Report_7

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Data

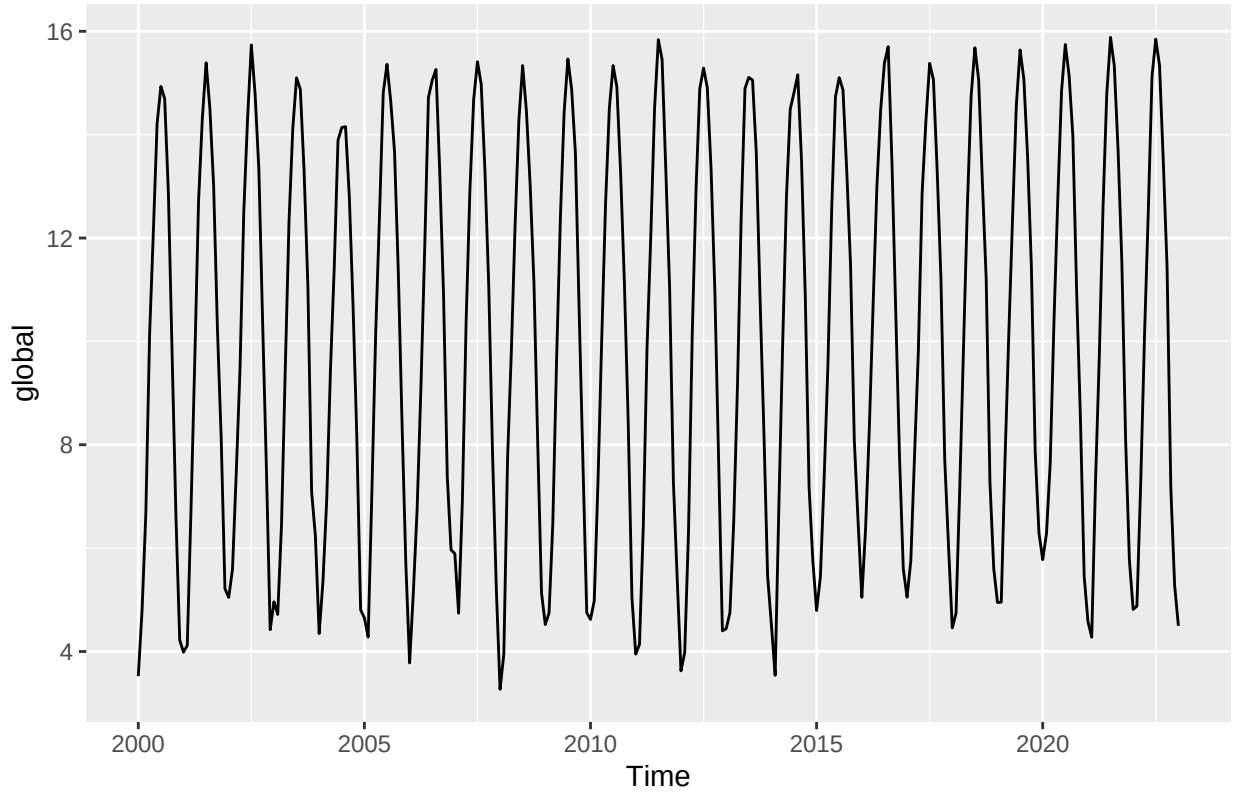
```
GLOBALTEMPERATURE = read.csv(file = "C:\\Users/ss/Desktop/Time_series_Analysis/MyGlobalTemperetures.csv
global_temp = ts(GLOBALTEMPERATURE[,1], start = c(1850, 1), frequency = 12)
northern_temp = ts(GLOBALTEMPERATURE[,2], start = c(1850, 1), frequency = 12)
southern_temp = ts(GLOBALTEMPERATURE[,3], start = c(1850, 1), frequency = 12)
Regional_temp = read.csv(file = "C:/Users/ss/Desktop/Time_series_Analysis/Regional_temperetures_data.csv
Africa_temp = ts(Regional_temp[, 2], start = c(1850, 1), frequency = 12)
Europe_temp = ts(Regional_temp[, 3], start = c(1850, 1), frequency = 12)
MidlleEast_temp = ts(Regional_temp[, 4], start = c(1850, 1), frequency = 12)
NorthAmerica_temp = ts(Regional_temp[, 5], start = c(1850, 1), frequency = 12)
time = ts(Regional_temp[, 1], start = c(1850, 1), frequency = 12)
```

