

Vicarious Calibration at CNES

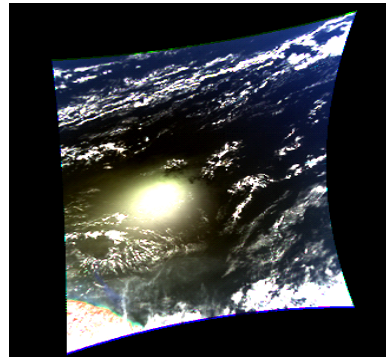
Patrice Henry

IVOS 24, Sioux Falls, 7th May, 2012

Calibration approaches that can be applied to OLCI



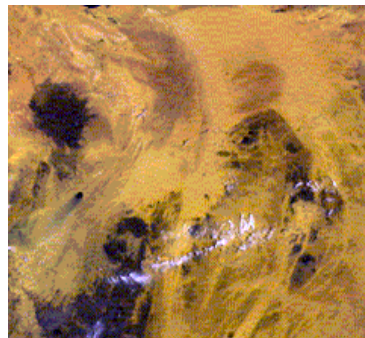
Rayleigh



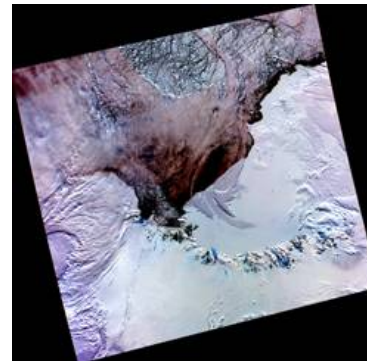
Sun Glint



Clouds



Deserts



Antarctica

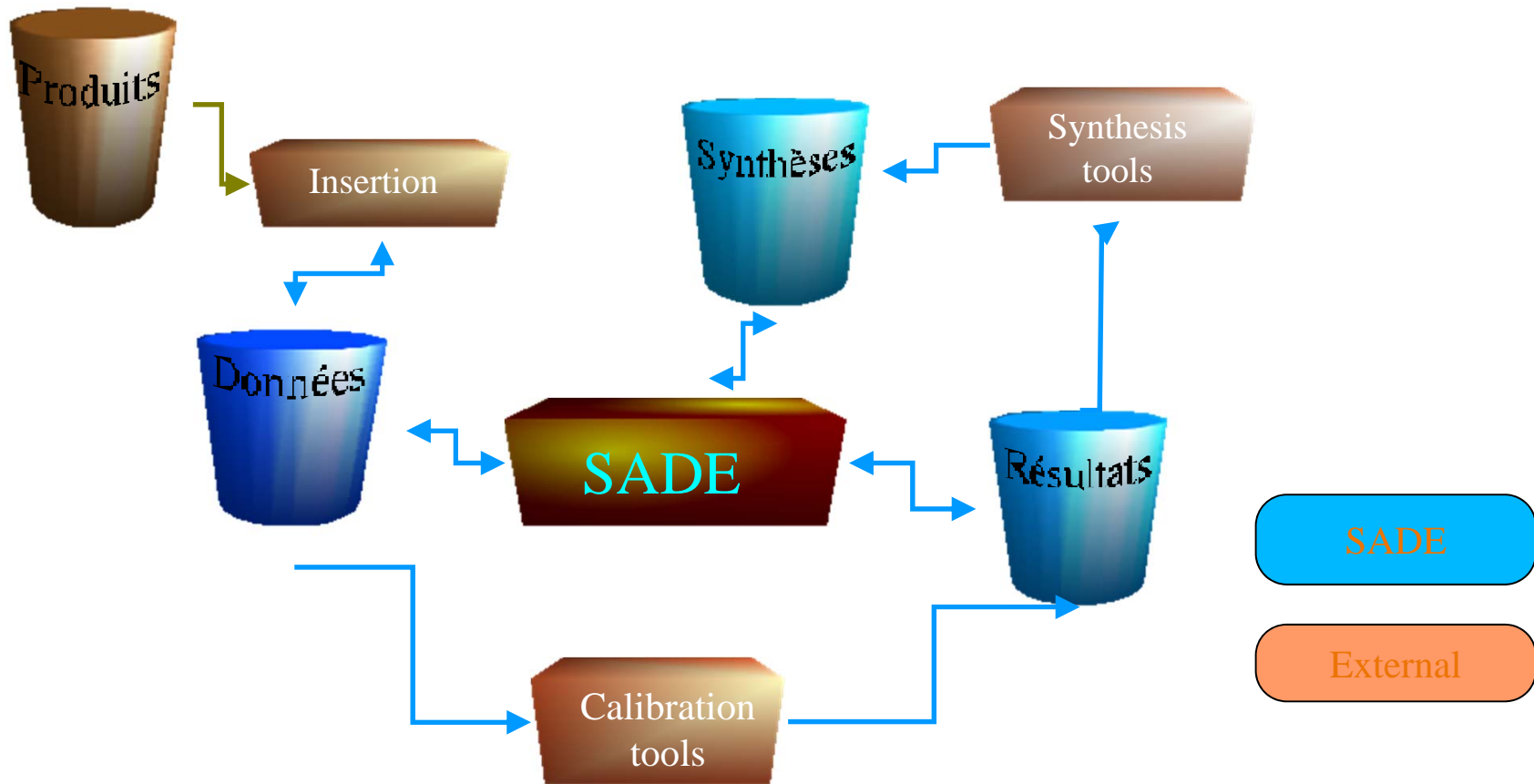
SADE: Structure d'Accueil de Données d'Etalonnage (Calibration Data Repository)

