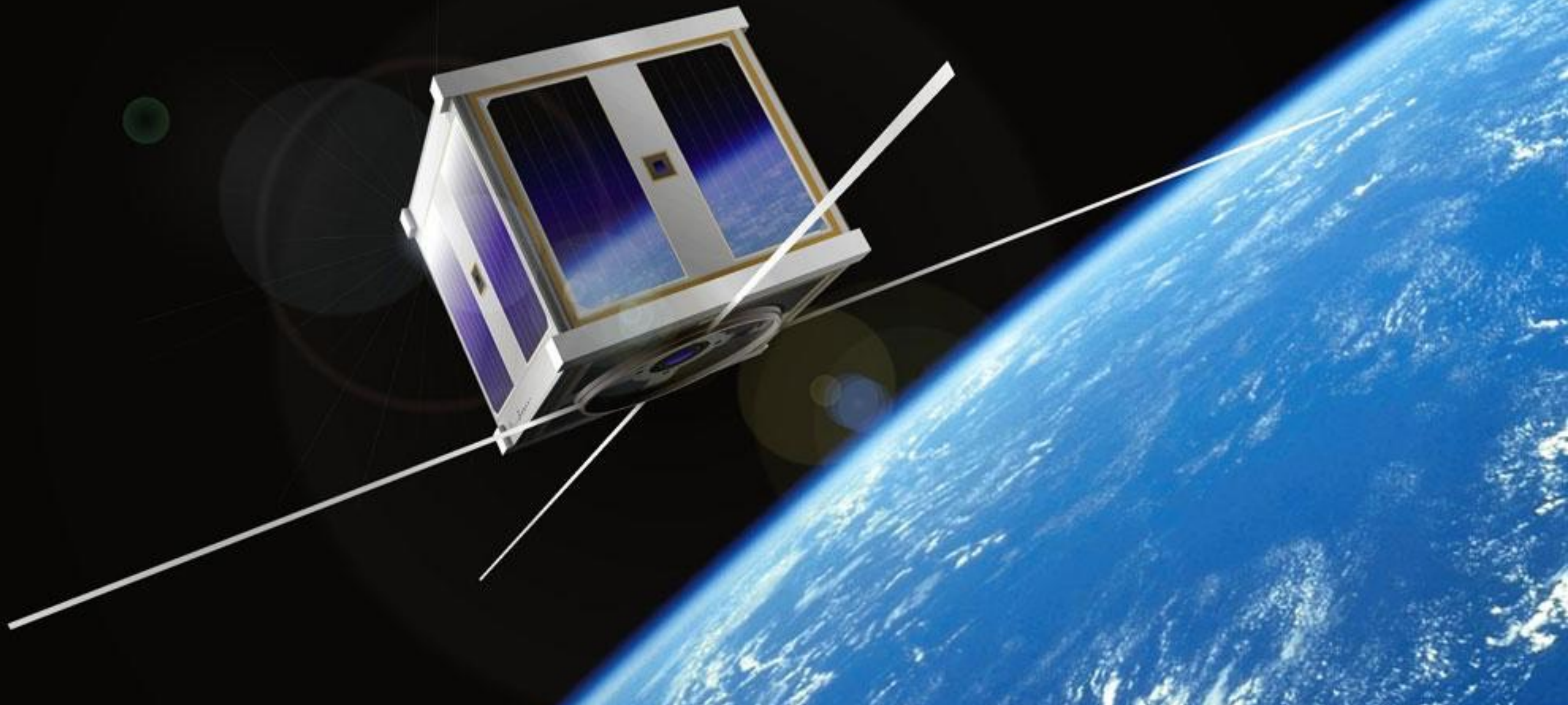


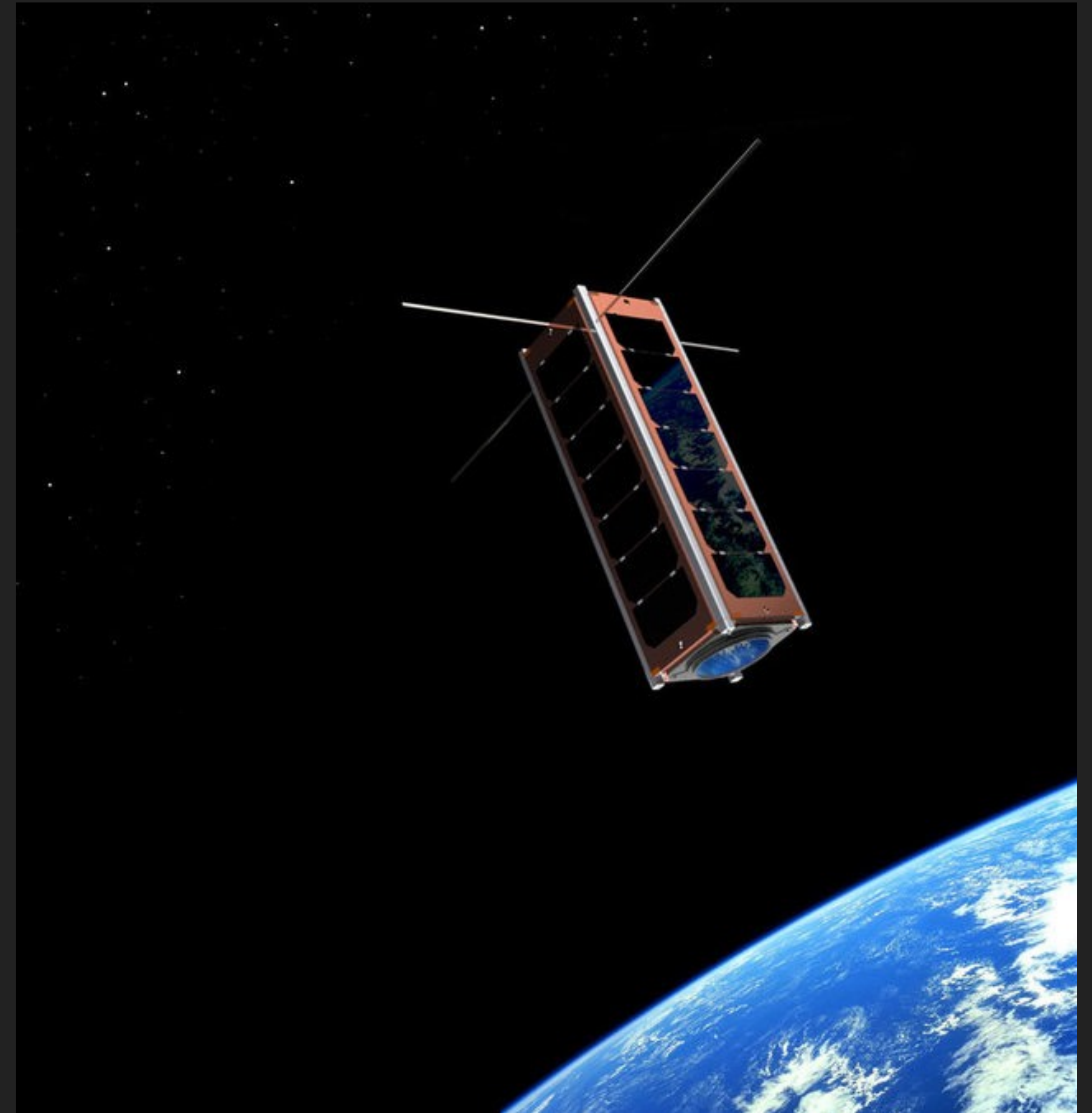
# AMATEUR RADIO SATELLITES





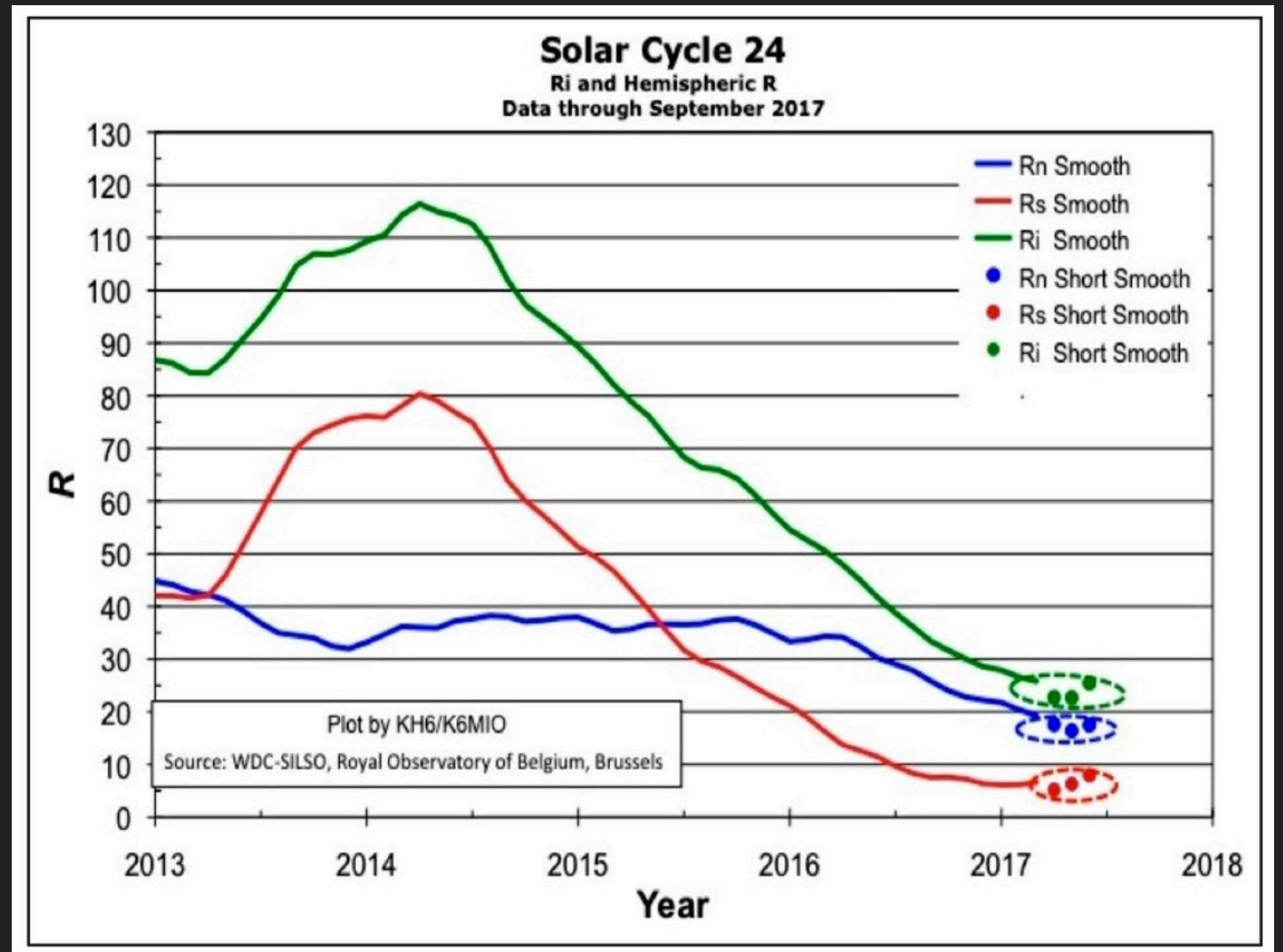
# WHAT WE'RE GOING TO TALK ABOUT

- ▶ Fun without Sunspots
- ▶ Fun with Satellites
- ▶ What are Ham Radio Satellites?
- ▶ Orbits and More – Active Satellites
