VLB ARRAY MEMO No. 181

NATIONAL RADIO ASTRONOMY OBSERVATORY
Edgemont Rd, Charlottesville, VA 22901

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To: VLBA and CLBA Design Groups

From: R. C. Walker and A. H. Bridle

Subject: (U,V) Sampling Comparisons of VLBA, CLBA, and a Joint Array.

There has been considerable discussion recently about a possible collaboration between the United States and Canada on a long baseline array. A major weakness of the CLBA as presently proposed is its poor coverage of southern sources (without co-opting US antennas). A major weakness of the VLBA as presently proposed is the gap that the 10 antenna design leaves between the longest VLA spacings and the shortest VLBA spacings. (This gap can be partially filled by placing the shortest baseline of the VLBA near the VLA, but the coverage in the 35 to about 500 km range would remain sparse).

If a joint project would allow sufficient "refinancing" of the proposals to increase the number of antennas to about 14, these deficiencies of the present proposals could be overcome.

Filling the VLA-VLBA gap is very attractive scientifically. It would permit studies of radio sources on any scale size from many arc minutes to fractions of an arc milli-second with very powerful and very similar instruments. Until recently, the angular scales corresponding to the gap between the techniques of linked interferometers and of VLBI have received little attention. MERLIN has clearly shown that there is much to be learned about extragalactic radio sources by exploring this range of angular scales with good dynamic range and sensitivity. The range of angular sizes that could be opened for detailed study by a joint array (about 0.01 to 0.1 arc second) is also very important for radio studies of stellar and circumstellar phenomena.

The figures attached to this memo show the coverages of the VLBA (Array AR31-14 - see VLBA memo 143), of the CLBA (Array J3M including Yellowknife), and of a preliminary model for a joint configuration with 14 antennas. The coverage of each array is shown for three declinations (+44, +6, and -30 degrees) on plots whose maximum scales are 8000, 4000, 2000, 1000, 500, and 200 km. On the last three plots, 4 antennas of the VLA (the ends of the A configuration arms and one near the center) are added to show the joint coverage. The goal of this joint configuration was to spread the holes in the uv sampling evenly over all scale sizes. Ideally, it would also be hard to distinguish the uv plots on the different scales. The array shown meets these goals fairly well, but we stress that it has not been carefully optimized and probably does not represent the best that can be done with 14 antennas. If a joint project actually gets going, more effort would be invested in optimization and in trying to meet probable Canadian constraints (such as the desire to have one or more antennas on the Superior Province of the Canadian Shield and (possibly) to have more antennas in Canada).

The self-similarity of the uv coverages of such joint US/Canadian arrays over a wide range of linear scales has a further attractive feature. It would allow studies of the distributions of the frequency-dependent properties of sources (spectral index, Faraday rotation and depolarization, etc.) over a wide frequency range with minimal bias due to different uv sampling at the different frequencies. This capability is not available (except over a limited frequency range or with rather restricted sub-arrays) using either the CLBA or the VLBA in their presently planned forms.

It may also be worth considering putting an antenna in Mexico and/or South America (VLBA Memo 124 shows the great advantage of an antenna in Ecuador).

The VLA and the long baseline array could be operated in various joint modes to cover the intermediate spacings. We currently envision having the capability to make VLB recordings on up to 4 VLA antennas and linking, by microwave, up to 6 of the VLB array antennas to the VLA for real time correlation with the rest of the VLA.

STATION COORDINATES

The station names, latitudes, and longitudes of the arrays shown in the attached figures are given below. The 4 VLA stations used in the 1000, 500 and 200 km plots are also given. Note that the coordinates of FDVSNEW, OVRO, HSTK, and DSS13 (Goldstone) are geocentric and will not quite match coordinates on maps. An elevation limit of 80 degrees has been assumed for all antennas.

