JST-JICA satreps program

CADAF PROJECT

Forest biomass distribution pattern in the upper Rio Negro Inferred from floristic composition and topography

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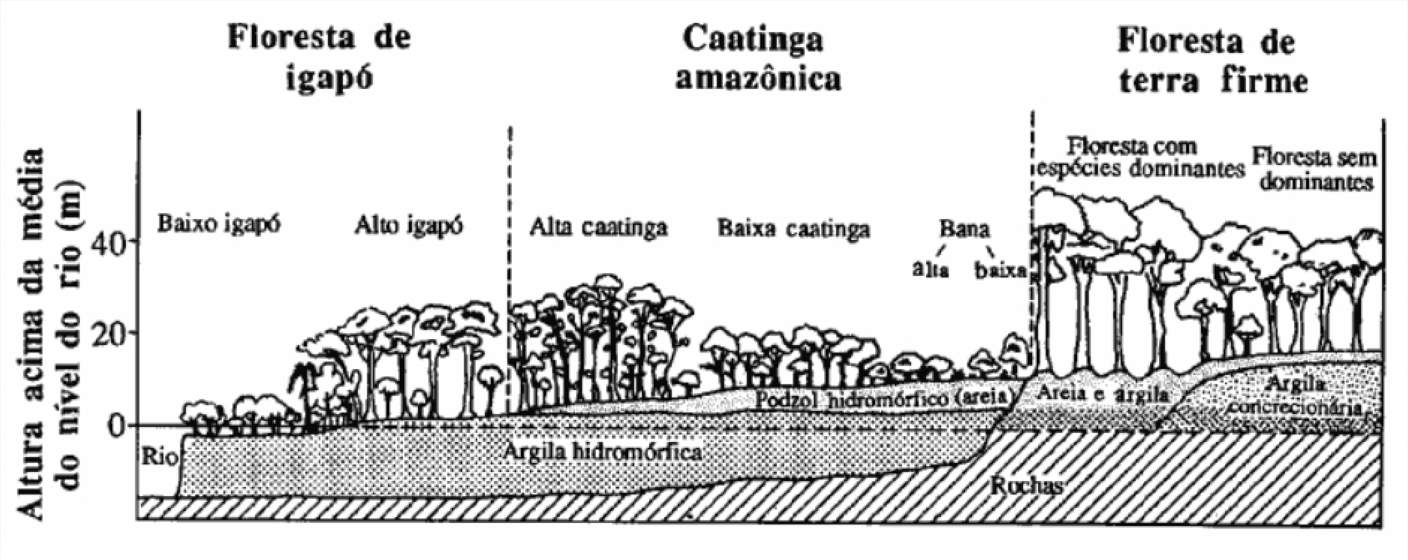
JST

JICA

Backgrounds: Forest types

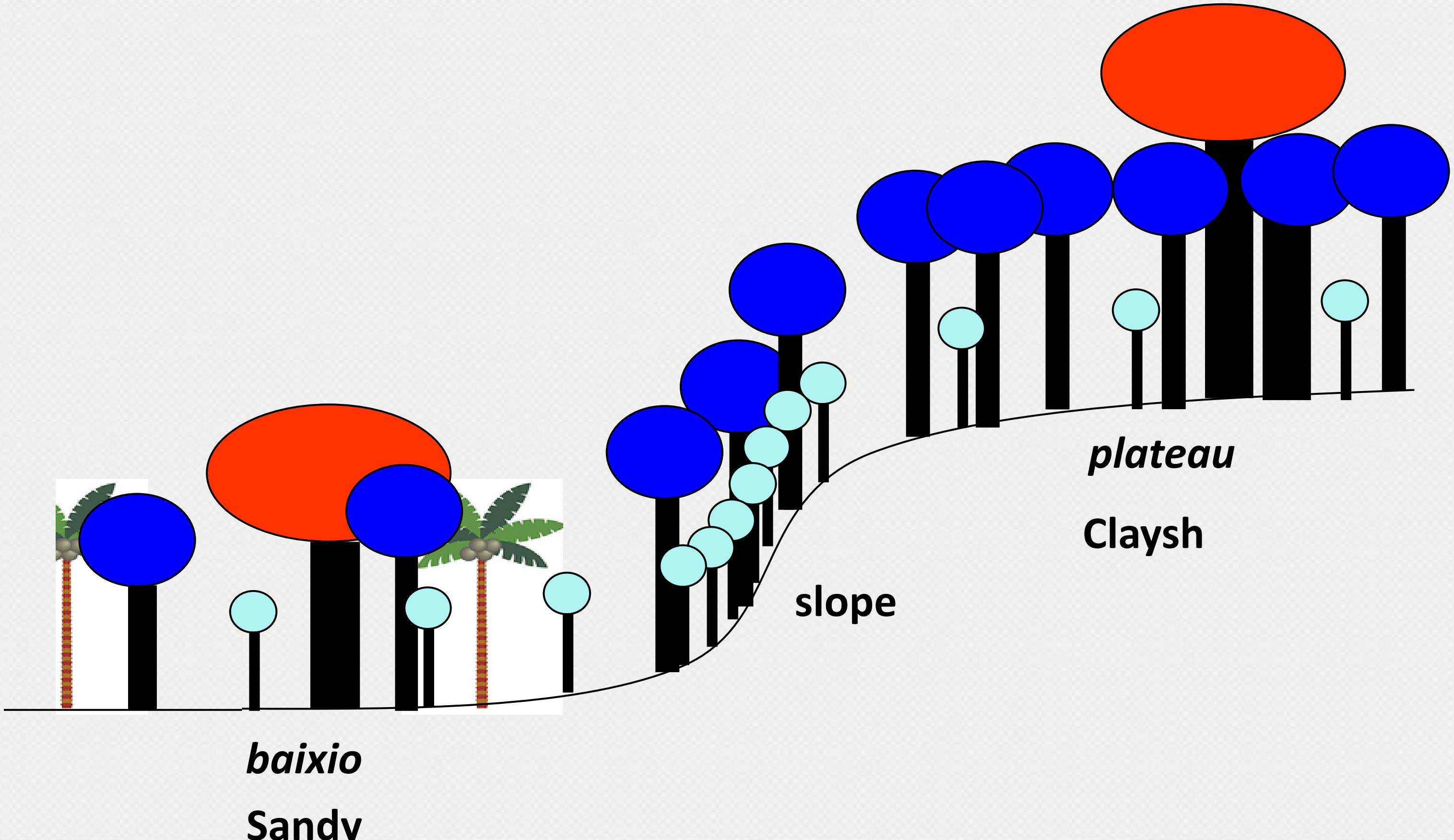
In the upper Rio Negro regions, the tropical forests established on infertile eluvial soils, and various forest types, including white sand (***campinarana***) and *terra-firme* forests are observed.



