A Decade of Sunspots: 2009 -2019

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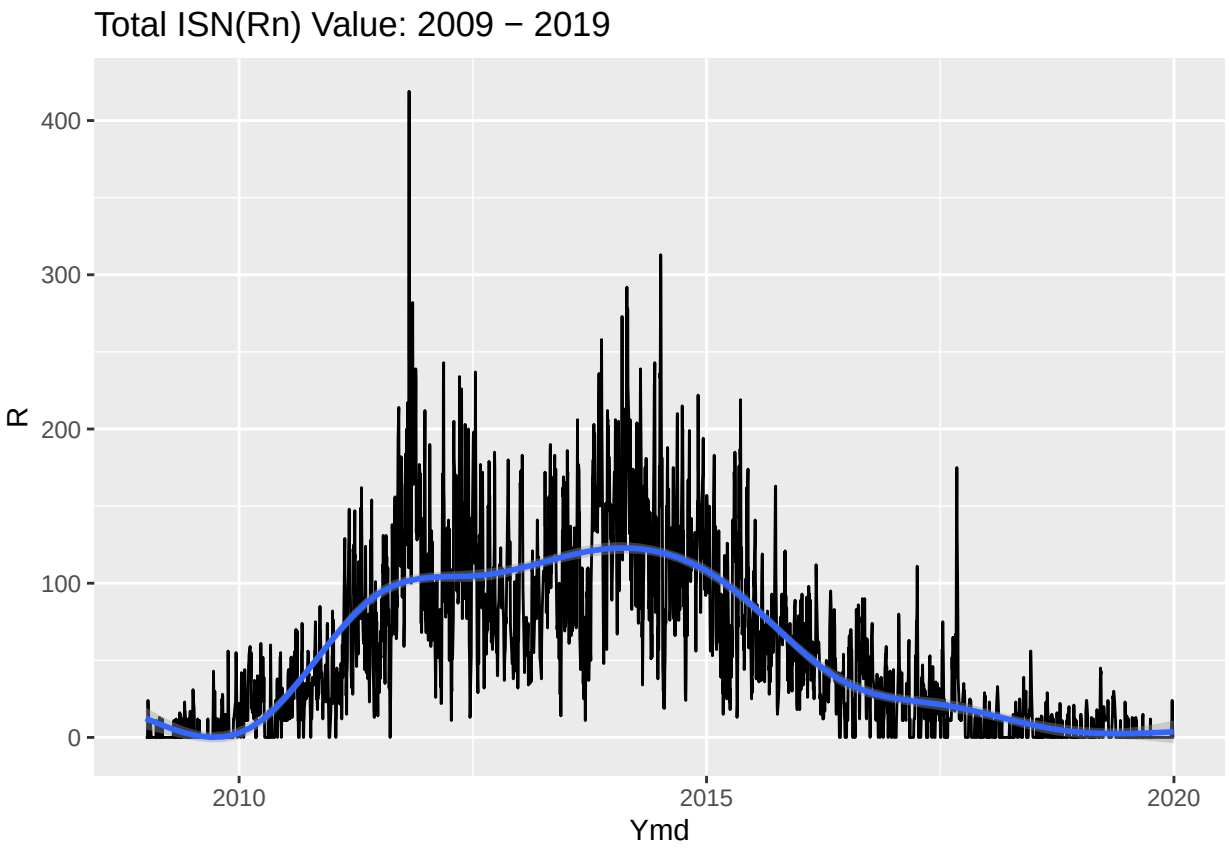
Introduction to International Suspot Number(ISN/R)

