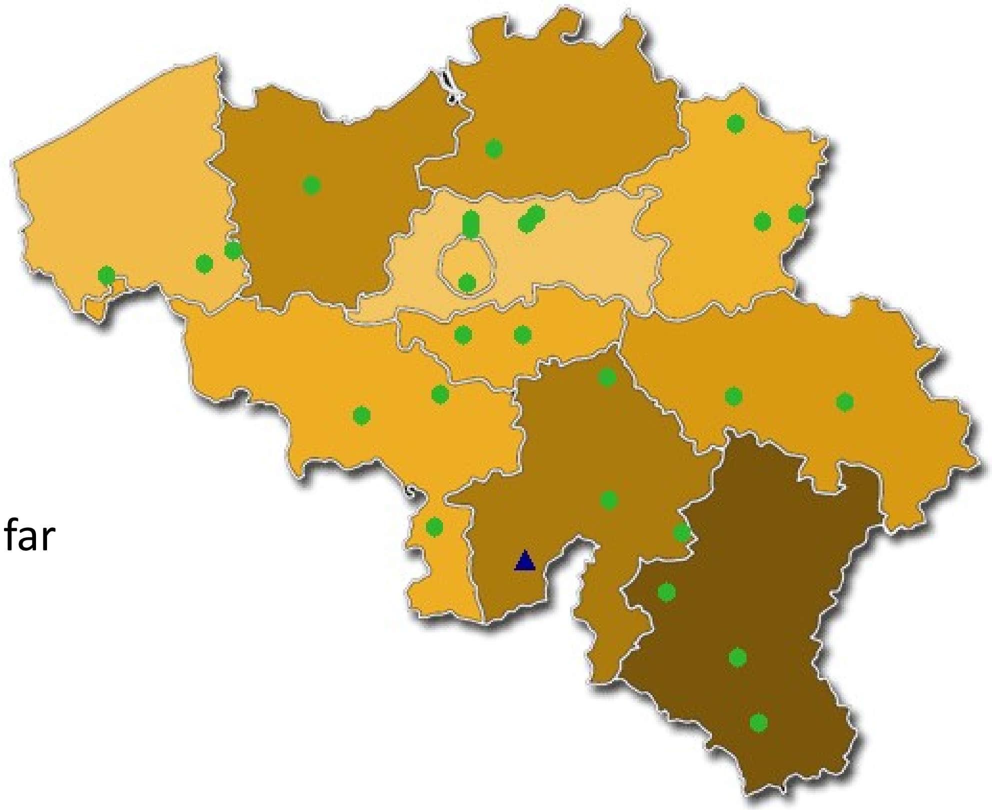
Status of the BRAMS network and recent progress

H. Lamy & BRAMS team

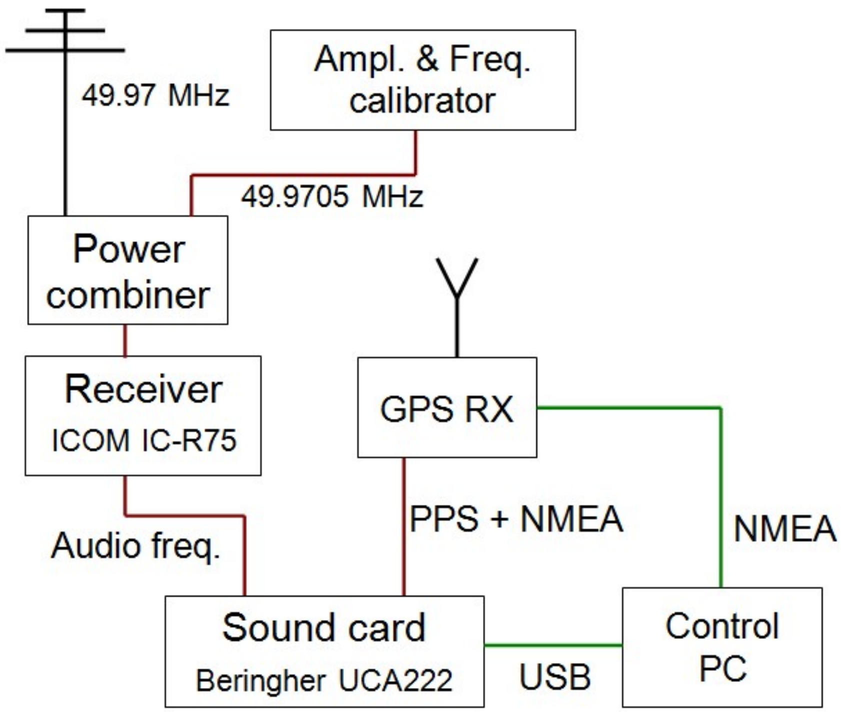
BRAMS network : full inspection during summer / fall 2018



- 26 active Rx
- 25 inspected so far
- 1 Tx

We solved many small (and not so small) problems

Receiving stations



Some problems encountered

- Calibrator unplugged
- Meinberg not using GPS NMEA to synchronize the PC Clock
- ICOM-R75 not using PRE-AMP2, AGC OFF or using additional functions
- ….