frm Clark and Uhl 1987

Backgrounds: Topography

Even within a same forest type, biomass varies along a soil gradient depending on topography (Laurance et al. 1999; Castilho et al. 2006; Suwa et al. 2012)



Objectives

Aims are

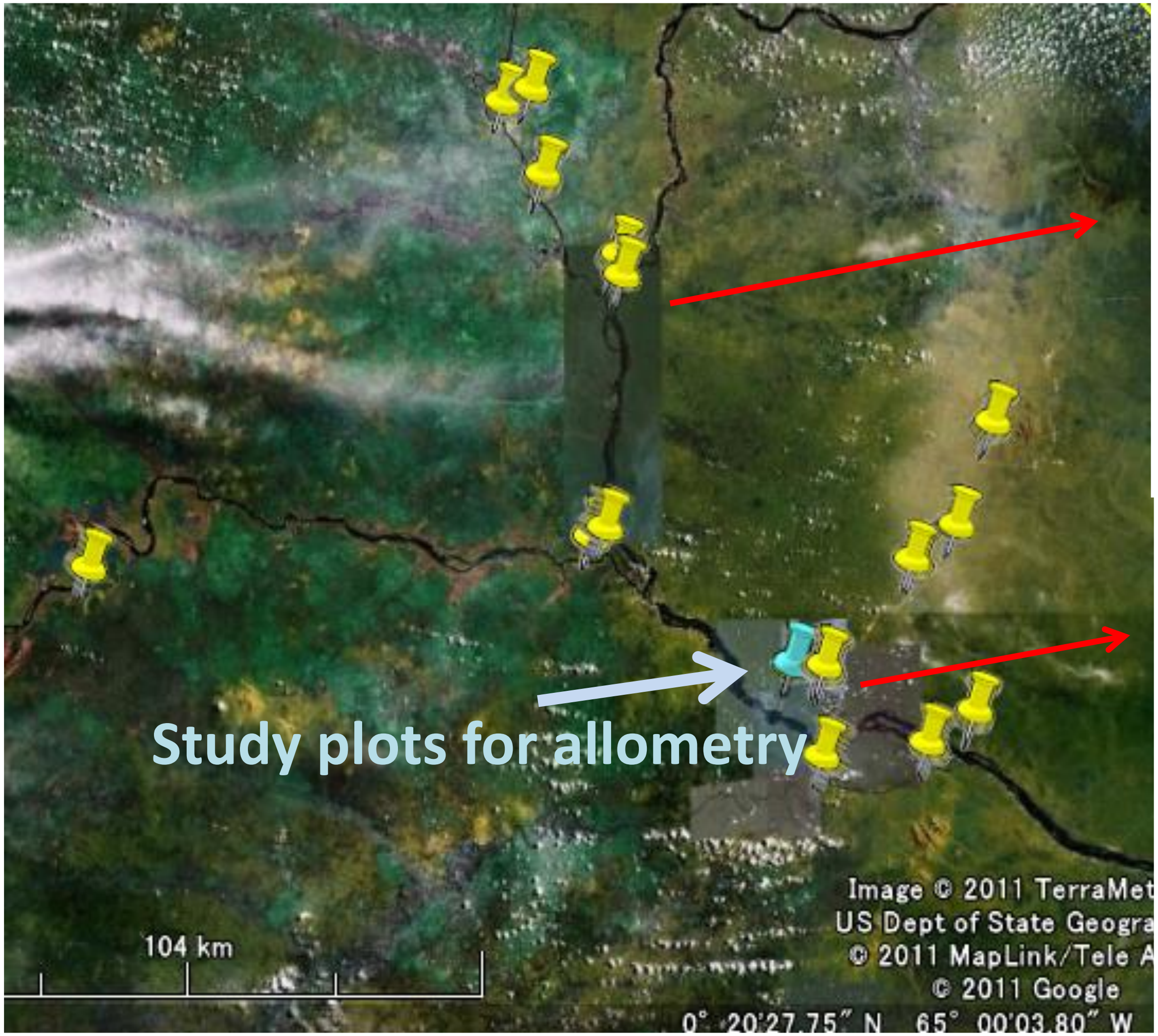
1) to examine a possibility to classify the forest types using an clustering analysis at genes level,

2) to examine the differences in biomass among the different forest types,

3) to examine the relationships of topography to biomass in the upper Rio Negro regions.

