

■ Practical investigation of the polarisation of 50MHz signals

Chris Deacon, G4IFX

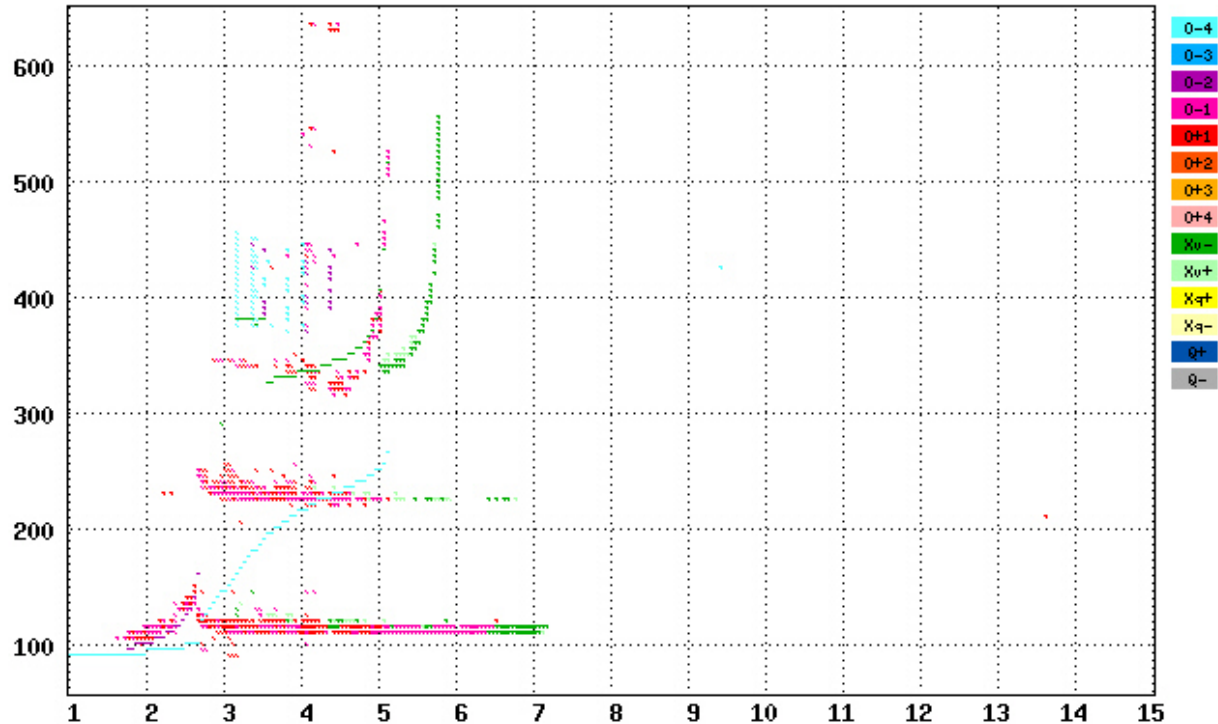
HAMSCI UK 13th October 2017



Is Es similar to F2 in terms of polarisation?

