Tianlai NCP

simulation and analysis II

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- See presentation I on indico, and comments by Peter (July 30th, August 6th)

https://indico.fnal.gov/event/44712/contributions/192973/attachments/132154/162250/TNCCS_simu_analysis.pdf

https://indico.fnal.gov/event/44873/contributions/193724/attachments/132475/163102/TNCCS-revisited_6Aug20.pdf

- Simulation of visibilities for NCP observations, as well as a band in declination close to $\delta = 60$ deg , with diffuse synchrotron + point sources NVSS , > 1 mJy , and possibly with HI sources , at three frequencies 1378, **1380**, 1382 MHz
- Effet of adding noise to visibilities 5 mK , 20 mK for 40" time sampled visibilities
- Effet of phase calibration errors, ±3 deg, ±10 deg (gaussian), one phase error per baselines
- Tianlai 16 dish setup, 120 independent baselines
- Visibilities simulated from map, to which sources has been added using m-mode decomposition

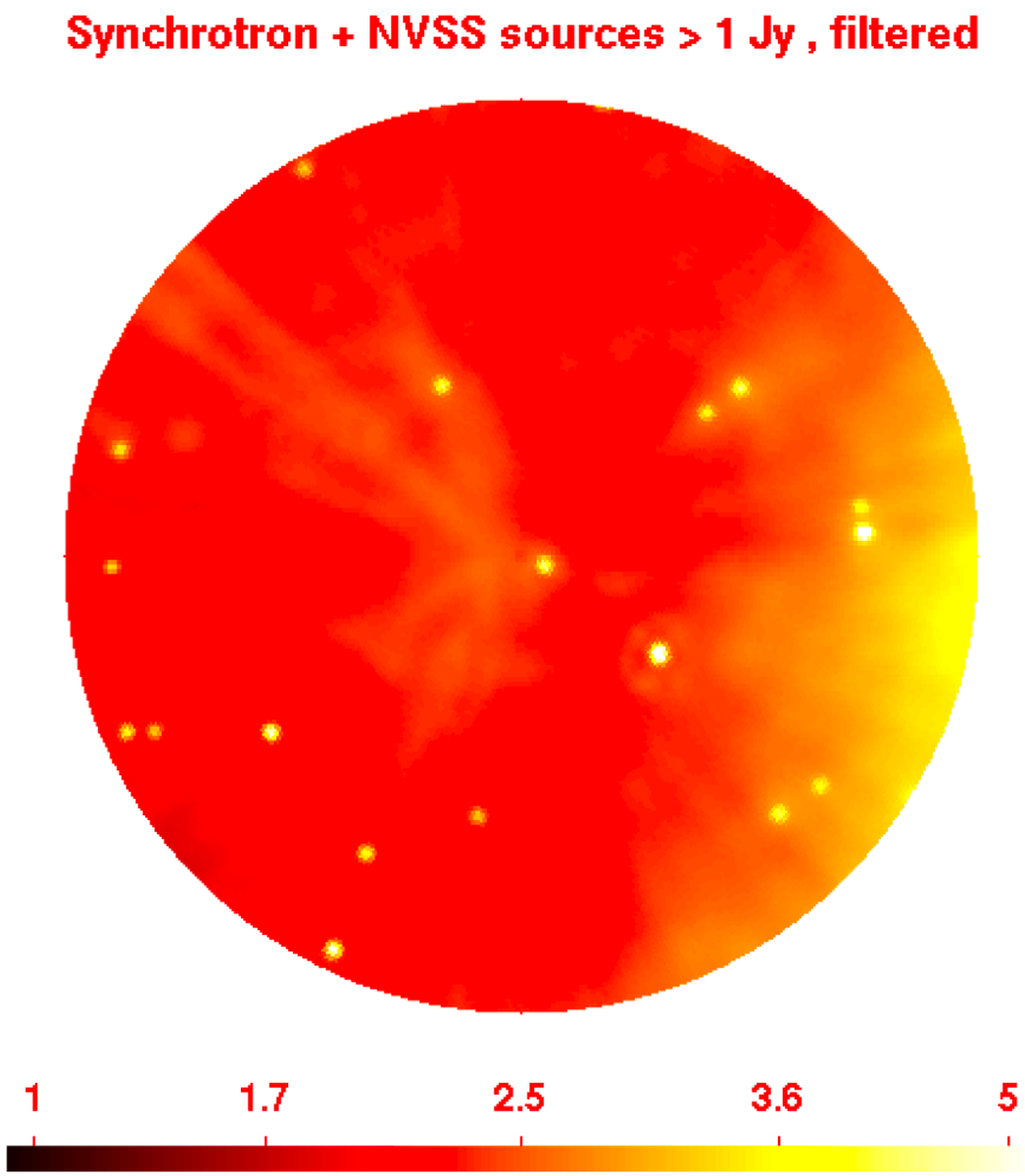
- Map reconstruction using also m-mode decomposition
- Updated JSkyMap package, to add functionalities like list of source to be added to the map for map2vis, adding noise or phase calibration error before map making (vis2map), possibility to save (or read) beams (in (l,m) space) to vis2map, and map2vis - Beam computation is indeed CPU intensive
- about 10-20 hours of CPU (~ 1 hours using 16 cores) for one simulation, dominated by beam computation or one map reconstruction - need about 10 000-100 000 hours , few days (or few weeks) on few nodes for a complete simulation (100 MHz) and several cases
- Checked compilation / running of JSkyMap (+ SOPHYA) on NERSC

