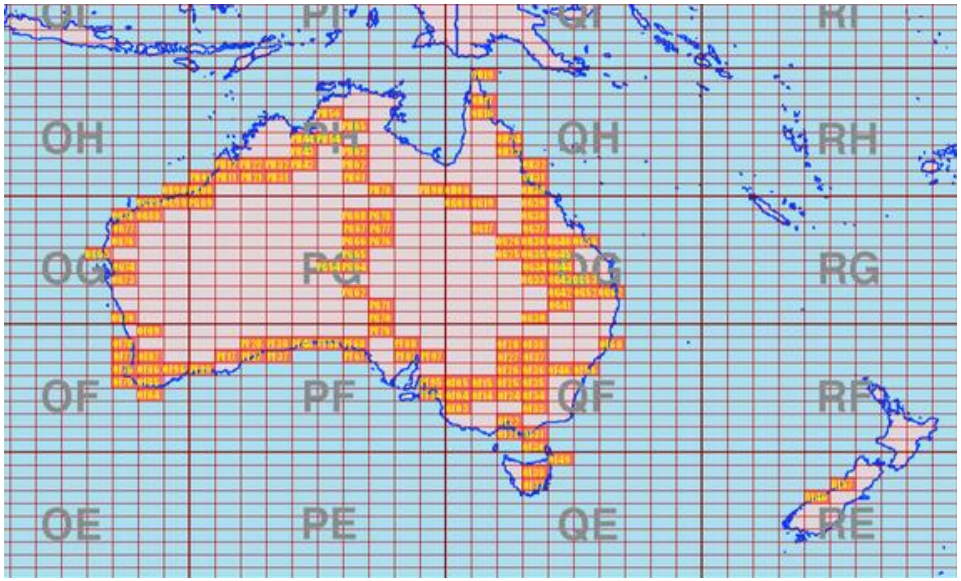
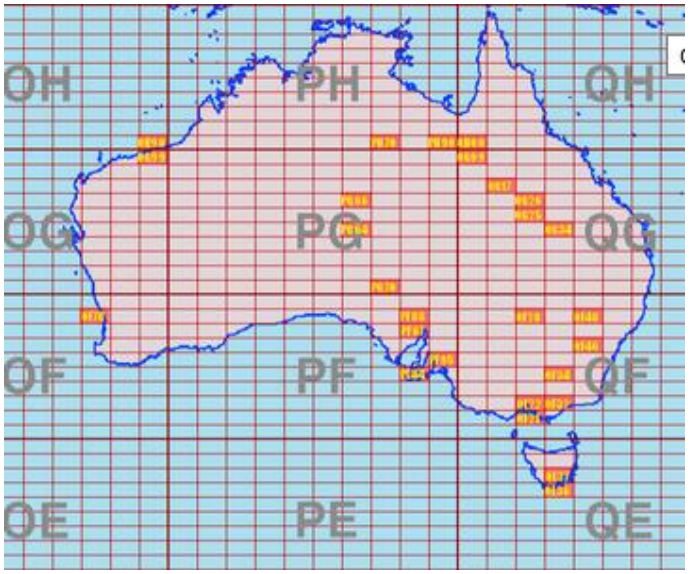
Small Dish Portable EME

By Rex Moncur
VK7MO

OK1KIR 10 & 24 GHz Digital Grids in VK/ZL



10 GHz



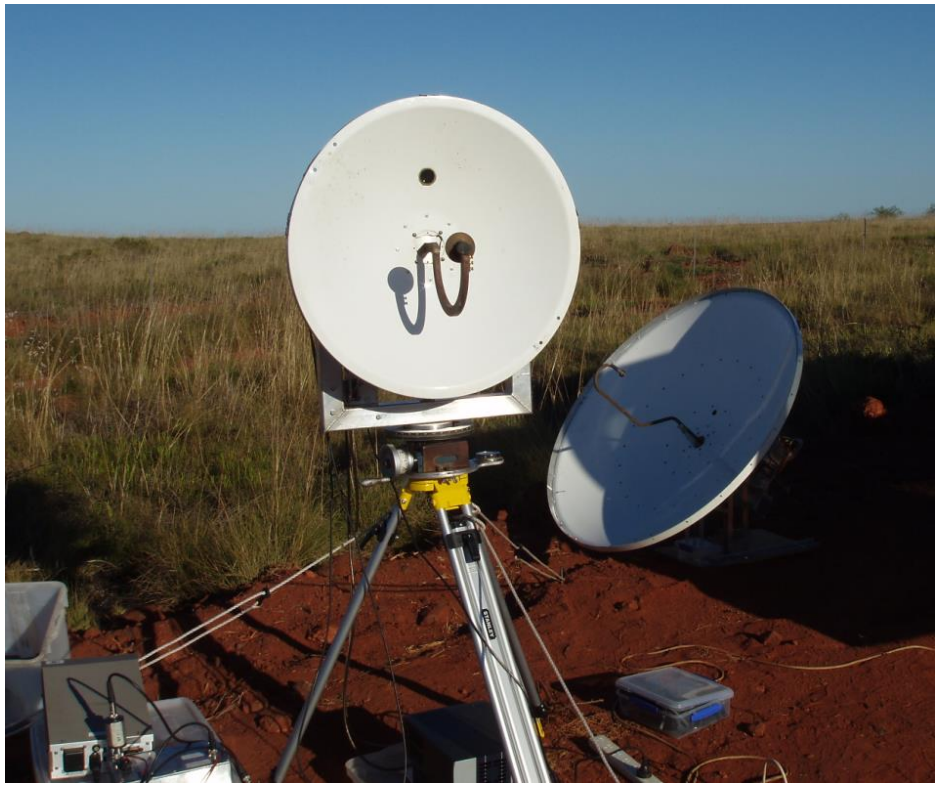
24 GHz

How do small portable stations work EME?

- Use digital modes & work big home stations.

10 GHz 2’6”
Dish & 60 watts

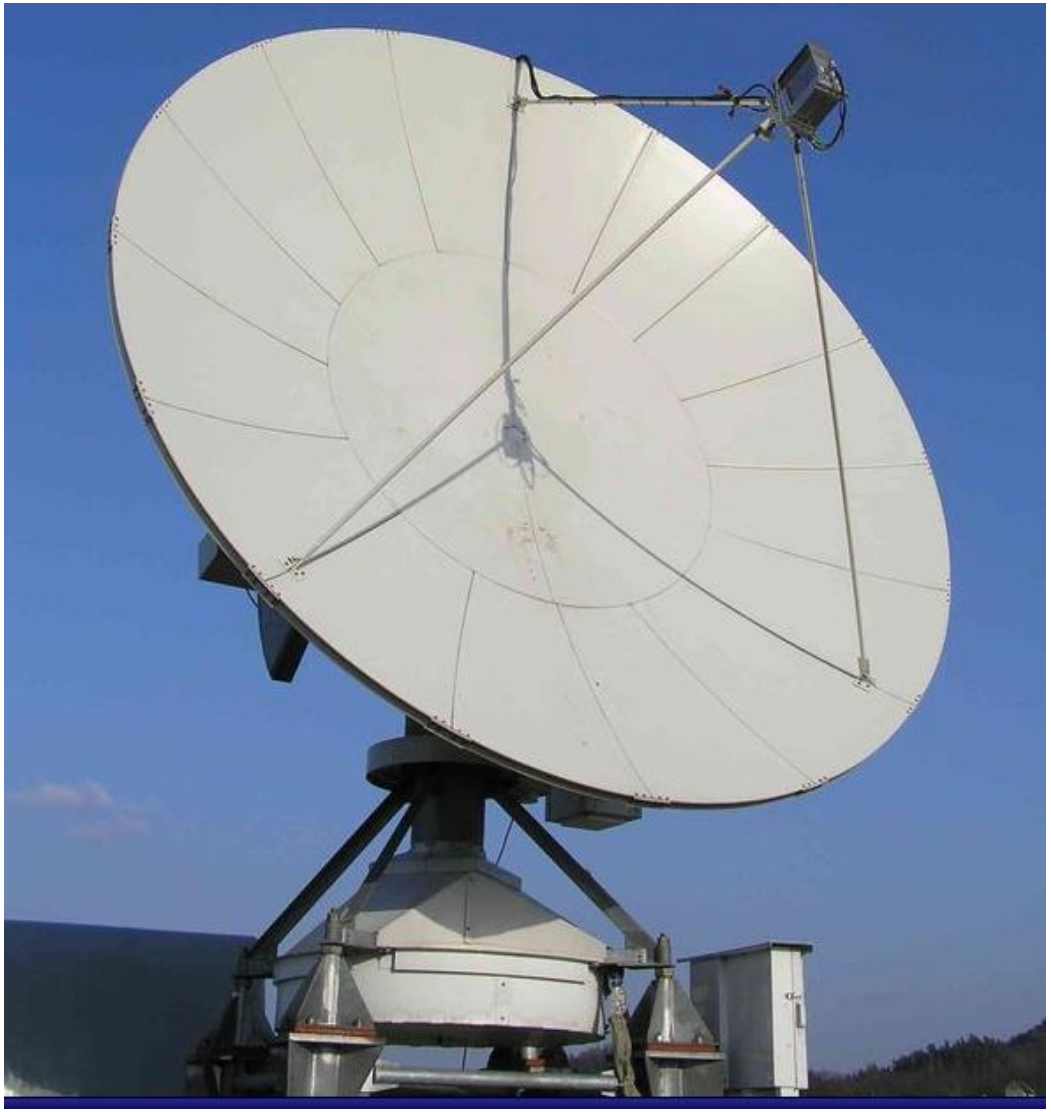
24 GHz 4 foot
Dish & 20 watts



HB9Q 32 foot Solid Dish 60 watts

OK1KIR 16 foot solid Dish 50 watts

OK1CA, 14 foot dish 50 watts



G3WDG 10 foot dish, 75 watts

OZ1LPR 8 foot offset,650 Watts

W5LUA 16 foot dish, 50 or 160 Watts

OK2AQ 4 foot dish and 40 watts

EME Propagation Loss

- Increases by 20 dB for every 10 times increase in frequency
- 144 MHz 253 dB
- 1296 MHz 271 dB
- 10,368 MHz 290 dB

37 dB additional loss from 144 MHz to 10 GHz

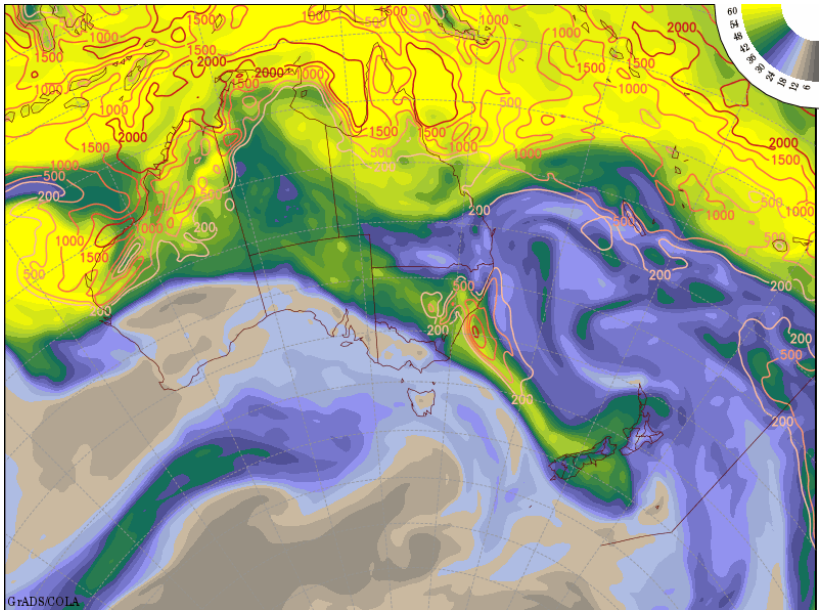
Antenna Gain for same Aperture

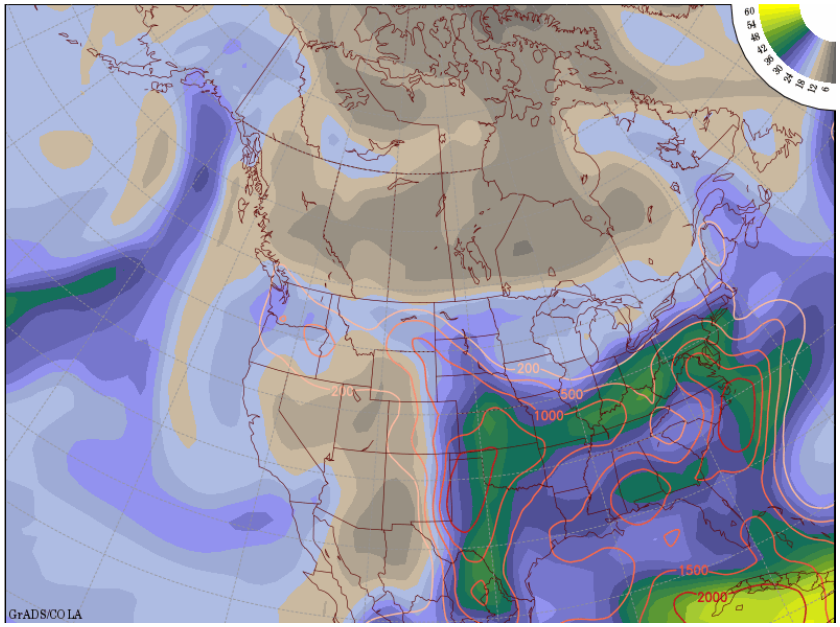
- Increases by 20 dB for each 10 times increase in frequency and so fully compensates for propagation loss.
- But the antenna gain applies both ends so you gain 20 dB for each 10 times increase in frequency.
- The penalty is that you must point accurately

System Noise

- Generally lower at 10 GHz compared to say 144 MHz were external noise, particularly in city areas, dominates.
- Moon Noise produces around 2 dB loss with high gain dishes (10 foot plus at 10 GHz)