Plots

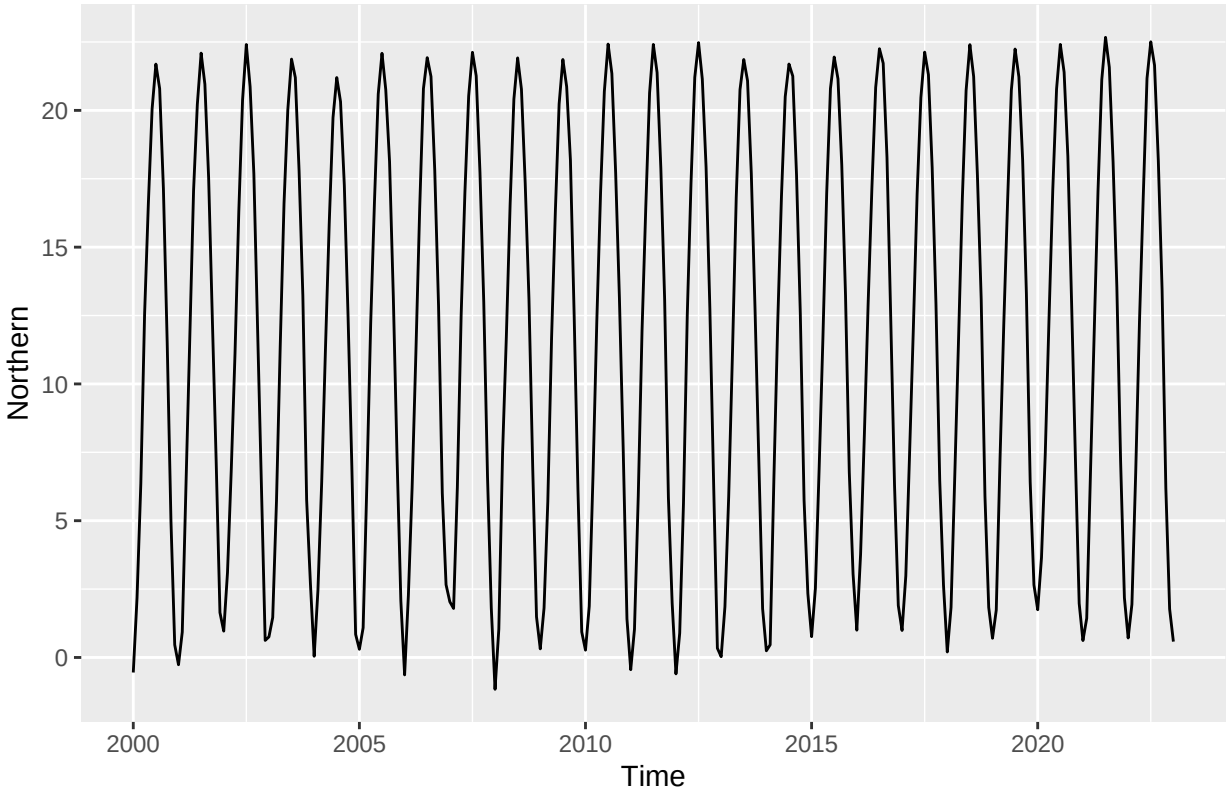
```
library(ggplot2)
library(gridExtra)
```

```
## Warning: package 'gridExtra' was built under R version 4.3.3
```

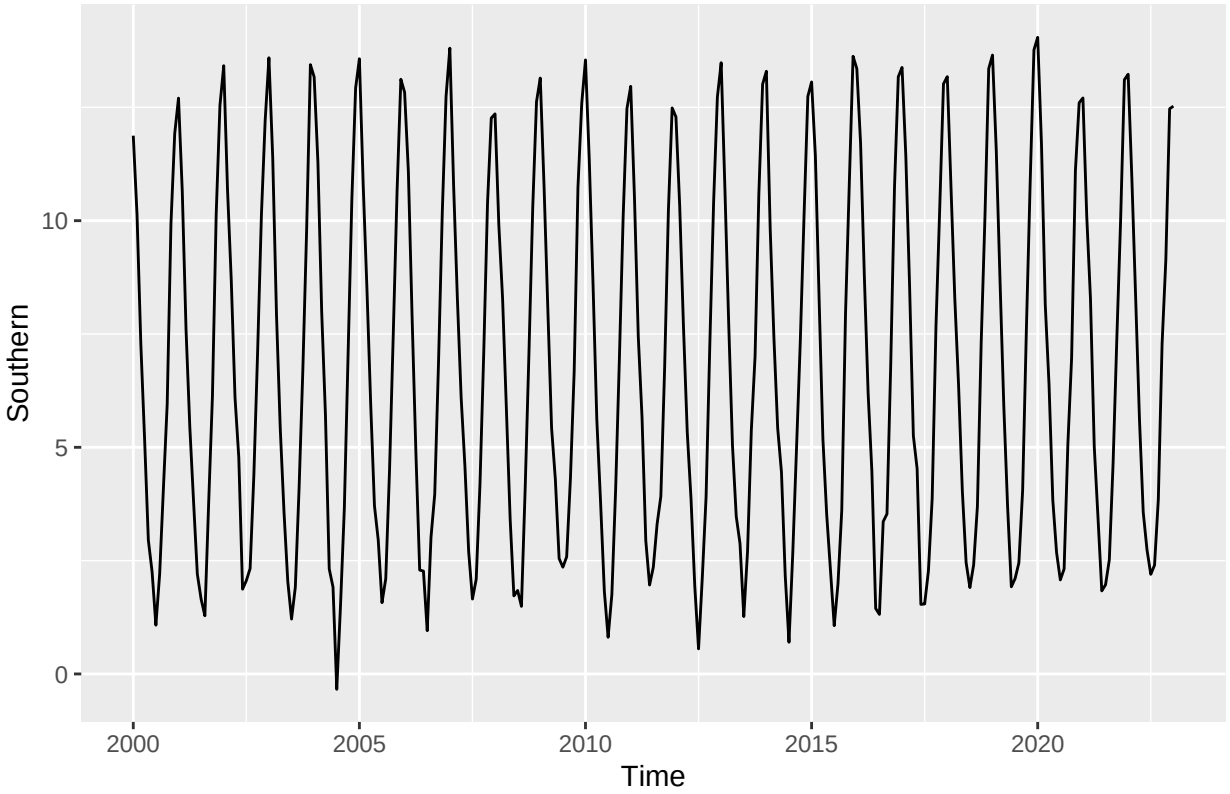
```
autoplot1 <- autoplot(window(global_temp, start = c(2000, 1), freq = 12), ylab = "global")

autoplot2 <- autoplot(window(northern_temp, start = c(2000, 1), freq = 12), ylab = "Northern")

autoplot3 <- autoplot(window(southern_temp, start = c(2000, 1), freq = 12), ylab = "Southern")

par(mfrow = c(1, 3))
plot(autoplot1)
```



