GDD10 Accumulated Monthly

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Accumulate gdd10 from the beginning to end of each month, and apply the model.

# Prepare the data  
# Make a list of input rasters  
in\_folder <- 'f:\\data\\rasters\\input\_rasters\\'  
raster\_names <- list('dem200m','cp200m','east200m','north200m','tpi5000m200m',  
 'asp200m','slp200m')  
ext = '.tif'  
rasters\_list <- lapply(X=paste0(in\_folder,raster\_names,ext),FUN=raster::raster)

## Warning in showSRID(SRS\_string, format = "PROJ", multiline = "NO", prefer\_proj  
## = prefer\_proj): Discarded datum NAD83 Canadian Spatial Reference System in Proj4  
## definition

#transform  
rasters\_list[[2]]<-rasters\_list[[2]]^0.5  
names(rasters\_list[[2]]) <- 'cp200m'  
rasters\_list[[6]] <- rasters\_list[[7]]\*cos(rasters\_list[[6]])  
names(rasters\_list[[6]]) <- 'asp200m'  
  
# brick rasters  
rasters\_brick2 <- raster::brick(rasters\_list)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer\_proj  
## = prefer\_proj): Discarded datum Unknown based on GRS80 ellipsoid in Proj4  
## definition

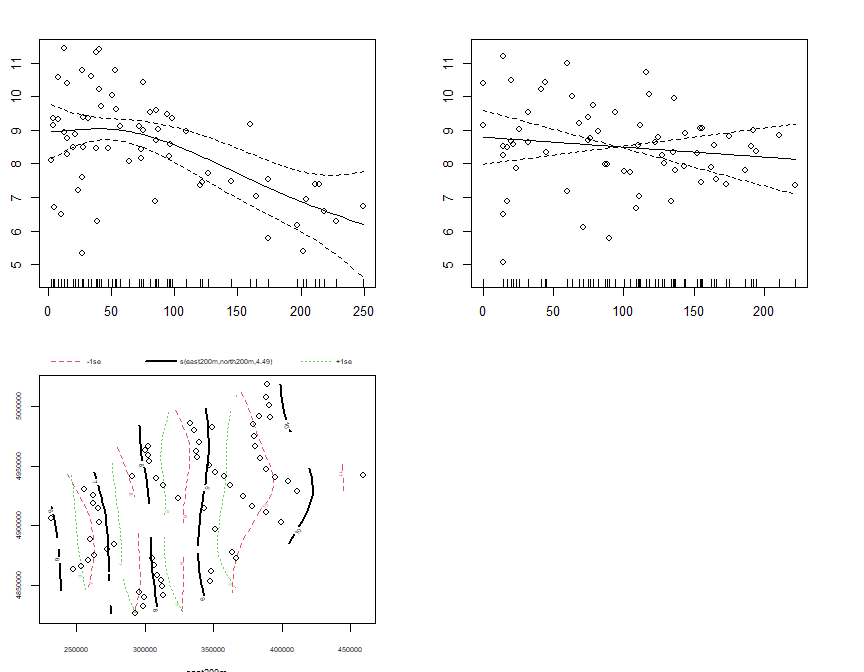
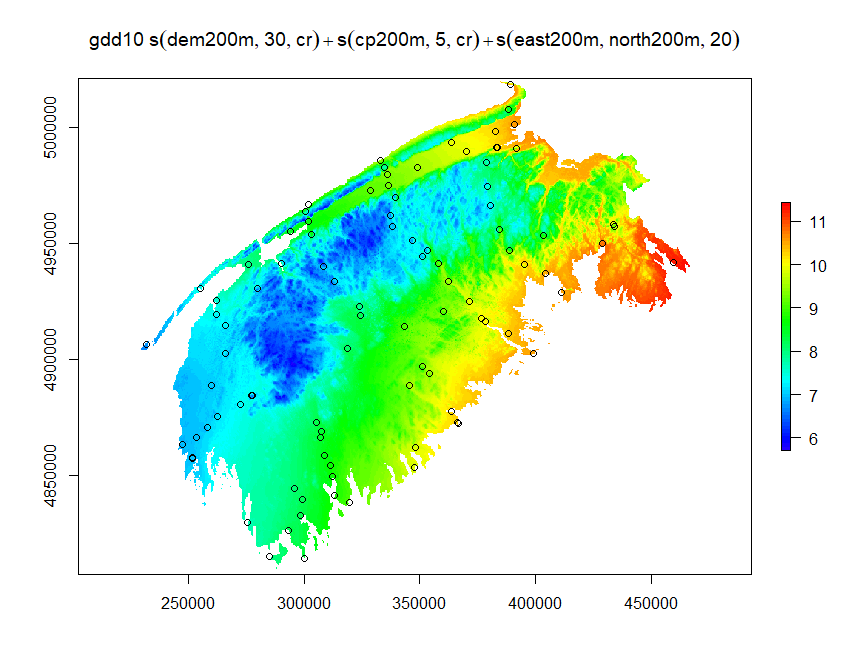
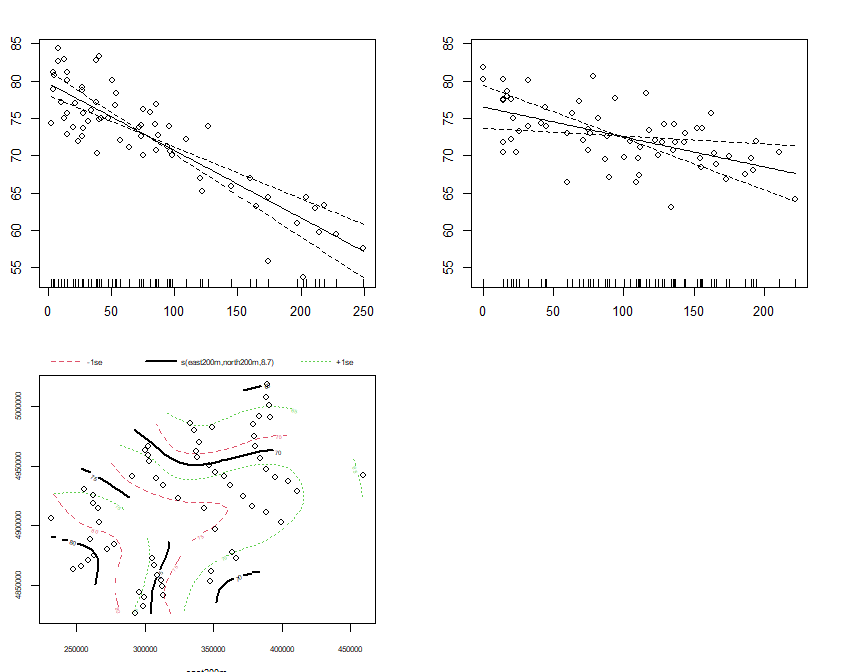
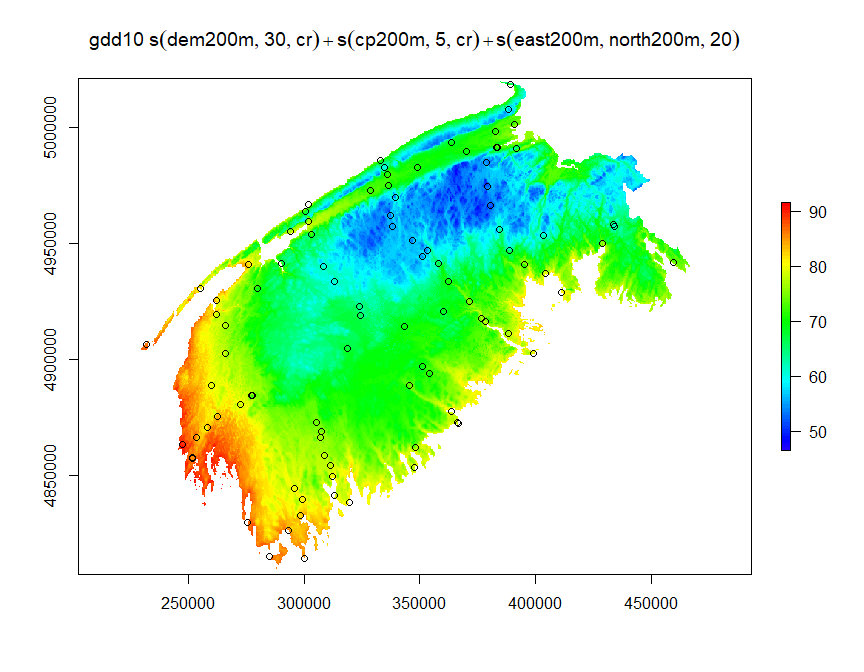
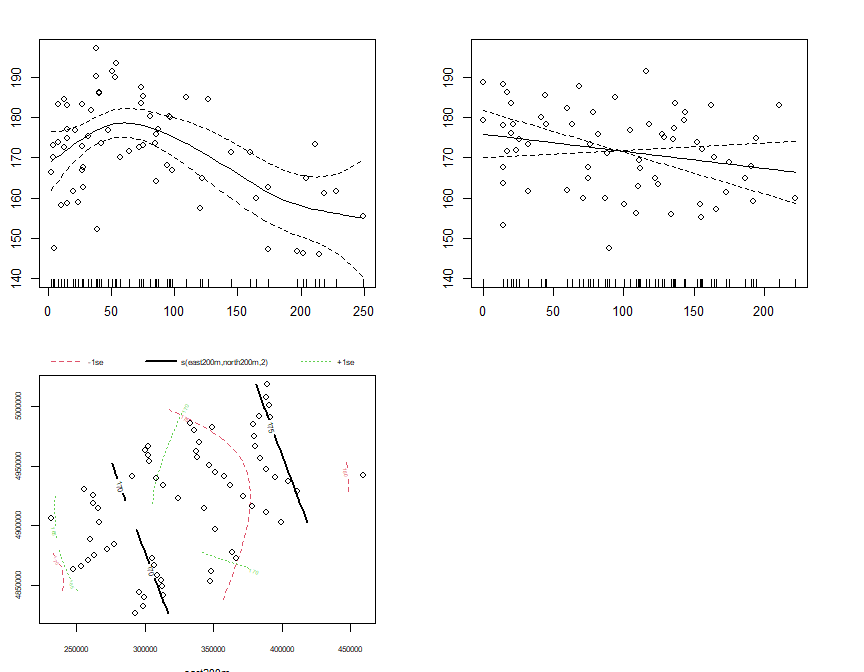
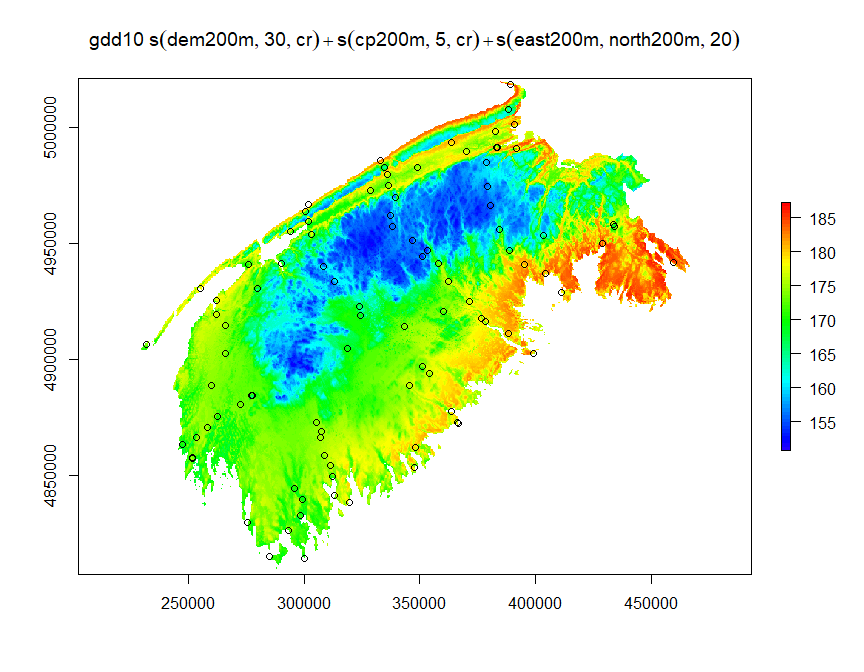
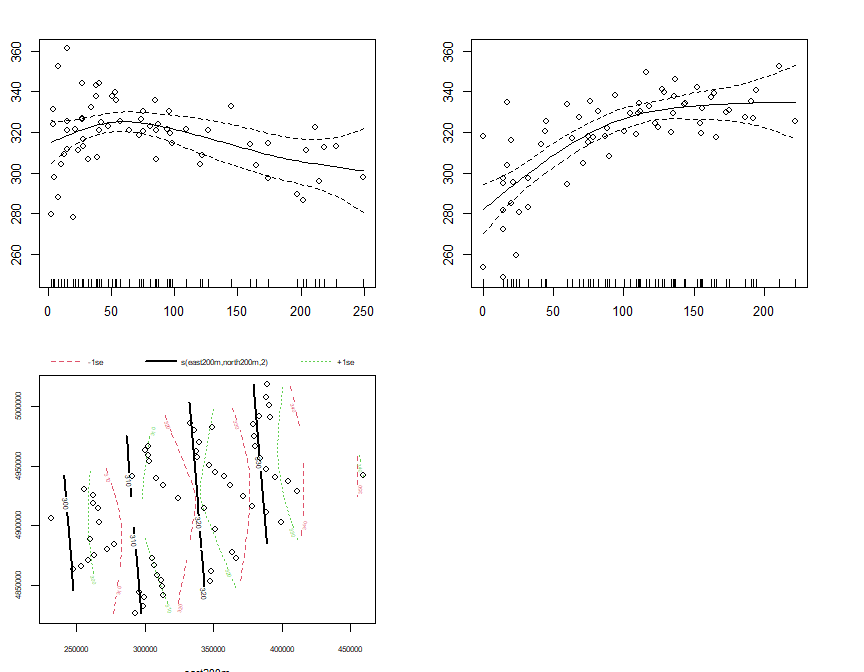
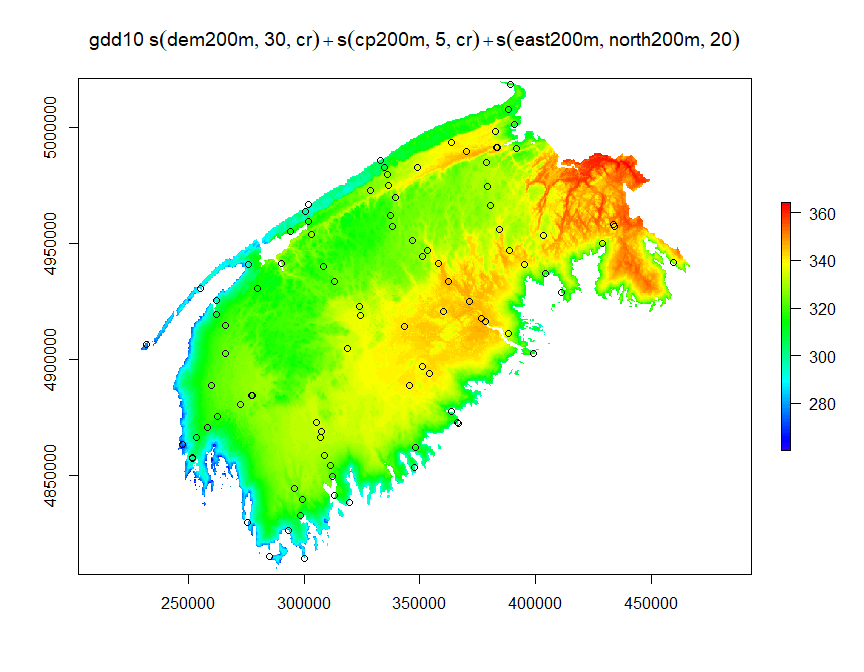
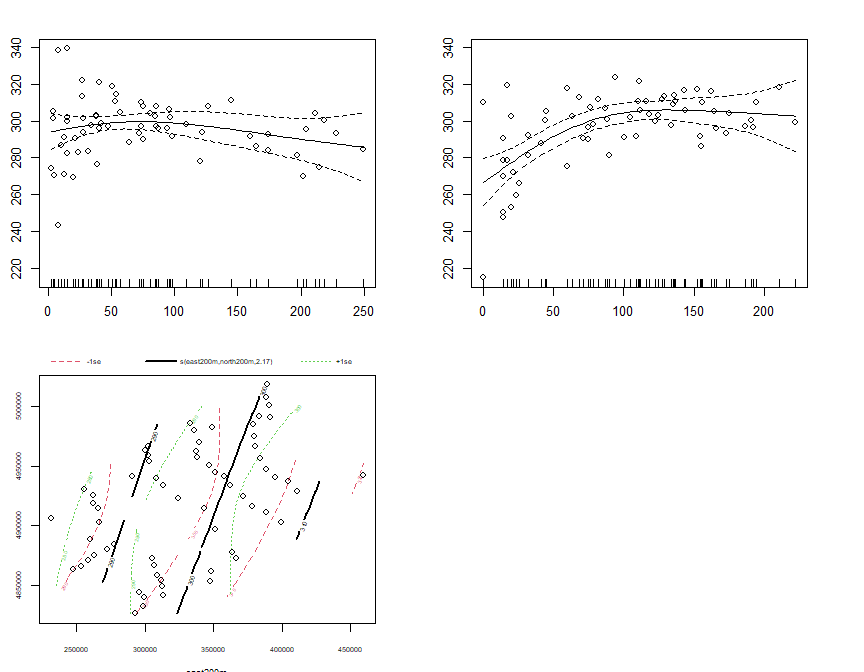
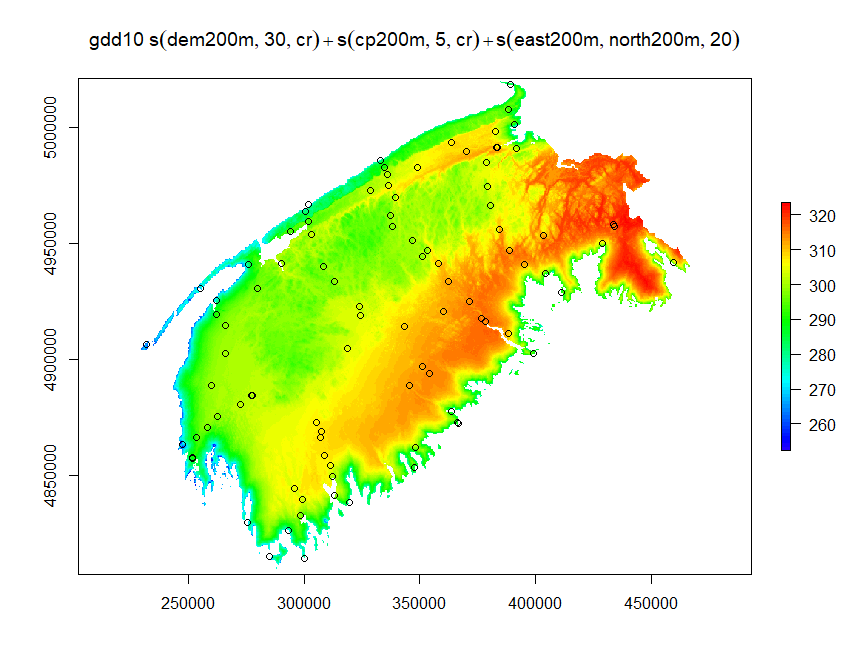
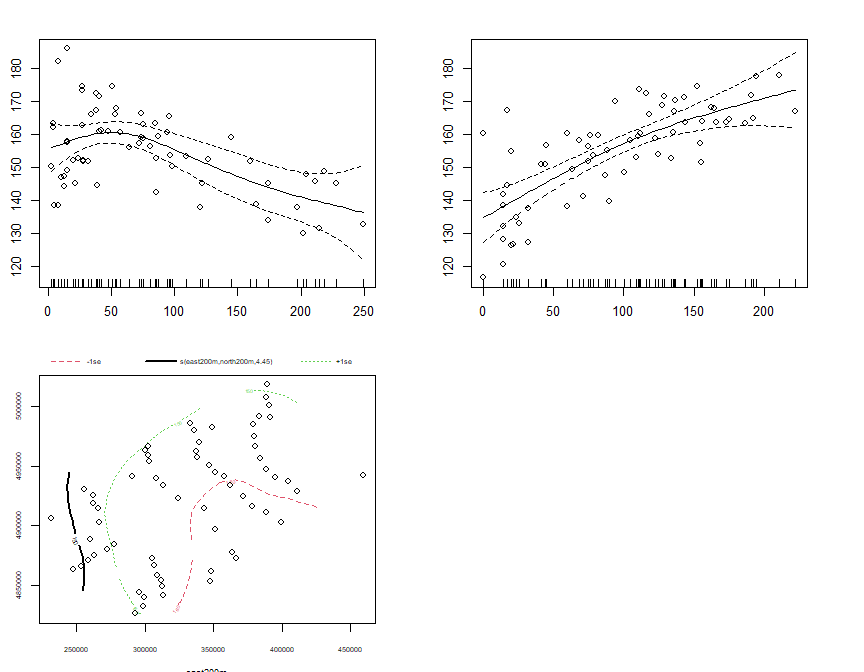
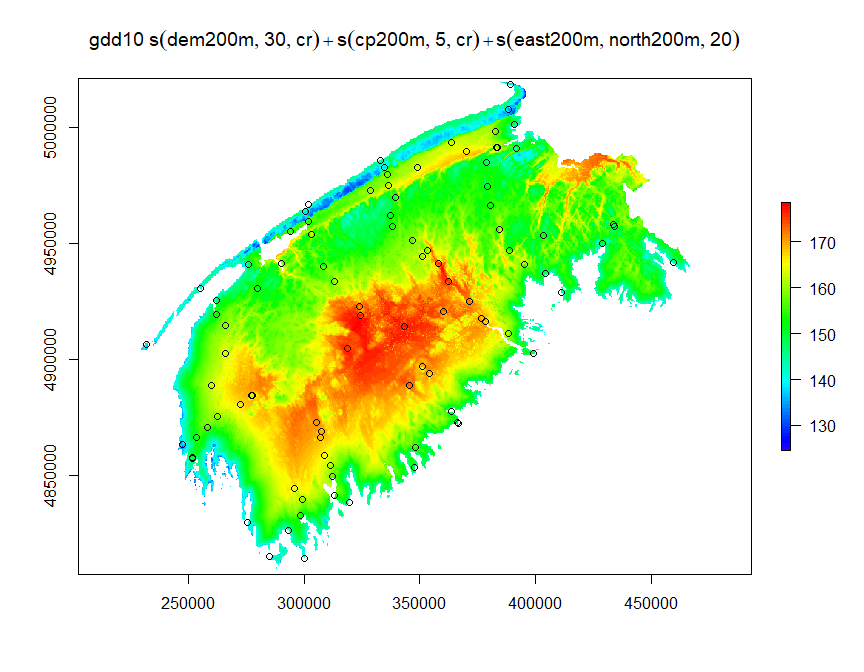
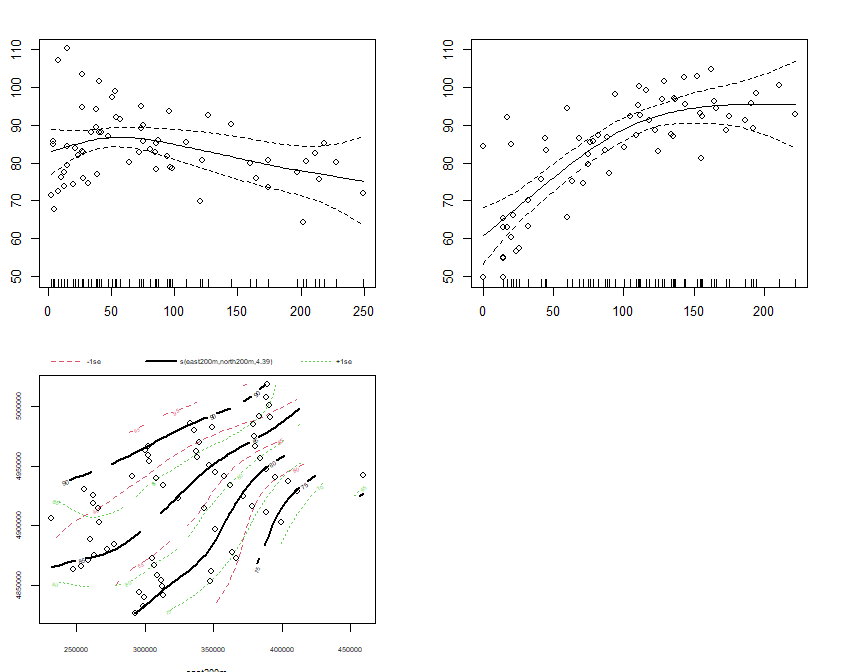
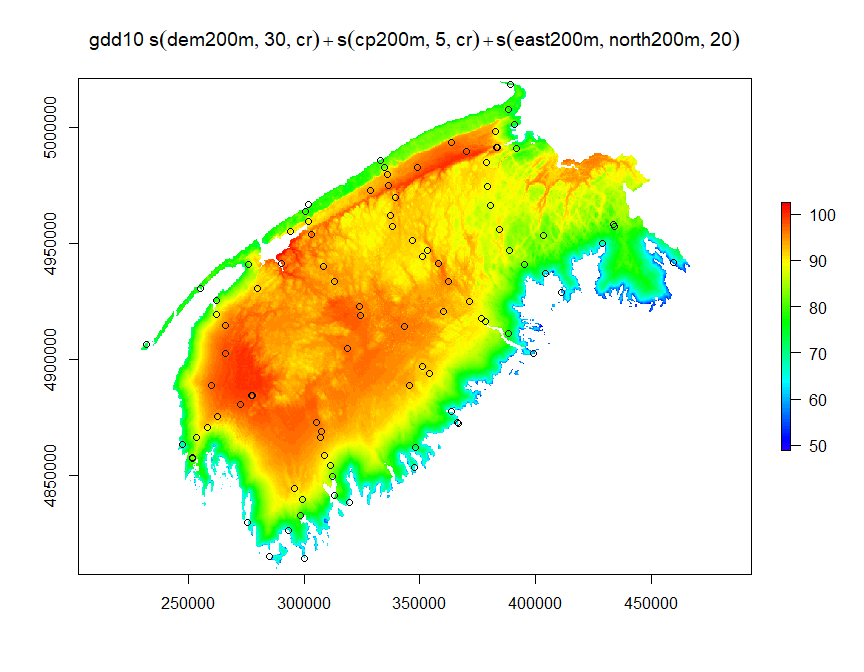
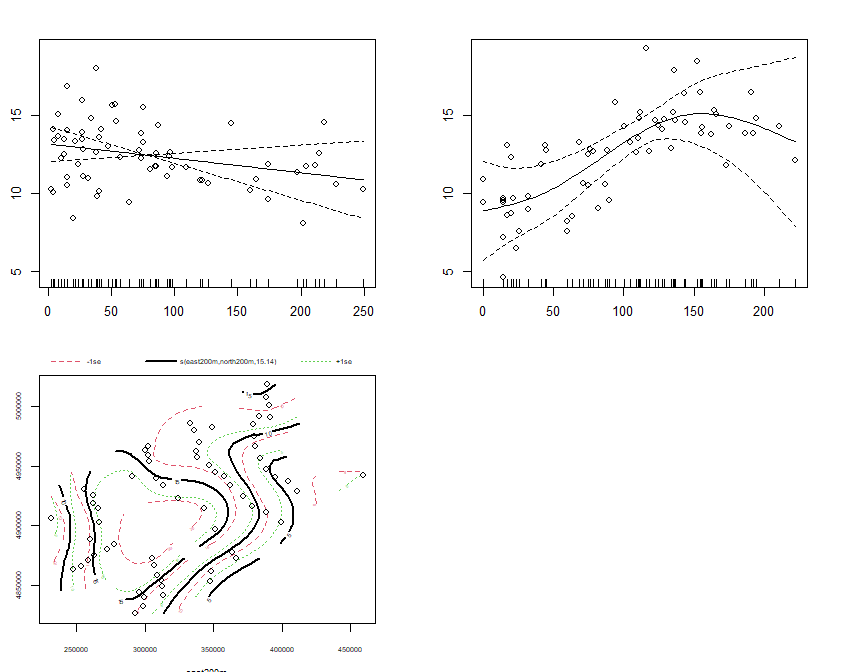
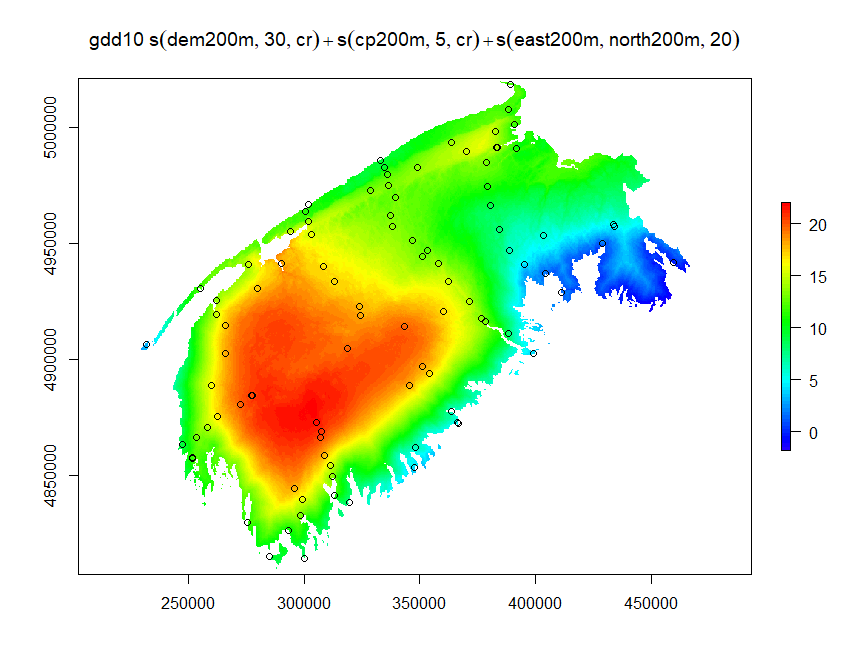
# extract rasters to dataframe  
stations\_df <- swns\_stations\_df %>% dplyr::select(date\_time,  
 stationid,  
 EASTING,  
 NORTHING,  
 temp\_min,  
 temp\_max)  
df\_in <- stations\_df %>%   
 dplyr::select(stationid,temp\_min,temp\_max,EASTING,NORTHING,date\_time) %>%  
 extract\_constant\_raster\_values(rasters\_list) %>% add\_date\_columns()

