Supplementary R code for Cochrane et al. (2019) ‘Mulifanua, Fagaloa, and Aleipata Excavations Indicate Lack of Early Terrestrial Archaeological Deposits along Various ‘Upolu (Samoa) Coastlines’

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# ABOUT

This document contains geostatistical estimates of the depth of subsurface sand deposits at Mulifanua and Aleipata on ’Upolu, Samoa. Values being interpolated are the starting depths of sand from auger cores.

# LOAD PACKAGES

Load the necessary R packages.

library(raster)  
library(gstat)

library(sp)  
library(GISTools)

library(rgdal)  
library(rasterVis)

library(rgl)

# Mulifanua

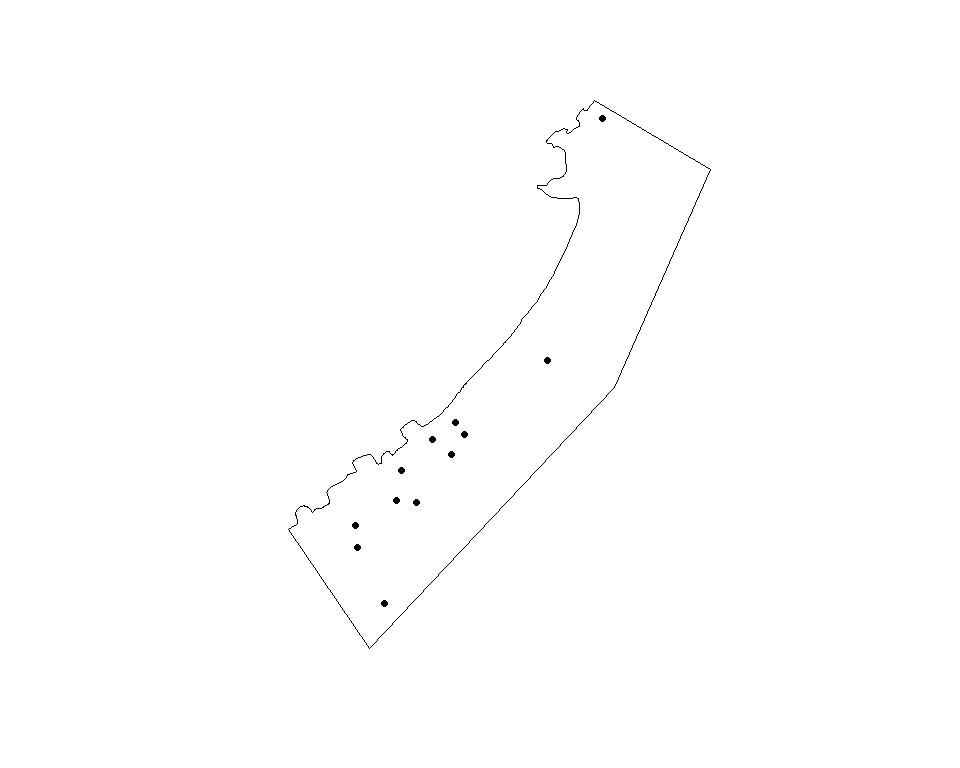
## LOAD DATA

Import necessary data. Ensure that data files are in the current working directory.

mulifanua <- readOGR(".", "mulifanua\_sand") #load core points  
m\_window <- readOGR(".", "mulifanua\_window") #load boundary window