Receiving stations : vertical orientation

BELEUZ

BEOVER

Radiation pattern much more closer to theoretical one

Receiving stations : change of azimut orientation

BEREDU

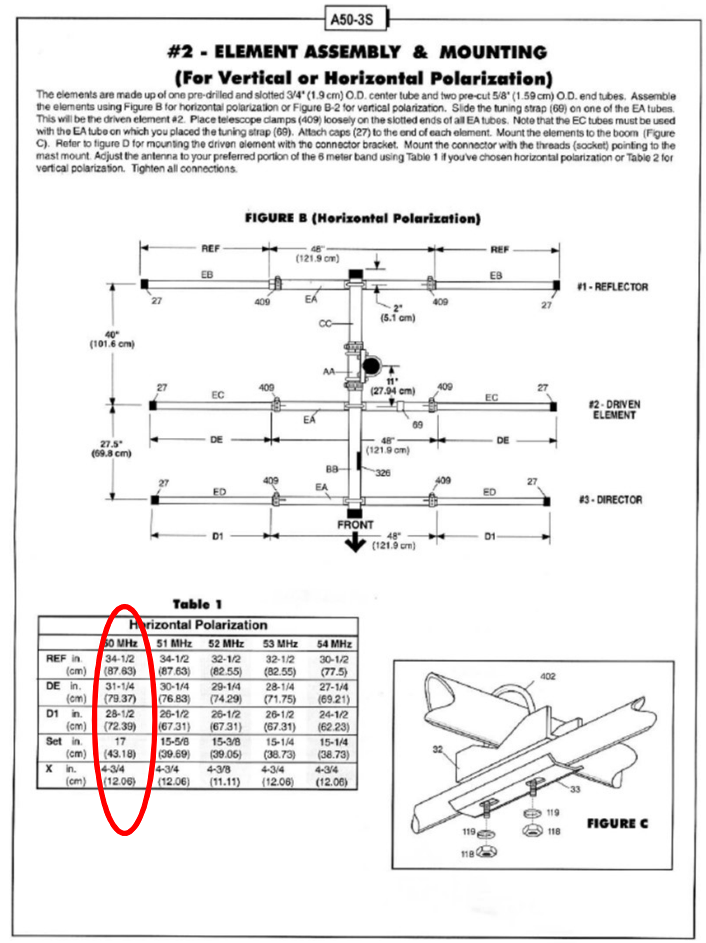
Goal : trying to minimize local interference

Receiving stations : impedance matching

- Mounting specifications of the antenna manual provided at best a return loss S11 ~ -15 dB at f = 49.97 MHz (for most antennas it was lower) and a dip for S11 which was never at ~ 50 MHz but more at f ~ 50.6 – 50.7 MHz

- Tests in June with an antenna in Uccle to increase the length of elements by a few cm to decrease the resonance frequency of the antenna. Increase by ~ 3 cm on each side of the 3 elements provides the best results

- Length of the matching element chosen to maximize the dip.



A50-3S

#2 - ELEMENT ASSEMBLY & MOUNTING

(For Vertical or Horizontal Polarization)

The elements are made up of one pre-drilled and slotted 3/4" (1.9 cm) O.D. center tube and two pre-cut 5/8" (1.59 cm) O.D. end tubes. Assemble the elements using Figure B for horizontal polarization or Figure B-2 for vertical polarization. Slide the tuning strap (69) on one of the EA tubes. This will be the driven element #2. Place telescope clamps (409) loosely on the slotted ends of all EA tubes. Note that the EC tubes must be used with the EA tube on which you placed the tuning strap (69). Attach caps (27) to the end of each element. Mount the elements to the boom (Figure C). Refer to figure D for mounting the driven element with the connector bracket. Mount the connector with the threads (socket) pointing to the mast mount. Adjust the antenna to your preferred portion of the 6 meter band using Table 1 if you've chosen horizontal polarization or Table 2 for vertical polarization. Tighten all connections.

FIGURE B (Horizontal Polarization)

Table 1

Horizontal Polarization		50 MHz	51 MHz	52 MHz	53 MHz	54 MHz
REF	in.	34-1/2	34-1/2	32-1/2	32-1/2	30-1/2
	(cm)	(87.63)	(87.63)	(82.55)	(82.55)	(77.5)
DE	in.	31-1/4	30-1/4	29-1/4	28-1/4	27-1/4
	(cm)	(79.37)	(76.83)	(74.29)	(71.75)	(69.21)
D1	in.	28-1/2	26-1/2	26-1/2	26-1/2	24-1/2
	(cm)	(72.39)	(67.31)	(67.31)	(67.31)	(62.23)
Set	in.	17	15-5/8	15-3/8	15-1/4	15-1/4
	(cm)	(43.18)	(39.69)	(39.05)	(38.73)	(38.73)
X	in.	4-3/4	4-3/4	4-3/8	4-3/4	4-3/4
	(cm)	(12.06)	(12.06)	(11.11)	(12.06)	(12.06)

FIGURE C

With these changes, all antennas have now S11 < -25 / -30 dB or SWR = $\frac{1-S11}{1+S11}$ ~ 1.05

ICOM-R75 receivers

- At least 15 of them had problems with a progressive loss of sensitivity.
- The origin of the problem was identified by M. Anciaux who was able to repair them
- ICOM-R75 are not commercially produce anymore → search for new solutions using SDR receivers (see talk by Michel)

Transmitter in Dourbes

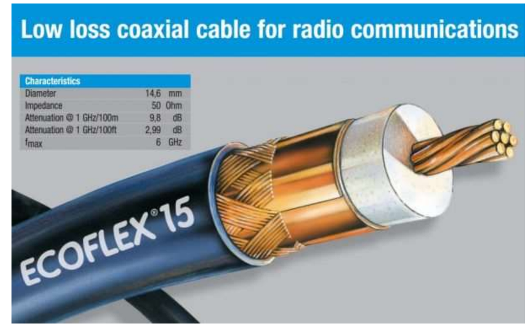
P ~ 150 W
Circular polarisation
f = 49.97 MHZ

Is this correct? → full characterization on 21 September

Transmitter in Dourbes

Picotest G5100A
Waveform generator

Tomco BT00400-
AlphaSA-CW



Ecoflex 15 RF cable

Transmitter in Dourbes

- Full characterization of the Tx on 21/09/2018 using dummy load, wattmeter, oscilloscope and antenna analyzer

- Power amplifier characterization : using the Wattmeter in between the amplifier and the antenna, we found P_forward ~ 110 W and P_reflected ~ 15 W, providing a SWR ~ 2.2. Total power at the antenna should then be of the order of 95 W. More accurate measurements using the dummy load and the oscilloscope give P_forward = 104.7 W incident on the antenna cable.