Create dataframe for each year

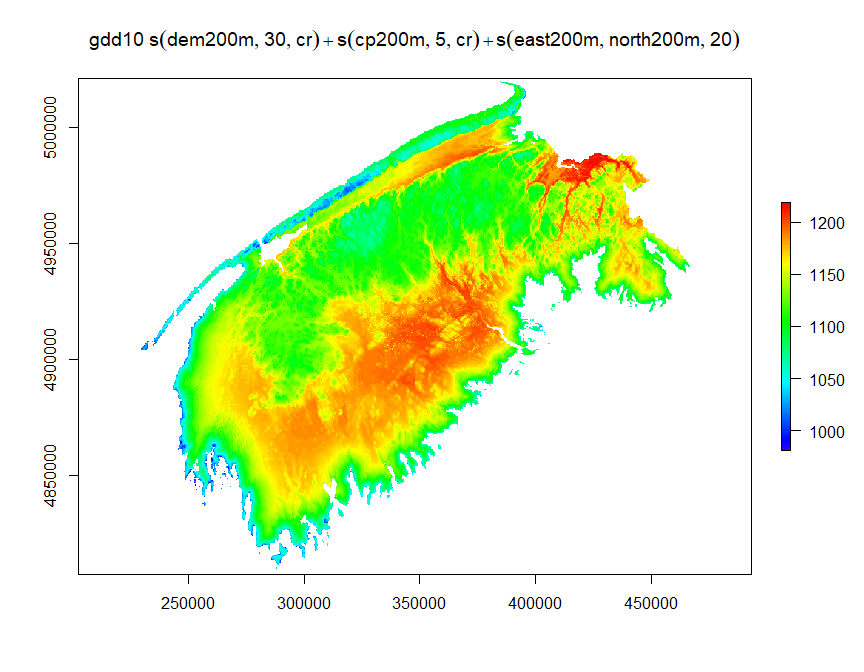
# calculate gdd10 in dataframe  
df <- df\_in %>% add\_date\_columns() %>%  
 # select(stationid,temp\_min,temp\_max,date\_time)%>%  
 mutate(temp\_mean=(temp\_min+temp\_max)/2)%>%  
 dplyr::filter(stationid %in% nscc\_stations\_list |  
 stationid == '47187' |  
 stationid == '6354')%>%  
 dplyr::filter(stationid!='S100') %>% # 2012  
 dplyr::filter(stationid!='S160') %>% # 2012, early in season/cold  
 dplyr::filter(stationid!='S20') %>% #2012  
 dplyr::filter(stationid != 'S60') %>% #2012  
 dplyr::filter(stationid != 'S80') %>% #2012  
 dplyr::filter(stationid != 'CL1') %>%  
 mutate(gdd10\_daily=ifelse(temp\_mean>10,temp\_mean-10,0)) %>%  
 group\_by(year,month,stationid) %>%  
 mutate(gdd10 = sum(gdd10\_daily, na.rm = TRUE))  
  
df\_12 <- df %>% dplyr::filter(year=='2012'&between(month,4,11)) %>%  
 group\_by(month)%>%  
 filter(yday==max(yday))  
  
df\_13 <- df %>% dplyr::filter(year=='2013'&between(month,4,11)) %>%  
 group\_by(month)%>%  
 filter(yday==max(yday))  
  
df\_14 <- df %>% dplyr::filter(year=='2014'&between(month,4,11)) %>%  
 group\_by(month)%>%  
 filter(yday==max(yday))  
  
df\_15 <- df %>% dplyr::filter(year=='2015'&between(month,4,11)) %>%  
 group\_by(month)%>%  
 filter(yday==max(yday))  
  
df\_16 <- df %>% dplyr::filter(year=='2016'&between(month,4,11)) %>%  
 group\_by(month)%>%  
 filter(yday==max(yday))

Model for each month of a year. 2012

w <- 1 # sum raster counter  
sum\_rasters <- list()  
months <- df\_12$month %>% unique()  
  
m\_list <- list()  
c = 1 # m counter  
for(month in months){  
 df\_month <- df\_12 %>% dplyr::filter(month== !!month)  
 m\_list[[c]] <- gam(gdd10~s(dem200m,k=30,bs='cr')+s(cp200m,k=5,bs='cr')+s(east200m,north200m,k=20),data=df\_month,method='REML',family=gaussian())  
 c <- c+1  
  
}  
gam\_rasters <- list()  
j <- 1   
for(m in m\_list){  
 gam\_rasters[[j]] <- raster::predict(rasters\_brick2,m)  
 plot(gam\_rasters[[j]], main=m$formula, col=rev(rainbow(100)[1:70]))  
 points(swns\_stations\_sp)  
 par(mfrow=c(2,2))  
 plot.gam(m, residuals = TRUE, pch = 1, cex = 1, shift = coef(m)[1])  
 par(mfrow=c(1,1))  
 j <- j + 1  
}



