Will the Sun Cooperate for the Upcoming DXpeditions?

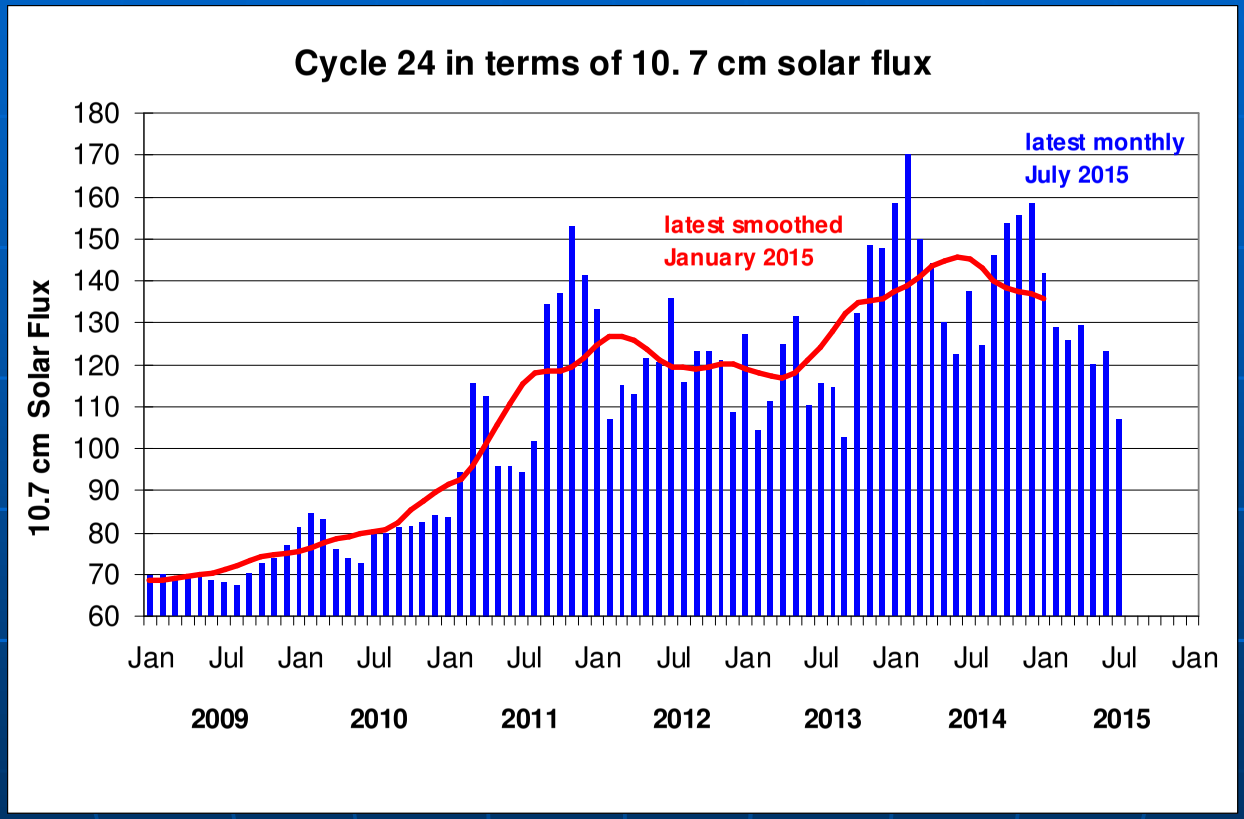
Carl Luetzelschwab K9LA
k9la@arrl.net
http://k9la.us

Topics

- Cycle 24 and beyond
- Predictions for upcoming DXpeditions
- Bonus
  - Trees as supports for low band antennas
  - Real-world low-noise receive antenna results
  - Improved solar cycle predictions?

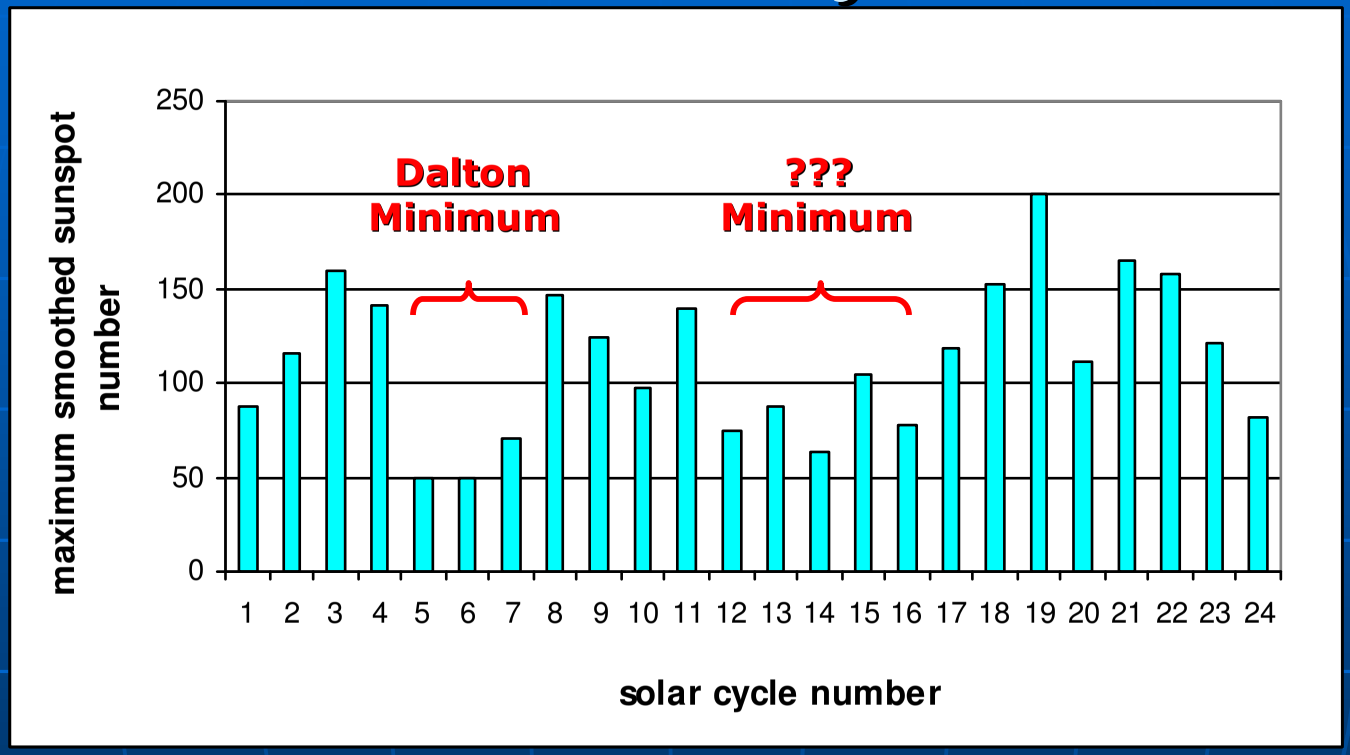
Cycle 24 and Beyond

Cycle 24



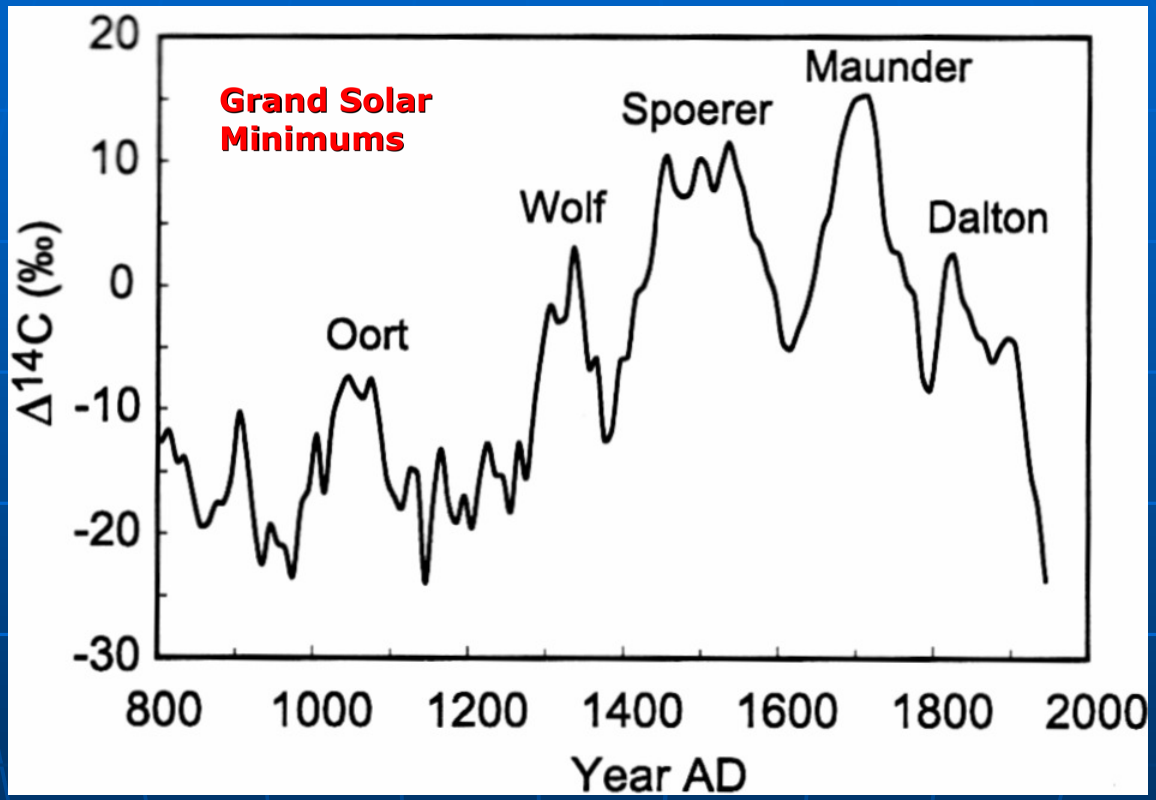
- Second peak in mid 2014 was best
- Other cycles with two peaks: 9, 22, 23

All Solar Cycles



- Three periods of higher solar activity
- Two periods of lower solar activity
- Looks like we're headed into another low period

How Low?