Atmospheric Attenuation and Noise



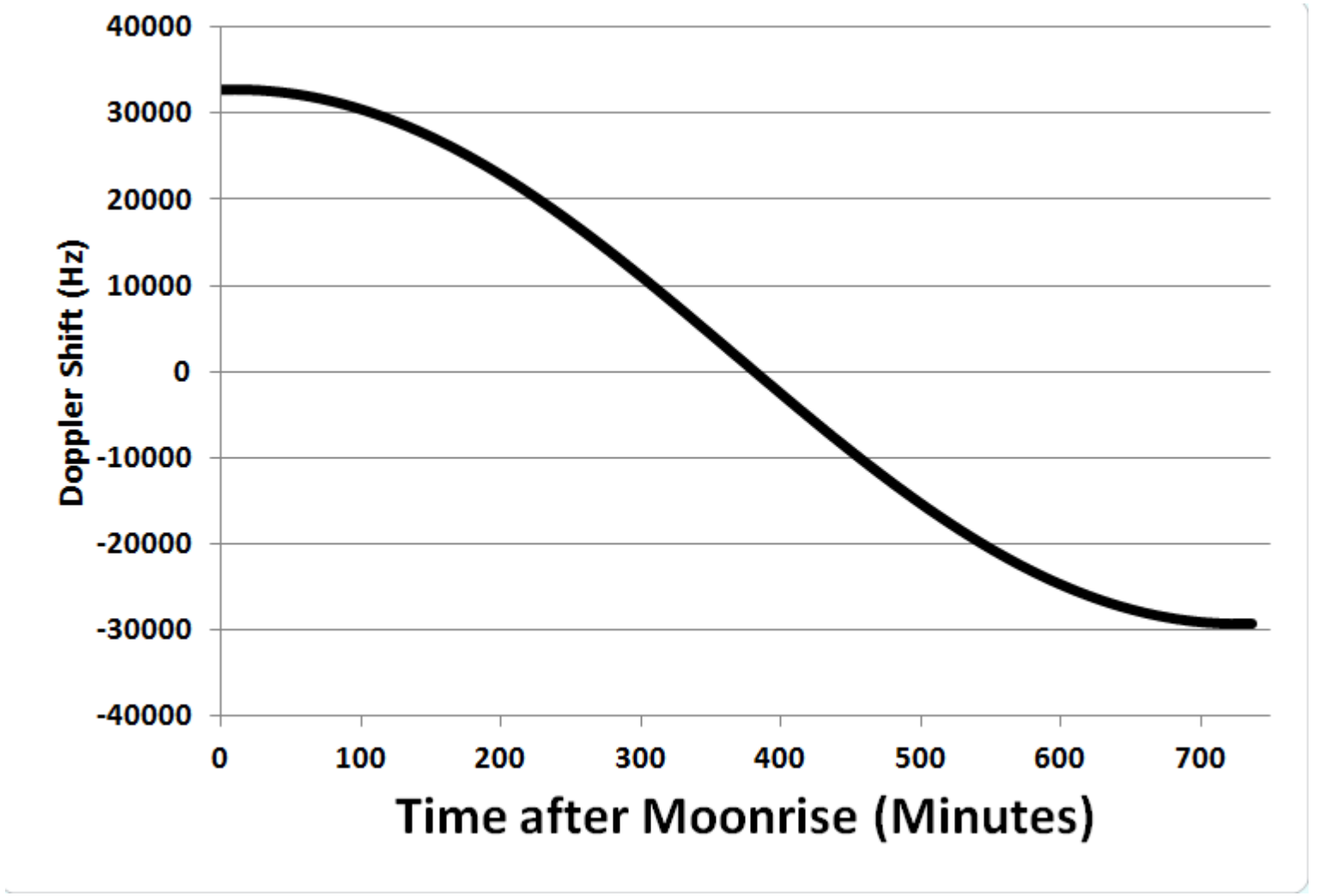


Precipitable Water, Grey 5 mm Yellow 60 mm

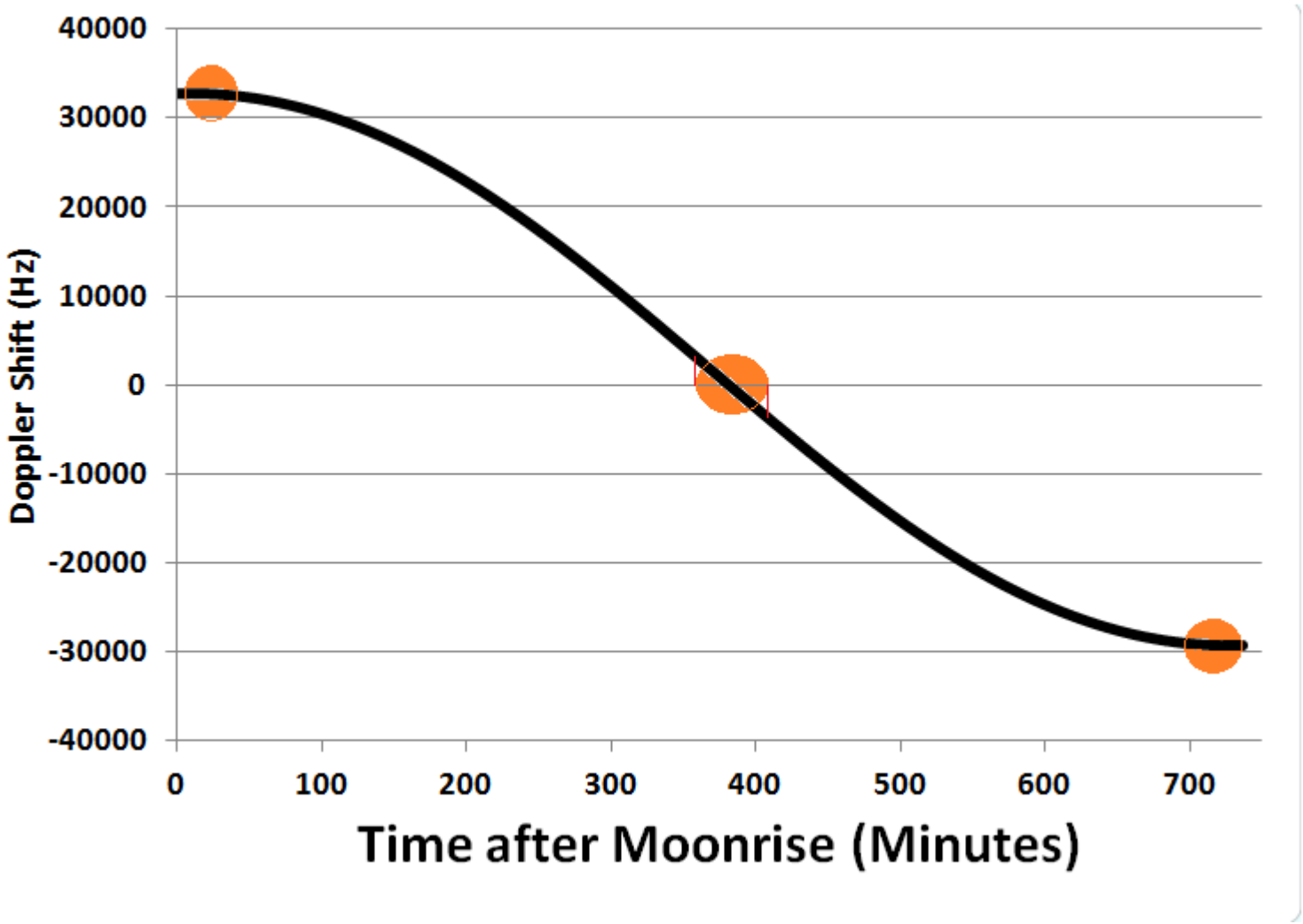
Lunar Degradation

- The Moon moves around the Earth in an elliptical orbit which cases a variation of around 2.3 dB.
- For QRP choose a time when lunar degradation is low

Doppler Shift (10 GHz)

