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
```

```
## NULL
```

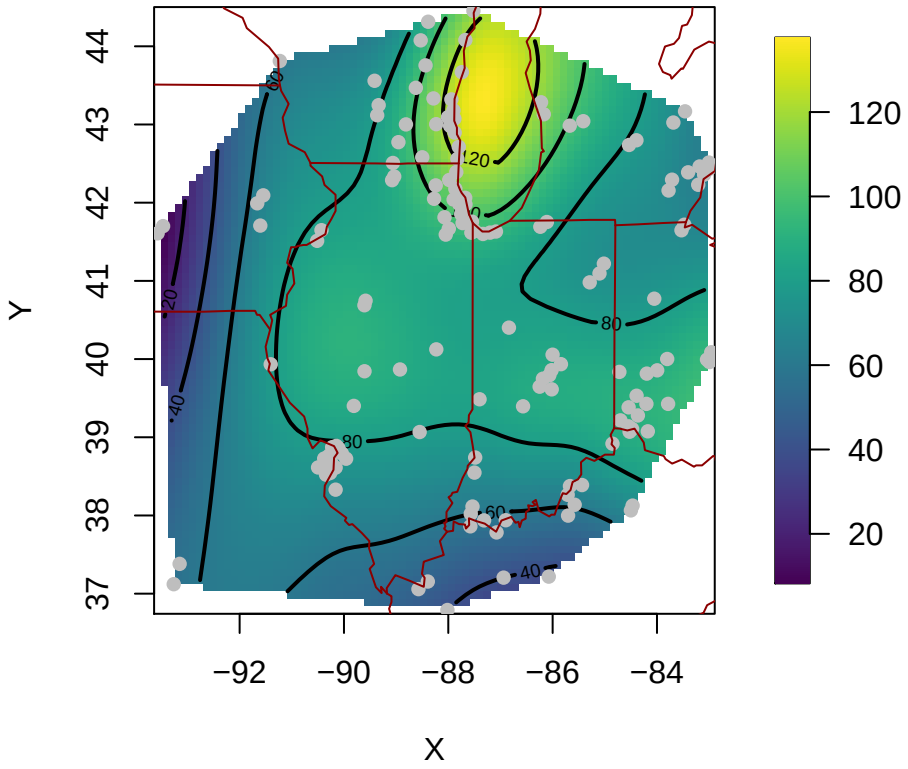
List out a summary of the fit and plot the fitted surface.

```
obj
```

```
## Call:
## LatticeKrig(x = x, y = y)
##
##
##  Number of Observations:                      147
##  Number of parameters in the fixed component 3
##   Effective degrees of freedom (EDF)         26.87
##     Standard Error of EDF estimate:          1.256
##  MLE sigma                                   13.34
##  MLE rho                                     96190
##  MLE lambda = sigma^2/rho                    0.001851
##
## Fixed part of model is a polynomial of degree 1 (m-1)
## Basis function :  Radial
## Basis function used:  WendlandFunction
## Distance metric:  Euclidean
##
## Lattice summary:
## 3  Level(s) 874 basis functions with overlap of  2.5 (lattice units)
##
##  Level Lattice points   Spacing
##      1            182 3.5373333
##      2            255 1.7686667
##      3            437 0.8843333
##
## Nonzero entries in Ridge regression matrix 49257
```

```
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
```

```
## 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:  8 8 8
##
## 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:  NA
```

```
obj1<- LatticeKrig( x, y , LKInfo=LKInfo)
```

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

```
obj1
```

```
## Call:
## LatticeKrig(x = x, y = y, LKInfo = LKInfo)
##
##
##  Number of Observations:                      147
##  Number of parameters in the fixed component 3
##   Effective degrees of freedom (EDF)         23.5
##     Standard Error of EDF estimate:          1.208
##  MLE sigma                                   13.34
##  MLE rho                                     96190
##  MLE lambda = sigma^2/rho                    0.001851
##
## Fixed part of model is a polynomial of degree 1 (m-1)
## Basis function :  Radial
## Basis function used:  WendlandFunction
## Distance metric:  Euclidean
##
## Lattice summary:
## 3  Level(s) 874 basis functions with overlap of  2.5 (lattice units)
##
##  Level Lattice points   Spacing
##      1            182 3.5373333
##      2            255 1.7686667
##      3            437 0.8843333
##
## Nonzero entries in Ridge regression matrix 49257
```

Try this out on the larger CO2 data set

