P80headDiffProbabilities.R

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Fri Feb 22 14:55:05 2019

#==================================================================================================  
# R:/ModflowBinary/P80headDiffProbabilities.R  
#==================================================================================================  
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# Beginning of P80 Head Difference evaluation for Probable Change in Stressed Acres  
#  
# Created by Kevin A. Rodberg - February 2019  
#  
# Purpose: Uses 2 matrices returned by P80headDifference.R,  
# inports csvfiles of wetland point locations, and probability calculation  
# data [zetaModels generated by ZetaCalcIntegrals.R].   
# Creates cell by cell probability matrix of change in  
# wetland stress and calculates the probable change in acres  
# by wetland type (ridge or plain) from stressed to unstressed and  
# from unstressed to stressed.  
#==================================================================================================  
list.of.packages <-c( "data.table","devtools","utils","tcltk2","rModflow",  
 "future.apply","future","listenv",  
 "rasterVis","sp","maptools","rgeos","raster",  
 "ggplot2","RColorBrewer","tictoc","dplyr","polynom")  
  
new.packages <- list.of.packages[!(list.of.packages %in% installed.packages()[,"Package"])]  
if (!'githubinstall' %in% installed.packages()[,"Package"]){  
 install.packages('githubinstall')  
}  
if(length(new.packages)) install.packages(new.packages)  
library(devtools)  
if ("rModflow" %in% new.packages) devtools::install\_github("KevinRodberg/rModflow")  
lapply(list.of.packages,require, character.only=TRUE)

## Loading required package: data.table

## Loading required package: tcltk2

## Loading required package: tcltk

## Loading required package: rModflow

## Loading required package: future.apply

## Warning: package 'future.apply' was built under R version 3.5.2

## Loading required package: future

##   
## Attaching package: 'future'

## The following objects are masked from 'package:tcltk2':  
##   
## value, values

## Loading required package: listenv

## Loading required package: rasterVis

## Loading required package: raster

## Loading required package: sp

##   
## Attaching package: 'raster'

## The following object is masked from 'package:future':  
##   
## values

## The following objects are masked from 'package:tcltk2':  
##   
## values, values<-

## The following object is masked from 'package:data.table':  
##   
## shift

## Loading required package: lattice

## Loading required package: latticeExtra

## Loading required package: RColorBrewer

## Loading required package: maptools

## Checking rgeos availability: TRUE

##   
## Attaching package: 'maptools'

## The following object is masked from 'package:tcltk2':  
##   
## label

## Loading required package: rgeos

## rgeos version: 0.3-28, (SVN revision 572)  
## GEOS runtime version: 3.6.1-CAPI-1.10.1 r0   
## Linking to sp version: 1.3-1   
## Polygon checking: TRUE

## Loading required package: ggplot2

##   
## Attaching package: 'ggplot2'

## The following object is masked from 'package:latticeExtra':  
##   
## layer

## Loading required package: tictoc

## Warning: package 'tictoc' was built under R version 3.5.2

## Loading required package: dplyr

## Warning: package 'dplyr' was built under R version 3.5.2

##   
## Attaching package: 'dplyr'

## The following objects are masked from 'package:rgeos':  
##   
## intersect, setdiff, union

## The following objects are masked from 'package:raster':  
##   
## intersect, select, union

## The following objects are masked from 'package:data.table':  
##   
## between, first, last

## The following objects are masked from 'package:stats':  
##   
## filter, lag

## The following objects are masked from 'package:base':  
##   
## intersect, setdiff, setequal, union

## Loading required package: polynom

## Warning: package 'polynom' was built under R version 3.5.2

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## [1] TRUE

options(warn=-1)

# Provides GUI to choose model   
# - may not be needed any long in this code since its used in P80headDifference.R

source ("//ad.sfwmd.gov/dfsroot/data/wsd/SUP/devel/source/R/ReusableFunctions/tclFuncs.R")  
#source ("./ECFTX/tclFuncs.R")  
  
plan(multiprocess)  
ip=0  
lowQuantile = 999  
hiQuantile = -999  
pltGrphs <- listenv(NULL)  
probReturn <- listenv(NULL)  
  
#==================================================================================================  
tic('Process one layer')  
#==================================================================================================

# Code provides option to not reread very large files  
# MFLay <- NULL is an easy way to force P80headDifference to start

if (!exists('Layer1SIM2d') | !exists('MFLay')) {  
 MFLay <- 1  
 source ("//ad.sfwmd.gov/dfsroot/data/wsd/SUP/devel/source/R/ModflowBinary/P80headDifference.R")  
} else {   
 if(!(utils::askYesNo(paste("Do you want to use layer ",MFLay,   
 " from the previous binary heads data?"),  
 prompts = getOption("askYesNo",   
 gettext(c("Yes", "No", "Cancel")))))){  
 if (MFLay == 1){ MFLay <- 3 } else { MFLay <-1 }  
 source ("//ad.sfwmd.gov/dfsroot/data/wsd/SUP/devel/source/R/ModflowBinary/P80headDifference.R")  
}  
}

## Initiating call to readHeadsbinByLay for Layer 1 as Reference Condition [+]  
## with input from \\ad.sfwmd.gov\dfsroot\data\wsd\SUP\proj\CFWI\_WetlandStress\Update2018\ModelRuns\Run\_50%Rd\TR11.hds   
## Initiating call to readHeadsbinByLay for Layer 1 as Model Simulation of Interest [:]  
## with input from \\ad.sfwmd.gov\dfsroot\data\wsd\SUP\proj\CFWI\_WetlandStress\Update2018\ModelRuns\Run\_Calib\TR11.hds   
## Waiting for background processing to complete   
## +:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+:+::  
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## Heads Retrieval: 58.41 sec elapsed  
## Initiating Percentile rank calculations   
## P80 Calculations: 82.09 sec elapsed  
## Modflow Binary Heads Data Processing: 140.5 sec elapsed

