



Test of REASoN Can AVHRR series in the framework of AMMA

Marc Leroy (1), Laurent Kergoat (2), Sarah Guibert (2), Roselyne Lacaze (1),
Olivier Hagolle (2,3), Patrice Henry (3), Mireille Huc (1)

+ AMMA Remote Sensing Team

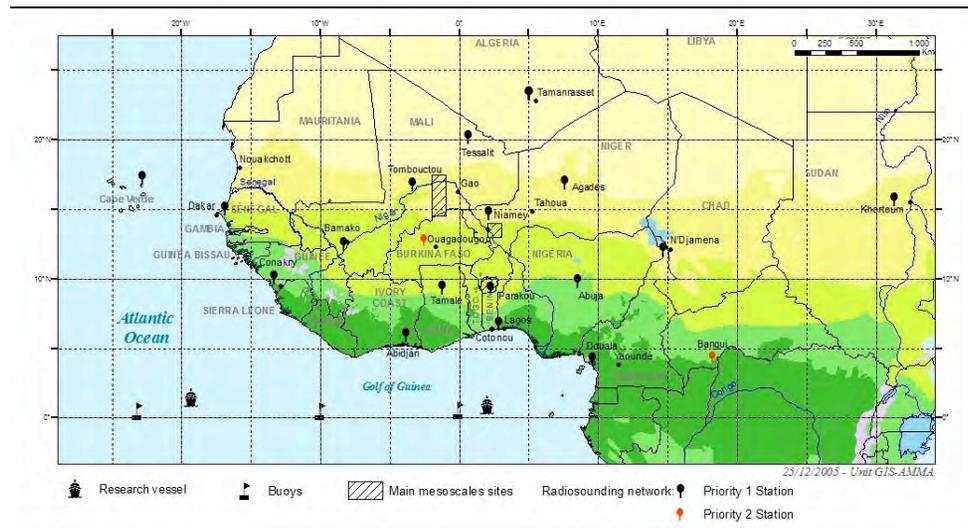
(1) POSTEL / Medias-France, Toulouse

(2) CESBIO, Toulouse

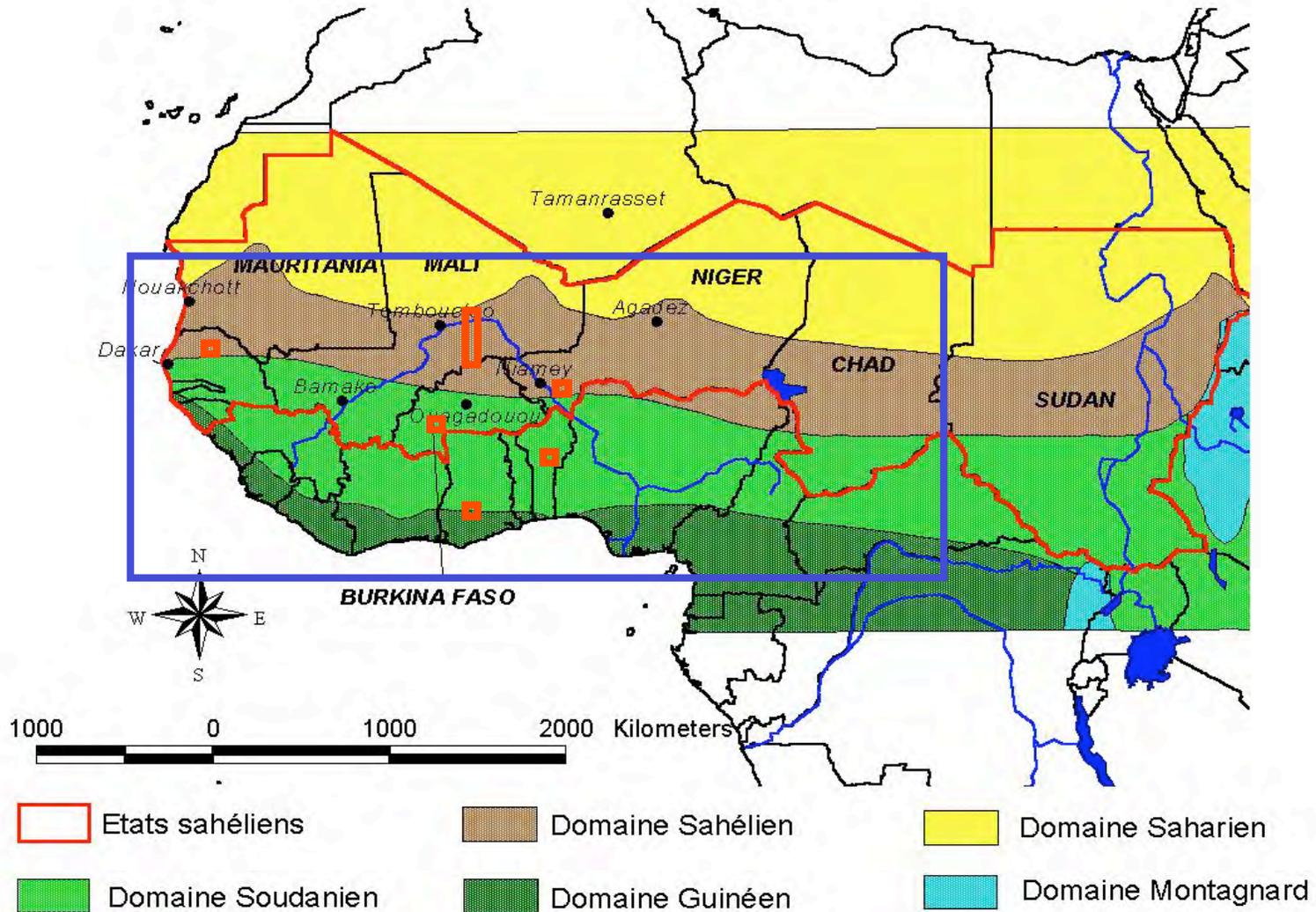
(3) CNES, Toulouse

THE AMMA PROJECT

- ❑ **African Monsoon Multidisciplinary Analysis (AMMA) is an international project to improve our knowledge and understanding of the West African Monsoon and its variability.**
- ❑ **Aim : forecast / assess likely rainfall changes during the 21st century due to natural fluctuations and global change**
- ❑ **29 countries, 140 institutions, 500 scientists involved**
- ❑ **Multi-scale, multi-temporal observation strategy**



