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# Calibration of SEVIRI / MSG2

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# Calibration of SEVIRI / MSG2
## (reflective bands)

Summary

- Context
- Cross-calibration LEO/GEO over desert sites
- Calibration over oceanic targets
  - Rayleigh scattering
  - Sunglint
- Synergy



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# Context

- SADE (database) / MUSCLE (toolbox) :
  - an operational environment for calibration activities
  - multiple calibration methods : Rayleigh, Desert, Sunglint, Antarctica, Clouds, Moon
  - powerful synergetic analysis
  - developed for “home” sensors, but also for “reference” sensors (MODIS, MERIS…)

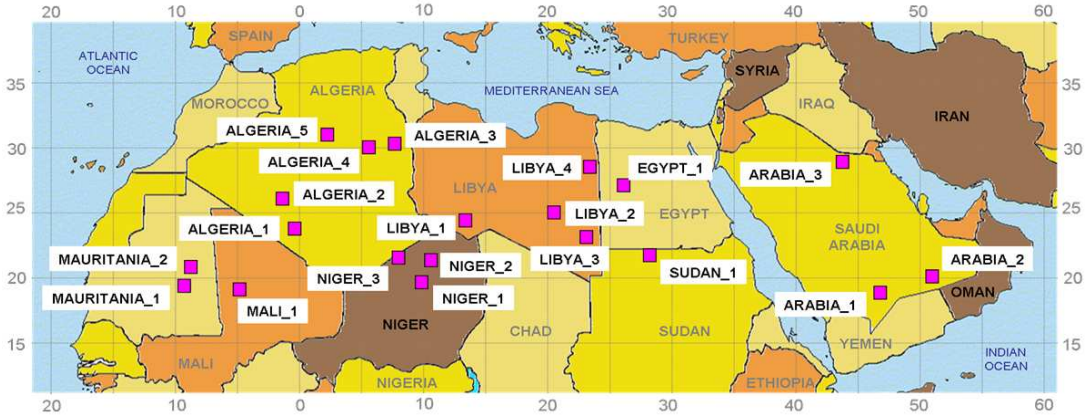
- In the framework of GSICS activities :
  - provide cross-calibrations of LEO/GEO sensors
  - evaluate / adapt methodology for absolute calibration

- Also a need to prepare future GEO missions, i.e. GeOCAPI

- Implement for SEVIRI/MSG2 reflective spectral bands :
  - Cross-calibration with LEO sensors over desert sites
  - Absolute calibration over Rayleigh scattering (red band)
  - Inter-band calibration over Sunglint (from VIS to SWIR)
  - Cross-compare all results - synergy

# Cross-calibration over Desert Sites

- Based on acquisitions
  over 20 desert sites
  - ✦ Available through EUMETSAT
    - » Extractions over sites
    - » Cloud mask for the full disk

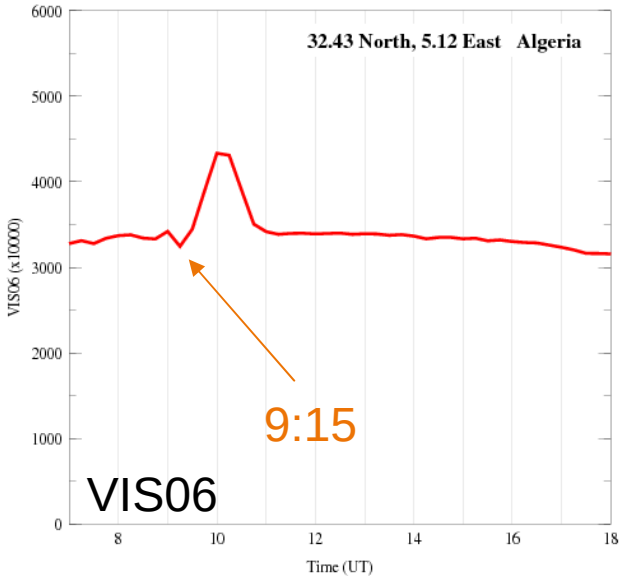


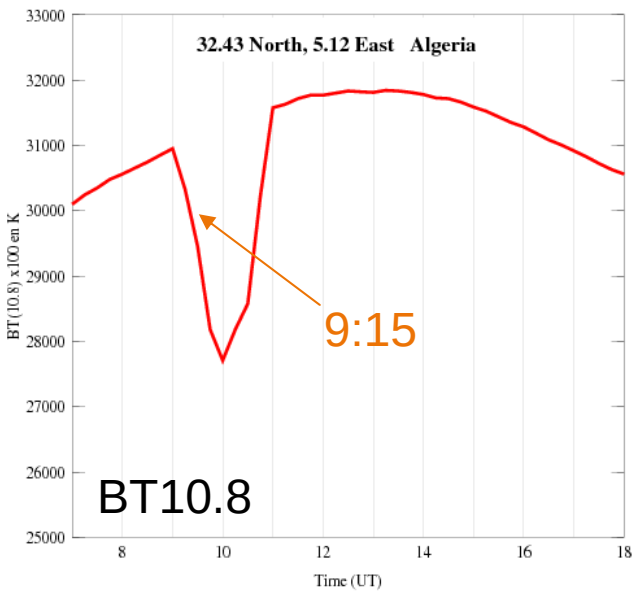

- Selection / Cloud screening is crucial
  - ✦ desert = very bright targets
  - ✦ Govaerts & Clerici approach
  - ✦ the SMAOL cloud mask
  - ✦ test already existing mask