- ▶ How Can I Work Them?
- ▶ What Radio and Antenna Do I Need?
- ▶ What Software Do I Need?



# FUN WITHOUT SUNSPOTS

- ▶ Solar Cycle 24
- ▶ Minimum Expected 2020+
- ▶ Limited F Layer Openings
- ▶ Lower Bands - 160/80
- ▶ VHF-UHF Modes
- ▶ Satellites





## HAVING FUN WITH AMATEUR RADIO SATELLITES

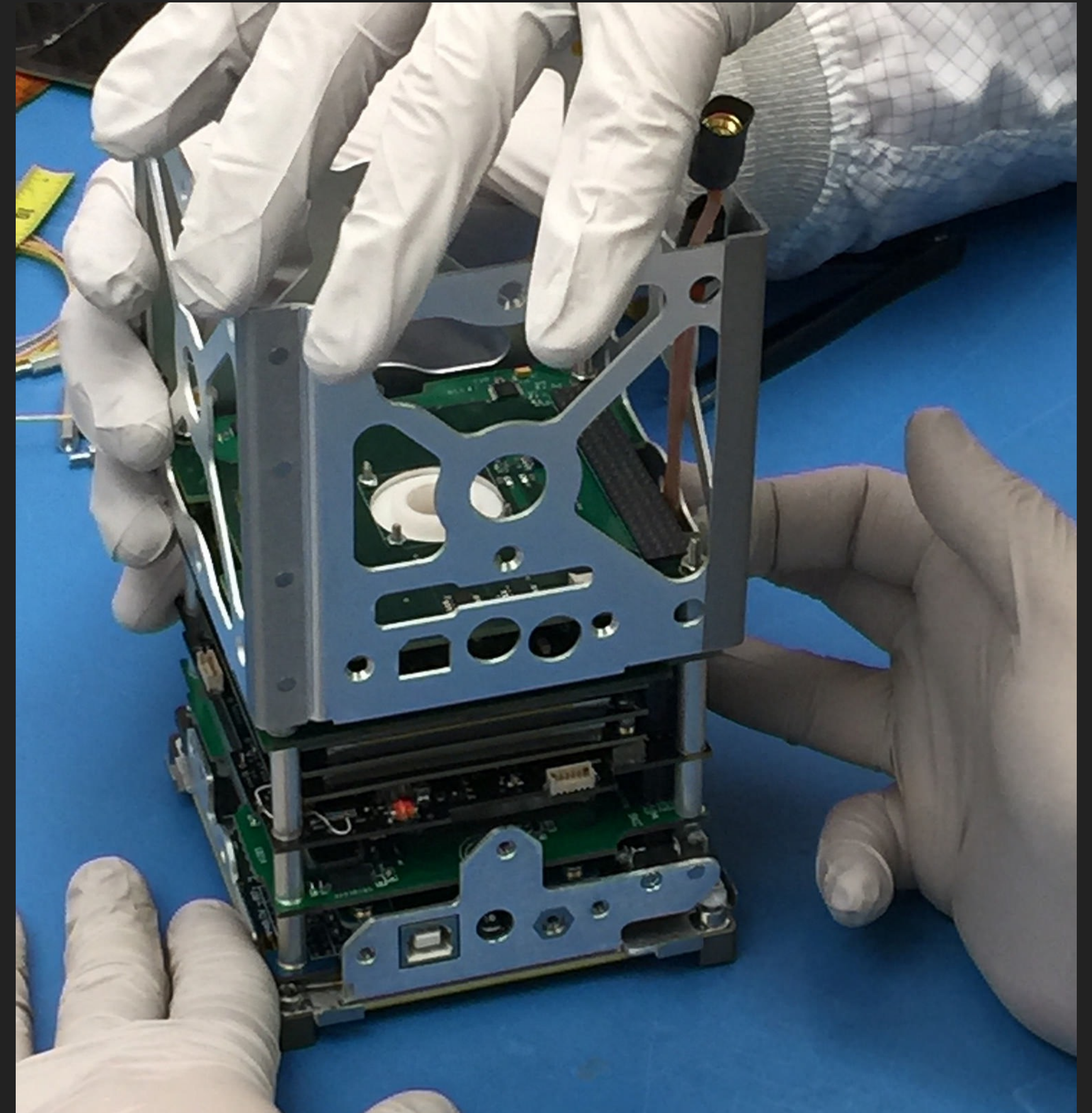
- ▶ Technical Achievement
- ▶ Working DX and Grids
- ▶ Activating DX and Grids as a Rover
- ▶ ARRL VUCC Satellites Awards
- ▶ AMSAT Awards
- ▶ Low Power, Small Antennas, Short QSOs, Predictable Operations, Welcoming Group of Operators





