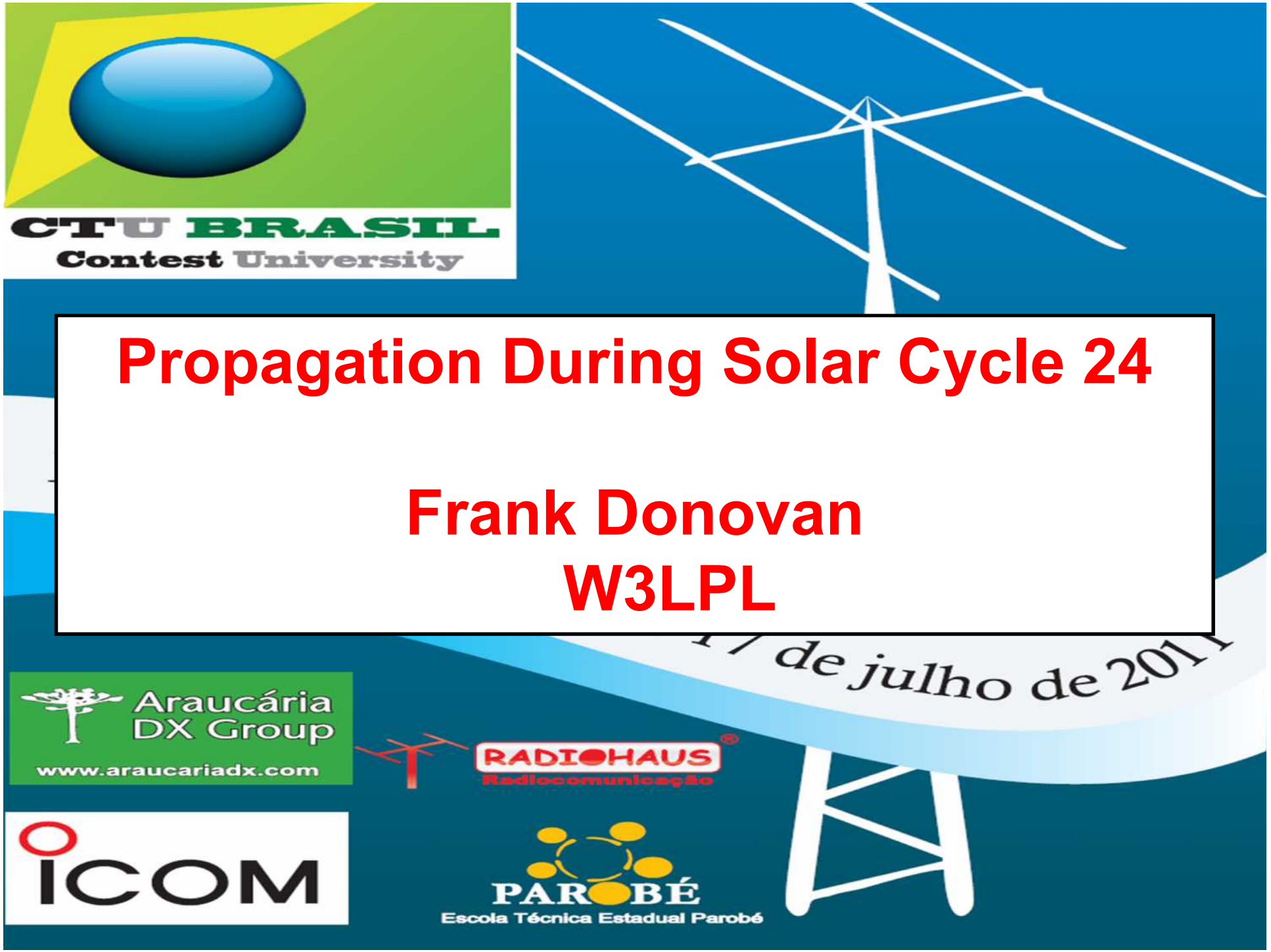

Propagation During Solar Cycle 24

Frank Donovan
W3LPL

Introduction

- This presentation focuses on:
  - The four major fall and winter DX contests:
    - CQ WW SSB and CW
    - ARRL DX SSB and CW
  - The years of highest solar activity: 2011-2015

- Its conclusions will need to be updated regularly as Cycle 24 progresses

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The Long, Deep Solar Minimum
Its Finally Over!

- The first spotless sun of Cycle 23 occurred in 2004
  - solar minimum was then predicted for January 2007
- Three years of exceptionally deep solar minimum
  - no sunspots during 44% of the days of 2007
  - no sunspots during 73% of the days of 2008
    - the “blankest year” since 1913
  - no sunspots during 71% of the days of 2009
- The official solar minimum occurred in December 2008
- Sunspot activity began to increase slowly in 2010

