Day 2 Lab Part 4

ISI Short Course | June 1-3

Fit ozone data with default choices.

```
data(ozone2)
x<-ozone2$lon.lat
y<- ozone2$y[16,]
# default a is a large correlation range.
obj<- LatticeKrig( x, y)
```

```
## Warning in LatticeKrig(x, y): NAs removed
```

```
#check the basis function size.
obj$LKinfo
```

```
## Classes for this object are:  LKinfo LKRectangle
## The second class usually will indicate the geometry
##      e.g.  2-d rectangle is  LKRectangle
##
## Some details on spatial autoregression flags:
## stationary:  TRUE TRUE TRUE
## first order (by level):  TRUE TRUE TRUE
## isotropic:  TRUE TRUE TRUE
##
## Ranges of locations in raw scale:
##         [,1]   [,2]
## [1,] -93.572 36.791
## [2,] -82.960 44.453
##
## Logical (collapseFixedEffect) if fixed effects will be pooled: FALSE
##
## Number of levels: 3
## delta scalings: 3.537333 1.768667 0.8843333
## with an overlap parameter of  2.5
## alpha:  0.7619048 0.1904762 0.04761905
## based on smoothness nu =  1
##
## a.wght:  4.01 4.01 4.01
##
## Basis  type: Radial using  WendlandFunction  and Euclidean  distance.
## Basis functions will be normalized
##
## Total number of basis functions  874
##  Level Basis size
##      1        182 14 13
##      2        255 17 15
##      3        437 23 19
##
```

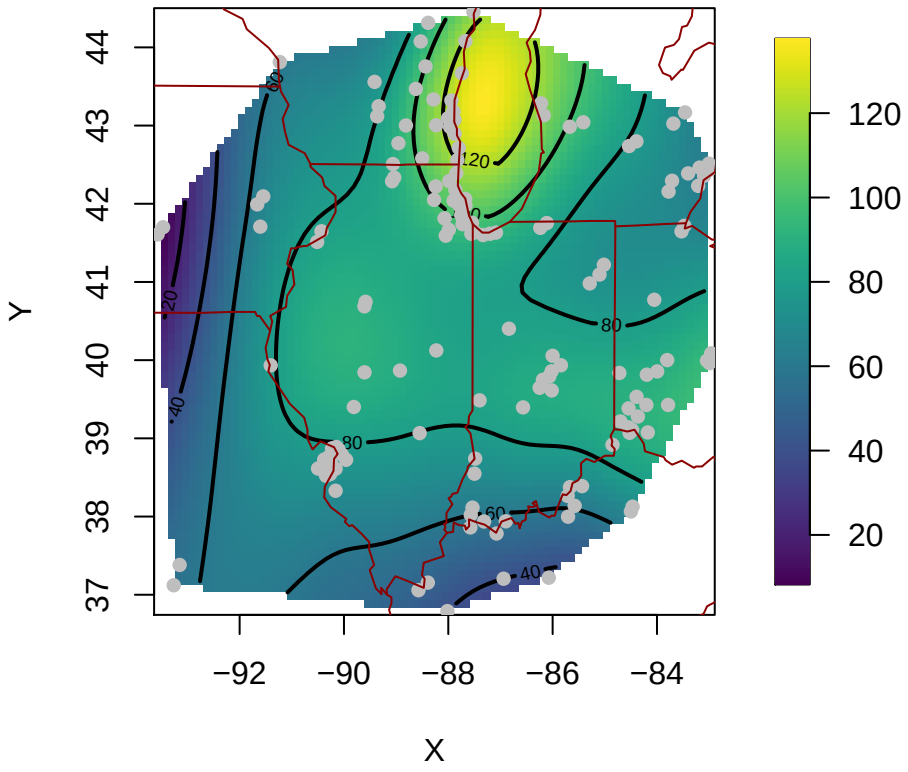
```
## Lambda value:  0.001851118
```

List out a summary of the fit and plot the fitted surface.

```
summary(obj)$parameters
```

```
##
## 1                        Number of Observations:   147.000000
## 2  Number of parameters in the fixed component     3.000000
## 3            Effective degrees of freedom (EDF)    25.140000
## 4              Standard Error of EDF estimate:      1.747000
## 5                  Smoothing parameter (lambda)     0.001851
## 6                                    MLE sigma     13.340000
## 7                                      MLE rho 96190.000000
## 8               Total number of basis functions   874.000000
## 9                        Multiresolution levels     3.000000
## 10                       log Profile Likelihood  -631.133849
## 11              log  Likelihood (if applicable)           NA
## 12  Nonzero entries in Ridge regression matrix 49257.000000
```

```
surface( obj)
points( x, pch=16, col="grey")
US( add=TRUE, col="red4")
```



A more flexible way is specify the model first then call the fitting function. ** a.wght= 8 ** is closer to what was suggested by maximum likelihood.

```
LKinfo<- LKrigSetup( x, NC=4, nlevel=3, a.wght=8,
                     nu=1.0)
LKinfo
obj1<- LatticeKrig( x, y , LKinfo=LKinfo)
```