- Historical data suggests we're due for another GSM
- Will it be a Maunder GSM or a Dalton GSM?

If It's a Maunder GSM . . .

- Run VOACAP or W6ELProp with zero sunspots or a 10.7 cm solar flux of 65
- Not much 15m, 12m, 10m via F_2
  - Still have sporadic E in the summer
- 17m and 20m should still offer F_2 DX openings
- Propagation similar to last minimum – but for a couple decades!

Early Predictions for Cycle 25

before Cycle 24 peak

- Smoothed sunspot number of 7
  - Penn & Livingston, IAU Symposium No. 273, September 2010
- Smoothed sunspot number of 118
  - Helai & Galal, IAGA-III International Symposium, November 2011

after Cycle 24 peak

- Smoothed sunspot number somewhat lower than Cycle 24
  - Tlatov, Advances in Space Research, Vol 55, Issue 3, February 2015
- Smoothed sunspot number of 62 +/- 12
  - Janardhan, et al, JGR Space Physics, July 2015

Upcoming DXpeditions

Chesterfield Island – Oct 2015
North Korea – Jan 2016
S. Sandwich & S. Georgia – Feb 2016
Heard Island – Mar 2016
Juan de Nova – Apr 2016
Palmyra – Apr 2016
Bouvet – delayed to 2016/2017 season

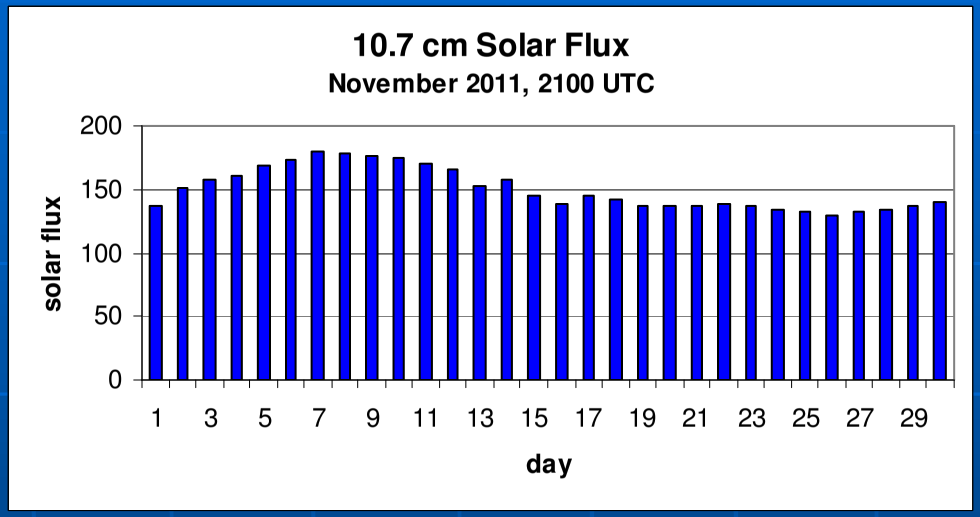
Ever See Comments Like This?

The solar flux is up today, but the bands aren't that good

The solar flux is down today, but there's still lots of DX

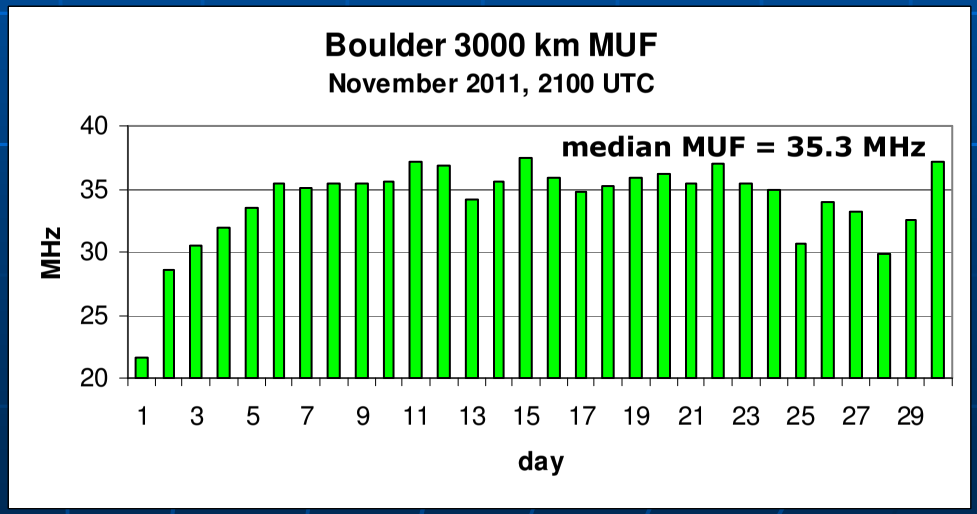
- What's going on?
- Let's look at some data

Solar Data and Ionosonde Data

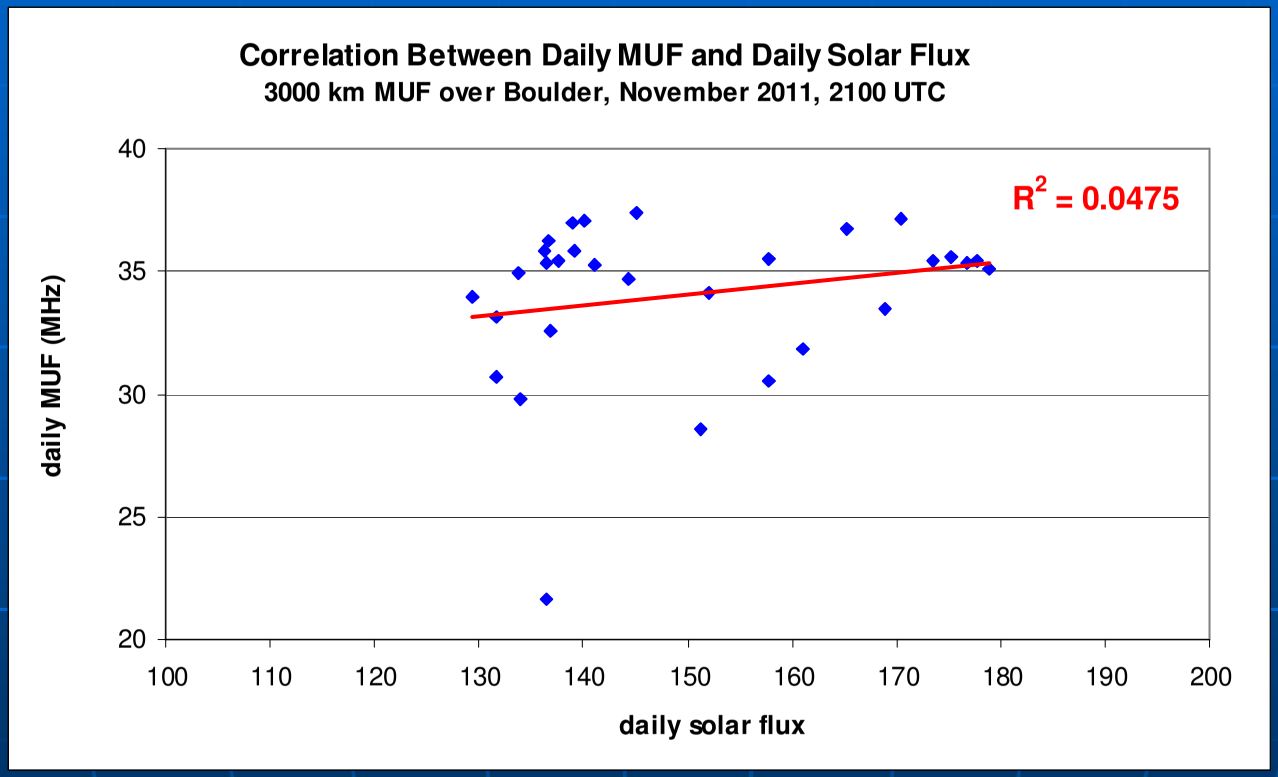


Solar flux peaked around the 8th and minimized around the 26th

MUF started the month very low, had a broad peak and then decreased somewhat at the end of the month

