CSIRO DIVISION OF RADIOPHYSICS

MEMORANDUM **from** JOHN BROOKS **Date** 5th June, 1984.

to RHF, DNC, JBW, AGL, AJP, KJW, PJH, JRF, RHW, MWS, WEW, ACY, MJK, DEY, BMT, AND GLJ.

AT/20.1.1/001

The accompanying technical note by T.M. Percival indicates the constraints put on the AT frequency coverage by various parts of the system. Your comments are welcomed.

N.B. Any changes in the frequency coverage of the AT (or any other change) will not be reflected in the A.T. systems definition document (AT/01.13/004) until after it has been ratified by the Advisory Committee.

J.W. BROOKS,
5th June, 1984.

(AT/20.1.1/006
JRF)

AT/20.1.1/001

FREQUENCY BANDS FOR THE A.T.

There are three sets of AT frequency bands listed below. The first list contains the widest bandwidths and sets the absolute limits on the frequency coverage which will be possible with the A.T.. These are the limits which will be built into the receiver system and are constrained by filter bandwidths and Local Oscillator tuning ranges.

L BAND	1.25	GHz	1.75	GHz
S BAND	2.2	GHz	2.5	GHz
C BAND	4.4	GHz	6.1	GHz
X BAND	8.0	GHz	10.8	GHz
K BAND	20.0	GHz	25.5	GHz
Q BAND	42.0	GHz	50.0	GHz

The second set are the current estimates of what will be possible with the first set of feeds.

L/S BAND	1.25	GHz	2.5	GHz
C/X BAND	4.4	GHz	10.8	GHz
K/Q BAND	20.0	GHz	50.0	GHz

The final list is the minimum target frequency bands for initial operation and are primarily set by the FET amplifiers and maybe the polarisers. These are narrower than the above bands and may be improved in the future.

L BAND	1.25	GHz	1.75	GHz
S BAND	2.2	GHz	2.5	GHz
C BAND	4.5	GHz	5.2	GHz
X BAND	8.0	GHz	9.3	GHz
K BAND	21.0	GHz	24.4	GHz
Q BAND	42.0	GHz	50.0	GHz

These are basically 15% bandwidths which is the minimum design goal for the FETS , Q band will probably be a cooled Schottky diode mixer and should have the full bandwidth available.

Frequency Selection of the four I.F.'s.

Observations will be possible on two bands simultaneously. L/S, C/X, and K/Q. The first two pairs of bands will have 4 I.F. channels which can be indepentantly tuned to any frequency in the two available bands. However only two of these I.F.'s will be available from the same polarisation of one band. It will however be possible to tune all four I.F.'s to the same polarisation sense.

At K band it will be possible to select 4 I.F's but only two will be completely tunable. The two I.F.'s comming from the same polarisation will have to be selected to

within 2.9 GHz of each other. However at Q band the same restriction applies with a limit of approximately 1.5 GHz. These limits are due to the relatively narrow I.F. bandwidths on the first mixers.

