A.R.I. Sezione di Udine Our Sun and Ionospheric Propagation from HF to 160 meters Chapter 4 – Updated May 2006 by Pierluigi "Luis" Mansutti, IV3PRK

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Here only the last part of chapter 4

# 160 meters by IV3PRK

has been translated from the original Italian version

Let me start with a follow-up to this Topic Fully translated in the Italian version, but mostly skipped here (if requested I can forward the original K9LA.pdf file)

DXing on 160m at Solar Maximum

Carl Luetzelschwab K9LA NW DX Convention – Seattle 2004

# **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?

2004 NW DX Conv - K9LA

# 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 a an issue, the <u>hypothesis</u> 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)

#### 2004 NW DX Conv - K9LA

## Log Data: IV3PRK's Paths



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



# Log Data: IV3PRK to Great Lakes



# Log Data: IV3PRK to SE US



Solar maximum holds up well when path not near auroral oval

K9LA says: thus specific path is important in answering the question "Do the low bands really get better at solar min?"

## 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

But that's NOT all: hypothesis tested and conclusions fit well on the paths between Europe and North America, but on some other low latitude paths they don't agree and the mystery of 160 meter propagation is still unsolved !

# Let's test some other paths with data from IV3PRK logs into areas with a <u>local</u> regular DX activity on 160 m:

n CA: 270°/290°
 7500/9500 km
 n SA: 210°/270°
 7000/14000 km
 n JA: 35°/49°
 8800/9400 km
 NK6: 105°
 13500 km
 n ZL: 60°/100°
 18300 km

NB: aurora ovals set at 21 Z with index 5



Caribbean and Central America: the path is further from the aurora oval compared to that to S.E.US, but we see that the <u>minimum years</u> seem to be clearly better

### Number of 160 METER Band "good days" from IV3PRK to Caribbean area and Central America



South America: the difference between minimum and maximum is even more pronounced (and the winter months activity in the last years has been mostly given by DXpeditions to PJ2, P4 and 9Y4)

### Number of 160 METER Band "good days" from IV3PRK to South America



Southern part of South America: below geographic Equator, with mainly summer activity (exception: march 2001 - 3G0Y heard for 8 days), the difference is abysmal (only 9 QSO's with Brazil since '99 versus 37 in the previous 5 years) and in Jánuary/March 2002 no copy on VP8GEO, PW0T and XR0X .....

### Number of 160 METER Band "good days" from IV3PRK to Southern South America (below the Equator)



**South America:** quarterly data related to the quarterly S.F. and A Index. The path seems to be <u>NOT influenced by the geomagnetic activity</u>, but only by the <u>solar flux</u> (which rose again at the end of 2001 and worsened CNDX in the next months)



South America: still the same data but on a monthly range. The path seems to be <u>NOT influenced by the geomagnetic activity</u>, but only by the <u>solar flux</u> (which rose again at the end of 2001 and worsened CNDX in the next months) (March 2002: heard only PJ2, but nothing from VP8GEO, PW0T and XR0X)

160 meters DX conditions from IV3PRK Monthly weighted band openings to SOUTH AMERICA from Oct.1992 to March 2006 300 60 2000 2001 2002 2003 2004 2005 1993 1994 1995 1996 1997 1998 1999 SF 227 250 50 SF 147 Opening Index 200 40 Jan.01= 0 Feb.01=32 Mar.01=90 150 30 Opening Index Jan.02= 0 Feb.02 = 0100 20 Mar.02=19 50 10 0 00 Jun. 95 Jun. 01 Jun. 93 Oct. 94 Feb. 94 Oct. 95 Oct. 96 Feb. 96 Jun. 97 Feb. 97 Jun. Oct. 98 Feb. Feb. 99 Jun. 99 Oct. Feb. 00 Oct. 01 Feb. 01 Oct. 02 Feb. 02 Jun. 02 Oct. 03 Jun. 03 Oct. Feb. 04 Jun. 04 Oct. 05 Feb. 05 Jun. Oct. 92 Oct. Feb. 93 Jun. 94 Jun. 95 Feb. 96 Oct. 98 Jun. 98 Oct. 03 Feb. Feb. 05 33 97 66 8 4 90 Monthly averaged Solar Flux Monthly weighted total openings Monthly A Index **IV3PRK** 

Daily DX conditions report for the month of <u>March 2001</u> South America is given by CE0A and PY0F – Let's note an exceptional QSO with KH6DX/mobile in California despite the big rise of the solar flux.