WEST AFRICA ECOCLIMATIC ZONES



OBSERVATIONS NETWORK



Bamba local Site
(17.1°N, 1.3°W)

Niger River



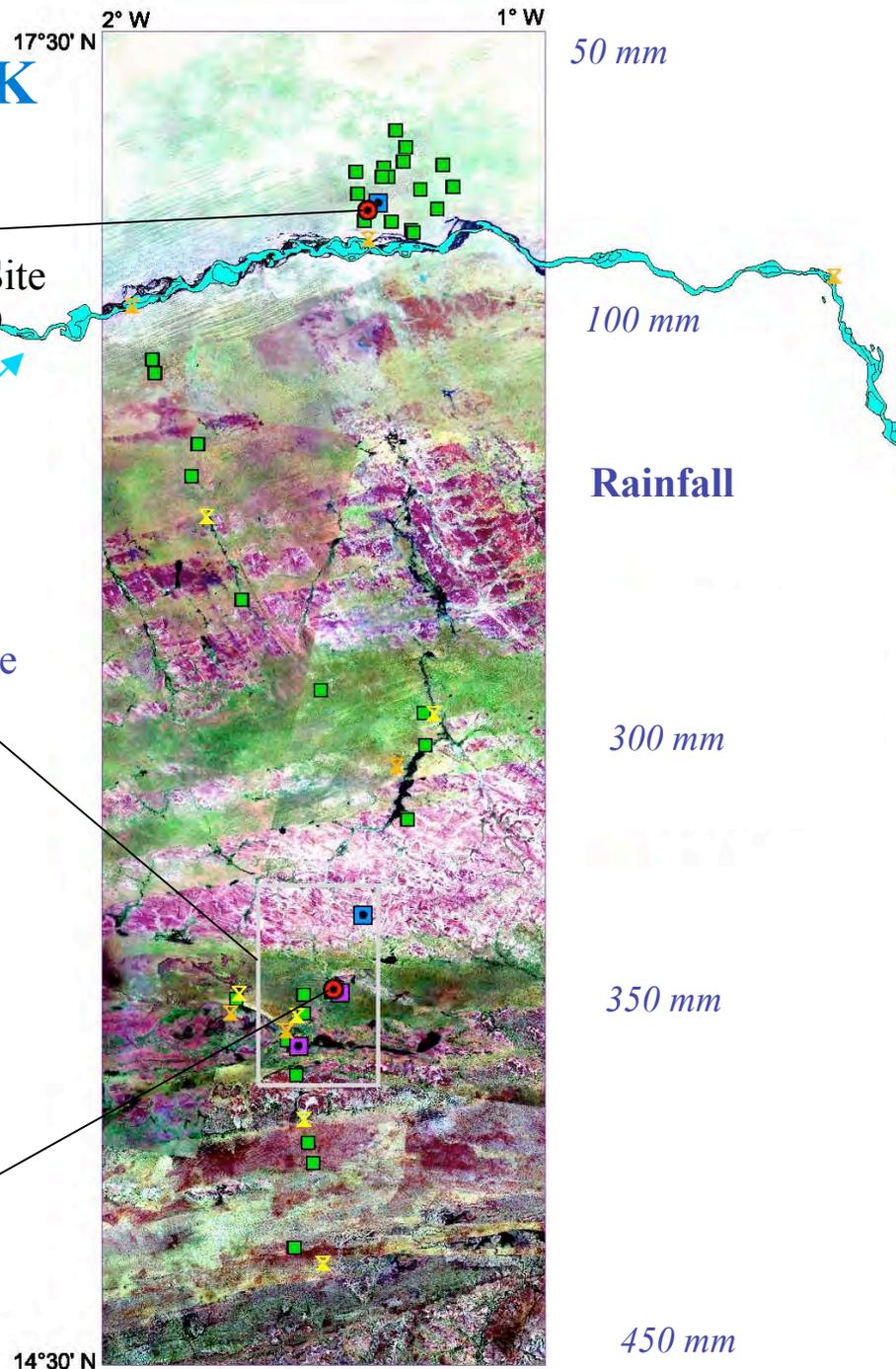
Hombori Supersite
(15.4°N, 1.6°W)



Agoufou local Site
(15.3°N, 1.5°W)