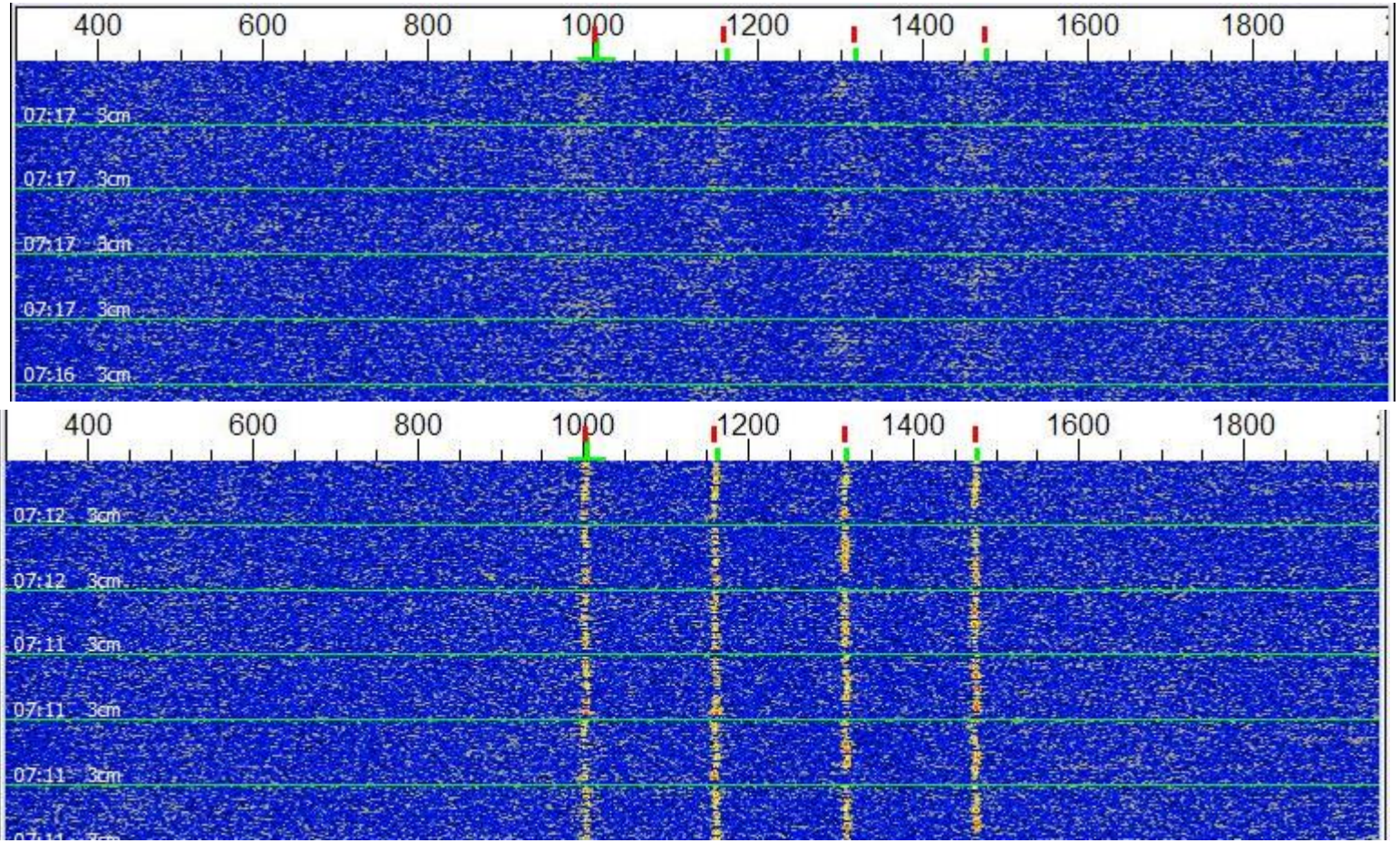


Doppler Spreading

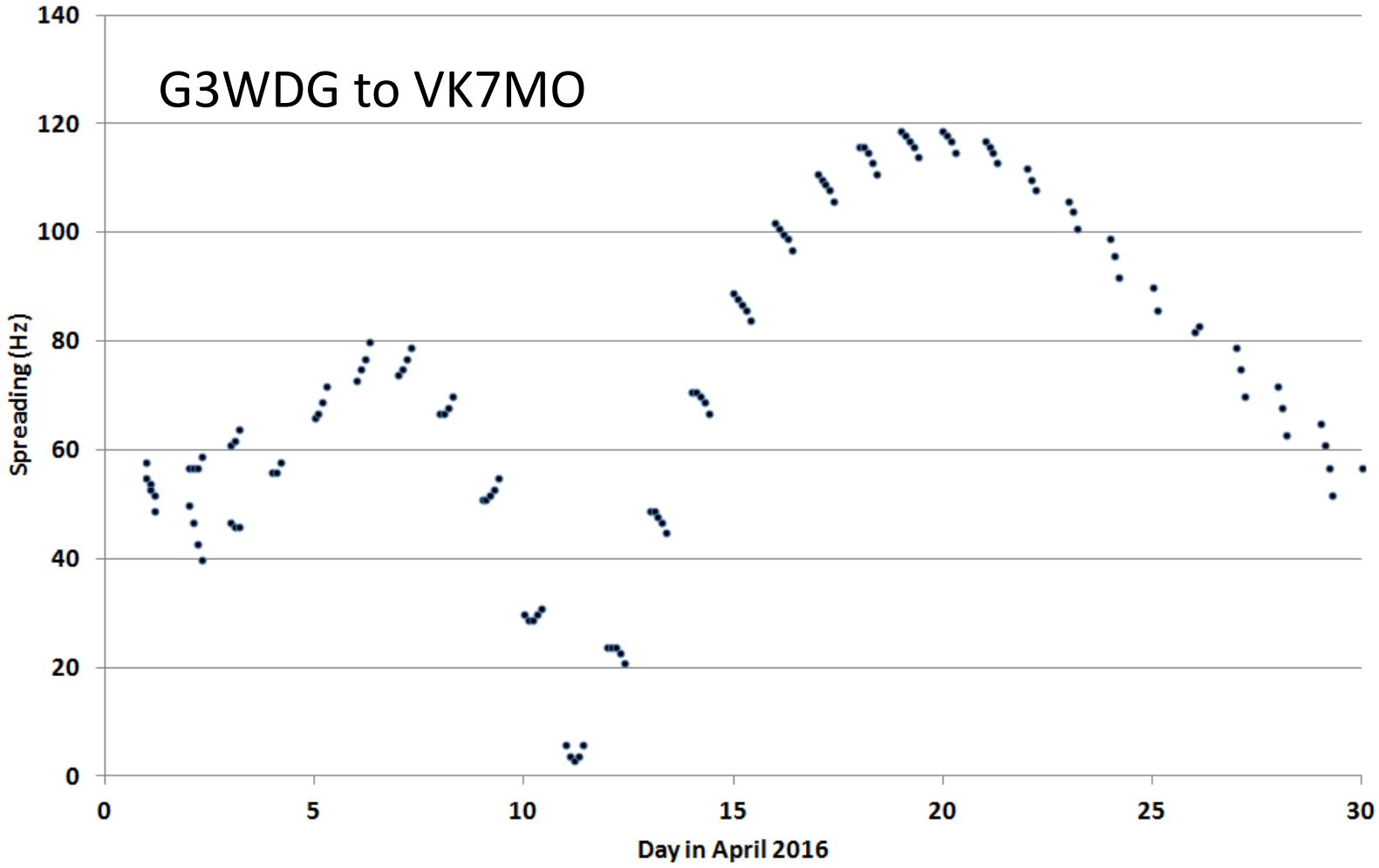


Doppler Spreading

10 GHz Spreading 160 Hz to 2 Hz



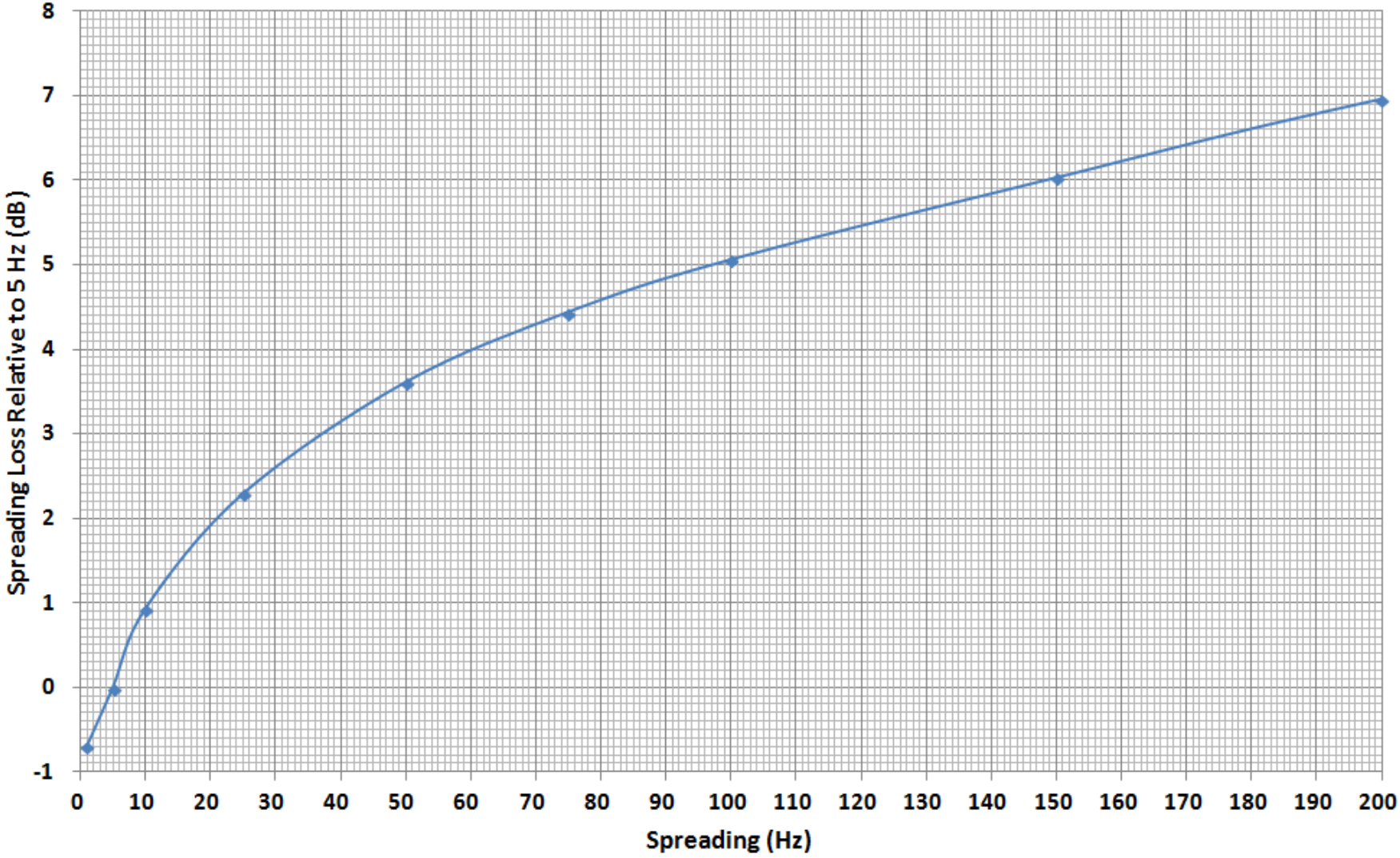
Variation of Spreading at 10 GHz



Program and Modes

- WSJT Program developed by Joe Taylor, K1JT and Development Team.
- Modes for EME -- JT65, JT4 and QRA64.
- QRA64 is best for spreading up to 160 Hz, does not require a callsign list but takes advantage of information built up during a QSO.
- QRA64 is virtually immune from false decodes
- QRA64D has become the standard for both 10 and 24 GHz EME.

QRA64: Doppler Spreading Loss



Variation of Propagation Loss with Conditions

- 5 Hz to 150 Hz spreading costs about 6dB
- Lunar degradation varies up to 2.3 dB
- Moon noise on a 10 foot dish costs about 2 dB compared to a 2’6” dish

Best case to worst case costs about 10 dB

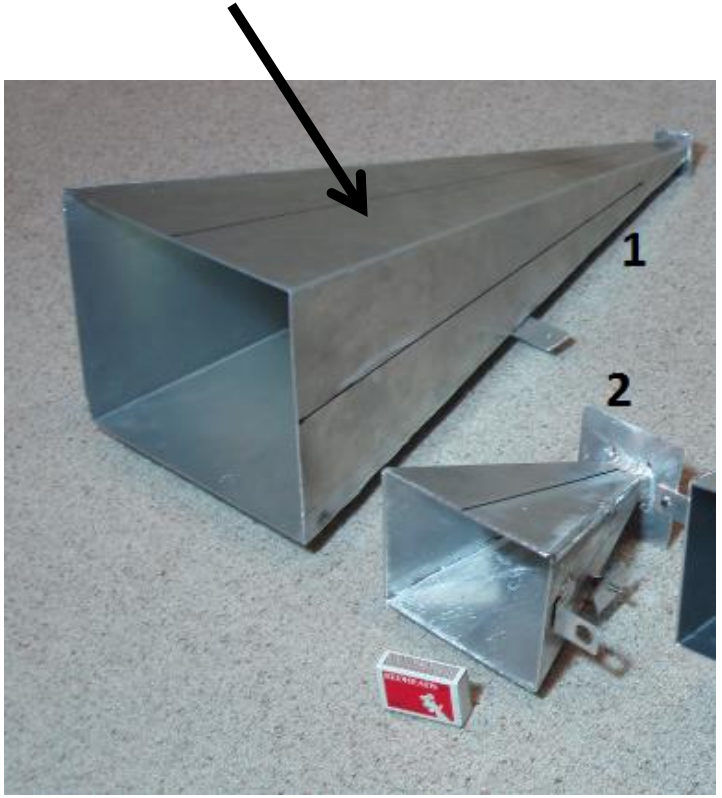
Options

	Best Conditions	Worst Conditions
2’6’’ to 10 foot	2 Watts	20 Watts
2’6” to 4 foot	15 Watts	too much
4 foot to 10 foot	1 Watt	10 Watts
4 foot to 4 foot	6 Watts	60 Watts

Small Horns

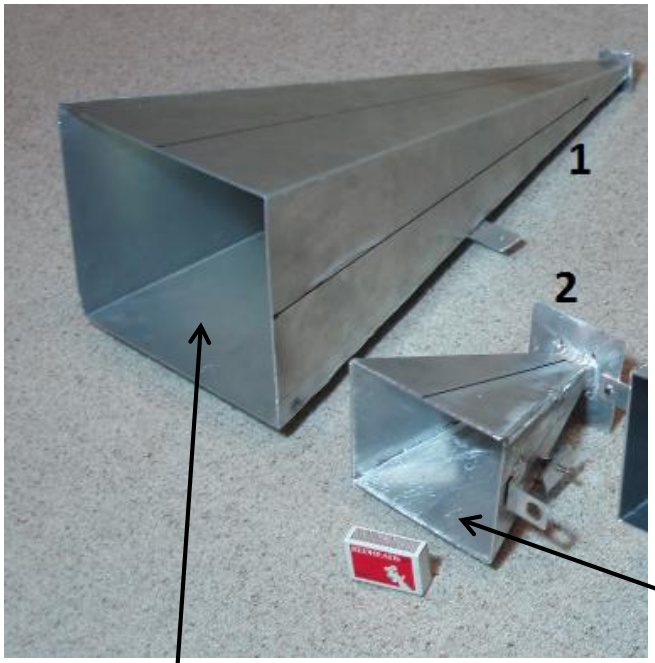
```
0958 -23   2.5 1002 :* VK7MO HB9Q JN47          0
0959 -23   2.6 1005 :* VK7MO G3WDG IO92         0
1000 -23   2.5 1003 :* VK7MO HB9Q JN47          0
1001 -23   2.5  999 :* VK7MO G3WDG IO92         0
1002 -22   2.5  997 :* VK7MO HB9Q JN47          0
1003 -22   2.2 1000 :* HI REX                   0
1004 -23   2.5 1002 :* VK7MO HB9Q JN47          0
1005 -24   2.2  998 :* REX RX 25DB H            0
1006 -22   2.5 1005 :* VK7MO HB9Q JN47          0
1007 -24   2.2 1005 :* REX RX 25DB H            0
1008 -25   2.5  997 :*
1009 -23   2.5 1001 :* VK7MO G3WDG -15          0
1010 -25   2.5 1002 :* GE DEAR REX              0
1011 -25   2.6 1002 :* VK7MO G3WDG -15          0
1012 -21   2.5  998 :*
1013 -23   2.5 1002 :* VK7MO G3WDG -15          0
1014 -24   2.5 1000 :* 12345                    0
1015 -21   2.5 1001 :* QWERTYUIOP               0
1016 -21   2.5 1002 :*
1017 -23   2.5 1000 :* VK7MO G3WDG IO92         0
1018 -25   2.6 1002 :* EXCELLENT REX            0
1019 -25   2.5 1002 :* VK7MO G3WDG IO92         0
1020 -21   2.5 1003 :*
1021 -24   2.5 1000 :* VK7MO G3WDG IO92         0
1022 -25   2.5 1005 :* EXCELLENT REX            0
1023 -22   2.5 1002 :* VK7MO G3WDG IO92         0
1024 -24   2.5 1004 :* VK7MO HB9Q R-15          0
1025 -21   2.6 1001 :* VK7MO G3WDG IO92         0
1026 -24   2.6 1003 :* VK7MO HB9Q R-15          0
1027 -22   2.6 1003 :* VK7MO G3WDG IO92         0
1028 -25   2.5 1001 :* VK7MO HB9Q RRR           0
1029 -24   2.2  997 :* VK7MO G3WDG IO92         0
1030 -24   2.5 1002 :* GN REX 73                0
```

Monitoring G3WDG and
HB9Q on a 25 dBi Horn
7x9 inch Aperture



Small Horns & DL0SHF Beacon

7x9 inch



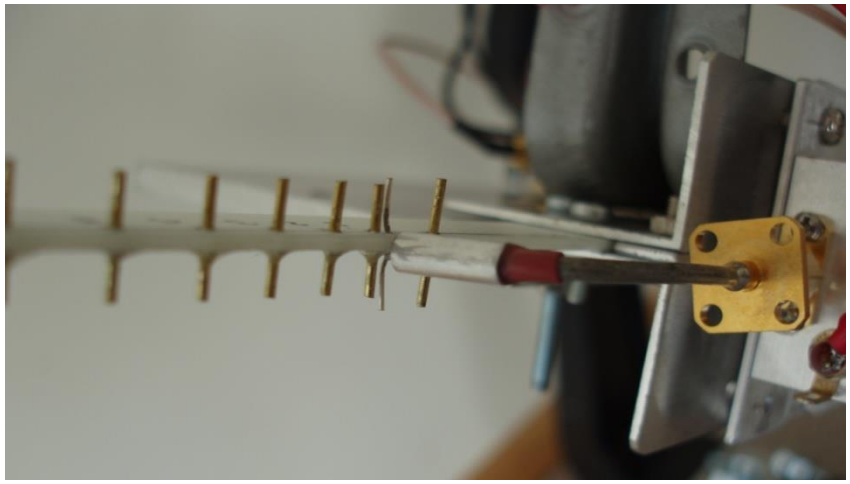
4x5 inch

24 foot dish

```
0720 -24  2.5 1000 :* CQ DL0SHF JO54          1
0722 -22  2.6 1002 :* CQ DL0SHF JO54          0
0724 -22  2.5 1003 :* CQ DL0SHF JO54          0
0726 -22  2.5  999 :* CQ DL0SHF JO54          0
0728 -23  2.6 1000 :* CQ DL0SHF JO54          0
0730 -22  2.5 1000 :* CQ DL0SHF JO54          0
0732 -23  2.5 1002 :* CQ DL0SHF JO54          0
0734 -23  2.5  991 :* CQ DL0SHF JO54          0
0736 -24  2.5 1000 :* CQ DL0SHF JO54          1
0738 -22  2.5 1000 :* CQ DL0SHF JO54          0
0740 -24  2.5 1002 :* CQ DL0SHF JO54          1
0742 -22  2.6 1002 :* CQ DL0SHF JO54          1
```

```
0812 -23  2.5  994 :*
0814 -27  2.4 1004 :* CQ DL0SHF JO54         11
0816 -24 -0.0 1000 :*
0818 -28  2.2  998 :* CQ DL0SHF JO54         11
0820 -21  2.4 1007 :*
0822 -25  2.4 1001 :* CQ DL0SHF JO54          9
0824 -23  2.4  994 :*
0826 -27  2.4  999 :* CQ DL0SHF JO54         11
0828 -24  3.8  990 :*
0830 -27  2.4 1001 :* CQ DL0SHF JO54          9
0832 -28  2.4 1000 :* CQ DL0SHF JO54         11
0834 -26  2.4 1001 :* CQ DL0SHF JO54         11
0836 -22  2.5 1000 :*
```

