Plot-based aboveground biomass estimates - AfriSAR sites

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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(oce) # to compute Earth magnetic declination
```

```
## Loading required package: gsw
```

```
library(lubridate) # convert ymd dates to decimal year
```

```
##
## Attaching package: 'lubridate'
```

```
## The following object is masked from 'package:base':
##
##     date
```

```
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$Species, family=AfriSARstem$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 = NA, incomparables = ???
AfriSARstem$SynSp <- dfsyn$newsp[match(AfriSARstem$NameCorr, dfsyn$oldname)]

dataWDsyn <- getWoodDensity(genus=AfriSARstem$SynGen, species=AfriSARstem$SynSp, stand=AfriSARstem$Stand, family=AfriSARstem$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] & coordplot.afri$Loc == "b")] - coordplot.afri$X_utm[which(coordplot.afri$Plot_code == afrisubplot[i] & coordplot.afri$Loc == "a")],
                     coordplot.afri$Y_utm[which(coordplot.afri$Plot_code == afrisubplot[i] & coordplot.afri$Loc == "b")] - coordplot.afri$Y_utm[which(coordplot.afri$Plot_code == afrisubplot[i] & coordplot.afri$Loc == "a")]))*180/pi)

  nwe.afri <- (atan2(coordplot.afri$X_utm[which(coordplot.afri$Plot_code == afrisubplot[i] & coordplot.afri$Loc == "c")] - coordplot.afri$X_utm[which(coordplot.afri$Plot_code == afrisubplot[i] & coordplot.afri$Loc == "d")],
                     coordplot.afri$Y_utm[which(coordplot.afri$Plot_code == afrisubplot[i] & coordplot.afri$Loc == "c")] - coordplot.afri$Y_utm[which(coordplot.afri$Plot_code == afrisubplot[i] & coordplot.afri$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 operator %%
coordplot.afri$True_bearing[which(coordplot.afri$Plot_code == "LPG02")] <- unique(coordplot.afri$True_bearing[which(coordplot.afri$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 true 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$Plot_code)] + AfriSARstem$Xrot_rel,
                            coordplot.afri$X_utm[match(AfriSARstem$Plot_code, coordplot.afri$Plot_code)] + AfriSARstem$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
## 1      LOP02h     1.2          0.8           2.1
## 2      LOP03h    29.2         21.5          40.6
## 3      LOP07h   342.8        316.0         373.4
## 4      LOP08h   306.0        287.0         326.6
## 5      LOP09h   366.0        330.5         405.3
## 6      LOP10h   417.3        376.7         464.0
## 7      LOP11h   405.1        361.9         458.9
## 8      LOP12h   382.7        349.8         416.9
## 9      LPG01h   474.6        397.5         580.8
## 10     LPG02h   597.1        518.4         687.2
```

```
## 11     MAB01h   376.3         343.1          412.4
## 12     MAB02h   349.3         312.0          389.5
## 13     MAB03h   378.6         337.4          432.5
## 14     MAB04h   501.9         440.7          572.3
## 15     MAB05h   481.5         420.5          572.2
## 16     MAB06h   356.9         319.0          402.9
## 17     MAB07h   286.0         258.5          321.5
## 18     MAB08h   350.5         318.2          388.8
## 19     MAB09h   466.4         421.0          516.1
## 20     MAB10h   393.9         348.1          446.9
## 21     MAB11h   495.1         450.8          544.3
## 22     MAB12h   216.0         196.7          238.9
## 23     MNG03h   528.3         484.4          574.4
## 24     MNG04h   460.4         421.9          508.7
## 25     MON01h    31.9          26.0           39.8
## 26     MON02h   338.5         278.6          422.6
## 27     MON03h    62.1          55.2           70.2
## 28     MON05h   111.7          99.5          125.8
## 29     MON09h     3.0           2.2            4.0
## 30     MON10h   125.8         107.3          150.4
## 31     MON11h    40.3          36.1           44.8
## 32     MON13h   282.2         251.5          323.2
## 33     MON14h   175.9         154.7          202.1
## 34     MON19h     4.2           3.4            5.2
## 35     MON20h    87.5          70.1          113.9
## 36    MON21Ah   171.7         158.5          186.0
## 37     MON21h     2.5           1.9            3.3
## 38     MON22h   342.7         305.0          389.5
## 39     MON23h   150.3         133.0          171.3
## 40     RAB01h   264.5         233.3          301.5
## 41     RAB02h   327.3         289.5          373.3
## 42     RAB03h   343.7         315.9          376.0
## 43     RAB04h   343.5         314.1          377.7
## 44     RAB05h   367.7         320.4          424.8
## 45     RAB06h   337.6         305.5          376.9
## 46     RAB07h   477.6         415.3          550.6
## 47     RAB08h   244.1         225.5          265.1
## 48     RAB09h   317.2         280.5          361.6
## 49     RAB10h   368.5         318.3          431.8
## 50     RAB11h   337.5         297.4          389.9
## 51     RAB12h   358.1         321.6          399.8
## 52     RAB13h   293.0         266.4          325.3
## 53     RAB14h   292.1         266.2          321.2
## 54     RAB15h   361.1         324.1          404.1
## 55     RAB16h   298.8         256.8          356.9
## 56     RAB17h   309.3         279.4          343.8
## 57     RAB18h   303.3         259.4          358.6
## 58     RAB19h   308.0         276.5          348.6
## 59     RAB20h   409.0         356.9          473.7
## 60     RAB21h   346.6         306.3          395.5
## 61     RAB22h   282.7         258.9          309.4
## 62     RAB23h   339.0         294.9          390.7
## 63     RAB24h   576.8         509.1          658.6
## 64     RAB25h   344.8         308.6          388.5
```

