REPORT ON
VALERI INDONESIAN CAMPAIGN
1-9 MAY, 2001

Under the palms of Aek Loba estate

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CONTENT *Erreur! Signet non défini.*

A] Localisation and description of the test area.

This VALERI test site is located in Aek Loba, North Sumatra, Indonesia. It consists of a 3 km x 3 km square area centred on the geographic coordinates 99°35' – 2°38'. Its general location is shown on the following maps (Figure 1).

The VALERI square area is part of an industrial oil palm estate, managed by the company SOCFINDO (based in Medan). Each parcel was homogeneously planted with given material of the same age. Material and age differ from one parcel to another with some repetition through the site, and several types of canopy architecture and density can be observed .

Figure 1: Maps of Sumatra Island, Indonesia, and location of Aek Loba oil palm estate.

B] Data acquisition sampling and protocol

Sampling was based on an RGB Landsat image acquired in September 2000 and the plantation data base, to select the more representative parcels in regards with the area variability. The 1km–lattice scheduled by the VALERI sampling protocol does not fit too well the estate organisation, where parcels size slightly exceeds 1km long and is less than 250m wide .Thus, the number of measured plots varies from one to six per square kilometre.

Measurement plots were chosen at the centre of each half of selected parcels, as shown on Figure 2, and consisted in several handlings: LAImeter (Licor Canopy Analyzer), numerical hemispheric camera (Nikonview with a FishEye lens), and Global Positioning System (Garmin III+). The two last types of data were acquired once per plot, at the centre of the LAImeter cross, this one corresponding to 6 acquisitions in the North/South axis and 6 in the East/West axis, at 4m from each other. The cross branches are thus 20m long, corresponding to SPOT image pixel dimension (Figure 3).

Remark: when underlying vegetation (adventitious) was present (two kinds of fern: a blue and a green one, Figure 4), LAImeter acquisition was done below this vegetation.

Figure 2 : location of measured parcels in the 2000-Landsat image.

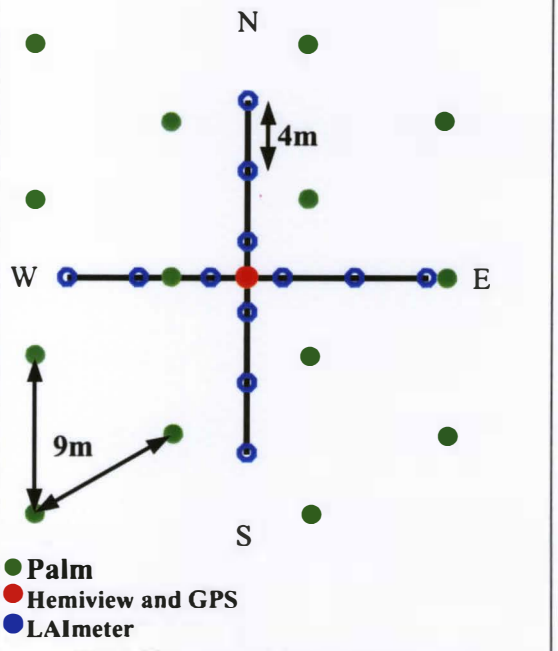

Figure 3 : location of the different data acquisitions at a given measurement plot, with their position relative to palms.

At the end, 32 measurement plots have been performed in the VALERI square area, corresponding to 17 of the 20 parcels of exploitation included in this square. Note that lower left corner of the test site is very badly sampled, due to huge heterogeneity in this area.

Figure 4 : two different kinds of adventitious vegetation: at the left, green fern, sometimes arborescent, and at the right: blue fern, with shot-silk effects.