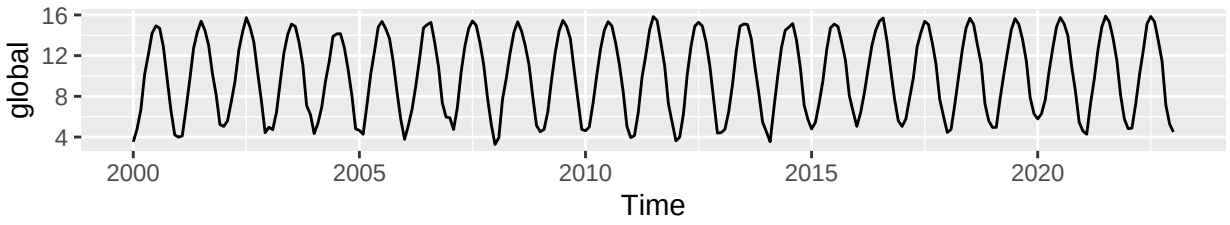

```
plot(autoplot2)
```

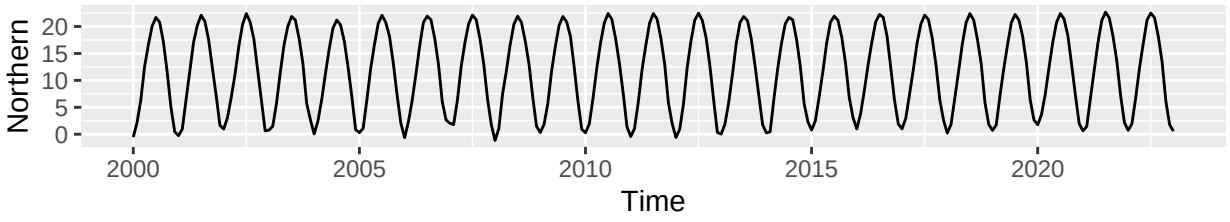


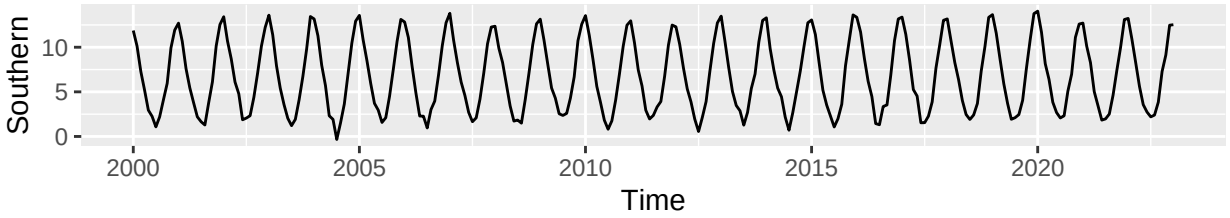

```
plot(autoplot3)
```




```
layout(matrix(c(1, 2, 3), nrow = 1))
grid.arrange(autoplot1, autoplot2, autoplot3)
```







Arima Fitting Function:

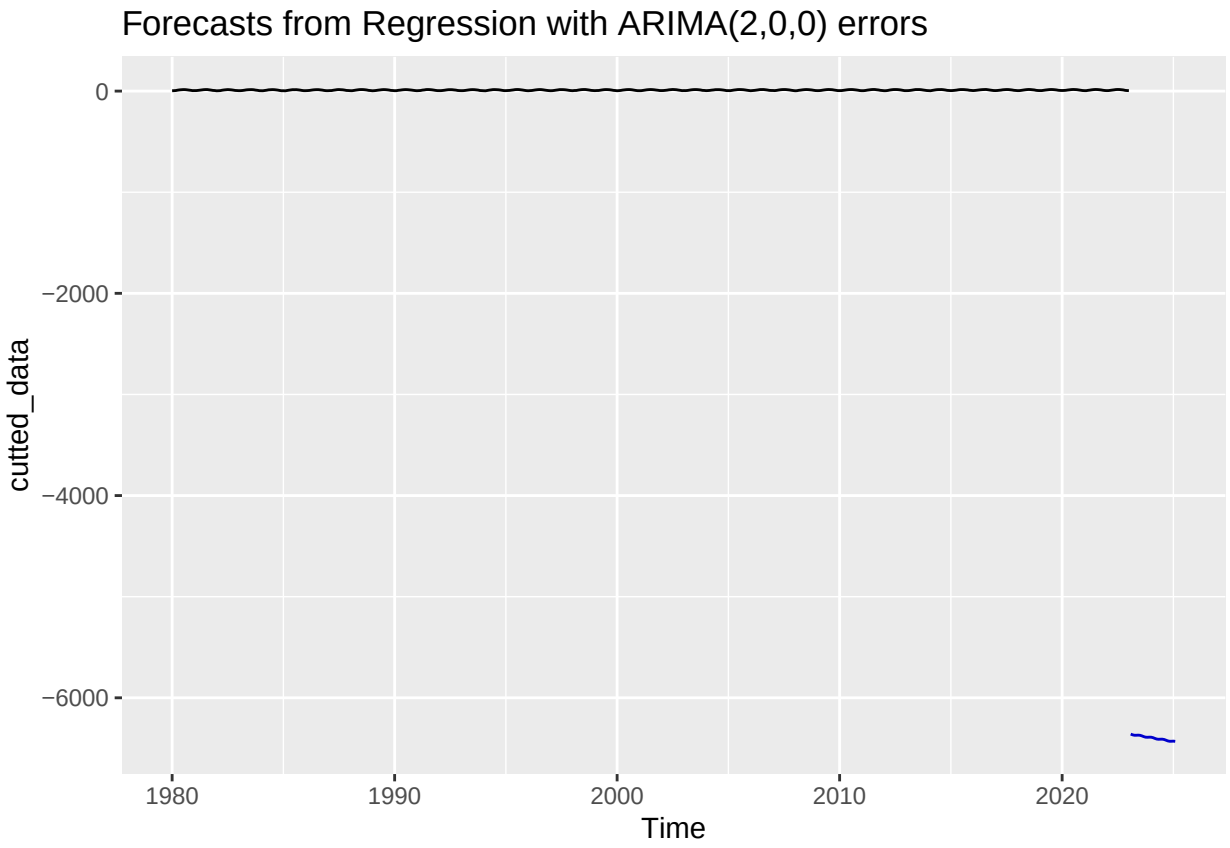
```
Arima_fittng <- function(timeseries, startingPoint = start(timeseries), endingPoint = end(timeseries)){
  cutted_data = window(timeseries, start = startingPoint, end = endingPoint, freq = 12)
  t = seq_along(cutted_data)
  regressors = cbind(sin(pi/6*t), cos(pi/6*t), t)
  arima_fit = auto.arima(cutted_data, xreg = regressors, approximation = FALSE, seasonal = TRUE)
  return(arima_fit)
}

global_fitting_sarima = Arima_fittng(global_temp, startingPoint = c(1980, 1))

summary(global_fitting_sarima)
```

```
## Series: cutted_data
## Regression with ARIMA(2,0,0) errors
##
## Coefficients:
##          ar1     ar2  intercept                          t
##       0.2333  0.1343     9.0796  -3.1481  -4.5257  0.0026
## s.e.  0.0435  0.0436     0.0644   0.0376   0.0376  0.0002
##
## sigma^2 = 0.2179:  log likelihood = -336.71
```