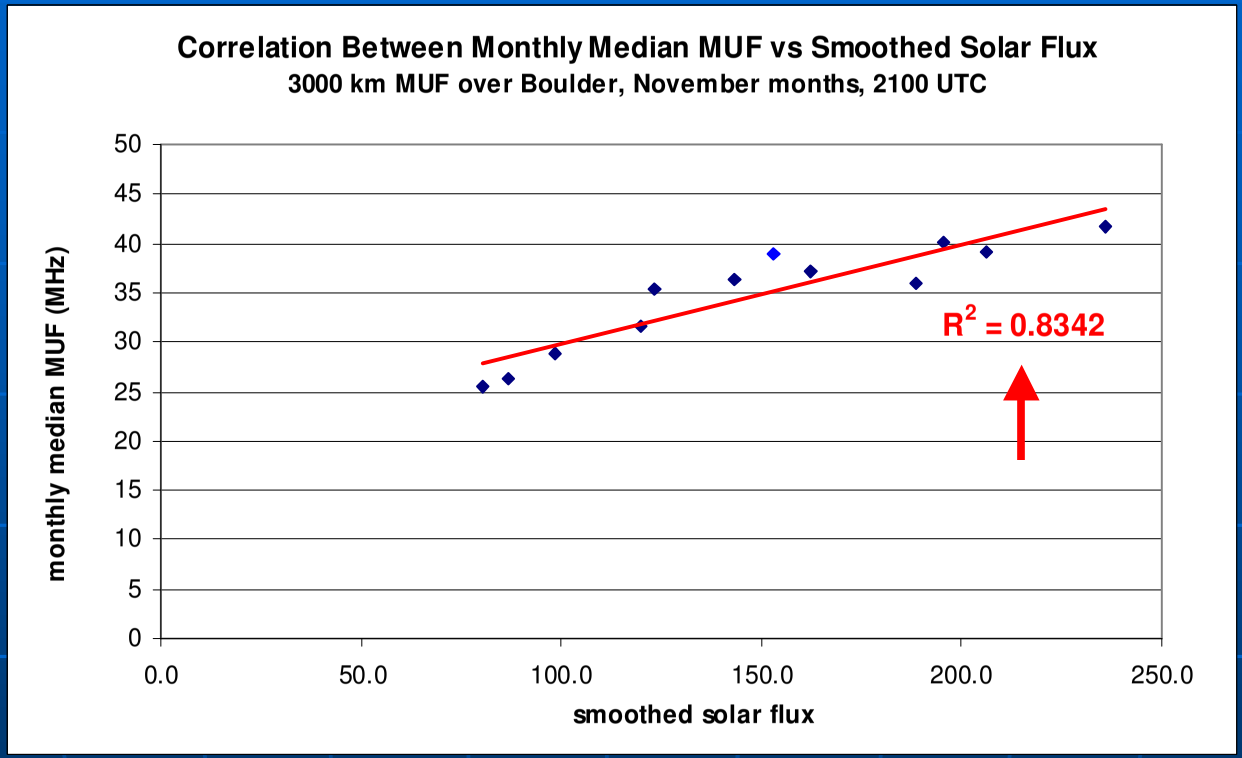


Daily MUF vs Daily Solar Flux



- Correlation is not good
- R-squared = 0.0475

Best Correlation

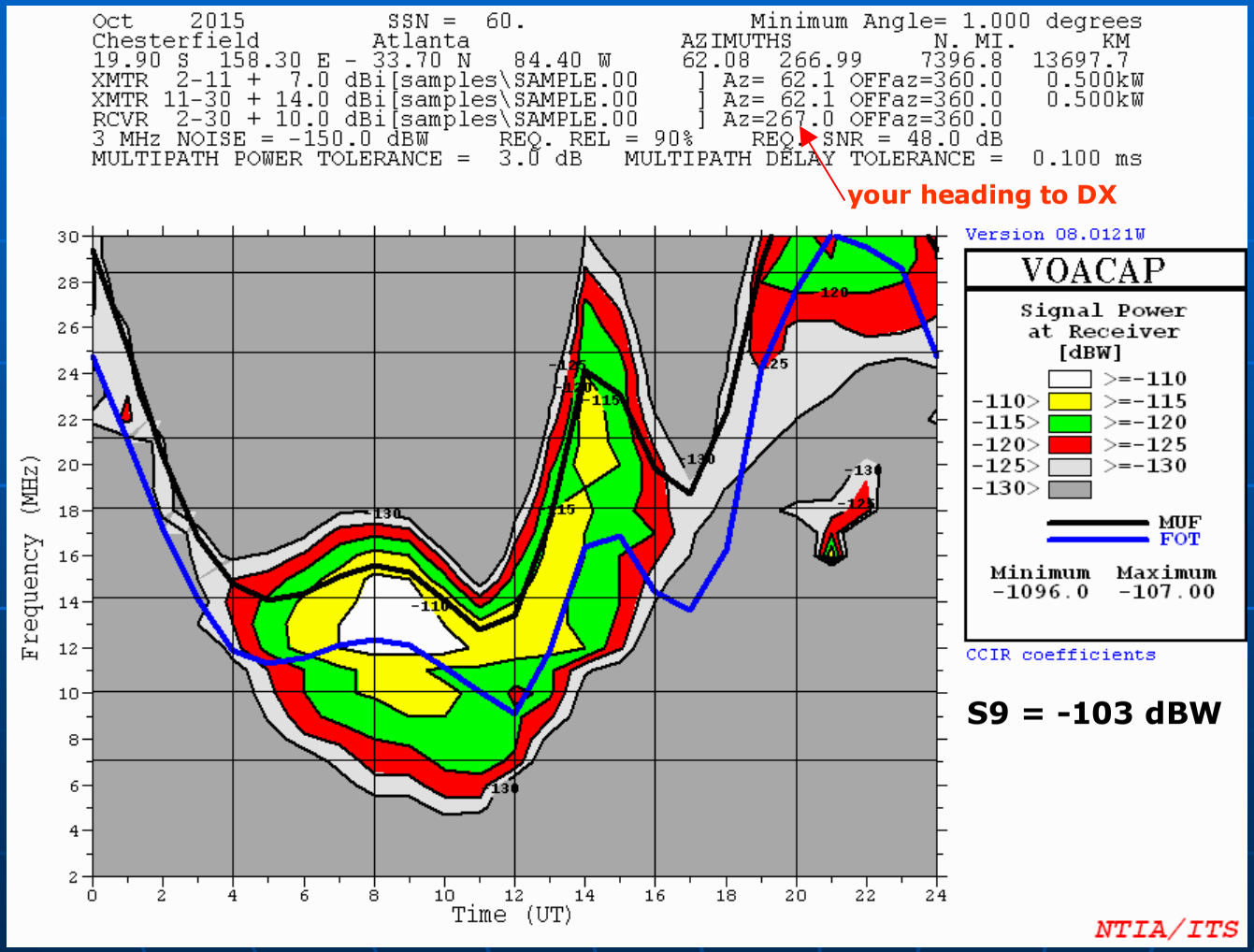


- This is basis for our propagation predictions
- Monthly median ionospheric parameters versus smoothed solar index
- Statistical in nature - median implies 50%

Assumptions for Predictions

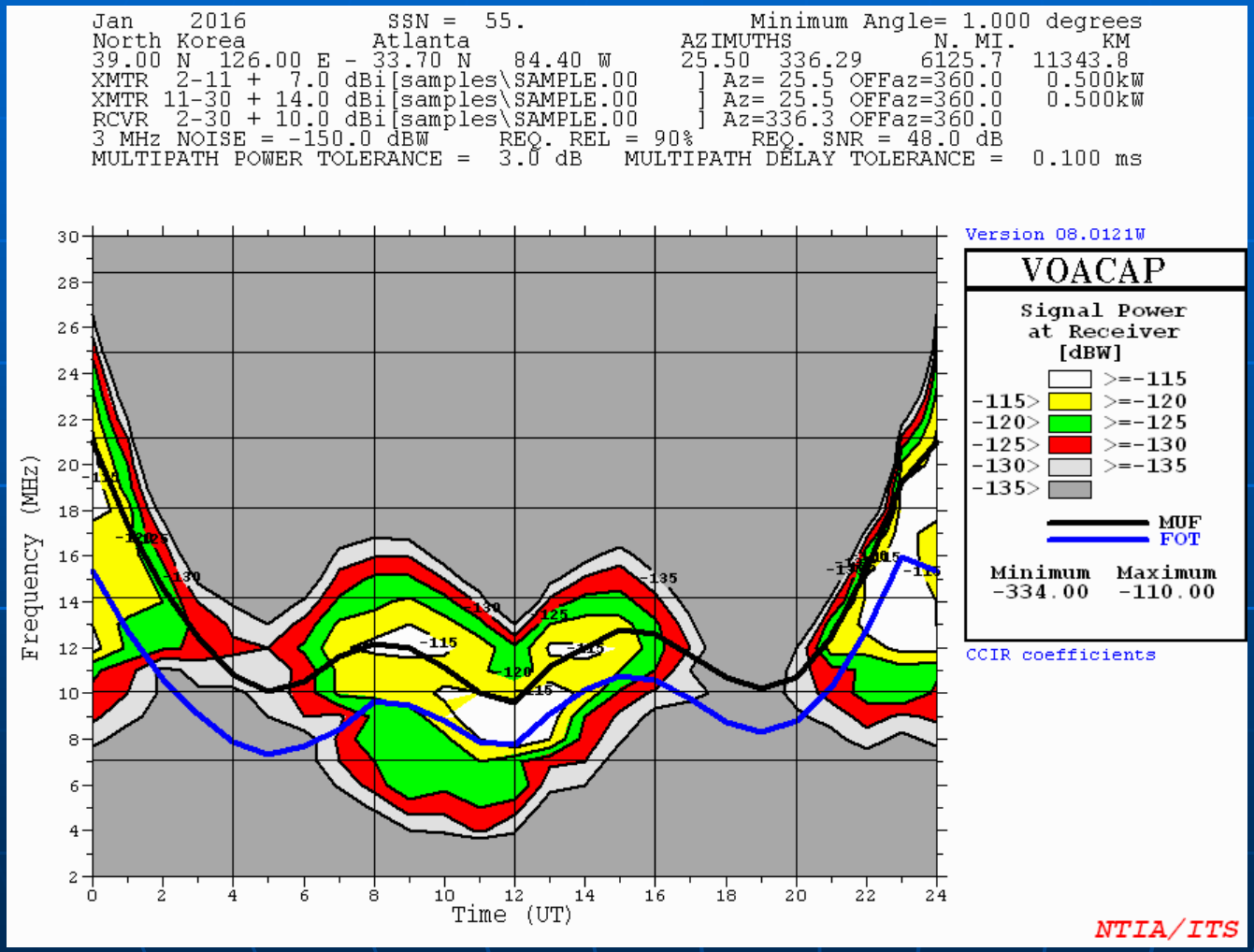
- I used VOACAP
- Smoothed solar index from SWPC at ftp://ftp.swpc.noaa.gov/pub/weekly/Predict.txt
- Predictions for 40m thru 10m
  - 160m and 80m when path in darkness, and especially around sunrise and sunset
- 500 Watts
- Antennas
  - Inverted vee on 40m and 30m, medium-size Yagi on 20m-10m
- Short path for sure, long path if usable signal level

