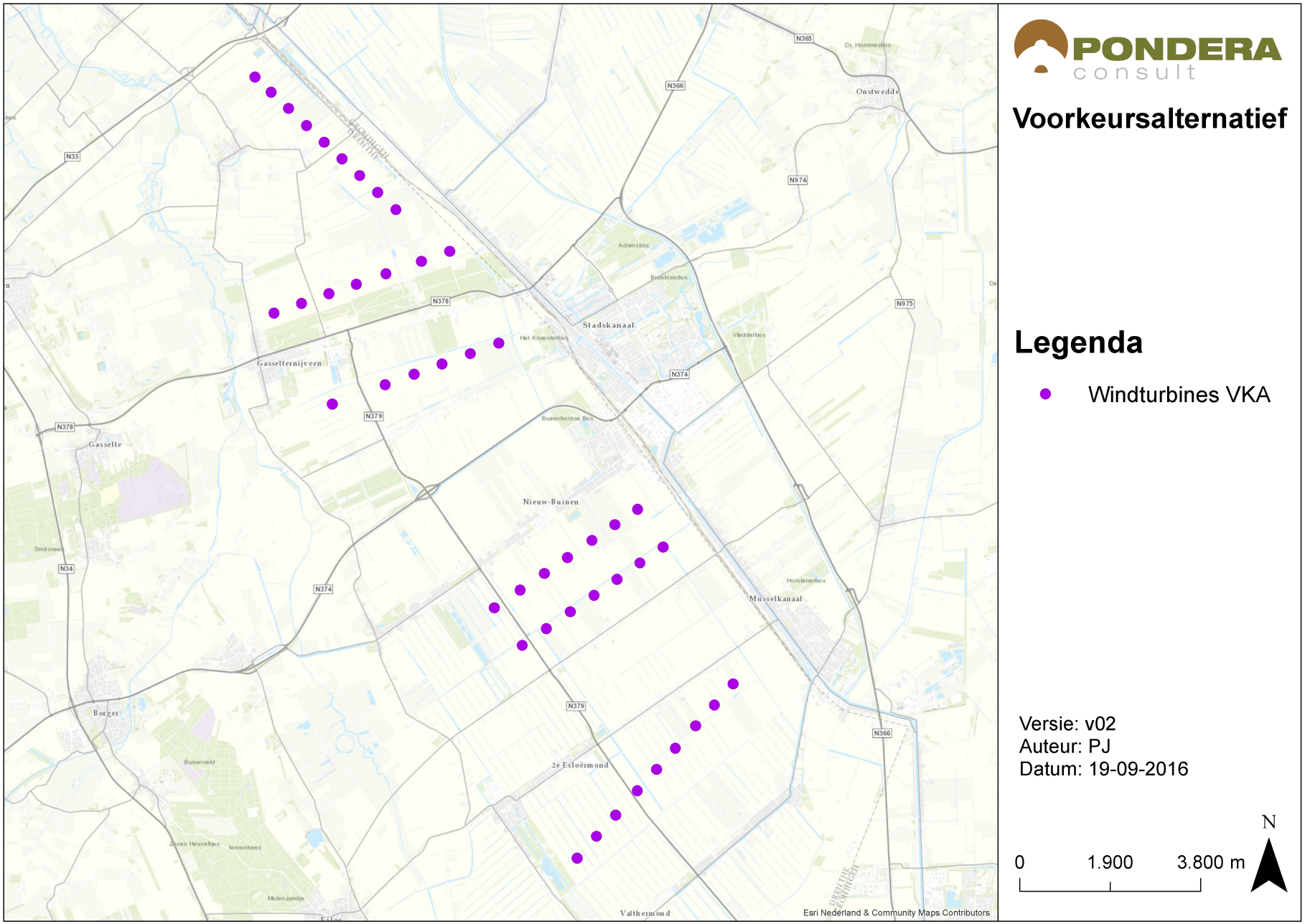
LOFAR Technical Working Group issues

Radio Observatory & R&D
ASTRON, Dwingeloo, The Netherlands

2017-06-23

Wind turbines: plans 45×3 MW at 200 m

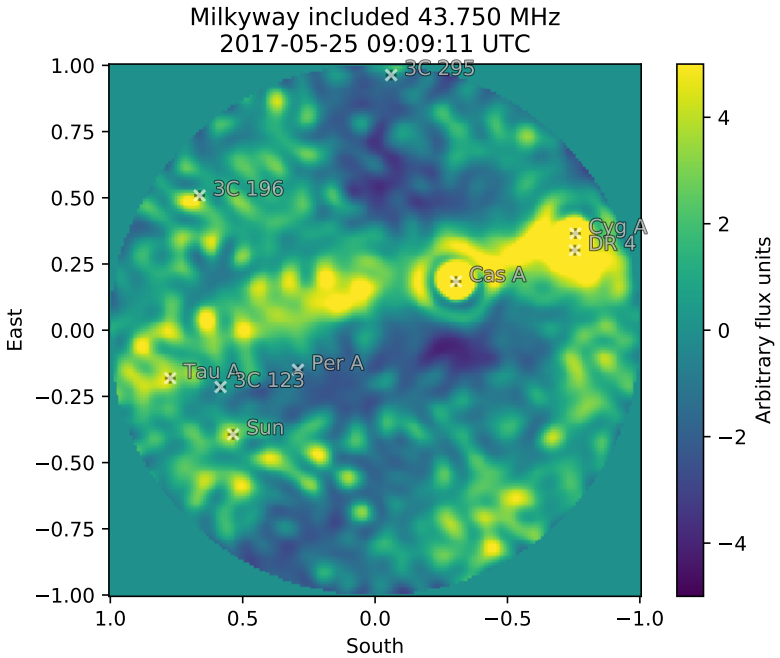


Wind turbines: covenant

EM interference reduction	Consequence
< 35 dB	No permission to build
35 dB $\leq$ improvement $<$ 40 dB	56–62$\times$ 12 h idle
40 dB $\leq$ improvement $<$ 50 dB	Reduced idle time to be negotiated
improvement $\geq$ 50 dB	No restrictions

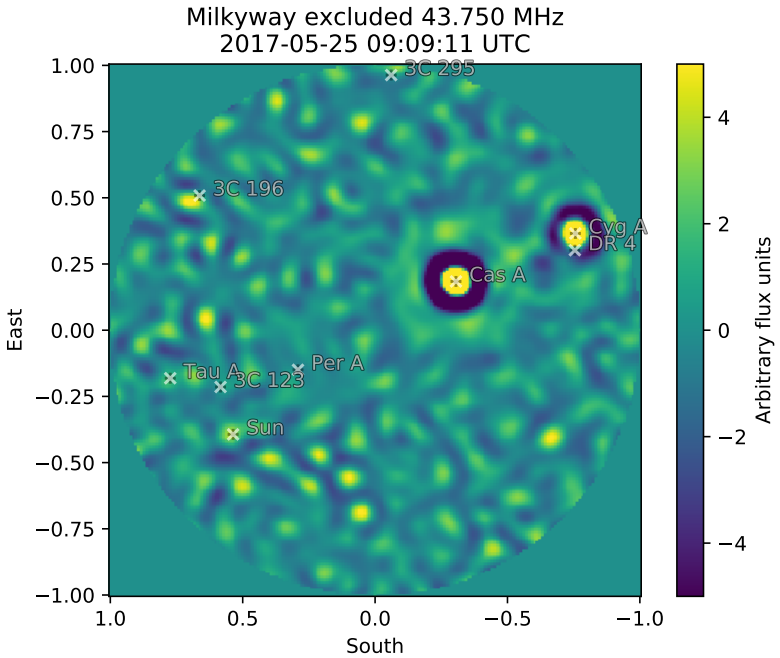
- Astron must find 7 dB additional improvement in signal processing.
- Agentschap Telecom establishes method to measure improvement in cooperation with Astron and wind farm developers.
- Measurement protocol must be established 2017-06-19. *(likely next month)*
- In case of conflict: binding arbitration.
- Neither party will claim damages due to wind farm or lack thereof.

