

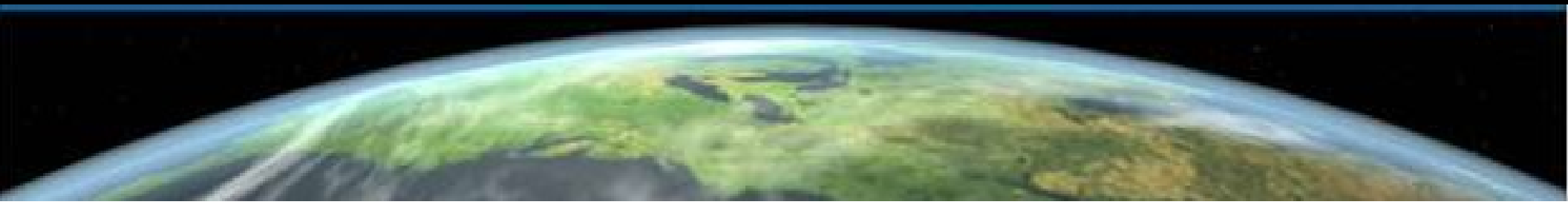
Amateur Radio Satellites

Exciting Communications made Fun and Easy!

A Presentation by Hams in Space!

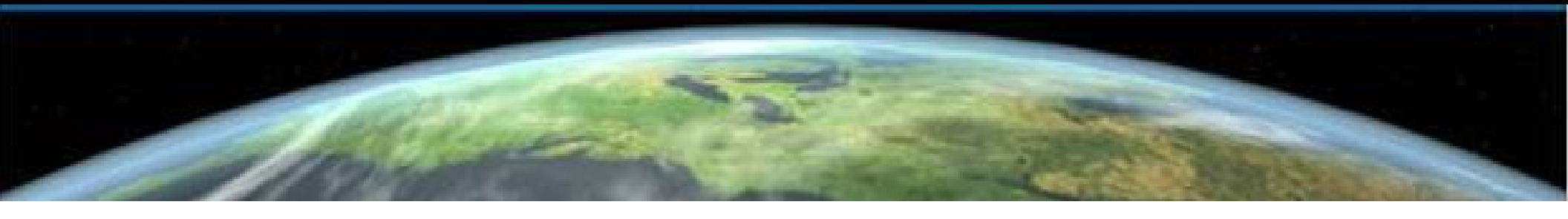
<http://hamsinspace.com>

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v.7.1.1 August 10, 2023 Raytown



A Short Explanation About This Version of the Presentation

Hams in Space was an in depth presentation which started out very small in 2010, and evolved into a major production. The Presentation Team consisted of Randy Schulze – KD0HKD (now W0ICQ), Eddy Paul – KY0F (SK), and Jeremy Widner – AC0DX. Between 2010 and 2015, we provided the presentation 45 times across Missouri, Kansas, Nebraska, and Arkansas, including twice for the National Hamvention in Dayton, Ohio. At its peak, the presentation discussed a wide selection of satellites, software, radios, antennas, and accessories, and was featured in the November 2014 edition of *CQ Amateur Radio Magazine*. A number of YouTube Videos were produced, and are still viewed and commented on today!



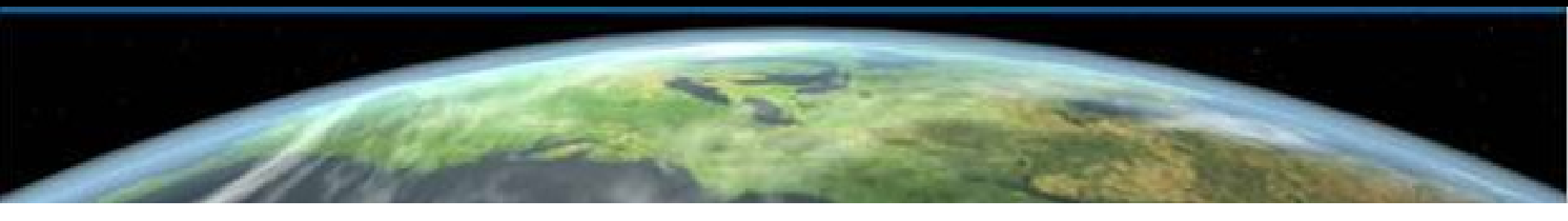
A Short Explanation About This Version of the Presentation

Our last “official” presentation occurred on November 17, 2015 at the Raytown Hamfest, not long after our second presentation at Dayton. Since just about everyone had seen our presentation, some more than once, so we opted to stop promoting the show, and started working on ideas for a new presentation on another topic.

This version of the presentation, while based on the last full version, has been edited down. While it focuses on only one satellite, SO-50; the instructions and process are basically the same. Some of the hardware displayed may seem old, but again the instructions can be applied to newer radios, etc.

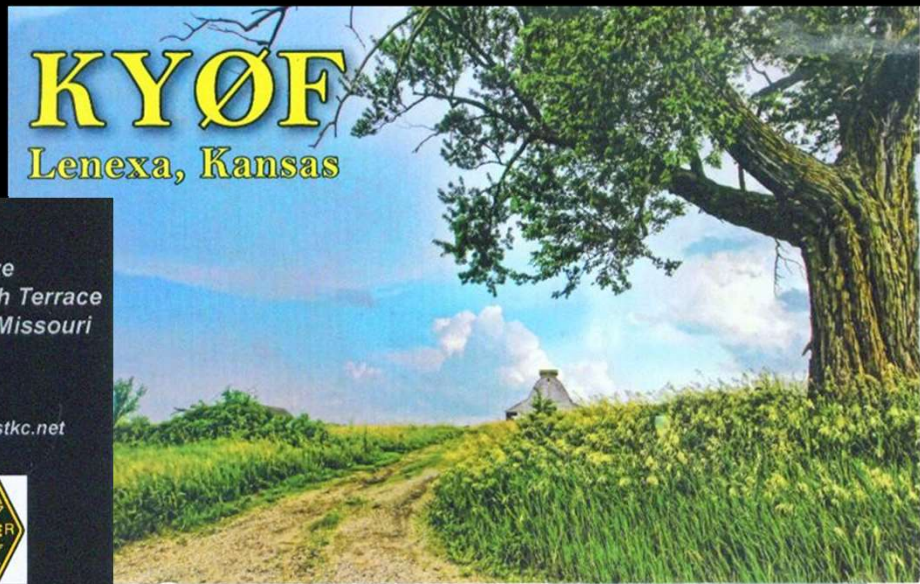
My Dear Friend, Eddy Paul – KY0F passed away unexpectedly in December 2019. This presentation is dedicated to Eddy.

- Randy Schulze – W0ICQ, August 2023



Hams in Space

In Honor of the Team



KDØHKD
EM28qw, Kansas City, Missouri, USA





Randy Schulze
500 East 105th Terrace
Kansas City, Missouri
64131-4333
USA
KDØHKD@everestkc.net



Confirming QSO With:

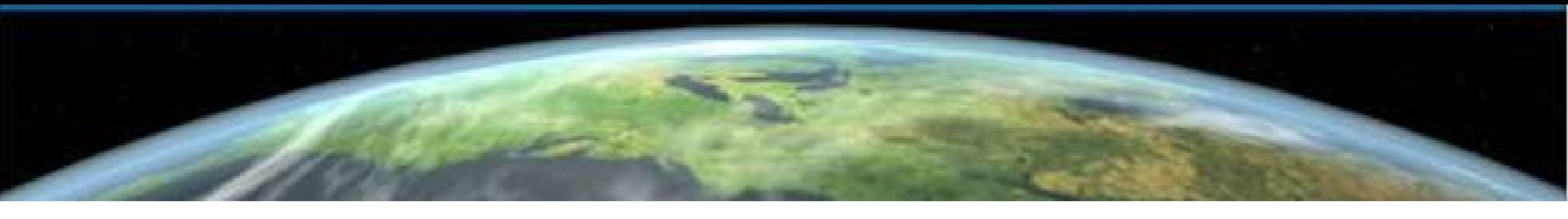
Day	Month	Year	UTC	MHz	RS



ACØDX

Jeremy Widner
11300 East 77th Terrace
Raytown, MO 64138
U.S.A.