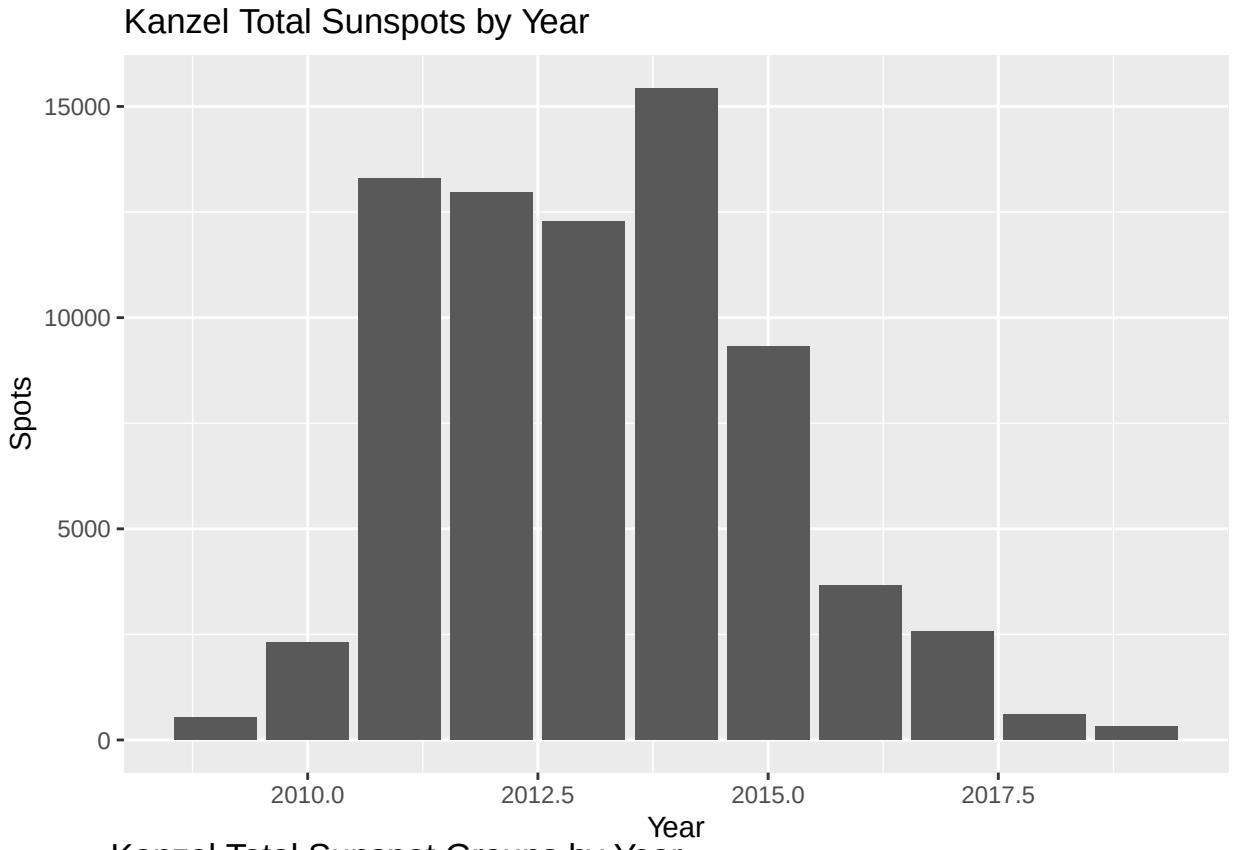
The first thing we need to understand is that the (raw) data used to predict (in the plot below) the values of "y" are sunspots or even mean sunspots but are daily mean Wolf(Rn) value. The Wolf(mean daily) values are calculate using the formula, Wolf = Groups *10 +Spots. Two examples: 1G 10 + 20S = 30 Wolf 2G 10 + 10S = 30 Wolf

