

HFIA Meeting

PropMan 2000 Applications and Review

Daniel P. Roesler

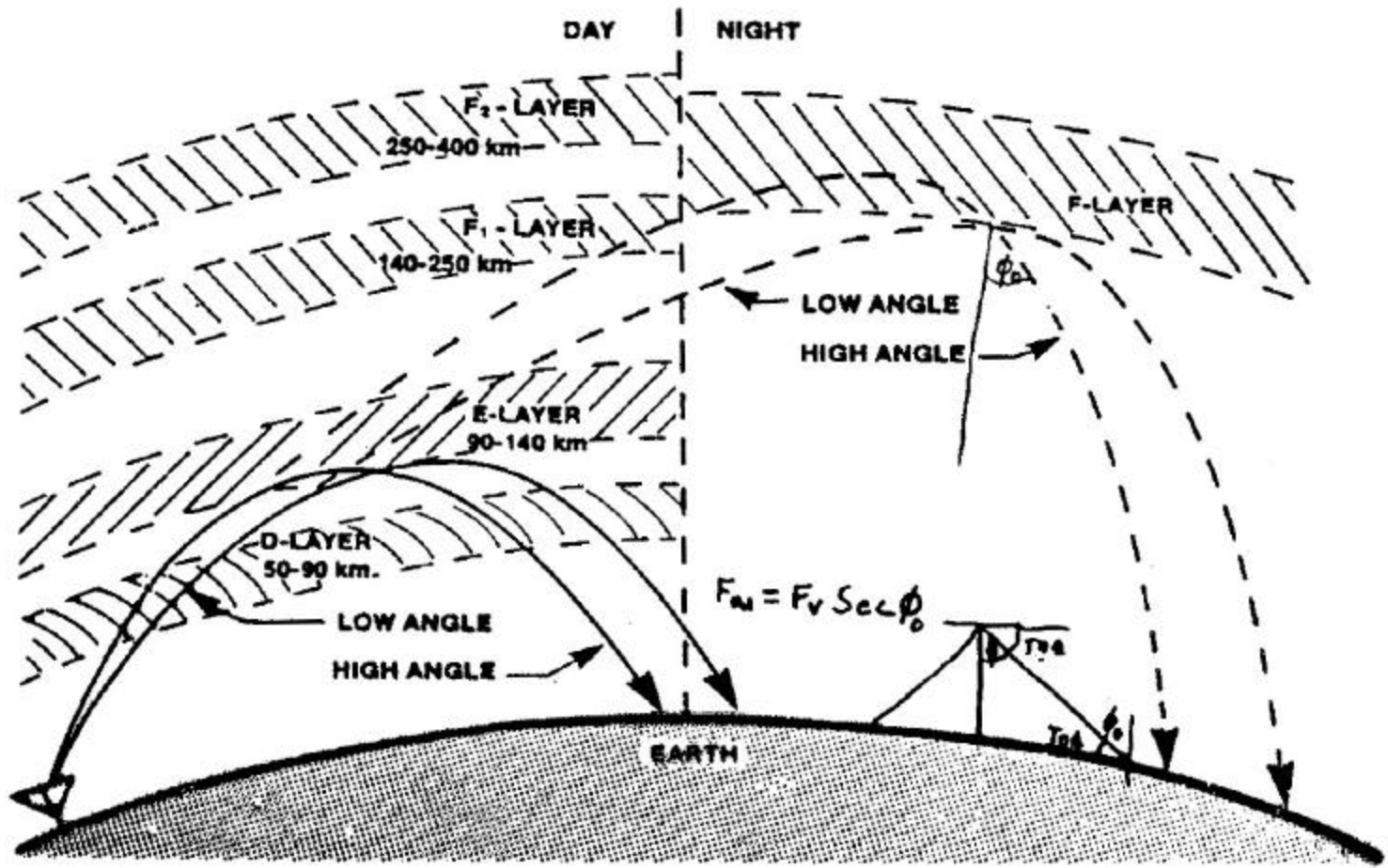
**Rockwell
Collins**

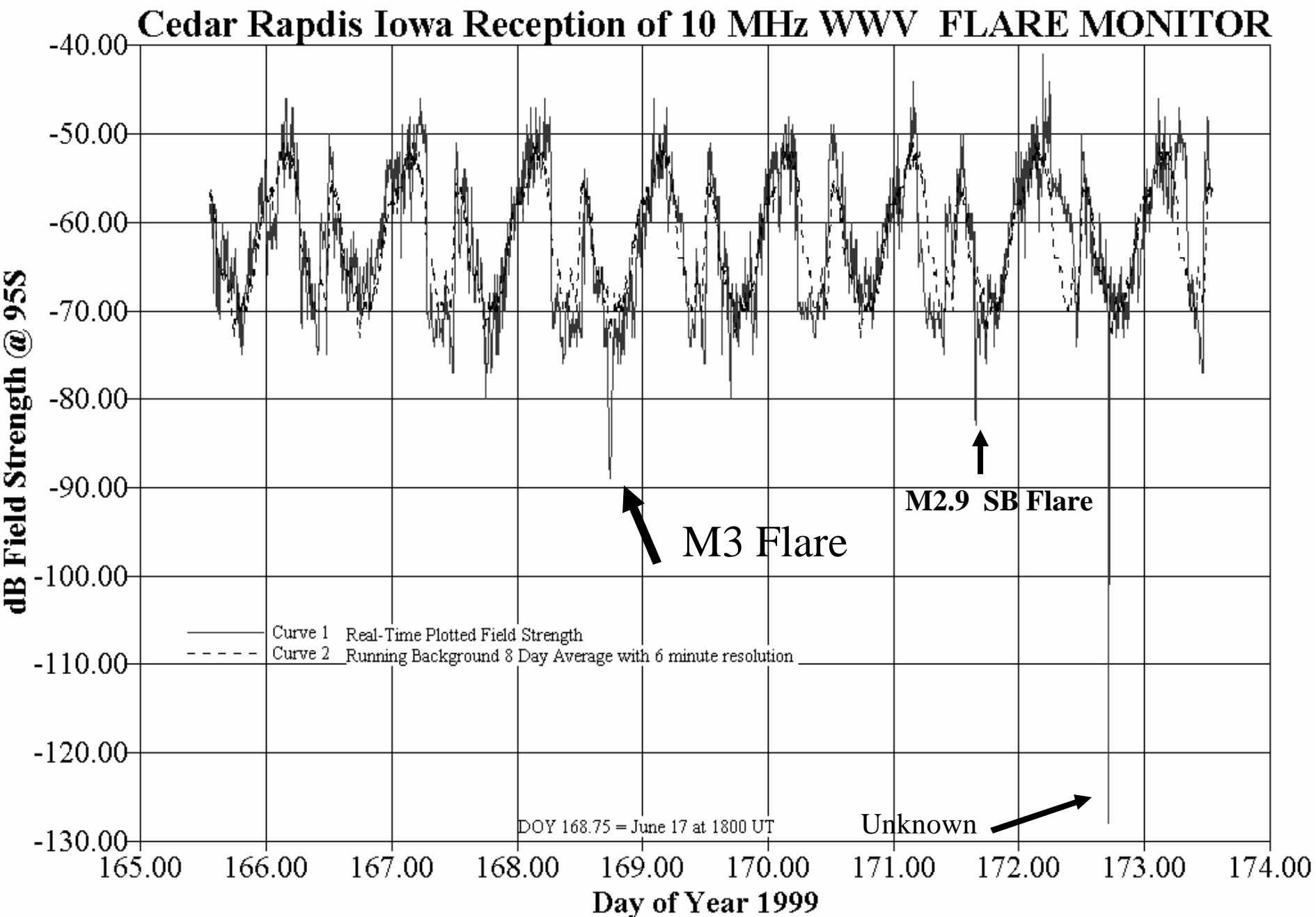
Objective:

- **Review PropMan Applications**
 - **Show Display Examples**
 - **Describe the Communications Context**
 - **Review the Real-Time Ionospheric Parameters**
 - **Show Added Features**
 - **Review the Modern Technologies Impact on HF Propagation Understanding**

