

# Monsoon Rainband Characteristic Analysis

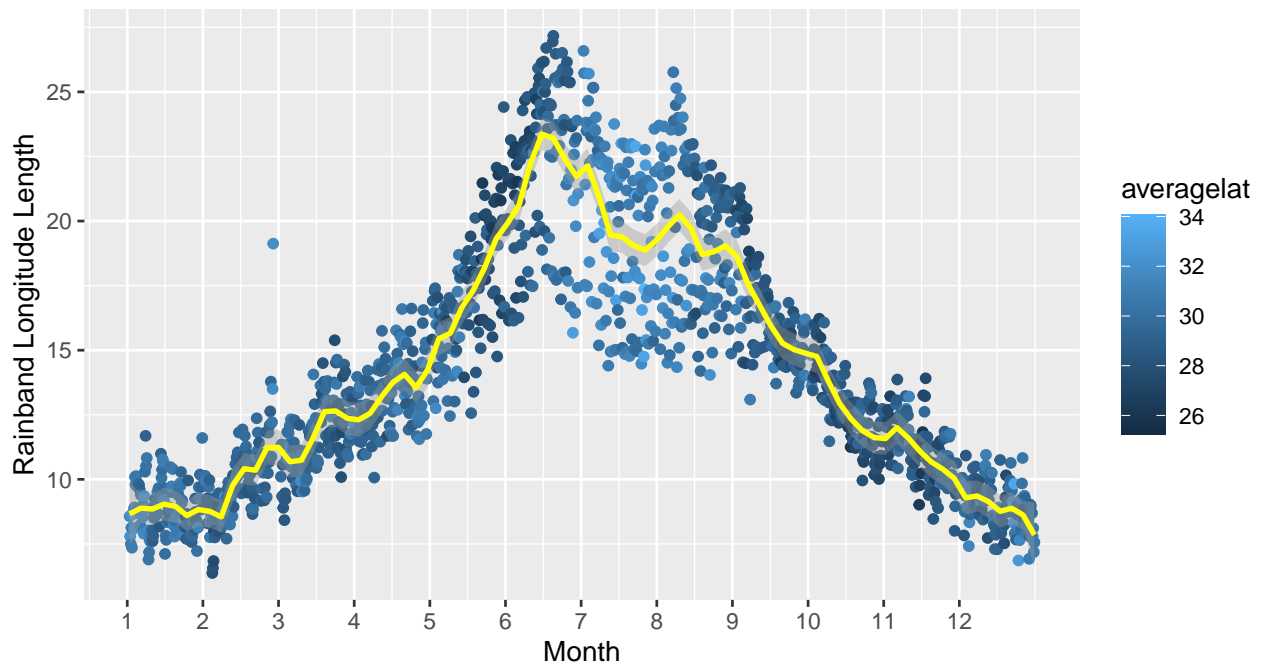
Rowan Pan

11/5/2020

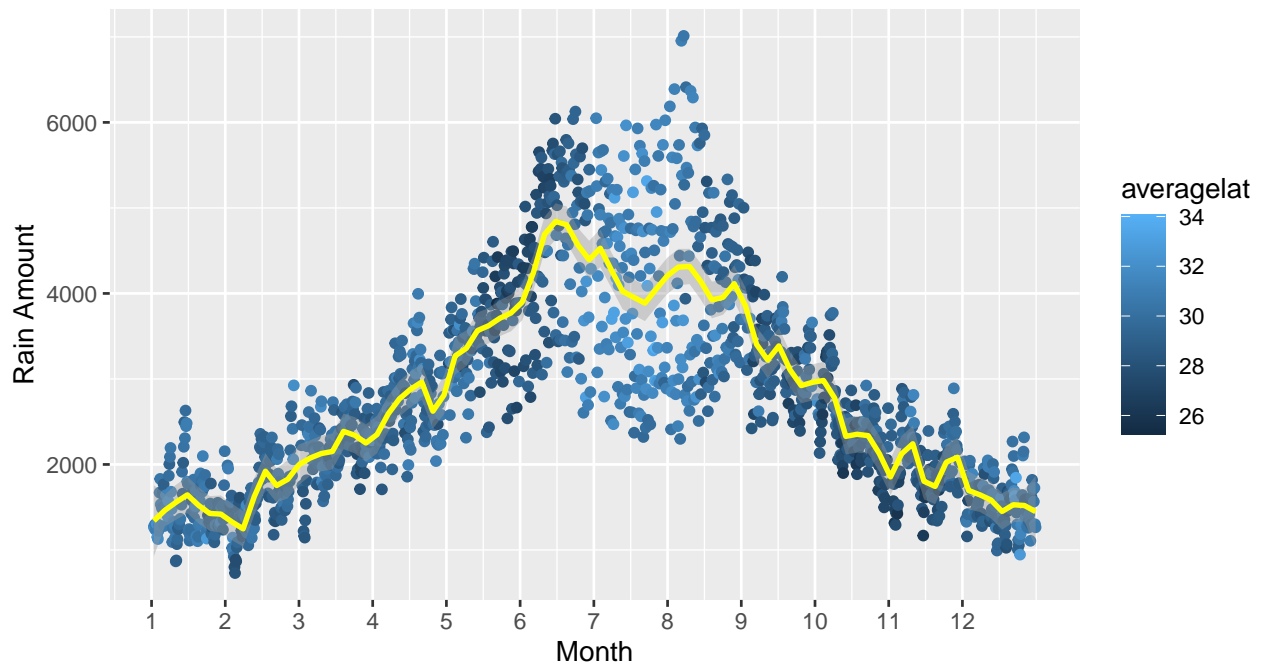
```
library(ggplot2)
rainbands_grouped <- read.csv('rainband_grouped.csv')
rainbands_grouped$averagelon <- (rainbands_grouped$lonmax + rainbands_grouped$lonmin)/2
head(rainbands_grouped)
```

```
##   month day hour   year  width  latmin  latmax  lonmin  lonmax
## 1     1   1   0 1998.5 8.568182 28.15909 34.90909 129.3182 137.8864
## 2     1   1   6 1998.5 7.795455 29.11364 35.15909 128.8864 136.6818
## 3     1   1  12 1998.5 7.500000 27.55645 34.16129 127.4032 134.9032
## 4     1   1  18 1998.5 8.129032 27.70161 33.91935 125.1774 133.3065
## 5     1   2   0 1998.5 7.354839 27.38710 34.23387 126.1452 133.5000
## 6     1   2   6 1998.5 8.648438 29.13281 35.36719 125.2031 133.8516
##   rain.amount grid.size averagelat decimaldate averagelon
## 1 109961675679  56.81818   31.53409    1.031250   133.6023
## 2 108380756064  55.96970   32.13636    1.039062   132.7841
## 3 112142459113  55.61290   30.85887    1.046875   131.1532
## 4 106550328202  59.83871   30.81048    1.054688   129.2419
## 5 109168471043  55.90323   30.81048    1.062500   129.8226
## 6 112664991040  61.34375   32.25000    1.070312   129.5273
```

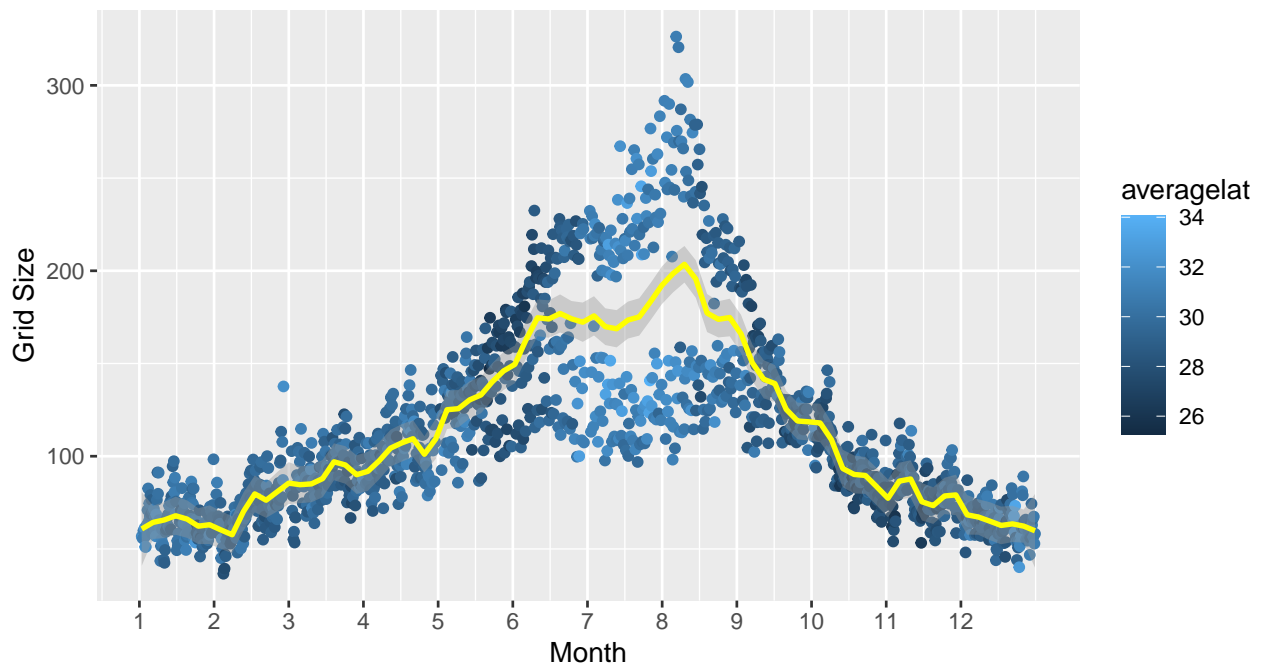
Longitude Length of Rainband (Across All)



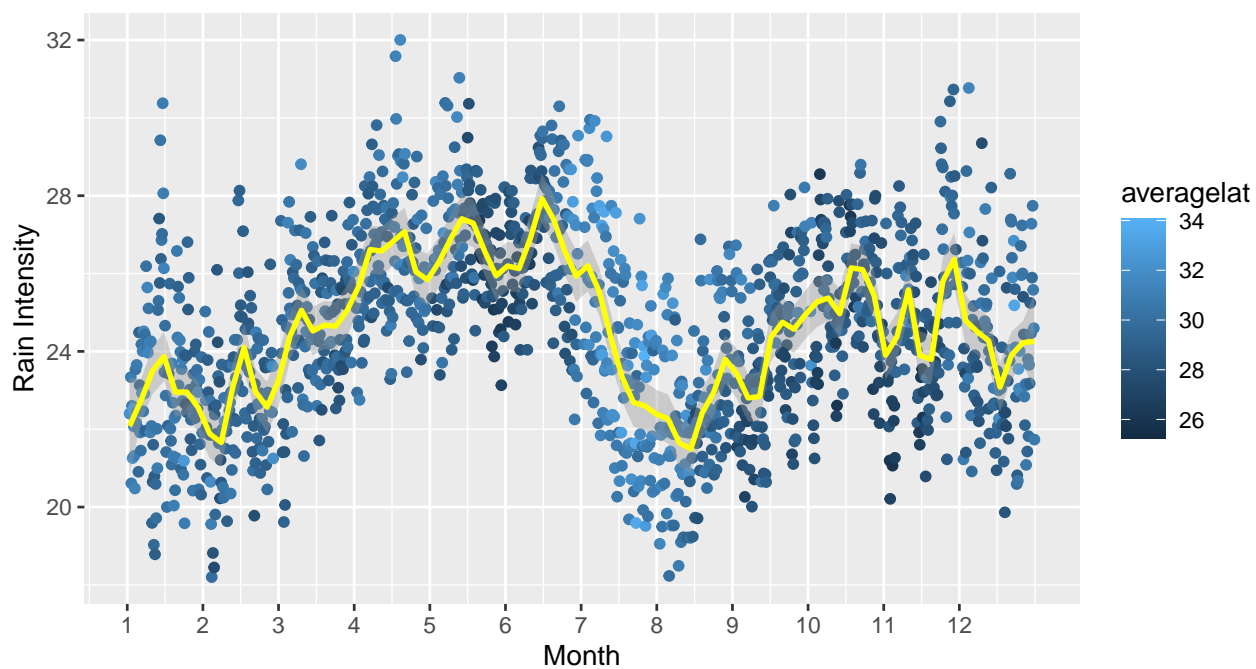
Rain Amount (Across All)