Wind turbines: measurement method



- Low signal levels: imaging interferometer
- Externally reviewed by experts from TNO (NL) and Faunhofer Institute (DE)
- Field tests conducted by Astron, AT, and INAF

Wind turbines: measurement method



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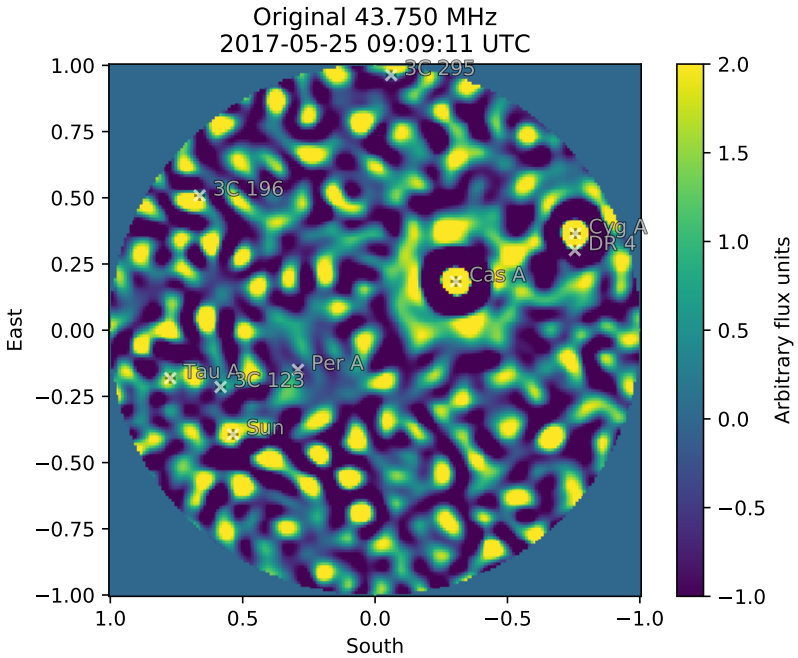

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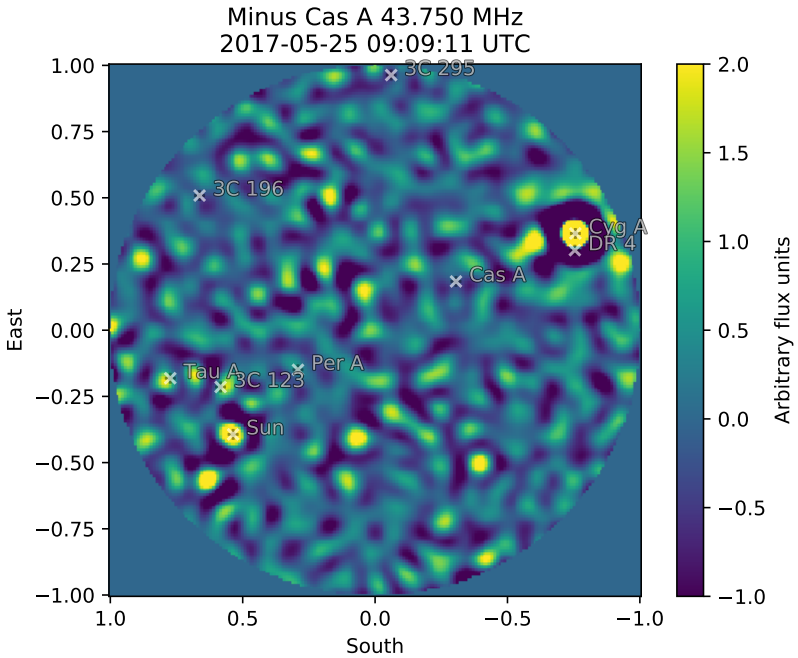

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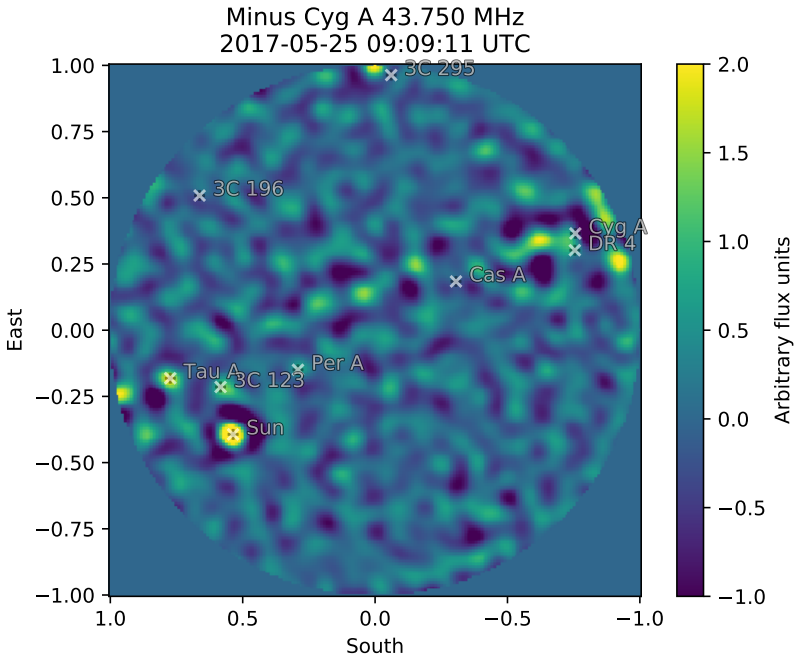

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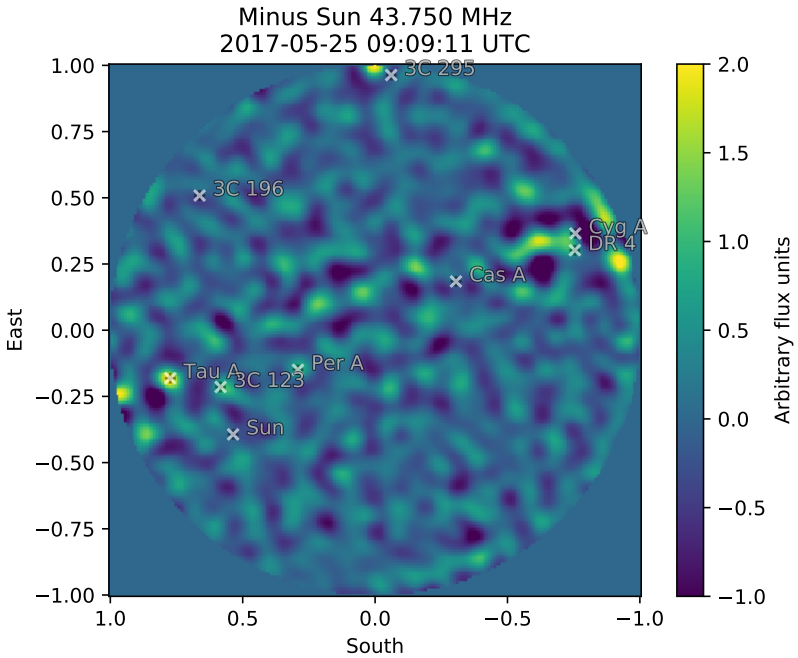

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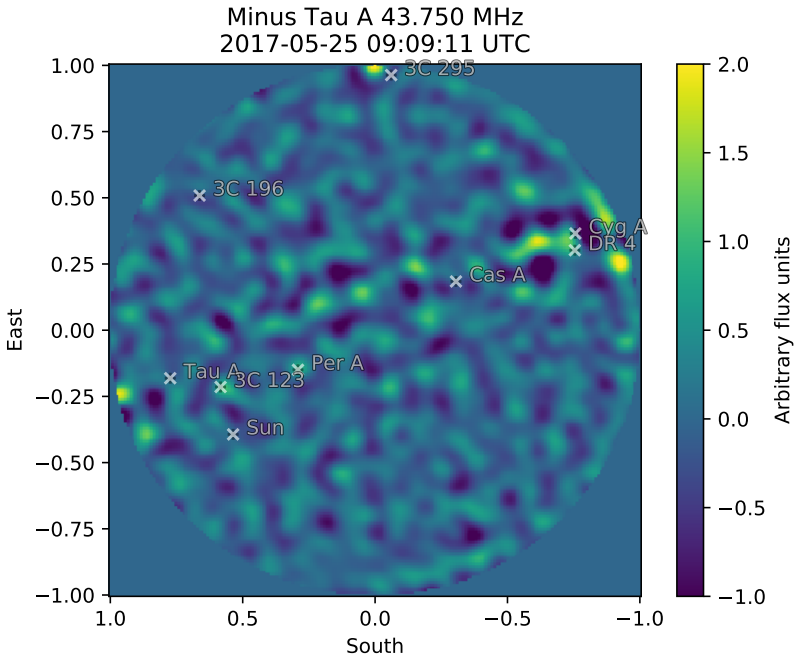

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Wind turbines: time line

- 2016-09-19: Covenant between Astron and prospective wind farm owners
- 2017-02: Raad van State decision on appeals postponed to seek advice from “Stichting Advisering Bestuursrechtspraak”)
- 2017-07: measurement protocol established
- 2017-H2 – 2018-H1: implementation of measurement apparatus/software
- 2017-Q4: Raad van State decision on appeals
- 2018: manufacturer selection
- 2019: start construction
- 2020–2021: wind farm operational