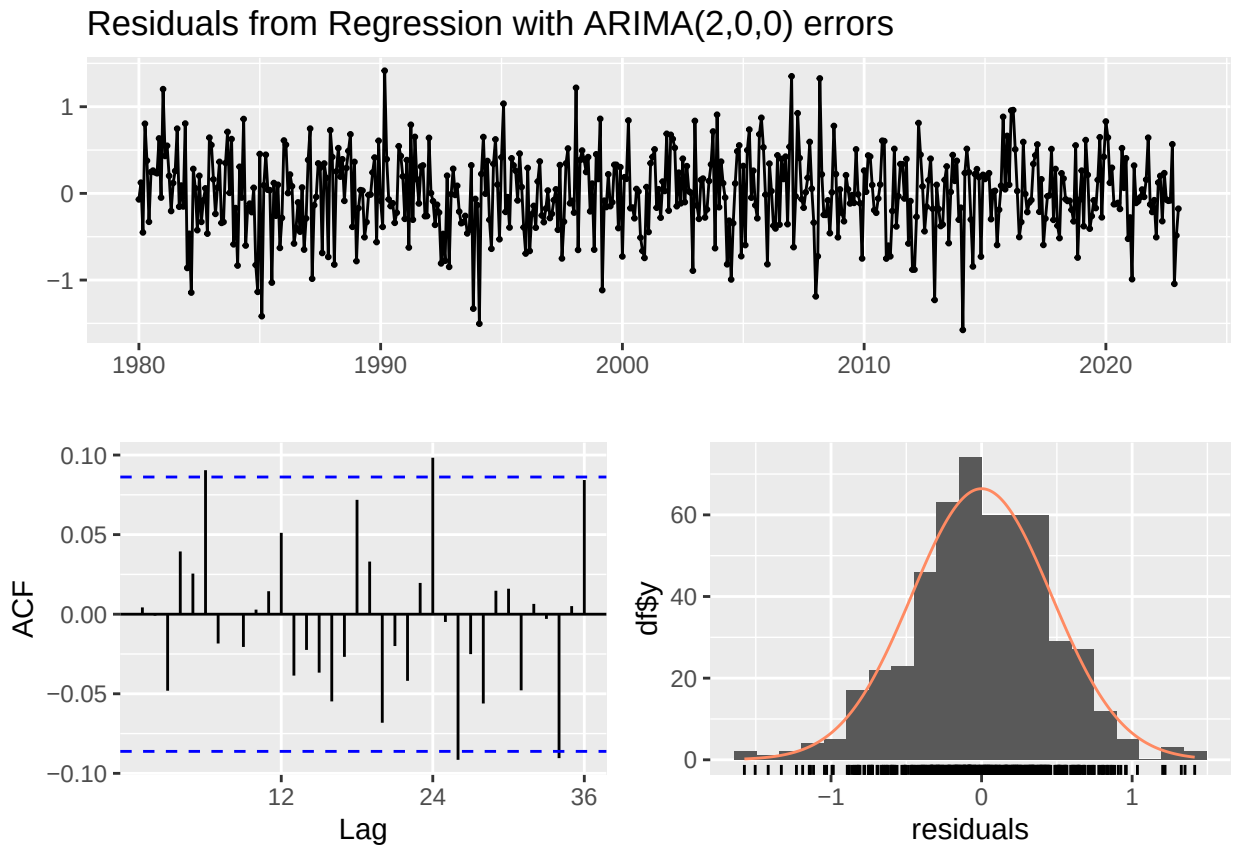
```
## AIC=687.43   AICc=687.65   BIC=717.16
##
## Training set error measures:
##                       ME      RMSE       MAE        MPE     MAPE      MASE
## Training set 3.873397e-05 0.4640496 0.3634273 -0.7169097 5.207208 0.6956044
##                     ACF1
## Training set 0.004266194
```

```
forecast_reg <- function(model, h){
  t_forecast = 2023:(2023+h)
  forecasting_regressors = cbind(t_forecast, sin(t_forecast), cos(t_forecast))
  model %>% forecast(xreg = forecasting_regressors) %>% autoplot() %>% return()
}

forecast_reg(global_fitting_sarima, 24)
```

```
## Warning in forecast.forecast_ARIMA(., xreg = forecasting_regressors): xreg
## contains different column names from the xreg used in training. Please check
## that the regressors are in the same order.
```




```
checkresiduals(global_fitting_sarima)
```

