CENTRE NATIONAL D'ÉTUDES SPATIALES

SADE DATABASE UPDATED INFORMATION

OPENING OF ACCESS

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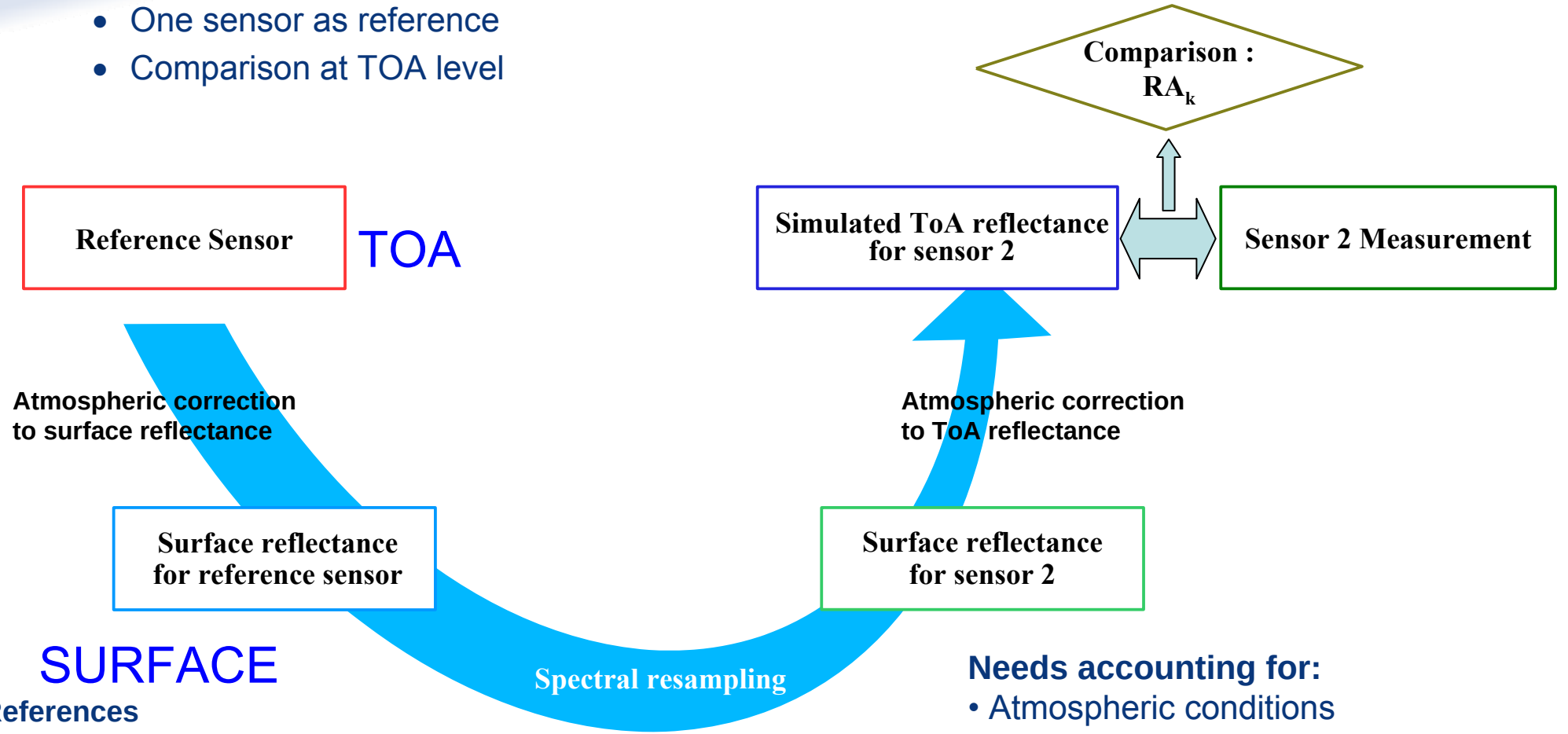
DCT/SI/MO

Calibration Method Using Deserts Sites

- **Compare two sensors :**
  - One sensor as reference
  - Comparison at TOA level



References

- GSICS/EP-1, Geneva, Oct 2006 (P.Henry)
- GSICS/GRWG-II, Darmstadt, June 2007 (P.Henry)
- GSICS/GRWG-III, Camps Spring, Feb 2008 (C.Tinel)

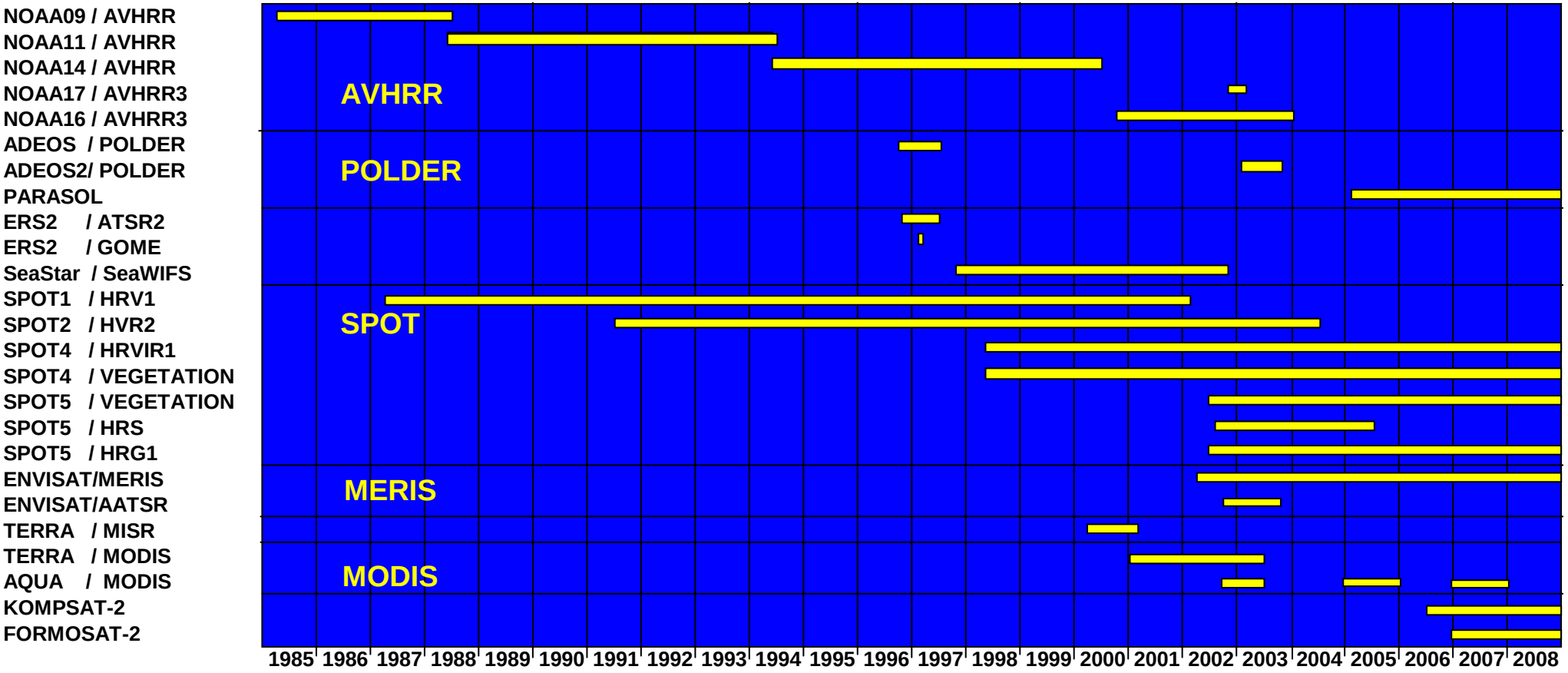
Needs accounting for:

- Atmospheric conditions
- Spectral discrepancies
- Directional effects

Similar geometry of acquisition
($|\Delta\theta s|<2$, $|\Delta\theta v|<2$, $|\Delta\phi|<5°$)

SADE Data Base : desert sites

Content of the SADE data base



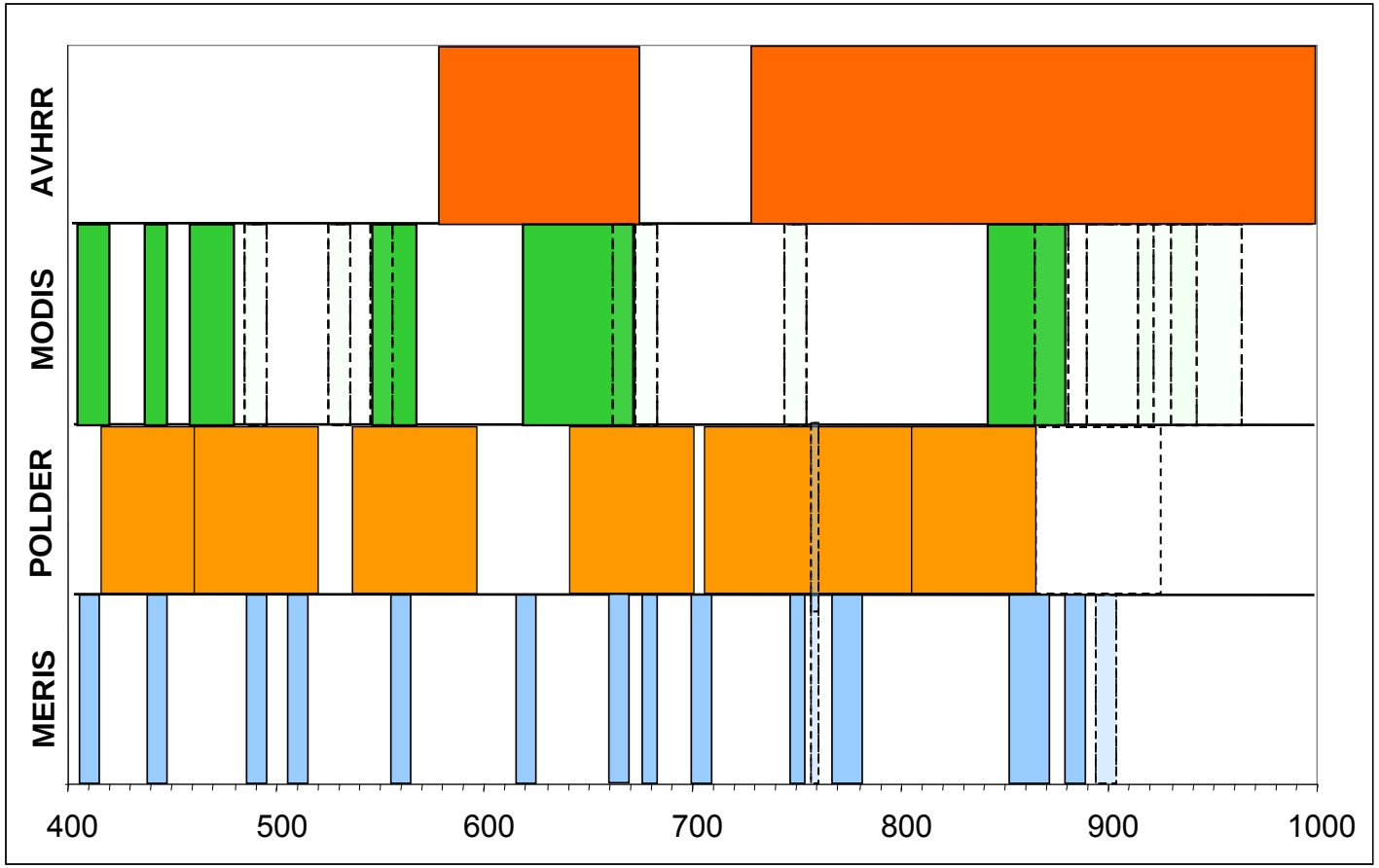
Which sensor to use as reference ?

- **Some important criteria to take into account**
  - **Spectral coverage**
  - **Geometry of the viewing (θ_s, θ_v)**

- **We test here 3 sensors as reference**
  - **MODIS (AQUA) : years 2005 and 2007**
    - Accessibility of data, good compromize
  - **POLDER (ADEOS): 1996 → 1998**
    - Multi-directional capability
  - **MERIS (ENVISAT) : 2002 → 2009**
    - Best spectral VNIR coverage

- **For intercalibration with AVHRR measurements**
  - **AVHRR_LTDR Version 3 (NOAA14): 1995 → 1999 (VERMOTE et al.)**

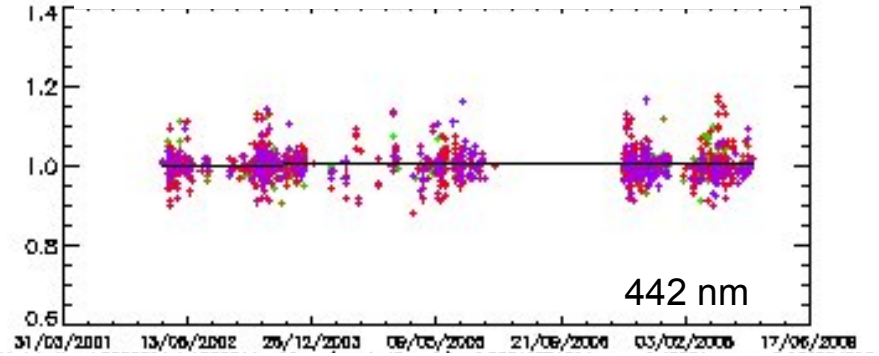
Spectral coverage of the studied sensors



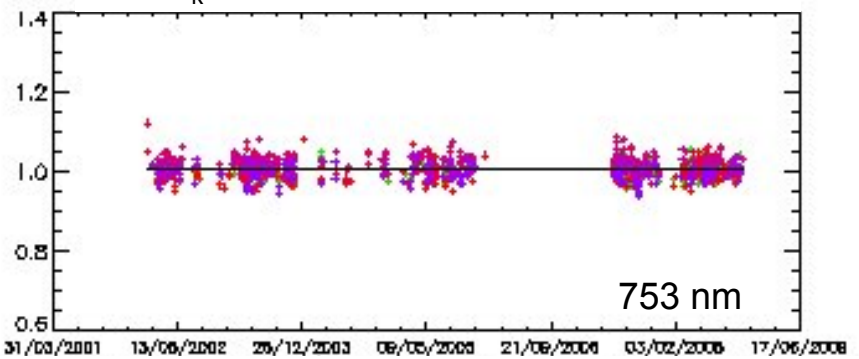
Band not used (saturation on bright targets, absorption, etc.)