```
## 65    LOP02q2     0.7           0.2           1.3
## 66    LOP02q3     2.5           0.8           5.6
## 67    LOP02q4     1.8           1.1           3.0
## 68    LOP03q1    15.6          11.9          21.0
## 69    LOP03q2    93.8          62.8         139.1
## 70    LOP03q3     3.1           2.2           4.2
## 71    LOP03q4     4.3           2.0           8.3
## 72    LOP04q1   312.3         269.5         362.2
## 73    LOP04q2   150.5         127.4         177.6
## 74    LOP05q1    53.7          44.0          64.9
## 75    LOP05q2    77.4          67.1          89.8
## 76    LOP06q1   166.3         149.2         184.5
## 77    LOP06q2   214.6         193.6         238.1
## 78    LOP07q1   382.2         321.6         452.5
## 79    LOP07q2   346.4         299.9         393.5
## 80    LOP07q3   312.5         267.2         363.3
## 81    LOP07q4   330.2         281.8         393.7
## 82    LOP08q1   310.5         272.7         351.2
## 83    LOP08q2   316.3         282.8         349.6
## 84    LOP08q3   293.2         257.0         334.4
## 85    LOP08q4   304.0         267.2         349.9
## 86    LOP09q1   464.8         373.7         582.5
## 87    LOP09q2   294.7         254.2         340.6
## 88    LOP09q3   266.9         225.0         319.0
## 89    LOP09q4   437.7         367.2         534.1
## 90    LOP10q1   371.5         318.9         434.0
## 91    LOP10q2   355.2         292.3         427.5
## 92    LOP10q3   540.9         444.8         661.6
## 93    LOP10q4   401.4         316.3         526.6
## 94    LOP11q1   483.6         395.6         614.7
## 95    LOP11q2   313.0         263.3         380.2
## 96    LOP11q3   446.5         341.5         600.7
## 97    LOP11q4   377.4         300.0         477.1
## 98    LOP12q1   427.7         369.4         489.8
## 99    LOP12q2   351.0         301.8         414.0
## 100   LOP12q3   494.2         411.6         609.2
## 101   LOP12q4   257.8         222.8         299.0
## 102   LPG01q1   404.1         332.0         495.7
## 103   LPG01q2   411.8         329.7         524.9
## 104   LPG01q3   273.0         226.4         328.7
## 105   LPG01q4   808.4         543.2        1202.0
## 106   LPG02q1   461.9         358.4         598.3
## 107   LPG02q2   948.3         735.6        1247.7
## 108   LPG02q3   296.0         234.4         373.7
## 109   LPG02q4   676.8         552.4         851.9
## 110   MND01q1   433.0         368.0         511.3
## 111   MND01q2   431.3         360.5         517.2
## 112   MND01q3   457.6         381.6         538.3
## 113   MND01q4   462.6         386.9         552.0
## 114   MND02q1   332.7         282.1         393.4
## 115   MND02q2   486.7         394.5         595.8
## 116   MND02q3   512.3         436.8         607.5
## 117   MND02q4   572.4         493.6         668.7
## 118   MNG03q1   574.6         495.5         670.7
```

```
## 119   MNG03q2   546.2         461.2          653.9
## 120   MNG03q3   426.2         360.7          502.0
## 121   MNG03q4   566.2         480.7          666.0
## 122   MNG04q1   628.7         524.8          753.8
## 123   MNG04q2   380.0         332.1          438.4
## 124   MNG04q3   360.5         300.1          436.0
## 125   MNG04q4   472.3         399.9          568.9
## 126   MON01q1    15.5          11.5           20.7
## 127   MON01q2     7.2           5.4            9.8
## 128   MON01q3    40.4          27.8           59.0
## 129   MON01q4    64.6          46.7           92.8
## 130   MON02q1   212.0         163.1          271.2
## 131   MON02q2   139.6         103.7          190.0
## 132   MON02q3   823.2         604.9         1153.7
## 133   MON02q4   179.4         153.1          211.1
## 134   MON03q1    30.5          21.9           45.2
## 135   MON03q2    19.4          13.7           28.0
## 136   MON03q3    76.8          63.7           94.0
## 137   MON03q4   121.7         103.4          142.1
## 138   MON05q1   182.7         146.7          226.3
## 139   MON05q2   184.2         158.9          221.0
## 140   MON05q3    31.6          22.8           43.0
## 141   MON05q4    48.4          37.4           63.3
## 142   MON09q1     2.5           1.3            4.4
## 143   MON09q2     1.6           0.9            2.4
## 144   MON09q3     0.7           0.4            1.2
## 145   MON09q4     7.0           4.6           10.5
## 146   MON10q1   115.4          67.5          198.5
## 147   MON10q2   132.5         104.8          167.7
## 148   MON10q3    75.8          58.6          101.4
## 149   MON10q4   179.4         139.3          233.3
## 150   MON11q1    24.8          19.5           31.3
## 151   MON11q2    36.7          28.9           47.2
## 152   MON11q3    36.0          27.8           46.8
## 153   MON11q4    63.7          55.1           73.2
## 154   MON13q1   368.6         308.2          443.5
## 155   MON13q2   294.5         250.9          344.6
## 156   MON13q3   187.5         149.2          241.9
## 157   MON13q4   278.2         204.3          401.7
## 158   MON14q1   285.8         227.4          368.0
## 159   MON14q2   217.0         179.0          269.2
## 160   MON14q3   132.4          99.6          179.4
## 161   MON14q4    68.4          60.9           77.9
## 162   MON19q1    10.2           7.7           13.2
## 163   MON19q2     0.4           0.1            0.8
## 164   MON19q3     5.8           3.9            8.3
## 165   MON19q4     0.6           0.2            1.1
## 166   MON20q1   176.7         114.3          284.4
## 167   MON20q2   134.2         111.1          166.1
## 168   MON20q3    26.3          19.8           34.8
## 169   MON20q4    12.9           9.9           16.9
## 170  MON21Aq1   142.4         123.8          164.8
## 171  MON21Aq2    95.7          79.3          117.7
## 172  MON21Aq3   249.7         221.1          281.4
```

```
## 173  MON21Aq4   198.9         171.7          230.2
## 174   MON21q1     0.3           0.1            0.8
## 175   MON21q3     5.5           3.6            8.3
## 176   MON21q4     4.3           3.0            6.0
## 177   MON22q1   150.8         131.2          173.6
## 178   MON22q2   521.7         416.6          647.6
## 179   MON22q3   150.4         130.3          174.3
## 180   MON22q4   547.9         453.1          677.6
## 181   MON23q1   360.7         306.2          425.4
## 182   MON23q2   186.7         146.9          236.7
## 183   MON23q3    21.2          11.7           36.3
## 184   MON23q4    32.6          19.9           52.4
## 185   RAB001q   294.5         242.3          365.4
## 186   RAB002q   192.8         165.2          230.0
## 187   RAB003q   429.7         356.3          525.3
## 188   RAB004q   246.6         179.9          362.7
## 189   RAB005q   330.3         284.5          379.7
## 190   RAB006q   268.3         229.0          316.5
## 191   RAB007q   414.6         350.8          490.8
## 192   RAB008q   328.5         280.0          386.0
## 193   RAB009q   485.0         385.2          628.7
## 194   RAB010q   495.8         360.4          683.5
## 195   RAB011q   233.4         197.9          274.9
## 196   RAB012q   337.3         246.5          475.2
## 197   RAB013q   358.7         277.8          465.3
## 198   RAB014q   270.9         225.4          330.3
## 199   RAB015q   372.0         316.3          443.0
## 200   RAB016q   404.0         339.5          494.8
## 201   RAB017q   267.5         221.8          323.0
## 202   RAB018q   363.1         306.5          432.8
## 203   RAB019q   235.8         193.3          288.9
## 204   RAB020q   254.3         214.6          307.9
## 205   RAB021q   277.7         240.4          322.4
## 206   RAB022q   414.6         341.4          510.1
## 207   RAB023q   424.6         328.6          555.1
## 208   RAB024q   734.1         565.1          955.1
## 209   RAB025q   284.2         251.5          319.5
## 210   RAB026q   182.2         155.4          214.3
## 211   RAB027q   216.6         182.4          261.8
## 212   RAB028q   375.8         304.5          474.8
## 213   RAB029q   517.2         417.4          661.2
## 214   RAB030q   209.0         168.1          272.1
## 215   RAB031q   353.0         285.6          453.6
## 216   RAB032q   305.0         259.3          359.5
## 217   RAB033q   530.5         415.7          667.0
## 218   RAB034q   221.3         185.1          268.2
## 219   RAB035q   256.1         219.7          303.7
## 220   RAB036q   253.8         214.5          305.9
## 221   RAB037q   390.2         294.5          532.0
## 222   RAB038q   286.4         246.3          334.8
## 223   RAB039q   287.0         238.6          357.8
## 224   RAB040q   461.0         314.7          678.9
## 225   RAB041q   383.4         283.6          542.0
## 226   RAB042q   309.3         248.7          392.5
```