Jackson County • Grid EM28sx
Email: k0pdx@arrl.net

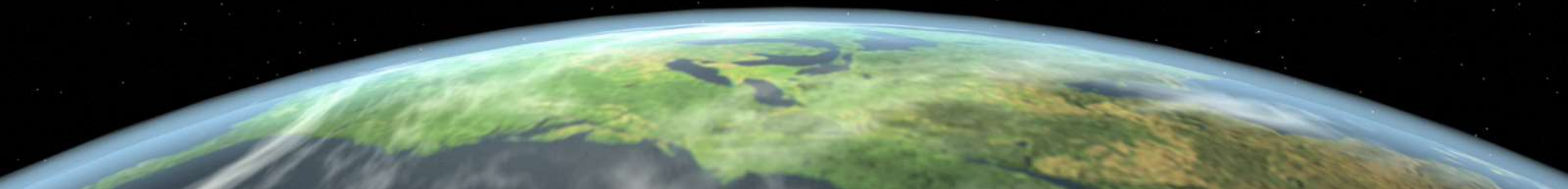


We Are Providing Our Experience!

Hams in Space provides instruction, and represents the opinions of Randy Schulze, Eddy Paul, and Jeremy Widner based on our experience of success and failures in the art and science of amateur radio. Although we may refer or defer to other people or organizations, we are not representatives of, nor do we speak for or on the behalf of any other organization. While we might mention equipment and / or brand names of products, equipment, hardware, or software we may have used or have experience with, we do not make or imply the endorsement of such items, nor have we sought out, nor have we accepted any offers, paid or otherwise, from any manufacturer or vendor of such items to endorse or promote their products.

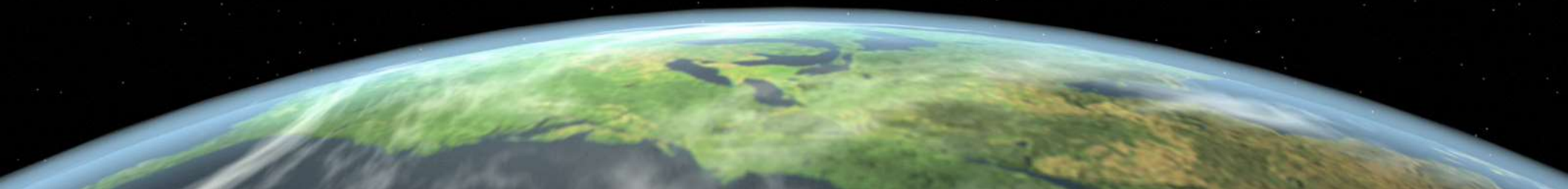
While we admit we may have a bias, like or dislike for something we've tried out based on our experience, or based on what we can financially afford, these are solely our personal opinions that we share with you.

In short; no one is paying us to put their words in our mouths.



We Are Not Experts!

- We're just having fun working satellites. Part of that fun, is we're still learning something new, all the time.
- We have just scratched the surface of what can be done with Amateur Radio Satellites. So far, we've been working the FM "Birds." There are also satellites which work SSB on 10m, others that work CW, and some that work in the microwave bands.
- Work the mode that most interests you.
- *Have Fun!*



History: *OSCAR, the 1st Amateur Radio Satellite*

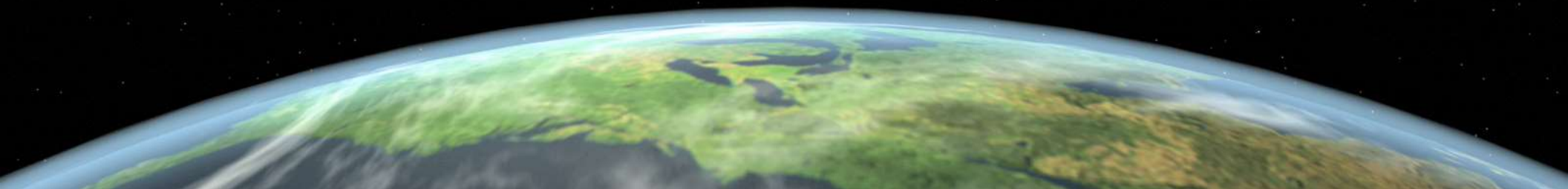
OSCAR: *Orbiting Satellite Carrying Amateur Radio*

Project OSCAR started in 1960 and was responsible for the construction of the first Amateur Radio Satellite OSCAR-1, that was successfully launched from Vandenberg AFB in California, on December 12, 1961, barely four years after the launch of Russia's first Sputnik. OSCAR-1 orbited the earth for 22 days, transmitting the "HI" greeting in Morse Code from above.



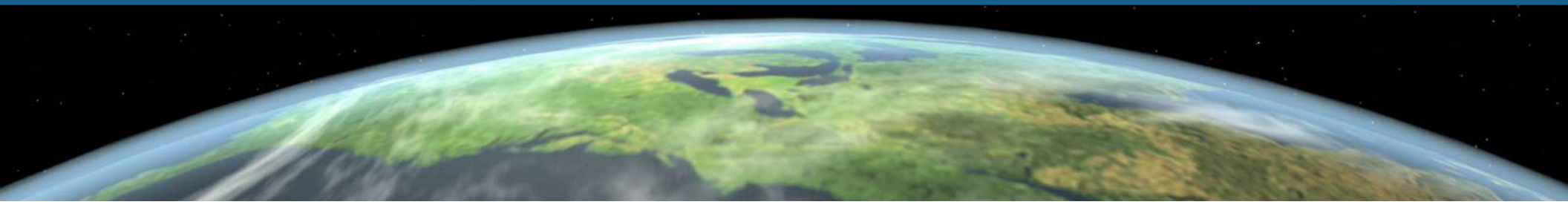
What Attracted Us to Amateur Radio Satellites?

- First Learned of Amateur Radio Satellites from the Audio CD with Gordon West's Study Guide for Technician Class.
- Became very interested while listening to the Clint Bradford – K6LCS Presentation on K0GQ Technology Net, September 11, 2009.
- Successfully tuned in (received only) the SO-50 Satellite with an HT and the standard, out-of-the-box antenna.
- Randy made his first, successful, two-way contact via the AO-51 Satellite on November 1, 2009.



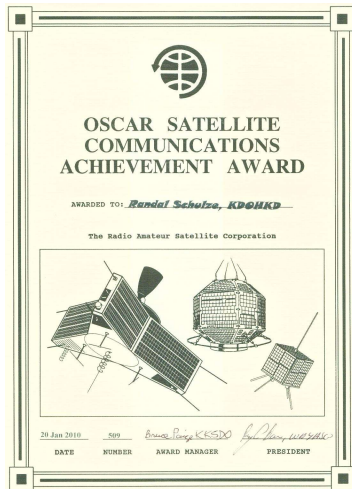
Randy's Results

- ***Over the next two and a half months, I logged over 38 successful contacts, 27 of which were confirmed by QSL Cards including 19 US States, 1 Canadian Province, and 1 Mexican State!***



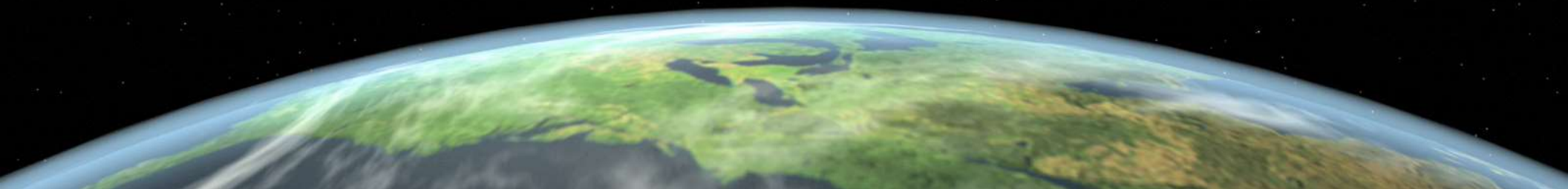
Randy Earned Three Awards:

- **The OSCAR Satellite Communications Achievement**
 - Contacts with 20 different U.S. states or Canadian call areas or DXCC countries
- **The South Africa AMSAT Satellite Communications Achievement Award**
 - Working 25 different stations on phase 2 satellites. Satellites
- **QRP All States Award**
 - Successful two-way communication with 20 of the United States of America while running a power output of 5 Watts or Less



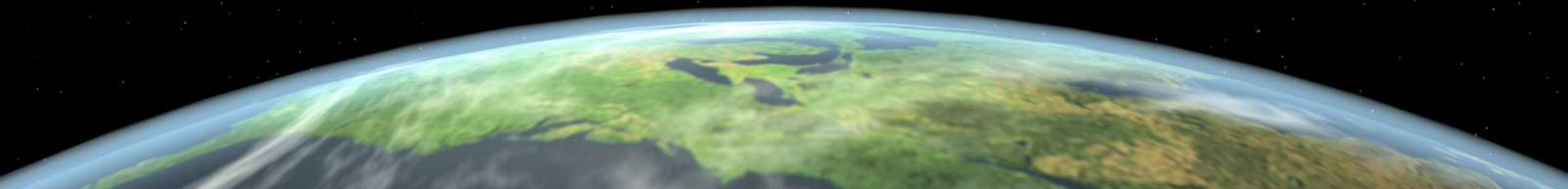
How We Work Amateur Satellites!

- Everyone may have their own style or method of working the Amateur Satellites.
- Although what we're doing with our equipment works very well for us, it is certainly not the *only* way to work satellites.
- There are various combinations of antennas and radios that can be very successful.



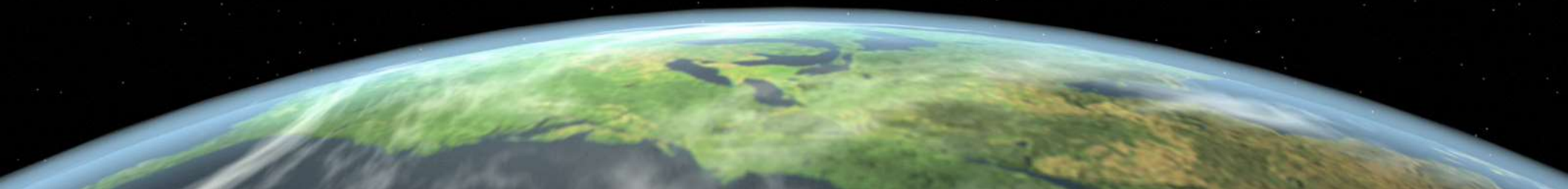
Power Should Not Be an Issue!

- You do not need very much power to work Amateur Radio Satellites.
- The best, and most cost effective way to improve your performance, is by using a better antenna. *This can not be overstated!*



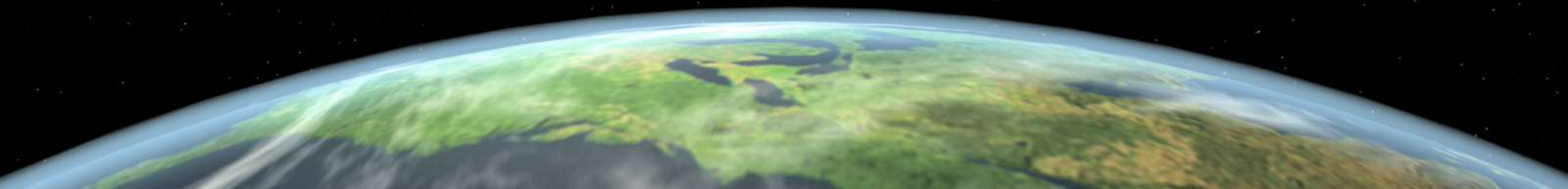
A Short Word About Protocol

- Option One: General Call Out:
 - *“KD0HKD; EM28; Handheld; Missouri!”*
- Option Two: Specific Call Out:
 - *“KY0F; (This is) KD0HKD; EM28; Handheld; Missouri;”*
- As a courtesy, “more powerful” stations should yield to you as a Handheld.
- DO NOT call out “CQ, CQ, CQ, *Satellite!*” In this arena, this is considered a very serious breach of etiquette!



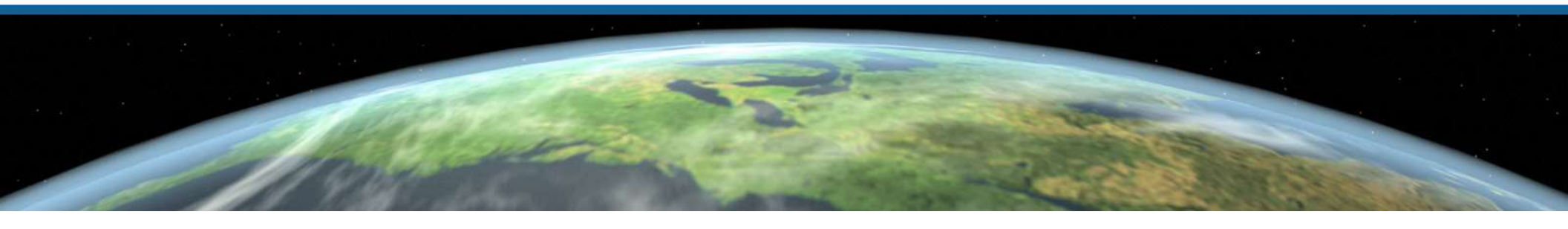
Some Basic Tools In Our Bag of Tricks!

- **Radio**
 - 5 Watt (or less) Split-Band, Hand Held HT Radio
- **Antenna**
 - Hand Held Yagi Antenna, or
 - After Market HT Whip
- **Voice Recorder**
 - Digital or Tape Recorder
- **Satellite Prediction Software**
 - For PC Computer:
 - For PDA Running or Smart Phone
- **A Simple Compass**



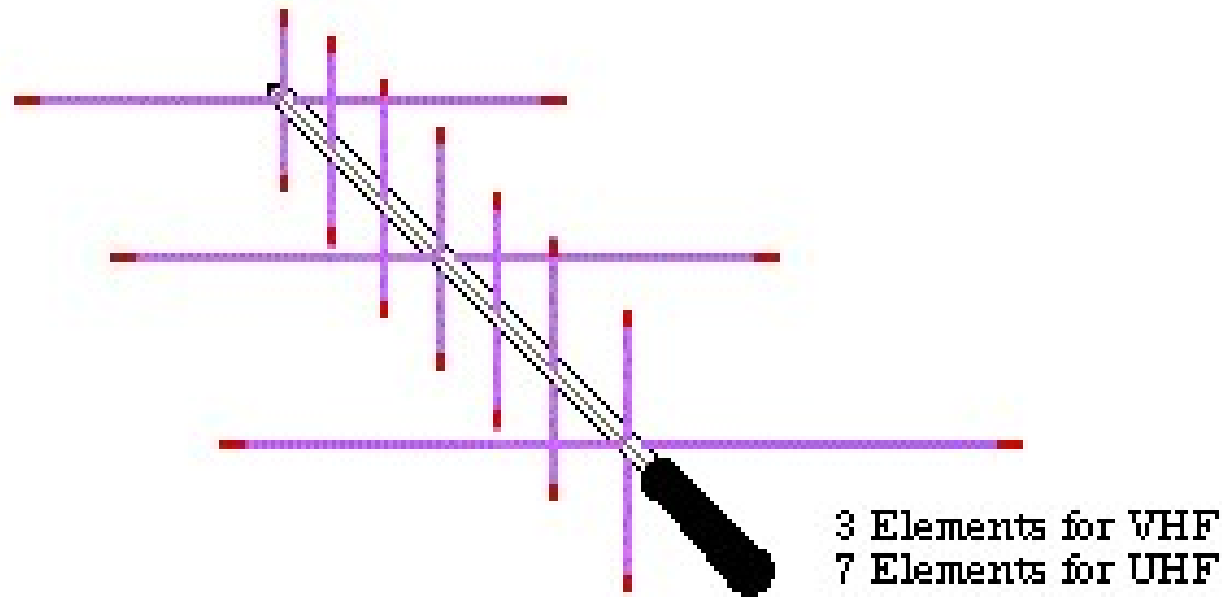
Radio: Yaesu FT-60R Hand Held

- Capable of “Split-Band” Operation. i.e. Transmit on UHF while Receive on VHF or visa versa.
- Up to 5 Watts Transmit Power
- Relatively low cost.
- Easy to connect to various antenna options.
- Channel Programming software is available, and highly recommended.