C] Central transepts acquisition protocol

In the aim of field data spatialisation with krigeage geostatistical method, special care has been given to characterise the "short distances" variability, which is the more difficult to reach through statistics. Thus, additional data acquisitions have been performed close to the test site centre, following two orthogonal transepts, 1km-long each, oriented North-South and East-West. LAImeter records were made at the centre of the corresponding cross, and each 50m to 50m point from the centre to the extremity of each branch (N, E, S, and W), leading to 10 measurements in each branch and 41 measurements in the whole. Figure 5 shows a schematics corresponding to this protocol. GPS measurements were performed at the centre and each extremity of the cross.

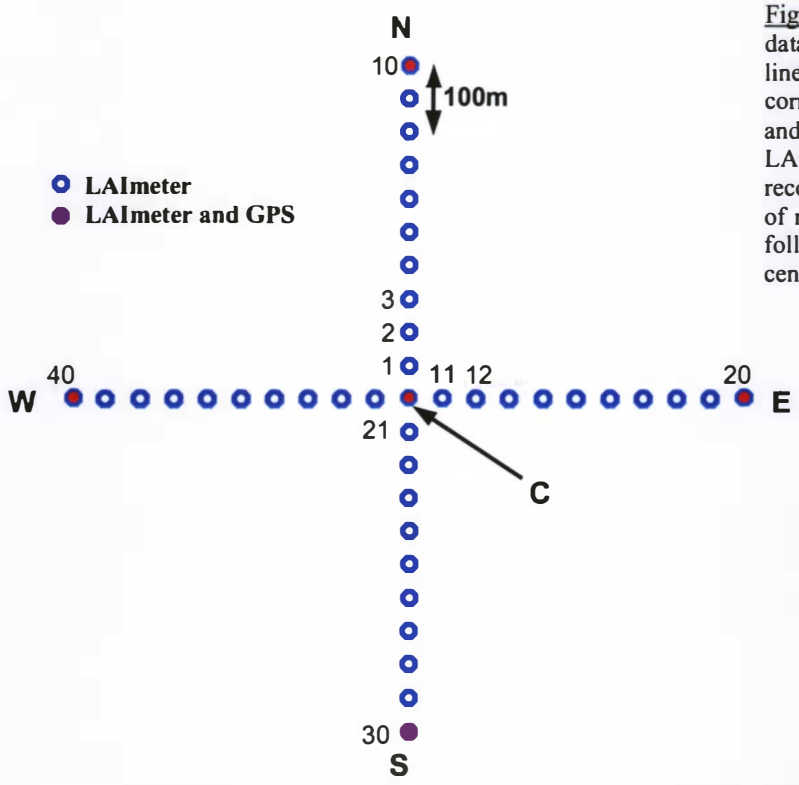

Figure 5 : location of the different data acquisitions along the two linear transepts. Blue circles correspond to LAImeter records and red and blue discs to LAImeter and GPS position records. Numbers indicate order of measurements in the sequence following measurement at the centre of the cross.

D] LAImeters intercalibration

Two Licor LAImeters were available for the data collection. One was lent by INRA-Avignon (named LI in the following) and the other by Cemagref-Montpellier (LC). LC was always posted in an open area (a football field), to provide the reference measurement above the canopy. When needed, an umbrella was used to avoid direct sunlit and sun reflection on the instrument sensor (Figure 6). LI was mobile, used to perform measurements below the canopy at each plot. Caps of the same aperture (90°) cover the lens of the two sensors during the whole campaign.

As the two LAImeters measurement sets will be combined to derive the LAI data, their respective flux sensitivity has to be estimated, compared, and intercalibrated. Fourteen flux acquisitions have been simultaneously acquired with the two instruments, in an open area without any obstacle, at different times and amount of light. The following graphs (Figure 7) show the interpolation derived from these measurements for each sensor ring, respectively 7°, 23°, 38°, 53°, and 68°. The multiplying coefficient k to be applied to all LC data files is defined by $Y = k.X$, with X = LC and Y = LI. These coefficients k are derived for each sensor ring respectively: k = 0.42, 0.366, 0.379, 0.385, 0.358.

Figure 6 : The reference LAImeter displayed in a football field, with its dedicated watchman.