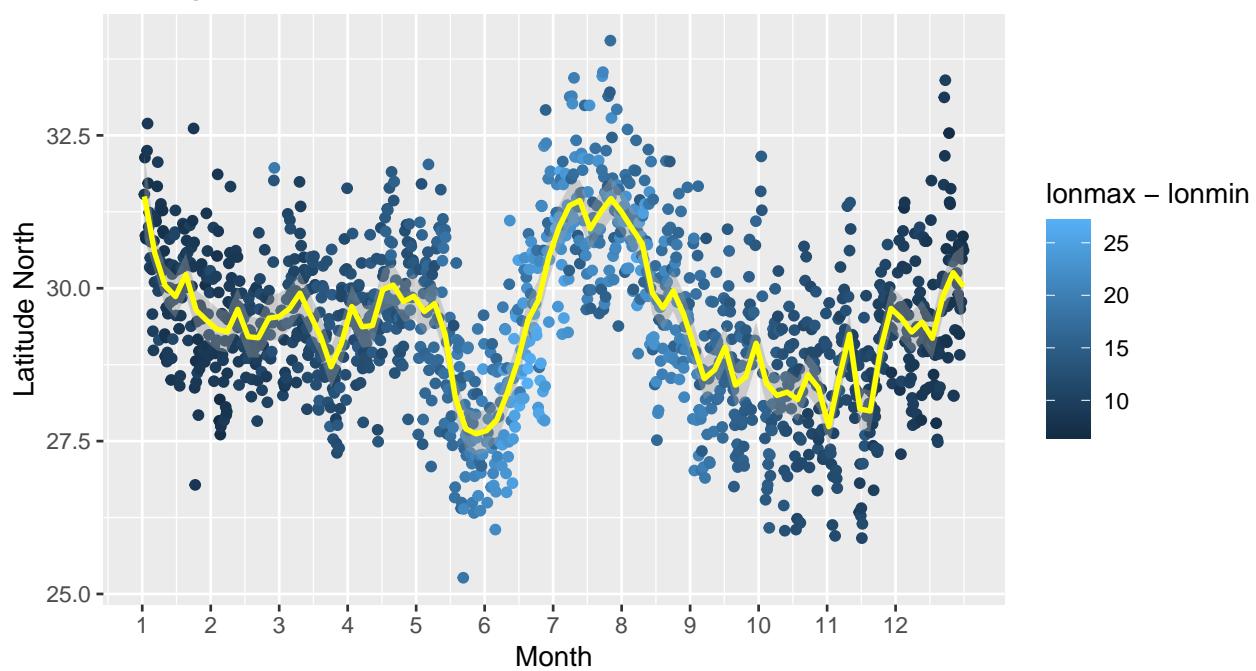
Grid Size (Across All)

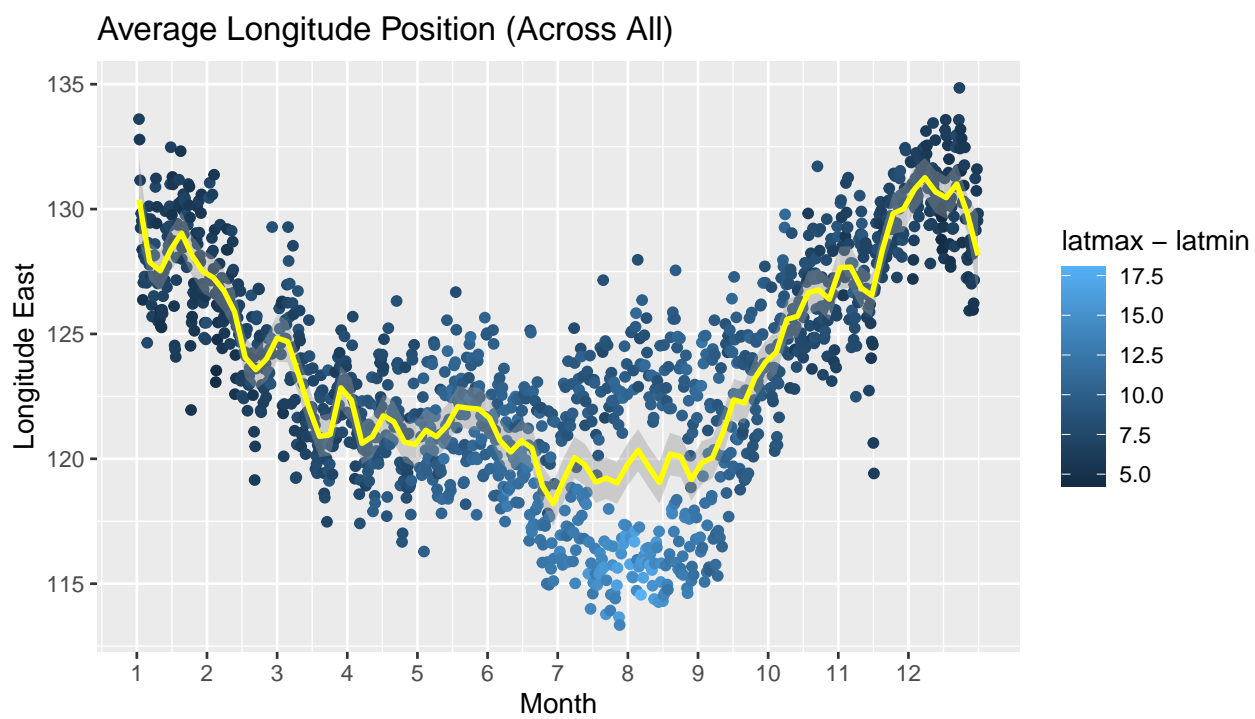


Rain Intensity (Across All)



Average Latitude (Across All)





## El Niño

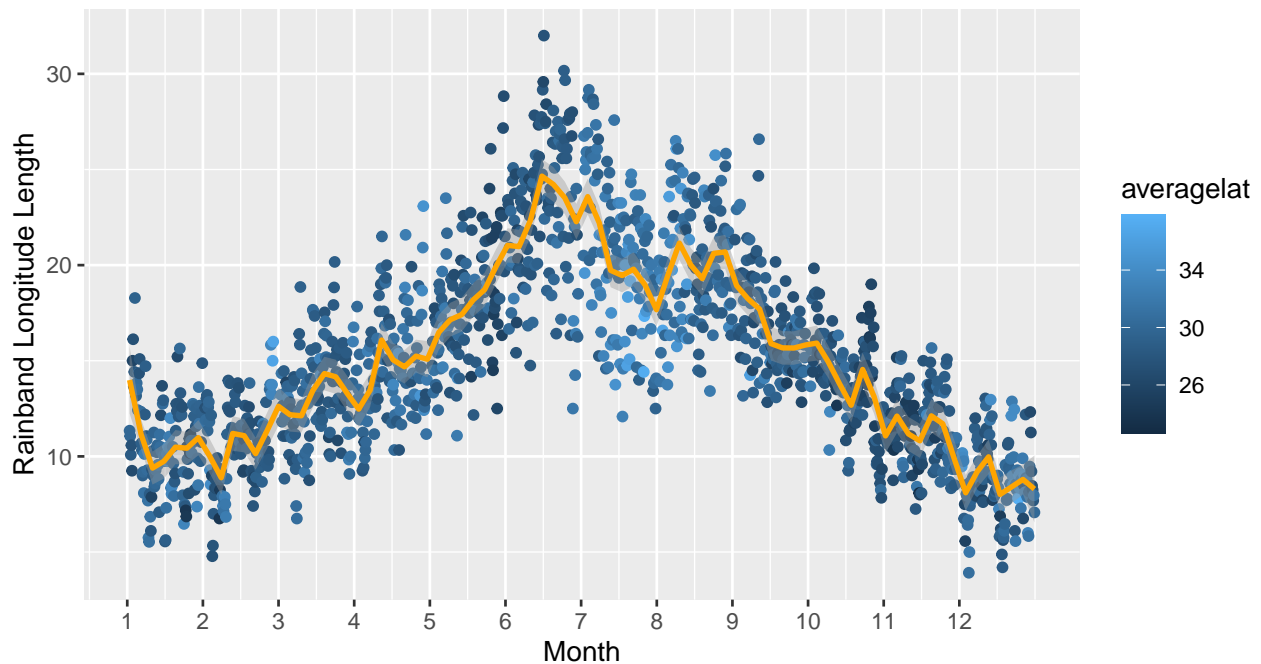
```
el_nino <- read.csv('el_nino_rainband.csv')
cat('Number of rows:', nrow(el_nino))
```

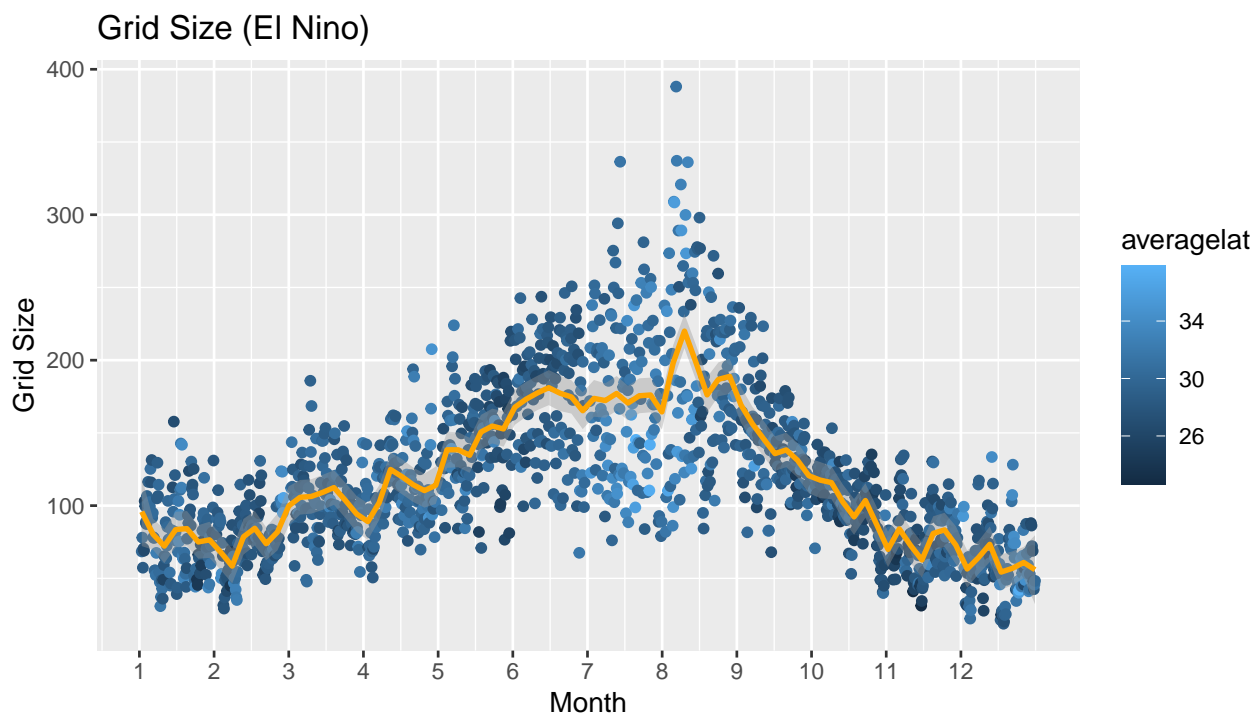
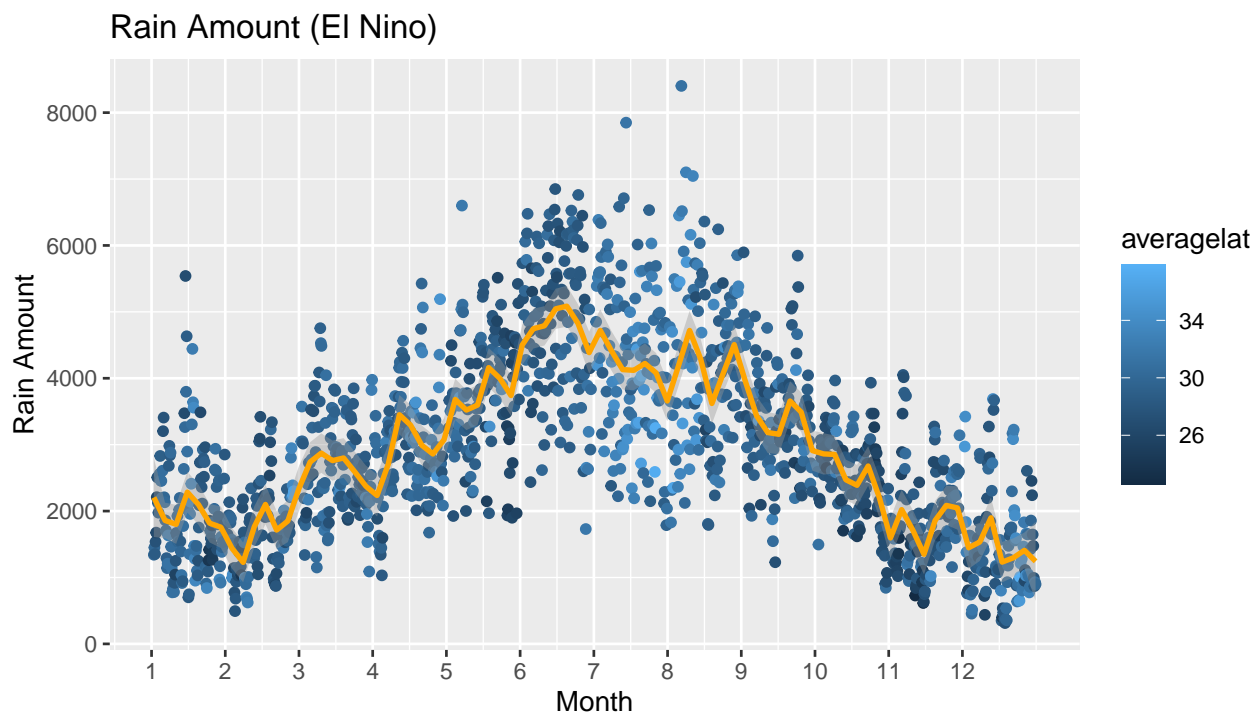
```
## Number of rows: 1464
```