Multi-temporal calibration and cross-calibration and/or absolute calibration of optical sensors (visible → NIR) through different methods

Easy data management, link between satellite measurements and calibration results (traceability)

+ MUSCLE: common calibration tools for all sensors

SADE



SADE

Base Content:

TOA reflectances

Calibration results (coefficients)

Synthesis results (means, models)

MUSCLE Tools (Front-End Graphic)

Extraction and insertion of measurements

Calibration

Synthesis

Exogen data (climatologic models 4/day)

NCEP : pressure, water vapour

EPTOMS : ozone

SADE

For each measurement:

Mean TOA reflectance value + standard deviation per band

Geometrical conditions : zenithal and azimuthal viewing/solar angles

Pressure, water vapour, ozone, aerosols optical depth

Product name N1, Viewing date

SADE identifier

For each "elementary " calibration result:

One calibration coefficient per band

Name of the method

Tool name, tool version and tool parameters

Processing date

User name

SADE identifier

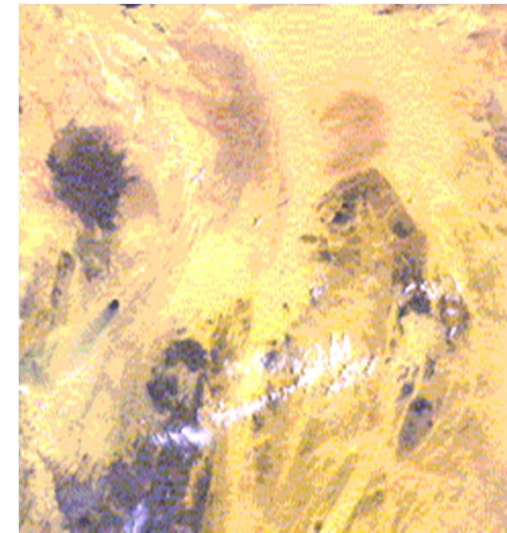
Inter-sensors and Multitemporal Calibration Over Deserts

General description of the method

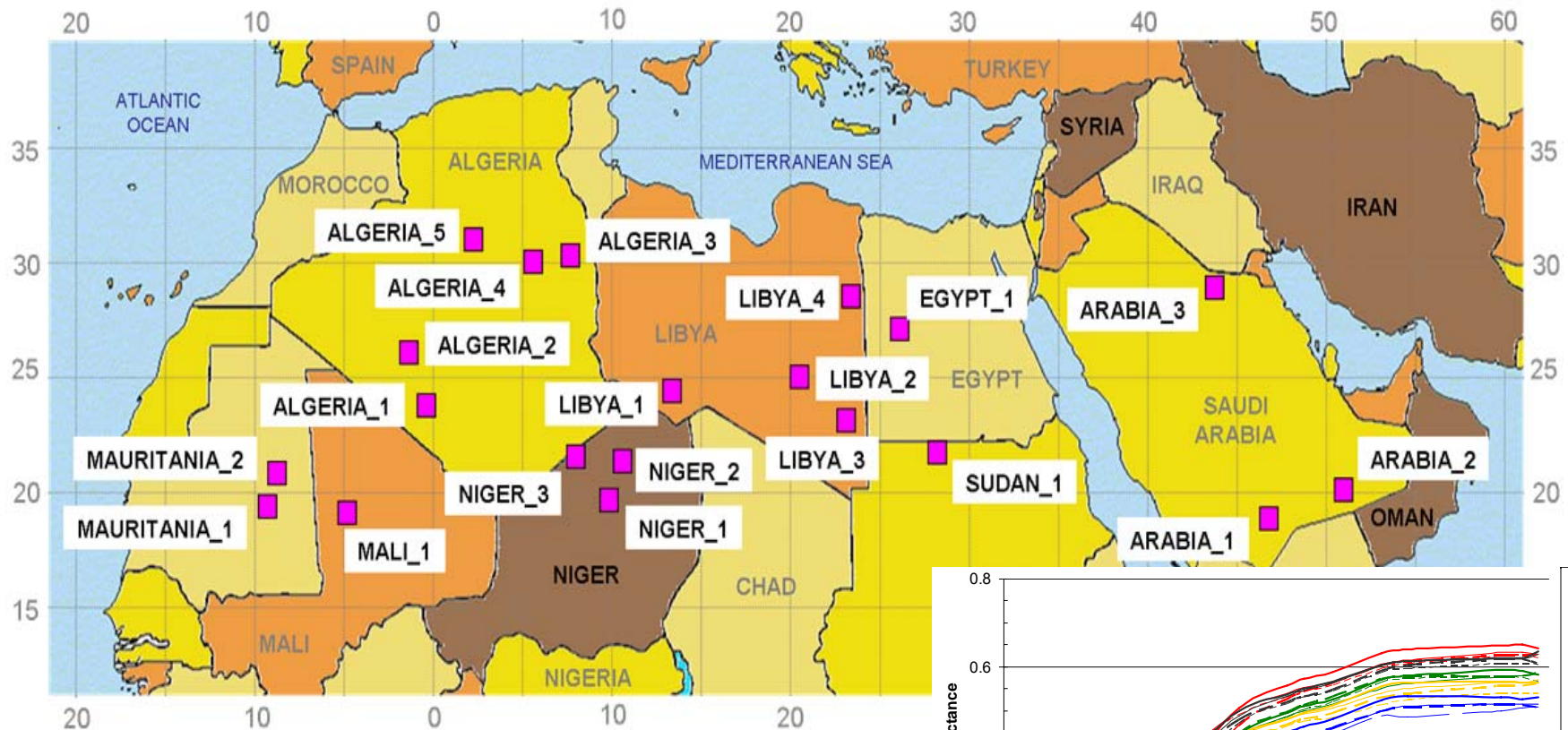
- Systematic observation of stable desert sites all along the years
- Multitemporal calibration and/or intersensor calibration

