

DXing on 160m at Solar Maximum

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NW DX Convention – Seattle 2004

What Started This Topic?

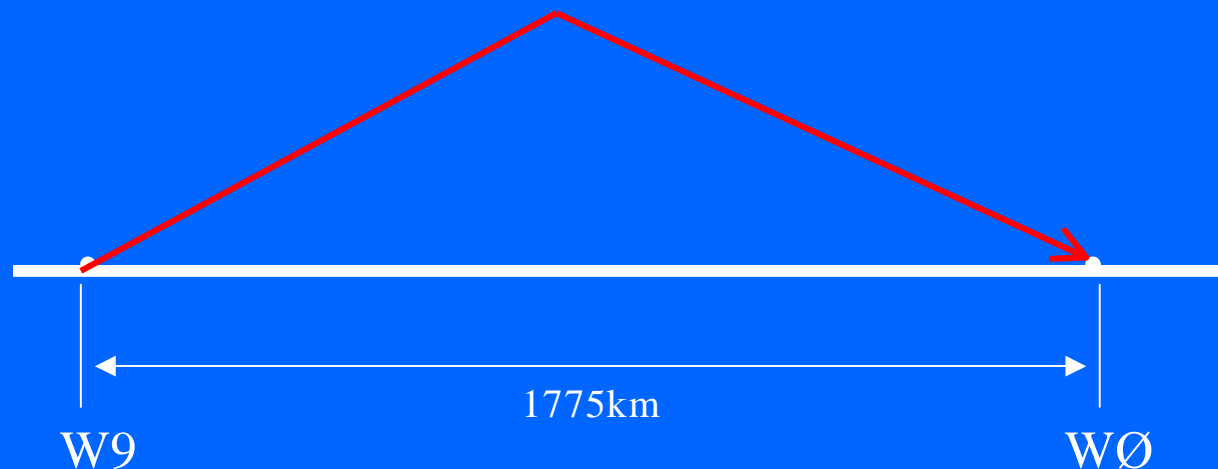
- An e-mail from Larry N8KU

Many people imply that when the sunspot cycle is “down”, the low bands (160/80/40) are “better”. My feeling (having operated through nearly 3 cycles now) is that this is only relative. In other words, the low bands stay the same, while the “high” bands get better or worse.

- What affects propagation over a solar cycle?
 - MUF (max usable freq), absorption, and geomagnetic field activity
 - But MUF is not an issue on 160m – always enough ionization
 - So we’ll look at absorption and geomagnetic field activity, and then formulate and compare a hypothesis to actual log data

