



## **Test of REASoN Can AVHRR series in the framework of AMMA**

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+ AMMA Remote Sensing Team

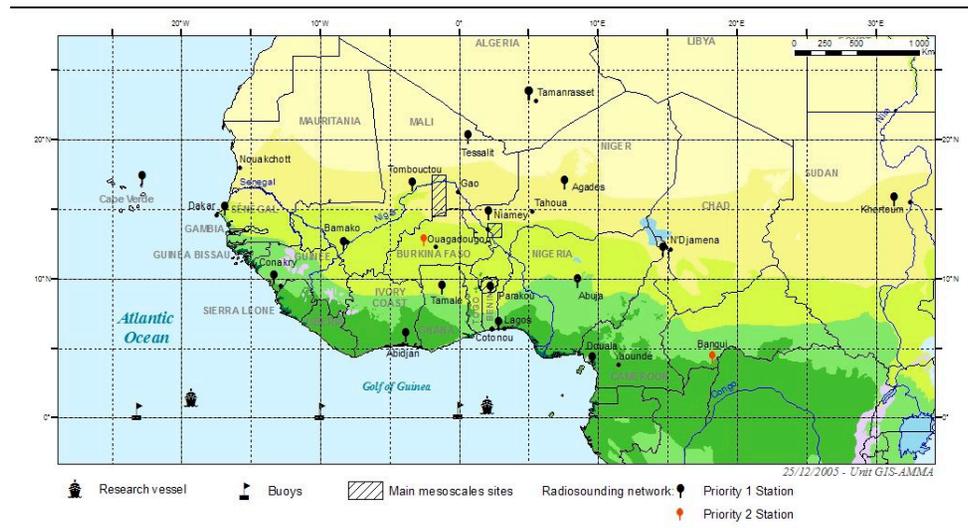
(1) POSTEL / Medias-France, Toulouse

(2) CESBIO, Toulouse

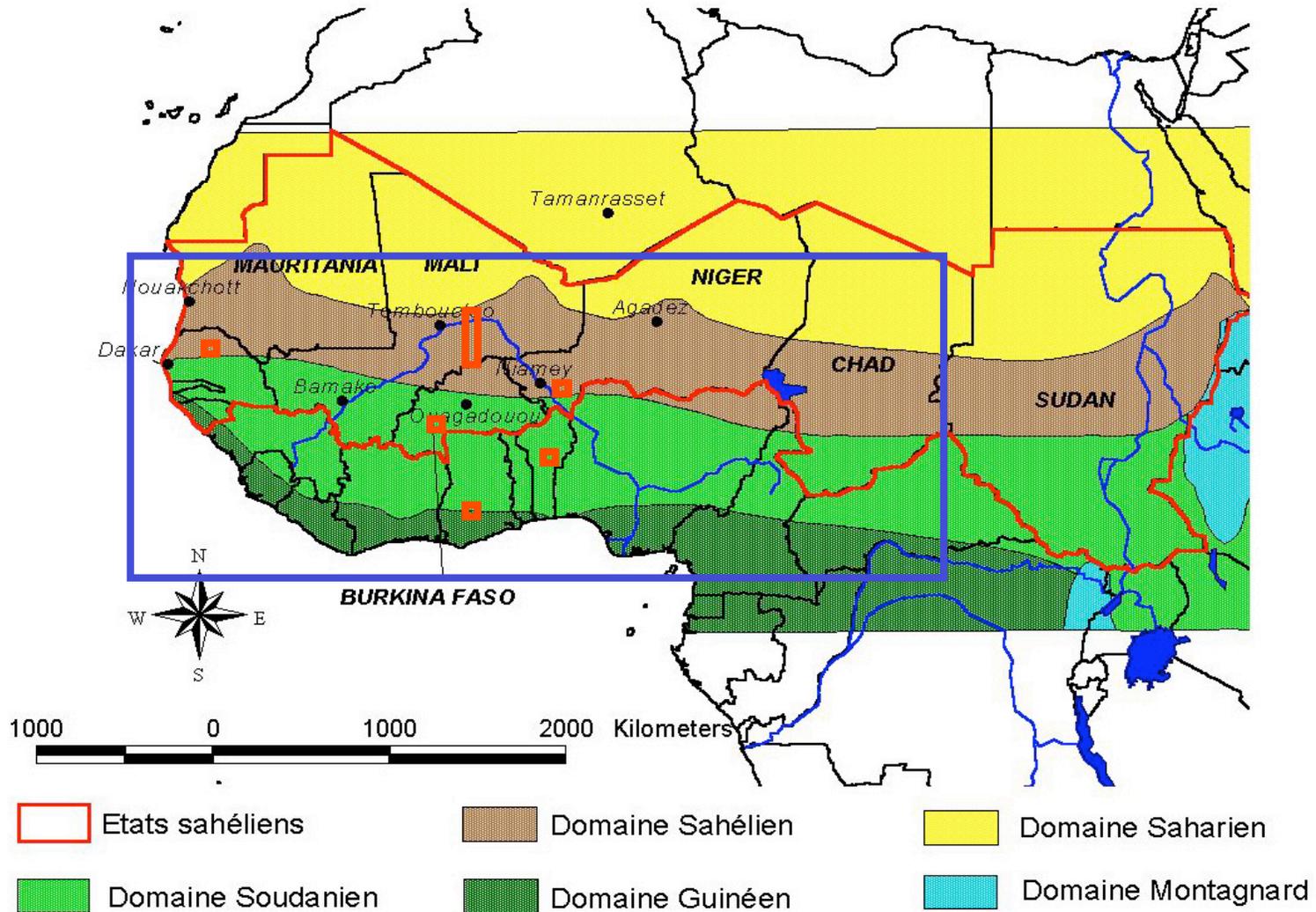
(3) CNES, Toulouse

# THE AMMA PROJECT

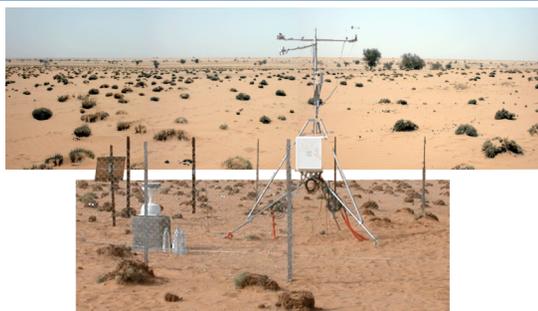
