Plot-based aboveground biomass estimates - AfriSAR sites

Nicolas LABRIERE

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NB. All aboveground biomass (AGB) estimates are in Mg ha-1. Calibration points with Area_code names including ‘h’, ‘q’ and ‘c’ represent 1ha, 0.25ha and 0.16ha, respectively.

Loading packages and datasets

```
# LOPE: nine 1 ha plots (100 x 100 m) from 10 cm DBH & three 0.5 ha plots (100 x 50 m) from 5 cm DBH
# MABOUNIE: twelve 1 ha plots (100 x 100 m) from 10 cm DBH
# MONDAH: fifteen 1 ha plots (100 x 100 m) from 5 cm DBH
# RABI: one 25 ha plot (500 x 500 m) from 1 cm DBH
# Plus GEM plots (2 in LOPE and 4 in MONDAH; data obtained from ForestPlots.net)

# Packages
library(BIOMASS)
library(knitr)
library(kableExtra)
library(oce) # to compute Earth magnetic declination
library(lubridate) # convert ymd dates to decimal year
library(sp)

# Tree-level and botanical datasets
load("AfriSARstem.rdata")
load("AfriSARbota.rdata")
```

Getting wood density (WD) using names and accepted synonyms

```
dfsyn <- read.csv("taxo_synonymes_acceptes_230414_modNL.csv", sep = ";"); dfsyn$taxon_concept_name_valid[which(dfsyn$taxon_concept_name_valid == "")] <- NA
old.list <- strsplit(as.character(dfsyn$taxon_name), " "); new.list <- strsplit(as.character(dfsyn$taxon_concept_name_valid), " ")
dfsyn$oldname <- paste(lapply(old.list, function(x) x[1]), lapply(old.list, function(x) x[2]))
dfsyn$newname <- paste(lapply(new.list, function(x) x[1]), lapply(new.list, function(x) x[2]))
dfsyn$newgen <- unlist(lapply(new.list, function(x) x[1]))
dfsyn$newsp <- unlist(lapply(new.list, function(x) x[2]))

AfriSARstem$Genus <- dfbota$genusCorr[match(AfriSARstem$Name, dfbota$ID)]
AfriSARstem$Species <- dfbota$speciesCorr[match(AfriSARstem$Name, dfbota$ID)]
AfriSARstem$FamilyAPG <- dfbota$familyAPG[match(AfriSARstem$Name, dfbota$ID)]
```

```
AfriSARstem$NameCorr <- paste(AfriSARstem$Genus, AfriSARstem$Species)

# Some trees (n=48) were identified at family level in the field; we manually fill the family
column
AfriSARstem$FamilyAPG[which(is.na(AfriSARstem$FamilyAPG) & !(is.na(AfriSARstem$Info_fam)))] <-
 AfriSARstem$Info_fam[which(is.na(AfriSARstem$FamilyAPG) & !(is.na(AfriSARstem$Info_fam)))]

AfriSARstem$Stand <- ifelse(AfriSARstem$Site == "RABI", "RABI", as.character(AfriSARstem$Plot_
code))
dataWD <- getWoodDensity(genus=AfriSARstem$Genus, species=AfriSARstem$Species, family=AfriSARs
tem$FamilyAPG, stand=AfriSARstem$Stand)
```

```
## The reference dataset contains 16467 wood density values
```

```
## Your taxonomic table contains 549 taxa
```

```
AfriSARstem$WD <- dataWD$meanWD
AfriSARstem$sdWD <- dataWD$sdWD
AfriSARstem$levelWD <- dataWD$levelWD
#table(dataWD$levelWD)

AfriSARstem$SynGen <- dfsyn$newgen[match(AfriSARstem$NameCorr, dfsyn$oldname)] # , nomatch = N
A, incomparables = ???
AfriSARstem$SynSp <- dfsyn$newsp[match(AfriSARstem$NameCorr, dfsyn$oldname)]

dataWDsyn <- getWoodDensity(genus=AfriSARstem$SynGen, species=AfriSARstem$SynSp, stand=AfriSAR
stem$Stand, family=AfriSARstem$FamilyAPG)
```

```
## The reference dataset contains 16467 wood density values
```

```
## Your taxonomic table contains 88 taxa
```

```
AfriSARstem$WDsyn <- dataWDsyn$meanWD
AfriSARstem$sdWDsyn <- dataWDsyn$sdWD
AfriSARstem$levelWDsyn <- dataWDsyn$levelWD

# 316 WD changed using synonyms
AfriSARstem$WD[which(!(AfriSARstem$levelWD %in% c("genus","species")) & AfriSARstem$levelWDsyn
 %in% c("genus","species"))] <- AfriSARstem$WDsyn[which(!(AfriSARstem$levelWD %in% c("genus","
species")) & AfriSARstem$levelWDsyn %in% c("genus","species"))]
AfriSARstem$sdWD[which(!(AfriSARstem$levelWD %in% c("genus","species")) & AfriSARstem$levelWDs
yn %in% c("genus","species"))] <- AfriSARstem$sdWDsyn[which(!(AfriSARstem$levelWD %in% c("genu
s","species")) & AfriSARstem$levelWDsyn %in% c("genus","species"))]
AfriSARstem$levelWD[which(!(AfriSARstem$levelWD %in% c("genus","species")) & AfriSARstem$level
WDsyn %in% c("genus","species"))] <- AfriSARstem$levelWDsyn[which(!(AfriSARstem$levelWD %in% c
("genus","species")) & AfriSARstem$levelWDsyn %in% c("genus","species"))]
#table(AfriSARstem$levelWD)
```

Refining permanent plot georeferencing

```
# Preliminary work in order to georeference the data
load("AfriSARplotcoord.rdata")

pattern <- c("SAV1","SAV2","SAV3","COL1","COL2","COL3","OKO1","OKO2","OKO3","MAR1","MAR2","MIX
1")
replacement <- c("LOP01","LOP02","LOP03","LOP04","LOP05","LOP06","LOP07","LOP08","LOP09","LOP1
0","LOP11","LOP12")
for (i in (1:length(pattern))) {
  coordplot.afri$Point <- gsub(pattern[i], replacement[i], coordplot.afri$Point) #  ignore.cas
e = FALSE, perl = FALSE, fixed = FALSE, useBytes = FALSE
  coordplot.afri$Plot_code <- gsub(pattern[i], replacement[i], coordplot.afri$Plot_code) #  ig
nore.case = FALSE, perl = FALSE, fixed = FALSE, useBytes = FALSE
}

FP.coord <- read.csv("Plot_coord_FP.csv", sep = ";") # Corresponds to coordinates of ForestPlo
ts.net plots that were added to the study
coordplot.afri <- rbind(coordplot.afri, FP.coord)
magdev <- magneticField(coordplot.afri$long, coordplot.afri$lat, decimal_date(ymd(coordplot.af
ri$Time_census)))
coordplot.afri$True_bearing <- round((coordplot.afri$Compass_bearing - magdev$declination) %%
360,0) # modulus operator %%

coordplot.afri$X_utm <- NA; coordplot.afri$Y_utm <- NA

coord.geoS <- SpatialPoints(cbind(coordplot.afri$long[which(coordplot.afri$lat < 0)], coordplo
t.afri$lat[which(coordplot.afri$lat < 0)]), proj4string = CRS("+proj=longlat"))
coord.utmS <- spTransform(coord.geoS, CRS("+proj=utm +zone=32 +south +datum=WGS84 +units=m +no
_defs +ellps=WGS84 +towgs84=0,0,0")) #; str(coord.utmS)
coordplot.afri$X_utm[which(coordplot.afri$lat < 0)] <- coord.utmS@coords[,1]
coordplot.afri$Y_utm[which(coordplot.afri$lat < 0)] <- coord.utmS@coords[,2]

coord.geoN <- SpatialPoints(cbind(coordplot.afri$long[which(coordplot.afri$lat > 0)], coordplo
t.afri$lat[which(coordplot.afri$lat > 0)]), proj4string = CRS("+proj=longlat"))
coord.utmN <- spTransform(coord.geoN, CRS("+proj=utm +zone=32 +north +datum=WGS84 +units=m +no
_defs +ellps=WGS84 +towgs84=0,0,0")) #; str(coord.utmN)
coordplot.afri$X_utm[which(coordplot.afri$lat > 0)] <- coord.utmN@coords[,1]
coordplot.afri$Y_utm[which(coordplot.afri$lat > 0)] <- coord.utmN@coords[,2]

## Get "true" bearing from coordinates for RABI, MONDAH, MABOUNIE and LOPE GEM (bearing from c
ompas only for other LOPE plots)
afrisubplot <- c(as.character(unique(coordplot.afri$Plot_code[-which(coordplot.afri$Site == "L
OPE")])), "LPG01")
coordplot.afri$Loc <- substring(coordplot.afri$Point, 6)
coordplot.afri$Loc[which(coordplot.afri$Plot_code %in% c("MON21A","RABI"))] <- c("a","b","c","
d","a","b","d","c")

for (i in (1:length(afrisubplot))) {
  swe.afri <- (atan2(coordplot.afri$X_utm[which(coordplot.afri$Plot_code == afrisubplot[i] & c
oordplot.afri$Loc == "b")] - coordplot.afri$X_utm[which(coordplot.afri$Plot_code == afrisubplo
t[i] & coordplot.afri$Loc == "a")],
```

```
                     coordplot.afri$Y_utm[which(coordplot.afri$Plot_code == afrisubplot[i] & c
oordplot.afri$Loc == "b")] - coordplot.afri$Y_utm[which(coordplot.afri$Plot_code == afrisubplo
t[i] & coordplot.afri$Loc == "a")])*180/pi)

  nwe.afri <- (atan2(coordplot.afri$X_utm[which(coordplot.afri$Plot_code == afrisubplot[i] & c
oordplot.afri$Loc == "c")] - coordplot.afri$X_utm[which(coordplot.afri$Plot_code == afrisubplo
t[i] & coordplot.afri$Loc == "d")],
                     coordplot.afri$Y_utm[which(coordplot.afri$Plot_code == afrisubplot[i] & c
oordplot.afri$Loc == "c")] - coordplot.afri$Y_utm[which(coordplot.afri$Plot_code == afrisubplo
t[i] & coordplot.afri$Loc == "d")])*180/pi)

  coordplot.afri$True_bearing[which(coordplot.afri$Plot_code == afrisubplot[i])] <- round(mean
(c(swe.afri, nwe.afri)),1) + 270
}
coordplot.afri$True_bearing <- round((coordplot.afri$True_bearing) %% 360,1) # modulus operato
r %%
coordplot.afri$True_bearing[which(coordplot.afri$Plot_code == "LPG02")] <- unique(coordplot.af
ri$True_bearing[which(coordplot.afri$Plot_code == "LPG01")])

# Converting "true" bearing in (1) radians, and then in (2) plot rotation
coordplot.afri$TB_rad <- (pi/2 - (coordplot.afri$True_bearing*pi/180)) %% pi # TB stands for t
rue bearing
coordplot.afri$RotAng_rad <- (coordplot.afri$TB_rad - pi/2)

AfriSARstem$TreeRad <- sqrt(AfriSARstem$X_rel^2 + AfriSARstem$Y_rel^2)
AfriSARstem$TreeAng_rel <- atan2(AfriSARstem$X_rel, AfriSARstem$Y_rel)

# Assigning plot rotation to each stem
AfriSARstem$PlotAng <- ifelse(AfriSARstem$Site == "RABI",
                              coordplot.afri$RotAng_rad[which(coordplot.afri$Site == "RABI")],
                              coordplot.afri$RotAng_rad[match(AfriSARstem$Plot_code, coordplot
.afri$Plot_code)])

# Computing new stem coordinates after plot rotation
AfriSARstem$Xrot_rel <- AfriSARstem$X_rel * cos(AfriSARstem$PlotAng) - AfriSARstem$Y_rel * sin
(AfriSARstem$PlotAng) # x' = x * cos(theta) - y * sin(theta)
AfriSARstem$Yrot_rel <- AfriSARstem$X_rel * sin(AfriSARstem$PlotAng) + AfriSARstem$Y_rel * cos
(AfriSARstem$PlotAng) # y' = x * sin(theta) + y * cos(theta)

# Works because it selects the first value in the data.frame and that value is the one we need
 (x=0; y=0)
AfriSARstem$X_abs <- ifelse(AfriSARstem$Site == "RABI",
                            coordplot.afri$X_utm[match(AfriSARstem$Site, coordplot.afri$Plot_c
ode)] + AfriSARstem$Xrot_rel,
                            coordplot.afri$X_utm[match(AfriSARstem$Plot_code, coordplot.afri$P
lot_code)] + AfriSARstem$Xrot_rel)

AfriSARstem$Y_abs <- ifelse(AfriSARstem$Site == "RABI",
                            coordplot.afri$Y_utm[match(AfriSARstem$Site, coordplot.afri$Plot_c
ode)] + AfriSARstem$Yrot_rel,
                            coordplot.afri$Y_utm[match(AfriSARstem$Plot_code, coordplot.afri$P
lot_code)] + AfriSARstem$Yrot_rel)

# CHANGING COORDINATES AFTER VISUAL INSPECTION OF BIG TREES LOCATION AND LIDAR-DERIVED CHM
```

```
# RABI, LOPE AND MONDAH OK; NOT POSSIBLE TO DO IT WITH MABOUNIE BECAUSE NO TREE-LEVEL COORDINA
TES
plotID.lope <- as.character(sort(unique(AfriSARstem$Plot_code[which(AfriSARstem$Site == "LOPE"
)])))
plotID.mondah <- as.character(sort(unique(AfriSARstem$Plot_code[which(AfriSARstem$Site == "MON
DAH")])))

df.changcoord <- data.frame(plot = as.character(c(plotID.lope, plotID.mondah)),
                            modX = c(2,-4,-3,-3,-2,-3,-1,-6,5,-1,5,0,0,2,3,1,6,0,-1,6,-3,3,-1,
-2,0,-4,2,3,0,-2,0,-14),
                            modY = c(-3,1,2,3,8,3,1,-4,-1,-1,3,0,0,-2,1,3,7,0,2,-3,4,-3,1,2,0,
3,3,4,0,7,0,4),
                            stringsAsFactors=F)

AfriSARstem$X_absCORR <- AfriSARstem$X_abs + df.changcoord$modX[match(AfriSARstem$Plot_code, d
f.changcoord$plot)]
AfriSARstem$Y_absCORR <- AfriSARstem$Y_abs + df.changcoord$modY[match(AfriSARstem$Plot_code, d
f.changcoord$plot)]

AfriSARstem$X_absCORR[which(AfriSARstem$Site == "RABI")] <- AfriSARstem$X_abs[which(AfriSARste
m$Site == "RABI")] - 114
AfriSARstem$Y_absCORR[which(AfriSARstem$Site == "RABI")] <- AfriSARstem$Y_abs[which(AfriSARste
m$Site == "RABI")] + 42

coordplot.afri$X_utmCORR <- coordplot.afri$X_utm + df.changcoord$modX[match(coordplot.afri$Plo
t_code, df.changcoord$plot)]
coordplot.afri$Y_utmCORR <- coordplot.afri$Y_utm + df.changcoord$modY[match(coordplot.afri$Plo
t_code, df.changcoord$plot)]

coordplot.afri$X_utmCORR[which(coordplot.afri$Site == "RABI")] <- coordplot.afri$X_utm[which(c
oordplot.afri$Site == "RABI")] - 114
coordplot.afri$Y_utmCORR[which(coordplot.afri$Site == "RABI")] <- coordplot.afri$Y_utm[which(c
oordplot.afri$Site == "RABI")] + 42

coordplot.afri$X_utmCORR[which(coordplot.afri$Site == "MABOUNIE")] <- coordplot.afri$X_utm[whi
ch(coordplot.afri$Site == "MABOUNIE")]
coordplot.afri$Y_utmCORR[which(coordplot.afri$Site == "MABOUNIE")] <- coordplot.afri$Y_utm[whi
ch(coordplot.afri$Site == "MABOUNIE")]

coordplot.afri$X_utmCORR[which(coordplot.afri$Plot_code == "LOP01")] <- coordplot.afri$X_utm[w
hich(coordplot.afri$Plot_code == "LOP01")]
coordplot.afri$Y_utmCORR[which(coordplot.afri$Plot_code == "LOP01")] <- coordplot.afri$Y_utm[w
hich(coordplot.afri$Plot_code == "LOP01")]
```