Digital Audio Broadcasts: rollout

FASE1 - September 2013

FASE2 - 2015

FASE3 - 2017

Dekking 2013

40%

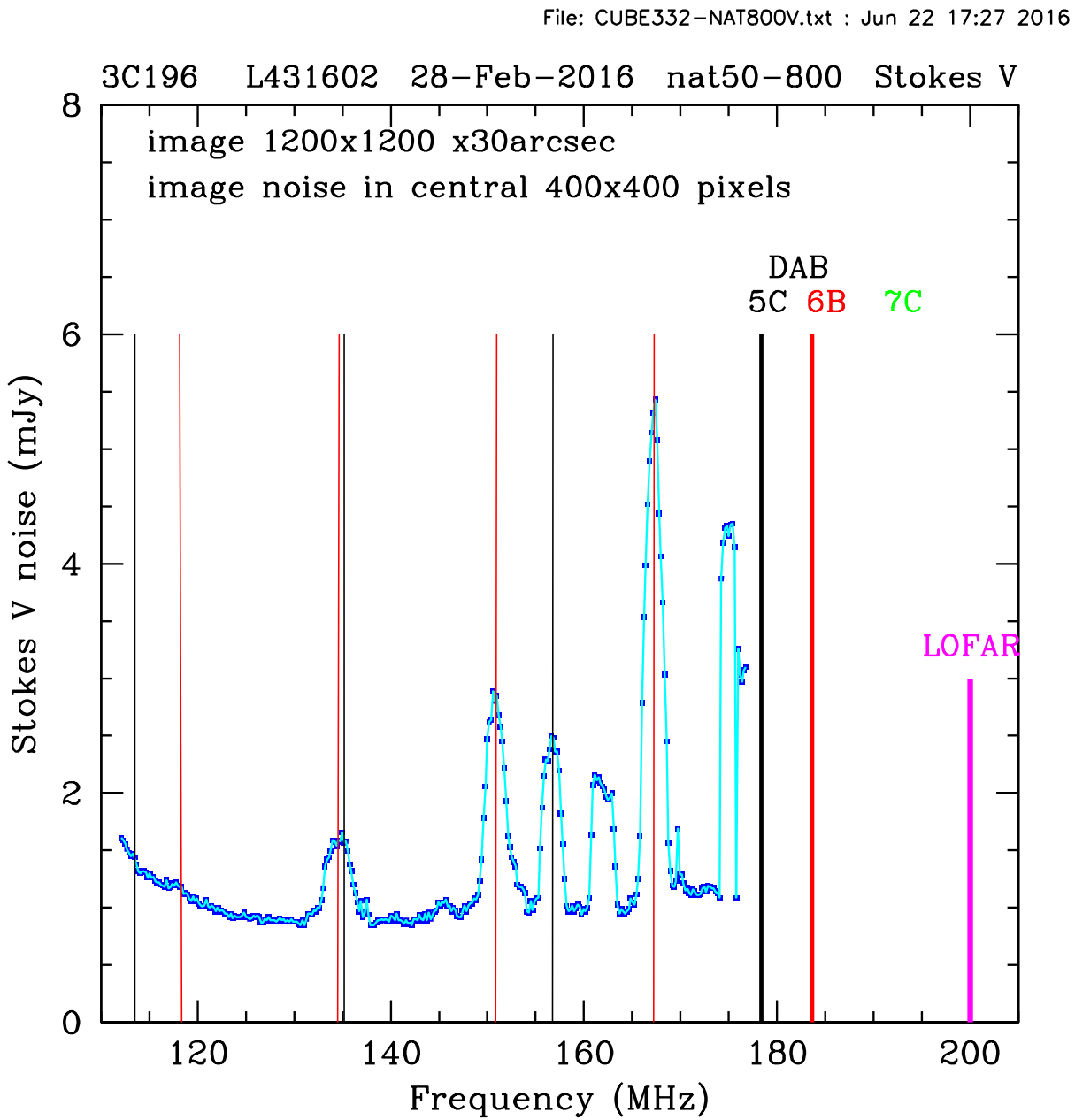
Dekking 2015

80%

Dekking 2017

100%

Digital Audio Broadcasts: core *A.G. de Bruyn*



Digital Audio Broadcasts: stations *M.J. Norden*

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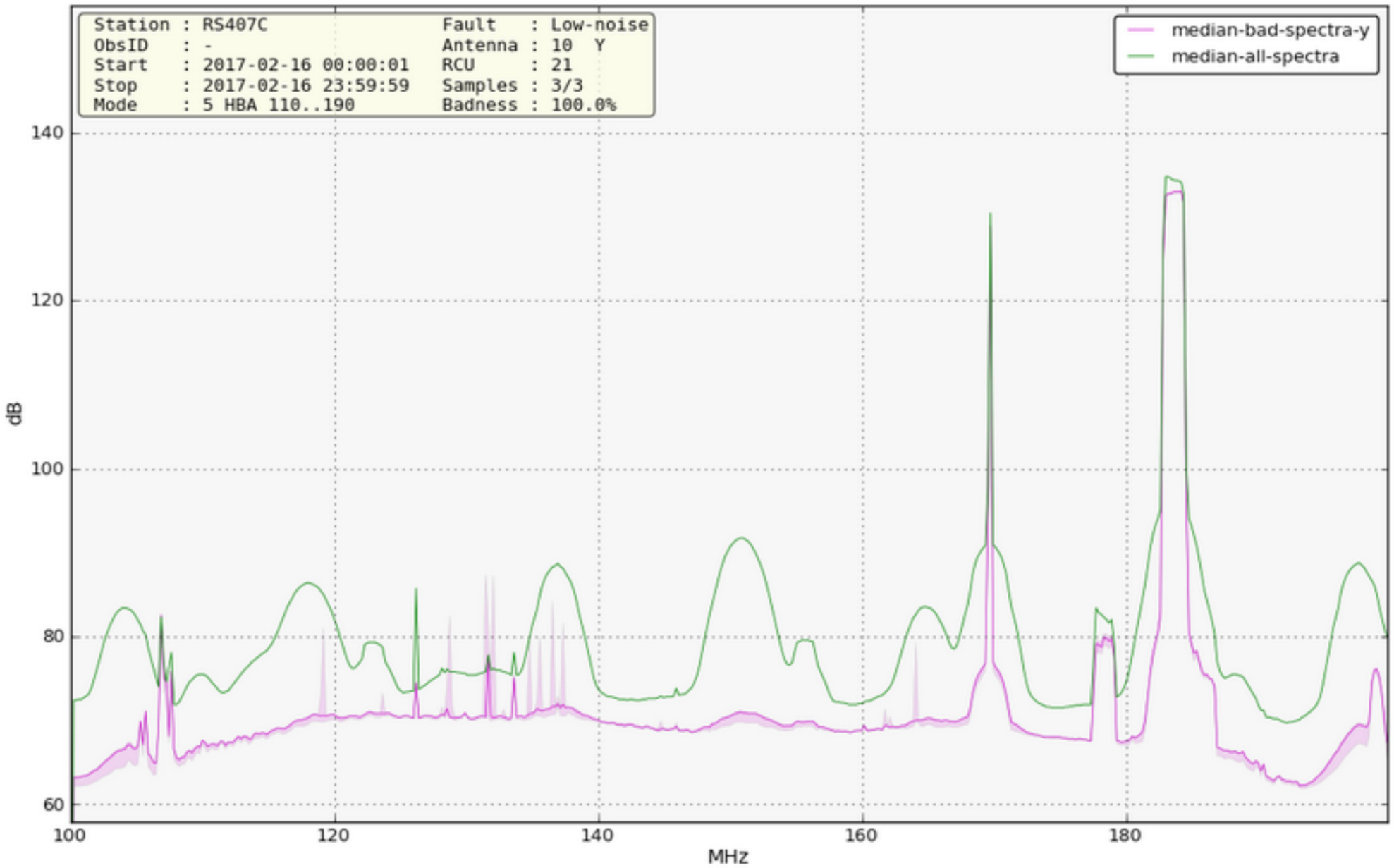
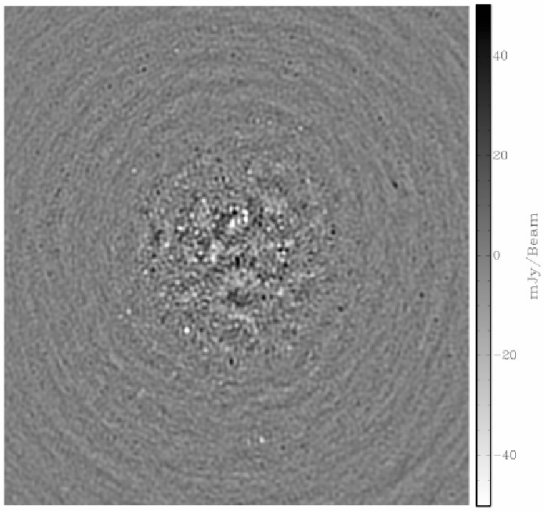
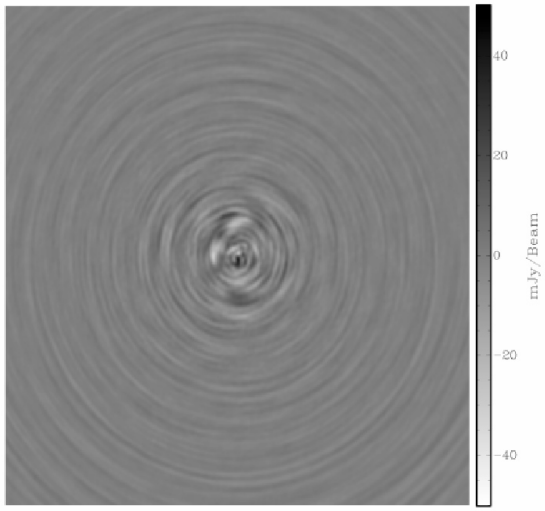
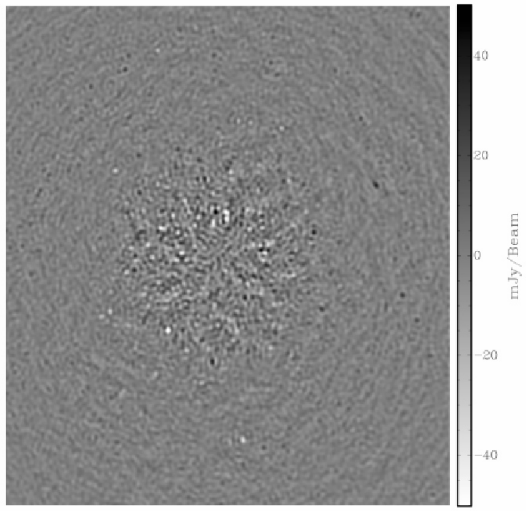