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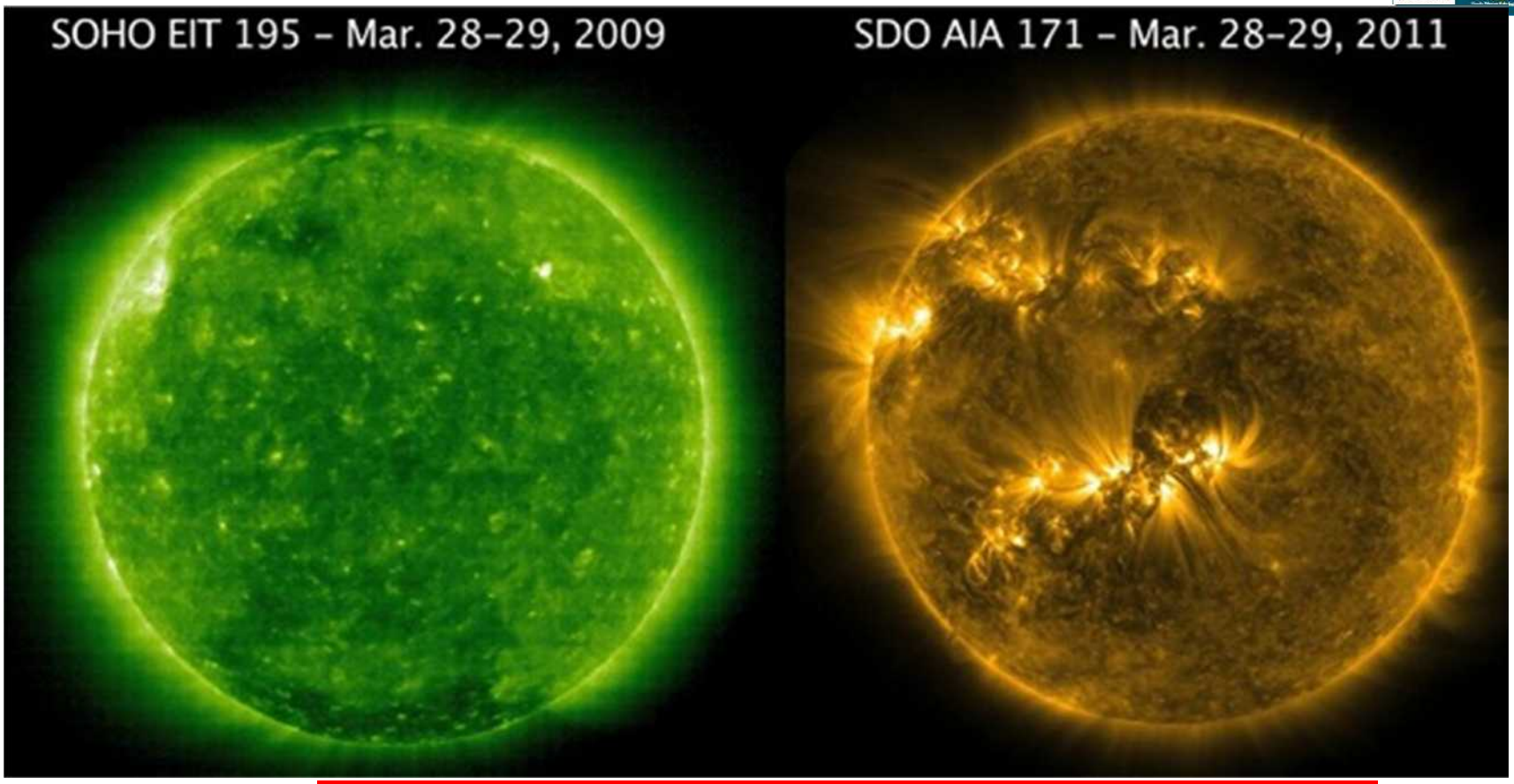
The Quietest Sun in the History of HF Radio

March 2009 vs. March 2011



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Many East Coast USA to VU4PB QSOs were made on March 28-29, 2011

The Slow Rise of Cycle 24

- Cycle 24 sunspots were first seen in January 2008
- Cycle 24 is rising much more slowly than any other space age solar cycle
- Solar flux suddenly increased in February 2011
- Solar maximum is forecast in less than two years:
  - May 2013
- Solar flux will decline to current levels in only four years
  - Late 2015

- **The most important take away from this presentation:**

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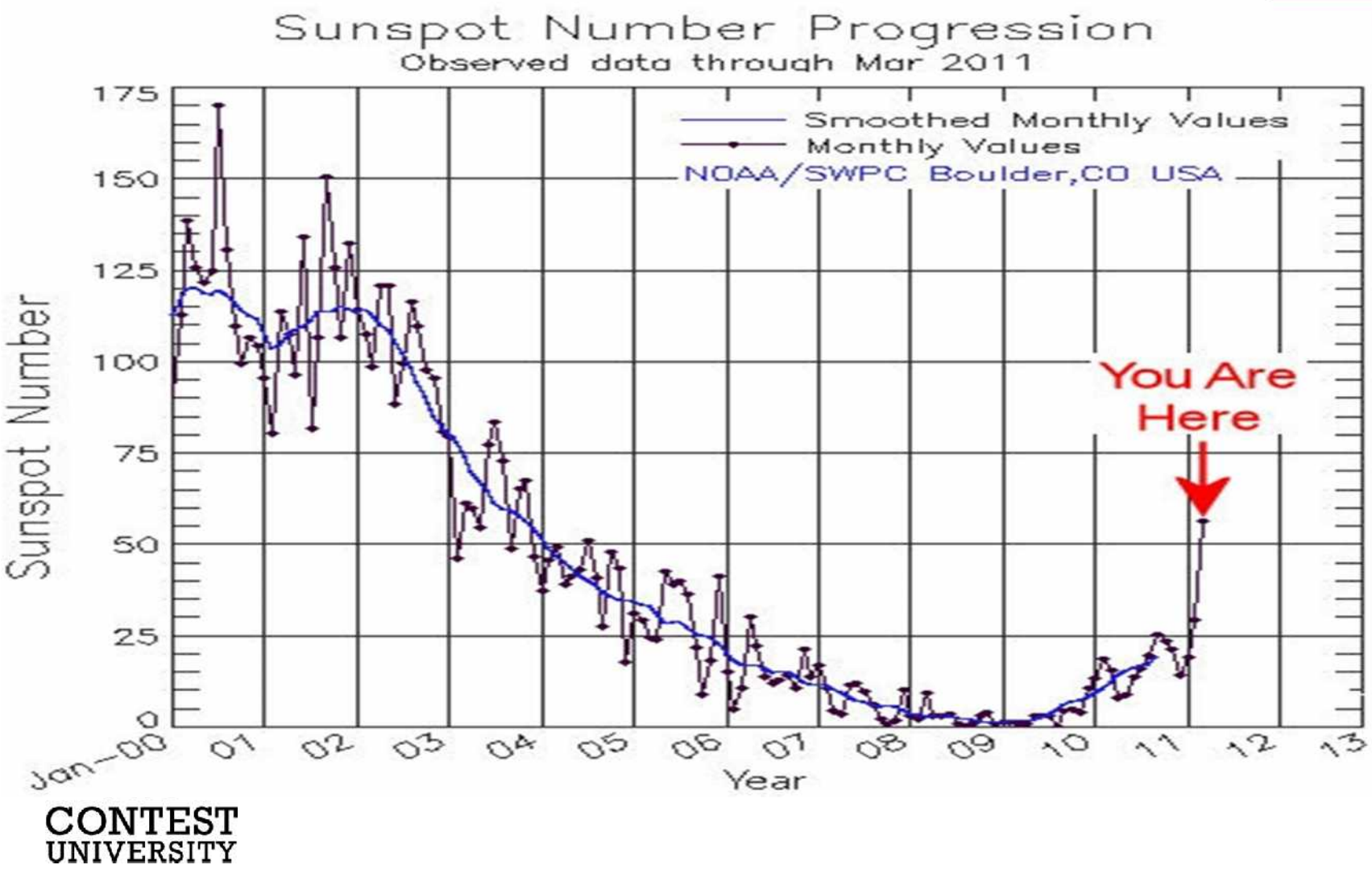
Improve the performance of your 10 and 15 meter antennas now