Chesterfield Island – Short Path



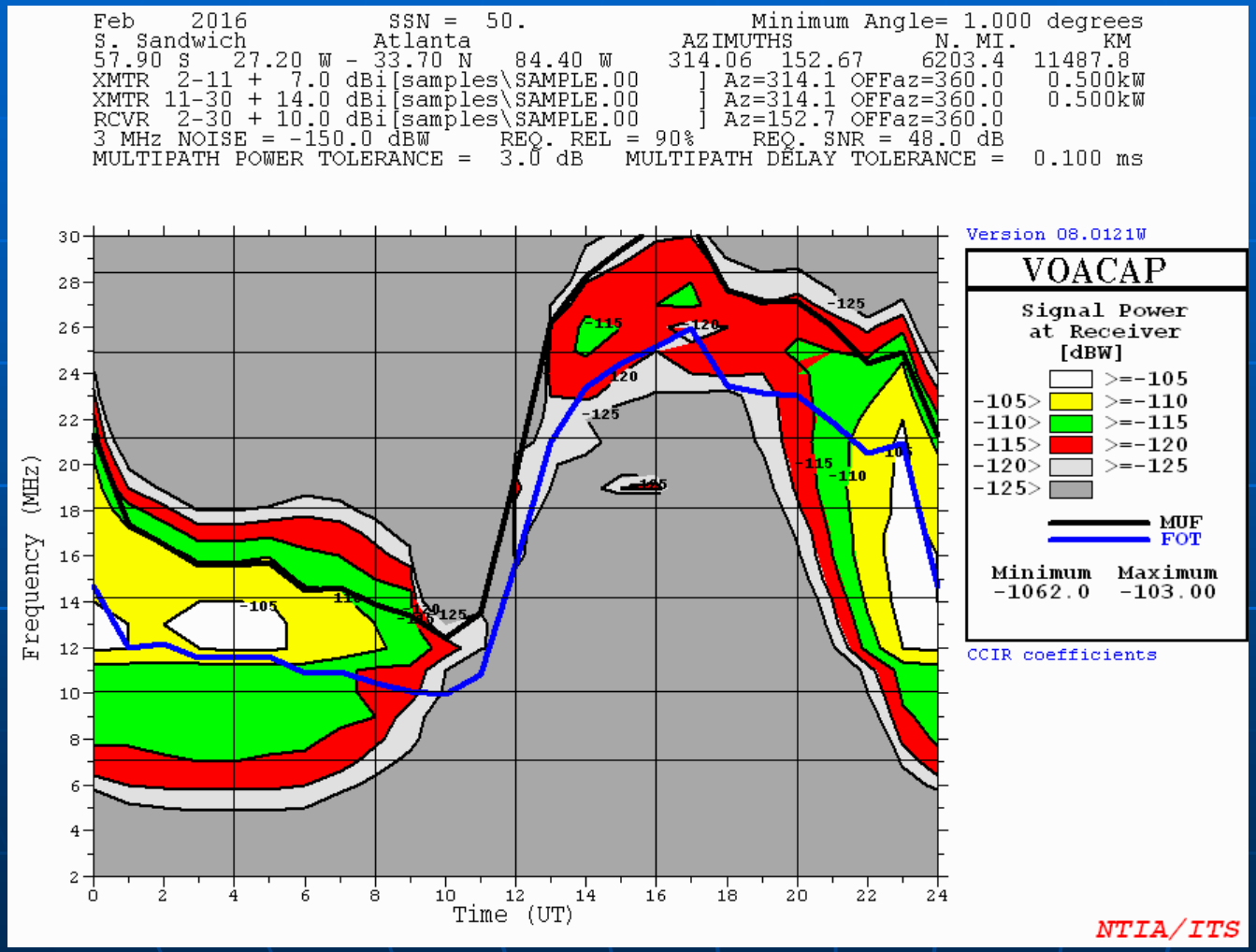
- Best
  - 20m from 07-10z
- Other good bands and times
  - 15m from 13-15z
  - 10m from 19-23z

North Korea – Short Path



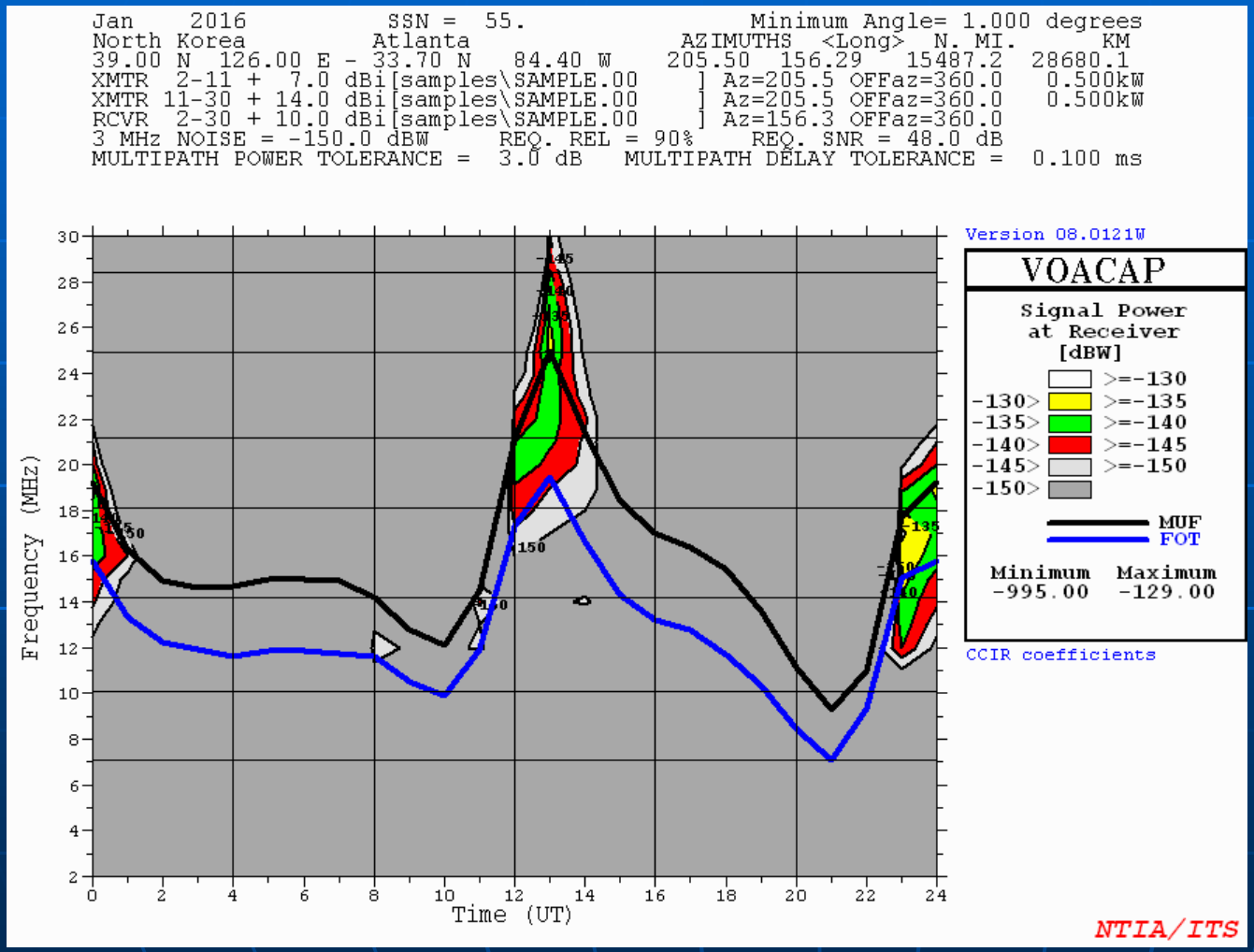
- Best
  - 20m from 21-00z
- Other good bands and times
  - 17m from 22-01z
  - 30m from 07-15z