## WHAT ARE HAM RADIO SATELLITES?

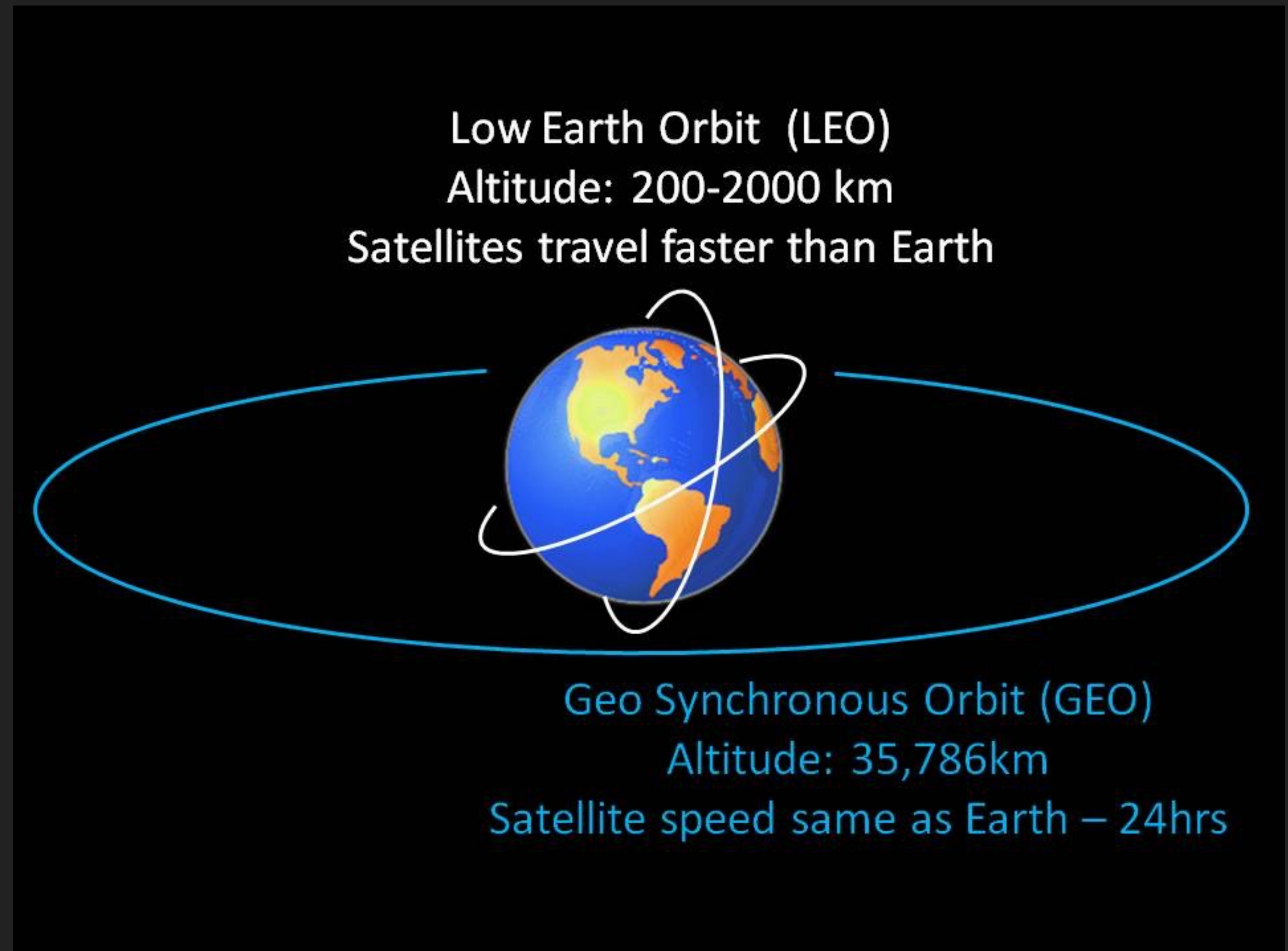
- ▶ Orbiting Repeaters and Transponders
  - ▶ Crossband VHF to UHF
  - ▶ Crossband UHF to VHF
- ▶ FM Repeaters
- ▶ SSB/CW/PSK Transponders
  - ▶ Bent Pipe Analogy
  - ▶ LSB Up and USB Down