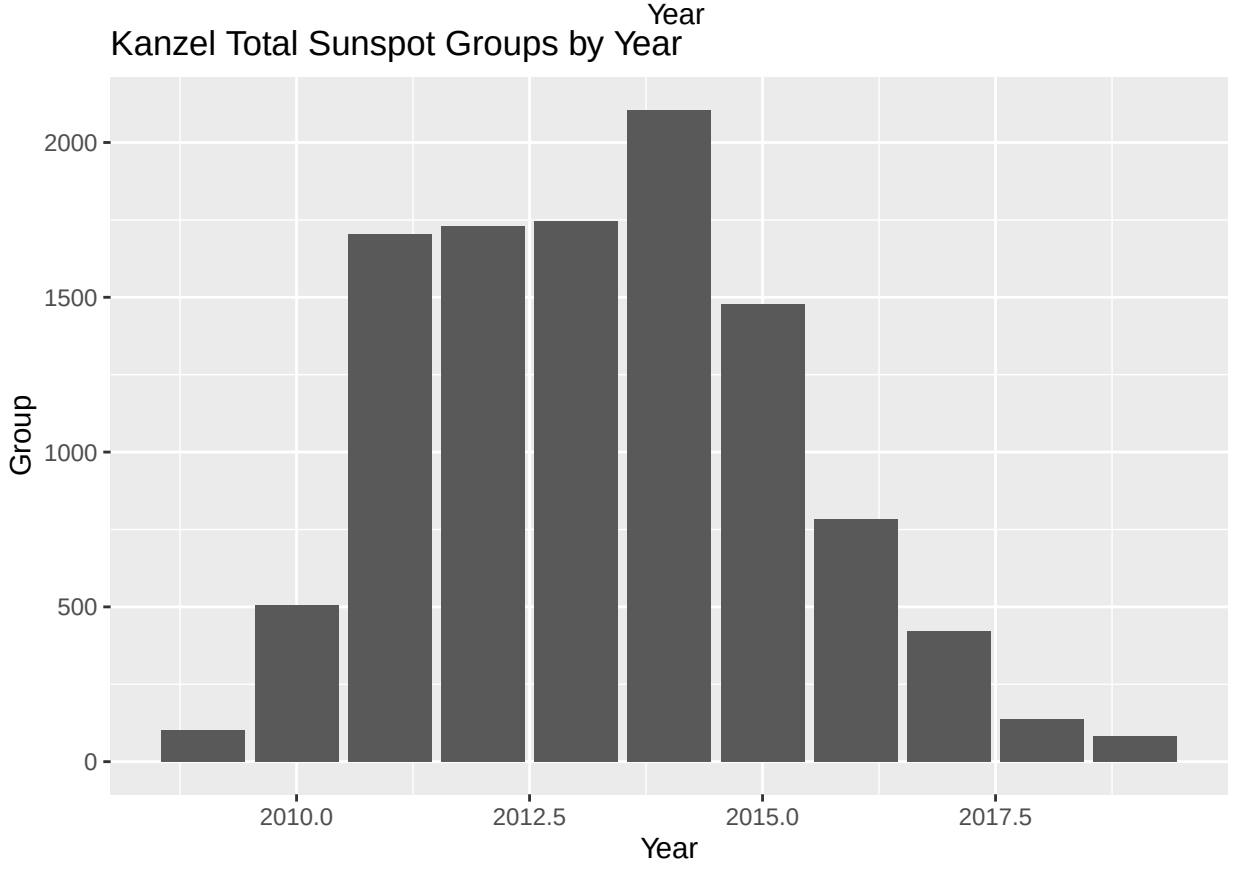
```
##          Ymd Year Month g_n s_n g_s s_s R R_n R_s Spots Groups
## 1 2009-01-01 2009     1   0   0   0   0 0   0   0     0      0
## 2 2009-01-02 2009     1   0   0   0   0 0   0   0     0      0
## 3 2009-01-03 2009     1   0   0   0   0 0   0   0     0      0
## 4 2009-01-04 2009     1   0   0   0   0 0   0   0     0      0
## 5 2009-01-05 2009     1   0   0   0   0 0   0   0     0      0
## 6 2009-01-06 2009     1   0   0   0   0 0   0   0     0      0
```