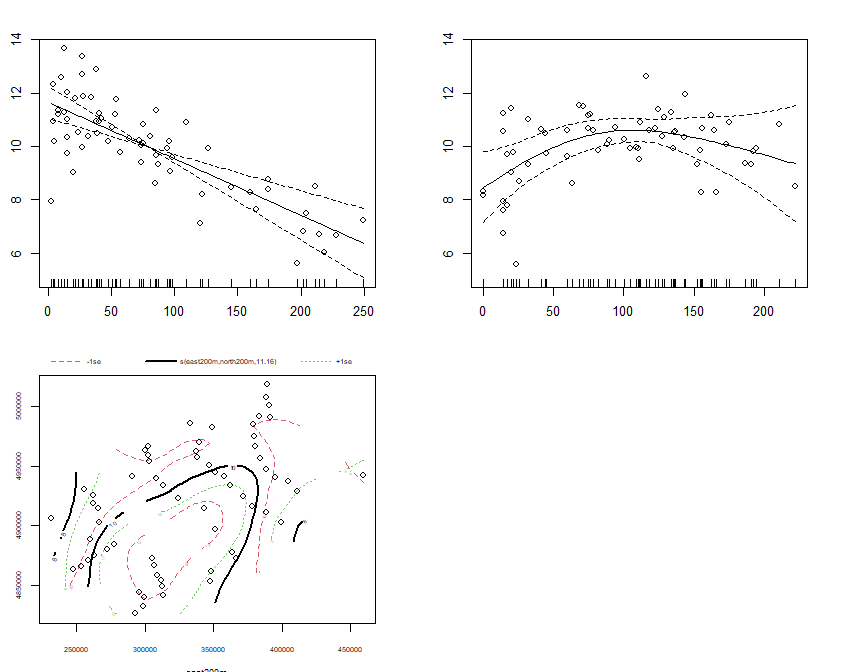
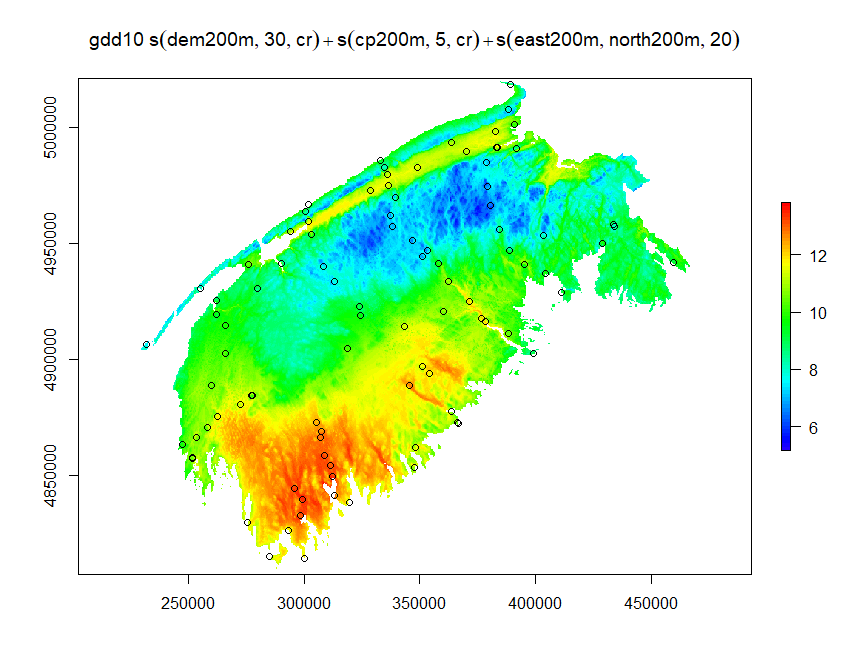
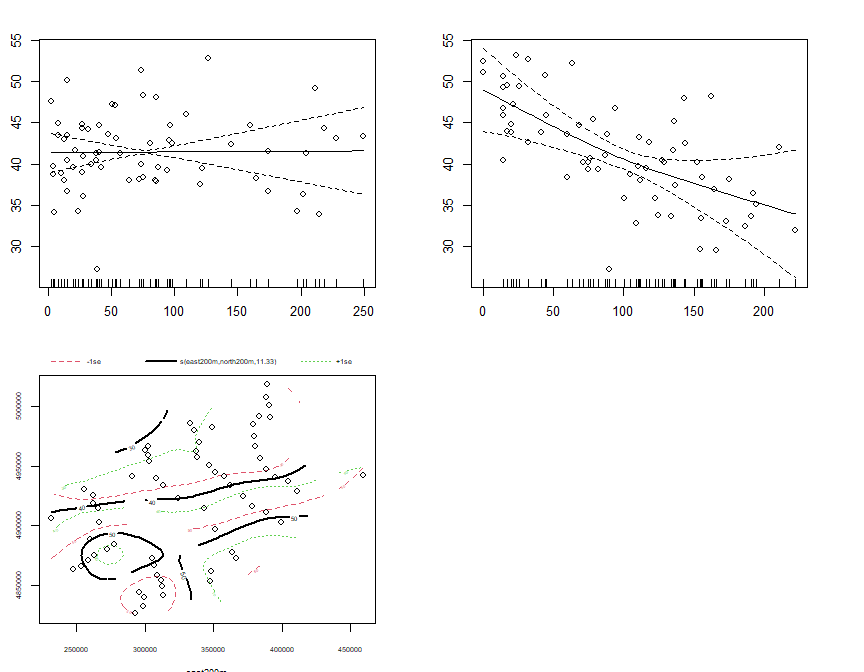
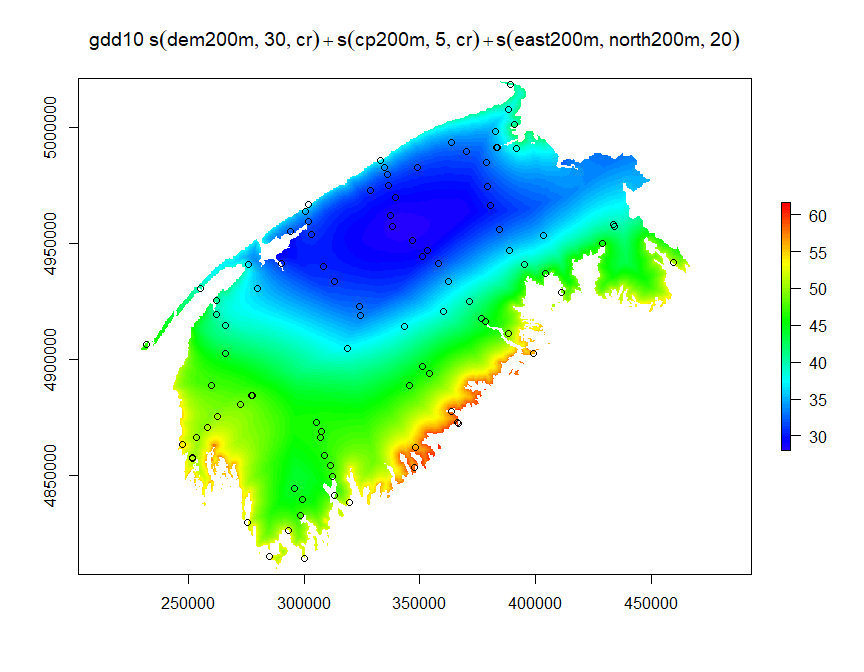
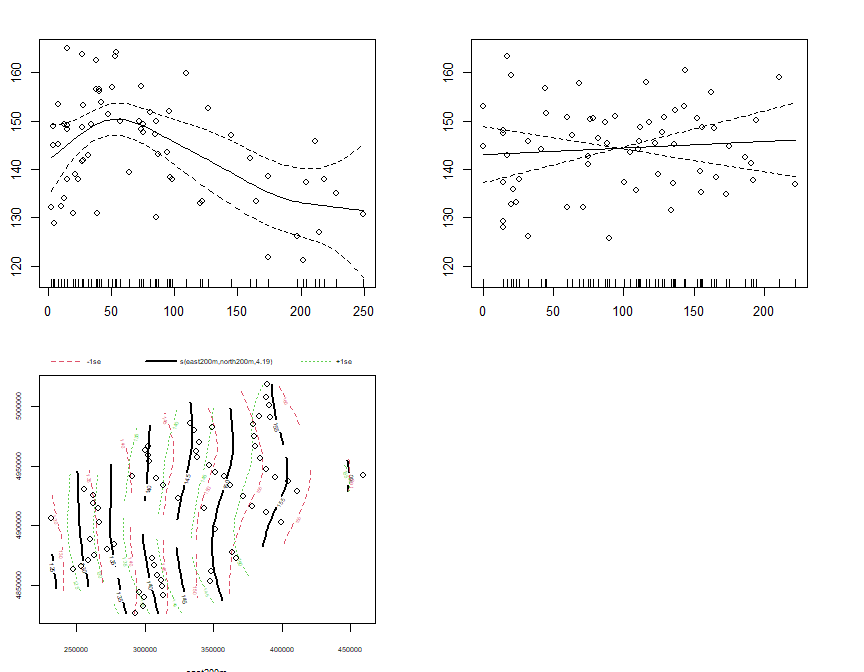
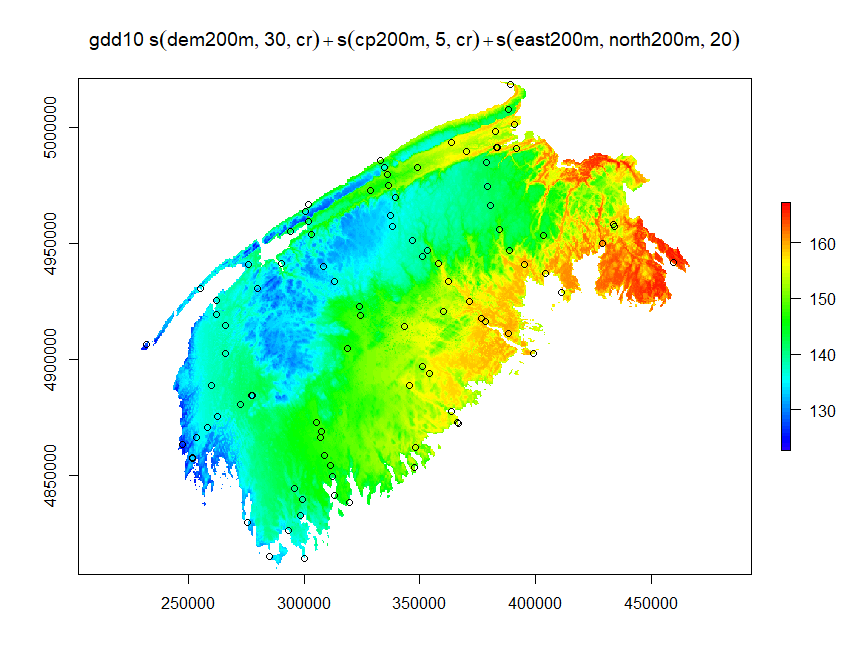
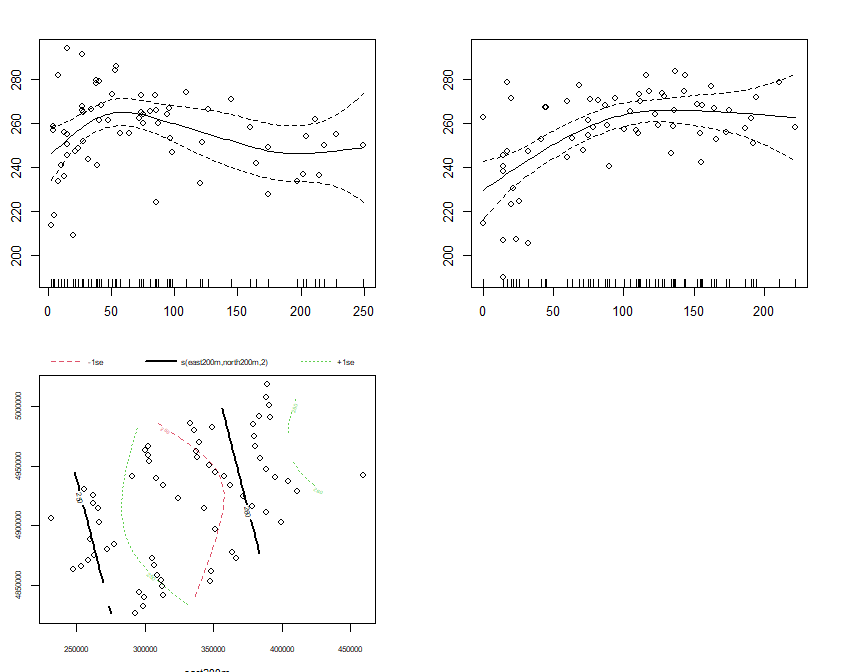
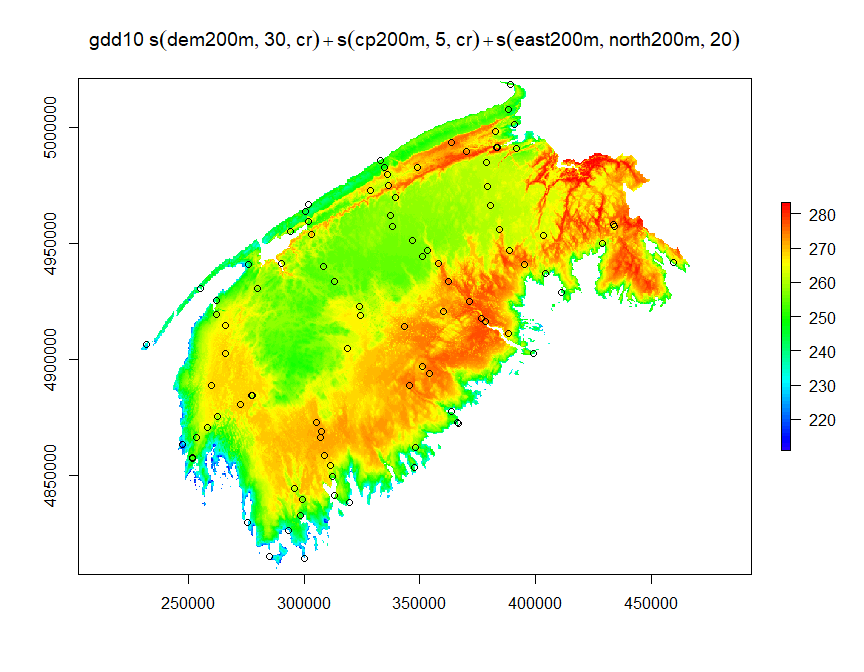
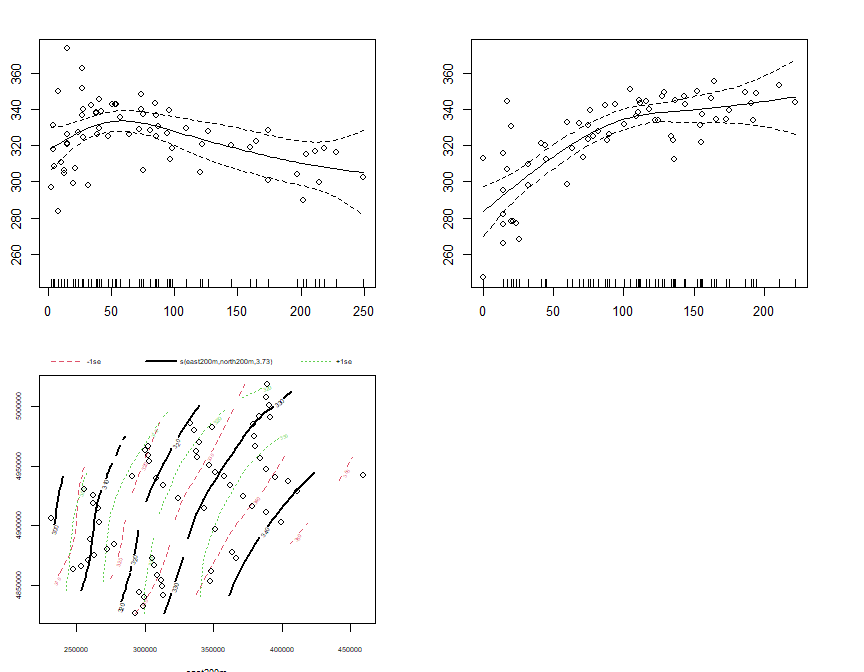
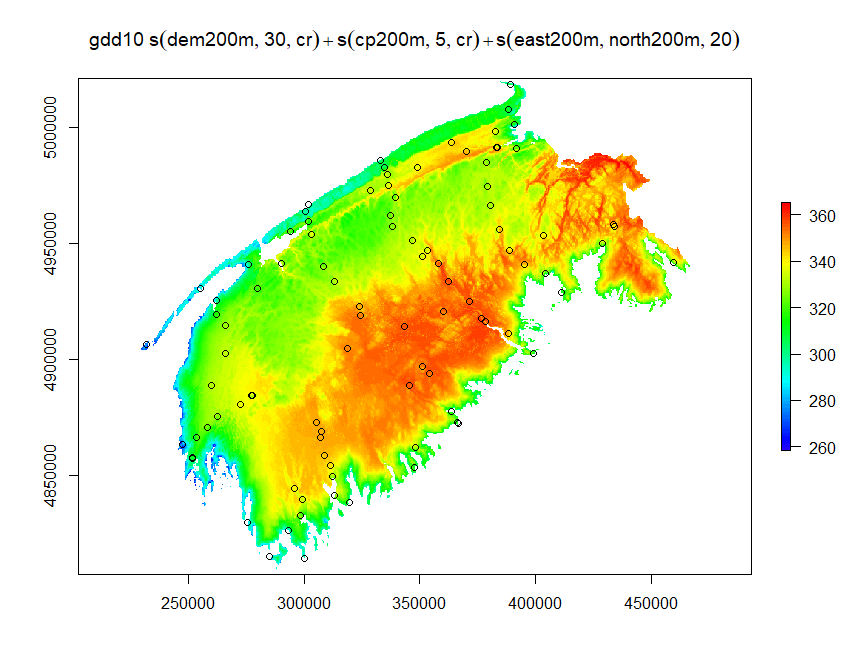
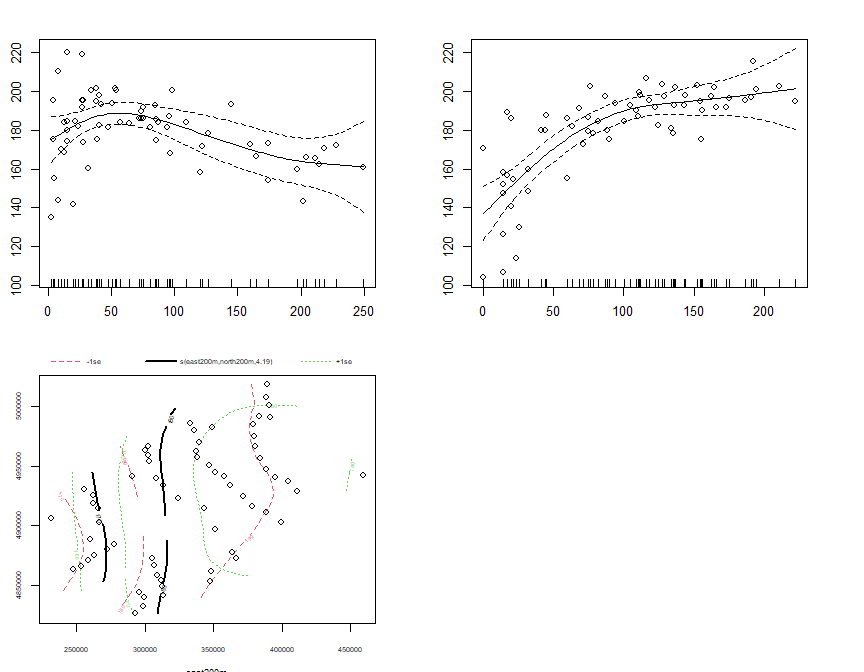
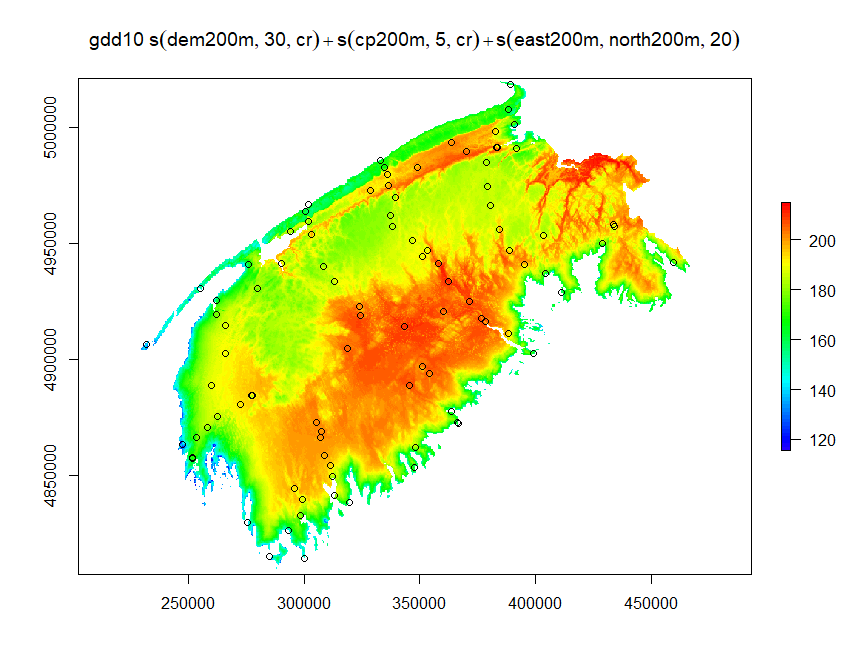
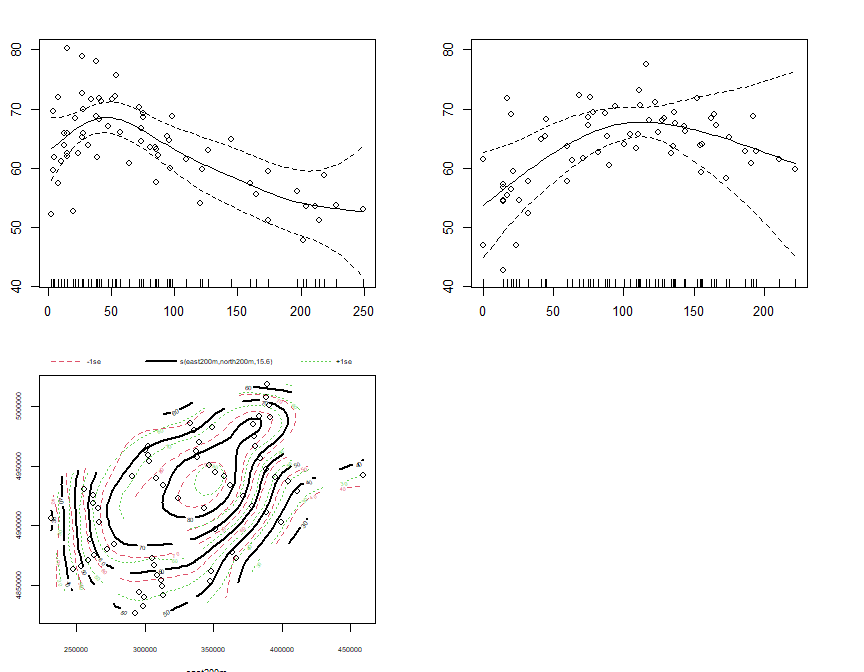
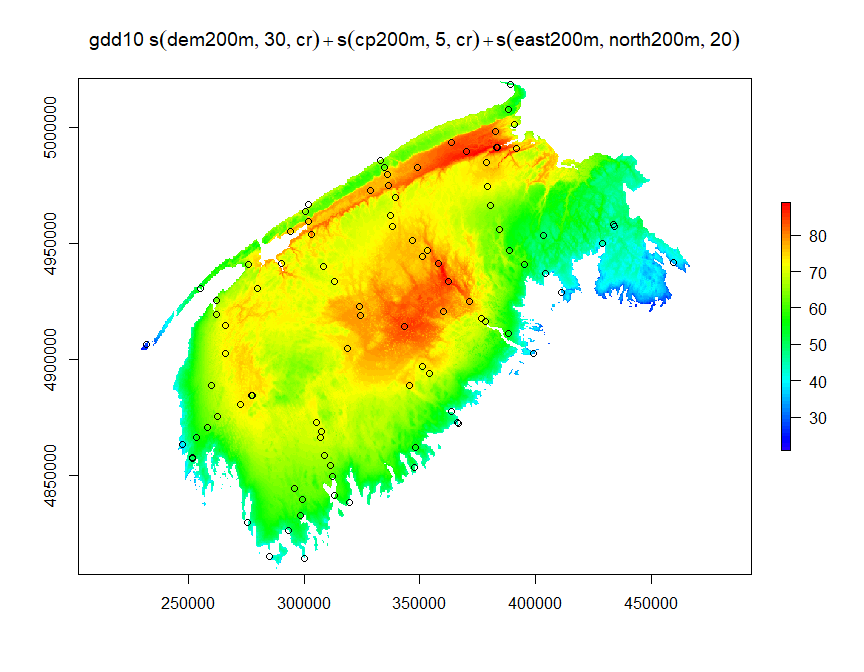
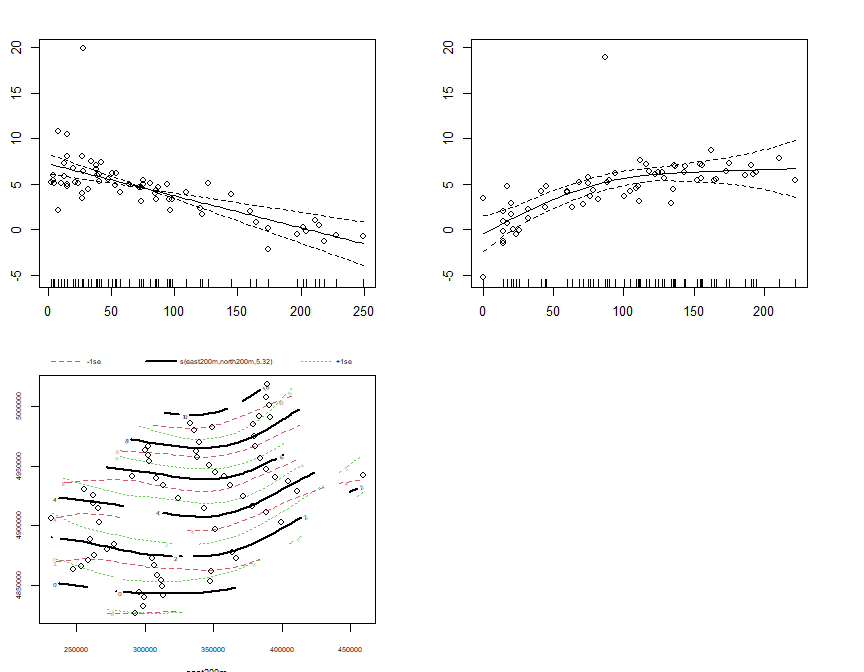
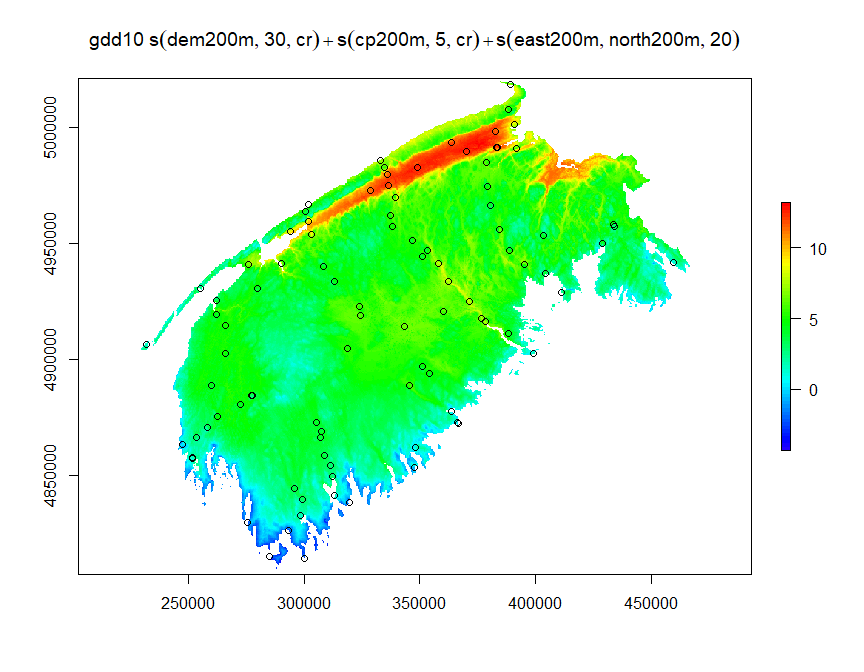
sum\_raster\_brick <- brick(gam\_rasters)  
sum\_rasters[[w]] <- raster::calc(sum\_raster\_brick, sum)  
plot(sum\_rasters[[w]], main=m$formula, col=rev(rainbow(100)[1:70]))