Creating georeferenced sets of calibration points (at 1ha and 0.16-0.25ha)

```
site = c("RABI", "LOPE", "MABOUNIE", "MONDAH")
fullscale = c(100, 50, 20)
smallplot = c("LOP04", "LOP05", "LOP06")
suffixe = c("h","q")
```

```
# Creating dataframe to georeference quarter hectare features (n=620)
coord_orig_q <- coordplot.afri[which(coordplot.afri$X_rel == 0 & coordplot.afri$Y_rel == 0),]
coord_orig_q$full_lengthX <- NA; coord_orig_q$full_lengthY <- NA
coord_orig_q$full_lengthX[-which(coord_orig_q$Plot_code == "LPG02")] <- coordplot.afri$X_rel[w
hich(coordplot.afri$Loc == "b")]
coord_orig_q$full_lengthY[-which(coord_orig_q$Plot_code == "LPG02")] <- coordplot.afri$Y_rel[w
hich(coordplot.afri$Loc == "d")]
coord_orig_q$full_lengthX[which(is.na(coord_orig_q$full_lengthX))] <- 100
coord_orig_q$full_lengthY[which(is.na(coord_orig_q$full_lengthY))] <- 100
coord_orig_temp <- coord_orig_q

# Creating dataframe to georeference hectare features (n=119)
coord_orig_h <- coord_orig_temp
coord_orig_h <- coord_orig_h[-which(coord_orig_h$full_lengthX < 100 | coord_orig_h$full_length
Y < 100),] # Removing 50x50m plots

scale.list <- list(); site.list <- list() # plot.df <- data.frame(); # Yet, plot.df already de
fined later in the loops
for (i in (1:length(site))) {
  if (site[i] %in%  c("RABI","LOPE", "MONDAH")) scale = fullscale[1:2] else scale = fullscale[
c(1,3)]

  for (j in (1:length(scale))) {
    if (j == 1) coord_orig = coord_orig_h else coord_orig = coord_orig_q
    plot.df <- data.frame()
    tempoplot <- as.character(coord_orig$Plot_code[which(coord_orig$Site == site[i])]); tempop
lot # used to be sort(as.character(...)) but plot order dealt with cf. coord_orig
    #tempoplot <- if (scale[j] == 100) tempoplot[!tempoplot %in% smallplot] else tempoplot; te
mpoplot # NB. ifelse() can't return vectors !

    for (k in (1:length(tempoplot))) {
      lengthX <- coord_orig$full_lengthX[which(coord_orig$Plot_code == tempoplot[k])]; lengthX
      lengthY <- coord_orig$full_lengthY[which(coord_orig$Plot_code == tempoplot[k])]; lengthY

      incrX_h <- cos(coord_orig$RotAng_rad[which(coord_orig$Plot_code == tempoplot[k])]) * sca
le[j] # increment for X coordinates horizontally
      incrY_h <- sin(coord_orig$RotAng_rad[which(coord_orig$Plot_code == tempoplot[k])]) * sca
le[j] # increment for Y coordinates horizontally

      incrX_v <- cos(coord_orig$RotAng_rad[which(coord_orig$Plot_code == tempoplot[k])] + pi/2
) * scale[j] # increment for X coordinates vertically; also equals (-incrY_h)
      incrY_v <- sin(coord_orig$RotAng_rad[which(coord_orig$Plot_code == tempoplot[k])] + pi/2
) * scale[j] # increment for Y coordinates vertically; also equals incrX_h

      nbptX <- length(seq(0, lengthX, scale[j]))
      nbptY <- length(seq(0, lengthY, scale[j]))
      incrX.mat <- matrix(rep(0:(nbptX-1),nbptY), nrow=nbptY, ncol=nbptX, byrow = T); incrX.ma
t
      incrY.mat <- matrix(rep(rev(0:(nbptY-1)),nbptX), nrow=nbptY, ncol=nbptX); incrY.mat

      XX <- coord_orig$X_utmCORR[which(coord_orig$Plot_code == tempoplot[k])] + incrX_h * incr
X.mat + incrX_v * incrY.mat
      YY <- coord_orig$Y_utmCORR[which(coord_orig$Plot_code == tempoplot[k])] + incrY_h * incr
```

```
X.mat + incrY_v * incrY.mat
      #plot(as.vector(YY) ~ as.vector(XX))

      XX_SW.mat <- XX[2:nbptY, 1:(nbptX-1)]; YY_SW.mat <- YY[2:nbptY, 1:(nbptX-1)]
      XX_NW.mat <- XX[1:(nbptY-1), 1:(nbptX-1)]; YY_NW.mat <- YY[1:(nbptY-1), 1:(nbptX-1)]
      XX_SE.mat <- XX[2:nbptY, 2:nbptX]; YY_SE.mat <- YY[2:nbptY, 2:nbptX]
      XX_NE.mat <- XX[1:(nbptY-1), 2:nbptX]; YY_NE.mat <- YY[1:(nbptY-1), 2:nbptX]

      XX_SW.vect <- as.vector(XX_SW.mat); YY_SW.vect <- as.vector(YY_SW.mat)
      XX_NW.vect <- as.vector(XX_NW.mat); YY_NW.vect <- as.vector(YY_NW.mat)
      XX_SE.vect <- as.vector(XX_SE.mat); YY_SE.vect <- as.vector(YY_SE.mat)
      XX_NE.vect <- as.vector(XX_NE.mat); YY_NE.vect <- as.vector(YY_NE.mat)

      for (l in (1:(nbptX-1))) {
        XX_SW.vect[((l-1)*(nbptY-1)+1):(l*(nbptY-1))] <- rev(XX_SW.vect[((l-1)*(nbptY-1)+1):(l
*(nbptY-1))])
        XX_NW.vect[((l-1)*(nbptY-1)+1):(l*(nbptY-1))] <- rev(XX_NW.vect[((l-1)*(nbptY-1)+1):(l
*(nbptY-1))])
        XX_SE.vect[((l-1)*(nbptY-1)+1):(l*(nbptY-1))] <- rev(XX_SE.vect[((l-1)*(nbptY-1)+1):(l
*(nbptY-1))])
        XX_NE.vect[((l-1)*(nbptY-1)+1):(l*(nbptY-1))] <- rev(XX_NE.vect[((l-1)*(nbptY-1)+1):(l
*(nbptY-1))])
      }
      for (l in (1:(nbptX-1))) {
        YY_SW.vect[((l-1)*(nbptY-1)+1):(l*(nbptY-1))] <- rev(YY_SW.vect[((l-1)*(nbptY-1)+1):(l
*(nbptY-1))])
        YY_NW.vect[((l-1)*(nbptY-1)+1):(l*(nbptY-1))] <- rev(YY_NW.vect[((l-1)*(nbptY-1)+1):(l
*(nbptY-1))])
        YY_SE.vect[((l-1)*(nbptY-1)+1):(l*(nbptY-1))] <- rev(YY_SE.vect[((l-1)*(nbptY-1)+1):(l
*(nbptY-1))])
        YY_NE.vect[((l-1)*(nbptY-1)+1):(l*(nbptY-1))] <- rev(YY_NE.vect[((l-1)*(nbptY-1)+1):(l
*(nbptY-1))])
      }

      if(site[i] == "MABOUNIE" & j == 2) {
        XX_SW.vect <- XX_SW.vect[c(1,4,16,19)];  YY_SW.vect <- YY_SW.vect[c(1,4,16,19)]
        XX_NW.vect <- XX_NW.vect[c(2,5,17,20)];  YY_NW.vect <- YY_NW.vect[c(2,5,17,20)]
        XX_SE.vect <- XX_SE.vect[c(6,9,21,24)];  YY_SE.vect <- YY_SE.vect[c(6,9,21,24)]
        XX_NE.vect <- XX_NE.vect[c(7,10,22,25)];  YY_NE.vect <- YY_NE.vect[c(7,10,22,25)]
        nbptX <- length(XX_SW.vect) - 1; nbptY <- length(YY_SW.vect) - 1
      }

      templot.df <- data.frame(Site = rep(site[i], (nbptX-1) * (nbptY-1)),
                               Area_code = if (site[i] == "RABI") paste(sprintf(fmt=paste("RAB
%0",nchar((nbptX-1)*(nbptY-1)),"d",sep=""),
                                                                                 c(1:((nbptX-1)
*(nbptY-1)))), suffixe[j],sep="")
                               else if (scale[j] == 100) paste(tempoplot[k], suffixe[j], sep="
")
                               else if (site[i] == "MABOUNIE" & j == 2) paste(tempoplot[k], "c
", c(1:((nbptX-1)*(nbptY-1))), sep="")
                               else paste(tempoplot[k], suffixe[j], c(1:((nbptX-1)*(nbptY-1)))
, sep=""),
```

```
                                    Plot_code = rep(tempoplot[k], (nbptX-1) * (nbptY-1)),
                                    Scale = paste(ifelse(site[i] == "MABOUNIE" & j == 2, scale[j] *
2, scale[j])^2/10^4,"ha", sep=""), # scale[j]
                                    sw_x = XX_SW.vect, sw_y = YY_SW.vect,
                                    nw_x = XX_NW.vect, nw_y = YY_NW.vect,
                                    se_x = XX_SE.vect, se_y = YY_SE.vect,
                                    ne_x = XX_NE.vect, ne_y = YY_NE.vect)
      plot.df <- rbind(plot.df, templot.df)
    }
    scale.list[[j]] <- plot.df
  }
  site.list[[i]] <- scale.list
}
#site.list
```