Operating procedure

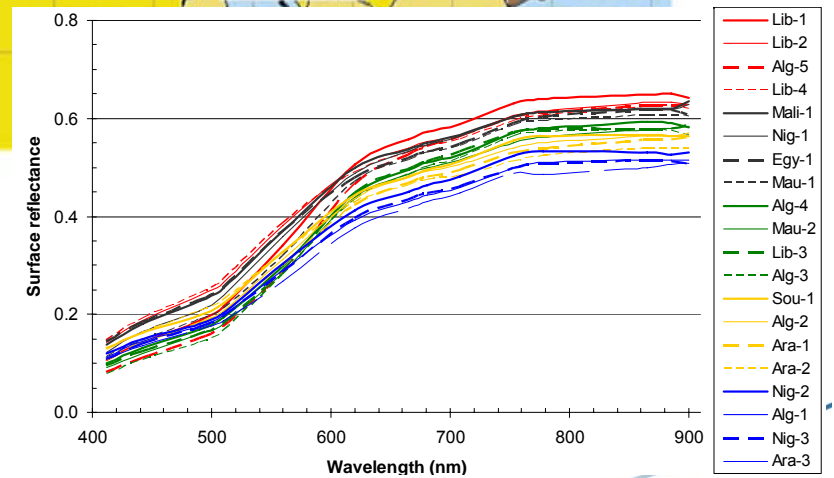
- Assumption of a perfect short term and long term stability of the sites
- One sensor taken as reference
- Cross calibration for identical geometry acquisitions with atmospheric correction and spectral resampling