#==================================================================================================  
tic('Create Differences from P80 Heads Layers')  
#==================================================================================================  
dataPath <- '//ad.sfwmd.gov/dfsroot/data/wsd/SUP/proj/CFWI\_WetlandStress/Update2018'  
#dataPath <- 'C:/Users/Kevin/Desktop/ECFTX'  
  
#Hint: If I subtract from this diffrence I get Stressed Wetlands Recovering  
  
DiffLay %<-% (qRC - qSIM)   
  
#DiffLay <- (qSIM - qRC) -1.5

# Calculate mean water level layers simultaneously

avgRC %<-% future\_apply (Layer1RC2d,MARGIN=c(1,2),FUN=mean,na.rm=T)  
avgSIM %<-%future\_apply (Layer1SIM2d,MARGIN=c(1,2),FUN=mean,na.rm=T)

# Calculate a mean difference water level layer

HdDif <- avgRC-avgSIM  
  
#==================================================================================================  
# Fisnished Creating Differences from P80 Heads Layers  
#==================================================================================================  
toc()

## Create Differences from P80 Heads Layers: 30.81 sec elapsed

#==================================================================================================  
tic('GIS overhead')  
#==================================================================================================  
cat('Developing GIS data sets for raster plots \n')

## Developing GIS data sets for raster plots

# NAD83 HARN StatePlane Florida East FIPS 0901 Feet

HARNSP17ft = CRS("+init=epsg:2881")  
HARNUTM17Nm = CRS("+init=epsg:3747")  
latlongs = CRS("+proj=longlat +datum=WGS84")

# Set up county boundry shapefile for overlay   
# on raster maps

gClip <- function(shp, bb) {  
 if (class(bb) == "matrix")  
 b\_poly <- as(extent(as.vector(t(bb))), "SpatialPolygons")  
 else  
 b\_poly <- as(extent(bb), "SpatialPolygons")  
 rgeos::gIntersection(shp, b\_poly, byid = T)  
}  
  
WMDbnd.Path <- "//whqhpc01p/hpcc\_shared/krodberg/NexRadTS"  
WMDbnd.Shape <- "CntyBnds"  
  
CFWIbnd.Path <-"//ad.sfwmd.gov/dfsroot/data/wsd/GIS/GISP\_2012/DistrictAreaProj/CFWI/Data"  
CFWIbnd.Shape <- "CFWI\_Boundary"  
  
physio.Path <-paste0("//ad.sfwmd.gov/dfsroot/data/wsd/GIS/GISP\_2012/",  
 "References/FDEP/Richardson\_Sept2012/PhysiograhicProvinces")  
physio.shape <- "PHYSIOGRAPHIC\_PROVINCES"  
  
SomeLakes.Path <- paste0("//ad.sfwmd.gov/dfsroot/data/wsd/GIS/GISP\_2012/DistrictAreaProj/",  
 "ECFT/Data/Waterbodies")  
SomeLakes.shape <- "Lakecells\_Dissolve"  
  
WMDbnd %<-% rgdal::readOGR(dsn=WMDbnd.Path,layer=WMDbnd.Shape,verbose=FALSE)  
CFWIbnd %<-% rgdal::readOGR(dsn=CFWIbnd.Path,layer=CFWIbnd.Shape,verbose=FALSE)  
physiobnd %<-% rgdal::readOGR(dsn=physio.Path,layer=physio.shape,verbose=FALSE)  
SomeLakes %<-% rgdal::readOGR(dsn=SomeLakes.Path,layer=SomeLakes.shape,verbose=FALSE)  
  
WMDbnd <- sp::spTransform(WMDbnd,CRS=HARNSP17ft)  
CFWIbnd <- sp::spTransform(CFWIbnd,CRS=HARNSP17ft)  
physiobnd <- sp::spTransform(physiobnd,CRS=HARNSP17ft)  
SomeLakes <- sp::spTransform(SomeLakes,CRS=HARNSP17ft)  
#==================================================================================================  
# Finished GIS overhead  
#==================================================================================================  
toc()

## GIS overhead: 4.78 sec elapsed

#==================================================================================================  
tic('Develop rasters')  
#==================================================================================================

# calculate number of rows and columns

res=MFmodel.Params[model,]$res  
xmin=MFmodel.Params[model,]$xmin  
ymin=MFmodel.Params[model,]$ymin  
rasRows=MFmodel.Params[model,]$nrows  
rasCols=MFmodel.Params[model,]$ncols  
xmax=xmin+(res\*rasCols)  
ymax=ymin+(res\*rasRows)  
  
cellsize=c(res,res)  
ras <- raster::raster(res=cellsize, xmn=xmin,xmx=xmax,ymn=ymin,ymx=ymax,crs=HARNSP17ft)

# define raster and map extents using MFmodel data extents

rasExt <- raster::extent(ras)  
clpBnds2 <- gClip(WMDbnd, ras)

