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**Analyzing Canopy Heterogeneity of the Tropical Forests  
By Texture Analysis of Very-High Resolution Images -  
A Case Study in the Western Ghats of India**

**Appendixes**

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# Appendixes

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## **APPENDIX 1: IKONOS satellite image metadata**

Full details on IKONOS image metadata are available at <http://geofuse.geoeye.com>

Image ID: 20020110053808200000116200612000012522202THC

Collection Date: 10-Jan-2002

Cloud Cover Percentage: 0

Imagery Source: IKONOS-2

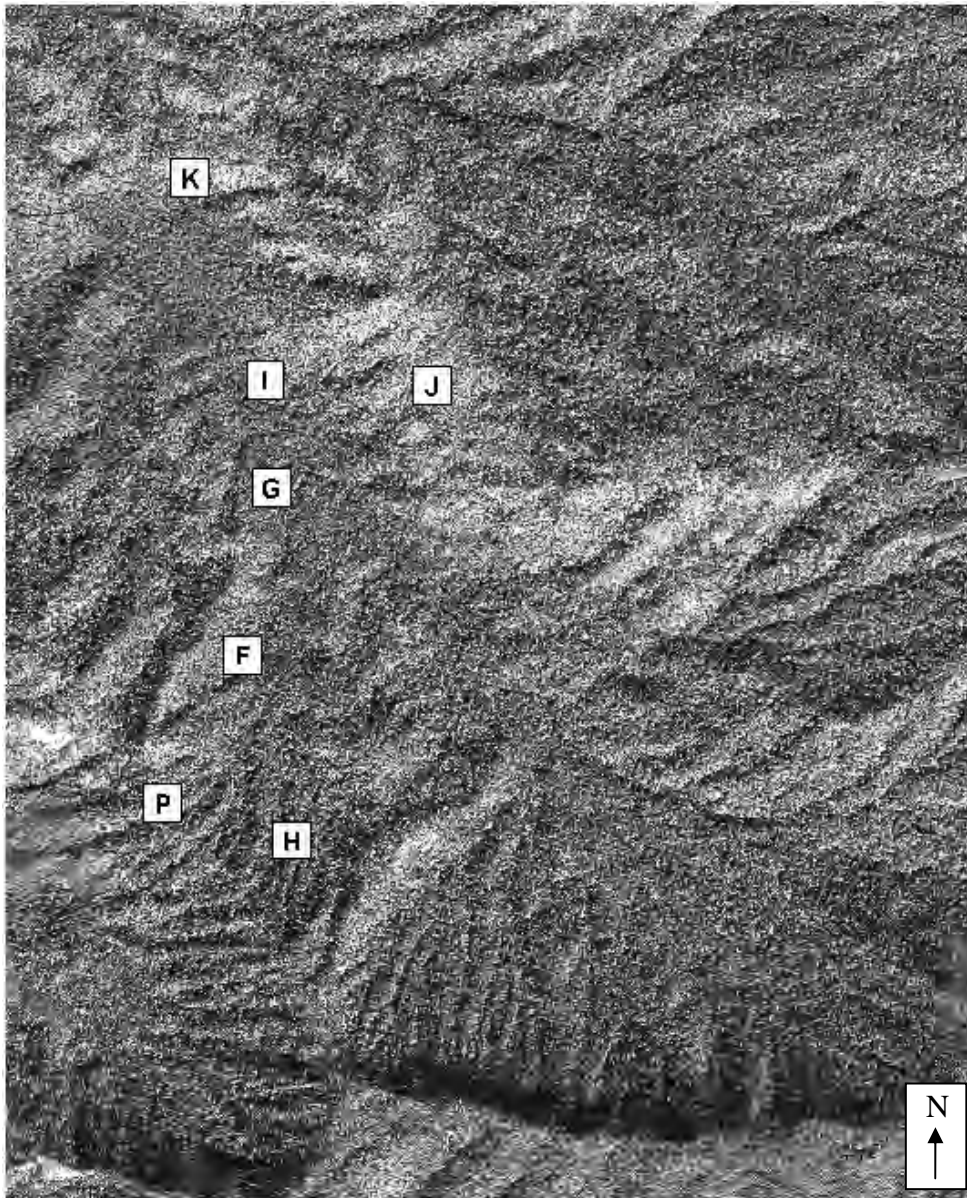