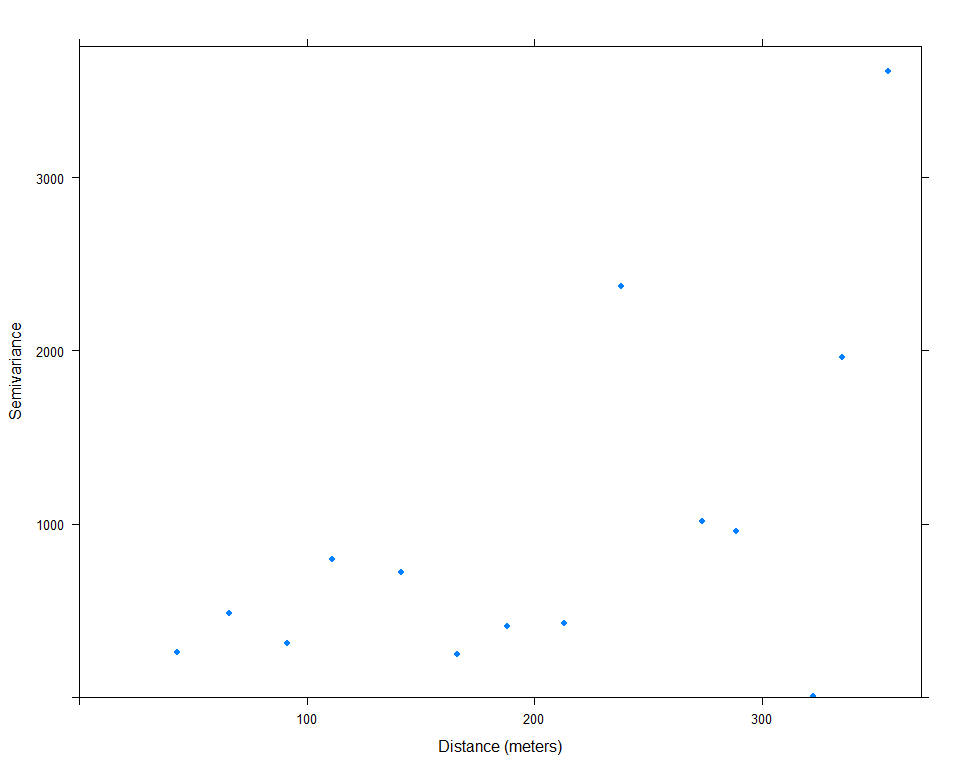
## PLOT DATA

plot(m\_window)  
plot(mulifanua, pch=16, add=T) #plot them



## CALCULATE SAMPLE VARIOGRAM

m\_vgm <- variogram(sand\_start~1, data=mulifanua)  
plot(m\_vgm, pch=16, xlab="Distance (meters)", ylab="Semivariance")



## FIT VARIOGRAM MODEL

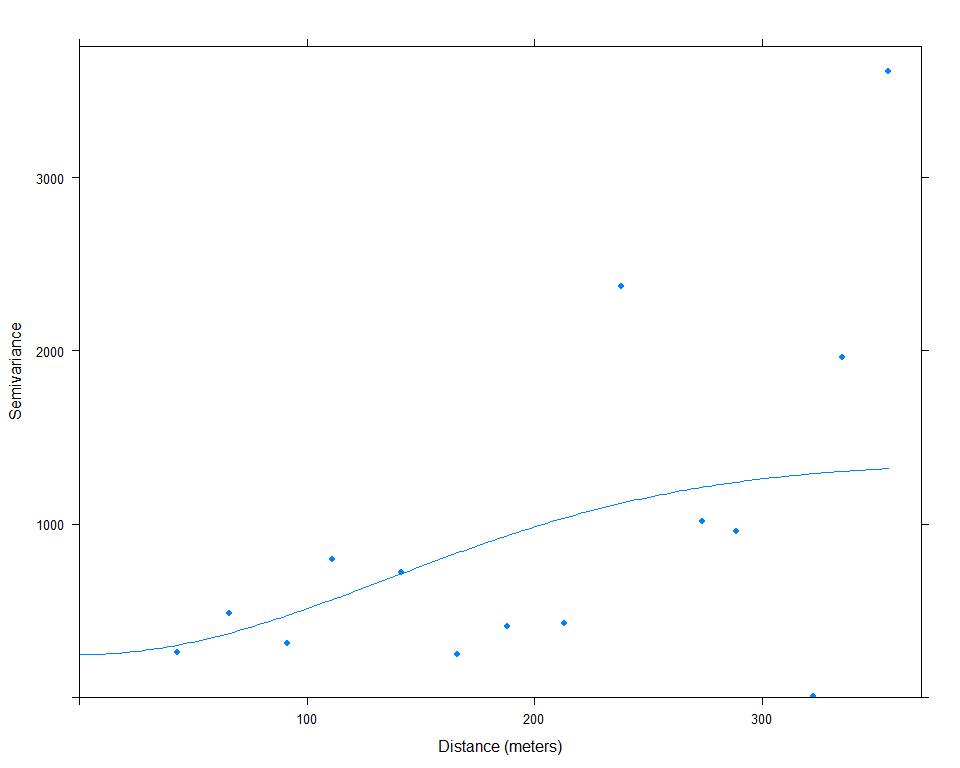
Here using a Gaussian model based on the distribution of points in the sample variogram.