CLBA
J3M + Yellowknife

J3M-1	47.36	53.11
J3M-2	46.05	74.13
J3M-3	49.16	97.95
J3M-4	49.50	106.26
J3M-5	49.57	108.04
J3M-6	49.62	109.03
J3M-7	49.77	112.99
J3M-8	50.74	125.74
YELKNF	62.70	114.50

VLBA
Modified AR31-14

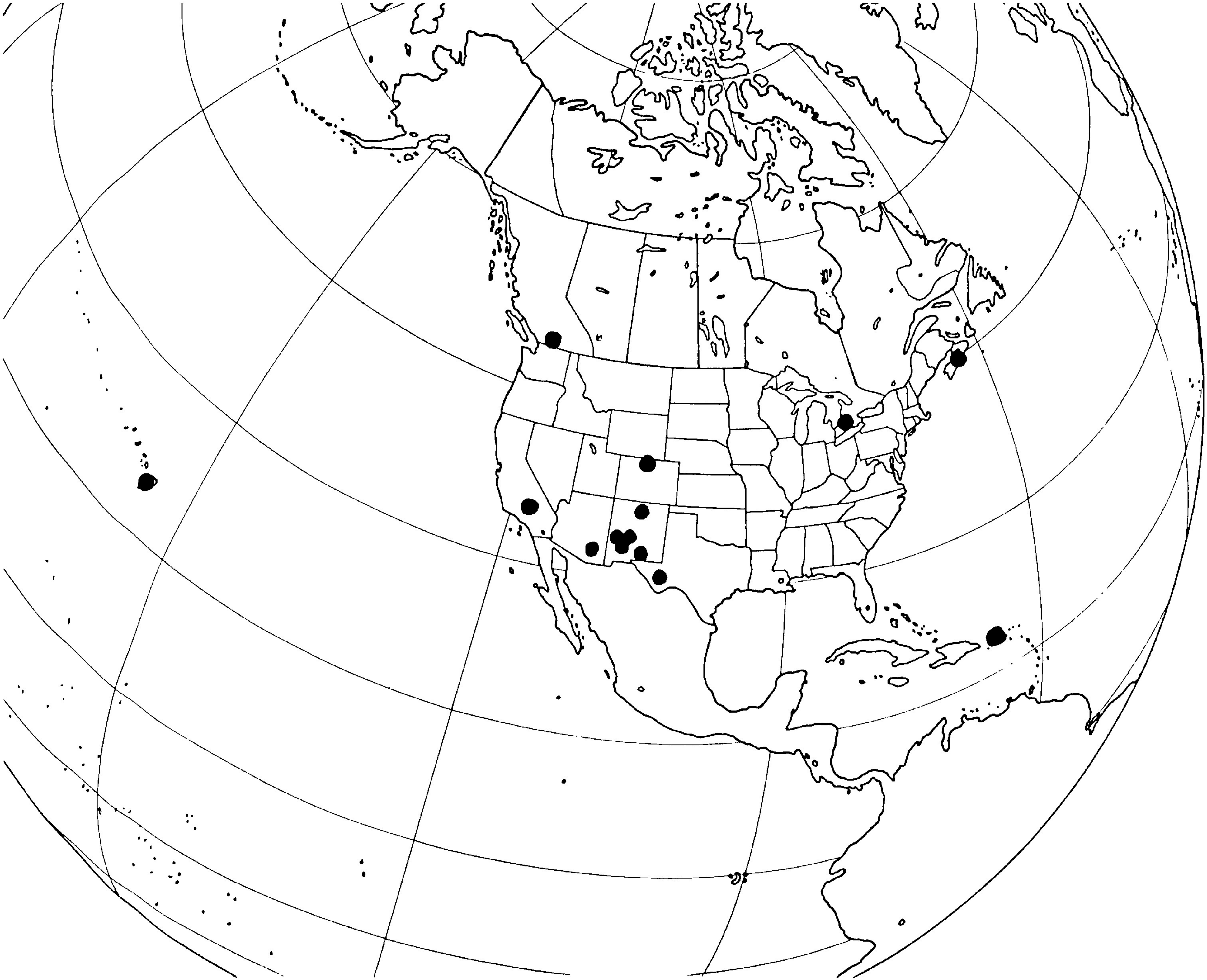
HAWAII	19.80	155.50
ARECIBO	18.34	66.75
WENATCH	47.40	120.30
HSTK	42.43	71.49
ILLN	40.06	87.57
OVRO	37.05	118.28
KITT	31.96	111.60
ELEPHANT	33.30	107.25
LAMY	35.50	105.85
FDVSNEW	30.47	103.95