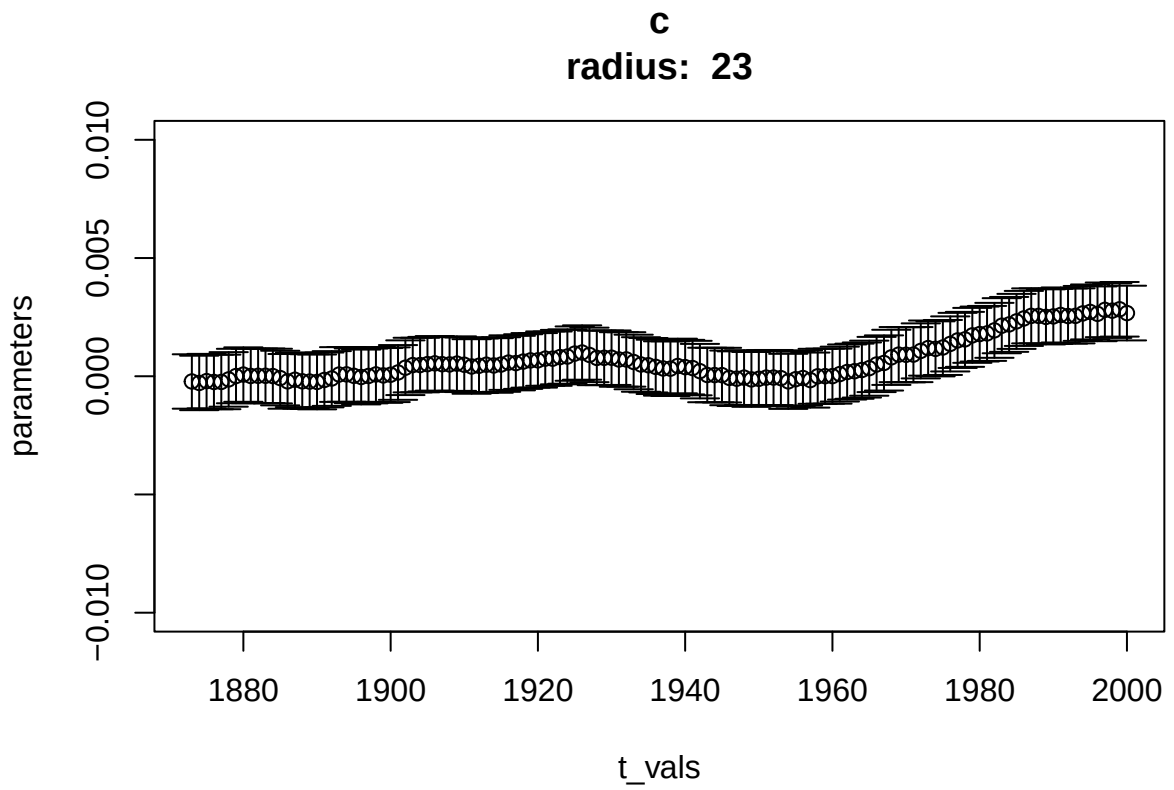



```
##
##  Ljung-Box test
##
## data:  Residuals from Regression with ARIMA(2,0,0) errors
## Q* = 24.865, df = 22, p-value = 0.3036
##
## Model df: 2.   Total lags used: 24
```

(Ar2- frequency?)

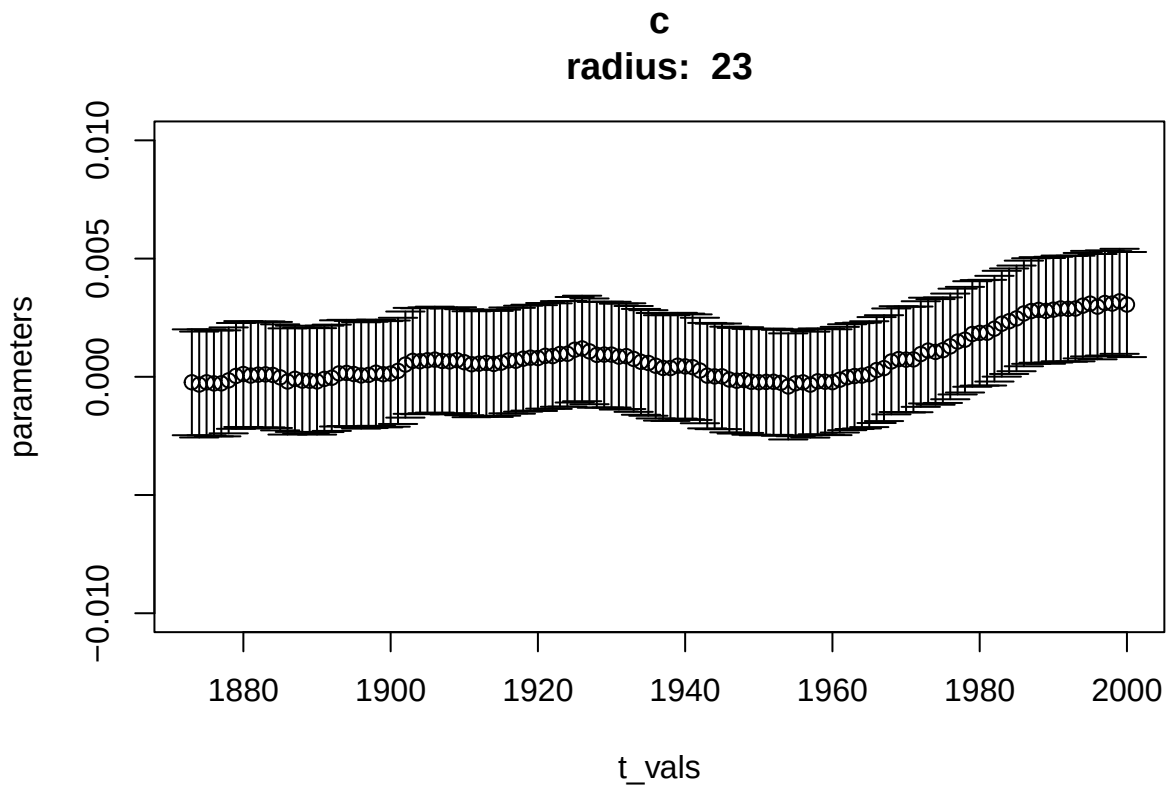
```
linear_coef <- function(DATA, x, Ord, sOrd, radius = 2){
  temporary_data = window(DATA, start = c(x-radius, 1), end = c(x+radius, 1))
  new_t <- seq_along(temporary_data)
  temporary_xreg = cbind(
    sin(new_t),
    cos(new_t),
    new_t
  )
  temporary_model = Arima(y = temporary_data, order = c(0, 0, 1), seasonal = c(0, 0, 0), xreg = tempora
  std_error <- sqrt(diag(vcov(temporary_model)))
  return(c(as.numeric(temporary_model$coef["new_t"]), as.numeric(sqrt(diag(vcov(temporary_model)))["new
}

plot_Global_warming <- function(timeseries){
  arima_fit = Arima_fittng(timeseries, startingPoint = c(1980, 1))
```

```
  ord = arima_fit$arma
  p = ord[1]; q = ord[2]; P = ord[3]; Q = ord[4]; period = ord[5]; d = ord[6]; D = ord[7];

  parameters =c()
  errors = c()
  rad = 23

  for (i in (1850 + rad):(2023 - rad)){
      u = linear_coef(timeseries,  i, c(p, d, q), c(P, D, Q) , rad)
      parameters <- cbind(parameters, u[1])
      errors <- cbind(errors, u[2])
  }

  t_vals = c((1850 + rad):(2023 - rad))

  MyPlot = (plot(t_vals, parameters, type='b', main=paste("c\nradius: ", toString(rad)), ylim = c(-0.01
    arrows(x0=t_vals, y0=parameters-errors, x1 = t_vals, y1=parameters+errors, code=3, angle = 90, leng

  return(list(arima_fit, parameters, errors, MyPlot))

}

Results_for_global = plot_Global_warming(global_temp)
```



