

115-185 MHz mJy-imaging with LOFAR

A first deep analysis of the NorthPole field



← Sarod Yatawatta & Ger de Bruyn

LOFAR Status meeting, 17-March-2010



Observations 20-22 Dec 2009

L2009_16167

3C61.1 (Dec=+86°)

3s integration

HBA 115 - 185 MHz

8 Core Stations (x 2) (CS002,003,004,005,006,007,030,032)

4 Remote Stations out to 30 km (RS106,208,307,503)

MeqTrees calibration + Casa imaging on LOFAR subcluster

~ 50 subbands processed in 12 MHz wide groups

Expected thermal noise about 0.2-0.3 mJy/beam

Observed with lots of snow on tiles!

Some 'issues' with this dataset

An aerial photograph of a large, circular, multi-lobed water reservoir or wetland area. The water is a deep blue color, and the surrounding land is a mix of brown and green, suggesting a semi-arid or agricultural environment. A winding road or path is visible in the foreground, leading towards the reservoir. The overall scene is a complex, geometric pattern of water and land.

No station calibration turned on as yet

Different station beams (both 24-tile and 48-tile) hence 3 different effective interferometer beams

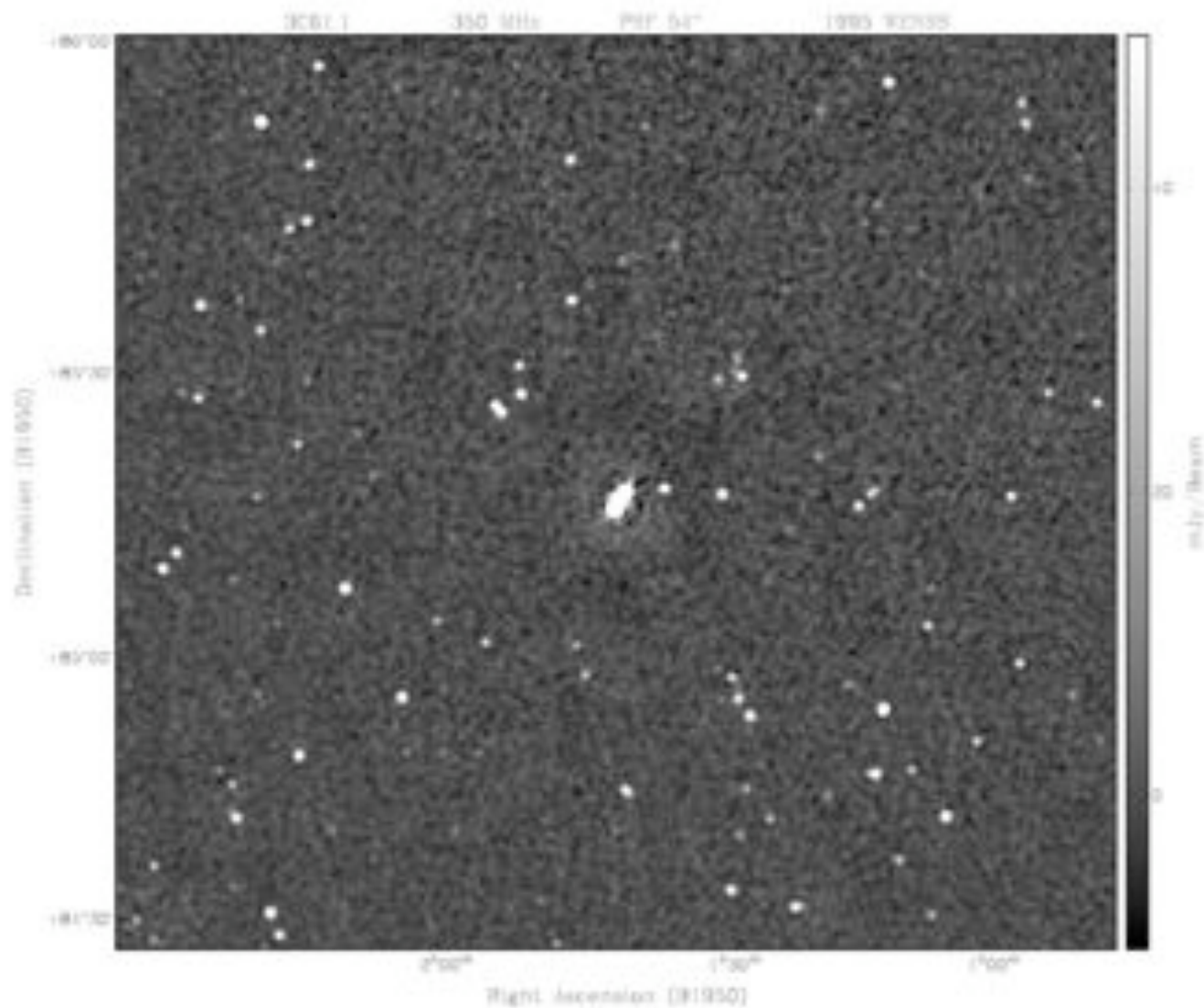
Extremely wide frequency range (115 - 185 MHz)

