

Detecting Strips

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Libraries

```
library(ncf)
library(ape)
```

```
## Warning: package 'ape' was built under R version 3.3.2
##
## Attaching package: 'ape'
## The following object is masked from 'package:ncf':
##
##      mantel.test
```

Data

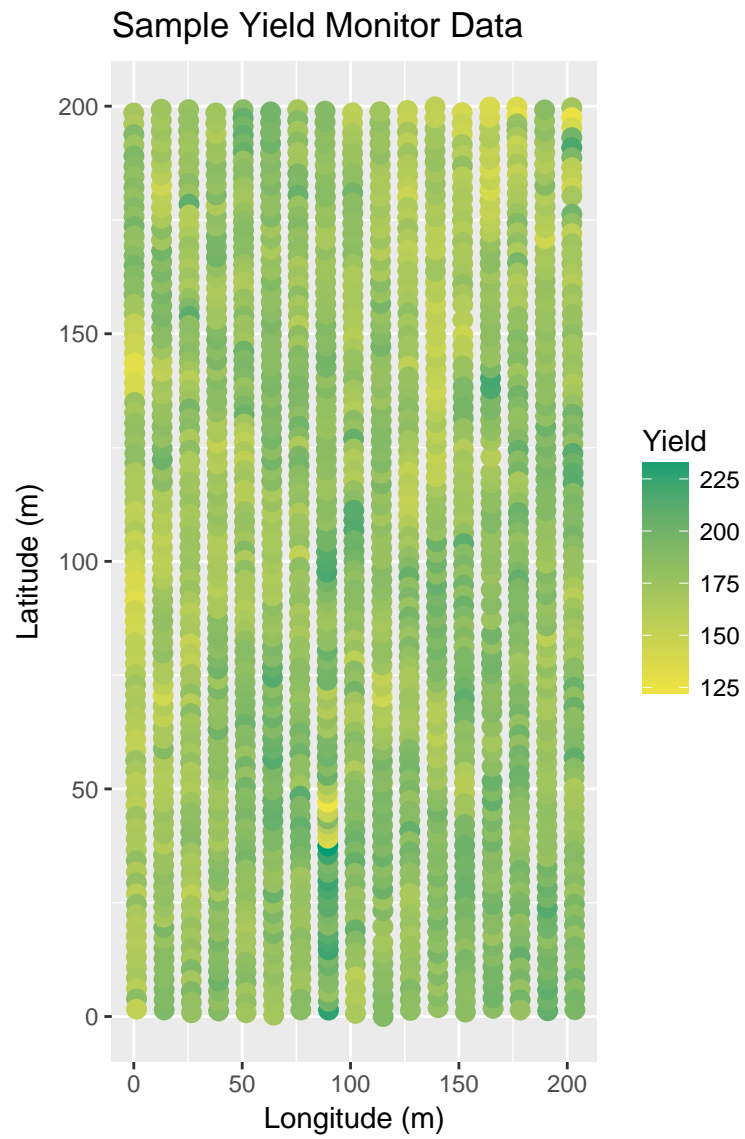
```
load(file="sample.dat.Rda")
```

Here we simulate a treatment that increases yield applied to two strips in the field, and we will use measure of spatial correlation to detect the effects of this treatment.

Again, we start with sample data,

```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.3.2
cbPalette <- c("#999999", "#E69F00", "#56B4E9", "#009E73", "#0072B2", "#D55E00", "#F0E442", "#CC79A7", "#F08080", "#4DBEEE", "#3CB371")
ggplot(sample.dat, aes(LonM, LatM)) +
  geom_point(aes(colour = Yield), size=3) +
  scale_colour_gradient(low=cbPalette[7], high=cbPalette[4]) +
  labs(colour = "Yield", x="Longitude (m)", y="Latitude (m)", title = "Sample Yield Monitor Data")
```



Create two strips with increased yield.

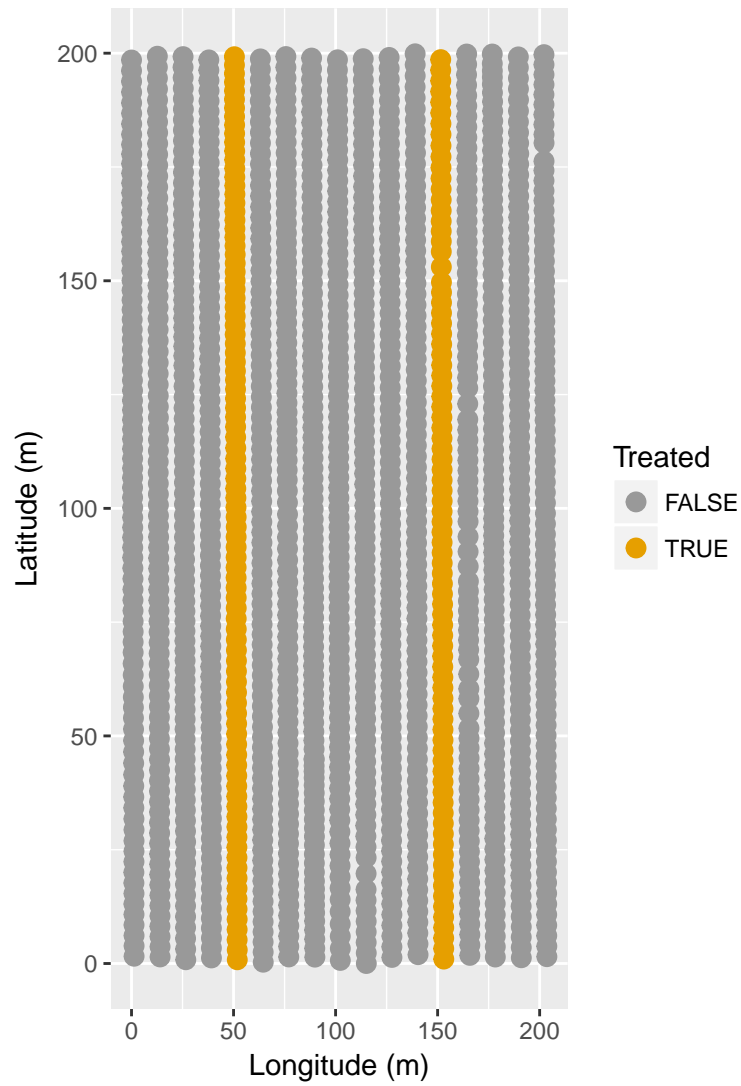
```
levels(sample.dat$PassNum)
```

```
## NULL
```