Assigning trees to hectares (1ha), quarters (0.25ha) and corners (0.16ha) based on Plot_code and relative XY

```
AfriSARstem$Hect_code <- ifelse(AfriSARstem$Plot_code %in% c(smallplot,"MND01","MND02"), NA, p
aste(AfriSARstem$Plot_code,"h",sep=""))

AfriSARstem$quartX <- ifelse(AfriSARstem$X_rel == 0, 1, ceiling(AfriSARstem$X_rel/50))
AfriSARstem$quartY <- ifelse(AfriSARstem$Y_rel == 0, 1, ceiling(AfriSARstem$Y_rel/50))
AfriSARstem$plotnbQ <- ifelse(AfriSARstem$Site == "RABI", (AfriSARstem$quartX-1)*10 + AfriSARs
tem$quartY,
                              ifelse(AfriSARstem$Plot_code %in% smallplot, (AfriSARstem$quartX
-1)*1 + AfriSARstem$quartY, (AfriSARstem$quartX-1)*2 + AfriSARstem$quartY))

AfriSARstem$Quart_code <- ifelse(is.na(AfriSARstem$plotnbQ), NA,
                                 ifelse(AfriSARstem$Site == "RABI", paste(sprintf(fmt="RAB%03d
",AfriSARstem$plotnbQ),"q",sep=""), paste(AfriSARstem$Plot_code,"q",AfriSARstem$plotnbQ,sep=""
)))

AfriSARstem$Corn_code <- NA
cornerblock <- list(c(1, 2, 6, 7), c(4, 5, 9, 10), c(16, 17, 21, 22), c(19, 20, 24, 25))
for (i in (1:length(cornerblock))) {
  AfriSARstem$Corn_code[which(AfriSARstem$Site == "MABOUNIE" & AfriSARstem$Info_loc %in% corne
rblock[[i]])] <- paste(AfriSARstem$Plot_code[which(AfriSARstem$Site == "MABOUNIE" & AfriSARste
m$Info_loc %in% cornerblock[[i]])],"c",i, sep="")
}
```

Estimating H from Feldpausch H:D relationship

```
range(AfriSARstem$Diameter)
```

```
## [1]  10.0 251.6
```

```
dataHfeld <- retrieveH(D=AfriSARstem$Diameter, region ="CAfrica"); range(dataHfeld) # H ranges
 from 6.2 - 49.7 m
```

```
## [1]  6.17700 49.69018
```

```
AfriSARstem$Hfeld <- dataHfeld$H
AfriSARstem$HfeldRSE <- dataHfeld$RSE
```

Developing local H:D relationships (5 in total: 1 per site + 1 for savanna specie SAV.SP)

```
# Subset data for HD model building (NB. sav sp. excluded)
AfriSARforHD <- AfriSARstem[-which(is.na(AfriSARstem$Height) | (AfriSARstem$NameCorr %in% c("C
rossopteryx febrifuga","Sarcocephalus latifolius"))),] # | AfriSARstem$Plot == "SAV3"
AfriSARforHD <- AfriSARforHD[which(AfriSARforHD$H_info %in% c("a","ae","e","efg","el","eq","es
","i","l","lq","q","s", NA)),]

# Compute site-specific H:D models
HDmodelPerSite <- by(AfriSARforHD, AfriSARforHD$Site,
                     function(x) modelHD(D=x$Diameter,H=x$Height, method="michaelis",useWeight
 =T),
                     simplify=FALSE)
RSEmodels <- sapply(HDmodelPerSite,function(x) x$RSE)
Coeffmodels <- lapply(HDmodelPerSite,function(x) x$coefficients)
ResHD <- data.frame(Site=names(unlist(RSEmodels)),
                    a=round(unlist(sapply(Coeffmodels,"[",1)),3),
                    b=round(unlist(sapply(Coeffmodels,"[",2)),3),
                    RSE=round(unlist(RSEmodels),3))

# Retrieve predicted height values in the database
AfriSARstem$Hlocal <- AfriSARstem$Height # keeping directly measured trees
AfriSARstem$HlocRSE <- 1 # to be refined?! Assume a 1-m error on directly measured trees
AfriSARstem$levelHloc <- "FIELD"

Site=as.character(ResHD$Site)
for(i in 1:length(ResHD$Site)){
  filt<-AfriSARstem$Site==Site[i] & is.na(AfriSARstem$Hlocal)
  AfriSARstem$Hlocal[filt]<-retrieveH(D=AfriSARstem$Diameter[filt],model=HDmodelPerSite[[Site[
i]]])$H
  AfriSARstem$HlocRSE[filt]<-HDmodelPerSite[[Site[i]]]$RSE
  AfriSARstem$levelHloc[filt]<-Site[i]
}

# Model for savanna species
# NB. from lope.csv keeping only sav sp. with flag1 %in% c("a","ae","e","i") and Diameter < 15
 (but DBH < 10, otherwise can't build allometry because n too small)
dfsavsp <- read.csv("savsp4hd.csv", sep=";", stringsAsFactors=T)
```

```
HDmodel.sav <- modelHD(D=dfsavsp$Diameter, H=dfsavsp$Height, drawGraph = FALSE, useWeight=TRUE
, method="michaelis")
coefHDmodel.sav <- HDmodel.sav$coefficients

dataHlocal.sav <- retrieveH(D=AfriSARstem$Diameter[which(!(AfriSARstem$levelHloc == "FIELD") &
 AfriSARstem$NameCorr %in% c("Crossopteryx febrifuga","Sarcocephalus latifolius"))], model = H
Dmodel.sav)
AfriSARstem$Hlocal[which(!(AfriSARstem$levelHloc == "FIELD") & AfriSARstem$NameCorr %in% c("Cr
ossopteryx febrifuga","Sarcocephalus latifolius"))] <- dataHlocal.sav$H
AfriSARstem$HlocRSE[which(!(AfriSARstem$levelHloc == "FIELD") & AfriSARstem$NameCorr %in% c("C
rossopteryx febrifuga","Sarcocephalus latifolius"))] <- dataHlocal.sav$RSE
AfriSARstem$HlocRSE[which((AfriSARstem$levelHloc == "FIELD") & AfriSARstem$NameCorr %in% c("Cr
ossopteryx febrifuga","Sarcocephalus latifolius"))] <- 0.1
AfriSARstem$levelHloc[which(!(AfriSARstem$levelHloc == "FIELD") & AfriSARstem$NameCorr %in% c(
"Crossopteryx febrifuga","Sarcocephalus latifolius"))] <- "SAVASP"

table(is.na(AfriSARstem$Hlocal)) # all stems have Hloc
```

Assigning mean plot coordinates to trees to get environmental factor E

```
longitude <- tapply(coordplot.afri$long, coordplot.afri$Plot_code, mean)
latitude <- tapply(coordplot.afri$lat, coordplot.afri$Plot_code, mean)
meancoord <- data.frame(Plot_code=names(longitude), long=as.numeric(longitude), lat=as.numeric
(latitude))

AfriSARstem$long <- ifelse(AfriSARstem$Site == "RABI",
                           meancoord[match(AfriSARstem$Site, meancoord$Plot_code),"long"],
                           meancoord[match(AfriSARstem$Plot_code, meancoord$Plot_code),"long"]
)
AfriSARstem$lat <- ifelse(AfriSARstem$Site == "RABI",
                          meancoord[match(AfriSARstem$Site, meancoord$Plot_code),"lat"],
                          meancoord[match(AfriSARstem$Plot_code, meancoord$Plot_code),"lat"])
```

Compute AGB at hectare/quarter/corner level using 3 different models

```
AfriSARstem <- AfriSARstem[with(AfriSARstem, order(Site, decreasing = c(F), method = "radix"))
,]
resolAGB <- c("Hect_code", "Quart_code", "Corn_code")
coefmult <- c(1, 4, 25/4)
```

AGB FELDPAUSCH (agb_fph)

```
AGB_fph.list <- list()
```

```
rm(resultMC_FeldGB); gc()
resultMC_FeldGB <- by(AfriSARstem, AfriSARstem[,"Site"],
                      function(x) AGBmonteCarlo(D=x$Diameter, WD=x$WD, errWD=x$sdWD, H=x$Hfeld
,
                                                errH=x$HfeldRSE, Dpropag="chave2004"), simplif
y=F)

tempLOP <- as.data.frame(resultMC_FeldGB$LOPE$AGB_simu)
tempMAB <- as.data.frame(resultMC_FeldGB$MABOUNIE$AGB_simu)
tempMON <- as.data.frame(resultMC_FeldGB$MONDAH$AGB_simu)
tempRAB <- as.data.frame(resultMC_FeldGB$RABI$AGB_simu)
tempAFRI <- rbind(tempLOP,tempMAB,tempMON,tempRAB)
Afriprop_FELD <- cbind(AfriSARstem, tempAFRI)

for (i in (1:length(resolAGB))) {
  tempocalc <- by(Afriprop_FELD, Afriprop_FELD[,resolAGB[i]],
                  function(x) list(meanAGB = mean(apply(x[,46:1045], 2, sum, na.rm = T)),
                                   #medAGB = median(apply(x[,46:1045], 2, sum, na.rm = T)),
                                   #sdAGB = sd(apply(x[,46:1045], 2, sum, na.rm = T)),
                                   credibilityAGB = quantile(apply(x[,46:1045], 2, sum, na.rm
= T), probs = c(0.025,0.975))))

  AGB_fph.list[[i]] <- data.frame(Area_code = names(tempocalc),
                                  agb_fph = round(as.numeric(sapply(tempocalc,"[",1))*coefmult
[i],1),
                                  cred_fph_2.5 = round(as.numeric(lapply(sapply(tempocalc,"[",
2), function(x) x[1]))*coefmult[i],1),
                                  cred_fph_97.5 = round(as.numeric(lapply(sapply(tempocalc,"["
,2), function(x) x[2]))*coefmult[i],1), stringsAsFactors = F)
  rownames(AGB_fph.list[[i]]) <- NULL
}
AGB_fph.list
AGB_fph.df <- Reduce(rbind, AGB_fph.list)
AGB_fph.df
```

Area_code	agb_fph	cred_fph_2.5	cred_fph_97.5
LOP02h	1.2	0.8	2.1
LOP03h	29.2	21.5	40.6
LOP07h	342.8	316.0	373.4
LOP08h	306.0	287.0	326.6
LOP09h	366.0	330.5	405.3
LOP10h	417.3	376.7	464.0
LOP11h	405.1	361.9	458.9
LOP12h	382.7	349.8	416.9
LPG01h	474.6	397.5	580.8
LPG02h	597.1	518.4	687.2