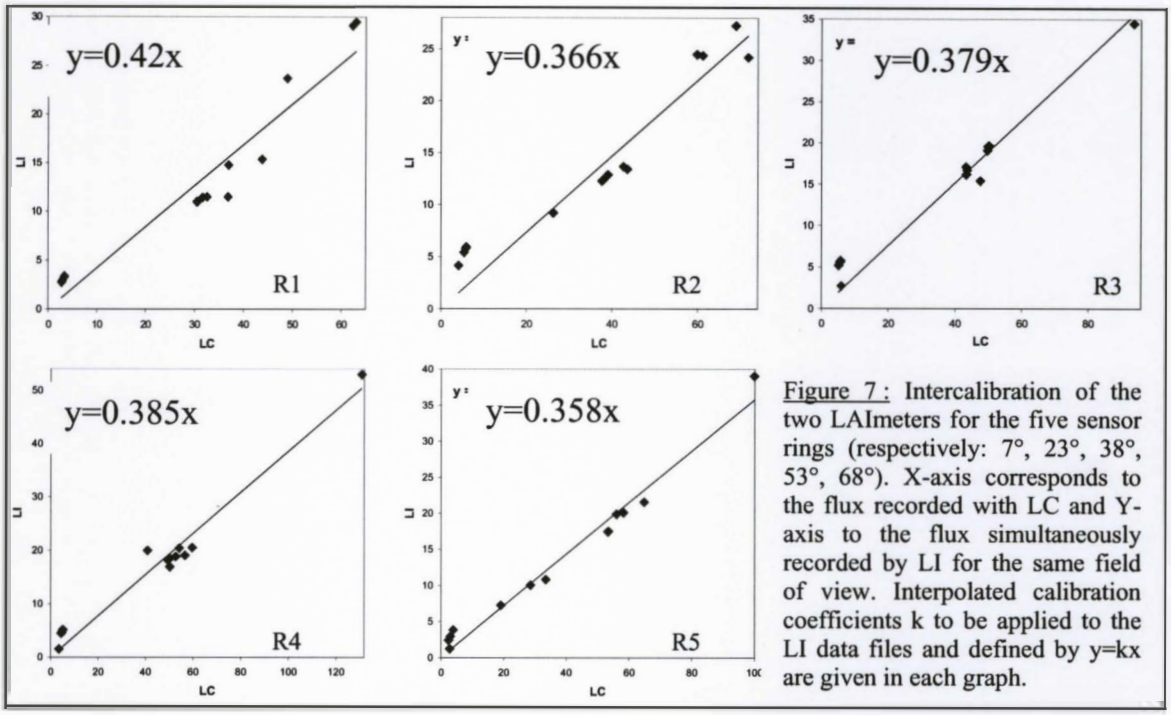

Figure 7 : Intercalibration of the two LAImeters for the five sensor rings (respectively: 7°, 23°, 38°, 53°, 68°). X-axis corresponds to the flux recorded with LC and Y-axis to the flux simultaneously recorded by LI for the same field of view. Interpolated calibration coefficients k to be applied to the LI data files and defined by y=kx are given in each graph.

E] SPOT image

XS image was acquired by HRV1 (SPOT 2) on June, the 1st, 04h05mn30s, corresponding to K-J=266-345. The whole scene is shown figure 6. It is centred on N2°30'00"-E99°45'08" (at pixel (1500,1500)). Characteristics of the observation were an orientation angle of 8.6 degrees and an incidence angle of L25 degrees, with a solar azimuth of 40.9 and a solar elevation of 63.7 degrees.

The whole VALERI square area is empty of any cloud or haze. Only few small clouds are included in the enlarged area of 10kmx10km, located at the upper left corner of the image.

The delivered product consists in SPOTView Basic Precision at geometric processing level 2B. It is projected following UTM on WGS84 datum and spheroid, Zone 47 North. Corner locations are given in Tableau 1.