Rxing DL0SHF Beacon on a Yagi



```
0642 -27  2.4  998 :* CQ DL0SHF JO54      9
0644 -23  2.5  998 :*
0646 -25  1.9 1001 :
0648 -28  2.5  996 :* CQ DL0SHF JO54     11
0650 -26  2.3  995 :* CQ DL0SHF JO54     11
0652 -26  2.5 1003 :* CQ DL0SHF JO54     11
0654 -23  2.6  999 :*
0656 -23  2.0 1007 :*
0658 -26  2.5  998 :* CQ DL0SHF JO54     11
0700 -24  0.5 1005 :*
0702 -26  2.4  997 :* CQ DL0SHF JO54     11
0704 -28  2.4 1001 :* CQ DL0SHF JO54     11
0706 -26  0.6 1010 :
0708 -23  1.0 1010 :*
0710 -25  3.3 1010 :*
0712 -28  2.4  999 :* CQ DL0SHF JO54      9
0714 -29  2.3  996 :* CQ DL0SHF JO54     11
```

QSO on Longer 4X5 inch Horn with 90 watt PA

Spreading 23 Hz and Lunar Degradation 0.5 dB

Received by VK7MO

```
0925 -23 -0.6  998 :*
0927 -22  2.0 1004 :*
0929 -23  2.6 1000 :* VK7MO G3WDG IO92        5
0931 -27  2.6 1001 :* VK7MO G3WDG IO92        8
0933 -26  2.5 1004 :* VK7MO G3WDG IO92        5
0935 -23  2.7 1002 :* VK7MO G3WDG R-26        5
0937 -27  2.6 1002 :* VK7MO G3WDG RRR         5
0939 -24  0.2 1009 :*
0941 -23  2.4 1003 :*
0943 -23  2.4  999 :*
0945 -24  2.5 1000 :*
0947 -23  2.6  999 :*
0949 -24  2.6  992 :*
0951 -23  2.6  998 :* VK7MO G3WDG -26         3
0953 -27  2.6 1006 :* VK7MO G3WDG -26         5
```

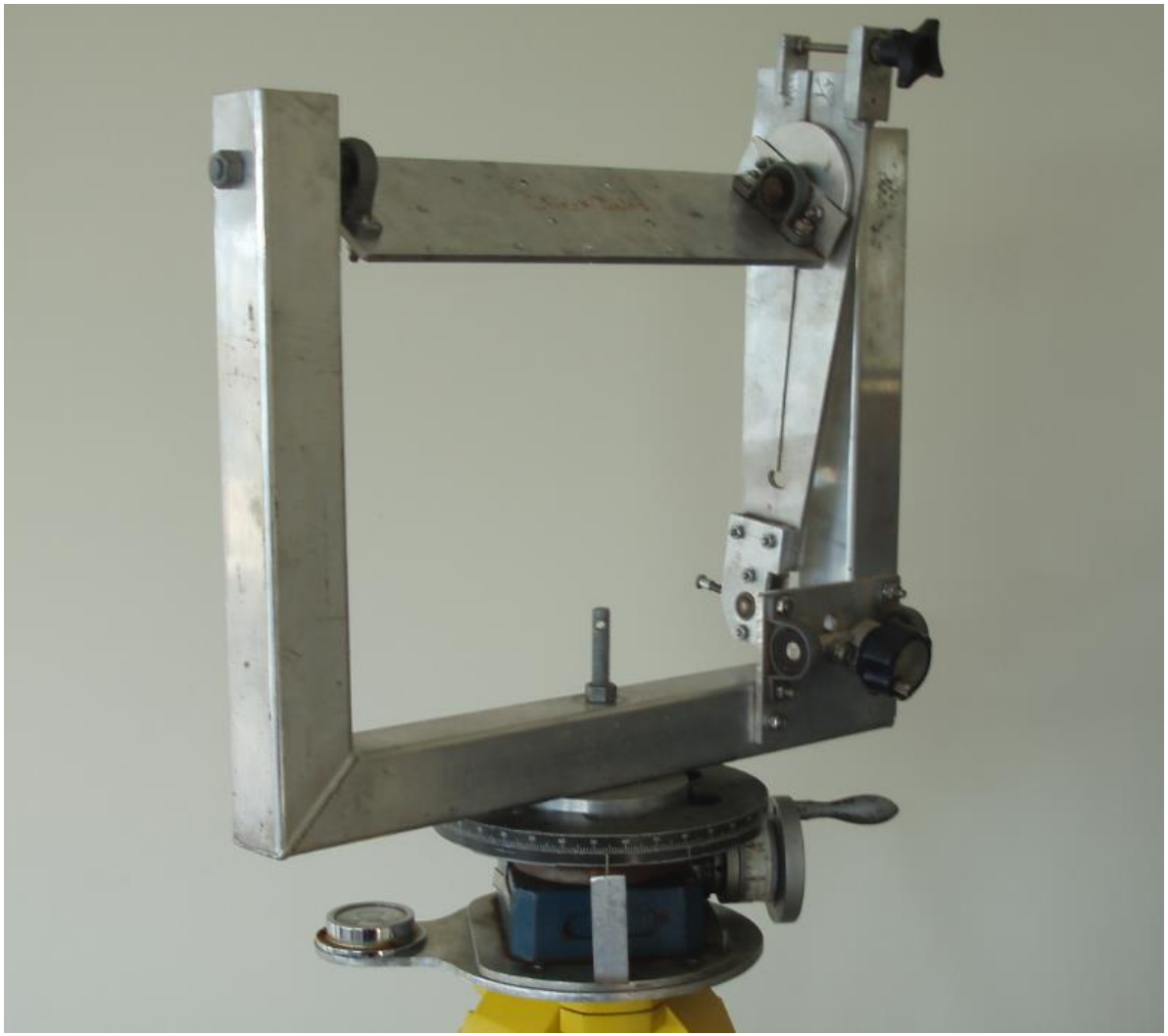
Received by G3WDG

```
0928 -24  2.2 1001 :*
0930 -22  2.4  998 :*
0932 -25  0.5  981 :*
0934 -26  2.5  995 :* G3WDG VK7MO -23         5
0936 -25  4.0 1007 :*
0938 -23  0.8  998 :*
0940 -25  2.6  994 :* G3WDG VK7MO 73          5
0942 -24  2.8  994 :* G3WDG VK7MO QE37        3
0944 -26  2.3  989 :* G3WDG VK7MO QE37        8
0946 -23  2.4  994 :*
0948 -27  2.4  993 :* G3WDG VK7MO QE37        5
0950 -27  2.4  996 :* G3WDG VK7MO QE37        5
0952 -25  2.4  995 :* G3WDG VK7MO QE37        8
0954 -24  2.4 1000 :* G3WDG VK7MO QE37        8
0955 -24 -0.7 1009 :*
```

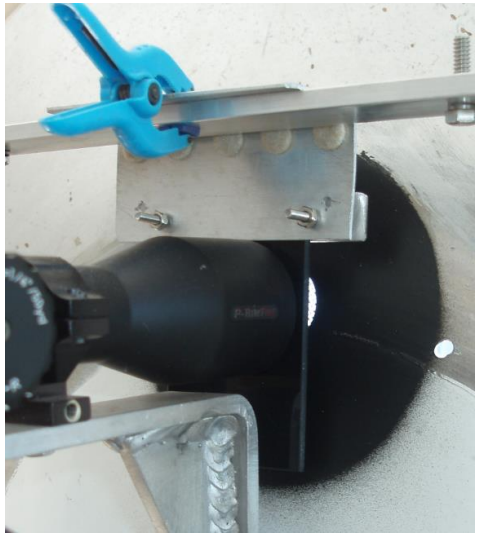
Critical Factors for Small Station 10 GHz EME

- Accurate pointing in all conditions.
- Frequency – GPS locking & Doppler correction.
- System Performance – Sun noise
- Reliability – equipment and operators.