20 Desert Calibration Sites

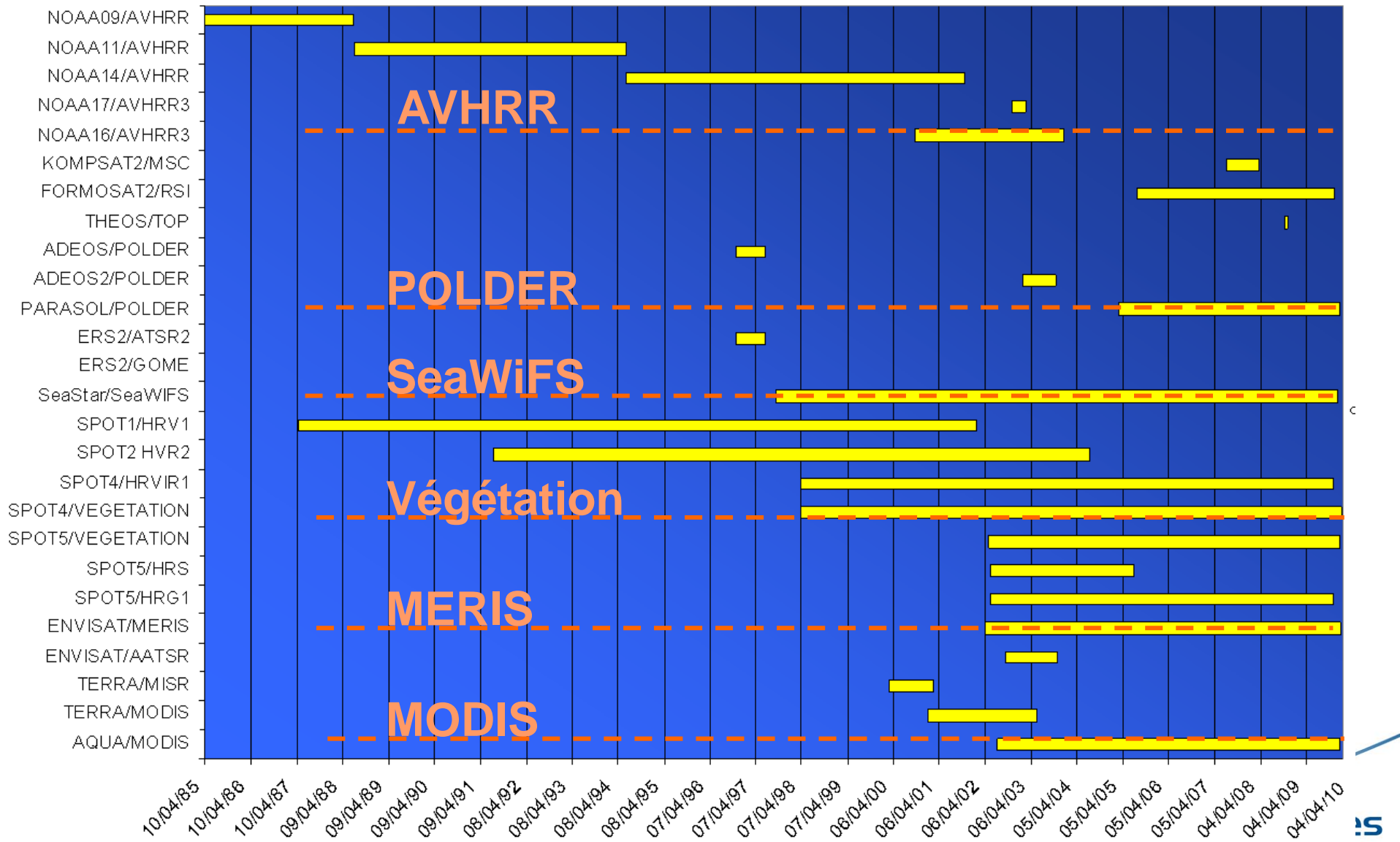


Surface reflectance



MUSCLE / SADE

700,000 measurements from various sensors currently stored into SADE database



SADE opening to GSICS and CEOS

Few feedbacks from beta-users : only one (very positive...)

SADE access through CNES scientific mission website

- <http://smc.cnes.fr/CALIBRATION/> (free access)
- Password mandatory (for the “SADE data” page only)

No procedure yet available for password delivery (contact Aimé Meygret or Patrice Henry)

A complete reprocessing of SADE exported files in March 2012

- *Data extension up to 2011*
- *New sensors :*
 - ◆ *Terra/Modis*
 - ◆ *Landsat 7*
 - ◆ *Theos*
- *New MERIS reprocessing (3rd)*
- *VGT1 updated calibration*



SADE WORKSHOP

SADE (Structure d'Accueil de Données d'Etalonnage, i.e. framework for Calibration Data) is a database allowing multi-sensor calibration on inflight optical sensors. It contains measurements and processing results for different sensors such as Polder (ADEOS 1, 2 and PARASOL), SPOT 4 and 5 sensors, VEGETATION 1 and 2 but also MERIS (ENVISAT), MODIS (AQUA) and other sensors. The database ensures traceability between the measurements and the calibration results.

Desert measurements

Attached to a measurement are stored elements information on the original product, the sensor, the pixel position, the sun and viewing angles, the weather at the time of acquisition, and for each spectral band, the reflectance values.

Whatever the method and the sensor used, measurements are stored in a single format. The measurements are stored in the database individually (not grouped by their original product).

Desert Calibration

Systematically, the deserts acquisitions of 20 sites located in Sahara are collected. The operational calibration of the CNES sensors is then monthly made (SPOT(s) High Resolution, VEGETATION 1 & 2, PARASOL). Previous sensors acquisitions and calibration of POLDER ADEOS 1 and 2 are stored. Cooperation with international space and meteo agencies allows to collect MERIS (ENVISAT), MODIS (AQUA), RSI (FORMOSAT-2) and MSC (KOMPSAT-2) deserts data and to process those data for cross-calibration.