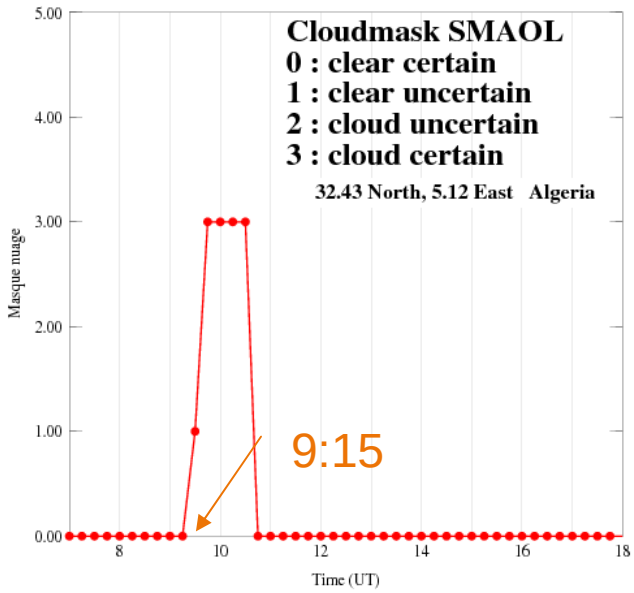
- Study by HYGEOS/CS-SI (CNES grant)
  - ✦ optimize the selection/cloud screening methodology (outside SADE/MUSCLE)
  - ✦ implement the calibration step (on SADE/MUSCLE)
  - ✦ data collected through ICARE-CGTD

# Cross-calibration over Desert Sites

- Selection / Cloud screening is crucial
  - desert = very bright targets → still difficult to catch some clouds
  - the SMAOL cloud mask
    - » available in ICARE, developed for MODIS, available from SEVIRI aerosol product
    - » uses combination of VIS/SWIR/TIR bands → provides classification clear/uncertain/cloud
    - » more robust than standard cloud mask
  - Govaerts & Clerici approach
    - » polynomial variation of the diurnal signal
    - » efficient for clear day but problematic for partly cloudy days



# Cross-calibration over Desert Sites

- Selection / Cloud screening is crucial
  - the SMAOL cloud mask was selected
- Data
  - test archive : from 01/01/2009 to 01/08/2010
  - 1 full day (every 15') every 10 days to limit amount of data
- Selected/extracted data were inserted into SADE
- MUSCLE cross-calibration with : MODIS/AQUA, MERIS, PARASOL, VGT2
  - validation not completed today :
    - Preliminary results on 2 sites Algeria-3 and Libya-4
  - anomaly on MODIS matchups - under investigation
  - cross-calibration preliminary results :
    - VIS06 and VIS08 with VGT2, PARASOL, and MERIS
    - NIR16 with VGT2



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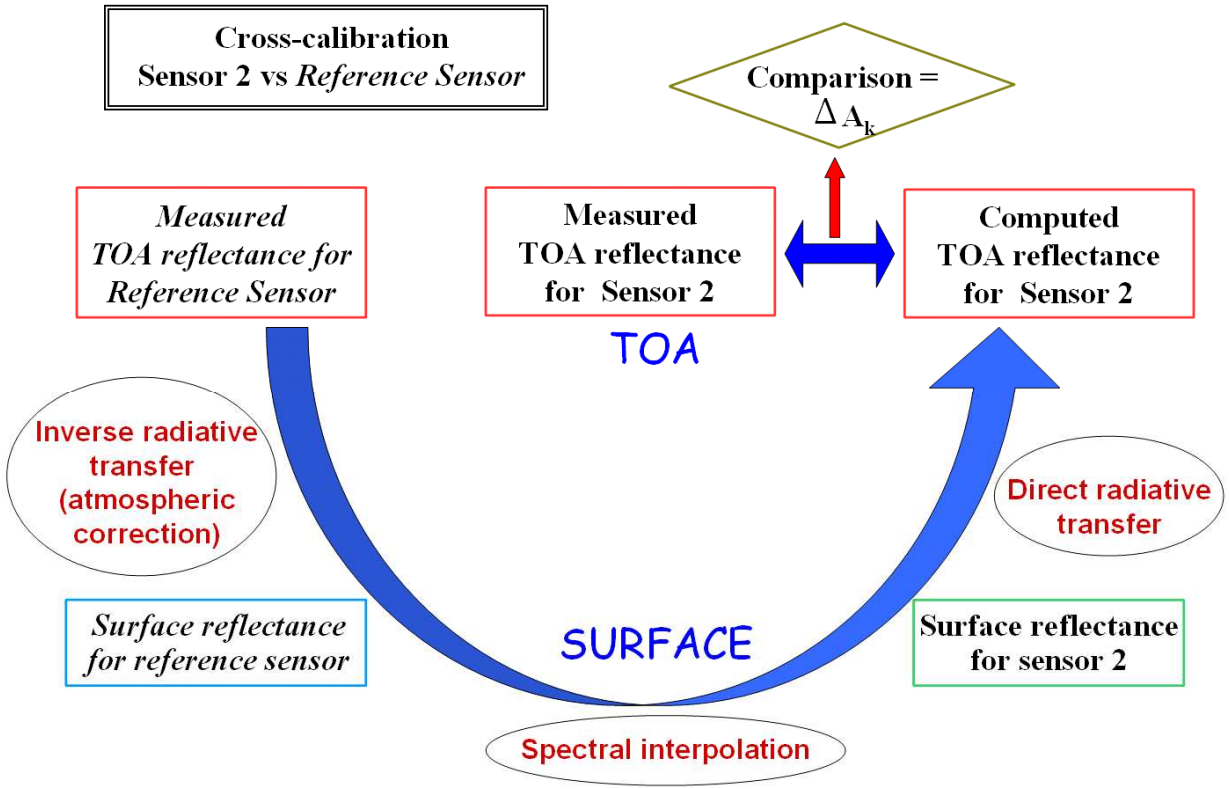
# Cross-calibration over Desert Sites