MAB01h	376.3	343.1	412.4
MAB02h	349.3	312.0	389.5
MAB03h	378.6	337.4	432.5
MAB04h	501.9	440.7	572.3
MAB05h	481.5	420.5	572.2
MAB06h	356.9	319.0	402.9
MAB07h	286.0	258.5	321.5
MAB08h	350.5	318.2	388.8
MAB09h	466.4	421.0	516.1
MAB10h	393.9	348.1	446.9
MAB11h	495.1	450.8	544.3
MAB12h	216.0	196.7	238.9
MNG03h	528.3	484.4	574.4
MNG04h	460.4	421.9	508.7
MON01h	31.9	26.0	39.8
MON02h	338.5	278.6	422.6
MON03h	62.1	55.2	70.2
MON05h	111.7	99.5	125.8
MON09h	3.0	2.2	4.0
MON10h	125.8	107.3	150.4
MON11h	40.3	36.1	44.8
MON13h	282.2	251.5	323.2
MON14h	175.9	154.7	202.1
MON19h	4.2	3.4	5.2
MON20h	87.5	70.1	113.9
MON21Ah	171.7	158.5	186.0
MON21h	2.5	1.9	3.3
MON22h	342.7	305.0	389.5
MON23h	150.3	133.0	171.3
RAB01h	264.5	233.3	301.5
RAB02h	327.3	289.5	373.3

RAB03h	343.7	315.9	376.0
RAB04h	343.5	314.1	377.7
RAB05h	367.7	320.4	424.8
RAB06h	337.6	305.5	376.9
RAB07h	477.6	415.3	550.6
RAB08h	244.1	225.5	265.1
RAB09h	317.2	280.5	361.6
RAB10h	368.5	318.3	431.8
RAB11h	337.5	297.4	389.9
RAB12h	358.1	321.6	399.8
RAB13h	293.0	266.4	325.3
RAB14h	292.1	266.2	321.2
RAB15h	361.1	324.1	404.1
RAB16h	298.8	256.8	356.9
RAB17h	309.3	279.4	343.8
RAB18h	303.3	259.4	358.6
RAB19h	308.0	276.5	348.6
RAB20h	409.0	356.9	473.7
RAB21h	346.6	306.3	395.5
RAB22h	282.7	258.9	309.4
RAB23h	339.0	294.9	390.7
RAB24h	576.8	509.1	658.6
RAB25h	344.8	308.6	388.5
LOP02q2	0.7	0.2	1.3
LOP02q3	2.5	0.8	5.6
LOP02q4	1.8	1.1	3.0
LOP03q1	15.6	11.9	21.0
LOP03q2	93.8	62.8	139.1
LOP03q3	3.1	2.2	4.2
LOP03q4	4.3	2.0	8.3
LOP04q1	312.3	269.5	362.2
LOP04q2	150.5	127.4	177.6

LOP05q1	53.7	44.0	64.9
LOP05q2	77.4	67.1	89.8
LOP06q1	166.3	149.2	184.5
LOP06q2	214.6	193.6	238.1
LOP07q1	382.2	321.6	452.5
LOP07q2	346.4	299.9	393.5
LOP07q3	312.5	267.2	363.3
LOP07q4	330.2	281.8	393.7
LOP08q1	310.5	272.7	351.2
LOP08q2	316.3	282.8	349.6
LOP08q3	293.2	257.0	334.4
LOP08q4	304.0	267.2	349.9
LOP09q1	464.8	373.7	582.5
LOP09q2	294.7	254.2	340.6
LOP09q3	266.9	225.0	319.0
LOP09q4	437.7	367.2	534.1
LOP10q1	371.5	318.9	434.0
LOP10q2	355.2	292.3	427.5
LOP10q3	540.9	444.8	661.6
LOP10q4	401.4	316.3	526.6
LOP11q1	483.6	395.6	614.7
LOP11q2	313.0	263.3	380.2
LOP11q3	446.5	341.5	600.7
LOP11q4	377.4	300.0	477.1
LOP12q1	427.7	369.4	489.8
LOP12q2	351.0	301.8	414.0
LOP12q3	494.2	411.6	609.2
LOP12q4	257.8	222.8	299.0
LPG01q1	404.1	332.0	495.7
LPG01q2	411.8	329.7	524.9
LPG01q3	273.0	226.4	328.7

LPG01q4	808.4	543.2	1202.0
LPG02q1	461.9	358.4	598.3
LPG02q2	948.3	735.6	1247.7
LPG02q3	296.0	234.4	373.7
LPG02q4	676.8	552.4	851.9
MND01q1	433.0	368.0	511.3
MND01q2	431.3	360.5	517.2
MND01q3	457.6	381.6	538.3
MND01q4	462.6	386.9	552.0
MND02q1	332.7	282.1	393.4
MND02q2	486.7	394.5	595.8
MND02q3	512.3	436.8	607.5
MND02q4	572.4	493.6	668.7
MNG03q1	574.6	495.5	670.7
MNG03q2	546.2	461.2	653.9
MNG03q3	426.2	360.7	502.0
MNG03q4	566.2	480.7	666.0
MNG04q1	628.7	524.8	753.8
MNG04q2	380.0	332.1	438.4
MNG04q3	360.5	300.1	436.0
MNG04q4	472.3	399.9	568.9
MON01q1	15.5	11.5	20.7
MON01q2	7.2	5.4	9.8
MON01q3	40.4	27.8	59.0
MON01q4	64.6	46.7	92.8
MON02q1	212.0	163.1	271.2
MON02q2	139.6	103.7	190.0
MON02q3	823.2	604.9	1153.7
MON02q4	179.4	153.1	211.1
MON03q1	30.5	21.9	45.2
MON03q2	19.4	13.7	28.0

MON03q3	76.8	63.7	94.0
MON03q4	121.7	103.4	142.1
MON05q1	182.7	146.7	226.3
MON05q2	184.2	158.9	221.0
MON05q3	31.6	22.8	43.0
MON05q4	48.4	37.4	63.3
MON09q1	2.5	1.3	4.4
MON09q2	1.6	0.9	2.4
MON09q3	0.7	0.4	1.2
MON09q4	7.0	4.6	10.5
MON10q1	115.4	67.5	198.5
MON10q2	132.5	104.8	167.7
MON10q3	75.8	58.6	101.4
MON10q4	179.4	139.3	233.3
MON11q1	24.8	19.5	31.3
MON11q2	36.7	28.9	47.2
MON11q3	36.0	27.8	46.8
MON11q4	63.7	55.1	73.2
MON13q1	368.6	308.2	443.5
MON13q2	294.5	250.9	344.6
MON13q3	187.5	149.2	241.9
MON13q4	278.2	204.3	401.7
MON14q1	285.8	227.4	368.0
MON14q2	217.0	179.0	269.2
MON14q3	132.4	99.6	179.4
MON14q4	68.4	60.9	77.9
MON19q1	10.2	7.7	13.2
MON19q2	0.4	0.1	0.8
MON19q3	5.8	3.9	8.3
MON19q4	0.6	0.2	1.1
MON20q1	176.7	114.3	284.4
MON20q2	134.2	111.1	166.1

MON20q3	26.3	19.8	34.8
MON20q4	12.9	9.9	16.9
MON21Aq1	142.4	123.8	164.8
MON21Aq2	95.7	79.3	117.7
MON21Aq3	249.7	221.1	281.4
MON21Aq4	198.9	171.7	230.2
MON21q1	0.3	0.1	0.8
MON21q3	5.5	3.6	8.3
MON21q4	4.3	3.0	6.0
MON22q1	150.8	131.2	173.6
MON22q2	521.7	416.6	647.6
MON22q3	150.4	130.3	174.3
MON22q4	547.9	453.1	677.6
MON23q1	360.7	306.2	425.4
MON23q2	186.7	146.9	236.7
MON23q3	21.2	11.7	36.3
MON23q4	32.6	19.9	52.4
RAB001q	294.5	242.3	365.4
RAB002q	192.8	165.2	230.0
RAB003q	429.7	356.3	525.3
RAB004q	246.6	179.9	362.7
RAB005q	330.3	284.5	379.7
RAB006q	268.3	229.0	316.5
RAB007q	414.6	350.8	490.8
RAB008q	328.5	280.0	386.0
RAB009q	485.0	385.2	628.7
RAB010q	495.8	360.4	683.5
RAB011q	233.4	197.9	274.9
RAB012q	337.3	246.5	475.2
RAB013q	358.7	277.8	465.3
RAB014q	270.9	225.4	330.3

RAB015q	372.0	316.3	443.0
RAB016q	404.0	339.5	494.8
RAB017q	267.5	221.8	323.0
RAB018q	363.1	306.5	432.8
RAB019q	235.8	193.3	288.9
RAB020q	254.3	214.6	307.9
RAB021q	277.7	240.4	322.4
RAB022q	414.6	341.4	510.1
RAB023q	424.6	328.6	555.1
RAB024q	734.1	565.1	955.1
RAB025q	284.2	251.5	319.5
RAB026q	182.2	155.4	214.3
RAB027q	216.6	182.4	261.8
RAB028q	375.8	304.5	474.8
RAB029q	517.2	417.4	661.2
RAB030q	209.0	168.1	272.1
RAB031q	353.0	285.6	453.6
RAB032q	305.0	259.3	359.5
RAB033q	530.5	415.7	667.0
RAB034q	221.3	185.1	268.2
RAB035q	256.1	219.7	303.7
RAB036q	253.8	214.5	305.9
RAB037q	390.2	294.5	532.0
RAB038q	286.4	246.3	334.8
RAB039q	287.0	238.6	357.8
RAB040q	461.0	314.7	678.9
RAB041q	383.4	283.6	542.0
RAB042q	309.3	248.7	392.5
RAB043q	353.7	287.8	442.4
RAB044q	360.1	293.5	451.7
RAB045q	278.2	235.5	331.5

RAB046q	255.3	215.2	302.4
RAB047q	380.9	317.4	466.3
RAB048q	342.7	286.7	408.6
RAB049q	264.7	220.4	320.5
RAB050q	408.2	332.4	513.0
RAB051q	352.5	295.1	426.0
RAB052q	304.9	236.5	406.1
RAB053q	267.0	224.4	322.4
RAB054q	451.6	372.8	553.9
RAB055q	393.1	320.4	491.6
RAB056q	245.4	207.1	294.3
RAB057q	202.9	163.7	252.7
RAB058q	242.0	206.0	287.1
RAB059q	404.1	323.6	520.7
RAB060q	367.5	300.4	443.6
RAB061q	409.2	290.9	618.9
RAB062q	175.1	144.7	212.5
RAB063q	321.4	267.9	400.4
RAB064q	369.3	297.6	470.4
RAB065q	272.3	206.0	374.8
RAB066q	344.9	249.2	505.6
RAB067q	310.9	248.0	394.1
RAB068q	196.1	168.2	232.1
RAB069q	563.5	417.1	773.1
RAB070q	416.3	335.9	525.7
RAB071q	282.9	219.6	374.1
RAB072q	327.4	266.2	406.7
RAB073q	274.4	228.9	335.6
RAB074q	271.9	230.8	325.4
RAB075q	207.9	177.3	241.4
RAB076q	388.1	292.2	544.3
RAB077q	317.1	264.0	391.4

RAB078q	407.7	330.3	524.0
RAB079q	400.3	325.4	490.2
RAB080q	252.9	198.4	330.2
RAB081q	419.9	344.5	515.6
RAB082q	364.5	287.6	476.7
RAB083q	306.7	261.5	365.1
RAB084q	320.5	264.6	401.9
RAB085q	220.7	173.7	282.0
RAB086q	360.3	287.3	460.6
RAB087q	795.2	607.0	1039.3
RAB088q	479.2	388.7	616.6
RAB089q	360.7	277.8	469.3
RAB090q	245.1	204.6	297.4
RAB091q	396.4	310.2	536.4
RAB092q	205.7	167.1	265.2
RAB093q	209.3	181.0	241.3
RAB094q	293.1	253.5	339.2
RAB095q	340.1	264.9	444.0
RAB096q	434.5	333.2	597.0
RAB097q	492.9	410.6	593.9
RAB098q	539.8	432.6	679.3
RAB099q	415.5	343.1	507.4
RAB100q	357.9	292.8	455.3
MAB01c1	245.6	197.7	300.5
MAB01c2	384.1	315.7	464.7
MAB01c3	341.4	285.6	405.4
MAB01c4	291.1	247.2	346.4
MAB02c1	335.3	267.5	435.2
MAB02c2	202.6	162.1	246.3
MAB02c3	317.2	240.9	408.2
MAB02c4	592.3	457.2	760.4

