

# Practice Session 1

## VLT/AMBER Data Reduction

instrument,  
algorithms,  
limitations.

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During this practice you will use the “amdlib” data-reduction package provided by the JMMC to reduce and calibrate typical AMBER observations.

Nowadays, this is pretty straightforward. But, there are some pitfalls to avoid... After all, nothing resembles more a good visibility than a bad...

# AMBER DATA OVERVIEW

AMBER paradigm: *spatially coded, spectrally dispersed, photometrically monitored, fringes.*

Resolution 1500 and 12000 in K.

Resolution ~70 in [J H K]

- **fringes** on an infrared Camera:

  - Cosmetics : *dark frames, bad pixels, flat field.*

- **spectrally dispersed** ... needs *spectral calibration*

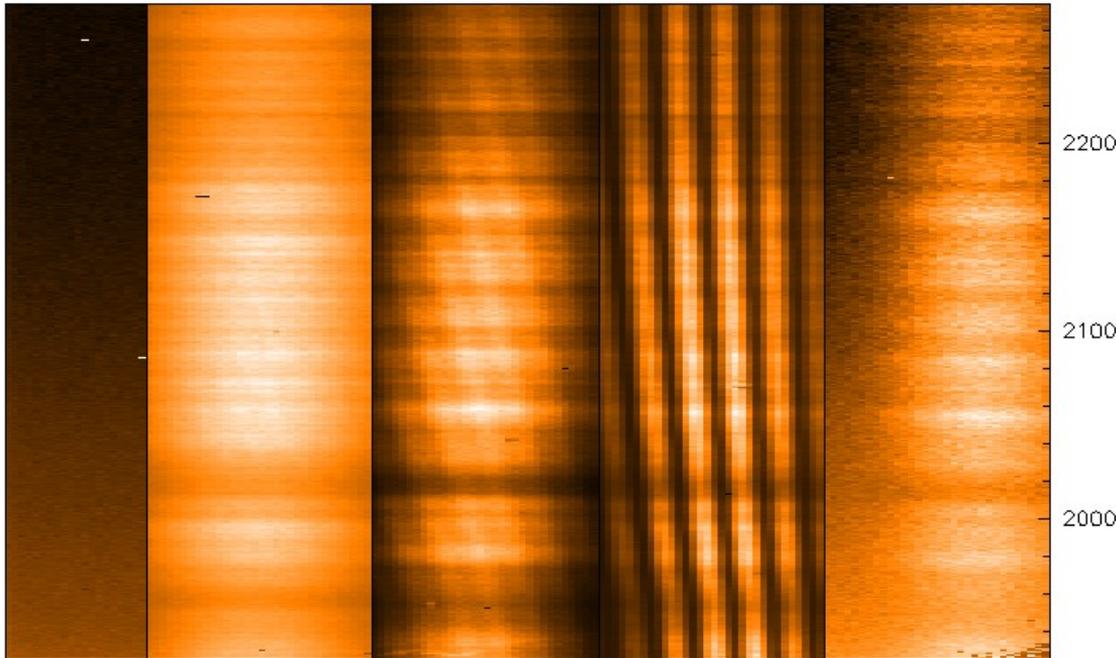
- **Photometrically monitored** ... needs *crossmatch*

  - *between photometry information and interferometry data.*

- **spatially coded** ... needs spatial coding calibration:  
*the P2VM (Pixel-to-Visibility Matrix)*

# WITH AMBER YOU SEE THE FRINGES

/TMP/gildas/AmberData/AMBER.2007-11-20T03:20:01.351.fits Source: HD 38678 Frame 1