Diurnal Cycle Geometry

Skywave

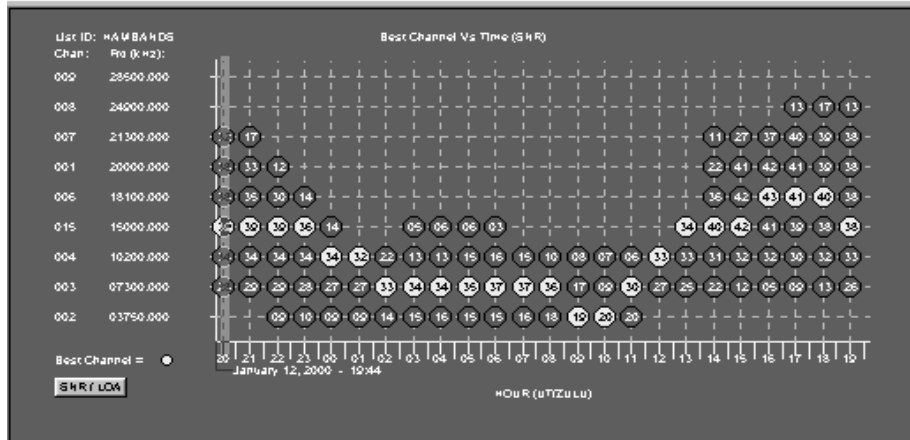
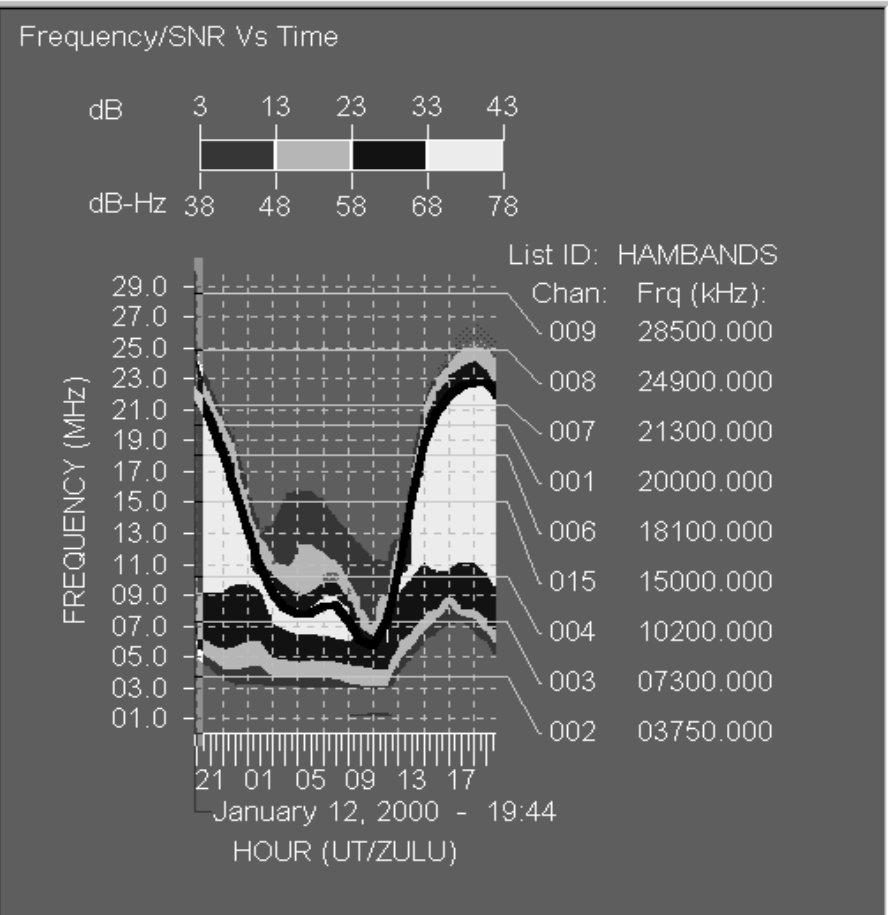
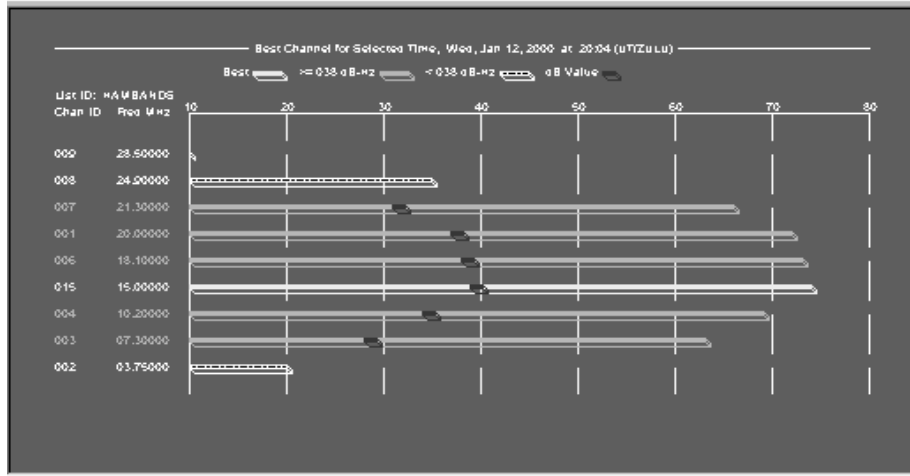




PropMan Overview Screen: Spectrum, User Schedule & Hour

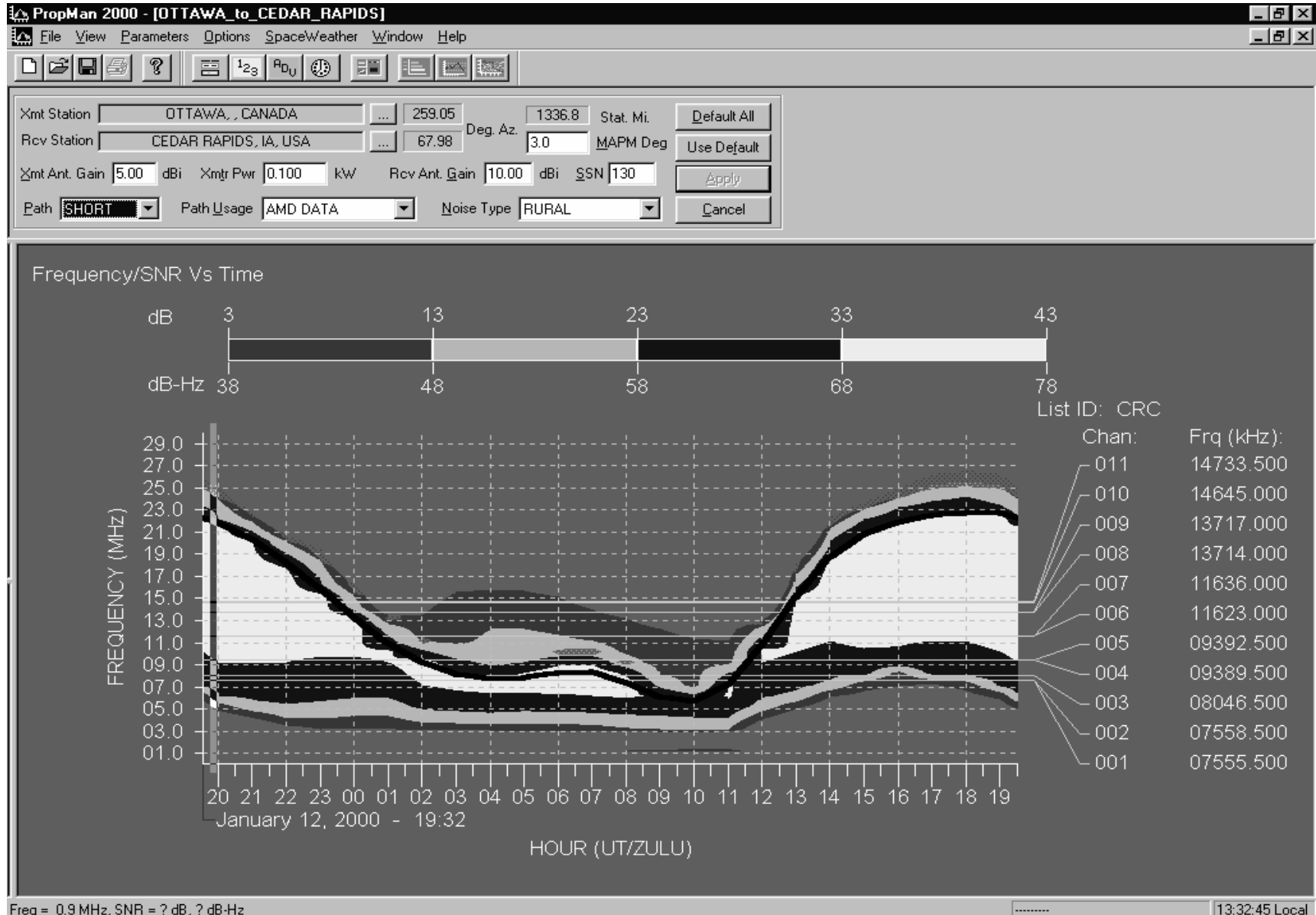
PropMan 2000 - [OTTAWA_to_CEDAR_RAPIDS] File View Parameters Options SpaceWeather Window Help

Xmt Station: OTTAWA, CANADA 259.05 Deg. Az: 1336.8 Stat. Mi. Default All
 Rcv Station: CEDAR RAPIDS, IA, USA 67.98 Deg. Az: 3.0 MAPM Deg. Use Default
 Xmt Ant. Gain: 5.00 dBi Xmtr Pwr: 0.100 kW Rcv Ant. Gain: 10.00 dBi SSN: 130 Apply
 Path: SHORT Path Usage: AMD DATA Noise Type: RURAL Cancel



Spectrum Screen:

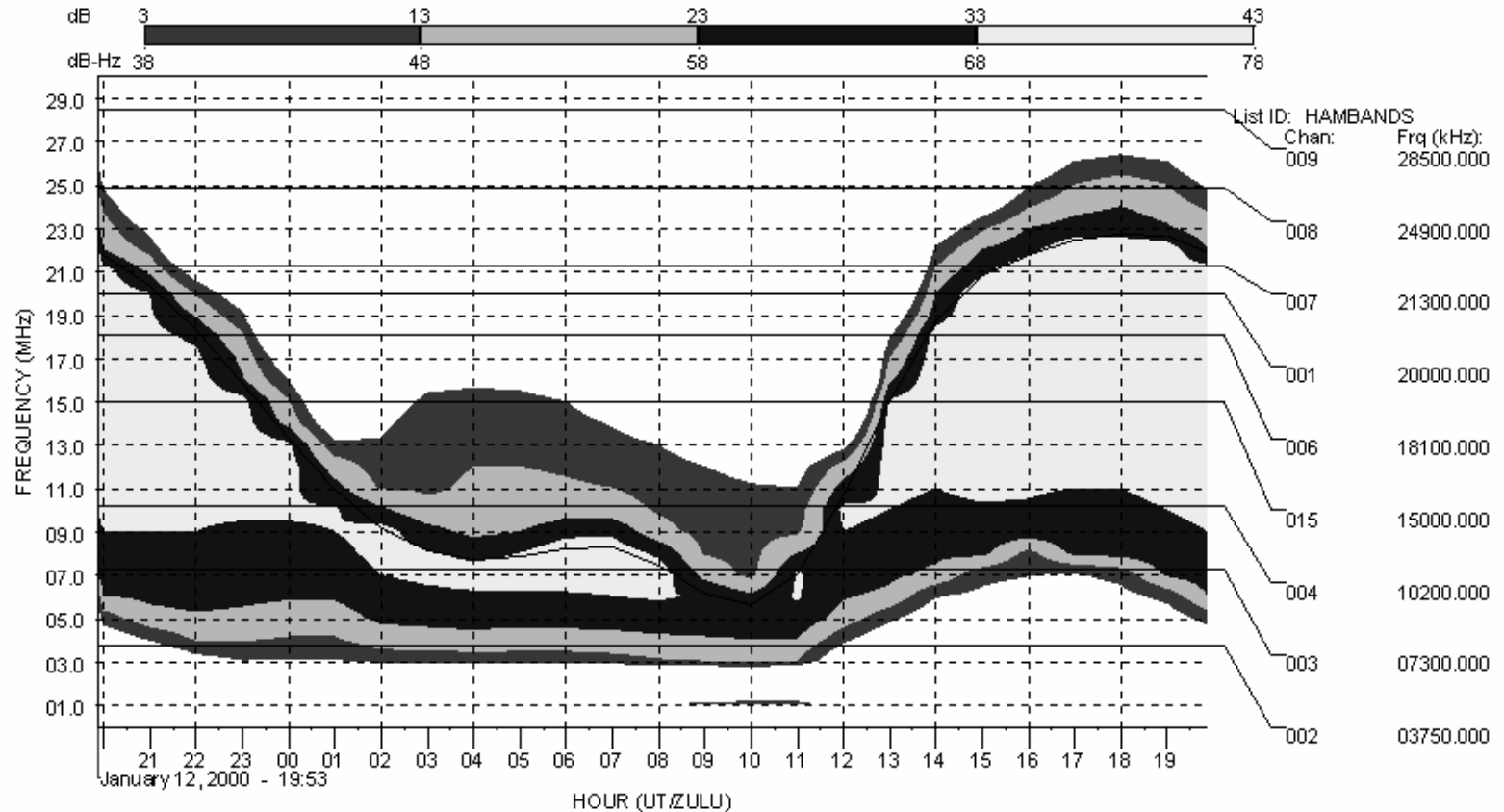
Allows user to make recommendations on adequacy on available frequency assignments for the mission



Spectrum Printout Page

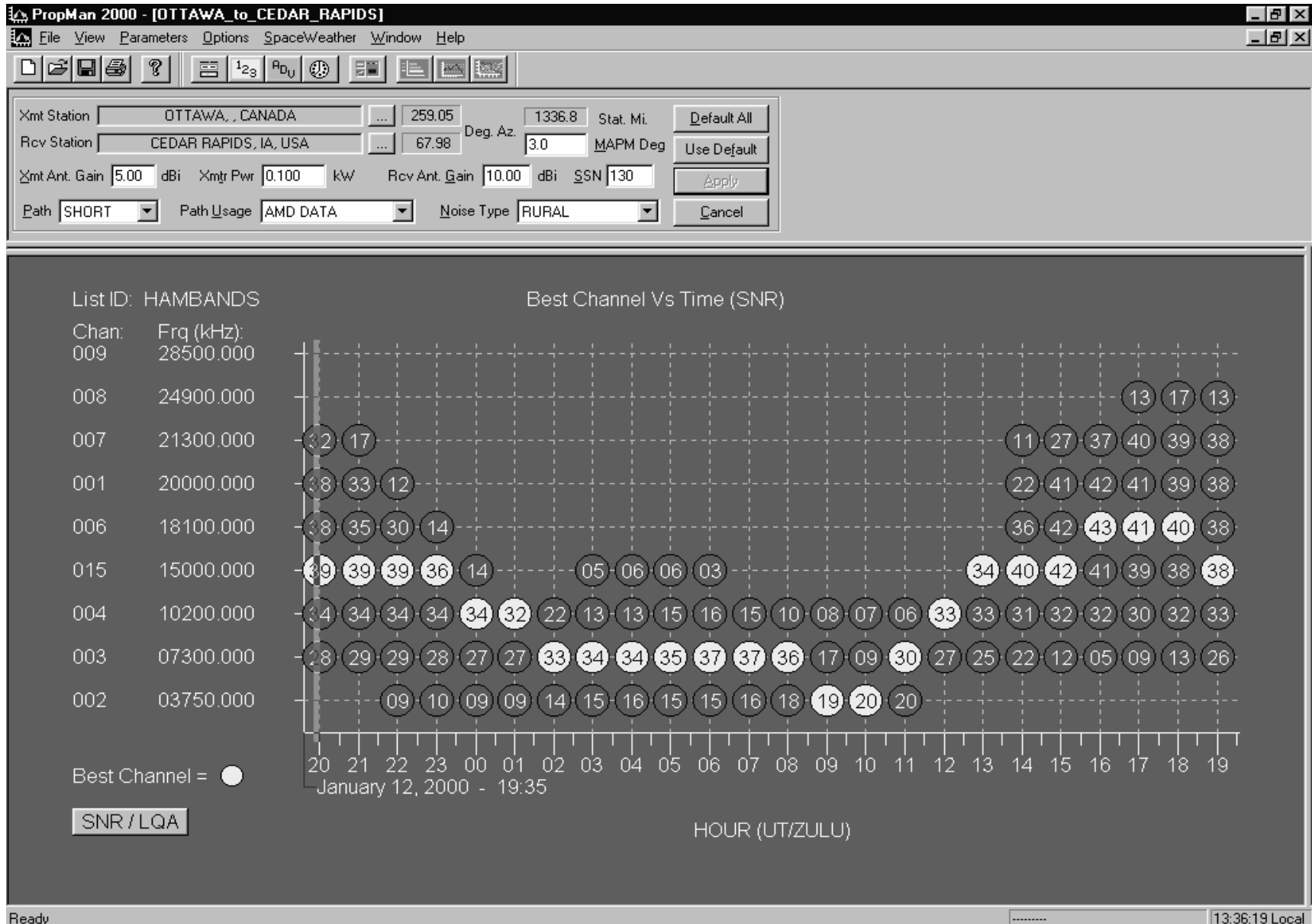
**Rockwell
Collins**

PropMan 2000 Version: 1.00 (Build 13), Sun Spot Number: 130
 Naut. miles: 0721.9, Stat. miles: 0831.3, KM: 1336.8 (SHORT Path)
 Xmtr pwr: 0.100 kW Xmtr gain: 5.00 Rcvr gain: 10.00
 Frq. Range: 2 - 30 MHz Minimum Angle of Propagation Mode: 3.0
 Man-made noise: -150 dBW
 Min SNR (3kHz BW): 3 Max SNR: 43 Min LQA: 10 Max LQA: 50
 XMT Station: OTTAWA, CANADA, Degrees Azimuth: 259.05
 RCV Station: CEDAR RAPIDS, IA, USA, Degrees Azimuth: 67.98



User Schedule Display

Allows operator to determine 24 hour frequency selection based on assigned frequencies



Printer Output

Schedule display for Best Channel versus time

Best Channel Vs Time (SNR)

**Rockwell
Collins**

PropMan 2000 Version: 1.00 (Build 13), Sun Spot Number: 130
 Naut. miles: 0721.9, Stat. miles: 0831.3, KM: 1336.8 (SHORT Path)
 Xmtr pwr: 0.100 kW, Xmtr gain: 5.00, Rcvr gain: 10.00
 Frq. Range: 2 - 30 MHz, Minimum Angle of Propagation Mode: 3.0
 Man-made noise: -150 dBW
 Min SNR (3kHz BW): 3, Max SNR: 43, Min LQA: 10, Max LQA: 50
 XMT Station: OTTAWA, CANADA, Degrees Azimuth: 259.05
 RCV Station: CEDAR RAPIDS, IA, USA, Degrees Azimuth: 67.98