```
## 227   RAB043q   353.7         287.8          442.4
## 228   RAB044q   360.1         293.5          451.7
## 229   RAB045q   278.2         235.5          331.5
## 230   RAB046q   255.3         215.2          302.4
## 231   RAB047q   380.9         317.4          466.3
## 232   RAB048q   342.7         286.7          408.6
## 233   RAB049q   264.7         220.4          320.5
## 234   RAB050q   408.2         332.4          513.0
## 235   RAB051q   352.5         295.1          426.0
## 236   RAB052q   304.9         236.5          406.1
## 237   RAB053q   267.0         224.4          322.4
## 238   RAB054q   451.6         372.8          553.9
## 239   RAB055q   393.1         320.4          491.6
## 240   RAB056q   245.4         207.1          294.3
## 241   RAB057q   202.9         163.7          252.7
## 242   RAB058q   242.0         206.0          287.1
## 243   RAB059q   404.1         323.6          520.7
## 244   RAB060q   367.5         300.4          443.6
## 245   RAB061q   409.2         290.9          618.9
## 246   RAB062q   175.1         144.7          212.5
## 247   RAB063q   321.4         267.9          400.4
## 248   RAB064q   369.3         297.6          470.4
## 249   RAB065q   272.3         206.0          374.8
## 250   RAB066q   344.9         249.2          505.6
## 251   RAB067q   310.9         248.0          394.1
## 252   RAB068q   196.1         168.2          232.1
## 253   RAB069q   563.5         417.1          773.1
## 254   RAB070q   416.3         335.9          525.7
## 255   RAB071q   282.9         219.6          374.1
## 256   RAB072q   327.4         266.2          406.7
## 257   RAB073q   274.4         228.9          335.6
## 258   RAB074q   271.9         230.8          325.4
## 259   RAB075q   207.9         177.3          241.4
## 260   RAB076q   388.1         292.2          544.3
## 261   RAB077q   317.1         264.0          391.4
## 262   RAB078q   407.7         330.3          524.0
## 263   RAB079q   400.3         325.4          490.2
## 264   RAB080q   252.9         198.4          330.2
## 265   RAB081q   419.9         344.5          515.6
## 266   RAB082q   364.5         287.6          476.7
## 267   RAB083q   306.7         261.5          365.1
## 268   RAB084q   320.5         264.6          401.9
## 269   RAB085q   220.7         173.7          282.0
## 270   RAB086q   360.3         287.3          460.6
## 271   RAB087q   795.2         607.0         1039.3
## 272   RAB088q   479.2         388.7          616.6
## 273   RAB089q   360.7         277.8          469.3
## 274   RAB090q   245.1         204.6          297.4
## 275   RAB091q   396.4         310.2          536.4
## 276   RAB092q   205.7         167.1          265.2
## 277   RAB093q   209.3         181.0          241.3
## 278   RAB094q   293.1         253.5          339.2
## 279   RAB095q   340.1         264.9          444.0
## 280   RAB096q   434.5         333.2          597.0
```

```
## 281   RAB097q   492.9         410.6          593.9
## 282   RAB098q   539.8         432.6          679.3
## 283   RAB099q   415.5         343.1          507.4
## 284   RAB100q   357.9         292.8          455.3
## 285   MAB01c1   245.6         197.7          300.5
## 286   MAB01c2   384.1         315.7          464.7
## 287   MAB01c3   341.4         285.6          405.4
## 288   MAB01c4   291.1         247.2          346.4
## 289   MAB02c1   335.3         267.5          435.2
## 290   MAB02c2   202.6         162.1          246.3
## 291   MAB02c3   317.2         240.9          408.2
## 292   MAB02c4   592.3         457.2          760.4
## 293   MAB03c1   244.6         193.2          316.3
## 294   MAB03c2   324.6         261.2          414.0
## 295   MAB03c3   832.0         627.4         1117.8
## 296   MAB03c4   371.2         297.2          475.7
## 297   MAB04c1   504.9         391.5          670.2
## 298   MAB04c2   446.5         334.1          624.0
## 299   MAB04c3   626.0         485.7          825.6
## 300   MAB04c4   301.5         238.5          384.5
## 301   MAB05c1   501.6         398.3          635.7
## 302   MAB05c2   321.6         257.7          401.4
## 303   MAB05c3   331.2         272.6          410.8
## 304   MAB05c4   391.3         306.2          494.4
## 305   MAB06c1   320.3         247.3          427.2
## 306   MAB06c2   404.9         316.4          521.8
## 307   MAB06c3   210.0         167.9          272.9
## 308   MAB06c4   463.2         364.6          596.0
## 309   MAB07c1   242.8         201.2          293.4
## 310   MAB07c2   264.7         218.9          323.2
## 311   MAB07c3   212.3         176.7          255.8
## 312   MAB07c4   416.8         310.2          592.0
## 313   MAB08c1   318.0         244.7          433.6
## 314   MAB08c2   370.8         282.6          508.7
## 315   MAB08c3   278.7         227.9          346.2
## 316   MAB08c4   354.2         290.6          438.2
## 317   MAB09c1   461.4         374.9          565.8
## 318   MAB09c2   404.7         335.6          488.4
## 319   MAB09c3   451.7         347.6          588.9
## 320   MAB09c4   657.1         526.6          822.4
## 321   MAB10c1   383.9         247.1          598.0
## 322   MAB10c2   258.1         218.4          307.1
## 323   MAB10c3   565.3         426.3          759.9
## 324   MAB10c4   674.1         533.0          865.6
## 325   MAB11c1   399.6         327.7          492.6
## 326   MAB11c2   406.7         310.9          546.2
## 327   MAB11c3   882.6         735.8         1056.4
## 328   MAB11c4   314.4         253.5          381.8
## 329   MAB12c1   319.4         264.0          394.1
## 330   MAB12c2   175.9         139.9          227.3
## 331   MAB12c3   169.4         137.4          212.7
## 332   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
## 1      LOP02h     1.2          0.7           2.0
## 2      LOP03h    27.5         19.6          39.3
## 3      LOP07h   331.3        302.2         365.0
## 4      LOP08h   288.0        265.7         310.4
## 5      LOP09h   357.5        317.3         403.4
## 6      LOP10h   403.3        357.9         461.6
## 7      LOP11h   391.4        339.5         453.5
## 8      LOP12h   364.6        328.5         406.4
## 9      LPG01h   492.8        387.0         685.8
## 10     LPG02h   602.1        500.7         722.9
## 11     MAB01h   344.8        310.4         385.0
## 12     MAB02h   327.5        284.0         378.3
## 13     MAB03h   352.8        303.6         415.2
```