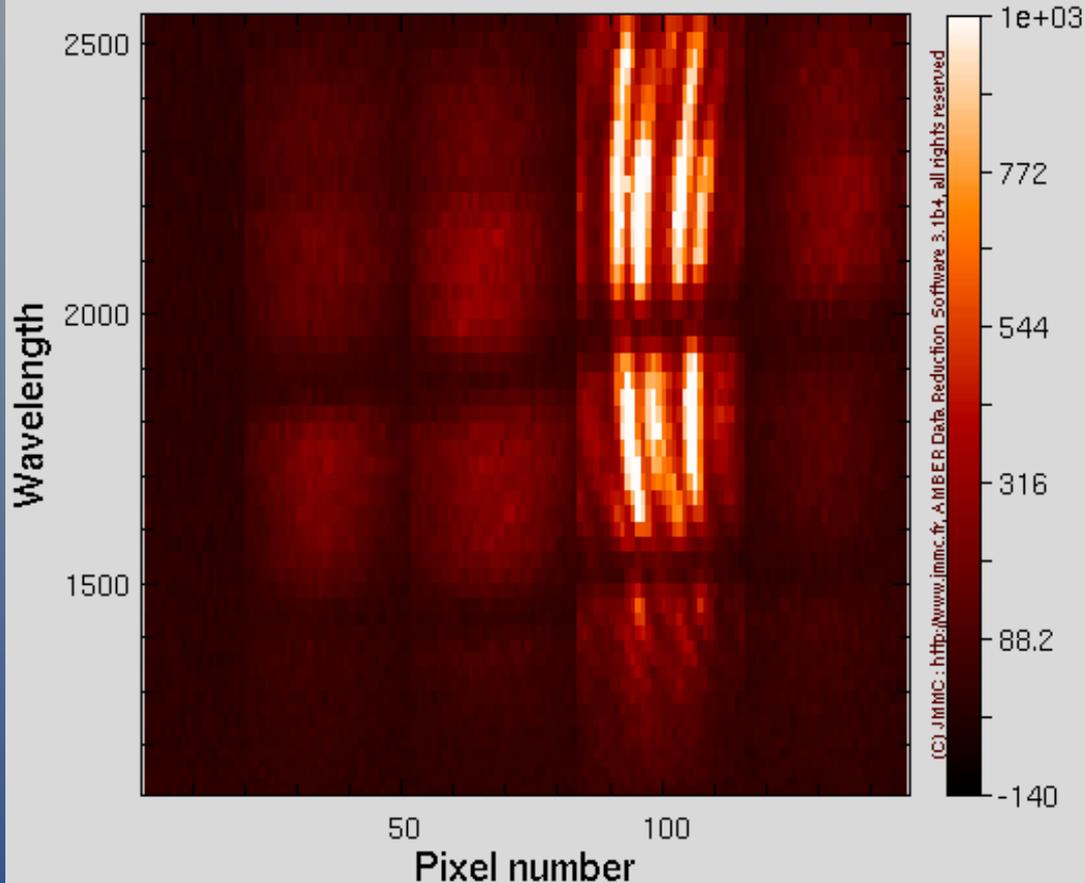
**3 telescopes, 3 beams: 3 sets of fringes, one per pair of telescope.**

**Spatial coding: the spatial frequency of each set is different from the others and do not overlap in fourier plane.**

**3 baselines: 3 complex coherent flux values per spectral element.**

AMBER image "AMBER.2007-12-06T04:21:04.862.fits.gz"