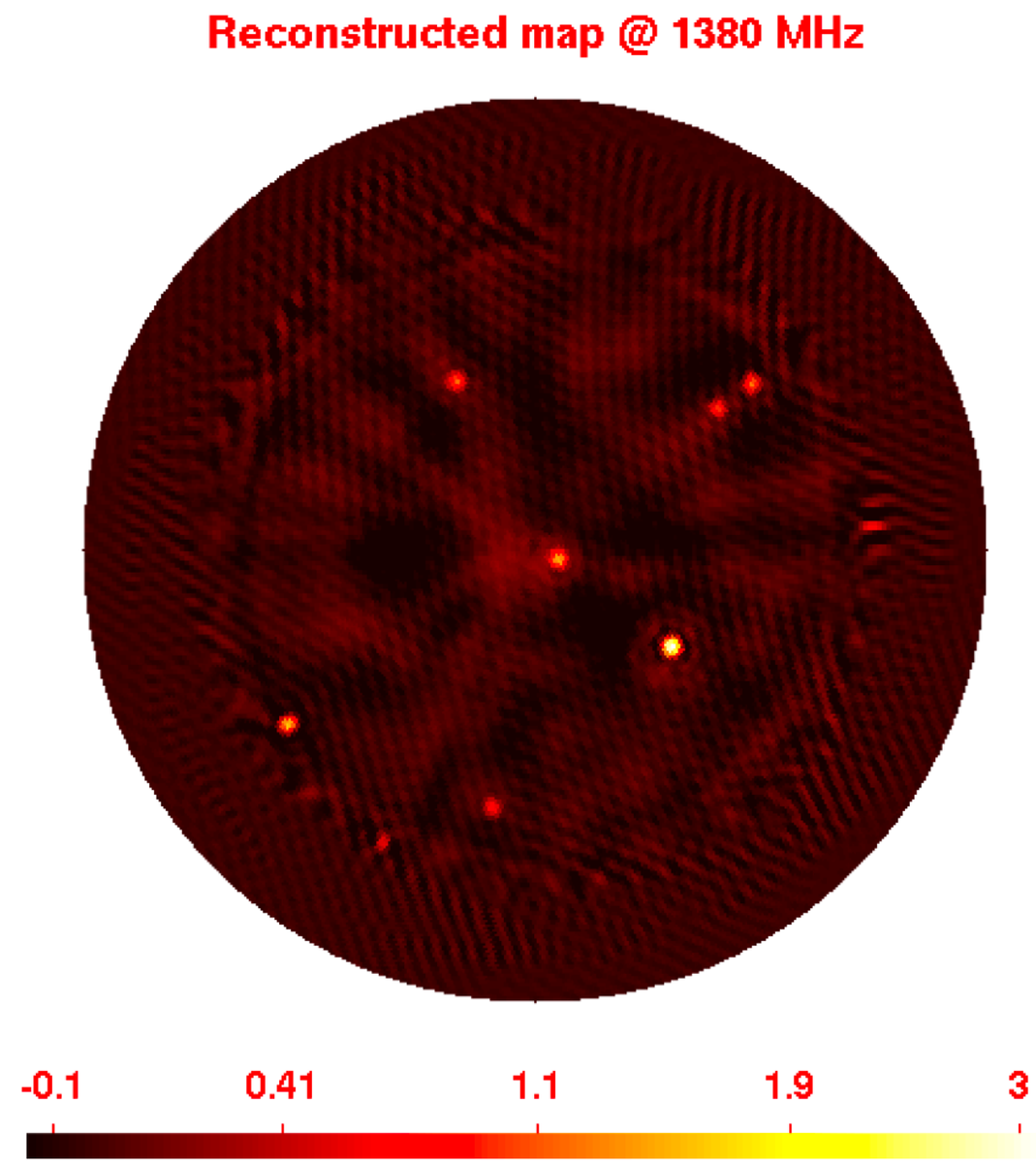
JSkyMap package on gitlab

JSkyMap wiki (documentation) on gitlab

NCP case

NCP region , Sychrotron + NVSS sources , 1380 MHz , reconstructed map (4 scans, δ=90 , 88.5, 87, 85.5 deg)