- ❑ **African Monsoon Multidisciplinary Analysis (AMMA) is an international project to improve our knowledge and understanding of the West African Monsoon and its variability.**
- ❑ **Aim : forecast / assess likely rainfall changes during the 21st century due to natural fluctuations and global change**
- ❑ **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*



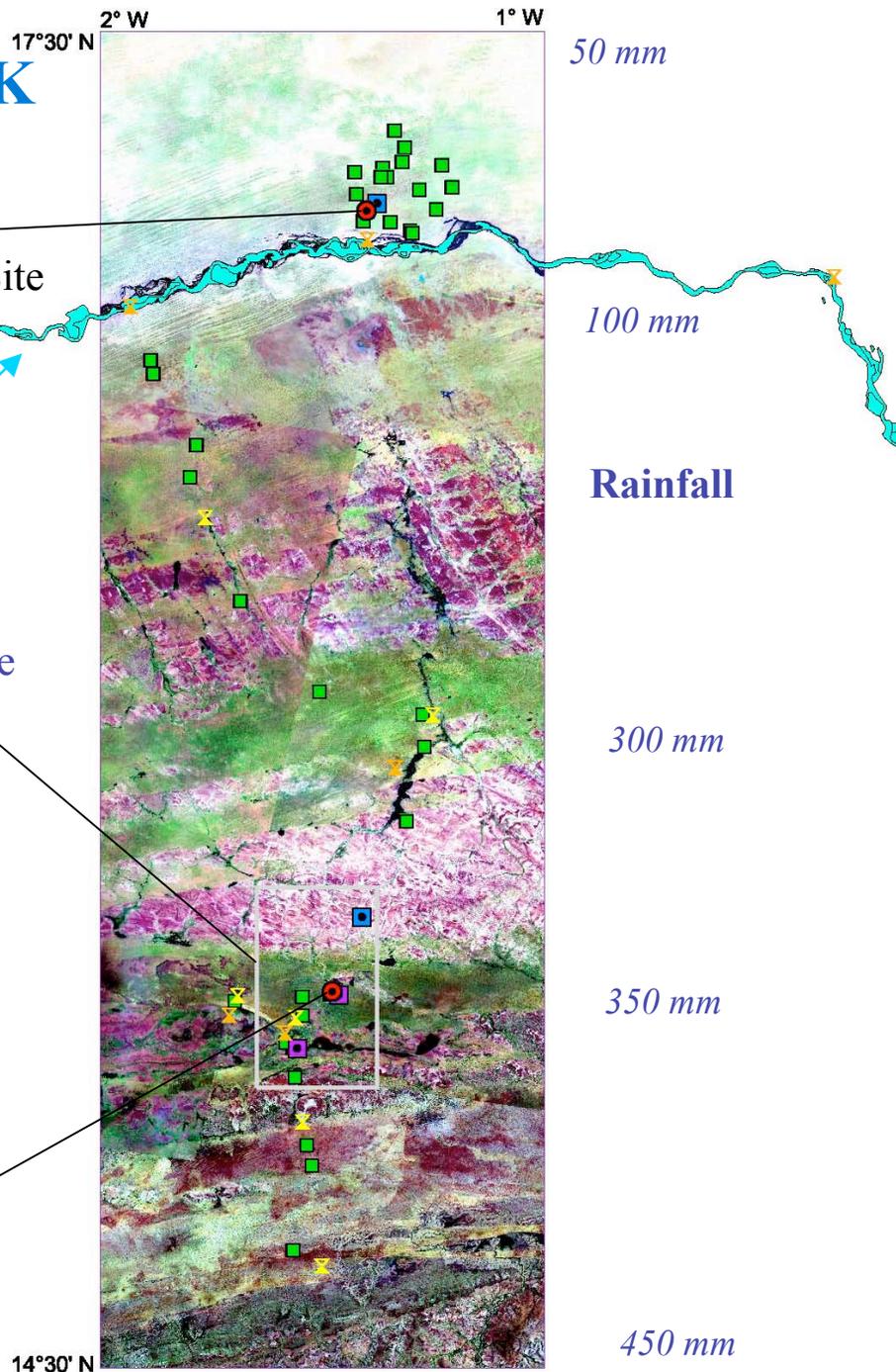
Hombori Supersite  
(15.4°N, 1.6°W)



Agoufou local Site  
(15.3°N, 1.5°W)