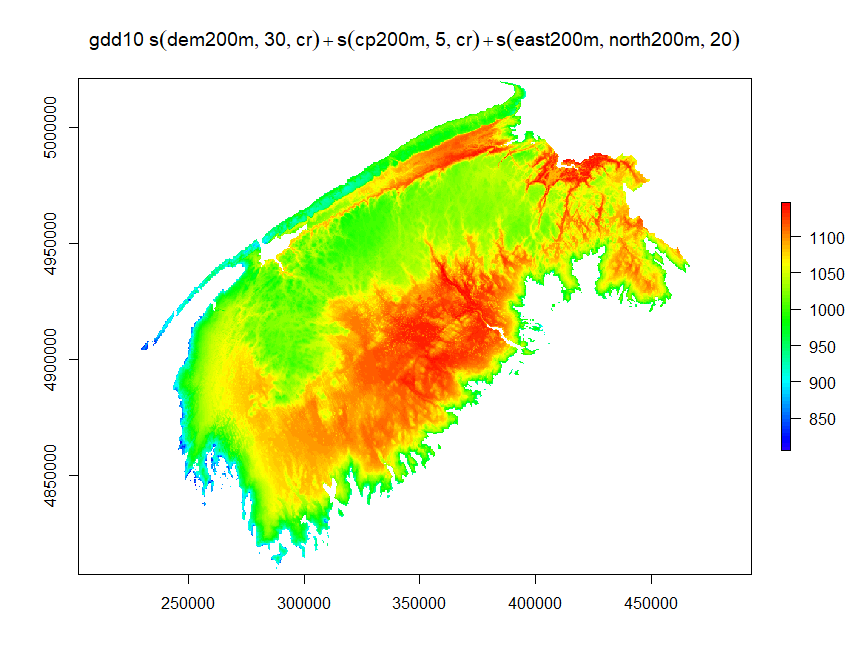
w <- w +1

2013

months <- df\_13$month %>% unique()  
  
m\_list <- list()  
c = 1  
for(month in months){  
 df\_month <- df\_13 %>% dplyr::filter(month== !!month)  
 m\_list[[c]] <- gam(gdd10~s(dem200m,k=30,bs='cr')+s(cp200m,k=5,bs='cr')+s(east200m,north200m,k=20),data=df\_month,method='REML',family=gaussian())  
 c <- c+1  
  
}  
gam\_rasters <- list()  
j <- 1  
for(m in m\_list){  
 gam\_rasters[[j]] <- raster::predict(rasters\_brick2,m)  
 plot(gam\_rasters[[j]], main=m$formula, col=rev(rainbow(100)[1:70]))  
 points(swns\_stations\_sp)  
 par(mfrow=c(2,2))  
 plot.gam(m, residuals = TRUE, pch = 1, cex = 1, shift = coef(m)[1])  
 par(mfrow=c(1,1))  
 j <- j + 1  
}