Two "low resolution pixels" of 10kmx10km have been extracted : a first one directly centred around the 3kmx3km test site, and one shifted to the East to provide more homogeneous pixel. Corresponding corner locations, and test site corners are also given in Tableau 1.

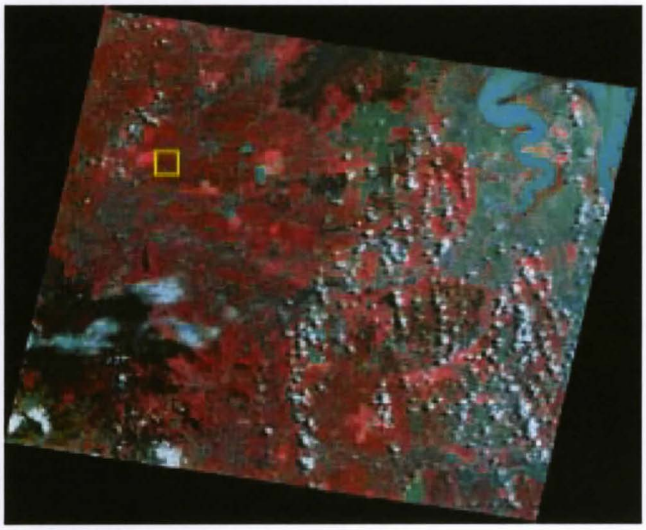

Figure 8 : SPOT full scene acquired around Aek Loba site on June 2001, the 1st.

Yellow box indicates the VALERI test site square of 3 km x 3 km.

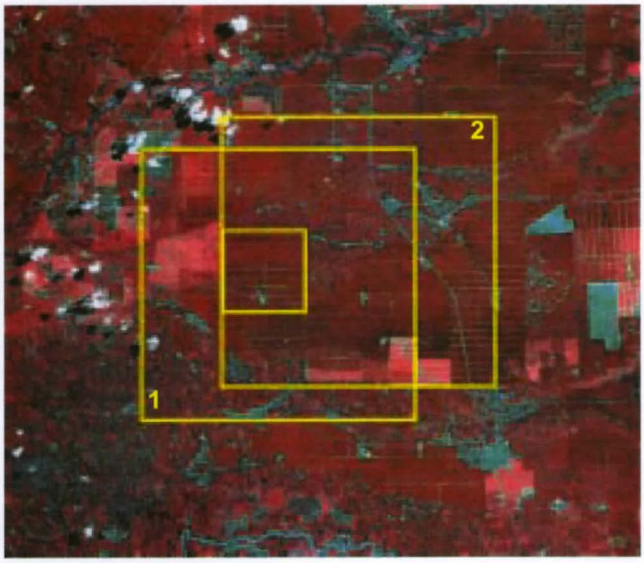

Figure 9 : Zoom on the VALERI Indonesian test site 10kmx10km "low resolution pixels" :

1) directly centred around the measurement square area

2) shifted to the east to provide a more homogeneous pixel.

The smaller yellow box correspond to the 3 km x 3 km VALERI square area

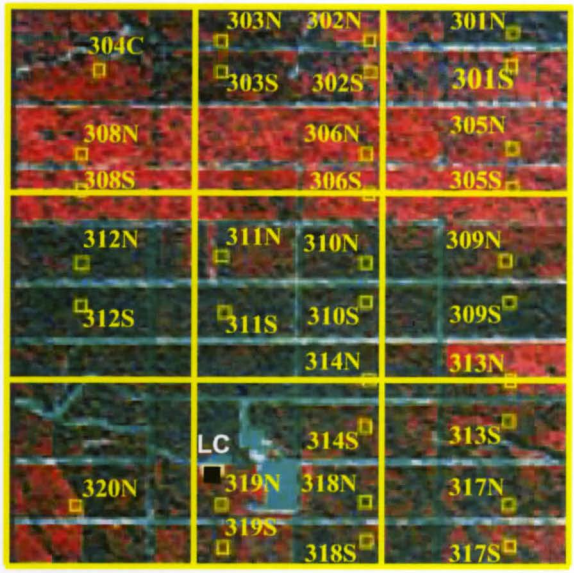

Figure 10 : Zoom on the VALERI Indonesian test site measurement square and measurements plots location.