fm\_vgm <- fit.variogram(m\_vgm, model=vgm(psill=NA, model= "Gau", range=NA, nugget=NA), fit.sills = T, fit.ranges = T)   
fm\_vgm

## model psill range  
## 1 Nug 245.7608 0.0000  
## 2 Gau 1109.9451 191.2799

## PLOT SAMPLE VARIOGRAM AND VARIOGRAM MODEL

plot(m\_vgm, fm\_vgm, pch=16, xlab="Distance (meters)", ylab="Semivariance")



## CREATE GRID TO INTERPOLATE OVER

mgrid1 <- spsample(m\_window, n=10000, type="regular")  
mgrid2 <- raster(extent(mgrid1), ncols=100, nrows=100)

## PERFORM ORDINARY KRIGING WITH A GAUSSIAN VARIOGRAM MODEL

mkrig1 <- krige(mulifanua$sand\_start~1, mulifanua, newdata=mgrid1, model=fm\_vgm)

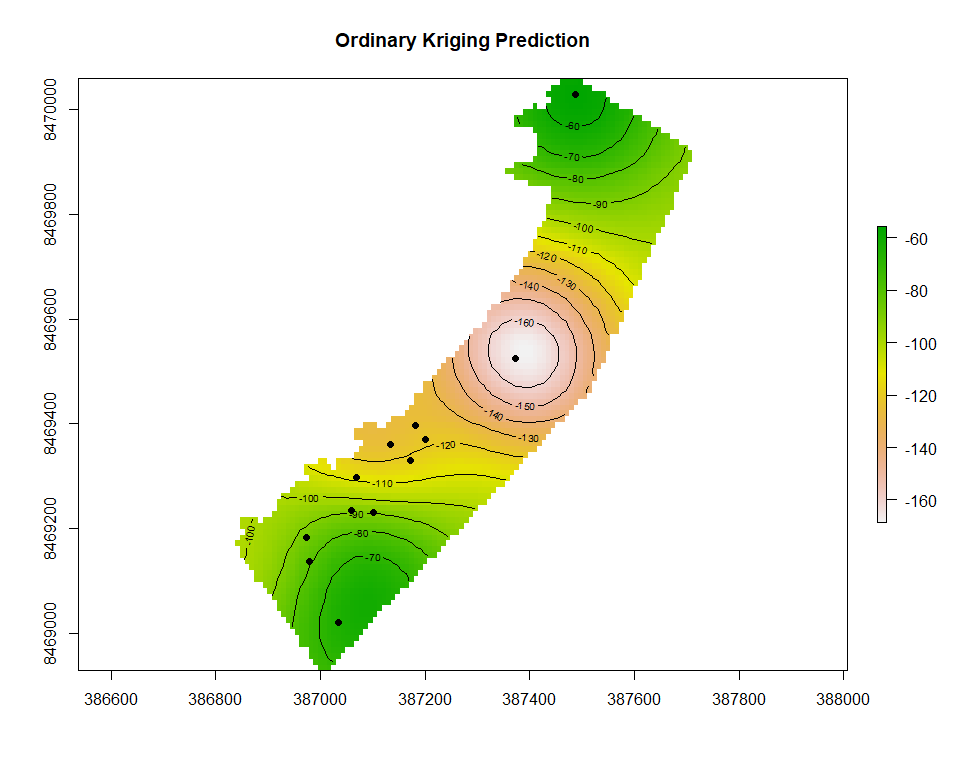
## [using ordinary kriging]