```
## 14     MAB04h   468.4         403.9          548.9
## 15     MAB05h   458.0         388.1          566.5
## 16     MAB06h   328.2         286.2          375.0
## 17     MAB07h   260.1         231.0          292.5
## 18     MAB08h   320.2         285.7          364.3
## 19     MAB09h   425.5         380.6          481.7
## 20     MAB10h   366.5         314.1          433.1
## 21     MAB11h   456.1         408.7          508.0
## 22     MAB12h   196.5         177.1          218.6
## 23     MNG03h   497.9         448.8          553.4
## 24     MNG04h   423.8         380.0          472.8
## 25     MON01h    29.4          23.3           37.1
## 26     MON02h   330.1         259.8          432.0
## 27     MON03h    56.7          50.3           65.1
## 28     MON05h   102.0          88.9          117.4
## 29     MON09h     2.7           2.1            3.6
## 30     MON10h   116.2          97.6          141.5
## 31     MON11h    36.6          32.9           41.0
## 32     MON13h   258.5         225.1          299.3
## 33     MON14h   164.1         142.9          192.4
## 34     MON19h     3.9           3.1            4.7
## 35     MON20h    81.9          64.0          109.2
## 36    MON21Ah   155.4         142.3          169.4
## 37     MON21h     2.3           1.8            2.9
## 38     MON22h   314.6         275.2          363.1
## 39     MON23h   139.2         121.2          162.1
## 40     RAB01h   228.6         197.8          273.9
## 41     RAB02h   284.8         247.7          337.3
## 42     RAB03h   294.9         265.7          335.2
## 43     RAB04h   291.5         265.1          322.3
## 44     RAB05h   329.2         277.1          401.6
## 45     RAB06h   290.0         258.6          328.4
## 46     RAB07h   427.1         361.2          513.9
## 47     RAB08h   204.9         186.9          225.9
## 48     RAB09h   275.3         241.1          322.1
## 49     RAB10h   329.1         274.5          406.7
## 50     RAB11h   295.8         254.5          354.7
## 51     RAB12h   311.5         275.2          354.3
## 52     RAB13h   250.9         224.9          281.0
## 53     RAB14h   247.8         221.4          278.6
## 54     RAB15h   313.0         273.3          355.0
## 55     RAB16h   262.8         220.2          326.9
## 56     RAB17h   265.6         236.4          299.1
## 57     RAB18h   267.9         223.2          327.6
## 58     RAB19h   267.1         235.3          304.9
## 59     RAB20h   363.7         308.1          440.4
## 60     RAB21h   303.1         260.5          359.0
## 61     RAB22h   241.5         218.1          269.3
## 62     RAB23h   295.4         255.0          348.8
## 63     RAB24h   513.9         444.9          602.2
## 64     RAB25h   300.3         263.8          349.5
## 65    LOP02q2     0.6           0.3            1.1
## 66    LOP02q3     2.4           0.9            5.3
## 67    LOP02q4     1.7           1.1            2.6
```

```
## 68    LOP03q1    14.6          11.1          19.5
## 69    LOP03q2    88.5          57.7         134.3
## 70    LOP03q3     3.0           2.2           4.1
## 71    LOP03q4     3.8           1.9           7.0
## 72    LOP04q1   301.2         257.8         352.0
## 73    LOP04q2   138.8         117.2         164.1
## 74    LOP05q1    49.7          41.0          60.8
## 75    LOP05q2    71.8          62.1          82.9
## 76    LOP06q1   154.4         137.6         172.3
## 77    LOP06q2   197.9         176.3         220.6
## 78    LOP07q1   375.5         312.5         464.6
## 79    LOP07q2   331.8         284.9         383.1
## 80    LOP07q3   301.0         254.2         350.2
## 81    LOP07q4   316.7         269.0         382.3
## 82    LOP08q1   292.7         254.9         335.0
## 83    LOP08q2   296.7         264.1         335.2
## 84    LOP08q3   276.3         242.0         316.6
## 85    LOP08q4   286.3         247.1         329.3
## 86    LOP09q1   466.6         360.8         597.3
## 87    LOP09q2   287.3         245.3         338.8
## 88    LOP09q3   259.5         213.4         318.5
## 89    LOP09q4   416.7         338.7         513.1
## 90    LOP10q1   347.9         300.1         411.2
## 91    LOP10q2   333.7         271.5         408.9
## 92    LOP10q3   534.8         423.5         671.3
## 93    LOP10q4   396.9         306.4         534.1
## 94    LOP11q1   465.2         371.8         596.3
## 95    LOP11q2   297.0         244.5         363.0
## 96    LOP11q3   438.5         323.8         604.7
## 97    LOP11q4   365.1         282.5         467.0
## 98    LOP12q1   412.0         349.8         492.1
## 99    LOP12q2   330.5         280.0         393.7
## 100   LOP12q3   474.4         385.3         598.1
## 101   LOP12q4   241.6         207.2         285.2
## 102   LPG01q1   389.9         312.6         492.1
## 103   LPG01q2   408.6         315.0         549.0
## 104   LPG01q3   260.7         209.5         327.2
## 105   LPG01q4   911.0         547.2        1636.7
## 106   LPG02q1   460.7         340.9         616.9
## 107   LPG02q2   990.2         704.8        1383.9
## 108   LPG02q3   288.5         224.4         376.3
## 109   LPG02q4   663.9         523.1         857.7
## 110   MND01q1   410.1         337.4         494.6
## 111   MND01q2   411.7         332.7         506.8
## 112   MND01q3   438.4         362.0         537.3
## 113   MND01q4   443.6         364.3         543.0
## 114   MND02q1   306.2         252.2         375.7
## 115   MND02q2   469.5         370.0         588.5
## 116   MND02q3   483.4         407.3         575.0
## 117   MND02q4   553.5         461.9         672.3
## 118   MNG03q1   541.5         457.5         645.9
## 119   MNG03q2   512.6         426.0         628.1
## 120   MNG03q3   400.1         331.6         482.8
## 121   MNG03q4   537.6         441.9         647.9
```