But:

good uv-coverage (24h)

only small variation in elevation (49° - 57°)

Area near 3C61.1 taken from WENSS 350 MHz



WENSS - 350 MHz

vs

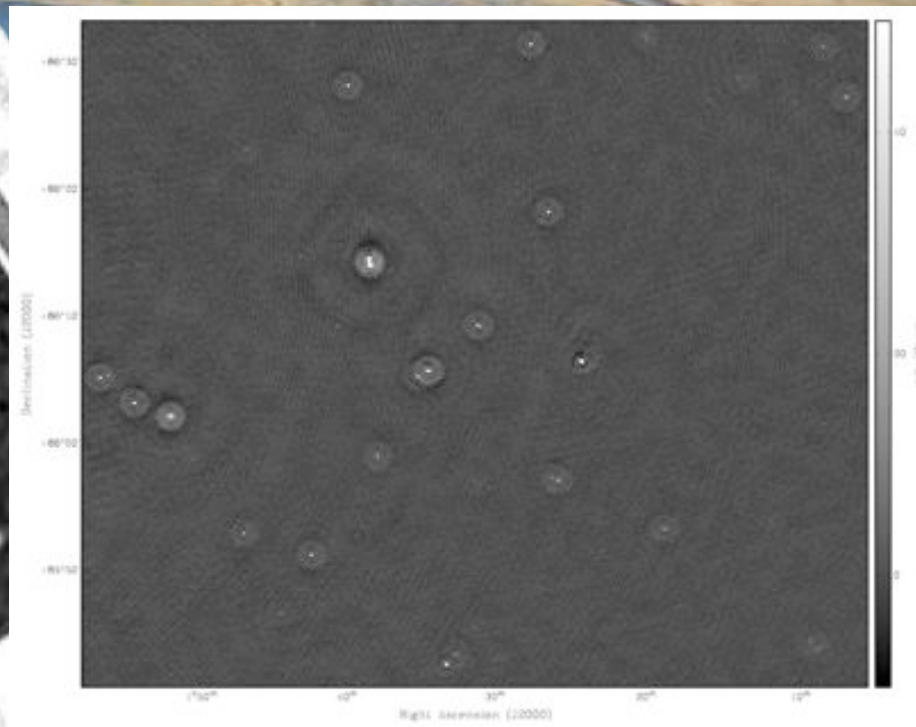
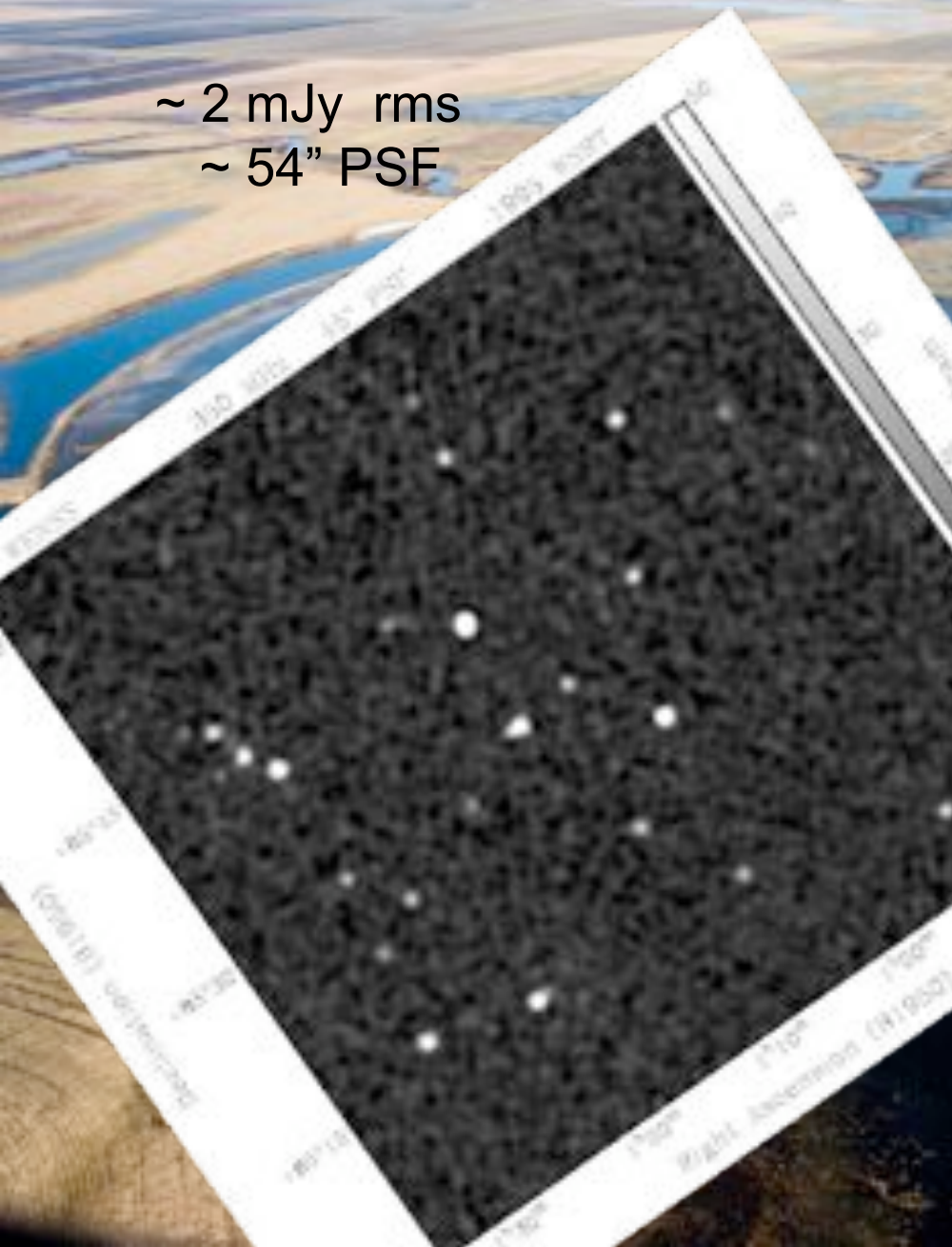
LOFAR - 150MHz