MAB03c1	244.6	193.2	316.3
MAB03c2	324.6	261.2	414.0
MAB03c3	832.0	627.4	1117.8
MAB03c4	371.2	297.2	475.7
MAB04c1	504.9	391.5	670.2
MAB04c2	446.5	334.1	624.0
MAB04c3	626.0	485.7	825.6
MAB04c4	301.5	238.5	384.5
MAB05c1	501.6	398.3	635.7
MAB05c2	321.6	257.7	401.4
MAB05c3	331.2	272.6	410.8
MAB05c4	391.3	306.2	494.4
MAB06c1	320.3	247.3	427.2
MAB06c2	404.9	316.4	521.8
MAB06c3	210.0	167.9	272.9
MAB06c4	463.2	364.6	596.0
MAB07c1	242.8	201.2	293.4
MAB07c2	264.7	218.9	323.2
MAB07c3	212.3	176.7	255.8
MAB07c4	416.8	310.2	592.0
MAB08c1	318.0	244.7	433.6
MAB08c2	370.8	282.6	508.7
MAB08c3	278.7	227.9	346.2
MAB08c4	354.2	290.6	438.2
MAB09c1	461.4	374.9	565.8
MAB09c2	404.7	335.6	488.4
MAB09c3	451.7	347.6	588.9
MAB09c4	657.1	526.6	822.4
MAB10c1	383.9	247.1	598.0
MAB10c2	258.1	218.4	307.1
MAB10c3	565.3	426.3	759.9

MAB10c4	674.1	533.0	865.6
MAB11c1	399.6	327.7	492.6
MAB11c2	406.7	310.9	546.2
MAB11c3	882.6	735.8	1056.4
MAB11c4	314.4	253.5	381.8
MAB12c1	319.4	264.0	394.1
MAB12c2	175.9	139.9	227.3
MAB12c3	169.4	137.4	212.7
MAB12c4	175.3	144.3	213.9

AGB USING ENVIRONMENTAL FACTOR E (agb_chv)

```
AGB_chv.list <- list()

rm(resultMC_ChaveGB); gc()
resultMC_ChaveGB <- by(AfriSARstem, AfriSARstem[,"Site"],
                       function(x) AGBmonteCarlo(D=x$Diameter, WD=x$WD, errWD=x$sdWD, coord=cb
ind(x$long,x$lat),
                                                  Dpropag="chave2004"), simplify=F)

tempLOP <- as.data.frame(resultMC_ChaveGB$LOPE$AGB_simu)
tempMAB <- as.data.frame(resultMC_ChaveGB$MABOUNIE$AGB_simu)
tempMON <- as.data.frame(resultMC_ChaveGB$MONDAH$AGB_simu)
tempRAB <- as.data.frame(resultMC_ChaveGB$RABI$AGB_simu)
tempAFRI <- rbind(tempLOP,tempMAB,tempMON,tempRAB)
Afriprop_CHAV <- cbind(AfriSARstem, tempAFRI)

for (i in (1:length(resolAGB))) {
  tempocalc <- by(Afriprop_CHAV, Afriprop_CHAV[,resolAGB[i]],
                  function(x) list(meanAGB = mean(apply(x[,46:1045], 2, sum, na.rm = T)),
                                   credibilityAGB = quantile(apply(x[,46:1045], 2, sum, na.rm
= T), probs = c(0.025,0.975))))

  AGB_chv.list[[i]] <- data.frame(Area_code = names(tempocalc),
                                  agb_chv = round(as.numeric(sapply(tempocalc,"[",1))*coefmult
[i],1),
                                  cred_chv_2.5 = round(as.numeric(lapply(sapply(tempocalc,"[",
2), function(x) x[1]))*coefmult[i],1),
                                  cred_chv_97.5 = round(as.numeric(lapply(sapply(tempocalc,"["
,2), function(x) x[2]))*coefmult[i],1), stringsAsFactors = F)
  rownames(AGB_chv.list[[i]]) <- NULL
}
AGB_chv.list
AGB_chv.df <- Reduce(rbind, AGB_chv.list)
```

```
AGB_chv.df
```

Area_code	agb_chv	cred_chv_2.5	cred_chv_97.5
LOP02h	1.2	0.7	2.0
LOP03h	27.5	19.6	39.3
LOP07h	331.3	302.2	365.0
LOP08h	288.0	265.7	310.4
LOP09h	357.5	317.3	403.4
LOP10h	403.3	357.9	461.6
LOP11h	391.4	339.5	453.5
LOP12h	364.6	328.5	406.4
LPG01h	492.8	387.0	685.8
LPG02h	602.1	500.7	722.9
MAB01h	344.8	310.4	385.0
MAB02h	327.5	284.0	378.3
MAB03h	352.8	303.6	415.2
MAB04h	468.4	403.9	548.9
MAB05h	458.0	388.1	566.5
MAB06h	328.2	286.2	375.0
MAB07h	260.1	231.0	292.5
MAB08h	320.2	285.7	364.3
MAB09h	425.5	380.6	481.7
MAB10h	366.5	314.1	433.1
MAB11h	456.1	408.7	508.0
MAB12h	196.5	177.1	218.6
MNG03h	497.9	448.8	553.4
MNG04h	423.8	380.0	472.8
MON01h	29.4	23.3	37.1
MON02h	330.1	259.8	432.0
MON03h	56.7	50.3	65.1
MON05h	102.0	88.9	117.4
MON09h	2.7	2.1	3.6

MON10h	116.2	97.6	141.5
MON11h	36.6	32.9	41.0
MON13h	258.5	225.1	299.3
MON14h	164.1	142.9	192.4
MON19h	3.9	3.1	4.7
MON20h	81.9	64.0	109.2
MON21Ah	155.4	142.3	169.4
MON21h	2.3	1.8	2.9
MON22h	314.6	275.2	363.1
MON23h	139.2	121.2	162.1
RAB01h	228.6	197.8	273.9
RAB02h	284.8	247.7	337.3
RAB03h	294.9	265.7	335.2
RAB04h	291.5	265.1	322.3
RAB05h	329.2	277.1	401.6
RAB06h	290.0	258.6	328.4
RAB07h	427.1	361.2	513.9
RAB08h	204.9	186.9	225.9
RAB09h	275.3	241.1	322.1
RAB10h	329.1	274.5	406.7
RAB11h	295.8	254.5	354.7
RAB12h	311.5	275.2	354.3
RAB13h	250.9	224.9	281.0
RAB14h	247.8	221.4	278.6
RAB15h	313.0	273.3	355.0
RAB16h	262.8	220.2	326.9
RAB17h	265.6	236.4	299.1
RAB18h	267.9	223.2	327.6
RAB19h	267.1	235.3	304.9
RAB20h	363.7	308.1	440.4
RAB21h	303.1	260.5	359.0

RAB22h	241.5	218.1	269.3
RAB23h	295.4	255.0	348.8
RAB24h	513.9	444.9	602.2
RAB25h	300.3	263.8	349.5
LOP02q2	0.6	0.3	1.1
LOP02q3	2.4	0.9	5.3
LOP02q4	1.7	1.1	2.6
LOP03q1	14.6	11.1	19.5
LOP03q2	88.5	57.7	134.3
LOP03q3	3.0	2.2	4.1
LOP03q4	3.8	1.9	7.0
LOP04q1	301.2	257.8	352.0
LOP04q2	138.8	117.2	164.1
LOP05q1	49.7	41.0	60.8
LOP05q2	71.8	62.1	82.9
LOP06q1	154.4	137.6	172.3
LOP06q2	197.9	176.3	220.6
LOP07q1	375.5	312.5	464.6
LOP07q2	331.8	284.9	383.1
LOP07q3	301.0	254.2	350.2
LOP07q4	316.7	269.0	382.3
LOP08q1	292.7	254.9	335.0
LOP08q2	296.7	264.1	335.2
LOP08q3	276.3	242.0	316.6
LOP08q4	286.3	247.1	329.3
LOP09q1	466.6	360.8	597.3
LOP09q2	287.3	245.3	338.8
LOP09q3	259.5	213.4	318.5
LOP09q4	416.7	338.7	513.1
LOP10q1	347.9	300.1	411.2
LOP10q2	333.7	271.5	408.9
LOP10q3	534.8	423.5	671.3

LOP10q4	396.9	306.4	534.1
LOP11q1	465.2	371.8	596.3
LOP11q2	297.0	244.5	363.0
LOP11q3	438.5	323.8	604.7
LOP11q4	365.1	282.5	467.0
LOP12q1	412.0	349.8	492.1
LOP12q2	330.5	280.0	393.7
LOP12q3	474.4	385.3	598.1
LOP12q4	241.6	207.2	285.2
LPG01q1	389.9	312.6	492.1
LPG01q2	408.6	315.0	549.0
LPG01q3	260.7	209.5	327.2
LPG01q4	911.0	547.2	1636.7
LPG02q1	460.7	340.9	616.9
LPG02q2	990.2	704.8	1383.9
LPG02q3	288.5	224.4	376.3
LPG02q4	663.9	523.1	857.7
MND01q1	410.1	337.4	494.6
MND01q2	411.7	332.7	506.8
MND01q3	438.4	362.0	537.3
MND01q4	443.6	364.3	543.0
MND02q1	306.2	252.2	375.7
MND02q2	469.5	370.0	588.5
MND02q3	483.4	407.3	575.0
MND02q4	553.5	461.9	672.3
MNG03q1	541.5	457.5	645.9
MNG03q2	512.6	426.0	628.1
MNG03q3	400.1	331.6	482.8
MNG03q4	537.6	441.9	647.9
MNG04q1	587.8	479.8	723.5
MNG04q2	343.1	299.6	391.5

MNG04q3	335.0	271.9	413.5
MNG04q4	429.3	354.6	526.0
MON01q1	13.9	10.1	18.8
MON01q2	6.6	5.0	8.7
MON01q3	37.2	24.9	54.9
MON01q4	59.8	42.7	88.2
MON02q1	197.6	149.4	258.1
MON02q2	129.9	94.8	190.4
MON02q3	831.7	564.2	1232.4
MON02q4	161.2	138.2	191.3
MON03q1	27.2	19.6	39.7
MON03q2	17.7	12.8	25.6
MON03q3	70.7	58.0	89.1
MON03q4	111.2	94.4	132.4
MON05q1	166.2	130.5	213.6
MON05q2	169.4	139.9	205.1
MON05q3	28.4	20.4	39.2
MON05q4	43.9	33.8	58.6
MON09q1	2.3	1.2	4.0
MON09q2	1.5	1.0	2.2
MON09q3	0.6	0.4	1.0
MON09q4	6.4	4.3	9.5
MON10q1	107.2	60.2	192.9
MON10q2	122.7	96.6	156.4
MON10q3	70.1	53.2	91.1
MON10q4	164.8	127.5	216.3
MON11q1	22.4	17.8	28.5
MON11q2	33.2	26.7	43.0
MON11q3	32.9	25.7	42.7
MON11q4	58.0	50.5	67.2
MON13q1	335.2	277.7	411.5

MON13q2	267.1	225.0	318.6
MON13q3	172.4	133.9	227.8
MON13q4	259.1	180.6	383.7
MON14q1	270.6	210.8	356.8
MON14q2	199.8	160.2	252.1
MON14q3	122.6	91.5	174.1
MON14q4	63.4	55.6	72.5
MON19q1	9.3	7.1	12.1
MON19q2	0.4	0.2	0.7
MON19q3	5.3	3.7	7.5
MON19q4	0.5	0.3	1.0
MON20q1	166.8	101.9	272.7
MON20q2	124.5	100.6	158.8
MON20q3	24.2	18.4	32.8
MON20q4	12.0	9.3	15.3
MON21Aq1	128.6	111.1	151.6
MON21Aq2	86.5	70.9	106.2
MON21Aq3	224.3	197.7	255.2
MON21Aq4	182.3	153.2	218.8
MON21q1	0.3	0.1	0.6
MON21q3	4.9	3.5	7.2
MON21q4	3.9	2.9	5.3
MON22q1	134.8	116.2	155.4
MON22q2	485.7	380.5	627.6
MON22q3	133.8	116.1	154.6
MON22q4	503.9	402.7	643.9
MON23q1	334.8	283.3	405.1
MON23q2	172.6	135.9	231.3
MON23q3	19.7	11.0	33.1
MON23q4	29.9	18.2	49.5
RAB001q	253.2	201.8	323.7
RAB002q	163.0	137.7	200.3

