SAN DIEGO STATE UNIVERSITY

Adventures in Bayesian Structural Time Series

Part 4: Analyzing SST Data With Regression

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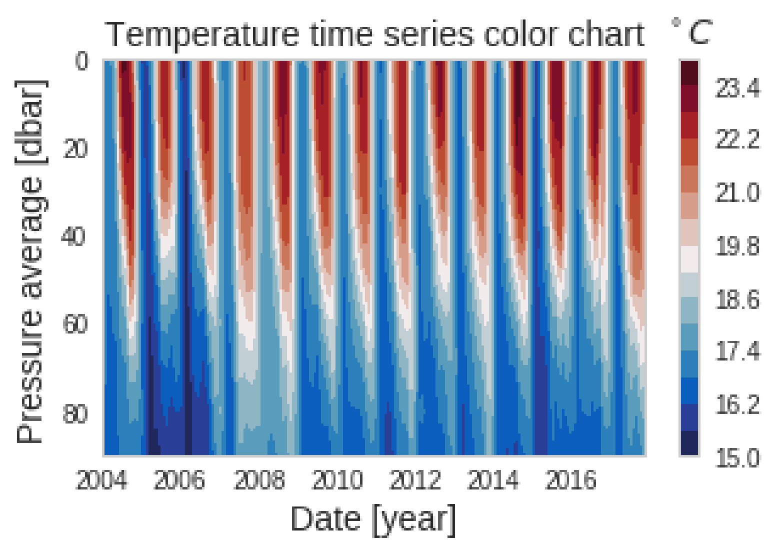
Outline

- SST data with covariates
- Use `bsts` to
  - Fit structural model with regression
  - Regression posterior
  - Forecast
  - Custom regresson prior

SST Data

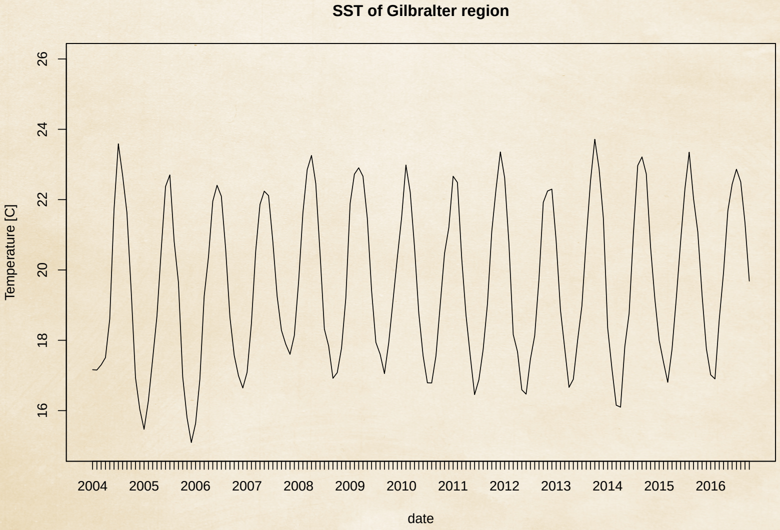
- Sea Surface Temperature near Gibraltar
- Aggregated monthly
- January 2004 to November 2017
- Covariates: depth at 10, 20, ..., 90 meters

SST Data



Temperature time series color chart
°C
Pressure average [dbar]
0
20
40
60
80
2004
2006
2008
2010
2012
2014
2016
Date [year]
23.4
22.2
21.0
19.8
18.6
17.4
16.2
15.0

SST Data



SST of Gilbralter region
Temperature [C]
16
18
20
22
24
26
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
date

Setup

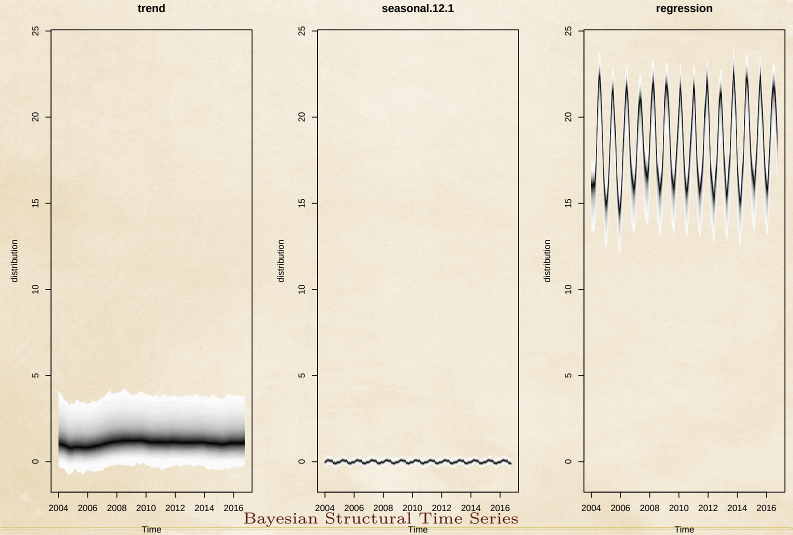
```r
library(readr)
library(bsts)

gib <- read_csv("data/gilbralter_time_series_r.csv",
                col_types = cols(startDate = col_skip(),
                                 timeIdx = col_skip()))
names(gib) <- c('SST', '10', '20', '30', '40',
                      '50', '60', '70', '80', '90')
gib <- zooreg(gibraltar, start = c(2004, 1, 1),
              end = c(2017, 11, 29),
              frequency = 12)
```