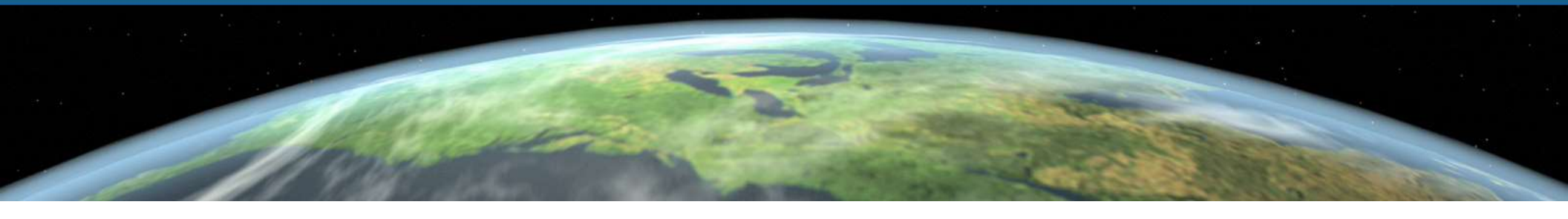
Antenna: Arrow II LEO Hand Held Antenna

- VHF – UHF Yagi
- Most expensive option with all the features costs less than \$150.00 retail.
- Easy to assemble / Easy to use.



Antenna: After Market HT Whips

- VHF – UHF After Market Antenna for Hand-Held
- Prices vary, but you will get what you pay for!
- Most aftermarket whips are very good antennas. Works not only for Satellite, but are excellent for general hand-held use.



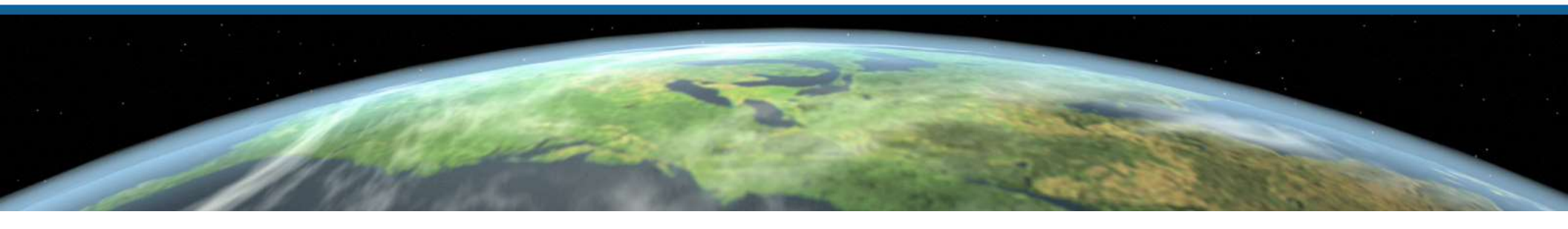
Voice Recorder

A recorder is recommended in lieu of writing notes to capture call signs, grid squares, etc.

- Digital Voice Recorder
- Time / Date Stamp for each recording
- Comes with software for loading recordings to computer as MP3 Files
- Cost is about \$60 at Target or Walmart
- May be worn on a lanyard or clipped to a belt or pocket for ease of use



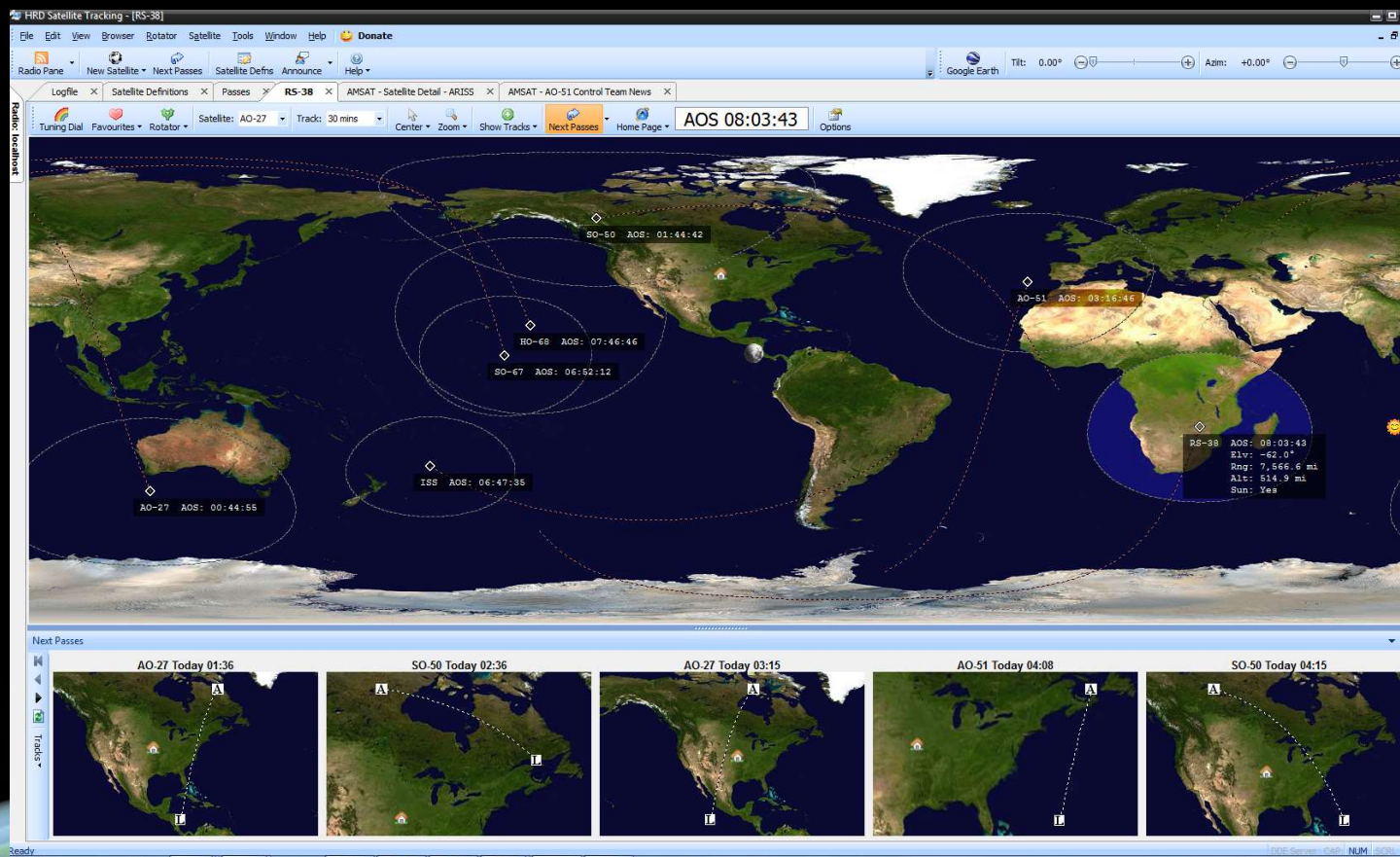
Sony
ICD PX-270



Prediction Software:

Ham Radio Deluxe (HRD)

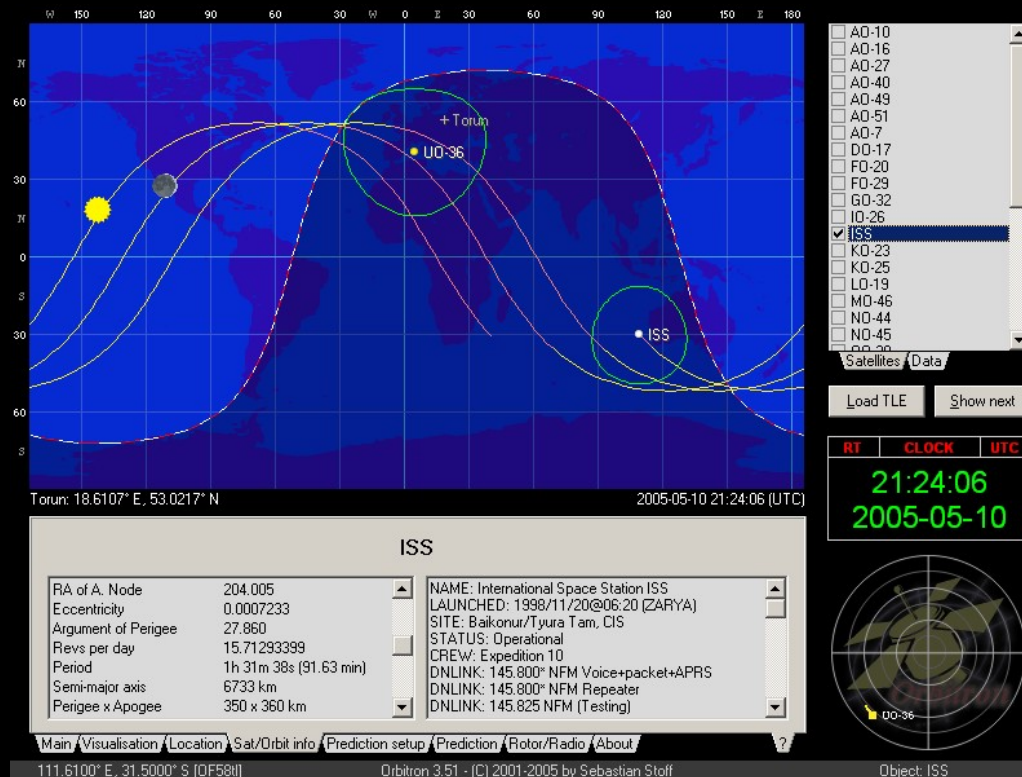
- Version 5.x is Free of Charge / Version 6.x Requires a License.
- Keeps Keplerian Data current via the Internet.
- Displays as many (or as few) satellites as you would like.
- Has *many* of the features enjoyed by satellite users.



Prediction Software:

Orbitron

- For radio amateur and observing purposes. It's also used by weather professionals, satellite communication users, astronomers, UFO hobbyist and even astrologers.
- Application shows the positions of satellites at any given moment (in real or simulated time).



<http://www.stoff.pl/>

Prediction Software:

HamSatDroid:

This software predicts future passes for amateur radio satellites for a specified location and period of time. It runs on the Android operating system (v 1.5 and above).

Features:

- Calculate passes for up to the next 24 hours
- Graphical pass display
- Map view showing current satellite position
- Update keps from a file on SD card or directly from AMSAT's webpage using your phone's internet connection
- Set home coordinates from Network or GPS

44° 8:58 AM

HamSatDroid

Satellite SO-50 Calculate passes for the next Next Pass Only

Starting: now

Calculate Pass Change Start Time

Pass predictions for satellite SO-50, for home coordinates (lat/lon/gridsquare) 38.8165/-94.9/EM28nt, for the next pass only, starting April 21, 2011 8:57 AM:

Date: April 21, 2011
Start Time: 8:52 PM
Duration: 11 min
AOS Azimuth: 170°
Max Elevation: 20°
LOS Azimuth: 45°

44° 8:59 AM

HamSatDroid

SO-50

Home Lat/Lon: 38.8165°/-94.9°
Home Gridsquare: EM28nt

Pass Information Satellite Location

Date: April 21, 2011 Elevation: -62°

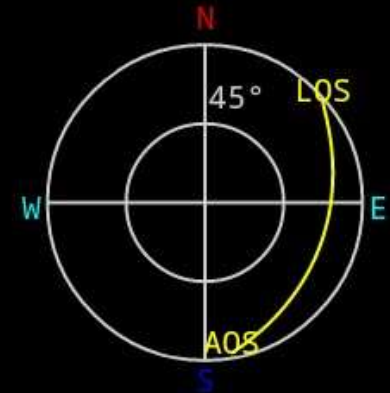
Start Time: 8:52 PM Azimuth: 147°

Duration: 11 min Latitude: -64.08°

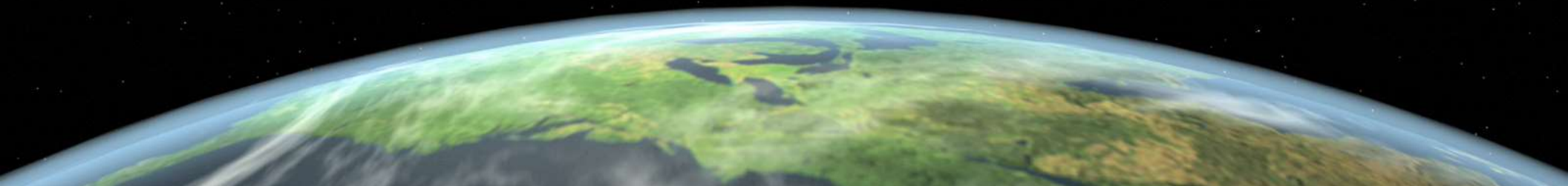
AOS Azimuth: 170° Longitude: 2.56°

Max Elevation: 20° Range: 12,007 Km

LOS Azimuth: 45°



<http://sites.google.com/site/hamsatdroid/home>



Prediction Software:

AMSAT Web Site

- Available on the internet to anyone.
- Data elements are always current.
- Only displays one satellite at a time.
- All times listed as UTC/GMT on this site.

AMSAT Online Satellite Pass Predictions - AO-51
[View the current location of AO-51](#)

Date (UTC)	AOS (UTC)	Duration	AOS Azimuth	Maximum Elevation	Max EI Azimuth	LOS Azimuth	LOS (UTC)
31 Jan 10	09:36:58	00:13:30	133	24	76	2	09:50:28
31 Jan 10	11:15:06	00:14:30	186	38	272	339	11:29:36
31 Jan 10	21:46:55	00:08:49	47	6	89	127	21:55:44
31 Jan 10	23:23:53	00:13:59	13	78	73	191	23:37:52
01 Feb 10	01:03:48	00:10:40	348	10	307	248	01:14:28
01 Feb 10	08:59:25	00:10:54	109	10	68	12	09:10:19
01 Feb 10	10:35:28	00:14:53	165	88	67	348	10:50:21
01 Feb 10	12:16:54	00:10:57	223	9	264	320	12:27:51
01 Feb 10	22:44:45	00:13:08	24	29	80	168	22:57:53
02 Feb 10	00:23:43	00:12:49	359	25	301	225	00:36:32

Your results are shown above
 Use the form below to request more pass predictions

Show Predictions for: for Next Passes

Calculate Latitude and Longitude from Gridsquare:

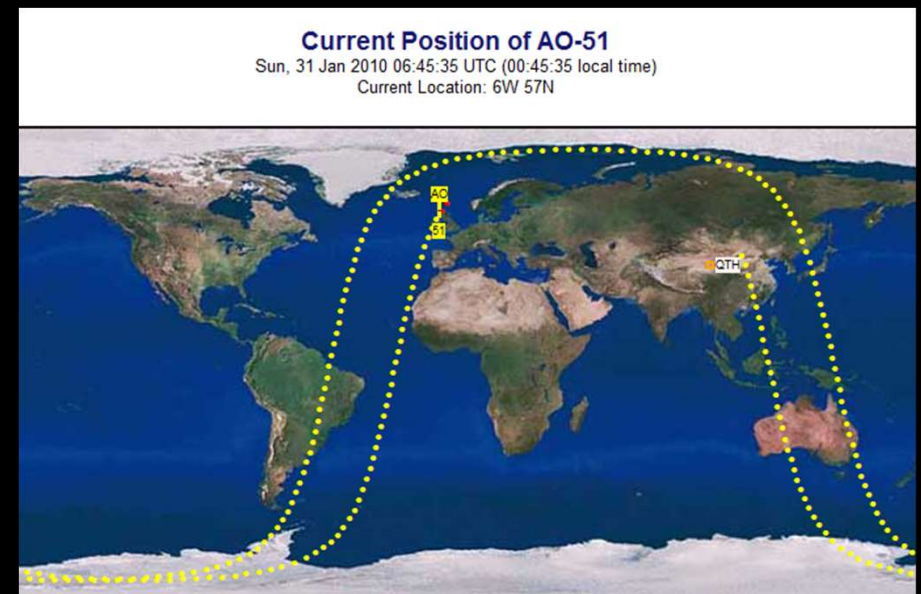
Or

Enter Decimal Latitude:*

Enter Decimal Longitude:*

Elevation (Metres):

Save my location for later use

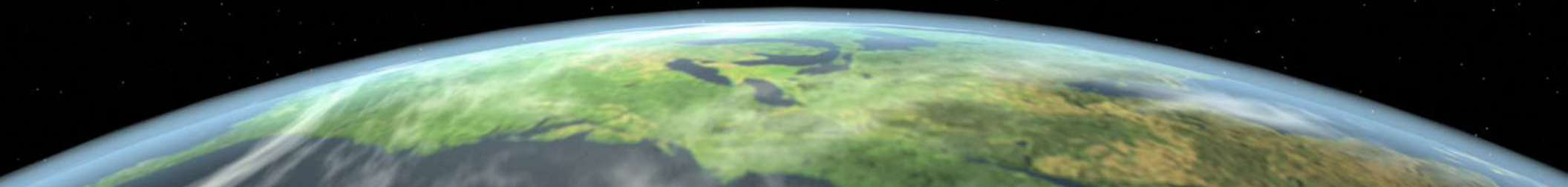


Tuning or Programming the Radio for: SO-50

Note: The Downlink, or Receive Frequency is at 5 KHz intervals to account for Doppler Shift. Also Note: CTCSS Tones.

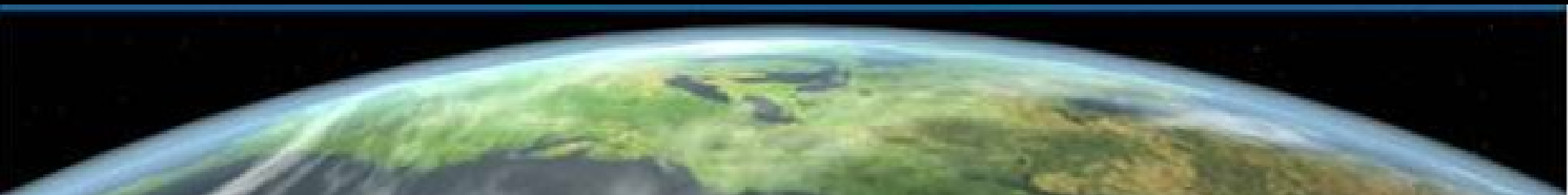
Receive Frequency	Transmit Frequency	Offset Frequency	Offset Direction	Operating Mode	Name	Tone Mode	Tone
436.81500	145.85000		Split	FM	50 +4	Tone	67.0 Hz
436.81000	145.85000		Split	FM	50 +3	Tone	67.0 Hz
436.80500	145.85000		Split	FM	50 +2	Tone	67.0 Hz
436.80000	145.85000		Split	FM	50 +1	Tone	67.0 Hz
436.79500	145.85000		Split	FM	50 MID	Tone	67.0 Hz
436.79000	145.85000		Split	FM	50 -1	Tone	67.0 Hz
436.78500	145.85000		Split	FM	50 -2	Tone	67.0 Hz
436.78000	145.85000		Split	FM	50 -3	Tone	67.0 Hz
<i>436.79500</i>	<i>145.85000</i>		<i>Split</i>	<i>FM</i>	<i>50 74</i>	<i>Tone</i>	<i>74.4 Hz</i>

What's this thing with the 74.4 Hz tone? That actually turns the radios in the satellite on! In the rare event that SO-50 comes over the horizon, and no traffic is heard, transmit this tone for about 2 seconds. This will turn the radios on. If there is no traffic detected for ten minutes, the radios will shut off. This saves battery power.



Hams in Space

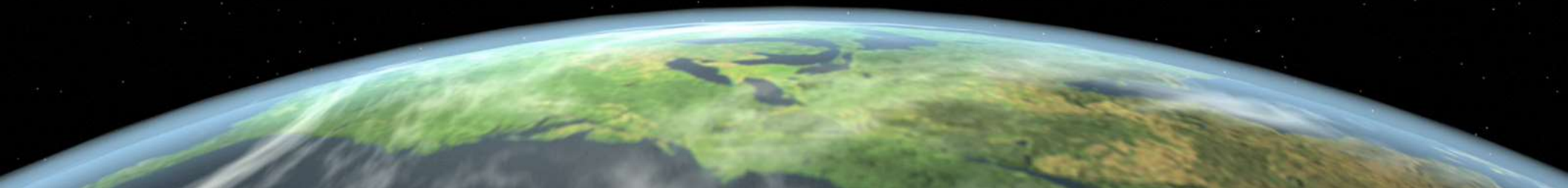
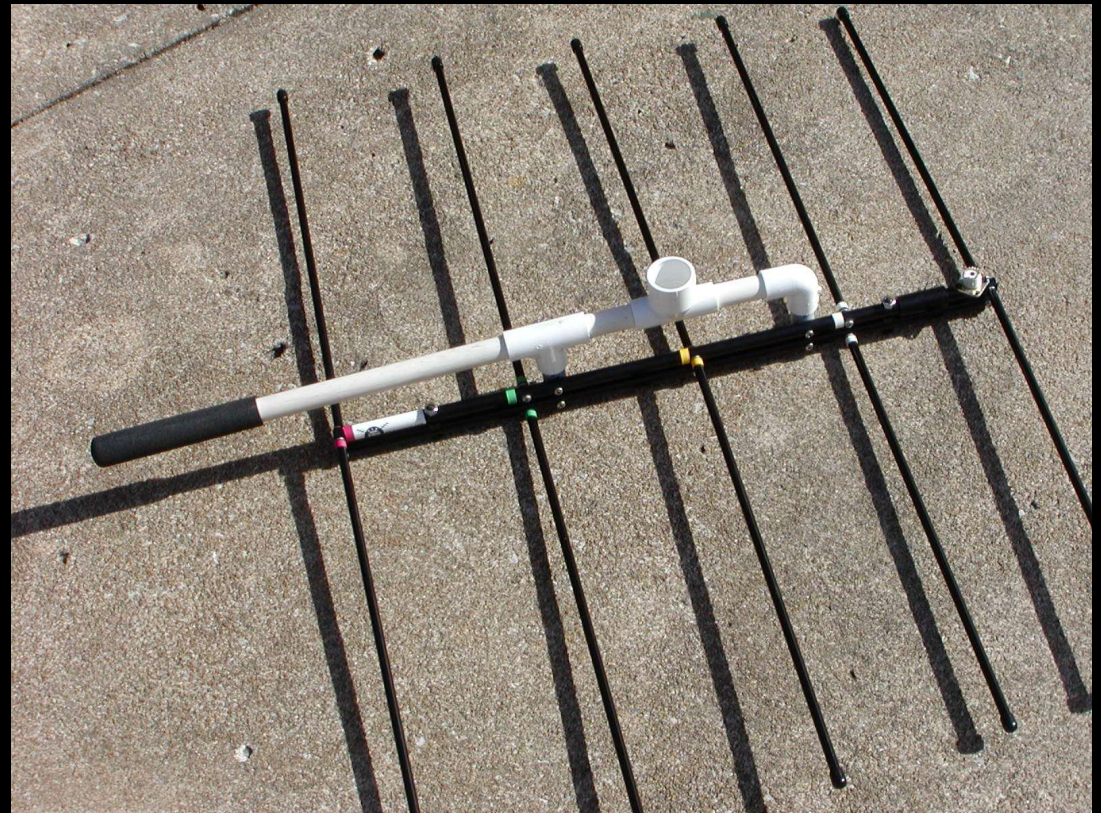
Gadgets!