Deserts Data Available in SADE Database:





BANDS DESCRIPTION FOR AVAILABLE SENSORS

Satellite/Sensor	Bands	Spectral bands	Comments
ADEOS/POLDER	443P 443 490 565 670P 763 765 910 865P	ADEOS_POLDER.dat	
ADEOS-2/POLDER	443P 443 490 565 670P 763 765 910 865P	ADEOS2_POLDER.dat	
AQUA/MODIS	412 443 469 488 555 645 858 1240 1640 2130	AQUA_MODIS.dat	
ENVISAT/MERIS	412 442 490 510 560 620 665 681 708 753 760 778 865 885 900	ENVISAT_MERIS.dat	
PARASOL/POLDER	443 490 565 670 763 765 865 910 1020	PARASOL_POLDER.dat	
SPOT-1/HRV1	XS1 XS2 XS3	SPOT1_HRV1.dat	
SPOT-2/HRV2	XS1 XS2 XS3	SPOT2_HRV2.dat	
SPOT-4/HRVIR1	XS1 XS2 XS3 MIR	SPOT4_HRVIR1.dat	
SPOT-4/VEGETATION	B0 B2 B3 MIR	SPOT4_VEGETATION.dat	
SPOT-5/HRG1	XS1 XS2 XS3 MIR	SPOT5_HRG1.dat	
SPOT-5/HRG2	XS1 XS2 XS3 MIR	SPOT5_HRG2.dat	
SPOT-5/VEGETATION	B0 B2 B3 MIR	SPOT5_VEGETATION.dat	

Link to web pages

Spectral bands file format:
1st column: wavelength (μm)
2nd column: solar spectral irradiance (WMO - Werhli reference)



SADE DESERTS DATA

Don't forget [to change](#) regularly your password !

Data are here provided in a tree structure as **Satellite/Sensor/desert site/viewing period**.

Satellites: [ADEOS/POLDER](#) - [ADEOS-2/POLDER](#) - [AQUA/MODIS](#) - [ENVISAT/MERIS](#) - FORMOSAT-2 - KOMPSAT-2 - NOAA-9 - NOAA-11 - NOAA-14 - NOAA-16 - NOAA-17 - [PARASOL/POLDER](#) - [SPOT-1/HRV1](#) - [SPOT-2/HRV2](#) - SPOT-4/HRVIR1 - [SPOT-4/VEGETATION](#) - SPOT-5/HRG1 - SPOT-5/HRG2 - [SPOT-5/VEGETATION](#) - TERRA - THEOS

Data are also provided in a tree structure as **desert site/all satellites, all sensors, all viewing period**.

Sites: [Algerie 1](#) - [Algerie 2](#) - [Algerie 3](#) - [Algerie 4](#) - [Algerie 5](#) - [Arabie 1](#) - [Arabie 2](#) - [Arabie 3](#) - [Egypte 1](#) - [Libye 1](#) - [Libye 2](#) - [Libye 3](#) - [Libye 4](#) - [Mali 1](#) - [Mauritanie 1](#) - [Mauritanie 2](#) - [Niger 1](#) - [Niger 2](#) - [Niger 3](#) - [Soudan 1](#)

The Format of the data issued from the SADE DataBase is:

ASCII File containing a set of lines, each line containing:

- ▶ Site area size (number of pixels)
- ▶ Latitude (deg, [-90°;+90°], convention North positive)
- ▶ Longitude (deg, [-180°;+180°], convention East Positive)
- ▶ Solar azimuth angle (deg) [0°;360°] counted from North (North = 0°, East=90°)
- ▶ Solar zenith angle (deg) [0°;90°]
- ▶ Water vapour content (g.cm²) [0.01 , 10]
- ▶ Ozone content (cm.atm) [0.08 , 0.6]
- ▶ Surface pressure (mbar) [650 , 1100]

SADE DATA ACCESS

▶ **Format**

The Format of the data issued from the SADE DataBase is:

ASCII File containing a set of lines, each line containing:

- ▶ Site area size (number of pixels)
- ▶ Latitude (deg, [-90°;+90°], convention North positive)
- ▶ Longitude (deg, [-180°;+180°], convention East Positive)
- ▶ Solar azimuth angle (deg) [0°;360°] counted from North (North = 0°, East=90°)
- ▶ Solar zenith angle (deg) [0°;90°]
- ▶ Water vapour content (g.cm²) [0.01 , 10]
- ▶ Ozone content (cm.atm) [0.08 , 0.6]
- ▶ Surface pressure (mbar) [650 , 1100]
- ▶ Surface wind speed (m.s⁻¹) (999.9 for deserts)
- ▶ Aerosols Optical Depth (at 550 nm) (set to 0.2 for deserts) [0.1 , 10]
- ▶ NO2 (-999 for deserts)
- ▶ Field 1 (-999 for deserts)
- ▶ Field 2 (-999 for deserts)
- ▶ Comment (maximum 32 chars)
- ▶ Viewing date (dd/mm/yy-hh:mm:ss)
- ▶ Product reference (maximum 64 chars)

And a serie of records separated by a space, corresponding to measurements and described as follows:

- ▶ Spectral band serial number
- ▶ Measurement identifier (number)
- ▶ Reflectance mean value (over the area)
- ▶ Reflectance mean value standard deviation
- ▶ Viewing azimuth angle (deg) [0°;360°]
- ▶ Viewing zenith angle (deg) [0°;90°]
- ▶
- ▶ ... repeated as necessary
- ▶ Spectral band serial number
- ▶ Measurement identifier...



