

A satellite is shown in space, tilted at an angle. A bright green laser beam originates from the Earth's surface and points directly at the satellite. The Earth's surface is visible in the background, showing a dark blue and black landscape. The satellite is a rectangular box with various panels and antennas. The overall scene is set against a black background of space.

HAMSATS!

Use What's New Up There!

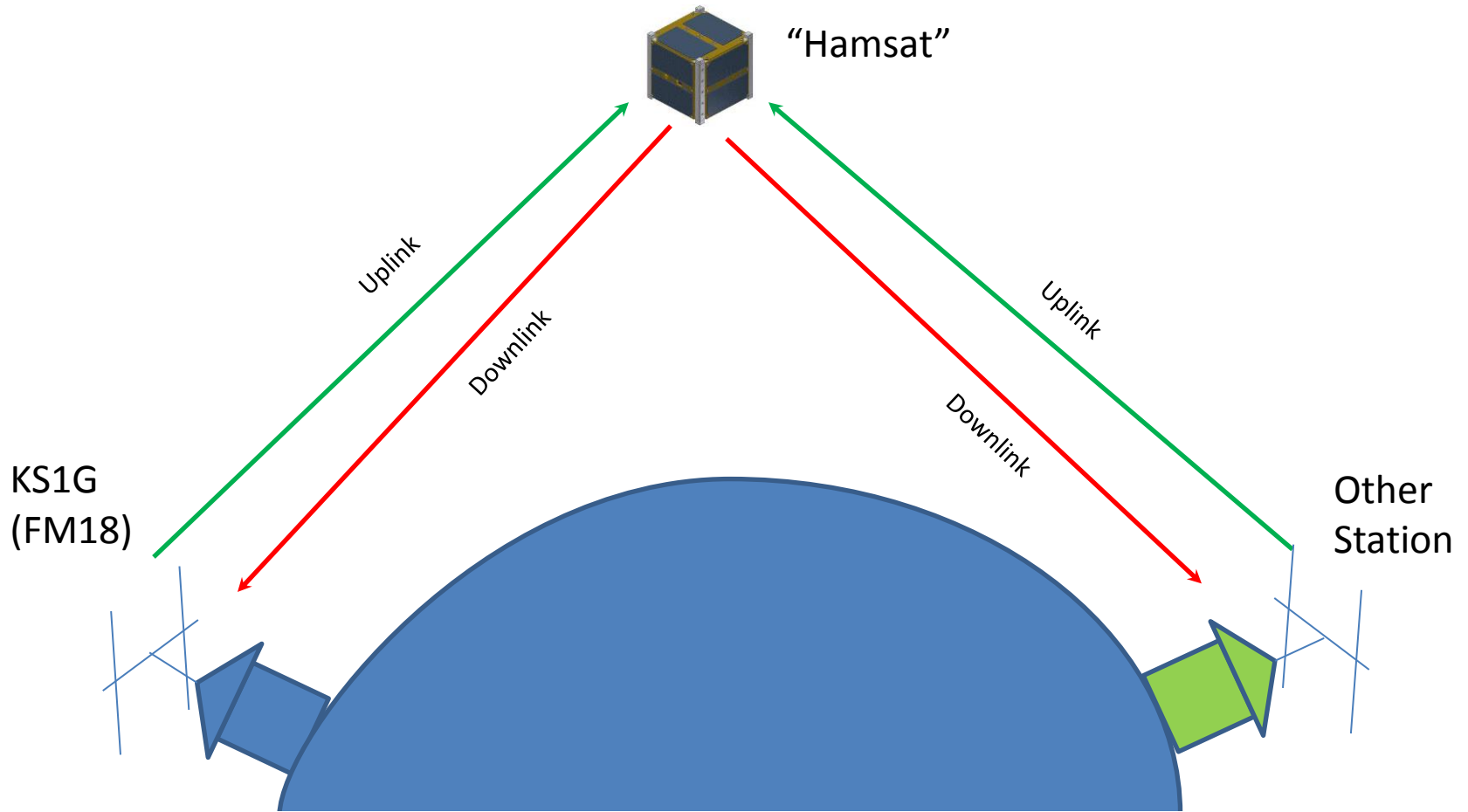
Steve Greene, KS1G

ks1g@amsat.org

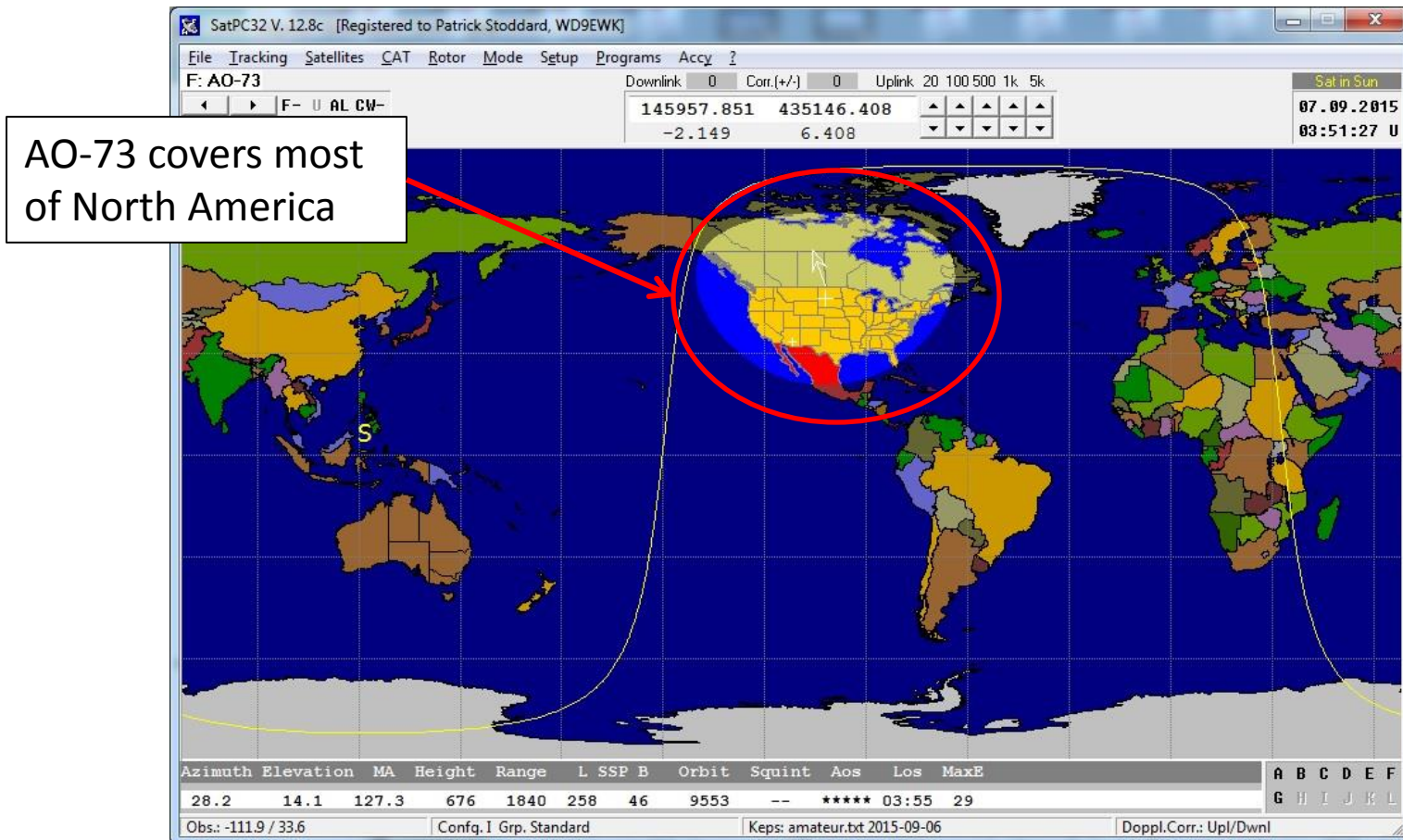
Goals

- After this talk, you will:
 - Can answer: What is a “Hamsat”? What is AMSAT?