Model Fitting

```r
ss <- AddLocalLinearTrend(list(), gib$SST)
ss <- AddSeasonal(ss, gib$SST, nseasons = 12)
model1 <- bsts(SST ~., state.specification = ss,
                data = gib, niter = 1000, ping = 0)
```

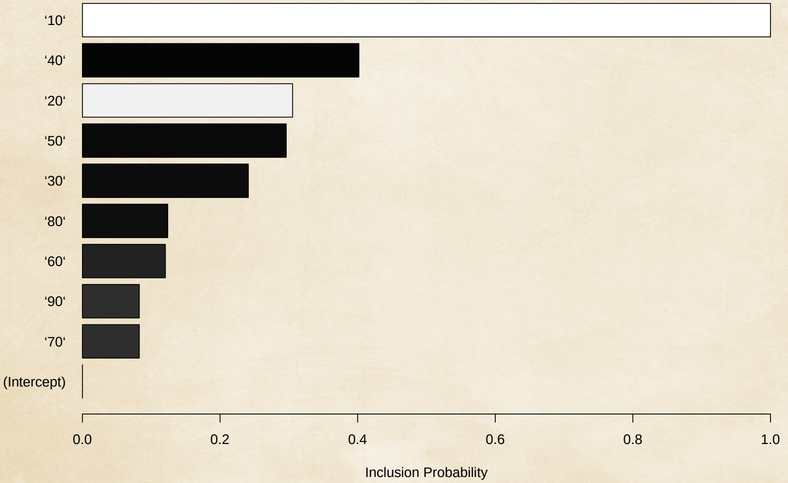
Model Plotting

```
plot(model1, 'components')
```



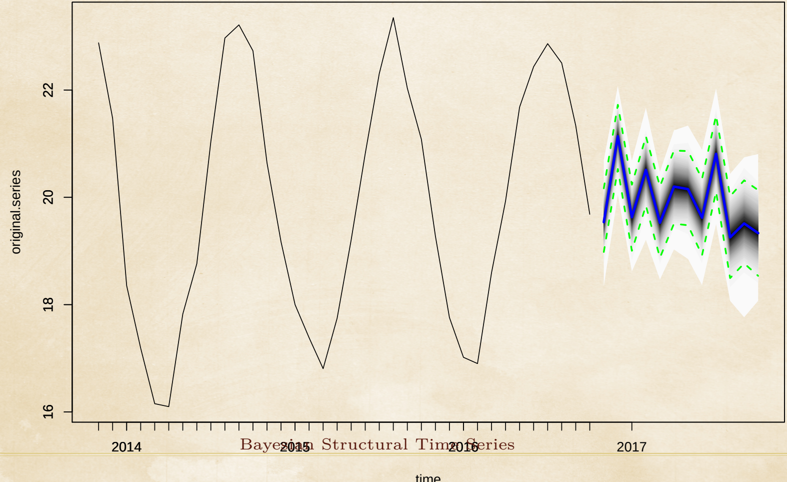
Model Plotting

```
plot(model1, 'coefficients')
```



Forecasting

```
model1_pred <- predict(model1, newdata = newdata,
                       horizon = 12)
plot(model1_pred, plot.original = 36)
```

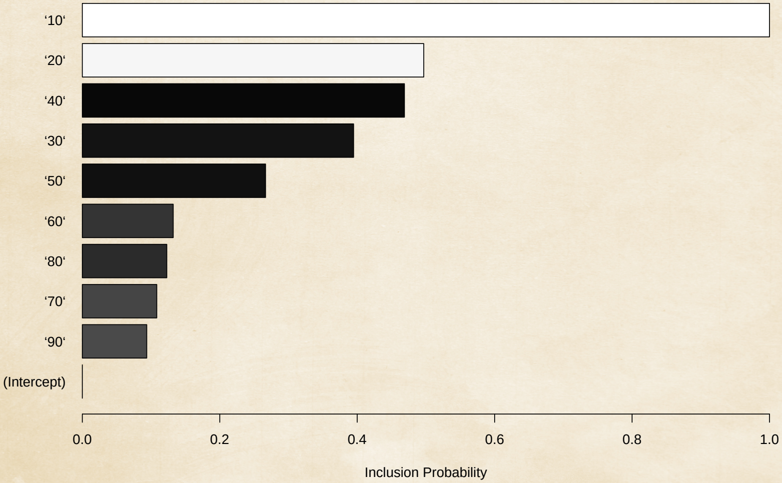


Custom Regression Prior

```
model2 <- bsts(SST ~., state.specification = ss,
               data = gib, niter = 1000, ping = 0,
               expected.model.size = 2)
```

Custom Regression Prior

```
plot(model2, 'coefficients')
```



```
model3 <- bsts(SST ~., state.specification = ss,
               data = gib, niter = 1000, ping = 0,
               prior.inclusion.probabilities =
                 c(0.01, 0.5, 0.3, 0.3, 0.1, 0.1,
                   0.1, 0.1, 0.1, 0.1))
```

Custom Regression Prior

```r
plot(model3, 'coefficients')
```