Digital Audio Broadcasts: filtering *S. Yatawatta*

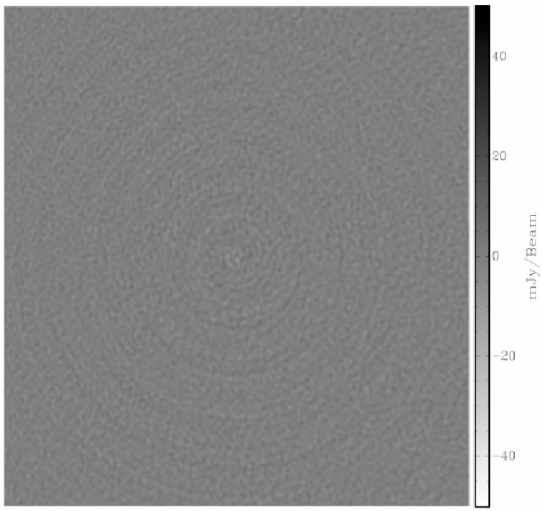


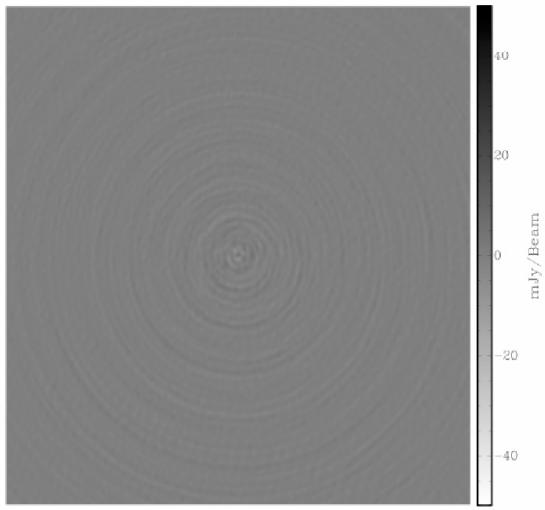


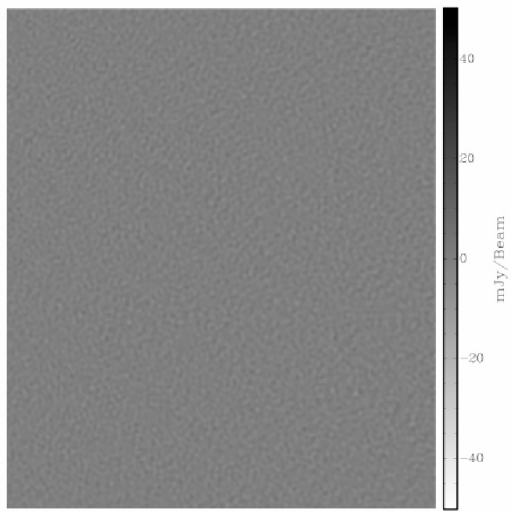


Stokes I: before, difference, after
Stokes V: before , difference, after

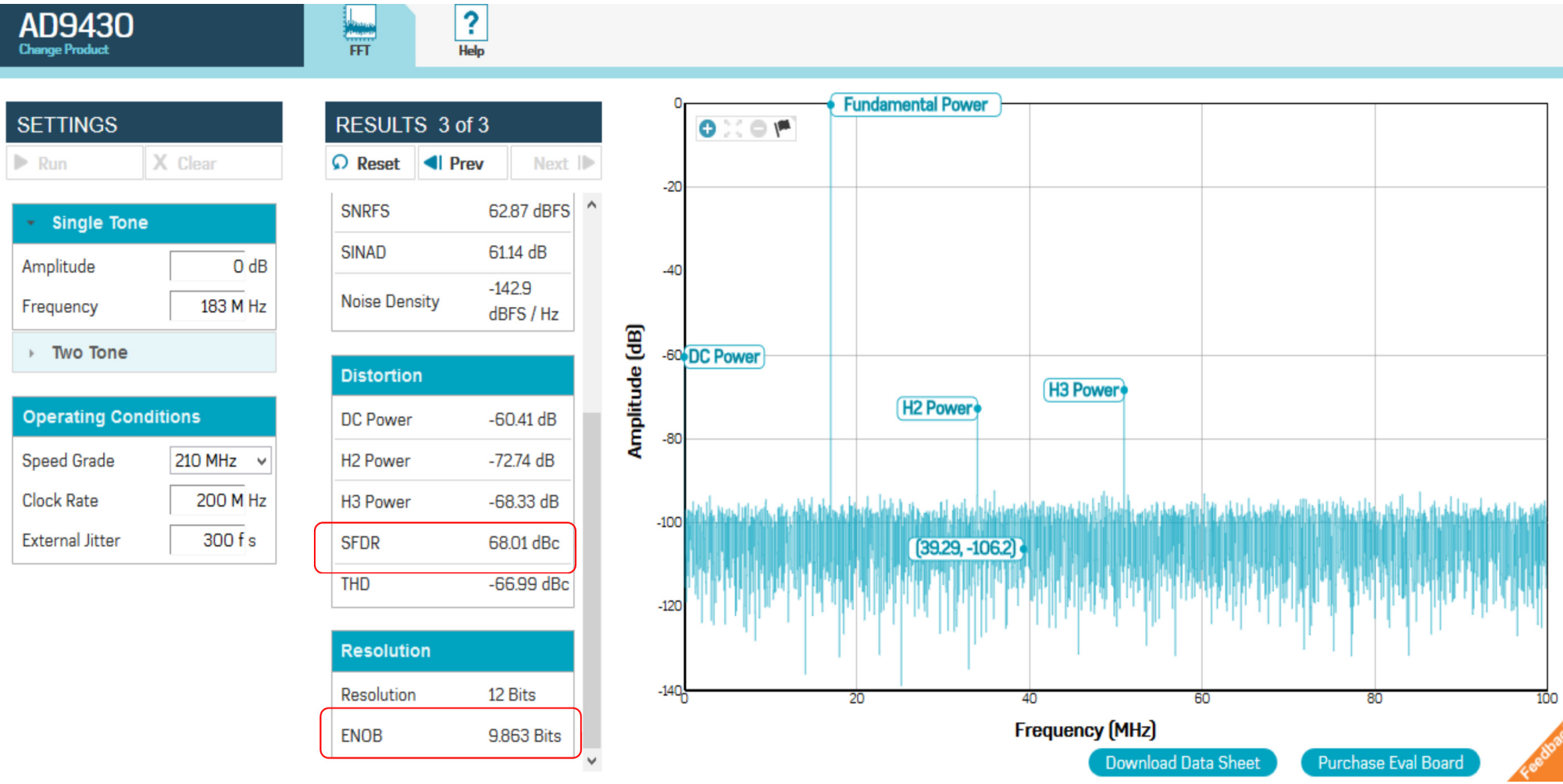
L412370
sb090-099
unif30-250







Digital Audio Broadcasts: replace ADCs



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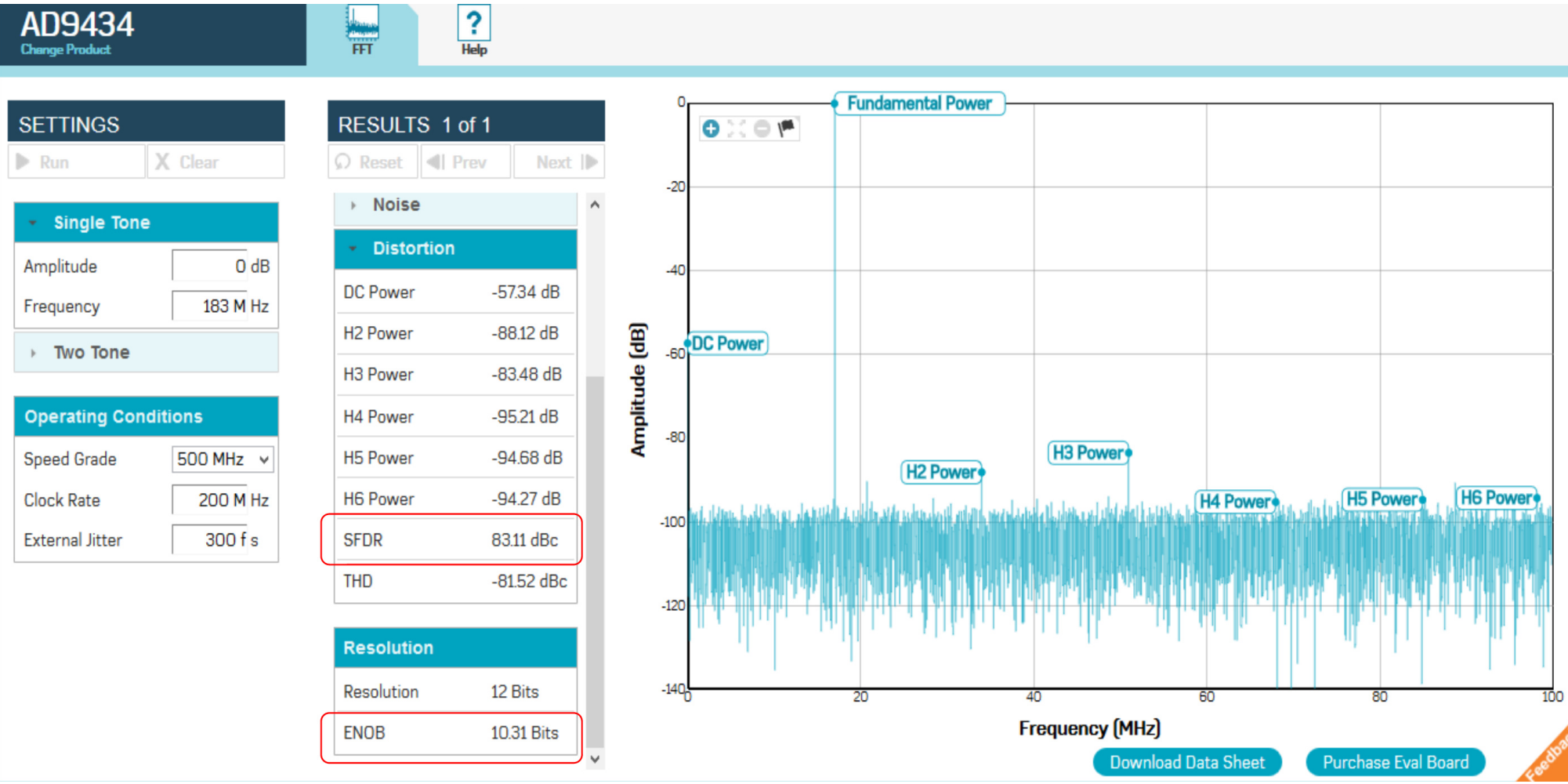