 - Know how to get started with the new (and old) satellites
 - Equipment
 - Operating techniques
 - Be eager to give it a try! (and to support AMSAT)

A Repeater In the Sky!...



...with a **BIG** Footprint!



- The higher the orbit, the greater the range.
- On some satellites, you can work stations in Europe!

A LONG & DISTINGUISHED History



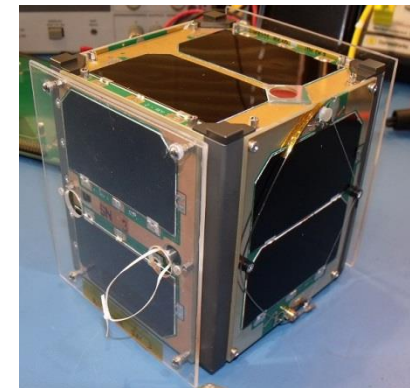
Oscar-1 (1961)



MicroSats (1990)



AO-40 (2000)



AO-85/Fox-1 (2015)

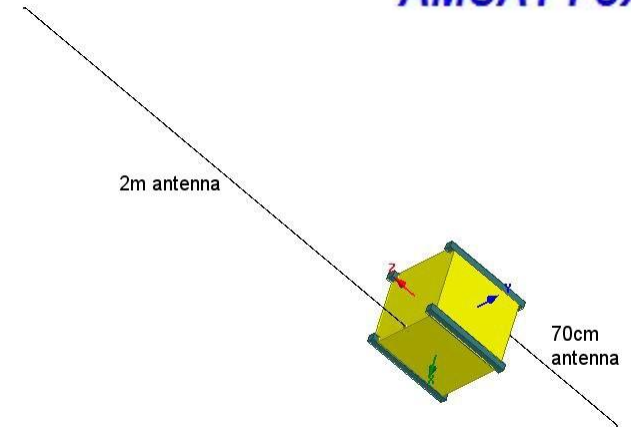
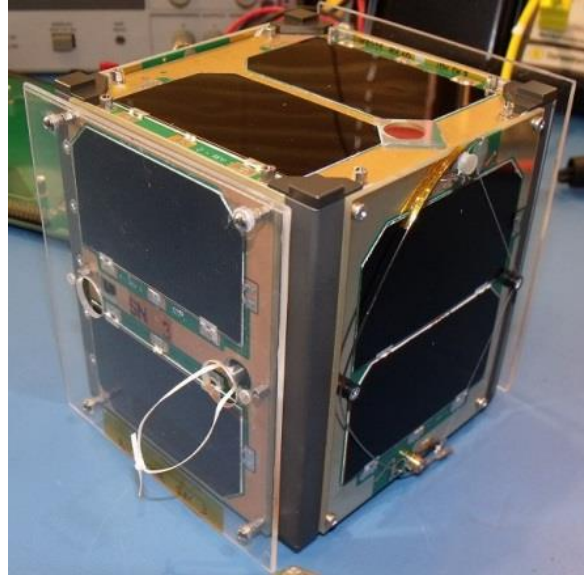
What Can You Work?

