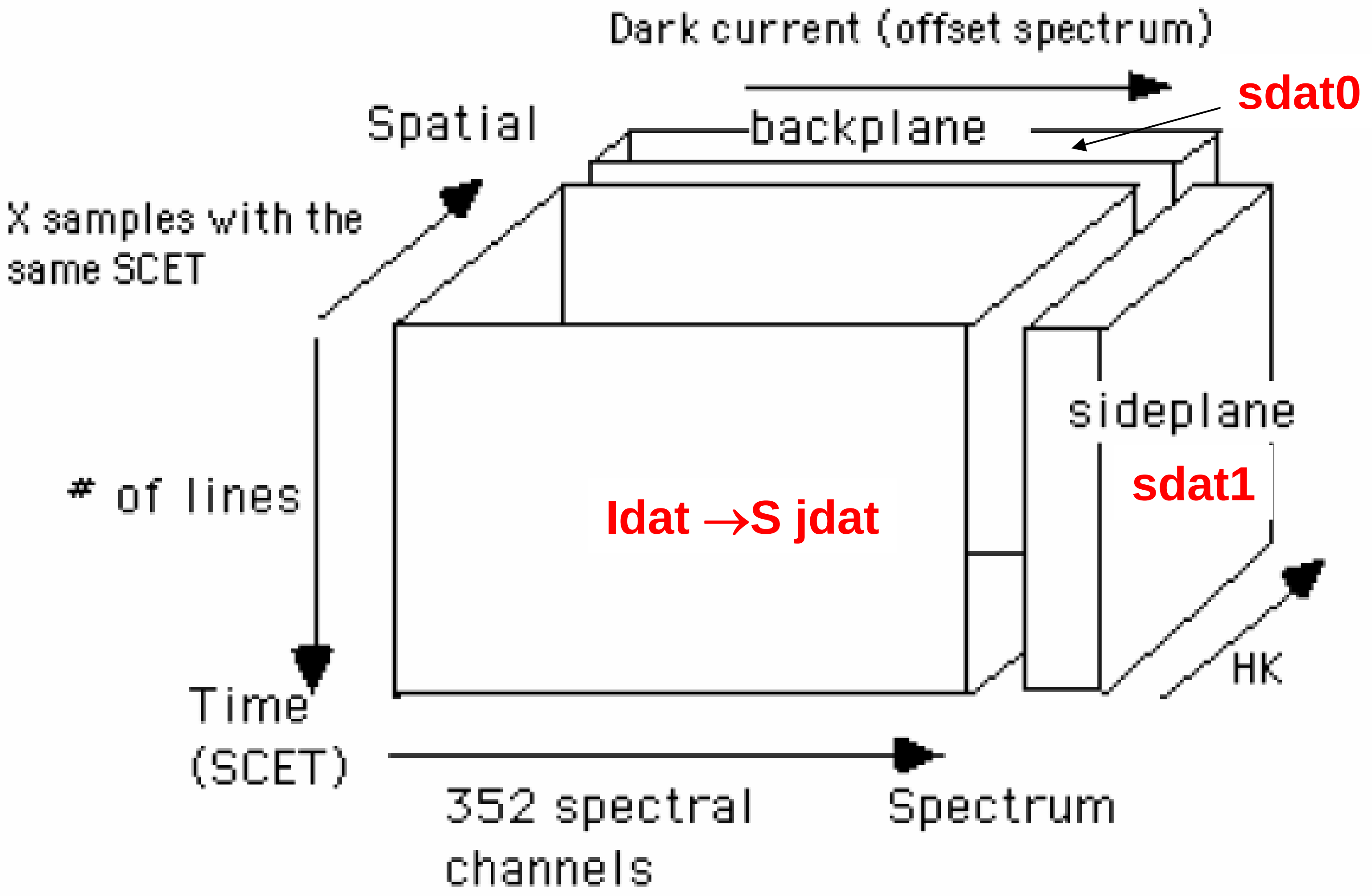
OMEGA dataset

- 2 “cubes” (.QUB & .NAV)
-1 software (readomega.pro under IDL)

OMEGA DATA CUBE ORBNNNN_M.QUB



OMEGA GEOMETRY CUBE (ORBNNNN_M.NAV)