Borders of image directly fit the 3 km x 3 km test site area.

Measurements plots are indicated by yellow cross with corresponding parcel number (N: northern half, S: southern half, C: centre of the parcel). Yellow lines correspond to the 1 km sampling lattice.

Black box indicates location of football field where LC LAImeter was set as a reference for above canopy measurements.

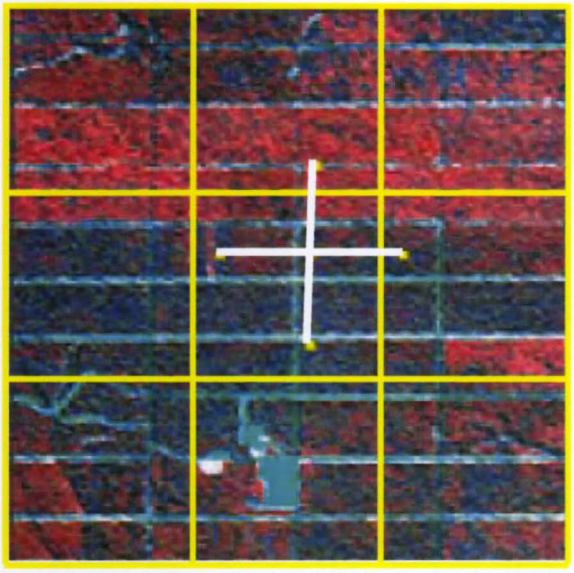

Figure 11 : Zoom on the VALERI Indonesian test site measurement square and transepts location.

The white cross indicates the location of the two linear transepts dedicated to short distance variability characterisation.

Tableau 1 : UTM and image coordinates of extractions corners:

Extraction name	Longitude (X)		Latitude (Y)	
	Upper Left Corner	Down Right Corner	Upper Left Corner	Down Right Corner
VALERI Square	562529.76	565527.82	292344.69	289346.63
100km^2 Pixel, centred	559541.39	569538.15	295357.28	285341.14
100km^2 Pixel, shifted	562466.80	572463.56	286542.30	296539.06

F] Hemiviews

At each measurement plots of VALERI square sampling, except in parcels 311N and 311S, a numerical photograph was acquired with a NikonView with a hemispherical lens (fisheye). File was recorded at highest resolution, in "tif" format, leading to images of 2048x1360 pixels.

Figure 12 : hemispherical photograph of the oil palm canopy as seen from below.

G] GPS coordinates measurements

Each measurement plot centre for the VALERI square sampling, and each central transept extremity, was localised with a Global Positioning System (GPS). The used instrument was a Garmin GeoIII+, giving an absolute position precision of 10 to 20 meters. Only measurements acquired with a PDOP lower than 4 and a distance measurement scattering lower than 5m, were kept as valid. Data were recorded in the UTM system of coordinates, with WGS84 datum and spheroid. The corresponding figures are given in the Tableau 2.

Tableau 2 : Measurement plots centre coordinates

parcel #	Lon (X)	Lat (Y)	parcel #	Lon (X)	Lat (Y)		Lon (X)	Lat (Y)
301N	565232	292255	311S	563662	290711	*Transept*		
301S	565226	292072	312N	562882	290980	center	564147	291029
302N	564451	292212	312S	562879	290750	extr N	564167	291513
302S	564454	292032	313N	565226	290342	extr E	564641	291018
303N	563640	292203	313S	565219	290124	extr S	564139	290516
303S	no gps	no gps	314N	564453	290343	extr W	563645	291018
304C	562977	292042	314S	564434	290092			
305N	565232	291614	315N	563662	290357			
305S	565234	291404	315S	no gps	no gps			
306N	564434	291583	316.	no gps	no gps			
306S	564448	291367	317N	565218	289666			
307.	no gps	no gps	317S	565230	289438			
308N	562876	291578	318N	564435	289677			
308S	562881	291379	318S	564442	289461			
309N	565220	290997	319N	563650	289661			
309S	565222	290771	319Nb	563574	289807			
310N	564436	290984	319S	563654	289425			
310S	564437	290769	320N	562859	289656			
311N	563646	291020	320S	562862	289433			