- Antenna characterization : Two 50Ω cables in parallel linked by a T → equivalent resistance (resistive part) measured at the extremity of the RF cable is ~ 25.6 Ω as expected. Taking into account the losses in the cable, we expect an incident power of 95.5 W at the entrance of the T

- Independent measurements of the adaptation of the two individual antennas: SWR=1.68 and 1.16

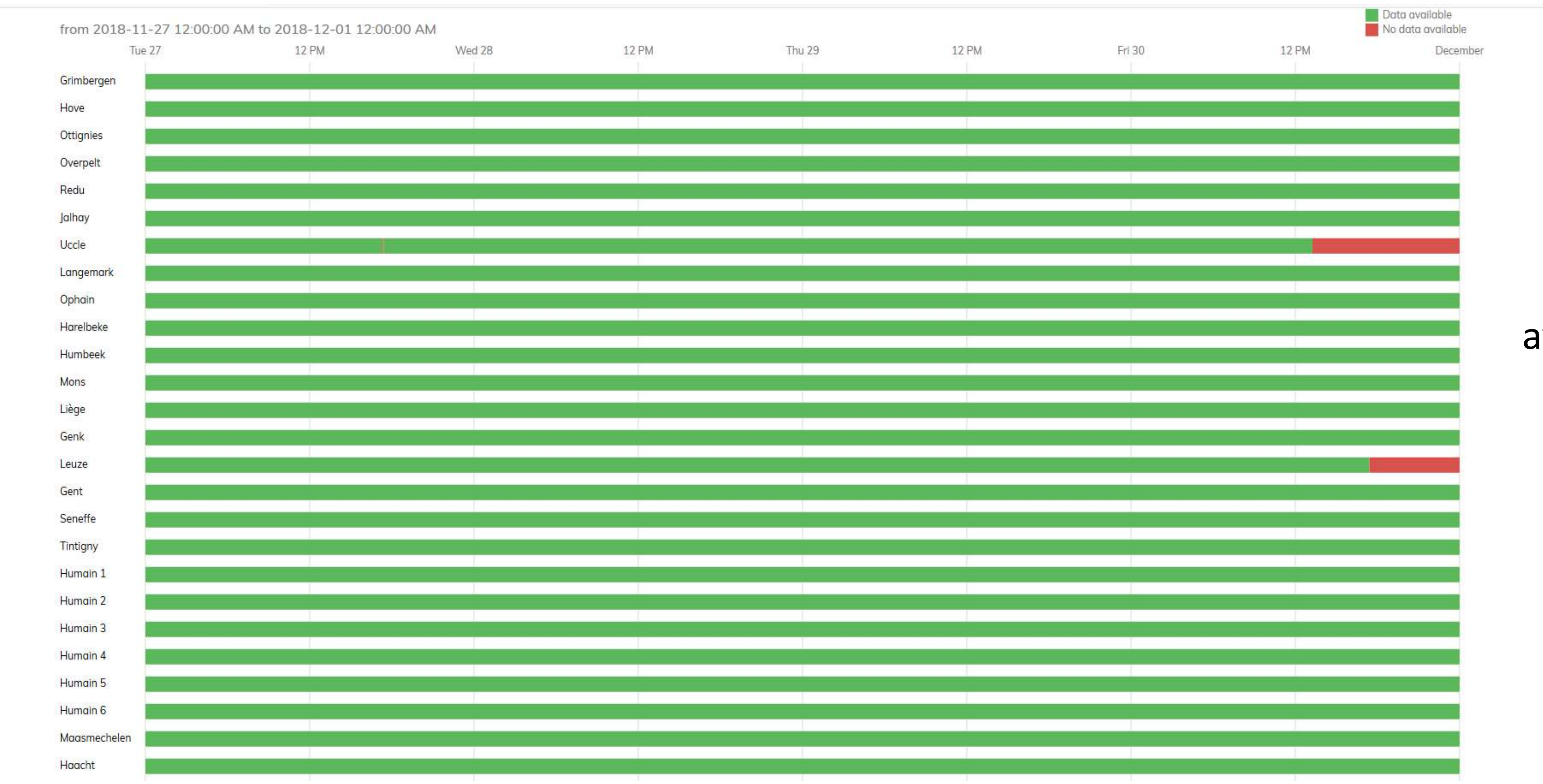
- Ant 1 : P=44.3 W – Ant 2 : P=40.6 W, θ = -96°

Transmitter in Dourbes

- Conclusions :
  - We emit far less than 150 Watts (~ 90 Watts)
  - The emitted wave is not perfectly circularly polarized but not too far (96° instead of 90°)
- Still to do :
  - Measurements of the radiation pattern in-situ using our drone (January?)
  - Replacement of the current system with an improved design to guarantee 150 W emission and perfectly circularly polarized wave

Data transfer

- Data from all 26 stations are now transferred via FTP
- 23 stations are automatically transferring the data daily using the BRAMS-FTP facility
- 3 stations are sending their data weekly using FileZilla
- 17 stations can be accessed remotely via Team Viewer or Remote Desktop.