S. Sandwich & S. Georgia – Short Path



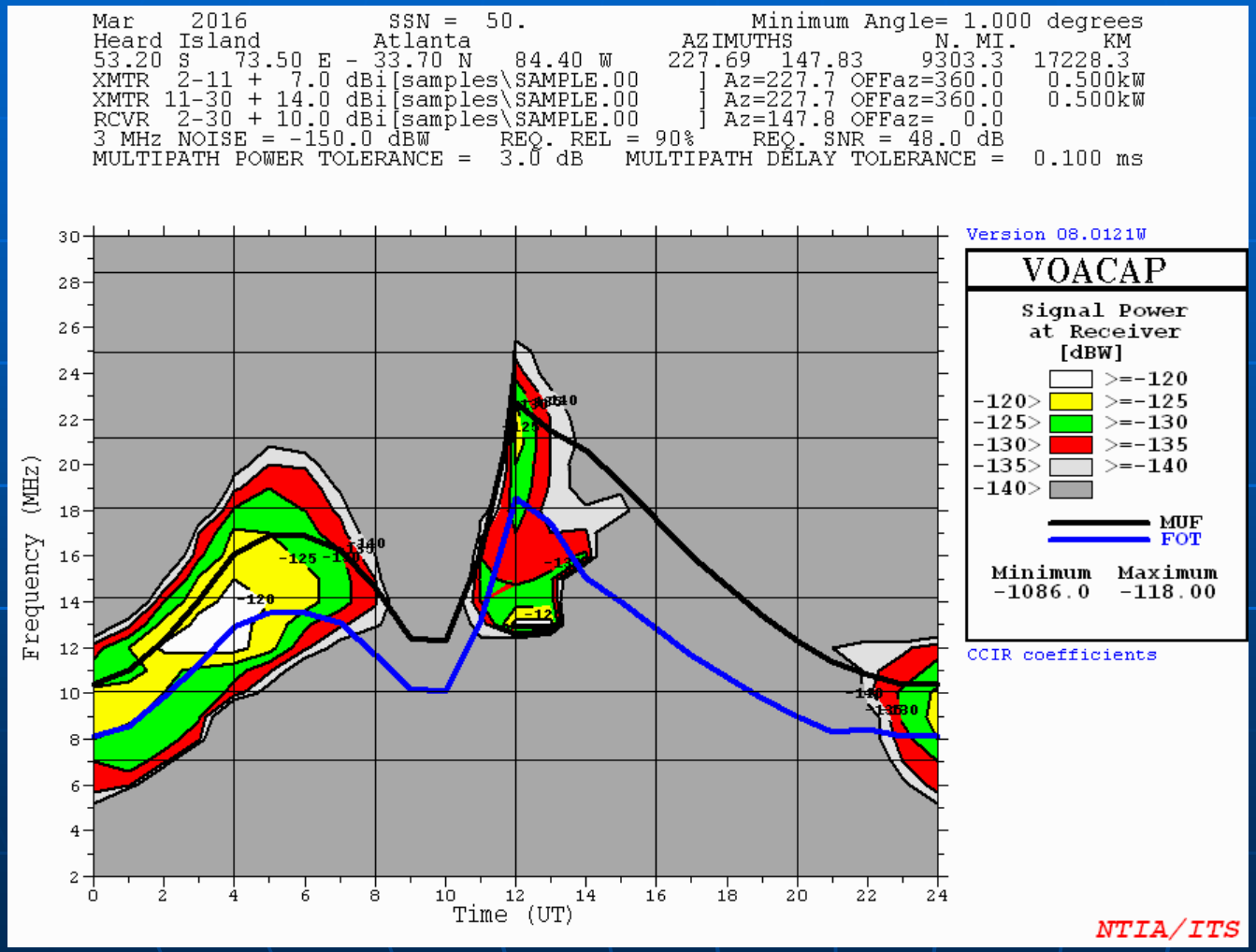
- Best
  - 20m, 17m from 22-08z
  - 15m, 12m from 21-00z
- Other good bands and times
  - 40m and 30m from 23-07z

North Korea – Long Path



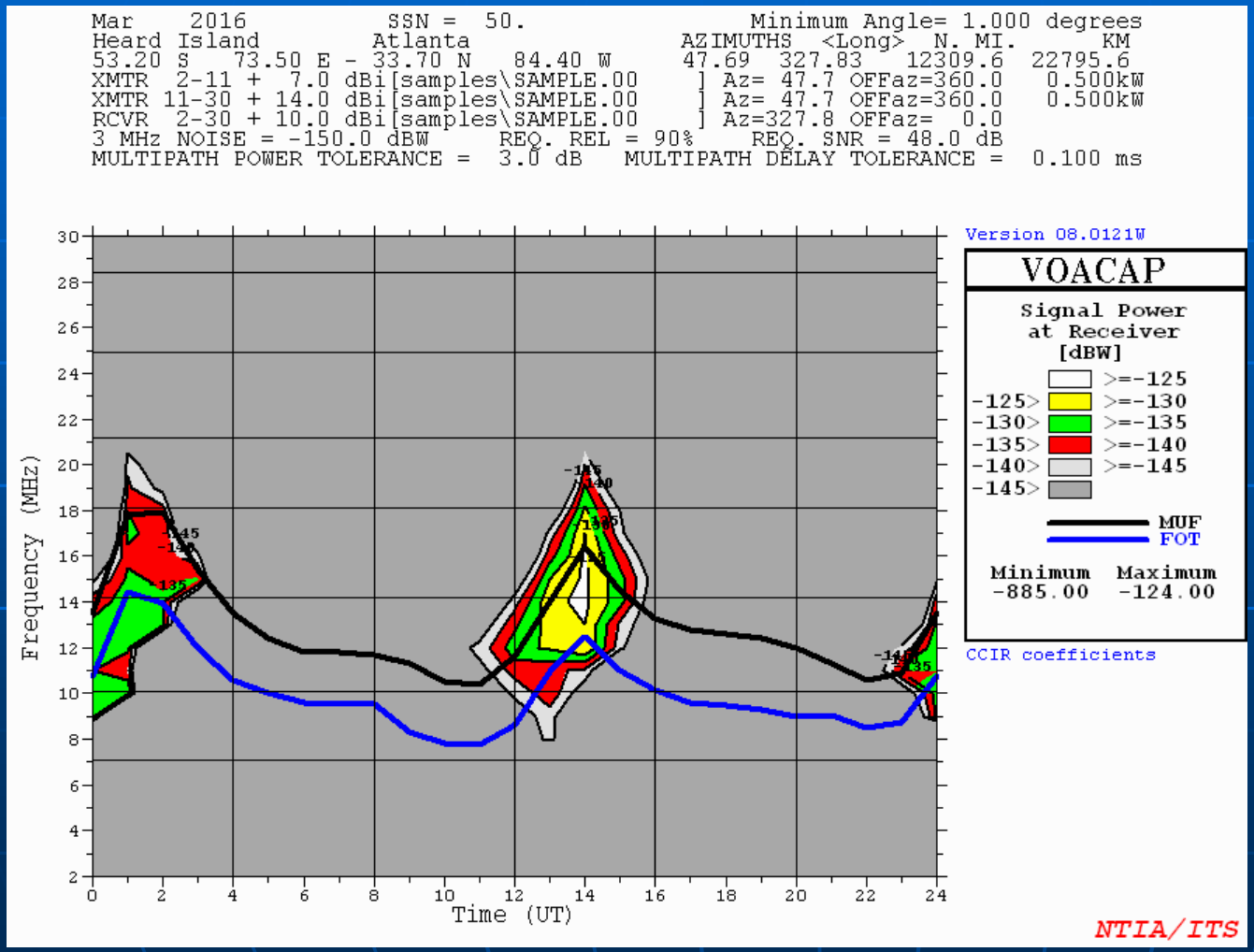
- Best
  - 20m and 17m from 23-01z
  - Weak signals
- Other bands and times
  - 12m and 15m from 12-14z
  - Very weak signals

Heard Island – Short Path



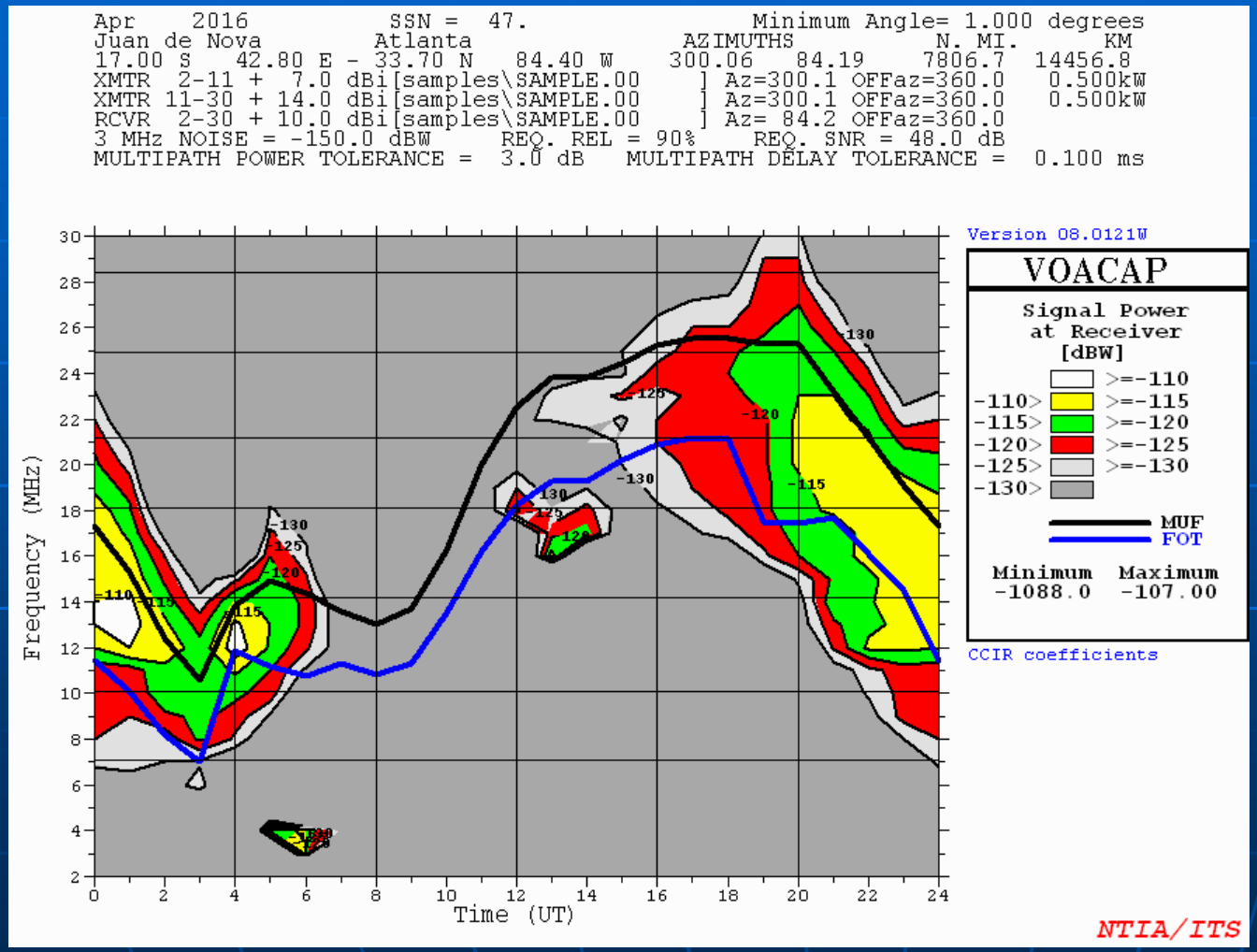
- Best
  - 20m from 03-06z
- Other bands and times
  - 15m and 17m from 12-13z
  - 20m from 11-13z

