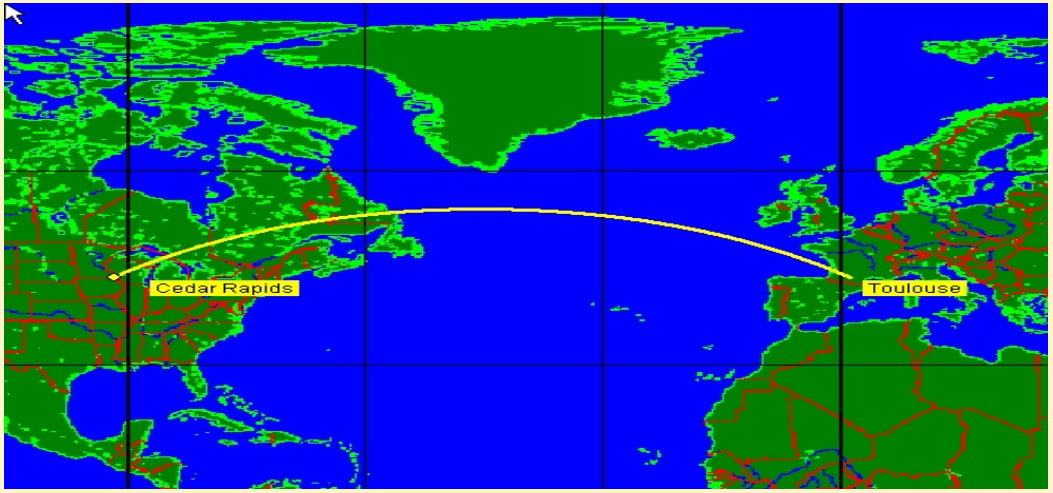
IMPROVED GUIDELINES FOR AUTOMATIC LINK ESTABLISHMENT OPERATIONS



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PREMISE:

The ALE best frequencies

should fall in the range of

the predicted MUF distribution

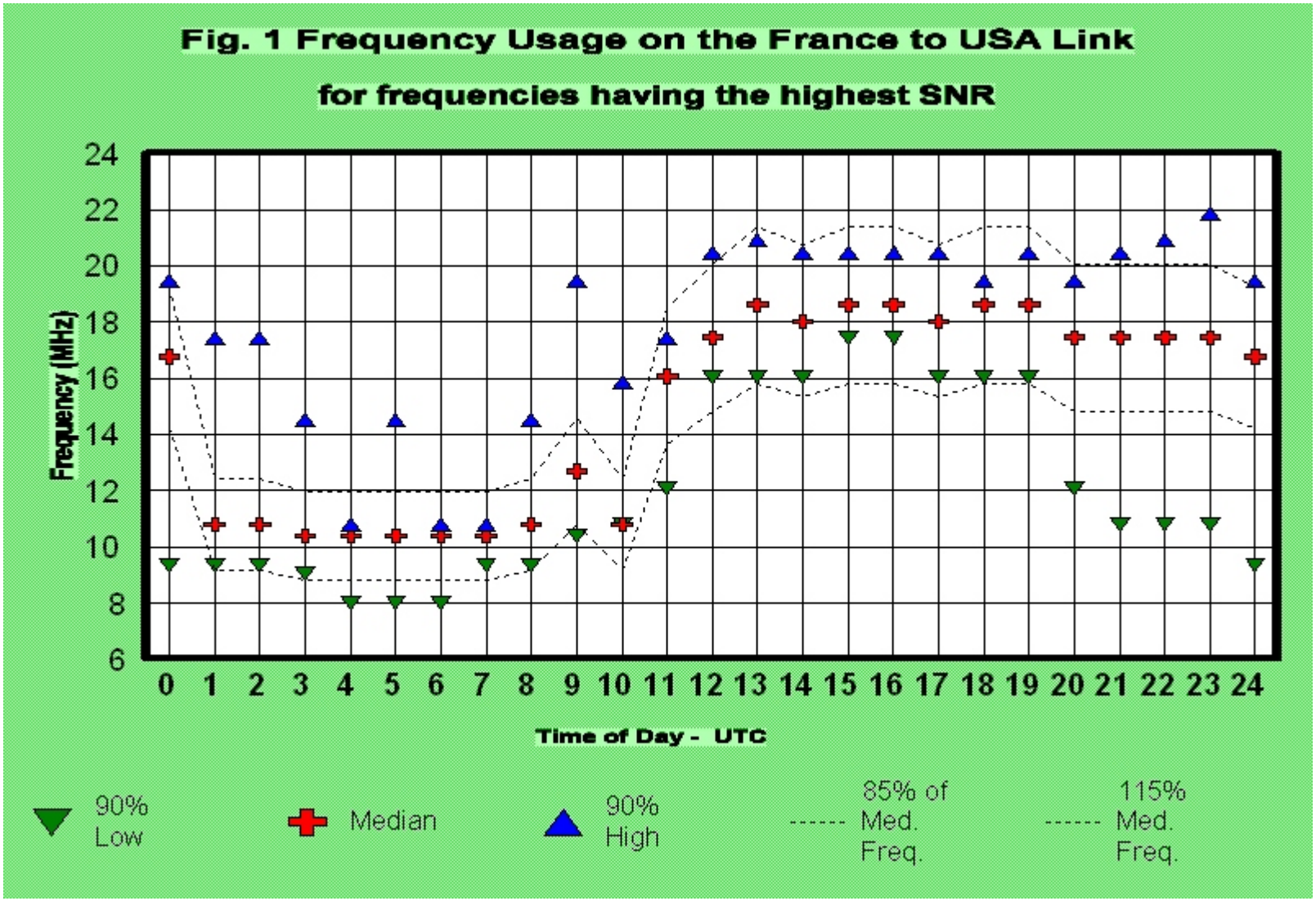


Fig. 1 Frequency Usage on the France to USA Link
for frequencies having the highest SNR
Frequency (MHz)
24
22
20
18
16
14
12
10
8
6
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time of Day - UTC
90% Low
Median
90% High
85% of Med. Freq.
115% Med. Freq.