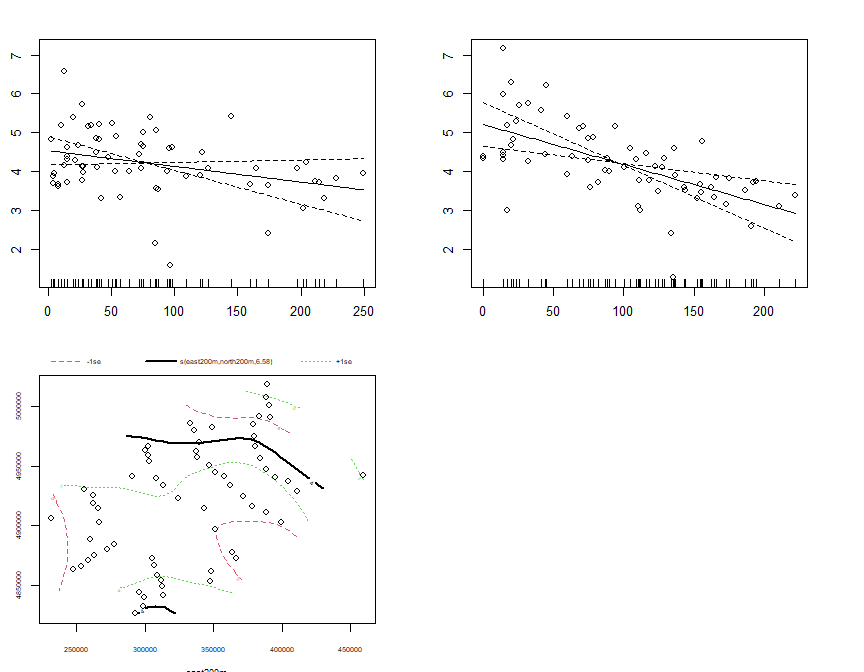
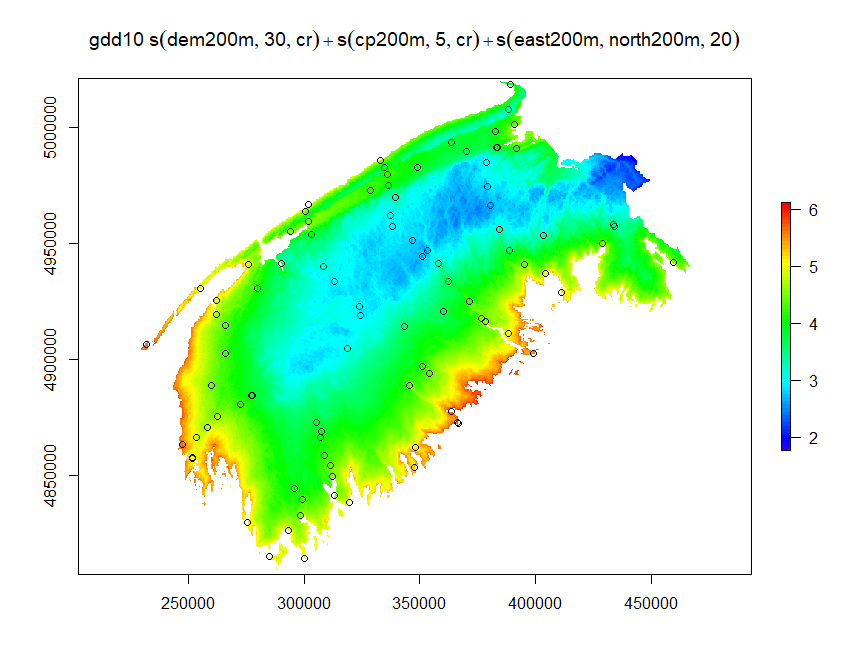
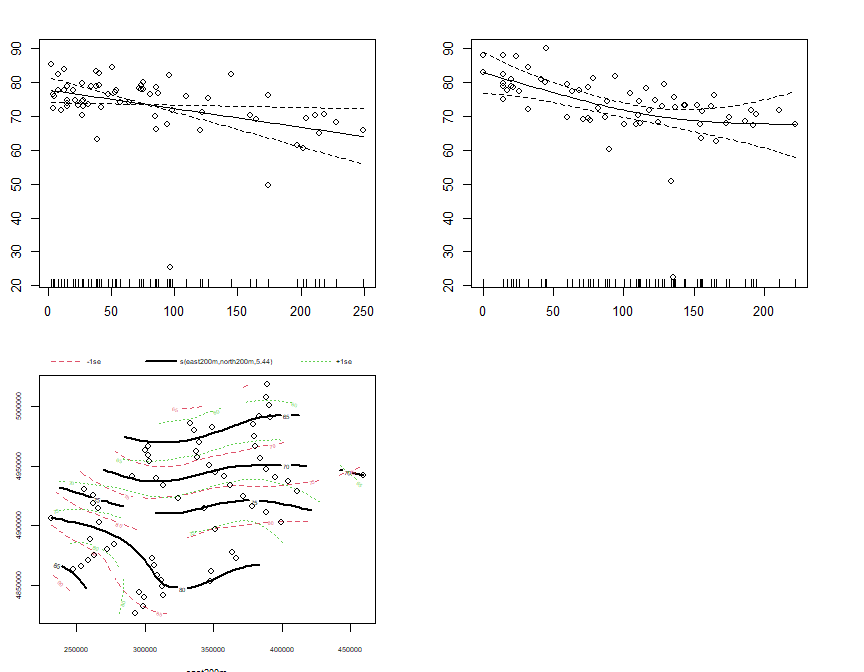
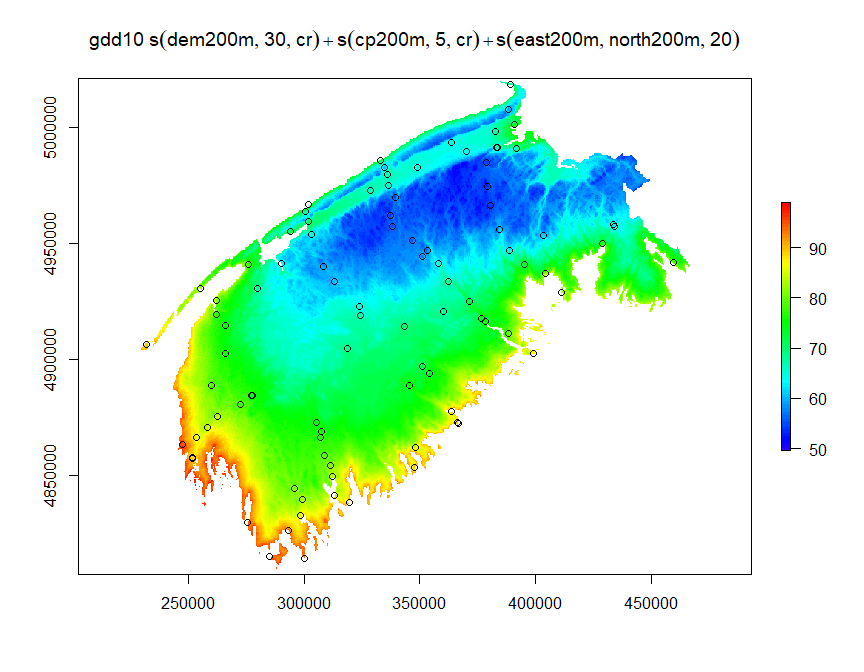
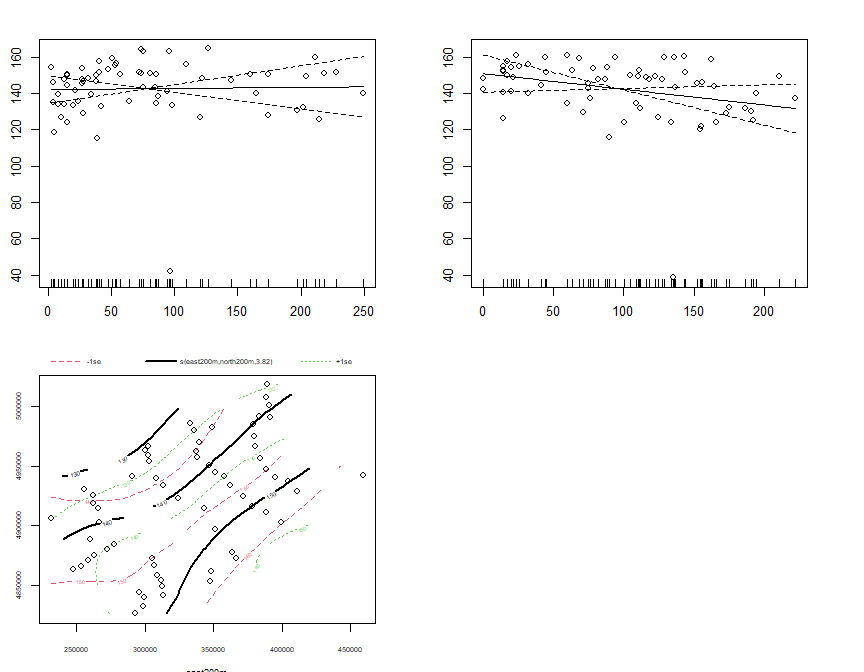
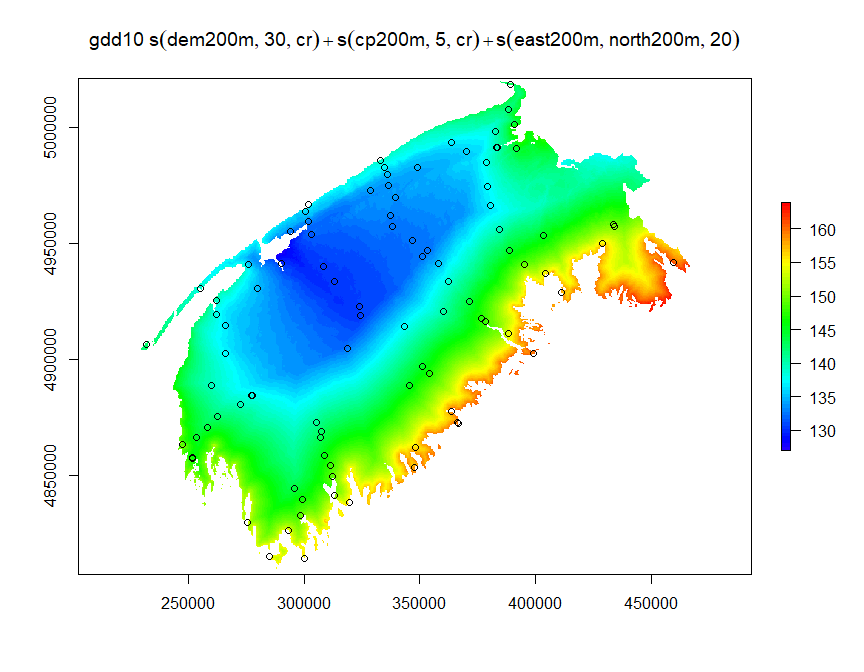
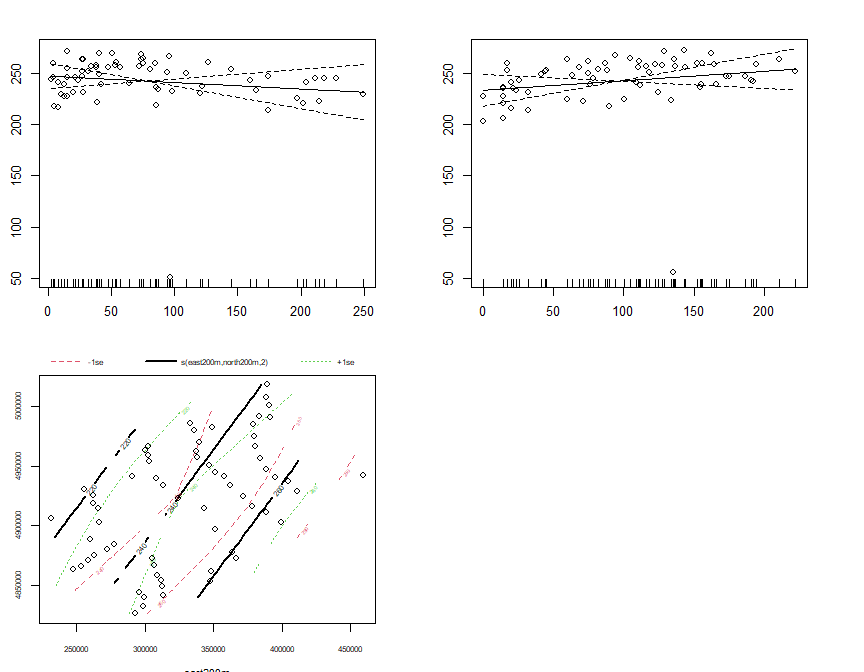
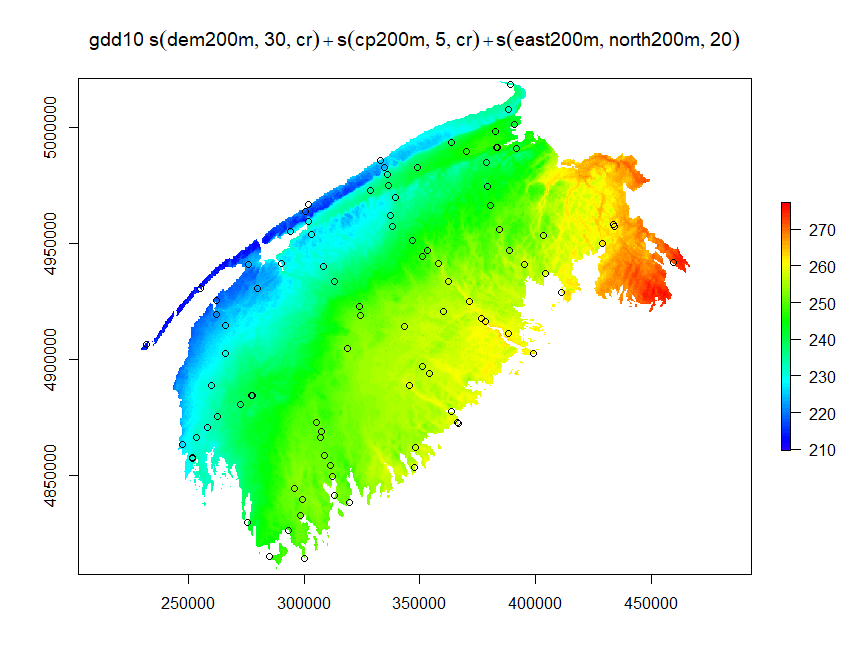
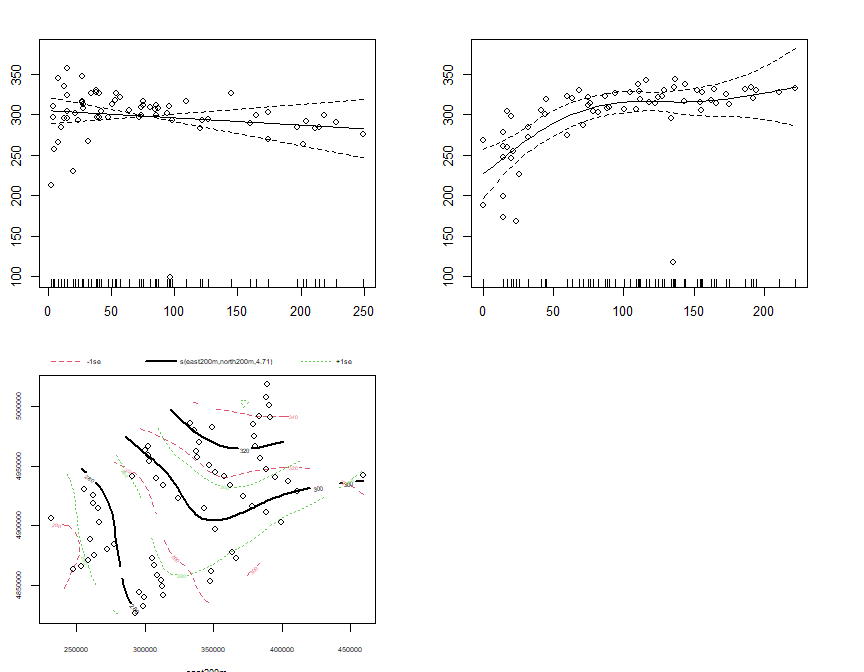
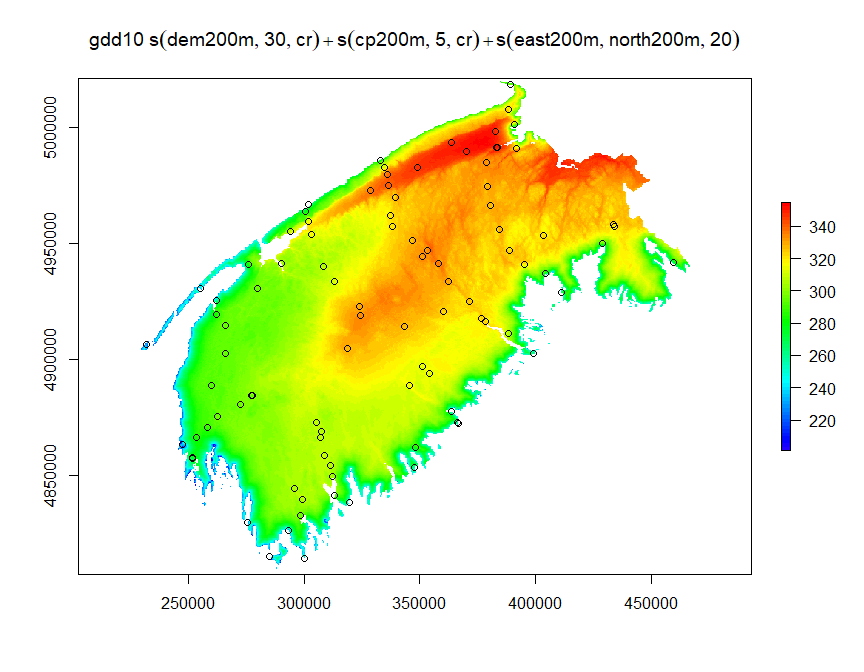
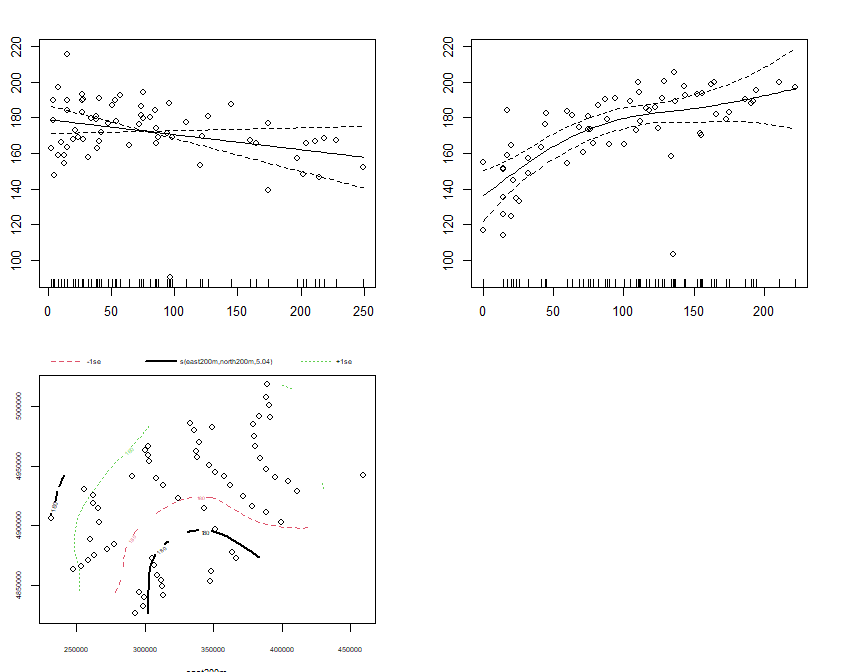
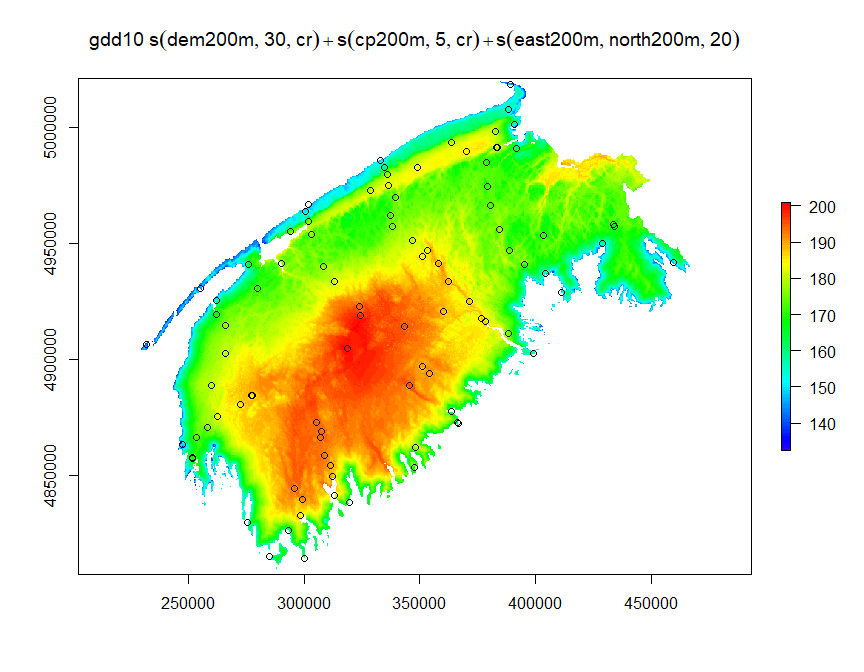
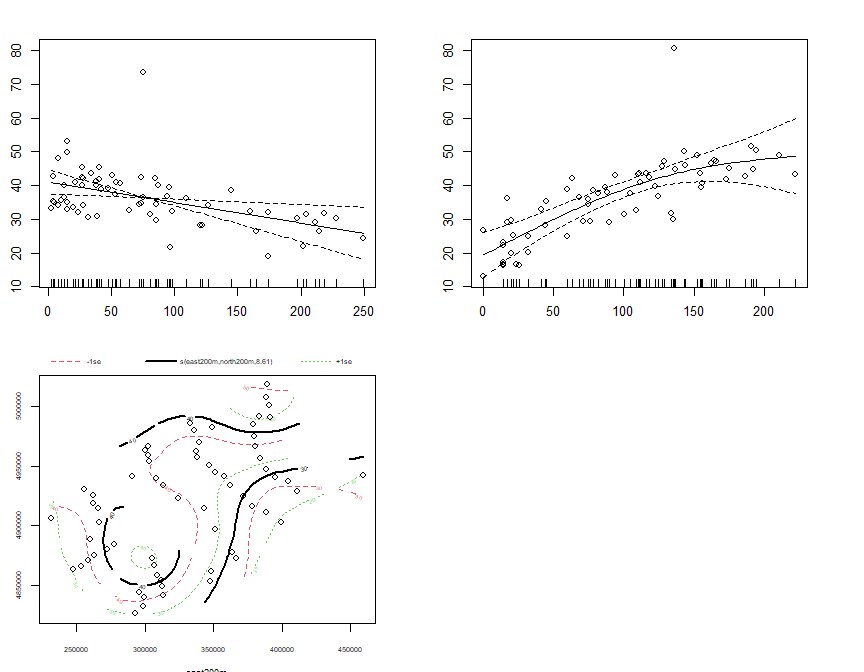
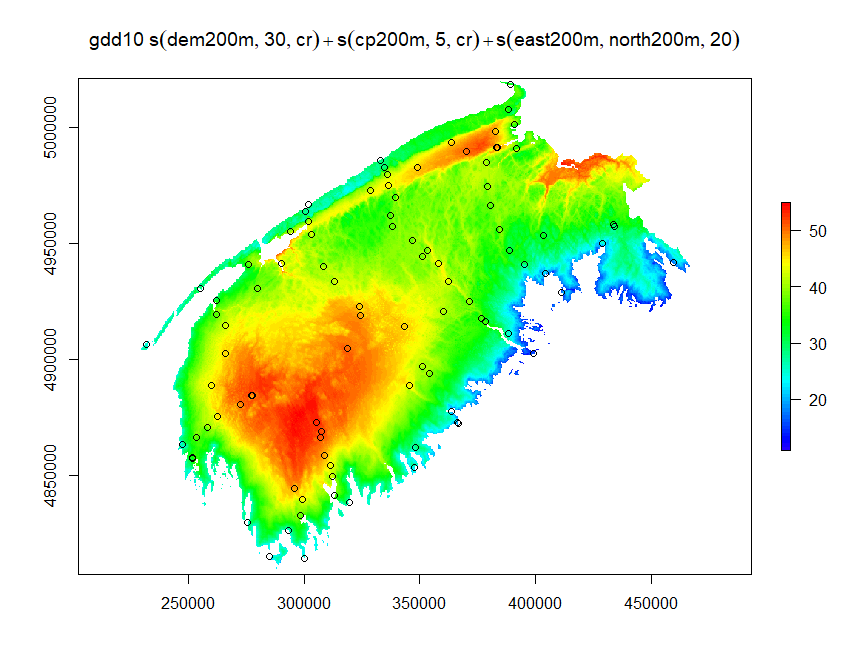
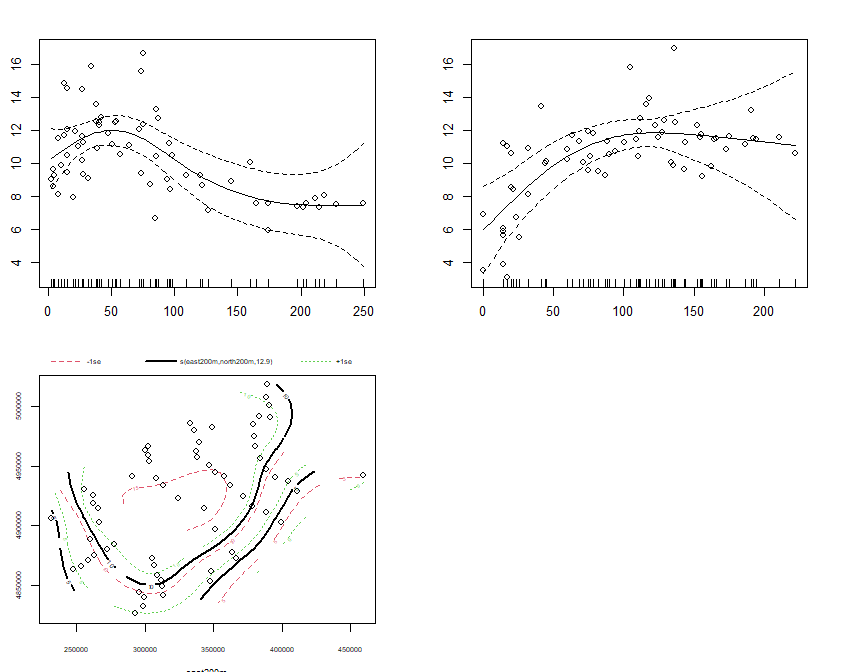
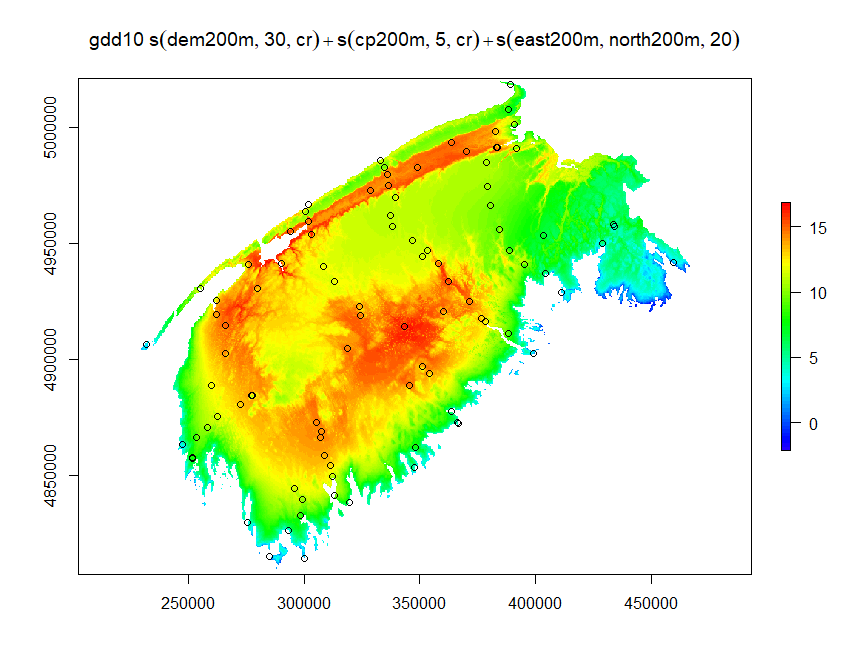
sum\_raster\_brick <- brick(gam\_rasters)  
sum\_rasters[[w]] <- raster::calc(sum\_raster\_brick, sum)  
plot(sum\_rasters[[w]], main=m$formula, col=rev(rainbow(100)[1:70]))



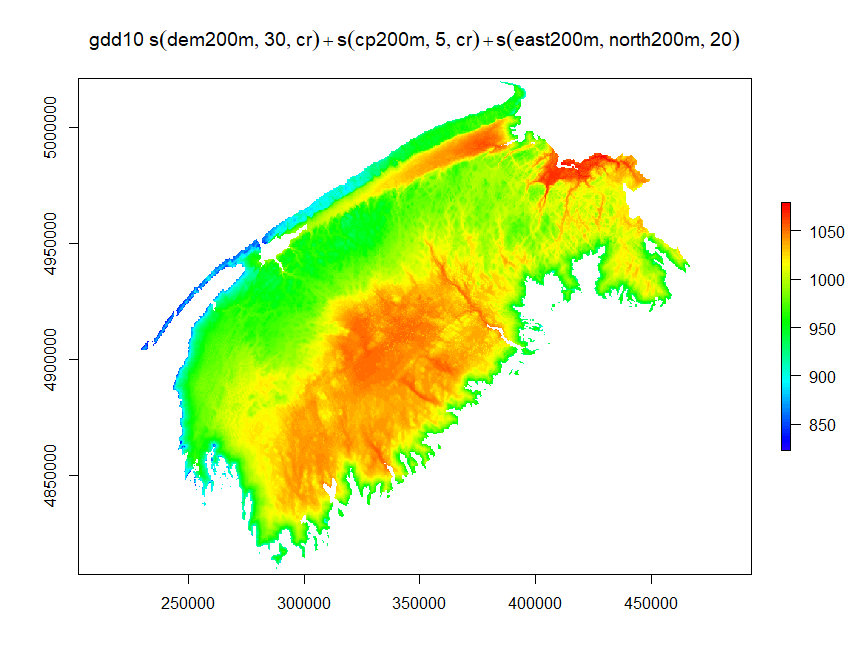
w <- w+1

2014

months <- df\_14$month %>% unique()  
  
m\_list <- list()  
c = 1  
for(month in months){  
 df\_month <- df\_14 %>% dplyr::filter(month== !!month)  
 m\_list[[c]] <- gam(gdd10~s(dem200m,k=30,bs='cr')+s(cp200m,k=5,bs='cr')+s(east200m,north200m,k=20),data=df\_month,method='REML',family=gaussian())  
 c <- c+1  
  
}  
gam\_rasters <- list()  
j <- 1  
for(m in m\_list){  
 gam\_rasters[[j]] <- raster::predict(rasters\_brick2,m)  
 plot(gam\_rasters[[j]], main=m$formula, col=rev(rainbow(100)[1:70]))  
 points(swns\_stations\_sp)  
 par(mfrow=c(2,2))  
 plot.gam(m, residuals = TRUE, pch = 1, cex = 1, shift = coef(m)[1])  
 par(mfrow=c(1,1))  
 j <- j + 1  
}