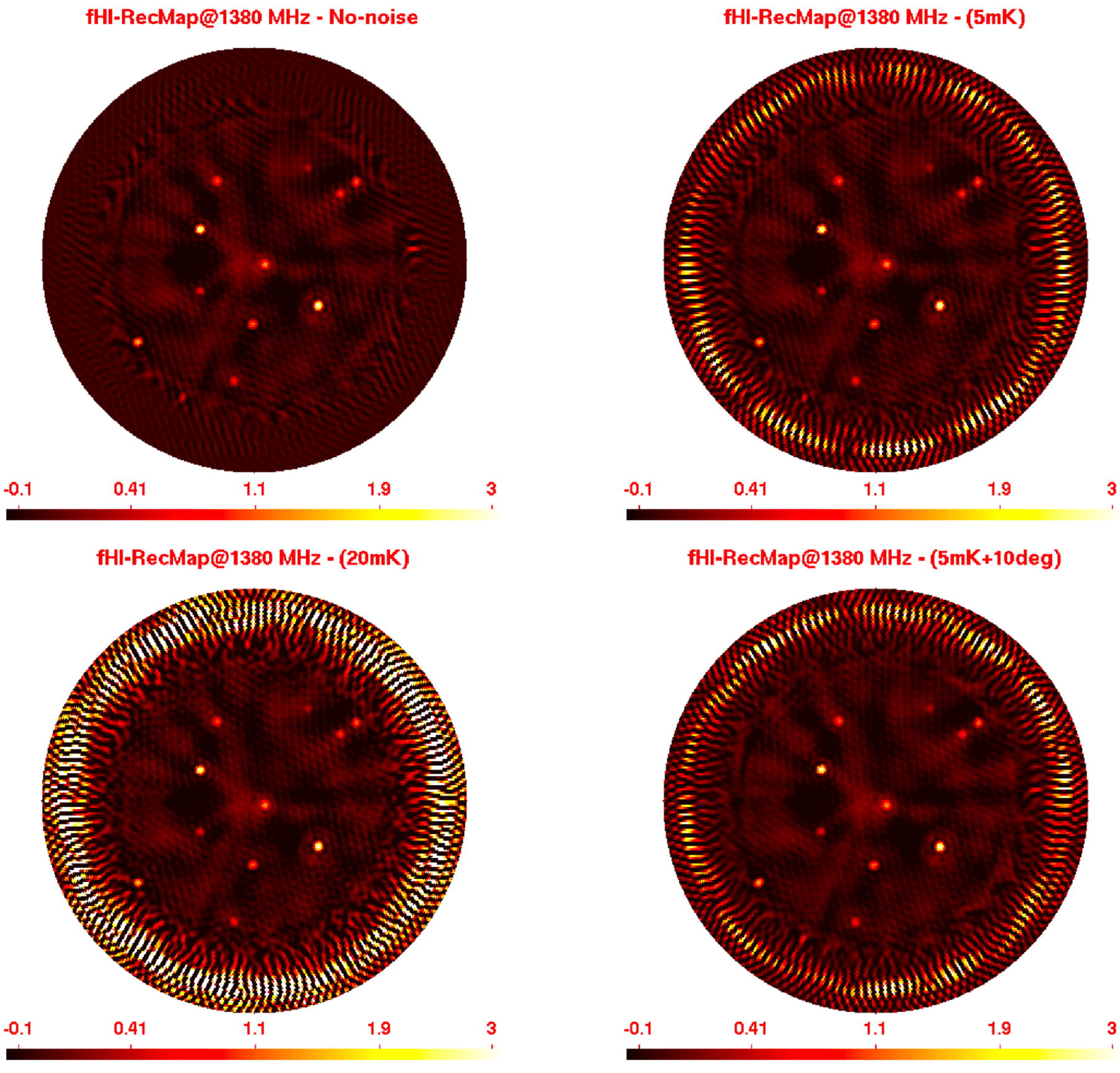


±10 deg (radius=10 deg)

