

Creating a FITS File from Visibilities with NRH Software

Introduction

This manual provides a step-by-step guide to creating a FITS file with images from visibilities using NRH software. Historically NRH data are delivered as a binary file containing the visibilities of all antenna pairs at all frequencies. We added recently a new file (csv format, i.e. comma-separated variables) that gives an account of the status of each antenna, and which can be read by the standard NRH software in order to eliminate malfunctioning antennas from the calculation of the images. The user will need the following files (for data starting on June 24, 2023):

- **Binary files**, name, e.g., 2d240528_102300_10.0: Visibilities
- **CSV files**: The state of the antennae

In this manual, Section 2 shows how to load visibility files and how to use the main window of NRH software to create FITS files containing the images (the standard procedure used for NRH data). Section 3 shows how to use the file of antenna state information to improve the quality of the images in the FITS files. Section 4 shows how to display the images in the fits files using NRH Software and the last section provides an illustrative example of viewing animation derived from FITS files using NRH Software.

1 Step 1: Download Required Files

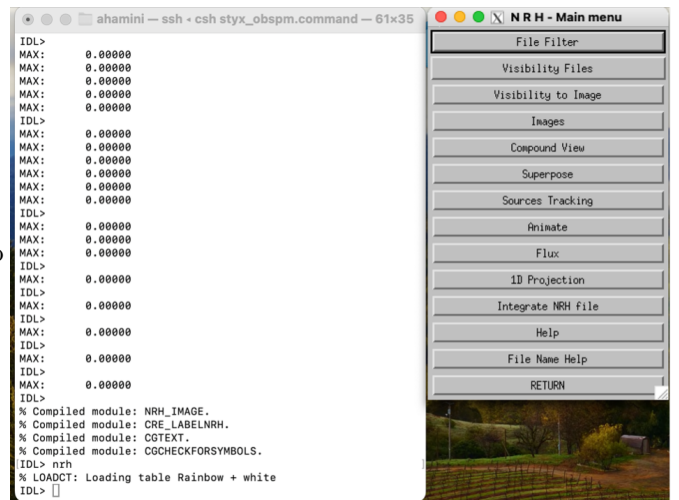
Ensure to download the necessary files from <https://rsdb.obs-nancay.fr/>

- **Binary files**: Visibilities files
- **CSV files**: The state of the antennae (csv files)

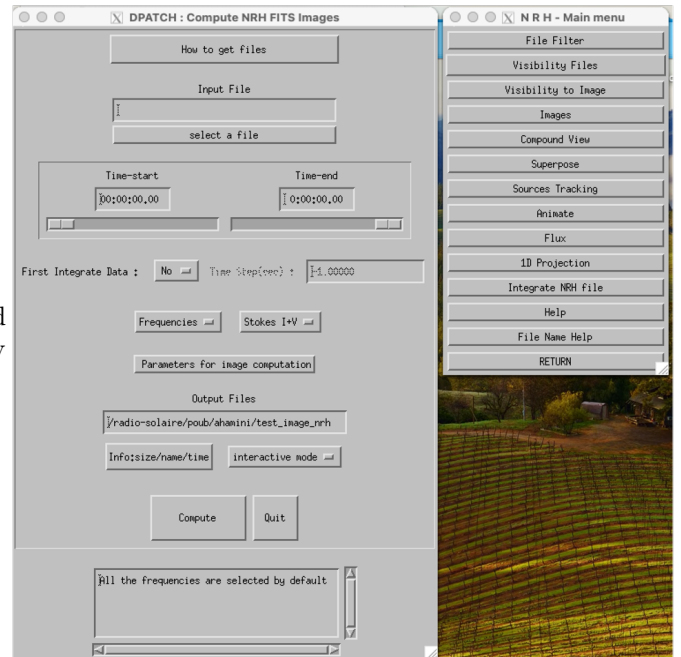
2 Step 2: Load the Visibilities File

1. **Open NRH Software**: Launch the NRH software (nrh with solarsoft on idl).

2. **Create FITS files**: Click on "Visibilities to Image."



- Load Binary File:** Go to **Select a File** and
- choose the binary file containing the visibility data.