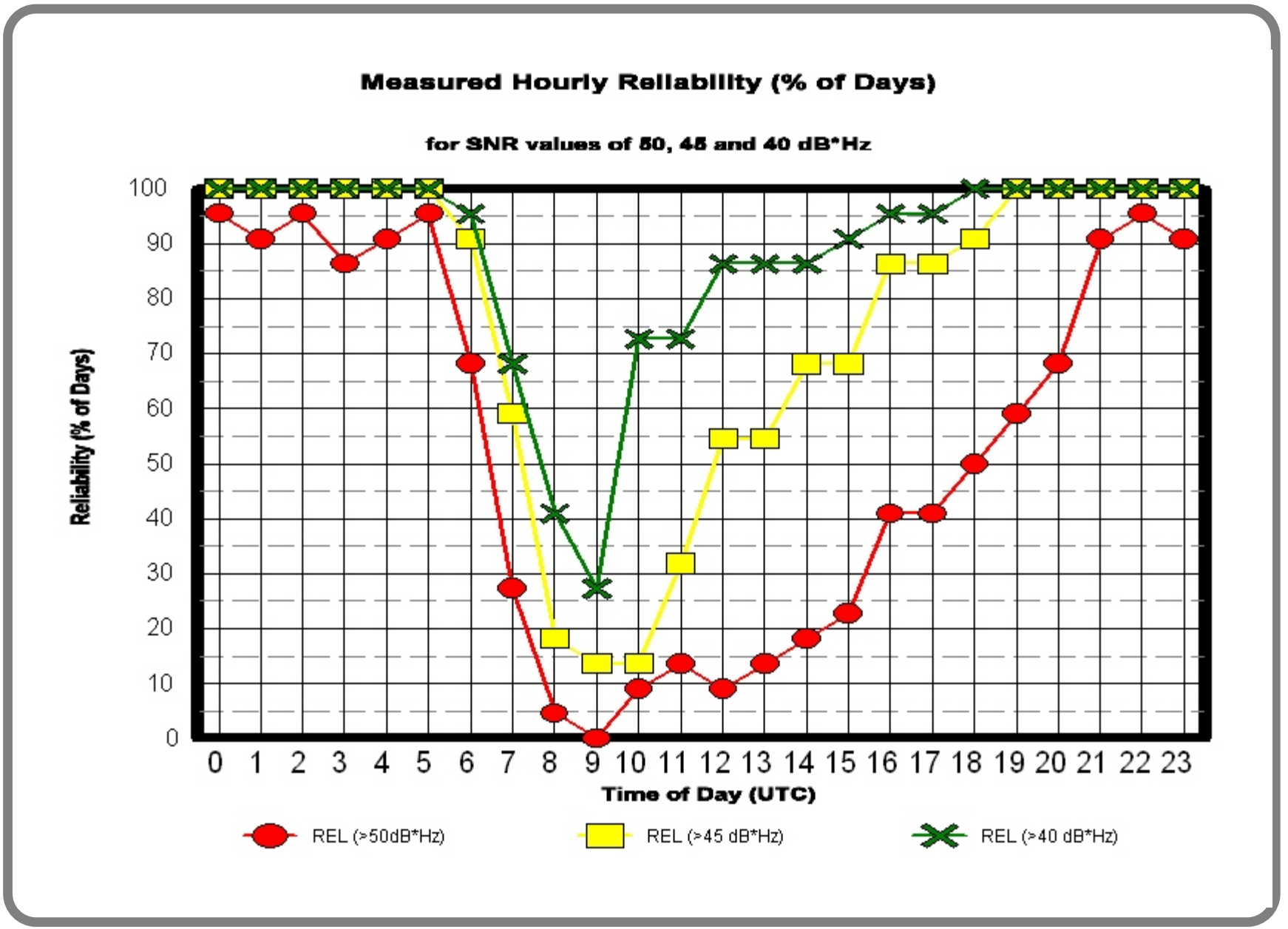

Measured Hourly Reliability (% of Days)
for SNR values of 50, 45 and 40 dB*Hz
Reliability (% of Days)
100
90
80
70
60
50
40
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time of Day (UTC)
REL (>50dB*Hz)
REL (>45 dB*Hz)
REL (>40 dB*Hz)