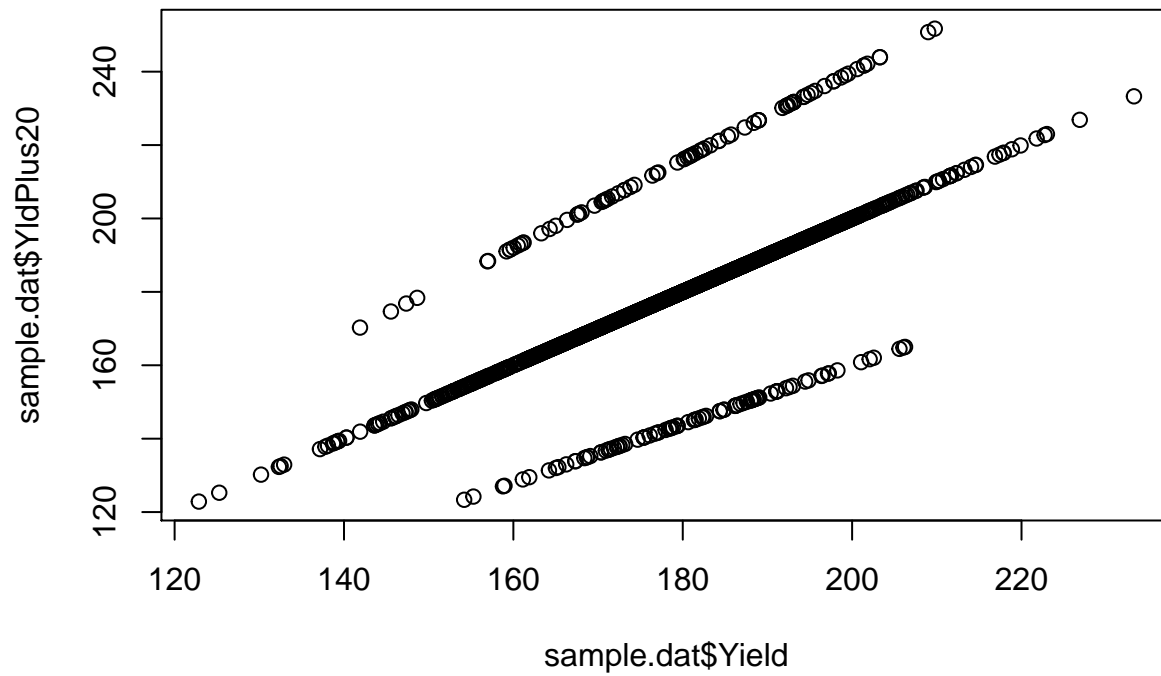
```
sample.dat$Treated <- sample.dat$PassNum %in% c(8,17)
```

```
ggplot(sample.dat, aes(LonM, LatM)) +
  geom_point(aes(colour = Treated),size=3) +
  scale_colour_manual(values=cbPalette) +
  labs(colour = "Treated", x="Longitude (m)", y="Latitude (m)", title = "Sample Yield Monitor Data")
```

Sample Yield Monitor Data

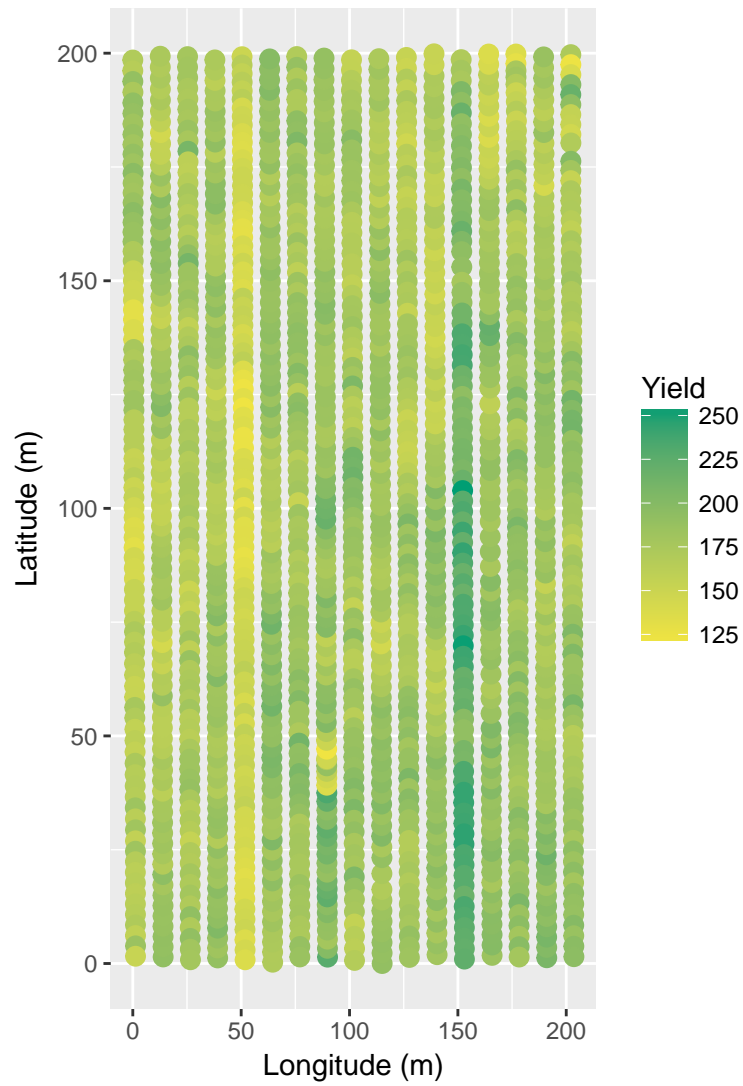


```
sample.dat$YldPlus20 <- sample.dat$Yield
sample.dat$YldPlus20[sample.dat$PassNum==8] <- 1.2*sample.dat$YldPlus20[sample.dat$PassNum==8]
sample.dat$YldPlus20[sample.dat$PassNum==17] <- 0.8*sample.dat$YldPlus20[sample.dat$PassNum==17]
plot(sample.dat$Yield,sample.dat$YldPlus20)
```



```
ggplot(sample.dat, aes(LonM, LatM)) +
  geom_point(aes(colour = YldPlus20), size=3) +
  scale_colour_gradient(low=cbPalette[7], high=cbPalette[4]) +
  labs(colour = "Yield", x="Longitude (m)", y="Latitude (m)", title = "Treated (20%) Yield Monitor Data")
```

Treated (20%) Yield Monitor Data



Create distance matrix

```
sample.dists <- as.matrix(dist(cbind(sample.dat$LonM, sample.dat$LatM)))  
sample.dists.inv <- 1/sample.dists  
diag(sample.dists.inv) <- 0
```

```
Moran.I(sample.dat$Yield, sample.dists.inv)
```

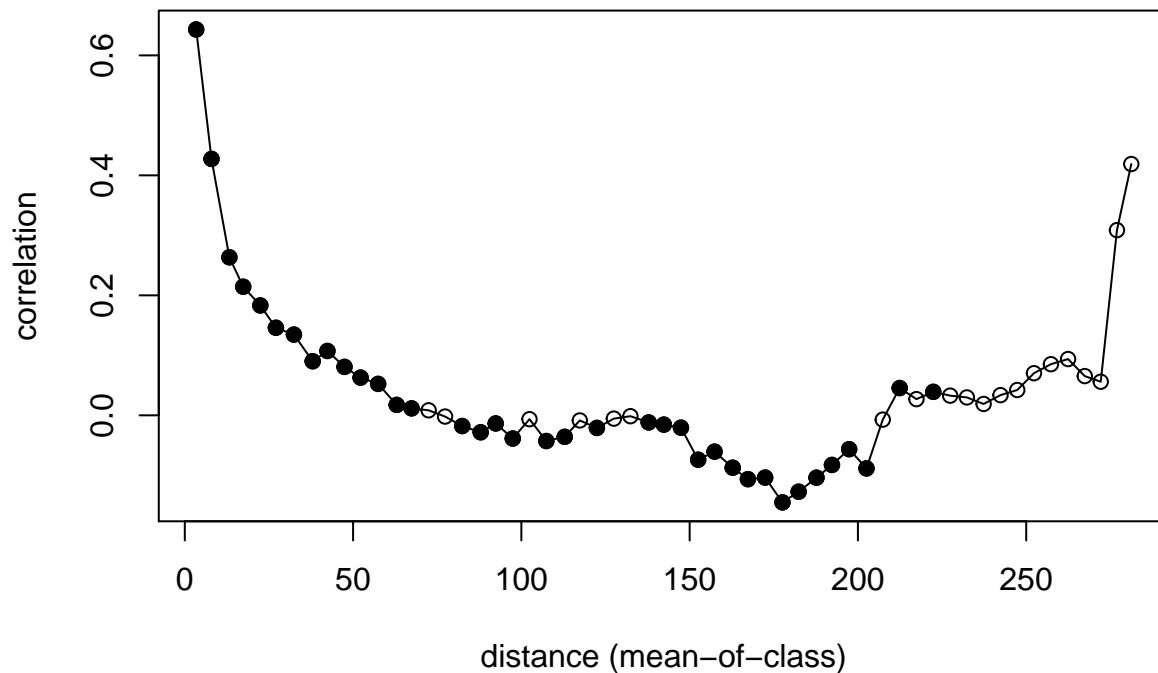
```
## $observed  
## [1] 0.1026924  
##  
## $expected  
## [1] -0.0006684492  
##  
## $sd  
## [1] 0.00145966  
##  
## $p.value  
## [1] 0
```

```
Moran.I(sample.dat$YldPlus20, sample.dists.inv)
```

```
## $observed  
## [1] 0.1220346  
##  
## $expected  
## [1] -0.0006684492  
##  
## $sd  
## [1] 0.001459401  
##  
## $p.value  
## [1] 0
```