Methods

Study plots for inventory



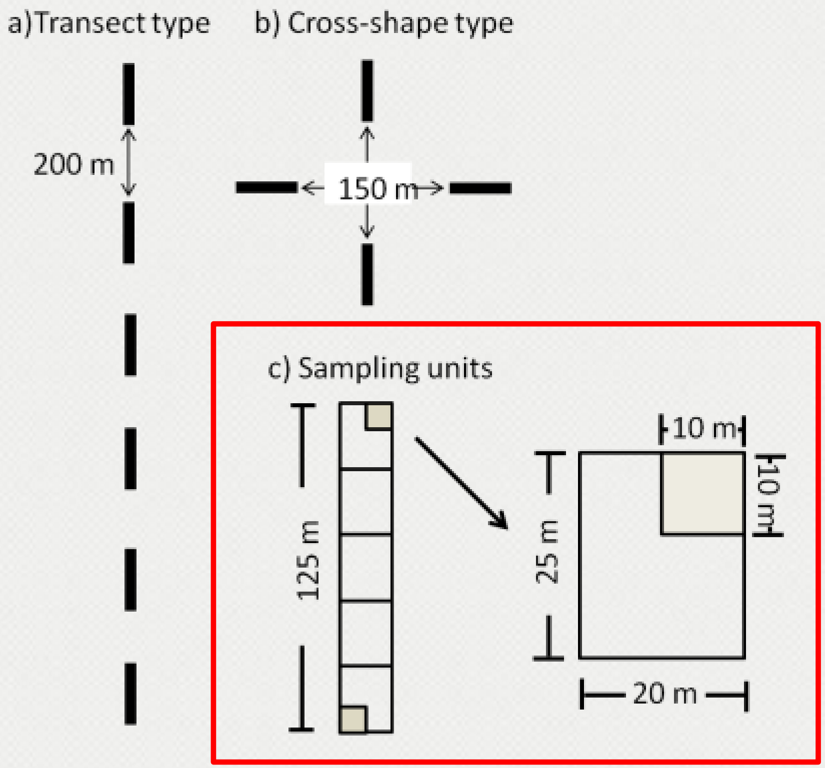
Inventory plots：n= 100 (20 m x 125 m) in 16 sites
Allometry plots：n = 2 (20 m x 20 m)

Methods

<u>**20 × 125-m^2**</u>

All individuals (*DBH* > 10 cm).

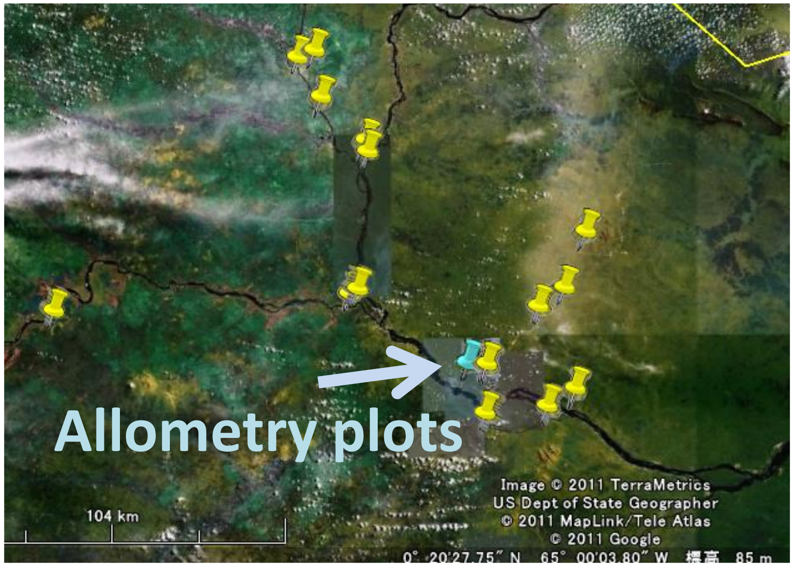
Local name ➡ Scientific name at genus level



Methods

Allometric models for estimating biomass

(Lima et al. 2012))




Contents lists available at SciVerse ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Allometric models for estimating above- and below-ground biomass in Amazonian forests at São Gabriel da Cachoeira in the upper Rio Negro, Brazil