Sensor Azimuth Angle: 348.4703

Sensor Elevation Angle: 83.6821

Sun Azimuth Angle: 147.9756

Sun Elevation Angle: 49.6094

**APPENDIX 2: Study area and plots overview (IKONOS) and geositions**



**Study area (~ 28.5 km<sup>2</sup>)**

Top: 12.572151

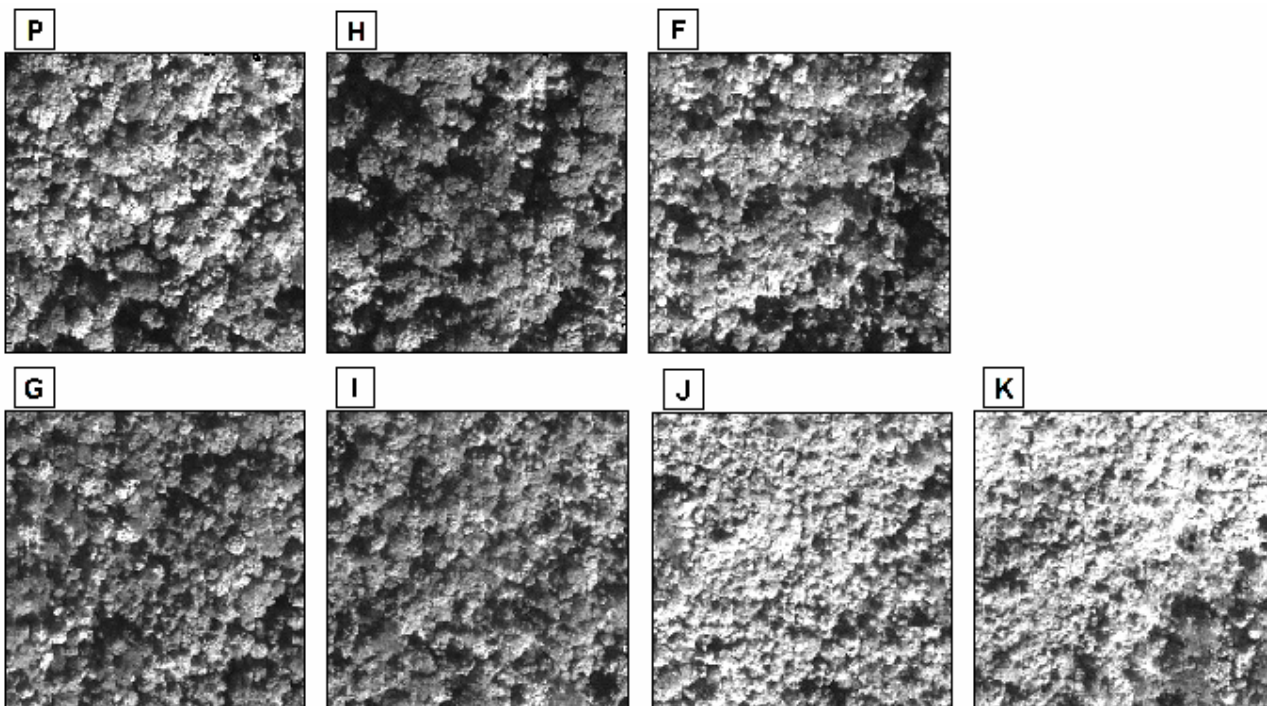
Left: 75.649295

Right: 75.693403

Bottom: 12.518764

**Plots center geosition :**

	<i>LAT</i>	<i>LONG</i>
<b>P :</b>	12,5365615	75,6564379
<b>H :</b>	12,5348947	75,6623173
<b>F :</b>	12,5431498	75,6600894
<b>G :</b>	12,5506170	75,6614312
<b>I :</b>	12,5554114	75,6611855
<b>J :</b>	12,5551442	75,6687495
<b>K :</b>	12,5644141	75,6577942