- Cross-calibration loop

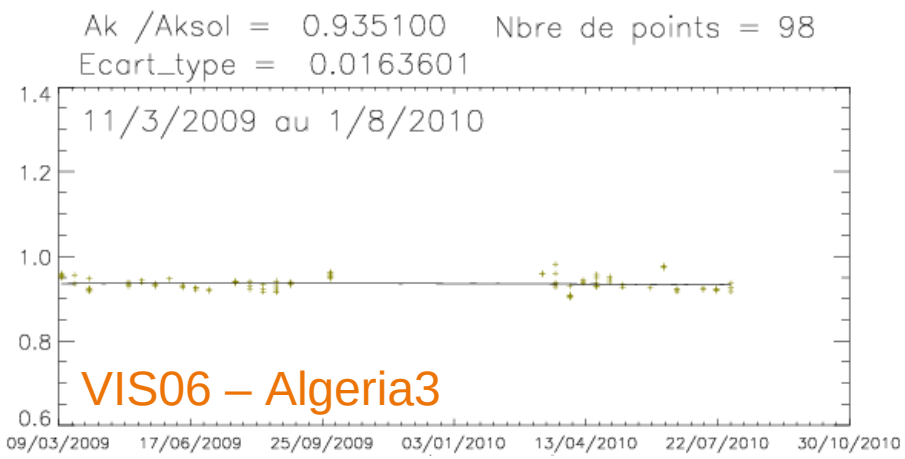
  2 important steps to predict the observed reflectance :

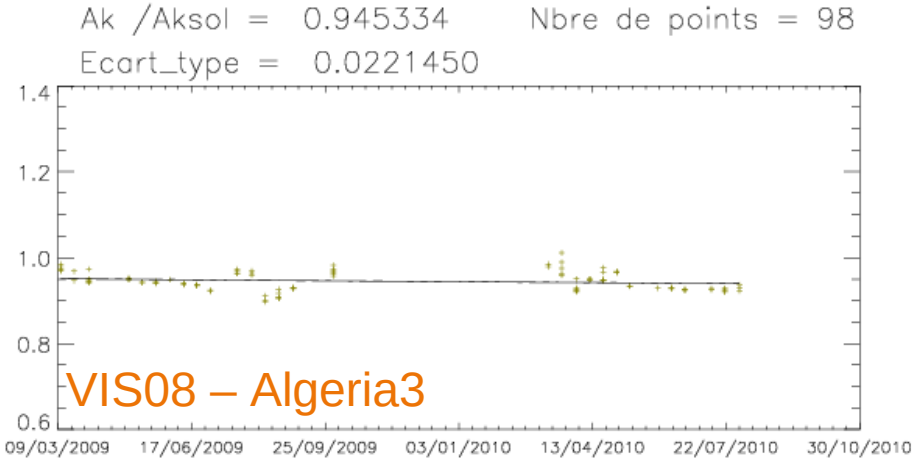
  - The geometrical matching
    - » 1 measurement to calibrated linked with one reference measurements <u>in the same geometry</u> but not necessarily the same date
  - The spectral interpolation
    - » surface reflectance from reference sensor are interpolated and weighted by the SEVIRI-ISR