```
library( tictoc)
data( CO2)
LKInfo<- LKrigSetup( CO2$lon.lat, NC=50, nlevel=3,
                     a.wght = 4.1,
                      nu=1.0,
                      normalize=TRUE)
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: 7.321429 3.660714 1.830357
## 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  28675
##  Level Basis size
##      1       1980  60  33
##      2       5995 109  55
##      3      20700 207 100
##
## Lambda value:  NA
```

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

```
## 78.349 sec elapsed
```

```
obj2
```

```
## Call:
## LatticeKrig(x = CO2$lon.lat, y = CO2$y, LKInfo = LKInfo)
##
##
##  Number of Observations:                     26633
##  Number of parameters in the fixed component 3
##   Effective degrees of freedom (EDF)         792.8
##     Standard Error of EDF estimate:          5.417
##  MLE sigma                                   0.5069
##  MLE rho                                     6.296
##  MLE lambda = sigma^2/rho                    0.04081
##
## Fixed part of model is a polynomial of degree 1 (m-1)
```

```
## Basis function :  Radial
## Basis function used:  WendlandFunction
## Distance metric:  Euclidean
##
## Lattice summary:
## 3  Level(s) 16050 basis functions with overlap of  2.5 (lattice units)
##
##  Level Lattice points Spacing
##      1           1242 10.2500
##      2           3483  5.1250
##      3          11325  2.5625
##
## Nonzero entries in Ridge regression matrix 9894210
```

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

```
##          user.self sys.self elapsed
## timewX      12.805    0.374  15.179
## timeQ        0.262    0.008   0.271
## timeM        0.838    0.050   0.903
## timeChol     2.505    0.408   3.162
## timeCoef     0.366    0.013   0.387
## timeLike     0.063    0.012   0.082
## timeTrA      1.528    0.030   1.562
##             18.367    0.895  21.546
```

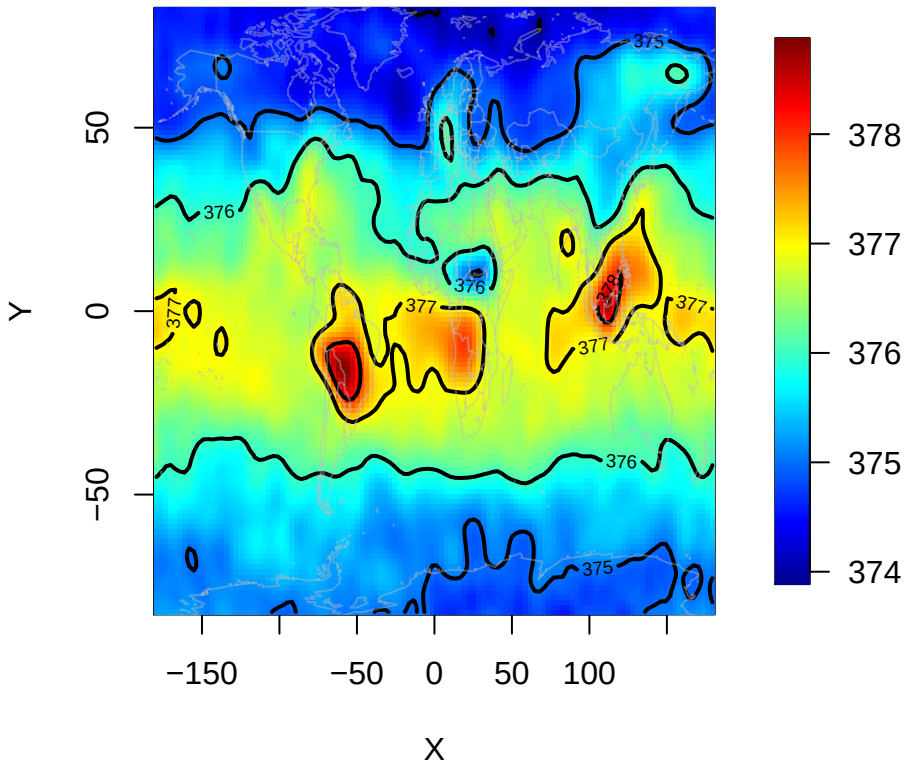
Plot the surface and add a world map

```
library( scales)
```

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

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

```
surface( obj2, nx=120, ny=120, col=tim.colors(256))
world( add=TRUE, col=alpha("grey",.4))
```


375
376
377
378
50
0
−50
Y
−150
−50
0
50
100
X
374
375
376
377
378