### **APPENDIX 3: Regression models quality assessment**

To characterize the quality of the regression models predicting forest structure parameters from windows ordination scores along PCA axes, we used the following indices:

- The adjusted coefficient of determination (**adj. R<sup>2</sup>**) provides an assessment of the goodness of the fit of the model by quantifying the proportion of explained variance. The closer R<sup>2</sup> is to 1, the better does the model. Unlike the simple coefficient of determination (R<sup>2</sup>), the adjusted coefficient of determination take into account the number of degree of freedom which is more reliable to compare models with different number of explanatory variables. The adj. R<sup>2</sup> value is computed as follow :

$adj.R^2 = 1 - (1 - R^2).df_t / df_e$  with  $df_t$ : total degrees of freedom,  $df_e$ : residuals degrees of freedom and R<sup>2</sup> computed as follow :

$$R^2 = \frac{\sum_i (\hat{Y}_i - \bar{Y})^2}{\sum_i (Y_i - \bar{Y})^2} \text{ with } \bar{Y} \text{ the arithmetic mean of } Y.$$

- The Akaike Information Criterion (**AIC**) is a trade-off between goodness of fit of a model and the number of parameters it involves. The AIC value has no meaning by itself but is a tool for model selection: the model providing the best trade-off obtain the lowest AIC value. The AIC is computed as follow :

$AIC = -2Ln(L) + 2p$  with L the likelihood of the model and p the number of parameters.

- The relative error (**s**) is the absolute error (i.e. magnitude of the difference between the exact value or ground data and the approximation or model prediction) divided by the magnitude of the exact value. The relative error is computed as follow :

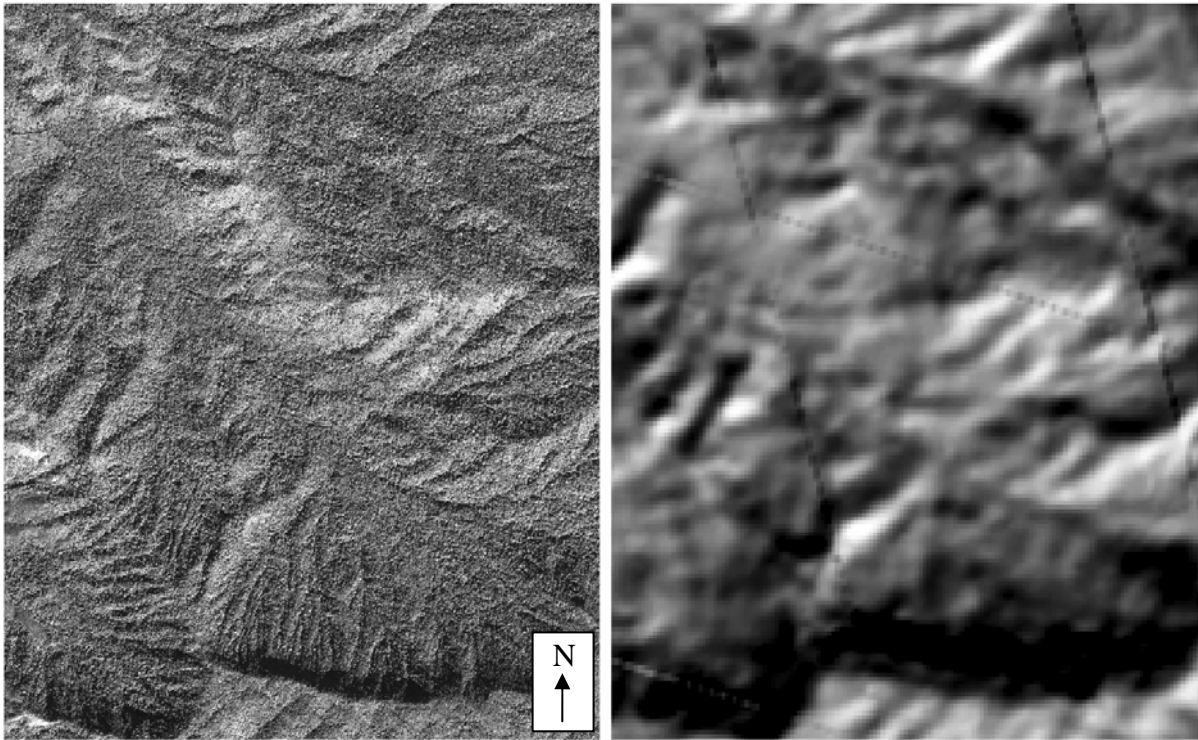
$s = (A / B) * 100$  with A: sum of model residuals absolute values and B : sum of exact data absolute values. The relative error is given in percent (i.e. percent error).