Daily DX conditions report for the month of March 2002 South America is given only by PJ – nothing heard from the PW0T and XR0X DXpeditions– note also no JAs despite the guiet solar and geomagnetic index



JAPAN: it is a high latitude path, not far from the aurora oval and with high losses by all ground (and snow) reflections. Nevertheless it is open 30% of the days (half of the days from December to February) and it appears to hold up well during the entire cycle, (but during the years JA frequency allocation has been changed)

#### Number of 160 m. band "good days" from IV3PRK to JAPAN



## For sure always a lot of activity from all the UA call areas

From the 160 meters log of IV3PRK Number of QSO's with JAPAN per Call Area



VK6 – W. Australia: log two regulars "VK6HD and VK6VZ" a classic transequatorial path - from 46° N to 44° S magnetic latitude – It does NOT seem to be influenced by the solar cycle.

### Number of 160 METER Band "good days" from IV3PRK to VK6 - Western Australia



New Zealand: over 18,000 km, the furthest distance reachable, where are regular 160 m. residents. This path is far from the aurora ovals, but with too many hops and a lot of lossy ground reflections. I think it could be possible only through "ducting". More on this later with Proplab Pro analysis of the path

#### Number of 160 METER Band "good days" from IV3PRK to New Zealand



Now let's go back to the North Atlantic path, which is the most common and easy one for us here in Europe, in order to confirm the K9LA hypothesis at the 2004 NWDX Convention of Seattle.



This path keeps out of the aurora oval, at least within a level of 7 (here the index is set at 5 ) but we will see definitely <u>a clear dependence of the solar cycle.</u>



# Finally this graph, taken from a different data base, shows more details of the most difficult openings for 160 m. WAS, related to the solar cycle.

Season's openings from IV3PRK to West Coast, Alaska and Hawaii



# So, what is the best time for 160 m.?

## n/Solar cycle:

- For sure it is best at minimum and at the beginning of a new one, during the rising years.
- On the downward slope there is an increase of solar storms with disturbing effects on the geomagnetic field with more frequent auroras.
- Anyhow some low latitude paths hold up well during the entire cycle.
- On the other side, some very difficult paths, like those (from Europe) to the West Coast, Alaska, New Zealand and the Pacific area in general, but also the southern part of South America, are getting worse and sometimes even prohibitive during the maximum and declining years of the cycle.

# So, what is the best time for 160 m.?

## Month or season:

- Without doubt winter months are better
  - Less ionospheric absorption thanks to the lower zenith sun angle in the northern hemisphere
  - Longer paths and opening times available thanks to the much longer nights
  - Deeper and extended electron recombination into lower ionization
  - Less atmospheric noise no lightning storms in our hemisphere
  - h Higher band activity with many more stations!
  - In addition, the summer months are prohibitive towards
    - Japan and the West Coast due to the too short nights and the lack of full darkness along these high latitude paths.
- But the summer months are better towards the southern part of Africa and South America which are in their winter season; there are enough hours of darkness and best conditions are after midnight until sunrise.
  - That's not the case of VK and ZL because ionization and absorption still too high on these long paths, which are just within the darkness limits.

Here is a quarterly global index of 13 years of daily activity records. It summarizes all the daily DX openings into <u>all the continents</u> — taking into consideration also the quality of the same (within the limits of my personal weighting system) — and it is compared with quarterly solar flux and A Index



160 meters DX conditions from IV3PRK Quarterly weighted WORLD WIDE index of band openings from Oct. 1992 to March 2006

## The same previous graph data on a monthly detail. Note the difference from one month to that immediately next. In particular the trend of the months from September to December is never the same.

160 meters DX conditions from IV3PRK Monthly weighted WORLD WIDE index of band openings from Oct.1992 to March 2006



Thus, which is be the best month? Of course it depends on the target path, but on a global scale the <u>best</u> <u>months appear to be January and February</u>, while the <u>worst is the</u> <u>month of May</u> (which is too late for the East-West paths, with increased noise, and not yet at the best for summer conditions towards South America).