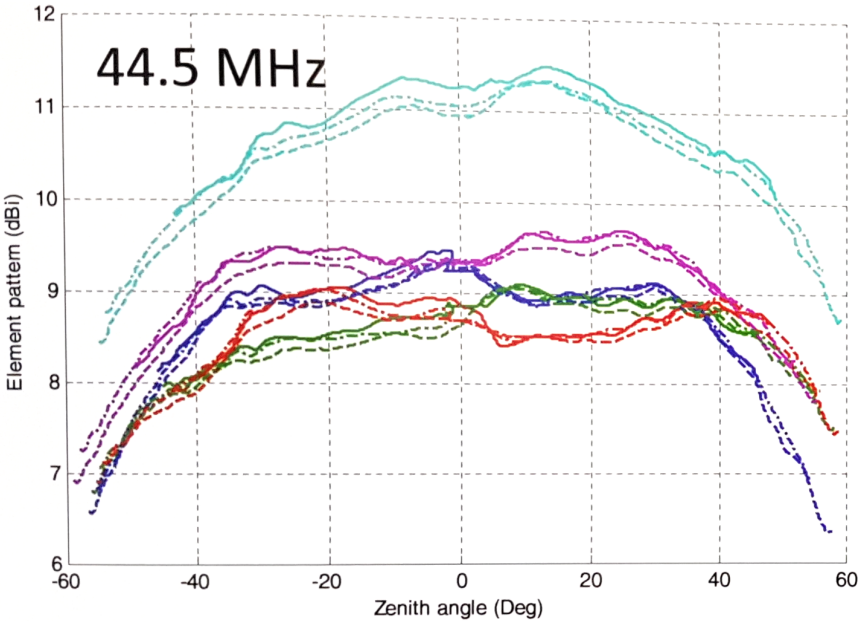
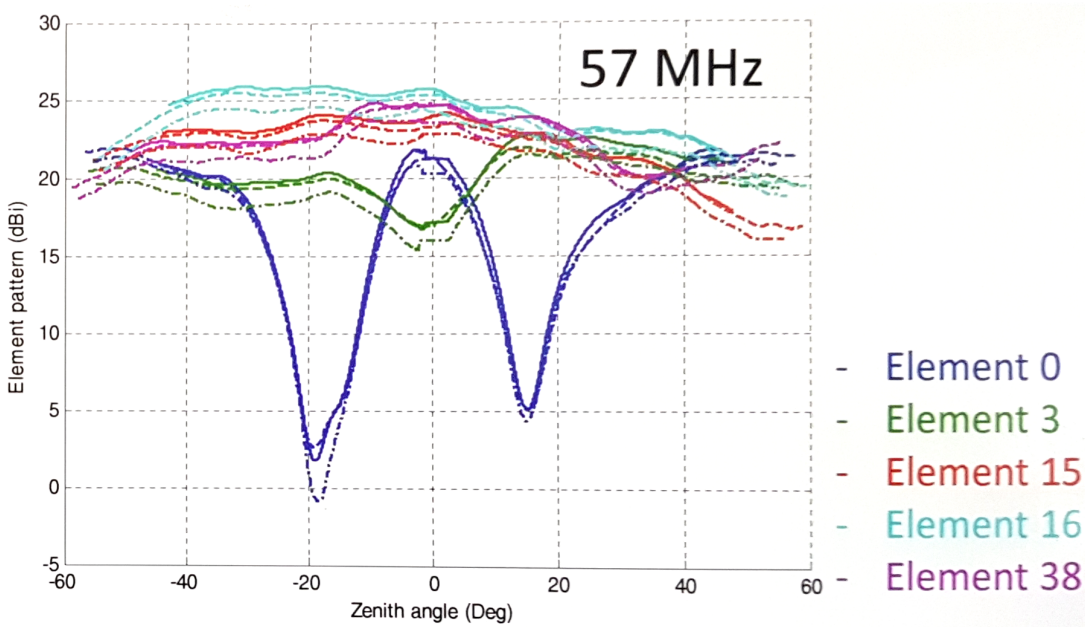


Beam model: goals

- Full EM simulation of loaded, embedded element patterns for every single dipole in LOFAR
- Verification of simulations against already recorded UAV data
- Implementation of new LOFAR beam library based on database of simulated element beams
- Full-band verification of this library using 24-h cross-calibration of several flux density calibrators at all their azimuths and elevations.