# Create raster plot of the DiffMatrix  
# note: t() is used to transpose the array axis for plotting

diffRas<-raster::raster(t(DiffLay[,]),rasExt[1:4], crs=HARNSP17ft)  
  
diffRas <- raster::crop(diffRas, extent(buffer(CFWIbnd,width=10000)))  
diffRas %<-% raster::mask(diffRas, CFWIbnd)  
  
title = paste("Change in Head Layer ",MFLay,": \n",  
 RCheadsFile, '\nminus\n',SIMheadsFile)  
  
basePath <- paste0("//ad.sfwmd.gov/dfsroot/data/wsd/SUP/proj/",  
 "CFWI\_WetlandStress/Update2018/Figures4StressAcres/")  
  
filename = paste0('p80headDiffLay',MFLay,'.tif')  
ip=ip+1  
pltGrphs[[ip]] <- future({  
 raster::writeRaster(diffRas, filename, format="GTiff", overwrite=TRUE)  
})  
  
lowQuantile = min(lowQuantile,quantile(DiffLay,probs=c(.03),na.rm=T),na.rm=T)  
hiQuantile = max(hiQuantile,quantile(DiffLay,probs=c(.97),na.rm=T),na.rm=T)  
my.at = c(quantile(DiffLay,probs=c(.00001),na.rm=T),  
 -2.5,-2.0,-1.5,-1.25,-1.0,-.75,-.5,-.25,-.2,-.15,-.1,-.05,0.0,  
 .05,.1,.15,.2,0.25,0.50,0.75,1.0,1.25,1.5,2.0,2.5,  
 quantile(DiffLay,probs=c(.99999),na.rm=T))  
  
Class1.Wetland.Info <-   
 read.csv(paste0(dataPath,"/Class 1 Wetland Info for Analysis ALLv1.csv"))  
c1Wtl.pnts <-  
 sp::SpatialPointsDataFrame(Class1.Wetland.Info[,11:12],Class1.Wetland.Info,  
 proj4string=latlongs)  
c1Wtl.pnts <- sp::spTransform(c1Wtl.pnts,HARNSP17ft)  
  
filename=paste0(basePath,"Lay",MFLay,"\_P80HeadDifference.png")  
WLTheme = rasterTheme(region = brewer.pal('BrBG', n = 9))  
options(scipen=7)  
myplot= (levelplot(diffRas,par.settings = WLTheme,at=my.at,main=title)+  
 latticeExtra::layer(sp.points(c1Wtl.pnts, pch = 20,col = "black")) +  
 latticeExtra::layer(sp.text(coordinates(c1Wtl.pnts),  
 txt=c1Wtl.pnts$CFCA.EMT.ID,pos=1,cex=.5 )) +  
 latticeExtra::layer(sp.polygons(clpBnds2, col='darkgray'))+  
 latticeExtra::layer(sp.polygons(physiobnd, col='brown'))+  
 latticeExtra::layer(sp.polygons(SomeLakes, col='gray'))+  
 latticeExtra::layer(sp.polygons(CFWIbnd, col='red'))  
)  
trellis.device(device="png", filename=filename, width=4500,height=4500,  
 units="px",res=300)  
print(myplot)  
dev.off()

## png   
## 2

# Convert array layers to rasters

qRCras %<-% raster::raster(t(qRC[,]),rasExt[1:4], crs=HARNSP17ft)  
qSIMras %<-% raster::raster(t(qSIM[,]),rasExt[1:4], crs=HARNSP17ft)  
RCras %<-% raster::raster(t(avgRC[,]),rasExt[1:4], crs=HARNSP17ft)  
SIMras %<-% raster::raster(t(avgSIM[,]),rasExt[1:4], crs=HARNSP17ft)  
HdDifras %<-% raster::raster(t(HdDif[,]),rasExt[1:4], crs=HARNSP17ft)  
  
qRCras[qRCras > 900]<-NA  
RCras[RCras > 900]<-NA  
qSIMras[qSIMras> 900 ]<-NA  
SIMras[SIMras> 900 ]<-NA

# Function to create maps as png and tif from rasters

plotTiffAndPng <- function(ras2Plot,rasName){  
 ras2Plot[ras2Plot > 900] <- NA  
 Rng = max(abs(quantile(ras2Plot,probs=c(.00001),na.rm=T)),  
 abs(quantile(ras2Plot,probs=c(.99999),na.rm=T)))  
 interval = Rng/10  
 my.at = c(seq(-Rng,Rng,interval))  
 filename = paste0(rasName,MFLay,'.tif')  
 writeRaster(ras2Plot, paste0(basePath,filename), format="GTiff", overwrite=TRUE)  
 filename = paste0(basePath,rasName,MFLay,'.png')  
 title =paste0(rasName,MFLay)  
 myplot= (levelplot(ras2Plot,par.settings = WLTheme,at=my.at, main = title)+  
 latticeExtra::layer(sp.polygons(clpBnds2, col='darkgray'))+  
 latticeExtra::layer(sp.polygons(physiobnd, col='brown'))+  
 latticeExtra::layer(sp.polygons(SomeLakes, col='blue'))+  
 latticeExtra::layer(sp.polygons(CFWIbnd, col='red')))  
 trellis.device(device="png", filename=filename, width=3000,height=4500,units="px",res=300)  
 print(myplot)  
 dev.off()  
}  
  
ip=ip+1  
pltGrphs[[ip]] <- future({plotTiffAndPng(HdDifras,'meanHeadDiffLay')})  
ip=ip+1  
pltGrphs[[ip]] <- future({plotTiffAndPng(SIMras,'meanSIMLay')})  
ip=ip+1  
pltGrphs[[ip]] <- future({plotTiffAndPng(RCras,'meanRCLay')})  
ip=ip+1  
pltGrphs[[ip]] <- future({plotTiffAndPng(qSIMras,'p80SIMLay')})  
ip=ip+1  
pltGrphs[[ip]] <- future({plotTiffAndPng(qRCras,'p80RCLay')})  
  