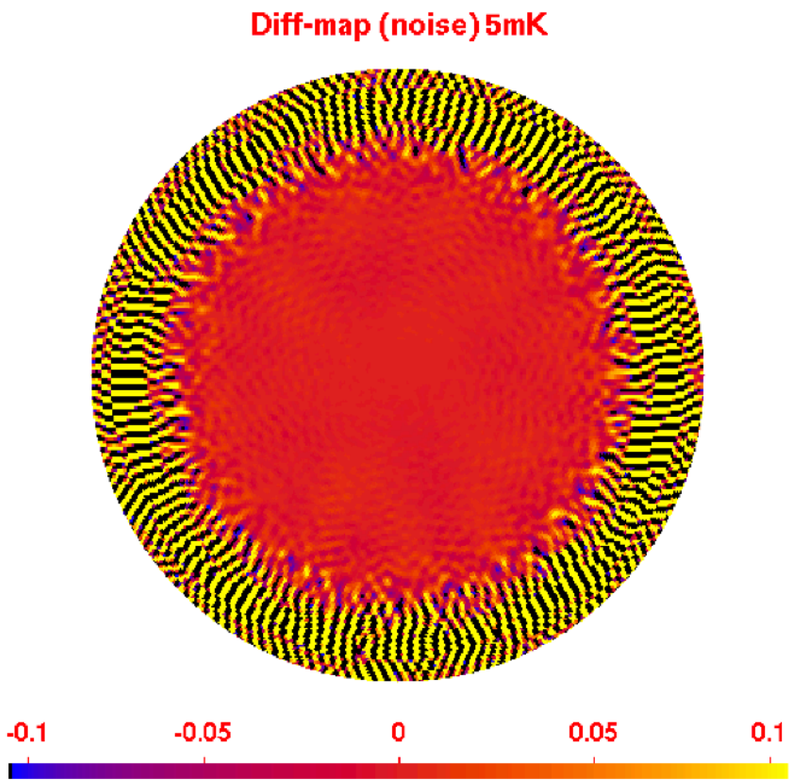
Effet of noise , Synchrotron+NVSS sources + 4 HI sources