List ID: HAMBANDS

Chan: Frq (kHz):
 009 28500.000

008 24900.000

007 21300.000

001 20000.000

006 18100.000

015 15000.000

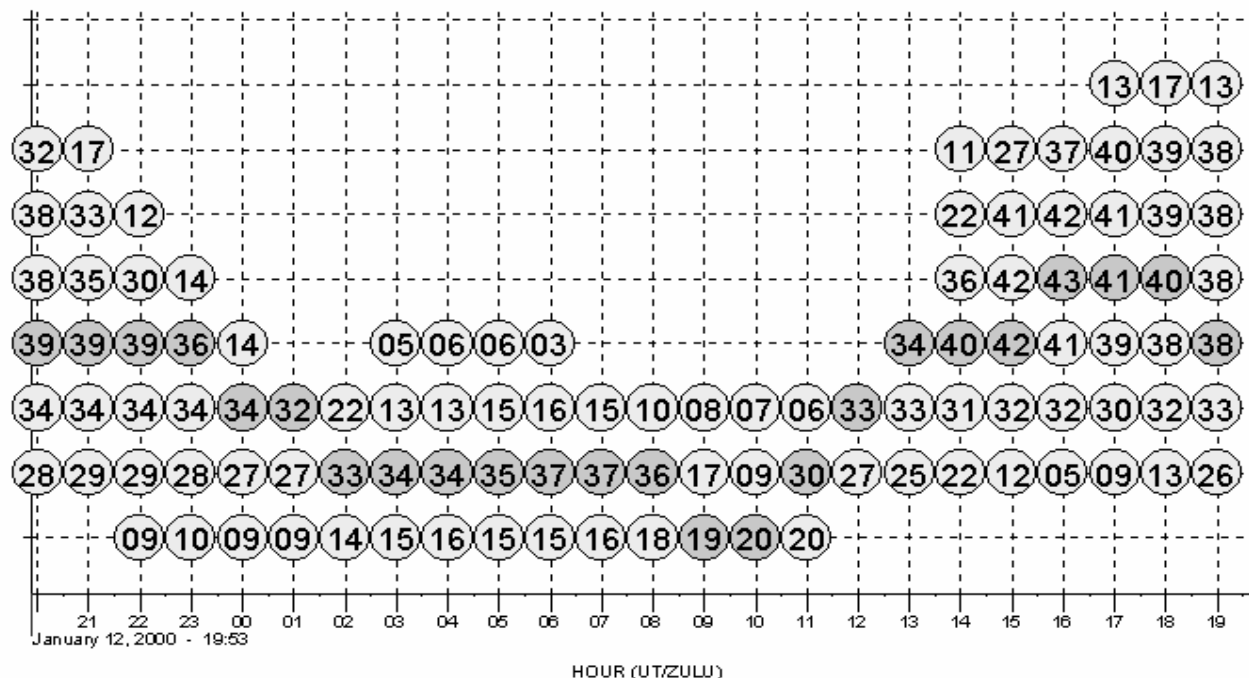
004 10200.000

003 07300.000

002 03750.000

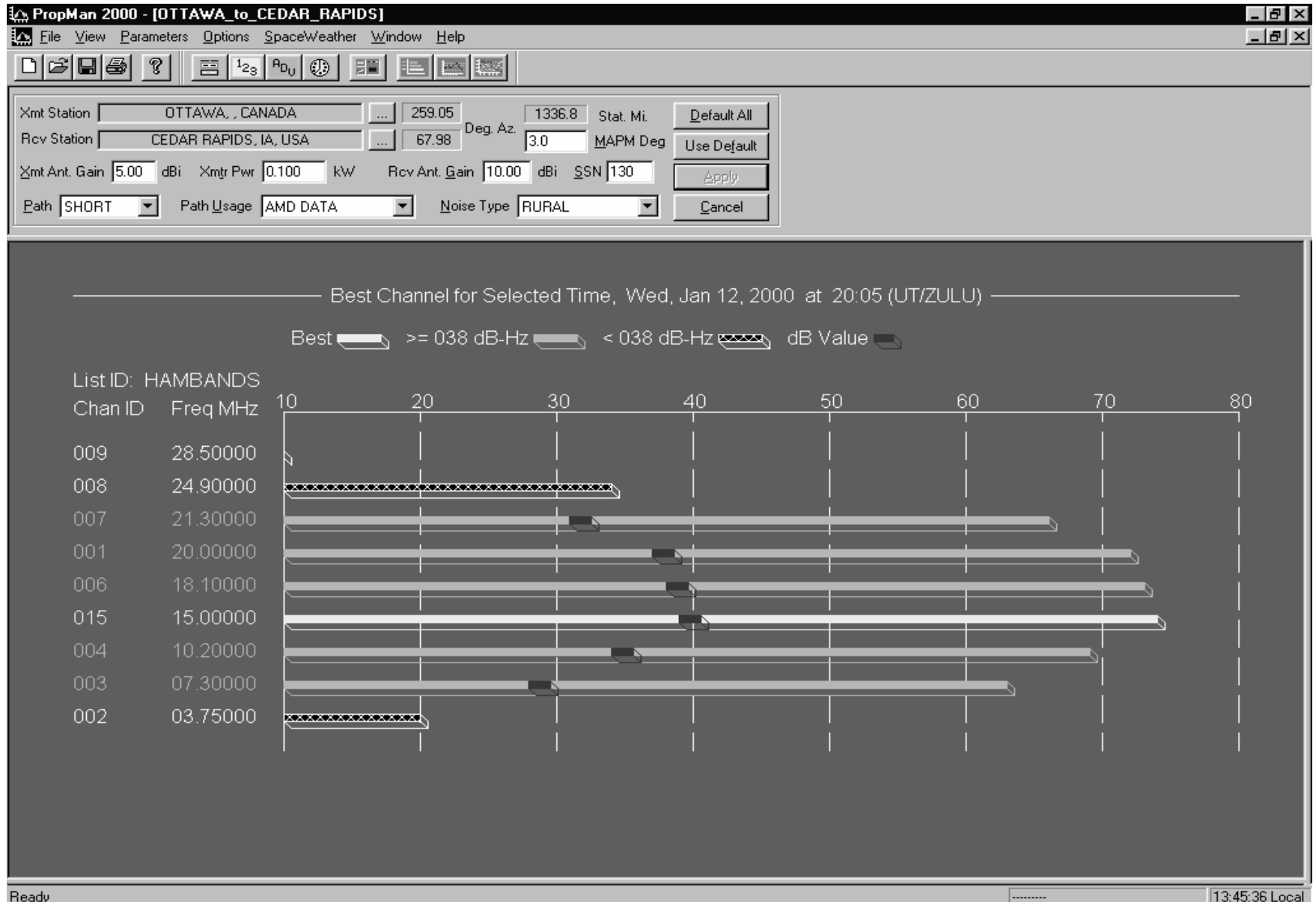
Best Channel = ○

SNR / LQA

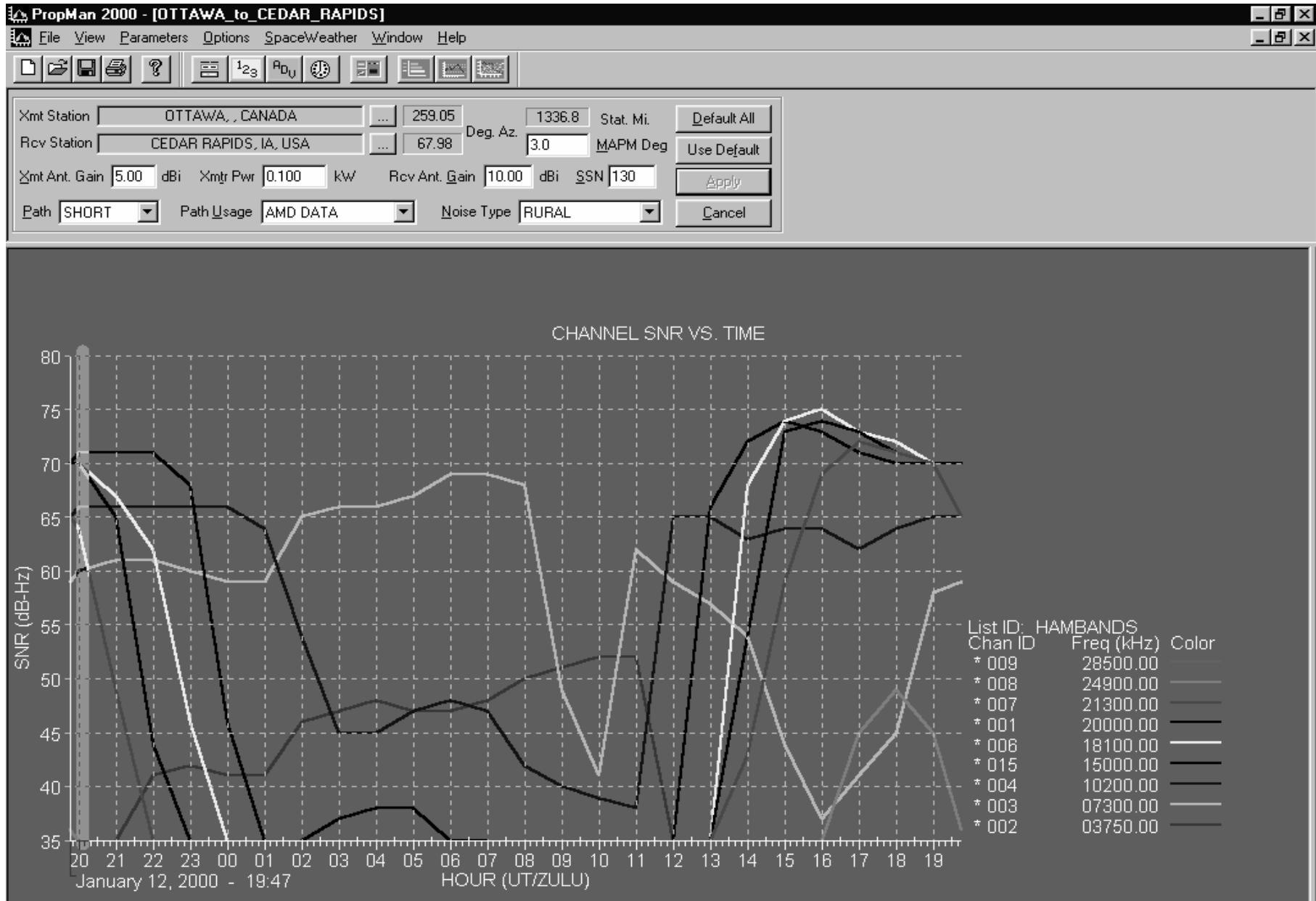


Hourly Performance

Allows operator to see the performance of each assigned frequency



24-Hour Frequency Performance

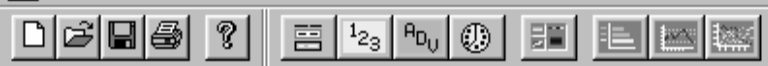


Best Frequency versus Time

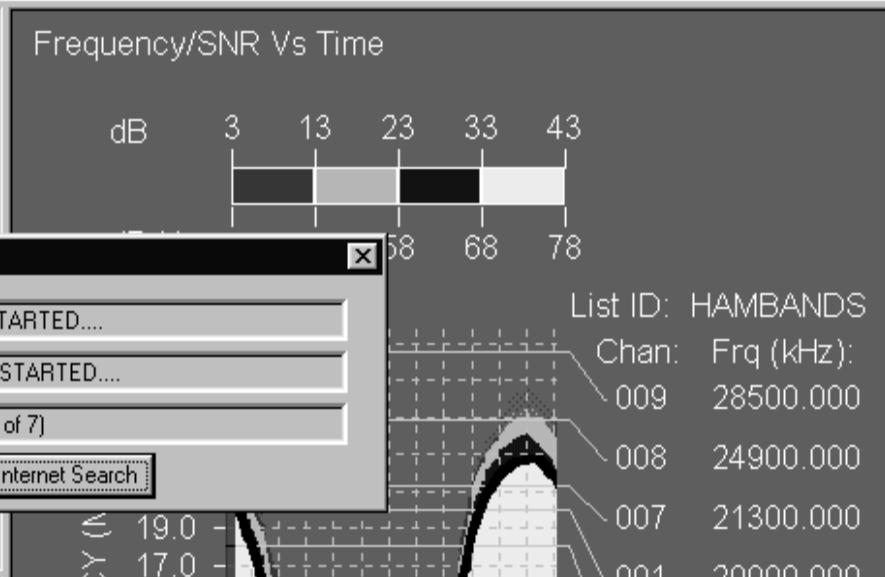
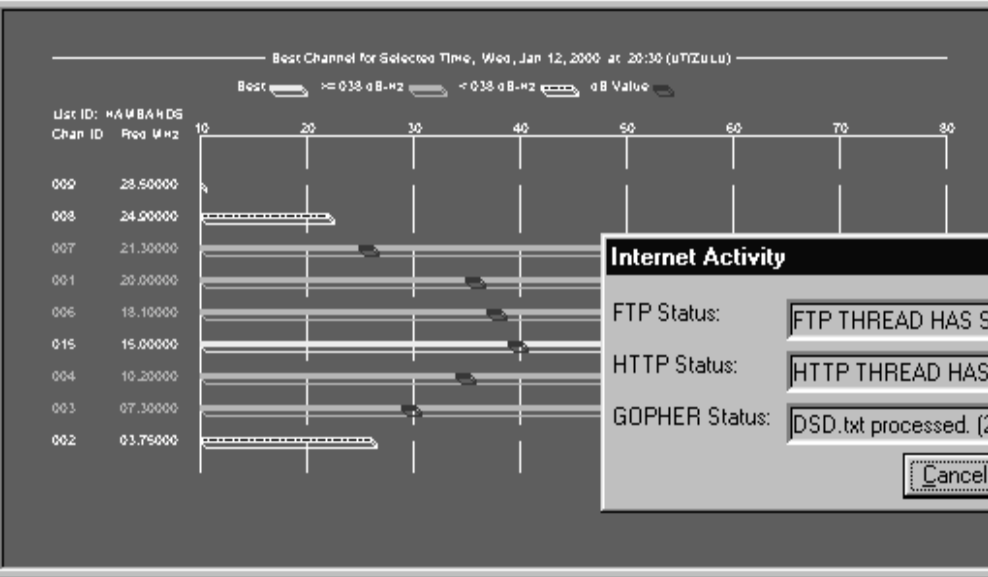


Near Real Time Data

- **PropMan attempts to determine the current stability of the ionosphere**
 - Yesterday and Today
- **Uses Rules from Lessons Learned (since 1986)**
 - X-ray Flares, PCA, Ion Storms
 - Ken Davies Ionospheric Storm model
 - Modified by University of Iowa
 - Two Summer projects
 - » Start of Storm
 - » Dst with K index



Xmt Station: OTTAWA, CANADA 259.05 Stat. Mi. 1336.8 Default All
 Rcv Station: CEDAR RAPIDS, IA, USA 67.98 Deg. Az. 3.0 MAPM Deg Use Default