Heard Island – Long Path



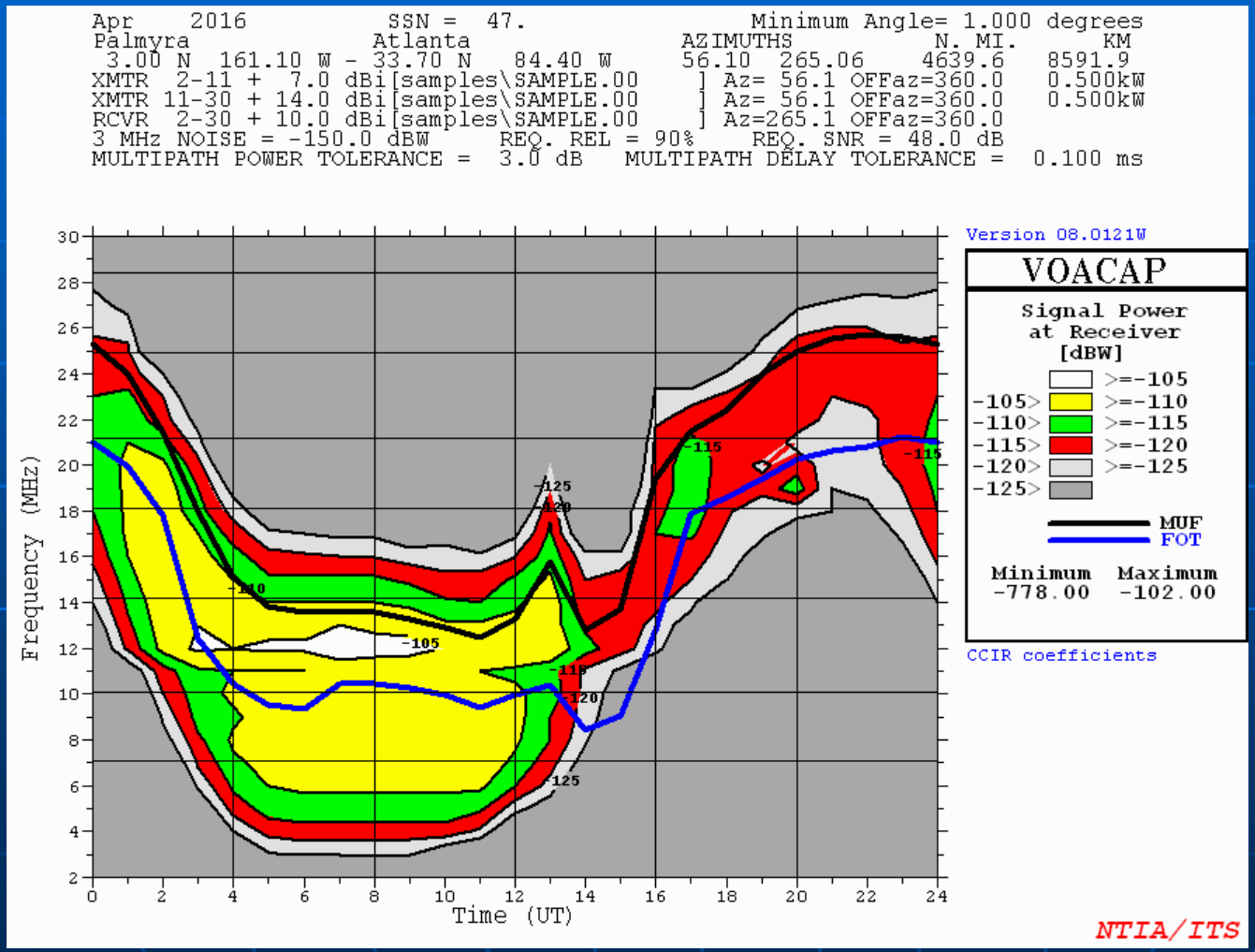
- Best
  - 20m from 13-15z
- Other bands and times
  - 20m from 00-02z

Juan de Nova – Short Path



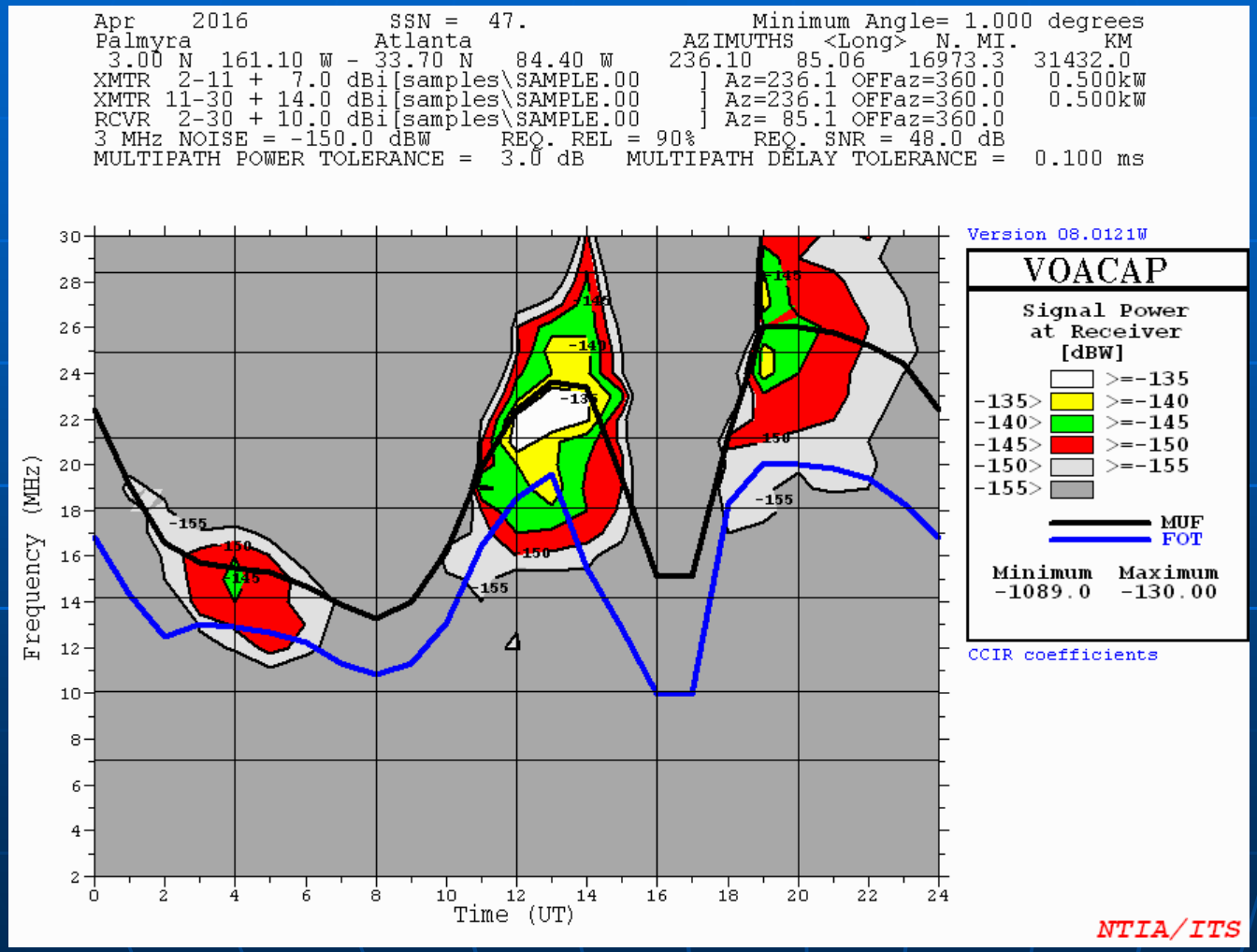
- Best
  - 20m, 17m, 15m from 20-02z
- Other bands and times
  - 20m from 03-05z

Palmyra – Short Path



- Best
  - 40m, 30m, 20m from 04-12z
- Other bands and times
  - 20m, 17m, 15m from 01-03z
  - 15m and 12m from 18-00z