(Today's Targets in BOLD Text)

Satellite	What	Uplink (TX)	Downlink (RX)	"Mode"
AO-85 (2015)*	FM	70cm	2M	U/V (old B)
SO-50 (2002)	FM	2M	70cm	V/U (old J)
LilacSat (2015)	FM	2M	70cm	V/U (old J)
ISS	FM (APRS)	2M	2M	V/V
NO-84 (PSAT) (2014)	PSK31 (some APRS)	10M (SSB) 2M (APRS)	70cm (FM) 2M (APRS)	
AO-73 (2013)	CW, SSB	70cm	2M	U/V
XW-2A, E, F (2015)	CW, SSB	70cm	2M	U/V
AO-7 (1974)	CW, SSB	70cm 2M	2M 10M	U/V (old B) V/H (old A)
FO-29 (1996)	CW, SSB	2M	70cm	

*Fox 1-B, 1-C, 1-D under construction for 2016+ launches

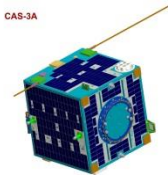
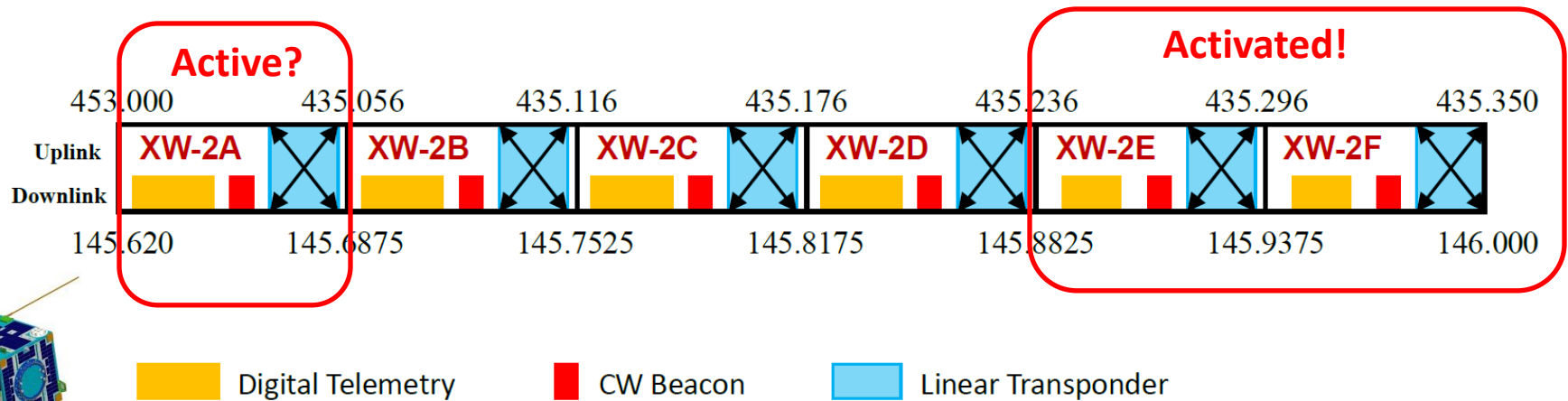
Oct 8, 2015: AO-85!



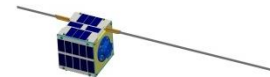
- Fox-1A: 10 cm x 10 cm x 10 cm "1U" Cubesat, ~1.3 Kg (3 lb)
- 1-channel FM transponder, Mode "U/V" (70cm up / 2M down)
- 400-800 mW 2M downlink (easier reception than SO-50!)
- Low-speed telemetry on sub-audible channel simultaneous with voice
- Operate as a "zombiesat/daysat" if IHU fails or batteries short
- University camera experiment + high speed telemetry mode
- NASA ELaNa program, NRO-55 launch
- 5 follow-ons built or planned: Fox-1B, C, D, E; Fox-2

4+ New Birds! – September 2015

China launches CAMSAT **XW-2** (CAS-3) cluster:



...and **LilacSat-2** (CAS-3H)



Mode	Uplink	Downlink
APRS	144.39 MHz	144.39 MHz
FM Voice	144.35 MHz	437.20 MHz
Beacon (CW)	-	437.20 MHz

<http://www.amsat.org/wordpress/uploads/2015/09/XW-2CAS-3-Sats.pdf>
<http://www.amsat.org/?p=4181>

What Neighbors, Family & YOU Think You Need

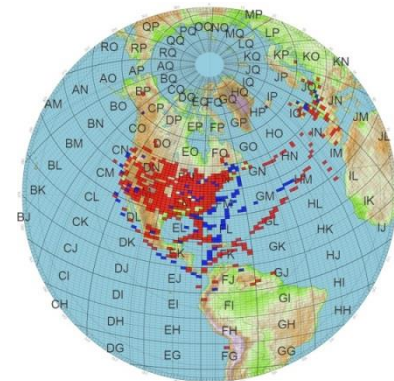


What You REALLY Need

(Paul, N8HM, Washington DC)



49 states, 48 countries, 4 continents
634 grids worked in 40 fields



Gear for Satellite Ops



2M



70cm

or

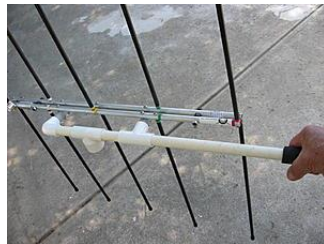


Dual-band

(Not shown: coax, power)



Arrow



Elk



or Homebrew



(maybe)

Prediction/
Tracking

AMSAT Online Satellite Pass Predictions

AMSAT Online Satellite Pass Predictions - SO-50									
Date (UTC)	AOA (UTC)	Duration	Max El	Max Az	Max El	LOS (UTC)	LOX (UTC)		
			Asimuth	Elevation	Asimuth				
09-Jul-15	19:22:17	00:12:07	100	25	125	44	19:20:14		
09-Jul-15	21:02:15	00:13:53	233	36	317	25	21:19:08		
09-Jul-15	22:46:15	00:09:41	287	7	327	13	22:55:56		
09-Jul-15	02:14:36	00:07:41	350	4	16	55	02:22:17		
09-Jul-15	03:54:16	00:13:14	359	21	34	111	04:07:30		
09-Jul-15	05:34:34	00:14:15	323	54	290	162	05:48:59		
09-Jul-15	07:17:29	00:07:35	290	4	265	225	07:25:04		
09-Jul-15	18:10:40	00:08:30	141	6	100	65	18:19:10		
09-Jul-15	19:47:26	00:14:09	203	66	132	35	20:01:35		
09-Jul-15	21:20:08	00:12:48	295	18	312	20	21:41:48		