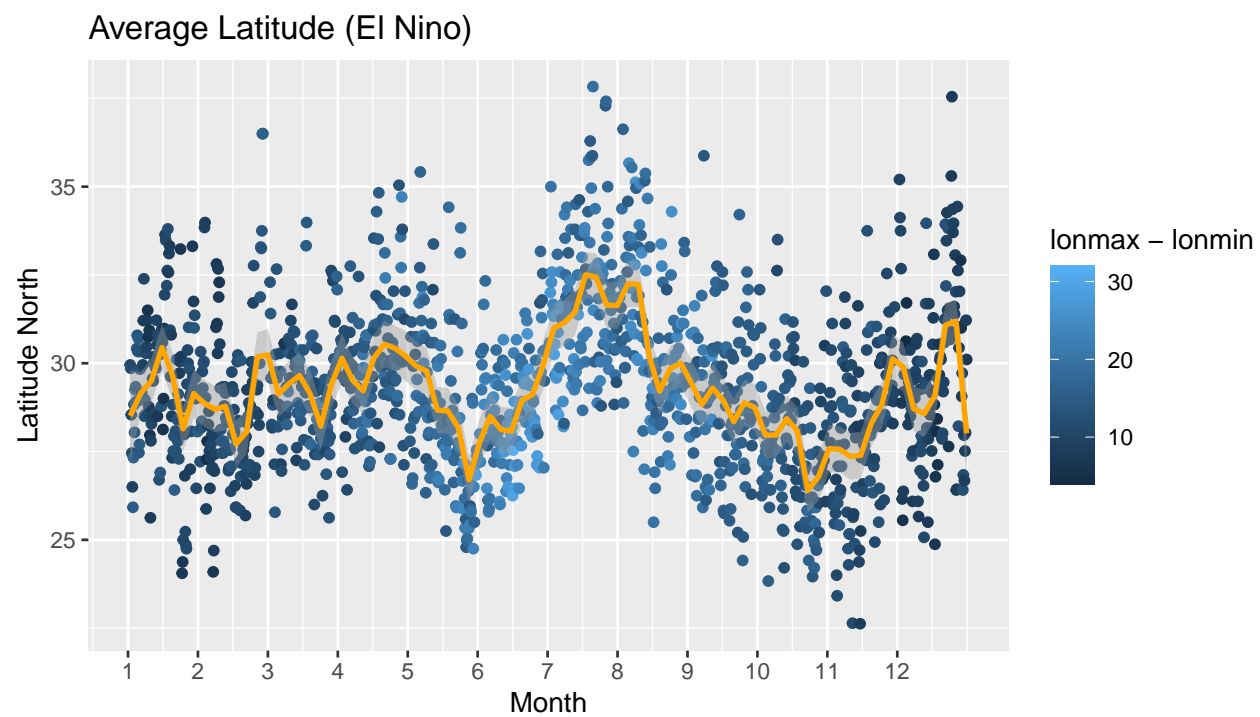
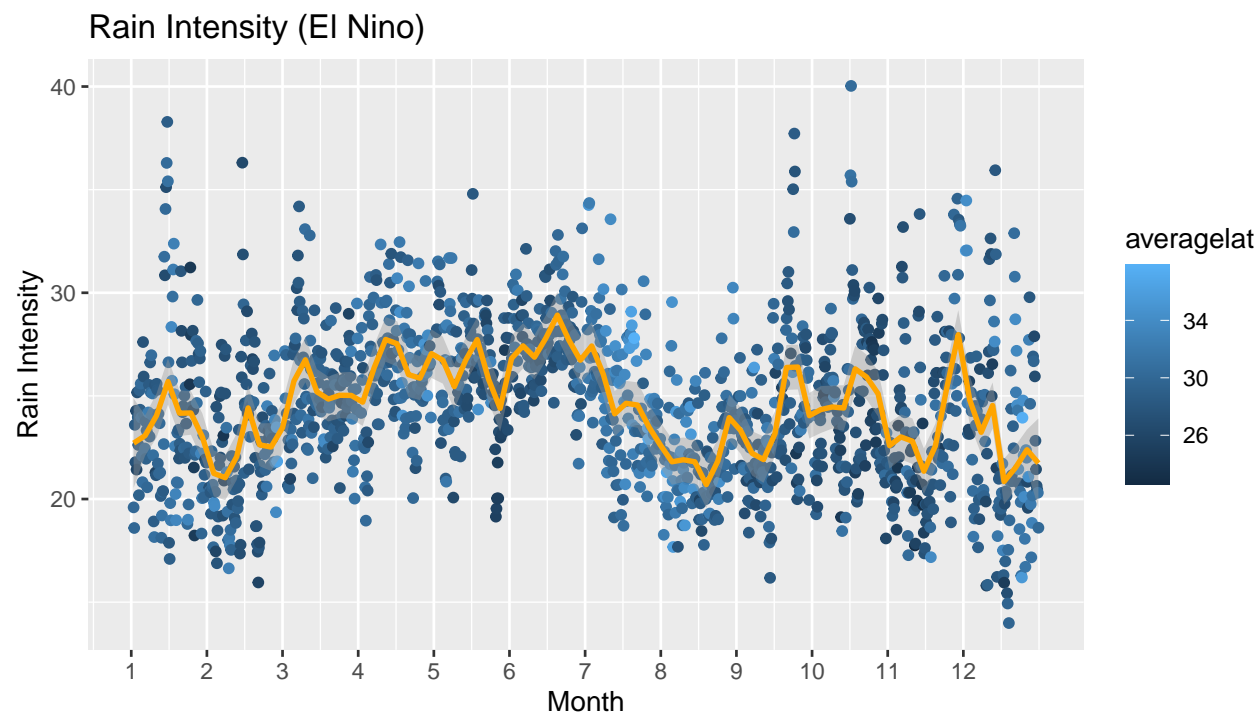
```
el_nino$averagelon <- (el_nino$lonmax + el_nino$lonmin)/2
head(el_nino)
```

```
##   month day hour   year   width  latmin  latmax  lonmin  lonmax
## 1     1    1    0 1996.889 11.34375 25.78125 34.12500 124.6875 136.0312
## 2     1    1    6 1996.889 11.06250 25.87500 33.84375 120.5625 131.6250
## 3     1    1   12 1996.889 10.08333 25.50000 31.58333 118.0833 128.1667
## 4     1    1   18 1996.889 10.58333 24.33333 30.58333 114.9167 125.5000
## 5     1    2    0 1996.889  9.25000 22.75000 30.25000 116.8333 126.0833
## 6     1    2    6 1996.889 15.00000 21.75000 30.09375 112.4062 127.4062
##   rain.amount grid.size averagelat decimaldate   type averagelon
## 1 115972009378  68.50000   29.95312    1.031250 El Nino   130.3594
## 2 125324063308  78.00000   29.85938    1.039062 El Nino   126.0938
## 3 116888816087  57.33333   28.54167    1.046875 El Nino   123.1250
## 4 132816612491  70.55556   27.45833    1.054688 El Nino   120.2083
## 5 144747219042  69.00000   26.50000    1.062500 El Nino   121.4583
## 6 190903991119 103.12500   25.92188    1.070312 El Nino   119.9062
```

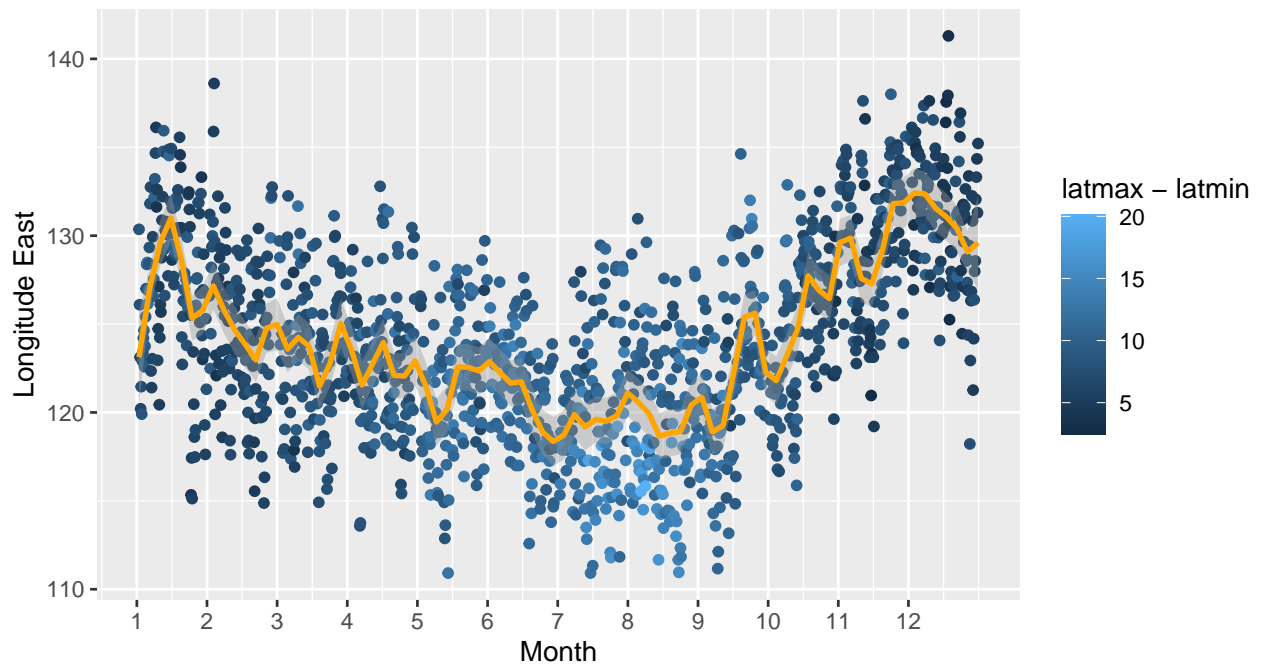
Longitude Length of Rainband (El Nino)







Average Longitude Position (El Nino)