# ORBITS AND MORE

- ▶ Low Earth Orbit (LEO)
- ▶ Altitude
- ▶ Azimuth
- ▶ 10 to 15 minutes AOS to LOS
- ▶ 1 hour 25 minute Orbit
- ▶ Doppler Shift





# ACTIVE SATELLITES

- ▶ ISS
- ▶ AO-7, FO-29, XW-2A/B/C/D/F, CAS-4B
- ▶ SO-50, AO-85
- ▶ AO-91 in orbit since November 2017
- ▶ Fox 1-D launched 11-January-2018
- ▶ Many, many more plus ongoing launches







LET'S DO SOMETHING

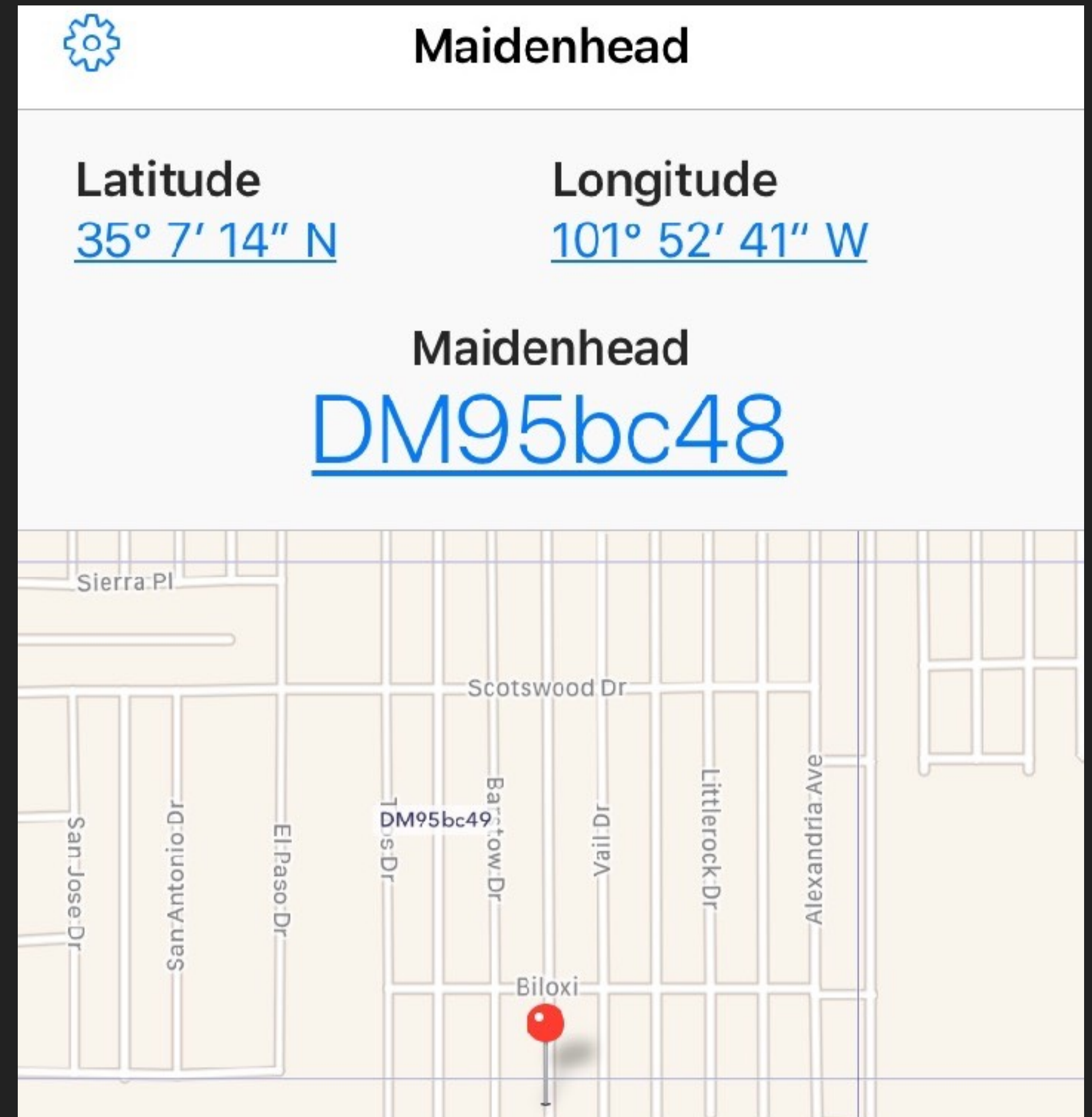
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**SATELLITE  
OPERATING**



## HOW CAN I WORK THEM?

- ▶ Know Your Location
- ▶ Know the Satellite
  - ▶ Frequencies
  - ▶ Keplerian Elements
- ▶ Determine Satellite Timing and Path
- ▶ Radio(s) and Antenna