Frame n<sup>0</sup> 1/1000



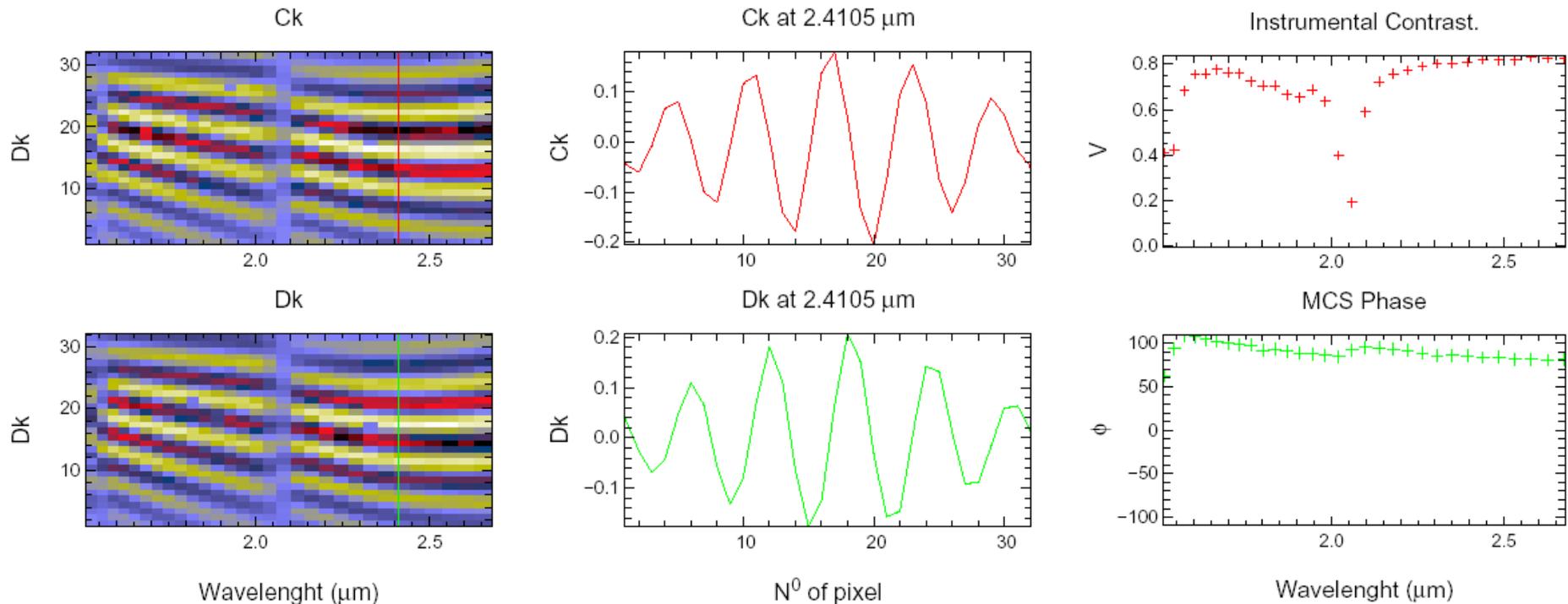
The same in Low resolution JHK mode.

Note the displacement of photometric « channels » : has to be calibrated.

...accurate wavelength calibration of the Interferometric « channel »? **NO** for Low Resolution.