Beam model: LBA status *G. Pupillo*

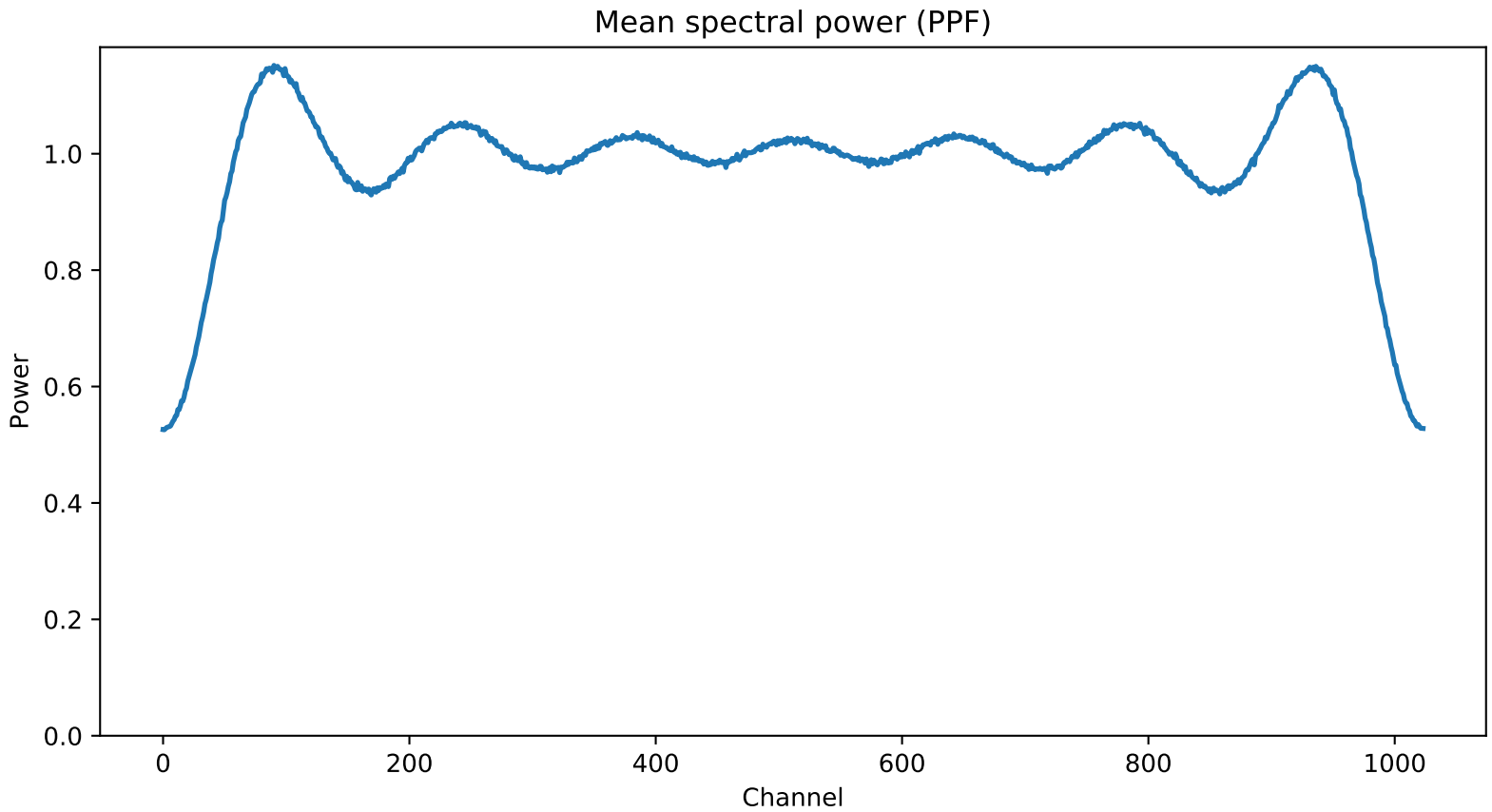




Beam model: time line

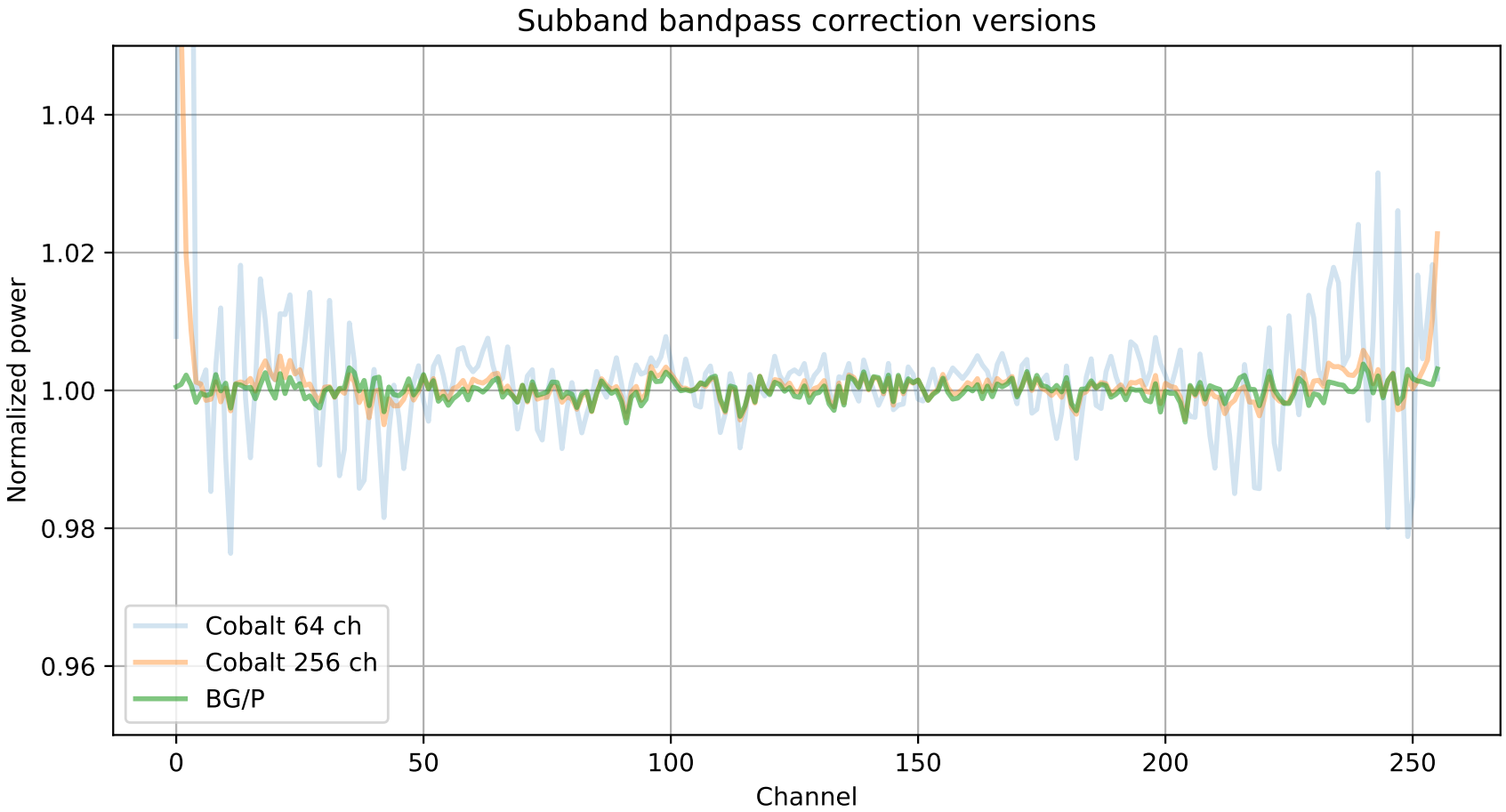
- Drone observations: completed April 2016
- CS302 LBA modeling/validation: underway at INAF (see poster)
- CS302 HBA modeling/validation: this summer at Astron
- EM Simulating every dipole in LOFAR: 2018
- Implementing beam model based on sims: 2018
- Final Verification by 24 h flux density observations: early 2019

Total power spectroscopy: main problems



- Station subband bandpass correction on Cobalt insufficient for narrowband work
- Core not coherent, particularly in LBA