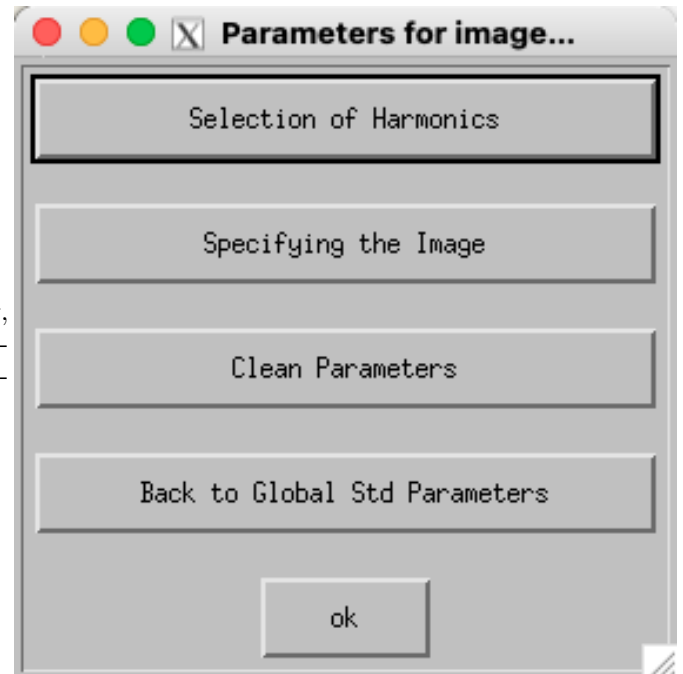


- Configure Main Window Settings:** choose the frequency, Stokes parameter (only I available since 2020), start and end time, and time resolution settings in the main window as follows:
 - Frequency Settings:** Select the appropriate frequency band. This can be done by choosing the desired frequency from the drop-down menu.
 - Time Settings:** Specify the time range for which you want to process the visibilities. This involves setting the start and end times either by entering the time values manually or using the graphical time selection tool.
 - Time Resolution Settings:** Define the time resolution for your data processing (button “First integrate data”). Higher time resolution provides more detailed temporal information but requires more computational resources. Choose an appropriate balance based on the analysis needs and computational capacity.

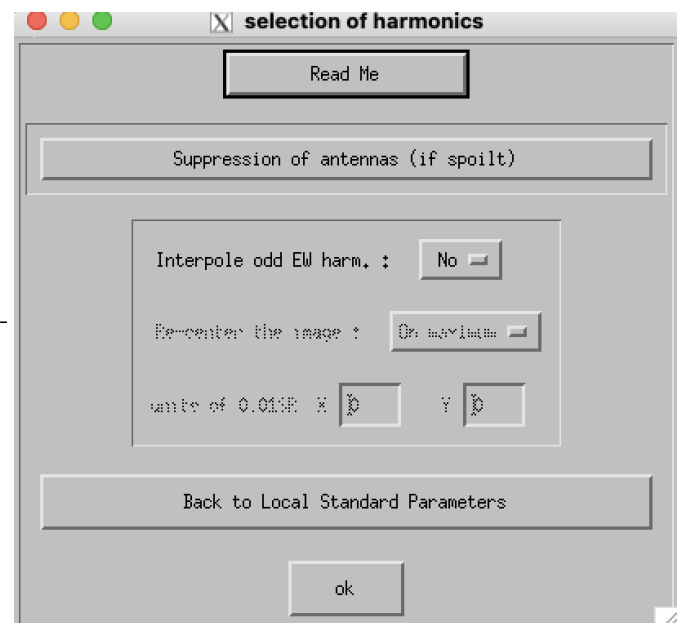
3 Step 3: Load the State of the Antennae

1. **Import CSV File:** Load the state of the antennae, usually stored in CSV files, into the NRH software.

(a) Click on Parameters for Image Computation.