Fig. 3 VOACAP Predicted MUF vs. Median Best Frequency

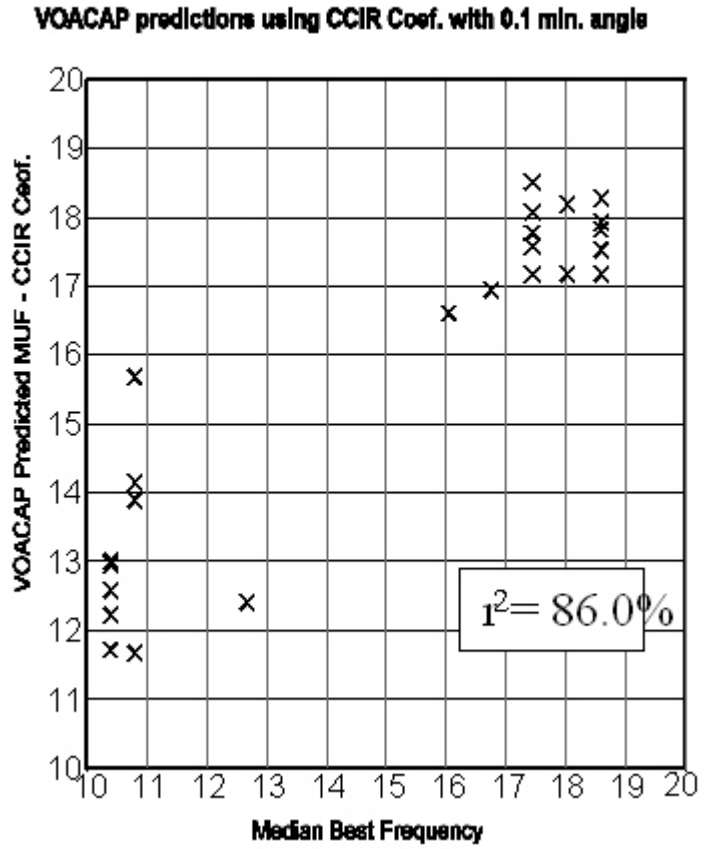


Fig. 4 VOACAP Predicted MUF vs Median Best Frequency

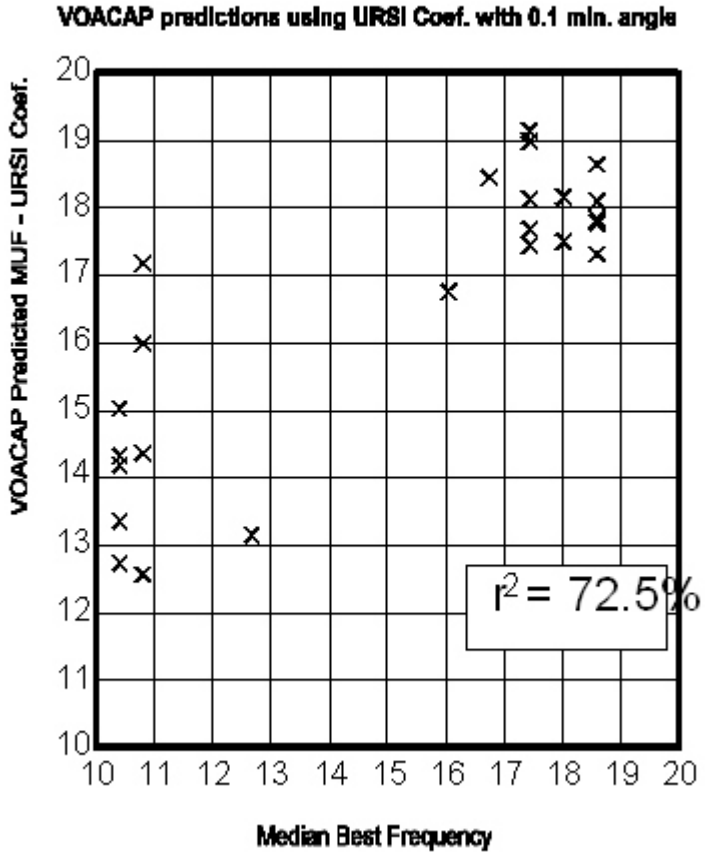