Archive through site identification

Libya_4 - Libye_4 Site

All Sade data periodes available for this site are:

- ▶ [1992 01 01-1992 06 30-SPOT1-HRV1-Libye 4.txt](#)
- ▶ [1992 07 01-1992 12 31-SPOT1-HRV1-Libye 4.txt](#)
- ▶ [1992 07 01-1992 12 31-SPOT2-HRV2-Libye 4.txt](#)
- ▶ [1993 01 01-1993 06 30-SPOT1-HRV1-Libye 4.txt](#)
- ▶ [1996 07 01-1996 12 31-ADEOS-POLDER-Libye 4.txt](#)
- ▶ [1997 01 01-1997 06 30-ADEOS-POLDER-Libye 4.txt](#)
- ▶ [1998 01 01-1998 06 30-SPOT4-VEGETATION-Libye 4.txt](#)
- ▶ [1998 07 01-1998 12 31-SPOT4-VEGETATION-Libye 4.txt](#)
- ▶ [1999 01 01-1999 06 30-SPOT4-VEGETATION-Libye 4.txt](#)
- ▶ [1999 07 01-1999 12 31-SPOT4-VEGETATION-Libye 4.txt](#)
- ▶ [2000 01 01-2000 06 30-SPOT4-VEGETATION-Libye 4.txt](#)
- ▶ [2000 07 01-2000 12 31-SPOT4-VEGETATION-Libye 4.txt](#)
- ▶ [2001 01 01-2001 06 30-SPOT4-VEGETATION-Libye 4.txt](#)
- ▶ [2001 07 01-2001 12 31-SPOT4-VEGETATION-Libye 4.txt](#)
- ▶ [2002 01 01-2002 06 30-SPOT2-HRV2-Libye 4.txt](#)
- ▶ [2002 01 01-2002 06 30-SPOT4-VEGETATION-Libye 4.txt](#)
- ▶ [2002 01 01-2002 06 30-SPOT5-VEGETATION-Libye 4.txt](#)
- ▶ [2002 07 01-2002 12 31-AQUA-MODIS-Libye 4.txt](#)
- ▶ [2002 07 01-2002 12 31-SPOT2-HRV2-Libye 4.txt](#)
- ▶ [2002 07 01-2002 12 31-SPOT4-VEGETATION-Libye 4.txt](#)
- ▶ [2002 07 01-2002 12 31-SPOT5-VEGETATION-Libye 4.txt](#)
- ▶ [2002 12 14-2003 12 31-ADEOS2-POLDER-Libye 4.txt](#)
- ▶ [2003 01 01-2003 06 30-AQUA-MODIS-Libye 4.txt](#)
- ▶ [2003 01 01-2003 06 30-SPOT2-HRV2-Libye 4.txt](#)
- ▶ [2003 01 01-2003 06 30-SPOT4-VEGETATION-Libye 4.txt](#)
- ▶ [2003 01 01-2003 06 30-SPOT5-VEGETATION-Libye 4.txt](#)
- ▶ [2003 07 01-2003 12 31-AQUA-MODIS-Libye 4.txt](#)
- ▶ [2003 07 01-2003 12 31-SPOT2-HRV2-Libye 4.txt](#)
- ▶ [2003 07 01-2003 12 31-SPOT4-VEGETATION-Libye 4.txt](#)
- ▶ [2003 07 01-2003 12 31-SPOT5-VEGETATION-Libye 4.txt](#)
- ▶ [2004 01 01-2004 06 30-AQUA-MODIS-Libye 4.txt](#)
- ▶ [2004 01 01-2004 06 30-SPOT2-HRV2-Libye 4.txt](#)
- ▶ [2004 01 01-2004 06 30-SPOT4-VEGETATION-Libye 4.txt](#)

Archive through sensor identification

AQUA Satellite / MODIS sensor

For [AQUA Satellite / MODIS sensor](#), 20 sites are available, for each site, one or several date are available:

- ▶ [Algeria 1](#)
- ▶ [Algeria 2](#)
- ▶ [Algeria 3](#)
- ▶ [Algeria 4](#)
- ▶ [Algeria 5](#)
- ▶ [Arabia 1](#)
- ▶ [Arabia 2](#)
- ▶ [Arabia 3](#)
- ▶ [Egypt 1](#)
- ▶ [Libya 1](#)
- ▶ [Libya 2](#)
- ▶ [Libya 3](#)
- ▶ [Libya 4](#)
- ▶ [Mali 1](#)
- ▶ [Mauritania 1](#)
- ▶ [Mauritania 2](#)
- ▶ [Niger 1](#)
- ▶ [Niger 2](#)
- ▶ [Niger 3](#)
- ▶ [Sudan 1](#)

