Purpose :

This is the readme file for the MODIS LAI/FAPAR products and the QA (quality flag) extracted on the "West_Africa" area of interest of the AMMA project.

Date:

This file was created on November 21st, 2003: I1.00

Updated on October 20th , 2004: I2.00

Updated on October 3rd , 2005 : I3.00

Background:

These products are derived from the MOD15_BU 1km data set generated at the Boston University and available to download on the site ftp://primavera.bu.edu/pub/datasets/MODIS/MOD15_BU/.

LAI (m^2/m^2) is defined as half the total foliage area per unit ground surface area. The FAPAR is the daily fraction of photosynthetically active radiation (PAR: [0.4-0.7µm]) absorbed by vegetation. FAPAR is dimensionless. The main algorithm use to generate the LAI and FAPAR is based on a 3D radiative model depending on the vegetation structure (Knyazikhin et al., 1998). If the main algorithm fails, a back-up procedure is applied to assess LAI and FAPAR from vegetation indices (Myneni et al., 1997).

A bug was found in the code generating MOD15A2 FPAR product: FPAR under diffuse radiation was produced instead of FPAR under direct solar radiation, as required by the product specifications. The correction scheme to calculate FPAR under direct radiation for MOD15_BU was proposed, and MOD15_BU FPAR data set was re-processed in January 2005. These changes have no impact on the LAI algorithm. The reprocessed version of MOD15_BU LAI/FPAR products is called version 4.1.

The MODIS LAI, FAPAR and QA products cover the period from February, 2000 to present with a monthly temporal resolution.

File name convention:

* LAI or FAPAR or QA: name of the parameter
* POSTEL : provider of the data
* MODIS : name of the sensor
* YYYY : year of acquisition
* MM: month of synthesis period
* WEST_AFR: spatial coverage of the products, region of the AMMA project
* v4.1: version of the algorithm used to create the products

The reference day is the 15th of month MM of the year YYYY.

Data encoding:

The binary files are arrays of 5000 columns and 2500 rows. Values are coded on 1 byte. For reading these files, for example, use the following IDL code:

```
openr, unit, filename, /get_lun
img = bytarr(5000,2500)
readu, unit, img
free_lun, unit
```

The physical range of the parameters are the following:
LAI: [0, 7]
FAPAR : [0, 1]
The encoding DN is as follow:
LAI products: valid values [0, 70]
FAPAR products: valid values [0, 100]
To obtain physical LAI, apply DN/10.
To obtain physical FAPAR, apply DN/100.

The encoding used for QA is:

1 – 4 : "High quality level": defined as number of pixels generated by main algorithm without saturation. The higher the value, the higher the quality

5 – 8: "Low quality level": defined as 4 + number of pixels generated by main algorithm with saturation and backup algorithm. The higher the value, the higher the quality

At the same resolution and the same month, QA for FAPAR is the same with QA for LAI.

The QA file for December 2000 is missing.

For LAI, FAPAR and QA:

- Urban, built-up class : 250
- Permanent wetlands, marshes : 251
- Perennial snow, ice, tundra : 252
- Barren desert, or sparsely vegetated area : 253
- Water(ocean or inland) : 254
- Fill value for non-computed pixels or missing pixels : 255

Projection:

The original MOD15_BU products are presented in the sinusoïdal projection. They have been put in the geographical lat/lon projection ("plate-carrée") with a grid step equal to 0.01°. The pixels of the grid are located by the coordinates of their center. The "West_Africa" area covers the zone from 25° West to 25° East, and from 5° South to 20° North.