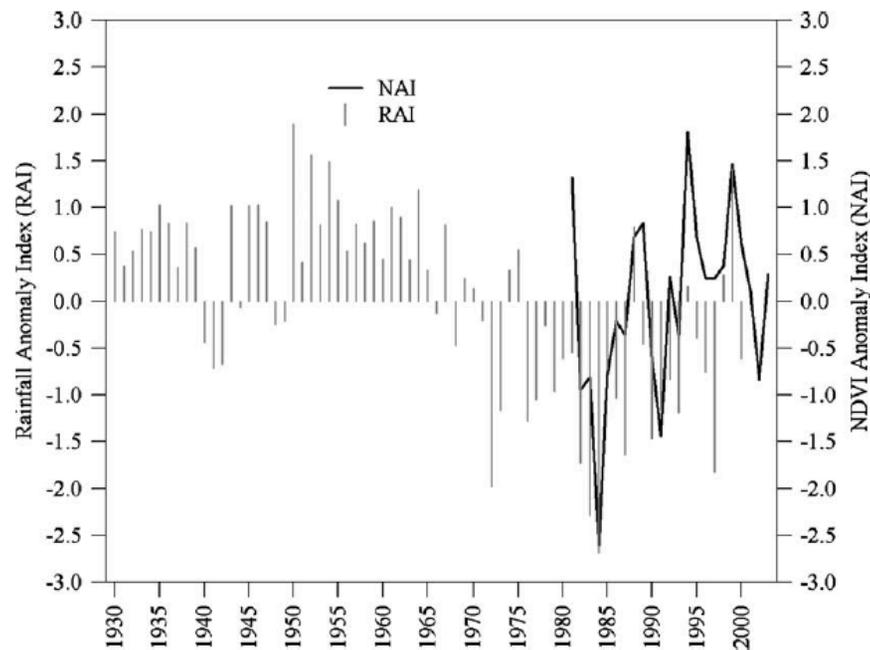
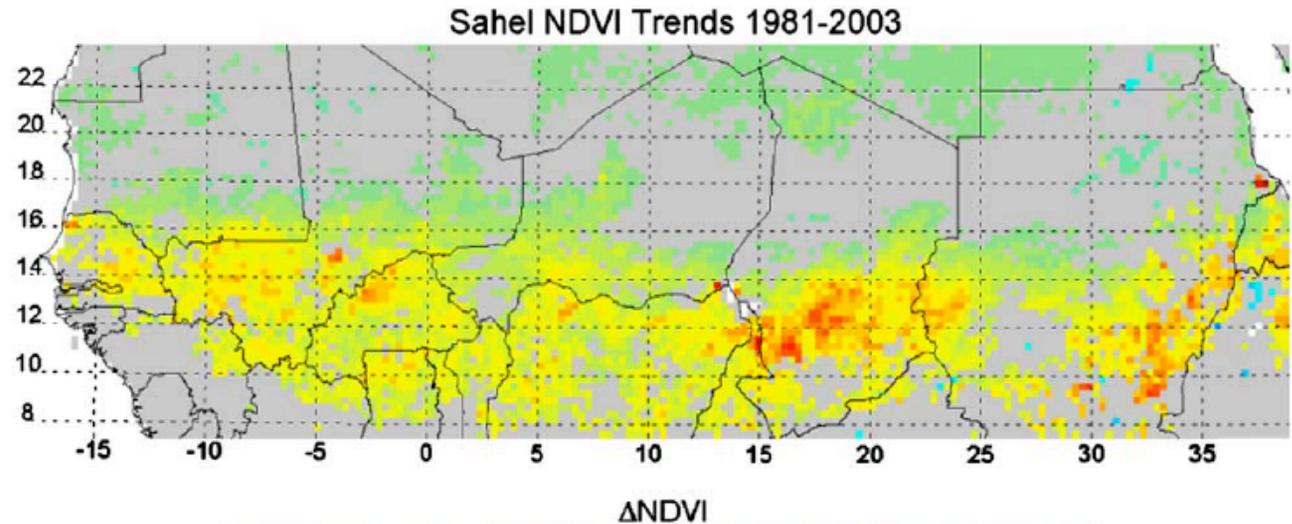
## Gourma mesoscale Site in Mali

LTDR Workshop, January 18, 2007, Washington



# RESPONSE OF VEGETATION TO CLIMATIC FLUCTUATIONS

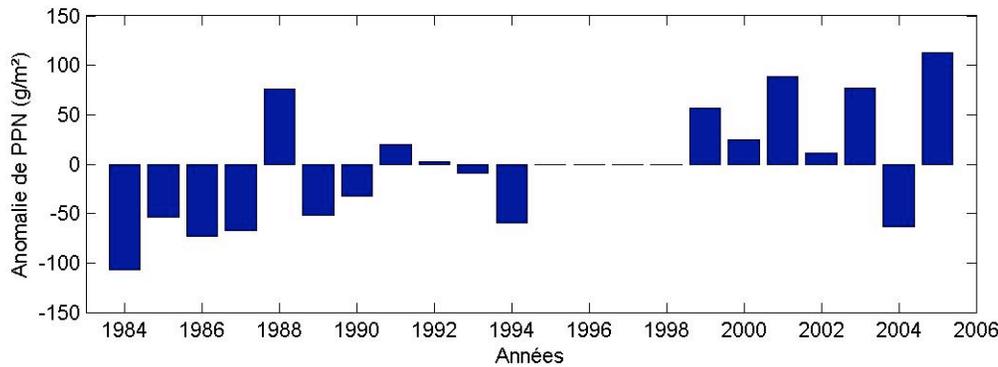
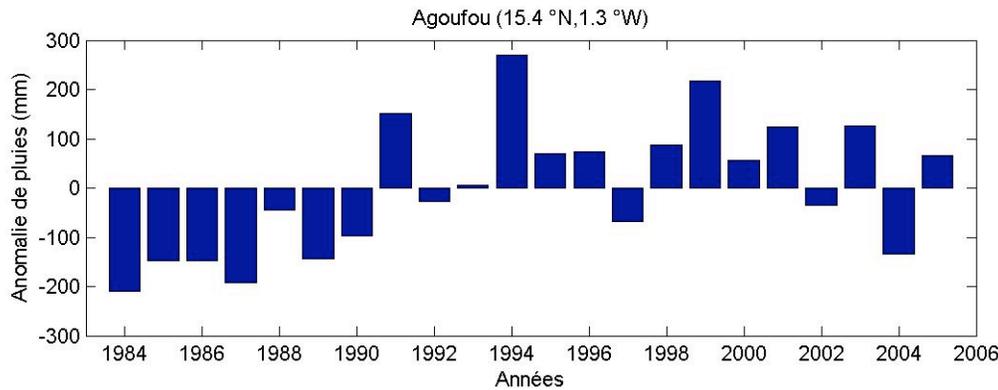
Summary trend map of changes in Sahel NDVI from 1981-2003.