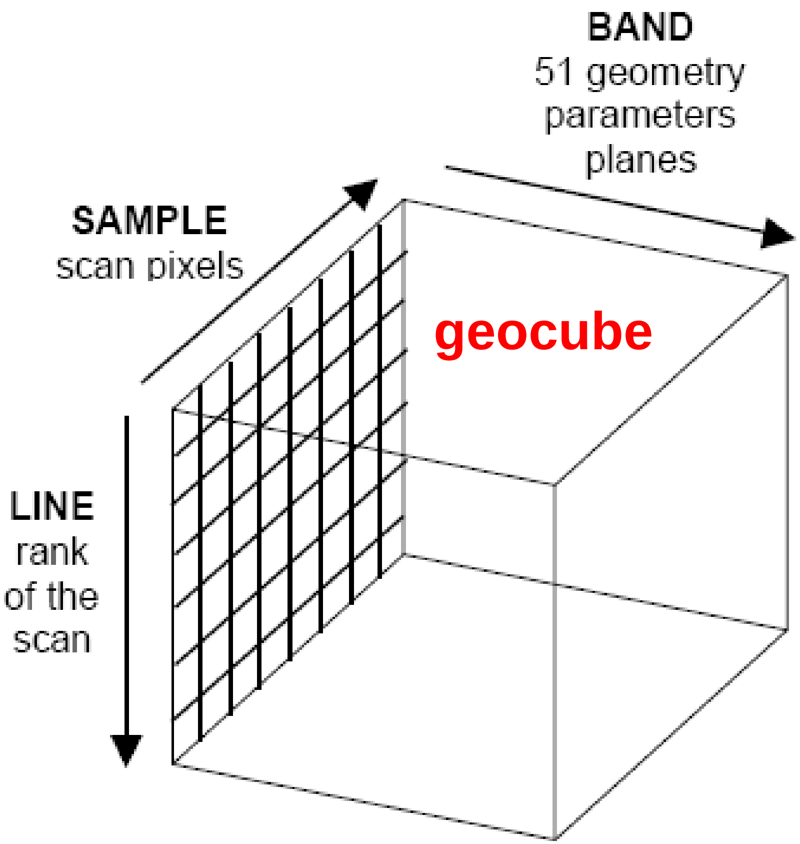


Figure 3 : Conceptual view of the geometry qube

Bands 0-20: SWIR-C

(All angles in units of 0.0001°)

2: incidence wrt reference ellipsoid
3: emergence wrt reference ellipsoid
4: incidence wrt center of Mars
5: emergence wrt center of Mars
6: longitude of the pixel center
7: latitude of the pixel center
8: incidence wrt the local normal (MOLA)
9: emergence wrt the local normal
10: phase wrt the local normal
11: slant distance (meters)
12: MOLA elevation (meters)
13-16: longitude of the 4 corners
17-20: latitude of the 4 corners

Bands 21-35: same as 16-20 for SWIR-L
Bands 36-50: same as 16-20 for VIS

First cut at positioning. Can be off by

THE OMEGA REDUCTION SOFTWARE (IDL)

- provided as a ZIP file in the SOFTWARE directory (present revision: SOFT05.ZIP)

- unzipping the latest ZIP file creates a subdirectory SOFTNN

- all files from the SOFTNN subdirectory must be copied to the working directory
  A users' guide and information on updates is provided in SOFTNN_readme.txt

- omega_path must be edited so as to point to the proper directories
  for the QUB and NAV files respectively (which can be the same)
  the path must end with a \ for windows, with a / for linux

- a QUB file and its NAV file can then be read by typing:
  IDL *(CR)*
  IDL> .run readomega *(CR)*
  OMEGA observation: ORBNNNN_M *(CR)* (name without the extension)

- readomega compiles required procedures, then creates the following arrays

idat: raw data	sdat0: dark current and offset
jdat: radiance	sdat1: housekeeping info
specmars: solar spectrum (→ I/F)	wvl: table of wavelengths
geocube: geometry information	mtf: photometric function
exposure: 3 values (C, L, Vis)	summation: co-added successive scans

- detailed information on the content of these arrays is provided in the EAICD
  (/doc repertory in PSA)

OMEGA DATA SET AND ARCHIVE

- Access through the Planetary Science Archive
  at ESAC with a mirror in the PDS data base