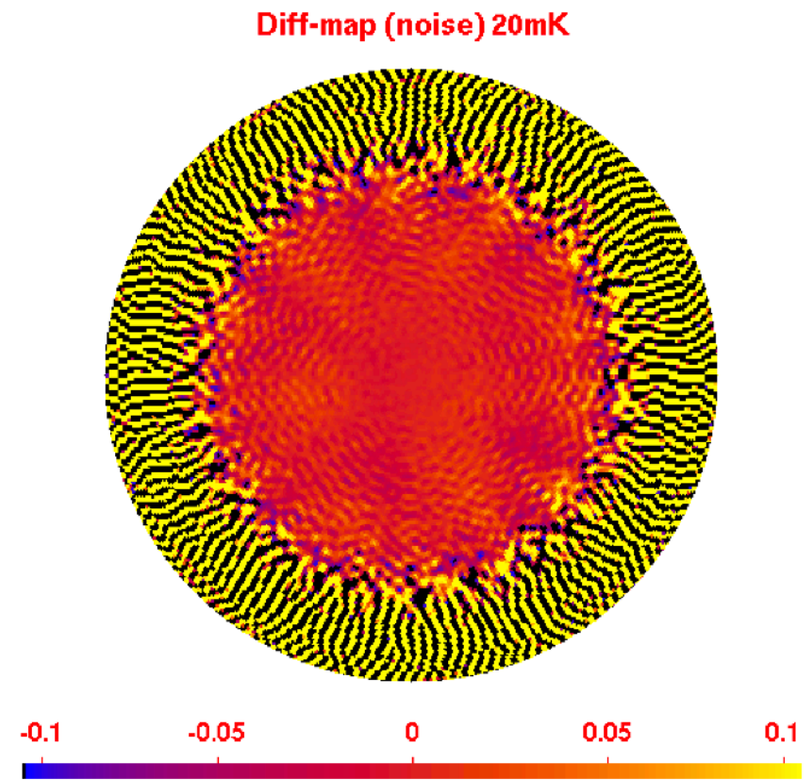
0.5, 1, 2, 5 Jy @ 1380 MHz

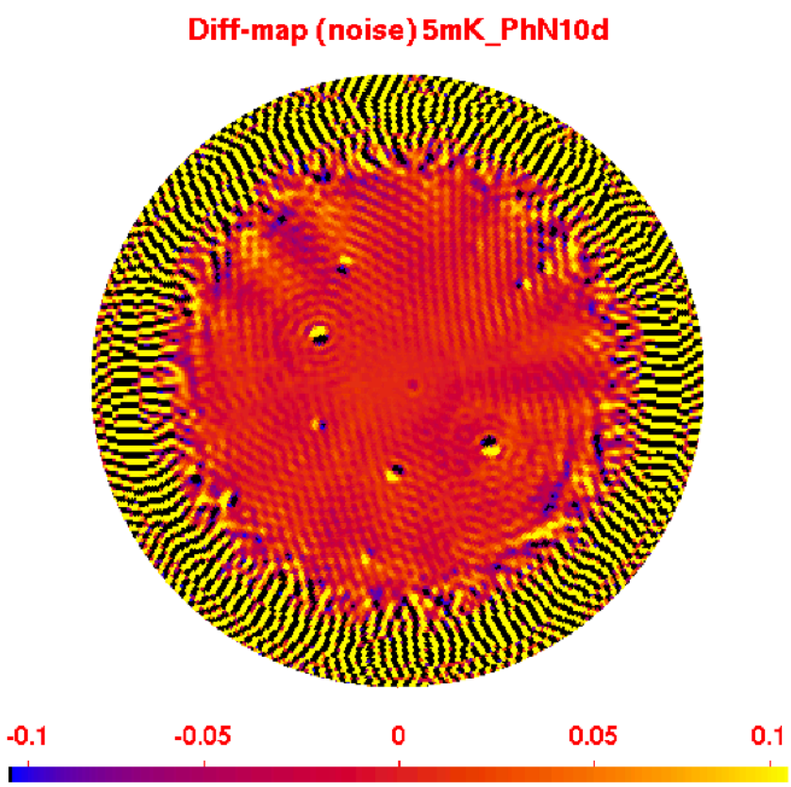
$10^{10} M_\odot$ of HI at 15 Mpc $\rightarrow$ 1 Jy



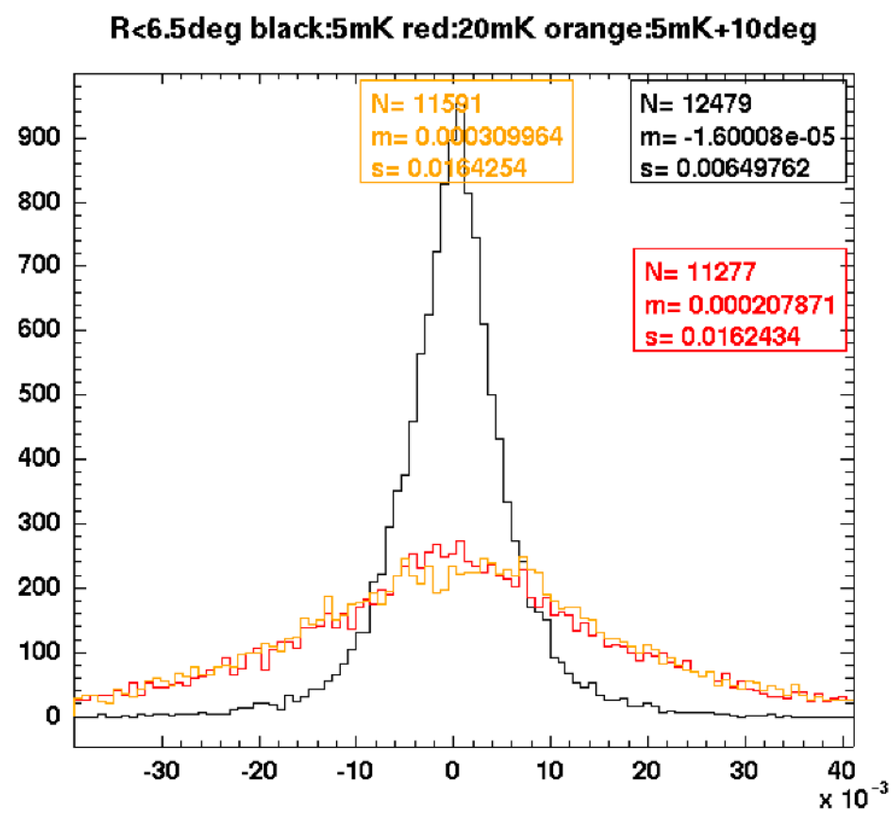
noise contribution (pixel values) - distribution for the central R=6.5 deg