## CONVERT KRIGED ESTIMATES AND VARIANCE TO RASTER FILES

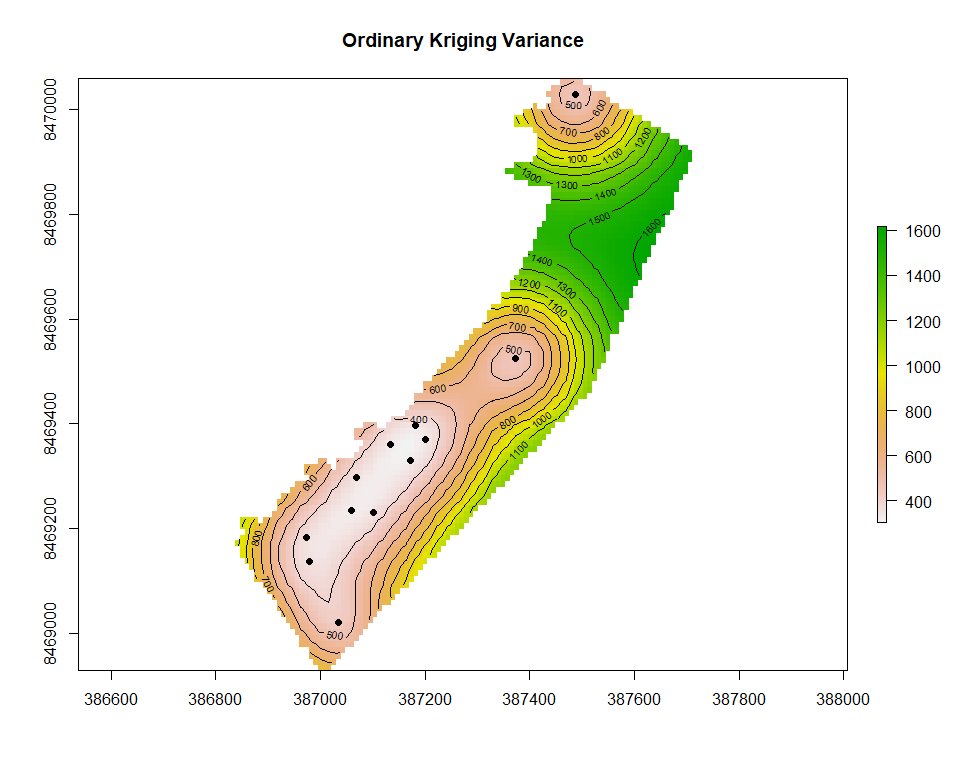
mkrig1\_pred\_ras <- rasterize(mkrig1, mgrid2, "var1.pred") #prediction  
mkrig1\_var\_ras <- rasterize(mkrig1, mgrid2, "var1.var") #variance

## PLOT RESULTS

#plot  
plot(mkrig1\_pred\_ras, main="Ordinary Kriging Prediction")  
contour(mkrig1\_pred\_ras, add=T)  
plot(mulifanua, pch=16, add=T)



plot(mkrig1\_var\_ras, main="Ordinary Kriging Variance")  
contour(mkrig1\_var\_ras, add=T)  
plot(mulifanua, pch=16, add=T)