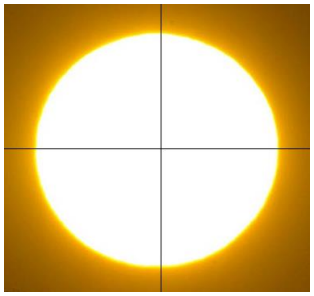
Pointing

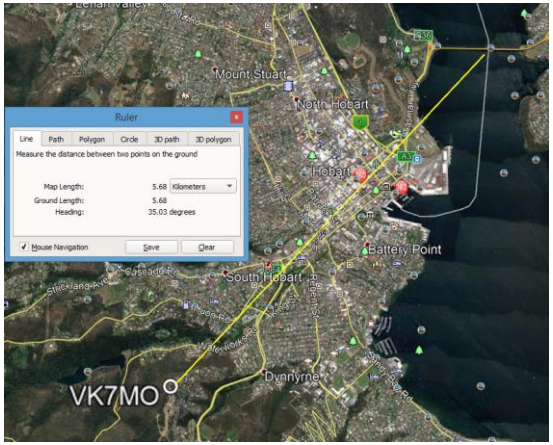


Alignment of Riflescope and Dish



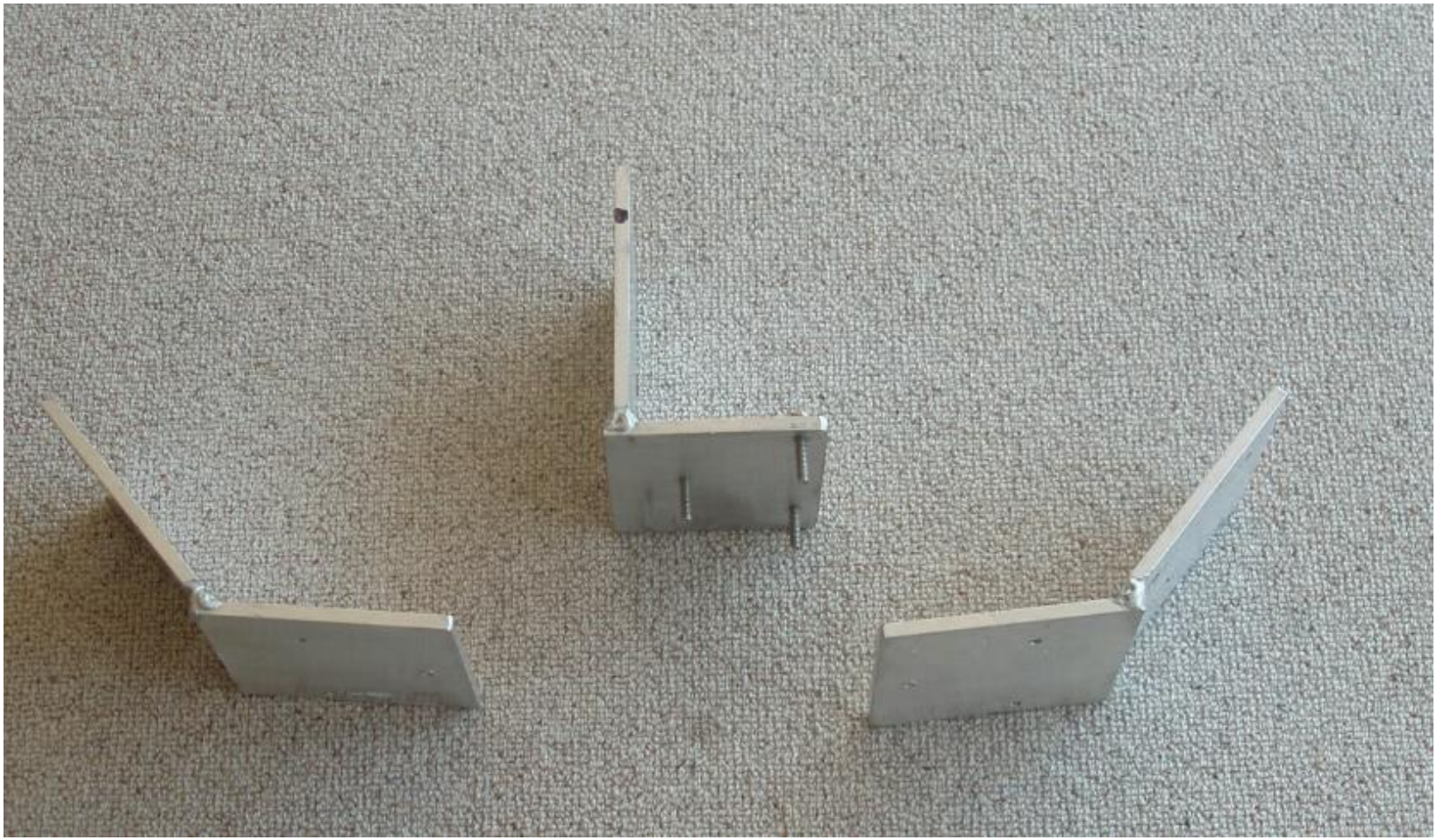
Azimuth References



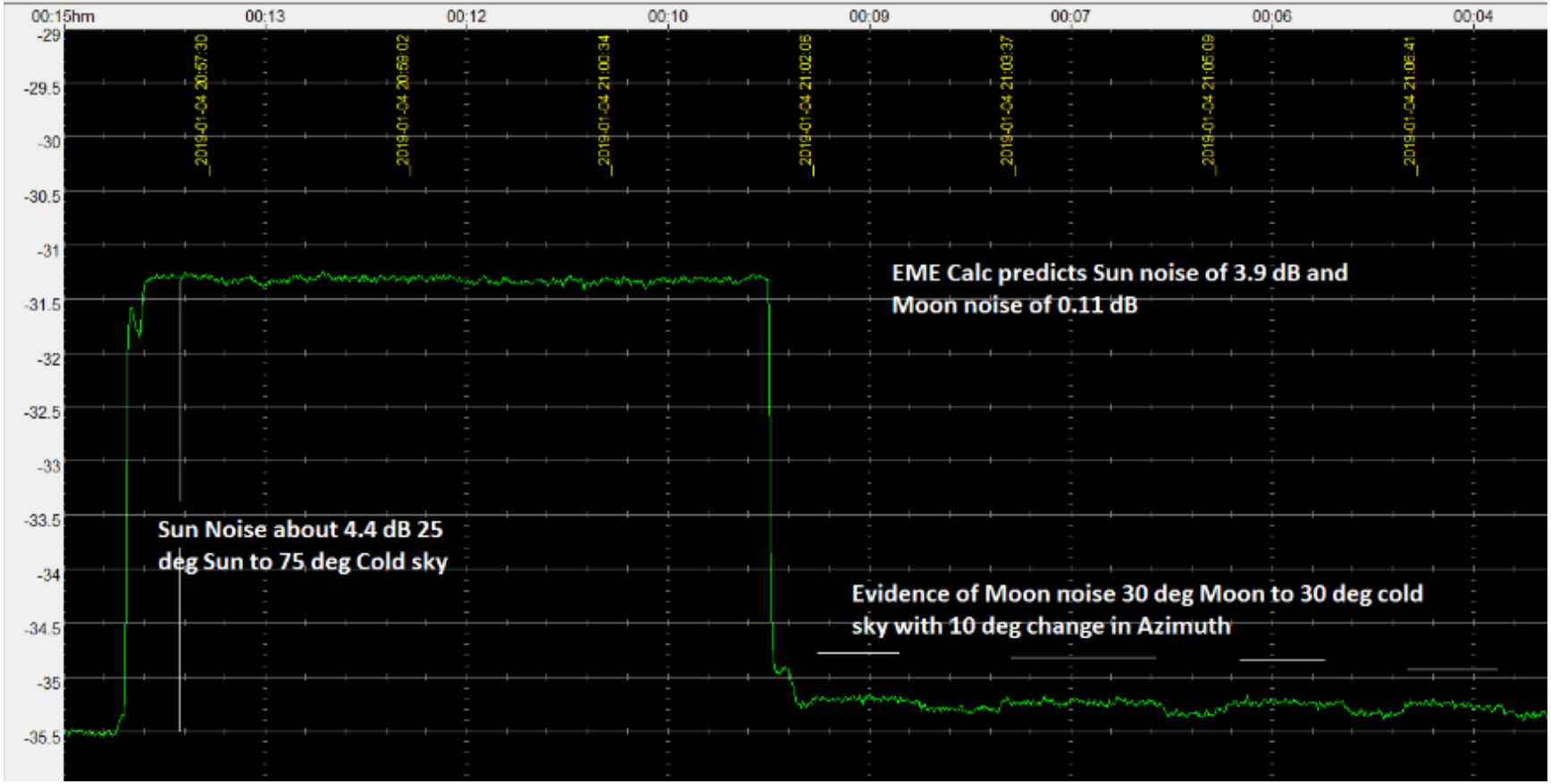


Elevation

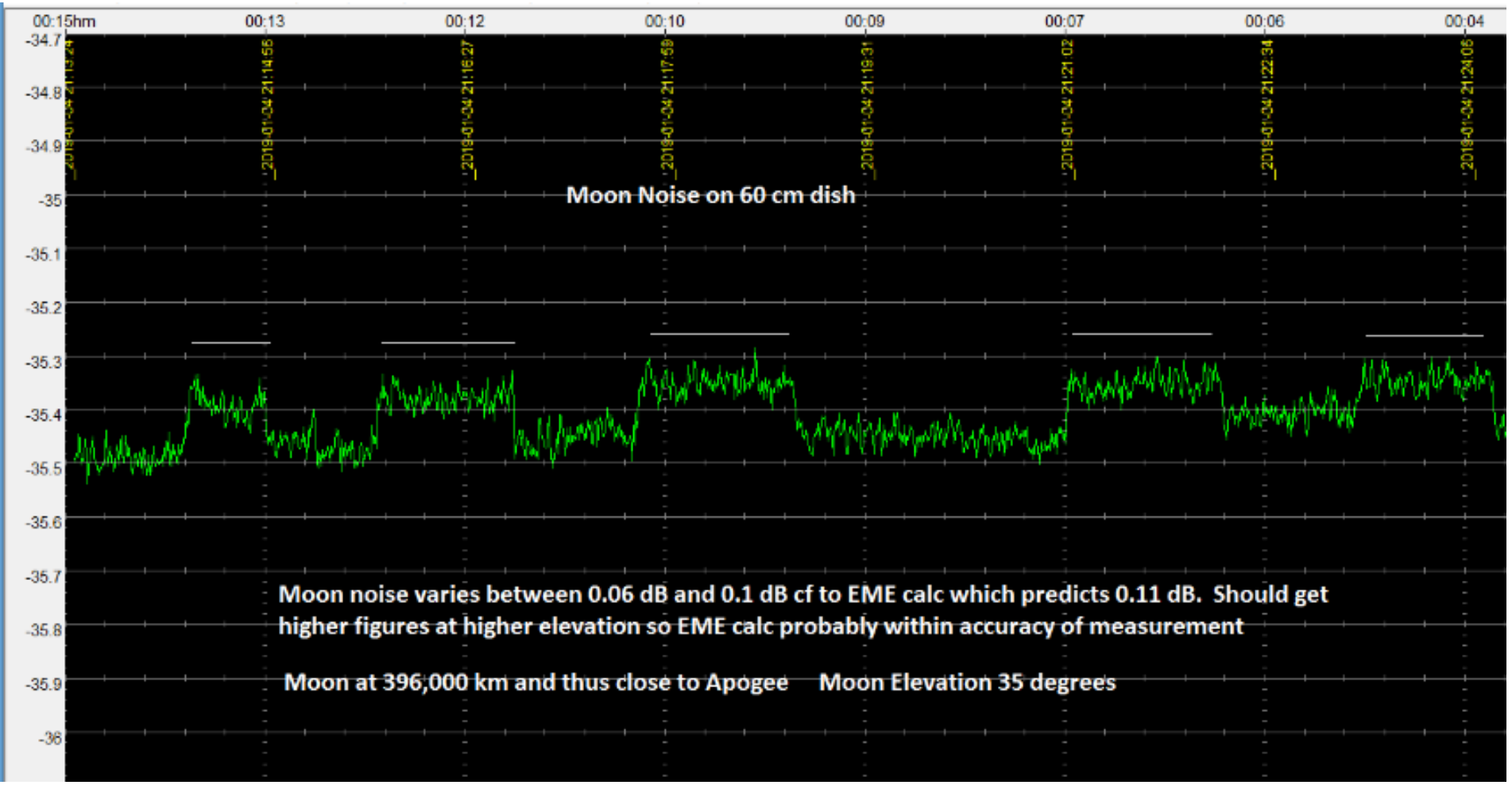
POLARISATION



Sun Noise on 2’6”dish

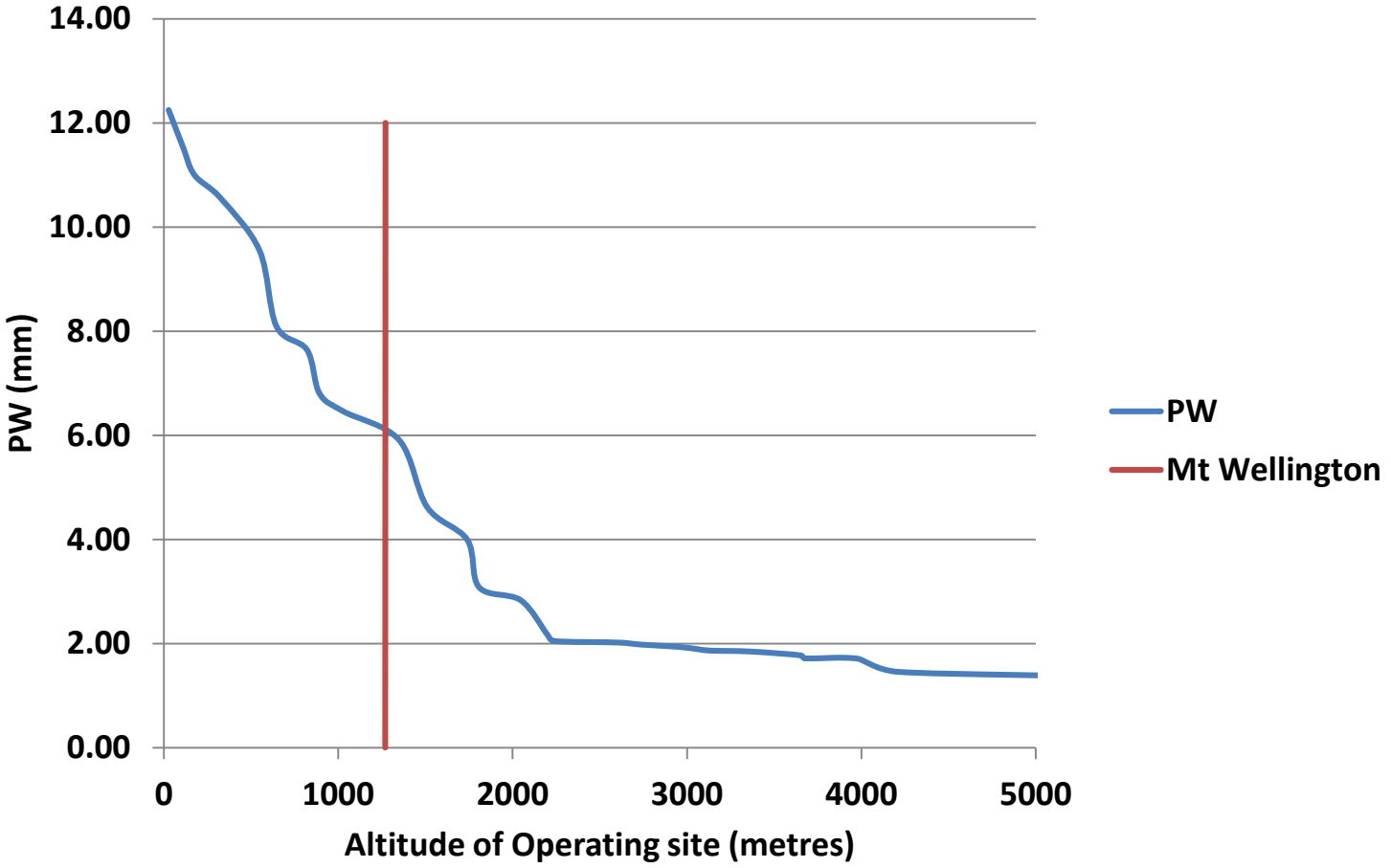


Moon Noise on 2’6”dish



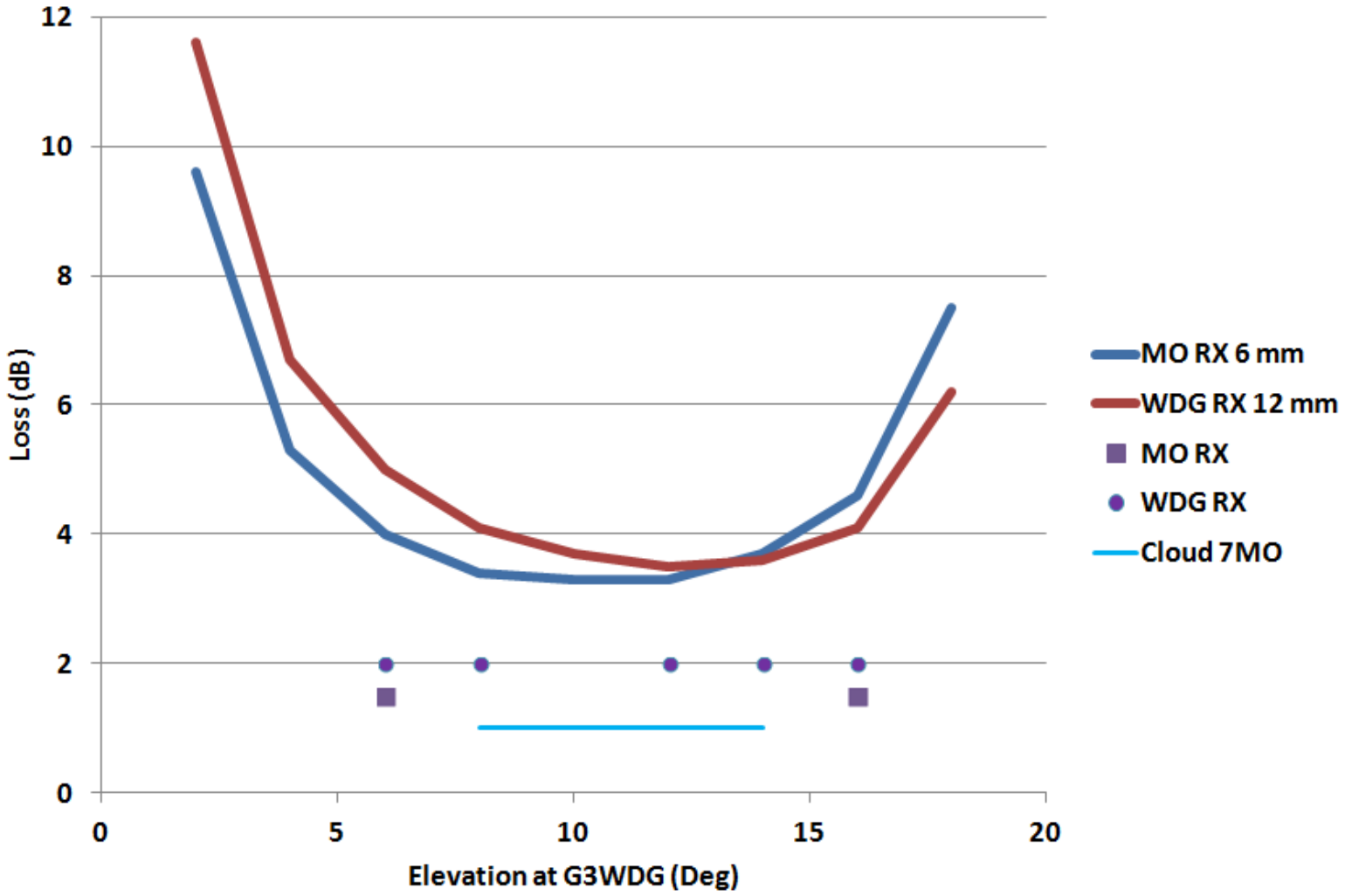
24 GHz World Record
G3WDG 17405 km

Reducing Water Vapour Losses

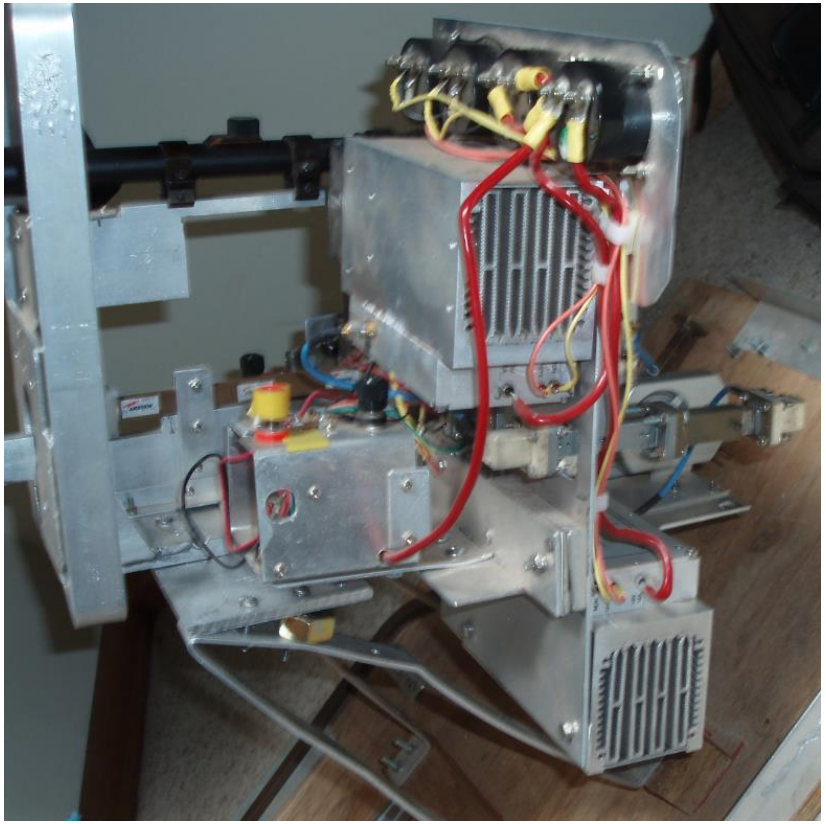


~ 2 dB improvement

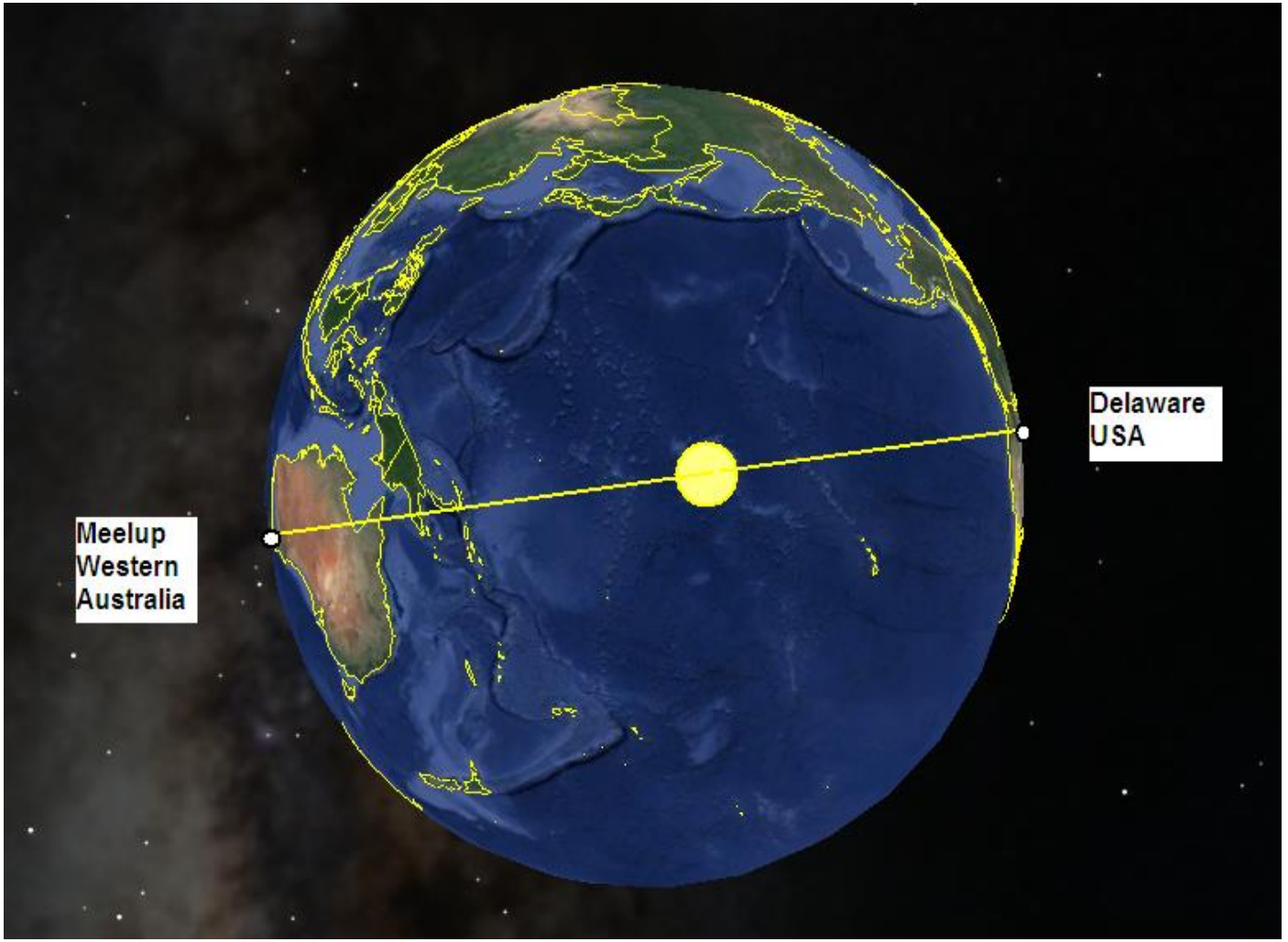
System Loss with Atmospheric Att.



Extending 24 GHz Record to 17464 km (G3WDG)

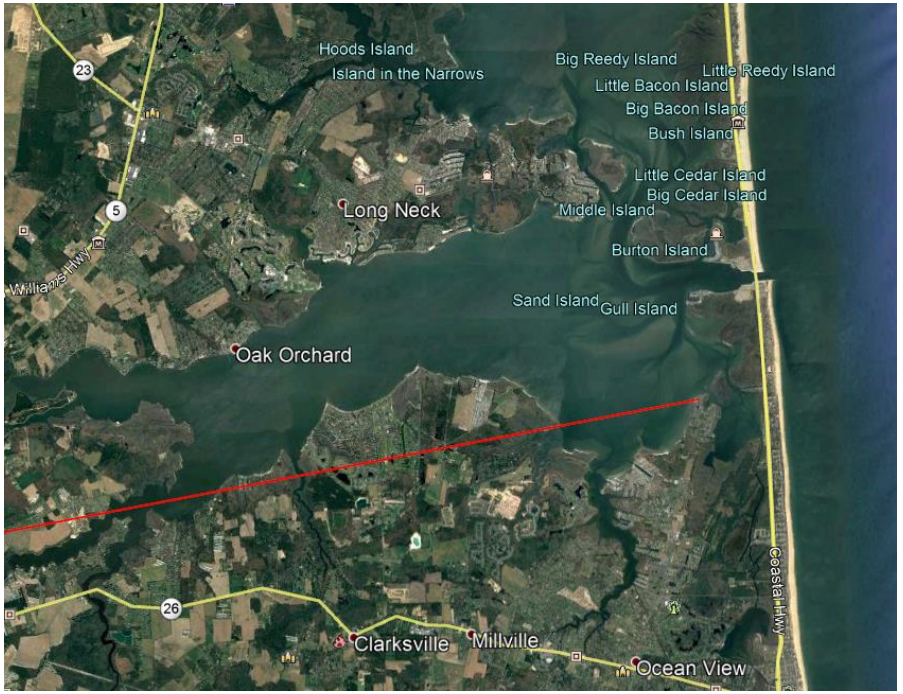


World Record 10 GHz EME 18949 km (WA3LBI)



Take-offs

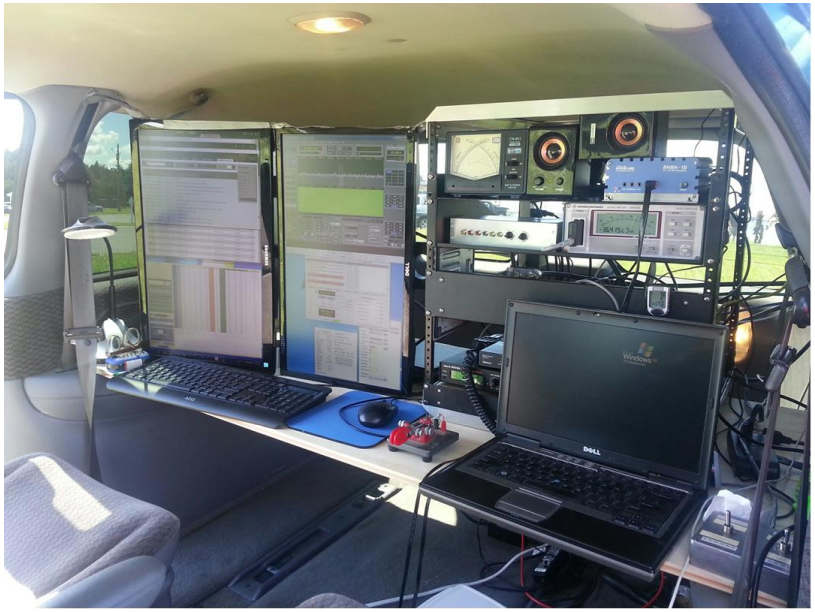

Darling Scarp
94
95
Perth
Geographe Bay