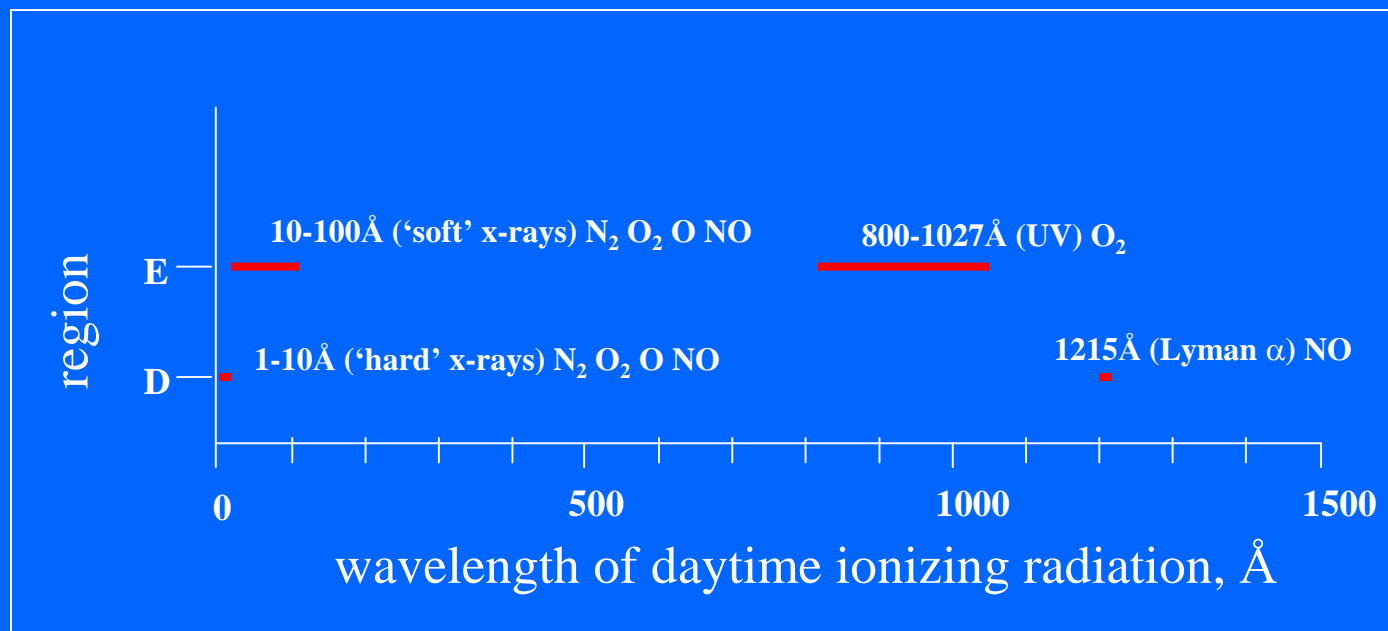
Absorption

- Let's look at a simple one-hop path on 160m



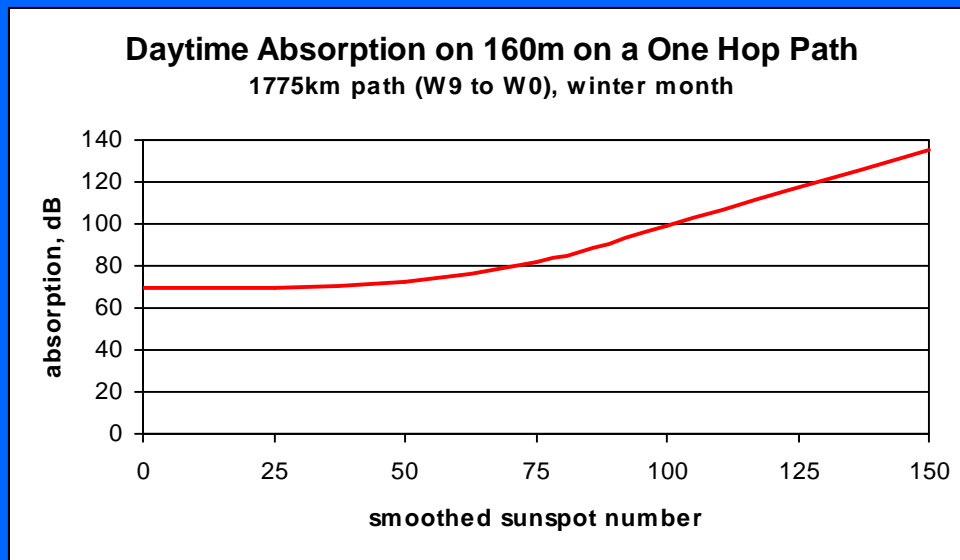
- This is the building block for many paths
- We'll use Proplab Pro ray tracing to determine absorption
- We'll start by looking at the daytime D region

What Ionizes the Daytime D Region?



- Two sources for daytime D region ionization
 - 1215Å Lyman α from quiet Sun
 - 1-10Å 'hard' x-rays from solar flares
- So what do we expect? *Significant residual absorption from the quiet Sun, plus additional absorption as the sunspot number increases*

Daytime Absorption for One Hop



data from Proplab Pro

- Significant absorption even at solar minimum
- But we don't DX on 160m during the day

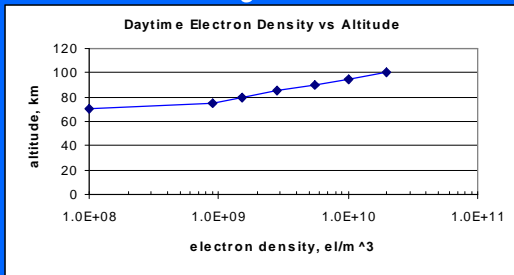
so let's look at nighttime absorption

Absorption at Night

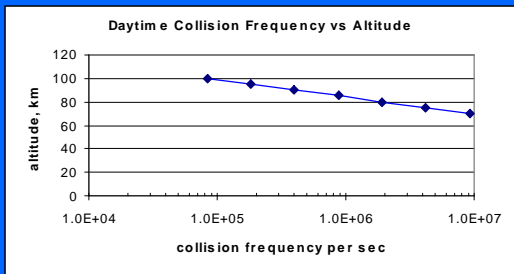
- Why is there any absorption at all?
 - To paraphrase books and articles: “the D layer disappears at night”
- Absorption is proportional to the product of the electron density times the electron-neutral collision frequency
- Let’s use typical daytime and nighttime electron density profiles and typical daytime and nighttime collision frequency profiles to see what this product looks like
 - Let Excel do the math

Absorption – Day vs Night

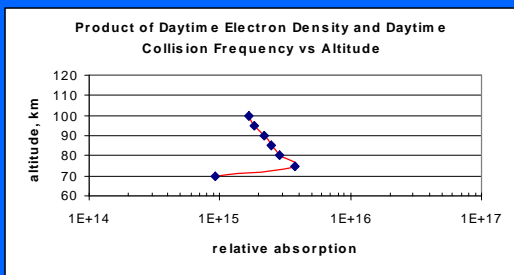
Daytime



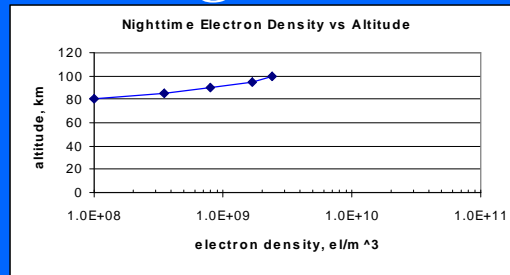
X



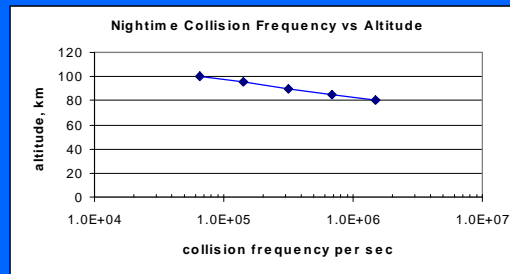
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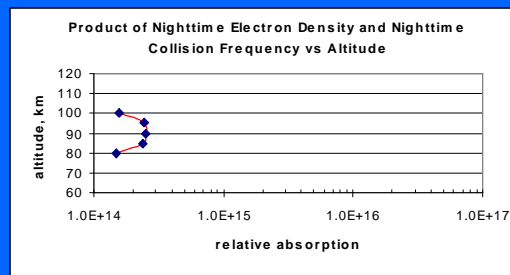
Nighttime