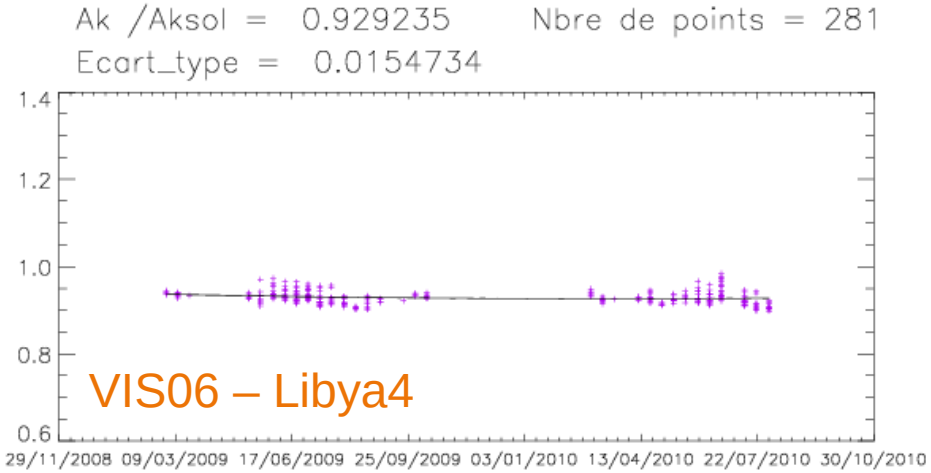


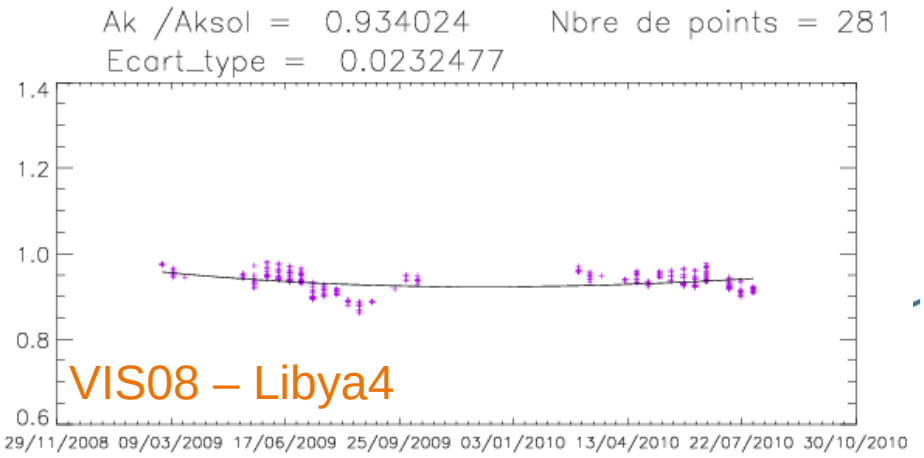
# Cross-calibration over Desert Sites

Preliminary results : MERIS as reference



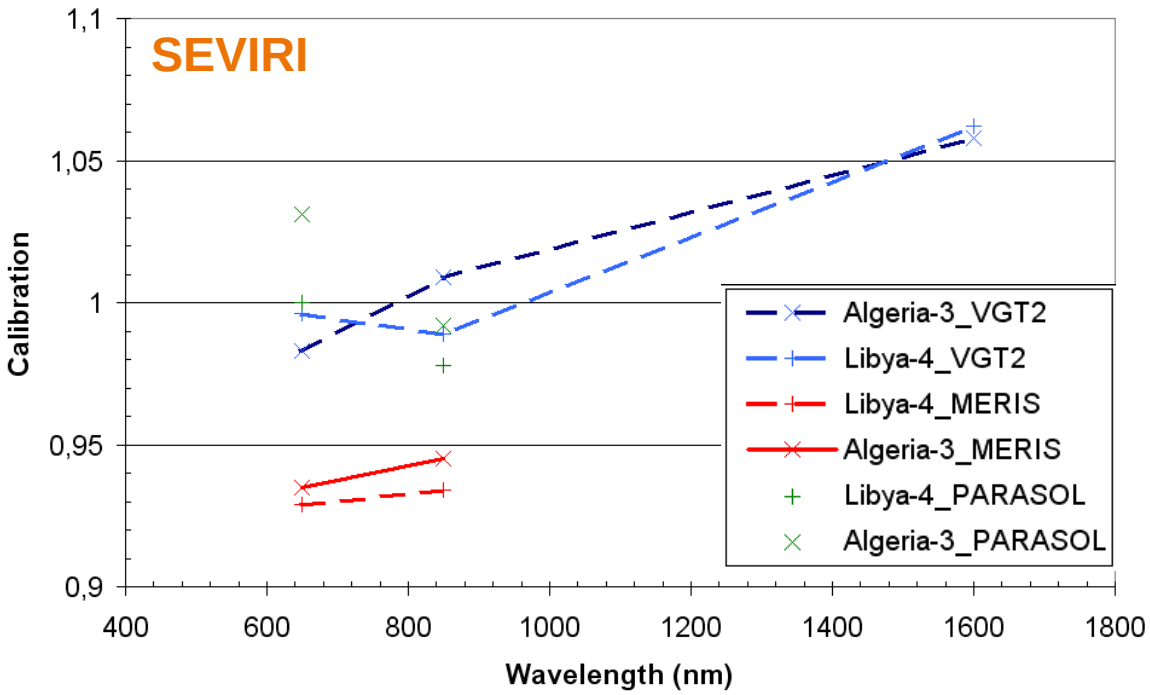



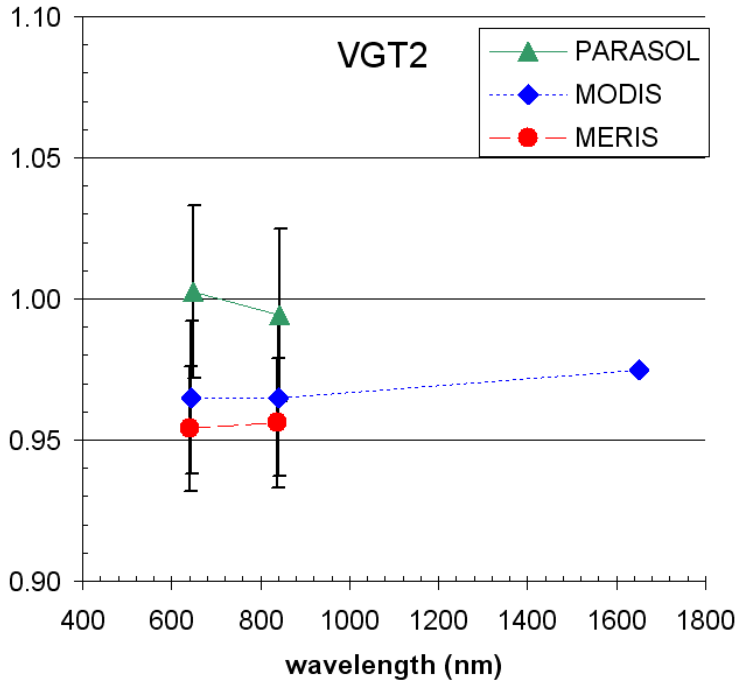



# Cross-calibration over Desert Sites

Preliminary results




according Lachérade et al.,
in press, *IEEE TGARS*, 2013

# Cross-calibration over Desert Sites

On-going activities

- Complete the validation
- Analyze matchups with MODIS/MERIS/VGT2/PARASOL for all sites