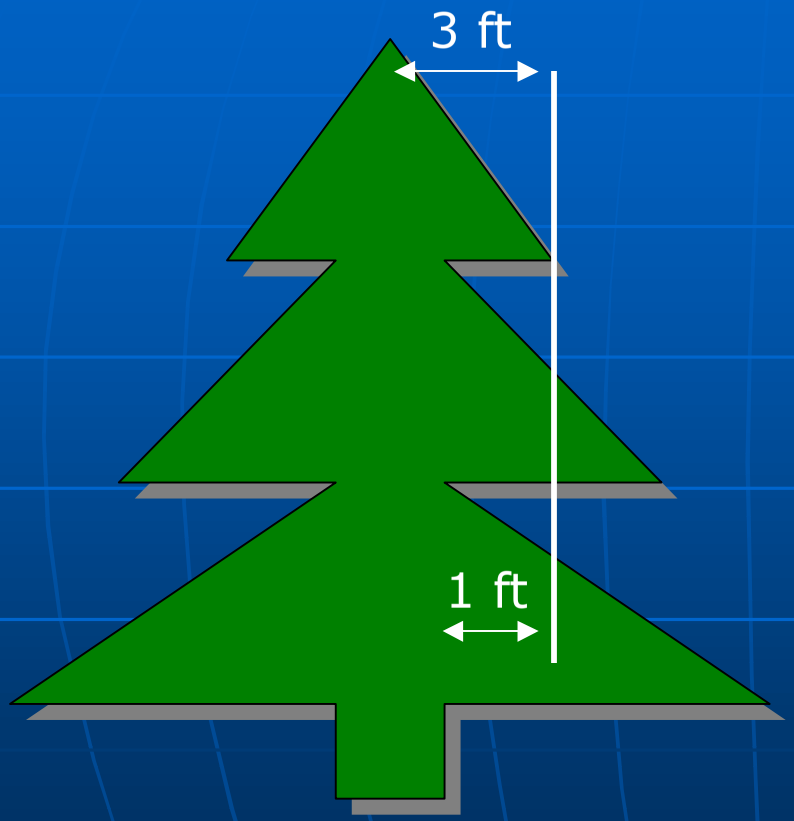
Palmyra – Long Path



- Best
  - 15m from 12-14z
  - Very weak signals

Trees As Supports for Low Band Antennas

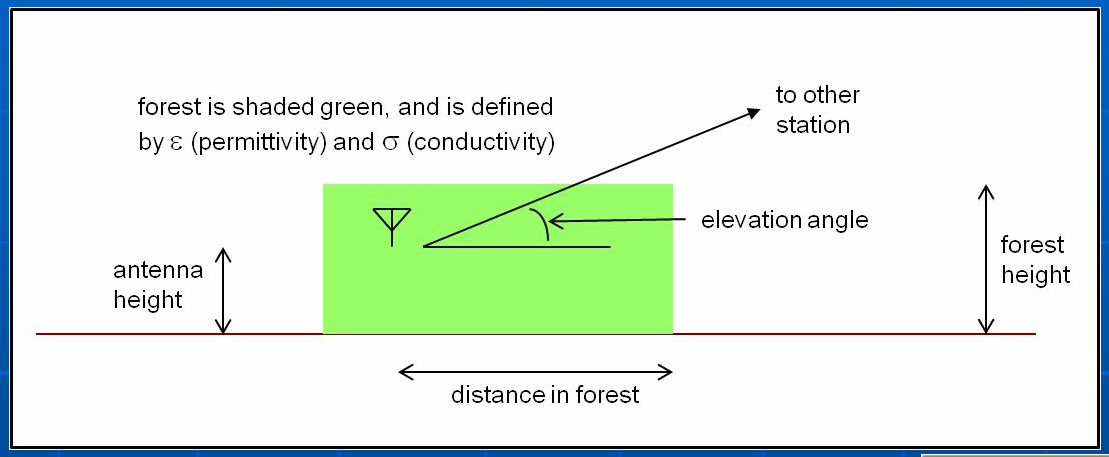
Trees: The Trunk



75m ¼-wave vertical in tall pine with 7 elevated radials

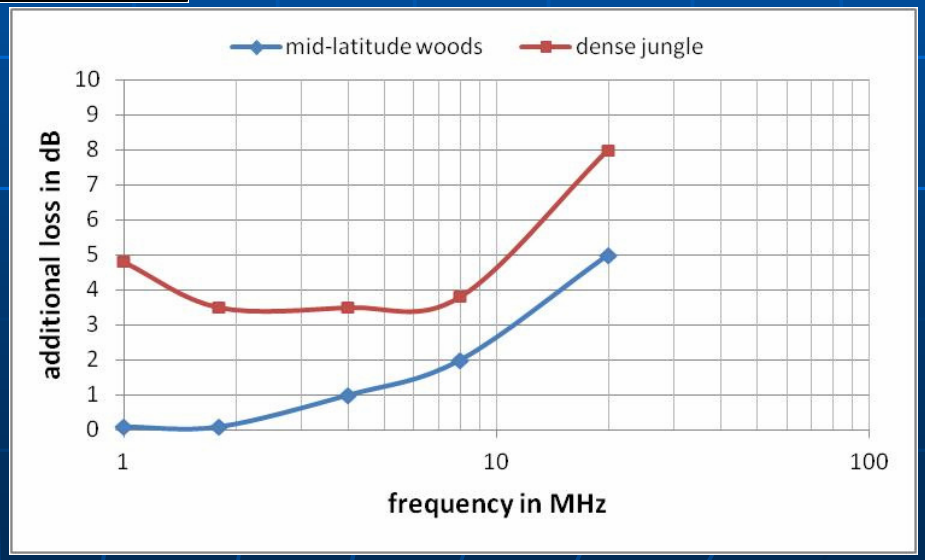
- Technical Correspondence, QST, Nov 1991
- Z = 50 Ω at resonance
  - Model says 32 Ω
- Moved bottom of antenna from 1 ft away to 15 ft away
  - No change
- Moved top of antenna from 3 ft away to 6 ft away
  - Resonant freq increased 30 KHz
  - Z = 35 Ω
- Concluded that high-voltage portion of antenna needs to be at least 6 ft away from trunk on 75m
  - 6 ft on 75m = .023 wavelengths

Trees: The Foliage



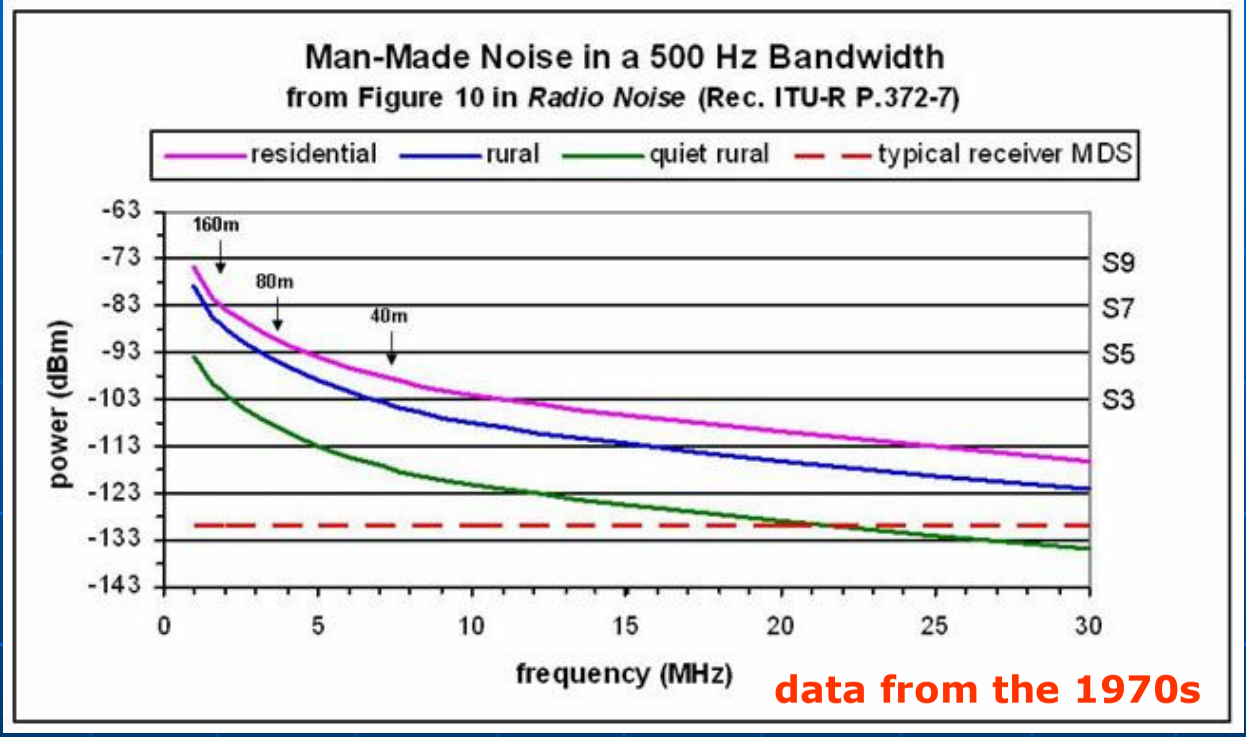
- Model of forest by Tamir
- My parameters
  - Antenna height 55 ft
  - Forest height 75 ft
  - Forest extends about ¼ mile

- Conductivity is critical parameter
  - 1E-5 S/m for dense jungle
  - 3E-8 S/m for mid-latitude woods
- Mid-latitude woods most likely are deciduous



Real-World Low-Noise Receive Antenna Results

Noise



Man-made noise raises the noise floor of receive system (from receiver minimum discernible signal as reported in Product Reviews) by at least 27 dB on 160m !!!