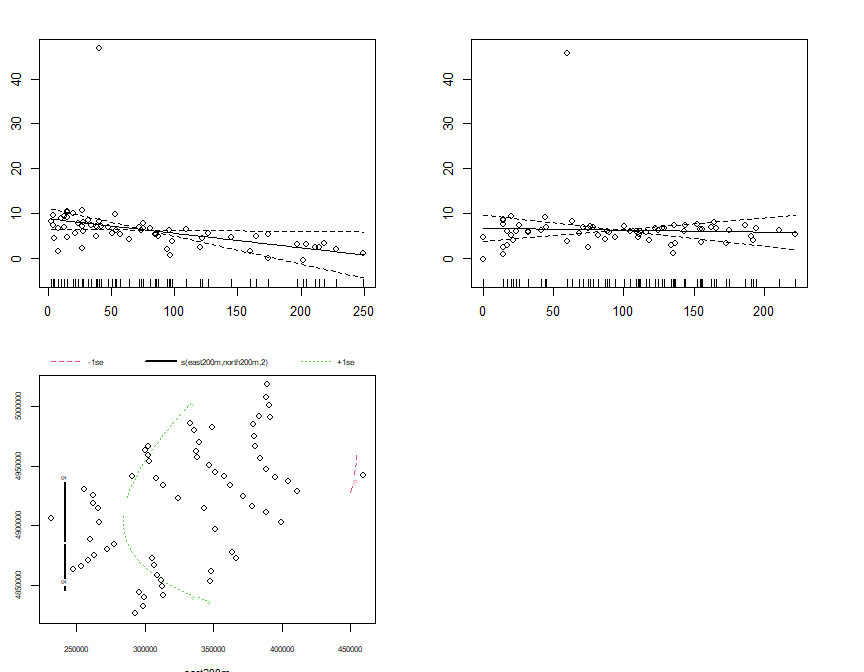
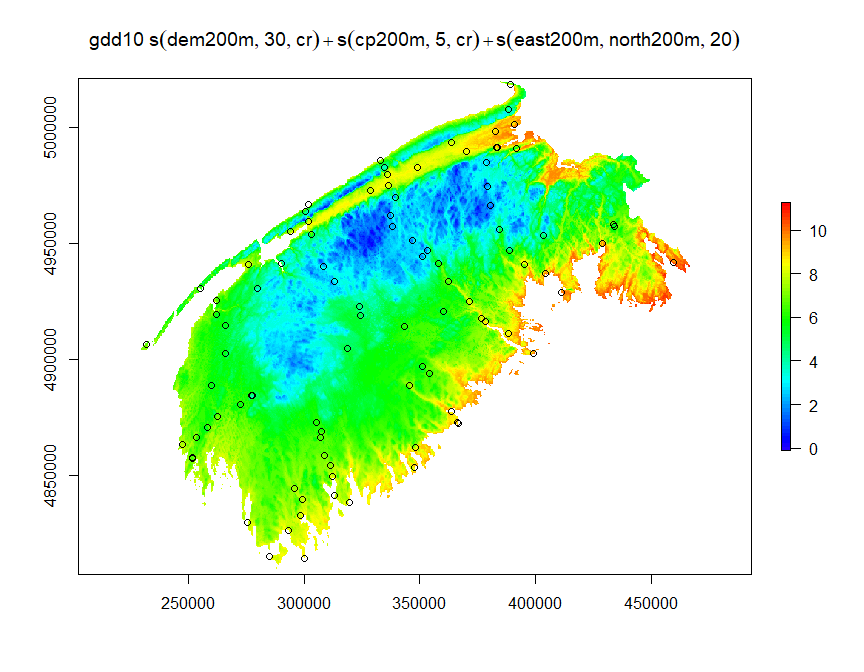
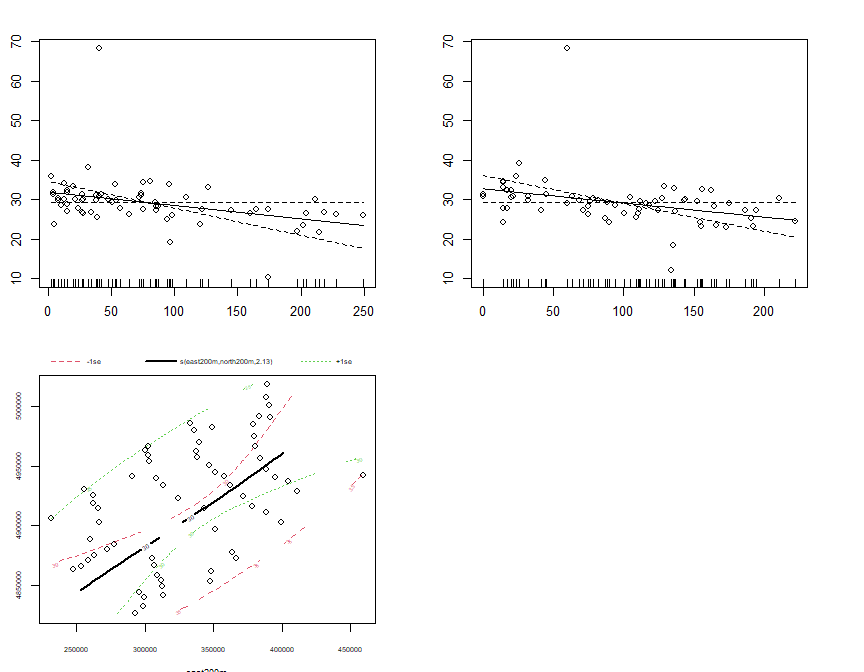
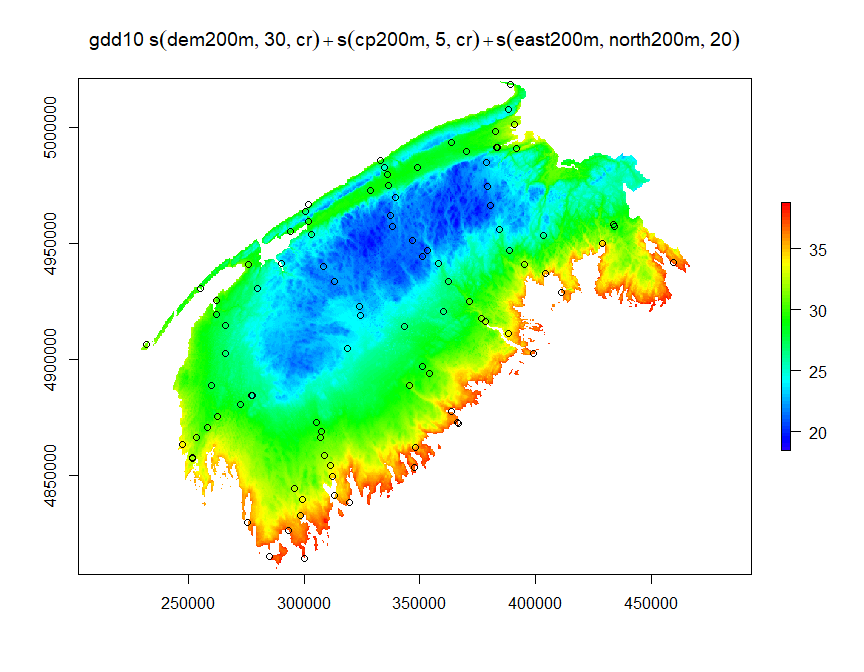
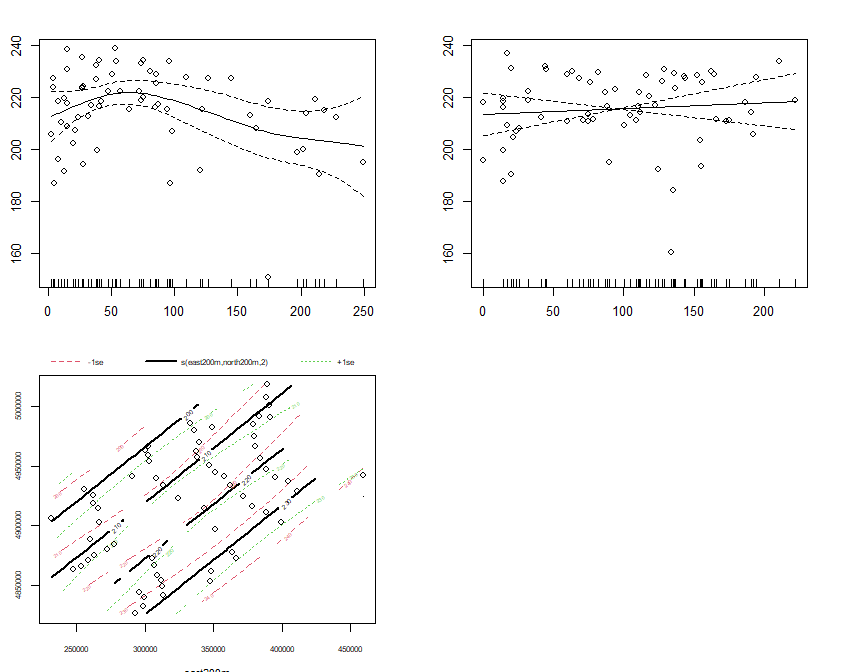
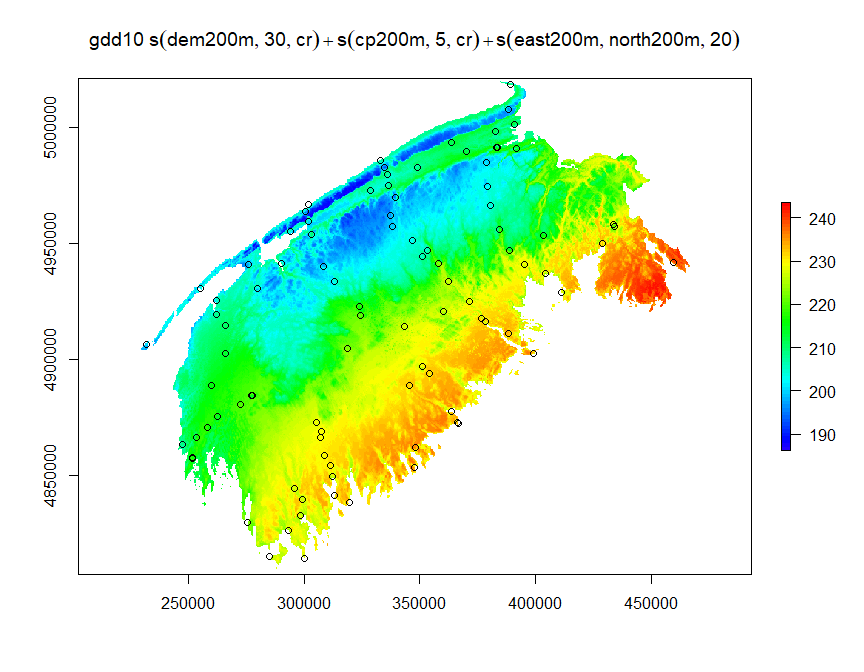
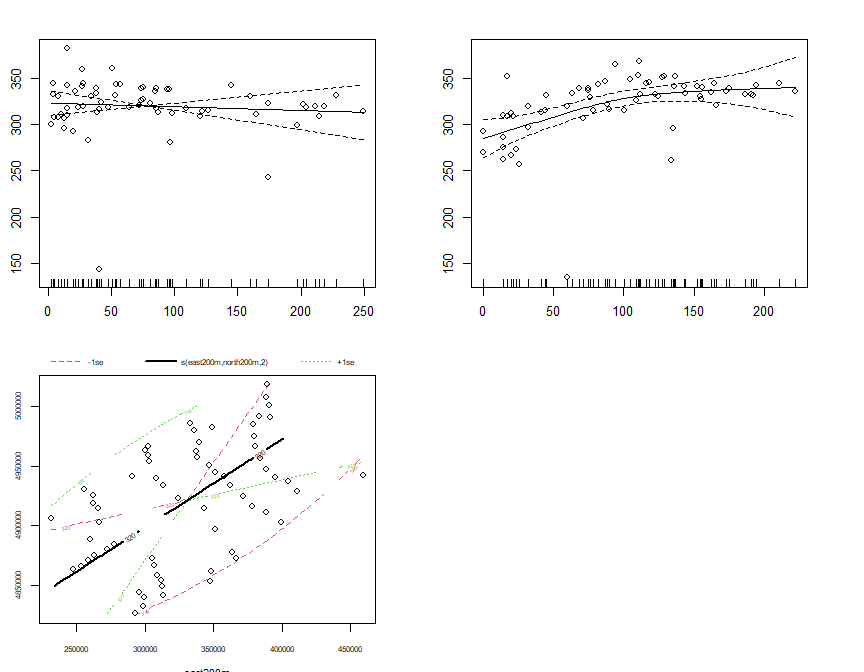
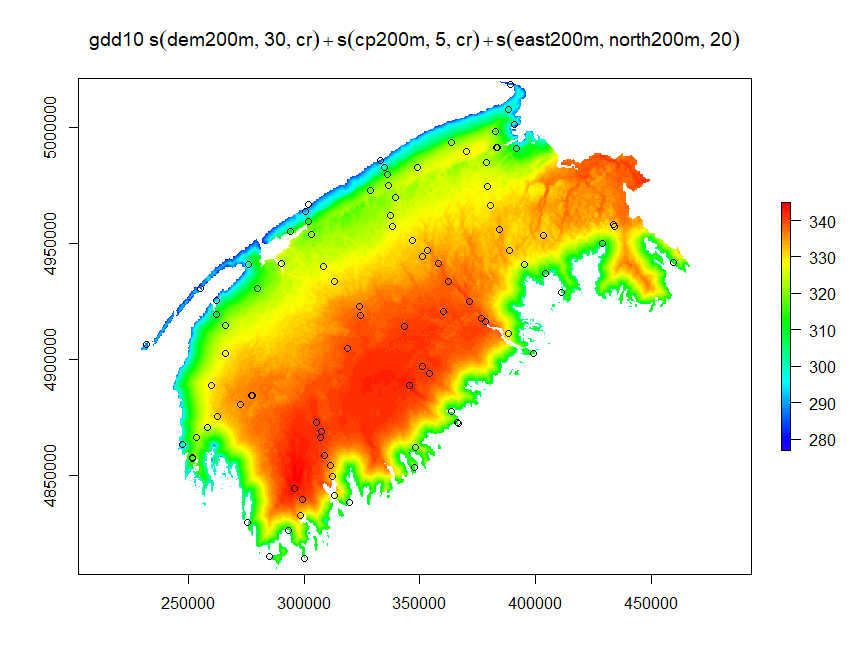
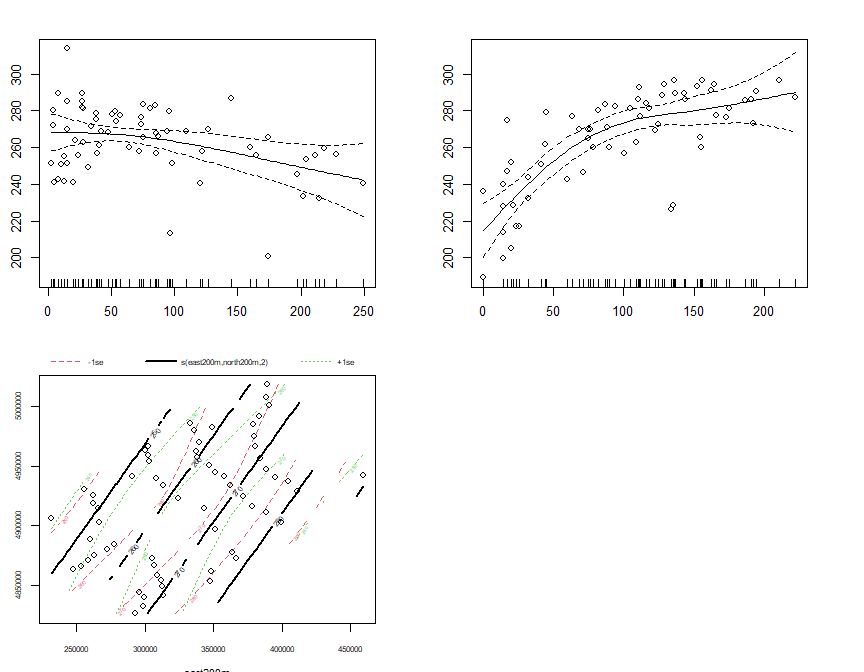
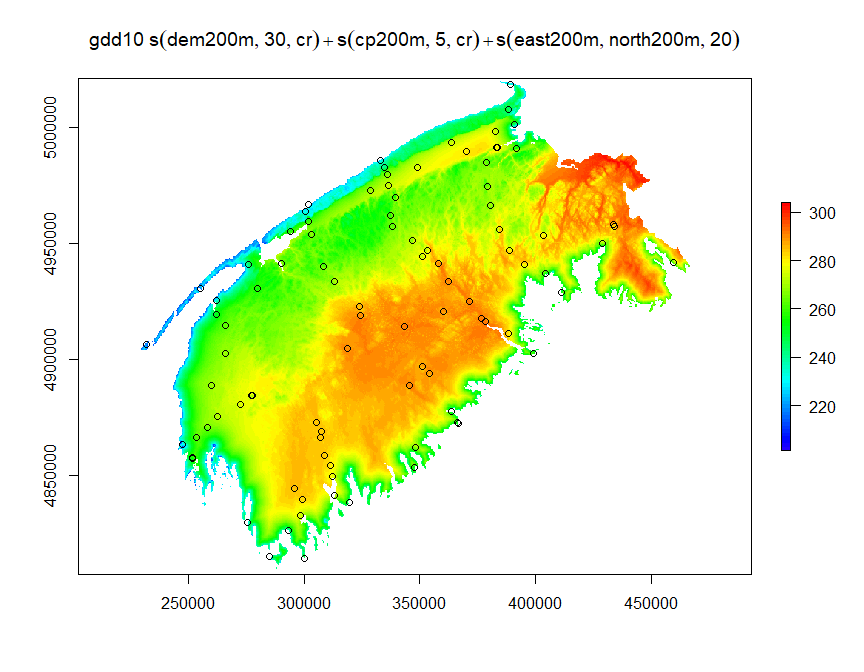
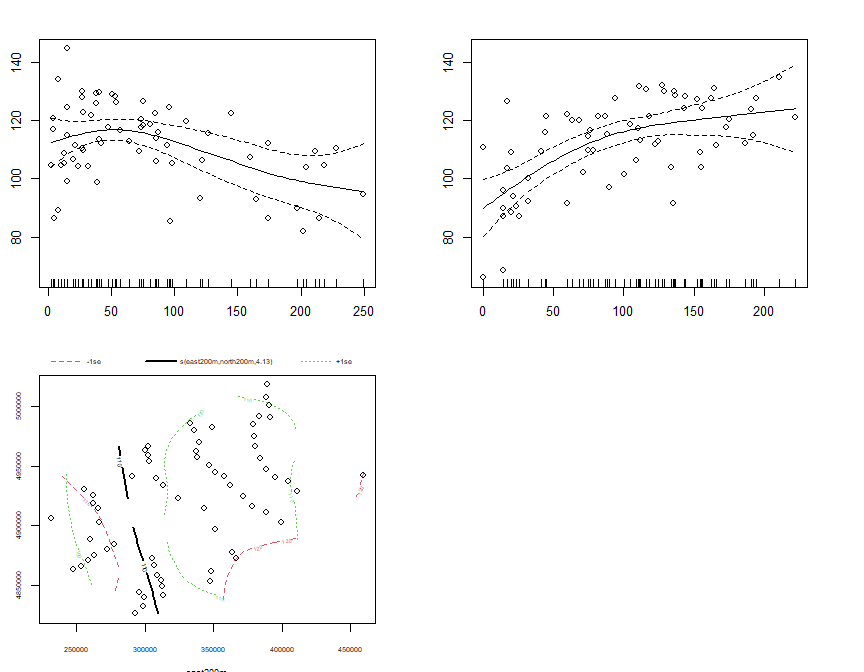
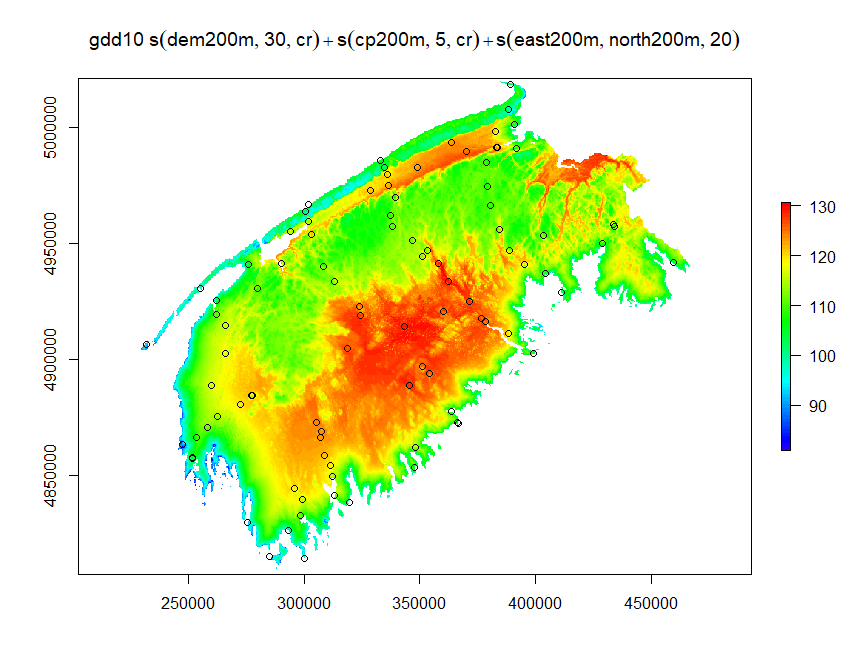
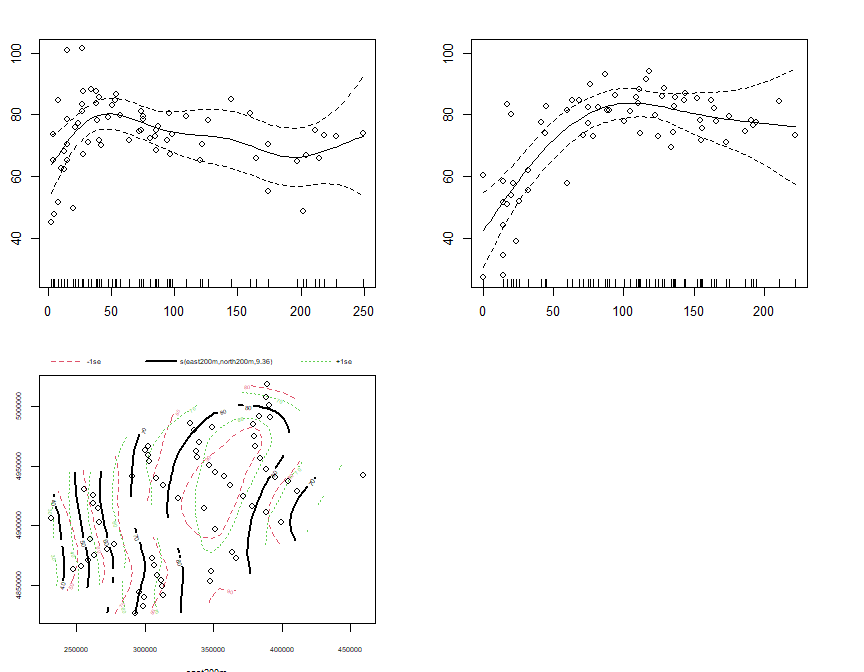
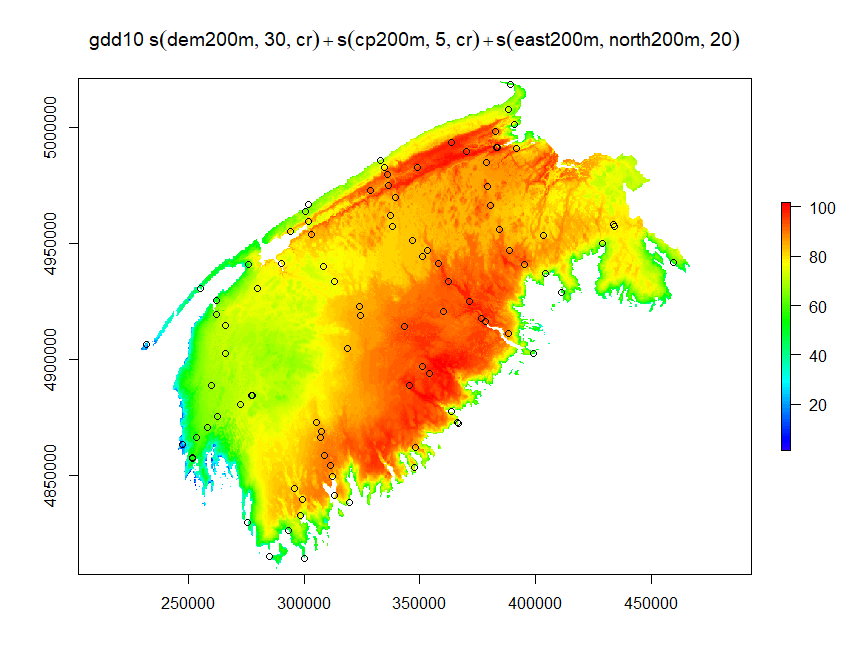
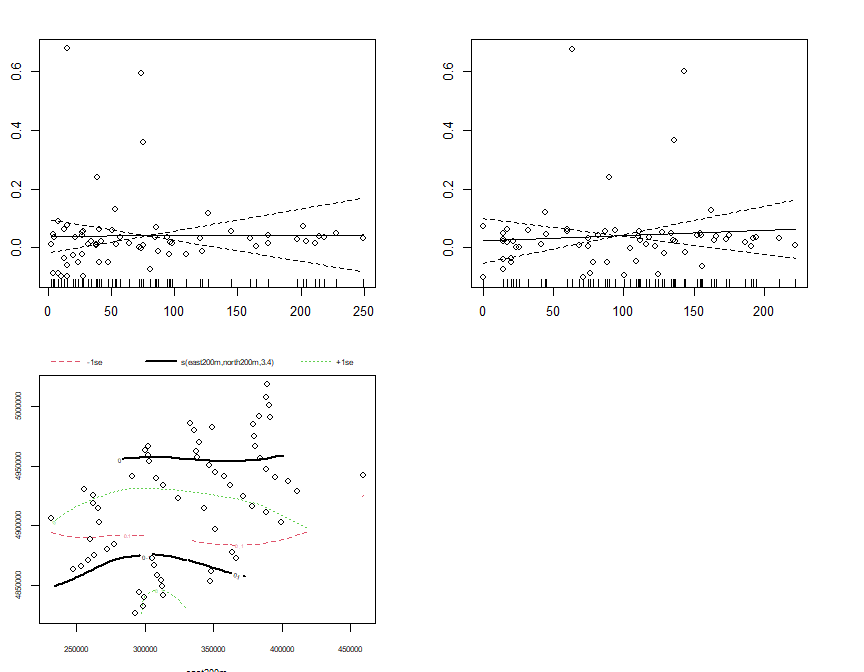
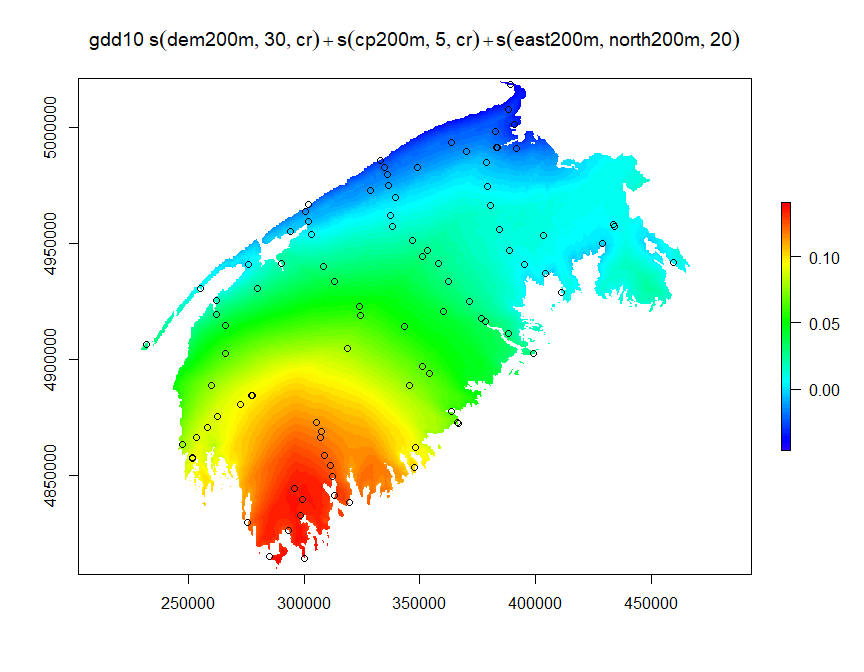
sum\_raster\_brick <- brick(gam\_rasters)  
sum\_rasters[[w]] <- raster::calc(sum\_raster\_brick, sum)  
plot(sum\_rasters[[w]], main=m$formula, col=rev(rainbow(100)[1:70]))