Your results are shown above

Use the form below to request more pass predictions

Show Predictions for: SO-50 for Next: 10 Passes

Calculate Latitude and Longitude from Gridsquare:

Or

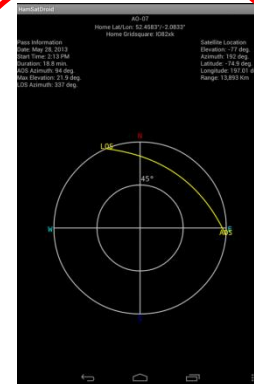
Enter Decimal Latitude: North

Enter Decimal Longitude: West

Elevation (Metres):

Save my location for later use

Internet
or



Smart Phone, PC

Useful



Gear for Satellite Ops

Station Component	Typical
Radios	Separate 2M, & 70cm HTs Dual-band HT “Multi-mode” radios SDR
Antennas	Arrow, Elk Cheap-Yagi Other Commercial Other Homebrew Omnis
Diplexer	Split bands for sep. antennas/radios, UHF desense
Preamp	If needed for Rx (AMSAT preamp shown)
Tracking Software	Web, PCs, smart phones
Voice recorder	Reduce workload, Log after the pass
Headset	Saves a hand

Program Your Radio

- Reduce workload (esp. when using Dual-Band HT)
- Set memories with Tx, Tone, Rx to manage Doppler
- Step through the channels during the pass

AO-85 (Fox-1A) Memory Programming		
Memory Channel	Transmit* (+ 67Hz Tone)	Receive
1 (AOS)	435.170 MHz	145.980 MHz
2 (Approaching)	435.175 MHz	145.980 MHz
3 (Passing)	435.180 MHz	145.980 MHz
4 (Departing)	435.185 MHz	145.980 MHz
5 (LOS)	435.190 MHz	145.980 MHz

Fox-1A Operating Guide from the AMSAT Station and Operating Hints page:

http://www.amsat.org/?page_id=2144

*** Recommended transmit frequencies changed *slightly* post-launch – see AMSAT.org**

Is It Working? Live Satellite Status

<http://oscar.dcarr.org/>

<http://www.amsat.org/status/>

AMSAT Live OSCAR Satellite Status Page

This web page was created to give a single global reference point for all users in the Amateur Satellite Service to show the most up-to-date status of all satellites as actually reported in real time by users around the world. Please help others and keep it current every time you access a bird.

If you want to practice reporting without affecting the real data, please select the dummy-satellites AO-98 and AO-99.

Name	Transponder/Repeater active		Telemetry/Beacon only		No signal		Conflicting reports		ISS Crew (Voice) Active	
	Oct 14	Oct 13	Oct 12	Oct 11	Oct 10	Oct 9				
CUTE-1	1 1	1 1 121	11121	1 1 111	11 112	212 2				
UKube-1		1 11		1 1						
LilacSat-2	1 21	131 2 233111145	3212	141 34 312	111	4 1122 1 53	1 2 1	2		
[A]_AO-7	2 1		1 11 2111		1 11	1				1
[B]_AO-7		21112 13462211	1 1 11	112243433		1 11	112455 321			
XI-V		1 11	11	1 11	1	1				
[B]_UO-11	111	1 11	1 1	1	1					1
RS-15		11	1 1		2					
LO-19	1	1	1	11		1				
Fox-1A						314184 182 3165688515134	151313			
FO-29	411 33	231323222	134 631122	1513563221	1 1 3 822121	1112 244 323				
XW-2A	1 12	11	1 11 1	1 11 1	1 1 1	21 1 1	32 2			
XW-2B	1 1	1	2 1	11 1 1	1 1 11	1 1	1 1			
XW-2C	1 11	1 11	2 1	12 1	1 1 1	1 1 1	1 1			
XW-2D	1 11	1	1 1	11 1 1	1 1 11	1 1	1 1			
XW-2E	4 14212 2 425123321	1 24411222211234	1251	331 1 4121	5421 4211454	3322 2				
XW-2F	3 2621211 463 2332	11352114311113361	261	331 1 3121	6421 3211443	3112 5				
GO-32		1		1						1
NO-44		1	11	1 1						1
SO-50	21 32	312221	2 1 35 421	33 432831	21 2 3 18 32 41	24 22	1			
HO-68	2 1	1 1 1 1	1 1 1 2	1 1 1 2	1 1 1 2	112	111 1			
AO-73	23 21 11	311221	211112221	1 12 12321222212 11	4 1 153111 2 232	3 7 21 1				
EO-79					1					
NO-84	11 11		1 1 1 1	111	1 1 1	1 1	1 1			
AO-85	212553265	1 13 2336443114821359795	236 41062							
AO-98					1 1		1			
AO-99	1	1								
Delfi-C3	111	21	2	1 121	11		1			
ISS-FM							1			
XI-V	1111	21112	1111	11211	2 212		111 11			
DUCHIEAT1		111 1 1 21	1		1		1			
ISS-DATA	21	4113	1 23122 22	5 341 221	13 1 12	1 1111321	1 1 2			

Which mode is AO-7 in?

FM

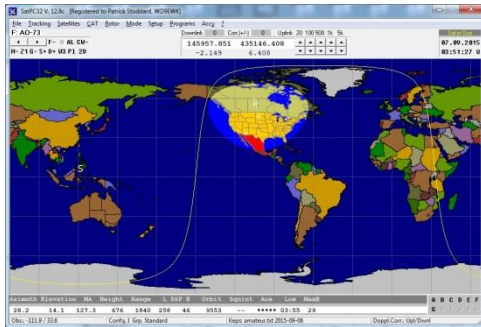
SSB & CW

PSK-31

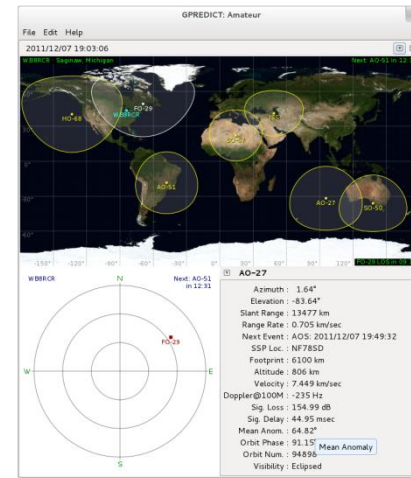
Space Station (ISS)