Example: Libya-4 PARASOL archive 07/2005 to 12/2005

```
15 28.549999 23.389999 247.080002 12.318000 2.105000 0.294900 994.200000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 01/07/2005-11:15:00 P3L1TBG10140
15 28.549999 23.389999 247.080002 12.***** 294900 994.200000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 01/07/2005-11:15:00 P3L1TBG10140
15 28.549999 23.389999 247.080002 12.453000 2.105000 0.294900 994.200000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 01/07/2005-11:15:00 P3L1TBG10140
15 28.549999 23.389999 247.080002 12.520500 2.105000 0.294900 994.200000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 01/07/2005-11:15:00 P3L1TBG10140
15 28.549999 23.389999 247.080002 12.588000 2.105000 0.294900 994.200000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 01/07/2005-11:15:00 P3L1TBG10140
15 28.549999 23.389999 247.080002 12.655500 2.105000 0.294900 994.200000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 01/07/2005-11:15:00 P3L1TBG10140
15 28.549999 23.389999 247.080002 12.724500 2.105000 0.294900 994.200000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 01/07/2005-11:15:00 P3L1TBG10140
15 28.549999 23.389999 247.080002 12.792000 2.105000 0.294900 994.200000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 01/07/2005-11:15:00 P3L1TBG10140
15 28.549999 23.389999 247.080002 12.859500 2.105000 0.294900 994.200000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 01/07/2005-11:15:00 P3L1TBG10140
15 28.549999 23.389999 247.080002 12.928500 2.105000 0.294900 994.200000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 01/07/2005-11:15:00 P3L1TBG10140
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15 28.549999 23.389999 247.080002 13.065000 2.105000 0.294900 994.200000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 01/07/2005-11:15:00 P3L1TBG10140
15 28.549999 23.389999 247.080002 13.134000 2.105000 0.294900 994.200000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 01/07/2005-11:15:00 P3L1TBG10140
15 28.549999 23.389999 239.979996 9.912000 2.209000 0.288900 990.300000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 03/07/2005-11:02:20 P3L1TBG101403
15 28.549999 23.389999 239.979996 9.973500 2.209000 0.288900 990.300000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 03/07/2005-11:02:20 P3L1TBG101403
15 28.549999 23.389999 239.979996 10.036500 2.209000 0.288900 990.300000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 03/07/2005-11:02:20 P3L1TBG10140
15 28.549999 23.389999 239.979996 10.098000 2.209000 0.288900 990.300000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 03/07/2005-11:02:20 P3L1TBG10140
15 28.549999 23.389999 239.979996 10.161000 2.209000 0.288900 990.300000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 03/07/2005-11:02:20 P3L1TBG10140
15 28.549999 23.389999 239.979996 10.224000 2.209000 0.288900 990.300000 -999.000000 0.200000 -999.000000 -999.000000 -999.000000 Desertique 03/07/2005-11:02:20 P3L1TBG10140
15 28.549999 1 22209321 0.246435 0.006649 145.900000 56.780000 443 2 22209322 0.251083 0.006237 145.900000 56.780000 ***** .319273 0.006138 145.900000 56.780000 565 4 2220932
15 28.549999 1 22209330 0.238245 0.006202 142.200000 51.790000 443 2 22209331 0.248665 0.006051 142.200000 51.790000 490 3 22209332 0.321985 0.005964 142.200000 51.790000 565 4 2220933
15 28.549999 1 22209339 0.228840 0.005827 136.900000 46.090000 443 2 22209340 0.244433 0.006260 136.900000 46.090000 490 3 22209341 0.321985 0.006354 136.900000 46.090000 565 4 2220934
15 28.549999 1 22209348 0.223582 0.005428 129.300000 39.780000 443 2 22209349 0.240202 0.006122 129.300000 39.780000 490 3 22209350 0.322386 0.006204 129.300000 39.780000 565 4 2220935
15 28.549999 1 22209357 0.219638 0.005303 117.700000 33.330000 443 2 22209358 0.236574 0.006433 117.700000 33.330000 490 3 22209359 0.322587 0.006371 117.700000 33.330000 565 4 2220936
15 28.549999 1 22209366 0.217616 0.004830 99.760000 27.960000 443 2 22209367 0.234257 0.005645 99.760000 27.960000 490 3 22209368 0.322386 0.005834 99.760000 27.960000 565 4 22209369 0