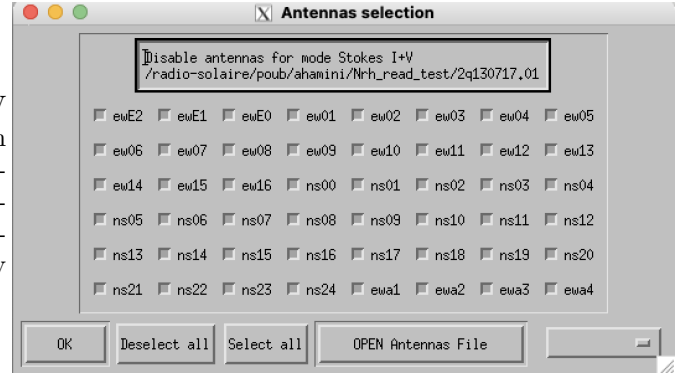


(b) **Selection of Harmonics:** In the new window, select the antenna used for the image reconstruction by clicking on "Selection of Harmonics."

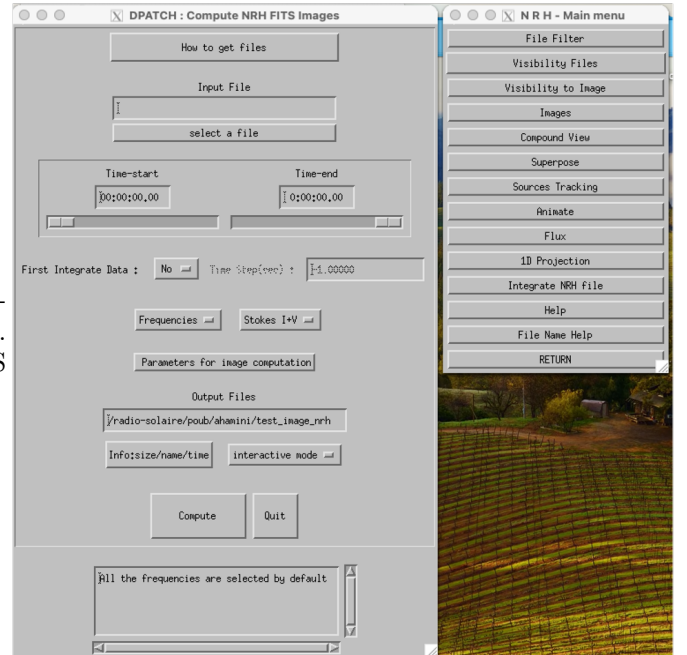


(c) **Suppression of Antennae:** In the new window, click on "Suppression of Antennas."

- CSV Files:** In the new window, read the CSV file automatically by clicking on the "Open Antennas File" button or choose the antennas manually. The CSV file provides the non-operational antennas for each frequency separately. The non-operational antennas vary from one frequency to another.
- (d)



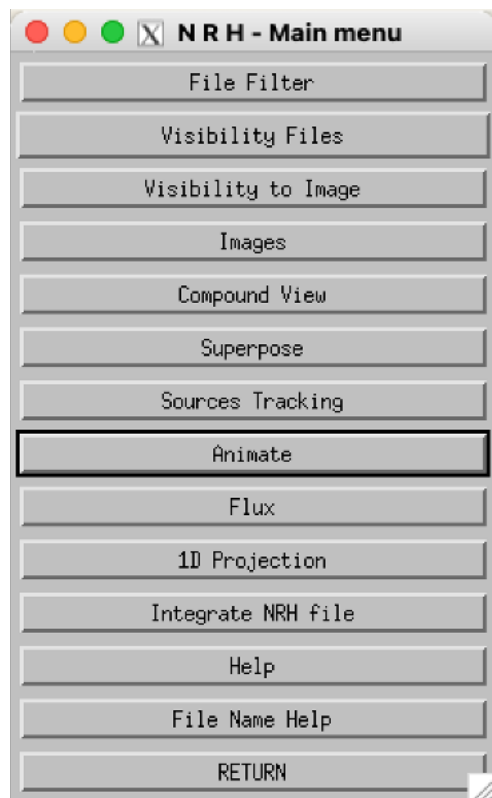
- Once you have properly selected the antennas, click "OK" to return to the main window. Then, click on "Compute" to create the FITS file.
- (e)



4 Verify and display the FITS File

Check the FITS File: After creating the FITS file, open it using NRH software to ensure that the data is correctly stored. You can read and display the image from the FITS file.

- **Image:** Display the image from the FITS file.
- **Animate:** Display animation of the FITS file, as shown in section 5.



5 Examples using NRH Software to view animation from created FITS Files

Figure below shows an illustrative example of using NRH Software to view animations generated from FITS files.