When? Tracking Software

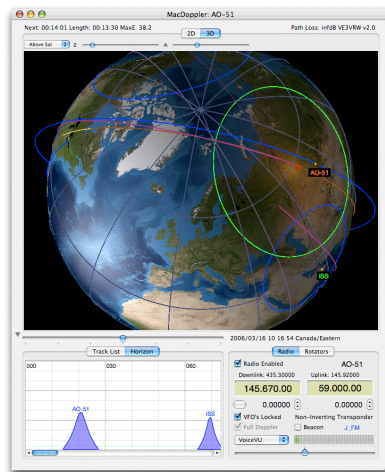
More info, purchase: <http://www.amsat.org>



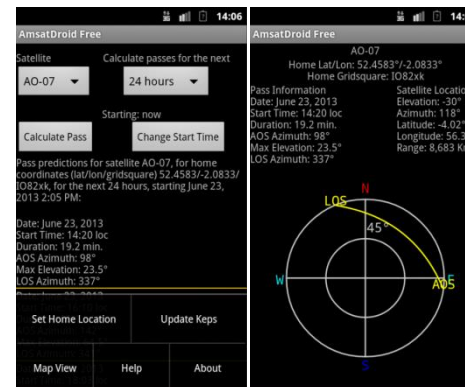
SatPC-32 (\$, Win)



Gpredict (Linux, Win)



MacDoppler (\$, Mac)



Amsat Droid (Android)

When? On-Line Pass Predictions

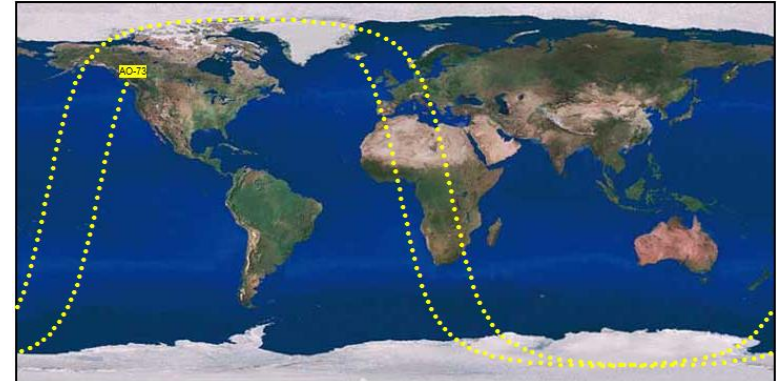
AMSAT Online Satellite Pass Predictions

NOTICE: XW-2 ephemerides now available.

Please select a satellite and provide your latitude, longitude and elevation or calculate them from your grid square. If you choose we will save your position information in a cookie on your system for future predictions.

Show Predictions for: AO-73		for Next	10	PASSES
Calculate Latitude and Longitude from Gridsquare:		FM18fc	Calculate Position	
Or				
Enter Decimal Latitude:*	38.1042	North		
Enter Decimal Longitude:*	77.5416	West		
Elevation (Metres):	100			
Predict				
<input type="checkbox"/> Save my location for later use				

Current Position of AO-73
Tue, 6 Oct 2015 18:40:35 UTC (14:40:35 local time)
Current Location: 124W 57.5N



Pass Predictions & Real-Time Tracking:

<http://www.amsat.org/amsat-new/tools/predict/index.php>
<http://www.heavens-above.com/amateursats.aspx>
<http://www.n2yo.com>

Tracking Data (Keplerian Element Sets):

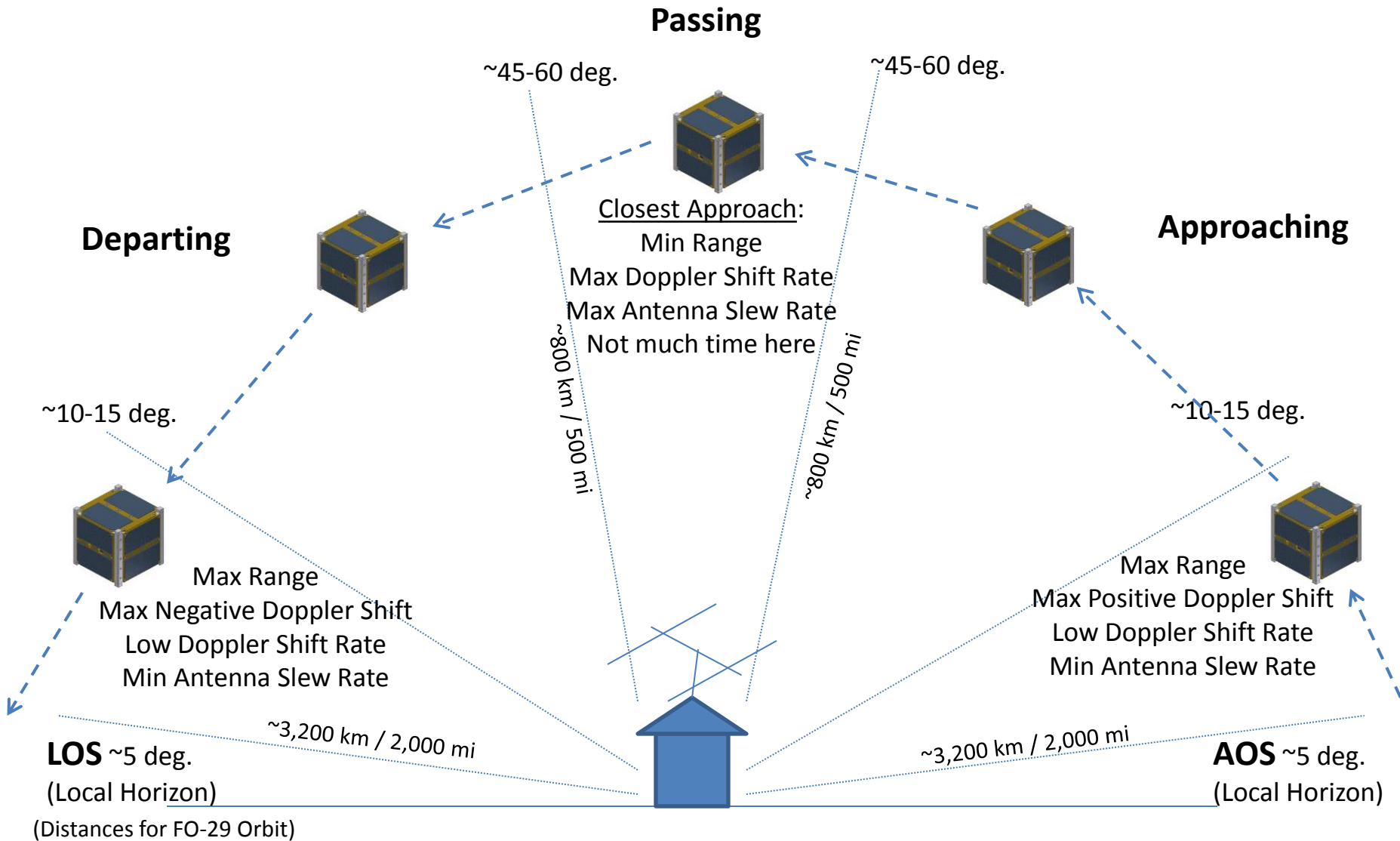
http://www.amsat.org/?page_id=2222 ← **BEST!**
<http://celestrak.com/>