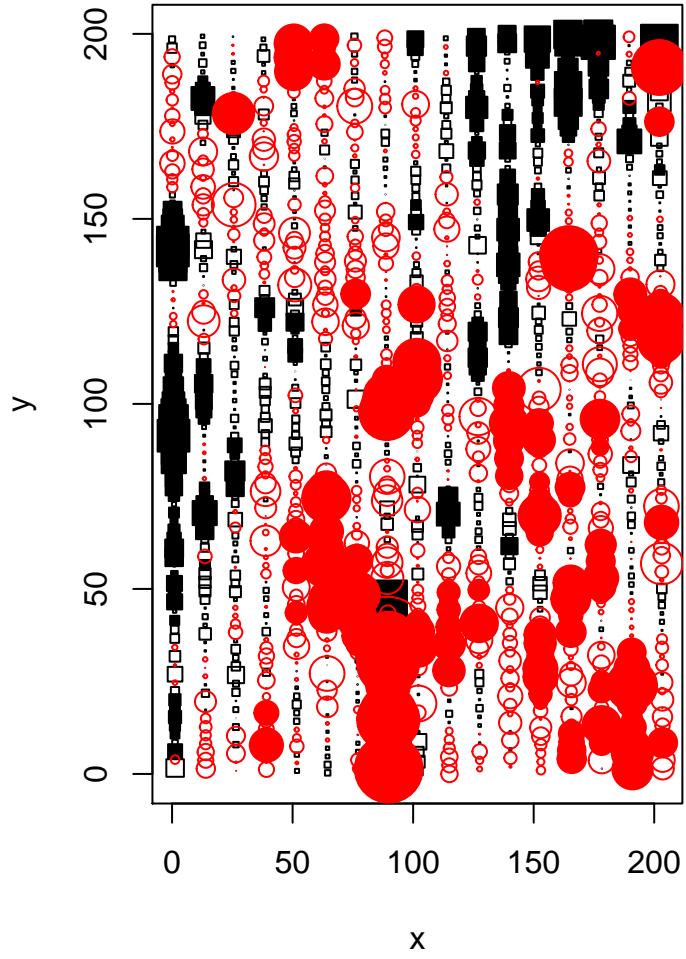
```
Yield.clg <- correlog(sample.dat$LonM, sample.dat$LatM, sample.dat$Yield,  
                    increment=5, resamp=500, quiet=TRUE)  
plot(Yield.clg)
```

Correlogram



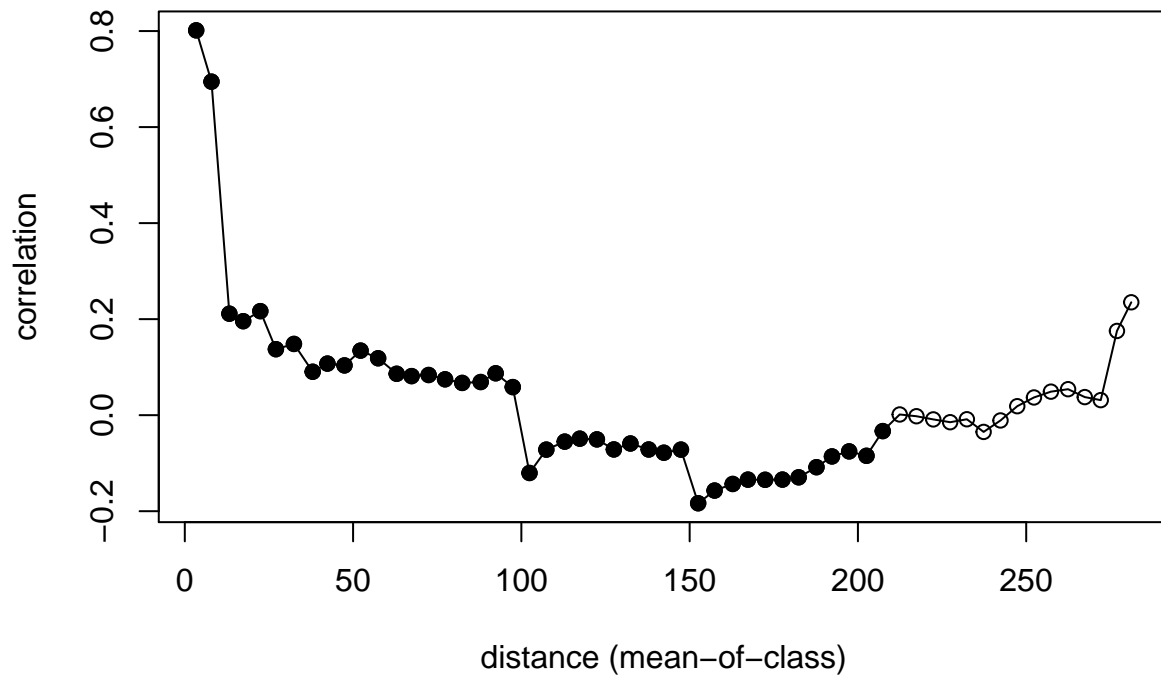
```
Yield.lisa <- lisa(sample.dat$LonM, sample.dat$LatM, sample.dat$Yield, neigh=10, resamp=500, quiet=TRUE)  
#Yield.lisa
```

```
plot.lisa(Yield.lisa, neigh.mean=FALSE)
```