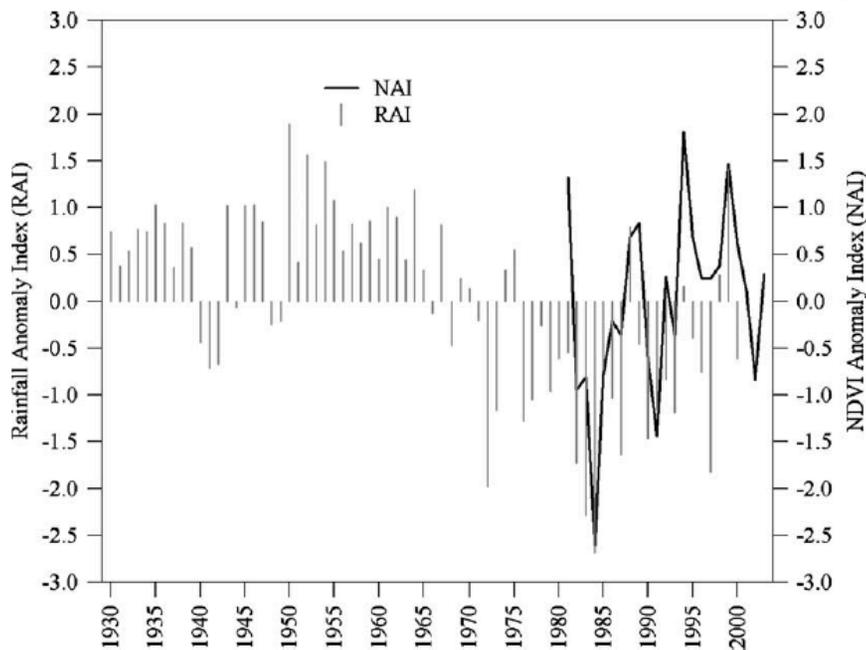
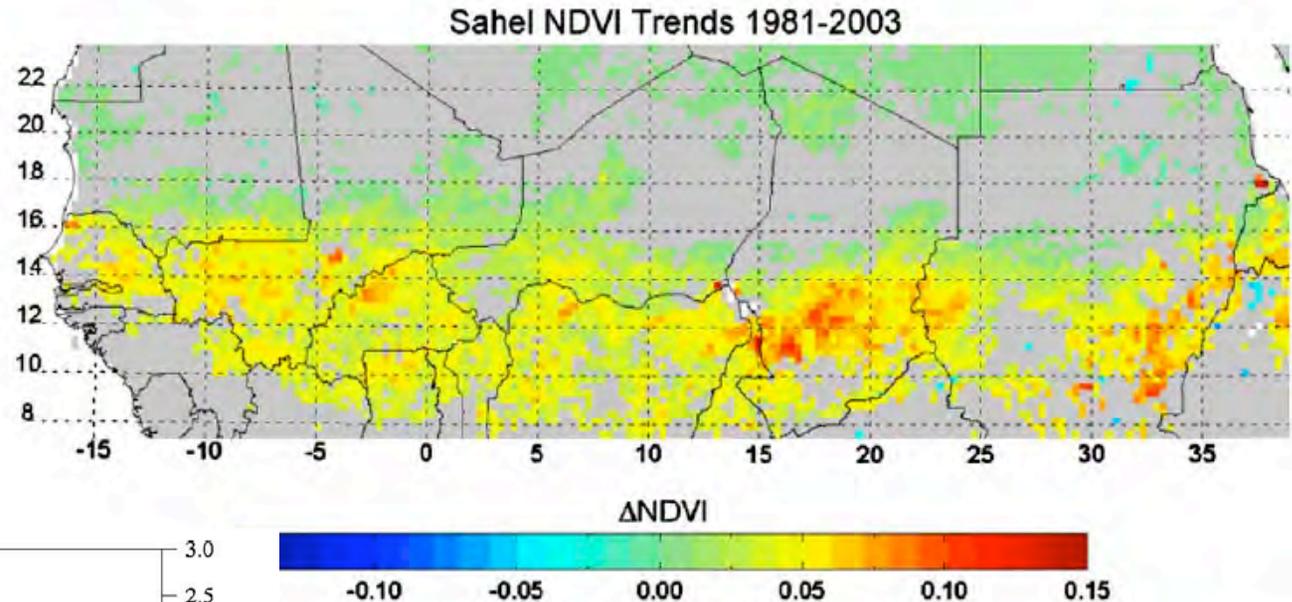
Gourma mesoscale Site in Mali

LTDR Workshop, January 18, 2007, Washington



RESPONSE OF VEGETATION TO CLIMATIC FLUCTUATIONS

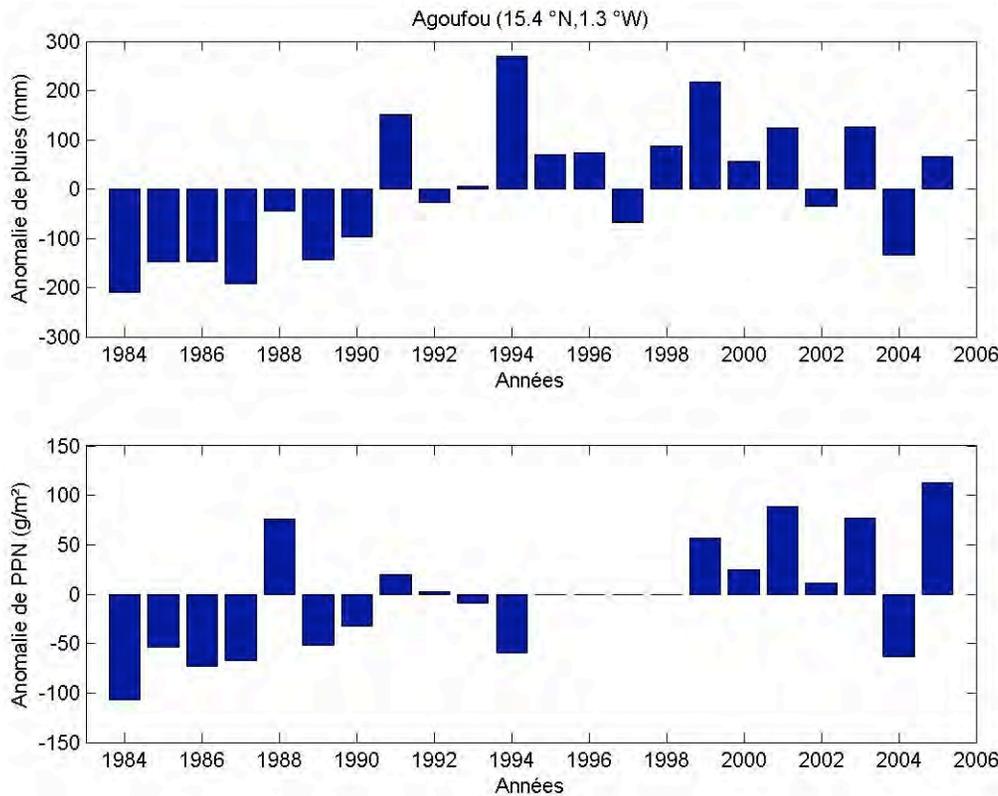
Summary trend map of changes in Sahel NDVI from 1981-2003.



Yellow to red colors indicate areas of significant change at 90% confidence, and gray areas show no significant trend.