Intercalibration of MERIS (/MODIS et /PARASOL)

RA_k vs time of MERIS measurement

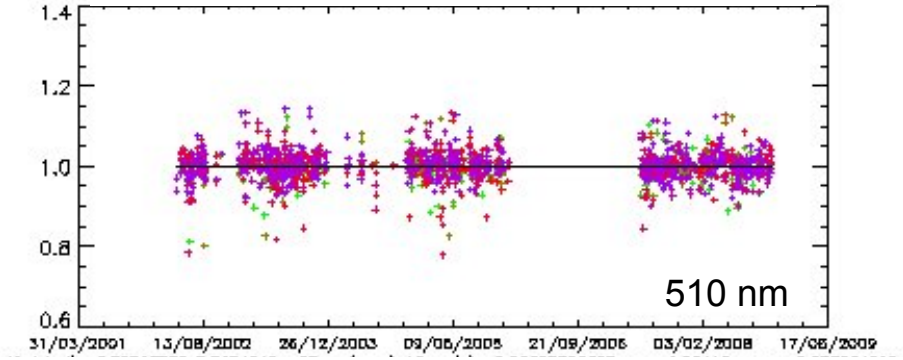


RA_k vs time of MERIS measurement

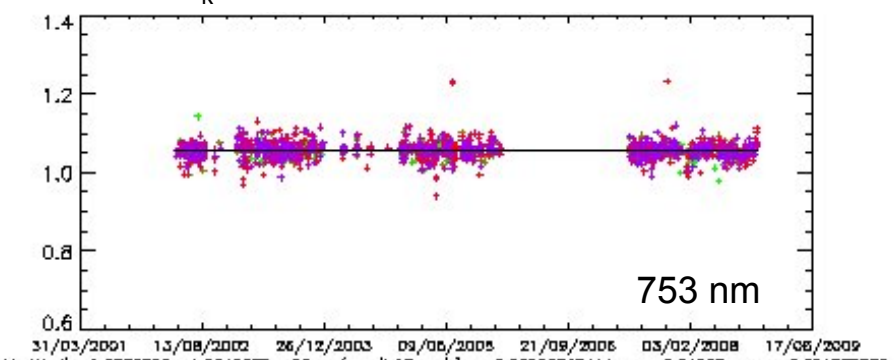


MERIS vs AQUA_MODIS used as reference

RA_k vs time of MERIS measurement



RA_k vs time of MERIS measurement

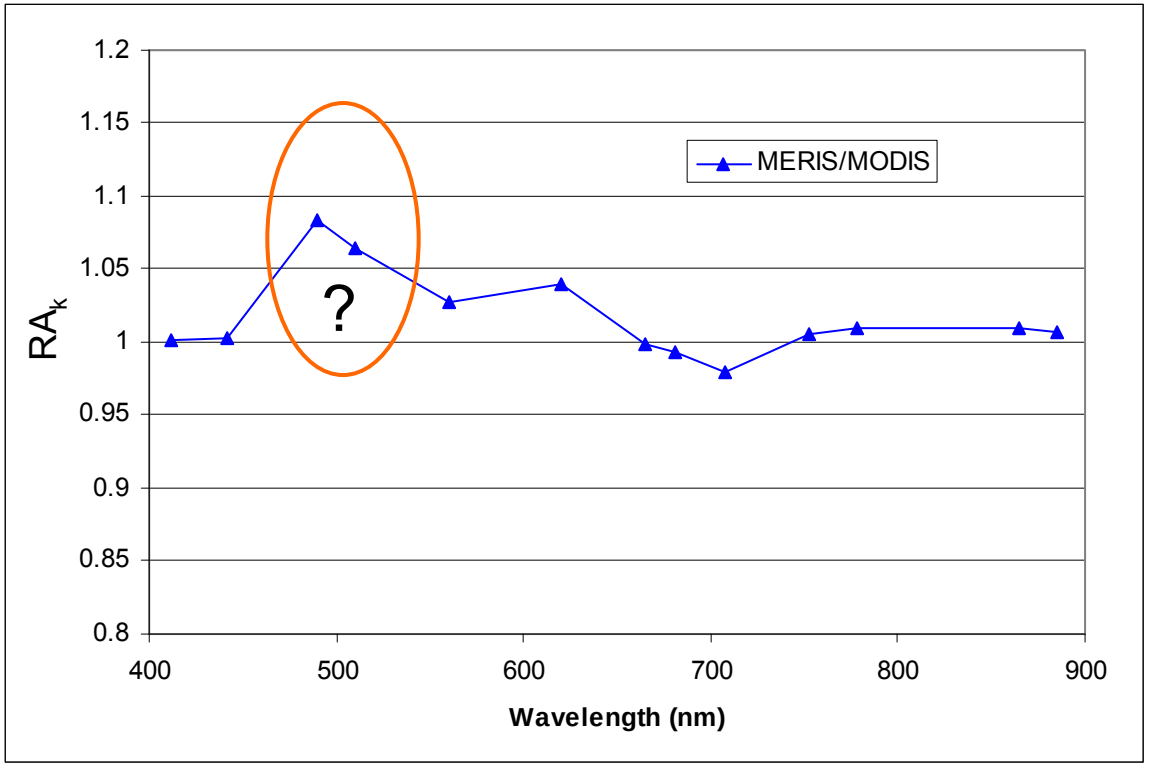


MERIS vs PARASOL_POLDER used as reference

Intercalibration MERIS/MODIS (MODIS as reference)

Good intercalibration for most of the spectral bands

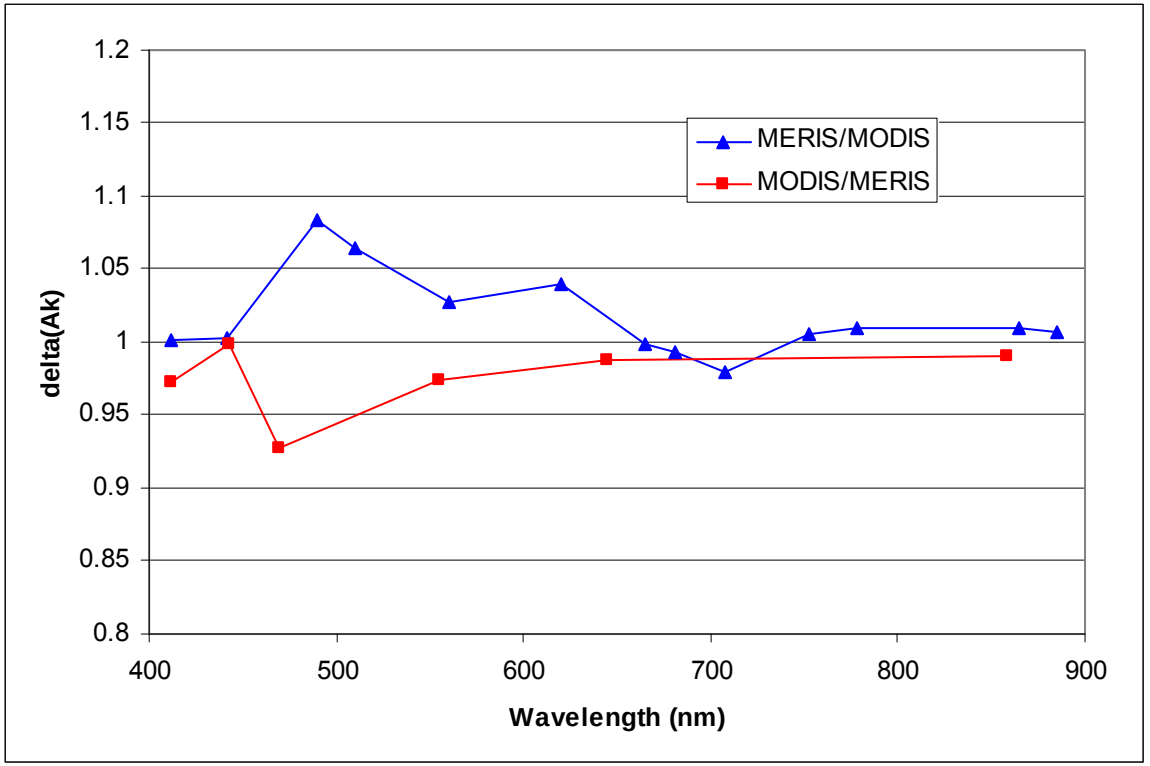
Bande	RA_k avg	σ (%)
412 nm	1.001	3.5
442 nm	1.003	3.7
490 nm	1.084	4.1
510 nm	1.065	3.6
560 nm	1.027	2.7
620 nm	1.041	2.3
665 nm	0.999	1.8
681 nm	0.993	1.9
708 nm	0.979	2.3
753 nm	1.006	2.3
778 nm	1.009	2.3
865 nm	1.010	1.9
885 nm	1.007	1.9