 Xmt Ant. Gain: 5.00 dBi Xmt Pwr: 0.100 kW Rcv Ant. Gain: 10.00 dBi SSN: 130 Apply
 Path: SHORT Path Usage: AMD DATA Noise Type: RURAL Cancel



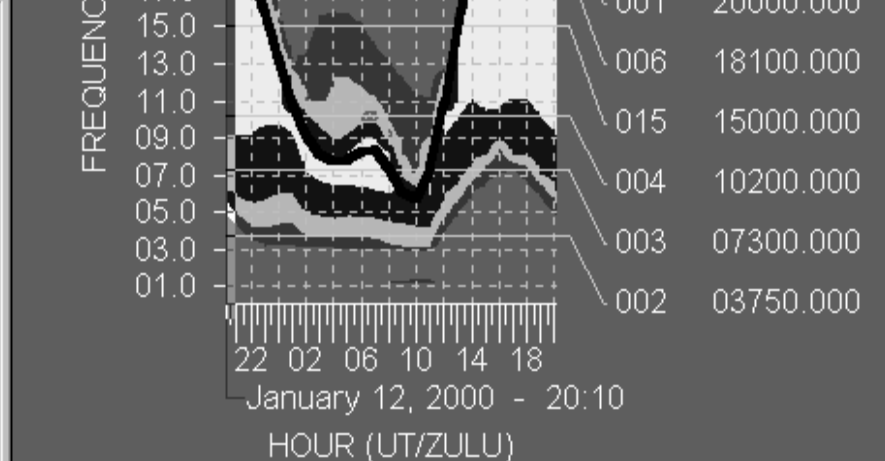
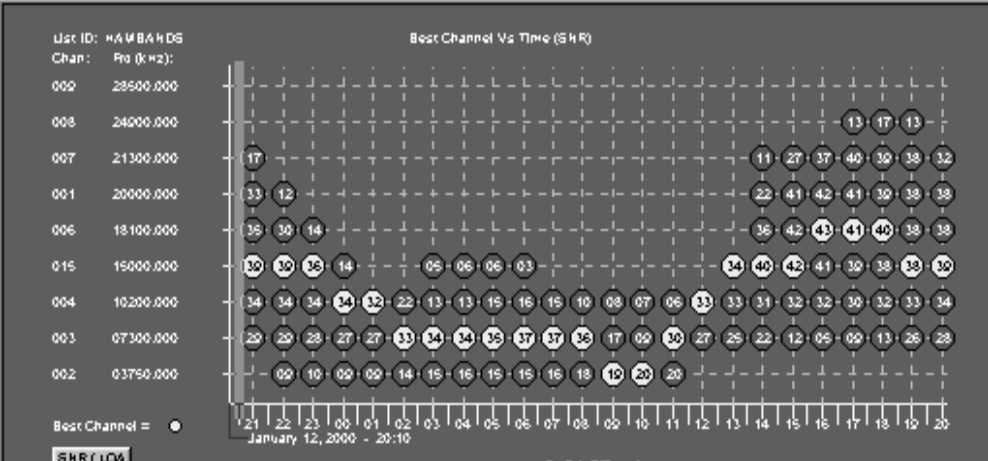
Internet Activity

FTP Status: FTP THREAD HAS STARTED....

HTTP Status: HTTP THREAD HAS STARTED....

GOPHER Status: DSD.txt processed. (2 of 7)

Cancel Internet Search



Ion Storm Warning

This file was generated on January 12, 20:11 U1/ZULU.

Station Pair = OTTAWA, , CANADA to CEDAR RAPIDS, IA, USA

This file displays the degradation of the Maximum Usable Frequency (MUF). The value given for each hour represents the percent decrease in the MUF.

This degradation is based on a first order approximation for the circuit calculated by PropMan using the ionospheric storm model. The degradation can be viewed as a percentage drop in the MUF or as a decrease in the probability that sufficient ionization will be available to support a particular frequency.

Example: If the MUF is 15 MHz at UTC 1100 and the MUF degradation value is 33%, then the effective MUF is 66% of 15 MHz: 10 MHz.