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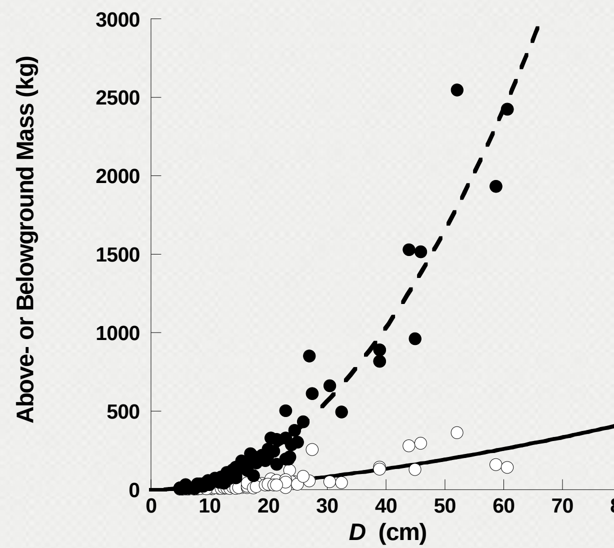
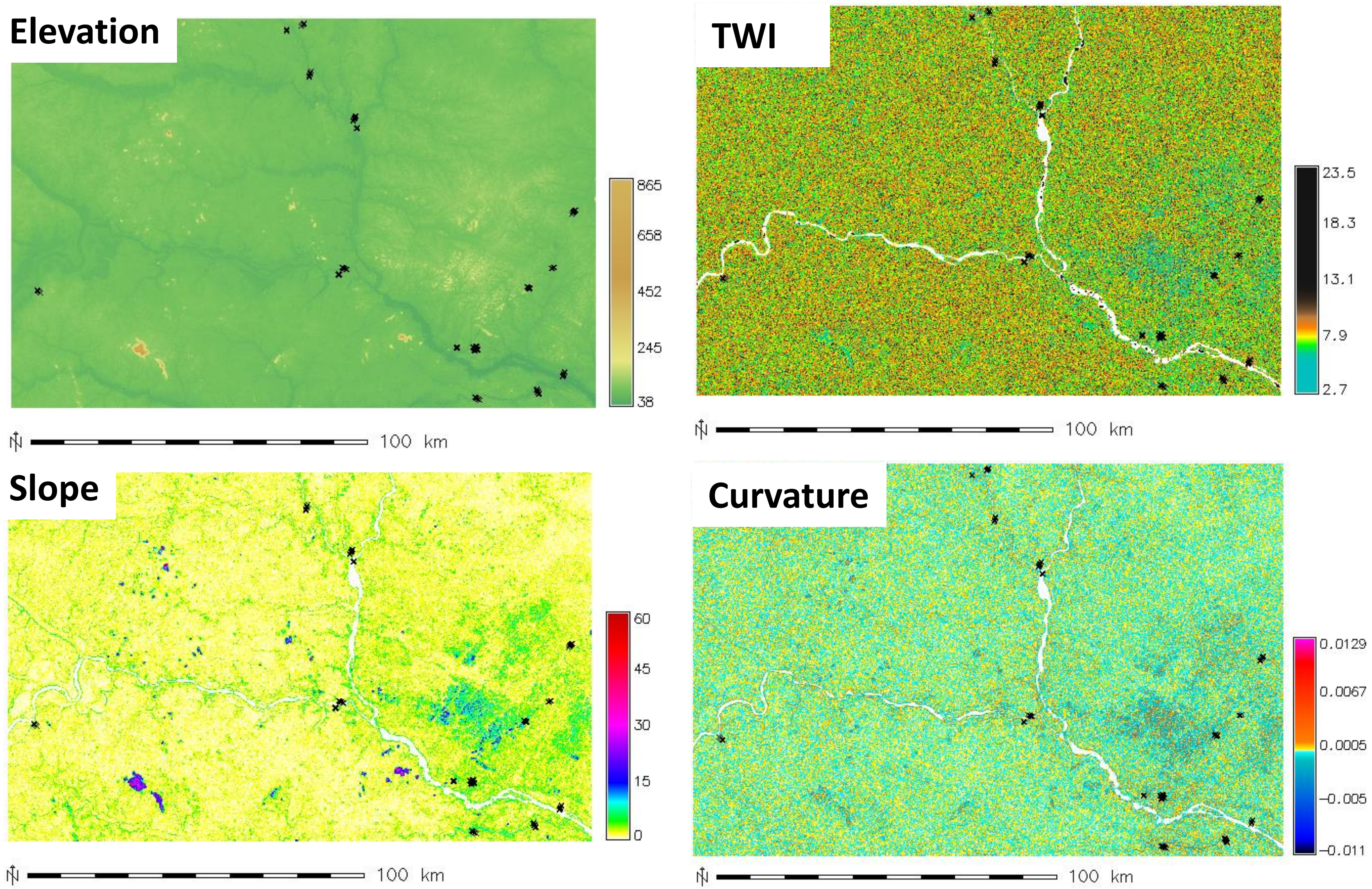