#==================================================================================================  
# Fisnished Developing rasters for GIS and map pngs  
#==================================================================================================  
toc()

## Develop rasters: 21.64 sec elapsed

#==================================================================================================  
tic("Read Wetland datasets")  
#==================================================================================================  
# Read Polynomial Coefficiencts for Zeta Calculations  
# and  
# wetlands points by class from GIS exports  
# and  
# eliminate unnecessary columns, rename fields for consistency,   
# as well as fix Stressed column indicator to be consistent for   
# Class 1 and 2  
#====================================================================  
# polys<-read.csv(paste0(dataPath,"/PolyCoeff2019.csv"))  
SFact<-read.csv(paste0(dataPath,"/StressFactor.csv"))  
  
#class1 %<-% read.csv(paste0(dataPath,"/WetlandsClass1\_2018.csv"))  
class1 %<-% read.csv(paste0(dataPath,"/WetlandsClass1\_2019.csv"))  
#class2 %<-% read.csv(paste0(dataPath,"/WetlandsClass2\_2018.csv"))  
class2 %<-% read.csv(paste0(dataPath,"/WetlandsClass2\_2019.csv"))  
#class3 %<-% read.csv(paste0(dataPath,"/WetlandsClass3\_2018.csv"))  
class3 %<-% read.csv(paste0(dataPath,"/WetlandsClass3\_2019.csv"))  
  
class1<- merge(x=class1,   
 y=Class1.Wetland.Info[,c('CFCA.EMT.ID','Stress.Status.in.2018')],  
 by.x = "CFCA\_EMT\_I", by.y = 'CFCA.EMT.ID')  
  
NotNeeded <- c("OBJECTID","CFCA\_EMT\_1","PERCENT\_AC","Shape\_Length","Shape\_Area")  
class1[NotNeeded]<-NULL  
setnames(class1, "CFCA\_EMT\_I", "CFCA\_EMT\_ID")  
setnames(class1, "Wetland\_Ty", "Wetland\_Type")  
setnames(class1, "Physiograp", "Phys")  
setnames(class1, "Stress.Status.in.2018", "Stressed")  
setnames(class1, "WetNoWater", "Acres")  
  
levels(class1$Stressed)[which(levels(class1$Stressed)=="Not Stressed")] <- "NO"  
levels(class1$Stressed)[which(levels(class1$Stressed)=="Stressed")] <- "YES"  
NotNeeded<- c( "OBJECTID\_1","FID\_09\_LU\_","Class\_2","FID\_Class2","OBJECTID" ,"MULTIPLE\_P",  
 "Acres","Shape\_Length","Shape\_Area")  
class2[NotNeeded]<-NULL  
setnames(class2, "CFCA\_ID", "CFCA\_EMT\_ID")  
setnames(class2, "ACRES\_COMB", "Acres")  
setnames(class2, "Wetland\_Ty", "Phys")  
  
# Needed<-c("SEQNUM","Hydroclass","EcoHydro\_T","Wetland\_Type","Urban\_Density","SusceptGW", "Lake\_",  
# "Name", "WETLAND\_CLASS3","ACRES\_COMBINED\_UNION","XCOORD\_UTM","YCOORD\_UTM")  
Needed<-c("SEQNUM","Hydroclass","EcoHydro\_T","Wetland\_Ty","Urban\_Dens","SusceptGW",   
 "Class","XCOORD\_UTM","YCOORD\_UTM","ACRES\_COMB")  
  
class3 <- class3[,Needed]  
class3[NotNeeded]<-NULL  
setnames(class3, "ACRES\_COMB", "Acres")  
setnames(class3, "Wetland\_Ty", "Phys")  
setnames(class3, "Urban\_Dens", "Urban\_Density")  
  
  
vars4AreaZ <- c("Zus","Zsu")  
class1[vars4AreaZ]<- NA  
class2[vars4AreaZ]<- NA  
class3[vars4AreaZ]<- NA  
  
vars4SF <- c("SFsu","SFus")  
class1[vars4SF]<-1.0  
class2[vars4SF]<-1.0  
class3[vars4SF]<-NA

# Wetland Weighting Factors:  
# The reason for the weighting factors is that the Class 1 & Class 2 wetlands have  
# been physically inspected.   
#  
# 1. Wetlands that are of the wrong hydrobiologic type have been excluded   
# 2. "Significantly Hydrologically Altered" (SHA) Wetlands have been excluded   
# 3. Wetland condition is known to be either stressed or unstressed.  
#   
# Without physical inspections of the Class 3 wetlands to supply that information,  
# the total GIS wetland area is assigned a probability factor to represent the   
# likelihood of the wetland being one for which either the Zu-s or Zs-u equation is   
# appropriate.   
#  
# These probability factors were derived by comparing the Class 2 wetlands to the   
# corresponding total wetland coverages.   
#  
# First multiply by the Dissimilarity Factor and the SHA Factor -   
# this reduces the total acreage by an amount that corrects for the likelihood   
# of GIS wetland area that is the "wrong" type of wetland, or that is SHA.   
#  
# Second Multiply that product again -   
# once by the fraction of the surviving wetlands that are initially unstressed   
# to produce the SFu-s total correction factor,   
# and once by the fraction of the surviving wetlands that are initially   
# stressed to produce the SFs-u total correction factor.  
#  
# TotCorrFact\_us = DisFac\*SHA\_Fact\*SFus  
# TotCorrFact\_su = DisFac\*SHA\_Fact\*SFsu