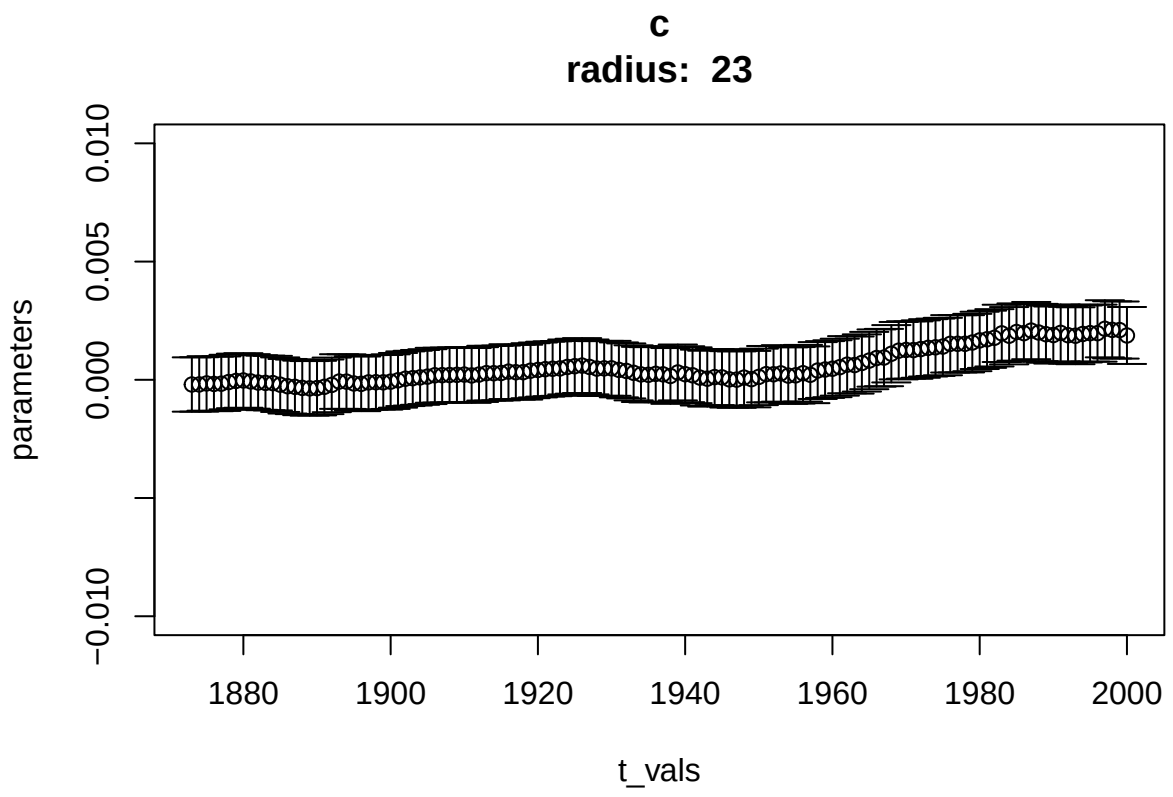
Northern Hemisphere

```
Results_for_northern = plot_Global_warming(northern_temp)
```