Hoods Island
Island in the Narrows
Big Reedy Island
Little Reedy Island
Little Bacon Island
Big Bacon Island
Bush Island
Little Cedar Island
Big Cedar Island
Middle Island
Long Neck
Burton Island
Sand Island
Gull Island
Oak Orchard
23
5
26
Clarksville
Millville
Ocean View
Coastal Hwy

VK7MO 4 foot Dish at Meelup

WA3LBI 2.4 meter dish & Take-off

Operating Position



WA3LBI

VK7MO

WR Decodes (18951 km)

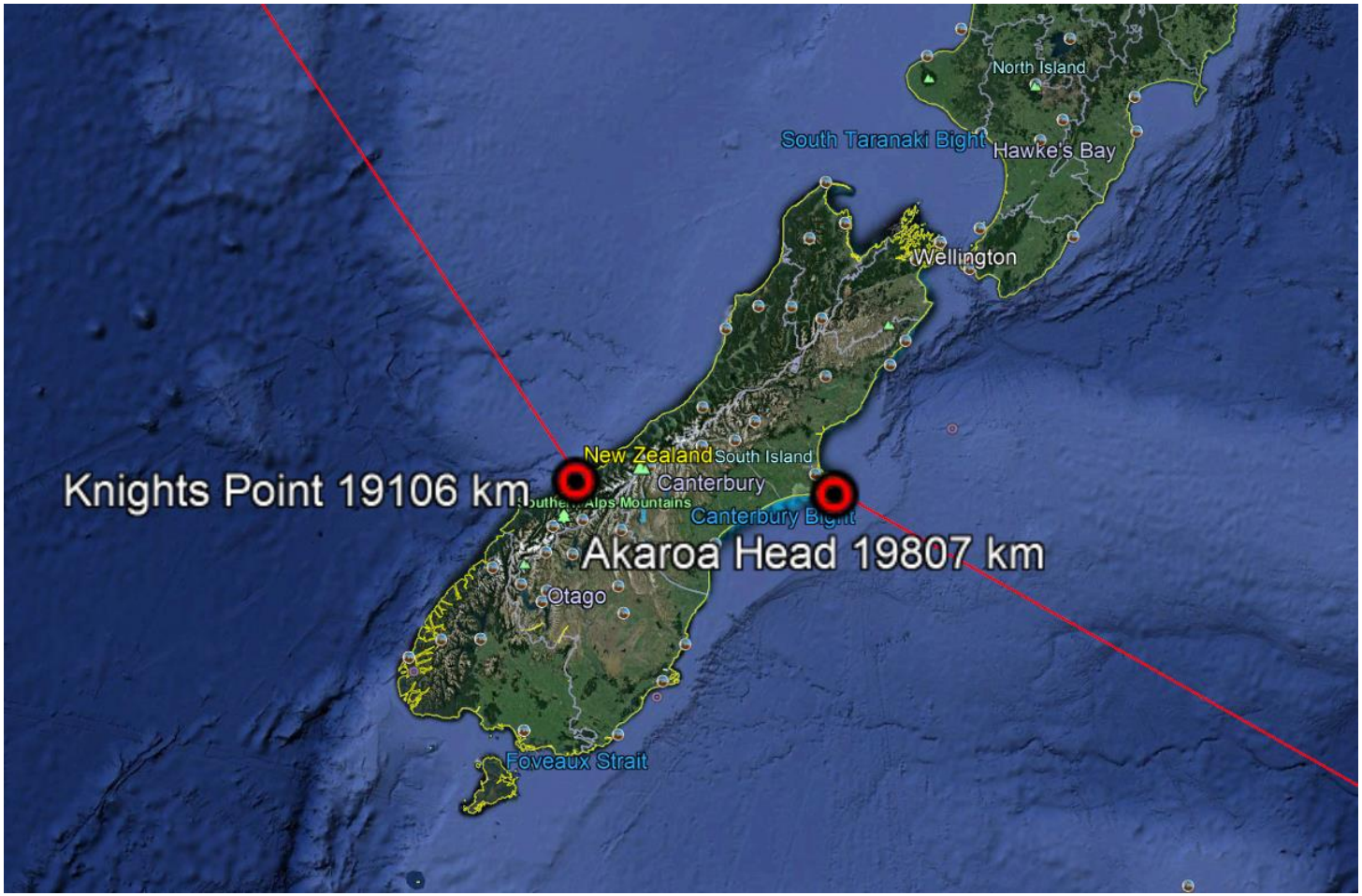
Rxed at VK7MO

```
1317 -23   2.6   998 :* VK7MO WA3LBI -24        3
1319 -21   2.6   997 :* VK7MO WA3LBI RRR        0
1321 -20   2.6   998 :* VK7MO WA3LBI 73         0
1323 -21   2.6   995 :* CONGRATS REX            0
1325 -21   2.8  1002 :* WR 18950 KM             0
1327 -19   2.6   996 :* WR 18950 KM             0
1329 -20   2.5   996 :* AWESOME REX             0
1331 -19   2.6   997 :* A SPECIAL DAY           0
```