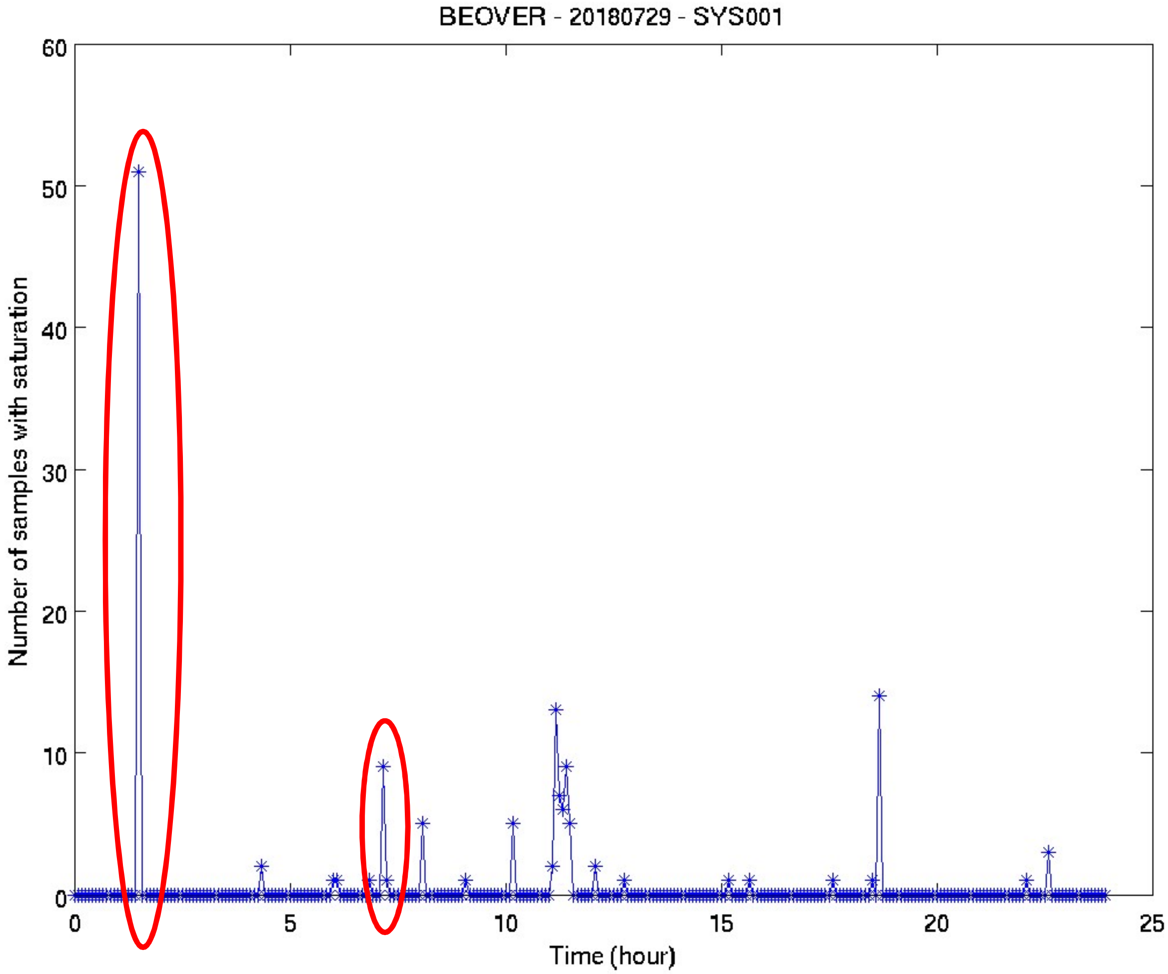


BRAMS availability tool

Quality check of the data

- ✓ Matlab and/or Python tools have been developed to
  - Check for saturation
  - Derive the amplitude and exact frequency of the calibrator
- ✓ Amplitude provides an estimate of the response of the front-end of the receiving station (ICOM R-75 + sound-card)
- ✓ Frequency provides an estimate of the frequency offset due to the poor stability of the LO of the ICOM-R75
- ✓ These tools are currently being implemented to the archiving system in order to quickly identify potential problems (mostly with the receiver but also calibrator off, etc …)