X

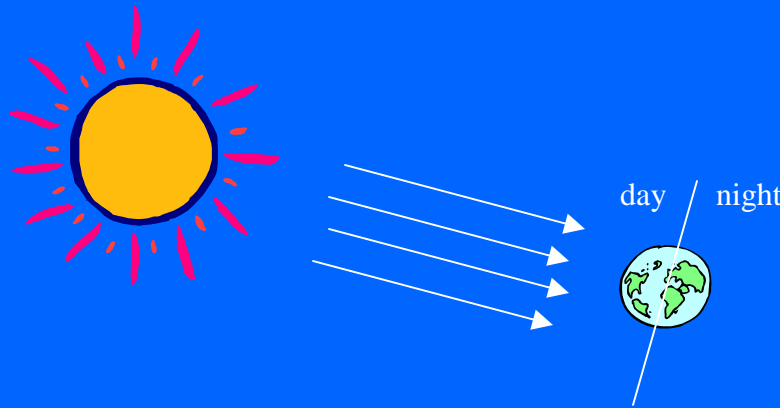


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- Daytime – absorption maximizes in the D region (bottom left plot)
- Nighttime – absorption maximizes in the lower E region (bottom right plot)
 - It's a lot less at night
 - But there's still absorption
- Thus at night we have to look at E region ionization

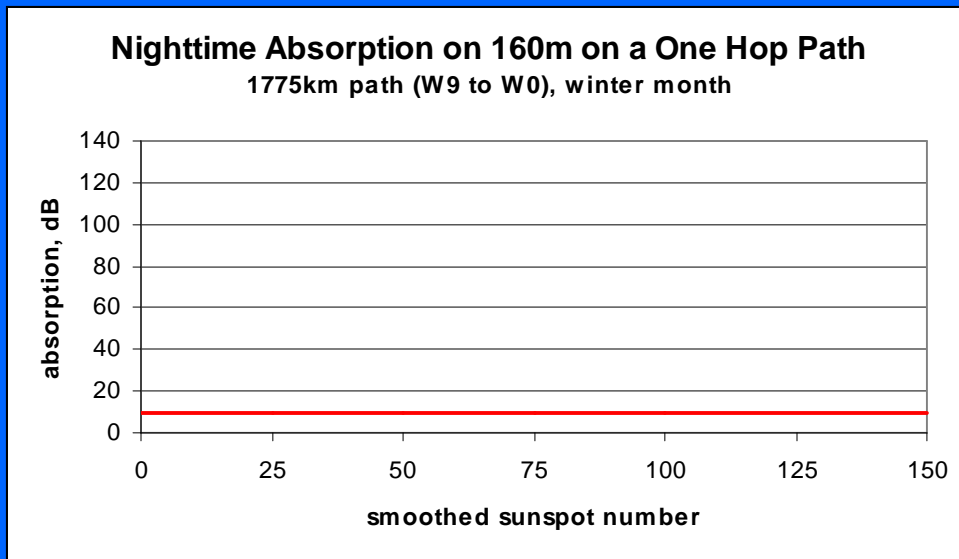
What Ionizes the Nighttime E Region?



Important issue – no direct solar radiation at night

- What are the sources of nighttime E region ionization?
 - UV radiation in starlight
 - Galactic cosmic rays
 - Sun's UV radiation scattered by the geocorona (cloud of neutral H atoms around Earth)
- So what do we expect? *Fairly constant absorption over a solar cycle*

Nighttime Absorption for One Hop



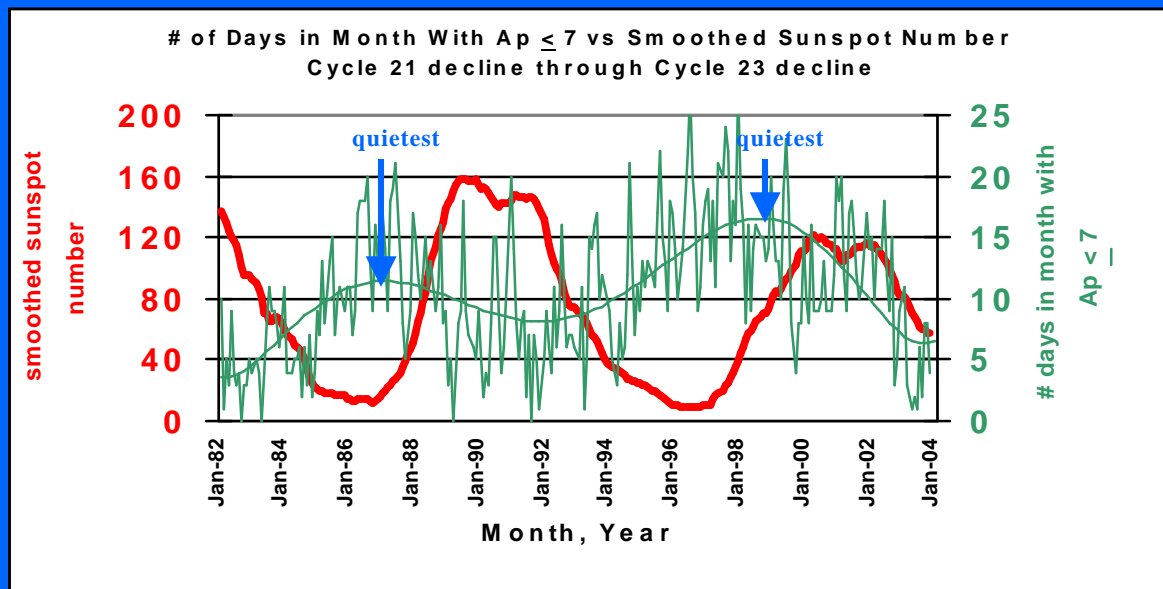
data from Proplab Pro

- For all intents and purposes, it's constant at ~ 11dB/hop
- Summer month is a couple dB more per hop