# Aleipata

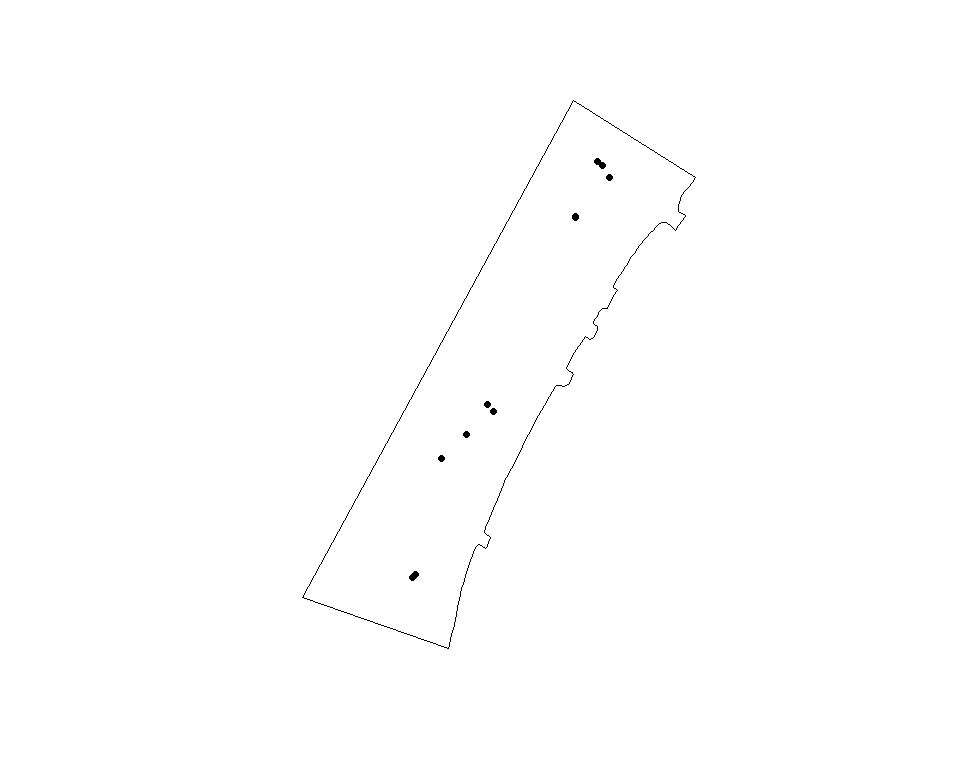
## LOAD DATA

Import necessary data. Ensure that data files are in the current working directory.

aleipata <- readOGR(".", "aleipata\_sand") #load core points  
a\_window <- readOGR(".", "aleipata\_window") #load boundary window

## PLOT DATA

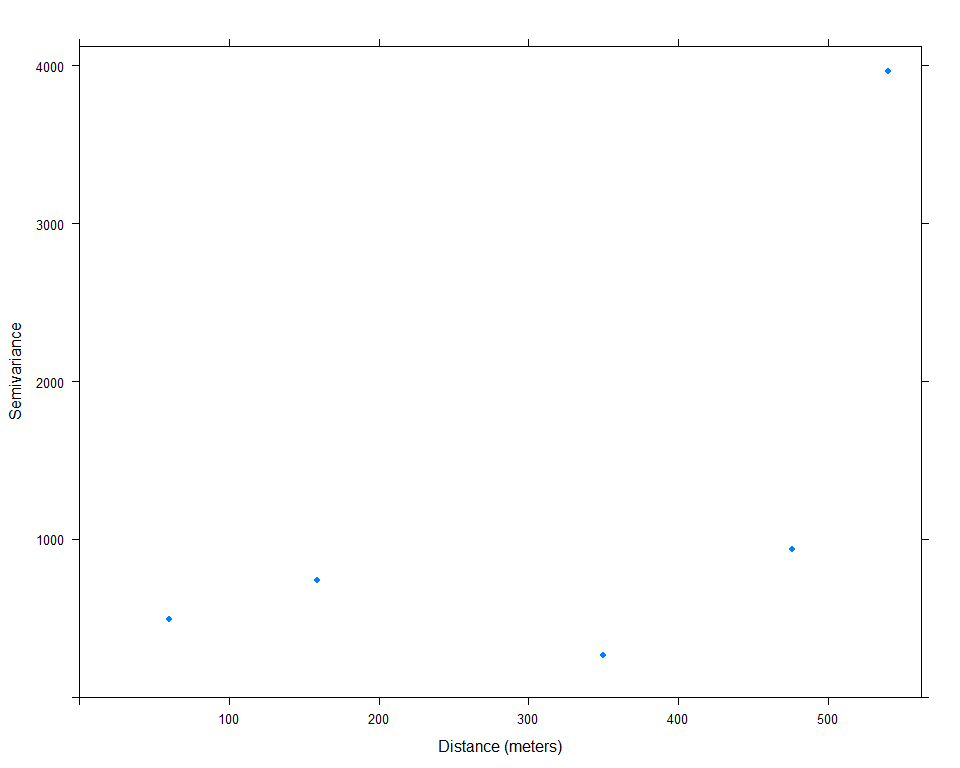
plot(a\_window)  
plot(aleipata, pch=16, add=T) #plot them