Methods Topographic parameters

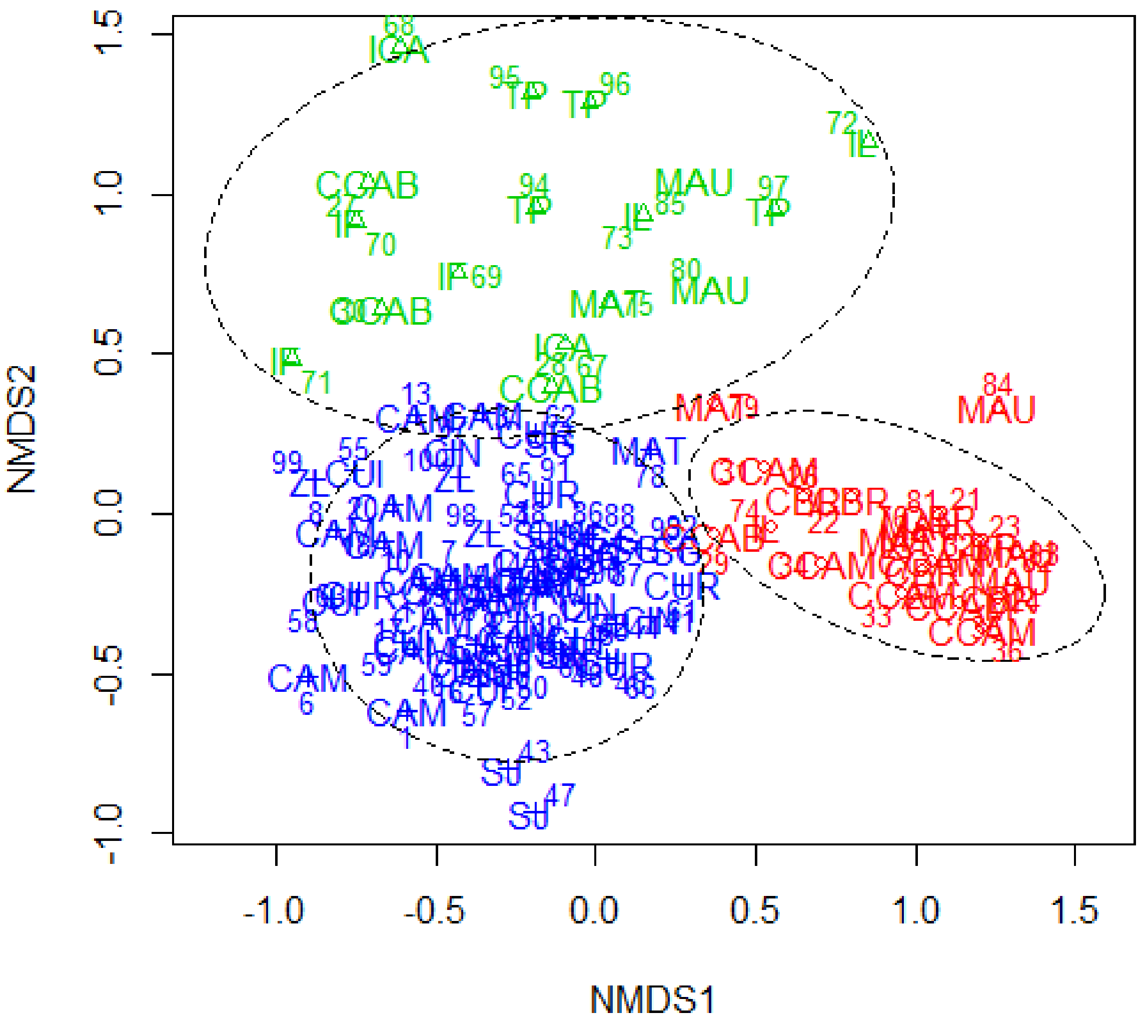


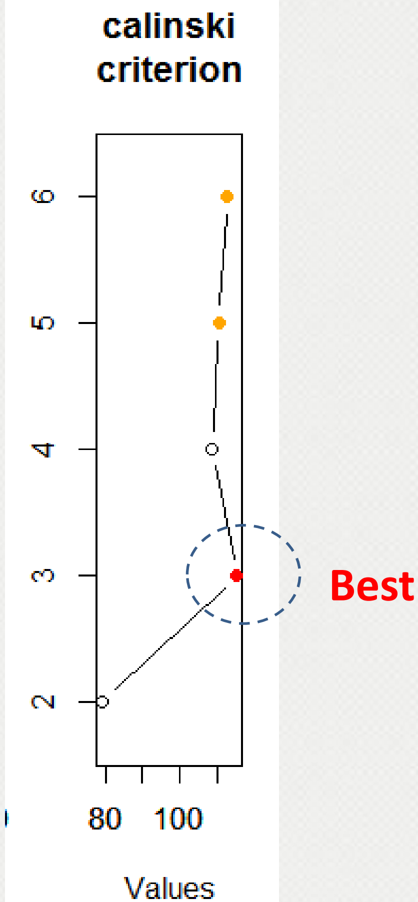
Source: SRTM
Resolution :90 x 90-m

Results and discussion

Clustering analysis based on genera

(*n* = 100 plots)





Important genus for each cluster

Cluster 1

Genus	Indicator value	*p*
Eschweilera	0.882	0.001
Alexa	0.875	0.001
Swartzia	0.767	0.001
Couratari	0.734	0.001
Maquira	0.636	0.001
Coussarea	0.486	0.015
Virola	0.448	0.013
Brosimum	0.436	0.01
Scleronema	0.368	0.093
Heterostemon	0.367	0.002

Cluster 2

Genus	Indicator value	*p*
Pradosia	0.828	0.001
Micrandra	0.8	0.001
Caraipa	0.566	0.001
Pouteria	0.478	0.041
Macrolobium	0.375	0.025
Humiria	0.375	0.003
Eperua	0.345	0.005
Ambelania	0.342	0.006
Pagamea	0.333	0.001
Aniba	0.299	0.603

Cluster 3

Genus	Indicator value	*p*
Licania	0.53	0.002
Guatteria	0.515	0.001
Protium	0.514	0.001
Inga	0.468	0.01
Ocotea	0.462	0.014
Iryanthera	0.428	0.043
Miconia	0.411	0.001
Vantanea	0.401	0.001
Goupia	0.382	0.003
Caryocar	0.357	0.001