```
## 122   MNG04q1   587.8         479.8          723.5
## 123   MNG04q2   343.1         299.6          391.5
## 124   MNG04q3   335.0         271.9          413.5
## 125   MNG04q4   429.3         354.6          526.0
## 126   MON01q1    13.9          10.1           18.8
## 127   MON01q2     6.6           5.0            8.7
## 128   MON01q3    37.2          24.9           54.9
## 129   MON01q4    59.8          42.7           88.2
## 130   MON02q1   197.6         149.4          258.1
## 131   MON02q2   129.9          94.8          190.4
## 132   MON02q3   831.7         564.2         1232.4
## 133   MON02q4   161.2         138.2          191.3
## 134   MON03q1    27.2          19.6           39.7
## 135   MON03q2    17.7          12.8           25.6
## 136   MON03q3    70.7          58.0           89.1
## 137   MON03q4   111.2          94.4          132.4
## 138   MON05q1   166.2         130.5          213.6
## 139   MON05q2   169.4         139.9          205.1
## 140   MON05q3    28.4          20.4           39.2
## 141   MON05q4    43.9          33.8           58.6
## 142   MON09q1     2.3           1.2            4.0
## 143   MON09q2     1.5           1.0            2.2
## 144   MON09q3     0.6           0.4            1.0
## 145   MON09q4     6.4           4.3            9.5
## 146   MON10q1   107.2          60.2          192.9
## 147   MON10q2   122.7          96.6          156.4
## 148   MON10q3    70.1          53.2           91.1
## 149   MON10q4   164.8         127.5          216.3
## 150   MON11q1    22.4          17.8           28.5
## 151   MON11q2    33.2          26.7           43.0
## 152   MON11q3    32.9          25.7           42.7
## 153   MON11q4    58.0          50.5           67.2
## 154   MON13q1   335.2         277.7          411.5
## 155   MON13q2   267.1         225.0          318.6
## 156   MON13q3   172.4         133.9          227.8
## 157   MON13q4   259.1         180.6          383.7
## 158   MON14q1   270.6         210.8          356.8
## 159   MON14q2   199.8         160.2          252.1
## 160   MON14q3   122.6          91.5          174.1
## 161   MON14q4    63.4          55.6           72.5
## 162   MON19q1     9.3           7.1           12.1
## 163   MON19q2     0.4           0.2            0.7
## 164   MON19q3     5.3           3.7            7.5
## 165   MON19q4     0.5           0.3            1.0
## 166   MON20q1   166.8         101.9          272.7
## 167   MON20q2   124.5         100.6          158.8
## 168   MON20q3    24.2          18.4           32.8
## 169   MON20q4    12.0           9.3           15.3
## 170  MON21Aq1   128.6         111.1          151.6
## 171  MON21Aq2    86.5          70.9          106.2
## 172  MON21Aq3   224.3         197.7          255.2
## 173  MON21Aq4   182.3         153.2          218.8
## 174   MON21q1     0.3           0.1            0.6
## 175   MON21q3     4.9           3.5            7.2
```

```
## 176   MON21q4     3.9           2.9           5.3
## 177   MON22q1   134.8         116.2         155.4
## 178   MON22q2   485.7         380.5         627.6
## 179   MON22q3   133.8         116.1         154.6
## 180   MON22q4   503.9         402.7         643.9
## 181   MON23q1   334.8         283.3         405.1
## 182   MON23q2   172.6         135.9         231.3
## 183   MON23q3    19.7          11.0          33.1
## 184   MON23q4    29.9          18.2          49.5
## 185   RAB001q   253.2         201.8         323.7
## 186   RAB002q   163.0         137.7         200.3
## 187   RAB003q   367.3         300.8         455.9
## 188   RAB004q   223.8         152.5         359.4
## 189   RAB005q   278.6         236.7         326.9
## 190   RAB006q   227.4         191.6         273.4
## 191   RAB007q   353.4         299.8         425.7
## 192   RAB008q   276.3         234.9         325.0
## 193   RAB009q   430.0         325.6         574.9
## 194   RAB010q   472.7         316.3         695.4
## 195   RAB011q   196.5         165.5         231.8
## 196   RAB012q   301.5         203.7         456.2
## 197   RAB013q   314.9         237.2         427.8
## 198   RAB014q   230.5         187.5         288.2
## 199   RAB015q   318.2         266.6         403.0
## 200   RAB016q   355.6         281.2         461.0
## 201   RAB017q   224.6         185.7         276.7
## 202   RAB018q   311.8         253.3         382.2
## 203   RAB019q   200.0         160.6         251.7
## 204   RAB020q   213.9         178.4         263.2
## 205   RAB021q   234.6         197.9         276.2
## 206   RAB022q   354.6         285.7         446.2
## 207   RAB023q   371.8         281.1         502.7
## 208   RAB024q   678.3         501.8         934.9
## 209   RAB025q   236.9         207.3         269.6
## 210   RAB026q   153.5         132.0         183.5
## 211   RAB027q   184.8         154.9         223.4
## 212   RAB028q   323.8         257.5         428.1
## 213   RAB029q   458.0         352.2         628.6
## 214   RAB030q   178.8         141.8         236.4
## 215   RAB031q   311.1         245.3         407.8
## 216   RAB032q   259.6         214.9         314.4
## 217   RAB033q   470.2         355.0         622.9
## 218   RAB034q   188.3         157.9         231.0
## 219   RAB035q   215.0         180.5         263.4
## 220   RAB036q   214.4         177.9         261.2
## 221   RAB037q   348.5         256.1         501.4
## 222   RAB038q   244.0         207.8         292.2
## 223   RAB039q   244.2         198.7         310.3
## 224   RAB040q   435.3         282.2         663.3
## 225   RAB041q   353.4         246.6         535.9
## 226   RAB042q   270.1         212.1         349.7
## 227   RAB043q   308.6         238.9         398.6
## 228   RAB044q   315.7         251.1         410.8
## 229   RAB045q   237.1         197.7         286.0
```

```
## 230   RAB046q   217.2         182.8          263.6
## 231   RAB047q   324.5         267.7          407.1
## 232   RAB048q   289.8         238.6          358.7
## 233   RAB049q   224.8         184.1          280.1
## 234   RAB050q   352.4         278.5          451.6
## 235   RAB051q   297.8         245.0          373.9
## 236   RAB052q   262.1         197.8          365.5
## 237   RAB053q   228.3         189.0          279.2
## 238   RAB054q   393.6         310.5          500.7
## 239   RAB055q   342.2         271.8          431.9
## 240   RAB056q   207.2         176.2          245.9
## 241   RAB057q   172.8         136.6          225.8
## 242   RAB058q   204.1         168.1          242.4
## 243   RAB059q   357.9         277.6          468.0
## 244   RAB060q   316.7         257.6          392.9
## 245   RAB061q   374.1         251.0          614.4
## 246   RAB062q   146.4         121.2          178.2
## 247   RAB063q   272.2         221.1          338.3
## 248   RAB064q   326.4         257.2          423.2
## 249   RAB065q   233.1         170.8          332.7
## 250   RAB066q   314.4         221.0          487.0
## 251   RAB067q   277.4         211.5          373.1
## 252   RAB068q   165.5         138.8          197.3
## 253   RAB069q   522.8         364.7          791.4
## 254   RAB070q   372.4         289.2          493.6
## 255   RAB071q   250.9         188.0          348.5
## 256   RAB072q   279.2         228.0          353.4
## 257   RAB073q   232.8         190.5          290.3
## 258   RAB074q   231.1         191.1          286.1
## 259   RAB075q   175.0         148.6          209.2
## 260   RAB076q   349.2         247.6          523.4
## 261   RAB077q   271.9         223.0          333.3
## 262   RAB078q   353.7         282.5          462.3
## 263   RAB079q   339.9         275.2          421.9
## 264   RAB080q   217.2         167.2          282.7
## 265   RAB081q   361.4         291.6          454.0
## 266   RAB082q   319.4         247.0          431.7
## 267   RAB083q   261.6         222.3          313.7
## 268   RAB084q   274.9         219.8          356.0
## 269   RAB085q   191.5         148.5          250.9
## 270   RAB086q   311.8         248.1          400.6
## 271   RAB087q   727.0         535.0         1003.5
## 272   RAB088q   425.4         330.4          560.5
## 273   RAB089q   321.6         243.4          449.2
## 274   RAB090q   207.6         170.5          255.4
## 275   RAB091q   352.6         258.0          505.5
## 276   RAB092q   178.9         137.4          246.6
## 277   RAB093q   177.6         151.9          211.9
## 278   RAB094q   251.0         213.0          303.4
## 279   RAB095q   296.3         223.0          401.7
## 280   RAB096q   381.5         285.1          533.3
## 281   RAB097q   421.1         343.1          525.5
## 282   RAB098q   482.0         377.3          631.4
## 283   RAB099q   361.9         296.5          454.7
```