- increasing numbers of bad pixels with time

The data and tools available to the « wide science community »
are those available to CoI's during the proprietary period

- Basic policy :

  - no « final truth » calibrated data set (level 2)

  - level 1B is the prime data set, with associated geometry cubes
    (for each pixel: longitude, latitude, incidence, emergence, phase,
    distance, MOLA altitude)

  - reduction software to level 2 is provided (IDL)

Main derived variables of interest (see EAICD for details)

Radiance factor: jdat(*,k,*)/specmars(k) for k=0,351
Cos(incidence): $\cos(\text{geocube}(*,2,*) * 1.e^{-4} * !\text{dtor})$
Reflectance factor: Radiance factor / cos(incidence)
Distance S/C to pixel center : $\text{geocube}(*,10,*) * 1.e^{-4}$
MOLA altitude: $\text{geocube}(*,11,*) * 1.e^{-4}$
MOLA local incidence: $\cos(\text{geocube}(*,8,*) * 1.e^{-4} * !\text{dtor})$

Center longitude: $\text{geocube}(*,6,*) * 1.e^{-4}$ (C channel)
Center latitude: $\text{geocube}(*,7,*) * 1.e^{-4}$ (C channel)

Relative positionning is very good for 16, 32 and 64 pixel modes.
A small correction is needed for 128 pixel modes, it will be
Included in a future release

Absolute positioning can be off by several km
(1 sec along track: 4 km at pericenter)

Repositioning the cube is required

REPOSITIONNING A CUBE

- agreed upon referential for Mex: IAU 2000 (East longitudes)

- available information:
  - MOLA derived variables (geocube): altitude, local incidence
  - Viking HR mosaic (MAPPS)
  - MGS image data set
  - in progress: MRO data

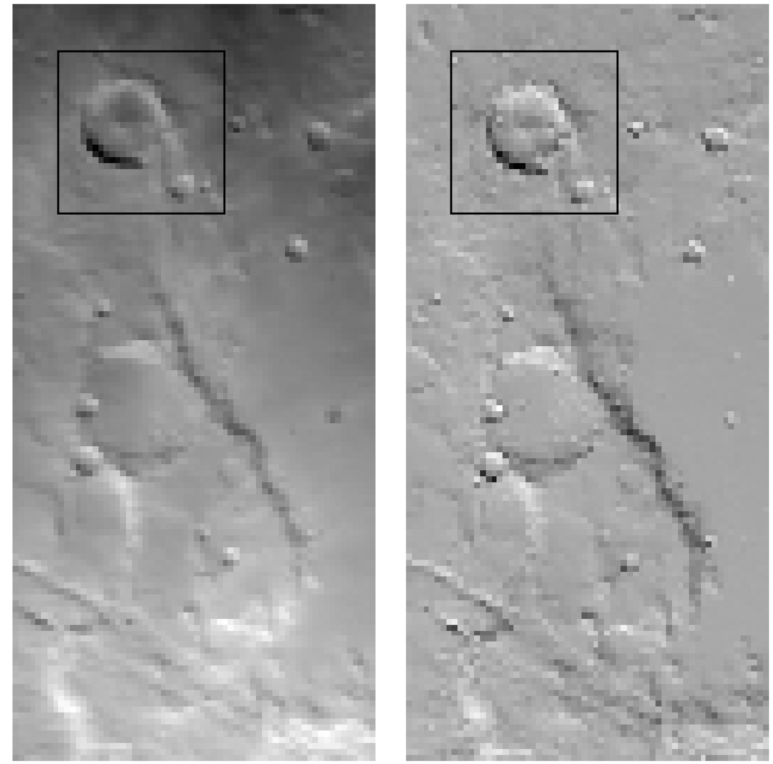
- already available in the data set: MOLA altitude and local incidence

```
local_light_level=cos(geocube(*,8,*)*!dtor*1.e-4)
```

a map of this variable is expected to match the albedo map
at wavelengths < 3.5 µm (no thermal contribution)
if the region is spectrally grey