Solar Activity Suddenly Increased in February 2011



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Dramatically Improving HF DX Propagation

- 15 meters started to dramatically improve during 2010
  - Strong openings nearly every day
    - except for a few severely disturbed days each month
- 10 meters dramatically improved in February and March
  - But only for a few days each month when the solar flux over ~ 120
    - short path propagation the Europe and the Mid East
    - Trans-polar and long path propagation to 9M, 9V, BV, HS, JA, VU4, YB
    - short path propagation to the far western Pacific
- The CQ WW and ARRL DX contests will be <u>incredible</u>
  - for at least the next four years

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More Frequently Degraded HF DX Propagation

- The historically quiet, predictable geomagnetic conditions of 2007-2009 are over
  - Geomagnetic conditions (measured by the k-index) will often degrade suddenly and without warning
  - Forecasting of disturbed geomagnetic conditions is less reliable
    - always prepare for the possibility of degraded propagation on Sunday of every DX contest, regardless of forecasts

- Always expect the unexpected during DX contests
  - DX contests will sometimes experience periods of moderate to severe geomagnetic activity and storms
  - Often without warning

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The K Index vs. the A Index

- K Index – a rapid indicator of changing auroral absorption
  - A *logarithmic* index (0 - 9) covering the last 3 hours
- A Index – an average of yesterday's auroral absorption
  - A *linear* index (0 - 400) covering the 24 hours before 2100Z
- The indexes and long haul DX propagation
  - Low K = 0-2 A = 0-10 Excellent propagation
  - Moderate K = 3-4 A = 10-50 Normal propagation
  - High K = 5-6 A = 50-100 Poor propagation
  - Severe K = 7-9 A = 100-400 Very poor propagation

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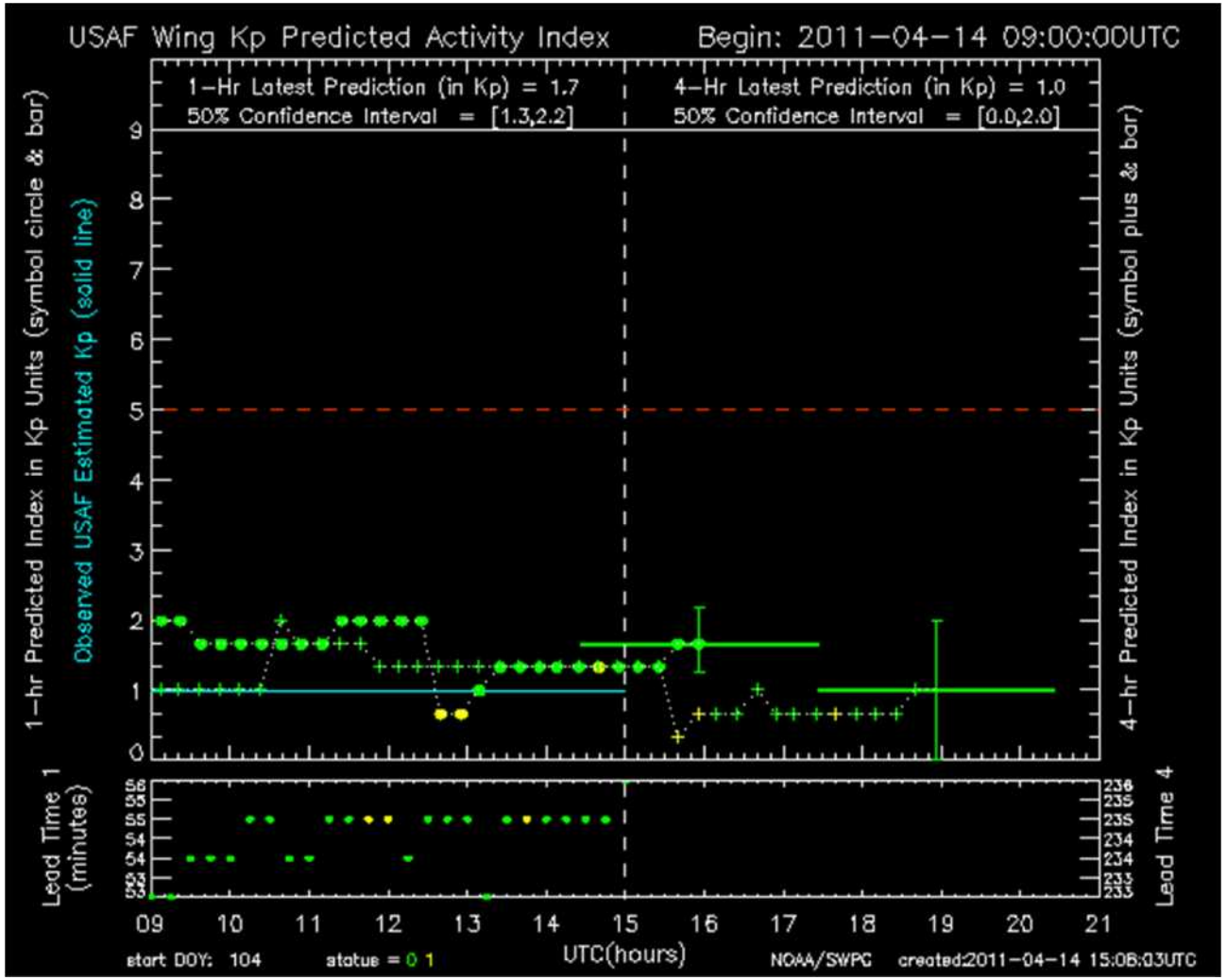
Wing K Index Prediction Model