## CALCULATE SAMPLE VARIOGRAM

Here the cutoff and lag distances are set manually as the Gstat default produced an unsuitable sample variogram. Cutoff is based on half the greatest interpoint distance for Aleipata.

a\_vgm <- variogram(sand\_start~1, data=aleipata,cutoff=600, width=100)  
plot(a\_vgm, pch=16, xlab="Distance (meters)", ylab="Semivariance")



## FIT VARIOGRAM MODEL

Here using the model selection function of the Gstat package as manual fitting was unsuccessful. The model fitting procedure does not converge after 200 iterations but still produces a satisfactory model variogram.

fa\_vgm <- fit.variogram(a\_vgm, vgm(c("Exp", "Gau", "Sph")))

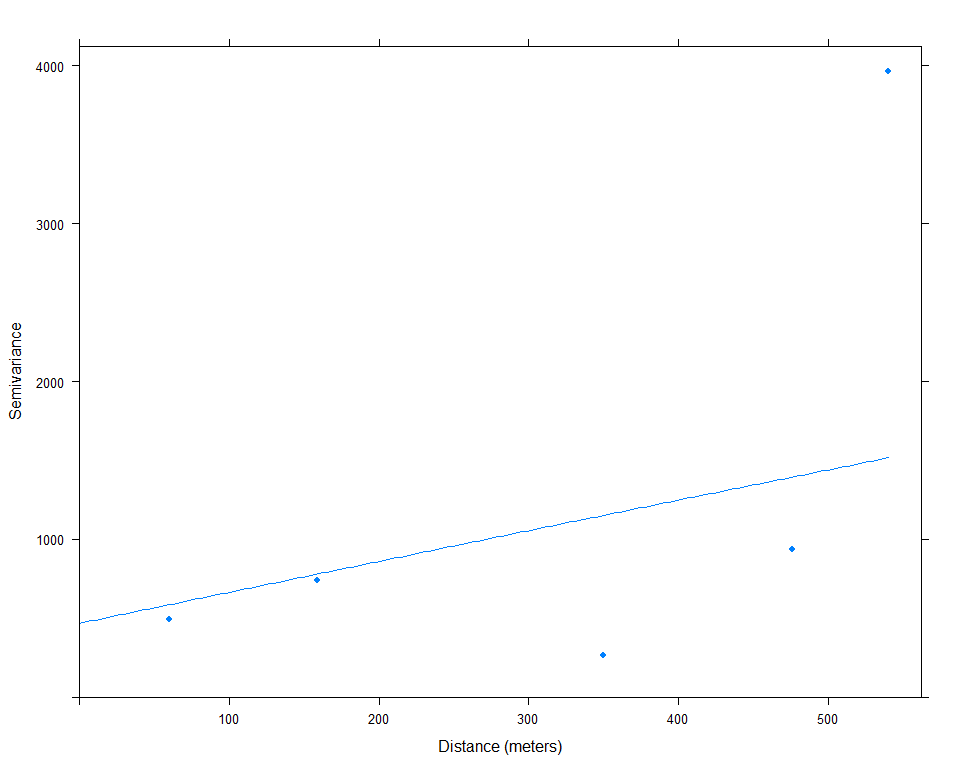
## Warning in fit.variogram(object, x, fit.sills = fit.sills, fit.ranges =  
## fit.ranges, : No convergence after 200 iterations: try different initial  
## values?  
  
## Warning in fit.variogram(object, x, fit.sills = fit.sills, fit.ranges =  
## fit.ranges, : No convergence after 200 iterations: try different initial  
## values?  
  