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*

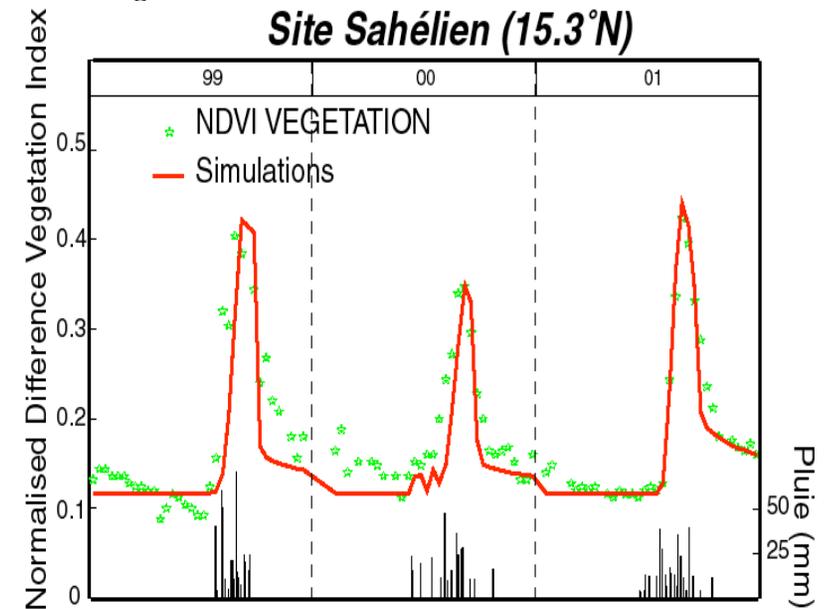
# RAINFALL AND PRODUCTION



**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



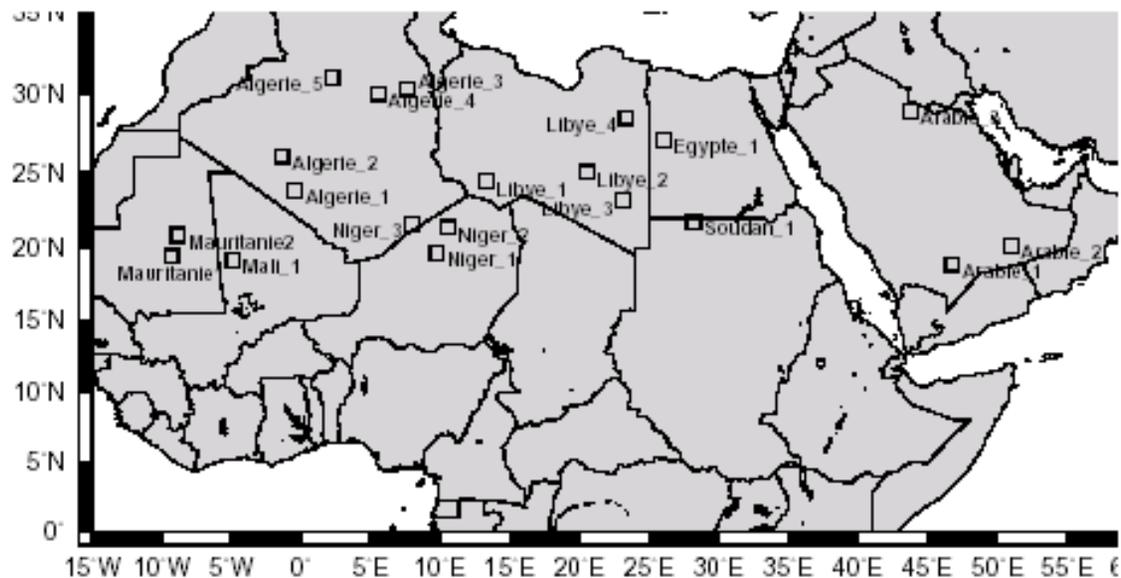
## RELATION WITH REASoN CAN

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- ❑ **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)