Joint Configuration
AR41-1

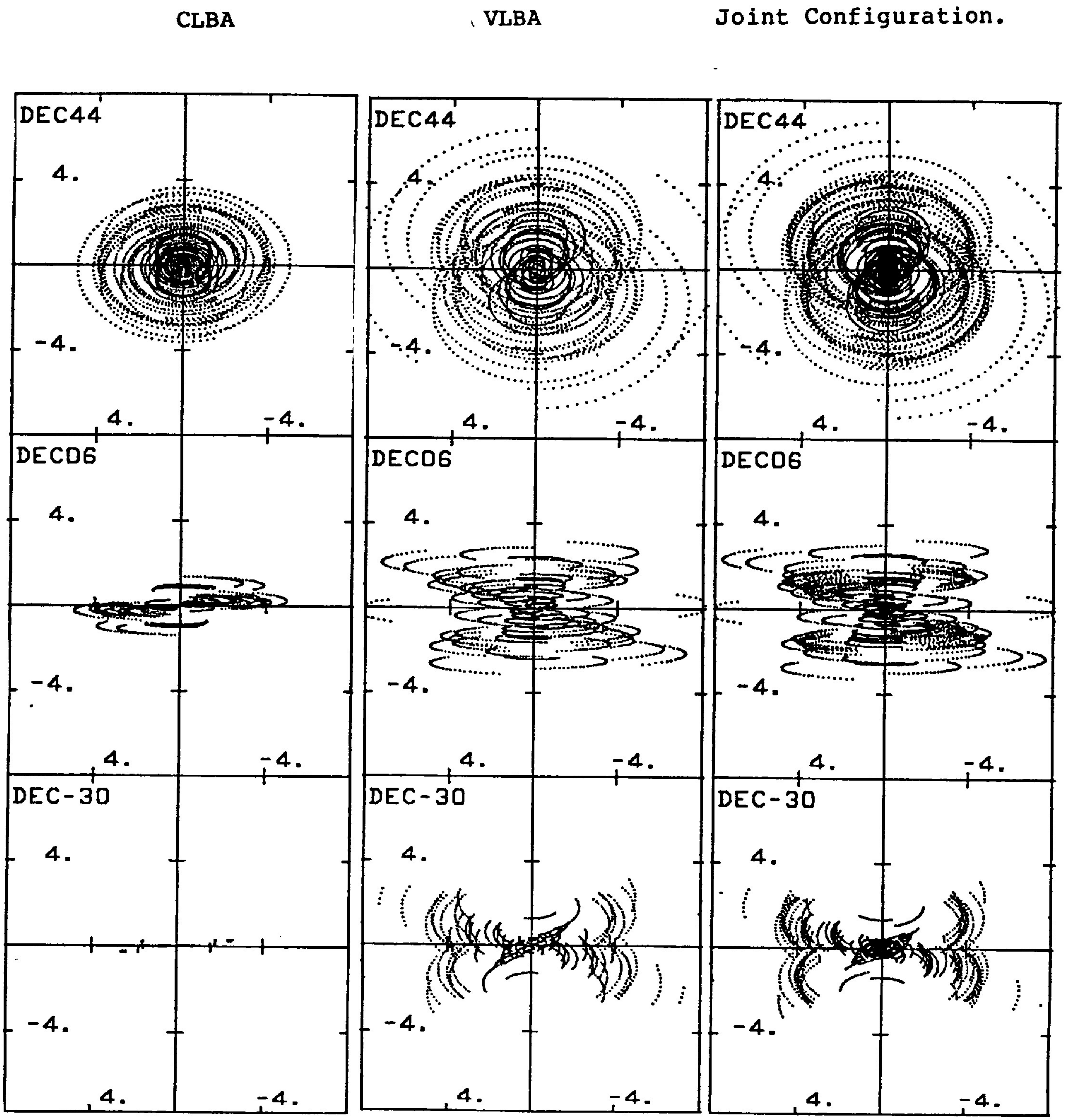
VLAE3	33.30	107.70
VLAE4	34.30	108.30
VLAE5	34.38	106.95
FDVSNEW	30.47	103.95
DSS13	35.07	116.79
HAWAII	19.80	155.50
ARECIBO	18.34	66.75
PENT	49.30	119.60
HALFX	44.70	63.50
BLDR	40.00	105.26
LEMMON	32.44	110.79
TAOS	36.40	105.50
SACPEAK	32.80	105.80
LONDON	43.00	81.40

VLA Stations
for 1000, 500 and 200 km plots.