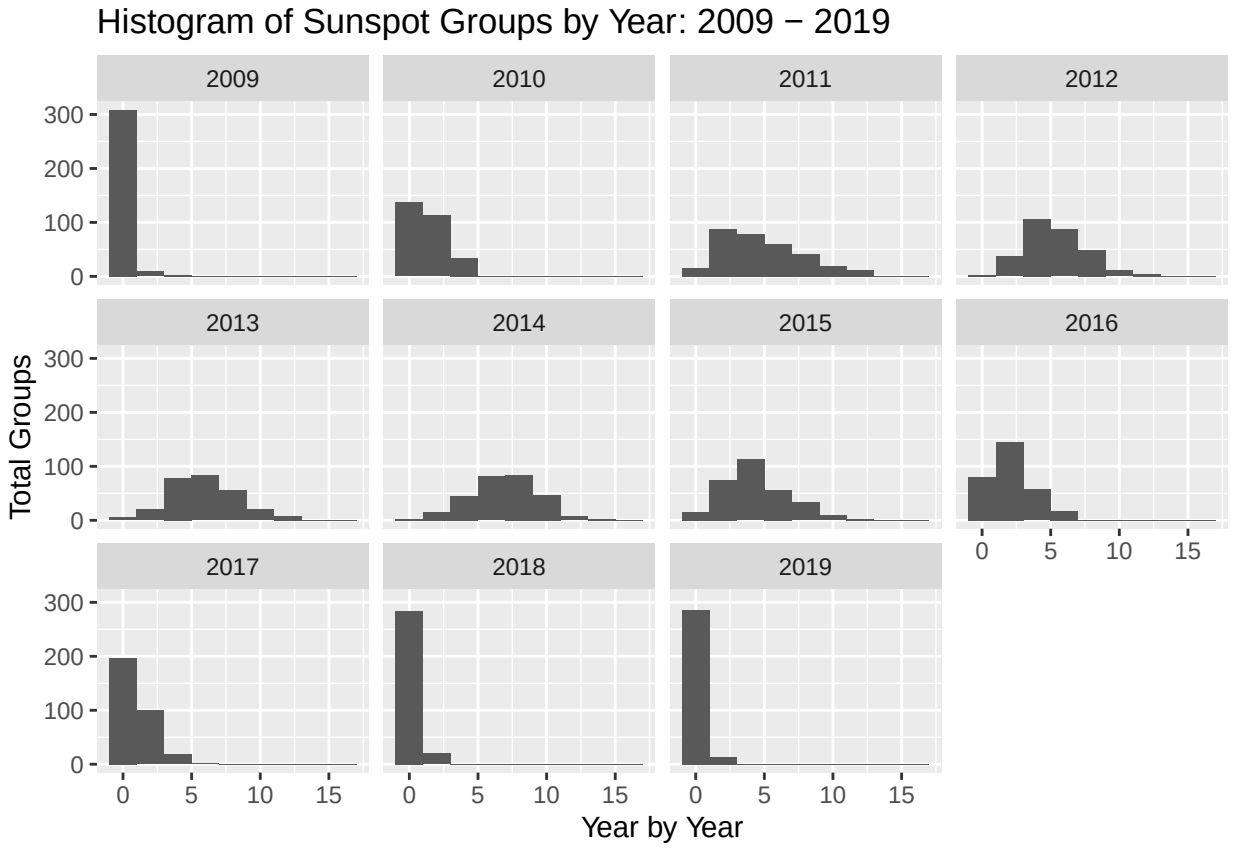
Total International Sunspot Number(ISN/Rn) by Year: 2009 - 2019

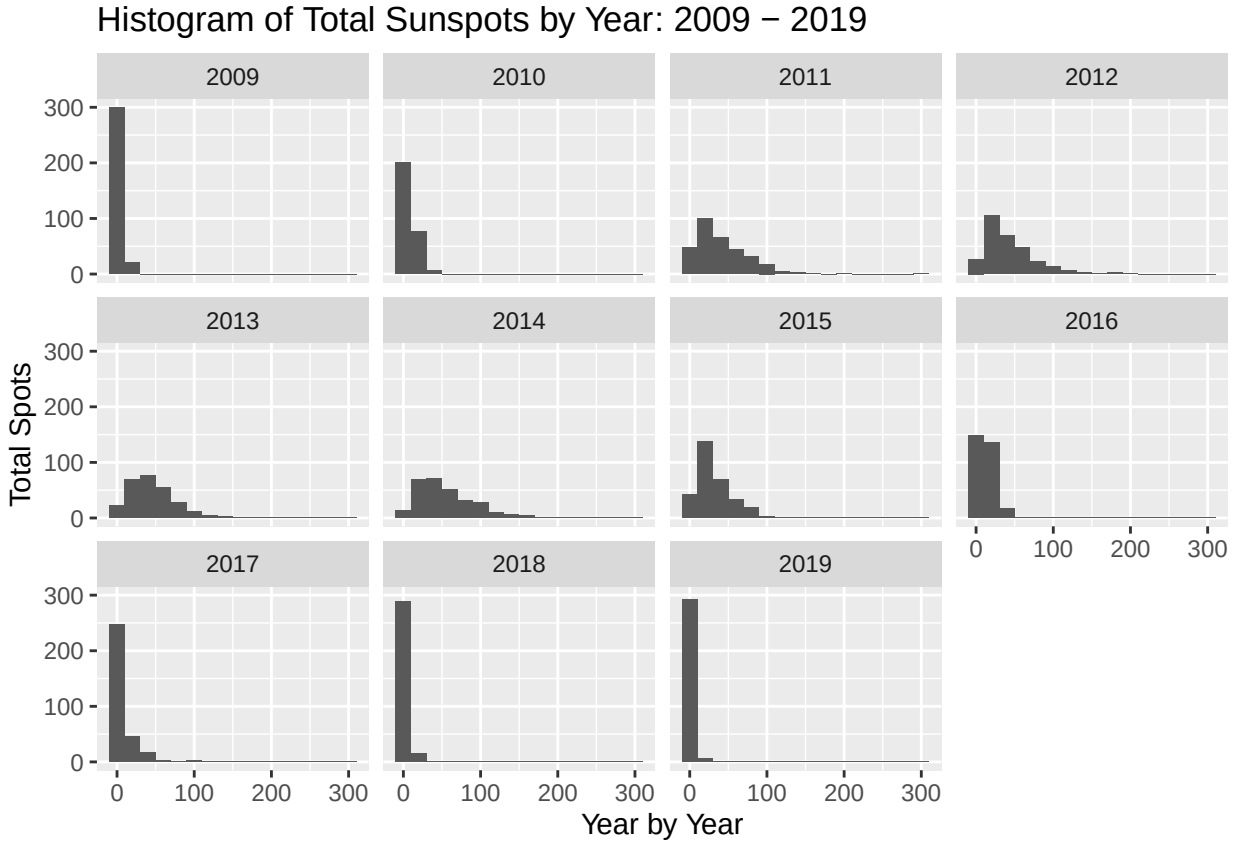
```
## `geom_smooth()` using method = 'gam' and formula 'y ~ s(x, bs = "cs")'
```