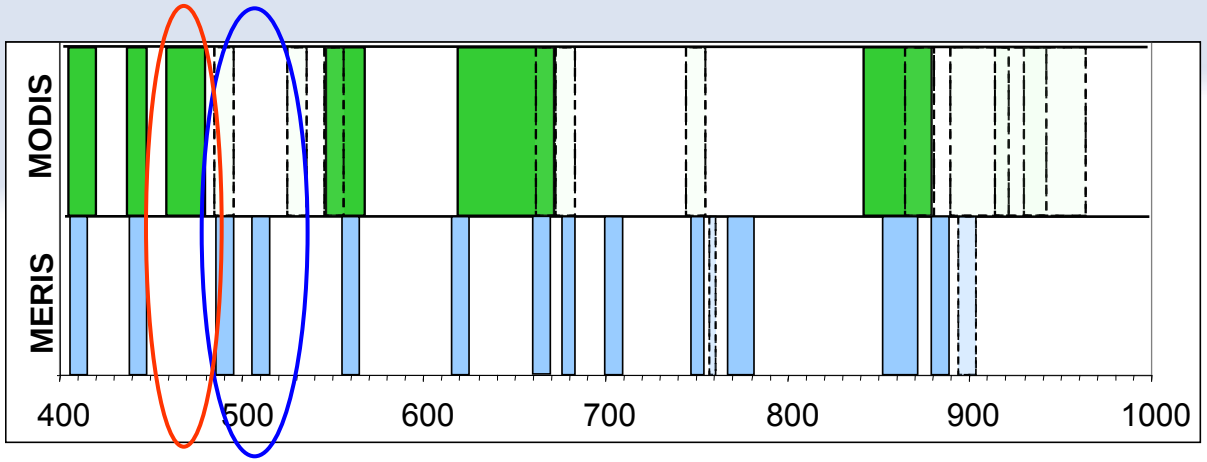


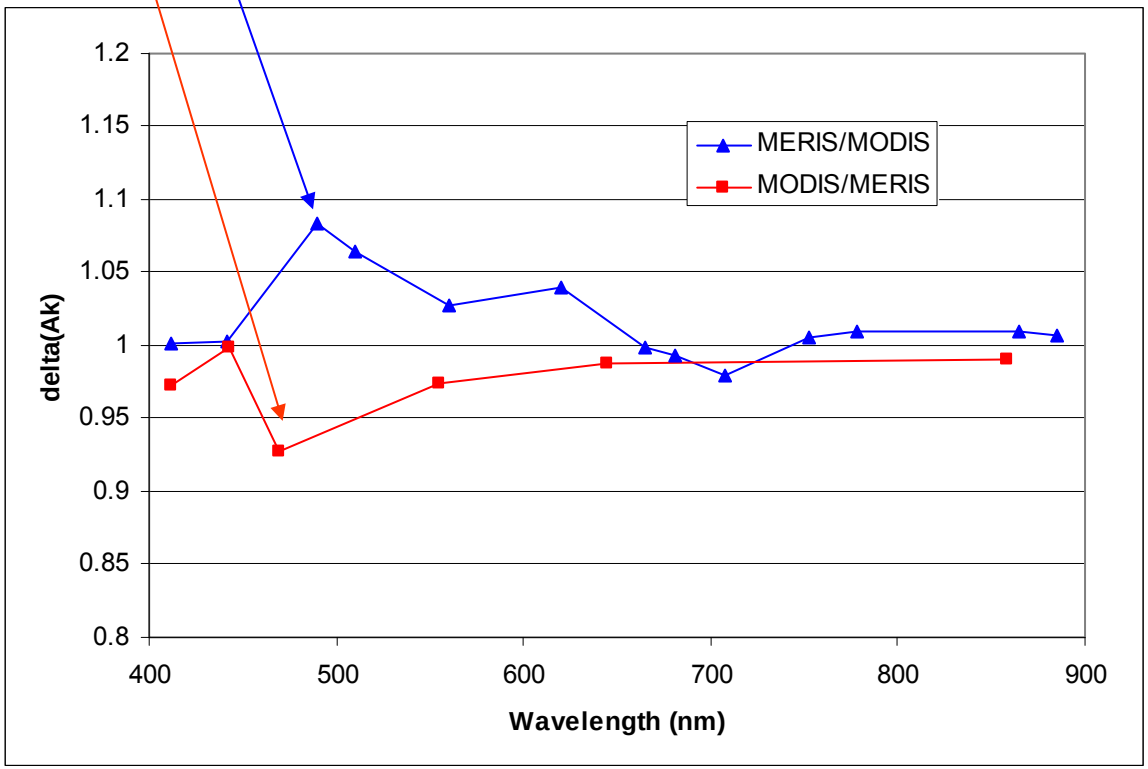
Intercalibration MODIS/MERIS (MERIS as reference)

Good consistancy MODIS/MERIS and MERIS/MODIS

Bande	RAk avg	σ (%)
412 nm	0.973	3.5
443 nm	0.999	3.7
469 nm	0.928	3.4
555 nm	0.974	2.6
645 nm	0.987	1.9
858 nm	0.991	1.8





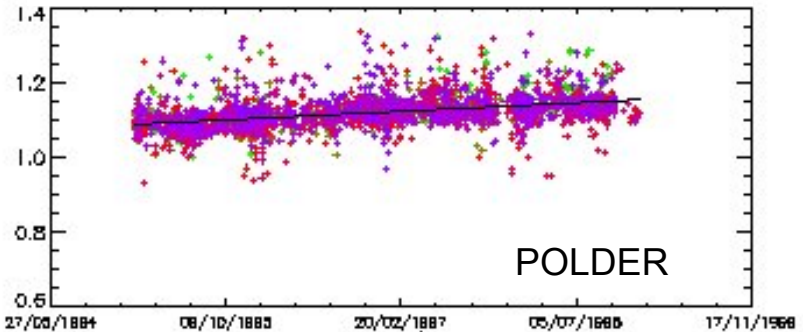


No MODIS band close to MERIS bands 490nm and 510nm

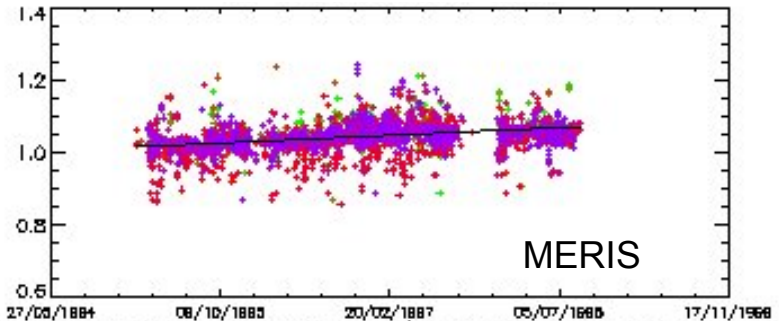
No MERIS band close to MODIS band 469 nm