~ 2 mJy rms

~ 54" PSF

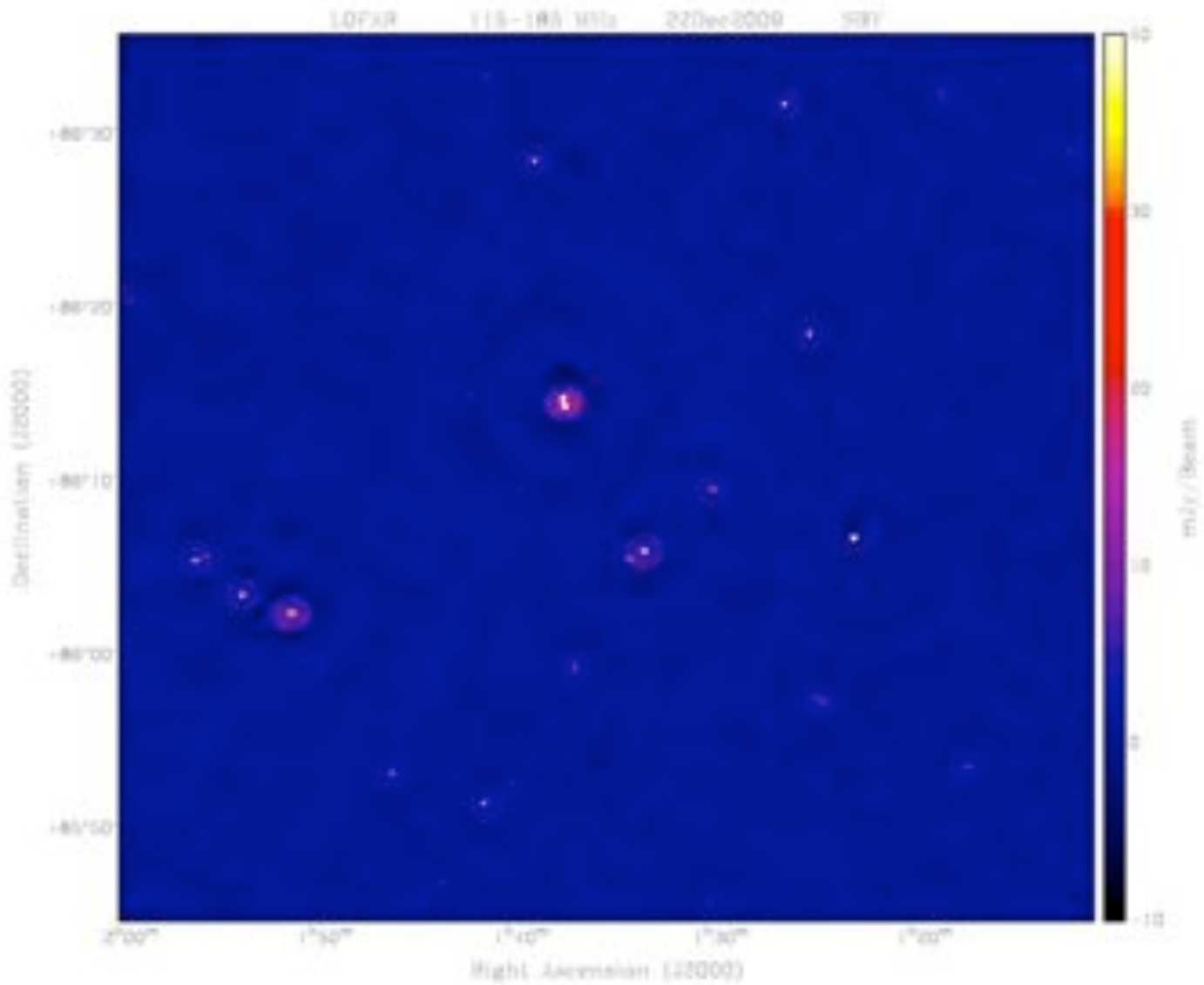
~ 1 mJy rms

~10" PSF



'cup-and-saucer' PSF