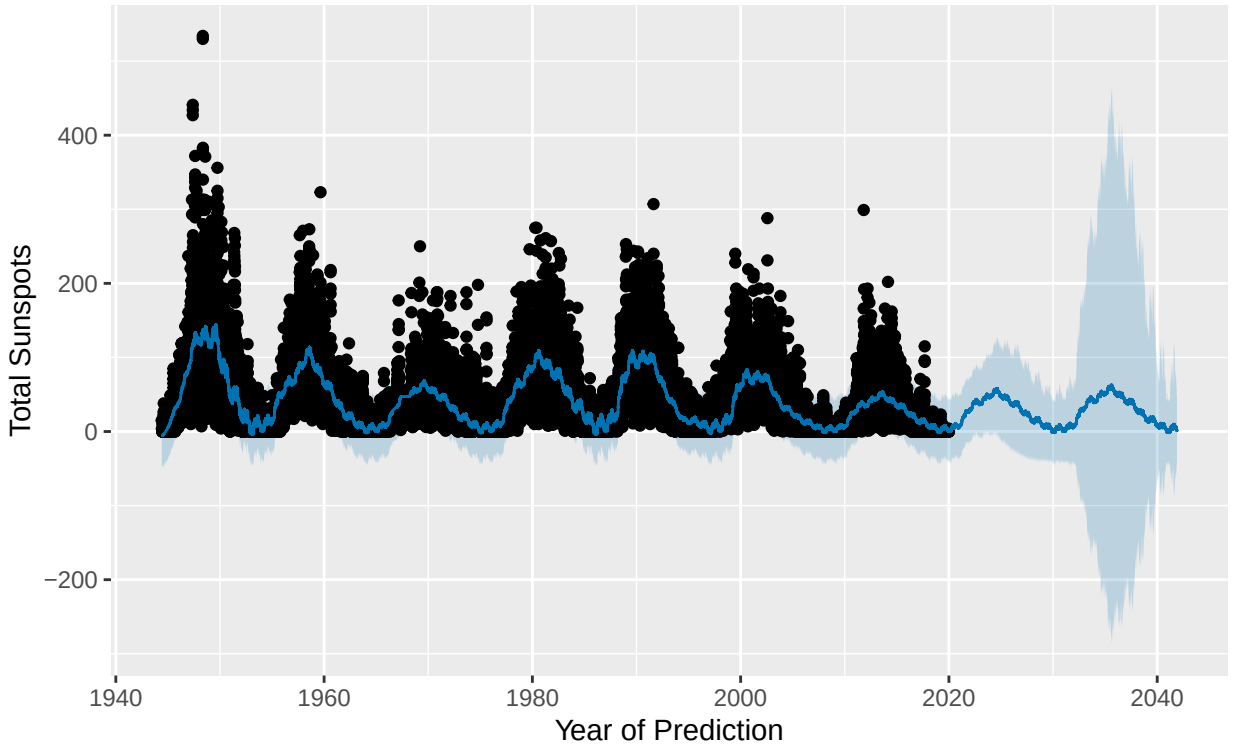

Kanzel Total Sunspots by Year
15000
10000
5000
0
Spots
2010.0
2012.5
2015.0
2017.5
Year