Example from orbit 1254_3

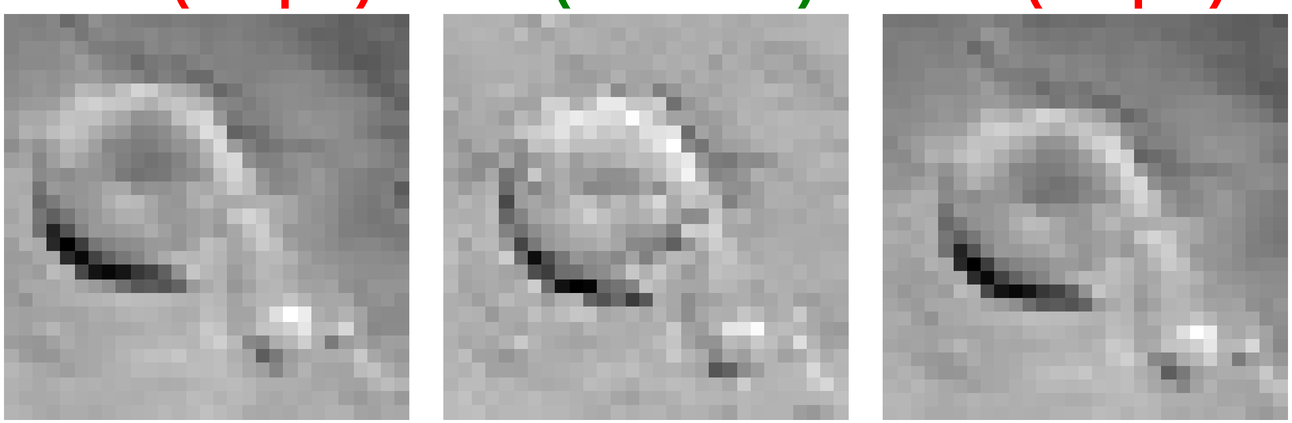
I/F (1.3 µm) cos(local inc.)



applying correlation methods makes it possible to reposition the I/F map relative to MOLA within a fraction of a pixel

the same process is required for each channel

I/F (1.3 µm) cos(local inc.) I/F (1.3 µm)



shift by
2 pixels left
and
1 pixel down

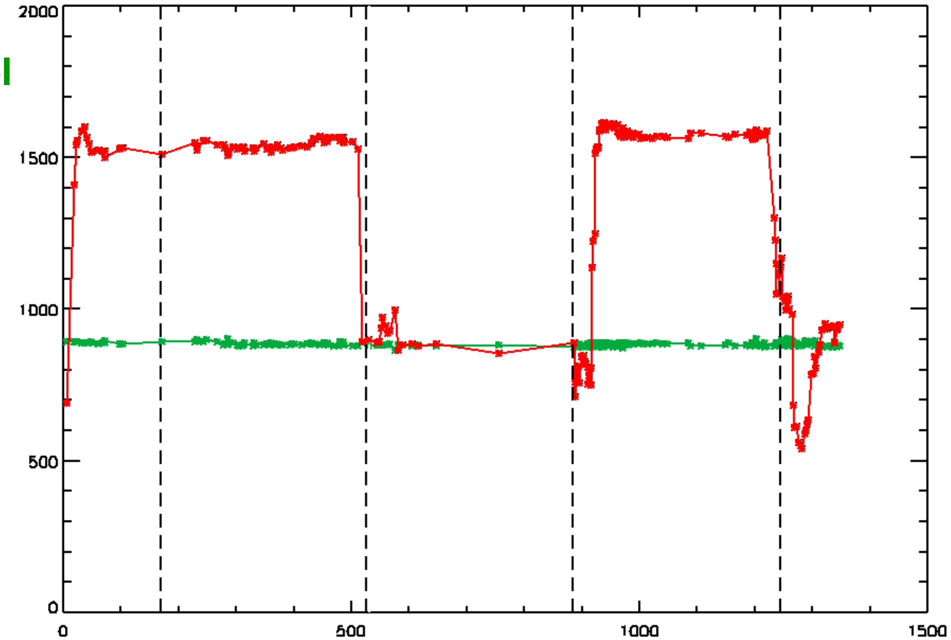
EVOLUTION OF THE L CHANNEL (128 to 255, 2.53 µm to 5.1 µm)