Area of about $1 \times 1^\circ$ East of 3C61.1



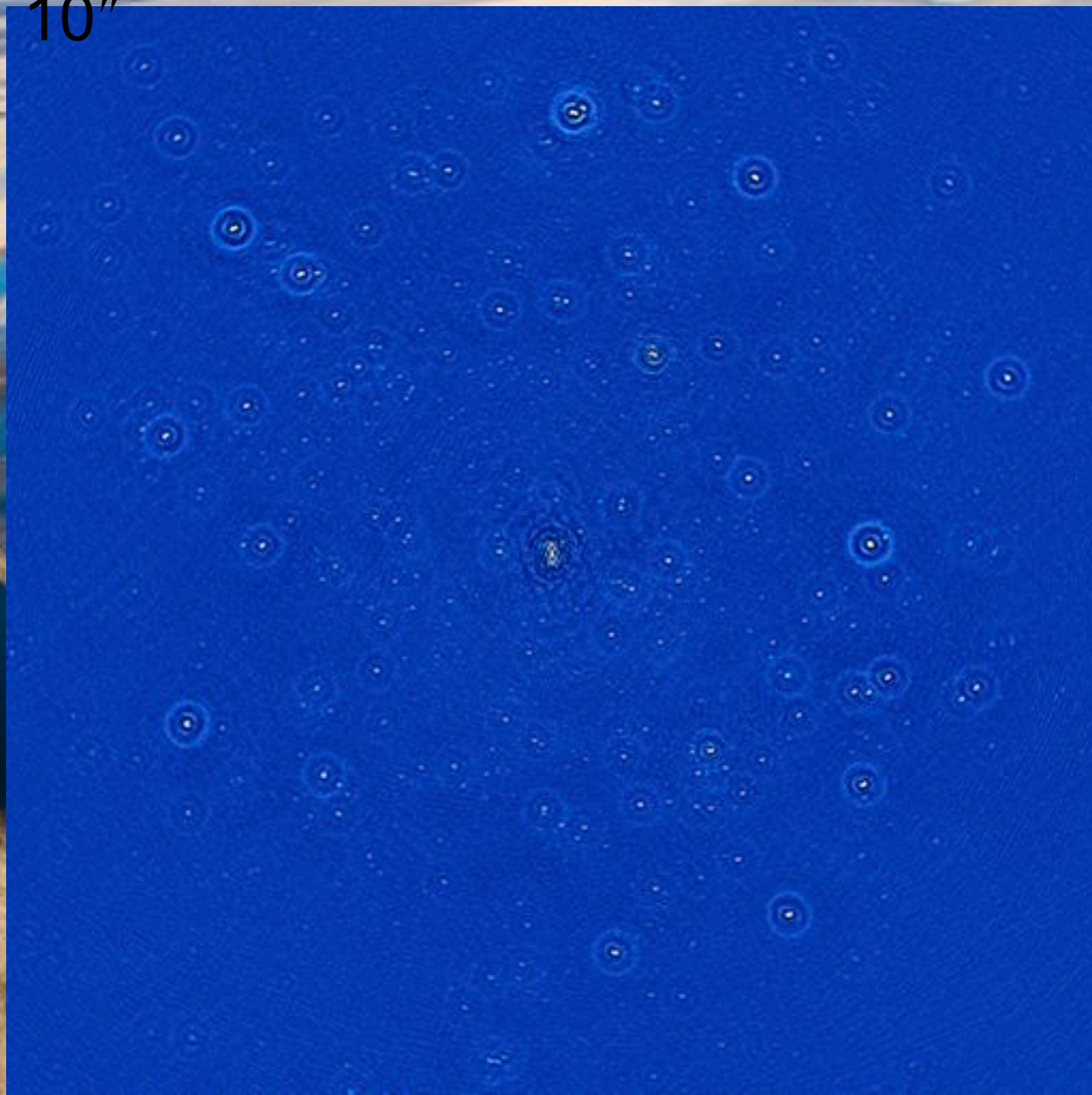
8° x 8° 7200x7200 pixels (4")
10"