Intercalibration of AVHRR RED band with the 3 studied references

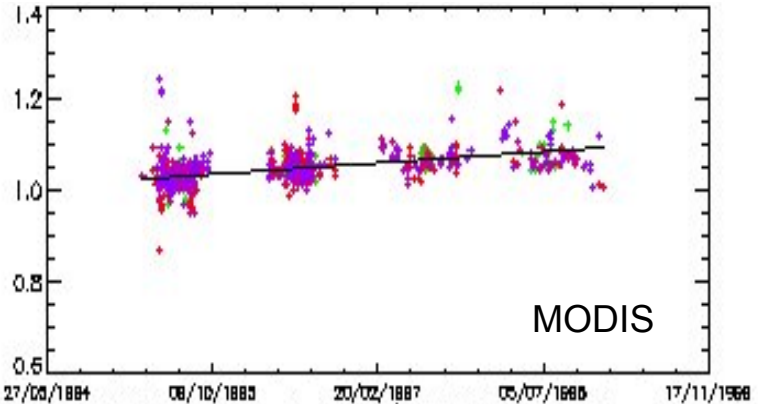
RA_k vs time of AVHRR (RED band)



RA_k vs time of AVHRR (RED band)



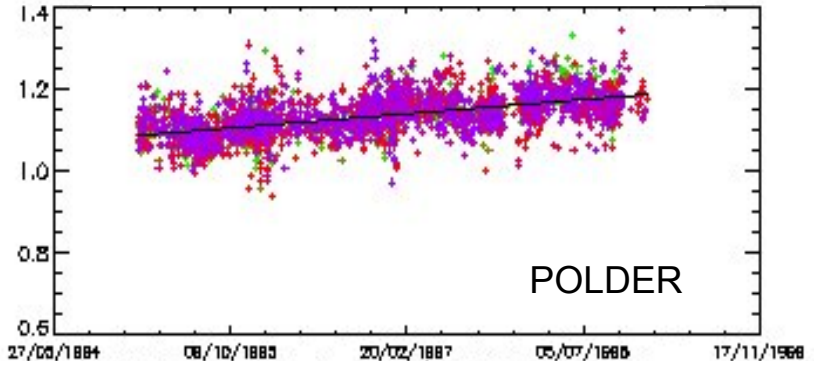
RA_k vs time of AVHRR (RED band)



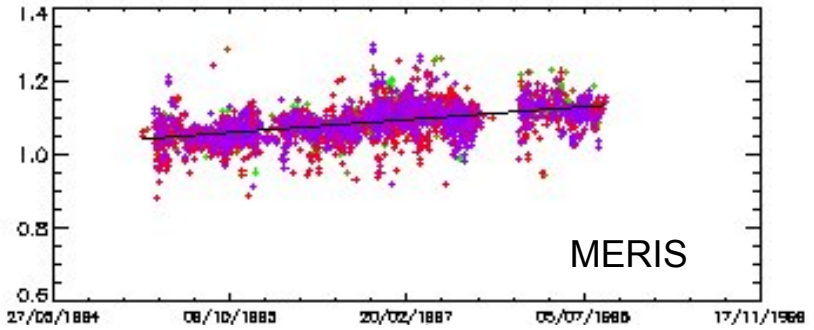
- Drift of bias observed with the 3 references (not found with version 2 parameters)
  - exchange of information with E.Vermote in progress

Intercalibration of AVHRR NIR band with the 3 studied references

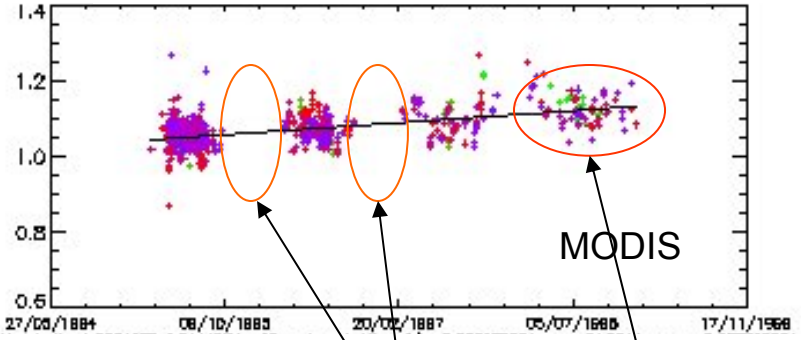
RAk vs time of AVHRR (NIR band)



RAk vs time of AVHRR (NIR band)



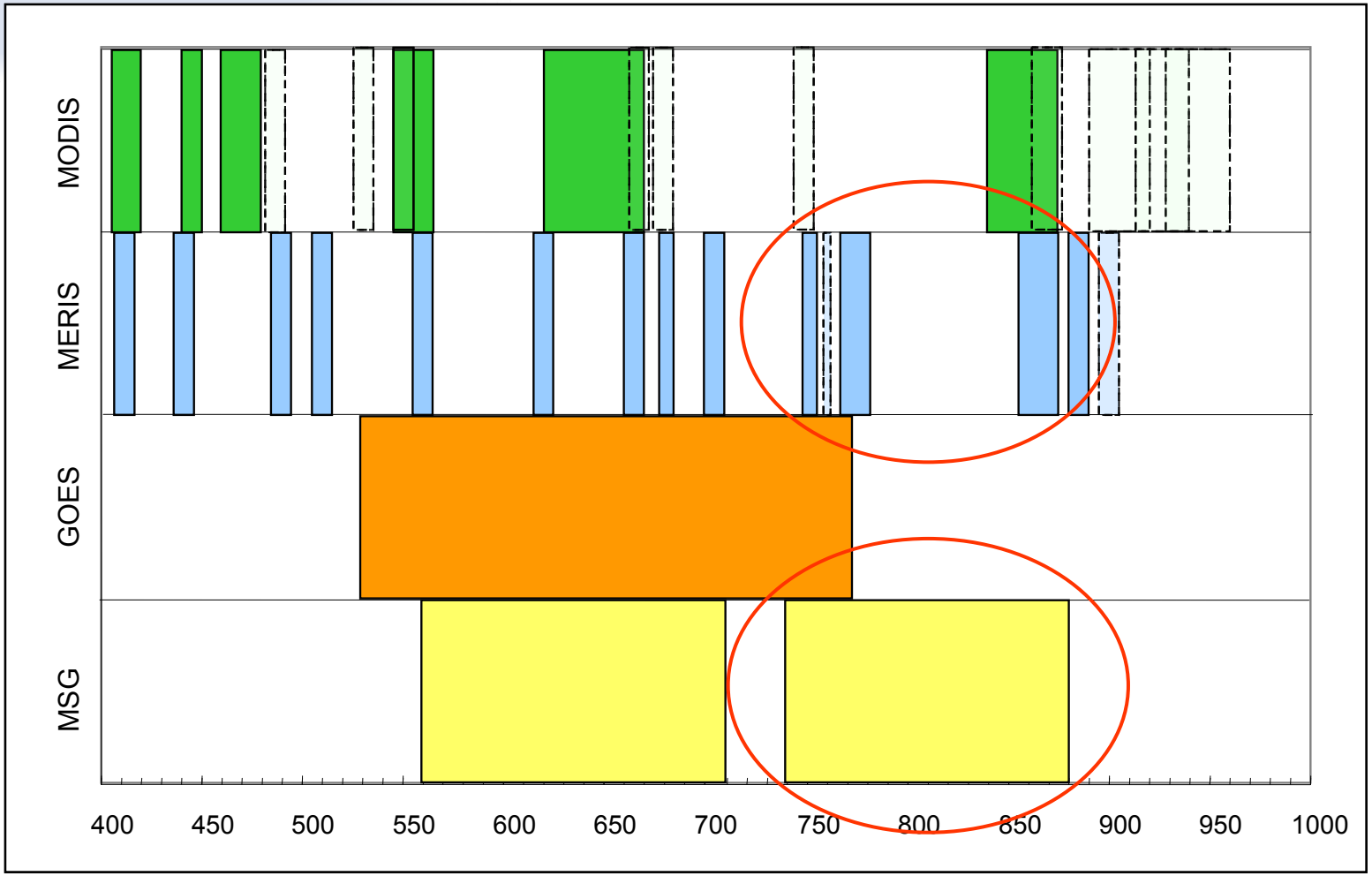
RAk vs time of AVHRR (NIR band)