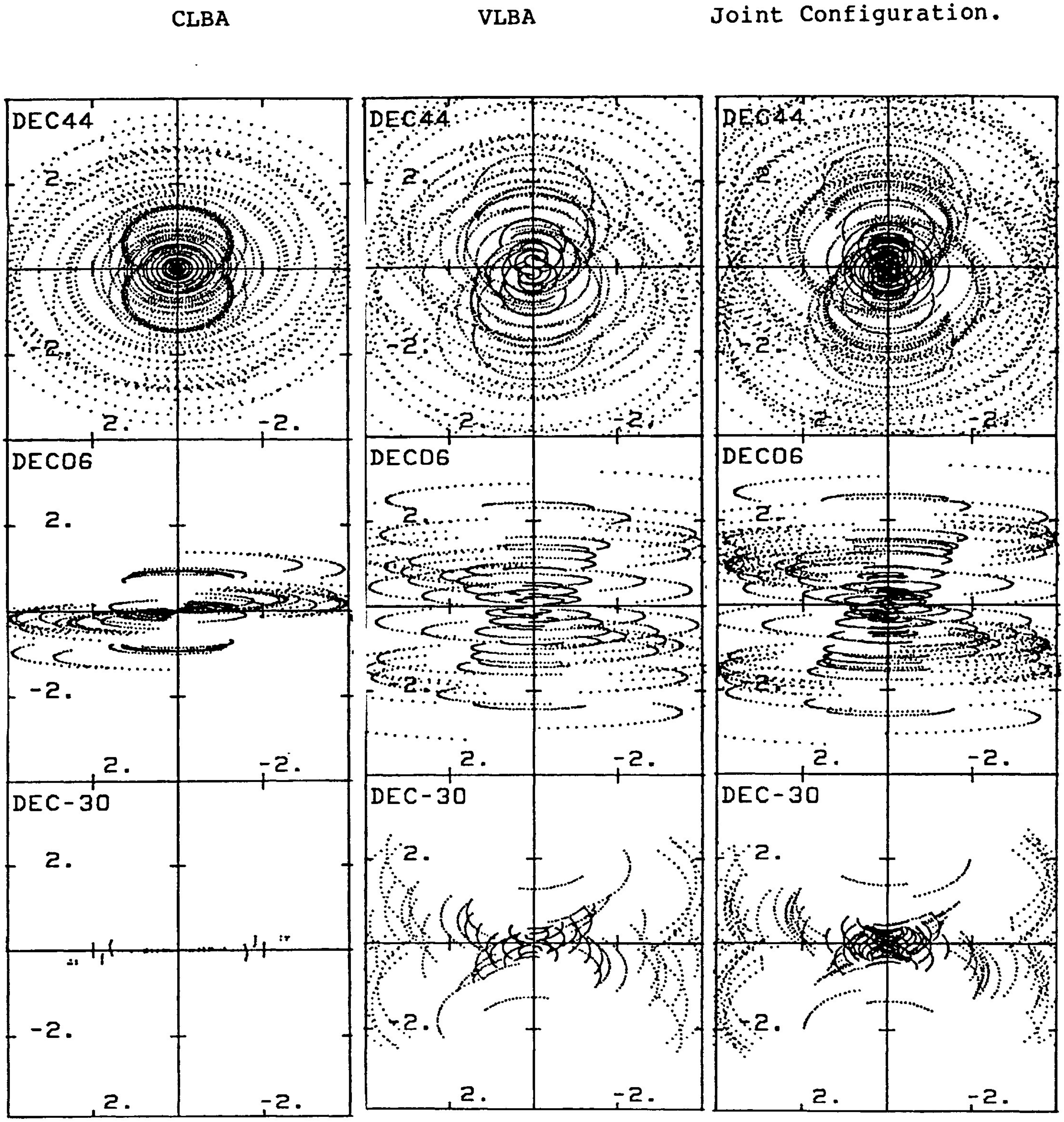
AN9	34.24	107.63
AW9	33.97	107.81
AE9	34.00	107.41
AW3	34.06	107.64



Comparison of CLBA, VLBA, and a Joint Configuration
on a maximum scale of 8000 km.