## ...and which is going to be the best hour?

- With few exceptions, full path and both terminal points must be in the dark.
- n / On the East-West paths the most favorable time is just before sunrise at the eastern point, when there is a signal strength enhancement and a deep noise reduction (specially that from the back, already in the light)
  - Generally this is the best or only chance given on some paths (eg.: to W6/7 at our sunrise – to JA, VK or ZL at their sunrise)
- There could be also good possibilities around sunset on the western point of the path, but with less efficiency (in truth l got very few sunset experiences here in my QTH)
  - For all southern paths the best hours are from around midnight until sunrise.
  - The use of the Gray-line
    - In this case the path does not go through the dark zone, but connects two points which are both in the dawn or twilight area. The Gray-line changes every day and the <u>use of software</u> <u>like DX Atlas, Geoclock, W6ELprop, etc., is a must.</u>

The Gray-line, or "Terminator" is the line around the Earth that separates the areas of daylight and darkness. Along this band the D layer is absent, while the F layer ionization is still good allowing very efficient propagation on low bands, especially on 80 and 40m, more than on 160 m





#### ≪ < Feb 24 > ≫ > № II

i2°, 6363 km (LP: 172°, 33640 km) 🔅 17:56 - 01:18 U

Right: 24 Feb. - <u>sunset gray-line</u> from Alaska through Central and South Africa

# What's the best time

- / On the following graphs the same statistical DX daily openings are distributed with a plot showing:
  - the time of the day on the vertical axis
    - with the reference sunrise time at the eastern point of the path on the top;
  - the day and the month on the horizontal axis
  - for every year since 1993 until 2006
- n for the most significant DX areas.
- All the days with a recorded opening (DX stations worked or only heard) are indicated.
  - Every day is counted only once, and its position is at the picking time or nearest, whenever possible, to the sunrise time.
  - Thus, on these graphs, the same dot may represent just a single QSO or a big opening with many strong signals.
    - It's shown only if a contact was possible, and at which time.

**North Atlantic area:** <u>hours distribution is almost uniform and</u> <u>openings seem to be possible during all the year</u> – of course activity and signal strengths are much higher in the winter months



West Coast and Rocky Mountains: here time distribution is limited to about 2/3 hours before sunrise (with the exception of 1995) – the openings <u>last until</u> the month of April (MT in May) and they start again in September



Caribbean and Central America: here time distribution again covers <u>all</u> <u>the night</u>, specially near the contest/ DXpeditions seasons – from May to August, the short nights limit the opening times within one hour from sunrise

8,00 7,00 1993 **1994** 6.00 <u>1995</u> ×1996 **×**1997 5.00 • 1998 +1999. . . . . . . . . . . . . . . . . . . -2000 -2001 2002 2003 3,00 ¥ 2004 ж ж 2005 2,00 2006 Sunrise IV3 1,00 0.00 1-Jan 31-Jan 2-Mar 30-Jun 30-Jul 29-Aug 28-Sep 28-Oct 27-Nov 27-Dec 1-Apr 1-May 31-May

Best opening times from IV3PRK to Caribbean and Central America

Southern part of South America: most of the activity is during the austral winter, from June to September, and they cover several hours in the central months, more close to sunrise before and after them (except contests)



Best opening times from IV3PRK to Southern South America

**Japan:** openings are only possible from October to March and generally within two hours from sunrise in Japan. The sunrise line is halfway through the country: openings start with JA8, JA7 and than JA1, JA3, etc. down to JA6 which is always the last to close the row.

#### 24,00 23,00 1993 1994 22,00 ×1996 **×**1997 21.00 • 1998 +1999-2000 J.T.C. 20,00 - 2001 2002 2003 + ж 2004 19,00 2005 2006 Sunrise JA 18,00 17.00 16,00 1-Jan 31-Jan 2-Mar 1-Apr 1-May 31-May 30-Jun 30-Jul 29-Aug 28-Sep 28-Oct 27-Nov 27-Dec IV3PRK

#### Best time openings from IV3PRK to JAPAN

Japan: in this graph the openings are plotted for call area from the north to the southern part of the country, with reference to the two different sunrise curves.



VK6 – Western Australia: here are logged two of the most active and regular 160 m. enthusiastics who, VK6HD at first, <u>can be worked during all the year</u>, but mostly from Oct. to March and at the picking of austral winter. <u>The time is usually restricted from 30 minutes before to 15 minutes after their sunrise.</u>



Néw Zeáland: contacts involved from ZL1 – north to ZL4 - south and are always performed within a few minutes from their sunrise. Possible months are generally from late January to the end of April. It is also drawn the local IV3 sunset line which marks the lower bound of the available time.



## In the following section (B)



Most difficult 160 m. path analysis from IV3PRK to

- ZL New Zealand
- KH6 Hawaii is.

## With the programs

- Proplab-Pro by Solar Terrestrial Dispatch
- Prop7R by Roger Graves, VE7VV