RAB003q	367.3	300.8	455.9
RAB004q	223.8	152.5	359.4
RAB005q	278.6	236.7	326.9
RAB006q	227.4	191.6	273.4
RAB007q	353.4	299.8	425.7
RAB008q	276.3	234.9	325.0
RAB009q	430.0	325.6	574.9
RAB010q	472.7	316.3	695.4
RAB011q	196.5	165.5	231.8
RAB012q	301.5	203.7	456.2
RAB013q	314.9	237.2	427.8
RAB014q	230.5	187.5	288.2
RAB015q	318.2	266.6	403.0
RAB016q	355.6	281.2	461.0
RAB017q	224.6	185.7	276.7
RAB018q	311.8	253.3	382.2
RAB019q	200.0	160.6	251.7
RAB020q	213.9	178.4	263.2
RAB021q	234.6	197.9	276.2
RAB022q	354.6	285.7	446.2
RAB023q	371.8	281.1	502.7
RAB024q	678.3	501.8	934.9
RAB025q	236.9	207.3	269.6
RAB026q	153.5	132.0	183.5
RAB027q	184.8	154.9	223.4
RAB028q	323.8	257.5	428.1
RAB029q	458.0	352.2	628.6
RAB030q	178.8	141.8	236.4
RAB031q	311.1	245.3	407.8
RAB032q	259.6	214.9	314.4
RAB033q	470.2	355.0	622.9

RAB034q	188.3	157.9	231.0
RAB035q	215.0	180.5	263.4
RAB036q	214.4	177.9	261.2
RAB037q	348.5	256.1	501.4
RAB038q	244.0	207.8	292.2
RAB039q	244.2	198.7	310.3
RAB040q	435.3	282.2	663.3
RAB041q	353.4	246.6	535.9
RAB042q	270.1	212.1	349.7
RAB043q	308.6	238.9	398.6
RAB044q	315.7	251.1	410.8
RAB045q	237.1	197.7	286.0
RAB046q	217.2	182.8	263.6
RAB047q	324.5	267.7	407.1
RAB048q	289.8	238.6	358.7
RAB049q	224.8	184.1	280.1
RAB050q	352.4	278.5	451.6
RAB051q	297.8	245.0	373.9
RAB052q	262.1	197.8	365.5
RAB053q	228.3	189.0	279.2
RAB054q	393.6	310.5	500.7
RAB055q	342.2	271.8	431.9
RAB056q	207.2	176.2	245.9
RAB057q	172.8	136.6	225.8
RAB058q	204.1	168.1	242.4
RAB059q	357.9	277.6	468.0
RAB060q	316.7	257.6	392.9
RAB061q	374.1	251.0	614.4
RAB062q	146.4	121.2	178.2
RAB063q	272.2	221.1	338.3
RAB064q	326.4	257.2	423.2

RAB065q	233.1	170.8	332.7
RAB066q	314.4	221.0	487.0
RAB067q	277.4	211.5	373.1
RAB068q	165.5	138.8	197.3
RAB069q	522.8	364.7	791.4
RAB070q	372.4	289.2	493.6
RAB071q	250.9	188.0	348.5
RAB072q	279.2	228.0	353.4
RAB073q	232.8	190.5	290.3
RAB074q	231.1	191.1	286.1
RAB075q	175.0	148.6	209.2
RAB076q	349.2	247.6	523.4
RAB077q	271.9	223.0	333.3
RAB078q	353.7	282.5	462.3
RAB079q	339.9	275.2	421.9
RAB080q	217.2	167.2	282.7
RAB081q	361.4	291.6	454.0
RAB082q	319.4	247.0	431.7
RAB083q	261.6	222.3	313.7
RAB084q	274.9	219.8	356.0
RAB085q	191.5	148.5	250.9
RAB086q	311.8	248.1	400.6
RAB087q	727.0	535.0	1003.5
RAB088q	425.4	330.4	560.5
RAB089q	321.6	243.4	449.2
RAB090q	207.6	170.5	255.4
RAB091q	352.6	258.0	505.5
RAB092q	178.9	137.4	246.6
RAB093q	177.6	151.9	211.9
RAB094q	251.0	213.0	303.4
RAB095q	296.3	223.0	401.7
RAB096q	381.5	285.1	533.3

RAB097q	421.1	343.1	525.5
RAB098q	482.0	377.3	631.4
RAB099q	361.9	296.5	454.7
RAB100q	309.9	245.9	410.1
MAB01c1	223.2	177.2	279.4
MAB01c2	349.6	283.5	442.3
MAB01c3	309.4	258.4	377.9
MAB01c4	263.8	218.9	322.3
MAB02c1	308.5	245.3	396.9
MAB02c2	183.7	147.7	232.0
MAB02c3	298.1	224.5	400.4
MAB02c4	557.9	414.2	746.7
MAB03c1	219.4	172.6	283.5
MAB03c2	295.7	236.1	375.0
MAB03c3	813.3	567.8	1163.6
MAB03c4	341.9	261.2	453.5
MAB04c1	464.1	350.8	635.1
MAB04c2	424.1	313.3	606.2
MAB04c3	580.2	451.1	783.5
MAB04c4	274.7	216.7	355.3
MAB05c1	462.3	364.6	597.0
MAB05c2	289.2	223.1	366.5
MAB05c3	301.9	245.4	384.7
MAB05c4	362.4	273.8	475.7
MAB06c1	294.5	222.3	406.3
MAB06c2	373.7	284.6	509.9
MAB06c3	192.2	149.1	247.4
MAB06c4	421.8	323.4	543.3
MAB07c1	219.6	182.4	268.9
MAB07c2	239.4	193.1	299.7
MAB07c3	190.3	158.7	231.7

MAB07c4	384.9	271.3	551.4
MAB08c1	295.6	217.3	411.8
MAB08c2	340.9	248.2	494.8
MAB08c3	252.8	204.5	318.9
MAB08c4	320.4	257.7	400.9
MAB09c1	421.3	334.9	537.7
MAB09c2	361.2	295.0	447.0
MAB09c3	411.7	307.4	567.3
MAB09c4	607.1	476.8	773.9
MAB10c1	374.2	232.1	624.3
MAB10c2	232.6	197.0	278.3
MAB10c3	529.5	383.1	742.0
MAB10c4	624.7	466.3	843.9
MAB11c1	362.9	287.6	452.1
MAB11c2	379.7	282.8	519.3
MAB11c3	813.3	664.4	986.2
MAB11c4	282.5	222.4	360.5
MAB12c1	291.3	238.4	361.6
MAB12c2	160.5	126.1	205.4
MAB12c3	154.0	124.4	195.7
MAB12c4	158.6	128.8	192.7

AGB USING LOCAL H:D RELATIONSHIP (agb_loc)

```
AGB_loc.list <- list()

rm(resultMC_LocalGB); gc()
resultMC_LocalGB <- by(AfriSARstem, AfriSARstem[,"Site"],
                       function(x) AGBmonteCarlo(D=x$Diameter, WD=x$WD, H=x$Hlocal, errWD=x$sd
WD,
                                                 errH=x$HlocRSE, Dpropag ="chave2004"), simpli
fy=F)

tempLOP <- as.data.frame(resultMC_LocalGB$LOPE$AGB_simu)
tempMAB <- as.data.frame(resultMC_LocalGB$MABOUNIE$AGB_simu)
```

```
tempMON <- as.data.frame(resultMC_LocalGB$MONDAH$AGB_simu)
tempRAB <- as.data.frame(resultMC_LocalGB$RABI$AGB_simu)
tempAFRI <- rbind(tempLOP,tempMAB,tempMON,tempRAB)
Afriprop_LOCAL <- cbind(AfriSARstem, tempAFRI)

for (i in (1:length(resolAGB))) {
  tempocalc <- by(Afriprop_LOCAL, Afriprop_LOCAL[,resolAGB[i]],
                  function(x) list(meanAGB = mean(apply(x[,46:1045], 2, sum, na.rm = T)),
                                   credibilityAGB = quantile(apply(x[,46:1045], 2, sum, na.rm
= T), probs = c(0.025,0.975))))

  AGB_loc.list[[i]] <- data.frame(Area_code = names(tempocalc),
                                  agb_loc = round(as.numeric(sapply(tempocalc,"[",1))*coefmult
[i],1),
                                  cred_loc_2.5 = round(as.numeric(lapply(sapply(tempocalc,"[",
2), function(x) x[1]))*coefmult[i],1),
                                  cred_loc_97.5 = round(as.numeric(lapply(sapply(tempocalc,"["
,2), function(x) x[2]))*coefmult[i],1), stringsAsFactors = F)
  rownames(AGB_loc.list[[i]]) <- NULL
}
AGB_loc.list
AGB_loc.df <- Reduce(rbind, AGB_loc.list)
AGB_loc.df
```

Area_code	agb_loc	cred_loc_2.5	cred_loc_97.5
LOP02h	0.3	0.2	0.6
LOP03h	15.5	11.5	22.1
LOP07h	317.9	294.3	342.8
LOP08h	290.4	272.3	308.9
LOP09h	348.6	316.7	383.0
LOP10h	375.1	339.2	414.8
LOP11h	349.7	314.1	393.7
LOP12h	321.4	296.3	352.0
LPG01h	439.1	371.8	534.2
LPG02h	547.3	482.3	628.6
MAB01h	327.7	299.0	361.8
MAB02h	302.4	269.0	338.6
MAB03h	333.6	296.5	386.9
MAB04h	459.0	407.4	526.0
MAB05h	438.8	377.9	518.5
MAB06h	309.4	279.4	344.6

MAB07h	247.0	225.7	272.7
MAB08h	290.9	265.3	318.7
MAB09h	411.0	375.0	454.5
MAB10h	344.8	304.7	393.9
MAB11h	523.2	477.4	576.0
MAB12h	171.8	156.8	186.9
MNG03h	510.6	468.5	561.3
MNG04h	444.0	403.2	487.7
MON01h	25.6	21.3	30.6
MON02h	294.7	248.7	357.8
MON03h	56.8	51.1	63.3
MON05h	93.2	83.8	104.5
MON09h	2.3	1.7	3.0
MON10h	103.4	88.1	121.4
MON11h	35.0	31.6	39.2
MON13h	247.8	222.9	275.9
MON14h	149.9	132.7	168.2
MON19h	3.4	2.8	4.2
MON20h	70.3	58.7	85.9
MON21Ah	160.3	148.3	174.1
MON21h	2.4	1.8	3.1
MON22h	289.1	258.2	322.5
MON23h	128.8	115.1	144.9
RAB01h	210.7	191.3	233.2
RAB02h	280.3	248.8	316.2
RAB03h	303.2	276.6	333.4
RAB04h	300.1	274.8	324.9
RAB05h	320.6	278.1	368.5
RAB06h	301.0	275.1	331.5
RAB07h	413.2	361.4	475.5
RAB08h	209.4	194.2	225.3
RAB09h	280.1	250.1	322.5

RAB10h	323.3	278.9	378.5
RAB11h	287.8	253.4	332.7
RAB12h	310.1	280.8	344.8
RAB13h	246.4	224.4	271.0
RAB14h	245.6	224.3	270.6
RAB15h	313.1	281.9	347.3
RAB16h	253.7	219.3	300.7
RAB17h	265.9	241.4	293.1
RAB18h	262.5	224.0	312.2
RAB19h	255.1	229.6	284.6
RAB20h	348.5	306.0	397.3
RAB21h	301.2	267.9	337.6
RAB22h	246.7	226.0	269.0
RAB23h	296.1	262.6	339.5
RAB24h	511.8	453.5	577.0
RAB25h	293.4	263.1	331.2
LOP02q2	0.2	0.1	0.3
LOP02q3	0.8	0.3	1.7
LOP02q4	0.4	0.3	0.6
LOP03q1	8.7	6.5	11.7
LOP03q2	50.1	34.3	76.3
LOP03q3	0.8	0.6	1.1
LOP03q4	2.4	1.2	4.4
LOP04q1	300.5	260.9	346.8
LOP04q2	138.0	120.9	159.3
LOP05q1	39.0	32.7	46.0
LOP05q2	63.3	55.1	72.0
LOP06q1	156.8	141.9	173.6
LOP06q2	206.1	187.9	226.9
LOP07q1	362.3	304.5	427.1
LOP07q2	324.6	286.9	364.8