Saturation of the data

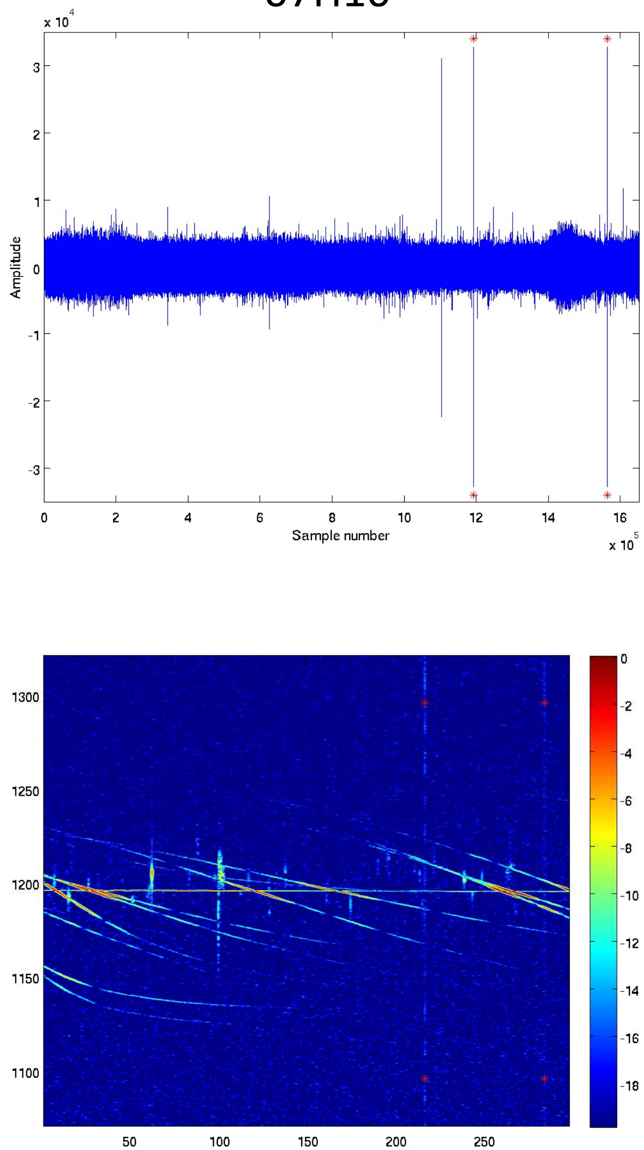


01H30 07H10

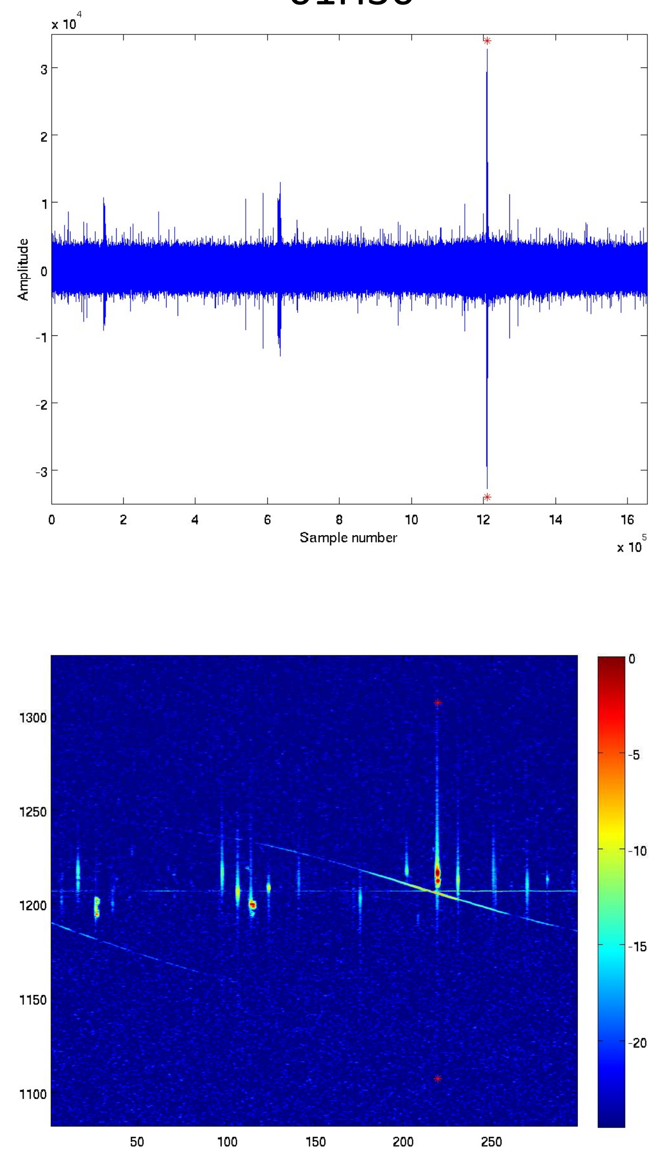
Total nb of samples in a WAV file ~ 5512 * 300 ~ 1 653 600