Rxed at WA3LBI

```
1316 -24   2.5  1014 :* WA3LBI VK7MO OF76       3
1318 -20   2.5  1011 :* WA3LBI VK7MO R-23       0
1320 -20   2.5  1010 :* WA3LBI VK7MO 73         0
1322 -21   2.5  1015 :* WR 18950 KM             0
1324 -20   2.7  1013 :* WR 18950 KM             0
1326 -20   2.6  1014 :* TNX JIM 73              0
1328 -21   2.6  1011 :* CONGRATS JIM           0
1330 -18   2.6  1012 :* CONGRATS JIM           0
1332 -21   2.6  1008 :* WELL DONE JIM          0
1334 -22   2.6  1010 :* WA3LBI VK7MO OF76       0
```

Extending 10 GHz EME World Record

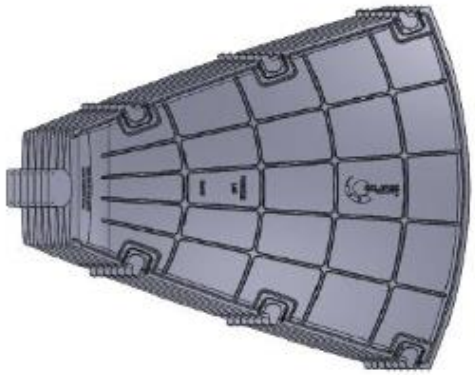


Getting a Dish to ZL

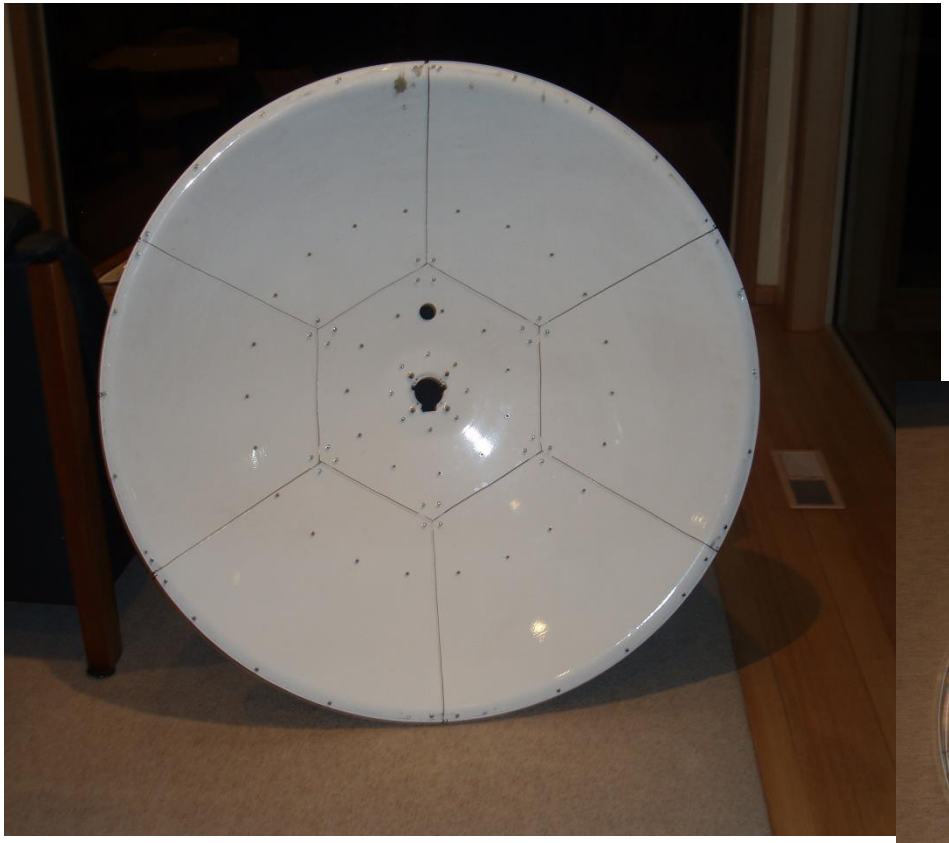
Compact, Light-weight Design

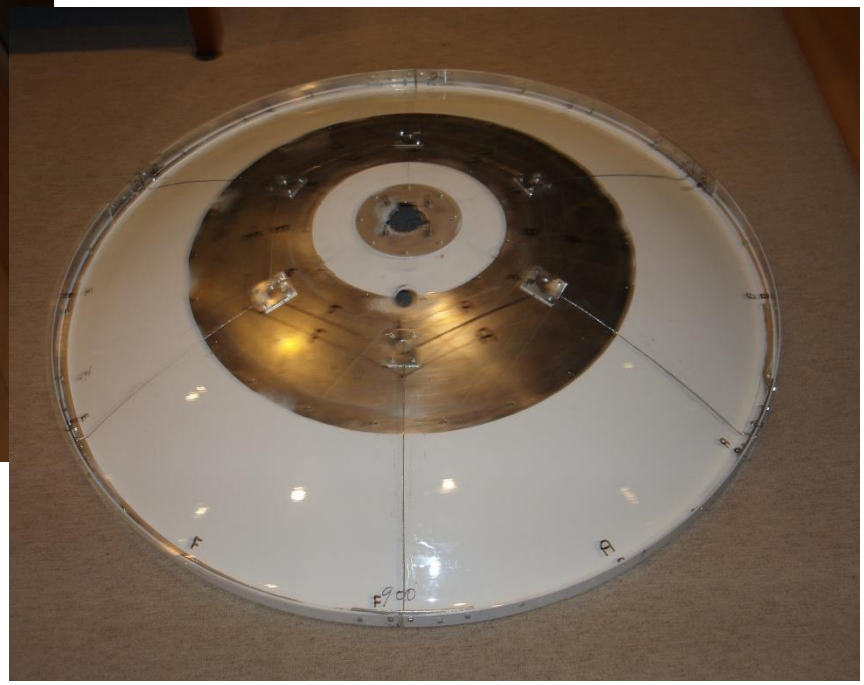
Eclipse Composites Engineering has teamed with Optim Microwave to produce an affordable 'off-the-shelf' antenna system. Designed for use in military, emergency, exploratory and SNG applications requiring easy transport and rapid deployment.

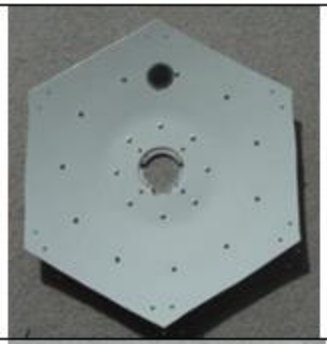
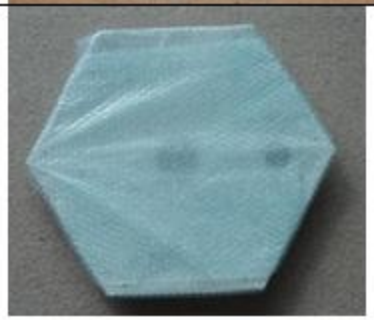
- ***50% lighter than aluminum***
- ***Less than 2 minute reflector assembly time***
- ***Multiband reflector (X, Ku, Ka-band)***
- ***Removeable Feed***
- ***Identical, Interchangeable petals***
- ***No particular order of assembly***
- ***Mil-Std 810G Environmental Compliance***
- ***45 Km/h Wind Load***
- ***Painted / Cerakote Options available***
- ***Patented Design***



Another Option



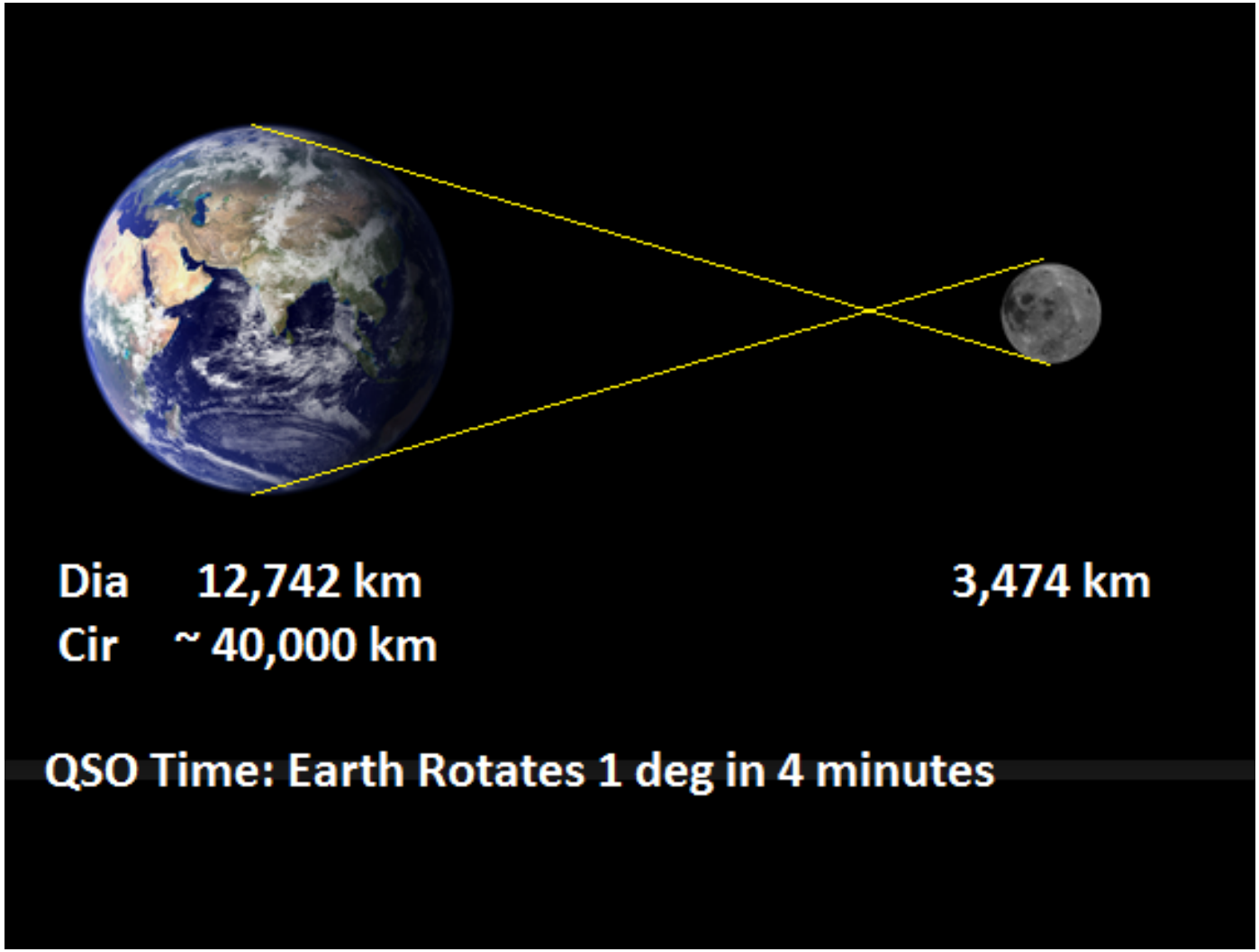


No	Description	Before Wrapping	Wrapped	In luggage Case
1	6 Petals for Dish			
2	Centre of Dish			
3	6 Ring Sections			
4	Elevation Mount			
5	5/8 inch Tripod to HV4 adaptor			