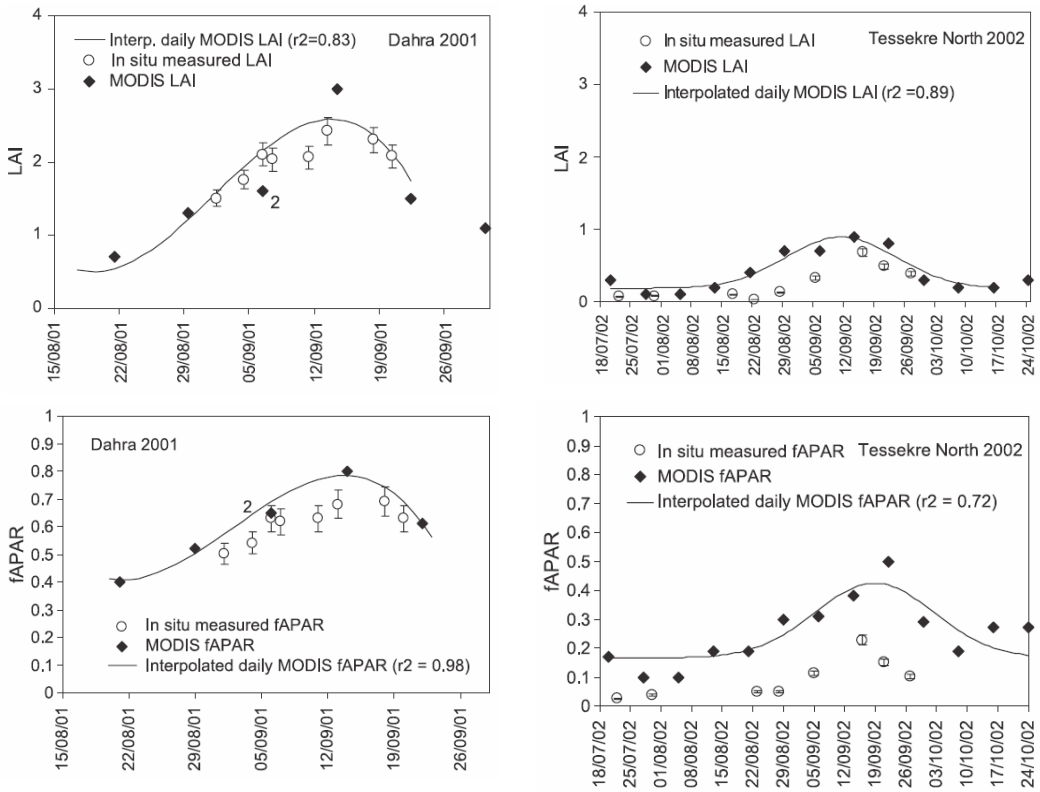
Quality analysis:

Best quality retrievals are obtained with the Main RT-based algorithm. In case of high LAI (>3.5) surface reflectances have low sensitivity to LAI (saturation domain). Only retrievals by main algorithm (with or without saturation) are recommended for application studies.
In case of main algorithm failure, the back-up algorithm (LAI/FPAR-NDVI empirical relationships) is employed. Such retrievals have generally low reliability and are not recommended for application studies, including validation.

The biome LAI profiles have generally the expected shape. Needle leaf forests, however, show anomalous seasonality. Low LAI during winter time is due to low availability (low solar zenith angle) and poor quality (snow and cloud contamination) of input reflectance data. The Main algorithm mostly fails and unreliable LAI retrievals over needle leaf forests are generated by the back-up algorithm.

Validation:

- **Grass savanna**, Senegal, western sudano-sahelian zone, 2001-2002
  Seasonal dynamics of both in situ LAI and FPAR were captured well by MODIS LAI and FPAR (Figure below). MODIS LAI is overestimated by approximately 2-15% and the overall level of FPAR is overestimated by 8-20%. (Fensholt et al., 2004)



- **Coniferous forests**, Finland, June 2000
  Comparison of aggregated high-resolution LAI map, derived from in-situ measurements, and corresponding MODIS LAI suggests satisfactory behavior of the MODIS LAI algorithm although variation in MODIS LAI product is higher than expected (Wang et al., 2004).

- **Croplands**, Alpilles, France, February-March 2001
  MODIS LAI is accurate to within 0.3LAI; precision is 20%, uncertainty is 25%. Biome misidentification deteriorates the accuracy by factor of 2 (Tan et al., 2004).

Contact information:

Any details about the MODIS LAI/FAPAR products and the algorithms are available on the Boston University website : http://cybele.bu.edu.

For any questions about the MODIS products provided by POSTEL to the AMMA-SAT database, please contact Roselyne Lacaze at roselyne.lacaze@medias.cnes.fr.

References:

Fensholt, R., Sandlholt, I., Rasmussen, M.S. Evaluation of MODIS LAI, fAPAR and the relation between fAPAR and NDVI in a semi-arid environment using in situ measurements. *Remote Sensing of Environment,* vol. 91, pp. 490-507, 2004.

Knyazikhin, Y.J., D.D. Hering, K.J. Ranson et G.J. Collatz, Earth observing system AM1 mission to Earth, *IEEE Transaction on Geoscience and Remote Sensing, 36, 1045-1055,* 1998.

Myneni, R.B., R.R. Nemani et S.W. Running, Estimation of global leaf area index and absorbed PAR using radiative transfer model, *IEEE Transactions on Geoscience and Remote Sensing, 35, 1380-1393,* 1997.

Wang et al., Evaluation of the MODIS LAI algorithm at a coniferous forest site in Finland. *Remote Sensing of Environment, 91, 114-127*, 2004.

Tan et al., Validation of MODIS LAI product in croplands of Alpilles, France. *Journal of Geophysical Research*, 110, D01107, 2005.