OK finally a big spatial problem

Try this out on the larger CO2 data set. Here we specify the a.wght parameter instead of estimating it.

```
library( tictoc)
data( CO2)
LKinfo<- LKrigSetup( CO2$lon.lat,
                     NC=40, nlevel=3,
                 a.wght = 4.1,
                     nu = 1.0)
LKinfo
```

```
## Classes for this object are:  LKinfo LKRectangle
## The second class usually will indicate the geometry
##      e.g.  2-d rectangle is  LKRectangle
##
## Some details on spatial autoregression flags:
## stationary:  TRUE TRUE TRUE
## first order (by level):  TRUE TRUE TRUE
## isotropic:  TRUE TRUE TRUE
##
## Ranges of locations in raw scale:
##          [,1] [,2]
## [1,] -179.375  -82
## [2,]  179.375   82
##
## Logical (collapseFixedEffect) if fixed effects will be pooled: FALSE
##
## Number of levels: 3
## delta scalings: 9.198718 4.599359 2.299679
## with an overlap parameter of  2.5
## alpha:  0.7619048 0.1904762 0.04761905
## based on smoothness nu =  1
##
## a.wght:  4.1 4.1 4.1
##
## Basis  type: Radial using  WendlandFunction  and Euclidean  distance.
## Basis functions will be normalized
##
## Total number of basis functions  19188
##  Level Basis size
##      1       1400  50 28
##      2       4094  89 46
##      3      13694 167 82
##
## Lambda value:  NA
```

```
tic()
obj2<- LatticeKrig(CO2$lon.lat,CO2$y, LKinfo=LKinfo)
toc()
```

```
## 94.171 sec elapsed
```

```
(summary(obj2))$parameters
```

```
##
## 1                      Number of Observations:    26633.0000
```

```
## 2  Number of parameters in the fixed component        3.0000
## 3           Effective degrees of freedom (EDF)      903.2000
## 4             Standard Error of EDF estimate:         7.6340
## 5                 Smoothing parameter (lambda)        0.3069
## 6                                    MLE sigma        0.5050
## 7                                      MLE rho        0.8307
## 8              Total number of basis functions    19188.0000
## 9                       Multiresolution levels        3.0000
## 10                      log Profile Likelihood   -20623.0320
## 11             log  Likelihood (if applicable)           NA
## 12  Nonzero entries in Ridge regression matrix 12663004.0000
```

```
# check out timing details
obj2$timingLKrig
```

```
##          user.self sys.self elapsed
## timewX      13.926    0.223  14.208
## timeQ        0.367    0.009   0.378
## timeM        0.989    0.051   1.052
## timeChol     3.255    0.323   4.084
## timeCoef     0.451    0.011   0.464
## timeLike     0.069    0.015   0.084
## timeTrA      1.942    0.037   1.988
##             20.999    0.669  22.258
```

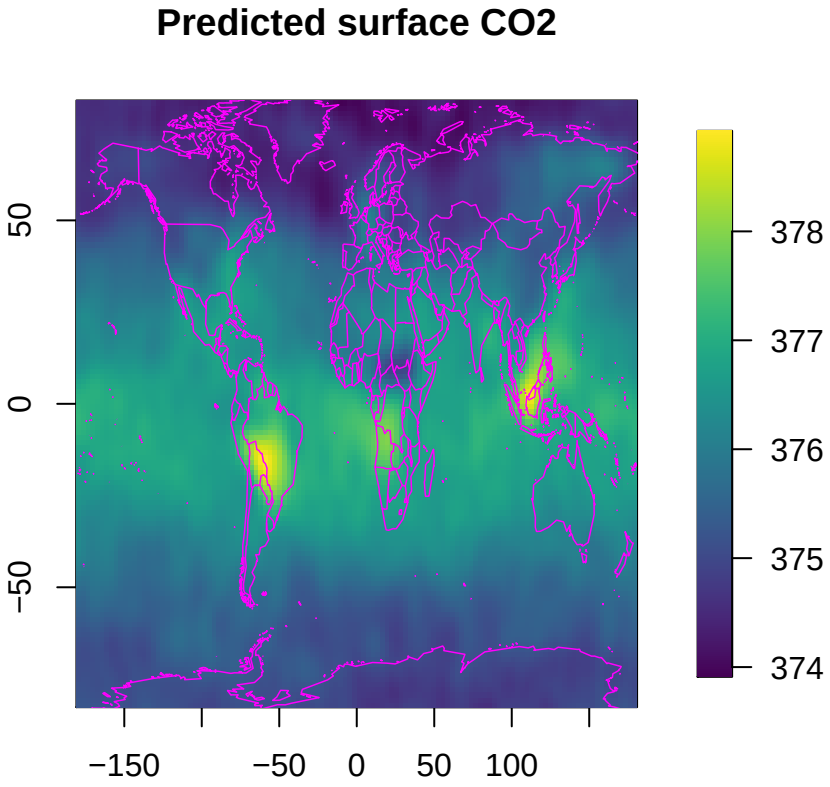
Plot the surface on a 120X120 grid and add a world map

```
library( scales)
```

```
##
## Attaching package: 'scales'
```

```
## The following object is masked from 'package:viridis':
##
##     viridis_pal
```

```
fitSurface<- predictSurface( obj2, nx=120, ny=120)
image.plot( fitSurface, col=viridis(256))
world( add=TRUE, col="magenta", lwd=.75)
title("Predicted surface CO2")
```


Predicted surface CO2
50
0
−50
−150
−50
0
50
100
378
377
376
375
374