T.M. PERCIVAL

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T.M. PERCIVAL

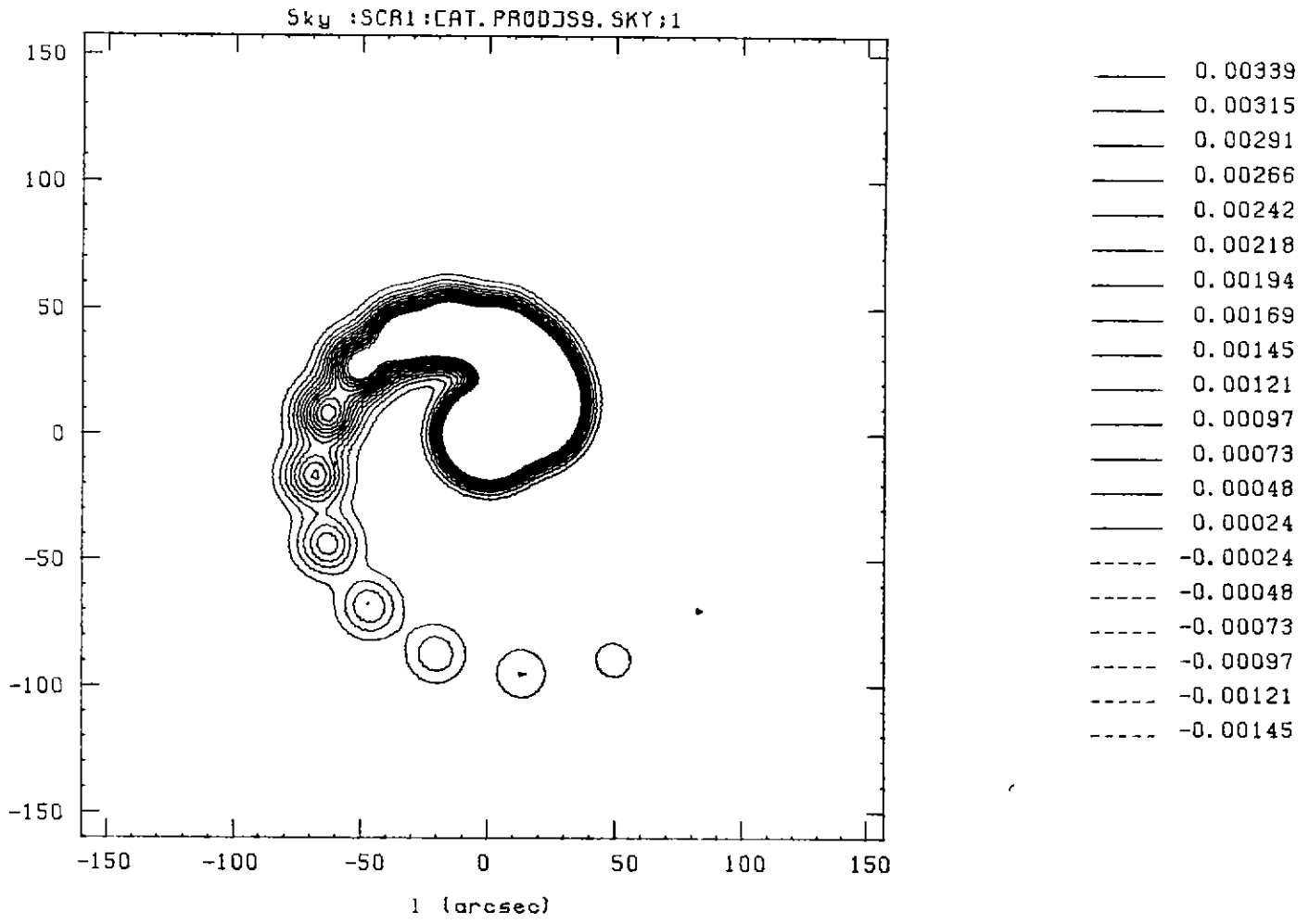
Figures 3 and 4 show raw maps for the 3km array and the 6km array with a fixed 6km antenna for both the single frequency and bandwidth synthesis cases. Similar maps for the 6km case with a moveable antenna were indistinguishable from those shown in Figure 4. Raw maps are compared since, as a general rule, the dynamic range of a cleaned map is closely related to the original sidelobe level. These maps therefore indicate the relative performance of the different configurations. The final dynamic range will depend on the level of system errors, at least for relatively strong sources, and is not easily predictable. Dynamic ranges and fidelities (for definition see AT/10.1/036) for the four maps are as follows:

	Dynamic Range	Fidelity
3km, single frequency:	9.1db	4.6db
3km, bandwidth synthesis:	14.6db	14.6db
6km, single frequency:	11.8db	13.5db
6km, bandwidth synthesis:	21.4db	20.2db

It is clear from the figures and from this table that bandwidth synthesis is going to be very beneficial, leading to dynamic range improvements of 5-10 db. This will be especially true of longer observations on the 6km array as it will be more effective than moving the 6km antenna in filling the U-V plane.