LOP07q3	289.5	252.8	334.6
LOP07q4	295.1	256.7	339.5
LOP08q1	296.9	263.8	334.0
LOP08q2	302.9	273.9	338.0
LOP08q3	276.8	247.9	309.8
LOP08q4	285.0	249.7	324.9
LOP09q1	433.2	352.4	536.5
LOP09q2	299.6	256.6	345.7
LOP09q3	262.0	223.4	310.2
LOP09q4	399.5	336.7	470.4
LOP10q1	337.0	291.9	388.0
LOP10q2	300.4	250.3	357.3
LOP10q3	502.4	415.3	603.6
LOP10q4	360.4	287.5	478.6
LOP11q1	431.8	357.2	537.9
LOP11q2	273.7	231.9	328.6
LOP11q3	371.2	297.7	490.8
LOP11q4	322.2	264.9	399.3
LOP12q1	359.5	308.3	414.5
LOP12q2	303.2	263.4	352.7
LOP12q3	398.8	335.7	489.9
LOP12q4	224.1	197.3	254.8
LPG01q1	370.2	305.8	450.1
LPG01q2	384.7	310.6	503.1
LPG01q3	254.2	209.9	310.9
LPG01q4	746.2	499.7	1132.0
LPG02q1	423.7	324.9	548.8
LPG02q2	860.4	659.7	1109.2
LPG02q3	275.2	217.9	348.7
LPG02q4	624.8	506.4	764.7
MND01q1	416.6	351.9	506.8

MND01q2	402.5	330.6	486.3
MND01q3	429.1	358.4	507.7
MND01q4	454.5	378.2	543.5
MND02q1	319.1	266.4	381.2
MND02q2	484.2	396.1	592.7
MND02q3	496.8	416.7	585.9
MND02q4	572.5	481.8	673.6
MNG03q1	564.2	480.7	660.9
MNG03q2	516.1	431.2	624.6
MNG03q3	416.8	352.1	486.7
MNG03q4	545.3	454.5	644.2
MNG04q1	610.5	504.8	751.4
MNG04q2	362.2	315.0	415.7
MNG04q3	344.2	283.3	420.5
MNG04q4	459.2	390.6	544.1
MON01q1	13.8	10.1	18.4
MON01q2	6.8	4.8	9.3
MON01q3	31.1	22.0	43.3
MON01q4	50.6	38.2	67.3
MON02q1	183.5	145.9	230.2
MON02q2	151.5	108.5	222.1
MON02q3	674.8	514.3	927.7
MON02q4	169.0	143.7	200.9
MON03q1	29.9	21.4	43.0
MON03q2	16.5	12.1	22.2
MON03q3	69.0	57.6	81.8
MON03q4	111.9	96.3	129.0
MON05q1	143.0	115.3	179.1
MON05q2	153.7	133.3	177.9
MON05q3	29.9	21.3	41.7
MON05q4	46.2	34.8	61.8
MON09q1	1.8	1.0	3.1

MON09q2	1.5	0.9	2.4
MON09q3	0.7	0.3	1.3
MON09q4	5.1	3.3	7.6
MON10q1	91.0	58.3	144.6
MON10q2	111.4	89.8	139.1
MON10q3	61.4	49.4	77.8
MON10q4	149.7	116.0	189.8
MON11q1	18.4	14.4	23.5
MON11q2	29.6	24.4	36.5
MON11q3	34.3	26.0	44.8
MON11q4	57.7	50.3	67.0
MON13q1	329.2	277.1	395.8
MON13q2	256.9	217.5	305.1
MON13q3	165.7	131.5	208.2
MON13q4	239.4	182.9	317.6
MON14q1	226.6	182.8	280.1
MON14q2	184.9	154.9	223.5
MON14q3	122.9	88.9	170.1
MON14q4	65.1	56.6	75.2
MON19q1	8.7	6.5	11.3
MON19q2	0.4	0.1	0.9
MON19q3	4.1	2.9	5.9
MON19q4	0.6	0.2	1.2
MON20q1	128.5	88.8	189.2
MON20q2	114.9	95.2	140.4
MON20q3	25.2	18.5	33.5
MON20q4	12.4	9.4	16.0
MON21Aq1	133.9	114.8	157.0
MON21Aq2	87.8	72.5	105.0
MON21Aq3	233.0	203.8	267.4
MON21Aq4	186.4	160.2	220.6

MON21q1	0.3	0.1	0.6
MON21q3	5.1	3.4	7.4
MON21q4	4.1	2.9	5.7
MON22q1	137.8	119.3	159.8
MON22q2	417.8	339.9	517.3
MON22q3	142.2	122.8	164.9
MON22q4	458.7	380.9	550.2
MON23q1	309.2	268.3	358.1
MON23q2	154.7	126.0	190.1
MON23q3	20.5	11.2	33.8
MON23q4	30.9	18.1	51.5
RAB001q	252.6	206.8	311.2
RAB002q	161.2	139.3	187.8
RAB003q	368.6	315.0	435.5
RAB004q	215.3	161.2	296.1
RAB005q	287.5	252.6	333.7
RAB006q	231.2	198.3	271.5
RAB007q	369.2	315.6	431.1
RAB008q	282.7	244.0	326.8
RAB009q	410.3	330.5	524.9
RAB010q	441.0	325.5	603.3
RAB011q	200.3	170.0	235.6
RAB012q	228.7	184.7	296.7
RAB013q	304.7	232.8	405.7
RAB014q	229.6	195.7	270.8
RAB015q	326.4	275.7	399.6
RAB016q	367.6	305.3	444.0
RAB017q	232.3	196.7	278.3
RAB018q	315.9	264.2	373.8
RAB019q	205.3	168.1	254.0
RAB020q	225.9	190.9	269.7

RAB021q	243.4	211.8	279.6
RAB022q	376.9	314.2	453.9
RAB023q	348.9	270.1	452.3
RAB024q	650.6	503.4	854.1
RAB025q	242.4	217.2	271.8
RAB026q	156.9	137.1	183.1
RAB027q	184.8	161.8	215.4
RAB028q	339.0	273.8	418.9
RAB029q	478.8	386.7	611.8
RAB030q	183.8	149.6	232.6
RAB031q	313.1	255.0	398.9
RAB032q	270.6	228.5	319.2
RAB033q	472.4	377.5	598.7
RAB034q	180.8	154.3	213.4
RAB035q	217.7	188.7	258.5
RAB036q	220.8	185.1	264.1
RAB037q	343.3	261.2	478.1
RAB038q	253.2	222.0	295.9
RAB039q	248.7	206.0	305.6
RAB040q	381.9	265.3	556.4
RAB041q	311.4	233.5	432.3
RAB042q	257.0	208.0	316.8
RAB043q	300.0	244.9	374.7
RAB044q	318.3	257.6	390.7
RAB045q	230.2	197.6	271.3
RAB046q	215.0	181.4	258.8
RAB047q	319.4	273.0	381.1
RAB048q	292.4	247.4	352.8
RAB049q	230.9	191.6	278.8
RAB050q	343.1	284.7	426.8
RAB051q	306.3	257.7	374.1
RAB052q	276.5	212.2	373.0

RAB053q	236.1	198.6	280.6
RAB054q	386.1	319.3	476.2
RAB055q	329.8	267.0	408.3
RAB056q	210.5	181.2	249.9
RAB057q	173.4	142.5	215.0
RAB058q	197.3	170.6	231.9
RAB059q	372.5	299.2	479.8
RAB060q	305.9	249.4	368.2
RAB061q	355.4	250.1	521.3
RAB062q	140.2	118.4	168.0
RAB063q	281.6	231.5	343.0
RAB064q	311.7	258.0	392.2
RAB065q	234.9	177.3	327.8
RAB066q	299.8	216.9	434.1
RAB067q	254.2	208.4	319.3
RAB068q	165.2	141.7	193.3
RAB069q	474.3	365.1	647.1
RAB070q	352.8	283.7	434.8
RAB071q	240.8	190.6	322.1
RAB072q	278.0	232.9	339.9
RAB073q	231.7	196.9	281.0
RAB074q	238.4	202.9	283.1
RAB075q	175.1	151.4	203.9
RAB076q	340.0	255.3	475.2
RAB077q	256.2	216.9	300.1
RAB078q	344.8	280.1	431.9
RAB079q	349.8	289.4	422.9
RAB080q	214.9	170.8	274.9
RAB081q	359.1	299.3	434.9
RAB082q	330.5	259.8	432.7
RAB083q	264.8	222.0	312.6

RAB084q	282.6	235.9	352.2
RAB085q	191.5	153.5	251.2
RAB086q	305.7	249.1	381.5
RAB087q	732.6	566.5	958.6
RAB088q	421.5	339.2	535.5
RAB089q	318.8	245.8	420.9
RAB090q	197.2	165.4	237.8
RAB091q	334.4	267.8	431.1
RAB092q	180.9	143.3	235.2
RAB093q	177.8	154.5	205.2
RAB094q	260.6	226.3	303.0
RAB095q	302.3	242.0	385.8
RAB096q	384.4	299.6	512.2
RAB097q	436.3	359.7	526.2
RAB098q	456.7	366.6	565.1
RAB099q	350.6	292.3	431.0
RAB100q	307.1	250.2	384.1
MAB01c1	208.5	168.6	253.1
MAB01c2	343.7	275.8	424.1
MAB01c3	284.2	240.3	336.6
MAB01c4	243.7	205.6	288.7
MAB02c1	295.8	238.1	370.0
MAB02c2	167.2	135.5	206.8
MAB02c3	272.0	207.0	350.8
MAB02c4	492.2	386.3	627.9
MAB03c1	219.7	175.3	279.3
MAB03c2	296.4	233.9	382.4
MAB03c3	737.9	550.7	1016.6
MAB03c4	310.0	247.7	382.8
MAB04c1	442.3	345.2	593.2
MAB04c2	416.5	308.3	594.5

MAB04c3	579.0	452.3	750.9
MAB04c4	265.4	210.0	336.1
MAB05c1	453.1	356.0	565.7
MAB05c2	283.7	225.2	353.0
MAB05c3	298.3	240.7	379.1
MAB05c4	360.5	281.0	465.7
MAB06c1	263.8	209.5	338.2
MAB06c2	351.6	277.7	448.0
MAB06c3	182.2	145.9	230.3
MAB06c4	406.1	316.5	515.2
MAB07c1	214.9	178.8	255.9
MAB07c2	218.8	180.8	268.7
MAB07c3	189.1	158.0	232.0
MAB07c4	341.8	258.8	468.6
MAB08c1	251.6	198.0	321.8
MAB08c2	298.8	238.4	392.7
MAB08c3	241.5	197.4	296.7
MAB08c4	304.4	243.1	374.1
MAB09c1	403.8	335.5	492.2
MAB09c2	379.9	317.2	460.8
MAB09c3	412.4	315.6	548.5
MAB09c4	567.5	450.2	706.6
MAB10c1	360.7	236.7	588.5
MAB10c2	231.7	194.1	274.9
MAB10c3	506.3	388.8	689.5
MAB10c4	559.3	453.2	700.8
MAB11c1	402.7	325.1	497.9
MAB11c2	424.3	324.3	582.8
MAB11c3	918.2	763.2	1103.4
MAB11c4	329.9	262.8	421.3
MAB12c1	263.0	219.8	320.7
MAB12c2	140.3	114.7	173.1