However this assumes you know what the actual MUF should be on day in question without a storm. This probability can also be associated with the MUFday parameter set in the Advanced parameters. The black line in the Frequency/SNR vs Time shows the frequencies that will be supported 50% of the days of the month. However observations have shown that the MUF predicted by VOACAP is very conservative. Thus PropMan shows the frequencies supported out to a MUFday of 10%. It is suggested that to illustrate the MUF degradation in PropMan, the MUFdays set in the advanced parameter should be set to 10% (.1) plus the degradation predicted below.

Example: For a 33% degradation predicted in the data below, the MUF Days Threshold in the Advanced Parameters dialog should be set to 43% (.43). This will result in showing the trend of the impact by an ionospheric storm on the circuit being evaluated by PropMan.

Predicted data follows

UTC Hour	% Degradation
20	0.0
21	0.0
22	0.0
23	0.0
0	0.0
1	0.0
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0
7	0.0

PropMan's View Data Text Files Options

(NVIS Example in Europe)

PropMan 2000 - [SUKHUMI_to_TBILISI1.prp]

File View Parameters Options SpaceWeather Window Help

Restore View to Default

- ✓ Status Bar
- ✓ Tool Bar
- ✓ PropMan Tool Bar
- Parameter Windgw
- ✓ Best Channel for Selected Time
- Best Frequency Vs Time
- Channel SNR Vs Time
- Ionstorm Warnings

111.38 Deg. Az. 183.8 Naut. Mi. Default All

293.95 Deg. Az. 3.0 MAPM Deg. Use Default

kW Rcv Ant. Gain 0.00 dBi SSN 150 Apply

TA Noise Type RURAL Cancel

View Data Text Files

- Raw VOACAP Data
- Ionstorm Degradation
- HFRP Data
- AK Data
- DSD Data
- DSI Data
- Particle 5 min Data
- Particle 10 5 min Data
- Xray 5 min Data
- Xray 10 5 min Data

User ID: CRC
Chan ID: 011 14.73300
010 14.64500
009 13.71700
008 13.71400
007 11.63600
006 11.62300
005 09.39200
004 09.38900
003 08.04600
002 07.55800
001 07.55500

Frequency/SNR Vs Time

dB 3 9 16 23 30

dB-Hz 38 44 51 58 65

List ID: CRC

Chan: Frq (kHz):

- 011 14733.500
- 010 14645.000
- 009 13717.000
- 008 13714.000
- 007 11636.000
- 006 11623.000
- 005 09392.500
- 004 09389.500
- 003 08046.500
- 002 07558.500
- 001 07555.500

Best Channel Vs Time (SNR)

User ID: CRC
Chan: Frq (kHz):

- 011 14733.500
- 010 14645.000
- 009 13717.000
- 008 13714.000
- 007 11636.000
- 006 11623.000
- 005 09392.500
- 004 09389.500
- 003 08046.500
- 002 07558.500
- 001 07555.500

Best Channel = ●

January 13, 2000 - 18:03

HOUR (UT/ZULU)

January 13, 2000 - 18:03

20 23 02 05 08 11 14 17

HOUR (UT/ZULU)

12:03:47 Local

Use a text editor to view actual VOACAP output data used to create views.

PropMan's VOACAP Data

```
.      CCIR Coefficients      ~METHOD 16 PCVOACAP 99.0708W PA E 1
.
.      Dec 1999      SSN = 150.      Minimum Angle= 3.000 degrees
.      SUKHUMI GEORGIA TBILISI GEORGIA AZIMUTHS      N. MI.      KM
.      42.90 N 41.00 E - 41.72 N 44.82 E 111.38 293.95 183.8 340.3
.      XMTR 2-30 + 0.0 dBi[SAMPLES\SAMPLE.00 ] Az=111.4 OFFaz=360.0 0.100kW
.      RCVR 2-30 + 0.0 dBi[SAMPLES\SAMPLE.00 ] Az=293.9 OFFaz= 0.1
.      3 MHz NOISE = -150.0 dBW REQ. REL = 50% REQ. SNR = 38.0 dB
.      MULTIPATH POWER TOLERANCE = 3.0 dB MULTIPATH DELAY TOLERANCE = 0.100 ms
.
.      1.0 4.5 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 0.0 FREQ
.      1F2 1F2 1F2 1F2 1F2 1F2 1F2 1F2 1F2 1F2 1F2 1F2 - MODE
.      67.8 61.0 58.9 60.4 64.1 67.8 67.8 67.8 67.8 67.8 67.8 - TANGLE
.      3.2 2.5 2.3 2.4 2.7 3.2 3.2 3.2 3.2 3.2 3.2 - DELAY
.      449 325 297 317 373 449 449 449 449 449 449 - V HITE
.      0.50 1.00 1.00 0.99 0.76 0.14 0.00 0.00 0.00 0.00 0.00 - MUFday
.      118 104 107 110 114 125 149 174 175 176 177 - LOSS
.      22 24 26 27 25 16 -6 -30 -30 -30 -30 - DBU
.      -98 -83 -87 -90 -94 -105 -129 -154 -155 -156 -157 - S DBW
.      -152 -136 -144 -148 -151 -154 -156 -159 -161 -162 -164 - N DBW
.      54 53 57 58 57 49 27 4 5 6 7 - SNR
.      -16 -15 -19 -20 -19 -11 11 34 33 32 31 - RPWRG
.      0.84 0.94 0.98 0.98 0.95 0.70 0.26 0.01 0.00 0.00 0.00 - REL
.      0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 - MPROB
.
```

Magnetic A & K Indices Near Real Time

```

:Product: Geomagnetic Data          AK.txt
:Issued: 1529 UT 13 Jan 2000
#
# Prepared by the U.S. Dept. of Commerce, NOAA, Space Environment Center.
# Please send comments and suggestions to sec@sec.noaa.gov
# Updated every 3 hours beginning at 0030 UT.
# Values shown as reported, SEC does not verify accuracy.
# Missing Data: -1
#
#      Geomagnetic A and K indices from the U.S. Geological Survey Stations
#
#      Geomagnetic
#      Dipole      A      ----- 3 Hourly K Indices -----
# Station      Lat Long  Index 00-03 03-06 06-09 09-12 12-15 15-18 18-21 21-24
#-----
2000 Jan 12
Boulder      N49 W 42      8      2      3      2      2      3      2      2      1
Chambon-la-foret N-- E--- -1     -1     -1     -1     -1     -1     -1     -1     -1
College      N65 W102     -1     3      2      3      2     -1     2      2     -1
Fredericksburg N49 W 8      8      2      3      2      2      3      2      2      1
Kergulen Island S57 E130    -1     -1     -1     -1     -1     -1     -1     -1     -1
Learmonth    S33 W175    -1     -1     -1     -1     -1     -1     -1     -1     -1
Planetary(estimated Ap) 9      3      3      2      2      1      2      3      2
Wingst       N54 E 95    -1     -1     -1     -1     -1     -1     -1     -1     -1

2000 Jan 13
Boulder      N49 W 42     -1     2      3      4      3      3     -1     -1     -1
Chambon-la-foret N-- E--- -1     -1     -1     -1     -1     -1     -1     -1     -1
College      N65 W102     -1     -1     -1     -1     -1     -1     -1     -1     -1
Fredericksburg N49 W 8      -1     -1     -1     -1     -1     -1     -1     -1     -1
Kergulen Island S57 E130    -1     -1     -1     -1     -1     -1     -1     -1     -1
Learmonth    S33 W175    -1     -1     -1     -1     -1     -1     -1     -1     -1
Planetary(estimated Ap) -1     2      2      3      3     -1     -1     -1     -1
Wingst       N54 E 95    -1     -1     -1     -1     -1     -1     -1     -1     -1