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http://www.swpc.noaa.gov/wingkp/index.html

Much More Active Auroral Oval

- The auroral oval is always present
  - normally a narrow band of mild absorption affecting only high latitude propagation to Asia and Australia
- The oval always tilts towards the night side of the Earth
  - the solar wind always pushes it away from the sunlit side
- During geomagnetic disturbances
  - the oval moves towards the equator, especially at night
  - the oval widens greatly especially when the K index is > 5
  - absorption on paths to Asia and Australia increases greatly

The Mid-Latitude Trough

- A 5 degree wide region of greatly lowered MUF
  - Located just beyond the equatorward edge of the auroral oval
  - Moves equatorward with the auroral oval during disturbances (K>3)
- Present on most - but not all - nights in late fall and winter
  - The MUF drops rapidly after most sunsets in the ionosphere
  - The MUF instantly returns to normal at sunrise in the ionosphere
  - Shuts down 20, 15 and 10 meter propagation to Asia and Australia during most -- but not all – afternoons
  - Shuts down 20, 15 and 10 meter propagation to Asia a few hours after most -- but not all – sunsets
  - Shuts down 40 meter short path propagation to Asia during most nights. Short path often opens just before sunrise

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Learn to recognize days when the trough is not active

Mid-Summer Propagation

- Cycle 24 improves propagation much less during January and February than during the rest of the year
  - 10 meters – little changed from low sunspot years
    - unpredictable sporadic-E remains the dominant summer propagation
  - 15 meters
    - longer and more frequent openings, especially to Asia and Australia
  - 20 meters
    - somewhat better during the evening and night, especially to Asia
  - 40 meters - little changed except for weaker early evening openings
  - 80 and 160 meters - significantly shorter and weaker openings

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Mid-summer propagation is much less improved by Cycle 24

Fall, Winter, Spring Propagation

- Major propagation improvements except during frequent geomagnetic activity and storms
  - 10 meters - a major worldwide DX band since February 2011
    - world wide propagation from March through December
  - 15 meters - strongest daytime DX band from April to November
  - 20 meters - a 24 hour worldwide DX band
    - openings to Asia and Australia return during many nights
    - strong night time propagation to Australia and Asia
  - 40 meters - weaker mid-afternoon DX propagation
  - 80 meters - significantly shorter openings and weaker propagation
  - 160 meters - less frequent and much weaker DX propagation

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Cycle 24 has started to significantly Improve propagation

10 Meters

- World wide propagation from March through November
  - most days, but less reliable when the K index is 4 or higher
- Strong long haul DX openings during most mornings
  - starting after sunrise until mid-afternoon
- Multiplier rich long path openings
- Frequent, strong propagation to Asia is unlikely to return until October 2012
  - But openings sometimes occur earlier when the solar flux is above 140 and the K index is 2 or less
- DX propagation until several hours after sunset

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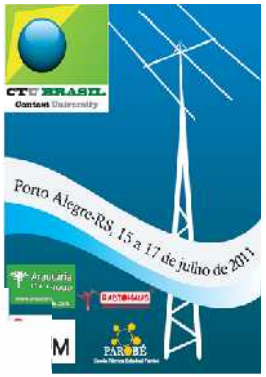
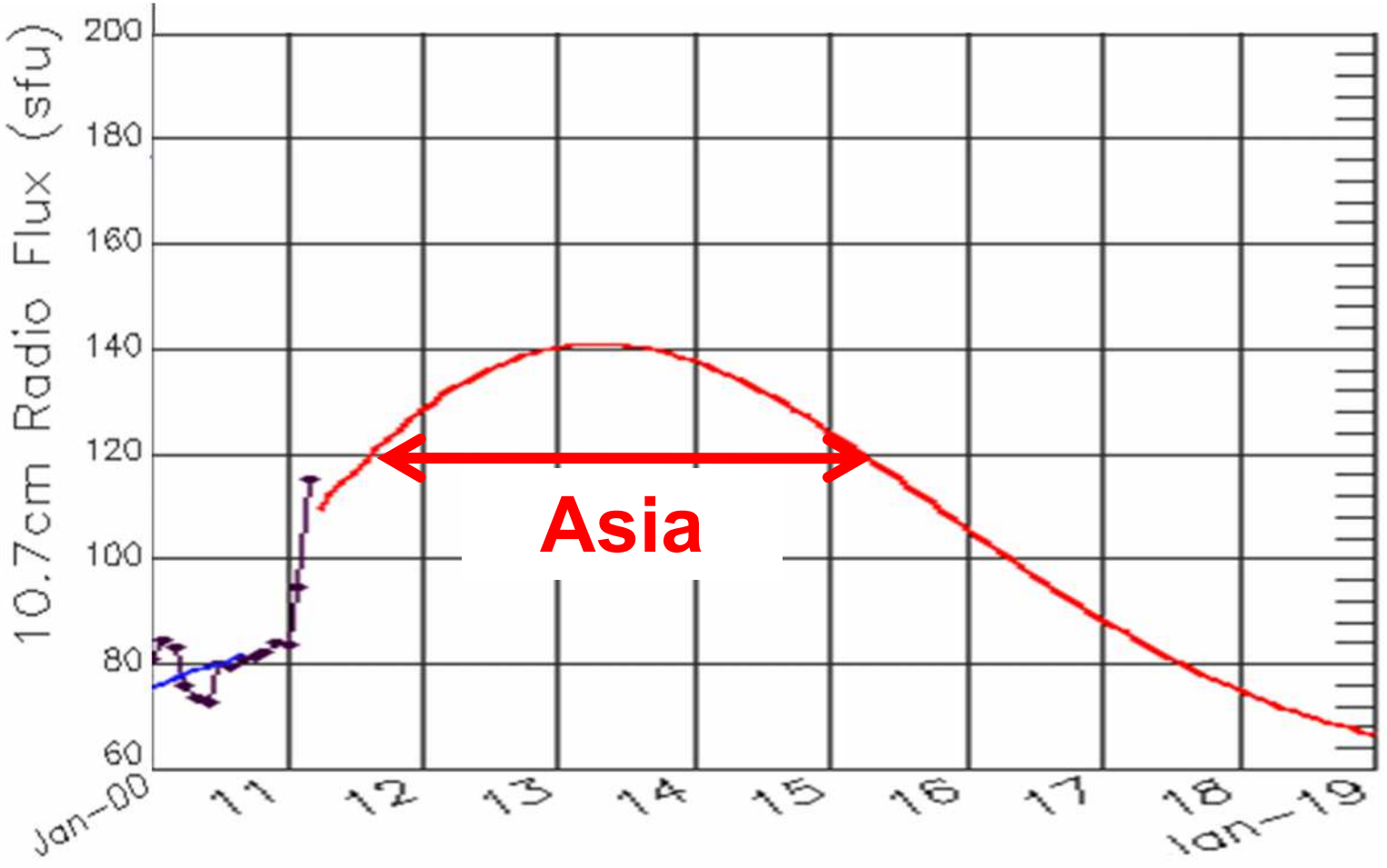
A worldwide daytime DX band since February 2011