- 1st step = Construct the archive
  - ✦ confirm the strategy 1 day every 10 days
    - » or alternative every hour/every day, or other…

- 2nd step = Setup the operational procedure for routine processing
  - ✦ identify the best strategy
    - » for data downloading
    - » for preprocessing (selection)

# Calibration over Rayleigh Scattering

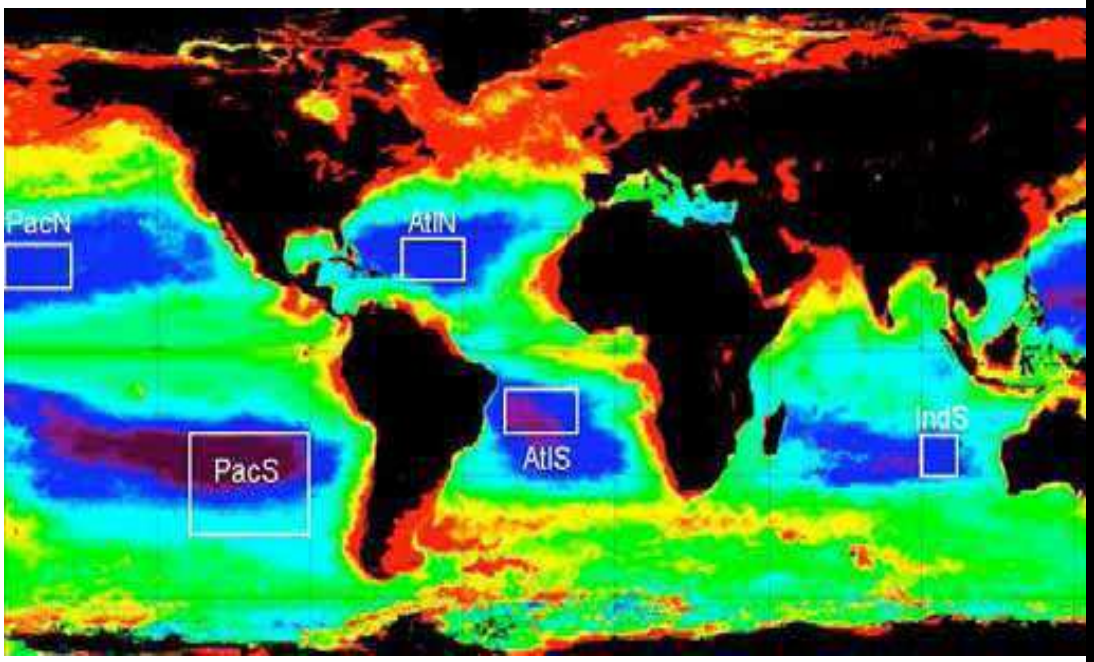
- Applicable for VIS06 band
  - but in the future for all VIS bands from 400 to 650nm

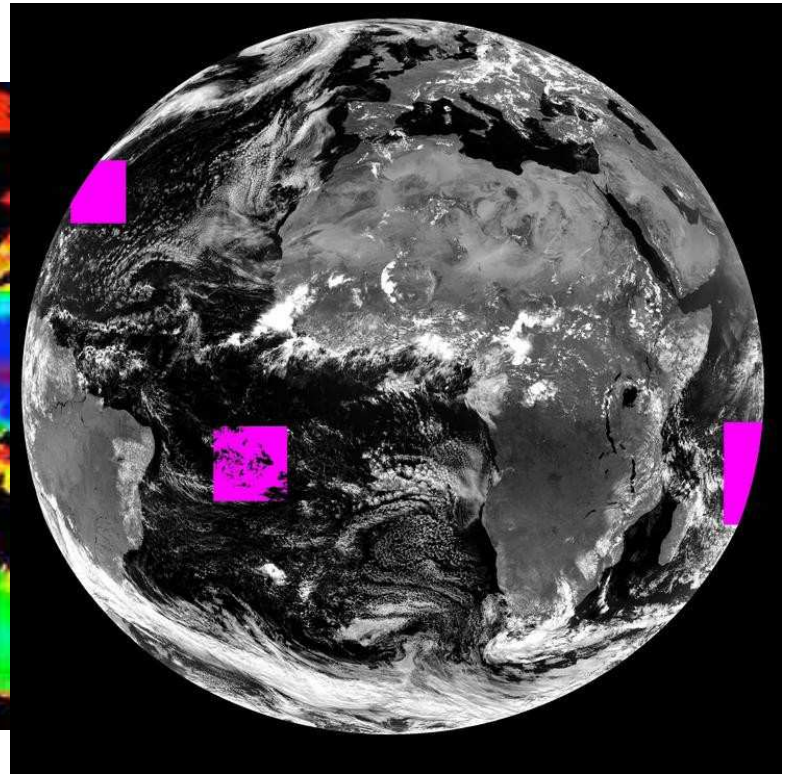
- Previous study (R&D) showing the possibility for SEVIRI
- Move to the SADE/MUSCLE environment
  - Need some optimization
    - Only 2 of the 6 operational oceanic sites are possible
  - Usual geometrical/radiometric criteria were applied
    - avoid clouds, avoid sunglint, avoid whitecaps
    - avoid doubtful situation (use of VIS08)
  - A huge amount of data are selected
    - again 1 day, every 10 days → need feedback to adjust this strategy
  - Extraction was performed for a 18 months archive (01/01/09 to 01/08/10)
  - Data are being inserting into SADE
    - No “new” operational result available today but coming very soon