Fig. 5 VOACAP Predicted HPF vs. Upper Decile of Best Frequency

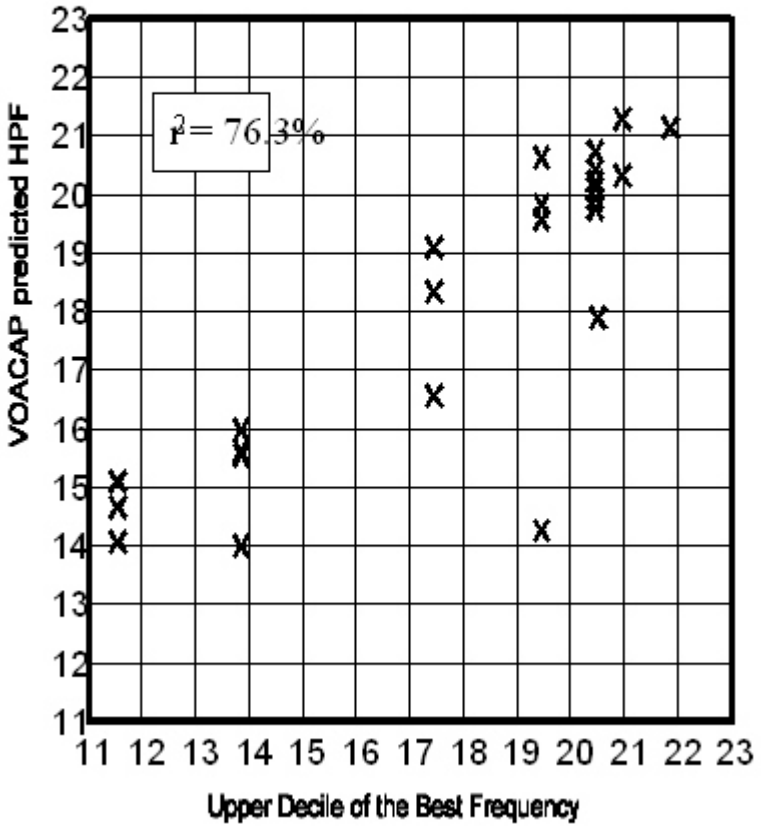
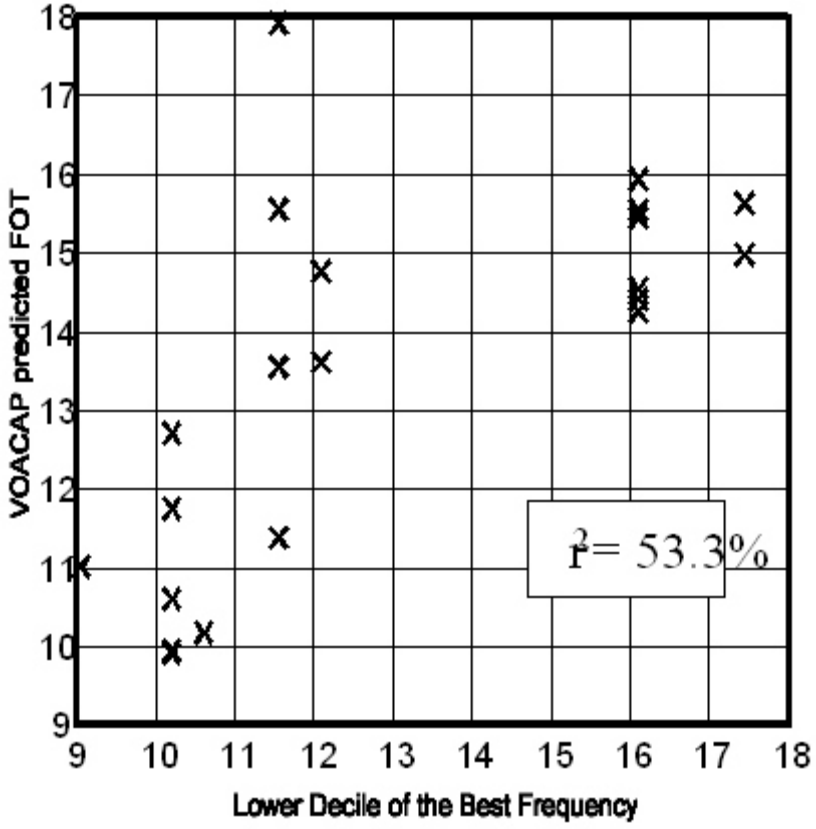
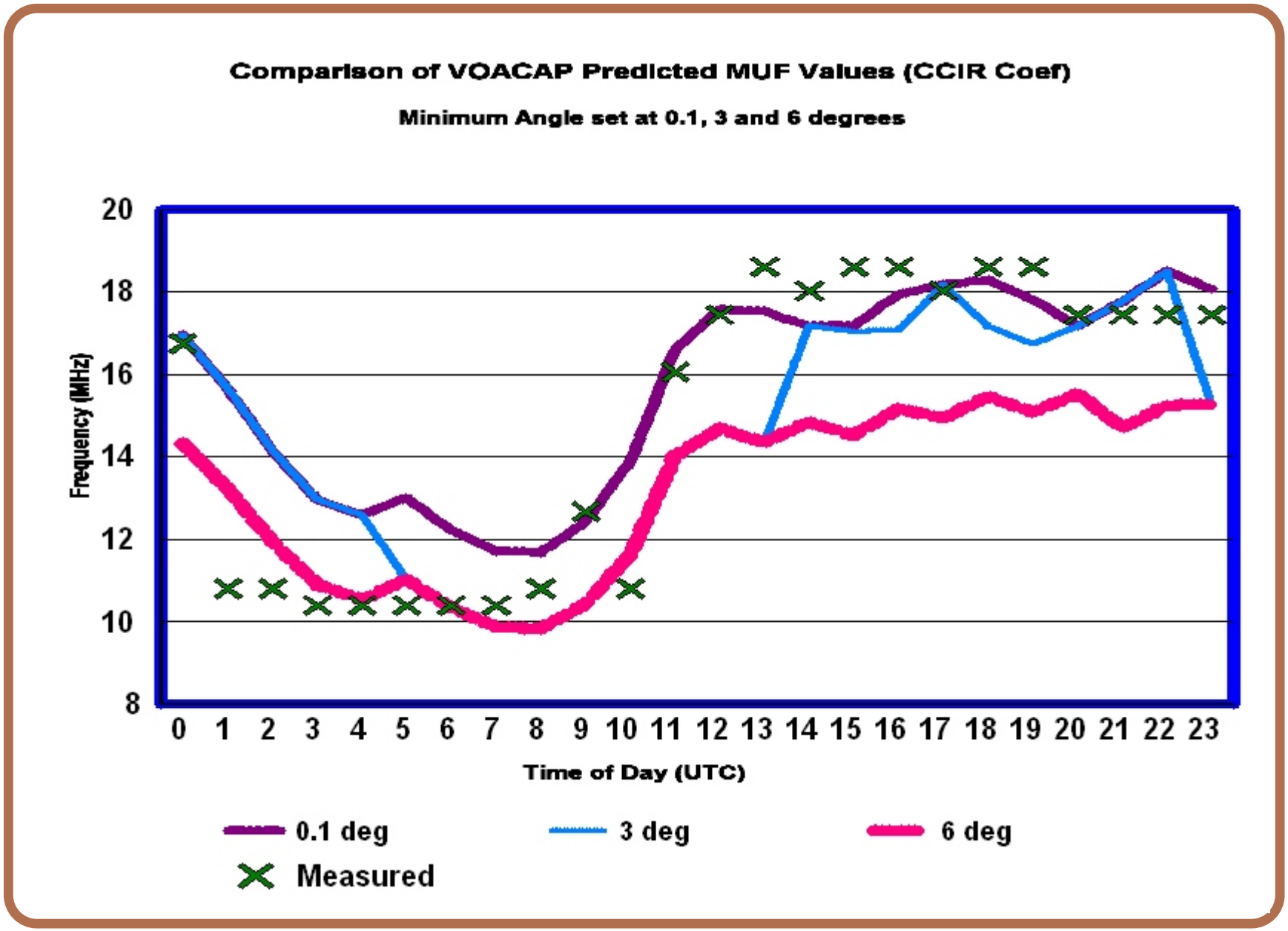