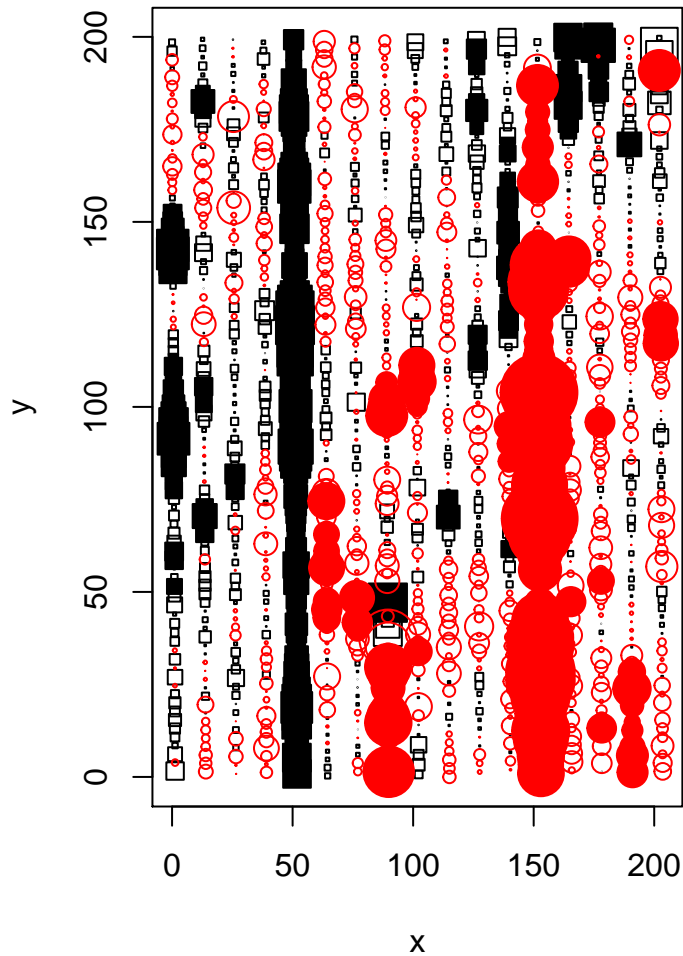
```
YldPlus20.clg <- correlog(sample.dat$LonM, sample.dat$LatM, sample.dat$YldPlus20, increment=5, resamp=5)
plot(YldPlus20.clg)
```

Correlogram



```
YldPlus20.lisa <- lisa(sample.dat$LonM, sample.dat$LatM, sample.dat$YldPlus20, neigh=10, resamp=500, qu
```

```
plot.lisa(YldPlus20.lisa, neigh.mean=FALSE)
```

Take out the trend, and compute LISA for the residuals for both original and “treated” fields.

```
YieldTrend.lm <- lm(Yield ~ poly(LonM, LatM, degree=11), data=sample.dat)
sample.dat$YieldTrend.resid <- YieldTrend.lm$residuals
Moran.I(sample.dat$YieldTrend.resid, sample.dists.inv)
```

```
## $observed
## [1] 0.02051911
##
## $expected
## [1] -0.0006684492
##
## $sd
## [1] 0.001459283
##
## $p.value
## [1] 0
```

```
YldPlus20Trend.lm <- lm(YldPlus20 ~ poly(LonM, LatM, degree=11), data=sample.dat)
sample.dat$YldPlus20Trend.resid <- YldPlus20Trend.lm$residuals
Moran.I(sample.dat$YldPlus20Trend.resid, sample.dists.inv)
```

```
## $observed
## [1] 0.03233332
```

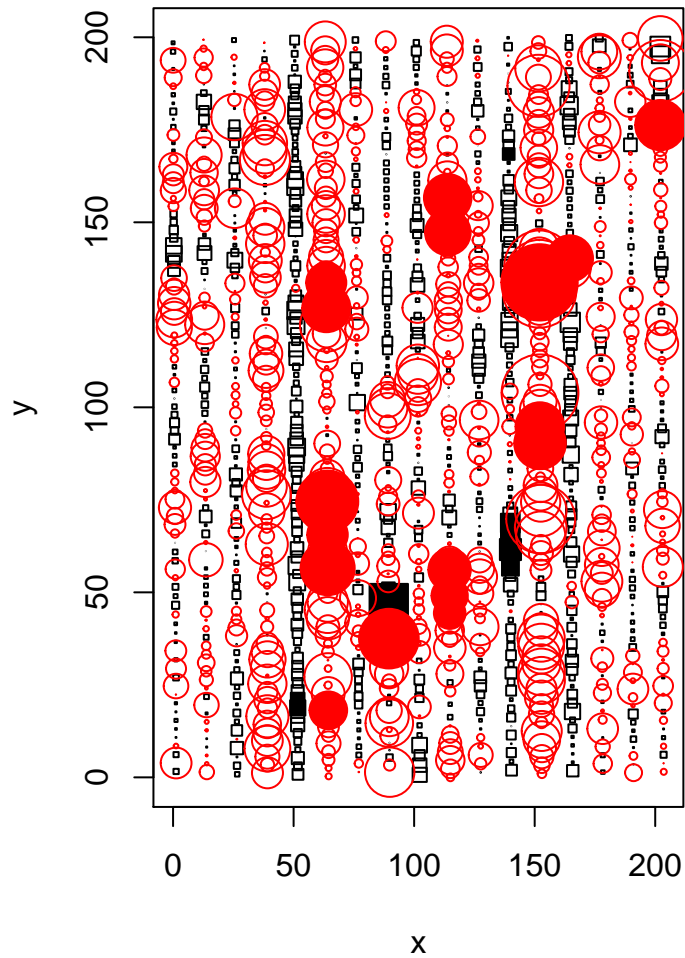
```
##
## $expected
## [1] -0.0006684492
##
## $sd
## [1] 0.001459776
##
## $p.value
## [1] 0
```

We'll try different neighborhood distances for the LISA plots.

Neighborhood = 40

```
YldPlus20Trend.resid.lisa <- lisa(sample.dat$LonM, sample.dat$LatM, sample.dat$YldPlus20Trend.resid,
                                neigh=40, resamp=500, quiet=TRUE)
```

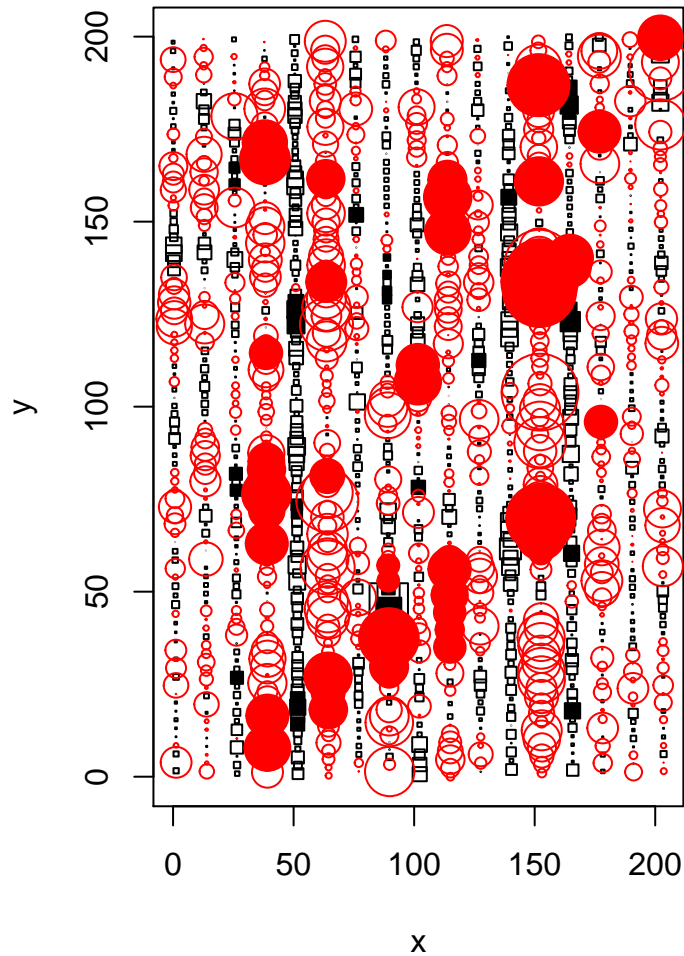
```
plot.lisa(YldPlus20Trend.resid.lisa, neigh.mean=FALSE)
```