PSF ~

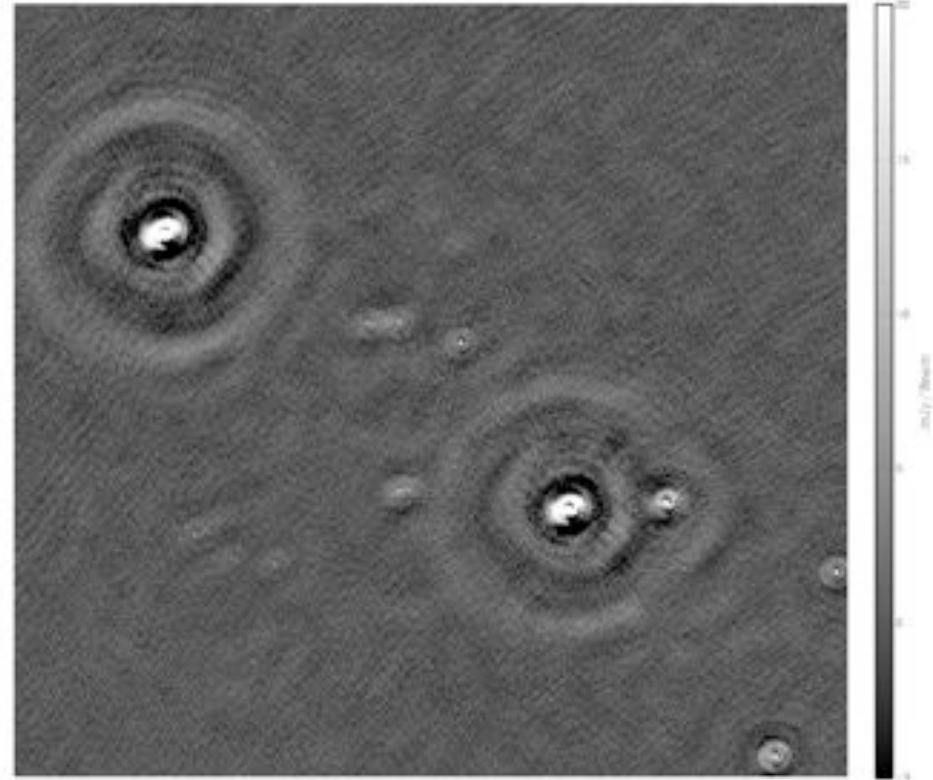
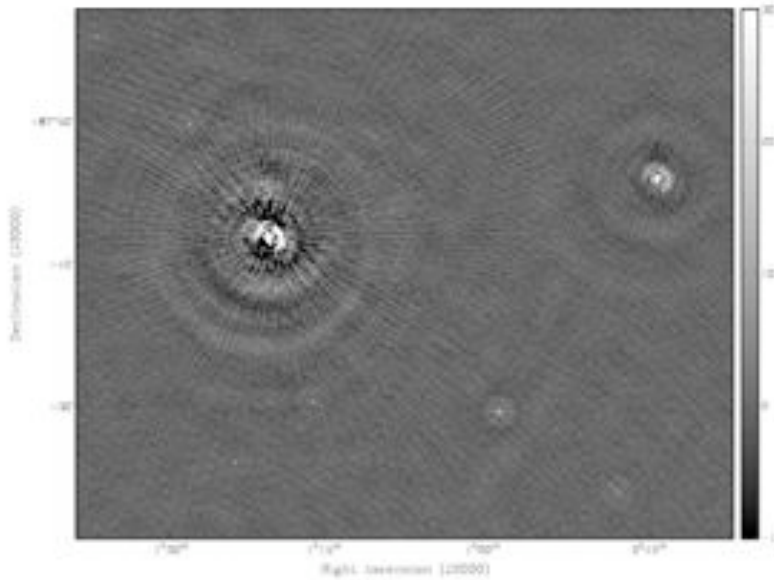
40 source
selfcal, all
subtracted
+restored