15 28.549999 1 22209375 0.216908 0.004298 75.190000 25.740000 443 2 22209376 0.235264 0.005152 75.190000 25.740000 490 3 22209377 0.323893 0.005540 75.190000 25.740000 565 4 22209378 0
15 28.549999 1 22209384 0.221155 0.004335 50.620000 27.950000 443 2 22209385 0.238186 0.005317 50.620000 27.950000 490 3 22209386 0.327207 0.005664 50.620000 27.950000 565 4 22209387 0
15 28.549999 1 22209393 0.222773 0.004333 32.660000 33.300000 443 2 22209394 0.239798 0.005305 32.660000 33.300000 490 3 22209395 0.327508 0.005810 32.660000 33.300000 565 4 22209396 0
15 28.549999 1 22209402 0.225301 0.004262 21.050000 39.730000 ***** .242922 0.005279 21.050000 39.730000 490 3 22209404 0.326805 0.006140 21.050000 39.730000 565 4 22209405 0
15 28.549999 1 22209411 0.227020 0.004614 13.460000 46.030000 443 2 22209412 0.246348 0.005569 13.460000 46.030000 490 3 22209413 0.324495 0.006187 13.460000 46.030000 565 4 22209414 0
15 28.549999 1 22209420 0.232582 0.004342 8.268000 51.720000 443 2 22209421 0.249673 0.005409 8.268000 51.720000 490 3 22209422 0.323993 0.005846 8.268000 51.720000 565 4 22209423 0.45
15 28.549999 1 22209429 0.240773 0.004328 4.524000 56.700000 443 2 22209430 0.253501 0.005321 4.524000 56.700000 490 3 22209431 0.323190 0.006187 4.524000 56.700000 565 4 22209432 0.45
15 22209195 0.244817 0.004388 133.500000 63.700000 443 2 22209196 0.247859 0.004530 133.500000 63.700000 490 3 22209197 0.310334 0.004556 133.500000 63.700000 565 4 22209198
15 22209204 0.238245 0.004591 128.900000 60.360000 443 2 22209205 0.244937 0.004532 128.900000 60.360000 490 3 22209206 0.312644 0.004672 128.900000 60.360000 565 4 22209207
15 22209213 0.231874 0.005096 123.200000 56.800000 443 2 22209214 0.242519 0.004905 123.200000 56.800000 490 3 22209215 0.313548 0.004849 123.200000 56.800000 565 4 2220921
15 22209222 0.222166 0.005137 116.100000 53.150000 443 2 22209223 0.238690 0.005061 116.100000 53.150000 490 3 22209224 0.313347 0.004814 116.100000 53.150000 565 4 2220922
15 22209231 0.215391 0.004782 107.300000 49.650000 443 2 22209232 0.235869 0.005091 107.300000 49.650000 490 3 22209233 0.314151 0.005080 107.300000 49.650000 565 4 2220923
15 22209240 0.210638 0.004304 96.540000 46.720000 443 2 22209241 0.233350 0.004928 96.540000 46.720000 490 3 22209242 0.314050 0.004914 96.540000 46.720000 565 4 22209243 0
15 22209249 0.210335 0.004034 84.060000 44.880000 443 2 22209250 0.232141 0.004529 84.060000 44.880000 490 3 22209251 0.314050 0.004462 84.060000 44.880000 565 4 22209252 0
15 22209258 0.212458 0.004156 70.710000 44.550000 443 2 22209259 0.234660 0.004860 70.710000 44.550000 490 3 22209260 0.319474 0.004617 70.710000 44.550000 565 4 22209261 0
15 22209267 0.212458 0.003964 57.750000 45.820000 443 2 22209268 0.236877 0.005098 57.750000 45.820000 490 3 22209269 0.322185 0.005343 57.750000 45.820000 565 4 22209270 0
15 22209276 0.213166 0.004104 46.280000 48.370000 443 2 22209277 0.238086 0.004893 46.280000 48.370000 490 3 22209278 0.321282 0.005357 46.280000 48.370000 565 4 22209279 0
15 22209285 0.215391 0.004023 36.720000 51.690000 443 2 22209286 0.240202 0.004819 36.720000 51.690000 490 3 22209287 0.320478 0.005301 36.720000 51.690000 565 4 22209288 0
15 22209294 0.217110 0.003964 29.010000 55.310000 443 2 22209295 0.243627 0.004681 29.010000 55.310000 490 3 22209296 0.319474 0.005021 29.010000 55.310000 565 4 22209297 0
15 22209303 0.218930 0.004110 22.850000 58.920000 ***** .247053 0.004493 22.850000 58.920000 490 3 22209305 0.319072 0.004746 22.850000 58.920000 565 4 22209306 0
15 22209312 0.220042 0.003641 17.870000 62.350000 443 2 22209313 0.250176 0.004422 17.870000 62.350000 490 3 22209314 0.317566 0.004561 17.870000 62.350000 565 4 22209315 0
15 22209078 0.251795 0.003824 197.300000 57.930000 443 2 22209079 0.258741 0.004734 197.300000 57.930000 490 3 22209080 0.331425 0.005364 197.300000 57.930000 565 4 2220908
15 22209087 0.249570 0.003602 202.000000 53.530000 443 2 22209088 0.257531 0.004604 202.000000 53.530000 490 3 22209089 0.333434 0.005282 202.000000 53.530000 565 4 2220909
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