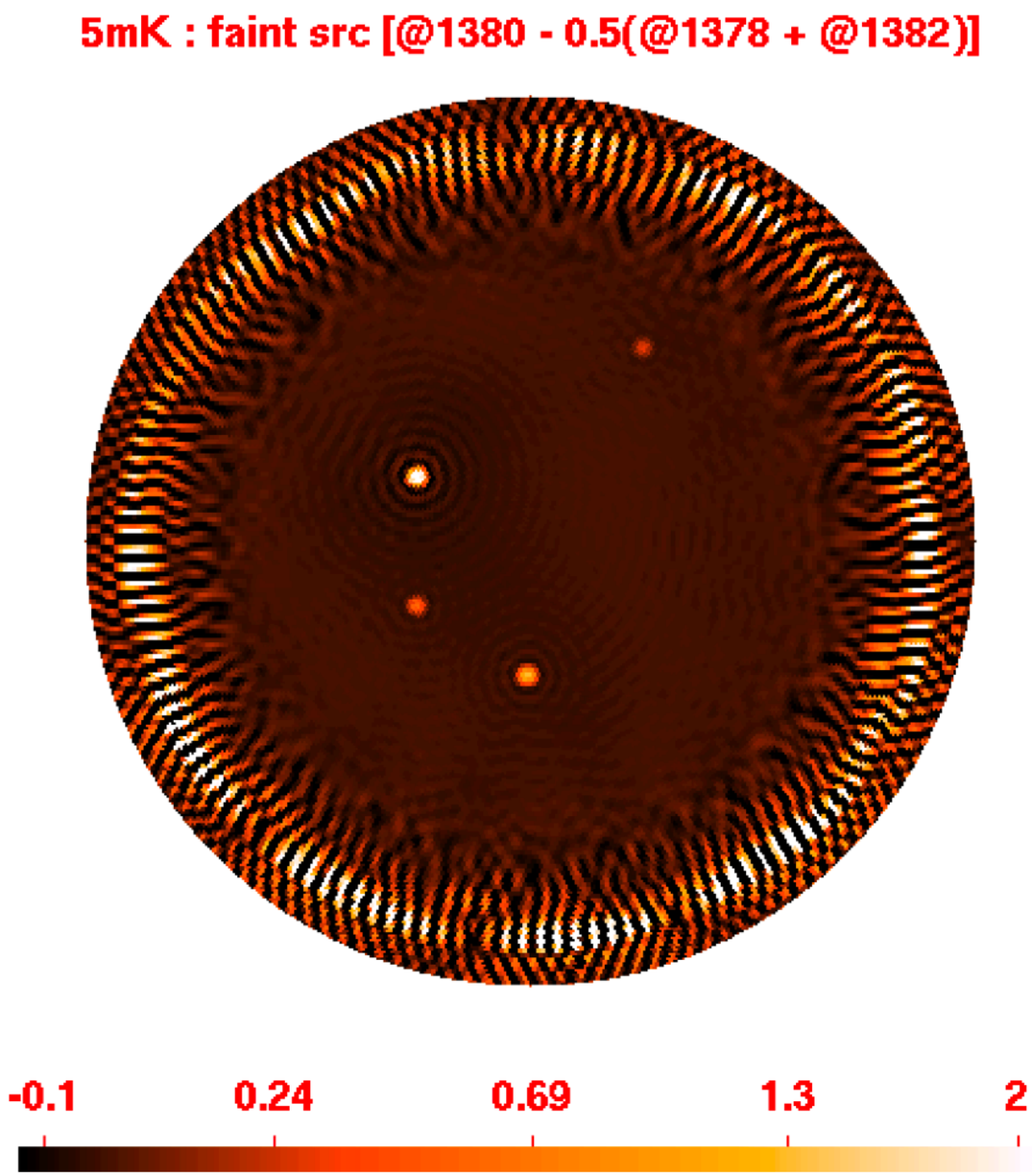


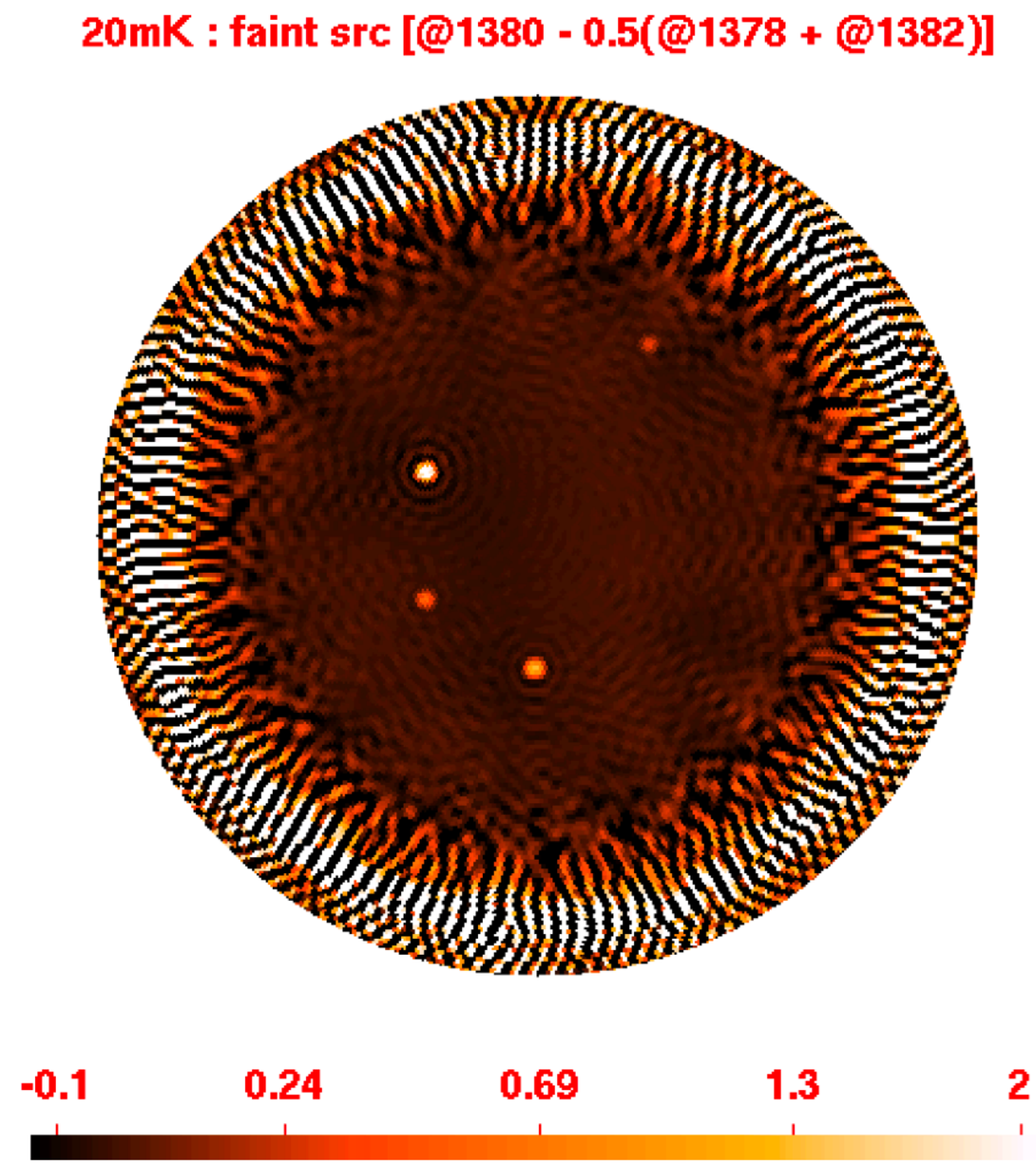
±10 deg (radius=10 deg)



map pixel noise ~ 6 mK for 5 mK visi noise, ~20 