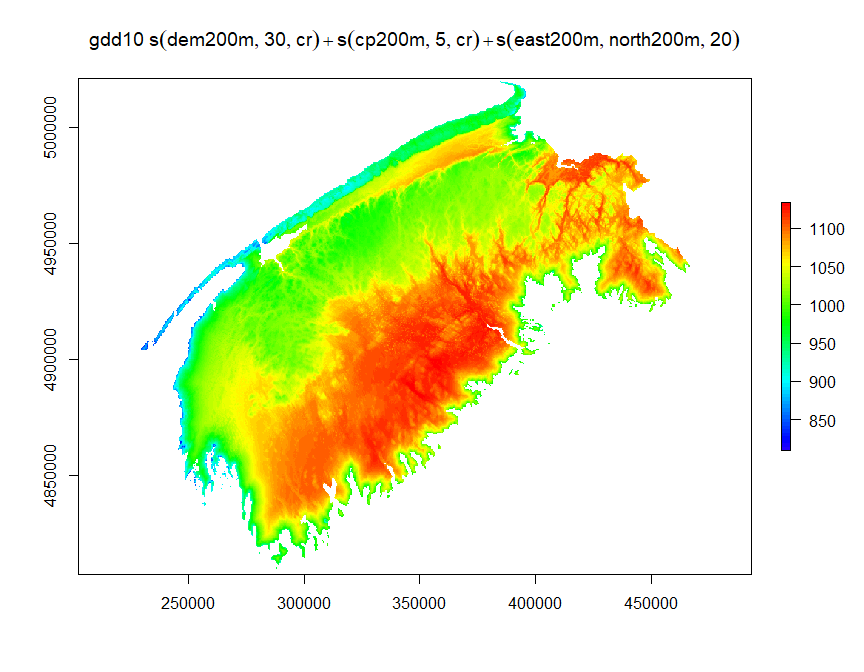
w <- w+1

2015

months <- df\_15$month %>% unique()  
  
m\_list <- list()  
c = 1  
for(month in months){  
 df\_month <- df\_15 %>% dplyr::filter(month== !!month)  
 m\_list[[c]] <- gam(gdd10~s(dem200m,k=30,bs='cr')+s(cp200m,k=5,bs='cr')+s(east200m,north200m,k=20),data=df\_month,method='REML',family=gaussian())  
 c <- c+1  
  
}  
gam\_rasters <- list()  
j <- 1  
for(m in m\_list){  
 gam\_rasters[[j]] <- raster::predict(rasters\_brick2,m)  
 plot(gam\_rasters[[j]], main=m$formula, col=rev(rainbow(100)[1:70]))  
 points(swns\_stations\_sp)  
 par(mfrow=c(2,2))  
 plot.gam(m, residuals = TRUE, pch = 1, cex = 1, shift = coef(m)[1])  
 par(mfrow=c(1,1))  
 j <- j + 1  
}