## La Niña

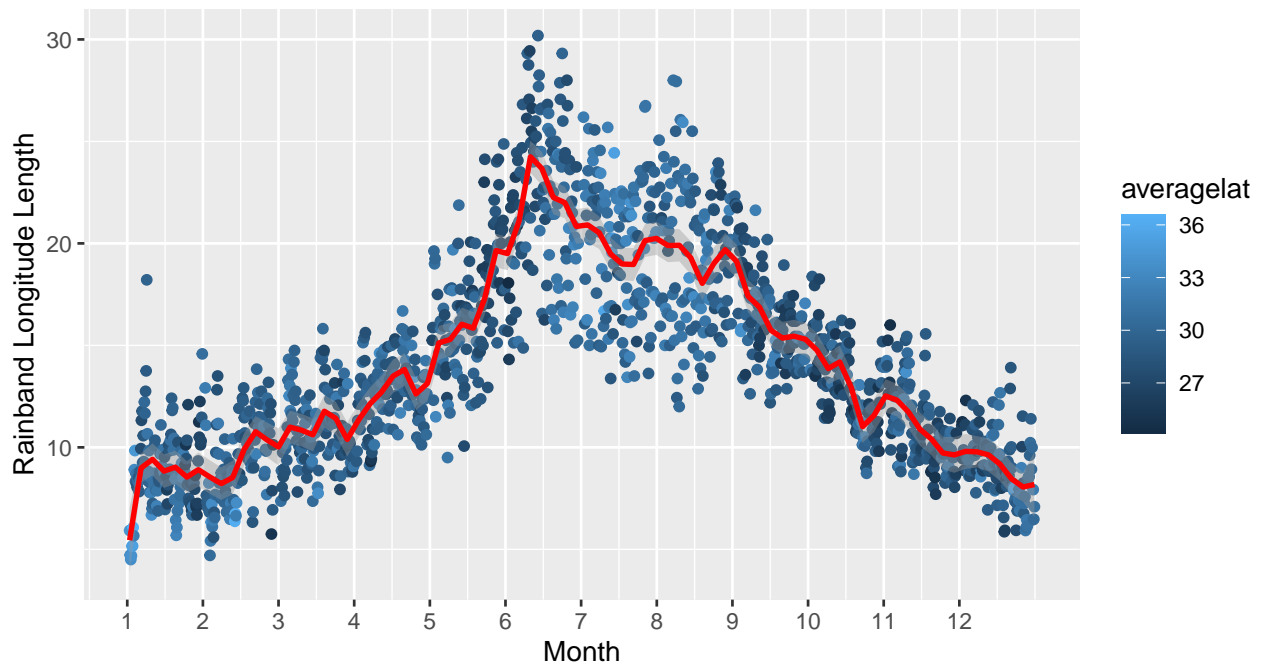
```
la_nina <- read.csv('la_nina_rainband.csv')  
cat('Number of rows:', nrow(la_nina))
```

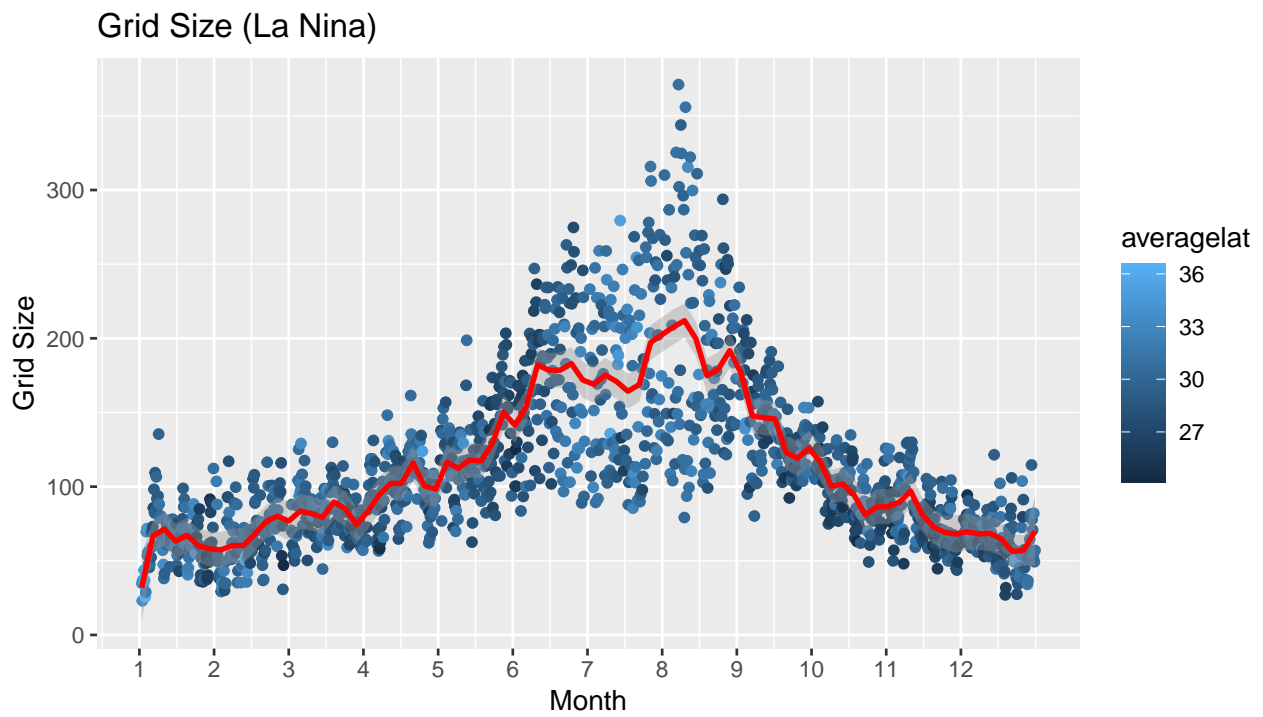
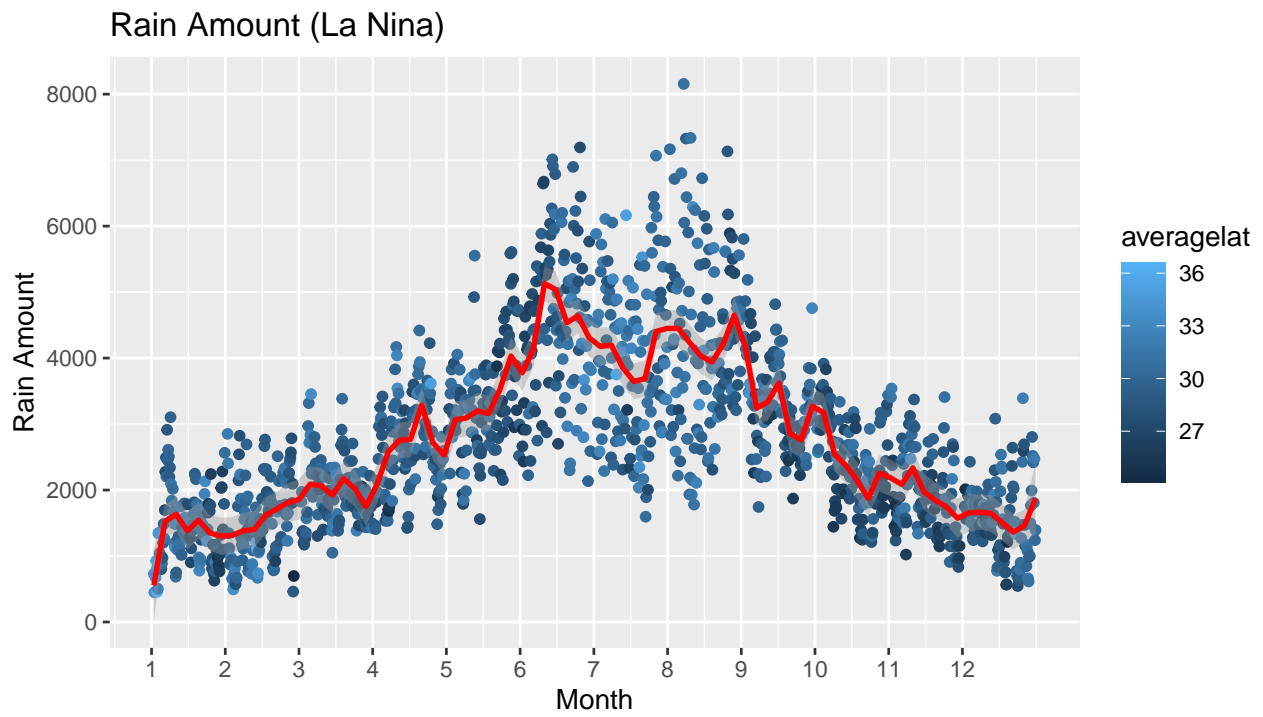
```
## Number of rows: 1464
```

```
la_nina$averagelon <- (la_nina$lonmax + la_nina$lonmin)/2  
head(la_nina)
```

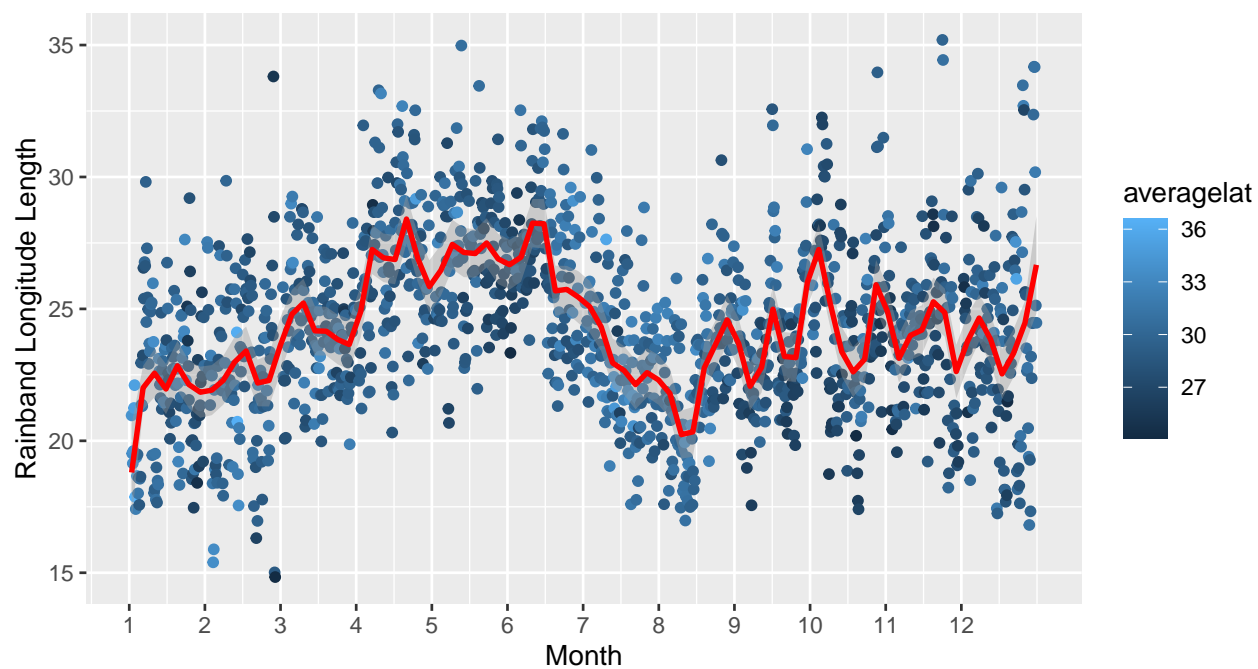
```
##   month day hour   year   width  latmin  latmax  lonmin  lonmax  
## 1     1   1   0 2001.833 5.925000 31.35000 36.60000 133.2750 139.2000  
## 2     1   1   6 2001.833 4.725000 31.50000 35.17500 134.6250 139.3500  
## 3     1   1  12 2001.833 4.500000 30.32143 36.64286 130.1786 134.6786  
## 4     1   1  18 2001.833 4.687500 31.40625 36.46875 131.2500 135.9375  
## 5     1   2   0 2001.833 5.156250 31.78125 38.25000 129.0000 134.1562  
## 6     1   2   6 2001.833 5.166667 32.83333 37.50000 125.7500 130.9167  
##   rain.amount grid.size averagelat decimaldate   type averagelon  
## 1 63032304140  34.80000  33.97500   1.031250 La Nina  136.2375  
## 2 38788506992  23.00000  33.33750   1.039062 La Nina  136.9875  
## 3 61201901619  37.00000  33.48214   1.046875 La Nina  132.4286  
## 4 58251167119  34.37500  33.93750   1.054688 La Nina  133.5938  
## 5 80072551834  43.62500  35.01562   1.062500 La Nina  131.5781  
## 6 70254559040  36.77778  35.16667   1.070312 La Nina  128.3333
```

Longitude Length of Rainband (La Nina)