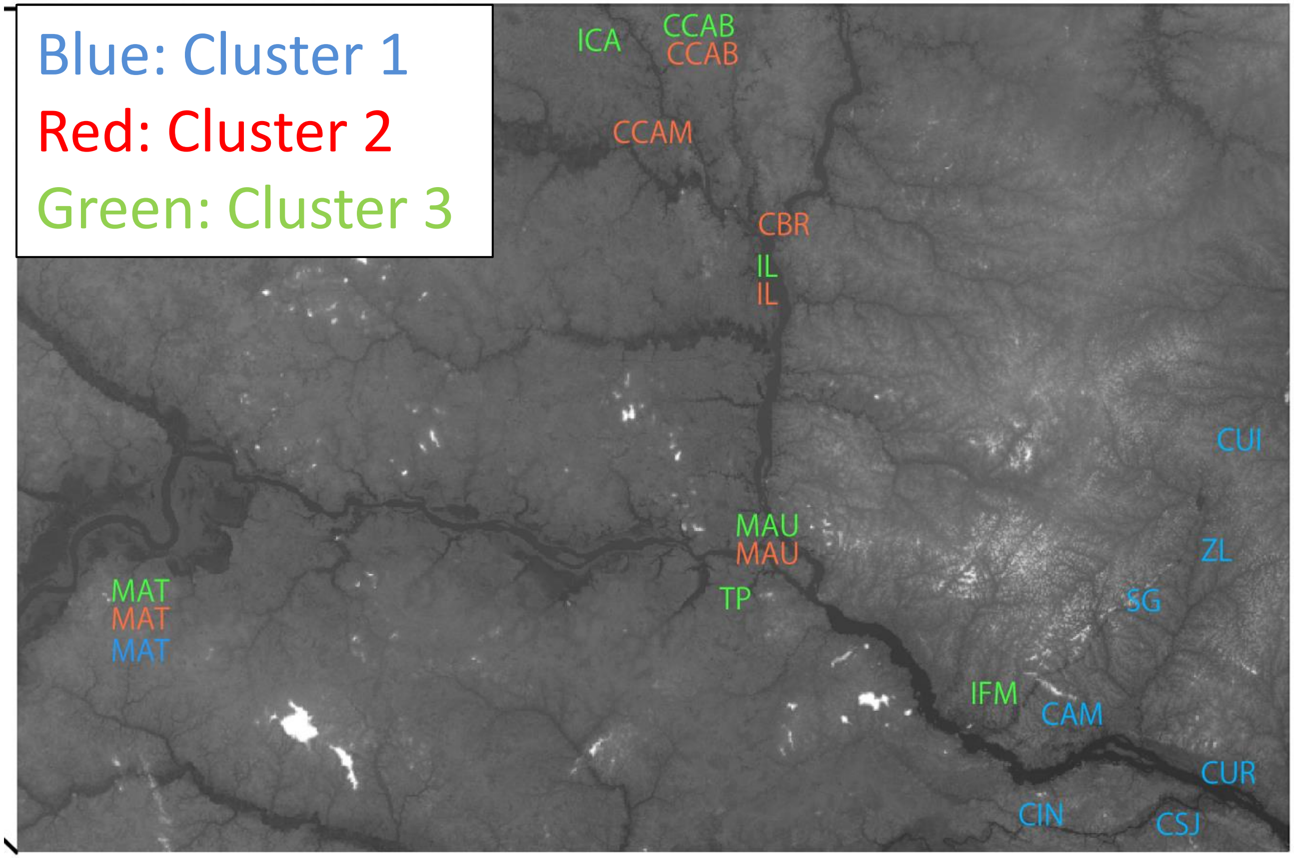
According to an intensive research work on floristic composition in the upper Rio negro (Stropp 2011),

Cluster 1: *Eschweilera*, *Swartzia*, *Coutari*, virola and *Brosimum* are reportedly typical for *terra-firme* in the upper Rio Negro.
Cluster 2: *Pradosia, Macrobium* and*Eperua* are reportedly typical for ***campinara***.
Cluster 3: *Protium, Inga* and *Iryanthera* are reportedly typical for ***terra-firme*** in the entire Amazon.

*Licania had 5 species associated with *campinarana* (*L. bruxifolia, L. cuprea, L. divaricata, L. hypoleuca, L. leptostacya*) and 3 with *terra-firme* forests (*L. bracteata, L. heteromorpha, L. octandra*) across the Amazon (Stropp 2011).

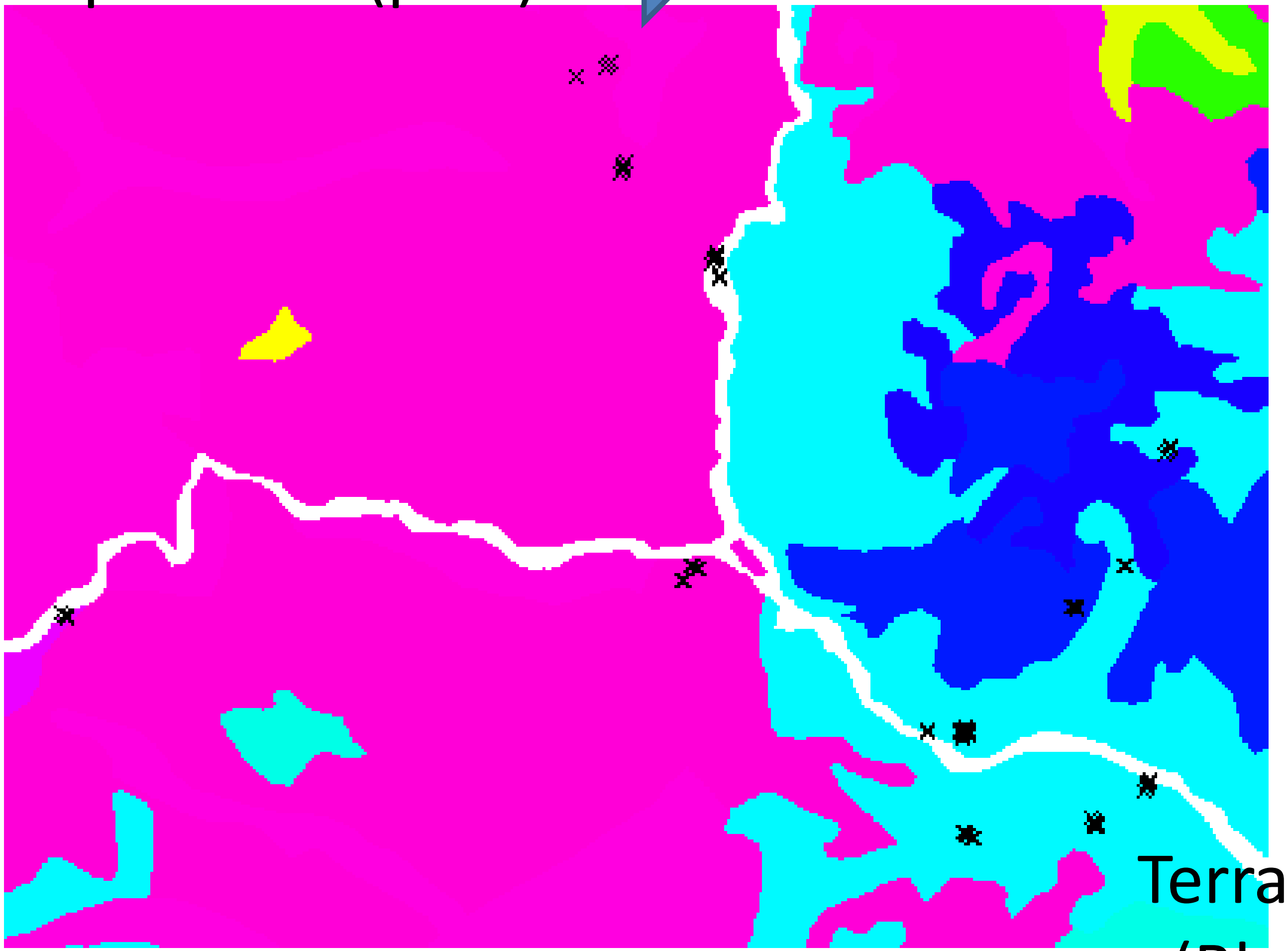
Spatial distribution pattern of each cluster