- The root mean square error (**rmse**) is a common measurement to quantify the difference between a predicted quantity and the actual quantity being predicted, so to characterize how well fit the model the data. It is expressed in the same units as the quantity being predicted, and is computed as follow :

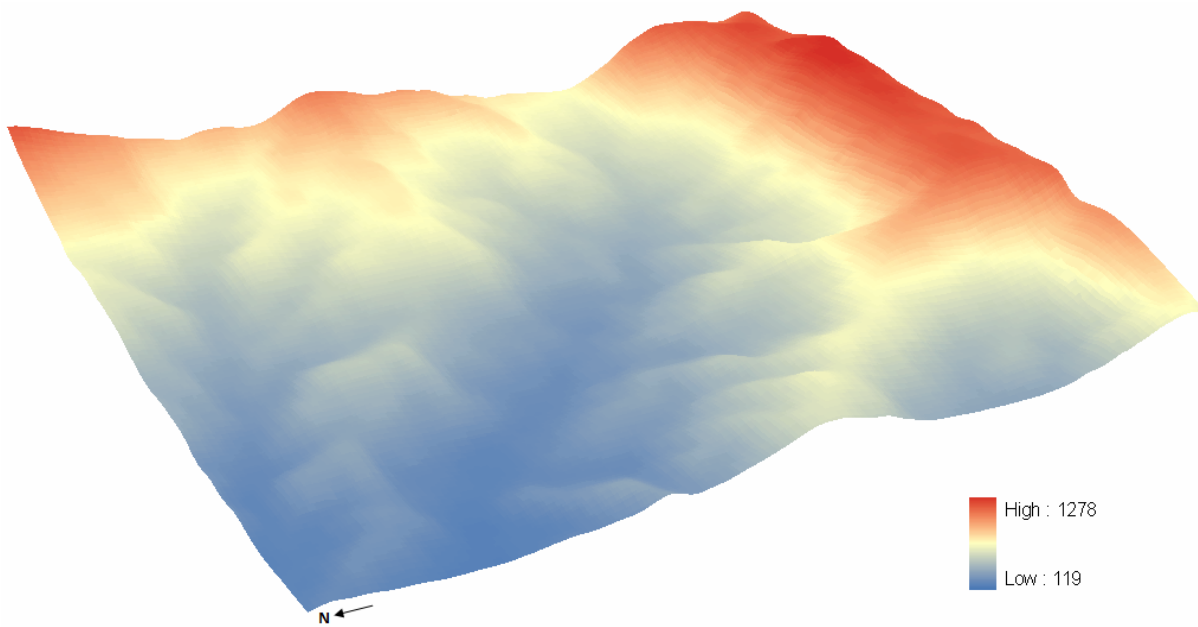
$$rmse = \sqrt{1/n \sum (P_i - A_i)^2} \text{ with } n \text{ the number of data, } P_i \text{ the predicted quantity } i \text{ and } A_i \text{ the actual quantity } i.$$