# HOW CAN I WORK THEM?

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## Radio Programming Chart

AO-91 Doppler Shift Correction		
Memory	Your Transmit Frequency(With 67 Hz Tone)	Your Receive Frequency
Acquisition of Signal (AOS)	435.240 MHz	145.960 MHz
Approaching	435.245 MHz	145.960 MHz
Time of Closest Approach (TCA)	435.250 MHz	145.960 MHz
Departing	435.255 MHz	145.960 MHz
Loss of Signal (LOS)	435.260 MHz	145.960 MHz





## HOW CAN I WORK THEM?

- ▶ Know Your Location
- ▶ Know the Satellite
  - ▶ Frequencies
  - ▶ Keplerian Elements
- ▶ Determine Satellite Path and Timing
- ▶ Radio(s) and Antenna

### AMSAT Online Satellite Pass Predictions - AO-91

[View the current location of AO-91](#)

Date (UTC)	AOS (UTC)	Duration	AOS Azimuth	Maximum Elevation	Max El Azimuth	LOS Azimuth	LOS (UTC)
12 Jan 18	20:09:01	00:09:39	203	15	267	326	20:18:40
13 Jan 18	06:25:44	00:08:44	52	6	95	135	06:34:28
13 Jan 18	08:00:19	00:13:03	10	79	286	196	08:13:22
13 Jan 18	09:38:54	00:07:08	329	4	302	260	09:46:02
13 Jan 18	18:54:11	00:10:43	153	37	99	358	19:04:54
13 Jan 18	20:32:24	00:07:31	222	7	265	311	20:39:55
14 Jan 18	06:46:56	00:11:07	38	14	101	152	06:58:03
14 Jan 18	08:22:37	00:12:56	2	40	265	208	08:35:33
14 Jan 18	17:43:41	00:04:34	90	2	77	39	17:48:15
14 Jan 18	19:16:14	00:10:58	167	87	331	349	19:27:12



## WHAT RADIO DO I NEED?

- ▶ Full Duplex versus Half Duplex
- ▶ FM HTs – Kenwood TH-D72A
- ▶ FM Mobile – Icom IC-2728H/2800
- ▶ Portable Rigs – FT 817/847
- ▶ Base Station – Icom IC-9100, Kenwood TS2000
- ▶ SDRs on the receive side





## WHAT ANTENNA DO I NEED?

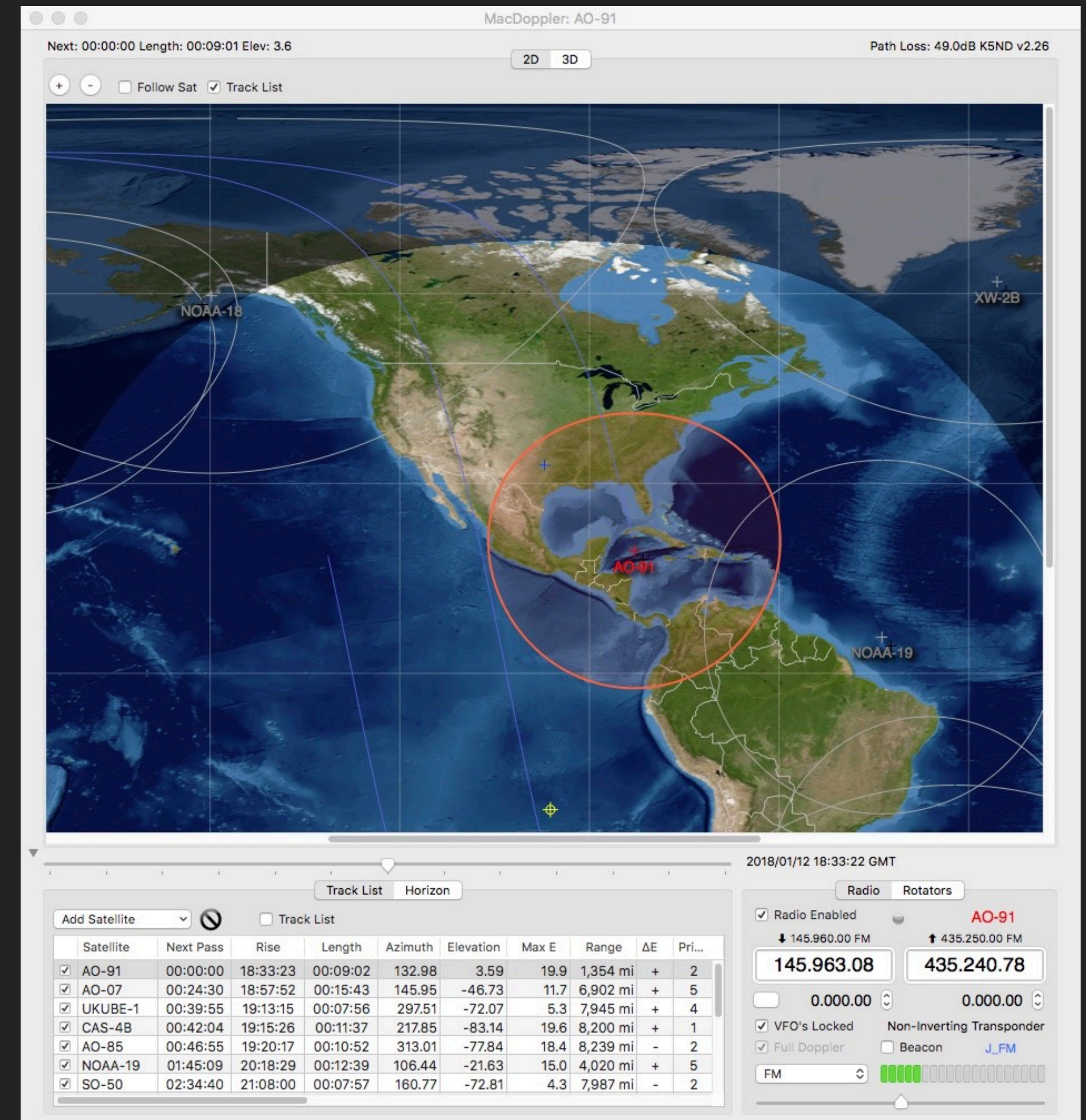
- ▶ HT Long Whips can work
- ▶ WA5VJB Cheap Yagis
- ▶ Hand-Held Arrow Satellite Antenna
- ▶ Fixed Elevation
- ▶ AZ-EL Rotators
- ▶ Switchable Circular Polarization
- ▶ Listen First