```

PropMan's DSD - Daily Solar Data

```

:Product: Daily Solar Data          DSD.txt
:Issued: 0225 UT 13 Jan 2000
#
# Prepared by the U.S. Dept. of Commerce, NOAA, Space Environment Center.
# Please send comments and suggestions to sec@sec.noaa.gov
#
# Last 30 Days Daily Solar Data
#
Date      Radio Flux 10.7cm  SESC Sunspot Number  Sunspot Area 10E-6  New Regions  Stanford Solar Mean Field  GOES8 X-Ray Bkgd Flux  X-Ray C M X S  Flares Optical 1 2 3
1999 12 14 168    139    490    2    -999    B6.8    3 0 0 4 0 0 0
1999 12 15 179    148    540    0    -999    B7.2    3 0 0 7 0 0 0
1999 12 16 194    146    710    3     3    C1.0    4 0 0 6 0 0 0
1999 12 17 201    179    1180   2    -16    C1.5    9 1 0 8 3 0 0
1999 12 18 206    190    1470   1    -999    C1.5    10 1 0 16 4 0 0
1999 12 19 207    154    1750   1    -999    B9.4    11 0 0 14 0 0 0
1999 12 20 209    149    1860   0    -37    C1.6    9 0 0 20 1 0 0
1999 12 21 217    129    1720   0     30    C1.1    7 1 0 9 1 0 0
1999 12 22 202    130    1720   0     20    C1.4    5 2 0 15 2 1 0
1999 12 23 198    112    1780   0    -12    B8.2    8 0 0 21 0 0 0
1999 12 24 182    149    1690   2    -16    B8.9    17 0 0 8 0 0 0
1999 12 25 178    141    1580   1     -5    B7.0    10 0 0 5 0 0 0
1999 12 26 177    125    1550   0     9    B8.9    9 0 0 6 0 0 0
1999 12 27 162    109    1450   0     31    B7.4    7 2 0 9 1 0 0
1999 12 28 150     77    1130   0    -999    B7.6    5 1 0 8 0 1 0
1999 12 29 144    123    1030   3    -999    B4.6    3 0 0 3 1 0 0
1999 12 30 136     88    530    0     73    B4.7    3 0 0 1 0 0 0
1999 12 31 130     91    530    1    -999    B4.4    2 0 0 1 0 0 0
2000 01 01 130     69    540    0     89    B5.7    3 0 0 1 0 0 0
2000 01 02 133     69    460    0     79    B3.7    1 0 0 2 0 0 0
2000 01 03 133     77    480    0     30    B3.6    2 0 0 2 0 0 0
2000 01 04 135    102    460    2    -999    B2.8    2 0 0 2 0 0 0
2000 01 05 137    100    410    1    -14    B3.2    3 0 0 0 0 0 0
2000 01 06 145    145    530    3    -42    B5.4    2 0 0 1 1 0 0
2000 01 07 150    146    500    1   -103    B4.1    8 0 0 9 0 0 0
2000 01 08 155    106    460    1    -65    B6.6    4 0 0 7 0 0 0
2000 01 09 161    119    490    1     5    B6.3    4 0 0 5 0 0 0
2000 01 10 163     88    470    1    -56    B6.8    8 1 0 5 0 1 0
2000 01 11 178    148    670    4    -999    B7.4    8 1 0 11 0 0 0
2000 01 12 196    204    930    2    -999    C1.7    9 3 0 14 1 0 0

```


PropMan's Solar Particle Data

from Goes 8 (and Goes 10)

```

:Data_list: 20000113_G8part_5m.txt
:Created: 2000 Jan 13 1600 UT
# Prepared by the U.S. Dept. of Commerce, NOAA, Space Environment Center.
# Please send comments and suggestions to sec@sec.noaa.gov
#
# Label: P > 1 = Particles at >1 Mev
# Label: P > 5 = Particles at >5 Mev
# Label: P >10 = Particles at >10 Mev
# Label: P >30 = Particles at >30 Mev
# Label: P >50 = Particles at >50 Mev
# Label: P>100 = Particles at >100 Mev
# Label: E>0.6 = Electrons at >0.6 Mev
# Label: E>2.0 = Electrons at >2.0 Mev
# Label: E>4.0 = Electrons at >4.0 Mev
# Units: Particles = Protons/cm2-s-sr
# Units: Electrons = Electrons/cm2-s-sr
# Source: GOES-8
# Location: W075
# Missing data: -1.00e+05
#
#           5-minute GOES-8 Solar Particle and Electron Flux
#
# Modified Seconds
# UT Date   Time   Julian of the
# YR MO DA  HHMM   Day   Day   P > 1   P > 5   P >10   P >30   P >50   P>100   E>0.6   E>2.0   E>4.0
#-----
2000 01 13 0000 51556 0 4.68e-01 1.35e-01 1.16e-01 8.69e-02 7.05e-02 5.29e-02 3.04e+05 4.96e+00 -1.00e+05
2000 01 13 0005 51556 300 1.79e+00 3.08e-01 6.86e-02 3.92e-02 3.07e-02 1.54e-02 2.56e+05 6.90e+00 -1.00e+05
2000 01 13 0010 51556 600 5.67e-01 2.44e-01 2.24e-01 1.87e-01 1.14e-01 3.46e-02 2.44e+05 7.05e+00 -1.00e+05
2000 01 13 0015 51556 900 5.84e-01 1.15e-01 9.58e-02 6.63e-02 3.49e-02 1.54e-02 2.32e+05 1.16e+01 -1.00e+05
2000 01 13 0020 51556 1200 4.75e-01 1.67e-01 1.47e-01 1.18e-01 9.40e-02 3.43e-02 2.42e+05 7.32e+00 -1.00e+05
2000 01 13 0025 51556 1500 5.65e-01 9.65e-02 7.69e-02 4.82e-02 3.28e-02 1.54e-02 2.35e+05 6.85e+00 -1.00e+05
2000 01 13 0030 51556 1800 7.48e-01 1.58e-01 1.38e-01 6.59e-02 5.74e-02 4.21e-02 2.30e+05 8.26e+00 -1.00e+05
2000 01 13 0035 51556 2100 9.07e-01 2.42e-01 2.10e-01 1.78e-01 1.43e-01 8.22e-02 2.53e+05 4.07e+00 -1.00e+05
2000 01 13 0040 51556 2400 3.31e-01 8.71e-02 6.75e-02 3.92e-02 3.07e-02 1.54e-02 2.55e+05 5.28e+00 -1.00e+05
2000 01 13 0045 51556 2700 9.50e-01 1.94e-01 7.93e-02 4.94e-02 4.10e-02 2.57e-02 2.40e+05 5.90e+00 -1.00e+05
2000 01 13 0050 51556 3000 6.72e-01 3.37e-01 1.21e-01 8.96e-02 4.33e-02 1.74e-02 -1.00e+05 -1.00e+05 -1.00e+05
2000 01 13 0055 51556 3300 9.29e-01 4.11e-01 1.81e-01 5.57e-02 4.24e-02 2.57e-02 2.63e+05 4.18e+00 -1.00e+05
2000 01 13 0100 51556 3600 4.50e-01 1.17e-01 9.78e-02 6.95e-02 6.10e-02 4.57e-02 2.78e+05 3.49e+00 -1.00e+05
2000 01 13 0105 51556 3900 3.65e-01 1.08e-01 8.87e-02 6.04e-02 5.19e-02 3.66e-02 2.53e+05 7.42e+00 -1.00e+05
2000 01 13 0110 51556 4200 1.29e-01 9.48e-02 7.52e-02 4.69e-02 3.84e-02 2.31e-02 2.50e+05 9.74e+00 -1.00e+05
2000 01 13 0115 51556 4500 1.20e+00 4.04e-01 1.72e-01 4.43e-02 3.19e-02 1.54e-02 2.57e+05 6.87e+00 -1.00e+05
2000 01 13 0120 51556 4800 5.18e-01 1.20e-01 1.01e-01 7.22e-02 6.37e-02 2.60e-02 2.39e+05 8.32e+00 -1.00e+05
2000 01 13 0125 51556 5100 7.11e-01 2.36e-01 1.56e-01 6.14e-02 4.99e-02 3.37e-02 2.33e+05 7.50e+00 -1.00e+05
2000 01 13 0130 51556 5400 3.79e-01 1.35e-01 1.15e-01 8.60e-02 5.61e-02 3.66e-02 2.68e+05 2.55e+00 -1.00e+05
2000 01 13 0135 51556 5700 3.27e-01 1.71e-01 1.51e-01 1.23e-01 1.14e-01 4.97e-02 2.60e+05 3.79e+00 -1.00e+05

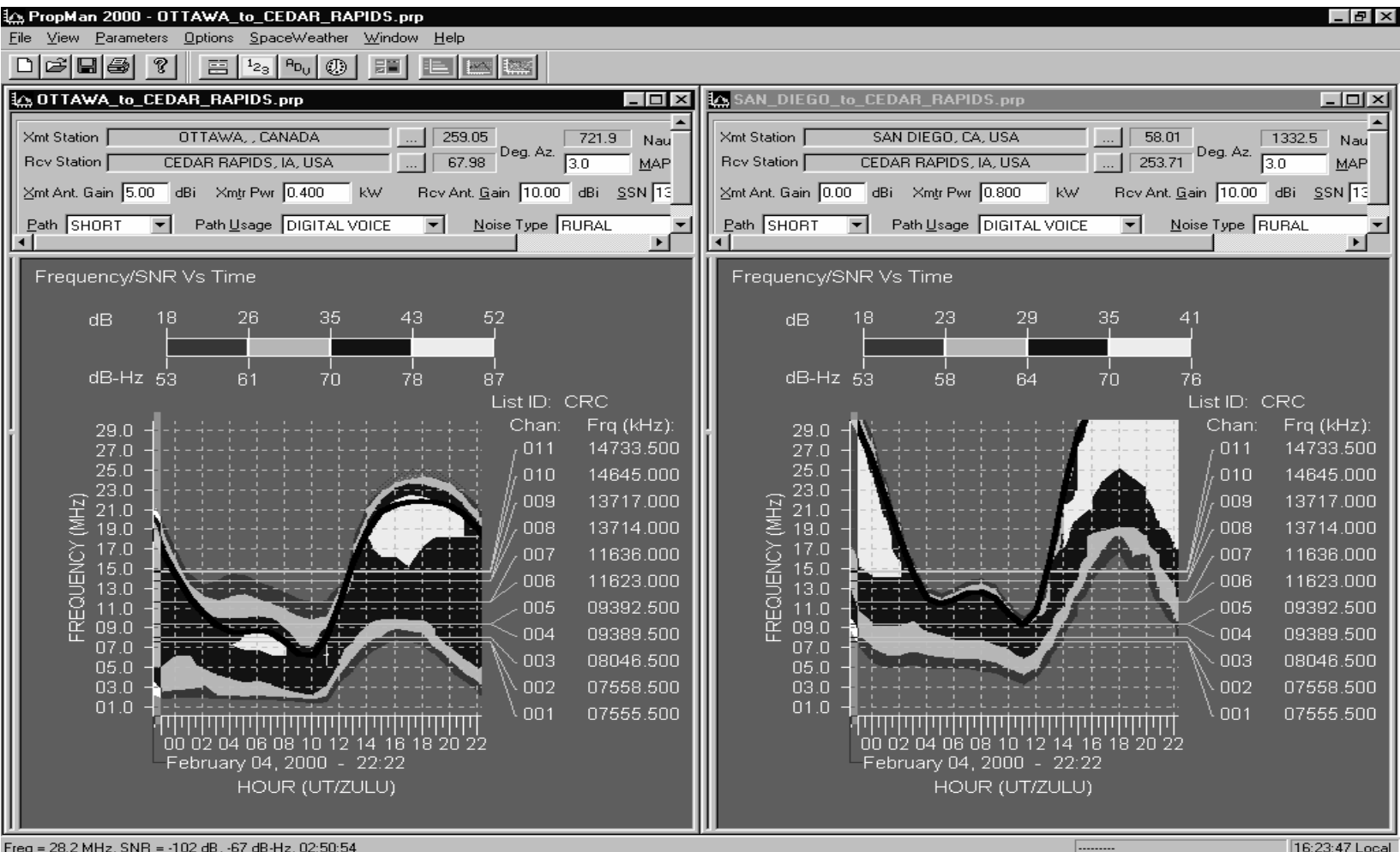
```