# Calibration over Rayleigh Scattering

- Oceanic Sites

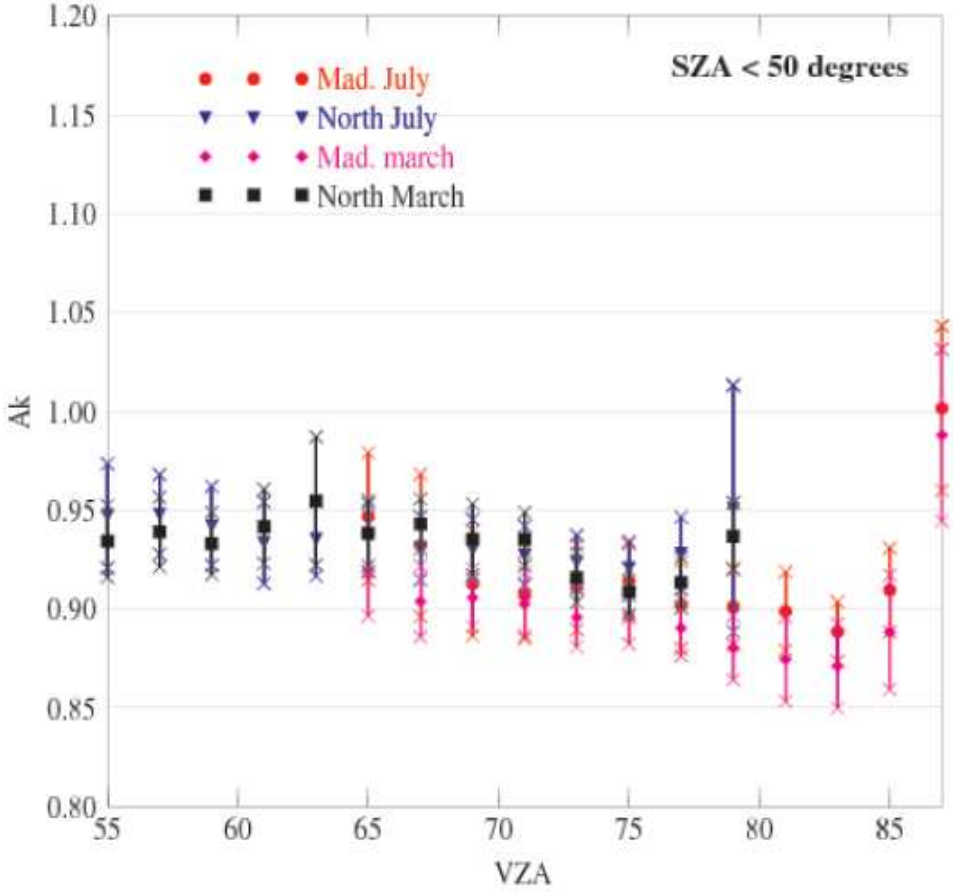
6 operational sites (recommended)



# Calibration over Rayleigh Scattering

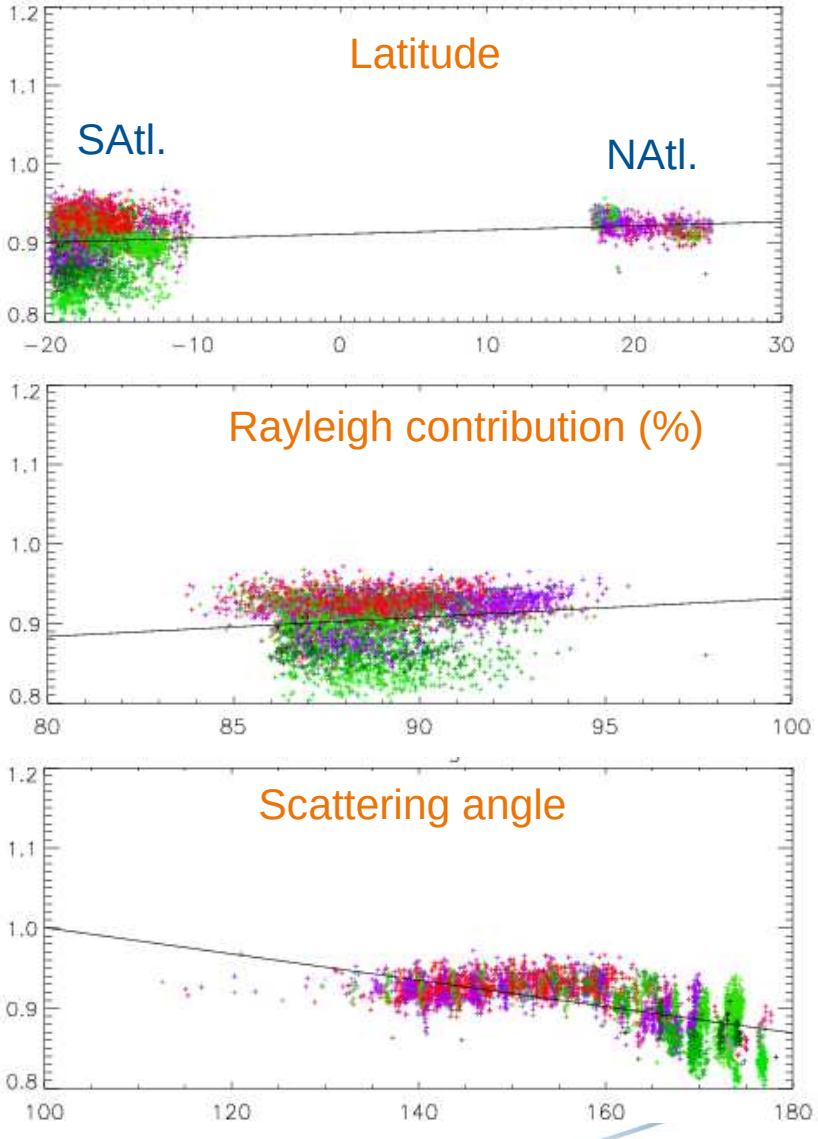
- Previous result from
  - experimental phase from CNES R&T (outside SADE/MUSCLE)
  - to be confirmed soon…