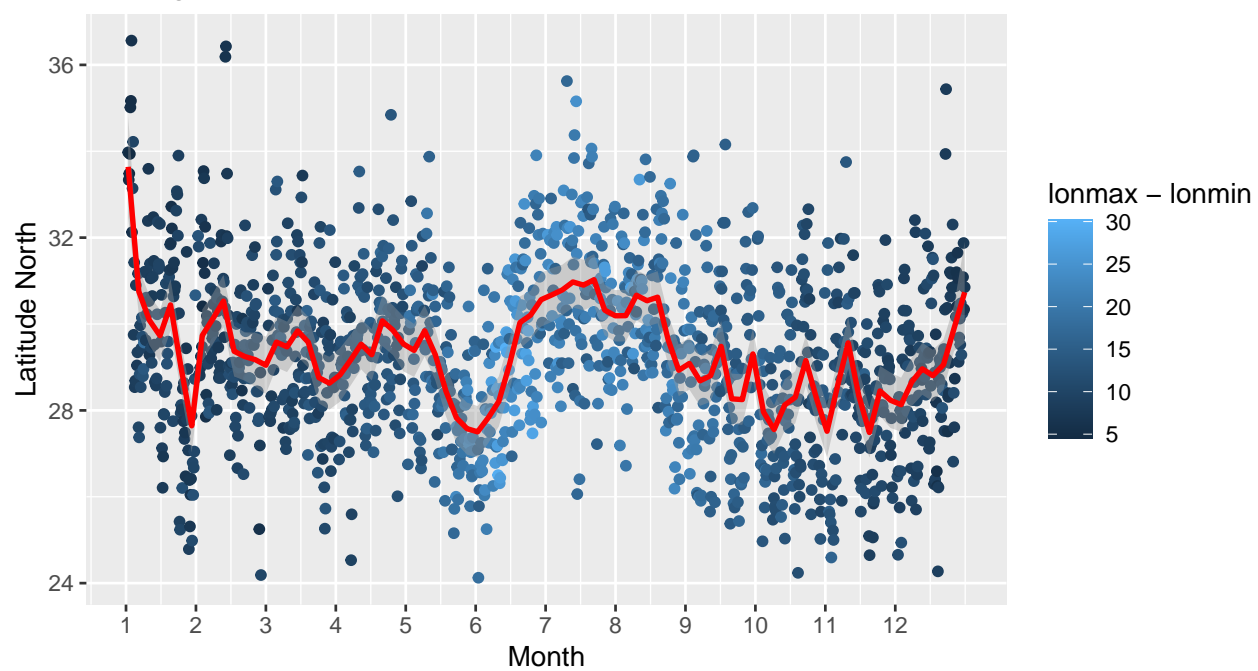




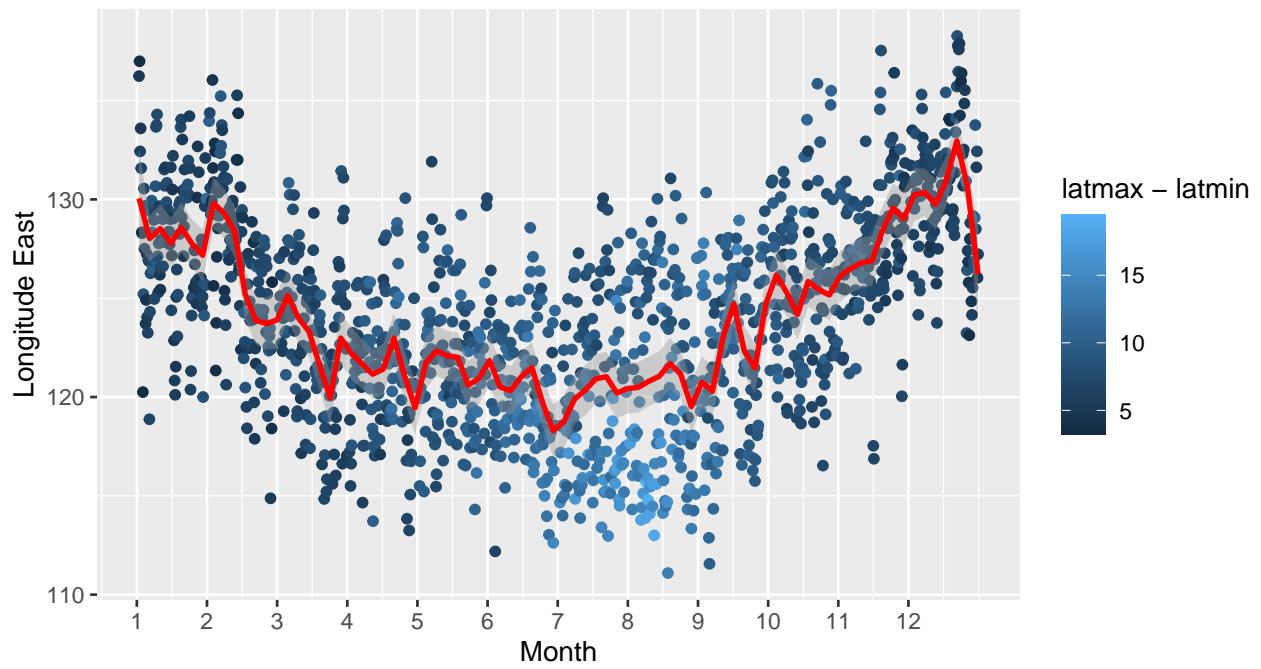
Rain Intensity (La Nina)



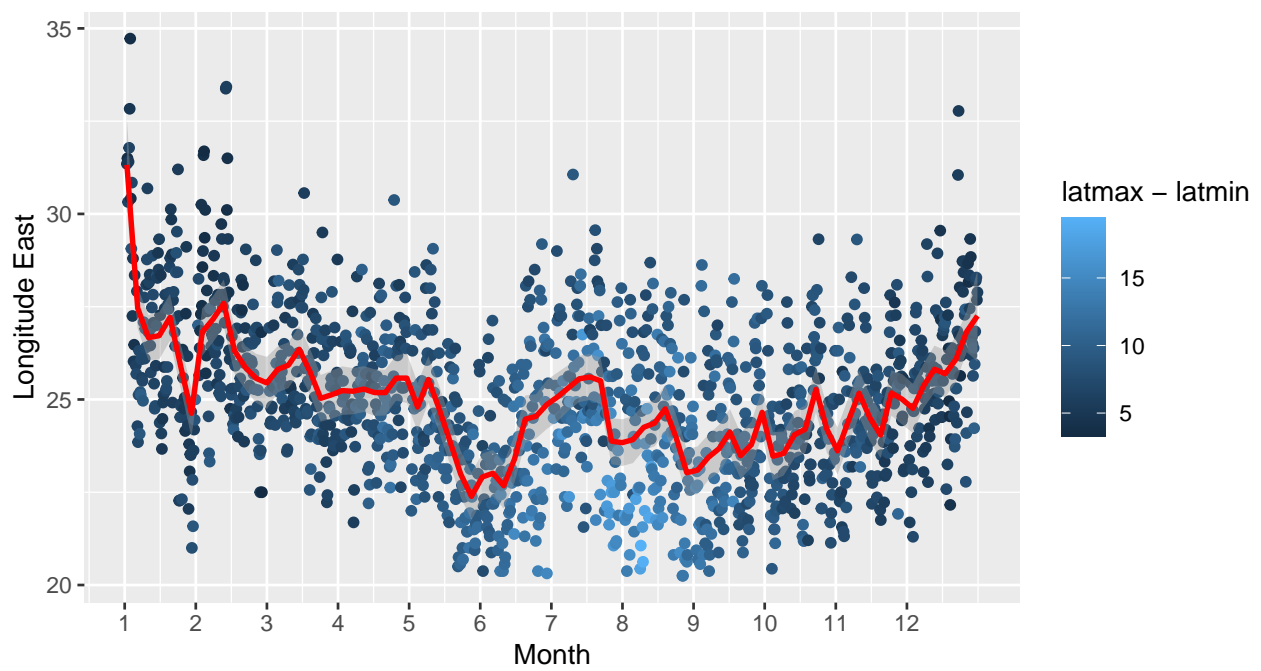
Average Latitude (La Nina)



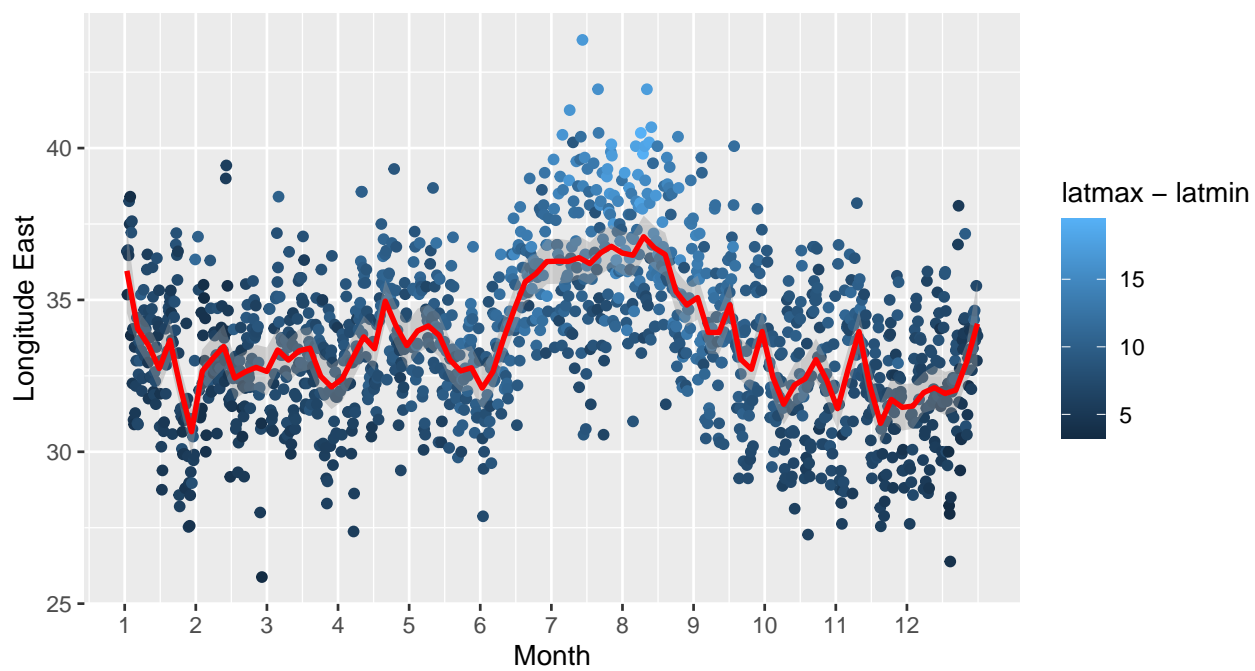
Average Longitude Position (La Nina)



Minimum Latitude Position (La Nina)



Maximum Latitude Position (La Nina)