## Warning in fit.variogram(object, x, fit.sills = fit.sills, fit.ranges =  
## fit.ranges, : No convergence after 200 iterations: try different initial  
## values?

fa\_vgm

## model psill range  
## 1 Nug 468.3472 0.000  
## 2 Sph 3735.9442 2855.508

## PLOT SAMPLE VARIOGRAM AND VARIOGRAM MODEL

plot(a\_vgm, fa\_vgm, pch=16, xlab="Distance (meters)", ylab="Semivariance")



## CREATE GRID TO INTERPOLATE OVER

agrid1 <- spsample(a\_window, n=10000, type="regular")   
agrid2 <- raster(extent(agrid1), ncols=100, nrows=100)

## PERFORM ORDINARY KRIGING WITH A SPHERICAL VARIOGRAM MODEL

akrig1 <- krige(aleipata$sand\_start~1, aleipata, newdata=agrid1, model=fa\_vgm)

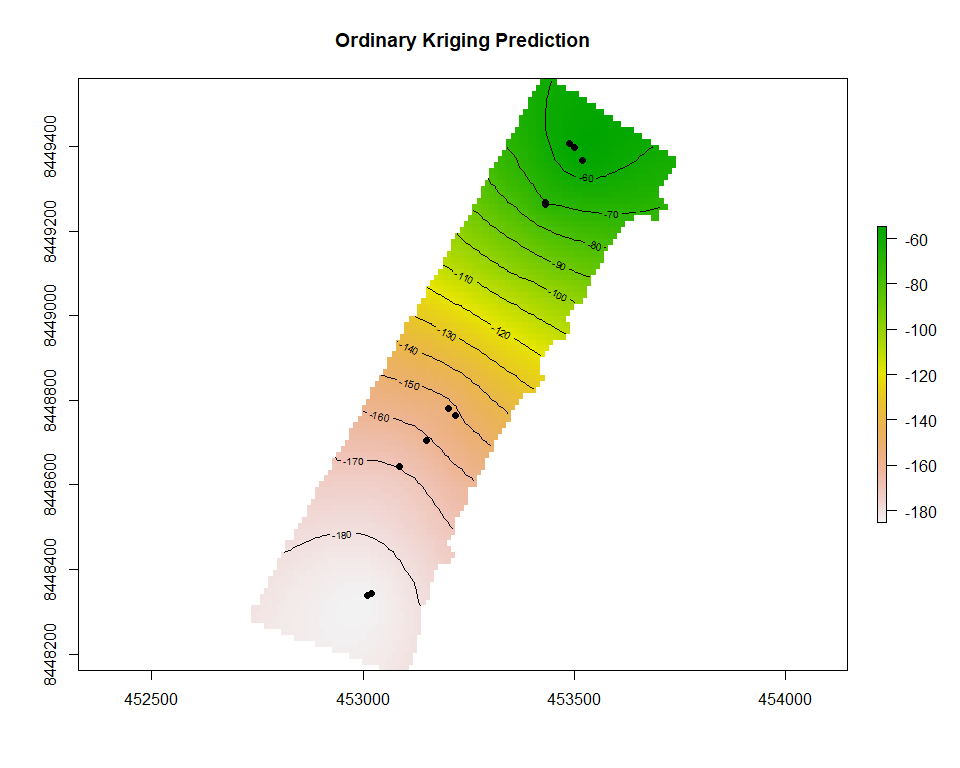
## [using ordinary kriging]

## CONVERT KRIGED ESTIMATES AND VARIANCE TO RASTER FILES

akrig1\_pred\_ras <- rasterize(akrig1, agrid2, "var1.pred")#prediction  
akrig1\_var\_ras <- rasterize(akrig1, agrid2, "var1.var")#variance

## PLOT RESULTS

#plot  
plot(akrig1\_pred\_ras, main="Ordinary Kriging Prediction")  
contour(akrig1\_pred\_ras, add=T)  
plot(aleipata, pch=16, add=T)



plot(akrig1\_var\_ras, main="Ordinary Kriging Variance")  
contour(akrig1\_var\_ras, add=T)  
plot(aleipata, pch=16, add=T)