Cluster 1 showed a geographical aggregation, and merely mixed with the other clusters.
Cluster 2 and Cluster 3 often appeared together.



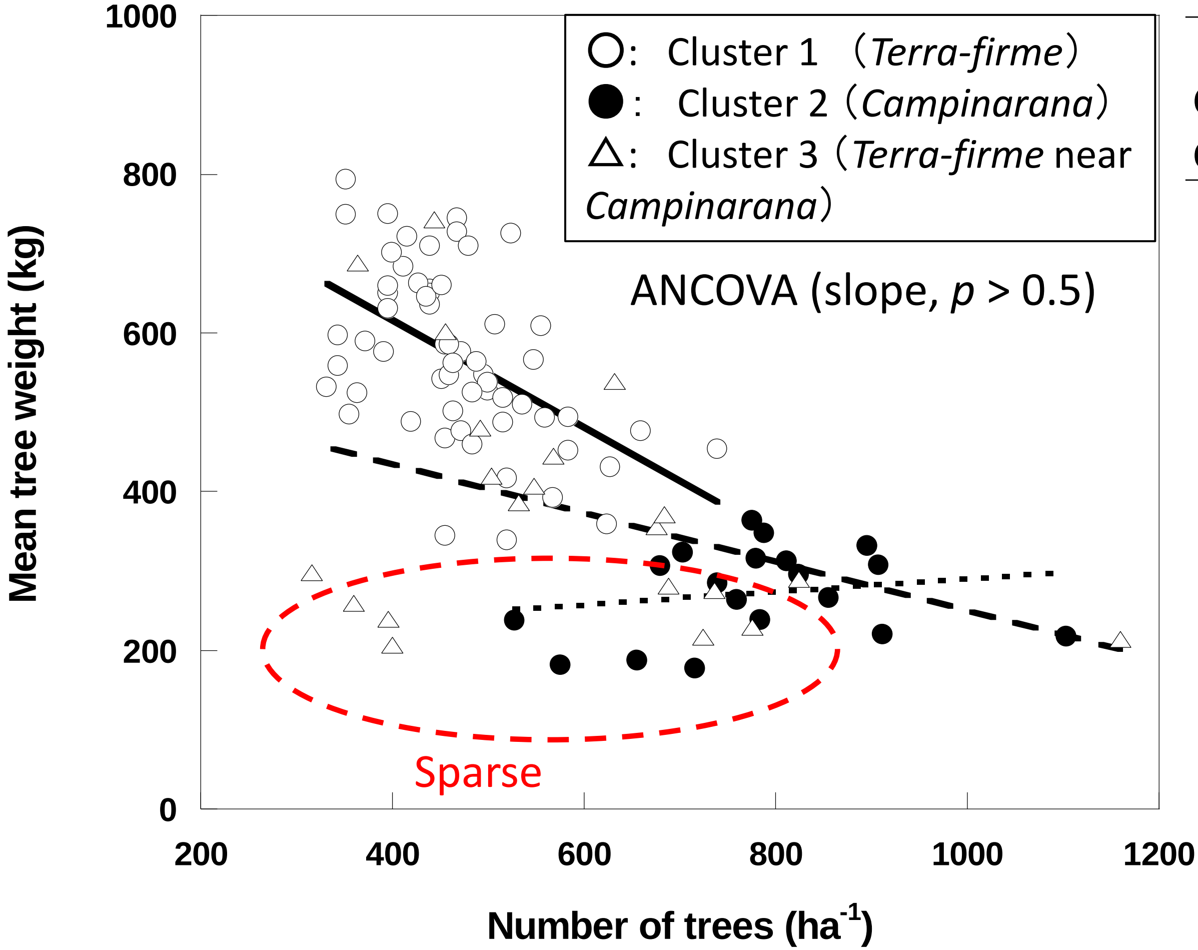
Comparison with the previous vegetation map（IGBE 2012)