## Neutral

```
neutral <- read.csv('neutral_rainband.csv')  
cat('Number of rows:', nrow(neutral))
```

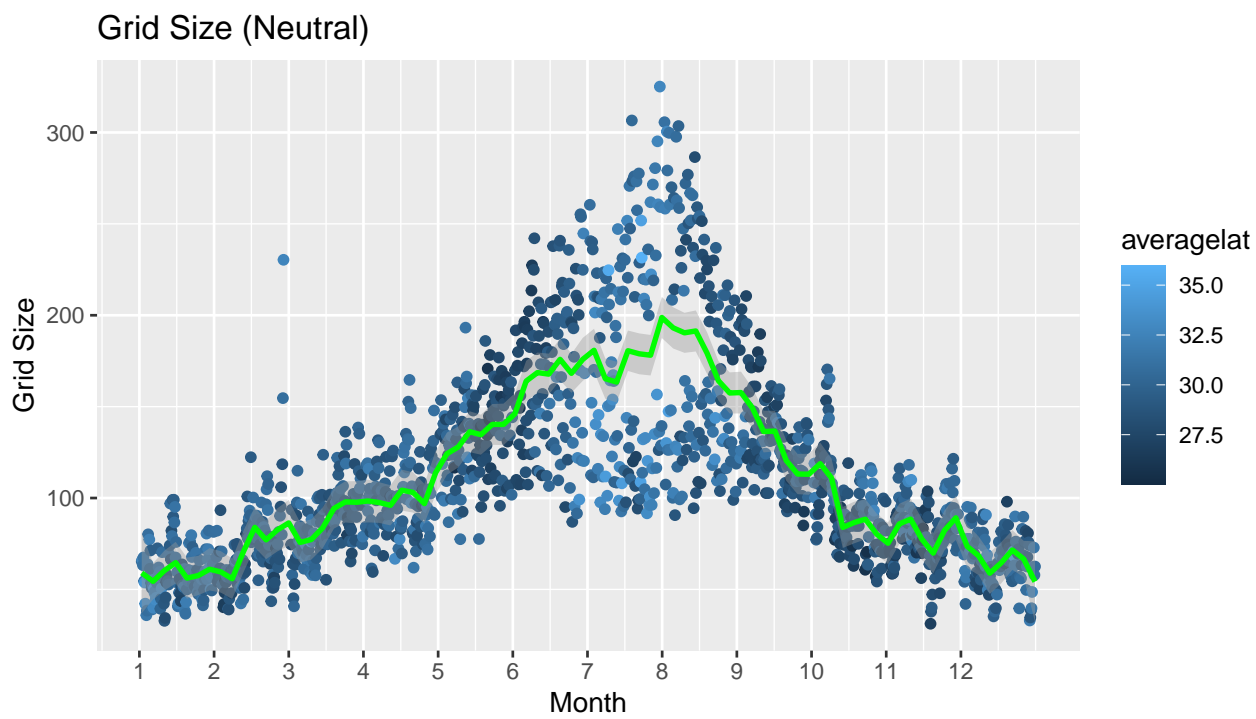
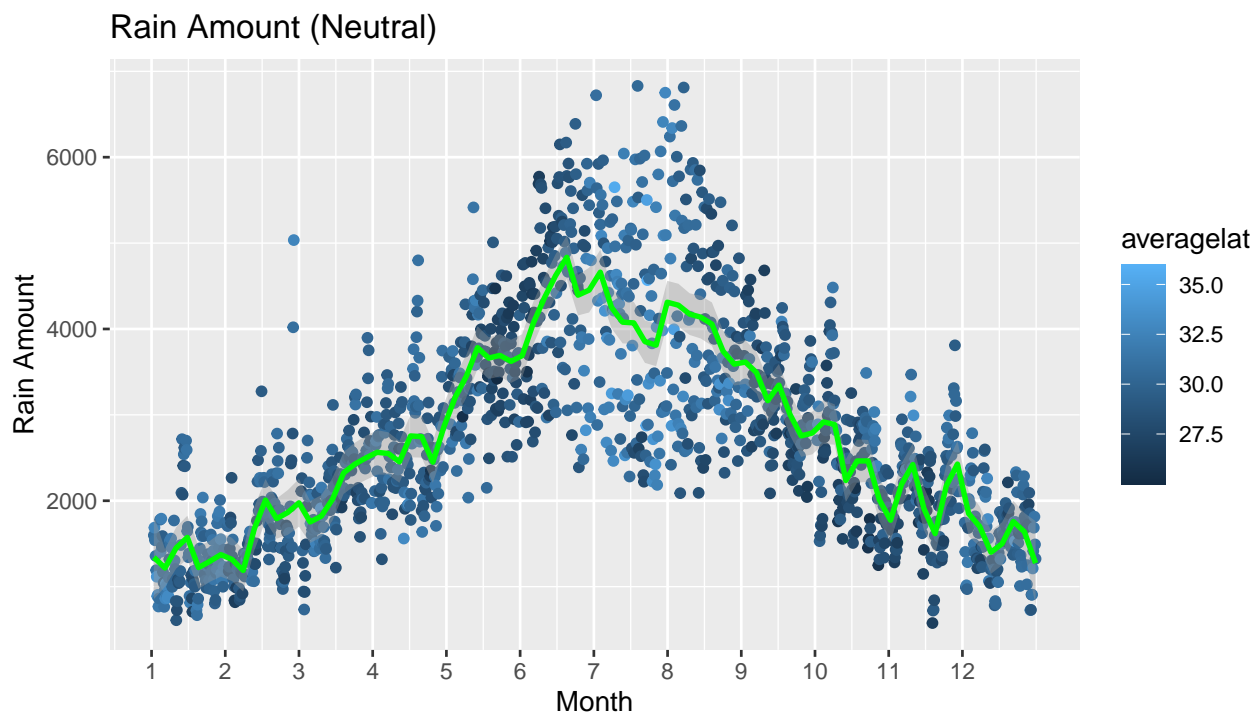
```
## Number of rows: 1464
```

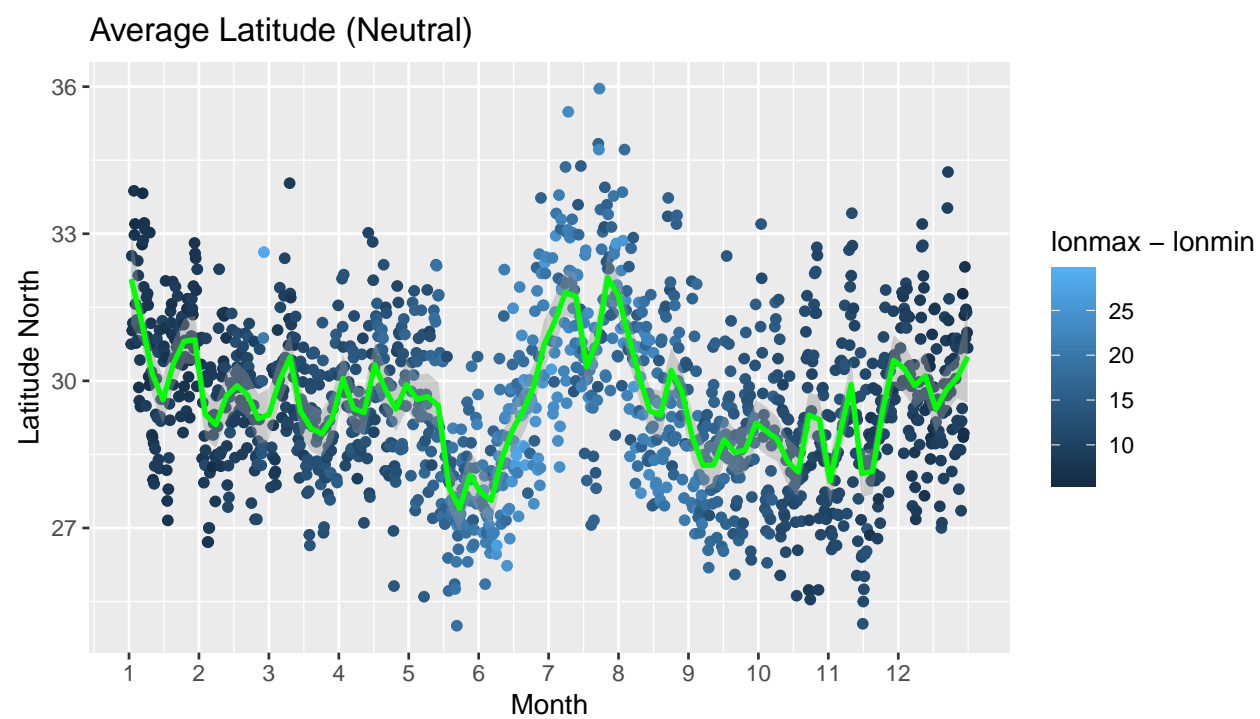
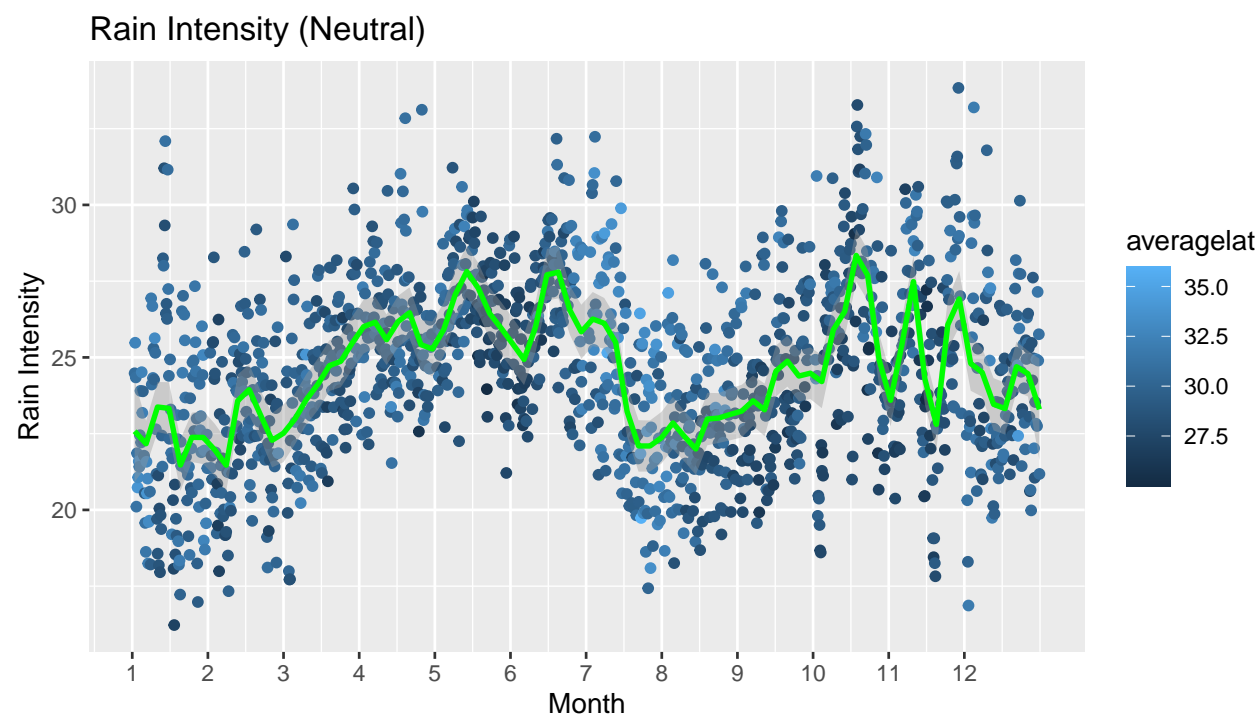
```
neutral$averagelon <- (neutral$lonmax + neutral$lonmin)/2  
head(neutral)
```

```
##   month day hour   year   width  latmin  latmax  lonmin  lonmax  
## 1     1   1   0 1997.158 8.850000 27.30000 34.20000 129.1500 138.0000  
## 2     1   1   6 1997.158 8.100000 29.25000 35.85000 129.5000 137.6000  
## 3     1   1  12 1997.158 7.350000 27.50000 34.55000 131.7000 139.0500  
## 4     1   1  18 1997.158 8.517857 27.75000 34.60714 128.3036 136.8214  
## 5     1   2   0 1997.158 7.392857 27.85714 34.50000 130.5000 137.8929  
## 6     1   2   6 1997.158 7.350000 30.85000 36.90000 131.7000 139.0500  
##   rain.amount grid.size averagelat decimaldate   type averagelon  
## 1 138042412064  65.26667  30.75000   1.031250 Neutral  133.5750  
## 2 145739158249  66.20000  32.55000   1.039062 Neutral  133.5500  
## 3 133066905094  63.26667  31.02500   1.046875 Neutral  135.3750  
## 4 117264380349  67.50000  31.17857   1.054688 Neutral  132.5625  
## 5 102922658306  54.50000  31.17857   1.062500 Neutral  134.1964  
## 6  96383783532  53.80000  33.87500   1.070312 Neutral  135.3750
```

Longitude Length of Rainband (Neutral)

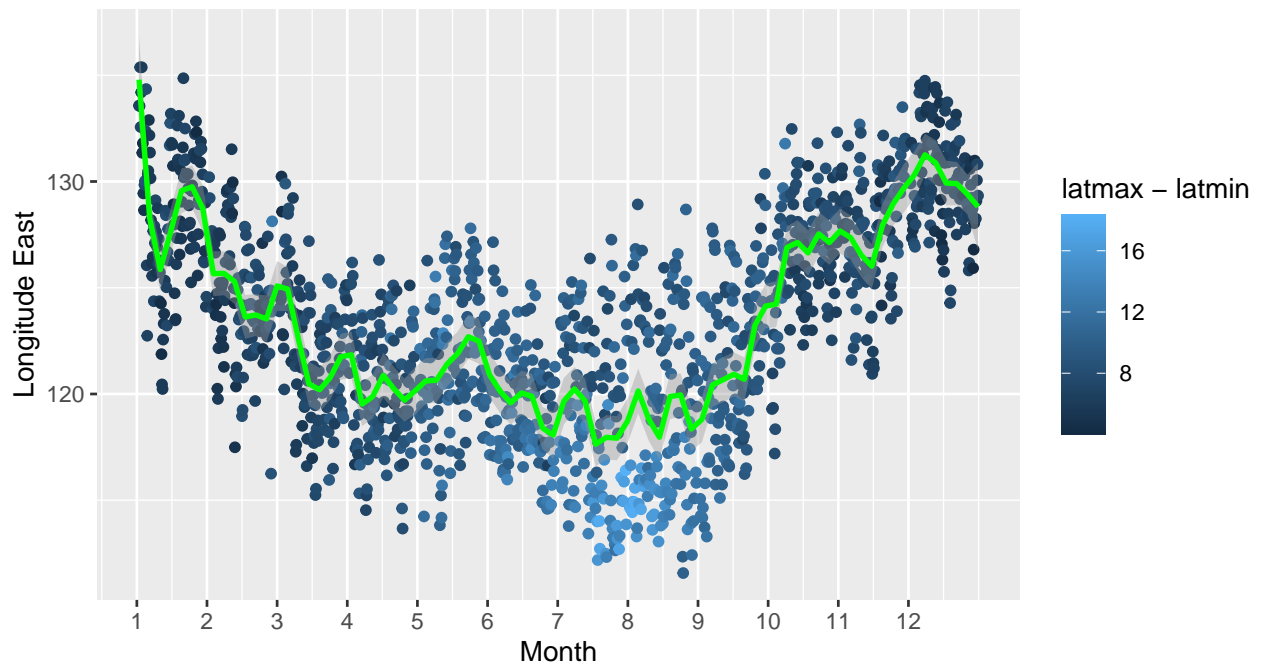








Average Longitude Position (Neutral)