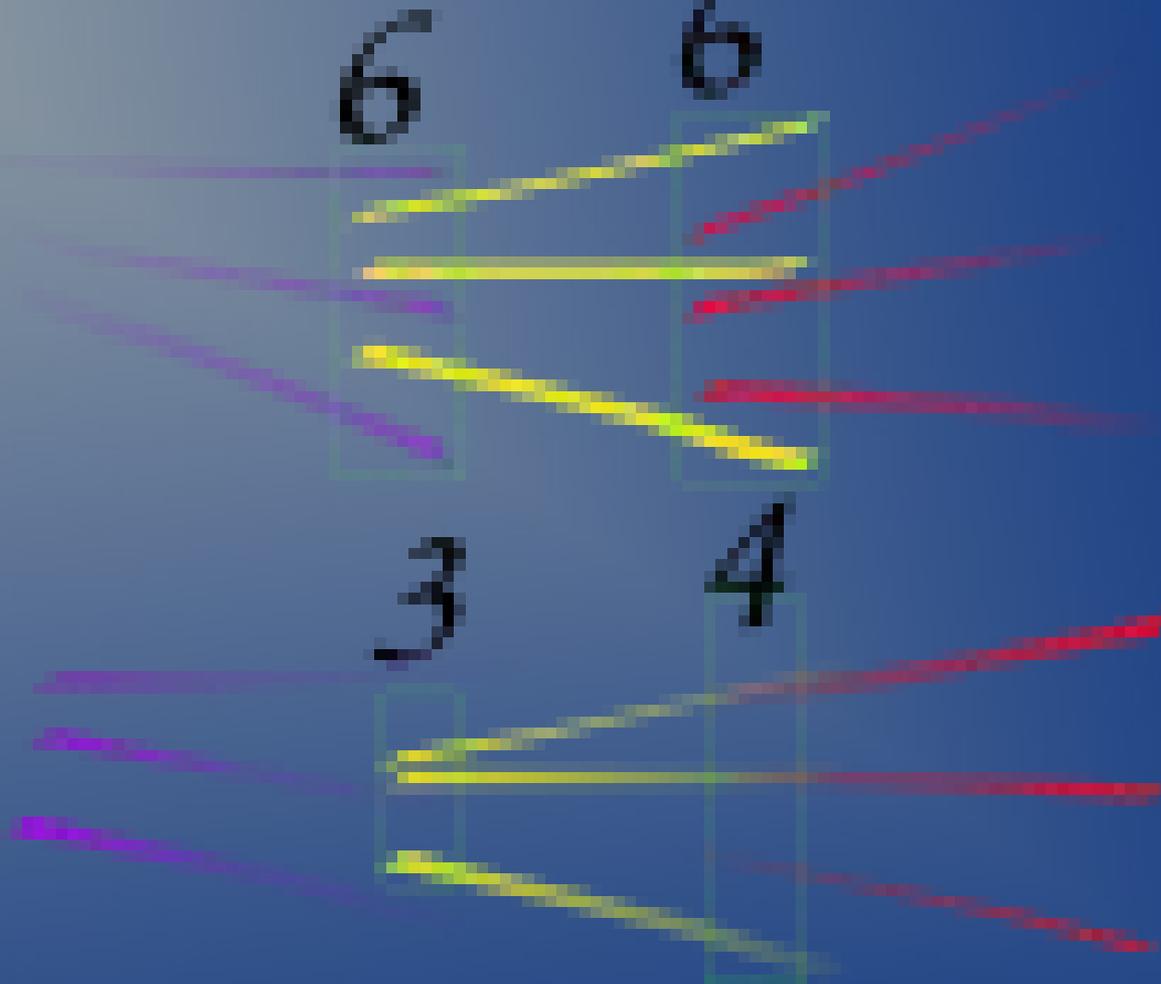
# The Pixel-To-Visibility Matrix (P2VM)

Calibrates each of the 3 fringe patterns present in the image.  
( gives matrix coefficients  $c_k$  and  $d_k$  to convert pixels values to complex visibilities for each baselines)



The P2VM calibration file does more: it contains all the calibrations.

In low resolution there is a problem between spectral bands



The P2VM will be invalid there, data at these wavelength must be discarded

# Typical Sequence of observations as seen in “gasgano”

GASGANO Version: 2.2.3 gildas / Linux

File Selected files Tools Help

Group by Directory collapse Find entry:  fin

File OBS.NAME DET.DIT DET.NDIT OCS.OBS.SPE... OBS.TARG.NA... DPR.CATG DPR.TYPE

Displaying 48 files grouped by directory. Unfiltered.

/home/gildas/TMP/gildas/test/alfara

074.A-9026(A) AMBER UNKNOWN

200147596 Bet-Cen-Hummel-3T

AMBER.2005-02-25T07:41:23.925.fits.gz	Bet-Cen...	0.1870000	2	Medium_K_1...	betcen	CALIB	WAVE,3TEL
AMBER.2005-02-25T07:41:36.616.fits.gz	Bet-Cen...	0.1870000	2	Medium_K_1...	betcen	CALIB	WAVE,3TEL
AMBER.2005-02-25T07:41:51.649.fits.gz	Bet-Cen...	0.1870000	2	Medium_K_1...	betcen	CALIB	WAVE,3TEL
AMBER.2005-02-25T07:42:01.825.fits.gz	Bet-Cen...	0.1870000	2	Medium_K_1...	betcen	CALIB	WAVE,3TEL
AMBER.2005-02-25T07:42:41.554.fits.gz	Bet-Cen...	0.1870000	10	Medium_K_1...	betcen	CALIB	3P2V
AMBER.2005-02-25T07:43:01.338.fits.gz	Bet-Cen...	0.1870000	10	Medium_K_1...	betcen	CALIB	3P2V
AMBER.2005-02-25T07:43:16.401.fits.gz	Bet-Cen...	0.1870000	10	Medium_K_1...	betcen	CALIB	3P2V
AMBER.2005-02-25T07:43:31.509.fits.gz	Bet-Cen...	0.1870000	10	Medium_K_1...	betcen	CALIB	3P2V
AMBER.2005-02-25T07:43:46.570.fits.gz	Bet-Cen...	0.1870000	10	Medium_K_1...	betcen	CALIB	3P2V
AMBER.2005-02-25T07:44:03.045.fits.gz	Bet-Cen...	0.1870000	10	Medium_K_1...	betcen	CALIB	3P2V
AMBER.2005-02-25T07:44:18.171.fits.gz	Bet-Cen...	0.1870000	10	Medium_K_1...	betcen	CALIB	3P2V
AMBER.2005-02-25T07:44:33.120.fits.gz	Bet-Cen...	0.1870000	10	Medium_K_1...	betcen	CALIB	3P2V
AMBER.2005-02-25T07:44:48.267.fits.gz	Bet-Cen...	0.1870000	10	Medium_K_1...	betcen	CALIB	3P2V
AMBER.2005-02-25T07:45:11.354.fits.gz	Bet-Cen...	0.1870000	10	Medium_K_1...	betcen	CALIB	3P2V