Saturation of the data

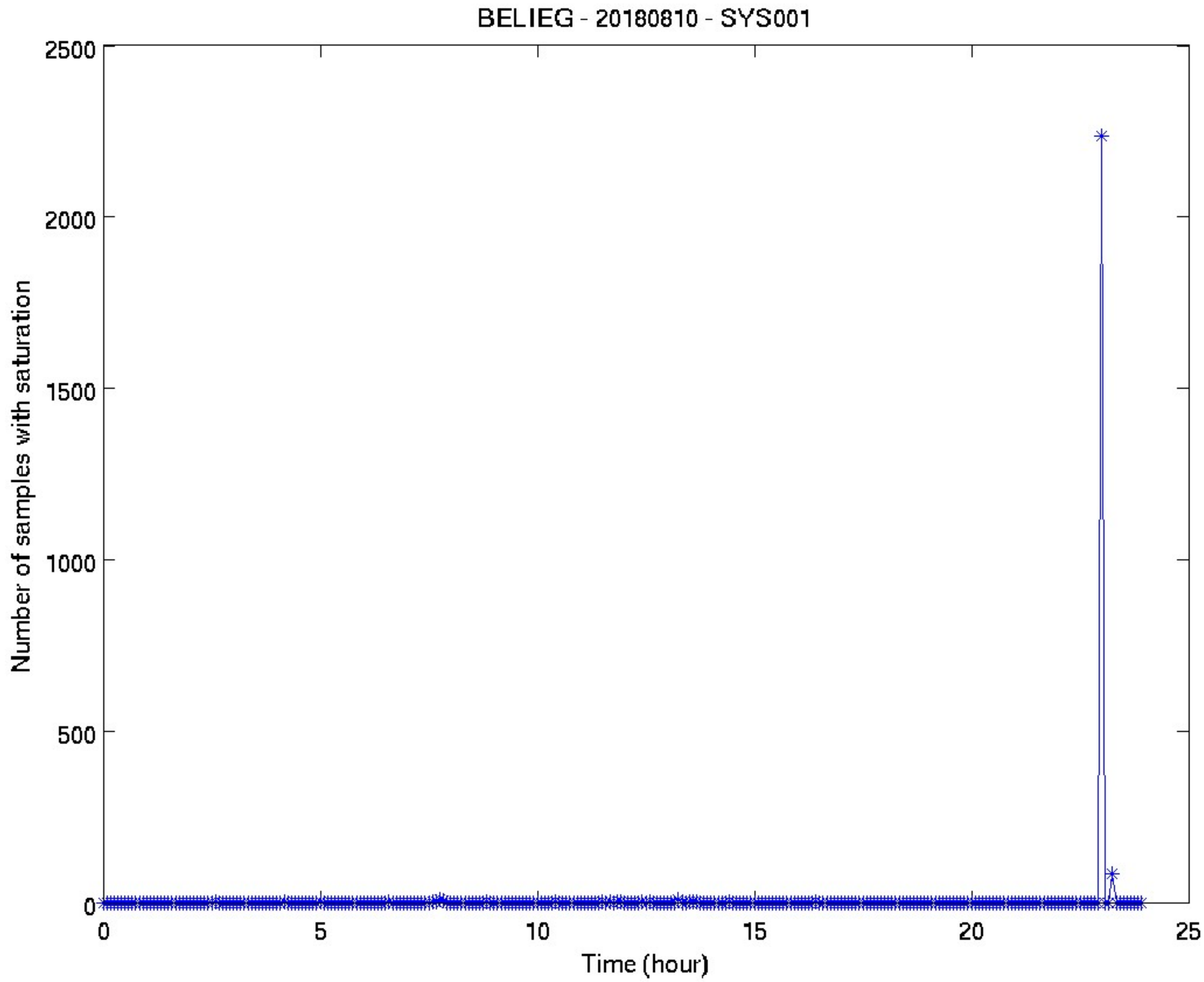
07H10



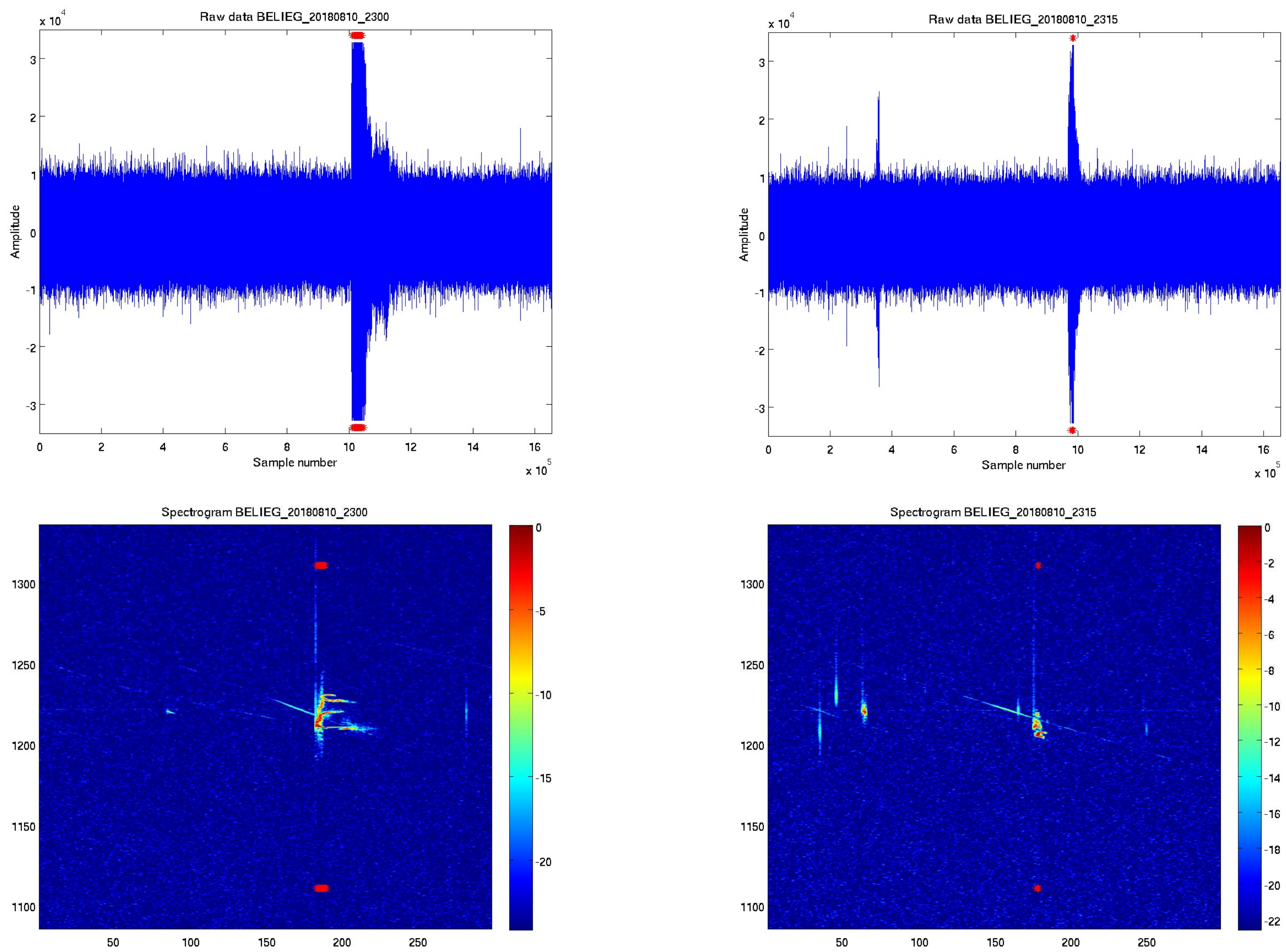
01H30



Saturation of the data



Saturation of the data



Amplitude and frequency of the calibrator signal

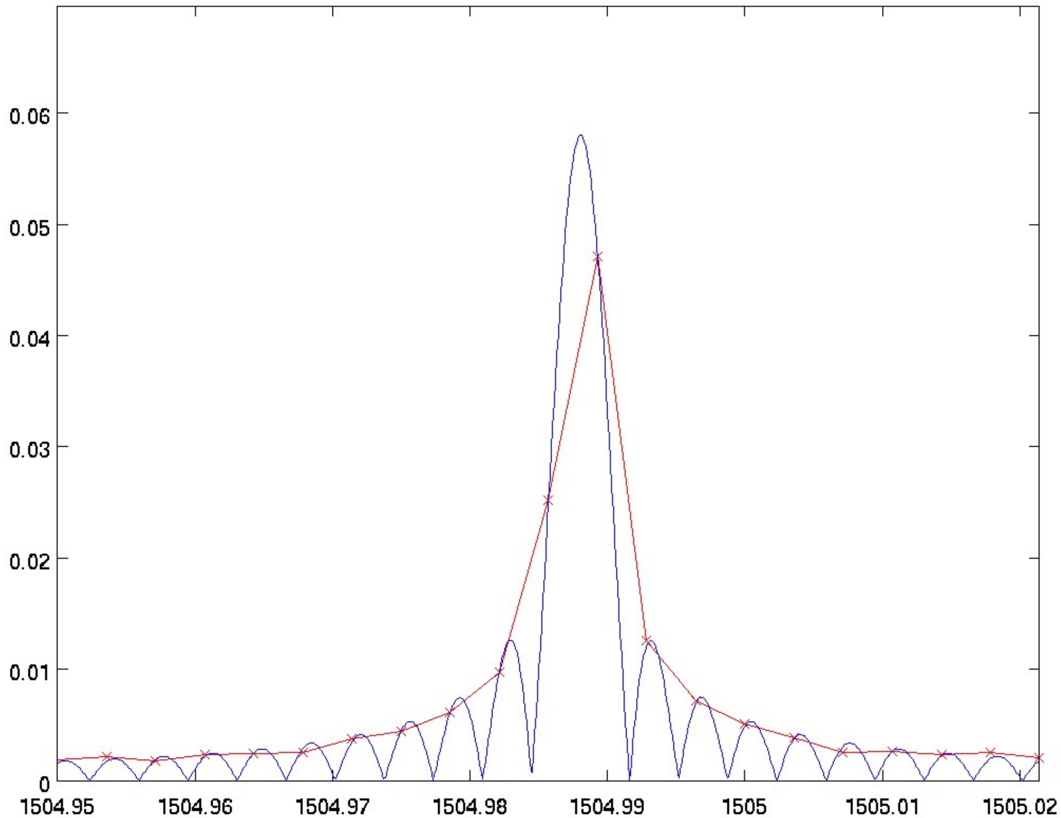
- ✓ First we take the FFT of the whole 5 minutes long WAV file ($\Delta f \sim 1/300$ Hz)