Total power spectroscopy: cobalt vs BG/P



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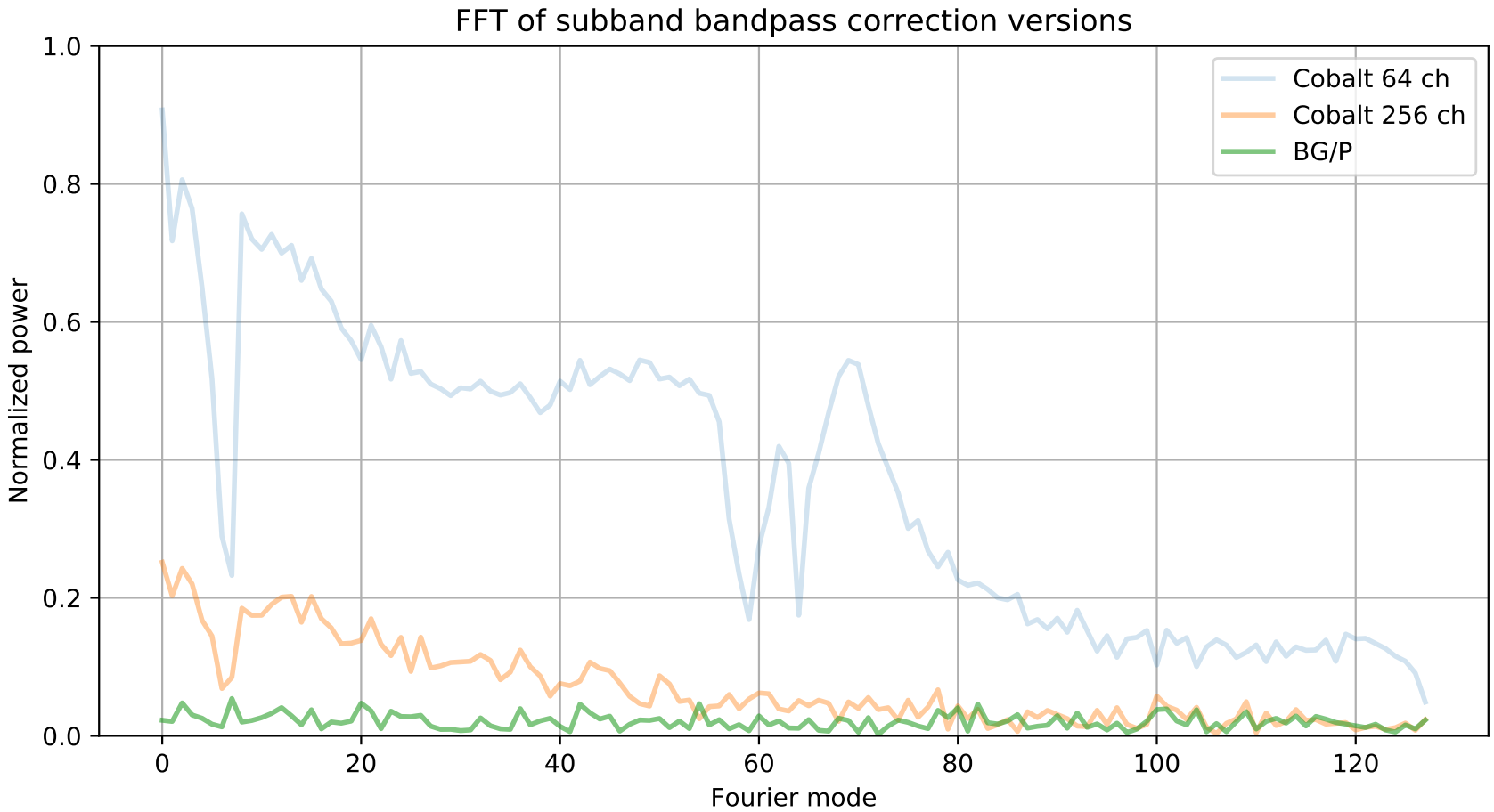


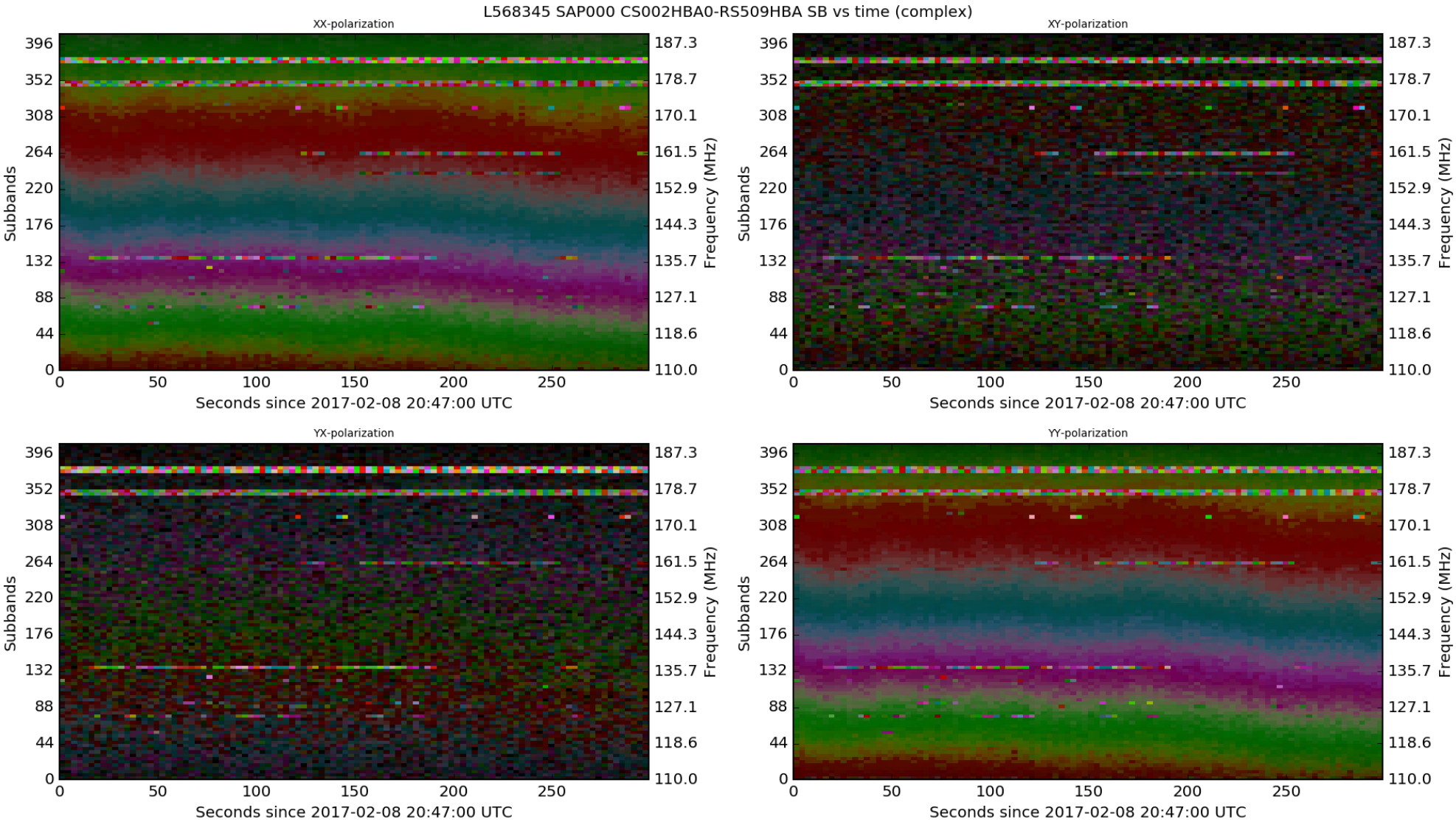
Total power spectroscopy: core coherence

- Reasonable in HBA
- Bad in LBA: never done proper calibration there due to ionosphere
- New avenues:
  - Average clock/tec solutions + higher order ionosphere over long time
  - Use calibrator underneath ionosphere: lightning

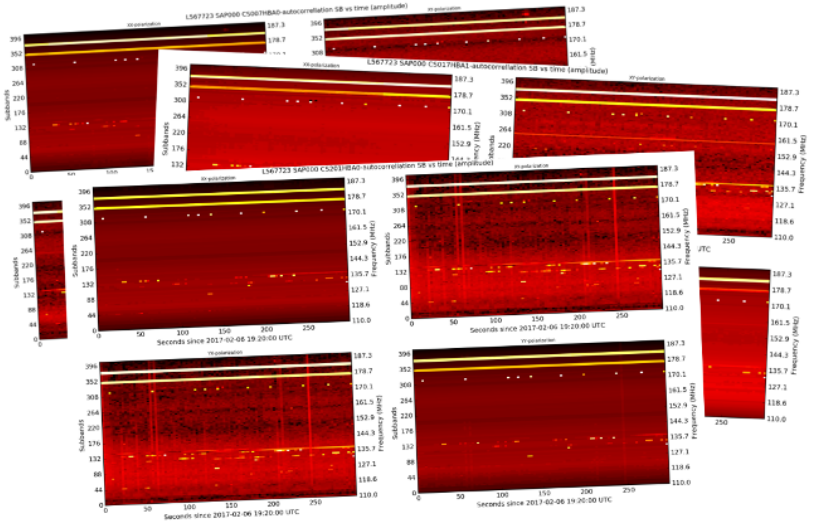
Data inspection: goals and status

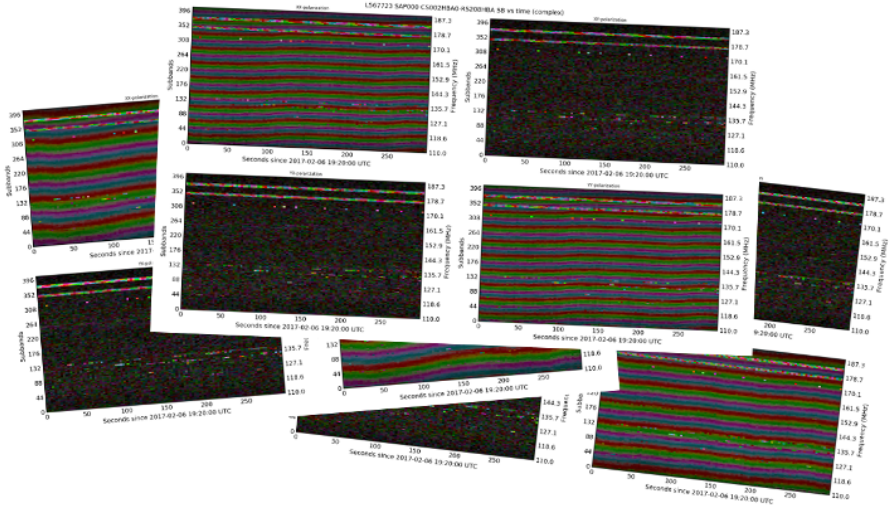
- Current inspection plots outlived their usefulness
- Machine learning for system health/data inspection
- End goal: have automated system produce suggestion for "operator/science support email" to users
- Store summary data in HDF5 per observation (2400+ made to date)
- Produce inspection plots (full-band complex dynamic spectra per baseline)
- Thousands of plots: first cluster into groups that are similar
- Show only small number of representative plots per cluster
- Typically of order 20 clusters
- Per cluster histogram of how often certain station is in certain cluster