These simulations assumed a source with spatially uniform spectral index. For many real (continuum) sources this will be an adequate assumption, at least over the 30% bandwidth assumed here. However in other cases it will not be adequate and the simple summing of U-V data will lead to errors. This can be turned to advantage if a processing algorithm which simultaneously solves for intensity and spectral index is employed. Such algorithms are currently under development (e.g. Cornwall and Wietfeldt, VLA preprint).

I thank Ray Norris for the initial setting up the COM files for the simulations.



:R1:CAT.PRODJS9.PAR;1
:y distribution generated 30-SEP-85 22:00:28
:y maximum = 0.4842E-01 Sky minimum = 0.0000E+00
.otted: 1-OCT-85 08:41:31 for DICK

Figure 1. Sky distribution for the test source SPIRAL. Contour spacing is 0.5%.

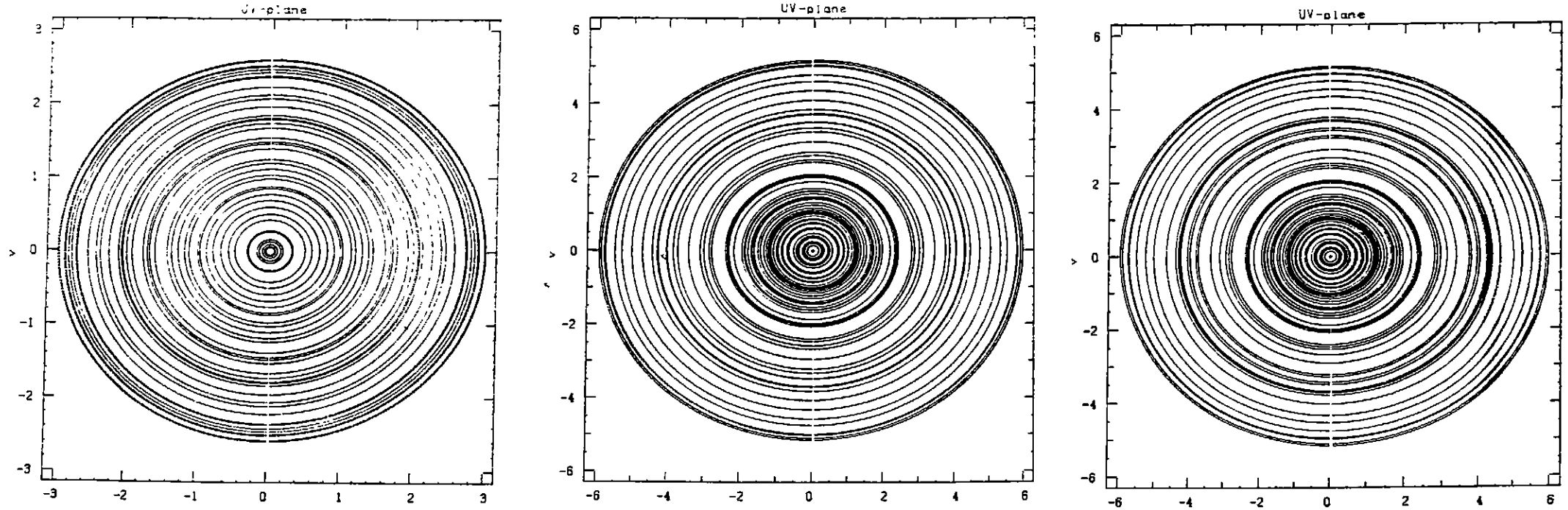
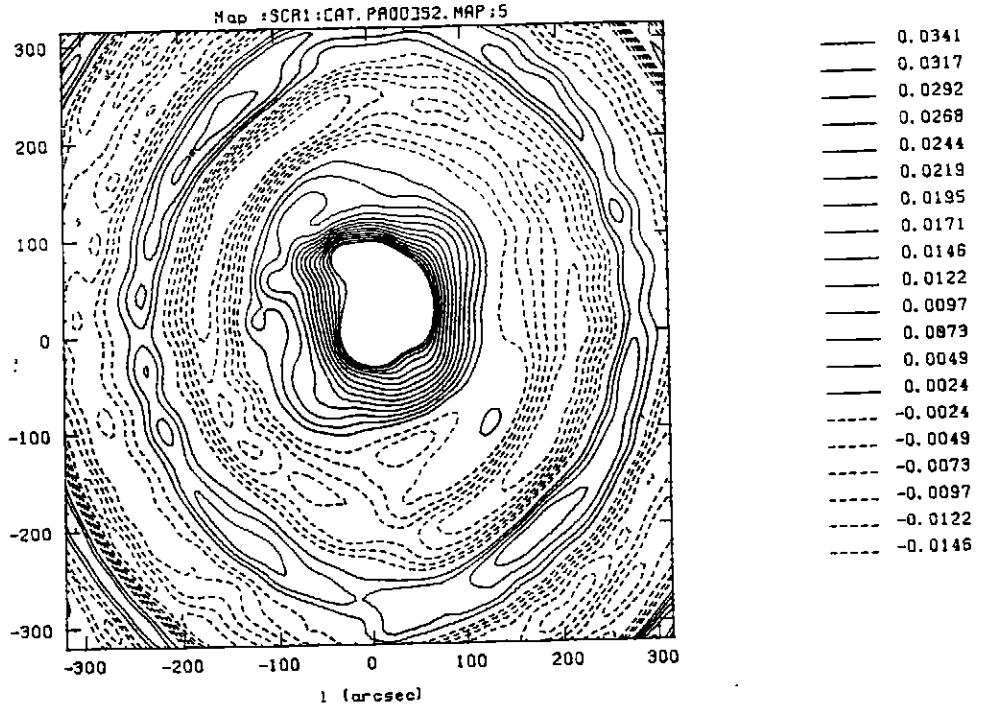
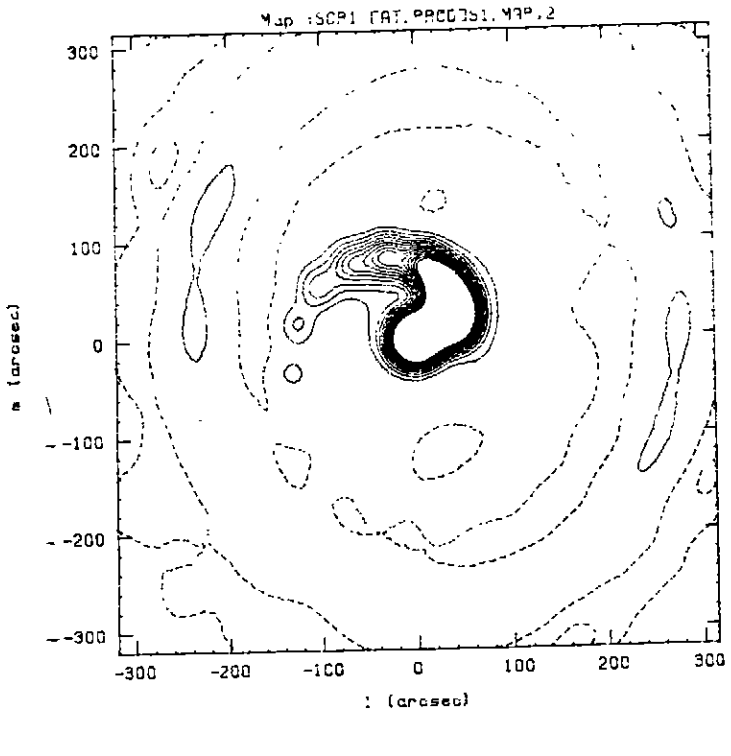


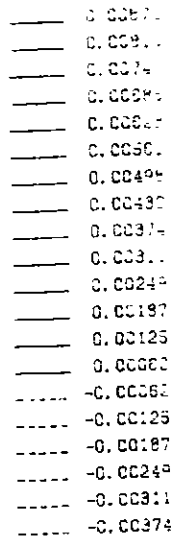
Figure 2. U-V plots for the three arrays, all 4-day syntheses. (a) 3km array (DR3D4). (a) 6km array with fixed 6km antenna (DMR6A). (c) 6km array with the two 6km stations used (DMR6).