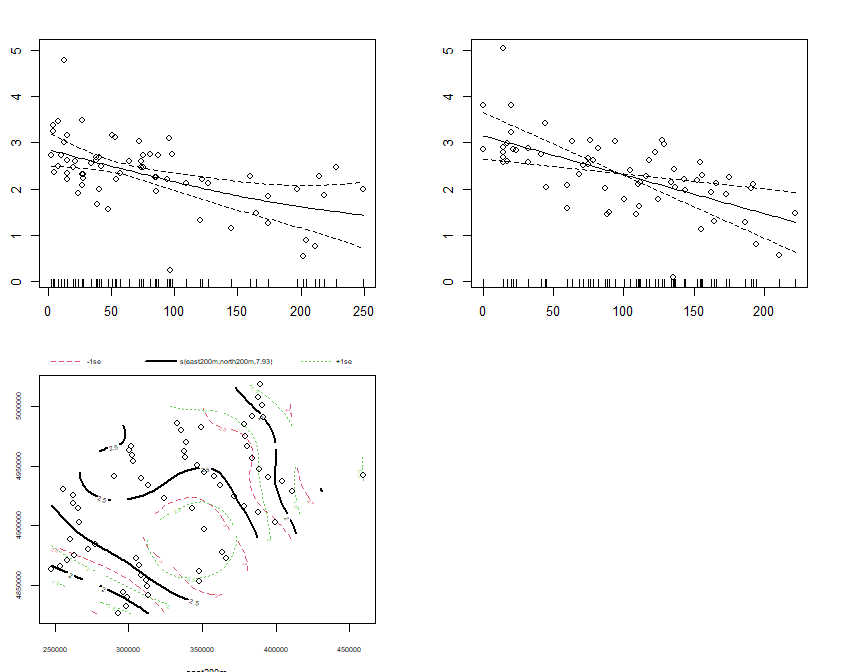
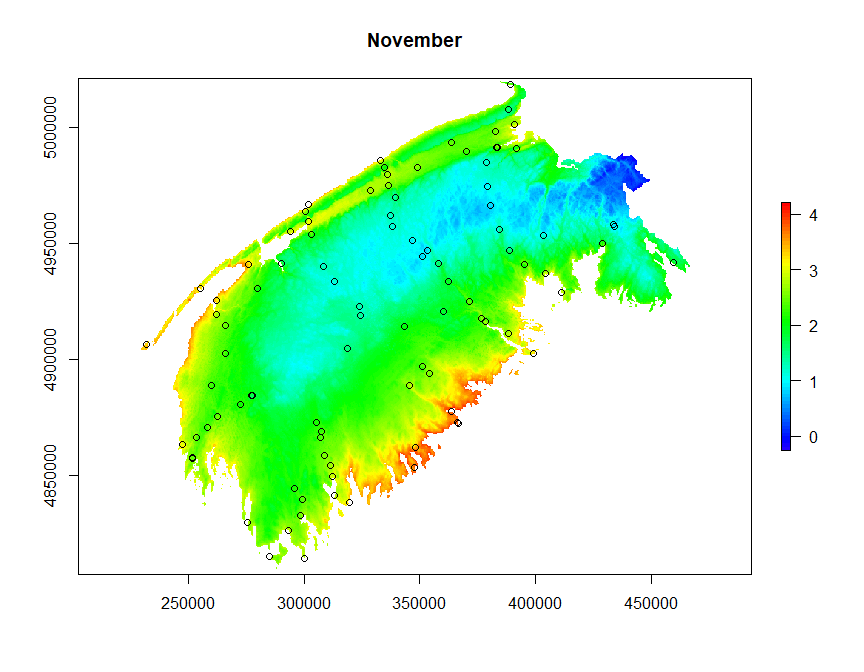
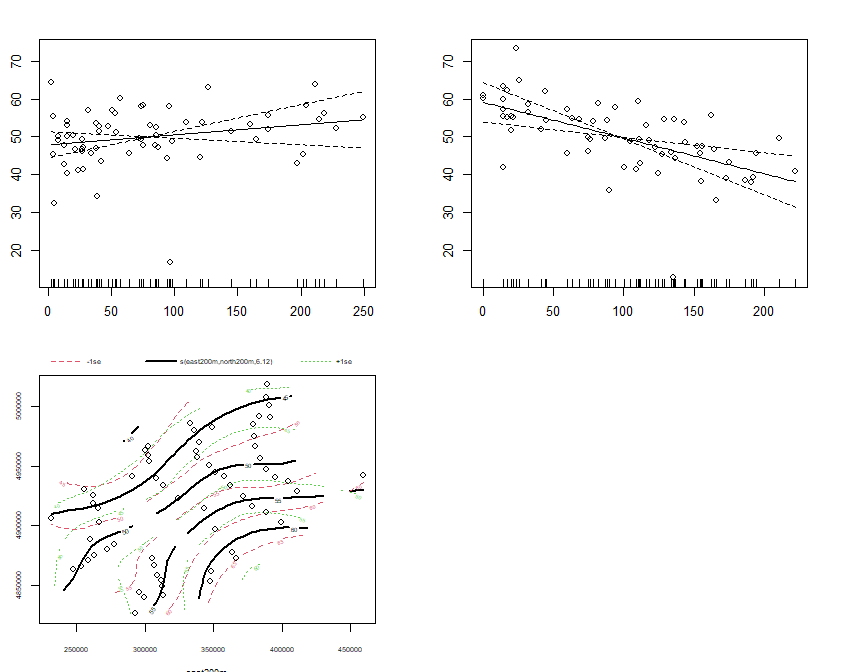
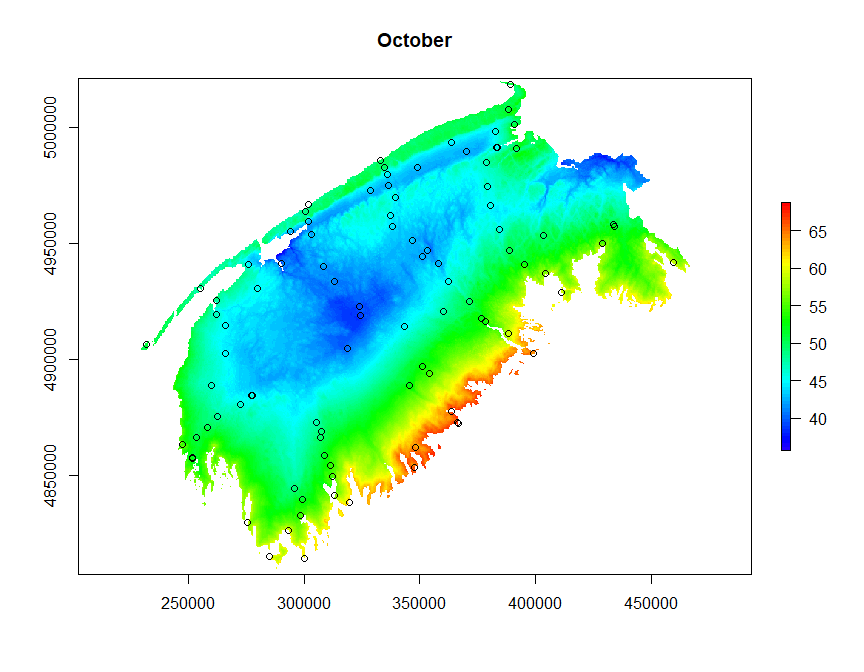
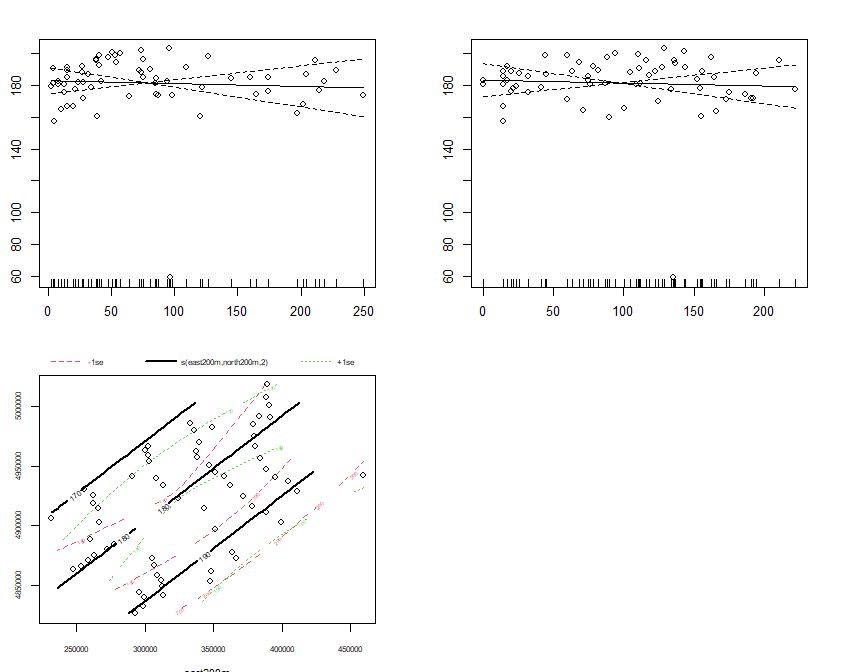
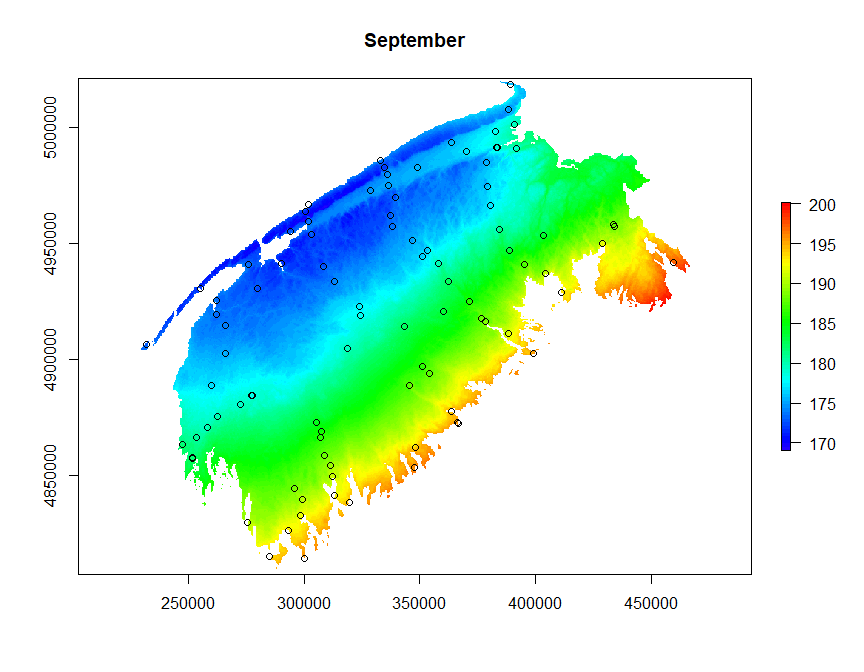
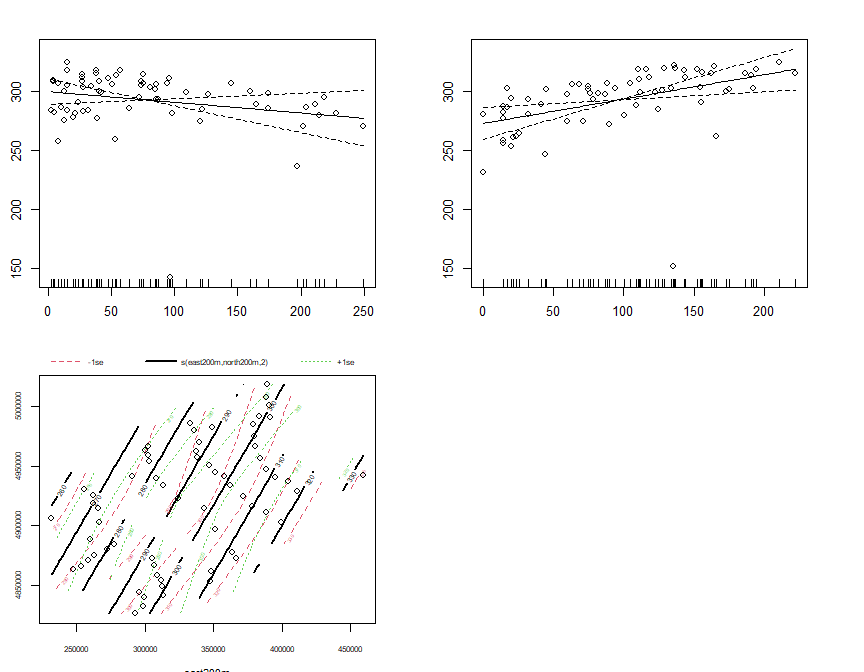
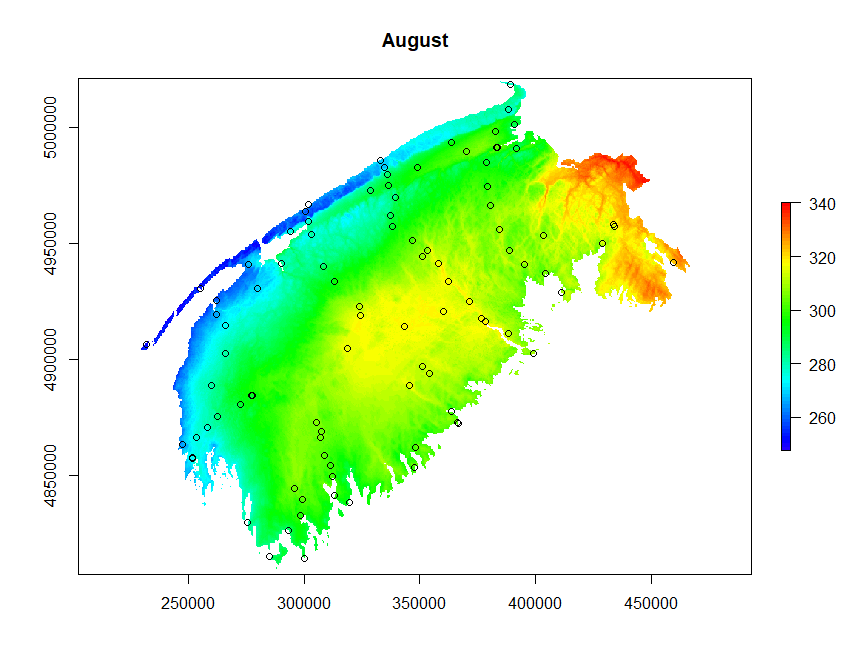
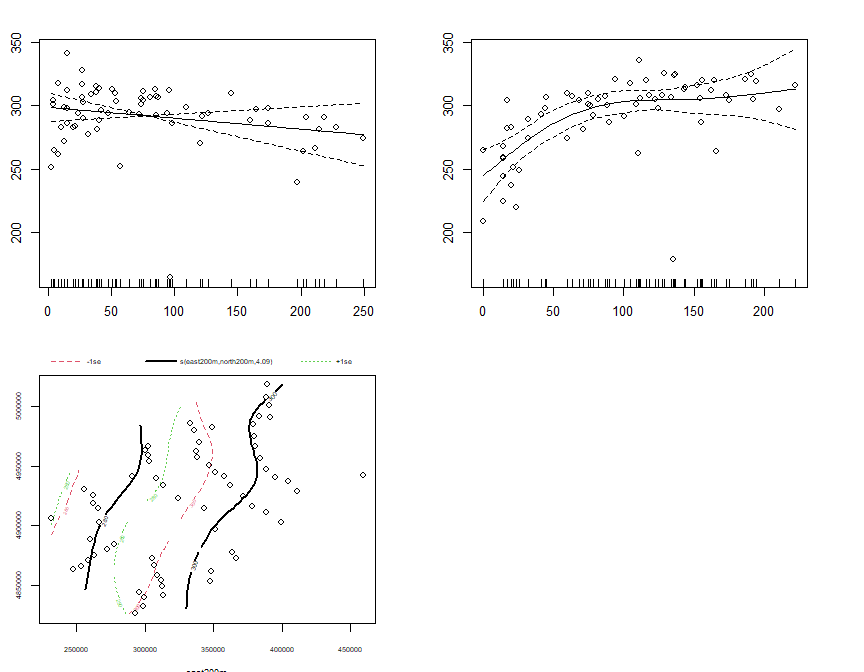
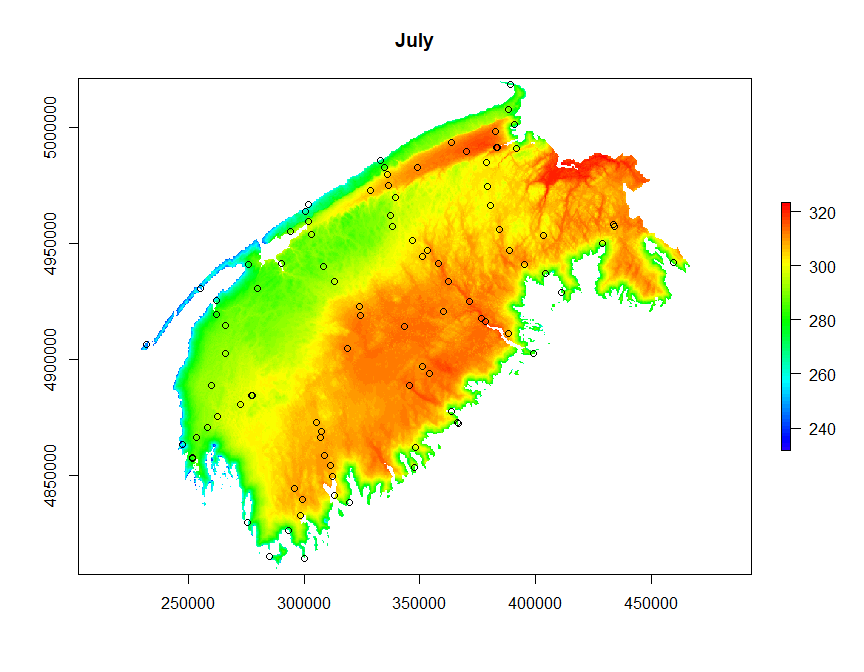
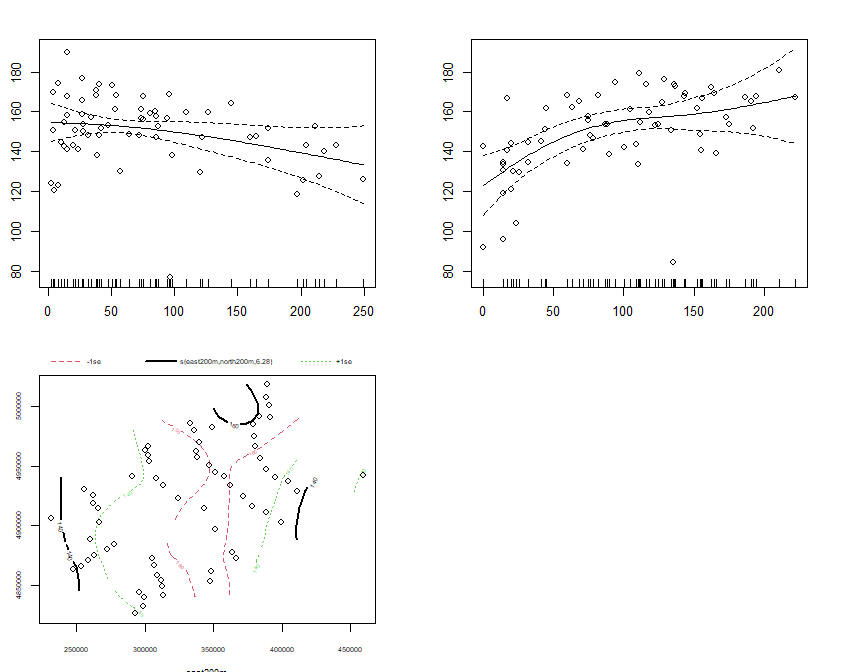
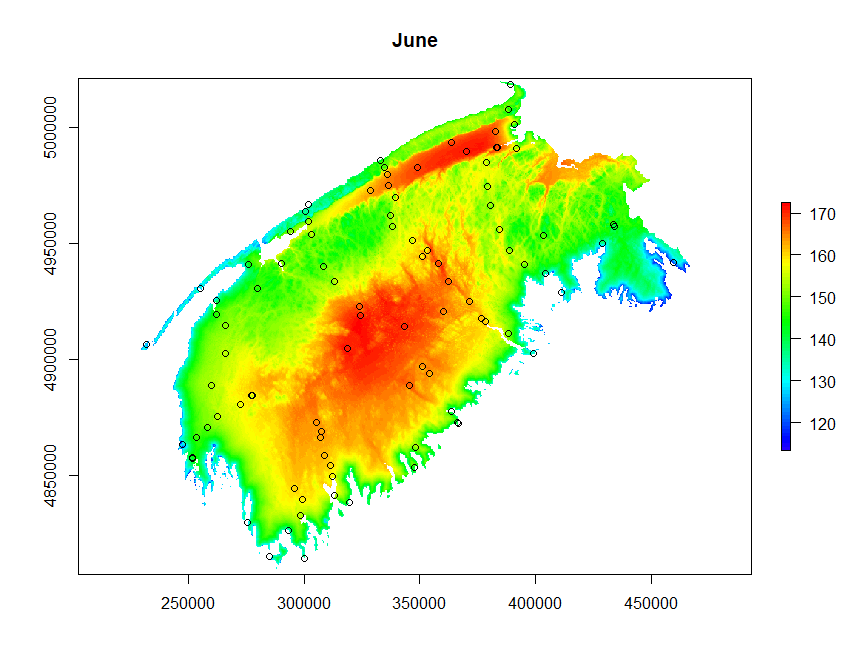
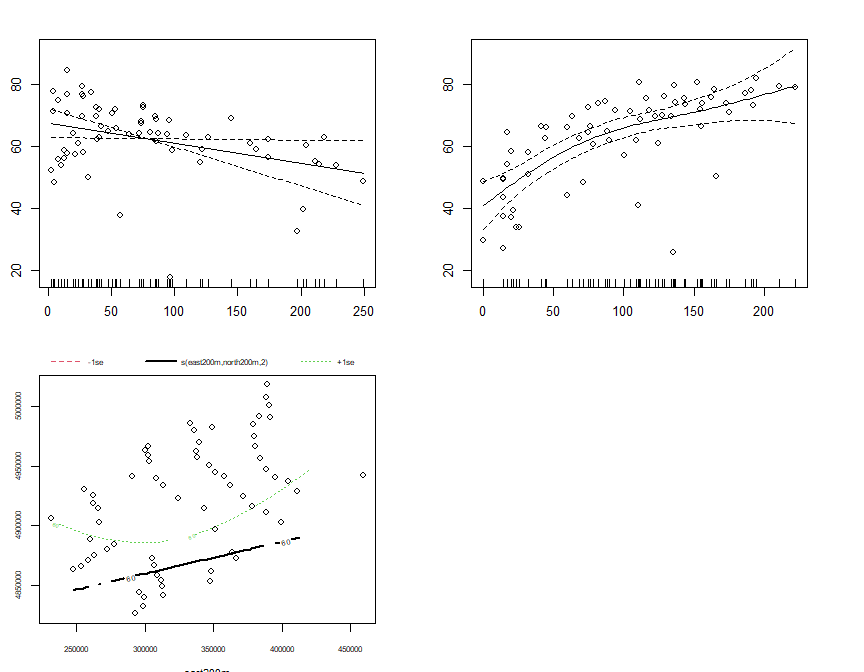
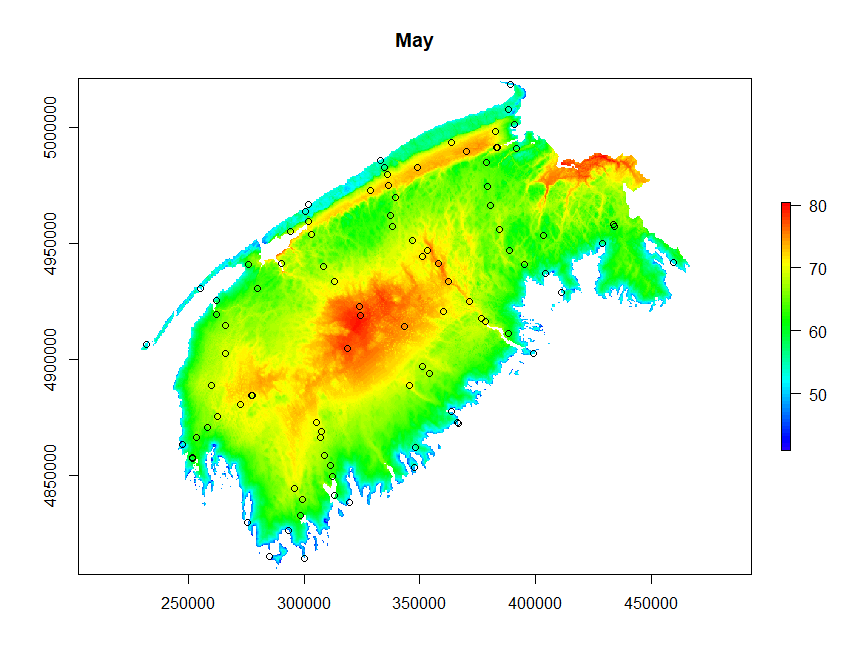
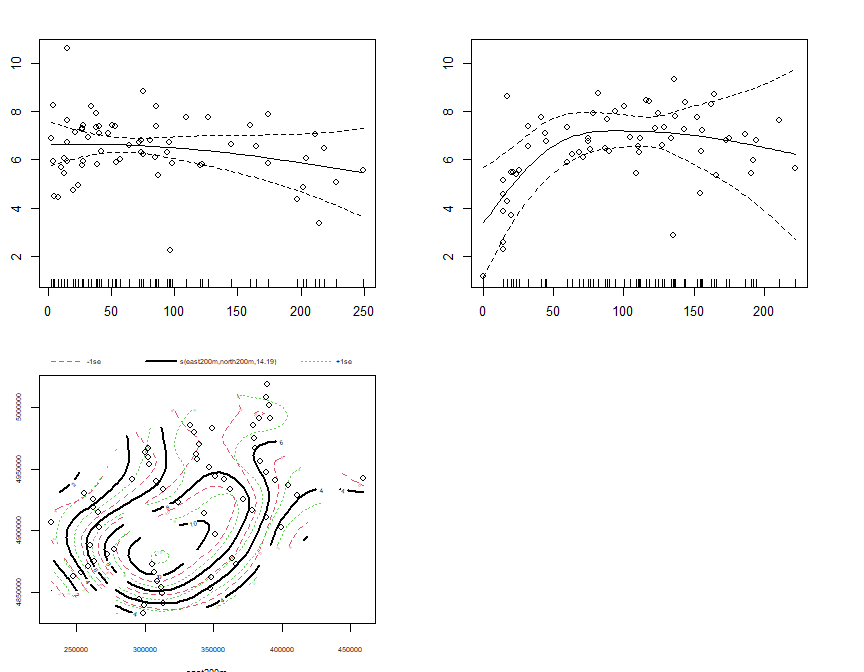
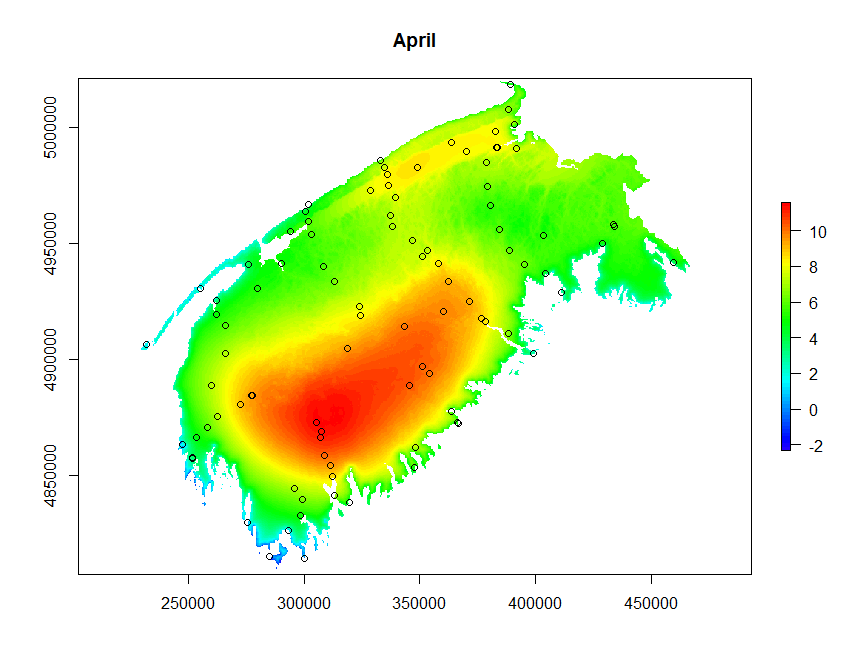
sum\_raster\_brick <- brick(gam\_rasters)  
sum\_rasters[[w]] <- raster::calc(sum\_raster\_brick, sum)  
plot(sum\_rasters[[w]], main=m$formula, col=rev(rainbow(100)[1:70]))



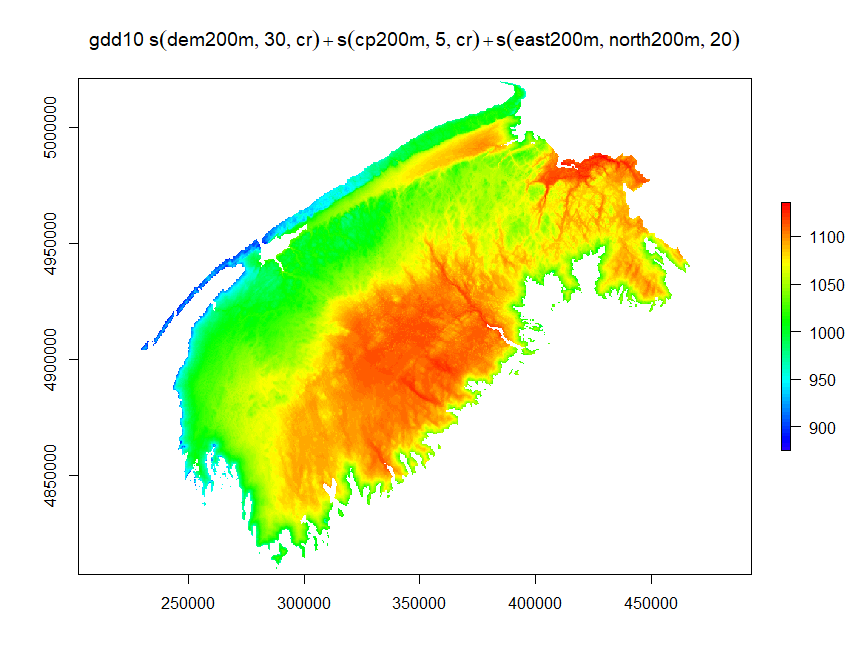
w <- w+1

2016

months <- df\_16$month %>% unique()  
  
m\_list <- list()  
c = 1  
for(month in months){  
 df\_month <- df\_16 %>% dplyr::filter(month== !!month)  
 m\_list[[c]] <- gam(gdd10~s(dem200m,k=30,bs='cr')+s(cp200m,k=5,bs='cr')+s(east200m,north200m,k=20),data=df\_month,method='REML',family=gaussian())  
 c <- c+1  
  
}  
gam\_rasters <- list()  
j <- 1  
month\_names <- c('April','May','June','July','August','September','October','November')  
for(m in m\_list){  
 gam\_rasters[[j]] <- raster::predict(rasters\_brick2,m)  
 plot(gam\_rasters[[j]], main=month\_names[[j]], col=rev(rainbow(100)[1:70]))  
 points(swns\_stations\_sp)  
 par(mfrow=c(2,2))  
 plot.gam(m, residuals = TRUE, pch = 1, cex = 1, shift = coef(m)[1])  
 par(mfrow=c(1,1))  
 j <- j + 1  
}



sum\_raster\_brick <- brick(gam\_rasters)  
sum\_rasters[[w]] <- raster::calc(sum\_raster\_brick, sum)  
plot(sum\_rasters[[w]], main=m$formula, col=rev(rainbow(100)[1:70]))



w <- w+1

Five year average

avg\_brick <- brick(sum\_rasters)  
avg\_raster <- calc(avg\_brick, mean)  
plot(avg\_raster, main=m$formula, col=rev(rainbow(100)[1:70]))