From Jolivet et al., Rayleigh calibration of SEVIRI, Eumetsat conference, 2009.

# Calibration over Rayleigh Scattering

- Very preliminary results from MUSCLE
  - ✦ validation set – Band VIS06
    1/1/2009 to 1/8/2010
    N=4745
  - ✦ confirmation of the previous value
    <Ak>~0.93
  - ✦ clear signature with scattering angle
    error in backscattering
    to be investigated



# Calibration over Sunglint

- Very useful way to inter-calibrate VIS and SWIR bands
  - Sunglint = white signal from VIS to SWIR (nearly)
  - some corrections are required : atmosphere, surface for shorter bands
    - Operational method need acquisitions over oceanic sites (same as Rayleigh)
- Successfully used for VGT/PARASOL/MERIS sensors
- Analysis of the possibility to use this approach for SEVIRI
  - quantify if sunglint is observable over usual oceanic sites (AtlN, AtlS)
  - usual geometrical/radiometric criteria to be applied
    - avoid clouds (local variance), avoid whitecaps
    - avoid doubtful situation, mainly aerosol (atmospheric turbidity)

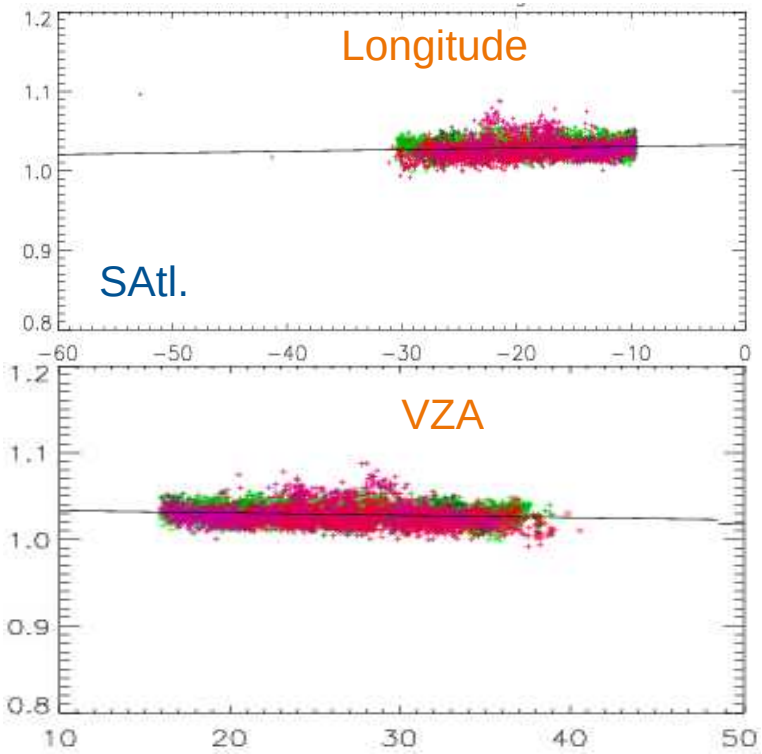
    exogenous data, index to detect excessive turbidity, use of out-of-glint observation (~2H earlier)
  - a huge amount of data are selected
    - again 1 day, every 10 days → need feedback to adjust this strategy
  - extraction was performed for a 18 months archive (01/01/09 to 01/08/10)
  - data are being inserting into SADE
    - No result available today but coming very soon

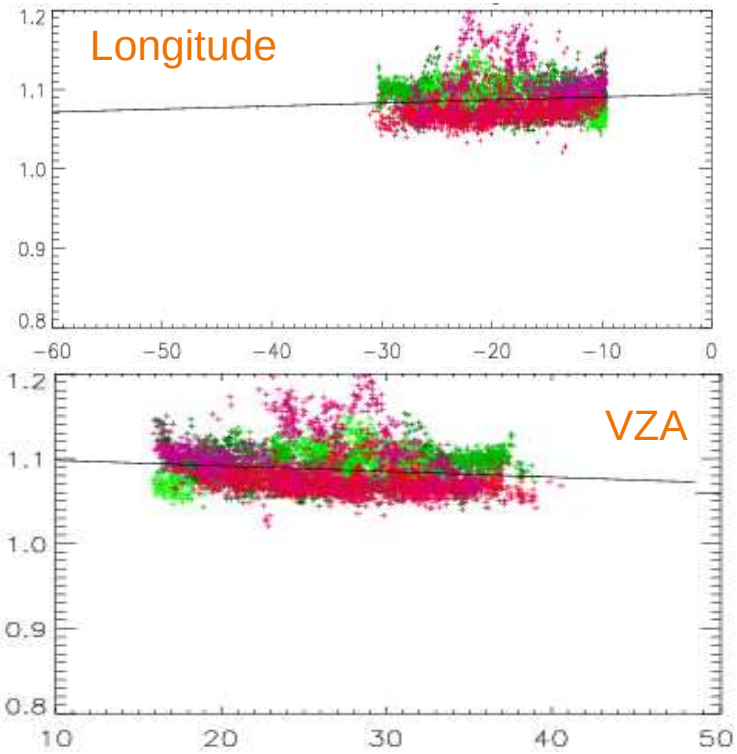
# Calibration over Sunglint

- Preliminary results
  - ✦ validation set – 1/1/2009 to 11/2/2010 over SAtl.