# Wetland Urban Dissimilar SHA Stress Stress Correction Correction   
# Type Density Factor Factor Factor Factor Factor Factor  
# (u to s) (s to u) (u-s) (s-u)

# Plain low 0.694 0.820 0.824 0.176 0.469 0.100  
# Plain Mod & High 0.616 0.581 0.824 0.176 0.295 0.063  
# Ridge All 0.671 1.000 0.581 0.419 0.390 0.281

class3[class3$Phys=='Plain',]$SFus = SFact[SFact$Wetland.Type=='Plain' & SFact$Urban.Density == 'low',]$Sfus  
class3[class3$Phys=='Plain',]$SFsu = SFact[SFact$Wetland.Type=='Plain' & SFact$Urban.Density == 'low',]$Sfsu  
  
class3[class3$Phys=='Plain' & (class3$Urban\_Density=='Moderate' | class3$Urban\_Density=='High') ,]$SFus =  
 SFact[SFact$Wetland.Type=='Plain' & SFact$Urban.Density == 'Mod & High',]$Sfus  
class3[class3$Phys=='Plain' & (class3$Urban\_Density=='Moderate' | class3$Urban\_Density=='High') ,]$SFsu =   
 SFact[SFact$Wetland.Type=='Plain' & SFact$Urban.Density == 'Mod & High',]$Sfsu  
  
class3[class3$Phys=='Ridge',]$SFus = SFact[SFact$Wetland.Type=='Ridge',]$Sfus  
class3[class3$Phys=='Ridge',]$SFsu = SFact[SFact$Wetland.Type=='Ridge',]$Sfsu  
#==================================================================================================  
# Finished Reading Wetland datasets  
#==================================================================================================  
toc()

## Read Wetland datasets: 2.38 sec elapsed

#==================================================================================================  
tic('Calculate probable stress for wetlands')  
#==================================================================================================

# Create template dataframe for Stats

if (!exists('Stats')){  
 Layer <- c(rep(1,12),rep(3,12))  
 Class<- rep(c(1,1,2,2,3,3,1,1,2,2,3,3),2)  
 Stress<-rep(c(rep('Stressed',6),rep('Unstressed',6)),2)  
 Phys<-rep(c('Ridge','Plain'),12)  
 Stats<-data.frame(Layer,Class,Stress,Phys,stringsAsFactors=FALSE)  
 statColumns<-c('Initial','Delta')  
 Stats[statColumns]<-NA  
}  
  
WetType = c("Plain" ,"Ridge")  
  
WetCond<-c('YES', 'NO')  
ZetaCond<-c('Stressed', 'Unstressed')

# Read zeta Models created by ZetaCalcIntegrals.R rather than polyCoeff.csv

#workdir= "Y:/proj/CFWI\_WetlandStress/Update2018"  
workdir= "//ad.sfwmd.gov/dfsroot/data/wsd/SUP/proj/CFWI\_WetlandStress/Update2018"  
zetaModels=readRDS( paste0(workdir,"zetaModels.RDS"))

# Function to create probLay matrix of probabilities

getProbLay<- function(DiffLay,NegModel,PosModel){  
 probLay<-DiffLay  
 newdata <- data.frame (delta = as.vector(DiffLay[DiffLay<0]))  
 probtemp<- predict(NegModel,newdata=newdata)  
 probLay[DiffLay<0]<-probtemp  
 newdata <- data.frame (delta = as.vector(probLay[DiffLay>=0]))  
 probtemp<- predict(PosModel,newdata=newdata)  
 probLay[DiffLay>=0]<-probtemp  
 return(probLay)  
}  
ip=0  
ipl=0  
for (c in ZetaCond){  
 p<- NULL  
 probLay<- (DiffLay\*0)  
 for (t in WetType) {  
 cc = 'NO'  
 zetaName = 'us'  
 probTitle <- 'Unstressed to Stressed'  
 if(c == 'Stressed'){  
 cc = 'YES'  
 zetaName = 'su'  
 probTitle <- 'Stressed to Unstressed'  
 }  
  
 if (t == 'Ridge' & c == 'Unstressed'){  
 probLay<-getProbLay(DiffLay,zetaModels$ZRPu\_sNeg,zetaModels$ZRPu\_sPos)  
 } else if (t == 'Ridge' & c == 'Stressed'){  
 probLay<-getProbLay(DiffLay,zetaModels$ZRPs\_uNeg,zetaModels$ZRPs\_uPos)  
 } else if (t == 'Plain' & c == 'Unstressed'){  
 probLay<-getProbLay(DiffLay,zetaModels$ZPPu\_sNeg,zetaModels$ZPPu\_sPos)  
 }else if (t == 'Plain' & c == 'Stressed'){  
 probLay<-getProbLay(DiffLay,zetaModels$ZPPs\_uNeg,zetaModels$ZPPs\_uPos)  
 } else {  
 cat('Something goofed up!\n')  
 cat(paste(c, t))  
 }  
 probLay[probLay<0] <- 0  
 probLay[probLay>1] <- 1  
 #--------------------------------------------------------------------------  
 # probLay matrix of probabilities is intersected w/wetlands pnts by SEQNUM  
 #--------------------------------------------------------------------------  
 zetaCol <-match(paste0('Z',zetaName),names(class1))  
 class1[class1$Phys == t & class1$Stressed ==cc,zetaCol] <-  
 round(probLay[class1[class1$Phys == t & class1$Stressed ==cc,]$SEQNUM],8)  
   
 zetaCol <-match(paste0('Z',zetaName),names(class2))  
 class2[class2$Phys == t & class2$Stressed ==cc,zetaCol] <-  
 round(probLay[class2[class2$Phys == t & class2$Stressed ==cc,]$SEQNUM],8)  
   