Neighborhood = 20

```
YldPlus20Trend.resid.lisa <- lisa(sample.dat$LonM, sample.dat$LatM, sample.dat$YldPlus20Trend.resid,  
                                neigh=20, resamp=500, quiet=TRUE)
```

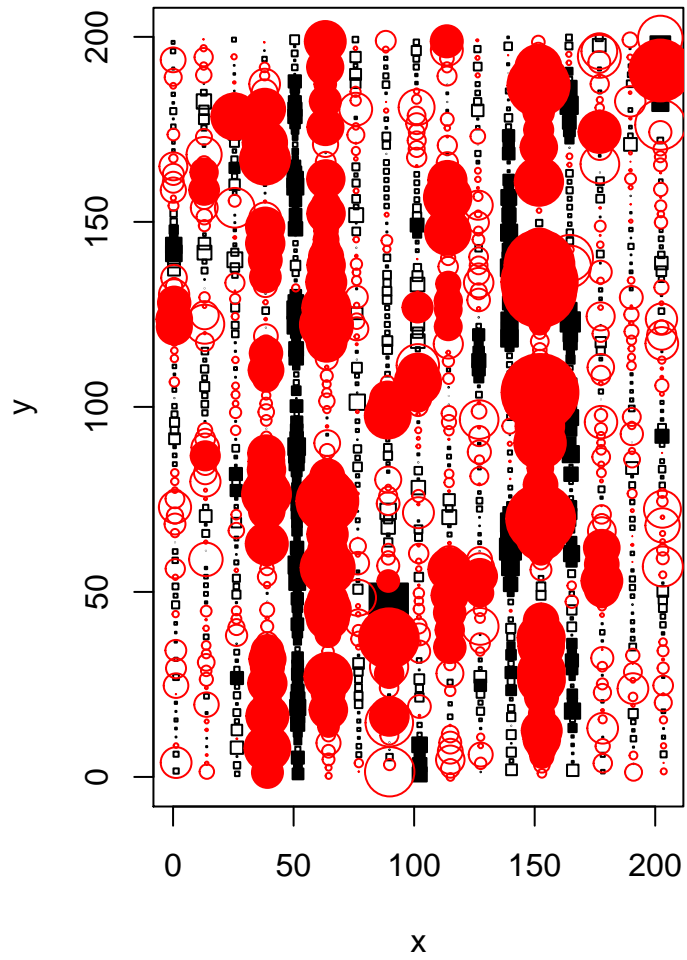
```
plot.lisa(YldPlus20Trend.resid.lisa, neigh.mean=FALSE)
```



Neighborhood = 10

```
YldPlus20Trend.resid.lisa <- lisa(sample.dat$LonM, sample.dat$LatM, sample.dat$YldPlus20Trend.resid,  
                                neigh=10, resamp=500, quiet=TRUE)
```

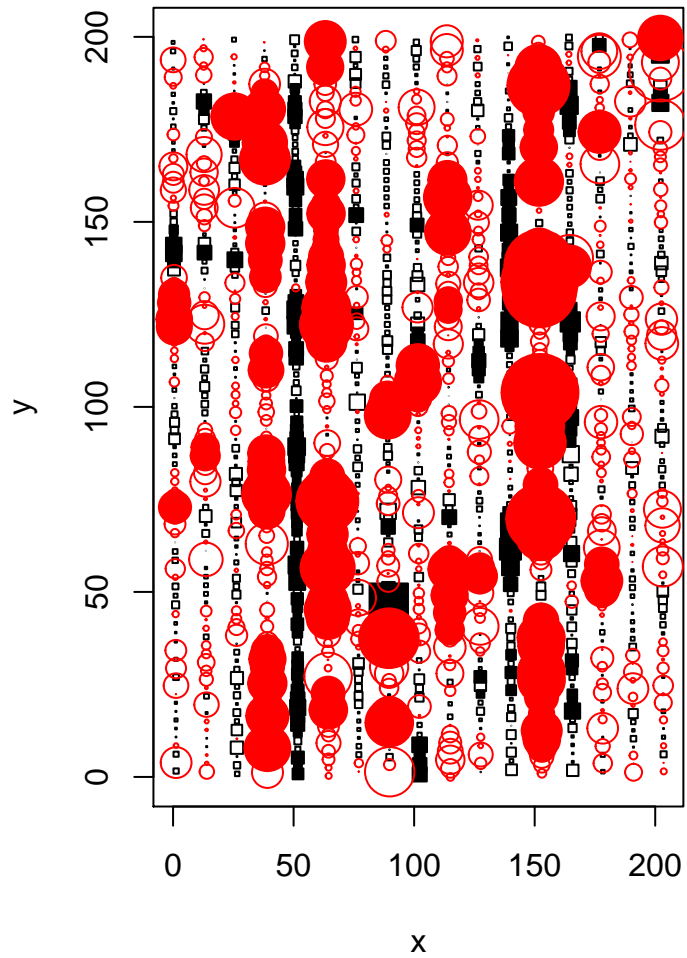
```
plot.lisa(YldPlus20Trend.resid.lisa, neigh.mean=TRUE)
```



Neighborhood = 5

```
YldPlus20Trend.resid.lisa <- lisa(sample.dat$LonM, sample.dat$LatM, sample.dat$YldPlus20Trend.resid,
                                neigh=5, resamp=500, quiet=TRUE)
```

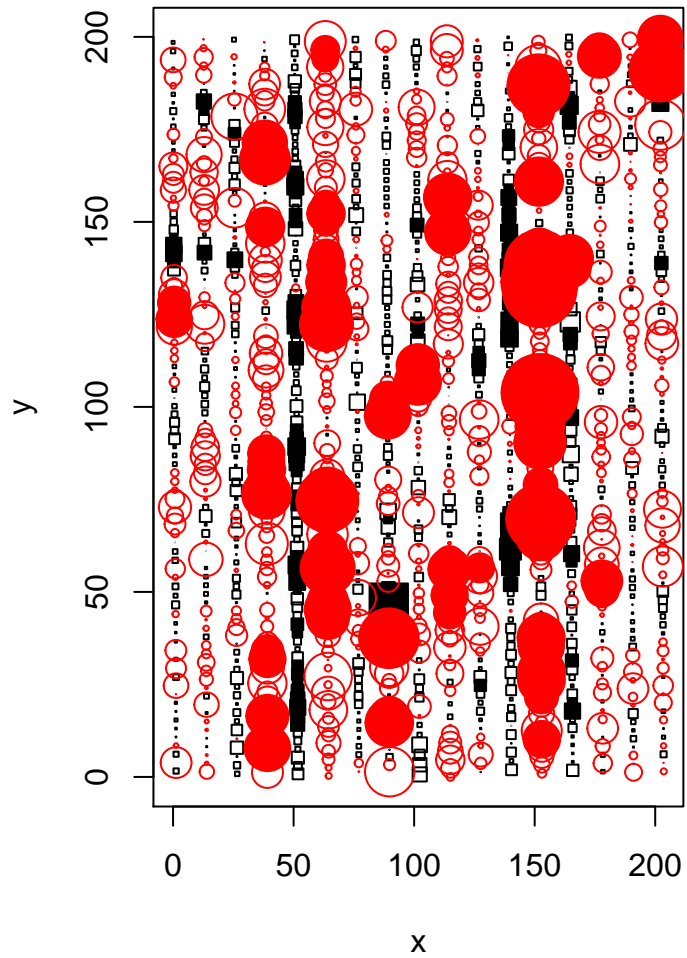
```
plot.lisa(YldPlus20Trend.resid.lisa, neigh.mean=FALSE)
```