Fig. 6 VOACAP Predicted FOT vs. Lower Decile of Best Frequency




Comparison of VOACAP Predicted MUF Values (CCIR Coef)
Minimum Angle set at 0.1, 3 and 6 degrees
Frequency (MHz)
20
18
16
14
12
10
8
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time of Day (UTC)
0.1 deg
3 deg
6 deg
Measured

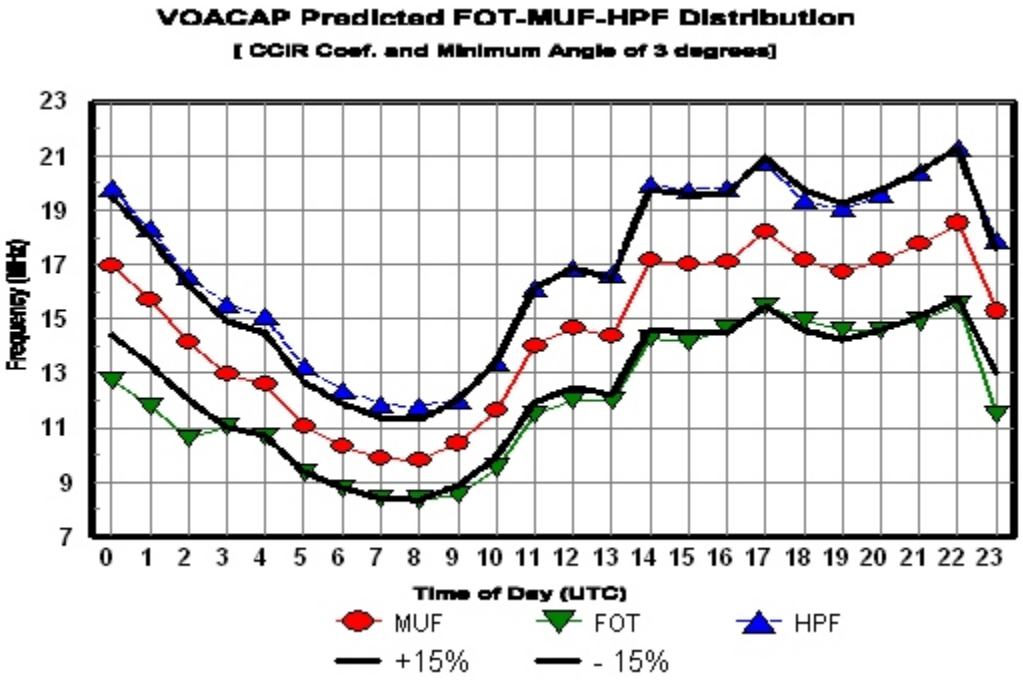
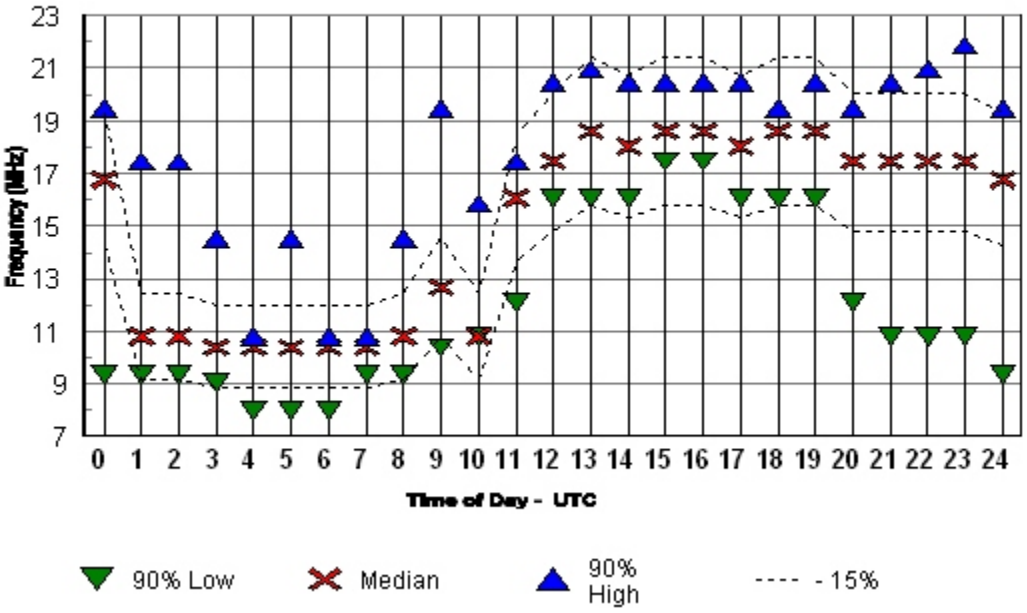
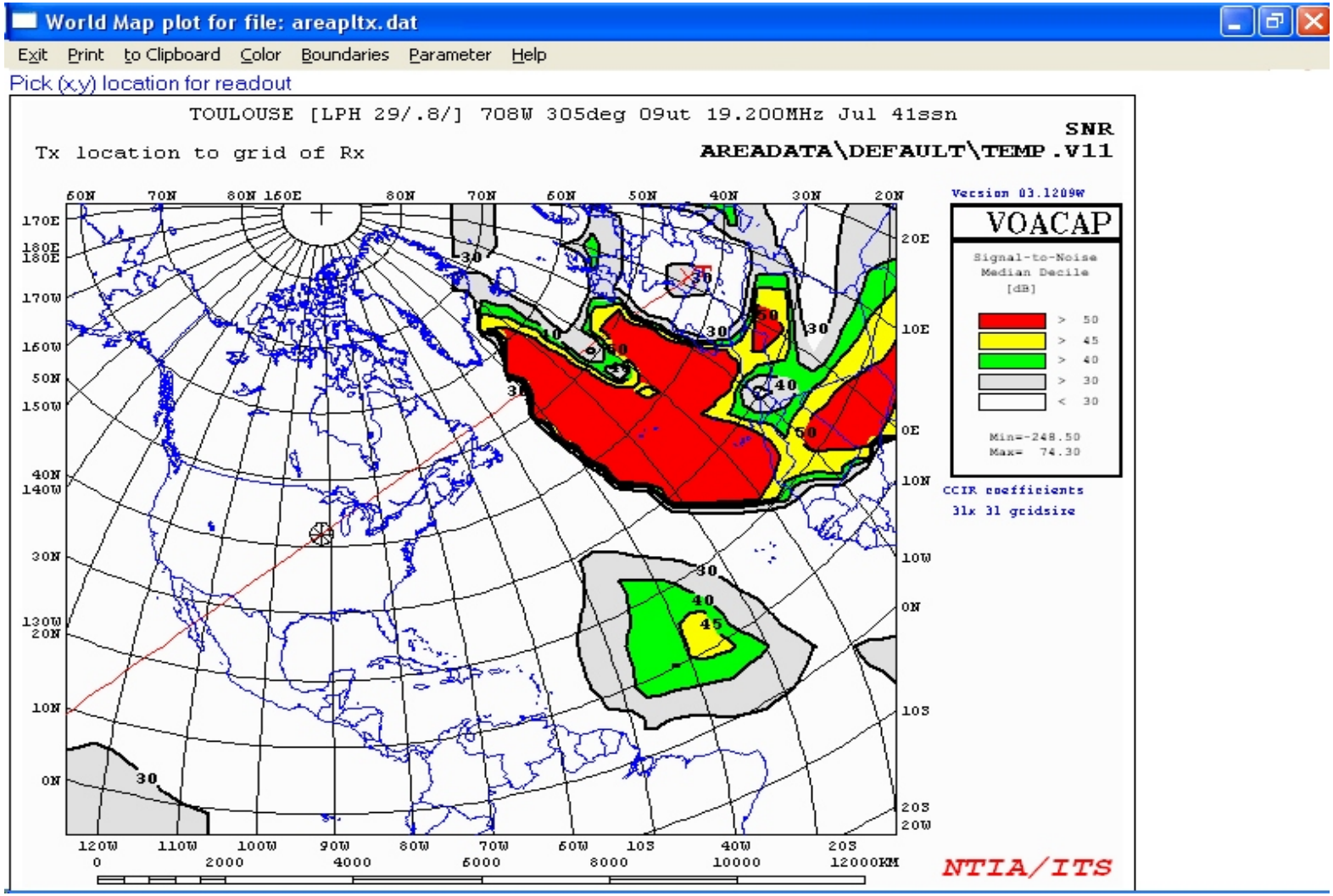