- Need to resolve man-made noise as best as you can
- That leaves atmospheric noise to deal with
- Here's where low-noise receive antennas come into play

My QTH

- RBOG runs under one of the 160m inv-L radials
- At 1 kW, +20 dBm into the shack on the RBOG coax

Comparison of My Antennas

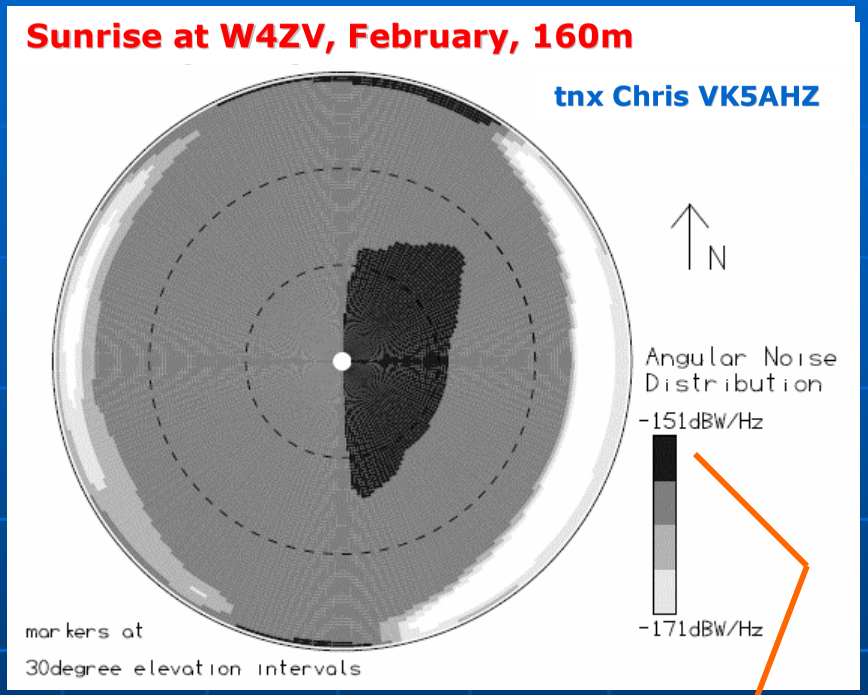
- Shared Apex Loop (Array Solutions SAL-20)
  - Eight directions - footprint is 40ft diameter
  - See my product review in the April 2014 QST
- KD9SV RBOG (reversible Beverage on ground)
  - Oriented ENE/WSW - 200ft long (need another SE/NW)
  - See my product review in the upcoming Sep/Oct 2015 NCJ
- W1AW SNRs on 1802.5 KHz - various nights

transmit inv-L	SAL-20	RBOG
5 dB	11 dB	19 dB
24 dB	33 dB	35 dB
14 dB	10 dB	12 dB
9 dB	7 dB	11 dB
17 dB	21 dB	32 dB

Need to calibrate S-meter to make these measurements

Comment on RDF

- RDF = Receiving Directivity Factor
- Compares the forward-lobe gain to the average gain of the antenna in all directions (both azimuth and elevation)
  - Assumes noise arrives from all azimuths and elevations

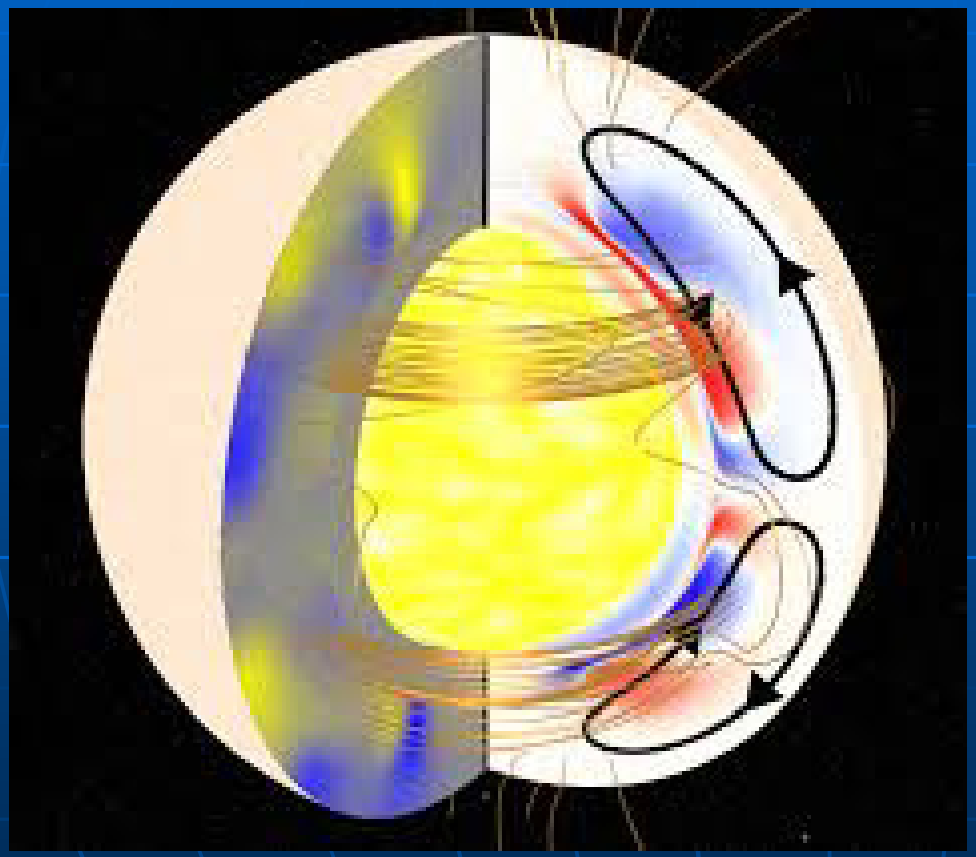


- In the real world, atmospheric noise does <u>not</u> arrive from all directions
  - It is directional in nature due to thunderstorms
- K7TJR and W8JI web sites have tables of RDFs for various antennas.

-151dBm/Hz = -94dBm/500Hz

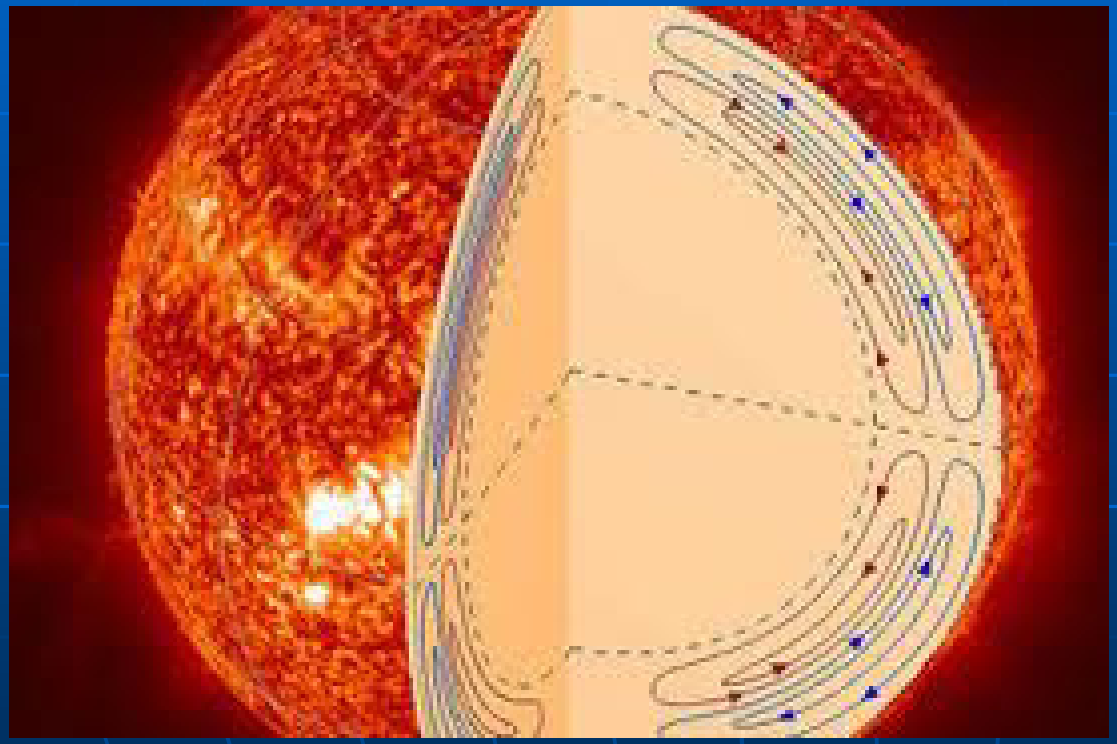
Improved Solar Cycle Predictions?

One-Cell Pattern of Plasma Flow



- This was the hypothesis for many years
- Resulted in solar cycle predictions that weren't very accurate
  - Early on NOAA carried two predictions for Cycle 24
    - Low – 90
    - High -140

Two-Cell Pattern of Plasma Flow



- Recently research has suggested that the plasma flow is at least a two-cell pattern
- Claims of much better predictions of previous solar cycles
- Next several cycles predicted to be low using this hypothesis

Summary

- Cycle 24 is the lowest in our lifetimes
- Data suggests the next several cycles will be low
- For the upcoming DXpeditions, 20m gives the best opportunity, with 17m and 15m likely, too
  - Low latitude paths give best shot on 12m and 10m
  - Long paths require DX end to be aware of long path!
- Trees are good for supporting low band antennas – but don't put them too close
- You can never have too many low band receive antennas
- We may now have a better understanding of the sunspot cycle process – time will tell