H| Annex measurements

H.1 Positions

Several other positions have been measured the same way, all through the VALERI square. Each GPS acquisition was made in the middle of the cross tracks at parcel corners.
14 of them are included inside the SPOT image extraction for the VALERI test square, the 16 others being at the edge of the square. Corresponding locations in the SPOT images are given Figure 13, and values in Tableau 3.

All these 30 positions have been given to SpotImage for the Level 2B SPOTView product performance.

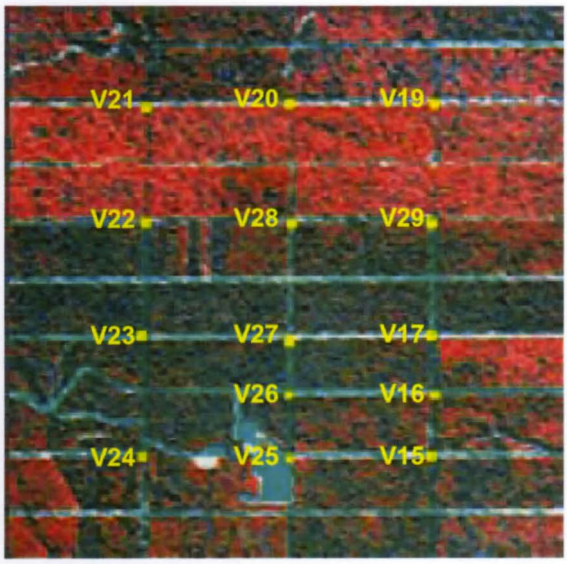

Figure 13 : Location of annex positions measurements for geometric corrections and georeferencing of the SPOT image product. Only inside-square points are shown here. The 16 others are located at the edge of the square.

Tableau 3 : Annex points coordinates

Point #	lon	lat	Point #	lon	lat
V1	565591	292371	V16	564851	290216
V2	564790	292366	V17	564836	290549
V3	564227	292447	V18	565594	290566
V4	563270	292360	V19	564846	291843
V5	562484	292461	V20	564058	291840
V6	562506	291485	V21	563261	291824
V7	562509	291173	V22	563263	291182
V8	562486	290541	V23	563257	290536
V9	562498	289878	V24	563264	289885
V10	562446	289220	V25	564052	289875
V11	563255	289229	V26	564052	290220
V12	564052	289227	V27	564052	290532
V13	564831	289222	V28	564061	291185
V14	565608	289216	V29	564835	291191
V15	564832	289881	V30	565615	292122

H.2 Photos

A general view of the surroundings of each measurement plots was performed, except for the plots in parcels number 310N, 311N and 311S.

Figure 14 : example of two types of oil palms canopy organisation.

H.3 Architectural data

Several palm architectural parameters measurements were performed on various trees in a few parcels. Such parameters are for instance trunk height, trunk diameter, palm insertion height, maximum palm height, palm length and width, leaflets numbers and dimension...
Figures are given in attached file named AL_field_form.xls, showing the compiled enquiry forms. Forms 1 to 50 concerns parcels 314N and 314S, forms 51 to 53 parcel 313N, forms 54 to 56 parcel 312N, forms 57 to 59 parcel 309S.

Figure 15 : architectural parameters measurements on oil palms

(palm length)

H.4 Planted material

Information on vegetal material in this estate area is available. Indeed, the date of plantation (Figure 16) is given for each parcel. All the palms of a given parcel have the same age.