MAB12c3	145.0	116.8	189.6
MAB12c4	135.8	113.2	166.3

Reshaping the different information (estimates, coordinates) in a single object

```
# Convert list of georeferenced hectares/quarters/corners into a single data.frame
site.df <- Reduce(rbind, c(site.list[[1]], site.list[[2]], site.list[[3]], site.list[[4]]))
site.df <- site.df[order(site.df$Site),]
rownames(site.df) <- NULL

# Calculating the maximum height and the Lorey's height per (sub)plot
AfriSARstem$Hchave <- retrieveH(D=AfriSARstem$Diameter, coord=cbind(AfriSARstem$long,AfriSARst
em$lat))$H

# Max height_QUART
maxHlocal <- tapply(AfriSARstem$Hlocal, AfriSARstem$Quart_code, max)
maxHchave <- tapply(AfriSARstem$Hchave, AfriSARstem$Quart_code, max)
maxHfeld <- tapply(AfriSARstem$Hfeld, AfriSARstem$Quart_code, max)

# Lorey height_QUART
AfriSARstem$BAm <- (pi*(AfriSARstem$Diameter/2)^2)/10000
AfriSARstem$HBAlocal <- AfriSARstem$Hlocal * AfriSARstem$BAm
AfriSARstem$HBAchave <- AfriSARstem$Hchave * AfriSARstem$BAm
AfriSARstem$HBAfeld <- AfriSARstem$Hfeld * AfriSARstem$BAm
LoreyLocal <- tapply(AfriSARstem$HBAlocal,AfriSARstem$Quart_code,sum) / tapply(AfriSARstem$BAm
,AfriSARstem$Quart_code, sum)
LoreyChave <- tapply(AfriSARstem$HBAchave,AfriSARstem$Quart_code,sum) / tapply(AfriSARstem$BAm
,AfriSARstem$Quart_code, sum)
LoreyFeld <- tapply(AfriSARstem$HBAfeld,AfriSARstem$Quart_code,sum) / tapply(AfriSARstem$BAm,A
friSARstem$Quart_code, sum)

hdf1 <- data.frame(Area_code = names(maxHlocal), LoreyLocal=LoreyLocal, LoreyChave=LoreyChave,
LoreyFeld=LoreyFeld, maxHlocal=maxHlocal, maxHchave=maxHchave, maxHfeld=maxHfeld)

# Max height_CORN
maxHlocalCORN <- tapply(AfriSARstem$Hlocal, AfriSARstem$Corn_code, max)
maxHchaveCORN <- tapply(AfriSARstem$Hchave, AfriSARstem$Corn_code, max)
maxHfeldCORN <- tapply(AfriSARstem$Hfeld, AfriSARstem$Corn_code, max)

# Lorey height_CORN
LoreyLocalCORN <- tapply(AfriSARstem$HBAlocal,AfriSARstem$Corn_code,sum) / tapply(AfriSARstem$
BAm,AfriSARstem$Corn_code, sum)
LoreyChaveCORN <- tapply(AfriSARstem$HBAchave,AfriSARstem$Corn_code,sum) / tapply(AfriSARstem$
BAm,AfriSARstem$Corn_code, sum)
LoreyFeldCORN <- tapply(AfriSARstem$HBAfeld,AfriSARstem$Corn_code,sum) / tapply(AfriSARstem$BA
m,AfriSARstem$Corn_code, sum)

hdf2 <- data.frame(Area_code = names(maxHlocalCORN), LoreyLocal=LoreyLocalCORN, LoreyChave=Lor
```

```
eyChaveCORN,LoreyFeld=LoreyFeldCORN,
                   maxHlocal=maxHlocalCORN, maxHchave=maxHchaveCORN, maxHfeld=maxHfeldCORN)
hdf <- rbind(hdf1, hdf2)
site.df <- merge(site.df, hdf, by="Area_code", sort = F, all=T)

# Merge dataframes
AGB_FIN1 <- merge(site.df, AGB_fph.df, by="Area_code", sort = F, all=T)
AGB_FIN1$agb_fph[which(is.na(AGB_FIN1$agb_fph))] <- 0

AGB_FIN2 <- merge(AGB_FIN1, AGB_chv.df, by="Area_code", sort = F, all=T)
AGB_FIN2$agb_chv[which(is.na(AGB_FIN2$agb_chv))] <- 0

AGB_AfriSAR <- merge(AGB_FIN2, AGB_loc.df, by="Area_code", sort = F, all=T)
AGB_AfriSAR$agb_loc[which(is.na(AGB_AfriSAR$agb_loc) & AGB_AfriSAR$Site != "RABI")] <- 0

# Reorder columns
#AGB_AfriSAR <- AGB_AfriSAR[c("Site","Area_code","Plot_code","Scale","sw_x","sw_y","nw_x","nw_
y","se_x","se_y","ne_x","ne_y","agb_fph","cred_fph_2.5","cred_fph_97.5","agb_chv","cred_chv_2.
5","cred_chv_97.5","agb_loc","cred_loc_2.5","cred_loc_97.5")]

# Reorder lines
AGB_AfriSAR$Site <- as.character(AGB_AfriSAR$Site)
AGB_AfriSAR$Scale <- as.character(AGB_AfriSAR$Scale)
AGB_AfriSAR$Plot_code <- as.character(AGB_AfriSAR$Plot_code)
AGB_AfriSAR$Area_code <- as.character(AGB_AfriSAR$Area_code)

AGB_AfriSAR <- AGB_AfriSAR[with(AGB_AfriSAR, order(Site, Scale, Plot_code, Area_code, decreasi
ng = c(T,T,F,F), method = "radix")),]

AGB_AfriSAR$Site <- as.factor(AGB_AfriSAR$Site)
AGB_AfriSAR$Scale <- as.factor(AGB_AfriSAR$Scale)
AGB_AfriSAR$Plot_code <- as.factor(AGB_AfriSAR$Plot_code)
AGB_AfriSAR$Area_code <- as.factor(AGB_AfriSAR$Area_code)
rownames(AGB_AfriSAR) <- NULL

### NORTH POINTS
AGB_AfriSAR$Lat_sw <- NA; AGB_AfriSAR$Lon_sw <- NA; AGB_AfriSAR$Lat_nw <- NA; AGB_AfriSAR$Lon_
nw <- NA;
AGB_AfriSAR$Lat_se <- NA; AGB_AfriSAR$Lon_se <- NA; AGB_AfriSAR$Lat_ne <- NA; AGB_AfriSAR$Lon_
ne <- NA

north_sw.utm <- SpatialPoints(cbind(AGB_AfriSAR$sw_x[which(AGB_AfriSAR$sw_y < 100000)], AGB_Af
riSAR$sw_y[which(AGB_AfriSAR$sw_y < 100000)]),
                              proj4string=CRS("+proj=utm +zone=32 +north +datum=WGS84 +units=m
 +no_defs +ellps=WGS84 +towgs84=0,0,0"))
north_sw.geo <- spTransform(north_sw.utm, CRS("+proj=longlat +datum=WGS84"))
AGB_AfriSAR$Lon_sw[which(AGB_AfriSAR$sw_y < 100000)] <- north_sw.geo@coords[,1]; AGB_AfriSAR$L
at_sw[which(AGB_AfriSAR$sw_y < 100000)] <- north_sw.geo@coords[,2]

north_nw.utm <- SpatialPoints(cbind(AGB_AfriSAR$nw_x[which(AGB_AfriSAR$sw_y < 100000)], AGB_Af
riSAR$nw_y[which(AGB_AfriSAR$sw_y < 100000)]),
                              proj4string=CRS("+proj=utm +zone=32 +north +datum=WGS84 +units=m
 +no_defs +ellps=WGS84 +towgs84=0,0,0"))
north_nw.geo <- spTransform(north_nw.utm, CRS("+proj=longlat +datum=WGS84"))
```

```
AGB_AfriSAR$Lon_nw[which(AGB_AfriSAR$sw_y < 100000)] <- north_nw.geo@coords[,1]; AGB_AfriSAR$L
at_nw[which(AGB_AfriSAR$sw_y < 100000)] <- north_nw.geo@coords[,2]

north_se.utm <- SpatialPoints(cbind(AGB_AfriSAR$se_x[which(AGB_AfriSAR$sw_y < 100000)], AGB_Af
riSAR$se_y[which(AGB_AfriSAR$sw_y < 100000)]),
                              proj4string=CRS("+proj=utm +zone=32 +north +datum=WGS84 +units=m
 +no_defs +ellps=WGS84 +towgs84=0,0,0"))
north_se.geo <- spTransform(north_se.utm, CRS("+proj=longlat +datum=WGS84"))
AGB_AfriSAR$Lon_se[which(AGB_AfriSAR$sw_y < 100000)] <- north_se.geo@coords[,1]; AGB_AfriSAR$L
at_se[which(AGB_AfriSAR$sw_y < 100000)] <- north_se.geo@coords[,2]

north_ne.utm <- SpatialPoints(cbind(AGB_AfriSAR$ne_x[which(AGB_AfriSAR$sw_y < 100000)], AGB_Af
riSAR$ne_y[which(AGB_AfriSAR$sw_y < 100000)]),
                              proj4string=CRS("+proj=utm +zone=32 +north +datum=WGS84 +units=m
 +no_defs +ellps=WGS84 +towgs84=0,0,0"))
north_ne.geo <- spTransform(north_ne.utm, CRS("+proj=longlat +datum=WGS84"))
AGB_AfriSAR$Lon_ne[which(AGB_AfriSAR$sw_y < 100000)] <- north_ne.geo@coords[,1]; AGB_AfriSAR$L
at_ne[which(AGB_AfriSAR$sw_y < 100000)] <- north_ne.geo@coords[,2]

### SOUTH POINTS
south_sw.utm <- SpatialPoints(cbind(AGB_AfriSAR$sw_x[which(AGB_AfriSAR$sw_y > 100000)], AGB_Af
riSAR$sw_y[which(AGB_AfriSAR$sw_y > 100000)]),
                              proj4string=CRS("+proj=utm +zone=32 +south +datum=WGS84 +units=m
 +no_defs +ellps=WGS84 +towgs84=0,0,0"))
south_sw.geo <- spTransform(south_sw.utm, CRS("+proj=longlat +datum=WGS84"))
AGB_AfriSAR$Lon_sw[which(AGB_AfriSAR$sw_y > 100000)] <- south_sw.geo@coords[,1]; AGB_AfriSAR$L
at_sw[which(AGB_AfriSAR$sw_y > 100000)] <- south_sw.geo@coords[,2]

south_nw.utm <- SpatialPoints(cbind(AGB_AfriSAR$nw_x[which(AGB_AfriSAR$sw_y > 100000)], AGB_Af
riSAR$nw_y[which(AGB_AfriSAR$sw_y > 100000)]),
                              proj4string=CRS("+proj=utm +zone=32 +south +datum=WGS84 +units=m
 +no_defs +ellps=WGS84 +towgs84=0,0,0"))
south_nw.geo <- spTransform(south_nw.utm, CRS("+proj=longlat +datum=WGS84"))
AGB_AfriSAR$Lon_nw[which(AGB_AfriSAR$sw_y > 100000)] <- south_nw.geo@coords[,1]; AGB_AfriSAR$L
at_nw[which(AGB_AfriSAR$sw_y > 100000)] <- south_nw.geo@coords[,2]

south_se.utm <- SpatialPoints(cbind(AGB_AfriSAR$se_x[which(AGB_AfriSAR$sw_y > 100000)], AGB_Af
riSAR$se_y[which(AGB_AfriSAR$sw_y > 100000)]),
                              proj4string=CRS("+proj=utm +zone=32 +south +datum=WGS84 +units=m
 +no_defs +ellps=WGS84 +towgs84=0,0,0"))
south_se.geo <- spTransform(south_se.utm, CRS("+proj=longlat +datum=WGS84"))
AGB_AfriSAR$Lon_se[which(AGB_AfriSAR$sw_y > 100000)] <- south_se.geo@coords[,1]; AGB_AfriSAR$L
at_se[which(AGB_AfriSAR$sw_y > 100000)] <- south_se.geo@coords[,2]

south_ne.utm <- SpatialPoints(cbind(AGB_AfriSAR$ne_x[which(AGB_AfriSAR$sw_y > 100000)], AGB_Af
riSAR$ne_y[which(AGB_AfriSAR$sw_y > 100000)]),
                              proj4string=CRS("+proj=utm +zone=32 +south +datum=WGS84 +units=m
 +no_defs +ellps=WGS84 +towgs84=0,0,0"))
south_ne.geo <- spTransform(south_ne.utm, CRS("+proj=longlat +datum=WGS84"))
AGB_AfriSAR$Lon_ne[which(AGB_AfriSAR$sw_y > 100000)] <- south_ne.geo@coords[,1]; AGB_AfriSAR$L
at_ne[which(AGB_AfriSAR$sw_y > 100000)] <- south_ne.geo@coords[,2]

AGB_AfriSAR$Lat_cnt <- rowMeans(AGB_AfriSAR[, c(28,30,32,34)])
AGB_AfriSAR$Lon_cnt <- rowMeans(AGB_AfriSAR[, c(29,31,33,35)])
```

```
AGB_AfriSARbis <- AGB_AfriSAR[,c("Site","Area_code","Plot_code","Scale",
                                  "Lat_cnt","Lon_cnt","Lat_sw","Lon_sw","Lat_nw","Lon_nw","Lat_
se","Lon_se","Lat_ne","Lon_ne",
                                  "LoreyLocal","LoreyChave","LoreyFeld","maxHlocal","maxHchave"
,"maxHfeld",
                                  "agb_fph","cred_fph_2.5","cred_fph_97.5","agb_chv","cred_chv_
2.5","cred_chv_97.5","agb_loc","cred_loc_2.5","cred_loc_97.5")]

#AGB_AfriSAR
```