```
## 284   RAB100q   309.9         245.9          410.1
## 285   MAB01c1   223.2         177.2          279.4
## 286   MAB01c2   349.6         283.5          442.3
## 287   MAB01c3   309.4         258.4          377.9
## 288   MAB01c4   263.8         218.9          322.3
## 289   MAB02c1   308.5         245.3          396.9
## 290   MAB02c2   183.7         147.7          232.0
## 291   MAB02c3   298.1         224.5          400.4
## 292   MAB02c4   557.9         414.2          746.7
## 293   MAB03c1   219.4         172.6          283.5
## 294   MAB03c2   295.7         236.1          375.0
## 295   MAB03c3   813.3         567.8         1163.6
## 296   MAB03c4   341.9         261.2          453.5
## 297   MAB04c1   464.1         350.8          635.1
## 298   MAB04c2   424.1         313.3          606.2
## 299   MAB04c3   580.2         451.1          783.5
## 300   MAB04c4   274.7         216.7          355.3
## 301   MAB05c1   462.3         364.6          597.0
## 302   MAB05c2   289.2         223.1          366.5
## 303   MAB05c3   301.9         245.4          384.7
## 304   MAB05c4   362.4         273.8          475.7
## 305   MAB06c1   294.5         222.3          406.3
## 306   MAB06c2   373.7         284.6          509.9
## 307   MAB06c3   192.2         149.1          247.4
## 308   MAB06c4   421.8         323.4          543.3
## 309   MAB07c1   219.6         182.4          268.9
## 310   MAB07c2   239.4         193.1          299.7
## 311   MAB07c3   190.3         158.7          231.7
## 312   MAB07c4   384.9         271.3          551.4
## 313   MAB08c1   295.6         217.3          411.8
## 314   MAB08c2   340.9         248.2          494.8
## 315   MAB08c3   252.8         204.5          318.9
## 316   MAB08c4   320.4         257.7          400.9
## 317   MAB09c1   421.3         334.9          537.7
## 318   MAB09c2   361.2         295.0          447.0
## 319   MAB09c3   411.7         307.4          567.3
## 320   MAB09c4   607.1         476.8          773.9
## 321   MAB10c1   374.2         232.1          624.3
## 322   MAB10c2   232.6         197.0          278.3
## 323   MAB10c3   529.5         383.1          742.0
## 324   MAB10c4   624.7         466.3          843.9
## 325   MAB11c1   362.9         287.6          452.1
## 326   MAB11c2   379.7         282.8          519.3
## 327   MAB11c3   813.3         664.4          986.2
## 328   MAB11c4   282.5         222.4          360.5
## 329   MAB12c1   291.3         238.4          361.6
## 330   MAB12c2   160.5         126.1          205.4
## 331   MAB12c3   154.0         124.4          195.7
## 332   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
## 1      LOP02h     0.3          0.2           0.6
## 2      LOP03h    15.5         11.5          22.1
## 3      LOP07h   317.9        294.3         342.8
## 4      LOP08h   290.4        272.3         308.9
## 5      LOP09h   348.6        316.7         383.0
## 6      LOP10h   375.1        339.2         414.8
## 7      LOP11h   349.7        314.1         393.7
## 8      LOP12h   321.4        296.3         352.0
## 9      LPG01h   439.1        371.8         534.2
## 10     LPG02h   547.3        482.3         628.6
## 11     MAB01h   327.7        299.0         361.8
## 12     MAB02h   302.4        269.0         338.6
## 13     MAB03h   333.6        296.5         386.9
## 14     MAB04h   459.0        407.4         526.0
```

```
## 15     MAB05h   438.8         377.9          518.5
## 16     MAB06h   309.4         279.4          344.6
## 17     MAB07h   247.0         225.7          272.7
## 18     MAB08h   290.9         265.3          318.7
## 19     MAB09h   411.0         375.0          454.5
## 20     MAB10h   344.8         304.7          393.9
## 21     MAB11h   523.2         477.4          576.0
## 22     MAB12h   171.8         156.8          186.9
## 23     MNG03h   510.6         468.5          561.3
## 24     MNG04h   444.0         403.2          487.7
## 25     MON01h    25.6          21.3           30.6
## 26     MON02h   294.7         248.7          357.8
## 27     MON03h    56.8          51.1           63.3
## 28     MON05h    93.2          83.8          104.5
## 29     MON09h     2.3           1.7            3.0
## 30     MON10h   103.4          88.1          121.4
## 31     MON11h    35.0          31.6           39.2
## 32     MON13h   247.8         222.9          275.9
## 33     MON14h   149.9         132.7          168.2
## 34     MON19h     3.4           2.8            4.2
## 35     MON20h    70.3          58.7           85.9
## 36    MON21Ah   160.3         148.3          174.1
## 37     MON21h     2.4           1.8            3.1
## 38     MON22h   289.1         258.2          322.5
## 39     MON23h   128.8         115.1          144.9
## 40     RAB01h   210.7         191.3          233.2
## 41     RAB02h   280.3         248.8          316.2
## 42     RAB03h   303.2         276.6          333.4
## 43     RAB04h   300.1         274.8          324.9
## 44     RAB05h   320.6         278.1          368.5
## 45     RAB06h   301.0         275.1          331.5
## 46     RAB07h   413.2         361.4          475.5
## 47     RAB08h   209.4         194.2          225.3
## 48     RAB09h   280.1         250.1          322.5
## 49     RAB10h   323.3         278.9          378.5
## 50     RAB11h   287.8         253.4          332.7
## 51     RAB12h   310.1         280.8          344.8
## 52     RAB13h   246.4         224.4          271.0
## 53     RAB14h   245.6         224.3          270.6
## 54     RAB15h   313.1         281.9          347.3
## 55     RAB16h   253.7         219.3          300.7
## 56     RAB17h   265.9         241.4          293.1
## 57     RAB18h   262.5         224.0          312.2
## 58     RAB19h   255.1         229.6          284.6
## 59     RAB20h   348.5         306.0          397.3
## 60     RAB21h   301.2         267.9          337.6
## 61     RAB22h   246.7         226.0          269.0
## 62     RAB23h   296.1         262.6          339.5
## 63     RAB24h   511.8         453.5          577.0
## 64     RAB25h   293.4         263.1          331.2
## 65    LOP02q2     0.2           0.1            0.3
## 66    LOP02q3     0.8           0.3            1.7
## 67    LOP02q4     0.4           0.3            0.6
## 68    LOP03q1     8.7           6.5           11.7
```