Lack of geometry similarity

NOAA14 orbit drift

Intercalibration of GEO sensors



Note : Interest of MODIS SWIR band (no such band on MERIS)

Interest of MERIS for MSG NIR band

MODIS ? MERIS ? As reference

- Both sensors are very close in terms of intercalibration
- Both sensors provide similar results when used as reference
- Interest of MERIS higher spectral sampling usable on desert sites
- Interest of SWIR MODIS band
- Availability of MERIS measurements
  - In CNES SADE database
  - 20 desert sites
  - Other sites : ocean, sun glint
- CNES uses both sensors

Opening the SADE database (I)

- **References to previous presentations**
  - **GSICS/EP-1, Geneva, Oct 2006 (P.Henry)**
  - **GSICS/GRWG-II, Darmstadt, June 2007 (P.Henry)**
  - **GSICS/GRWG-III, Camps Spring, Feb 2008 (C.Tinel)**

- **Database content : 3 levels**
  - **Measurements (Visible and NIR)**
    - Sensors : Polder1, Polder2, Parasol, SPOTs, SeaWiFS, VEGETATION 1&2, AVHRR, MERIS, MODIS, ...
    - Targets : Deserts, Ocean, Sun Glint, Clouds (DCC) and Snowy sites
    - Associated Meteo Data
  - **Elementary Calibration Results**
  - **Vicarious Calibration Results**
- **Only desert measurements are used for intercalibration**
  - **CNES proposes to provide access to desert data to GSICS members via WEB interface**
  - **Simple data format (ASCII, to be discussed)**

Opening the SADE database (II)

- Export measurements available on Desert sites (possibly Dôme-C)
- Existing SADE export format

	Field Name	Unit
common to all bands	Area size	—
	Latitude	deg
	Longitude	deg
	Solar azimuth angle	deg
	Solar Zenith angle	deg
	Water Vapour content	g.cm-2
	Ozone content	cm.atm
	Surface Pressure	mbar
	Surface Wind Speed	m.s-1
	Aerosols	
	NO2	
	CHP1	
	CHP2	
	Date/time of the measurement	
	Product Reference	

+ Bands Characteristics

	Field Name	Unit
Band 1	Band Id	
	Measurement Id	
	Measurement value = average	
	Measurement std.dev.	
	Viewing azimuth angle	deg
	Viewing Zenith angle	deg
Band 2	Band Id	
	Measurement Id	
	Measurement value = average	
	Measurement std.dev.	
	Viewing azimuth angle	deg
	Viewing Zenith angle	deg
...	Band Id	
	Measurement Id	
	Measurement value = average	
	Measurement std.dev.	
	Viewing azimuth angle	deg
	Viewing Zenith angle	deg

Opening the SADE database (III)

- **Two major options**
  1. **Provide data based upon user request (web site interface)**
     - Selection by user : Sensor, Site, Period, …
     - SADE database Request done by CNES
     - Data made available on a server for a limited period of time
  2. **Put data systematically on a server**
     - Hierarchical organization of the files : Sensor / Year / Site
     - Other organization of data that better suits GSICS member needs ?
     - Updated every 6 months (TBC)

- **Choice will depend on**
  - **Frequency of export requests**
  - **Typology of the requests (1 or many sensors ?, 1 or many sites ?, …)**

- **GSICS members feedback would be helpful to make the correct choice (today the option 2 is the preferred one for CNES)**

SADE database capability extension

- It is very easy to add a new sensor in the database
  - Done recently for THEOS satellite
  - Measurements provided in the format described earlier
  - Could be used for GEO satellites without any modification

- Other deserts sites can also be easily added
  - For example, DOME-C sites where introduced recently

BACKUP SLIDES

Calibration of opical sensors using natural targets

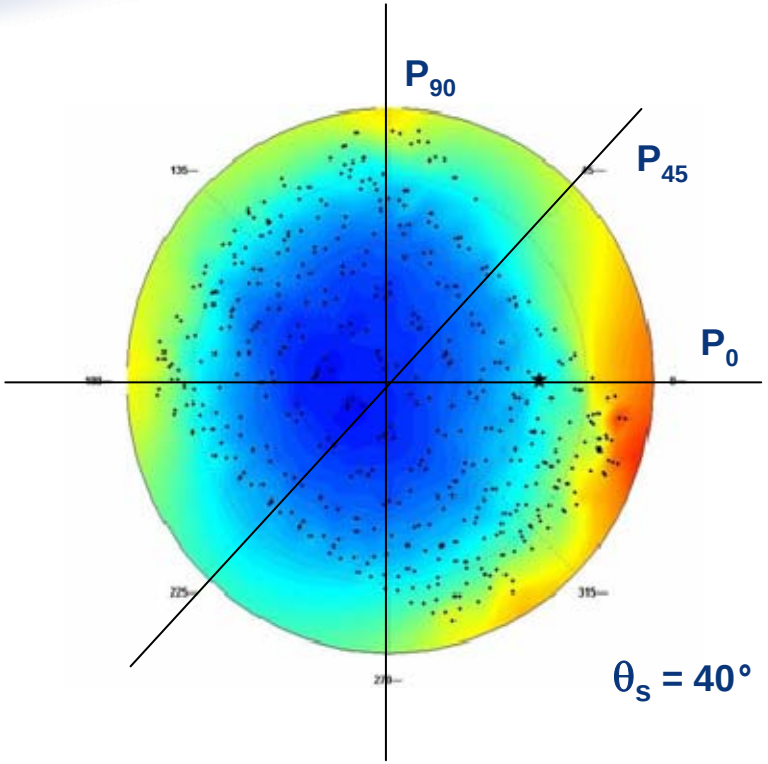
- **Definitions**
  - **Optical sensors are calibrated against reflectance**

$$DN_k = A_k . \rho_k . \cos(\theta_s)$$

    - k: Spectral band
    - DN : Digital Number (Meris Level 0, corrected for instrumental defects)
    - ρ : Reflectance
    - A_k : Sensitivity of instrument for spectral band k
  - **Calibration results are expressed this way**

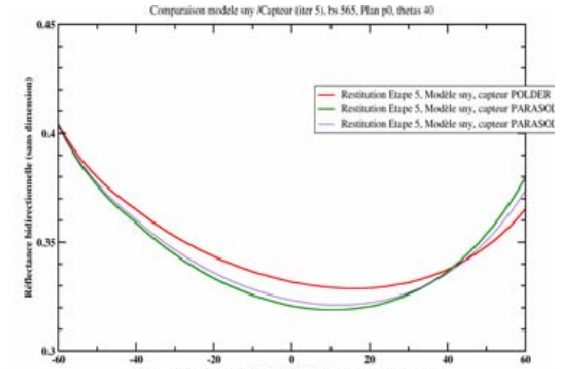
$$RA_k = \frac{A_{k,method}}{A_{k,L1}} = \frac{\rho_{k,measured(L1)}}{\rho_{k,predicted}(Method)}$$

