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library(nlme)
library(stargazer)

data(ests_out)
tmp <- filter(ests_out, seg == '303') %>%
  select(z_cmax, long, lat)

modn1 <- gls(z_cmax ~ 1, data = tmp)
mod1 <- gls(z_cmax ~ 1, correlation = corSpher(form = ~ long + lat, nugget = TRUE),
  data = tmp)
mod2 <- gls(z_cmax ~ 1, correlation = corLin(form = ~ long + lat, nugget = TRUE),
  data = tmp)
mod3 <- gls(z_cmax ~ 1, correlation = corRatio(form = ~ long + lat, nugget = TRUE),
  data = tmp)
mod4 <- gls(z_cmax ~ 1, correlation = corGaus(form = ~ long + lat, nugget = TRUE),
  data = tmp)
mod5 <- gls(z_cmax ~ 1, correlation = corExp(form = ~ long + lat, nugget = TRUE),
  data = tmp)

# AIC(modn1, mod1, mod2, mod3, mod4, mod5)

stargazer(modn1, mod1, mod2, mod3, mod4, mod5,
  title = 'Comparison of regression models with different correlation structures for grid 1',
  column.labels = c('null', 'Spher', 'Lin', 'Ratio', 'Gaus', 'Exp'),
  model.numbers = F
)

```

Table 1: Comparison of regression models with different correlation structures for grid locations.

	<i>Dependent variable:</i>					
	z_cmax					
	null	Spher	Lin	Ratio	Gaus	Exp
Constant	2.382*** (0.070)	2.355*** (0.136)	2.271*** (0.506)	2.356*** (0.219)	2.364*** (0.144)	2.349*** (0.177)
Observations	31	31	31	31	31	31
Log Likelihood	-16.082	-7.722	-9.699	-8.044	-7.326	-8.639
Akaike Inf. Crit.	36.165	23.445	27.399	24.088	22.652	25.279
Bayesian Inf. Crit.	38.967	29.050	33.003	29.693	28.256	30.883

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

```

data(choc_light)
data(irl_light)
data(tb_light)

choc_light <- select(choc_light, z_c_all, light, seg, Longitude, Latitude) %>%
  mutate(bay = 'choc')
irl_light <- select(irl_light, z_c_all, light, seg, Longitude, Latitude) %>%
  mutate(bay = 'irl')
tb_light <- select(tb_light, z_c_all, light, seg, Longitude, Latitude) %>%
  mutate(bay = 'tb')

all_light <- rbind(choc_light, irl_light, tb_light)

znl <- gls(z_c_all ~ 0 + bay, data = all_light)
zm1 <- gls(z_c_all ~ 0 + bay,
  correlation = corGaus(form = ~ Latitude + Longitude | bay, nugget = TRUE),
  data = all_light)

lnl <- gls(light ~ 0 + bay, data = all_light)
lm1 <- gls(light ~ 0 + bay,
  correlation = corGaus(form = ~ Latitude + Longitude | bay, nugget = TRUE),
  data = all_light)

```

```

summary(znl)