Neighborhood = 2.5

```
YldPlus20Trend.resid.lisa <- lisa(sample.dat$LonM, sample.dat$LatM, sample.dat$YldPlus20Trend.resid,
                                neigh=2.5, resamp=500, quiet=TRUE)
```

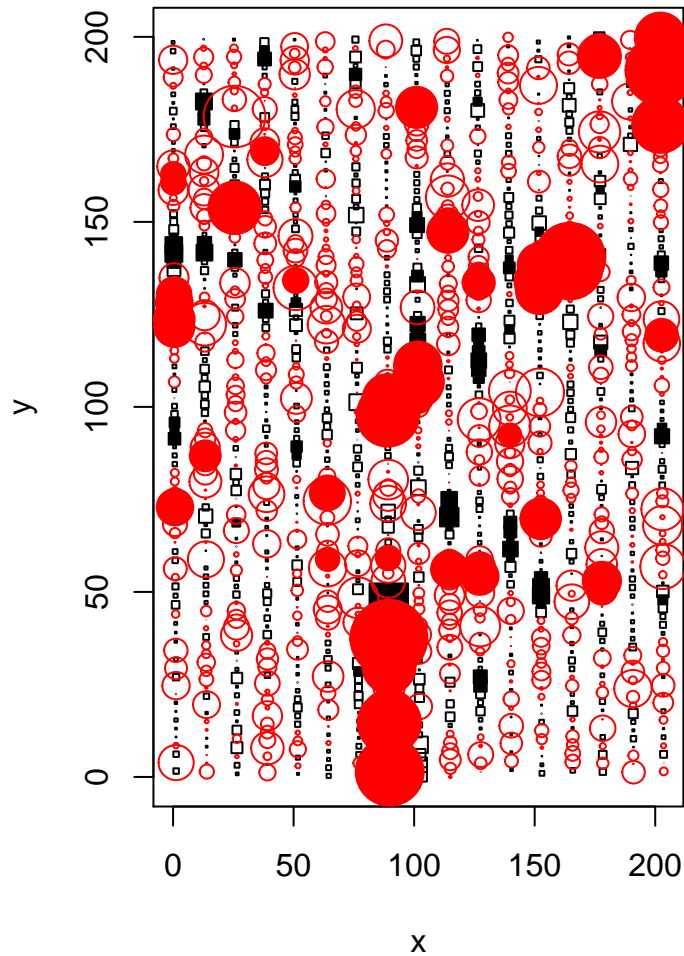
```
plot.lisa(YldPlus20Trend.resid.lisa, neigh.mean=FALSE)
```



By inspection, a neighborhood of 2.5 meters, less than a full swath width, gives the the most points with significant local correlation, in the “treated” strips. Compare this with the original data:

```
YieldTrend.resid.lisa <- lisa(sample.dat$LonM, sample.dat$LatM, sample.dat$YieldTrend.resid,
                             neigh=2.5, resamp=500, quiet=TRUE)
```

```
plot.lisa(YieldTrend.resid.lisa, neigh.mean=FALSE)
```



Effect Size

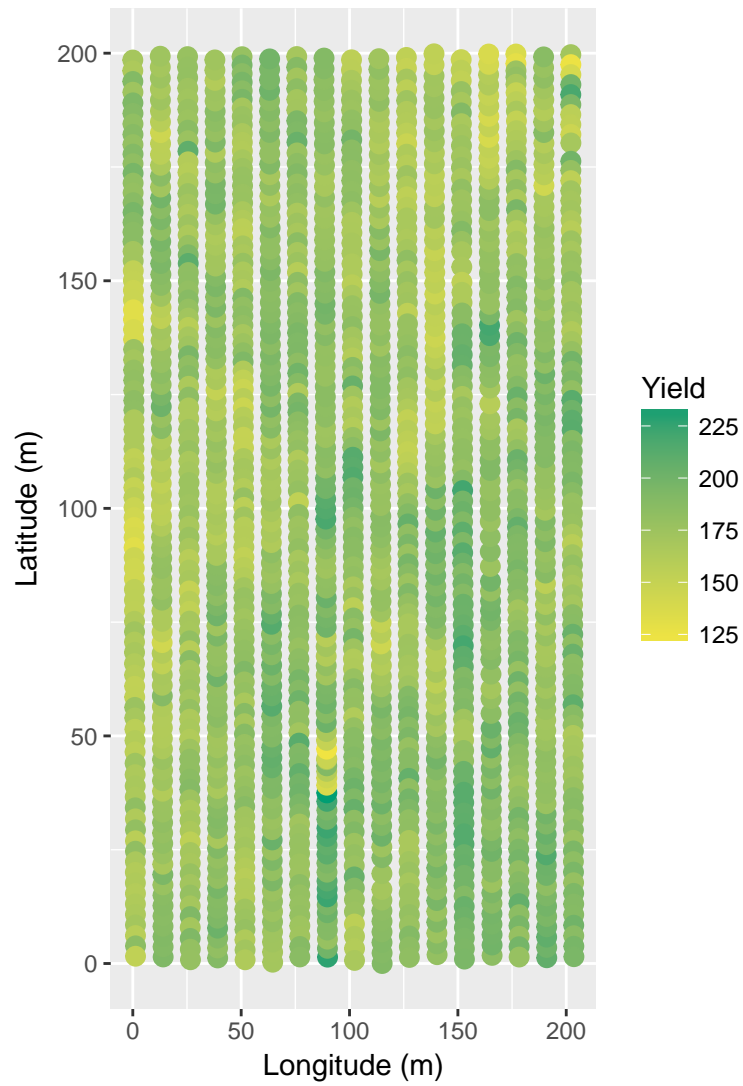
We started with a very large treatment effect. We'll try smaller effects, from 5%-15% observed yield.

5% Increase

```
sample.dat$YldPlus05 <- sample.dat$Yield
#sample.dat$YldPlus05[sample.dat$Treated] <- 1.05*sample.dat$Yield[sample.dat$Treated]
sample.dat$YldPlus05[sample.dat$PassNum==8] <- 1.05*sample.dat$YldPlus05[sample.dat$PassNum==8]
sample.dat$YldPlus05[sample.dat$PassNum==17] <- 0.95*sample.dat$YldPlus05[sample.dat$PassNum==17]
```

```
ggplot(sample.dat, aes(LonM, LatM)) +
  geom_point(aes(colour = YldPlus05),size=3) +
  scale_colour_gradient(low=cbPalette[7], high=cbPalette[4]) +
  labs(colour = "Yield", x="Longitude (m)", y="Latitude (m)", title = "Treated (5%) Yield Monitor Data")
```