conclusion: absorption during the night shouldn't prevent us from working DX at solar maximum

now let's look at geomagnetic field activity

Geomagnetic Field Activity

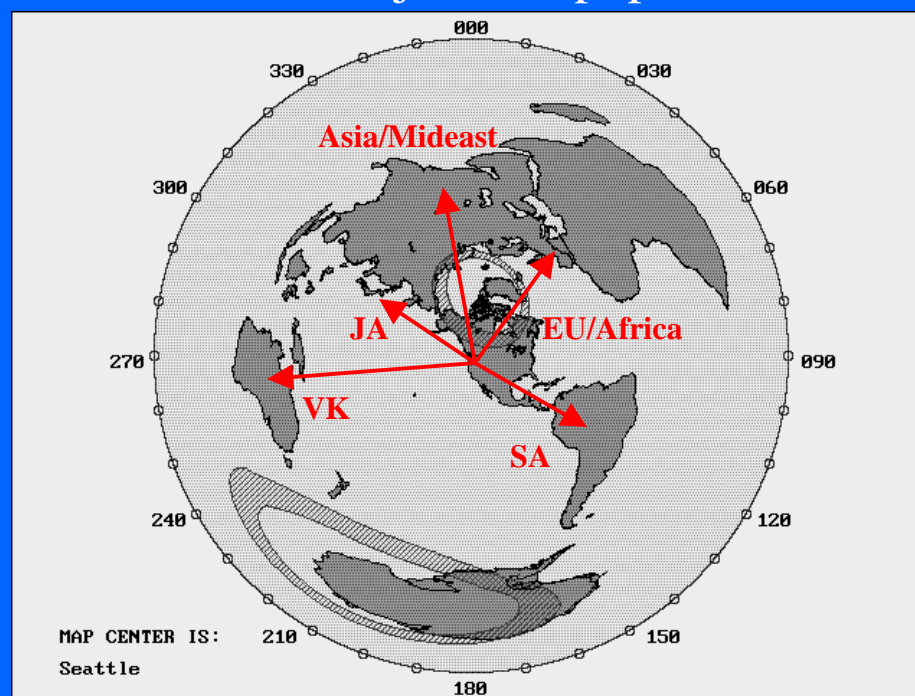


- Geomagnetic field activity can disrupt propagation
 - Auroral absorption, E region skewed paths, depletion of the F region
- From the above plot, the geomagnetic field is quietest at, and a couple years after, solar minimum
- So is 160m only good around solar minimum?

It May Depend on the Path

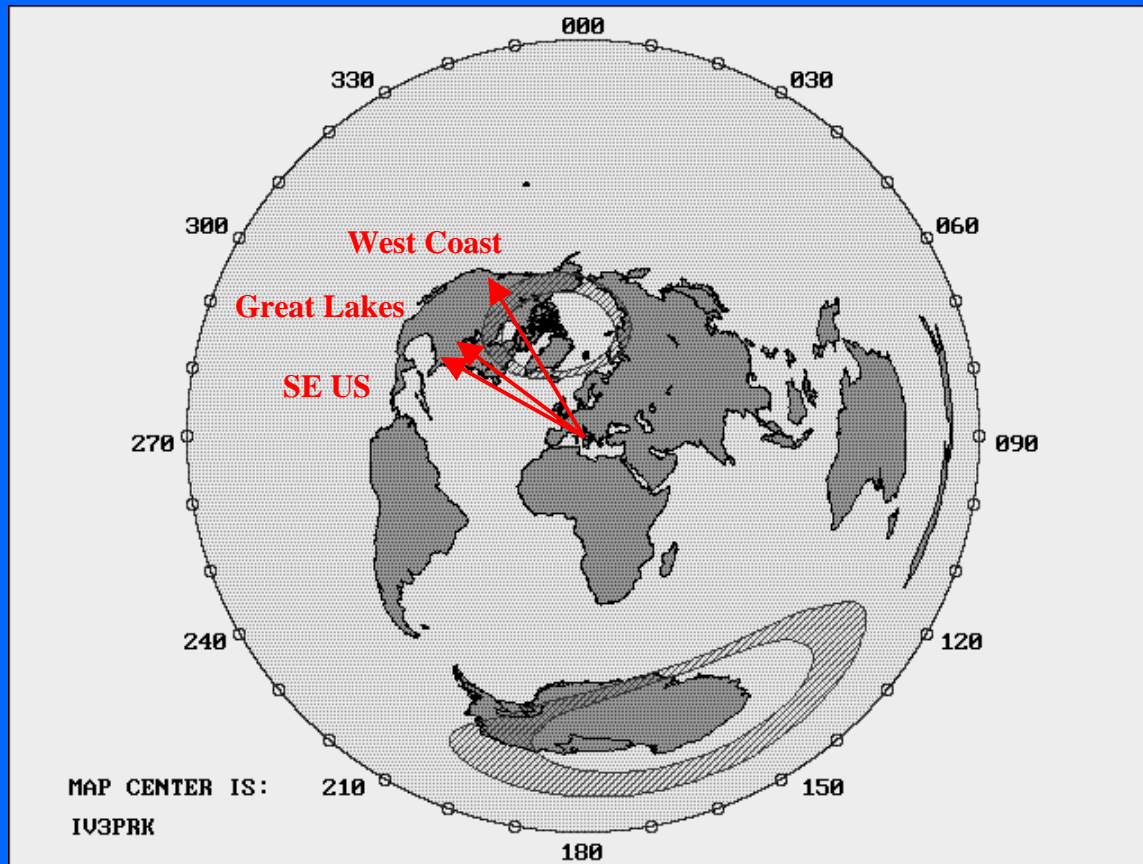
- Geomagnetic field activity mainly affects high latitude paths – the ones that get near or go through the auroral ovals
- Assuming absorption isn't an issue, the hypothesis is
 - High latitude paths are best at solar minimum
 - Paths that don't get to high latitudes hold up well throughout entire solar cycle
- Let's test this hypothesis with log data