## Together By Type (More smoothing (56-day))

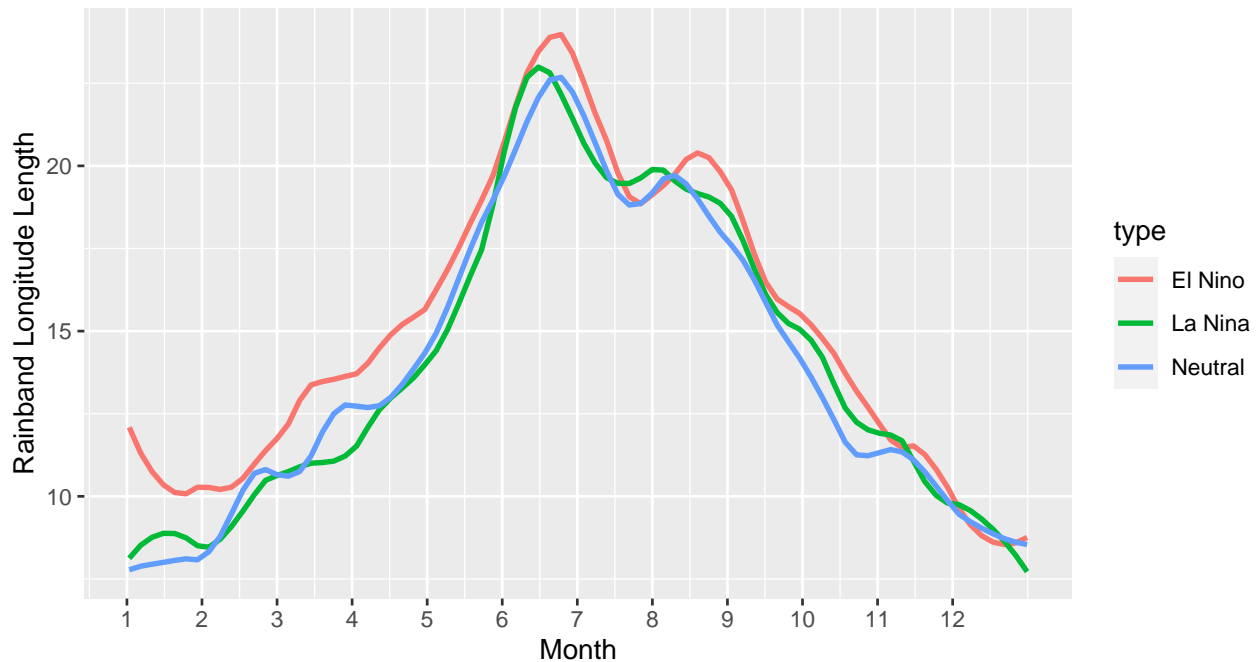
```
by_type <- read.csv('full_rainband_by_type.csv')
cat('Number of rows:', nrow(by_type)) # el nino, la nina, and then neutral
```

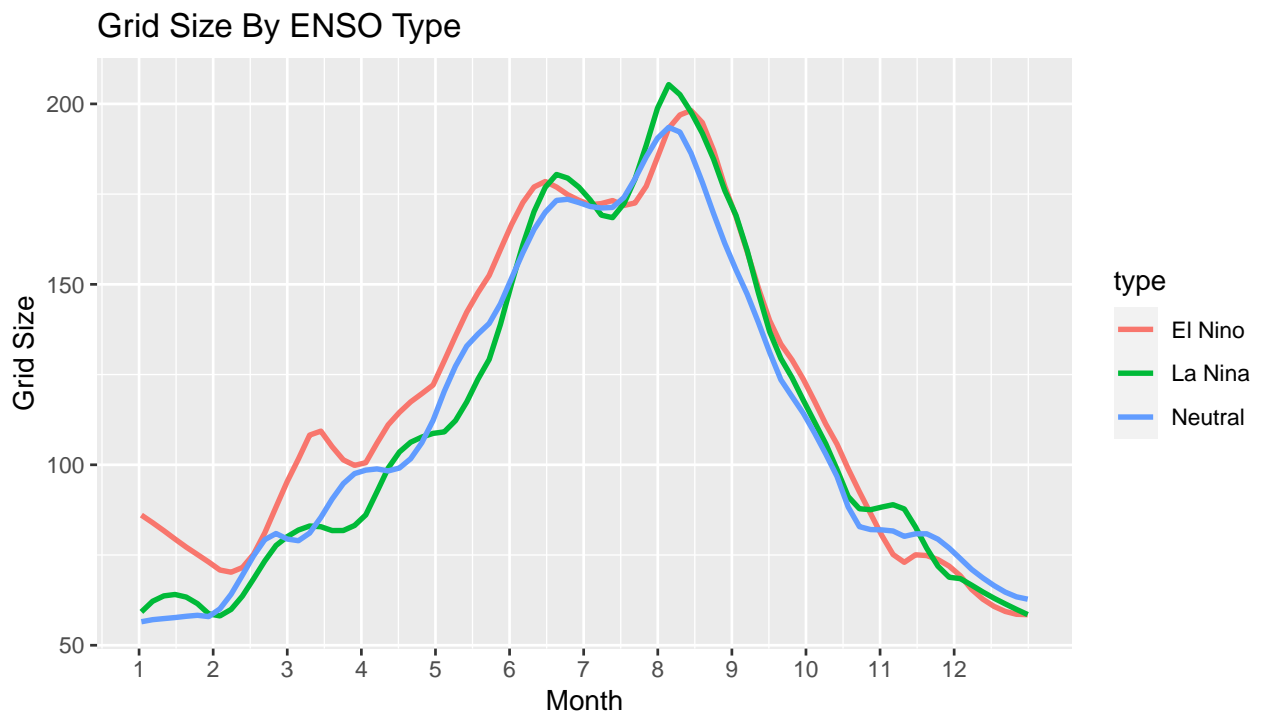
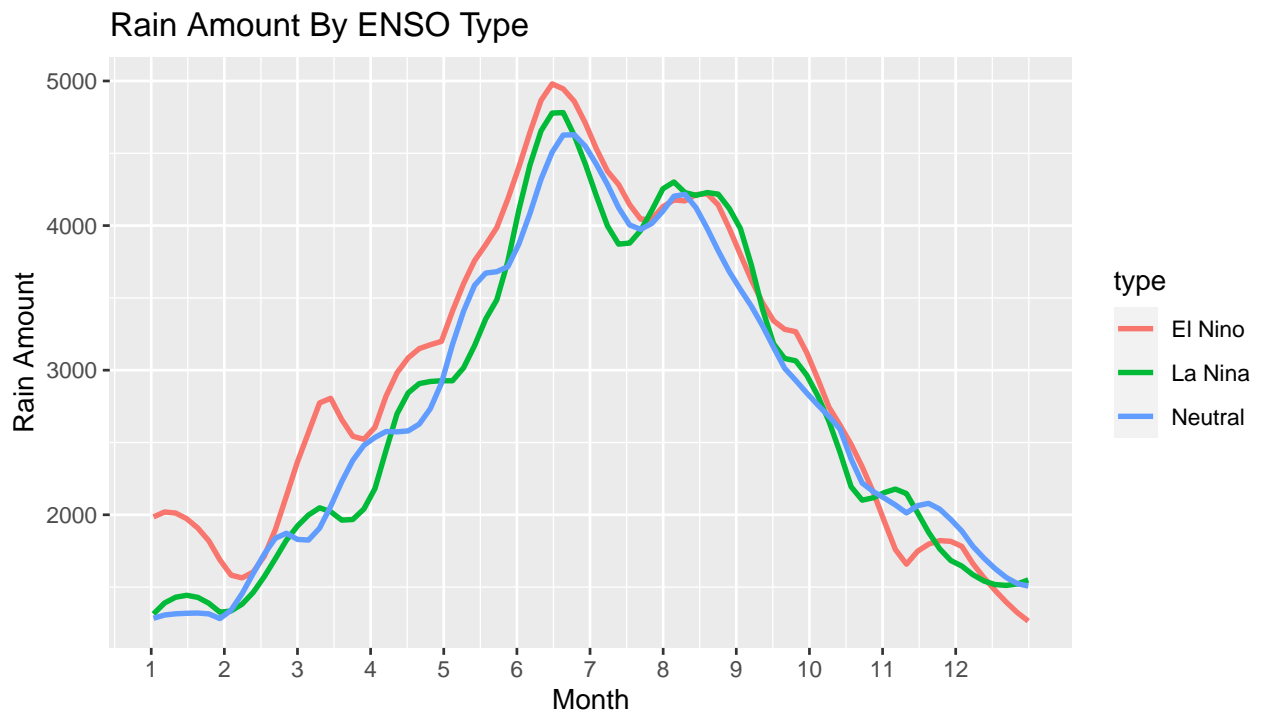
```
## Number of rows: 4392
```

```
by_type$averagelon <- (by_type$lonmax + by_type$lonmin)/2
head(by_type)
```

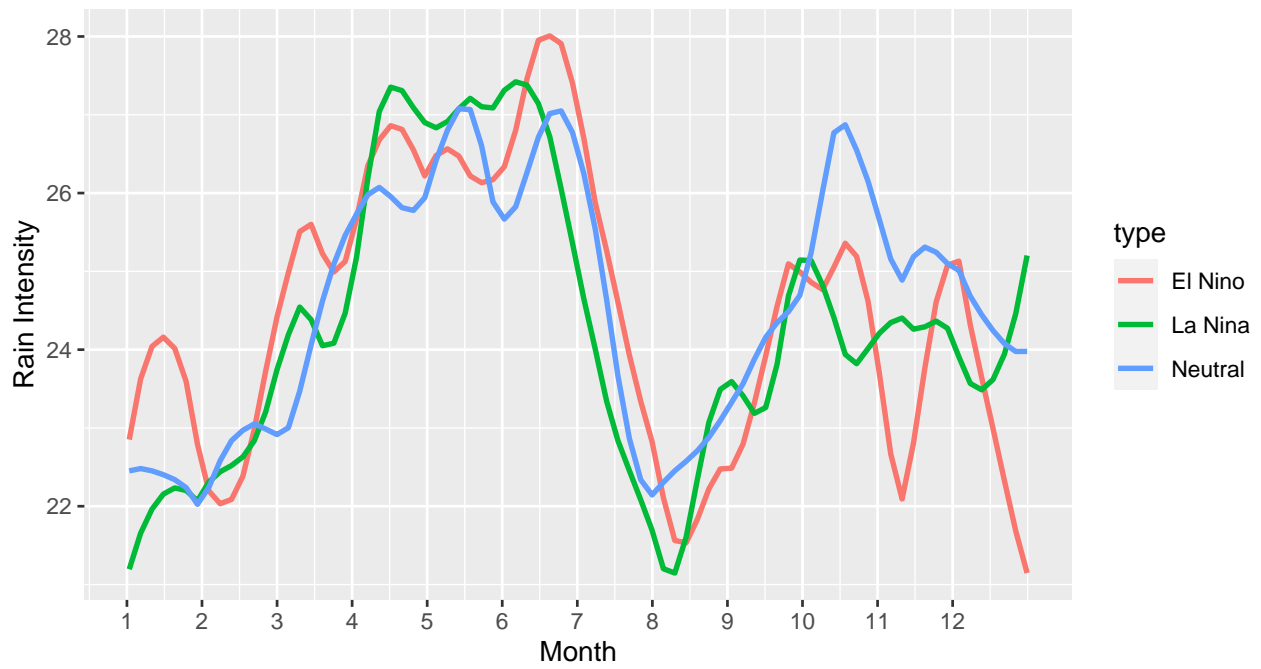
```
##   month day hour   year   width  latmin  latmax  lonmin  lonmax
## 1     1    1    0 1996.889 11.34375 25.78125 34.12500 124.6875 136.0312
## 2     1    1    6 1996.889 11.06250 25.87500 33.84375 120.5625 131.6250
## 3     1    1   12 1996.889 10.08333 25.50000 31.58333 118.0833 128.1667
## 4     1    1   18 1996.889 10.58333 24.33333 30.58333 114.9167 125.5000
## 5     1    2    0 1996.889  9.25000 22.75000 30.25000 116.8333 126.0833
## 6     1    2    6 1996.889 15.00000 21.75000 30.09375 112.4062 127.4062
##   rain.amount grid.size averagelat decimaldate   type averagelon
## 1 115972009378  68.50000   29.95312   1.031250 El Nino   130.3594
## 2 125324063308  78.00000   29.85938   1.039062 El Nino   126.0938
## 3 116888816087  57.33333   28.54167   1.046875 El Nino   123.1250
## 4 132816612491  70.55556   27.45833   1.054688 El Nino   120.2083
## 5 144747219042  69.00000   26.50000   1.062500 El Nino   121.4583
## 6 190903991119 103.12500   25.92188   1.070312 El Nino   119.9062
```