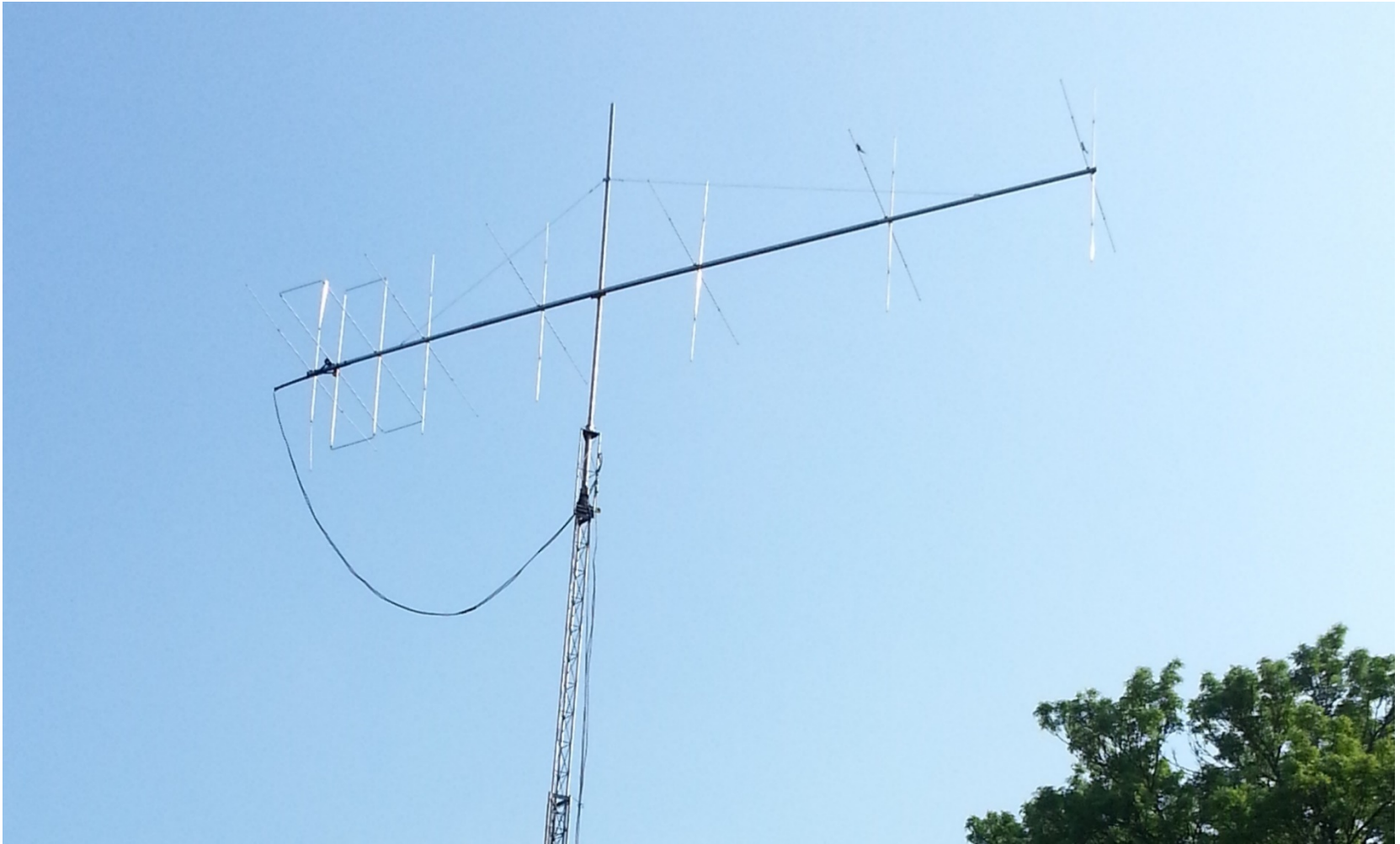
foF2	5.10
foF1	N/A
foF1p	3.79
foE	2.66
foEp	2.59
fxI	5.80
foEs	6.45
<hr/>	
MUF	15.83
M	3.104
D	3000
<hr/>	
h ^o F	324
h ^o F2	N/A
h ^o E	95
h ^o Es	110
<hr/>	
zmF2	265
zmF1	N/A
zmE	103
yF2	74
yF1	N/A
yE	16
<hr/>	
C-level	11

STATION YYYY DAY DDD HMM P1 FFS S AXN PPS IGA PS
 Chilton (RAL) 2006 May20 140 1700 MMM 000-1 085 200 +0+ B1



/data/ionosondes/chilton/2006/05/RL052_2006140170000.MMM / 280fx128h 50 kHz 5.0 km 2x3 / DPS-1 (052-052) 51.6 N 358.7 W

Experiments at G4IFX - antenna



Innovantennas 7-ele X-POL antenna @ 20m
Separate feeders, identical feeder lengths