Pacific NW to major ham population areas



great circle map from DXAID (P. Oldfield)

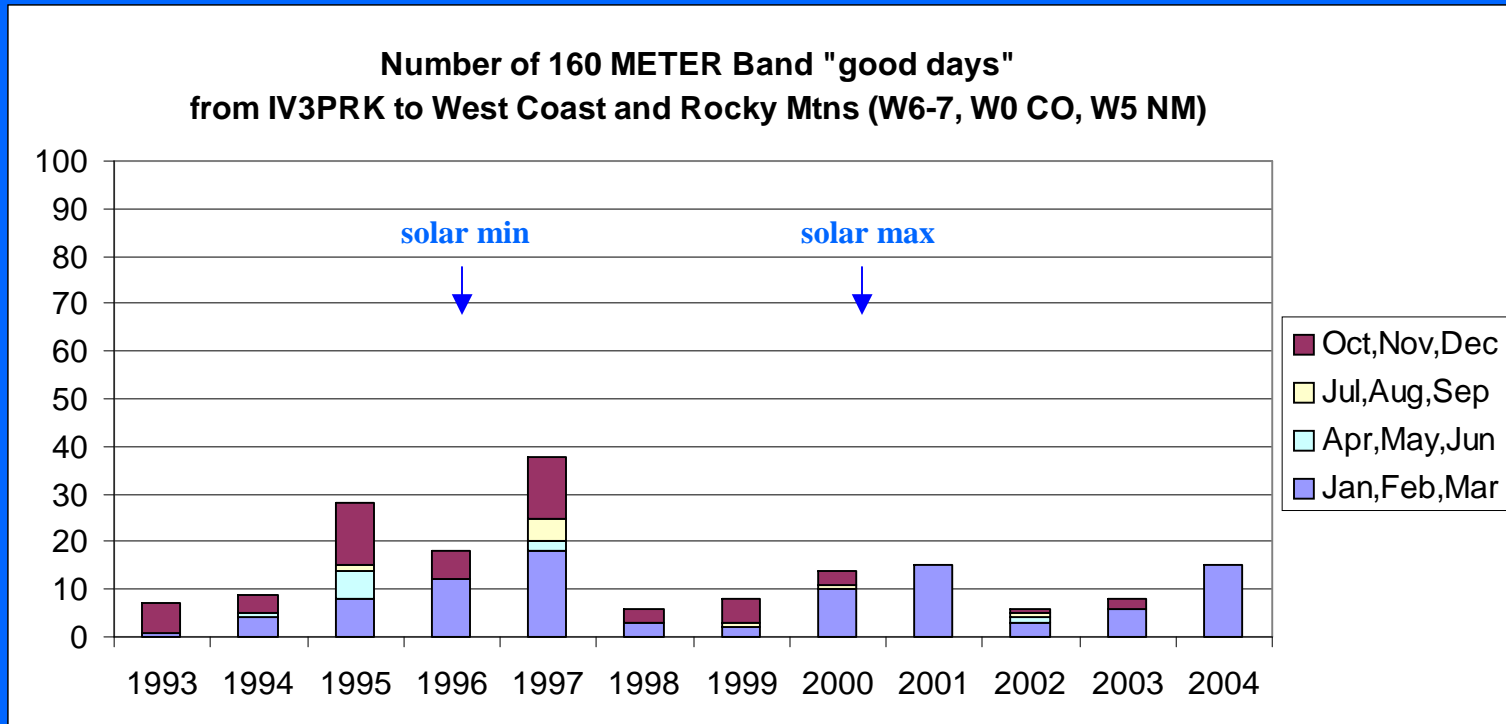
Log Data: IV3PRK's Paths



tnx DXAID

- West Coast
 - Thru auroral oval
- Great Lakes
 - Just misses auroral oval
- SE US
 - Well away from auroral oval