```
## 69    LOP03q2    50.1         34.3          76.3
## 70    LOP03q3     0.8          0.6           1.1
## 71    LOP03q4     2.4          1.2           4.4
## 72    LOP04q1   300.5        260.9         346.8
## 73    LOP04q2   138.0        120.9         159.3
## 74    LOP05q1    39.0         32.7          46.0
## 75    LOP05q2    63.3         55.1          72.0
## 76    LOP06q1   156.8        141.9         173.6
## 77    LOP06q2   206.1        187.9         226.9
## 78    LOP07q1   362.3        304.5         427.1
## 79    LOP07q2   324.6        286.9         364.8
## 80    LOP07q3   289.5        252.8         334.6
## 81    LOP07q4   295.1        256.7         339.5
## 82    LOP08q1   296.9        263.8         334.0
## 83    LOP08q2   302.9        273.9         338.0
## 84    LOP08q3   276.8        247.9         309.8
## 85    LOP08q4   285.0        249.7         324.9
## 86    LOP09q1   433.2        352.4         536.5
## 87    LOP09q2   299.6        256.6         345.7
## 88    LOP09q3   262.0        223.4         310.2
## 89    LOP09q4   399.5        336.7         470.4
## 90    LOP10q1   337.0        291.9         388.0
## 91    LOP10q2   300.4        250.3         357.3
## 92    LOP10q3   502.4        415.3         603.6
## 93    LOP10q4   360.4        287.5         478.6
## 94    LOP11q1   431.8        357.2         537.9
## 95    LOP11q2   273.7        231.9         328.6
## 96    LOP11q3   371.2        297.7         490.8
## 97    LOP11q4   322.2        264.9         399.3
## 98    LOP12q1   359.5        308.3         414.5
## 99    LOP12q2   303.2        263.4         352.7
## 100   LOP12q3   398.8        335.7         489.9
## 101   LOP12q4   224.1        197.3         254.8
## 102   LPG01q1   370.2        305.8         450.1
## 103   LPG01q2   384.7        310.6         503.1
## 104   LPG01q3   254.2        209.9         310.9
## 105   LPG01q4   746.2        499.7        1132.0
## 106   LPG02q1   423.7        324.9         548.8
## 107   LPG02q2   860.4        659.7        1109.2
## 108   LPG02q3   275.2        217.9         348.7
## 109   LPG02q4   624.8        506.4         764.7
## 110   MND01q1   416.6        351.9         506.8
## 111   MND01q2   402.5        330.6         486.3
## 112   MND01q3   429.1        358.4         507.7
## 113   MND01q4   454.5        378.2         543.5
## 114   MND02q1   319.1        266.4         381.2
## 115   MND02q2   484.2        396.1         592.7
## 116   MND02q3   496.8        416.7         585.9
## 117   MND02q4   572.5        481.8         673.6
## 118   MNG03q1   564.2        480.7         660.9
## 119   MNG03q2   516.1        431.2         624.6
## 120   MNG03q3   416.8        352.1         486.7
## 121   MNG03q4   545.3        454.5         644.2
## 122   MNG04q1   610.5        504.8         751.4
```

```
## 123   MNG04q2   362.2         315.0          415.7
## 124   MNG04q3   344.2         283.3          420.5
## 125   MNG04q4   459.2         390.6          544.1
## 126   MON01q1    13.8          10.1           18.4
## 127   MON01q2     6.8           4.8            9.3
## 128   MON01q3    31.1          22.0           43.3
## 129   MON01q4    50.6          38.2           67.3
## 130   MON02q1   183.5         145.9          230.2
## 131   MON02q2   151.5         108.5          222.1
## 132   MON02q3   674.8         514.3          927.7
## 133   MON02q4   169.0         143.7          200.9
## 134   MON03q1    29.9          21.4           43.0
## 135   MON03q2    16.5          12.1           22.2
## 136   MON03q3    69.0          57.6           81.8
## 137   MON03q4   111.9          96.3          129.0
## 138   MON05q1   143.0         115.3          179.1
## 139   MON05q2   153.7         133.3          177.9
## 140   MON05q3    29.9          21.3           41.7
## 141   MON05q4    46.2          34.8           61.8
## 142   MON09q1     1.8           1.0            3.1
## 143   MON09q2     1.5           0.9            2.4
## 144   MON09q3     0.7           0.3            1.3
## 145   MON09q4     5.1           3.3            7.6
## 146   MON10q1    91.0          58.3          144.6
## 147   MON10q2   111.4          89.8          139.1
## 148   MON10q3    61.4          49.4           77.8
## 149   MON10q4   149.7         116.0          189.8
## 150   MON11q1    18.4          14.4           23.5
## 151   MON11q2    29.6          24.4           36.5
## 152   MON11q3    34.3          26.0           44.8
## 153   MON11q4    57.7          50.3           67.0
## 154   MON13q1   329.2         277.1          395.8
## 155   MON13q2   256.9         217.5          305.1
## 156   MON13q3   165.7         131.5          208.2
## 157   MON13q4   239.4         182.9          317.6
## 158   MON14q1   226.6         182.8          280.1
## 159   MON14q2   184.9         154.9          223.5
## 160   MON14q3   122.9          88.9          170.1
## 161   MON14q4    65.1          56.6           75.2
## 162   MON19q1     8.7           6.5           11.3
## 163   MON19q2     0.4           0.1            0.9
## 164   MON19q3     4.1           2.9            5.9
## 165   MON19q4     0.6           0.2            1.2
## 166   MON20q1   128.5          88.8          189.2
## 167   MON20q2   114.9          95.2          140.4
## 168   MON20q3    25.2          18.5           33.5
## 169   MON20q4    12.4           9.4           16.0
## 170  MON21Aq1   133.9         114.8          157.0
## 171  MON21Aq2    87.8          72.5          105.0
## 172  MON21Aq3   233.0         203.8          267.4
## 173  MON21Aq4   186.4         160.2          220.6
## 174   MON21q1     0.3           0.1            0.6
## 175   MON21q3     5.1           3.4            7.4
## 176   MON21q4     4.1           2.9            5.7
```

```
## 177   MON22q1   137.8        119.3         159.8
## 178   MON22q2   417.8        339.9         517.3
## 179   MON22q3   142.2        122.8         164.9
## 180   MON22q4   458.7        380.9         550.2
## 181   MON23q1   309.2        268.3         358.1
## 182   MON23q2   154.7        126.0         190.1
## 183   MON23q3    20.5         11.2          33.8
## 184   MON23q4    30.9         18.1          51.5
## 185   RAB001q   252.6        206.8         311.2
## 186   RAB002q   161.2        139.3         187.8
## 187   RAB003q   368.6        315.0         435.5
## 188   RAB004q   215.3        161.2         296.1
## 189   RAB005q   287.5        252.6         333.7
## 190   RAB006q   231.2        198.3         271.5
## 191   RAB007q   369.2        315.6         431.1
## 192   RAB008q   282.7        244.0         326.8
## 193   RAB009q   410.3        330.5         524.9
## 194   RAB010q   441.0        325.5         603.3
## 195   RAB011q   200.3        170.0         235.6
## 196   RAB012q   228.7        184.7         296.7
## 197   RAB013q   304.7        232.8         405.7
## 198   RAB014q   229.6        195.7         270.8
## 199   RAB015q   326.4        275.7         399.6
## 200   RAB016q   367.6        305.3         444.0
## 201   RAB017q   232.3        196.7         278.3
## 202   RAB018q   315.9        264.2         373.8
## 203   RAB019q   205.3        168.1         254.0
## 204   RAB020q   225.9        190.9         269.7
## 205   RAB021q   243.4        211.8         279.6
## 206   RAB022q   376.9        314.2         453.9
## 207   RAB023q   348.9        270.1         452.3
## 208   RAB024q   650.6        503.4         854.1
## 209   RAB025q   242.4        217.2         271.8
## 210   RAB026q   156.9        137.1         183.1
## 211   RAB027q   184.8        161.8         215.4
## 212   RAB028q   339.0        273.8         418.9
## 213   RAB029q   478.8        386.7         611.8
## 214   RAB030q   183.8        149.6         232.6
## 215   RAB031q   313.1        255.0         398.9
## 216   RAB032q   270.6        228.5         319.2
## 217   RAB033q   472.4        377.5         598.7
## 218   RAB034q   180.8        154.3         213.4
## 219   RAB035q   217.7        188.7         258.5
## 220   RAB036q   220.8        185.1         264.1
## 221   RAB037q   343.3        261.2         478.1
## 222   RAB038q   253.2        222.0         295.9
## 223   RAB039q   248.7        206.0         305.6
## 224   RAB040q   381.9        265.3         556.4
## 225   RAB041q   311.4        233.5         432.3
## 226   RAB042q   257.0        208.0         316.8
## 227   RAB043q   300.0        244.9         374.7
## 228   RAB044q   318.3        257.6         390.7
## 229   RAB045q   230.2        197.6         271.3
## 230   RAB046q   215.0        181.4         258.8
```