*Anyamba and Tucker 2005,
J Arid Envir. 'greening' of Sahel special issue*

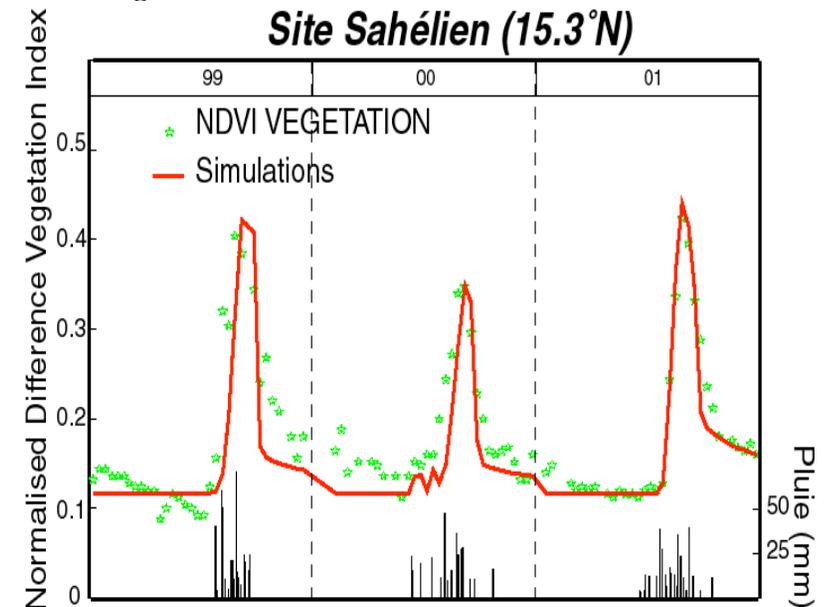
RAINFALL AND PRODUCTION



Rainfall and NPP anomalies in Agoufou over 1984 - 2006

Approach : calibrate SVAT – vegetation functioning model (STEP) using local measures, and using NDVI from VEGETATION on a few years

Then, assimilate AVHRR data in the model on a large period & area

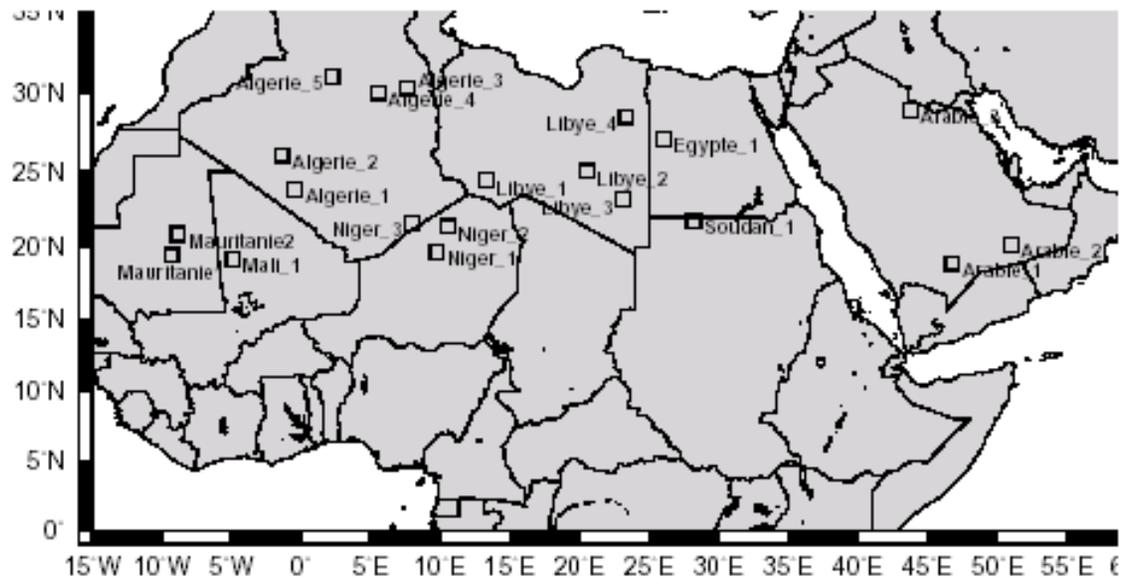


RELATION WITH REASoN CAN

- ❑ **A very good quality of AVHRR data is mandatory to conduct the AMMA study**
- ❑ **The REASoN CAN data set provides a very promising opportunity**
- ❑ **Our team is willing to act as a Beta user of REASoN CAN and perform the following specific activities :**
 - validate the sensor calibration / intercalibration ; if needed propose alternatives
 - investigate the BRDF correction and time compositing
 - provide an assessment of REASoN CAN w.r.t. its use in our vegetation process model applied to the West Africa region.

CALIBRATION (1/2)

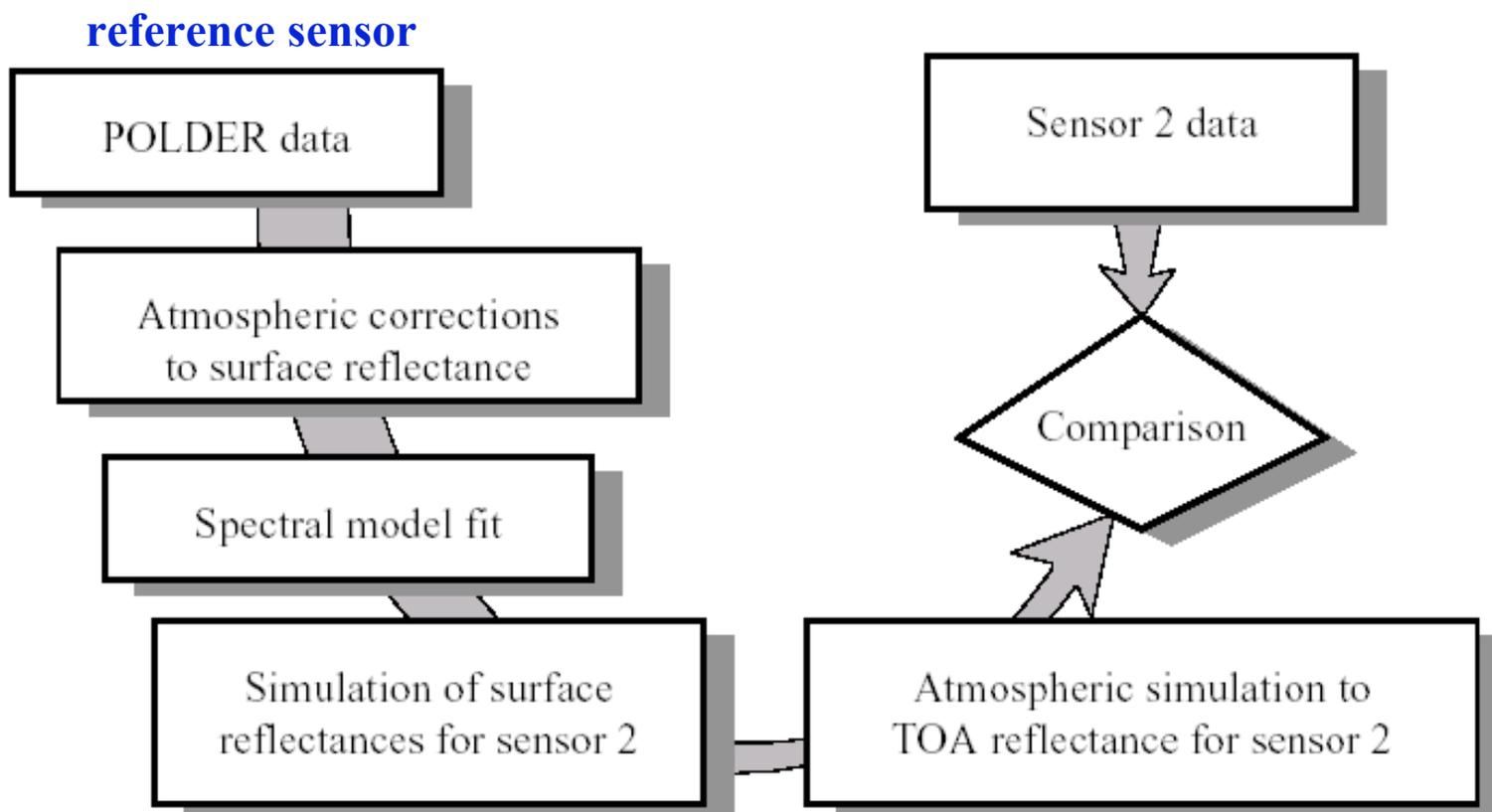
- ❑ Use 20 desert sites (*Cosnefroy et al., RSE, 1996*) selected according to :
 - Spatial uniformity
 - Stability over time
 - Low directional effect