<AkVIS08>=1.028 wrt reference VIS06
<AkNIR16>=1.085 wrt reference VIS06

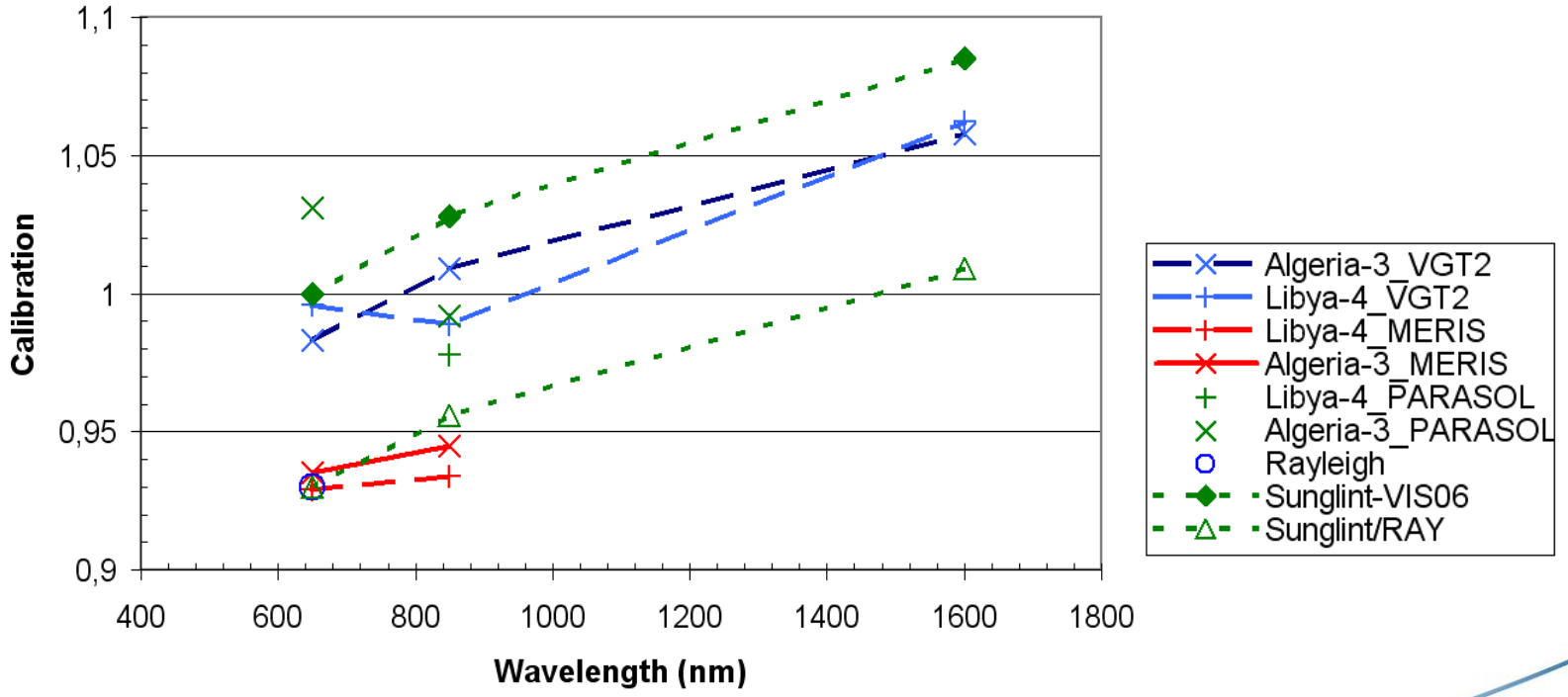
<AkVIS08>=0.958 considering Rayleigh(VIS06)
<AkNIR16>=1.010 considering Rayleigh(VIS06)



# Calibration over SEVIRI/MSG2

- Synergy from preliminary results :
  - ✦ probable bias for VIS06 and VIS08 bands, 7% and 5% respectively
    - » from MERIS cross-cal (and MODIS), from Rayleigh
  - ✦ consistent inter-band gaps : 2% between VIS06/VIS08 and 5% between NIR16/VIS08
    - » from Desert cross-calibrations, from Sunglint



# Calibration over SEVIRI/MSG2

- For DESERT, RAYLEIGH, SUNGLINT :
- SEVIRI is being now
  - collected on SADE database (at least a sample period)
  - analyzed through operational algorithms MUSCLE
  - synergetic analysis (various methods + various reference sensors) is on-going

- Once validation will be completed

  - The “past” archive has to be constructed
    - not necessarily the same for the 3 methods

  - An operational “routine” processing has to be put in place
    - not necessarily the same for the 3 methods