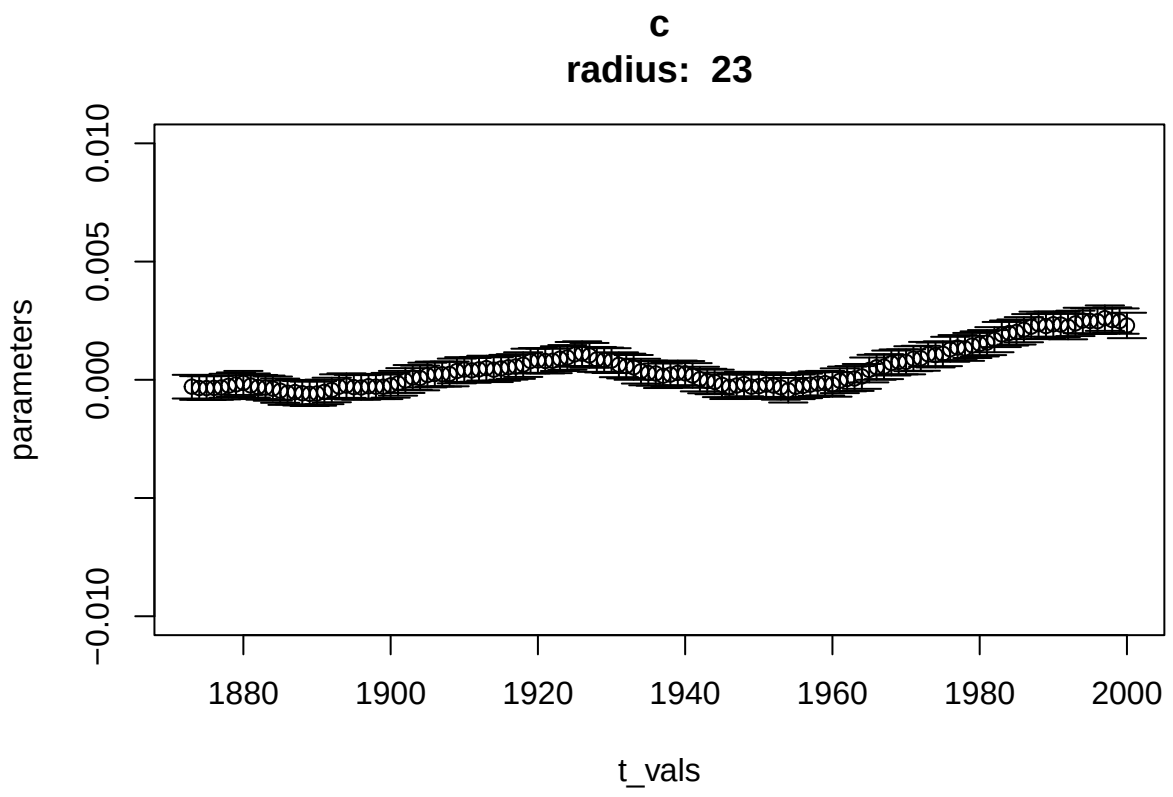
Southern Hemishpere

```
Results_for_southern = plot_Global_warming(southern_temp)
```



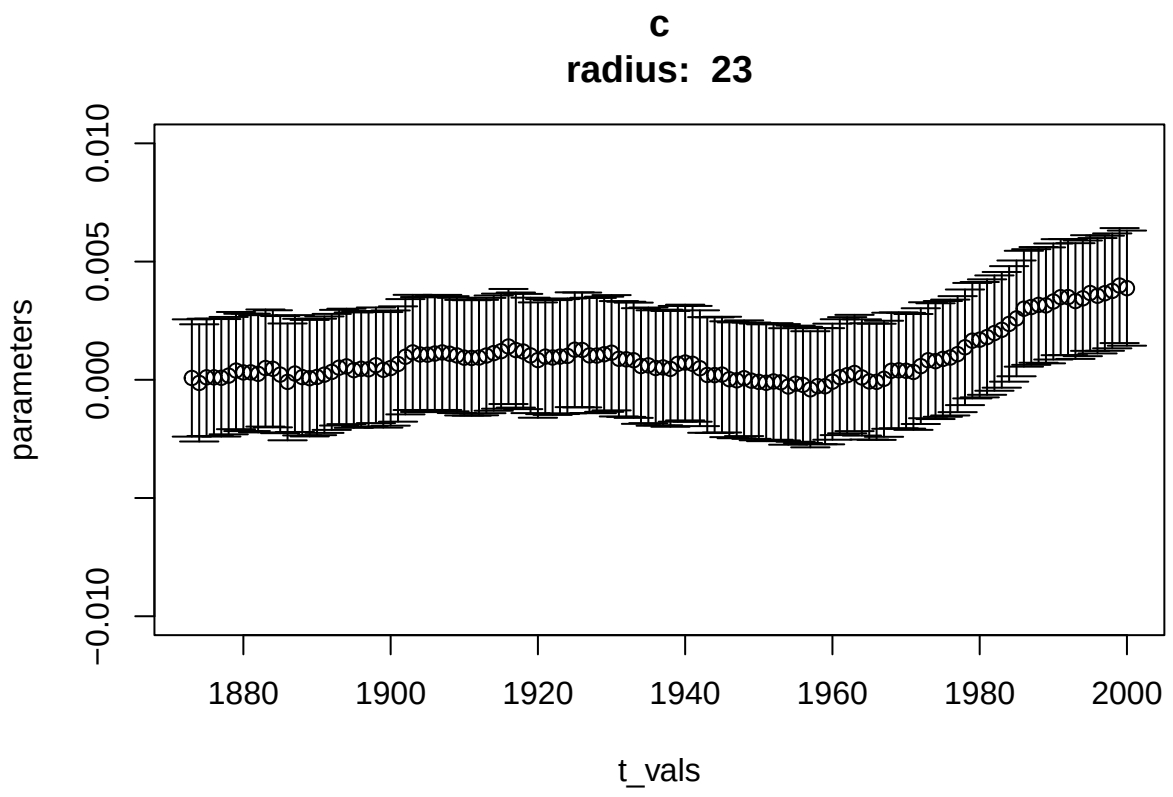
Africa

```
Results_for_Africa = plot_Global_warming(Africa_temp)
```