Software:

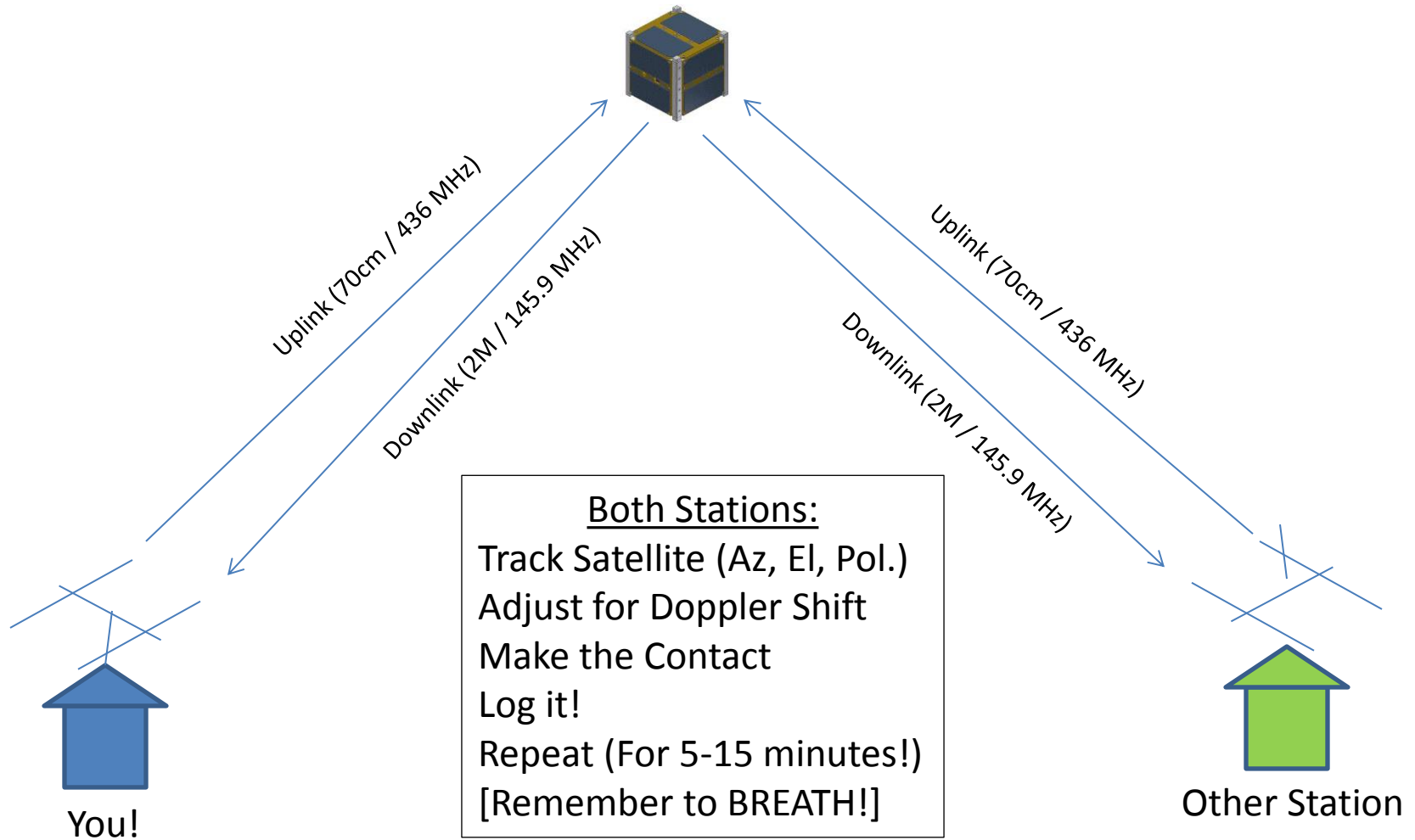
<http://www.amsat.org/amsat-new/tools/softwareArchive.php>
SatPC32, **MacDoppler**, Nova, Predict, **GPredict**
 Android - **"AMSATdroid"** (formerly HamsatDroid)
 Apple iOS – several in App Store