Each couple of half-parcels is planted with the same vegetal material, except some very small scattered areas. Hybrid origin is indicated for each parcel as the breeding code on the Figure 16. No information is given for the four first top parcels. Some repetitions are found across the square.

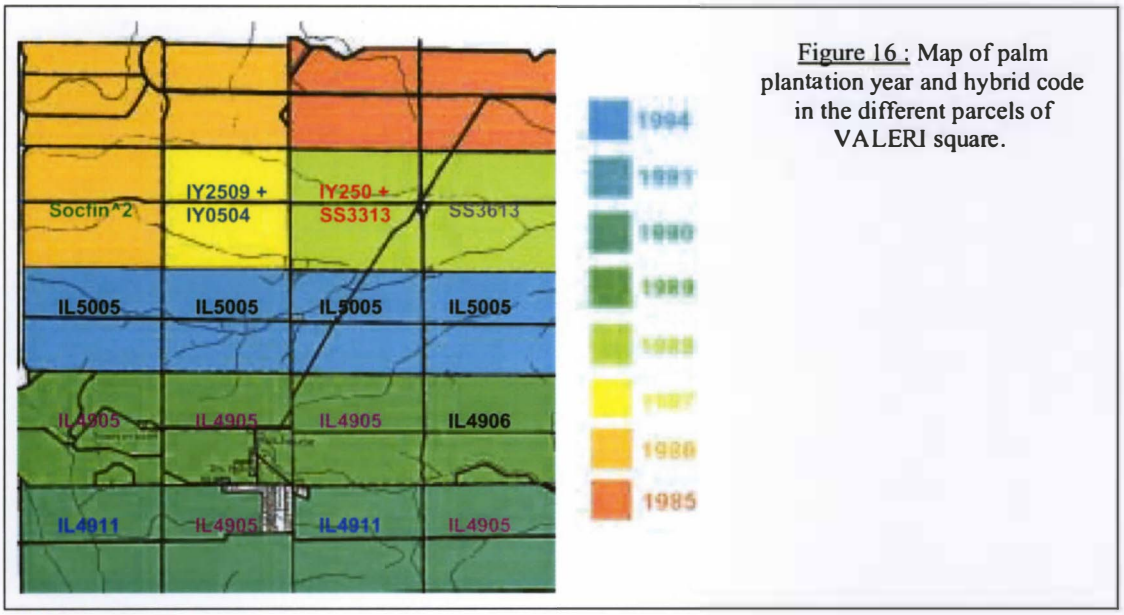

Figure 16 : Map of palm plantation year and hybrid code in the different parcels of VALERI square.

I] Files description

Data files are sorted in different folders:

Main:
- ALreport.pdf: this file, general report on the Aek Loba VALERI campaign, 2001
- AL_gps.xls: Excel file giving all GPS measurements, as well as LAI derived with C2000 software, for each sampling plot.
- AL_field_form.xls:

RAWdata:
above and below measurement files directly downloaded from the LAImeter, names of files correspond to dates of downloading.

SORTEDdata:
rawA: above data sorted by parcel number or transept branch
intercalibA: above data multiplied by intercalibration coefficient, sorted by parcel number or transept branch
B: below data sorted by parcel number or transept branch

Intercalib:
files of clear-cut simultaneous measurements for intercalibration of the two LAImeters, plus Excel file of coefficients derivation out of linear interpolation

COMPUTEDdata:
final files corresponding to Above and Below files merged together, after intercalibration of the two instruments. LAI values are derived with the C2000 Licor software.

SPOTimage:
SPOT image extractions: .bil corresponds to image data in Binary Inter Leave format, and .hdr to ENVI header file(including georeference data). .flt is a standard floating point values file.