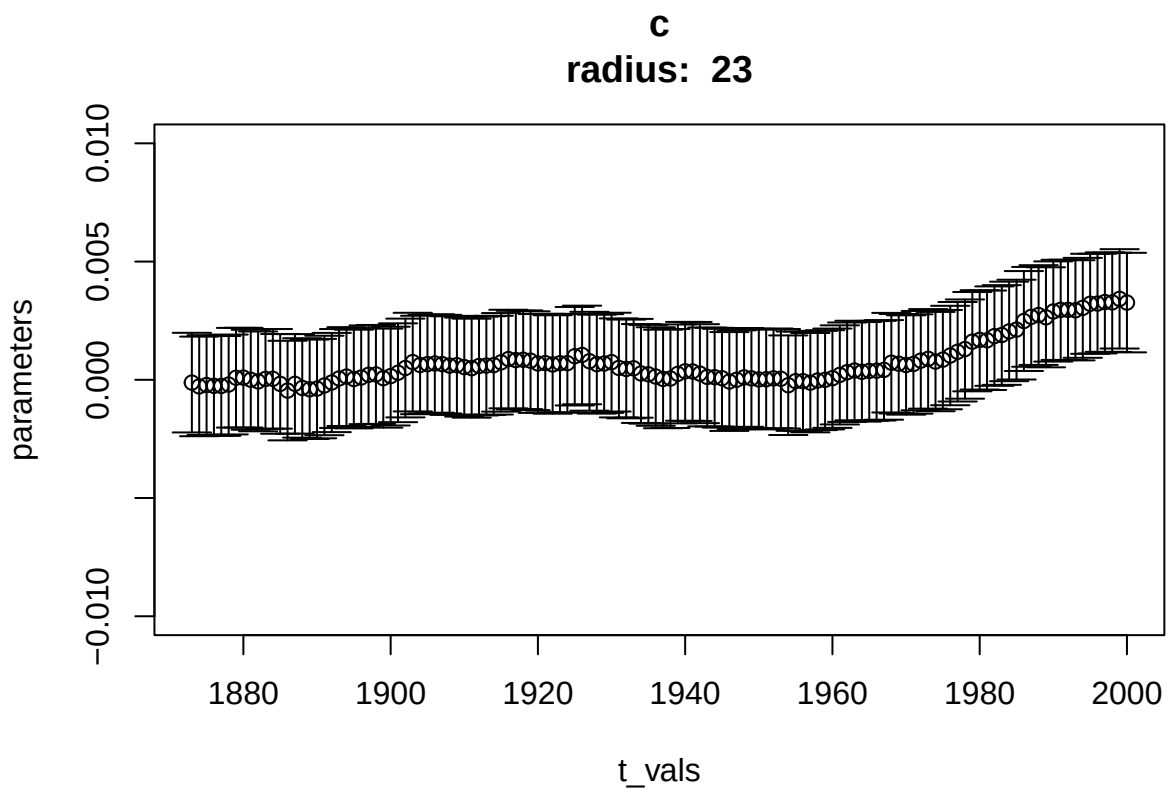
Europe

```
Results_for_Europe = plot_Global_warming(Europe_temp)
```



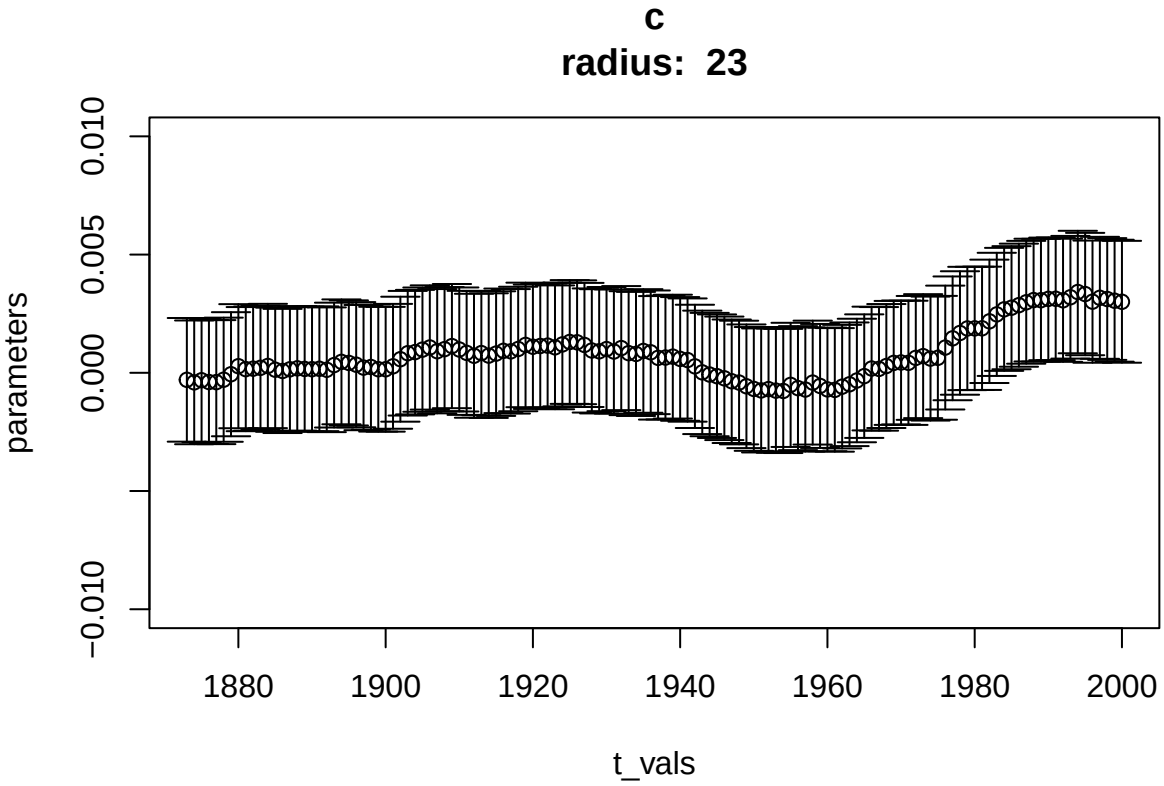
Middle East

```
Results_for_ME = plot_Global_warming(MidlleEast_temp)
```



North America

```
Results_for_NA = plot_Global_warming(NorthAmerica_temp)
```


c
radius: 23
parameters
0.010
0.005
0.000
−0.010
1880
1900
1920
1940
1960
1980
2000
t_vals