AMSAT Online Satellite Pass Predictions - AO-73							
View the current location of AO-73							
Date (UTC)	AOS (UTC)	Duration	AOS Azimuth	Maximum Elevation	Max El Azimuth	LOS Azimuth	LOS (UTC)
07 Oct 15	00:44:27	00:09:31	111	9	69	16	00:53:58
07 Oct 15	02:18:17	00:13:08	170	77	242	347	02:31:25
07 Oct 15	03:57:53	00:07:46	236	5	278	310	04:05:39
07 Oct 15	14:08:35	00:11:29	28	21	90	161	14:20:04
07 Oct 15	15:44:42	00:11:47	359	27	300	220	15:56:29
08 Oct 15	01:03:09	00:10:57	124	15	63	9	01:14:06
08 Oct 15	02:38:04	00:12:54	181	44	274	341	02:50:58
08 Oct 15	14:27:57	00:12:13	22	33	78	174	14:40:10
08 Oct 15	16:04:37	00:10:54	353	17	291	232	16:15:31
09 Oct 15	01:22:06	00:11:57	137	24	77	3	01:34:03

Anatomy of a Satellite Pass



“Working” The Pass



Operating Hints

(For Single-channel FM satellites: SO-50, AO-85, ...)

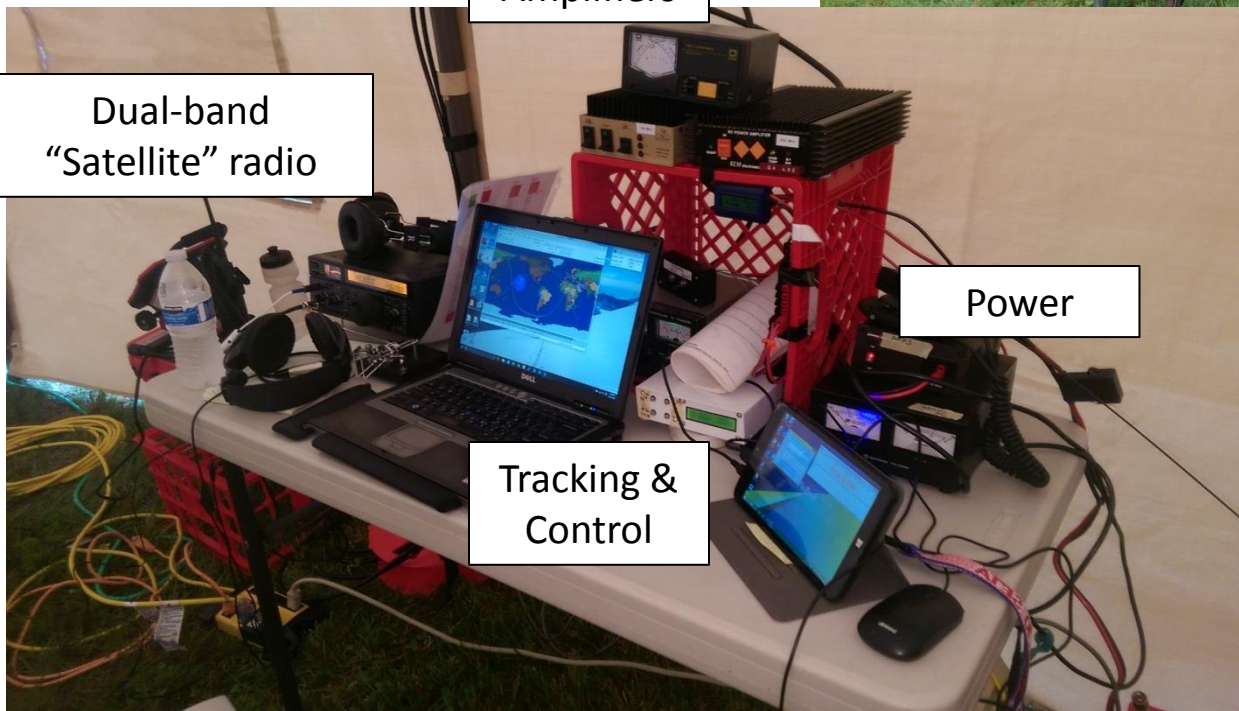
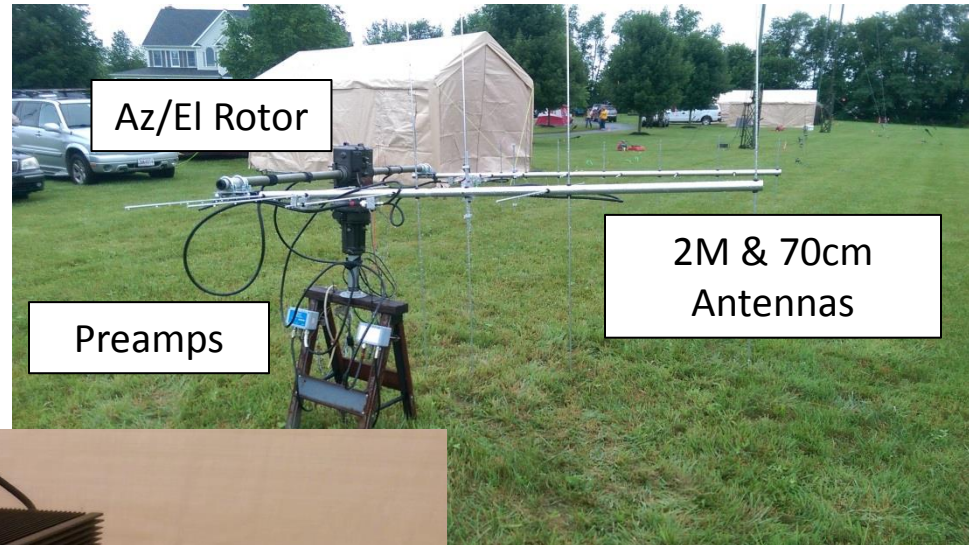
- Listen, Listen, Listen!
- DON'T CALL "CQ"!
- Contest Style – exchange Call, Grid
- Leave time for other ops
- Listen for HTs, Mobiles
- AVOID RAGCHEWING!