SCR1:CAT.PA00352.PAR;5
Array generated 6-FEB-84 17:09:08
USRO:CAT.PA00JDR304.ARR;1
Sky distribution generated 30-SEP-85 09:29:10
SCR1:CAT.PA00JS2.SKY;5
Map generated 30-SEP-85 10:21:33
Ha= -6.00 6.00, ha step= 0.02, dec= -60.00, elev lim= 10.00
Freq= 1.6 GHz, bandwidth= 64.0 MHz, nch= 1
Pixel= 5.000 sec. Noise & errors added
Day range for synthesis is 1 to 4
Uniform weighting.
Kaiser-Bessel convolution function
Map max= 0.1218 min= -0.1431E-01 rms= 0.6355E-02
Convolution correction applied
Fidelity (to 0.10%) (dB): 4.6 Dynamic Range (dB): 9.1
Plotted: 30-SEP-85 10:25:18 for NORRIS

(a)

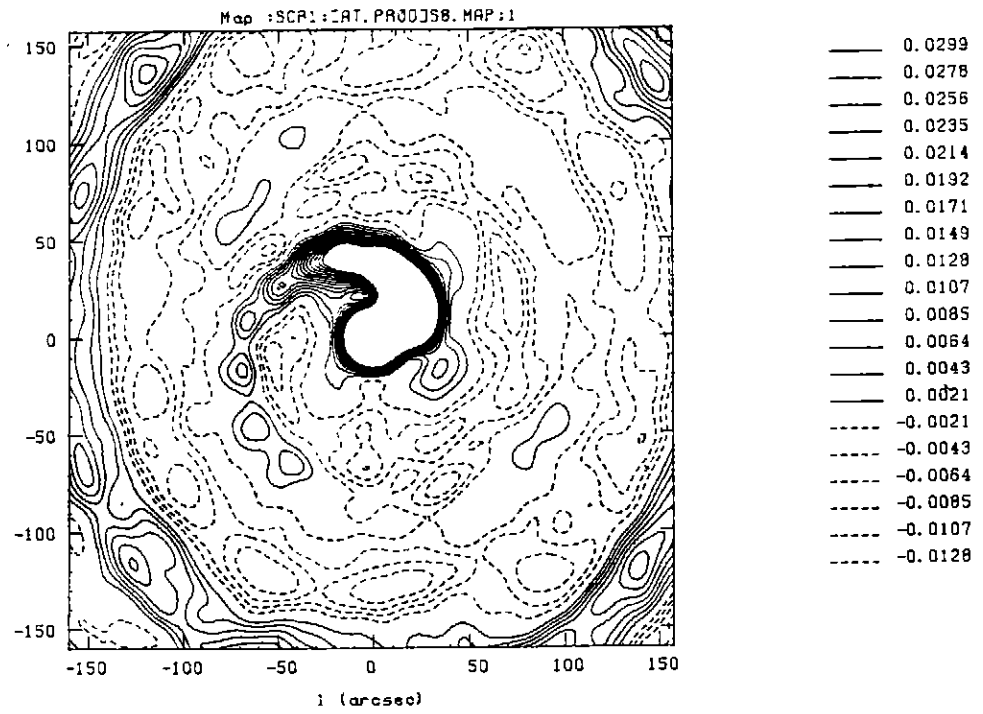




SCR1:CAT.PA00JS1.PAR;2
Array generated 6-FEB-84 17:09:08
USRO:CAT.PA00JDR304.ARR;1
Sky distribution generated 2-AUG-83 17:14:46
USRO:CAT.PA00JSPIRAL.SKY;1
Map generated 14-SEP-85 01:58:49
Ha= -6.00 6.00, ha step= 0.02, dec= -60.00, elev lim= 10.00
Freq= 1.6 GHz, bandwidth= 64.0 MHz, nch= 8
Pixel= 5.000 sec. Noise & errors added
Day range for synthesis is 1 to 4
Uniform weighting.
Kaiser-Bessel convolution function
Map max= 0.3115E-01 min= -0.8887E-03 rms= 0.1163E-02
Convolution correction applied
Plotted: 18-SEP-85 21:23:13 for NORRIS
Fidelity 14.0 db D.R. 14.6 db