PropMan's X-ray Flare Data

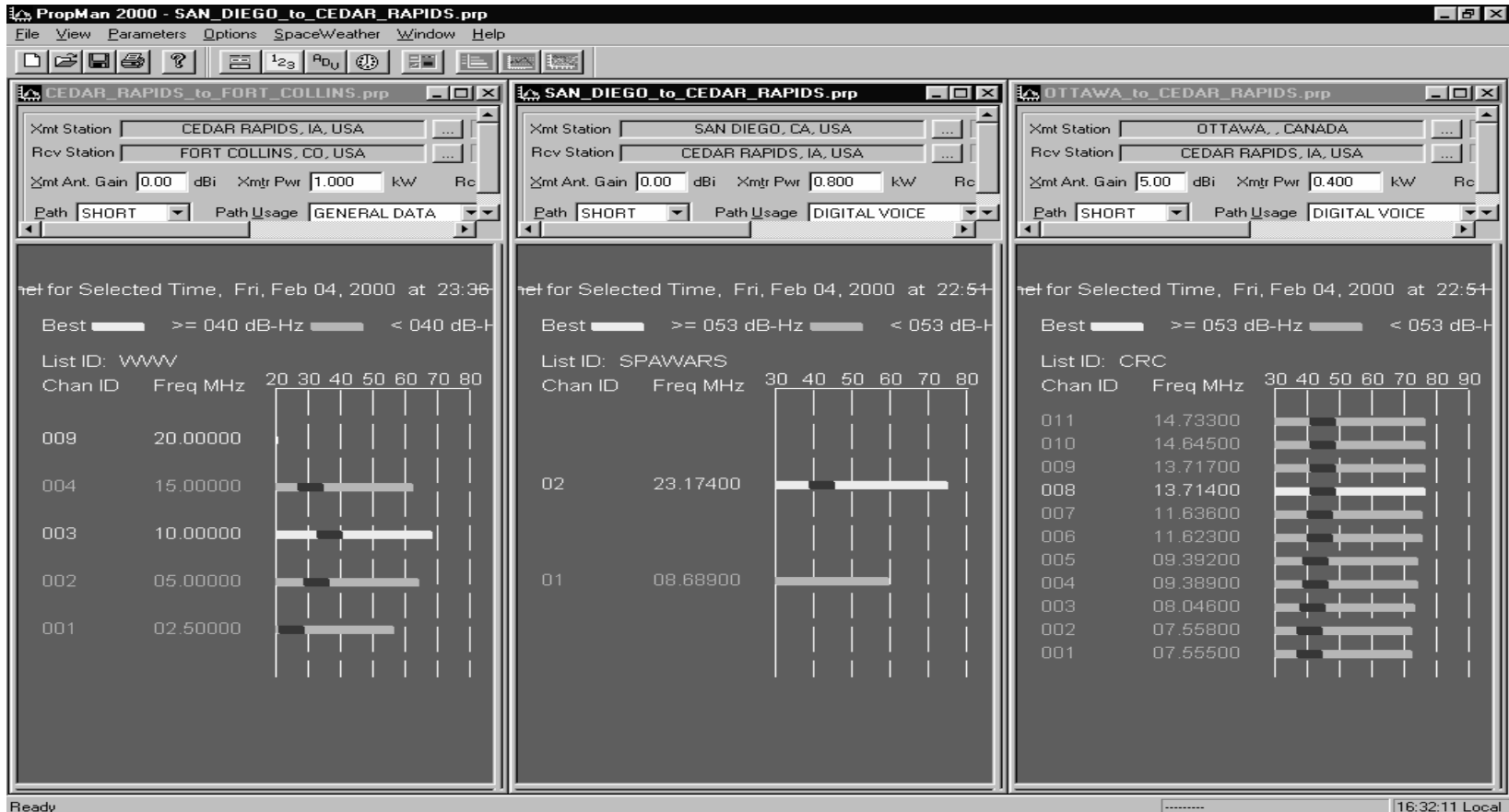
from Goes 8 (and Goes 10)

```
:Data_list: 20000113 G8xr 5m.txt
:Created: 2000 Jan 13 1600 UT
# Prepared by the U.S. Dept. of Commerce, NOAA, Space Environment Center.
# Please send comments and suggestions to sec@sec.noaa.gov
#
# Label: Short = 0.05 - 0.4 nanometer
# Label: Long = 0.1 - 0.8 nanometer
# Units: Short = Watts per meter squared
# Units: Long = Watts per meter squared
# Source: GOES-8
# Location: W075
# Missing data: -1.00e+05
#
# GOES-8 Solar X-ray Flux
#
# Modified Seconds
# UT Date Time Julian of the
# YR MO DA HHMM Day of Day Short Long Ratio
#-----
2000 01 13 0000 51556 0 2.25e-08 1.78e-06 1.26e-02
2000 01 13 0005 51556 300 1.63e-08 1.62e-06 1.01e-02
2000 01 13 0010 51556 600 1.17e-08 1.48e-06 7.93e-03
2000 01 13 0015 51556 900 1.03e-08 1.38e-06 7.46e-03
2000 01 13 0020 51556 1200 8.27e-09 1.29e-06 6.40e-03
2000 01 13 0025 51556 1500 6.26e-09 1.20e-06 5.24e-03
2000 01 13 0030 51556 1800 5.05e-09 1.12e-06 4.51e-03
2000 01 13 0035 51556 2100 5.86e-09 1.11e-06 5.27e-03
2000 01 13 0040 51556 2400 6.97e-09 1.11e-06 6.27e-03
2000 01 13 0045 51556 2700 6.42e-09 1.10e-06 5.86e-03
2000 01 13 0050 51556 3000 7.50e-09 1.10e-06 6.82e-03
2000 01 13 0055 51556 3300 1.52e-08 1.21e-06 1.26e-02
2000 01 13 0100 51556 3600 7.11e-09 1.11e-06 6.38e-03
2000 01 13 0105 51556 3900 5.56e-09 1.07e-06 5.22e-03
2000 01 13 0110 51556 4200 4.40e-09 1.03e-06 4.29e-03
2000 01 13 0115 51556 4500 4.00e-09 9.98e-07 4.01e-03
2000 01 13 0120 51556 4800 4.80e-09 1.01e-06 4.75e-03
2000 01 13 0125 51556 5100 5.82e-09 1.01e-06 5.74e-03
2000 01 13 0130 51556 5400 2.13e-08 1.15e-06 1.86e-02
2000 01 13 0135 51556 5700 2.92e-08 1.33e-06 2.20e-02
2000 01 13 0140 51556 6000 1.61e-08 1.23e-06 1.31e-02
2000 01 13 0145 51556 6300 1.24e-08 1.18e-06 1.05e-02
2000 01 13 0150 51556 6600 1.84e-08 1.25e-06 1.47e-02
2000 01 13 0155 51556 6900 1.17e-08 1.15e-06 1.02e-02
2000 01 13 0200 51556 7200 6.59e-09 1.05e-06 6.28e-03
2000 01 13 0205 51556 7500 7.95e-09 1.04e-06 7.63e-03
2000 01 13 0210 51556 7800 9.27e-09 1.07e-06 8.65e-03
```

Dual Link Real-Time Display



Vertical Tile of 3 Open Propagation Runs



Conclusions

- **PropMan attempts to present predictions relative to the communications mission**
 - **Propagation is much more predictable than most will believe**
 - 1% impact per year (365 days X 24 Hours = 8760 hours/year)=87.6 Hours
- **PropMan provides a first order approximation to the art of HF propagation prediction**
- **Future Challenge:**
 - **Enhanced SNR Approximations**
 - **Fade Predictions**
- **See the sites below:**
 - <http://www.collins.rockwell.com/government-systems/index.asp>
 - <http://www.collins.rockwell.com/government-systems/products/index.asp>
 - 1 800 321 2233 or Collins@Collins.Rockwell.com
 - Over 1200 users