## Generalized least squares fit by REML
##   Model: z_c_all ~ 0 + bay
##   Data: all_light
##           AIC      BIC    logLik
##   615.1603 634.0605 -303.5802
##
## Coefficients:
##           Value Std.Error   t-value p-value
## baychoc 2.241611 0.02161190 103.72114      0
## bayirl  1.054048 0.05144661  20.48818      0
## baytb   1.209990 0.01490667  81.17107      0
##
## Correlation:
##           baychc bayirl
## bayirl 0
## baytb  0      0
##
## Standardized residuals:
##           Min      Q1      Med      Q3      Max
## -4.9005199 -0.4794889  0.1430016  0.6854605  5.6116229

```

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##
## Residual standard error: 0.3451143
## Degrees of freedom: 836 total; 833 residual

summary(zm1)

## Generalized least squares fit by REML
## Model: z_c_all ~ 0 + bay
## Data: all_light
##      AIC      BIC    logLik
## -1062.961 -1034.611 537.4807
##
## Correlation Structure: Gaussian spatial correlation
## Formula: ~Latitude + Longitude | bay
## Parameter estimate(s):
##      range      nugget
## 0.02545925 0.03293515
##
## Coefficients:
##      Value Std.Error t-value p-value
## baychoc 2.020700 0.09239280 21.87075      0
## bayirl  1.101049 0.07573749 14.53770      0
## baytb   1.162806 0.05511339 21.09843      0
##
## Correlation:
##      baychc bayirl
## bayirl 0
## baytb  0      0
##
## Standardized residuals:
##      Min      Q1      Med      Q3      Max
## -3.9370251 -0.3373829 0.3062355 0.8650886 5.7771938
##
## Residual standard error: 0.3734619
## Degrees of freedom: 836 total; 833 residual

summary(ln1)

## Generalized least squares fit by REML
## Model: light ~ 0 + bay
## Data: all_light
##      AIC      BIC    logLik
## 6030.477 6049.378 -3011.239
##
## Coefficients:
##      Value Std.Error t-value p-value
```

```

## baychoc 50.75848 0.5576516 91.02184 0
## bayirl 17.93223 1.3274763 13.50851 0
## baytb 41.57704 0.3846366 108.09435 0
##
## Correlation:
##      baychc bayirl
## bayirl 0
## baytb 0      0
##
## Standardized residuals:
##      Min      Q1      Med      Q3      Max
## -3.50916796 -0.49953556 0.01144066 0.48987965 4.08229910
##
## Residual standard error: 8.904982
## Degrees of freedom: 836 total; 833 residual

summary(lm1)

## Generalized least squares fit by REML
## Model: light ~ 0 + bay
## Data: all_light
##      AIC      BIC      logLik
## 5097.712 5126.062 -2542.856
##
## Correlation Structure: Gaussian spatial correlation
## Formula: ~Latitude + Longitude | bay
## Parameter estimate(s):
##      range      nugget
## 0.02741658 0.12826392
##
## Coefficients:
##      Value Std.Error  t-value p-value
## baychoc 48.07661 2.554597 18.819648 0
## bayirl 17.66437 2.041874 8.651056 0
## baytb 42.06220 1.517634 27.715639 0
##
## Correlation:
##      baychc bayirl
## bayirl 0
## baytb 0      0
##
## Standardized residuals:
##      Min      Q1      Med      Q3      Max
## -2.93104423 -0.43027644 0.06738397 0.47640756 3.90853899
##
## Residual standard error: 9.987022

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```
## Degrees of freedom: 836 total; 833 residual
```

```
stargazer(znl, zm1, lnl, lm1,
  title = 'Inter-bay differences for median depth of colonization and light requirements. Null models do not include a grouped correlation structure.',
  column.labels = c('null', 'Gaus', 'null', 'Gaus'),
  model.numbers = F
)
```

Table 2: Inter-bay differences for median depth of colonization and light requirements. Null models do not include a grouped correlation structure.

	<i>Dependent variable:</i>			
	z_c.all		light	
	null	Gaus	null	Gaus
baychoc	2.242*** (0.022)	2.021*** (0.092)	50.758*** (0.558)	48.077*** (2.555)
bayirl	1.054*** (0.051)	1.101*** (0.076)	17.932*** (1.327)	17.664*** (2.042)
baytb	1.210*** (0.015)	1.163*** (0.055)	41.577*** (0.385)	42.062*** (1.518)
Observations	836	836	836	836
Log Likelihood	-303.580	537.481	-3,011.239	-2,542.856
Akaike Inf. Crit.	615.160	-1,062.961	6,030.477	5,097.712
Bayesian Inf. Crit.	634.060	-1,034.611	6,049.378	5,126.062

*Note:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01