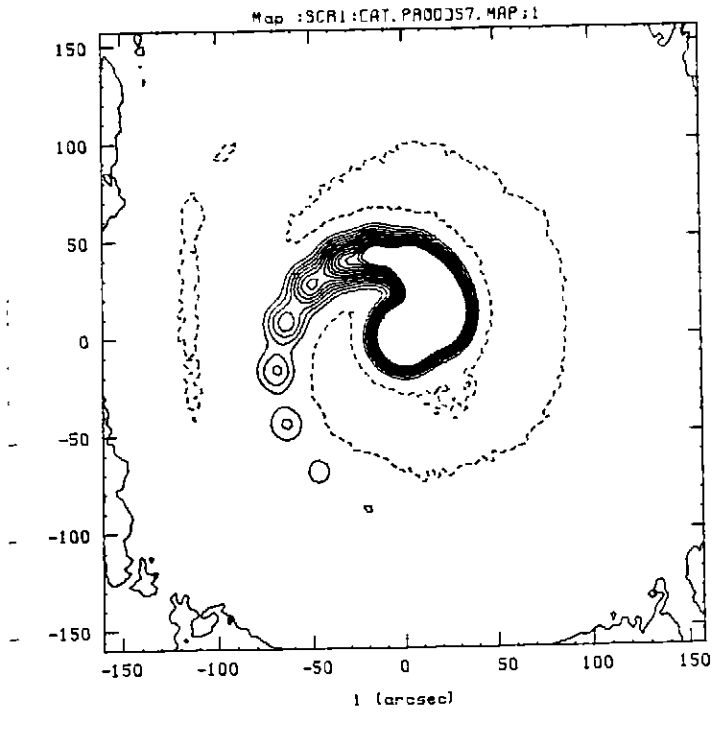
(b)

Figure 3. Simulated maps for the 3km array. (a) No bandwidth synthesis. (b) With bandwidth synthesis over a 32% bandwidth. Contour interval 2%



SCR1:CAT.PR00JS8.PAR;1
Array generated 30-SEP-85 14:55:56
USR0:CAT.PR00JOMR6A.ARR;1
Sky distribution generated 30-SEP-85 18:00:22
SCR1:CAT.PR00JS8.SKY;1
Map generated 30-SEP-85 19:23:23
Ha= -6.00 6.00, ha step= 0.02, dec= -60.00, elev lim= 10.00
Freq= 1.6 GHz, bandwidth= 64.0 MHz, nch= 1
Pixel= 2.500 sec. Noise & errors added
Day range for synthesis is 1 to 4
Uniform weighting.
Kaiser-Bessel convolution function
Map max= 0.2136 min= -0.9131E-02 rms= 0.8067E-02
Convolution correction applied
Fidelity (to 0.10%) (dB): 13.5 Dynamic Range (dB): 11.8
Plotted: 30-SEP-85 19:30:49 for NORRIS

(a)



SCR1:CAT.PR00JS7.PAR;1
Array generated 30-SEP-85 14:55:56
USR0:CAT.PR00JOMR6A.ARR;1
Sky distribution generated 14-SEP-85 09:49:23
USR0:CAT.PR00J3PIRALL6.SKY;1
Map generated 1-OCT-85 01:01:38
Ha= -6.00 6.00, ha step= 0.02, dec= -60.00, elev lim= 10.00
Freq= 1.6 GHz, bandwidth= 64.0 MHz, nch= 8
Pixel= 2.500 sec. Noise & errors added
Day range for synthesis is 1 to 4
Uniform weighting.
Kaiser-Bessel convolution function
Map max= 0.3259E-01 min= -0.4319E-03 rms= 0.1189E-02
Convolution correction applied
Fidelity (to 0.10%) (dB): 20.2 Dynamic Range (dB): 21.4
Plotted: 1-OCT-85 01:05:22 for NORRIS

(b)

Figure 4. Simulated maps for the 6km array with a fixed 6km antenna. (a) No bandwidth synthesis. (b) With bandwidth synthesis over a 32% bandwidth. Contour interval 1%.