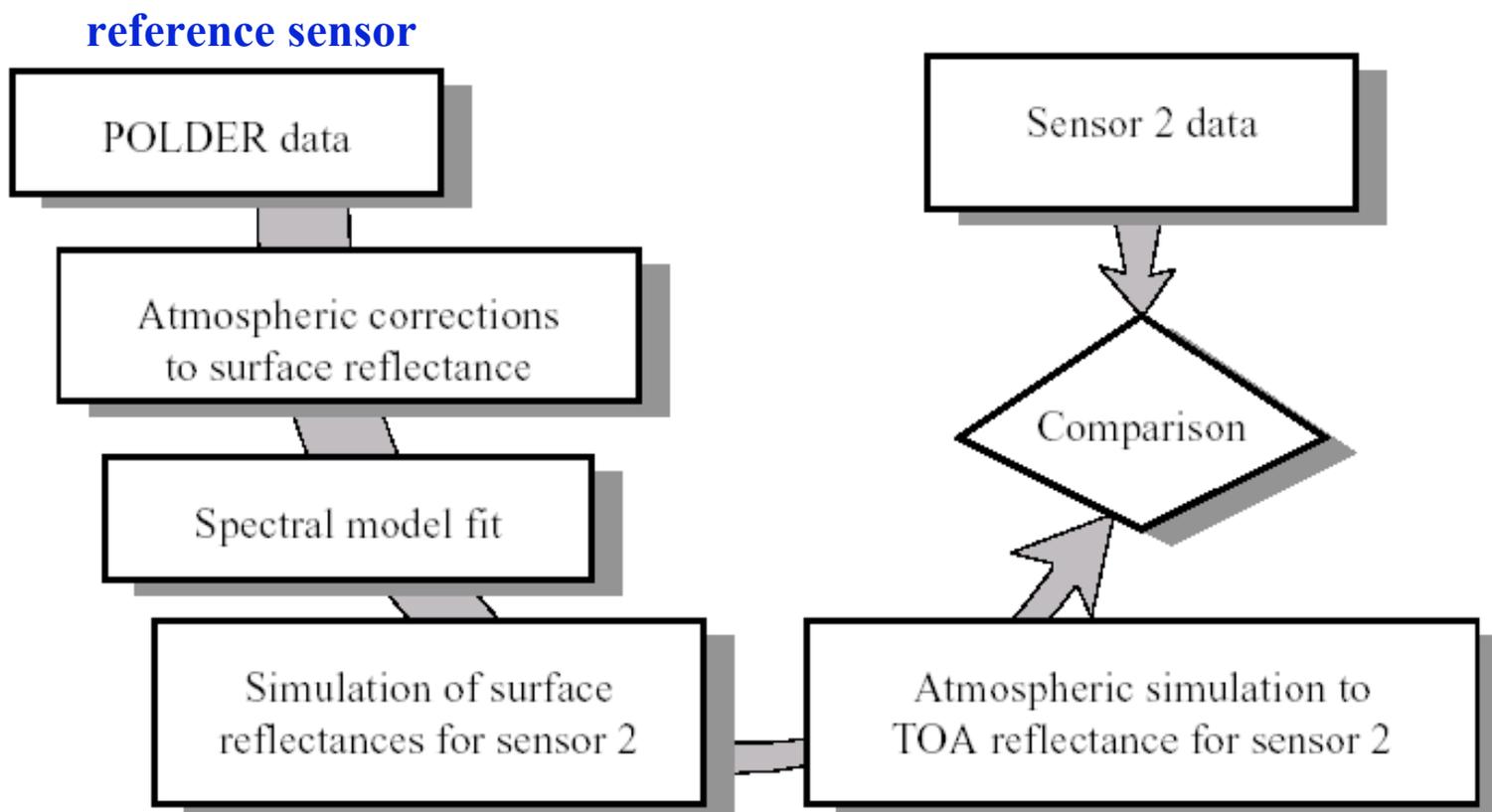
- ❑ Use 20 desert sites (*Cosnefroy et al., RSE, 1996*) selected according to :
  - Spatial uniformity
  - Stability over time
  - Low directional effect



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

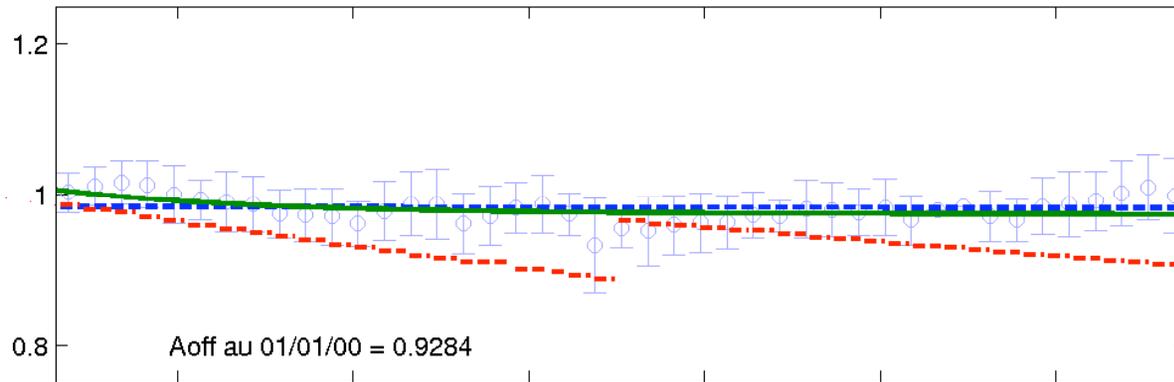
## CALIBRATION (2/2)

