6.543, -0.086, 75.52143, 0, 0, 0, 1, 0, 0.94, 2.129, 5.714, -1.914,
82.33, 1, 0, 0, 1, 0, 0.9142857, 5.221, 7.829, 1.771, 79.67, 1, 0, 0, 1, 0, 1.06, 4.721, 7.571, 1.057, 64.33, 1,
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0, 10.707, 13.971, 5.057, 70.33, 1, 0, 0, 1, 0, 3.685714, 10.021, 13.686, 4.8, 50.67, 1, 0, 0, 1, 0, 0.03, 13.5,
17.971, 6.114, 70.33286, 1, 0, 0, 1, 0, 0, 18.057, 22.571, 12.229, 49.33, 1, 0, 0, 1, 0, 0, 21.186,
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15.543, 69.33, 1, 0, 0, 1, 0, 1.51, 21.329, 25.029, 15.543, 69, 0, 1, 0, 1, 0, 0, 23.457, 27.971, 14.4, 78, 0, 1,
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0, 25.55, 29.8, 16.657, 83.67, 0, 1, 0, 1, 0, 0, 27.257, 31.8, 16.943, 81.67, 0, 1, 0, 1, 0, 0, 26.779, 30.714,
18.629, 79.33, 0, 1, 0, 1, 0, 27.014, 31.229, 19.029, 70.67, 0, 1, 0, 1, 0, 0, 24.836, 28.571, 17.371, 58.33,
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24.821, 28.8, 17.486, 80, 0, 1, 0, 1, 1, 0.5714286, 21.85, 25.971, 15.8, 73.33, 0, 1, 0, 1, 2, 1.59, 19.921,
23.743, 13.4, 52.67, 0, 0, 1, 1, 2, 0, 17.993, 22.657, 12, 72.67, 0, 0, 1, 1, 5, 1.971429, 19.936,
23.829, 14.714, 66.67, 0, 0, 1, 1, 10, 0, 17.05, 20.886, 12.857, 61, 0, 0, 1, 1, 6, 0.41, 16.414, 19.314, 12.857,
69.47714, 0, 0, 1, 1, 8, 0, 15.214, 20.114, 9.171, 59.33, 0, 0, 1, 1, 4, 0, 12.586, 17.057, 5.971, 80.67, 0, 0, 1,
1, 7, 2.19, 11.293, 16.486, 5.371, 61.33, 0, 0, 1, 1, 6, 0, 11.829, 18.171, 4.629, 60, 0, 0, 1, 1, 8, 0, 9.207,
13.6, 4.829, 67.67, 0, 0, 1, 1, 11, 2.54, 13.586, 16.486, 8.257, 75, 0, 0, 1, 1, 8, 14.25714, 12.471, 15.771,
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1, 2, 0, 8.575, 11.6, 3.85, 68.33, 0, 0, 0, 1, 0, 3.928571, 7.764, 10.029, 5.171, 54.67, 0, 0, 0, 1, 0, 0.37,
4.264, 8.114, 1.2, 67.33, 0, 0, 0, 1, 1, 0, 5.543, 10, 0.371, 66.67, 0, 0, 0, 1, 0, 0, 2.529, 7.971, -
2.857, 65.85571, 0, 0, 0, 1, 0, 0, 2.121, 7.343, -2.471, 67.67, 0, 0, 0, 1, 0, 0, 7.329, 12.771, 0.429, 55.67,
0, 0, 0, 1, 0, 0.39, 5, 9.143, 0.629, 64, 0, 0, 0, 1, 0, 1.19, 7.85, 11.971, 4.114, 75.33, 0, 0, 0, 1, 0,

44.94, 61.39, 42.33, 7.24, 62.02, 56.41, 56.31, 59.38, 46.9, 56, 12.71, 46.05, 44.78, 25.02, 25.01, 16.29, 54.37, 15.07, 40.22, 42.45, 47.61, 45.41, 19.93, 37.49, 6.51, 18.23, 24.59, 36.67, 53.91, 27.04, 45.15, 56.26, 31.57, 30.07, 28.08, 49.42, 44.3, 52.04, 50.6, 36.79, 47.94, 35.71, 16.03, 18.03, 19.64, 41.26, 36.98, 51.07, 33.83, 18.61, 63.36, 40.36, 54.9, 14.95, 38.68, 34.46, 20.66, 12.88, 25.41, 50.07, 19.94, 32.14, 37.14, 42.36, 35.87, 10.34, 44.41, 16.61, 21.12, 31.69, 51.7, 18.56, 42.37, 52.14, 24.48, 26.92, 27.57, 48.84, 36.14, 50.28, 43.55, 29.23, 44.4, 39.54, 30.84, 21.49, 10.94, 35.24, 27.95, 45.41, 25.81, 25.35, 19.48, 16.3, 9.86, 14.28, 12.68, 9.25, 63.92, 15.02, 22.68, 32.43, 64.45, 2.08, 68.57, 21, 15.01, 9.88, 20.42, 62.47, 93.22, 49.76, 20.57, 5.88, 33.59, 11.23, 11.33, 17.98, 7.56, 11.19, 23.23, 8.32, 90.03, 50.36, 71.09, 41.55, 16.98, 25.28, 7.52, 26.56, 73.51, 51.34, 46.22, 47.74, 49.77, 44.1, 47.6, 28.74, 44.11, 45.7, 25.69, 40.33, 30.08, 48.78, 30.58, 39.79, 39.2, 43.59, 45.53, 35.39, 49.65, 14.29, 40.58, 34.21, 46.59, 30.22, 39.3, 47.6, 45.93, 43.63, 41.19, 43.32, 44.53, 47.83, 36.56, 42.38, 49.55, 33.49, 26.39, 38.83, 37.99, 47, 34.65, 33.02, 26.11, 77.68, 73.98, 57.6, 31.04, 19.63, 21.54, 71.23, 75.31, 75.32, 29.96, 7.74, 41.64, 19.45, 69.55, 88.49, 57.27, 79.35, 21.91, 15.73, 12.8, 75.32, 68.08, 81.85, 18.94, 48.91, 73.68, 67.19, 83.9, 64.7, 17.11, 42.72, 36.9, 34.78, 38.83, 21.99, 34.32, 31.49, 21.03, 20.47, 33.51, 39.88, 30.41, 36.19, 15.29, 17.81, 23.1, 20.74, 30.72, 61, 18.67, 40.93, 11.99, 31.31, 5.46, 22, 45.08, 46.93, 46.85, 28.18, 19.32, 29.77, 25.65, 11.86, 24.32, 38.67, 9.72, 16.38, 12.58, 26.46, 9.23, 41.23, 40.47, 35.07, 30.94, 35.69, 12.77, 30.33, 41.41, 10.83, 7.91, 39.61, 50.78, 23.22, 46.37, 4.33, 10.96, 15.45, 8.46, 38.21, 30.87, 49.07, 8.18, 26.42, 10.17, 17.91, 51.74, 54.8, 55.5, 25.68, 8.19, 25.6, 15.67, 3, 18.75, 48.52, 18.5, 8.72, 18.01, 3.36, 51.68, 29.99, 81.6, 37.34, 21.32, 25.02, 75.27, 35.54, 43.82, 25.75, 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2206, 2207, 2208))

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Note: In order to simplify the WinBUGS code, the covariates (and therefore $\mu^{(i)}$) have been shifted by a time point, hence $M[i]$ corresponds to $\mu^{(i-1)}$.