Campinarana (pink) → Clusters 2 and 3



Terra-firme (Blue and light blue) → Cluster 1

Biomass in each cluster



	Biomass (t ha-1)	SE
Custer 1	262.9	6.0
Cluster 2	209.6	15.9
Cluster 3	213.5	13.3

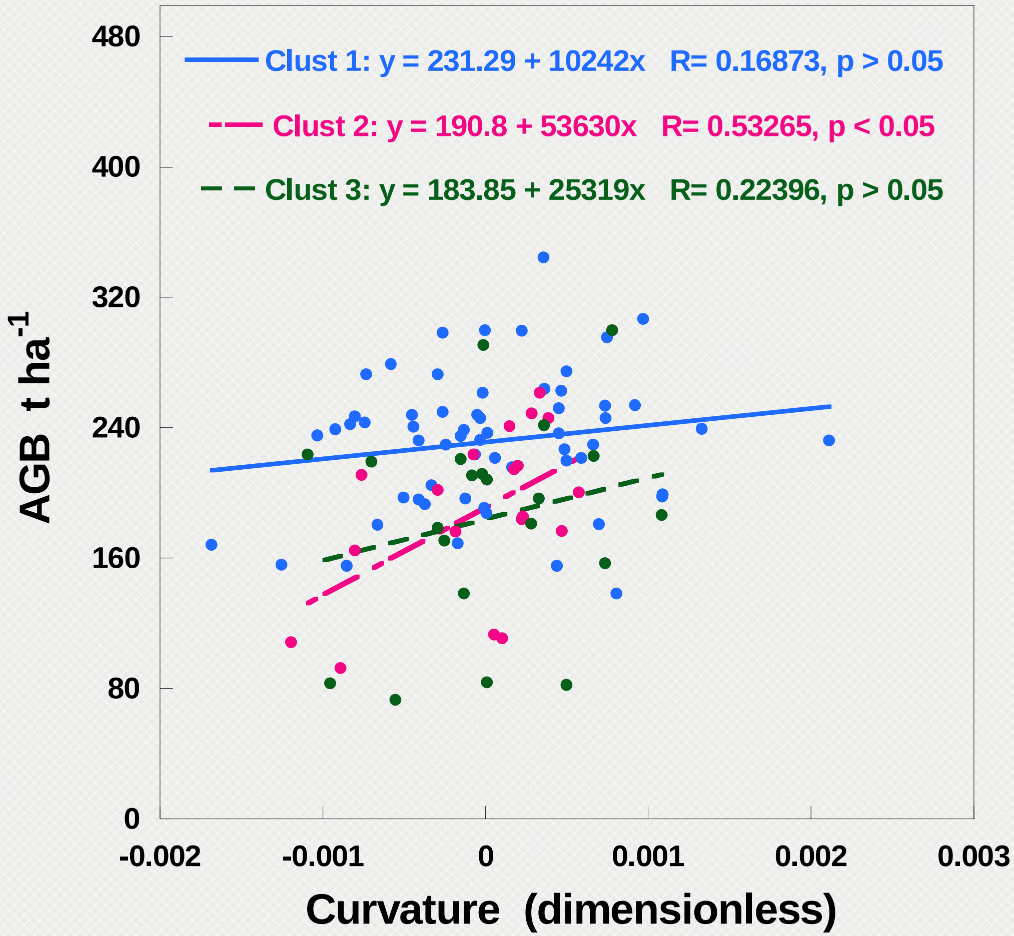
Generalized linear mixed model GLMM using topographic parameters and forest types

The estimated biomass were grouped by each site, and
the site effect was incorporated into the model as random variable.

Stepwise selection of parameters based on AIC

Best model was model 2 including *Slop, Curv* and forest types

Models	Elev	se	Slope	se	Curv	se	Clust1	se	Clasut3	se	Intercept	se	AIC
1	0.51	0.7	-5.10	4.0	18630	8804	49.0	18.7	-6.3	19.1	178.2	67.3	1045
2			-4.49	3.8	20368	8504	51.1	17.7	-5.8	18.5	222.6	15.6	**1044**
3					19314	8455	45.9	17.9	-5.2	18.8	215.9	15.0	1048
4							46.8	18.4	-4.3	19.3	215.3	15.4	1071
Null model											236.0	10.4	1091


Clust 1: y = 231.29 + 10242x R= 0.16873, p > 0.05
Clust 2: y = 190.8 + 53630x R= 0.53265, p < 0.05
Clust 3: y = 183.85 + 25319x R= 0.22396, p > 0.05
AGB t ha-1
480
400
320
240
160
80
0
-0.002
-0.001
0
0.001
0.002
0.003
Curvature (dimensionless)

Summary

１：The terra-firme and campinarana were succesfuly separated on the basis of an floristic pattern at genus level

２：The terra-firme and campinarana showed distinct difference in the tree density – tree weight relationships, and biomass.

３：The curvature was selected as the most important topographic factors in the GLMM, and showed positive relationship to biomass.

Obrigado por sua attenção.

Results of multiple linear model

```
summary(lm(TW4~slope+curve+clust3,data=d))
Call:
lm(formula = TW4 ~ slope + curve + clust3, data = d)

Residuals:
    Min       1Q   Median       3Q      Max
-123.795  -25.199   -0.092   36.608  115.263

Coefficients:
                Estimate  Std. Error t value   Pr(>|t|)
(Intercept)     223.8     13.564     16.501    < 2e-16 ***
slope           -5.988    3.711      -1.613    0.109965
curve           21380     8660.7     2.469     0.015349 *
clust3TR        54.639    14.785     3.696     0.000367 ***
clust3UK        -5.986    17.014     -0.352    0.725738
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 53.69 on 95 degrees of freedom
Multiple R-squared:  0.2427,    Adjusted R-squared:  0.2108
F-statistic:  7.61 on 4 and 95 DF,  p-value: 2.312e-05
```

Methods

Clustering analysis (the **k-means clustering method**) was carried out on the basis of values of first and second coordinates of **NMDS** (non-metric multidimensional scaling) at genus level.

Calinski criterion was employed for determining the number of partitioning, where higher values of the Calinski criterion means better partitioning. This method is based on the *F*-test. The number of partitioning (*K*) was tested for a range from two to six.

Results

The optimal *K* was obtained as 3.