mK for 20 mK , ~20 mK for 5mK+10deg

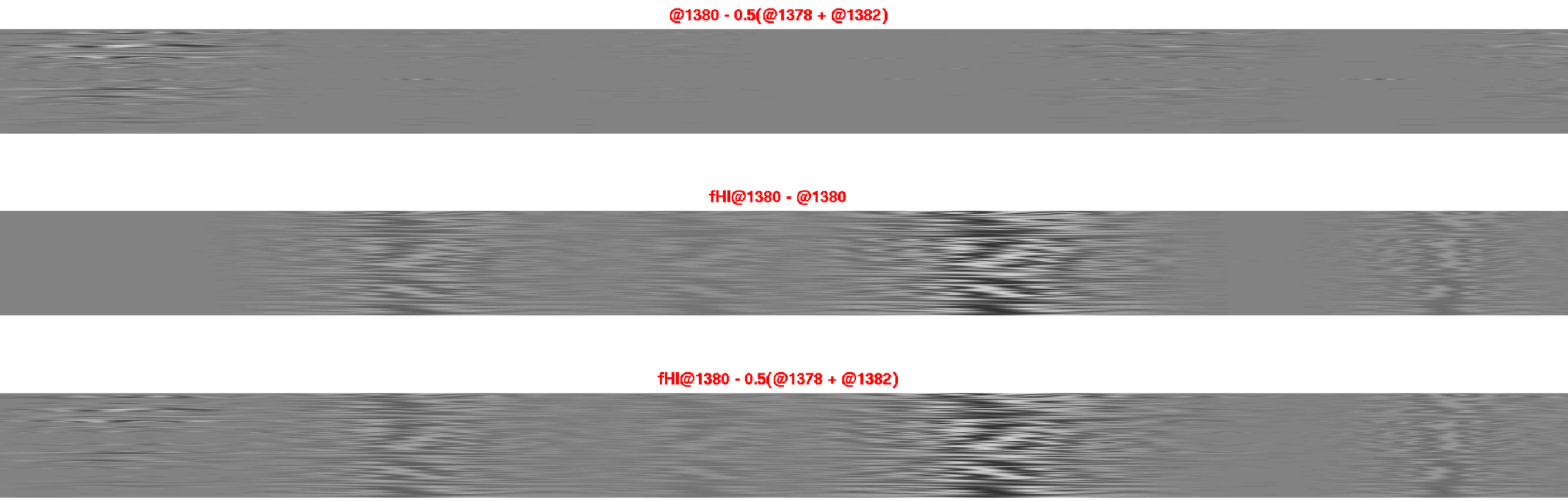
Differentiating along the frequency axis





±10 deg (radius=10 deg)