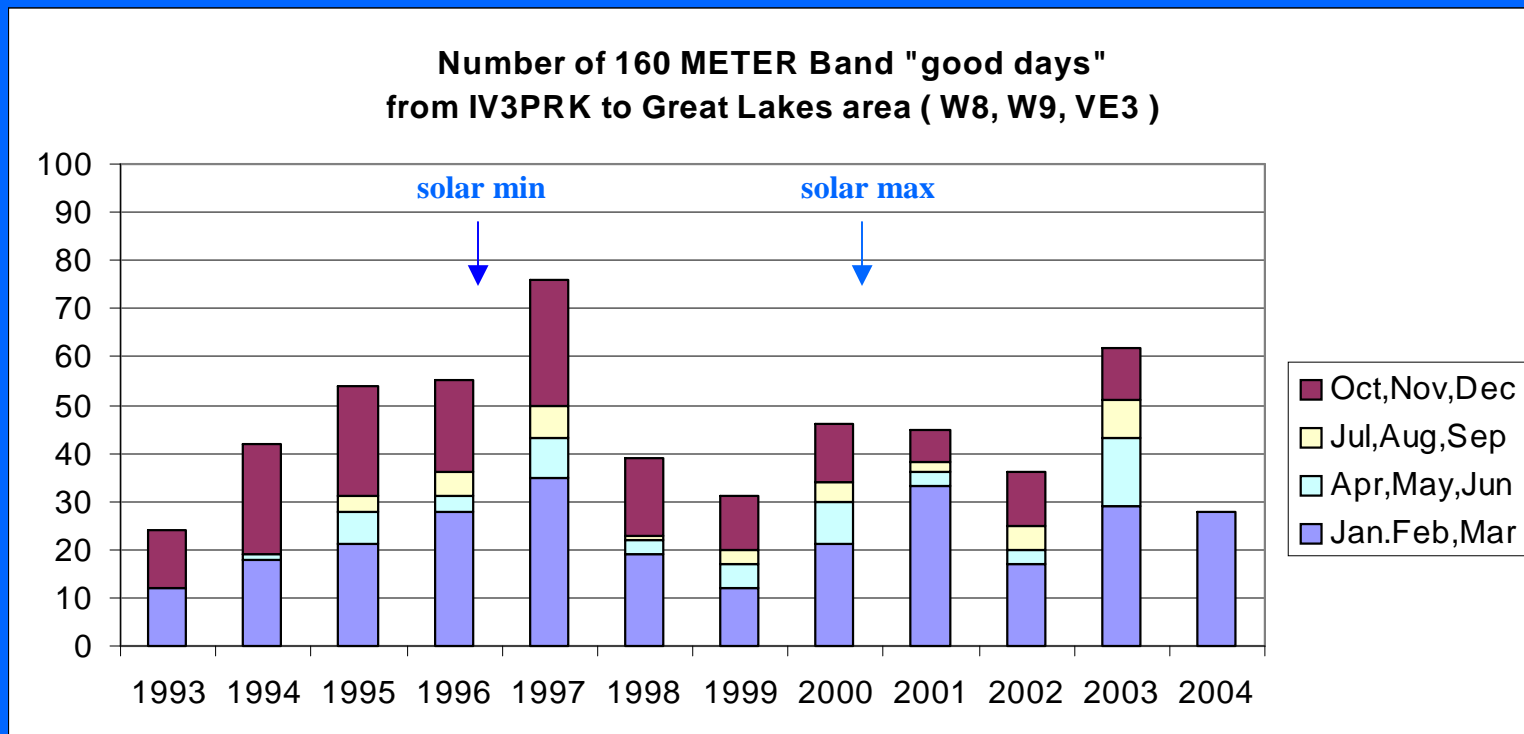
Log Data: IV3PRK to West Coast



tnx IV3PRK

Solar minimum definitely best

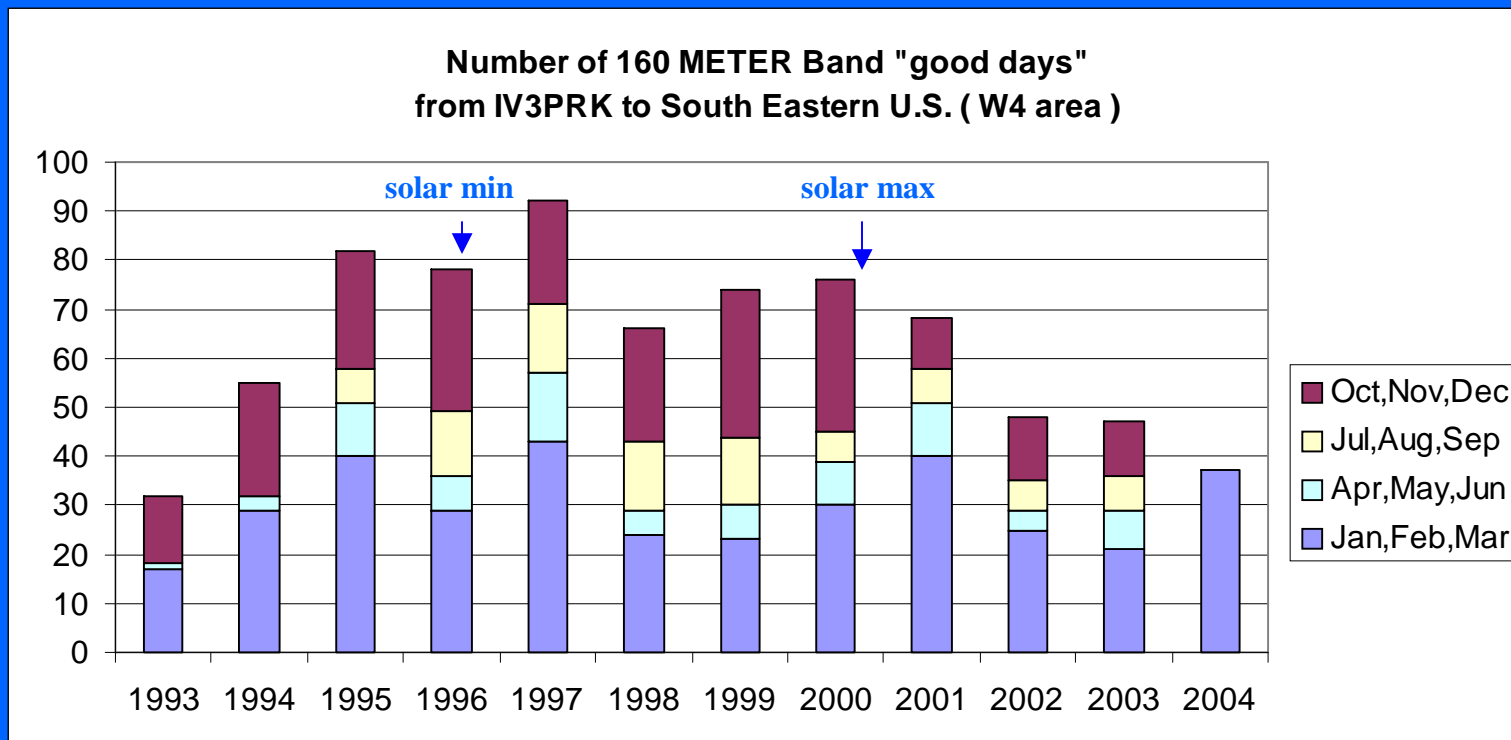
Log Data: IV3PRK to Great Lakes



tnx IV3PRK

Solar min still best, but solar max hanging in there

Log Data: IV3PRK to SE US



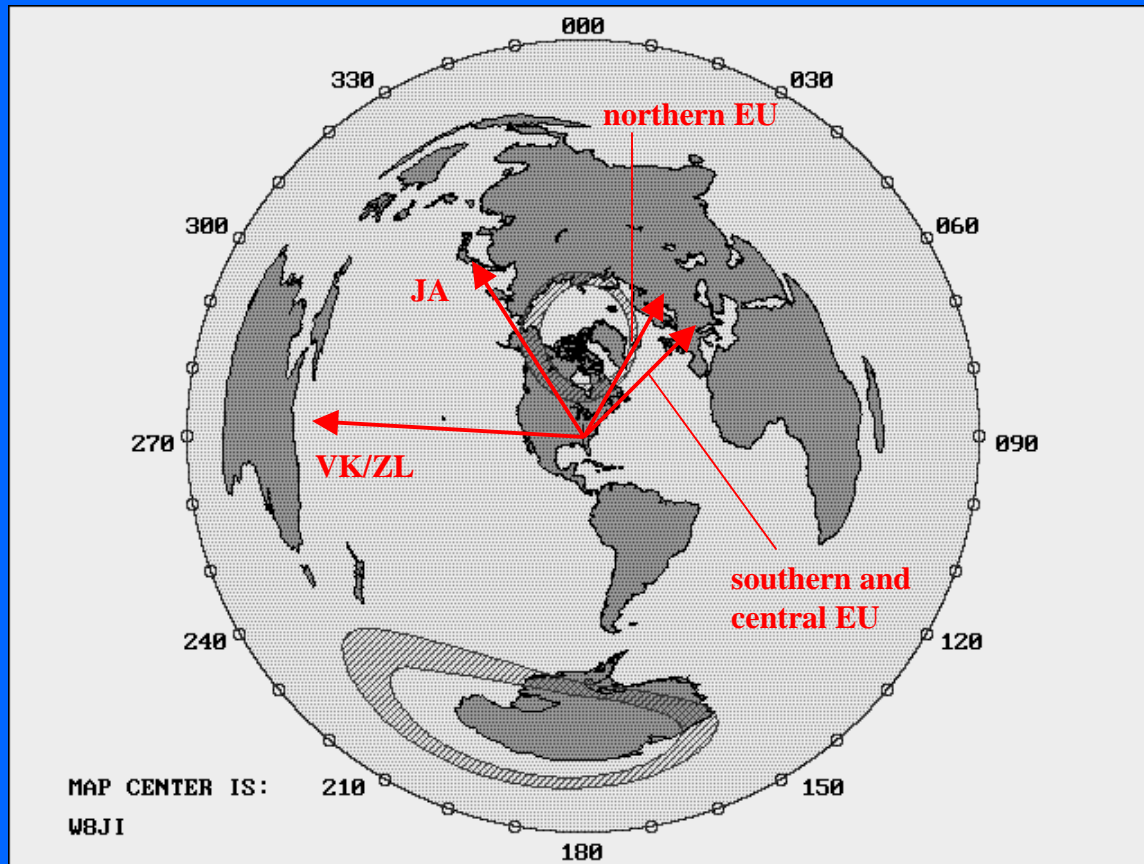
tnx IV3PRK

Solar maximum holds up well when path not near auroral oval

IV3PRK data says solar max for SE US better than solar min for West Coast!

2004 NW DX Conv - K9LA

Log Data: W8JI's Paths



tnx DXAID

- How much DX can you work at solar maximum?
- We'll look at Tom's 160m DX QSO log data from September 1999 thru July 2002
 - Cycle 23 smoothed sunspot number > 100
- Expect most QSOs to VK/ZL and southern and central EU

Log Data: W8JI Sep 99 thru Jul 02

DX QSOs around Cycle 23 max - smoothed sunspot number > 100

low latitude paths	mid latitude paths	high latitude paths
~ 1450 QSOs	~ 2700 QSOs	~ 975 QSOs
VK (71%) NA (13%) northern SA (8%) Oceania (6%) northern AF (2%)	South & central EU (87.5%) ZL (8%) southern SA (2.8%) Mideast (1.4%) southern AF (0.3%)	JA (54%) northern EU (42%) Asia (3%) KL7 (1%)