 # Initial stress condition is not know for class 3  
 zetaCol <-match(paste0('Z',zetaName),names(class3))  
 class3[class3$Phys == t,zetaCol] <-  
 round(probLay[class3[class3$Phys == t,]$SEQNUM],8)  
 #--------------------------------------------------------------------------  
 # Crop raster data by extent of CFWI bndry  
 #--------------------------------------------------------------------------  
 probRas<-raster::raster(t(probLay[,]),rasExt[1:4], crs=HARNSP17ft)   
 yourTheme = rasterTheme(region = brewer.pal('YlOrRd', n = 9))  
 CFWIprobs <- raster::crop(probRas, extent(buffer(CFWIbnd,width=10000)))  
 CFWIprobs <- raster::mask(CFWIprobs, CFWIbnd)  
 ip=ip+1  
 pltGrphs[[ip]] <- future({  
 plotTiffAndPng(CFWIprobs,paste('CFWIprob',t,probTitle))   
 })  
   
 }  
}

# Class 1, 2, & 3 wetland probable change in area is calculated as  
# Stressed becoming unstressed:  
# AreaXZsu = Acres \* SFsu \* probs  
#  
# Unstressed becoming stressed:  
# AreaXZus = Acres \* SFus \* probs

class1 <- class1 %>% mutate(AreaXZsu = Acres\*SFsu\*Zsu)  
class1 <- class1 %>% mutate(AreaXZus = Acres\*SFus\*Zus)  
  
class2 <- class2 %>% mutate(AreaXZsu = Acres\*SFsu\*Zsu)  
class2 <- class2 %>% mutate(AreaXZus = Acres\*SFus\*Zus)  
  
class3 <- class3 %>% mutate(AreaXZsu = Acres\*SFsu\*Zsu)  
class3 <- class3 %>% mutate(AreaXZus = Acres\*SFus\*Zus)  
#==================================================================================================  
# Fisnised Calculating probable stress for wetlands  
#==================================================================================================  
toc()

## Calculate probable stress for wetlands: 31.84 sec elapsed

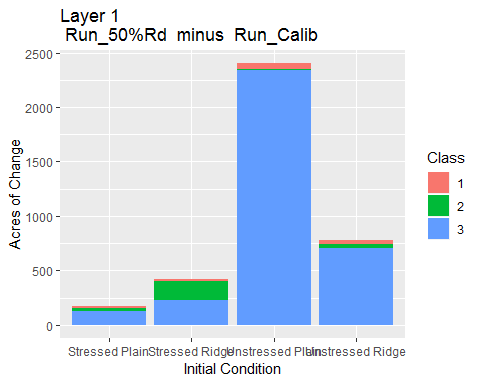
#==================================================================================================  
tic("Creating maps")  
#==================================================================================================  
class1.pnts <- sp::SpatialPointsDataFrame(coords = class1[, c("XCOORD\_UTM", "YCOORD\_UTM")],   
 data = class1,proj4string = HARNUTM17Nm)  
c1.pnts<-sp::spTransform(class1.pnts,HARNSP17ft)  
  
class2.pnts <- sp::SpatialPointsDataFrame(coords = class2[, c("XCOORD\_UTM", "YCOORD\_UTM")],   
 data = class2,proj4string = HARNUTM17Nm)  
c2.pnts<-sp::spTransform(class2.pnts,HARNSP17ft)  
  
class3.pnts <-sp::SpatialPointsDataFrame(coords = class3[, c("XCOORD\_UTM", "YCOORD\_UTM")],  
 data = class3,proj4string = HARNUTM17Nm)  
c3.pnts<-sp::spTransform(class3.pnts,HARNSP17ft)  
  
probRas<-raster::raster(t(probLay[,]),rasExt[1:4], crs=HARNSP17ft)  
yourTheme = rasterTheme(region = brewer.pal('YlOrRd', n = 9))

# Crop raster data by extent of CFWI bndry

CFWIprobs <- raster::crop(probRas, extent(buffer(CFWIbnd,width=10000)))  
CFWIprobs <- raster::mask(CFWIprobs, CFWIbnd)  
  
updateStatsDelta<- function(Stats,MFLay,t,c,class,source) {  
 # cat(paste(Stats[Stats$Layer == MFLay &   
 # Stats$Phys ==t &   
 # Stats$Stress ==c &   
 # Stats$Class==class,]$Delta,  
 # MFLay,t,c,class,sum(source,na.rm=T),'\n'))  
 Stats[Stats$Layer == MFLay &   
 Stats$Phys ==t &   
 Stats$Stress ==c &   
 Stats$Class==class,]$Delta <- round(sum(source,na.rm=T),2)  
 return(Stats)  
}  
updateStatsInitial<- function(Stats,MFLay,t,c,class,Acres) {  
 # cat(paste(Stats[Stats$Layer == MFLay &   
 # Stats$Phys ==t &   
 # Stats$Stress ==c &   
 # Stats$Class==class,]$Initial,  
 # MFLay,t,c,class,sum(Acres,na.rm=T),'\n'))  
 Stats[Stats$Layer == MFLay &   
 Stats$Phys ==t &   
 Stats$Stress ==c &   
 Stats$Class==class,]$Initial <- round(sum(Acres,na.rm=T),2)  
 return(Stats)  
}  
  
ip=0  
deltas = stack()  
for (t in WetType) {  
 ttlWetAcres = 0  
 for (c in ZetaCond){  
 if (c == 'Stressed') {  
 cc <-'YES'  
 c1sub <-c1.pnts[c1.pnts$Phys==t & c1.pnts$Stressed==cc,c('Phys','AreaXZsu')]  
 c2sub <-c2.pnts[c2.pnts$Phys==t & c2.pnts$Stressed==cc,c('Phys','AreaXZsu')]  
 c3sub <-c3.pnts[c3.pnts$Phys==t ,c('Phys','AreaXZsu')]  
 c123sub<-rbind(c1sub,c2sub)  
 c123sub<-rbind(c123sub,c3sub)  
 Stats<-updateStatsDelta(Stats,MFLay,t,c,1,c1sub$AreaXZsu)  
 Stats<-updateStatsDelta(Stats,MFLay,t,c,2,c2sub$AreaXZsu)  
 Stats<-updateStatsDelta(Stats,MFLay,t,c,3,c3sub$AreaXZsu)  
  