## WHAT SOFTWARE DO I NEED?

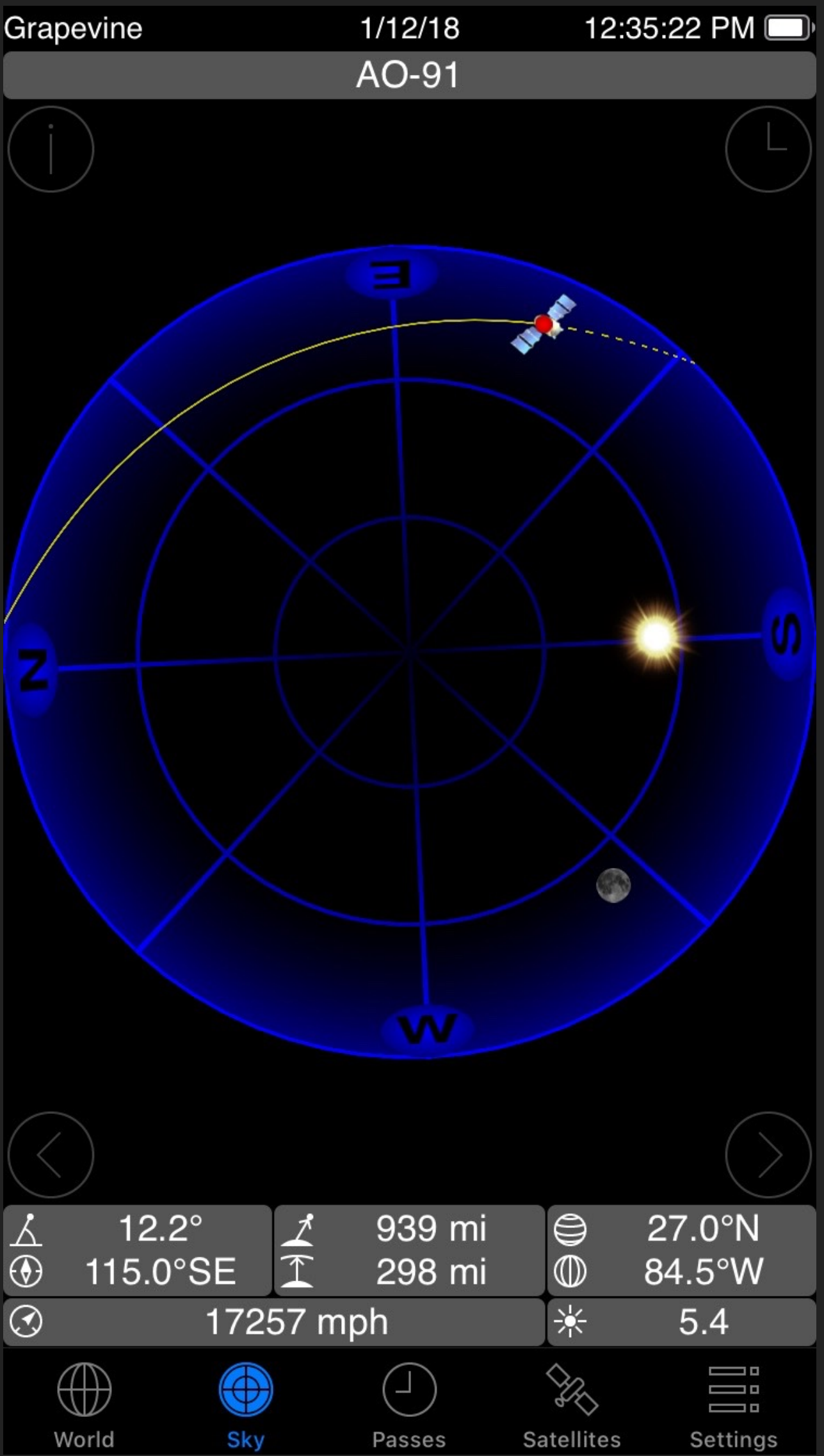
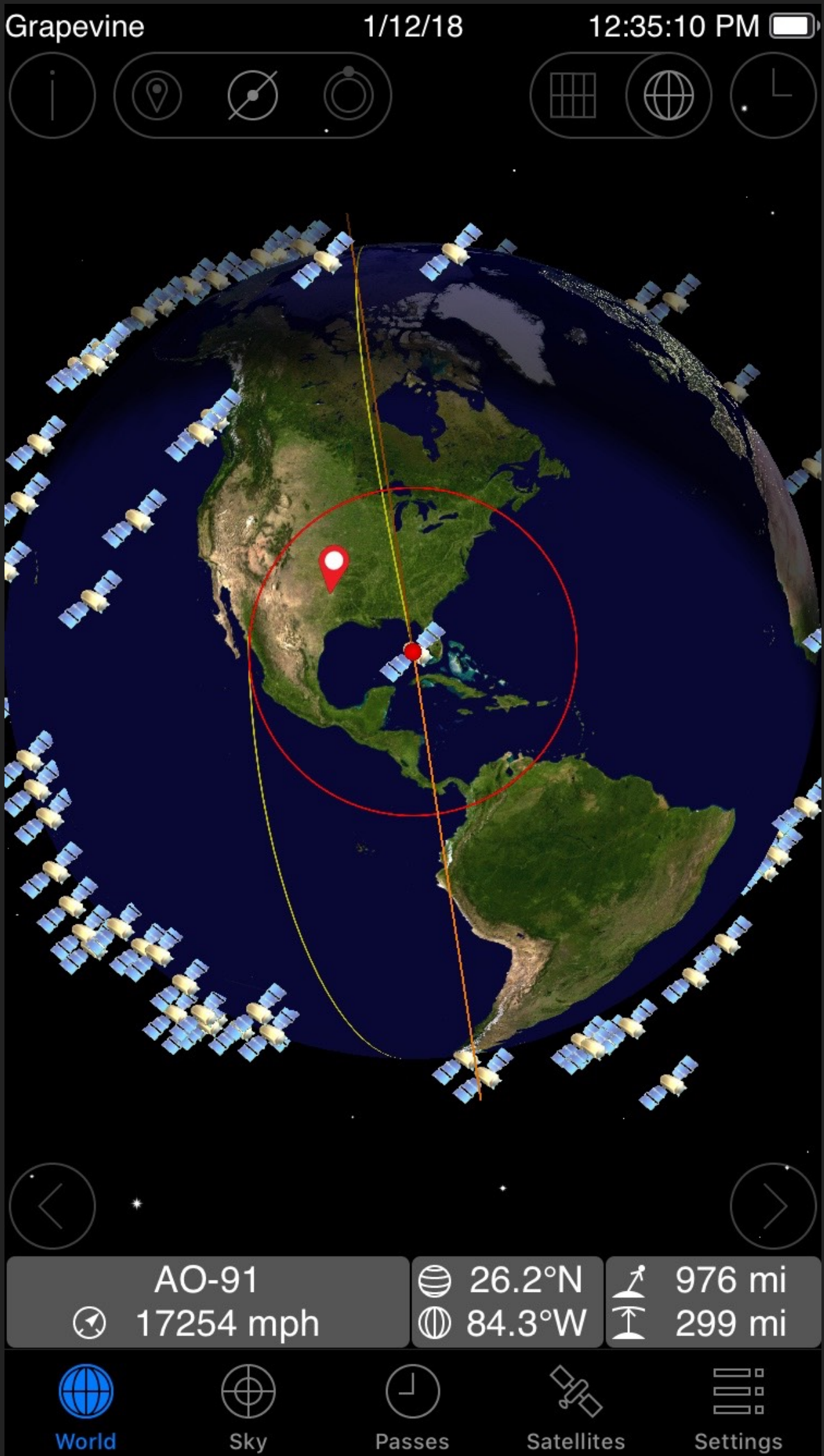
- ▶ Phone Apps for predictions and paths
- ▶ Online prediction software
- ▶ SatPC32 tracking software
- ▶ MacDoppler tracking software
- ▶ Manual or automatic doppler correction





PHONE APP

- ▶ GoSatWatch App on iPhone
- ▶ World Map of AO-91
- ▶ Overhead Chart of Satellite Path







LIVE CONTACT — KG4AKV

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[HTTPS://YOUTU.BE/](https://youtu.be/VCCFED0BC_U)

[VCCFED0BC U](https://youtu.be/VCCFED0BC_U)



# Craggy Gardens

KG4AKV



## FOR MORE INFORMATION

- ▶ Books – AMSAT Getting Started with Amateur Satellites, ARRL Sat Handbook
- ▶ Website – AMSAT
- ▶ Social Media – Twitter and Facebook, start with AMSAT and add others
- ▶ Contact K5ND – [jim@k5nd.net](mailto:jim@k5nd.net) and website [www.k5nd.net](http://www.k5nd.net)
- ▶ Slide Deck and Links at <https://www.k5nd.net/2018/01/ham-radio-satellite-presentation/>