- ❑ Use the SADE database (CNES)
Systematic collection of satellite acquisitions (POLDER, SPOT MERIS, VEGETATION, MODIS, AVHRR, ...) over the 20 sites

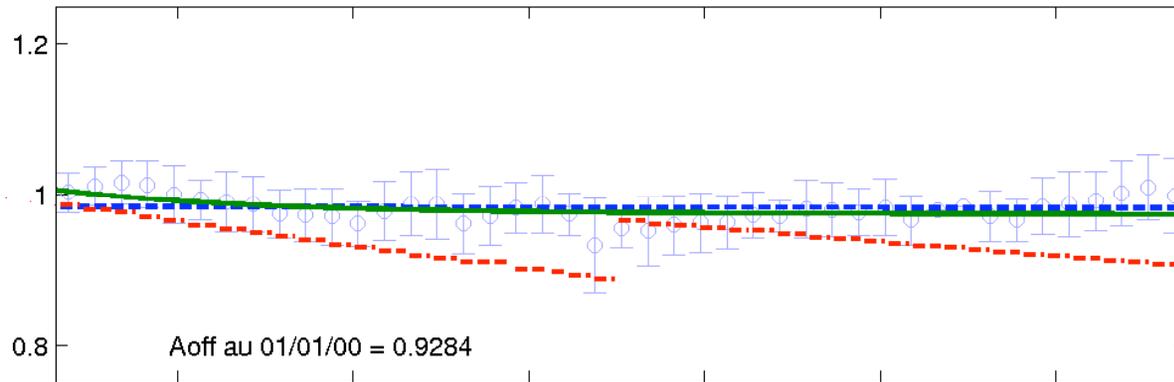
CALIBRATION (2/2)

- ❑ Use the POLDER calibration as a reference



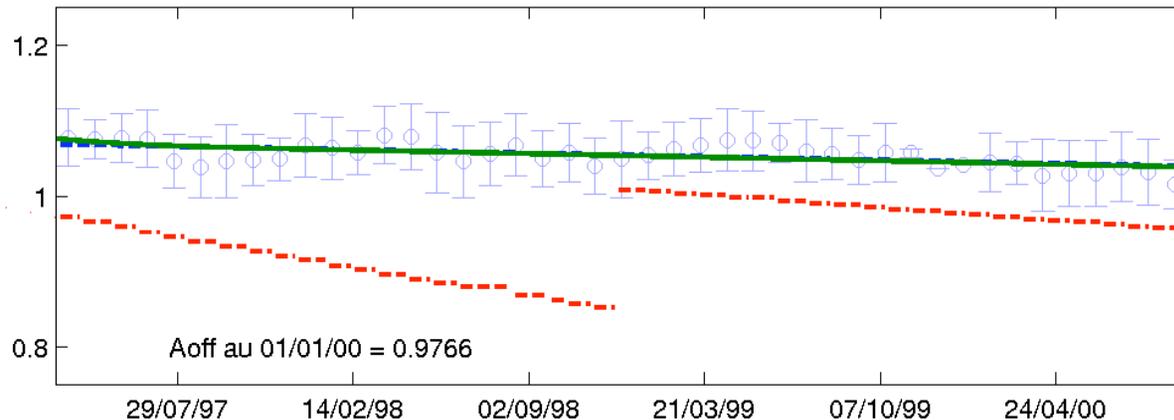
CALIBRATION RESULTS EXAMPLE

Au 01/01/00: $A_0 = 0.974$, $dA/dt = -0.115 \%/an$, $rmse = 0.015$, $A = 0.00072 \exp(-0.00438 (J-29/07/99)) + 0.974$



Example :
AVHRR 14/POLDER

Au 01/01/00: $A_0 = 1.044$, $dA/dt = -0.860 \%/an$, $rmse = 0.013$, $A = 0.00363 \exp(-0.00650 (J-28/10/97)) + 1.059$