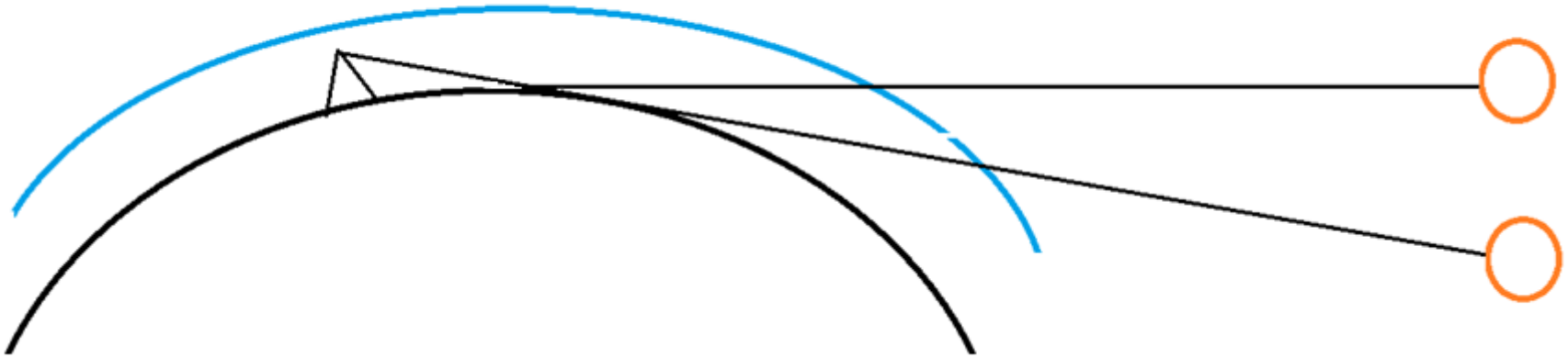
Cabin Bag

Item	Item Photo	Bag
1 C. PA/Head unit		

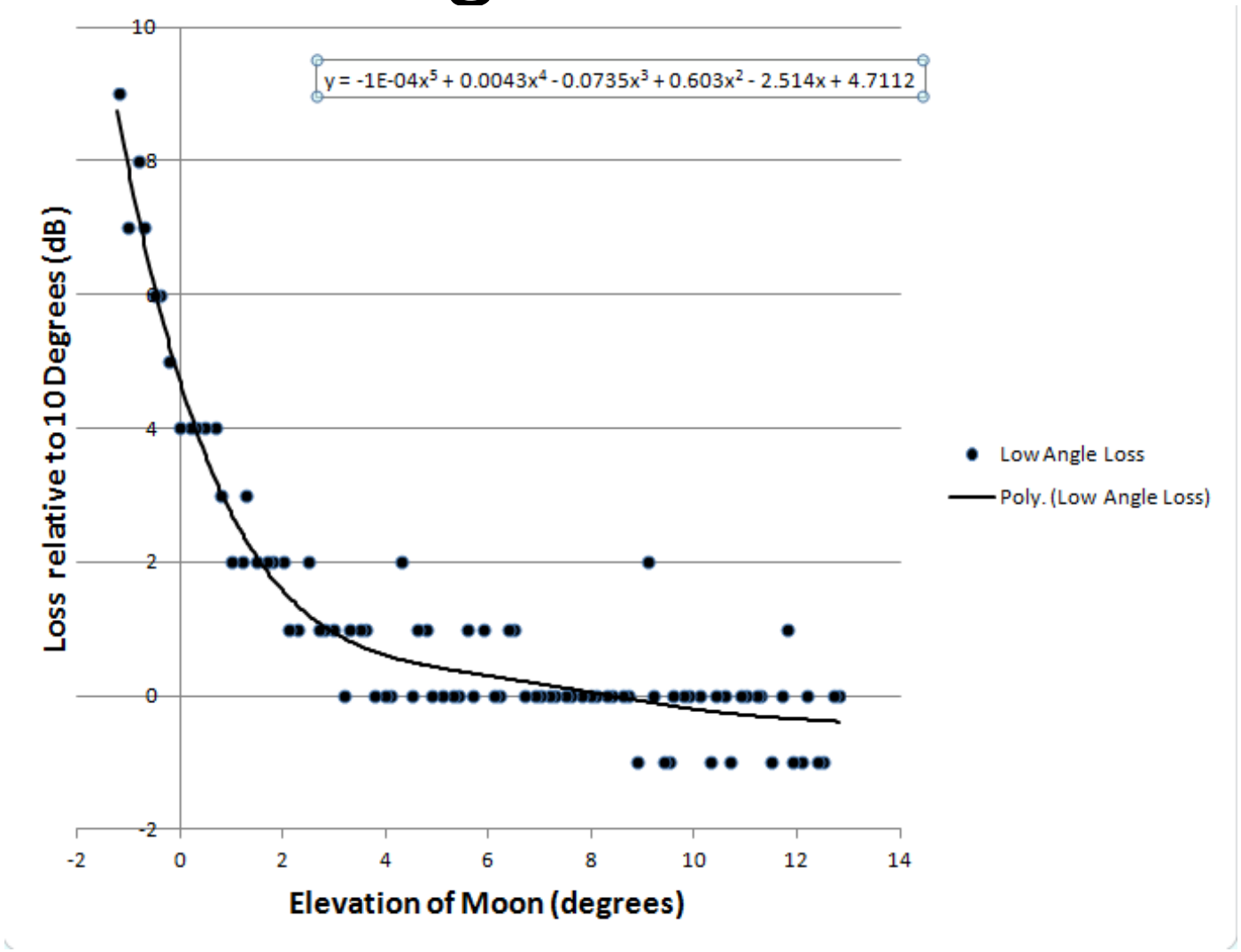
Extending 10 GHz EME World Record



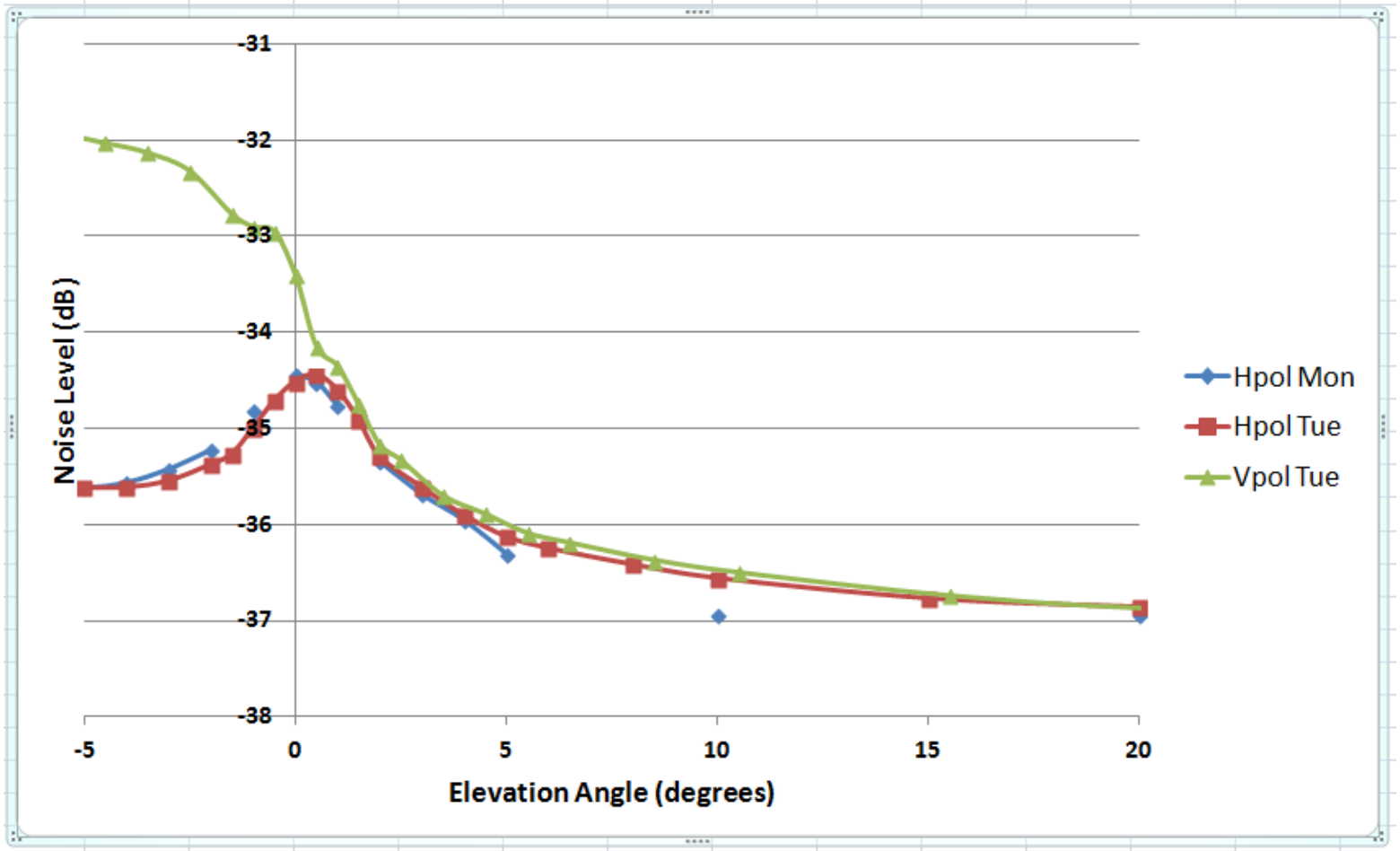
While Height allows a lower angle atmospheric attenuation increases



Low angle Loss on RX

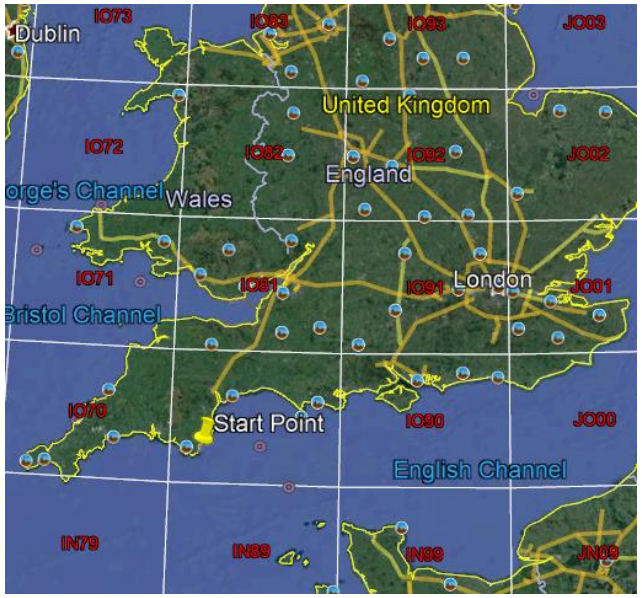


Absorption and Sea Noise with Polarization



Knights Point, ZL

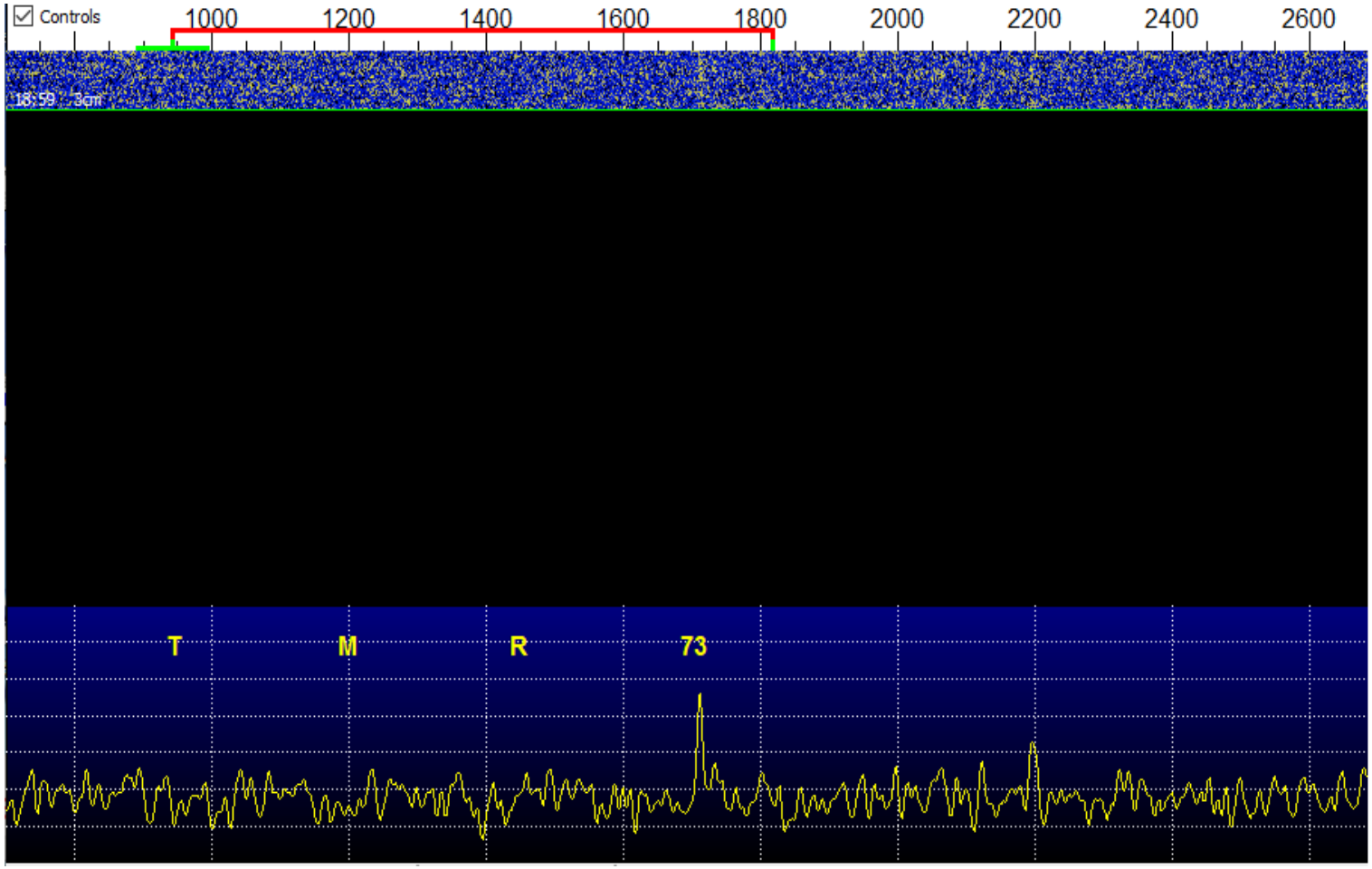
G3WDG at Start Point IO80ef



Decodes at ZL/VK7MO

```
1801 -21  2.8 1010 :*
1803 -27  2.9 1016 :
1805 -22  2.9 1015 :* ZL/VK7MO G3WDG          0
1807 -21  2.9 1014 :* VK7MO G3WDG R-24        0
1809 -21  2.9 1014 :* VK7MO G3WDG -23         0
1811 -23  2.9 1013 :* VK7MO G3WDG 73          0
1813 -27  2.9 1012 :
1815 -23  2.8 1015 :* TNX SO HAPPY            0
1817 -20  2.9 1013 :* TNX SO HAPPY            0
1819 -20  2.9 1015 :* TT FB 19105             0
1821 -20  2.9 1015 :* TNX WR 73               0
1823 -25  2.9 1013 :*
1825 -22  2.9 1013 :* VK7MO G3WDG -20         0
1827 -22  2.9 1015 :* VK7MO G3WDG -21         0
1829 -23  2.9 1014 :* VK7MO G3WDG IO80        0
1831 -21  2.9 1012 :* VK7MO G3WDG RRR         0
1833 -23  2.9 1014 :* VK7MO G3WDG 73          6
1835 -29  2.9 1016 :
1837 -29  1.2 1011 :
1839 -29  1.5 1019 :
1841 -29  2.0 1003 :
1843 -29  0.7 1003 :
```

Single tone 73 at -1.0 degrees



Success -- 19106 km