**require(INLA); setwd("C://R files")**

**# columns year, month, y**

**D <- read.table("arctic\_sea\_ice.txt",header=T)**

**y <- D$y**

**# extend data to include forecast horizon**

**f <- 12; D <- c(y,rep(NA,f))**

**n = length(D); m = n-1**

**# data for augmented structure**

**Y = matrix(NA, n+m, 2); Y[1:n,1] = D; Y[1:m + n,2] = 0**

**# model indices**

**i =c(1:n, 2:n) # T\_t**

**j = c(rep(NA,n), 1:m) # T\_{t-1}**

**wt1 = c(rep(NA,n), rep(-1,m)) # weights for j**

**l = c(rep(NA,n), 1:m) # \delta\_{t-1}**

**wt2 = c(rep(NA,n), rep(-1,m)) # weights for l**

**w1 = c(rep(NA,n), 2:n) # w\_{1,t}**

**q = c(1:n, rep(NA,m)) # S\_t**

**# model**

**formula = Y ~ f(q, model="seasonal", season.length=12,initial=4) +**

**f(l, wt2, model="rw1",initial=4, constr=F) +**

**f(i, model="iid", initial=-10, fixed=TRUE) + f(j, wt1, copy="i") + f(w1, model ="iid") -1**

**rsn = inla(formula, data = data.frame(i,j,wt1,l,wt2,q,w1),family = rep("sn",2),**

**quantiles=c(0.025, 0.05, 0.5, 0.95, 0.975),** **control.compute=list(graph=T, dic=T),**

**control.family = list(list(),list(initial=10, fixed=T)),control.predictor=list(compute=T))**

**rgn = inla(formula, data = data.frame(i,j,wt1,l,wt2,q,w1),family = rep("gaussian",2),**

**quantiles=c(0.025, 0.05, 0.5, 0.95, 0.975),** **control.compute=list(graph=T, dic=T),**

**control.family = list(list(),list(initial=10, fixed=T)),control.predictor=list(compute=T))**

**# Plot of Trend and Forecast Trend with 90%CI**

**rang <- range(rsn$summary.random$i[1:n, 4:8])**

**plot(rsn$summary.random$i[1:n,2], type="l",**

**ylim=rang, col="red", xlim=c(1,n),ylab="Ice Extent",xlab="Time (months from Jan 1979)")**

**lines(rsn$summary.random$i[1:n,5], col="blue", lty=3)**

**lines(rsn$summary.random$i[1:n,7], col="blue", lty=3)**

**legend("bottomleft",legend=c("posterior mean","90% CI"), col=c( "red","blue"),lty=c(1,1,2),bty="n")**

**title("Arctic Ice Cover 1979-2011 Underlying Trend")**

**# Plot of seasonal effect**

**rang <- range(rsn$summary.random$q[1:n, 4:8])**

**plot(rsn$summary.random$q[1:n,2], type="l",**

**ylim=rang, col="red", xlim=c(1,n),ylab="z",xlab="time")**

**lines(rsn$summary.random$q[1:n,5], col="blue", lty=3)**

**lines(rsn$summary.random$q[1:n,7], col="blue", lty=3)**

**legend("topleft",legend=c("observed","posterior mean","90% CI"), col=c("black", "red","blue"),lty=c(1,1,2),bty="n")**

**#title("Seasonal term")**