Rainband Longitude Length By ENSO Type

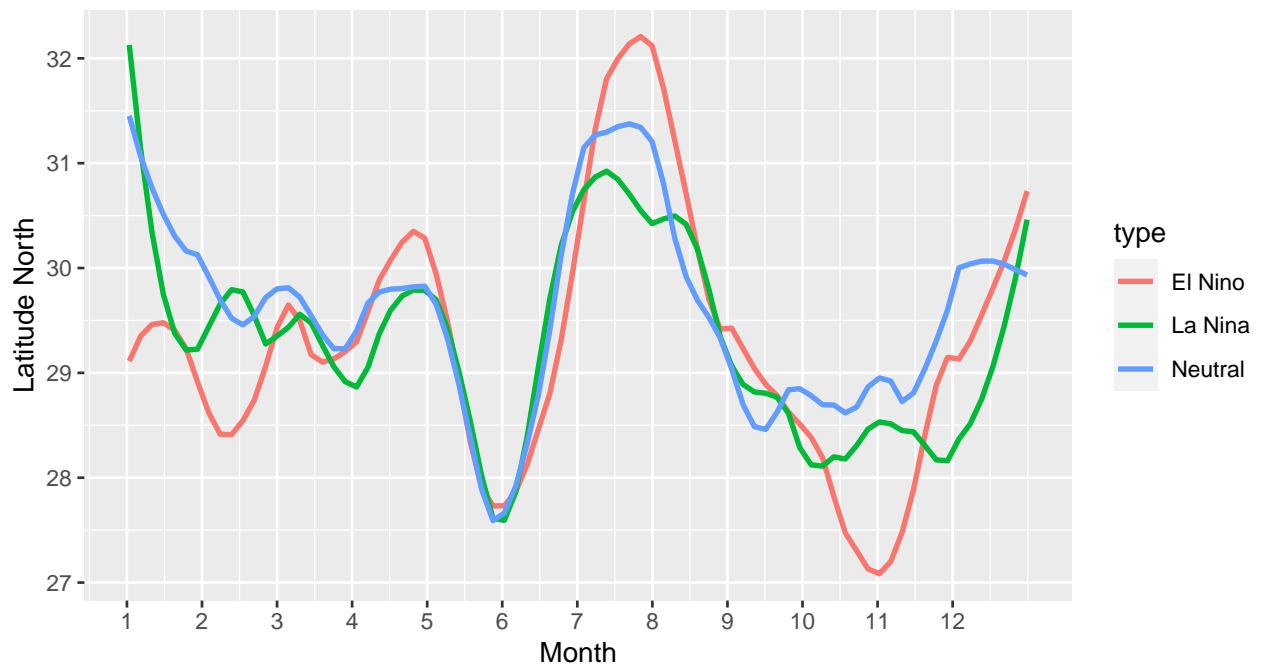


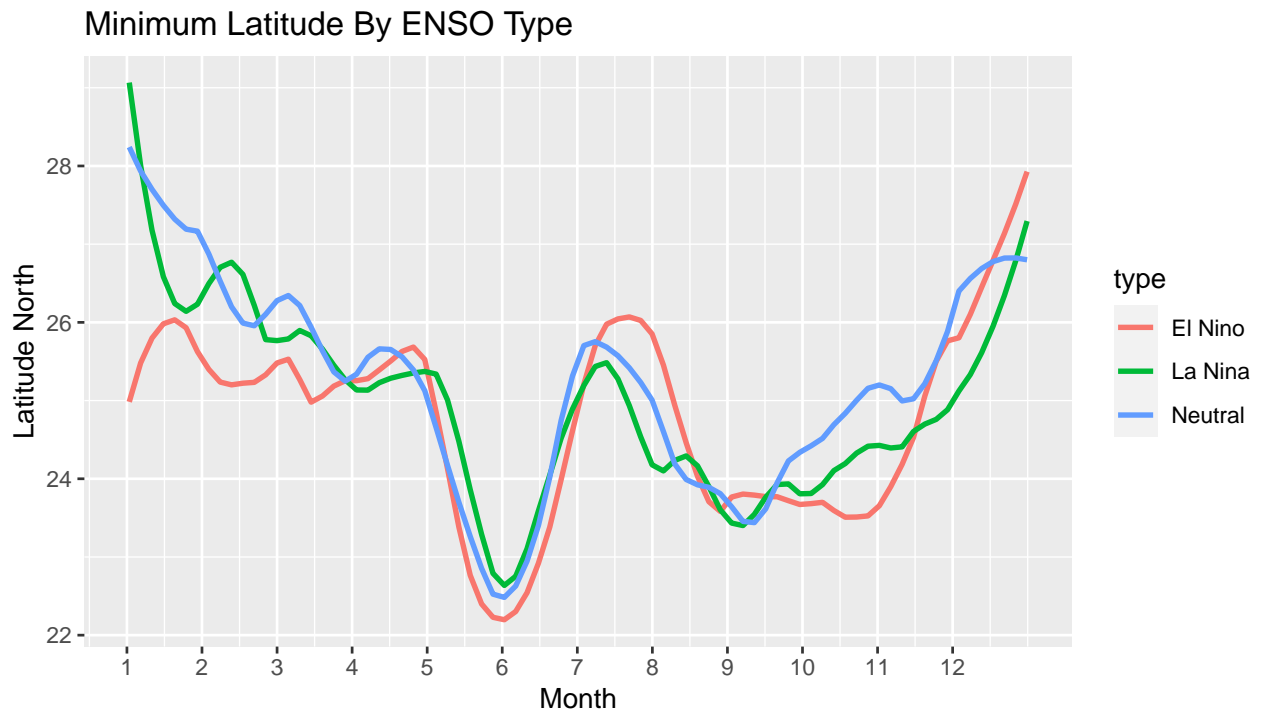
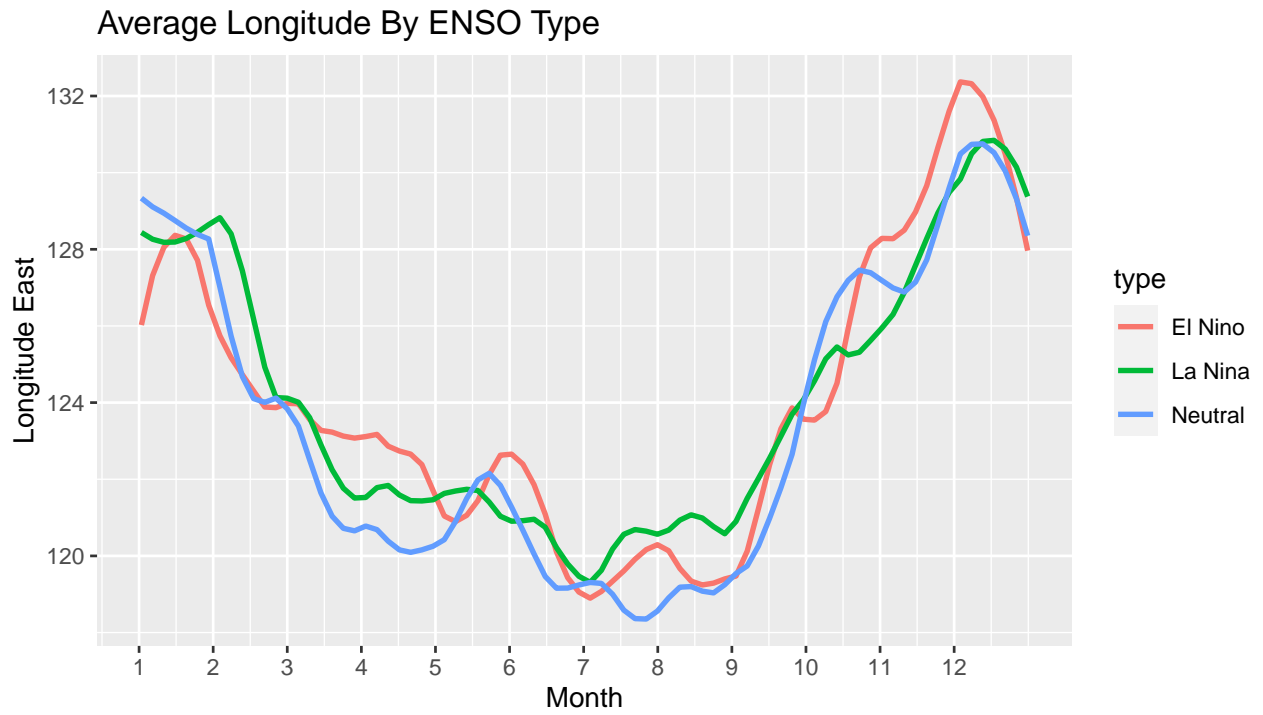


Rain Intensity By ENSO Type

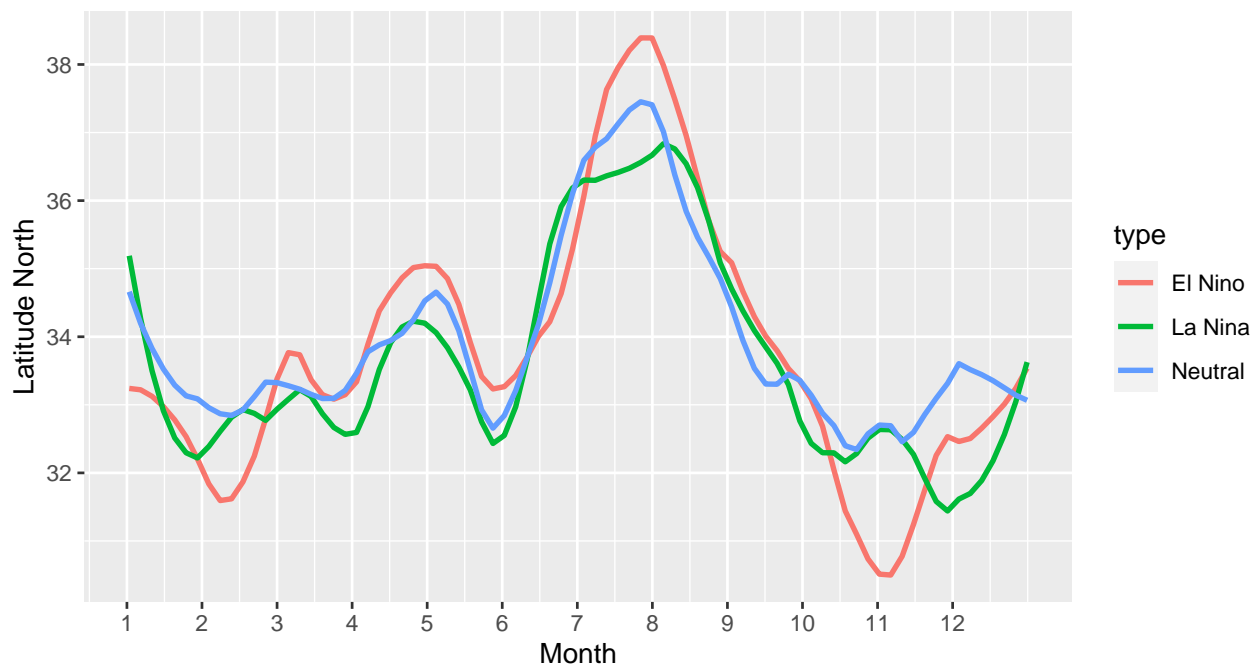


Average Latitude By ENSO Type





Maximum Latitude By ENSO Type



```
## El Nino July Mean Minimum Latitude: 23.19375
## La Nina July Mean Minimum Latitude: 23.69583

## El Nino July Minimum Latitude SD: 1.868118
## La Nina July Minimum Latitude SD: 2.082811

## T-stat for Difference in Minimum Latitude in June: -1.965812
## T-test for Significant Minimum Latitude Shift for all Months:

##      Jan      Feb      Mar      Apr      May      Jun
## -2.88602197 -4.37982470 -2.68183458  1.14314679 -3.32008719 -1.96581210
##      Jul      Aug      Sep      Oct      Nov      Dec
##  2.41490681  1.70827530 -0.12673667 -2.05614402 -0.06016647  2.97310934
```