200147600 Alf-Ara-Stee-3T

AMBER.2005-02-25T09:20:43.945.fits.gz	Alf-Ara-S...	0.1000000	500	Medium_K_1...	alfara	SCIENCE	DARK
AMBER.2005-02-25T09:22:40.696.fits.gz	Alf-Ara-S...	0.0700000	500	Medium_K_1...	alfara	SCIENCE	DARK
AMBER.2005-02-25T09:24:22.488.fits.gz	Alf-Ara-S...	0.0700000	500	Medium_K_1...	alfara	SCIENCE	OBJECT
AMBER.2005-02-25T09:26:02.281.fits.gz	Alf-Ara-S...	0.0700000	500	Medium_K_1...	alfara	SCIENCE	OBJECT
AMBER.2005-02-25T09:27:39.957.fits.gz	Alf-Ara-S...	0.0700000	500	Medium_K_1...	alfara	SCIENCE	OBJECT
AMBER.2005-02-25T09:29:45.946.fits.gz	Alf-Ara-S...	0.0700000	500	Medium_K_1...	alfara	CALIB	SKY
AMBER.2005-02-25T09:37:14.383.fits.gz	Alf-Ara-S...	0.0700000	500	Medium_K_1...	alfara	SCIENCE	DARK
AMBER.2005-02-25T09:38:46.349.fits.gz	Alf-Ara-S...	0.0700000	500	Medium_K_1...	alfara	SCIENCE	OBJECT

The first observations calibrate the P2VM and the spectral dispersion, the DARKs or SKY are needed for the cosmetics of each science frame.



“gasgano” is a useful ESO Fits Viewer.

# Typical data processing Pipeline:

- 1) Compute the P2VM(s) (`amdlibComputeAllP2vm`) provides all the necessary calibrations;
- 2) Process each raw data file to compute instantaneous correlated fluxes (complex numbers, typically  $3 \times 128 \times 1000$  values) with command `amdlibComputeAllOiData`;
- 3) From all, or a selection of, these values, compute time averaged values of all relevant interferometric observables ( $V^2$ , differential visibility, phase closure) with command `amdlibPerformAllFrameSelection`.

Warning! These are not yet 'calibrated visibilities'. One has to remove the adverse effects of atmosphere and instrument by comparing with the results for calibrator stars observed quasi-simultaneously:

- 4) Calibrate the science with the calibrator using `amdlibCalibrateAllOiData`.

# A word about...

## Frame selection:

Before averaging 1000's of interferometric observables, amdlib permits to drop some values based on quality criteria.

Fringe S/N : (drops in case of, e.g., clouds, bad seeing, or piston jitter during integration)

Piston between beams: spectral coherence length is only 70 microns for Ambers's LowRes mode

Photometry flux: varies with seeing

To be used with caution but seems necessary **for low-resolution** (without FINITO -?-) where at least a threshold on maximum piston (say, 15 microns) should be applied.