- ❑ Use the POLDER calibration as a reference



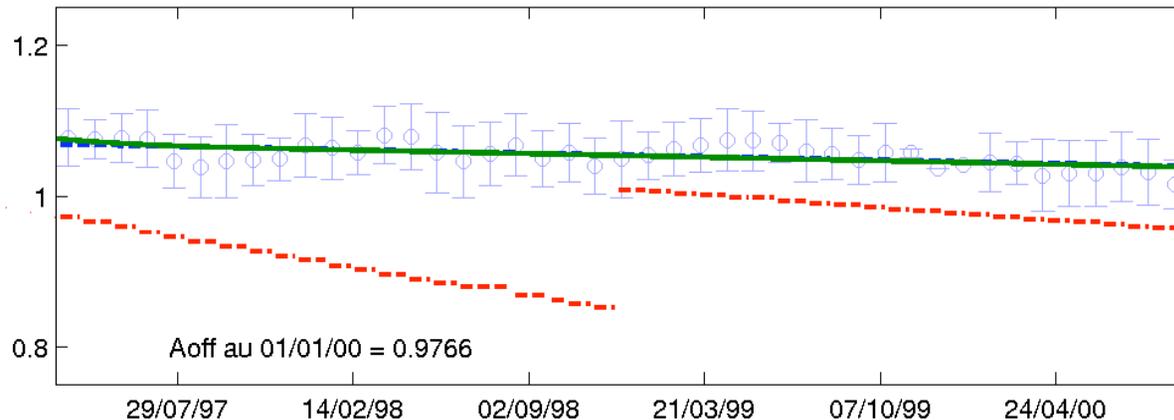
# CALIBRATION RESULTS EXAMPLE

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



Example :  
AVHRR 14/POLDER

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



**=> We could provide calibration coefficients for each AVHRR sensor**

# DIRECTIONAL NORMALISATION

## Directional & time compositing used in CYCLOPES

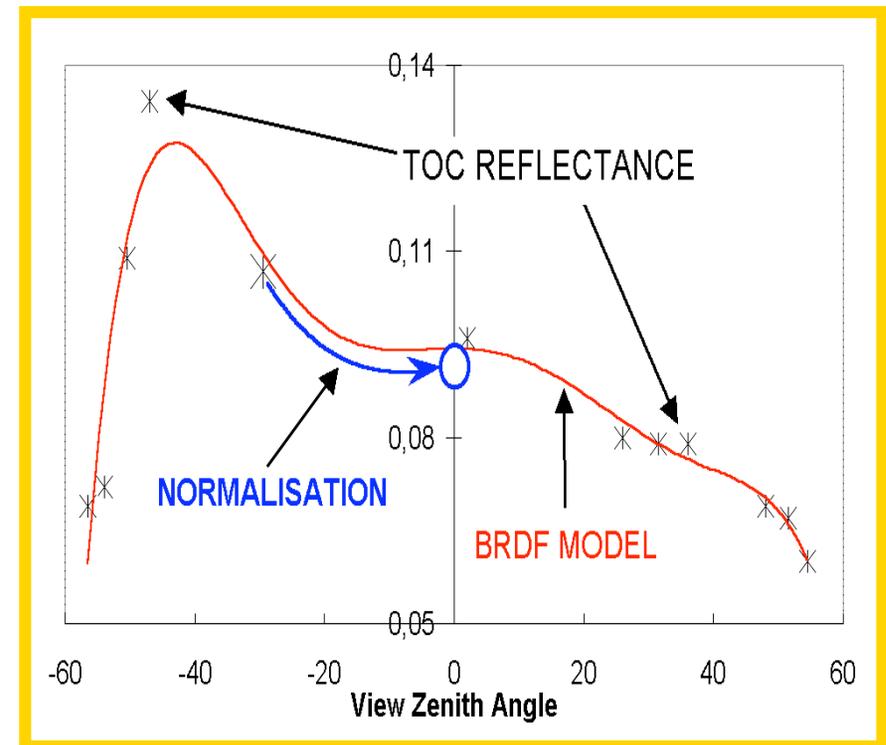
- Fit a BRDF model (*Roujean et al, 1992*) to data acquired during compositing period

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

- 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

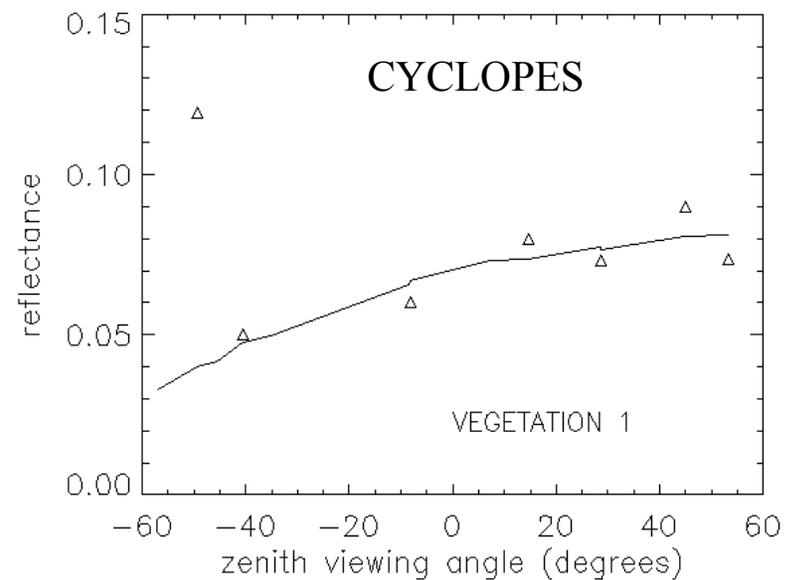
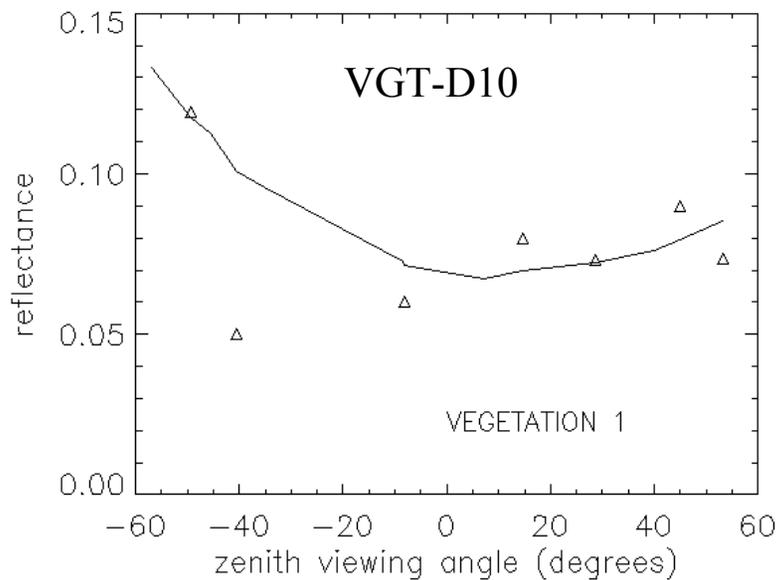


(© Philippe Maisongrande-CESBIO)