Improved 10M DX Propagation for Four Years





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March 2011 – March 2015

15 Meters

- World wide propagation from before sunrise until late evening almost every day
- Strong DX openings almost every day
  - from before sunrise until late afternoon
- Frequent, strong propagation to Asia
  - multiplier rich long path openings
- Night time DX propagation almost every day
  - Until three to four hours after sunset during many evenings

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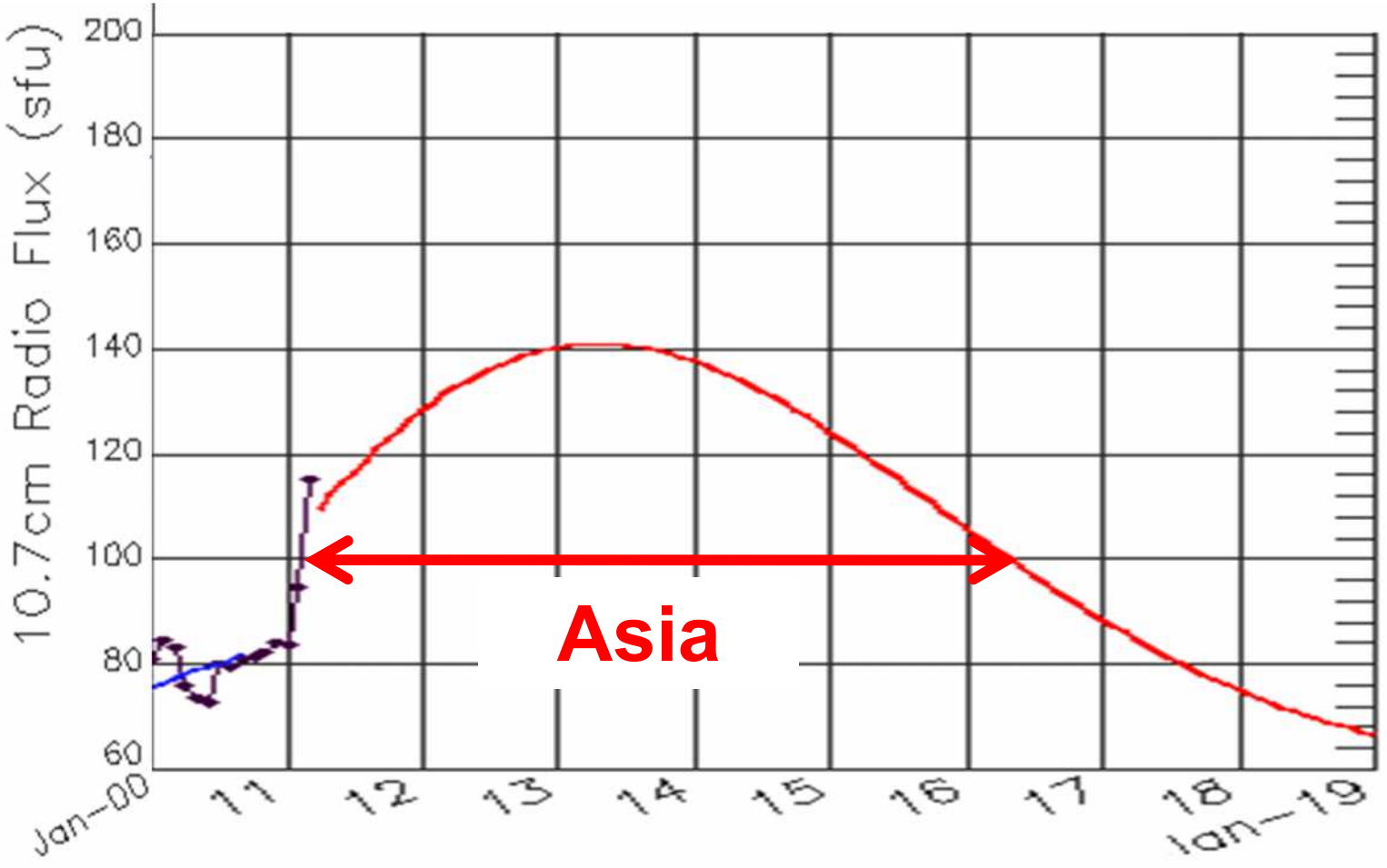
The strongest daytime DX band from March through November