Antennas:

Elk Model 2M/440L5 Five Element, Log Periodic Antenna

- Pros:
 - No Diplexer Required for 145 Through 440 MHz
 - Strong Clear Signal
 - Sturdy, Well Built Construction
- Cons:
 - Heavy
 - Requires More Precision
 - Handle Could be Better Engineered
- Available from:
<http://www.elkantennas.com>



Antennas:

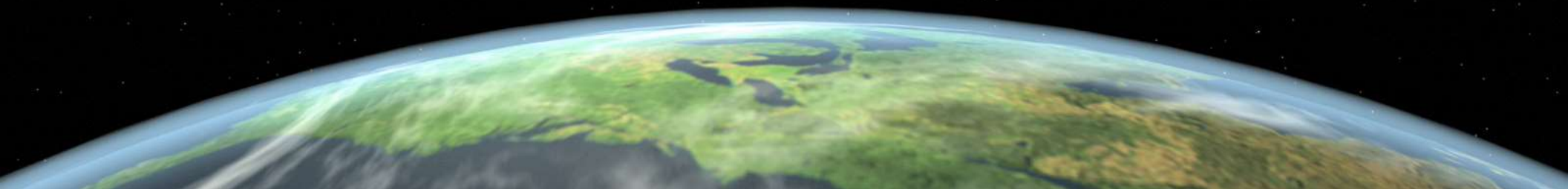
Stephen Gulyas BNC-to-SMA Adapters

- **Pros:**
 - TRUE protection of your HT's antenna connector
 - Not "one size fits all" - several models for different HTs
- **Cons:**
 - Only available from Stephen - no big store carries them, yet.
 - Cost - but compare with a \$100 bill to repair you HT's broken antenna center pin connector, and the cost is nothing



Hard rubber displaces the stress placed on your HT when attaching larger antennas or cabling. These fine adapters "mate" to a much larger surface area on your HT than the "all-metal" CN3-like adapters. Click on the link above for a .pdf file with pictures, model numbers, and ordering instructions.

Submitted By: K6LCS – Clint Bradford



Antenna Rotator:

Azimuth – Elevation (Az-El) Antenna Rotator System

- **Pros:**
 - Ability to track your satellite pass from Horizon to Horizon.

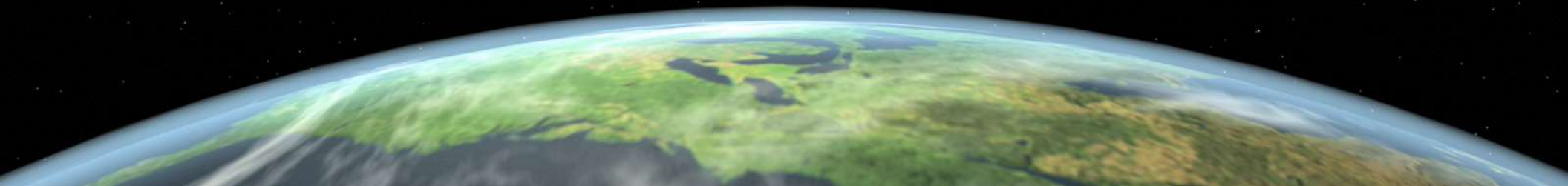
- **Cons:**
 - Prohibitively EXPENSIVE!
 - *You Don't Need One*

If you really want a rotator for tracking across the horizon, use a single plane, (azimuth) rotator with a suitable antenna permanently affixed at 30 to 45 degrees elevation. This will provide superb performance for 95% of all satellite passes.

- The one pictured here is a Yaesu G5500:

<http://www.yaesu.com>

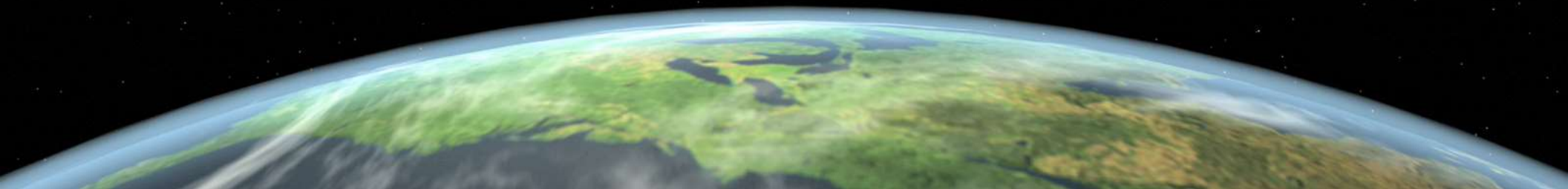
- \$589 for the Rotator, \$569 for the Computer Interface



Radios – Hand Held:

Yaesu VX-3R

- **Pros:**
 - Very Small, Light Weight, and Compact.
 - With the right antenna, capable of successful amateur radio satellite communication.
- **Cons:**
 - Difficult to program. (RDMS Software is available.)
- **Available from:**
<http://www.associatedradio.com/>
- Really, any good HT, be it Yaesu, Icom, Kenwood, or whatever, so long as it is capable of “split-banding” and PL Tone will be more than satisfactory to work Satellites!



Radios – Hand Held:

Wouxun KG-UVD1P

- **Pros:**
 - Good value.
 - With the right antenna, capable of successful amateur radio satellite communication.
- **Cons:**
 - Output sounds a little “clipped.”
- **Available from:**
<http://www.associatedradio.com/>

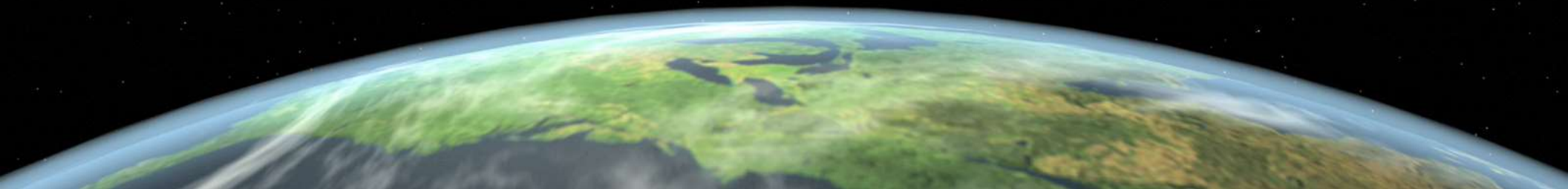
For the money, this is a great little radio! Comes with Programming Software and USB Cable, all in the same Package.



Radios – Hand Held:

Baofeng UV-3R

- **Pros:**
 - Good value. About \$50.00 Including Shipping
 - With the right antenna, capable of successful amateur radio satellite communication.
- **Cons:**
 - Programming Is Very Difficult, Even With Software
 - User Groups and Forums on the Internet
- **Available from:**
 - Several Outlets on the Internet
- For the money, this is a great little radio!
It is very similar in form to the Yaesu VX-3R



Radios – Hand Held:

Baofeng UV-5R

- **Pros:**
 - Good value. About \$50.00 Including Shipping
 - Up to 5 Watts
 - With the right antenna, capable of successful amateur radio satellite communication.
- **Cons:**
 - Programming Is Very Difficult, Even With Software
 - User Groups and Forums on the Internet
- **Available from:**
 - Several Outlets on the Internet
- For the money, this is a another great little radio!