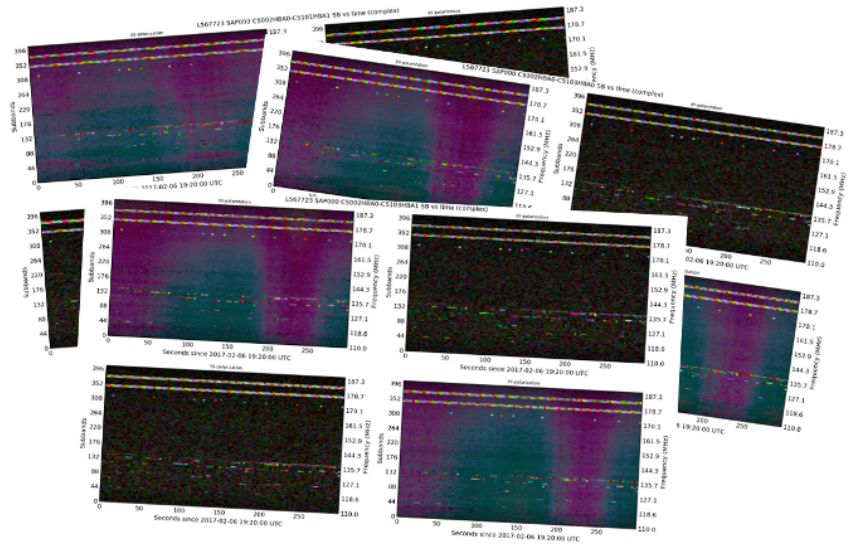
ADDER: single baseline *J.Schaap*

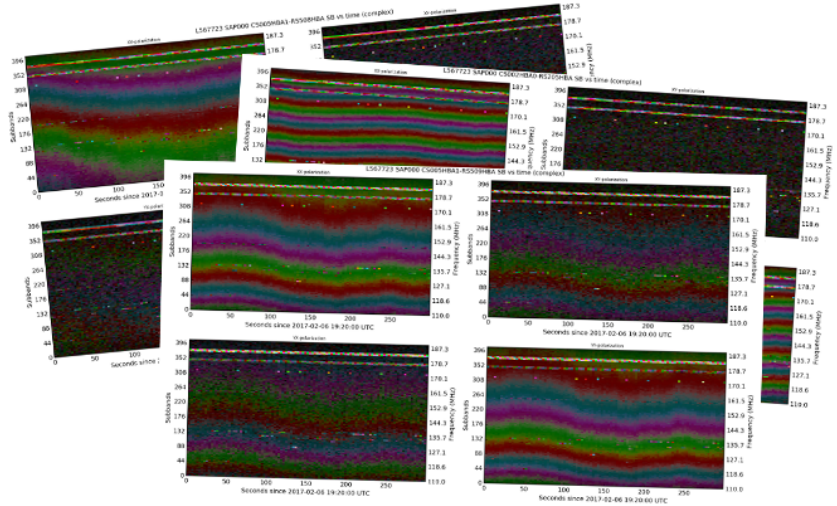


ADDER: clustering example *J.Schaap*





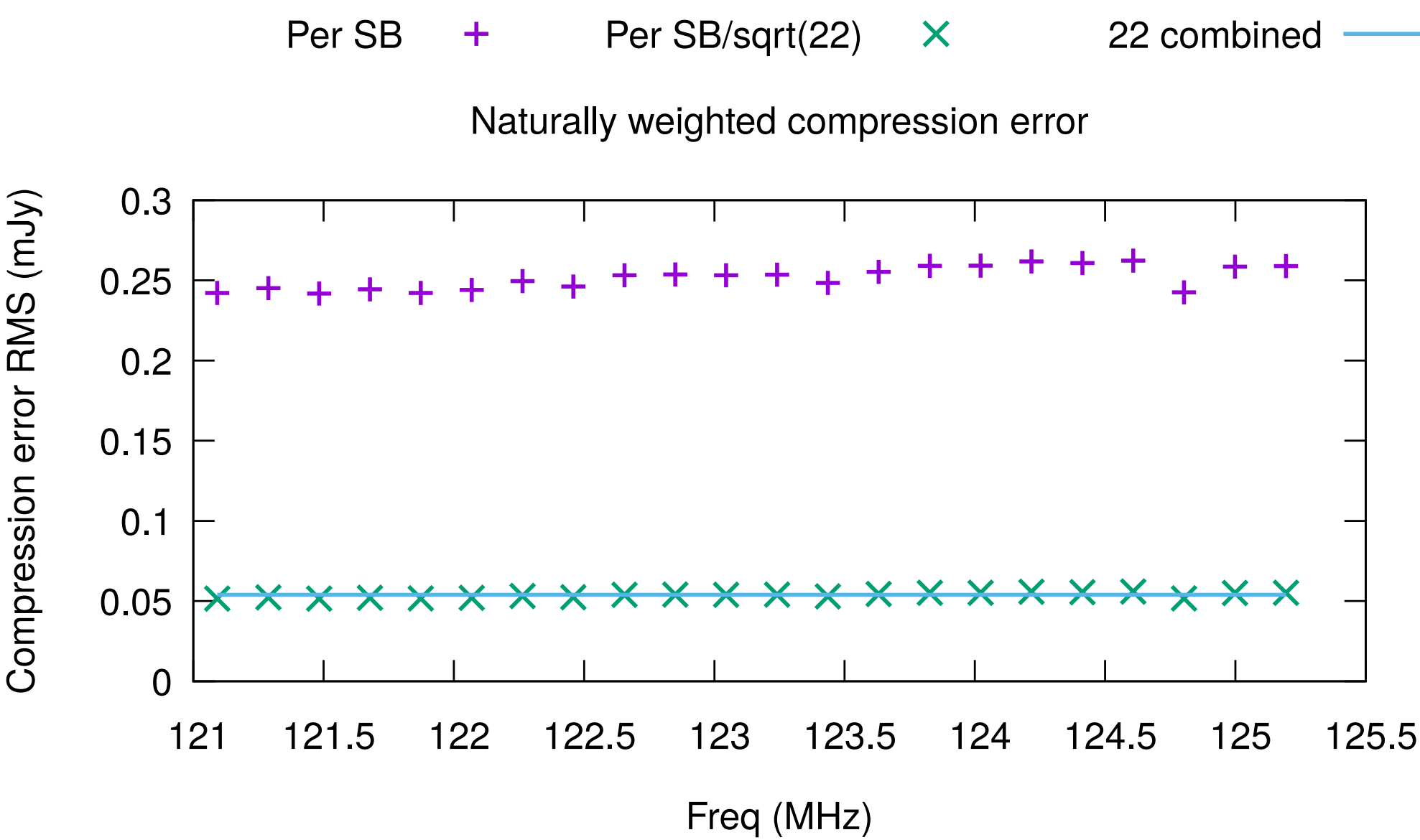




Dysco: visibility compression

- Developed by André Offringa
- Lossy compression by factor of a few while adding small amount of unbiased noise.
- Added noise behaves thermally for all intents and purposes: uncorrelated along baselines, time, and subbands
- Already implemented in DPPP
- Can be activated in pipelines as soon as some software-administrative business has been taken care of (passing parameters, consequences for LTA, etc...)

Dysco: compression noise map *A.R. Offringa*


Per SB
Per SB/sqrt(22)
22 combined
Naturally weighted compression error
Compression error RMS (mJy)
0.3
0.25
0.2
0.15
0.1
0.05
0
121
121.5
122
122.5
123
123.5
124
124.5
125
125.5
Freq (MHz)