Regular 15M DX Propagation for Five Years



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February 2011 – March 2016

20 Meters

- World wide propagation for nearly 24 hours on most days
- Strong DX openings every day and many nights
- Strong propagation to Asia
  - After sunrise most mornings
  - For several hours after sunset
- Strong long-path propagation
  - After sunrise most mornings
  - For several hours before sunset

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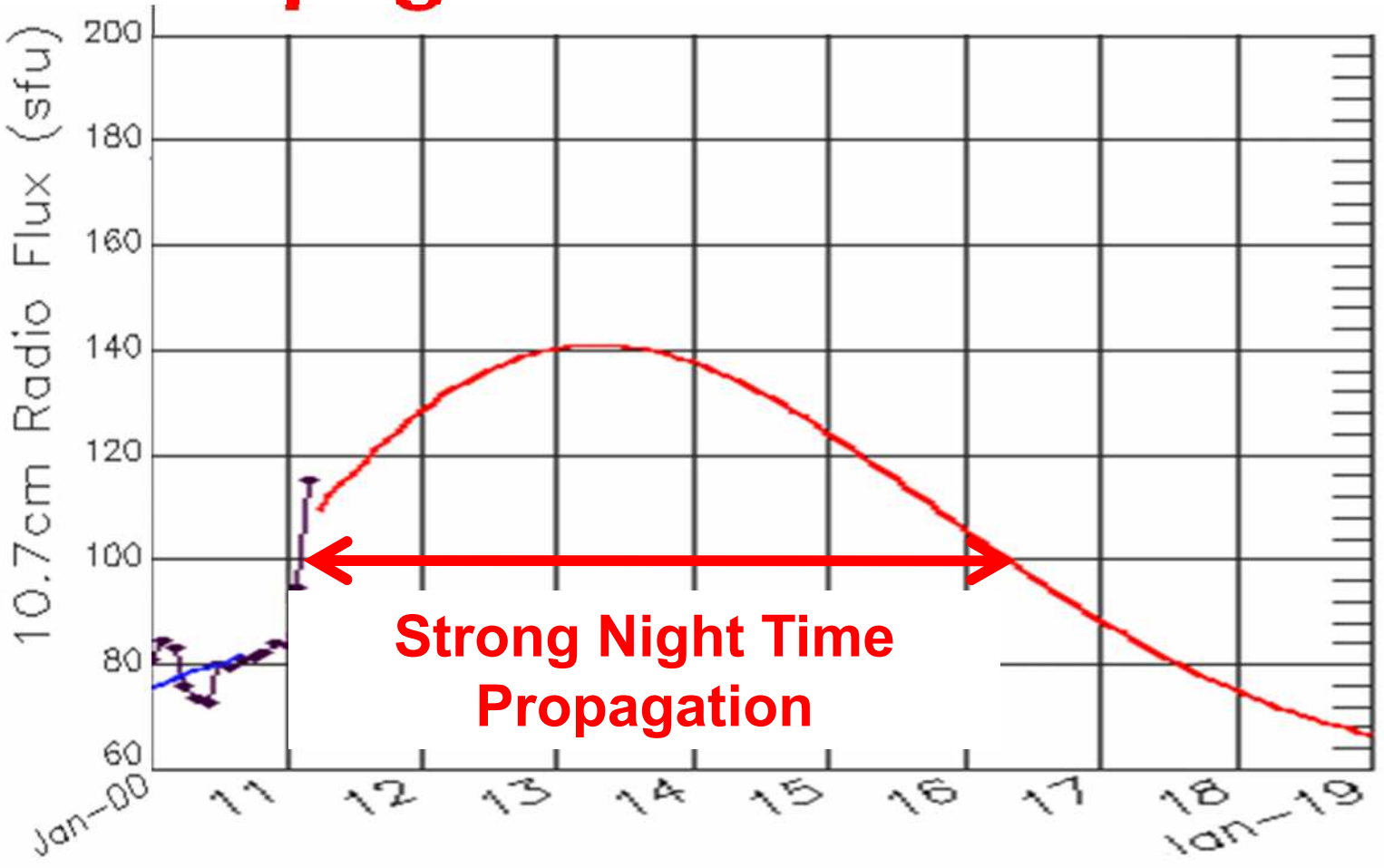
The most reliable year round worldwide day/night DX band

Strong 20M Night Time Propagation for Five Years



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February 2011 – March 2016

40 Meters

- Mid-afternoon DX propagation weakens significantly
- Strong worldwide openings begin about an hour before sunset
- Short path openings over the south pole will become less frequent during the winter
  - Caused by the reduced MUFs in the Mid-Latitude Trough