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

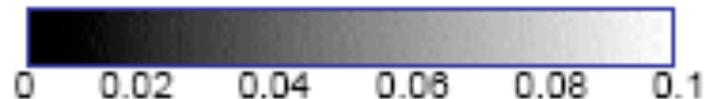
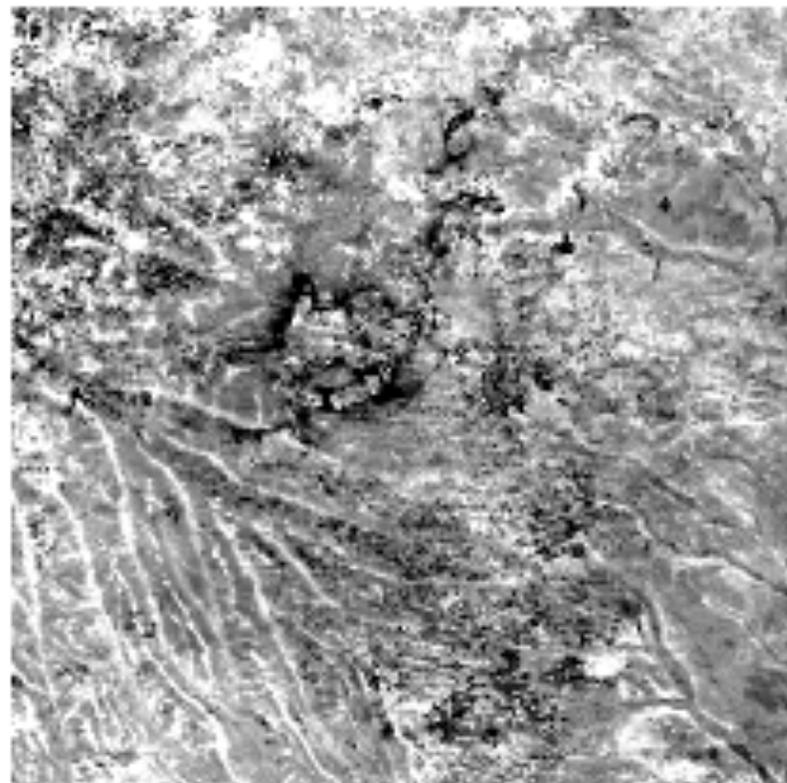
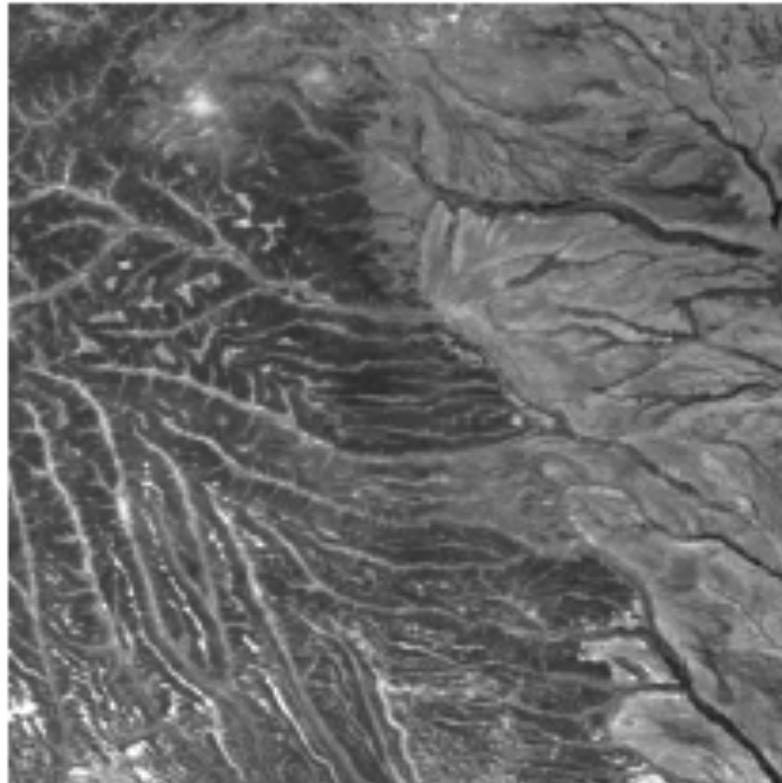
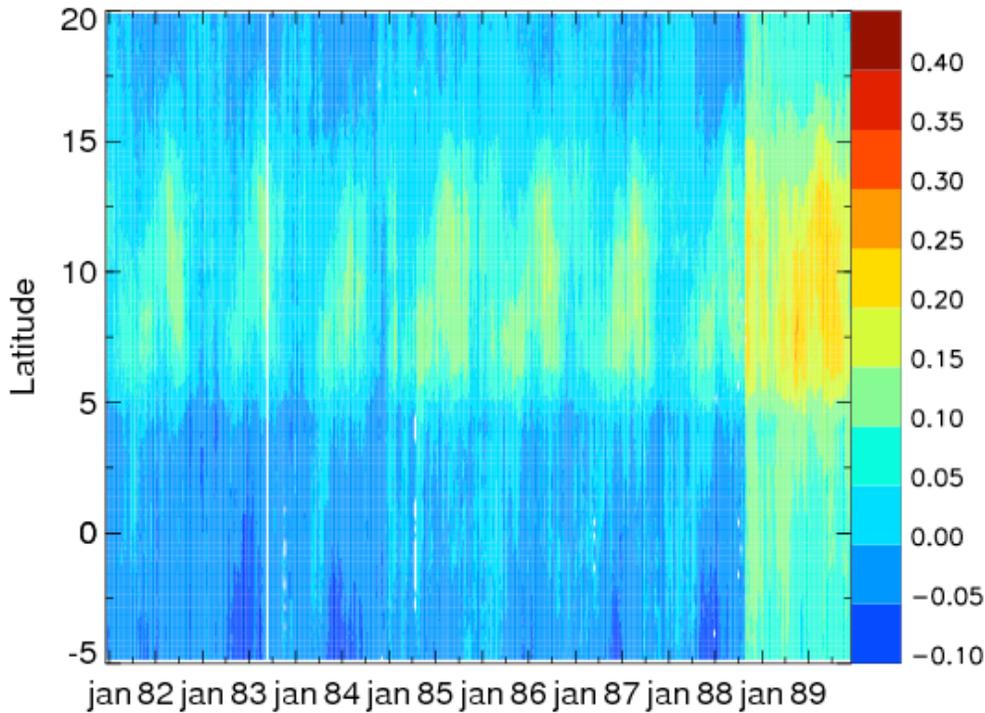