- Internal cal level is very stable for the C channel

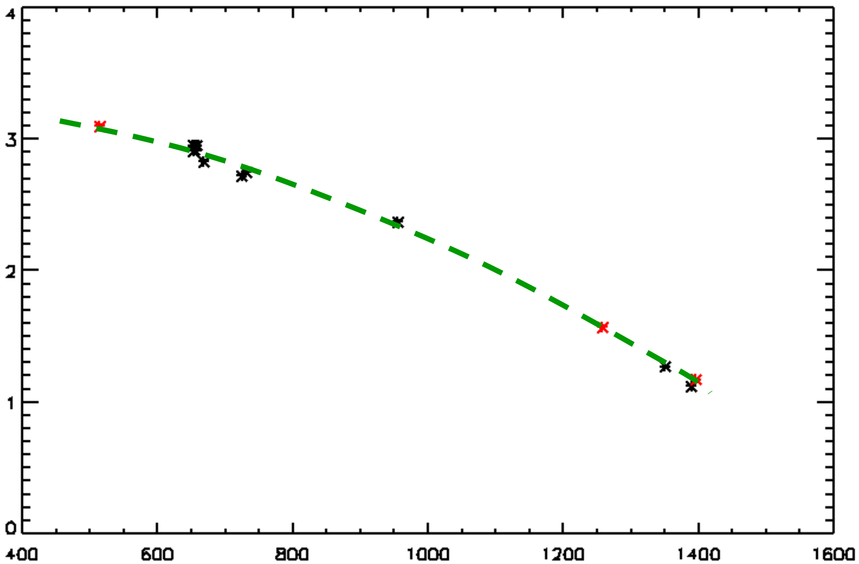
- variations by more than a factor of 2 for the L channel over 1 year of operations

- lesser impact for the signal from Mars

- the photometric function for the L channel applies only to high level regions (close to ground calibration levels):
  - orbits 0018 to 0500
  - orbits 0905 to 1206



Level of internal cal, spectel 102 (green, C) and 165 (red, L)



C to L angular distance / level of the internal cal

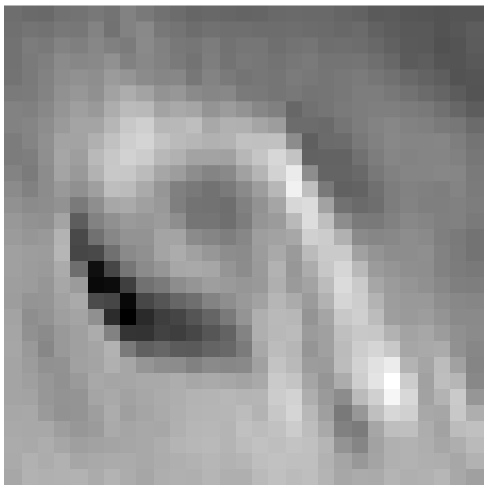
- the C to L angular distance (nominally ~ 1 pixel = 1.2 mrad) increases up to 3 mrad (nearly 3 pixels) for low levels of the internal calibration

  C to L co-registration is required so as to obtain a reliable full spectrum

  common reference: MOLA DTM (provided in geocube)

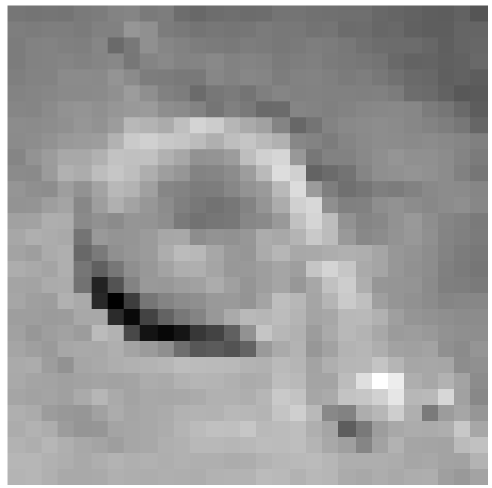
Co-registering the three channels: cube 1254_3