# A word about...

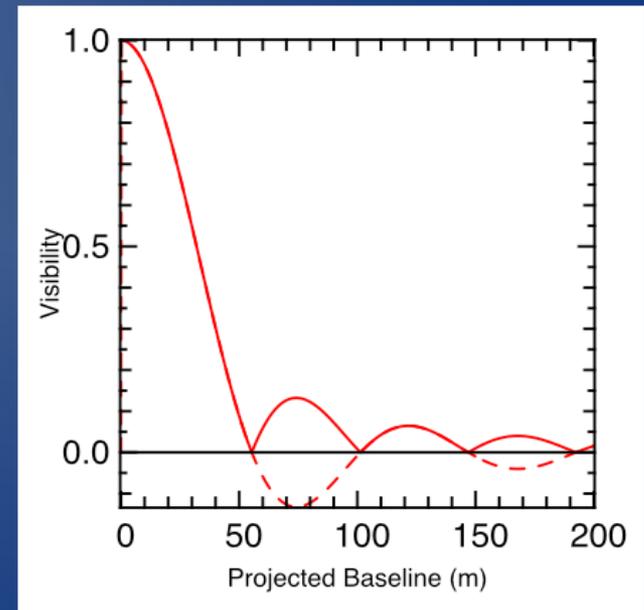
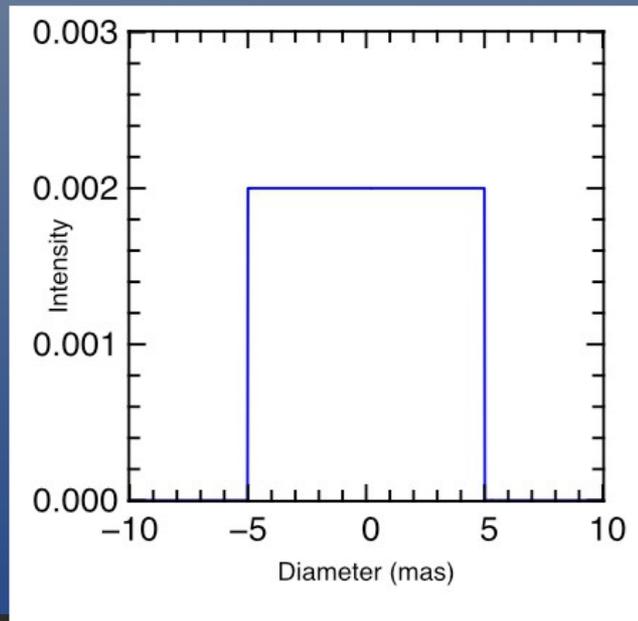
## Model Fitting.

We'll try to fit a simple model in our calibrated data, (a star's Uniform Disk), using the 'litpro' program (more on Friday)

$$\begin{aligned} I(r) &= 4/(\pi a^2), \text{ if } r = \sqrt{x^2 + y^2} \leq a/2 \\ I(r) &= 0 \text{ otherwise} \end{aligned}$$



$$F(\rho) = \frac{J_1(\pi a \rho)}{\pi a \rho} \text{ with } \rho = \sqrt{u^2 + v^2}$$



# Amdlib

The screenshot shows a Mozilla Firefox browser window displaying the website 'JMMC - AMBER data processing'. The page title is 'JMMC - AMBER data processing V3'. The main content area includes a description of the AMBER instrument, a list of related scientific publications, documentation and support links, and a download section. The download section contains a warning: 'PLEASE NOTE THAT YOU CAN DOWNLOAD SOFTWARE ONLY IF YOU ARE REGISTERED ON JMMC USER ACCOUNT MANAGEMENT PAGE. This will ensure that you are kept informed about software's upgrades or bug fixing.' Below this, it states: 'If you are not yet registered, please fill the right form onto the jmmc user account management page.. You will quickly receive your password by mail. This password will be required, with your e-mail address, to access to the download page (see above).'

Find the last version at  
[http://www.mariotti.fr/data\\_processing\\_amber.htm](http://www.mariotti.fr/data_processing_amber.htm)

You can



subscribe to AmberDRS feed

To keep in touch.

Also, read the manual...

and the Release Notes that are continuously updated