SAMPLE QSO	
<u>Me</u>	<u>Other Station</u>
KS1G, FM18	
	KS1G, WX4XYZ, EM63
W4XYZ, copy EM63 Thanks!	
	73s
<i>on to the next contact....</i>	

Getting Fancier

- Add CW/SSB (AO-7, FO-29, AO-73, XW-2,...)
 - 2 x 2M/70cm “all mode”
 - or 2M/70cm “all mode” + SDR (FCD Pro+, SDRPlay, ...)
- Circular-Polarized Antennas
 - Commercial (M2, HyGain), 2x Arrow, Homebrew,...
- Rotator
 - Az-Only (elevate antennas 15-20 deg)
 - Az/EI - AMSAT WRAPS, CNC Track, Yaesu (\$\$),...
- Computer control
- Preamps, Low-loss coax, ...

Field Day Satellite Station



You don't need all that to start!



Cheap HTs?

- Rx sensitivity
- Receiver desense on 70cm
- True “full duplex”?
- Ease of programming
- Used Icom/Kenwood/Yaesu >> new Chinese
- WD9EWK tests of cheap HTs (Nov ‘15 – Jan ‘16)
 - QRZ.com sat forum, amsat-bb email list archive

Cheap Antennas

- WA5VJB “CheapYagis”
- Tape Measure Yagis
- Many designs on web: amsat.org, amsat-uk.org, QRZ.com, www.work-sat.com
- Omnis
 - Cebick Turnstile Moxons (QST, 2001)
 - Passive Lindenblad (AMSAT)
- Commercial: Arrow (x-yagi), Elk (log-periodic)
 - Modified Arrow – see AMSAT WRAPS

I Don't Want to Buy *Another* \$\$\$ Rig!

- Answer: Use **SDR**!



Cheap (under \$100) Windows tablet (Winbook) and inexpensive software (SatPC32, HDSDR, ...)!



(See posts by **WD9EWK** @QRZ.com, amsat-bb list)

Being "Rare" DX is Easier on Satellites!

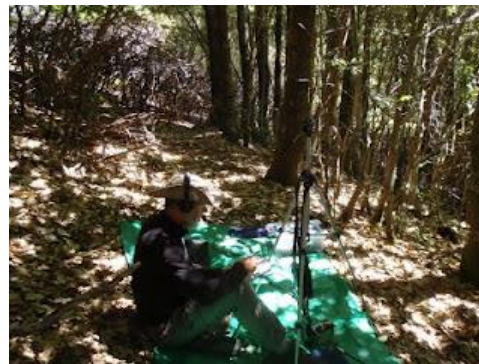
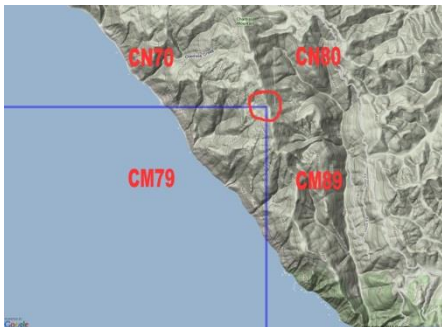
HF, traditional way, or...



Go on vacation (K8YSE)



Go on a hike (KB5WIA/6)



2 x FT817, ELK LPA ant.

Go to work! (UT1FG/MM)

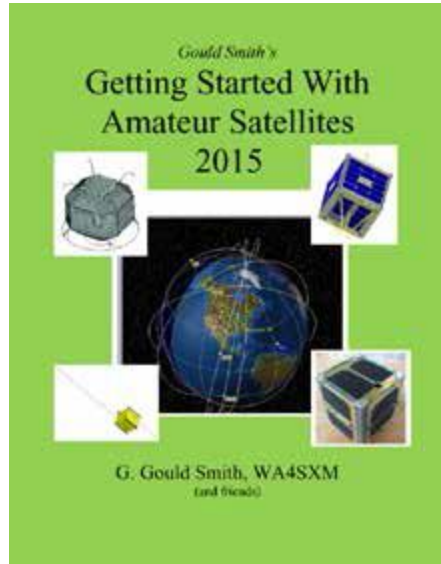


It's "Pledge Week"!

- Hams pioneered small satellites. Government & Commercial users (re)discovered them.
- Business Opportunity = Launch Cost \$\$\$ = No "free" rides (or even cheap rides)
- **Many satellites are old** (AO-7: 1974 (!), FO-29: 1996, SO-50: 2002)
- **AMSAT Fox** series need \$\$\$ to complete, test, fly.
 - AMSAT teams with school programs - get ride, provides comms. for experiment & tech advice to students
- ***Please SUPPORT AMSAT!***



Bonus!



Fox-1A Launch New Member Special Offer

For a limited time new memberships received via the **on-line AMSAT Store** receive a free downloaded copy of our book, “Getting Started With Amateur Satellites 2015” ... a \$15 value.

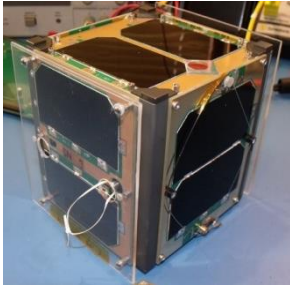
Join today at: <http://store.amsat.org>

And you also receive ...



More info

- AMSAT-NA: <http://www.amsat.org>
 - <http://www.amsat.org/amsat-new/information/faqs/>
- Work-Sat: <http://www.work-sat.com>
 - Yahoo: <http://groups.yahoo.com/group/Work-Sat/>
- Elmering:
 - AMSAT Area Coordinators (nearby in Maryland-DC)
<http://www.amsat.org/amsat-new/information/ac.php>
 - <http://www.papays.com/sat/general.html>
- AO-85:
 - Fox Project: http://ww2.amsat.org/?page_id=1113
 - Amsat.org (www.amsat.org, amsat-bb emails)



73's

&

Hope to work you
on “the Birds”!