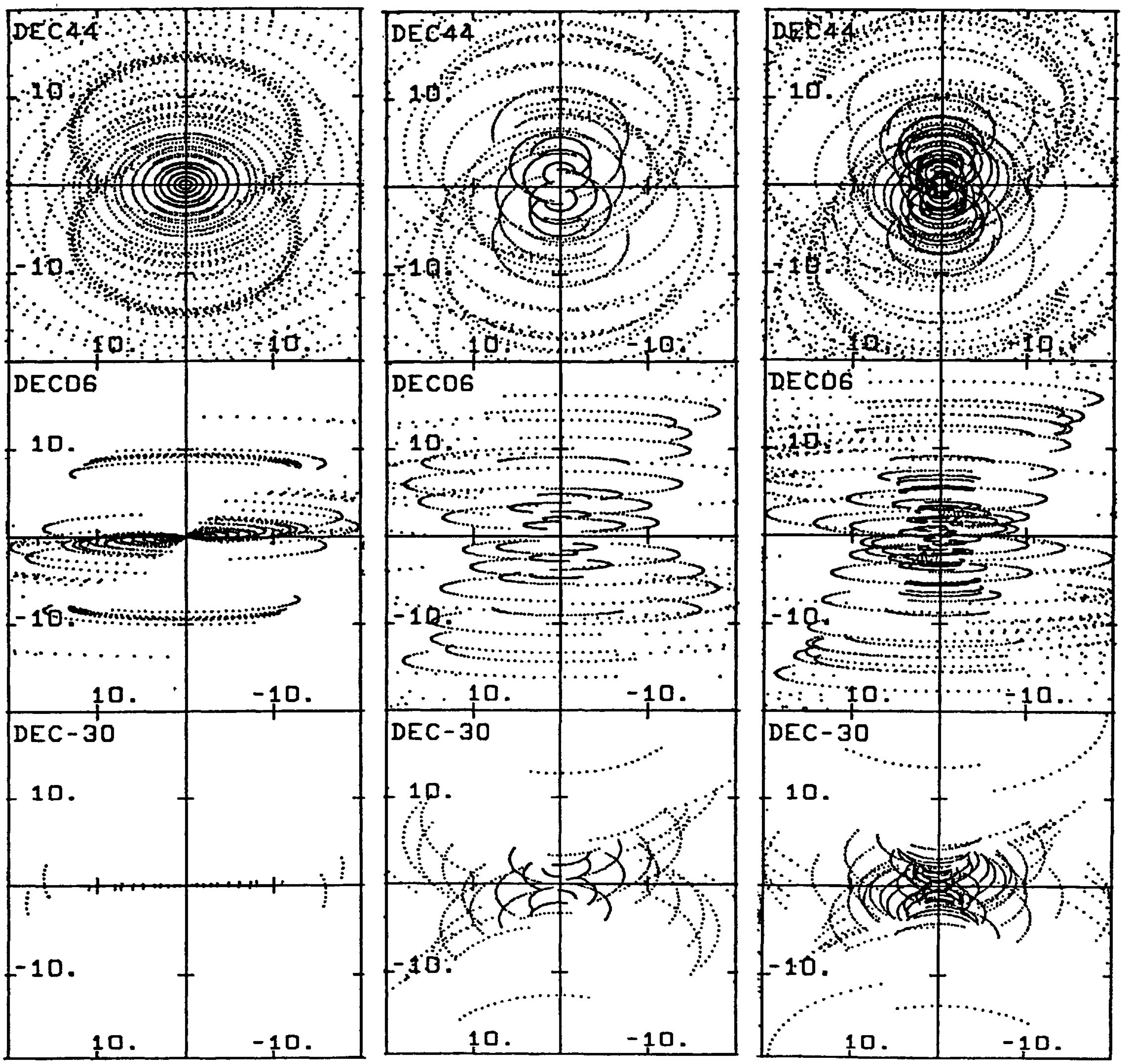


Comparison of CLBA, VLBA, and a Joint Configuration
on a maximum scale of 4000 km.