```
## 231   RAB047q   319.4        273.0         381.1
## 232   RAB048q   292.4        247.4         352.8
## 233   RAB049q   230.9        191.6         278.8
## 234   RAB050q   343.1        284.7         426.8
## 235   RAB051q   306.3        257.7         374.1
## 236   RAB052q   276.5        212.2         373.0
## 237   RAB053q   236.1        198.6         280.6
## 238   RAB054q   386.1        319.3         476.2
## 239   RAB055q   329.8        267.0         408.3
## 240   RAB056q   210.5        181.2         249.9
## 241   RAB057q   173.4        142.5         215.0
## 242   RAB058q   197.3        170.6         231.9
## 243   RAB059q   372.5        299.2         479.8
## 244   RAB060q   305.9        249.4         368.2
## 245   RAB061q   355.4        250.1         521.3
## 246   RAB062q   140.2        118.4         168.0
## 247   RAB063q   281.6        231.5         343.0
## 248   RAB064q   311.7        258.0         392.2
## 249   RAB065q   234.9        177.3         327.8
## 250   RAB066q   299.8        216.9         434.1
## 251   RAB067q   254.2        208.4         319.3
## 252   RAB068q   165.2        141.7         193.3
## 253   RAB069q   474.3        365.1         647.1
## 254   RAB070q   352.8        283.7         434.8
## 255   RAB071q   240.8        190.6         322.1
## 256   RAB072q   278.0        232.9         339.9
## 257   RAB073q   231.7        196.9         281.0
## 258   RAB074q   238.4        202.9         283.1
## 259   RAB075q   175.1        151.4         203.9
## 260   RAB076q   340.0        255.3         475.2
## 261   RAB077q   256.2        216.9         300.1
## 262   RAB078q   344.8        280.1         431.9
## 263   RAB079q   349.8        289.4         422.9
## 264   RAB080q   214.9        170.8         274.9
## 265   RAB081q   359.1        299.3         434.9
## 266   RAB082q   330.5        259.8         432.7
## 267   RAB083q   264.8        222.0         312.6
## 268   RAB084q   282.6        235.9         352.2
## 269   RAB085q   191.5        153.5         251.2
## 270   RAB086q   305.7        249.1         381.5
## 271   RAB087q   732.6        566.5         958.6
## 272   RAB088q   421.5        339.2         535.5
## 273   RAB089q   318.8        245.8         420.9
## 274   RAB090q   197.2        165.4         237.8
## 275   RAB091q   334.4        267.8         431.1
## 276   RAB092q   180.9        143.3         235.2
## 277   RAB093q   177.8        154.5         205.2
## 278   RAB094q   260.6        226.3         303.0
## 279   RAB095q   302.3        242.0         385.8
## 280   RAB096q   384.4        299.6         512.2
## 281   RAB097q   436.3        359.7         526.2
## 282   RAB098q   456.7        366.6         565.1
## 283   RAB099q   350.6        292.3         431.0
## 284   RAB100q   307.1        250.2         384.1
```

```
## 285   MAB01c1   208.5        168.6         253.1
## 286   MAB01c2   343.7        275.8         424.1
## 287   MAB01c3   284.2        240.3         336.6
## 288   MAB01c4   243.7        205.6         288.7
## 289   MAB02c1   295.8        238.1         370.0
## 290   MAB02c2   167.2        135.5         206.8
## 291   MAB02c3   272.0        207.0         350.8
## 292   MAB02c4   492.2        386.3         627.9
## 293   MAB03c1   219.7        175.3         279.3
## 294   MAB03c2   296.4        233.9         382.4
## 295   MAB03c3   737.9        550.7        1016.6
## 296   MAB03c4   310.0        247.7         382.8
## 297   MAB04c1   442.3        345.2         593.2
## 298   MAB04c2   416.5        308.3         594.5
## 299   MAB04c3   579.0        452.3         750.9
## 300   MAB04c4   265.4        210.0         336.1
## 301   MAB05c1   453.1        356.0         565.7
## 302   MAB05c2   283.7        225.2         353.0
## 303   MAB05c3   298.3        240.7         379.1
## 304   MAB05c4   360.5        281.0         465.7
## 305   MAB06c1   263.8        209.5         338.2
## 306   MAB06c2   351.6        277.7         448.0
## 307   MAB06c3   182.2        145.9         230.3
## 308   MAB06c4   406.1        316.5         515.2
## 309   MAB07c1   214.9        178.8         255.9
## 310   MAB07c2   218.8        180.8         268.7
## 311   MAB07c3   189.1        158.0         232.0
## 312   MAB07c4   341.8        258.8         468.6
## 313   MAB08c1   251.6        198.0         321.8
## 314   MAB08c2   298.8        238.4         392.7
## 315   MAB08c3   241.5        197.4         296.7
## 316   MAB08c4   304.4        243.1         374.1
## 317   MAB09c1   403.8        335.5         492.2
## 318   MAB09c2   379.9        317.2         460.8
## 319   MAB09c3   412.4        315.6         548.5
## 320   MAB09c4   567.5        450.2         706.6
## 321   MAB10c1   360.7        236.7         588.5
## 322   MAB10c2   231.7        194.1         274.9
## 323   MAB10c3   506.3        388.8         689.5
## 324   MAB10c4   559.3        453.2         700.8
## 325   MAB11c1   402.7        325.1         497.9
## 326   MAB11c2   424.3        324.3         582.8
## 327   MAB11c3   918.2        763.2        1103.4
## 328   MAB11c4   329.9        262.8         421.3
## 329   MAB12c1   263.0        219.8         320.7
## 330   MAB12c2   140.3        114.7         173.1
## 331   MAB12c3   145.0        116.8         189.6
## 332   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

# 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

#AGB_AfriSAR
```