=> We could provide calibration coefficients for each AVHRR sensor

DIRECTIONAL NORMALISATION

Directional & time compositing used in CYCLOPES

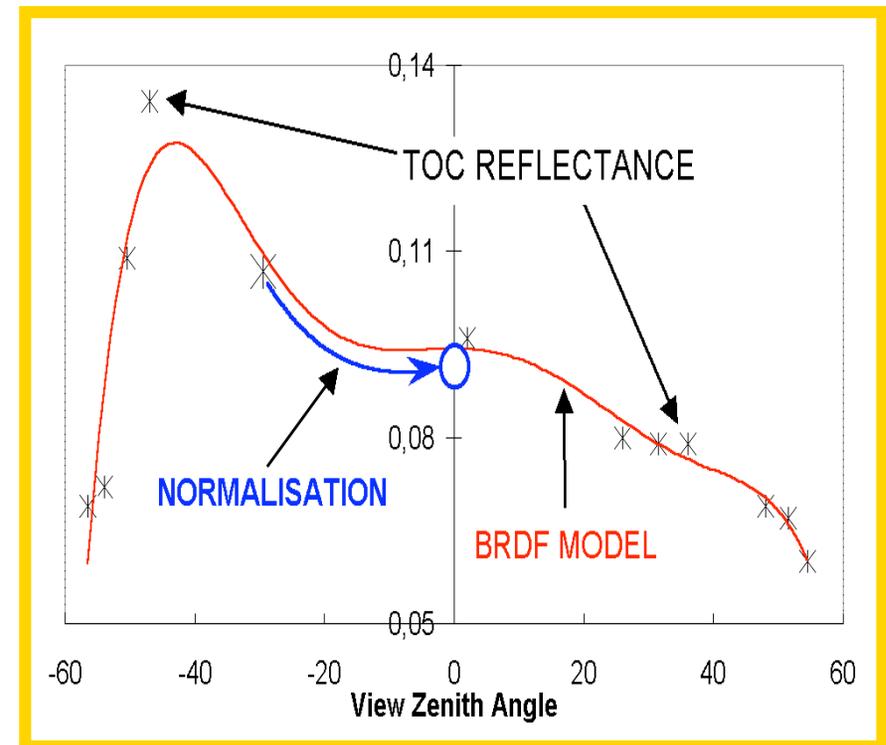
- Fit a BRDF model (*Roujean et al, 1992*) to data acquired during compositing period

$$\rho(\theta_s, \theta_v, \phi) = k_0 + k_1 f_1(\theta_s, \theta_v, \phi) + k_2 f_2(\theta_s, \theta_v, \phi)$$

- values of k_1 and k_2 are mildly constrained to avoid fitting of cloudy data

$$\left(\sum_{i=1}^N \frac{(\rho_i - \hat{\rho}_i)^2}{\sigma_i^2} \right) + \frac{(k_1 - C1(\lambda))^2}{\sigma_{k1}^2} + \frac{(k_2 - C2(\lambda))^2}{\sigma_{k2}^2}$$

- Outliers (clouds, aerosols, shadows) are discarded with an iterative procedure

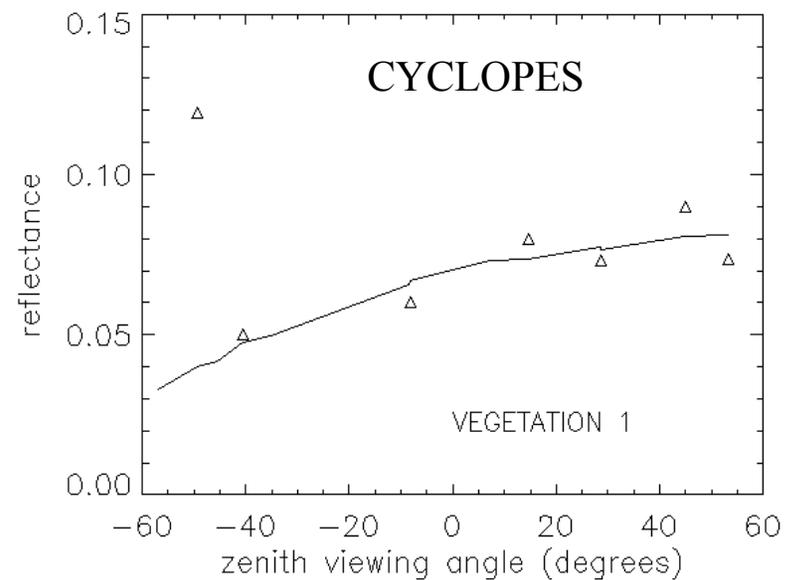
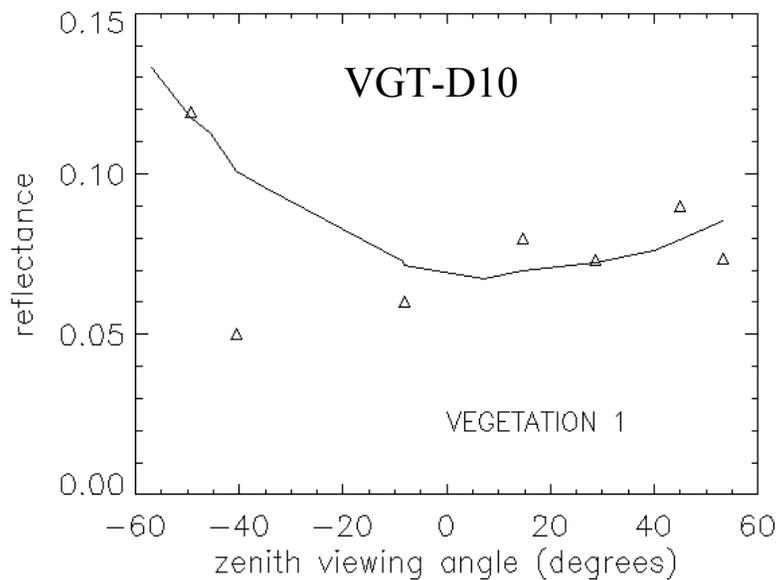


(© Philippe Maisongrande-CESBIO)

Detailed in Hagolle et al, RSE, 2004

DIRECTIONAL COMPOSITING

- ❑ Many clouds/cirrus/fumes/shadows escape the cloud screening method
- ❑ How to discard them ?
 - Discard data too far from the model (B2 band), threshold 2 sigma
 - Adding a priori information is useful to choose which observation to discard
 - Discard data above model first (undetected clouds)