BRDF Study of desert sites

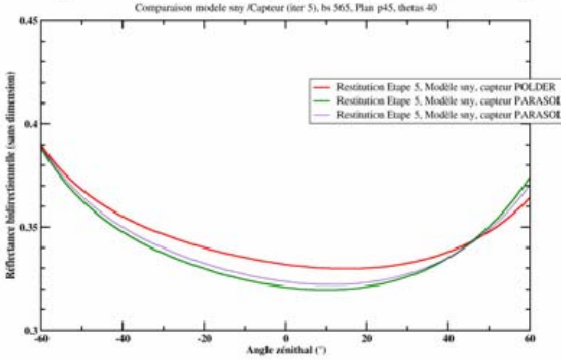


Libya 1 site – 565 nm band
(Snyder model)

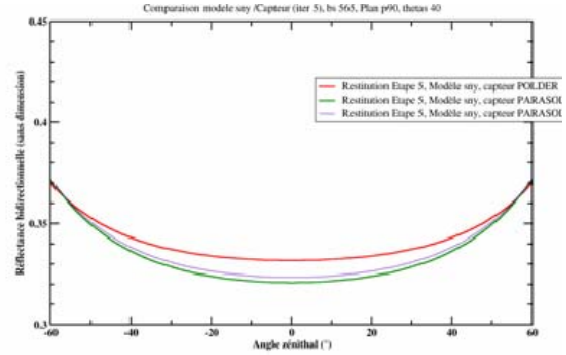
P_0



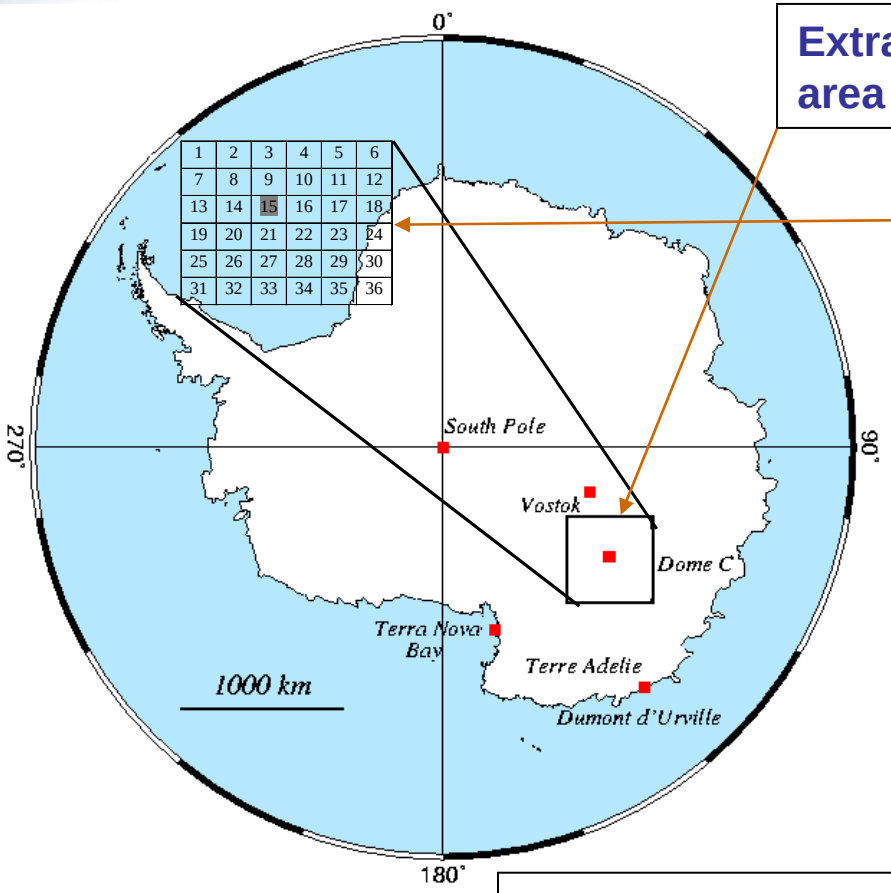
P_{45}



P_{90}

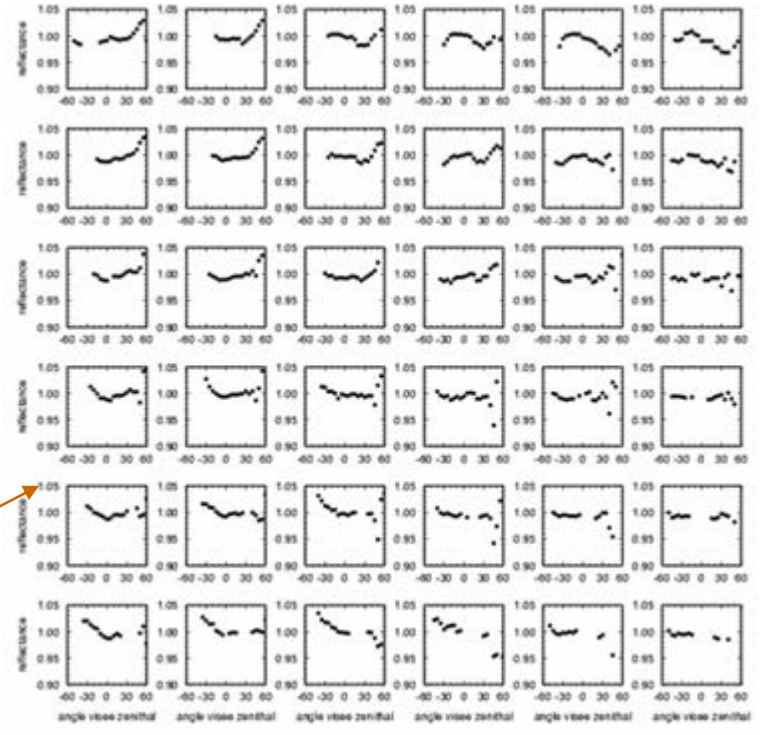


Dôme C characterization using VGT images



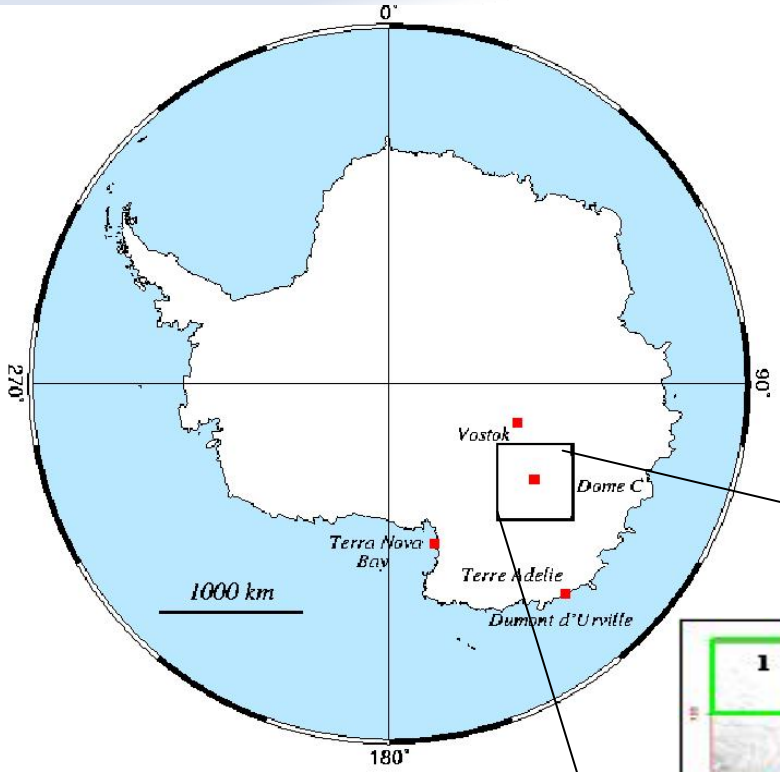
Extraction of a 720*720 km² area centred on Dome C base