shapelets+
component
model 3C61.1

10 Jy peak
1 mJy noise



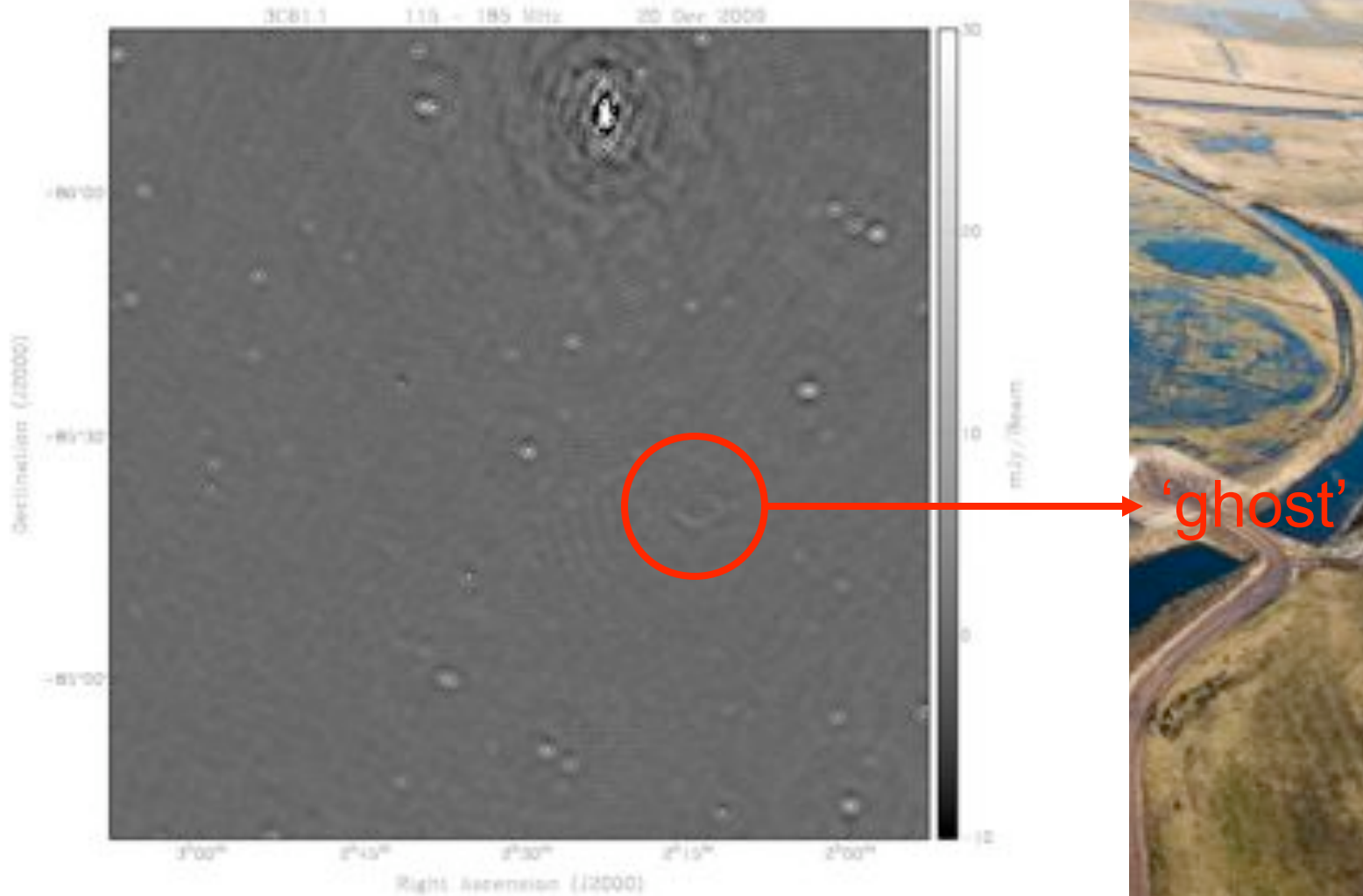
Mild non-isoplanaticity for distant off-axis sources