 Acres = c1.pnts[c1.pnts$Phys ==t & c1.pnts$Stressed ==cc ,]$Acres  
 Stats<-updateStatsInitial(Stats,MFLay,t,c,1,Acres)  
 Acres = c2.pnts[c2.pnts$Phys ==t & c2.pnts$Stressed ==cc ,]$Acres  
 Stats<-updateStatsInitial(Stats,MFLay,t,c,2,Acres)  
 Acres = c3.pnts[c3.pnts$Phys ==t,]$Acres \* c3.pnts[c3.pnts$Phys ==t,]$SFsu  
 Stats<-updateStatsInitial(Stats,MFLay,t,c,3,Acres)  
   
 } else {  
 cc<-'NO'  
 c1sub <-c1.pnts[c1.pnts$Phys==t & c1.pnts$Stressed==cc,c('Phys','AreaXZus')]  
 c2sub <-c2.pnts[c2.pnts$Phys==t & c2.pnts$Stressed==cc,c('Phys','AreaXZus')]  
 c3sub <-c3.pnts[c3.pnts$Phys==t,c('Phys','AreaXZus')]  
   
 c123sub<-rbind(c1sub,c2sub)  
 c123sub<-rbind(c123sub,c3sub)  
   
 Stats<-updateStatsDelta(Stats,MFLay,t,c,1,c1sub$AreaXZus)  
 Stats<-updateStatsDelta(Stats,MFLay,t,c,2,c2sub$AreaXZus)  
 Stats<-updateStatsDelta(Stats,MFLay,t,c,3,c3sub$AreaXZus)  
  
 Acres = c1.pnts[c1.pnts$Phys ==t & c1.pnts$Stressed ==cc ,]$Acres  
 Stats<-updateStatsInitial(Stats,MFLay,t,c,1,Acres)  
 Acres = c2.pnts[c2.pnts$Phys ==t & c2.pnts$Stressed ==cc ,]$Acres  
 Stats<-updateStatsInitial(Stats,MFLay,t,c,2,Acres)  
 Acres = c3.pnts[c3.pnts$Phys ==t,]$Acres \* c3.pnts[c3.pnts$Phys ==t,]$SFus  
 Stats<-updateStatsInitial(Stats,MFLay,t,c,3,Acres)  
 }   
 if (MFLay == 3){  
 Stats[Stats$Layer == 3 & Stats$Phys =='Plain' ,]$Delta<- 0  
 Stats[Stats$Layer == 3 & Stats$Phys =='Plain' ,]$Initial<- 0  
 }  
 c1.delta<-Stats[Stats$Layer == MFLay & Stats$Phys ==t & Stats$Stress ==c & Stats$Class==1,]$Delta  
 c2.delta<-Stats[Stats$Layer == MFLay & Stats$Phys ==t & Stats$Stress ==c & Stats$Class==2,]$Delta  
 c3.delta<-Stats[Stats$Layer == MFLay & Stats$Phys ==t & Stats$Stress ==c & Stats$Class==3,]$Delta  
   
 c1.initial <-Stats[Stats$Layer == MFLay & Stats$Phys ==t & Stats$Stress ==c & Stats$Class==1,]$Initial  
 c2.initial <-Stats[Stats$Layer == MFLay & Stats$Phys ==t & Stats$Stress ==c & Stats$Class==2,]$Initial  
 c3.initial <-Stats[Stats$Layer == MFLay & Stats$Phys ==t & Stats$Stress ==c & Stats$Class==3,]$Initial  
   
 tabStats = paste('c1=',round(c1.delta,2),'c2=',round(c2.delta,2),'c3=',round(c3.delta,2),'\n',  
 round(sum(c1.delta,c2.delta,c3.delta),2),'/',  
 round(sum(c1.initial,c2.initial,c3.initial),2),'=',   
 round(100\*sum(c1.delta,c2.delta,c3.delta)/  
 sum(c1.initial,c2.initial,c3.initial),2),'% of',t,'Wetlands')  
 if (c == ZetaCond[2]){  
 title = paste0('Layer ',MFLay,' ',c,' ',t,' to ', ZetaCond[1], '\n',tabStats)  
 filename=paste(basePath,paste0('Lay',MFLay,t,'-',c,'\_to\_',ZetaCond[1]),".png",sep="")  
 acre.At = c(0,.5,1,2.5,5,7.5,10,max(c123sub$AreaXZus))  
 deltaArea<- rasterize(c123sub,CFWIprobs,c123sub$AreaXZus)  
 tiffilename=paste(basePath,paste0('Lay',MFLay,t,'-',c,'\_to\_',ZetaCond[1]),".tif",sep="")  
 }else {  
 title = paste0('Layer ',MFLay,' ',c,' ',t,' to ', ZetaCond[2], '\n',tabStats)  
 filename=paste(basePath,paste0('Lay',MFLay,t,'-',c,'\_to\_',ZetaCond[2]),".png",sep="")  
 acre.At = c(0,.5,1,2.5,5,7.5,10,max(c123sub$AreaXZsu,na.rm=TRUE))  
 deltaArea<- rasterize(c123sub,CFWIprobs,c123sub$AreaXZsu)  
 tiffilename=paste(basePath,paste0('Lay',MFLay,t,'-',c,'\_to\_',ZetaCond[2]),".tif",sep="")  
 }  
   