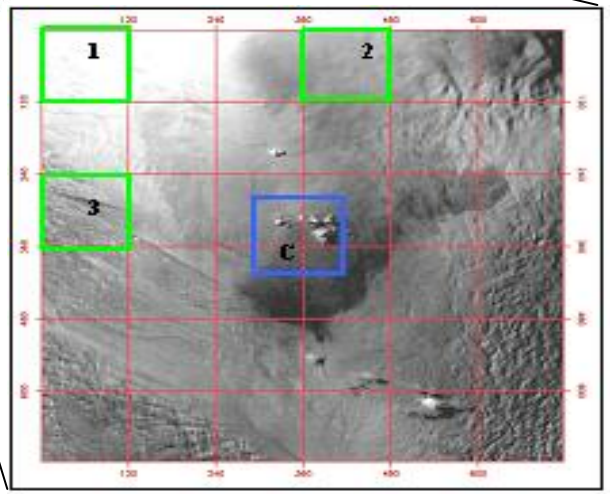
divided in 36 smaller areas (120*120 km²)



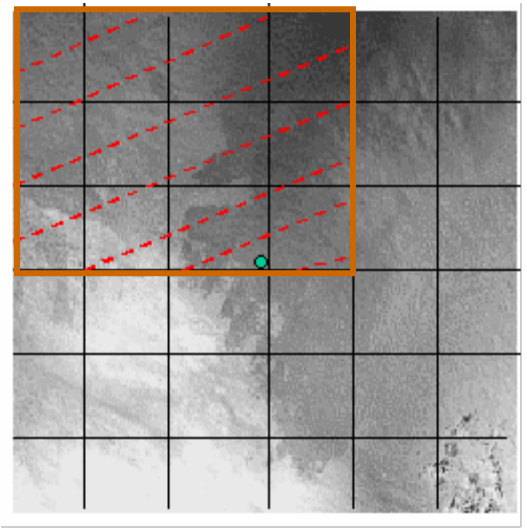
each zone carefully studied against different parameters

Choice of 4 calibration sites





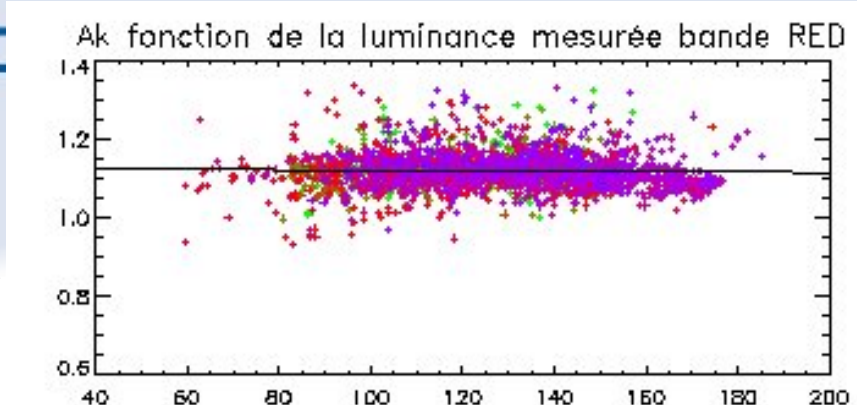
4 zones (120*120 km²) finally selected : Dome 1,2,3 & C

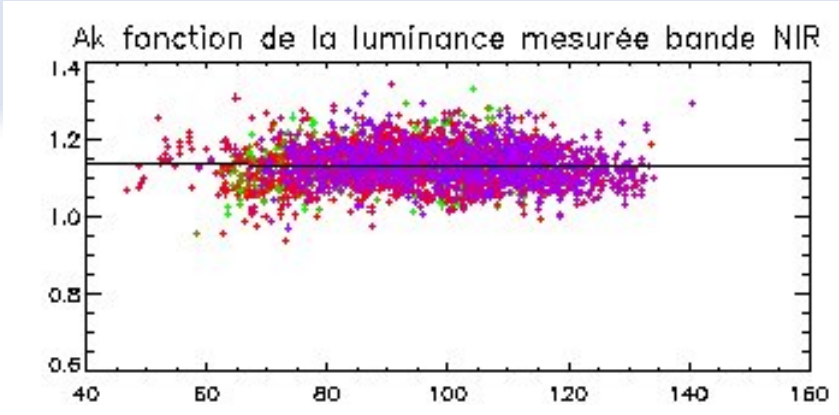


large zone (480*360 km²) more suitable for calibration

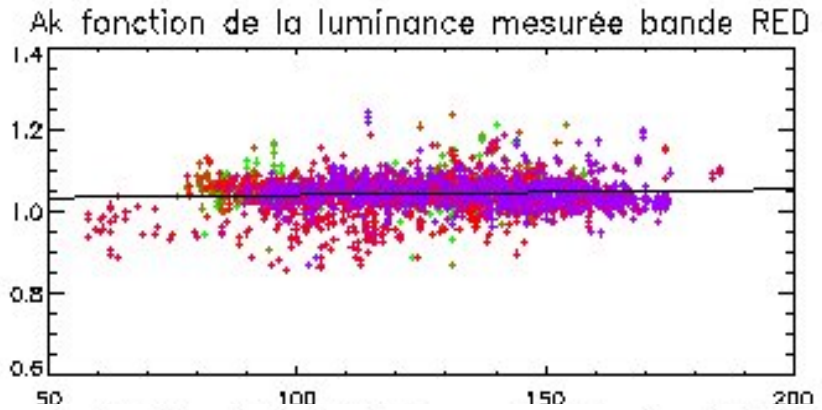
✞ Calibration over different zones allows to distinguish sensor behaviour from site behaviour

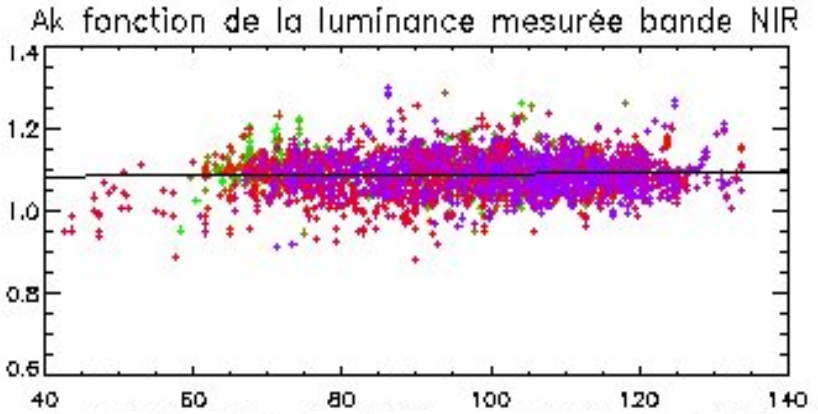
POLDER





MERIS





MODIS