VIS channel
I/F at 0.69 µm

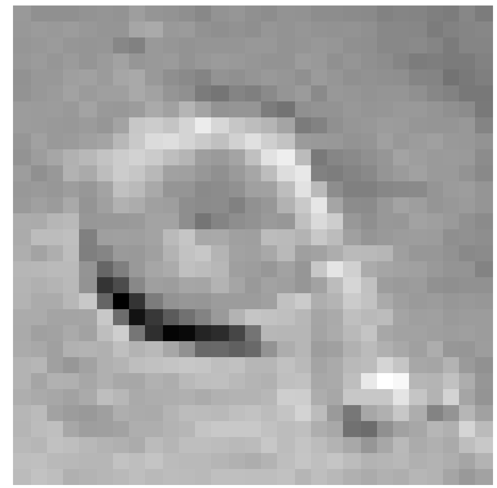


shift by 5 pixels right
shift by 4 pixels down

C channel
I/F at 1.30 µm



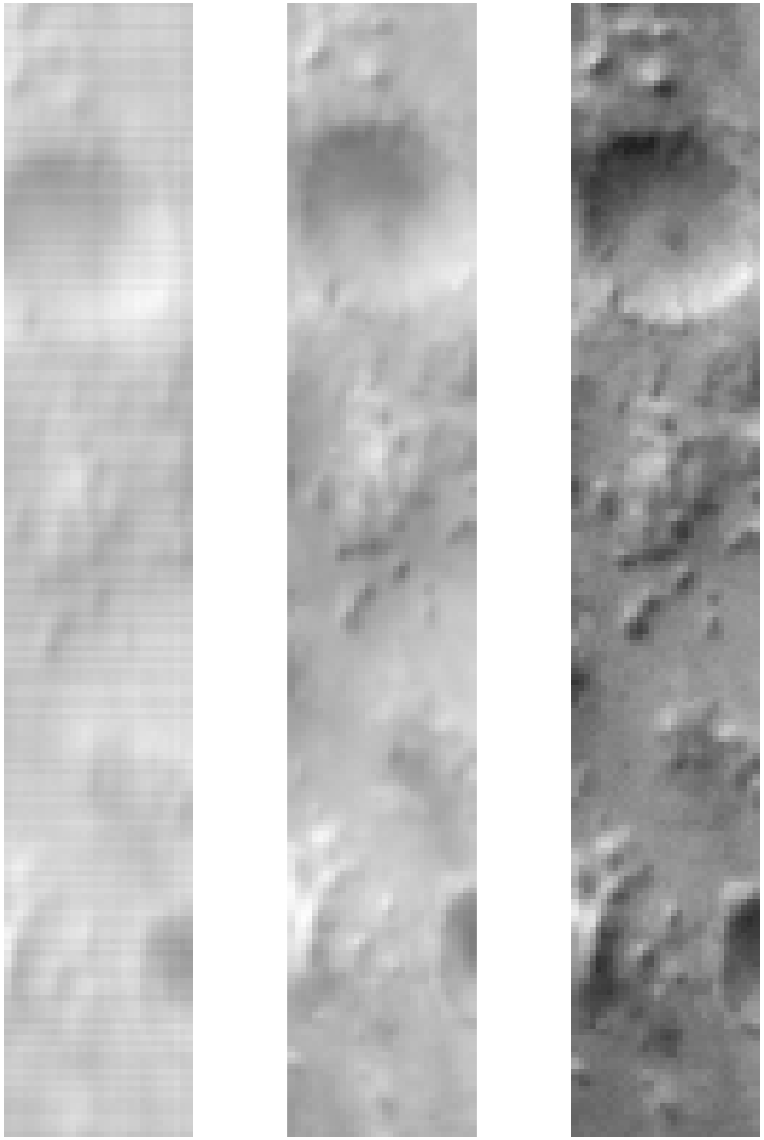
L channel
I/F at 3.52 µm



shift by 2 pixels down

the elongated PSF of the VIS channel impacts the spatial resolution

co-registration of channels, cube 18_01



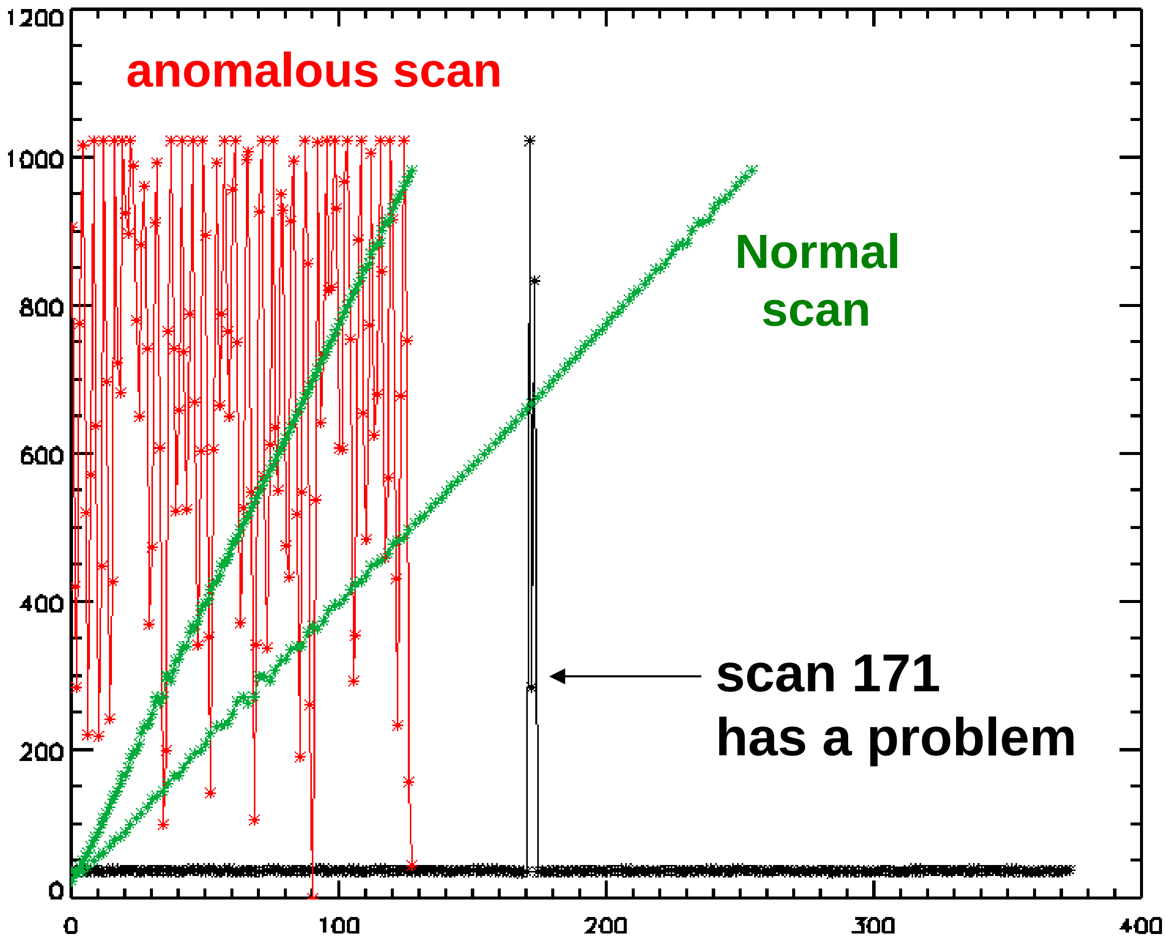
black: 0.5 max, white: max

solar longitude : Ls 333°
(late southern summer)

aerosols:
Optical thickness ~ 1
In the visible

decreases with wavelength:
Improving contrast

SCANNING PROBLEMS AT 128 PIXELS WHEN THE SCANNER IS TOO COLD (< -15 C)



Scan position, pixel 2, 128 pixel mode, cube 1354_3

SCANNER WARM-UP CUBES

- a solution to this problem consists in operating the scanner in a "safe" mode (64 pixels) so as to heat it up

- warm-up 64 pixels cubes are always labeled "NNNN_0" (only when before a 128 pixel cube, some are fully OK) they are stored with high compression (1 bit/data)

- they can include the last stages of detector cooling

- litmus test for using "NNNN_0" cubes: check detector temperatures
  "C" detector: sdat1(0,2, j) where j is the number of the scan
  "L" detector: sdat1(1,2, j) where j is the number of the scan

  Units: 0.001 °C. Valid temperatures: < -190 °C

CONCLUSIONS

- the positioning information provided by SOFTNN is reliable as a first indication. If it goes wild, this is real (the scanner is oscillating at high frequency)

- fine tuning is needed for each channel. Accurate positioning at sub-pixel levels can be achieved by comparing with MOLA slopes, altitudes.

- the offset between the C channel and the L channel depends on the status of the instrument, which can be inferred from the level of the calibration lamp