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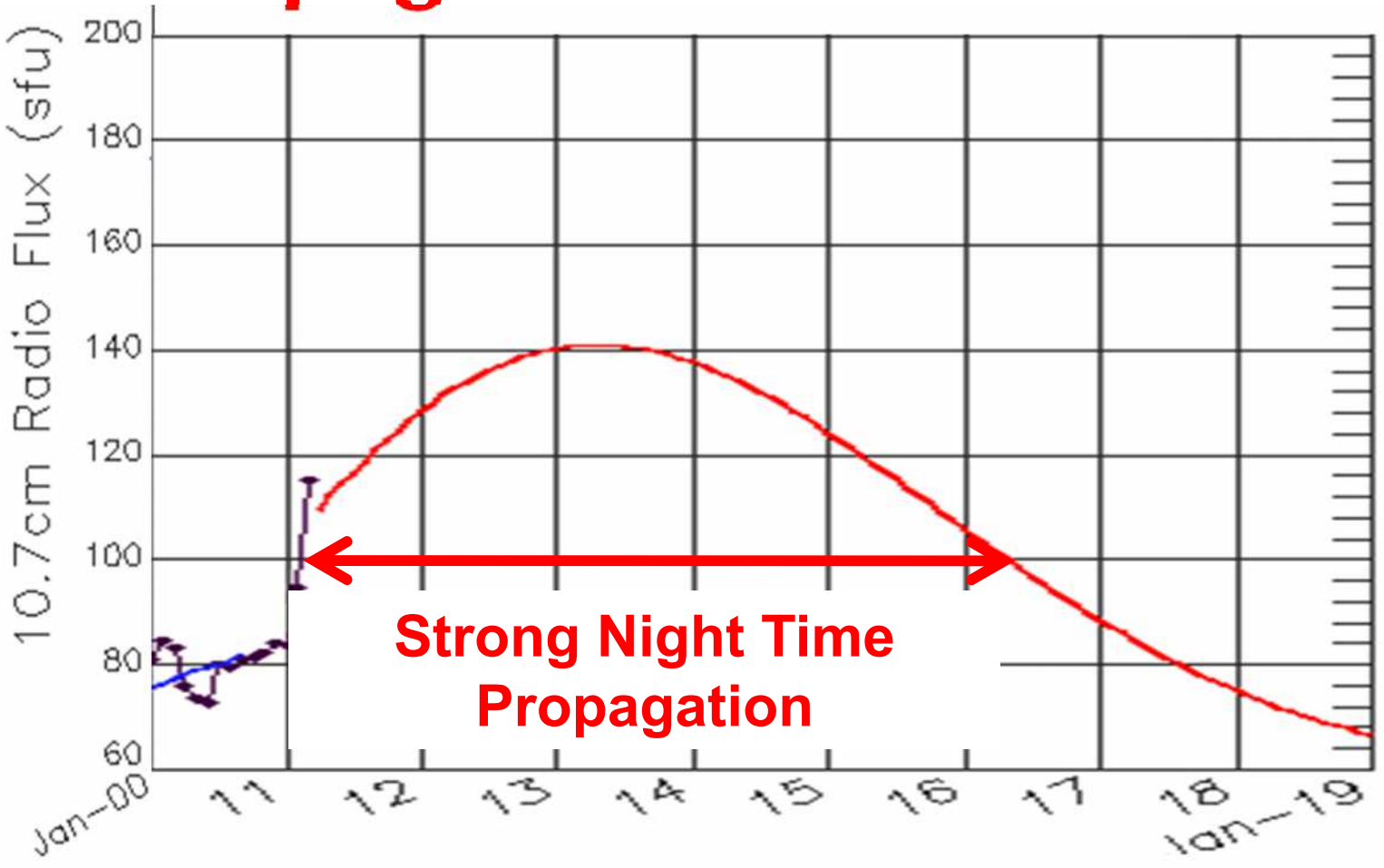
A strong night time worldwide DX band

Strong 40M Night Time Propagation for Five Years



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February 2011 – March 2016

80 Meters

- Much shorter and less reliable openings
  - but this band will continue to be very important to overall multiplier totals
- Knowledge of worldwide 80 meter DX propagation is critical to competitive QSO and multiplier totals
- Competitors must remain serious about this important band
  - even as night time propagation returns to the higher bands

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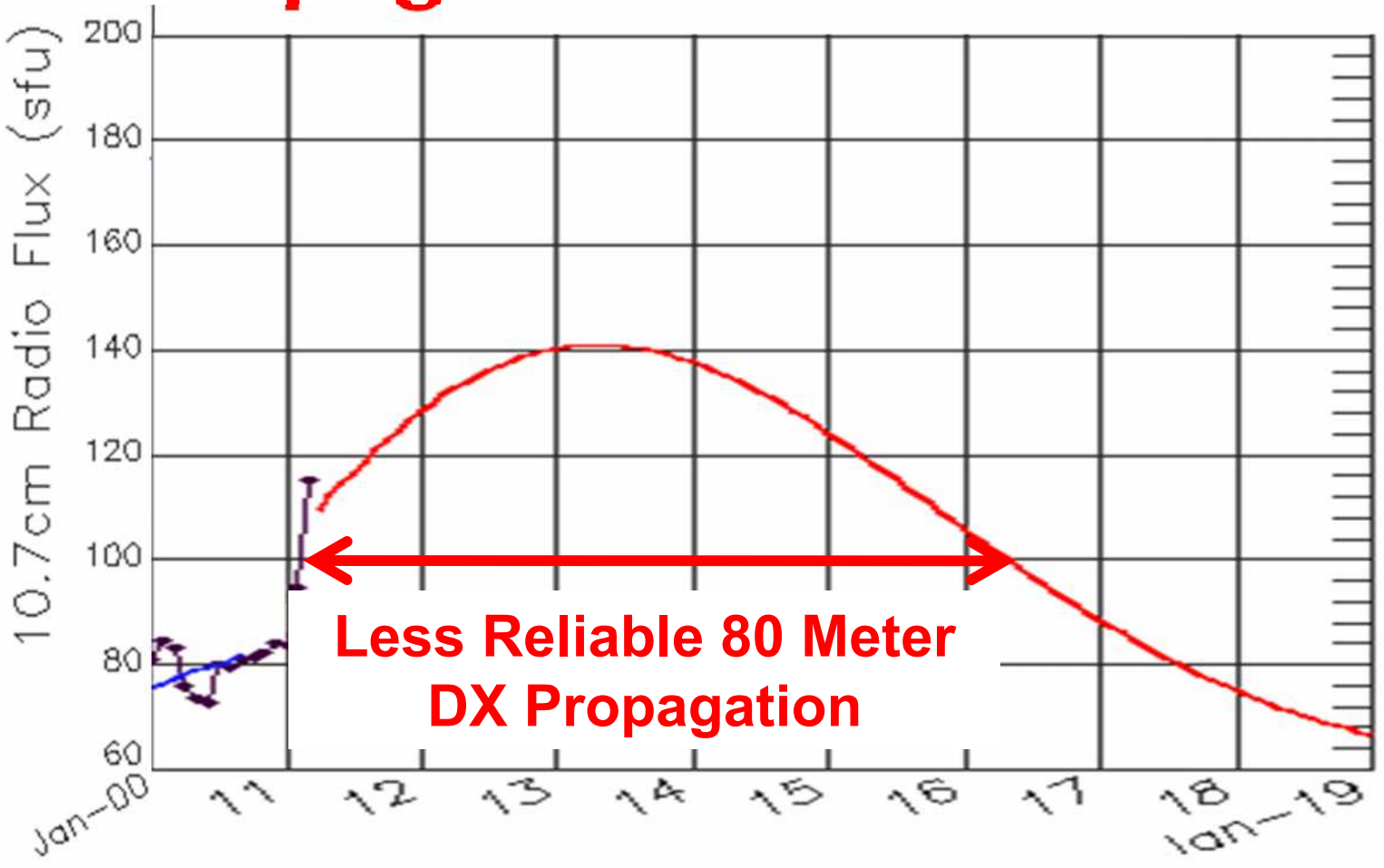
Weaker and less frequent openings for five years