Comparison of CLBA, VLBA, and a Joint Configuration
on a maximum scale of 2000 km.

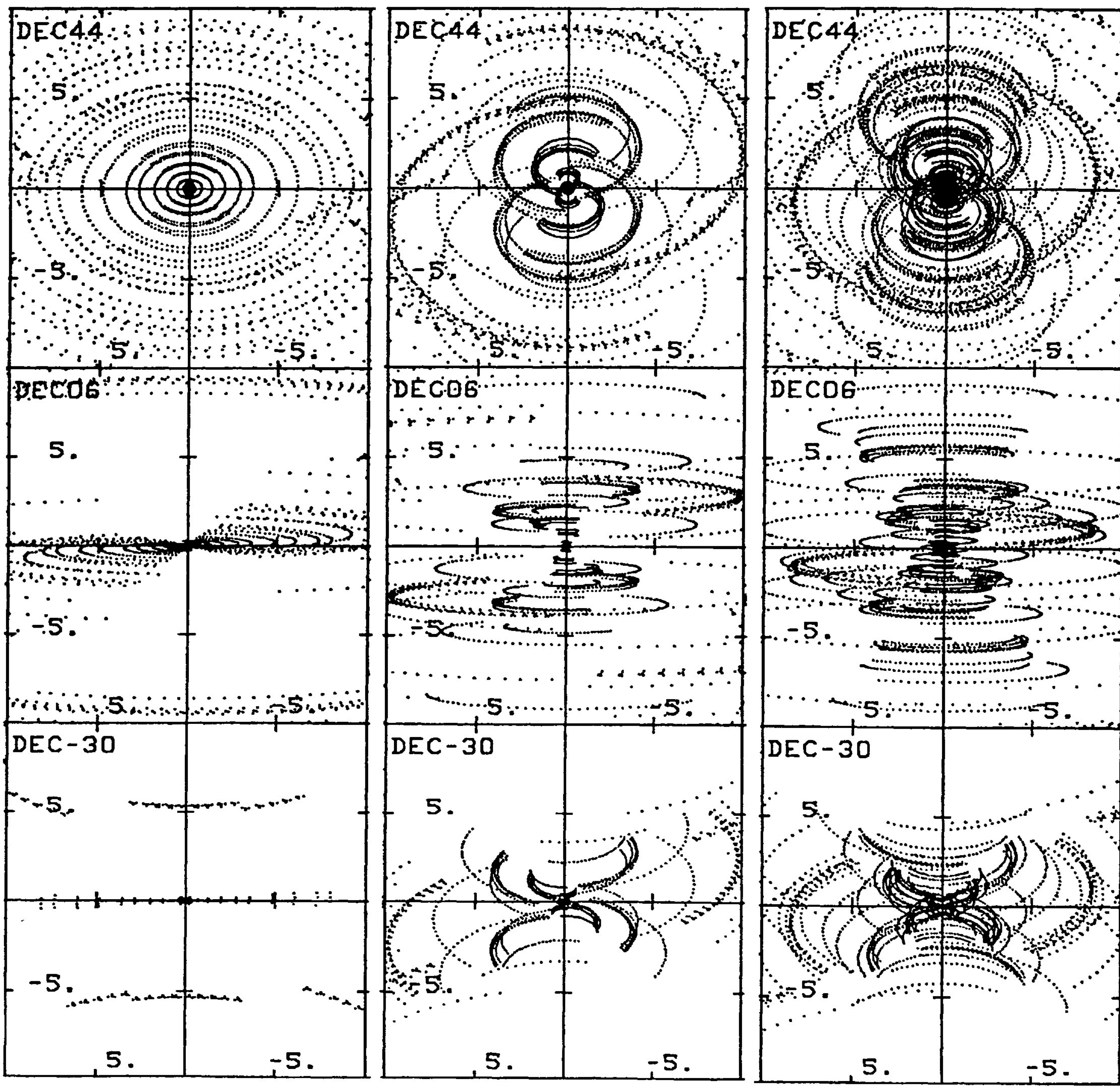
CLBA VLBA Joint Configuration.



Comparison of CLBA, VLBA, and a Joint Configuration
on a maximum scale of 1000 km.