Figure 5: CYCLOPES surface reflectance (left) and nadir-zenith reflectance from D10 VEGETATION product (right) in the red band for April 2003 over Angola (11° S-14° S; 19° E-22° E)

# FIRST ACTIVITIES WITH REASoN CAN DATA...

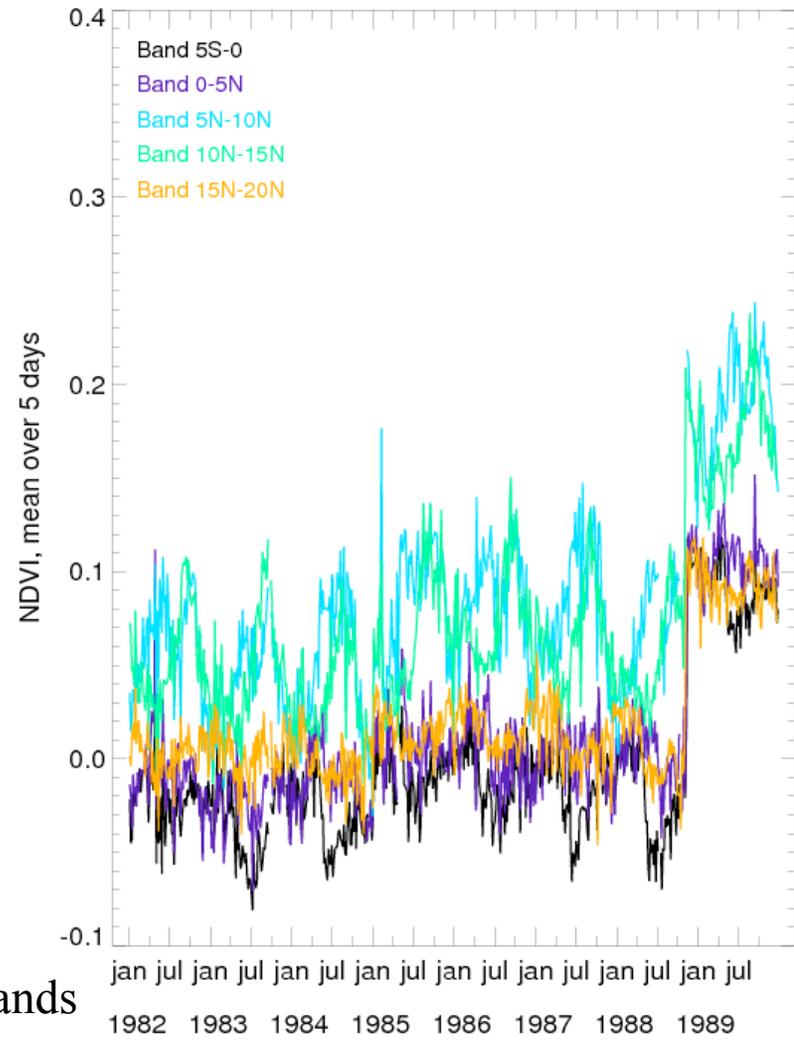
NDVI values from 1982 to 1989



Latitudinal average over the area  $-25^{\circ}$ - $25^{\circ}$ E

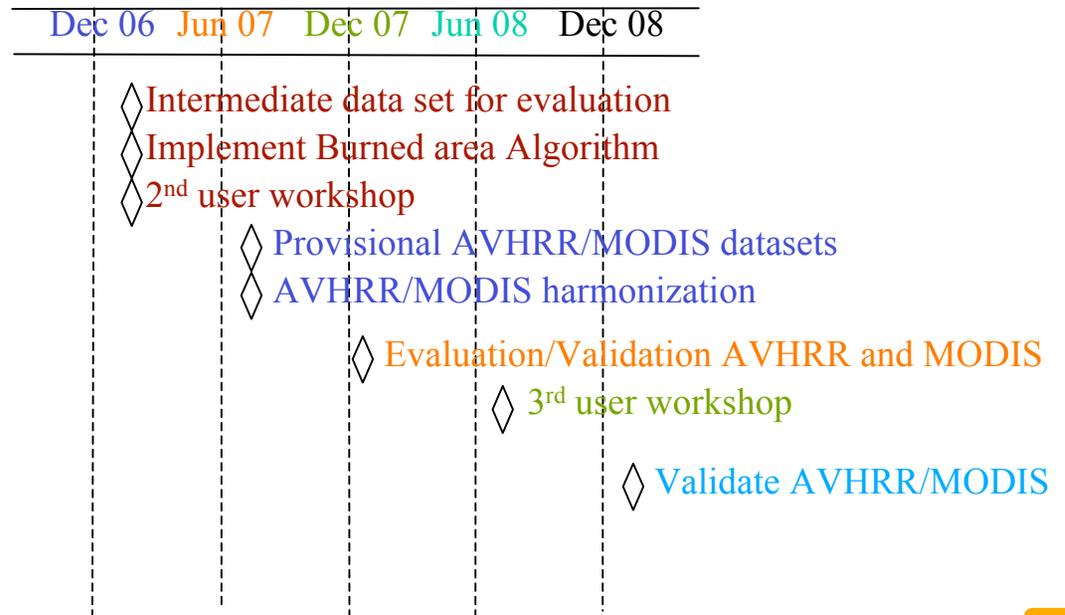
Then average over  $5^{\circ}$  latitude bands

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

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- ❑ **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.**