Less Reliable 80 Meter DX Propagation for Five Years



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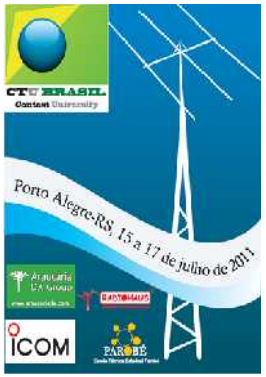
February 2011 – March 2016

160 Meters



- Strong knowledge of 160 meter DX propagation is critical to a competitive multiplier total
- Openings will occur unpredictably and unreliably
  - especially just before sunrise on the eastern end of the path
- Good openings soimetimes occur just before sunrise

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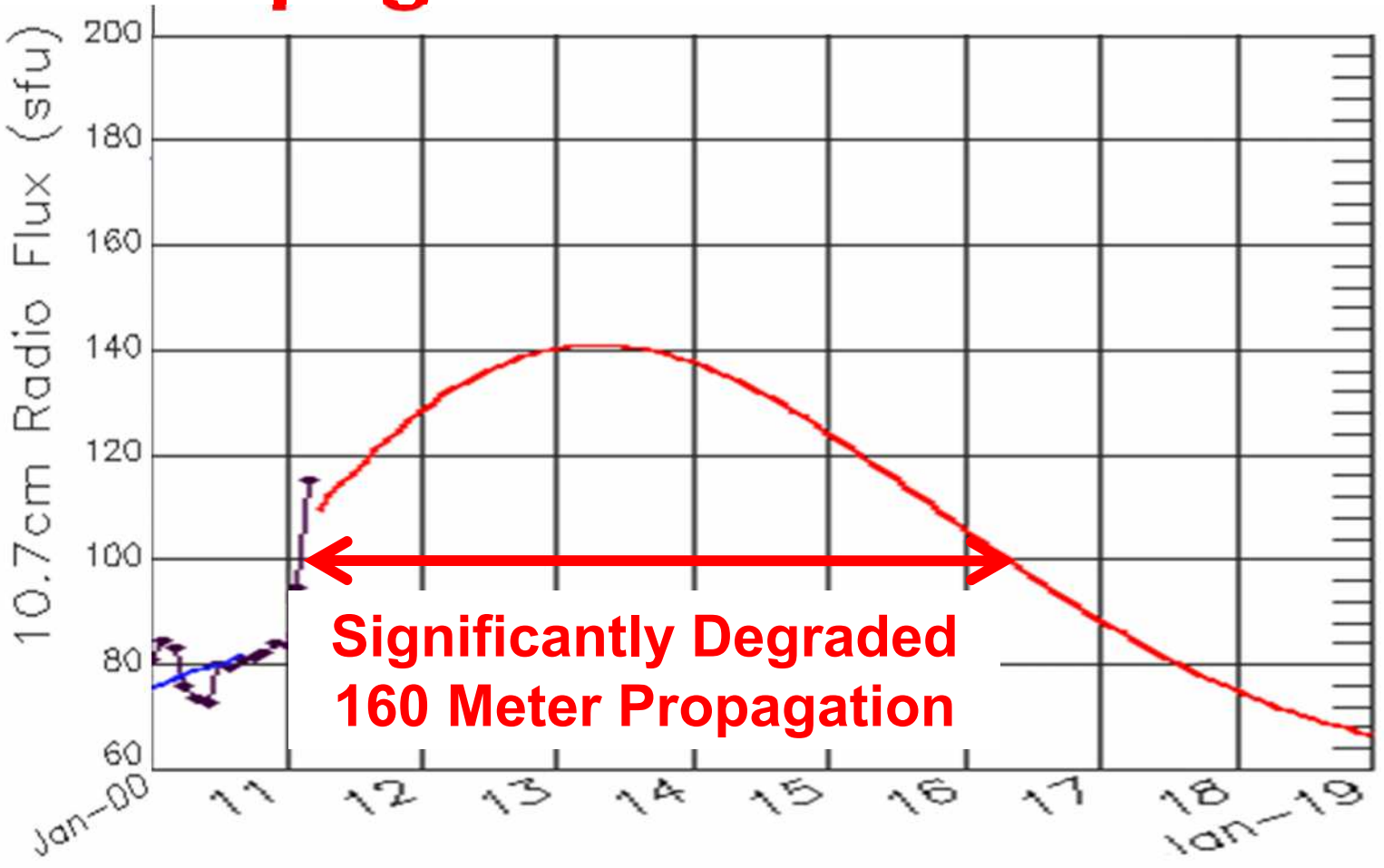
Much weaker and less frequent openings for five years

Significantly Degraded 160M Propagation For Five Years



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February 2011 – March 2016

Cycle 24 – Yes Its Finally Here!

- Refurbish your 10 and 15 meter antennas this summer
  - build them bigger and better !
    - they're smaller and more affordable than lower band antennas
  - 10 and 15 meter antennas and transmission lines are more susceptible to moisture and ultraviolet damage than lower band antennas
    - regular inspections and preventative maintenance are more important than ever
- Develop your high sunspot contest skills and strategies
  - you will need new skills and strategies for the next five years

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Prepare now for CQ WW