- ✓ We then accurately determine the frequency and amplitude of the calibrator signal. Two different techniques have been used

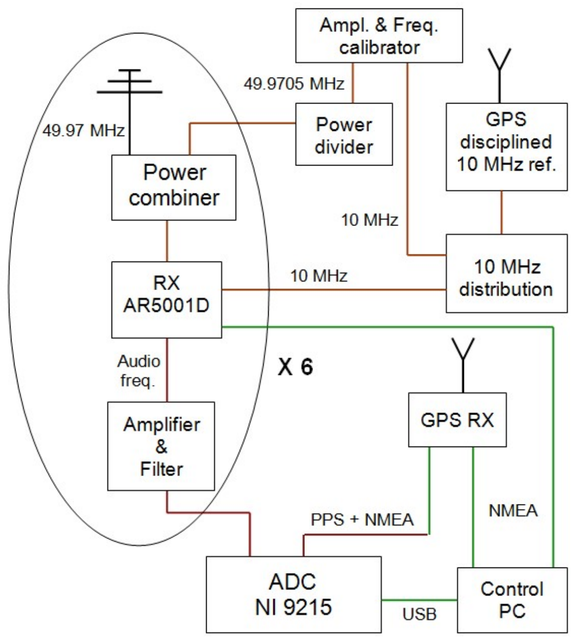
  1. Fit a sinc function to the FFT spectrum in the region of the calibrator frequency

  2. « Integrate » the contributions of the various FFT frequencies in a limited range of frequencies and subtract an estimate of the local noise