**APPENDIX 4: Hillshade and elevation of the study area**

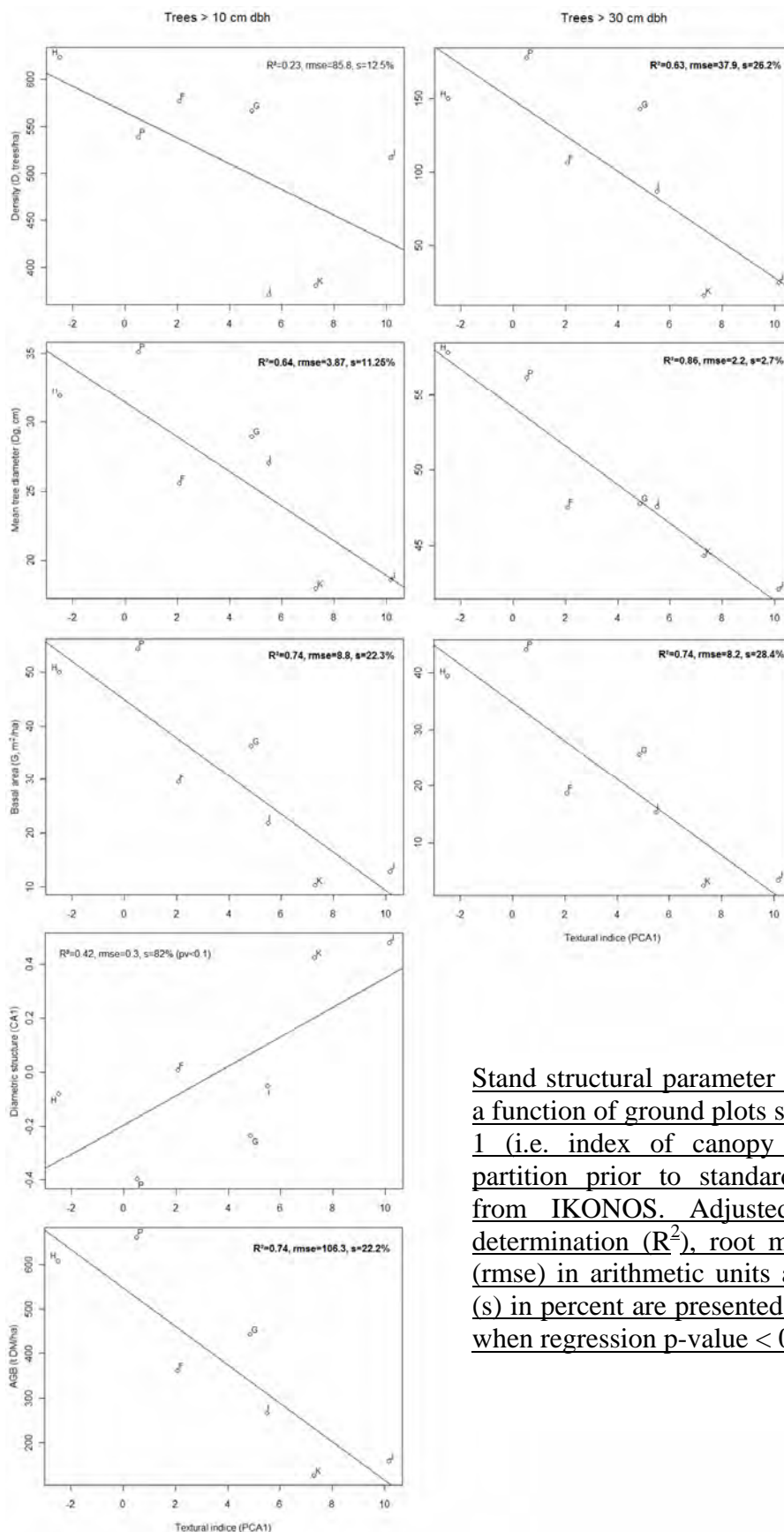


(left) IKONOS image and (right) Hillshade map of the study area

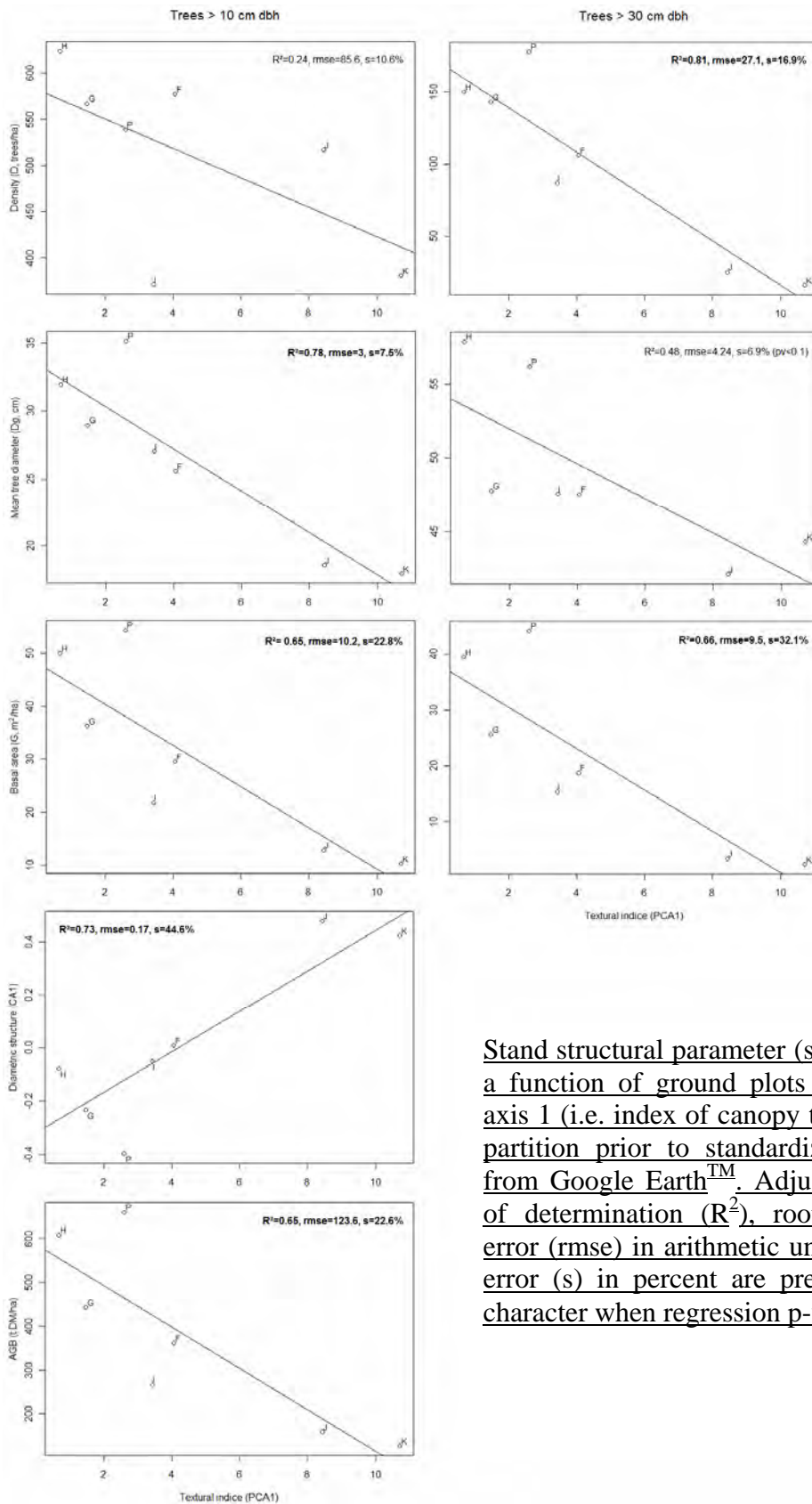


3D view of elevation variations on the study area

## Appendix 5 : FOTO predictive power on stand structure without partitionned standardization



Stand structural parameter (see Table 12) as a function of ground plots score on PCA axis 1 (i.e. index of canopy texture, without partition prior to standardization) derived from IKONOS. Adjusted coefficient of determination ( $R^2$ ), root mean square error (rmse) in arithmetic units and relative error (s) in percent are presented in bold character when regression p-value < 0,05.



Stand structural parameter (see Table 12) as a function of ground plots score on PCA axis 1 (i.e. index of canopy texture, without partition prior to standardization) derived from Google Earth<sup>TM</sup>. Adjusted coefficient of determination ( $R^2$ ), root mean square error (rmse) in arithmetic units and relative error (s) in percent are presented in bold character when regression p-value < 0,05.