Kanzel Total Sunspot Groups by Year
2000
1500
1000
500
0
Group
2010.0
2012.5
2015.0
2017.5
Year


Histogram of Sunspot Groups by Year: 2009 − 2019
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Total Groups
Year by Year


Histogram of Total Sunspots by Year: 2009 − 2019
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Total Spots
Year by Year

```
## Disabling daily seasonality. Run prophet with daily.seasonality=TRUE to override this.
```

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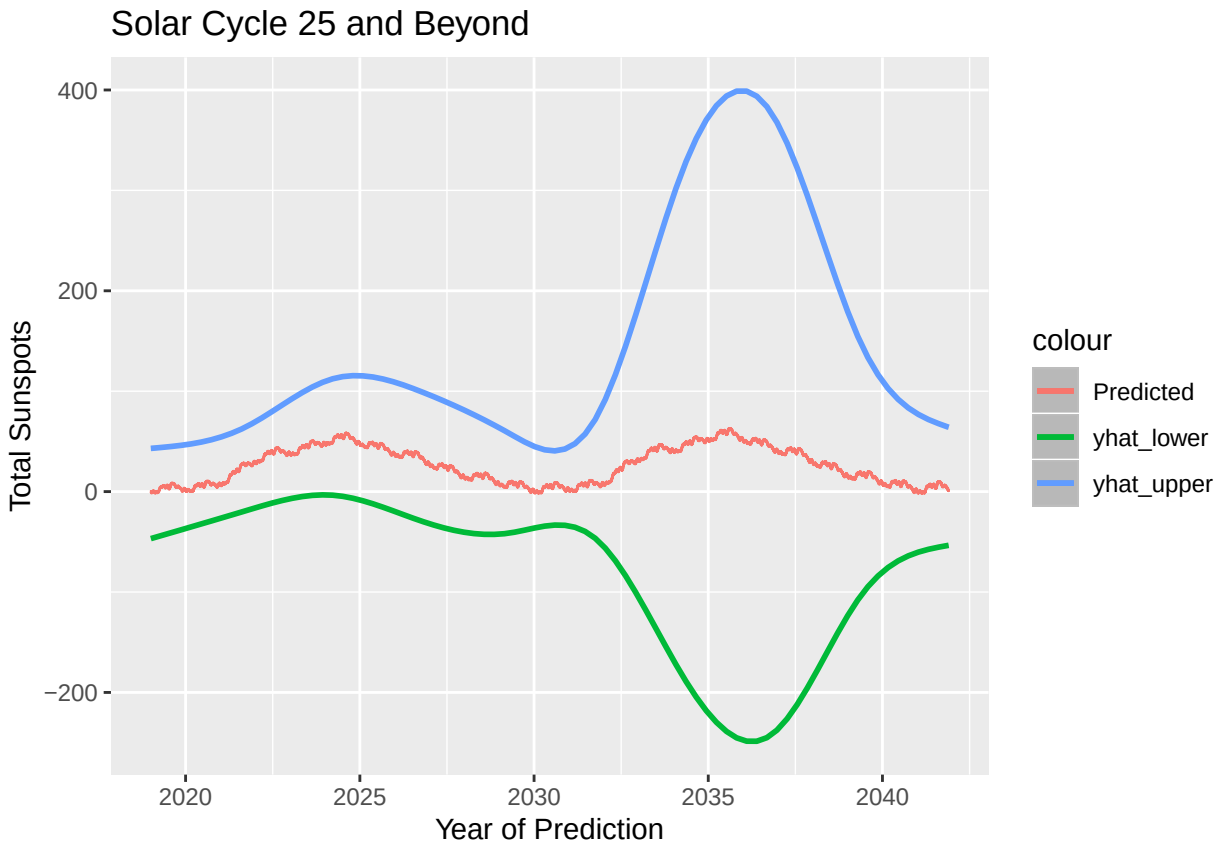
Solar Cycle 25 and Beyond
Total Sunspots
400
200
0
−200
2020
2025
2030
2035
2040
Year of Prediction
colour
Predicted
yhat_lower
yhat_upper