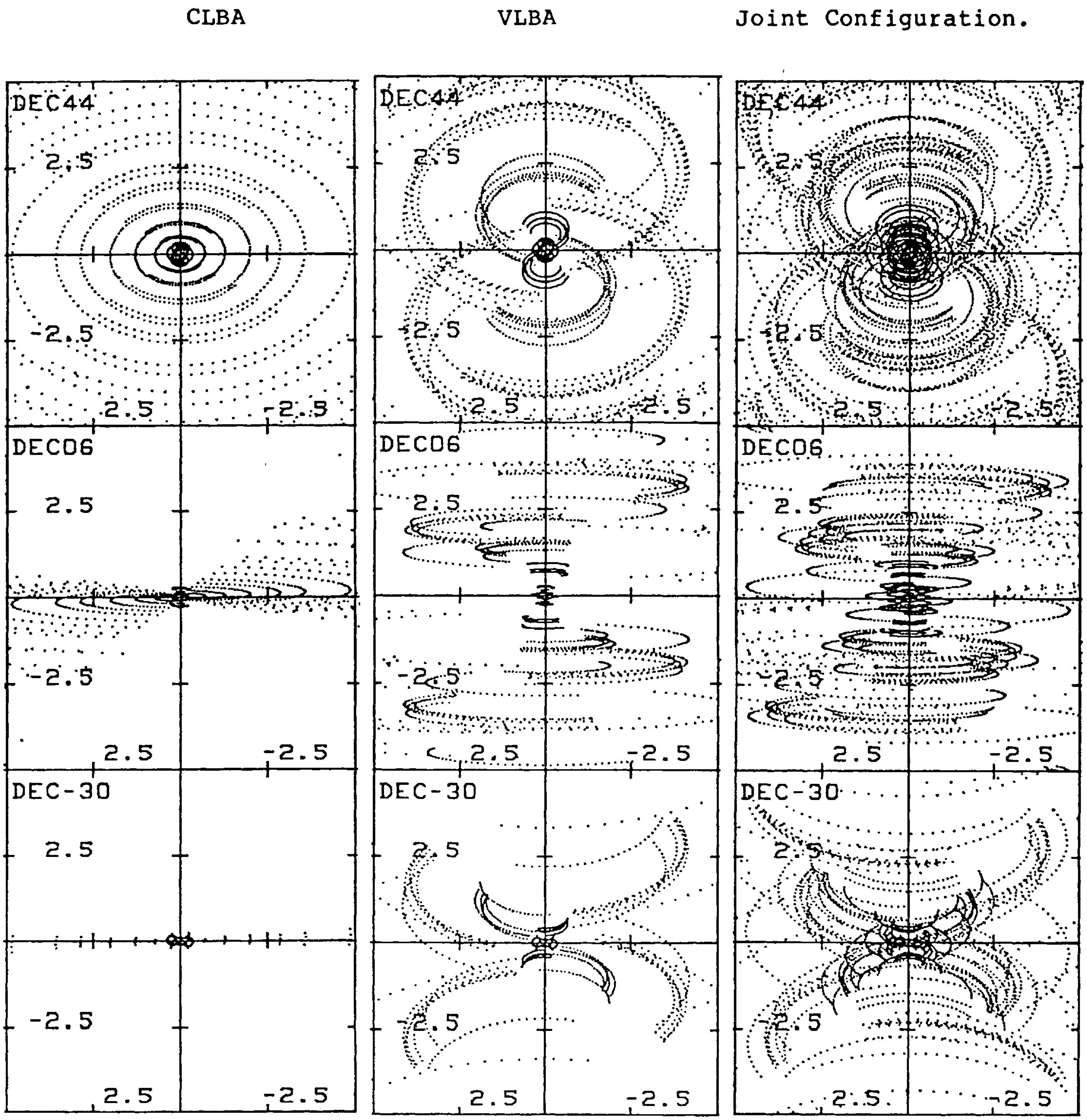
N.B. These arrays include four VLA antennas.

CLBA VLBA Joint Configuration.



Comparison of CLBA, VLBA, and a Joint Configuration
on a maximum scale of 500 km.

N.B. These arrays include four VLA antennas.



Comparison of CLBA, VLBA, and a Joint Configuration
on a maximum scale of 200 km.

N.B. These arrays include four VLA antennas.