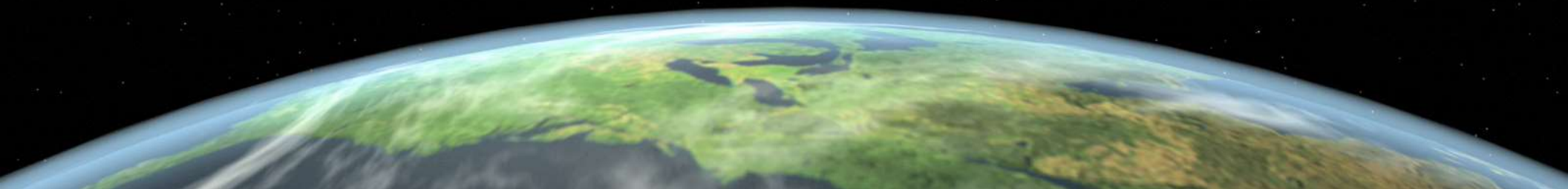
Resources:

Work-Sat

- This is the web site of Clint Bradford, K6LCS from Southern California. He has an outstanding website, containing Satellite Schedules, Antenna Projects, Advice, and an outstanding blog. *This is a must have on the favorites list for any satellite aficionado!* Clint has also orchestrated contacts with the ISS for schools!
- <http://work-sat.com>

AMSAT

- The Radio Amateur Satellite Corporation or AMSAT is the mother-ship for all who are interested in Amateur Radio Satellites.
- <http://www.amsat.org/>



Putting All of This Together:

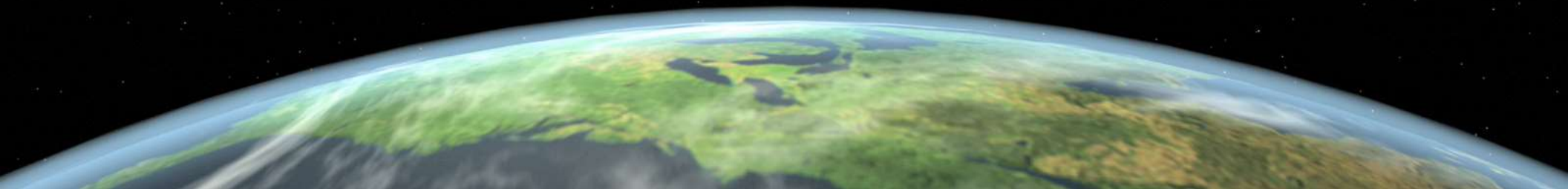
- Satellite

- Antenna

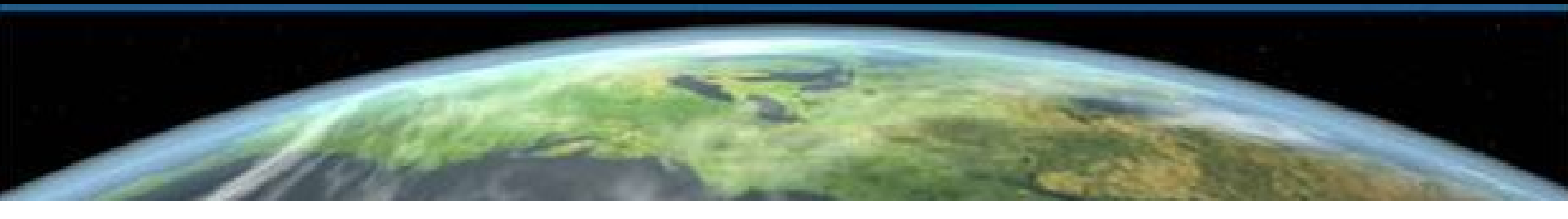
- Radio

- Results

Keep It Simple! Have Fun!



Q&A



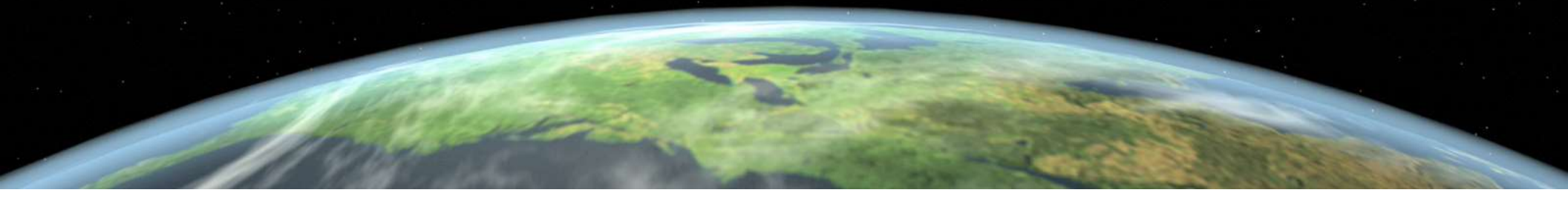
Web Sites Mentioned in Our Presentation:

- **KD0HKD's Radio Web Site:**
<http://kd0hkd.com>
- **KD0HKD's Satellite Web Site:**
<http://kd0hkd.com/satellite>
- **AMSAT (Radio Amateur Satellite Corporation):**
<http://www.amsat.org>
- **QRP Association:**
<http://www.qrparci.org>
- **Arrow Antennas:**
<http://www.arrowantennas.com>
- **Ham Radio Deluxe:**
<http://ham-radio-deluxe.com>
- **Orbitron:**
<http://www.stoff.pl/>
- **PockerSat+ :**
<http://www.bigfattail.com/pocketsat/>
- **HamSatDroid:**
<http://sites.google.com/site/hamsatdroid/home>



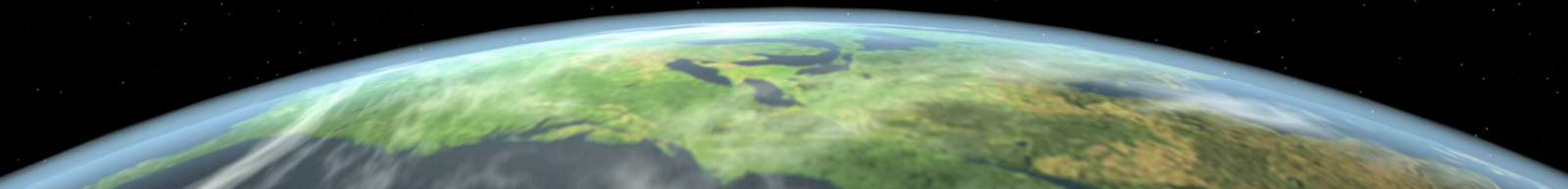
Web Sites Mentioned in Our Presentation:

- **Elk Antennas:**
<http://www.elkantennas.com>
- **Myers Engineering:**
<http://www.antennas.us>
- **Smiley Antennas:**
<http://www.htantennas.com>
- **Stephen Gulyas BNC-to-SMA Adapters :**
http://www.work-sat.com/Antennas_files/GULYAS-03292018.pdf
- **Associated Radio:**
<http://www.associatedradio.com/>
- **eBay:**
<http://ebay.com>
- **Bass Pro Shops:**
<http://www.basspro.com>



Web Sites Mentioned in Our Presentation:

- **Cabella's:**
<http://www.cabellas.com>
- **Harbour Freight:**
<http://harbourfreight.com>
- **Clint Bradford, K6LCS Web Site:**
<http://work-sat.com>
- **Allen Mattis, N5AFV Web Site:**
<http://www.qsl.net/n5afv/>
- **Ron Nutter, KA4KYI Web Site:**
<http://ka4kyi.com/>





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