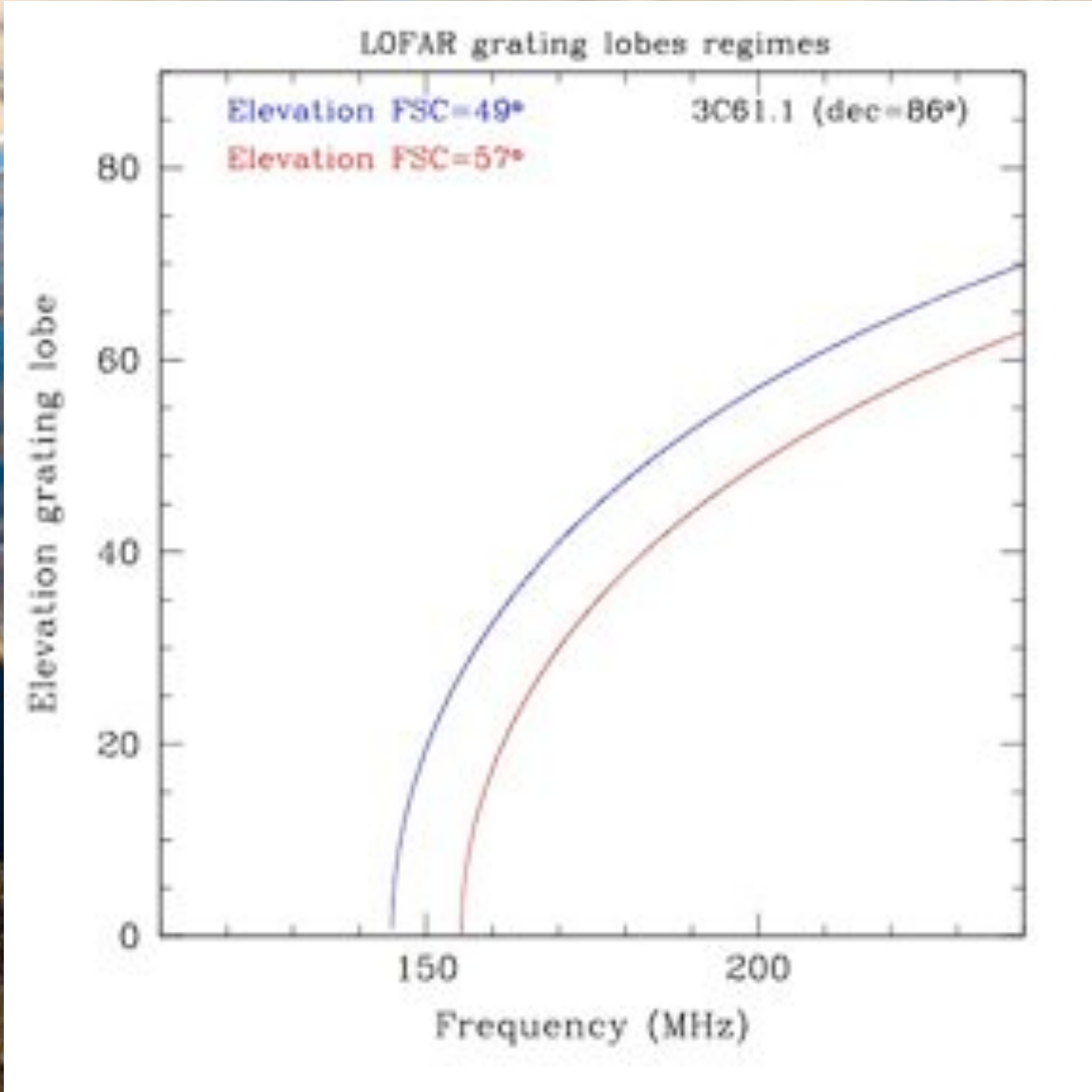
~ 2 Jy peak ($r \sim 1.5^\circ$)

~ 0.2 Jy peak ($r \sim 3^\circ$)

Central area south of 3C61.1



LOFAR HBA-tile grating lobes



Some preliminary conclusions:

Some results:

- Imaging with good PSF over $\sim 5^\circ$ diameter after single direction-independent selfcal
- Only $8 \times 2 + 4$ stations but wide bandwidth and 24h gave good uv-coverage
- Differential ionospheric motion ('seeing') (over 24h) $< 10''$
- Noise level ~ 1 mJy \Rightarrow DR $\sim 10,000:1$ (within factor ~ 4 from thermal)
- Very weak artefacts near NCP

Some remaining issues:

- Ghost structures
- Off-axis image 'distortions' (at $r > 3^\circ$)

Further improvements (mostly in new datasets) to be expected due to:

- Focused stations (+ 30-40% sensitivity, better/narrower station beams)
- Proper dealing with time/frequency variable beams
- Peeling / SPAM on off-axis sources
- Including spectral properties of sources in LSM
- Much better uv-coverage on long baselines
- Full polarization.