 deltaArea[deltaArea==0]<-NA  
   
 if(!(MFLay ==3 & t == 'Plain')){  
 if (cc=='NO'){  
 yourTheme = rasterTheme(region = brewer.pal('YlOrRd', n = 9))  
 } else {  
 yourTheme = rasterTheme(region = brewer.pal('YlGn', n = 9))  
   
 }  
   
 ip=ip+1  
 deltas <- stack(deltas,deltaArea)  
 pltGrphs[[ip]] <- future({  
 myplot= (levelplot(deltaArea,par.settings = yourTheme,at=acre.At, main = title)+  
 latticeExtra::layer(sp.polygons(clpBnds2, col='darkgray'))+  
 latticeExtra::layer(sp.polygons(physiobnd, col='brown'))+  
 latticeExtra::layer(sp.polygons(SomeLakes, col='blue'))+  
 latticeExtra::layer(sp.polygons(CFWIbnd, col='red')))  
 trellis.device(device="png", filename=filename, width=3000,height=4500,units="px",res=300)  
 print(myplot)  
 dev.off()  
 })  
 ip=ip+1  
 pltGrphs[[ip]] <- future({  
 raster::writeRaster(deltaArea, tiffilename, format="GTiff", overwrite=TRUE)  
 })  
 }  
 }  
}  
if (MFLay == 1){  
 names(deltas)<- c('Plain\_StoU','Plain\_UtoS','Ridge\_StoU','Ridge\_UtoS')  
 deltas$Plain\_StoU <- deltas$Plain\_StoU\*(-1.0)  
} else {  
 names(deltas)<- c('Ridge\_StoU','Ridge\_UtoS')  
}  
deltas$Ridge\_StoU <- deltas$Ridge\_StoU\*(-1.0)  
index<-names(deltas)  
FinalNetStress <- stackApply(deltas,1,fun=sum,na.rm=TRUE)  
tiffilename=paste(basePath,paste0('Lay',MFLay,"\_NetStress.tif",sep=""))  
ip=ip+1  
  
# extreme = max(abs(maxValue(FinalNetStress)), abs(minValue(FinalNetStress)))  
filename=paste(basePath,paste0('Lay',MFLay,"\_NetStress.png",sep=""))  
title = paste('Lay',MFLay,'\_NetStress')  
if (lowQuantile <0){  
 ramp<-c(seq(lowQuantile, -.01, length=5), seq(0.01, hiQuantile, length=5))  
 yourTheme = rasterTheme(region = c(colorRampPalette(c("seagreen", "white"))(5),  
 colorRampPalette(c("white", "firebrick"))(5)))  
}else {  
 ramp<-seq(-1, hiQuantile, length=10)  
 yourTheme = rasterTheme(region =colorRampPalette(c("white", "firebrick"))(11))  
}  
pltGrphs[[ip]] <- future({  
 myplot= (levelplot(FinalNetStress,par.settings = yourTheme,at=ramp, main = title)+  
 latticeExtra::layer(sp.polygons(clpBnds2, col='darkgray'))+  
 latticeExtra::layer(sp.polygons(SomeLakes, col='blue'))+  
 latticeExtra::layer(sp.polygons(CFWIbnd, col='red')))  
 trellis.device(device="png", filename=filename, width=3000,height=4500,units="px",res=300)  
 print(myplot)  
 dev.off()  
})  
pltGrphs[[ip]] <- future({  
 raster::writeRaster(FinalNetStress, tiffilename, format="GTiff", overwrite=TRUE)  
})  
  
toc()

## Creating maps: 16.71 sec elapsed

#==================================================================================================  
# Finished Creating maps  
#==================================================================================================  
  
write.csv(Stats,paste0(basePath,'WetlandStressStats.csv'))  
#==================================================================================================  
# Create Bar Charts from Wetland Stats  
#==================================================================================================  
  
colours <- c("red", "orange", "blue", "yellow", "green")  
longStats<-melt(Stats,id.vars=1:4)  
longStats<-within(longStats, Class <- factor(Class))  
  
pieces<-unlist(strsplit(RCheadsFile,"[\\\\]|[^[:print:]]"))  
RCtitle <- pieces[length(pieces)-1]  
pieces<-unlist(strsplit(SIMheadsFile,"[\\\\]|[^[:print:]]"))  
SIMtitle <- pieces[length(pieces)-1]  
L = MFLay  
  
ggplot(longStats[longStats$variable=='Delta' & longStats$Layer == L,],   
 aes(x = paste(Stress,Phys), y = value,   
 fill = Class)) +  
 geom\_bar(stat = 'identity') +  
 xlab("Initial Condition") +  
 ylab("Acres of Change") +  
 ggtitle(paste("Layer",L,'\n',RCtitle,' minus ',SIMtitle))



plotfile =paste0(basePath,'Lay',L,'Barchart.png')  
ggsave(plotfile,width = 10,height = 7.5,units = "in",dpi = 300,device = "png")  
  
  
#==================================================================================================  
toc()

## Process one layer: 319.84 sec elapsed