- AL_VAL_sq : VALERI test square (151x151 pixels)
- AL_VAL_sq_NDVI : Normalised difference vegetation index of the VALERI test square
- AL_VAL_pix1 : 100km^2 "Low Resolution pixel", centred (501x501 pixels)
- AL_VAL_pix2 : 100km^2 "Low Resolution pixel", shifted (501x501 pixels)
- Kj266345 : full SPOT scene

Miscell_spot_jpg:
Miscellaneous jpg files corresponding to SPOT view shown in that report.

Hemiview:
Hemispherical numerical photos of each measurement plot, sorted by parcel number.

GeneralView:
Numerical photo of the surrounding area of each measurement plot, sorted by parcel number.

WorkViews:
Some photos of the field workers during the campaign!
Including photos of the adventitious vegetation types (blue and green ferns, bamboo-grass).

J] LAI and NDVI: a short glance

Pixel radiometric values have been extracted for each measurement plots in the SPOT image, to derive the Normalised Difference Vegetation Index (NDVI). LAI values computed with the Licor C2000 software is then compared to NDVI for each of these points, as shown in the graph Figure 17.
This raw extraction does not provides with an obvious tendency as it could be waited for. Plot locations certainly have to be better fitted to estimate the exact position of the pixel, in order to get the appropriate figures correlating satellite and ground data.

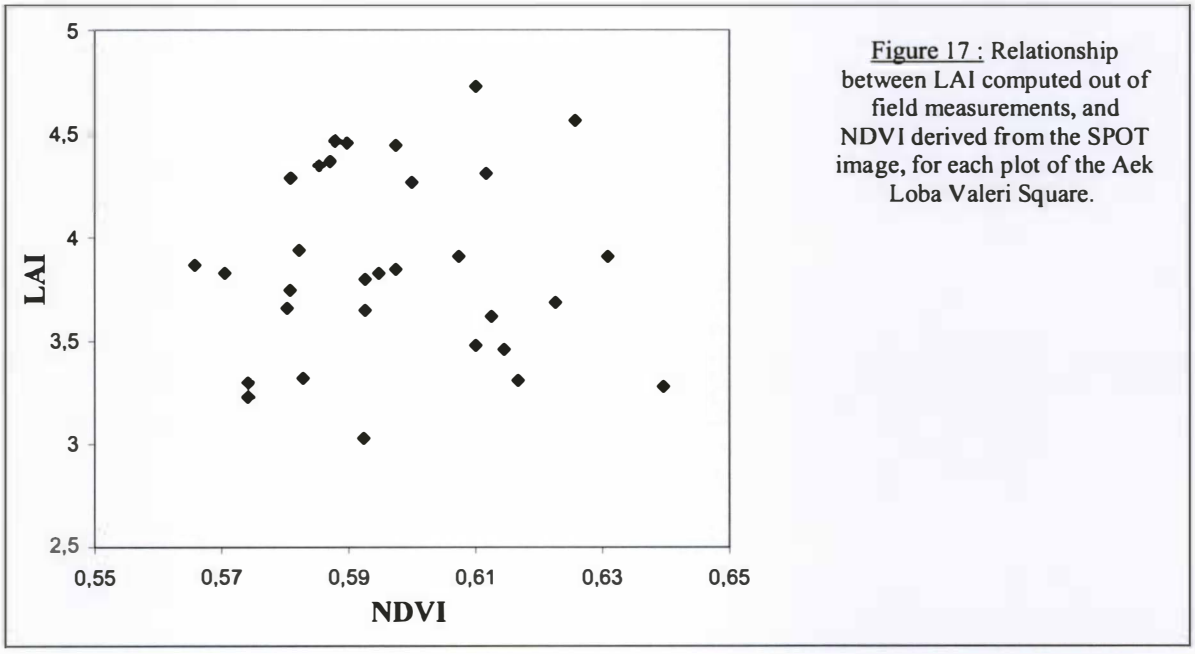

Figure 17 : Relationship between LAI computed out of field measurements, and NDVI derived from the SPOT image, for each plot of the Aek Loba Valeri Square.

Tracks delimitating the parcels in Aek Loba oil palms Estate