Treated (5%) Yield Monitor Data

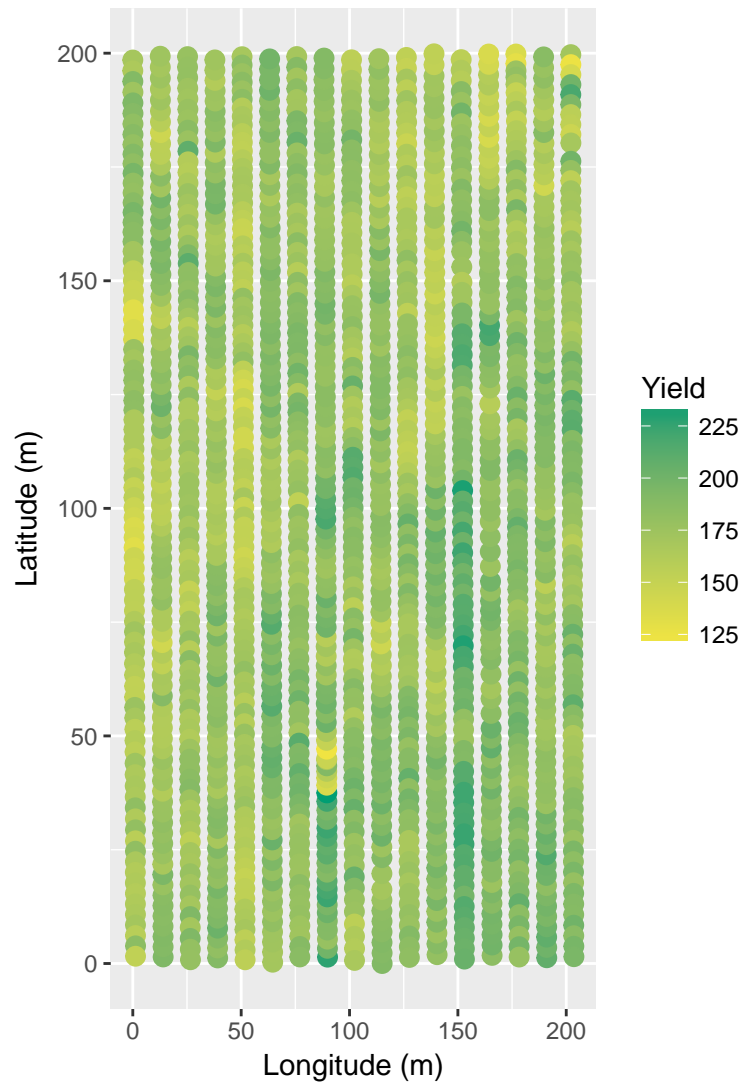


10% Increase

```
sample.dat$YldPlus10 <- sample.dat$Yield
#sample.dat$YldPlus10[sample.dat$Treated] <- 1.10*sample.dat$YldPlus10[sample.dat$Treated]
sample.dat$YldPlus10[sample.dat$PassNum==8] <- 1.10*sample.dat$YldPlus10[sample.dat$PassNum==8]
sample.dat$YldPlus10[sample.dat$PassNum==17] <- 0.9*sample.dat$YldPlus10[sample.dat$PassNum==17]
```

```
ggplot(sample.dat, aes(LonM, LatM)) +
  geom_point(aes(colour = YldPlus10), size=3) +
  scale_colour_gradient(low=cbPalette[7], high=cbPalette[4]) +
  labs(colour = "Yield", x="Longitude (m)", y="Latitude (m)", title = "Treated (10%) Yield Monitor Data")
```


Treated (10%) Yield Monitor Data

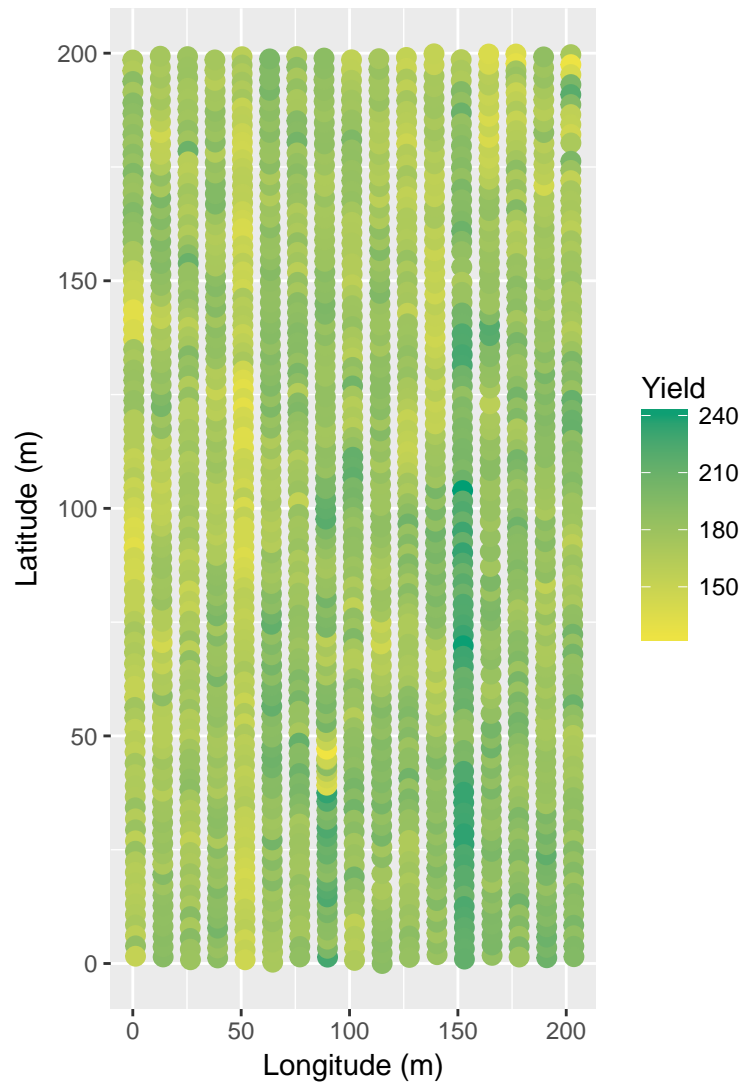


15% Increase

```
sample.dat$YldPlus15 <- sample.dat$Yield
#sample.dat$YldPlus15[sample.dat$Treated] <- 1.15*sample.dat$YldPlus15[sample.dat$Treated]
sample.dat$YldPlus15[sample.dat$PassNum==8] <- 1.15*sample.dat$YldPlus15[sample.dat$PassNum==8]
sample.dat$YldPlus15[sample.dat$PassNum==17] <- 0.85*sample.dat$YldPlus15[sample.dat$PassNum==17]
```

```
ggplot(sample.dat, aes(LonM, LatM)) +
  geom_point(aes(colour = YldPlus15), size=3) +
  scale_colour_gradient(low=cbPalette[7], high=cbPalette[4]) +
  labs(colour = "Yield", x="Longitude (m)", y="Latitude (m)", title = "Treated (15%) Yield Monitor Data")
```