Differentiating along the frequency axis , in the visibility space

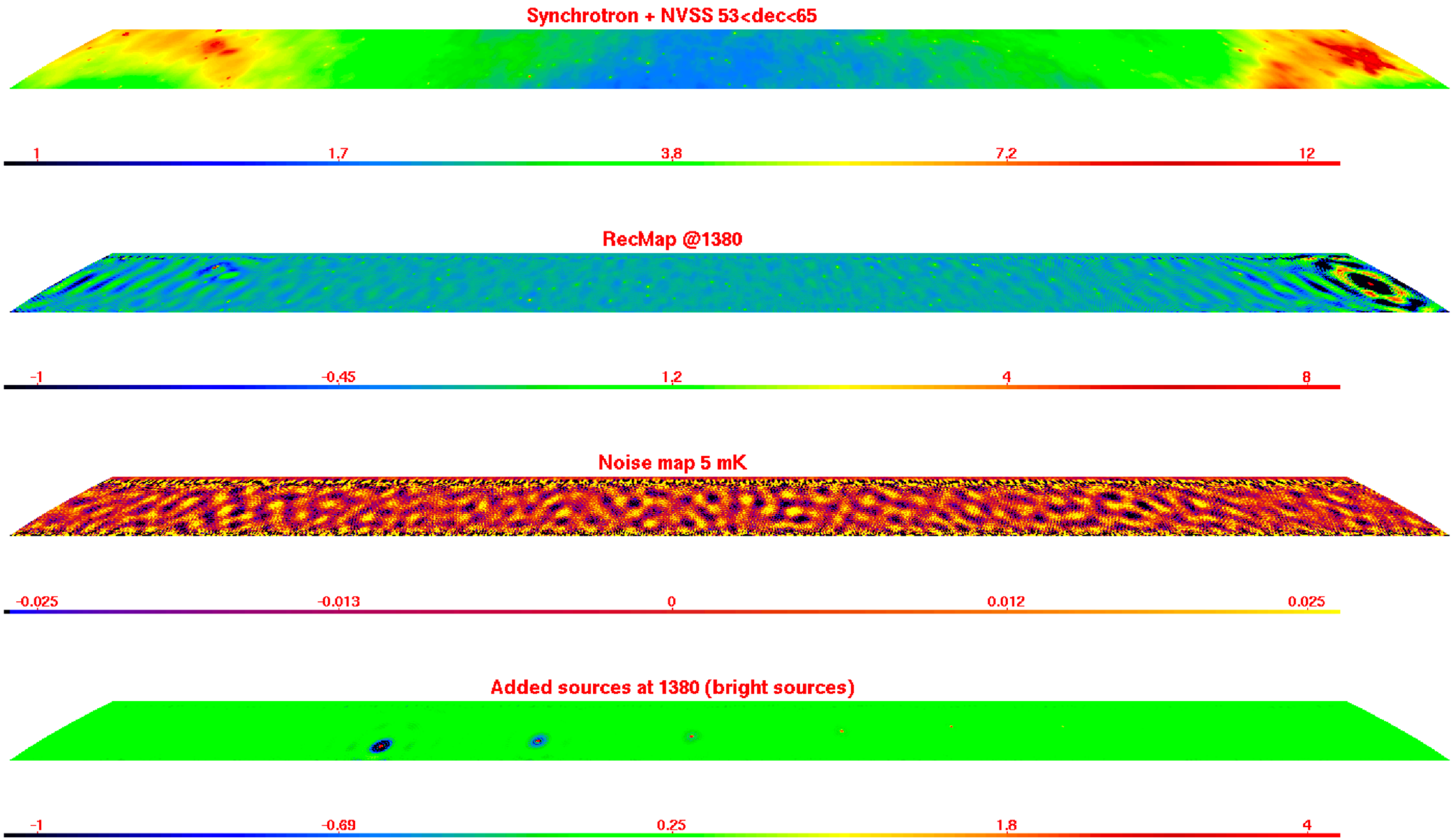


Color scale ± 20 mK

Horizontal axis : RA (or time) - Vertical axis : visibility number (baseline)
Notice color scale ±20 mK for real part of the visibilities - No noise added
top : effect of frequency dependence of the interferometric beams
middle : effet of the four additional sources @ 1380MHz (0.5, 1, 2, 5 Jy)
bottom : effet of the four additional sources and frequency dependence of the beams

MID LATITUDE CASE (58 DEG. DEC)

CasA region , Sychrotron + NVSS sources , 1380 MHz , reconstructed map (5 scans, δ=55.5 , 57, 58.5 , 60, 61.5 deg)



band 53 < δ < 65 deg - Notice different color scales -
Map pixel flucutations at ~ 20 mK for 5 mK visibiliy (40″) noise