

# NRH analysis

From UMN github in 2018

Example of analysis with jet on Feb 16 2011

## Obtaining data

### Check data availability

Go to <http://secchirh.obspm.fr/select.php>

Go to composite to see NRH data. Once on the plot page, one can go to NRH movie. Select 10 frames/min to have a fast computation of the movie. Two frequencies are available for movies.

[https://github.umn.edu/smusset/Jets/blob/master/grc20110216\\_1300.png](https://github.umn.edu/smusset/Jets/blob/master/grc20110216_1300.png)

NRH stop observing on January 21 2015.

### Find data on mesopl

go to [/radio-solaire/AC-rhnancay/2011/02/16](#)

### Request data

To download NRH quicklook data (10 sec time cadence), one must fill the following form: [http://secchirh.obspm.fr/download\\_lowtime.php](http://secchirh.obspm.fr/download_lowtime.php)

To request NRH high time resolution, one must fill the following form:

[http://secchirh.obspm.fr/download\\_hightime.php](http://secchirh.obspm.fr/download_hightime.php)

### Description of the data files

Can be found at [http://bass2000.obspm.fr/data\\_guide.php?what=7](http://bass2000.obspm.fr/data_guide.php?what=7)

## Using NRH soft in SSWIDL

Documentation about the NRH software can be found here:

[http://bass2000.obspm.fr/soft\\_guide.php?what=nrh](http://bass2000.obspm.fr/soft_guide.php?what=nrh)

To start the soft in SSWILD: `nrh`

A GUI opens. Select "Files Filter" to select data. Alternatively go directly to "Visibility to Image".

## Basic Imaging

### Creating image files

In the box "Compute NRH FITS Images":

- Select input file (e.g. `2i.110216.02` )
- Change "time-start" and "time-end" to what you want (long time interval will take a long time to be processed)  
ATTENTION make sure to press 'enter' after entering the time, otherwise the change will not be taken into account.
- If you want, change "parameters for image computation". In particular, you need to set CLEAN (back projection is the default).
- You can also select the frequencies that you want. Normally all frequencies are selected by default.
- When ready, press "compute".

For a 35 minute interval, computation took around 11 minutes for CLEAN images.

This will create a fits file for each frequency. File names are in the form

`nrh2_1509_h70_20110216_132009c00_i.fits`

### Displaying images

In the NRH GUI, go to "Images". In the "Visualisation - 2 D", one can

- Plot and save an image
- Span through time using the "increment" button
- Plot the contours of an image

- Select a region: click on "Select", then to modify the box, click left to displace, middle click to change the size of the box, right click to save. If happy press "done". ATTENTION: I did not find a way to save the region. One can note the X and Y limits of the box to make sure to be able to retrieve the results later.

To see an animation (a movie), go to "ANIMATE" in the main NRH GUI window.

## Compute flux

In the NRH GUI, go to "Flux".

- Here again, one can select a region. See above.
- Press "Compute FLUX".
- Press "Plot" (above in the NRH FLUX window).

You can write a fits file containing the flux. It will be easy to read it back in the nrh gui. However, I did not find yet any easy way to read this file in IDL to plot the flux lightcurve. So what I do is:

- Save the flux in an ASCII table (option available in the nrh soft)
- Read the file with the procedure `read_nrh_ascii_flux` to retrieve the flux and the time axis

Note that I developed my own routine to generate the NRH lightcurves similarly to what I have done with AIA. This takes longer because it transform all the images into maps. On the other hand it uses ROI which can be nice. But for NRH data a big rectangle is all we need for ROI anyway.

## Advanced Imaging

It must be noted that advanced tools exist to:

- Correct for oscillations (shift of the source locations due to gravity waves in the ionosphere)
- Visibility interpolation before CLEAN

- Suppression of a source (artefact)

## Plot different frequencies

Maybe there are tools to do this in the NRH soft, nevertheless I wrote my own piece of code to do this, providing in addition a more flexible way to produce images for a paper for example. This code plots with the `plot_map` procedure, which calls the `plot` procedure. A more careful way to plot has to be written to use the `plot` function of IDL, which could produce nicer images and on which it will be easy to overplot a box for example.

[https://github.com/smusset/Jets/blob/master/plot\\_nrh\\_all\\_frequencies.pro](https://github.com/smusset/Jets/blob/master/plot_nrh_all_frequencies.pro)

For our example jet, see

[https://github.com/smusset/Jets/blob/master/plot\\_nrh\\_20110216.pro](https://github.com/smusset/Jets/blob/master/plot_nrh_20110216.pro)

Update: now NRH maps can be called with the function `charge_nrh_in_maps`, for a given directory. If there are several images files for several days in the directory, one can specify the date with the keyword 'date'. There is currently no solution if there are several sets of images for the same day in the same directory. My advice is to have one directory per set of images.

## Plot lightcurves

Note that the routine `nrh_lightcurves.pro` might be use to plot lightcurves at all frequencies on a small time interval (because it takes time). Useful to see which frequencies are useful? Need to complete this procedure with the possibility to save the lightcurves.

## When are the type IIIs? Or how to complete NRH data with spectrograph data

It may be useful to have spectral data at the same time and frequency range than the NRH data to spot type IIIs. A possibility is to go on the Zurich radio webpage

<http://soleil.i4ds.ch/solarradio/> and to look for e-CALLISTO quicklooks

<http://soleil.i4ds.ch/solarradio/callistoQuicklooks/?date=20110216>

The BLEN7M radio spectrograph as a good quality.

[http://soleil.i4ds.ch/solarradio/qkl/2011/02/16/BLEN7M\\_20110216\\_133009\\_24.fit.gz.png](http://soleil.i4ds.ch/solarradio/qkl/2011/02/16/BLEN7M_20110216_133009_24.fit.gz.png)

Fits files can be downloaded. Some documentation about the SSW routines to plot dynamic spectrum can be find here:

[http://soleil.i4ds.ch/solarradio/data/documentation/phoenix\\_howto.html](http://soleil.i4ds.ch/solarradio/data/documentation/phoenix_howto.html)

Piece of code to plot a spectrogram:

[https://github.com/smusset/Jets/blob/master/plot\\_spectrogram.pro](https://github.com/smusset/Jets/blob/master/plot_spectrogram.pro)

Example with our jet:

[https://github.com/smusset/Jets/blob/master/plot\\_spectrogram\\_20110216.pro](https://github.com/smusset/Jets/blob/master/plot_spectrogram_20110216.pro)

## Identification of type IIIs

When their is no list, how should we look for type IIIs?

First, check this list (but stops in 2011): <ftp://ftp.ngdc.noaa.gov/STP/space-weather/solar-data/solar-features/solar-radio/radio-bursts/reports/spectral-listings/>

But the other way is to look manually each day in radio monitoring. The data quality is better in summer so one should focus first on the May-August period.