Treated (15%) Yield Monitor Data



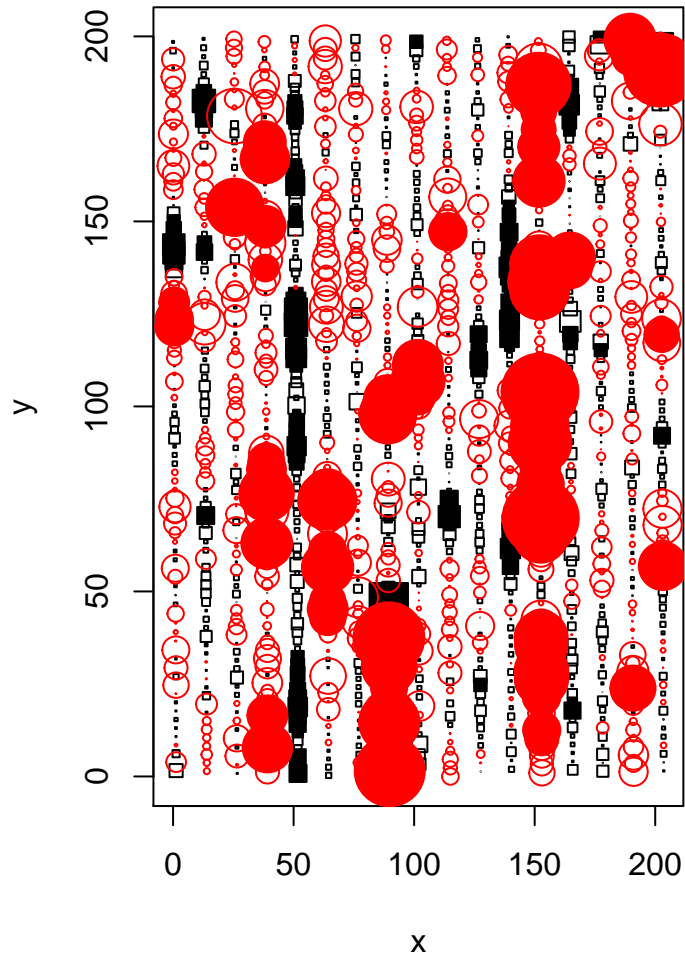
Detrend the different cases.

```
YldPlus05Trend.lm <- lm(YldPlus05 ~ poly(LonM, LatM, degree=7), data=sample.dat)
sample.dat$YldPlus05Trend.resid <- YldPlus05Trend.lm$residuals
YldPlus10Trend.lm <- lm(YldPlus10 ~ poly(LonM, LatM, degree=7), data=sample.dat)
sample.dat$YldPlus10Trend.resid <- YldPlus10Trend.lm$residuals
YldPlus15Trend.lm <- lm(YldPlus15 ~ poly(LonM, LatM, degree=7), data=sample.dat)
sample.dat$YldPlus15Trend.resid <- YldPlus15Trend.lm$residuals
```

Residual LISA, 15% increase

```
YldPlus15Trend.resid.lisa <- lisa(sample.dat$LonM, sample.dat$LatM, sample.dat$YldPlus15Trend.resid,
                                neigh=2.5, resamp=500, quiet=TRUE)
```

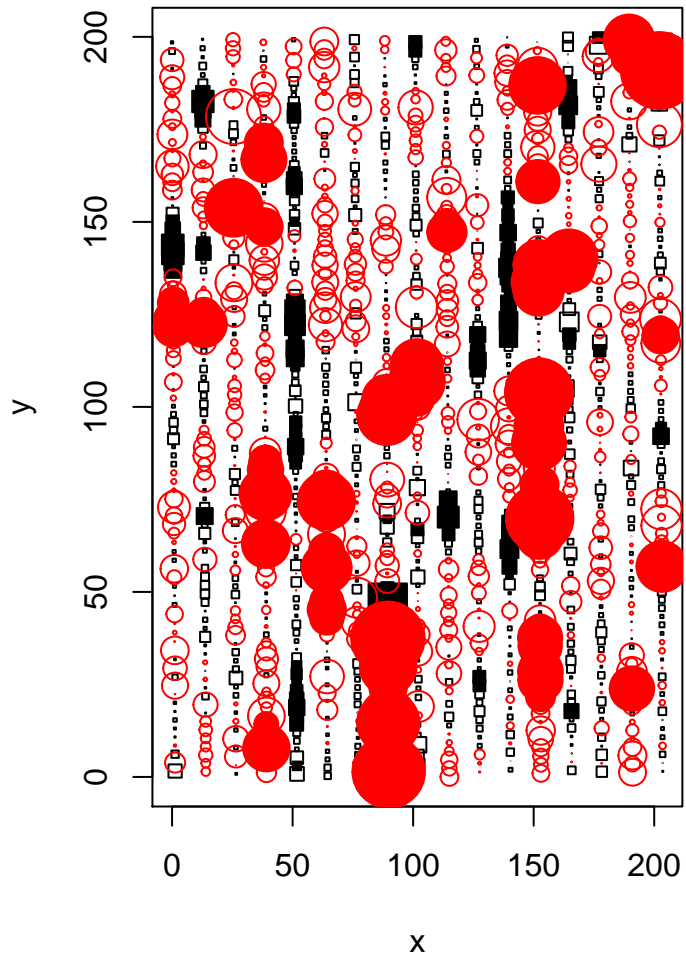
```
plot.lisa(YldPlus15Trend.resid.lisa, neigh.mean=FALSE)
```



Residual LISA, 10% increase

```
YldPlus10Trend.resid.lisa <- lisa(sample.dat$LonM, sample.dat$LatM, sample.dat$YldPlus10Trend.resid,  
    neigh=2.5, resamp=500, quiet=TRUE)
```

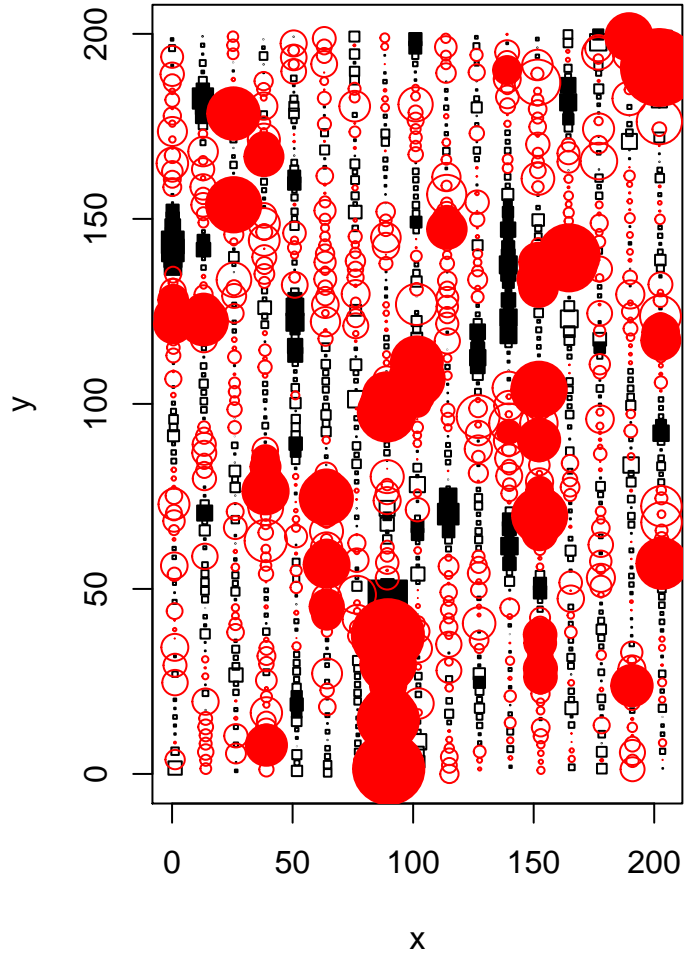
```
plot.lisa(YldPlus10Trend.resid.lisa, neigh.mean=FALSE)
```



Residual LISA, 5% increase

```
YldPlus05Trend.resid.lisa <- lisa(sample.dat$LonM, sample.dat$LatM, sample.dat$YldPlus05Trend.resid,
                                neigh=2.5, resamp=500, quiet=TRUE)
```

```
plot.lisa(YldPlus05Trend.resid.lisa, neigh.mean=FALSE)
```



We might plausibly detect a 15% increase, but at 10% increase, spatial correlations become lost in the background signal. However, we might have more luck after applying these methods to smoothed data.