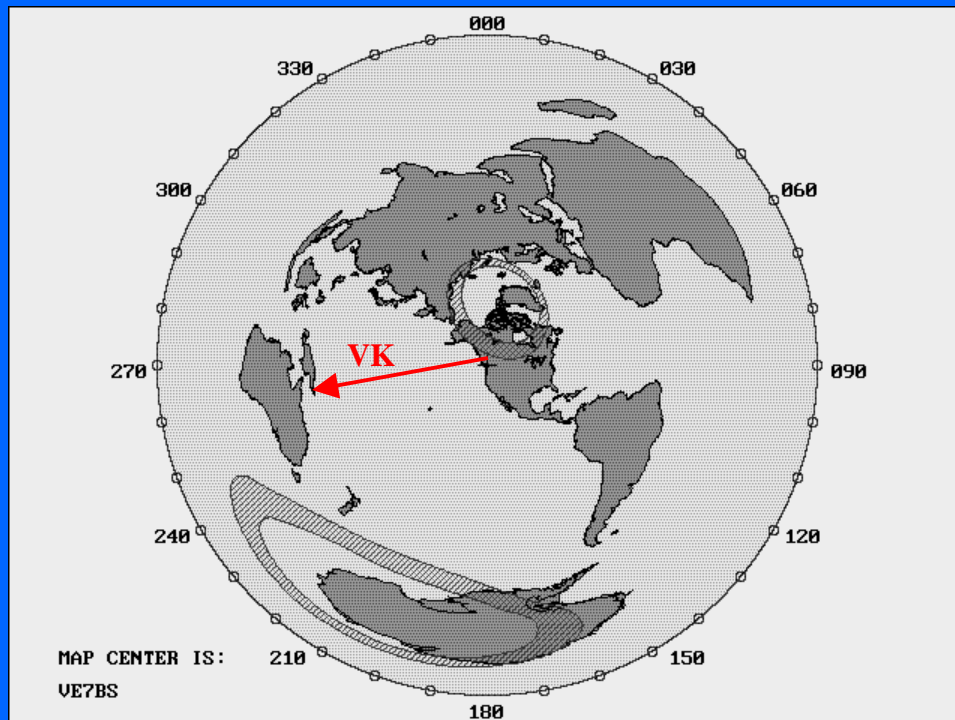
tnx W8JI

Log Data: W8JI Summary

- Over 5,000 DX QSOs from Sep 99 to Jul 02
 - ~ 3,000 in winter
 - ~ 400 in summer
 - ~ 800 in spring
 - ~ 800 in fall
- Almost 200 countries (more properly called entities)
- All 40 CQ zones

Lots of DX can be worked around solar maximum

Log Data: VE7BS's Path to VK



tnx DXAID

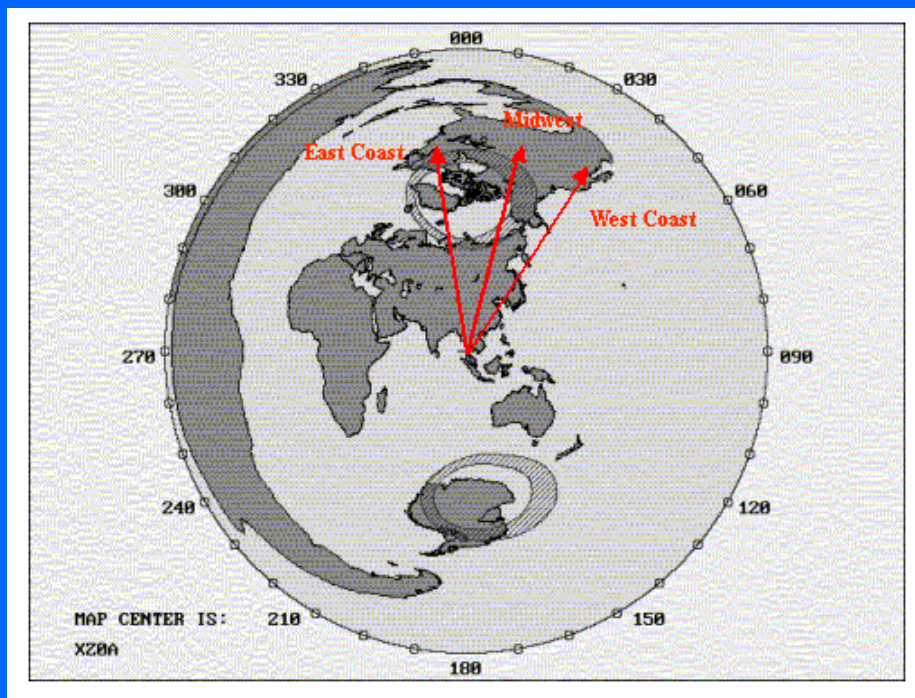
- April 12 through August 31 of 1991
 - Smoothed sunspot number ~ 146 for all months
 - Cycle 22 peaked at 158 in the fall of 1989
 - Definitely near solar maximum
- Of the 142 days, Bob worked a VK on SSB on 114 of them (80%)

DX can be worked in the summer on SSB near solar max

More VK-to-North America Data

- SEANCE (Southeast Australia North America Communications Exchange) net
 - Introduced by Roger VK4YB in 1991
 - At 1100 UTC on 1832KHz SSB from mid-May to mid-August
 - 1991 (smoothed sunspot number ~ 146)
 - Path from VK4 to somewhere in NA ‘open’ on 95% of the days
 - 1993 (smoothed sunspot number ~ 55, geomagnetic field most active)
 - 160m ‘open’ every day to NA
 - Best NA signal strength varied from S2 to S9+15

Log Data: XZØA's Paths



tnx DXAID

- DXpedition in January and February 2000
- Smoothed sunspot number ~ 115
 - Very near Cycle 23 peak in April 2000
- West Coast should be better than Midwest and East Coast

Log Data: XZØA to NA

- 261 NA QSOs (tnx N5IA)
- Time distribution
 - 8 at NA sunset
 - 253 at NA sunrise
- QTH distribution
 - 132 with the West Coast (longitude $> 110^\circ$)
 - 66 with the Midwest ($85^\circ < \text{longitude} < 110^\circ$)
 - 63 with the East Coast (longitude $< 85^\circ$)

DX can be worked even to the ‘problem’ areas around solar max – just have to be there

Conclusions

- 160m is 'open' a lot more than we think
- Your DX success on 160m depends on your location
 - For paths that get near or go through the auroral ovals, 160m is best at solar minimum
 - For all other paths, 160m appears to hold up well over an entire solar cycle
- Action item – when Cycle 24 nears its peak
 - Throw away your pre-conceptions and get on 160m!
 - Set up skeds
 - Let everyone know your results