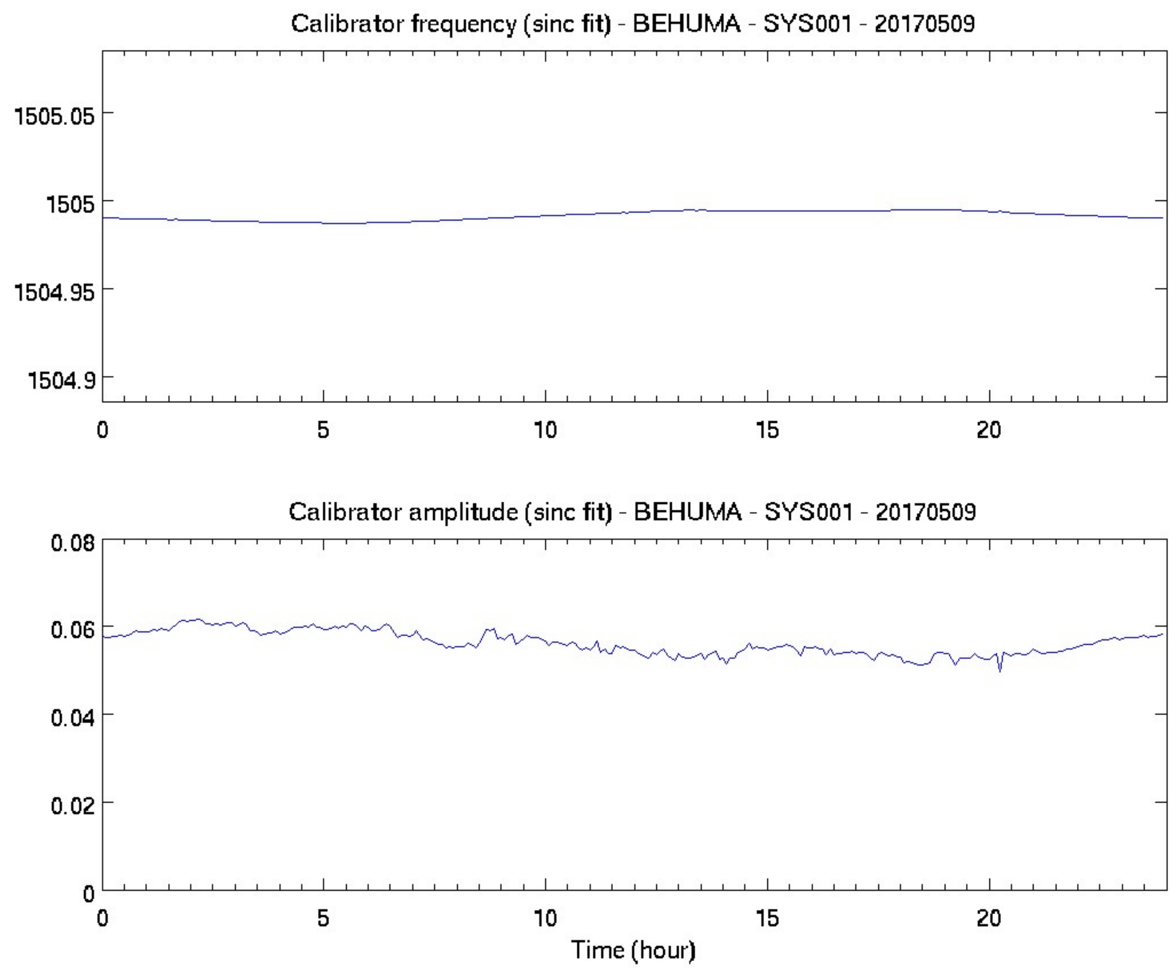
Method 1 : sinc fit of the FFT spectrum



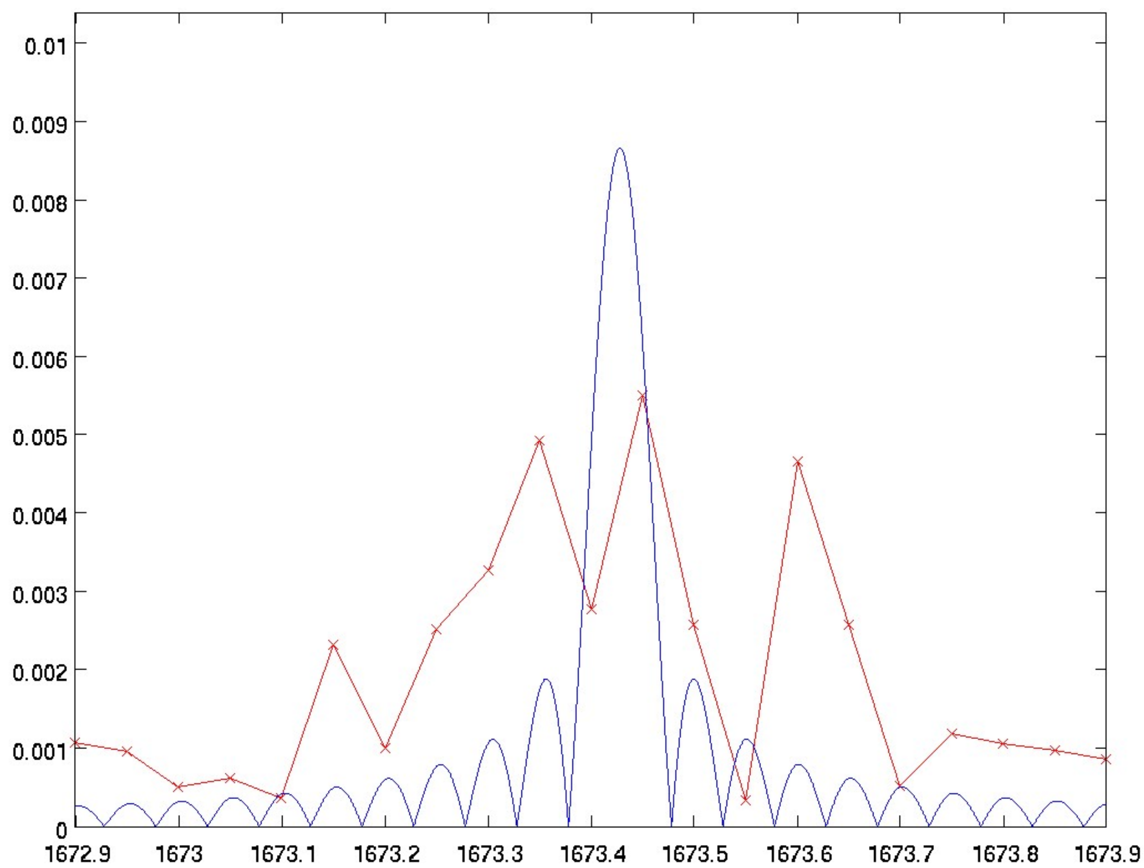
Works well in Humain



Method 1 : sinc fit of the FFT spectrum



Method 2 : « integration » of the FFT spectrum contributions



The LO of the ICOM-R75 is not stabilized.

Instead we locate the max of the FFT spectrum and sum the values of the FFT spectrum in a small frequency range centered on it

Then we estimate the contribution of the noise in a frequency range nearby and subtract it

Utility of the amplitude of the calibrator signal

- To detect a potential problem with the ICOM-R75 (progressive decrease of amplitude over a period of time)
- To calibrate power measurements of meteor echoes in Watts (see talk this afternoon)

The meteor radar in Dourbes

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