DIRECTIONAL NORMALISATION EXAMPLE

VEGETATION-CYCLOPES

VEGETATION-D-10

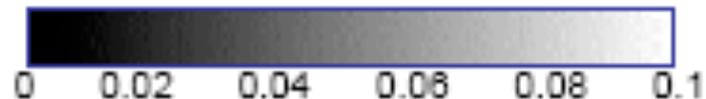
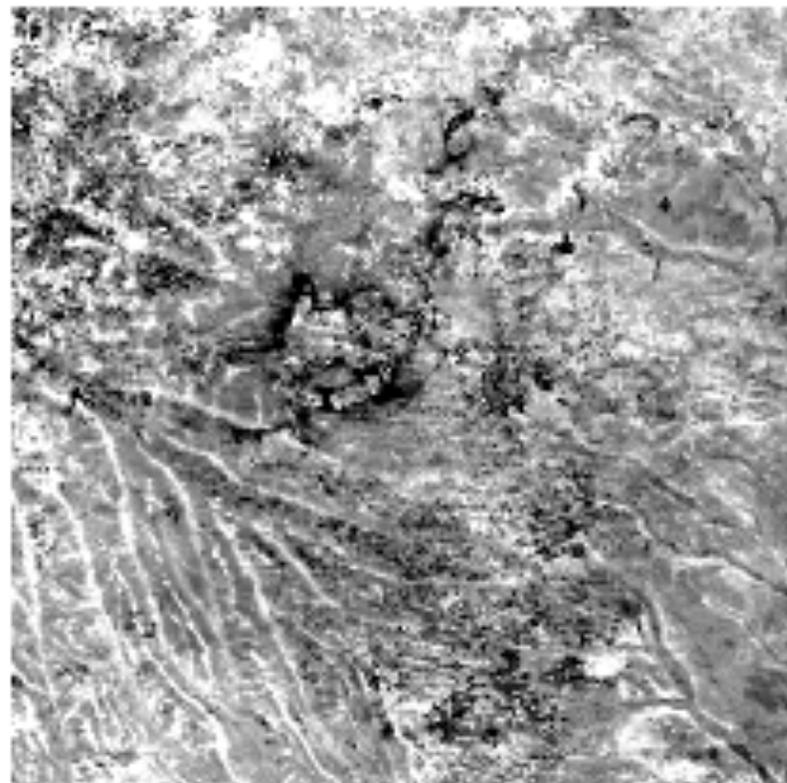
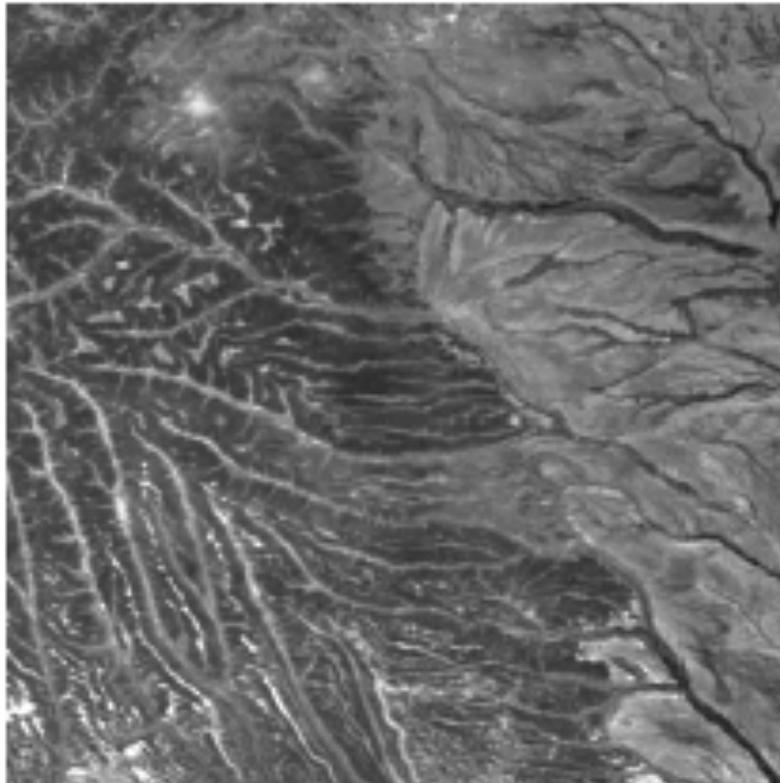
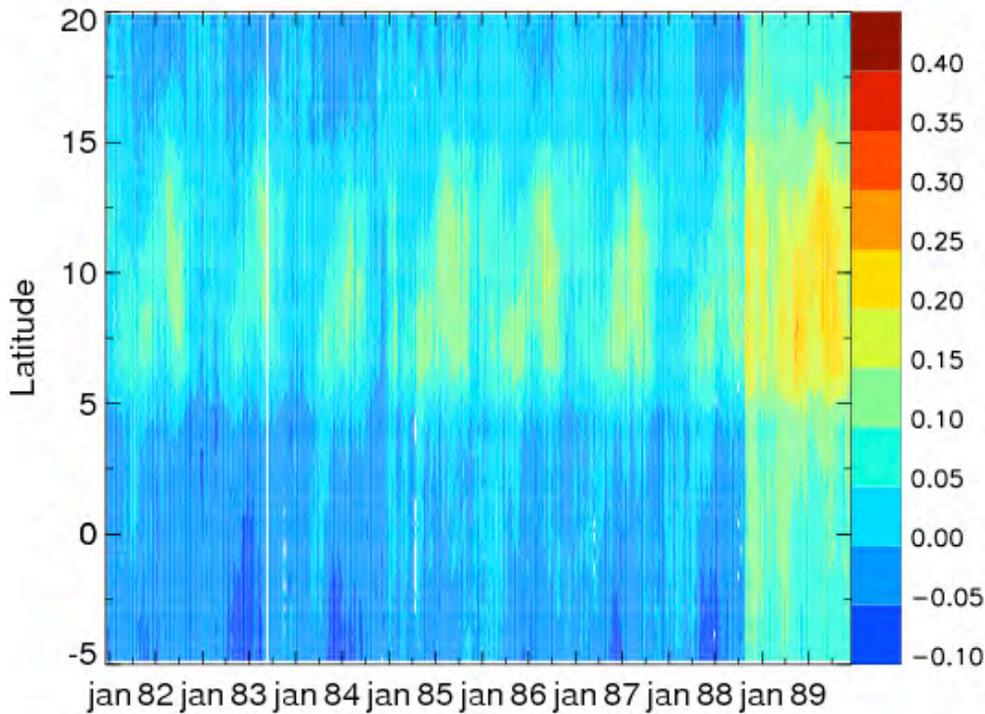


Figure 5: CYCLOPES surface reflectance (left) and nadir-zenith reflectance from D10 VEGETATION product (right) in the red band for April 2003 over Angola (11° S-14° S; 19° E-22° E)

FIRST ACTIVITIES WITH REASoN CAN DATA...