Fig. 1 Frequency Usage on the France to USA Link

for frequencies having the highest SNR



VOAAREA Coverage Map: Toulouse France to Cedar Rapids Circuit showing side scatter reception at 09 UTC at 19.2 MHz.



CONCLUSIONS

1. The ALE system was far more reliable than was predicted. However, antenna pattern shortcomings disrupted communications during periods of poor propagation (e.g. pre-dawn dip hours).

2. Best agreement with measurement is found using the **CCIR ionospheric coefficients** (NOT the newer URSI-88) and the **smoothed International Sunspot number**.

3. A **minimum angle of 0.1** degrees should be used under most circumstances. Horizon blockage of higher angles should be modeled by adjusting the antenna radiation pattern to account for the loss of gain at the low angles.

4. ALE frequency scan list should follow the VOACAP predicted **diurnal variation of the hourly MUF** values and include a frequency close to the highest HPF and below the lowest FOT.

RECOMMENDATIONS

A. The statistical Signal-to-Noise ratio distribution at a frequency given by VOACAP should be modified to yield the expected distribution for the optimum ALE frequency scan list.

B. Until VOACAP can be modified, it is suggested that the ALE system be designed to provide at least 50% RELIABILITY at each hour for the month and for the minimum required signal-to-noise ratio needed to achieve linkage.