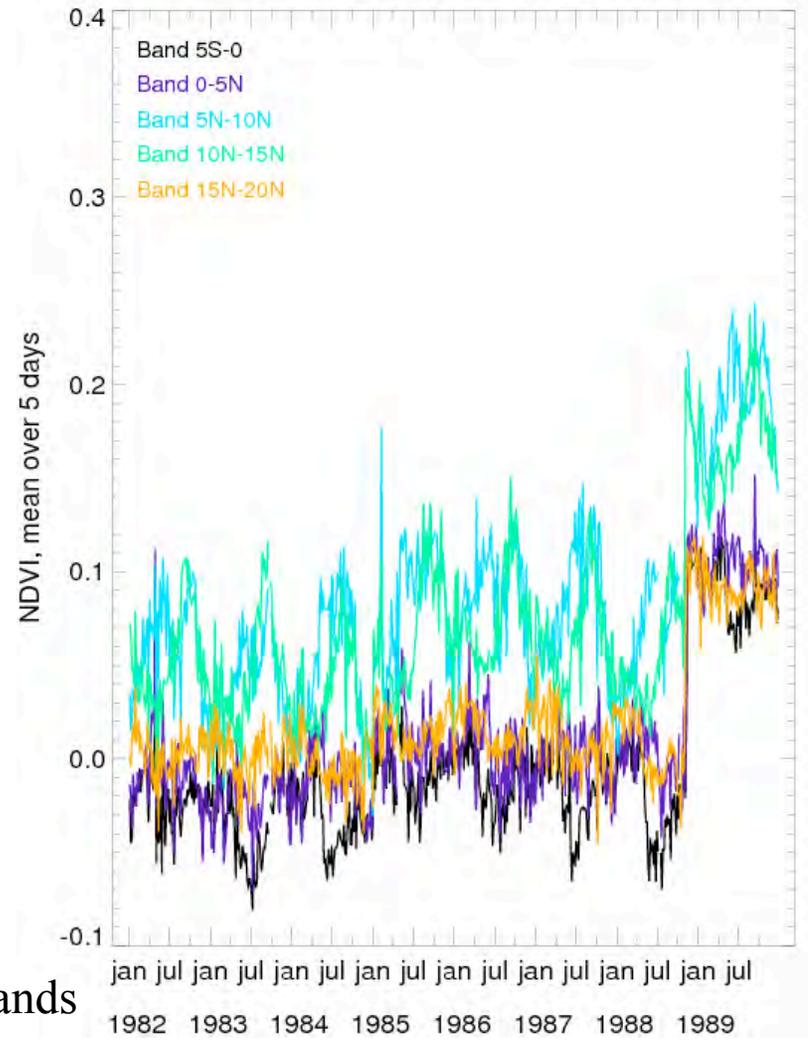
NDVI values from 1982 to 1989



Latitudinal average over the area -25° - 25° E

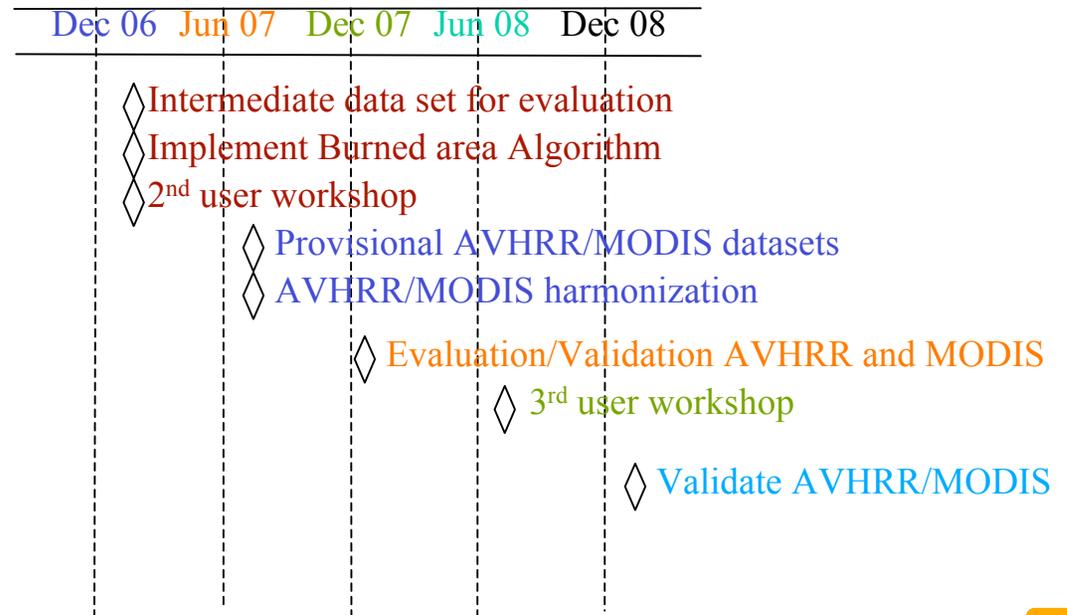
Then average over 5° latitude bands

NDVI values from 1982 to 1989



PLANNING

- proposition of updated calibration : T0 +6 months
- proposition of updated BRDF correction algorithm : T0 +12 months
- use of REASon CAN in AMMA context : T0 + 18 months



PERSPECTIVES

- ❑ **Beyond the AMMA / West African study, we intend to intensify our effort on AVHRR in 2008 – 2010 in the context of GMES**
- ❑ **The need then would be to have a global AVHRR archive raccordable to VEGETATION and MODIS time series (NDVI, LAI, ...)**
- ❑ **We will then look for further cooperation with the REASon CAN Project in this context.**