Experiments at G4IFX - receiver



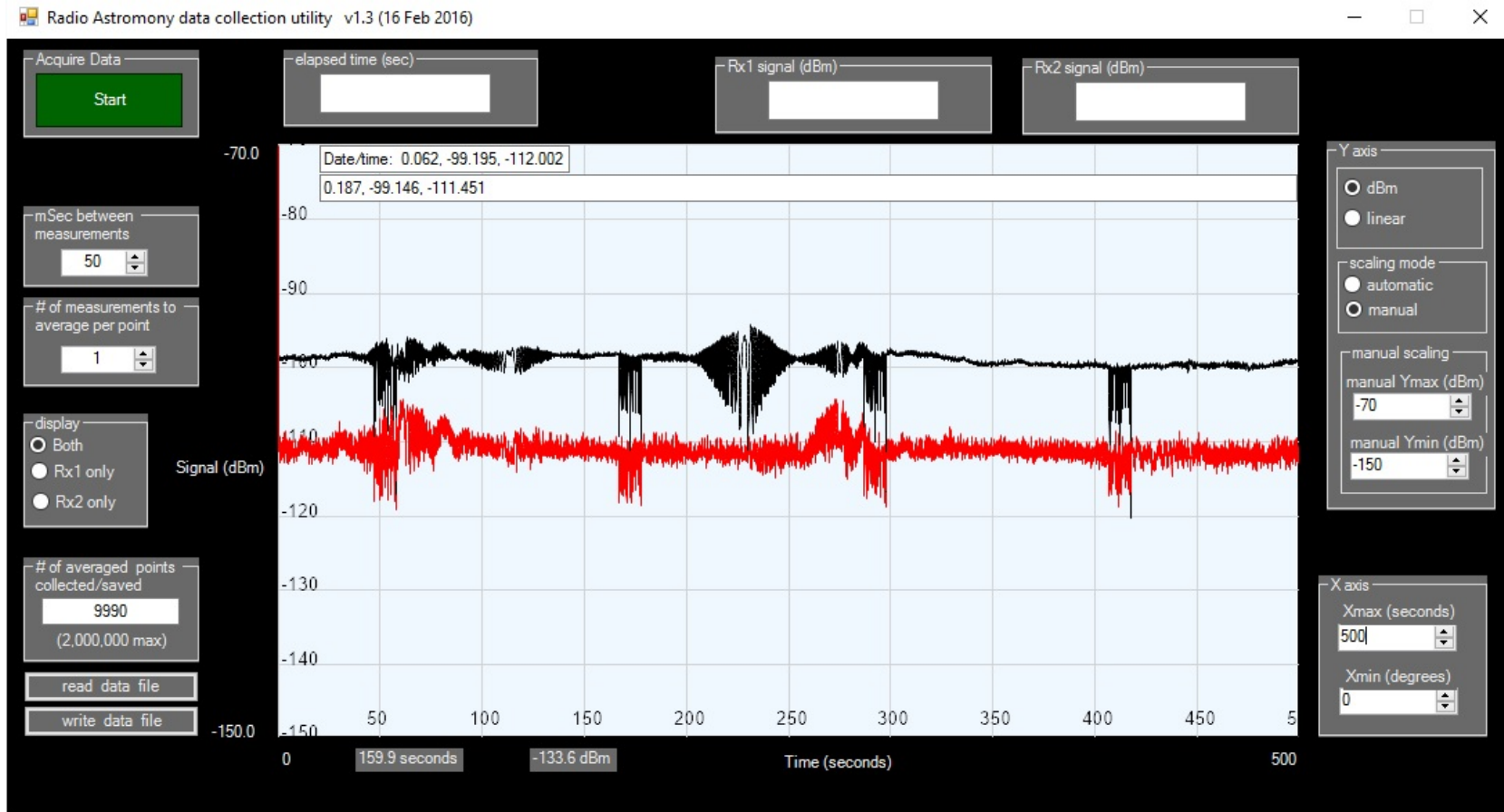
GB3BAA

RX1:
HORIZONTAL

RX2:
VERTICAL

Apache ANAN-100D, dual receivers, OpenHPSDR mRX PS
(nearly) identical receiver chains – effectively a dual channel spectrum analyser

Experiments at G4IFX – data capture



Radio Astronomy data collection utility, OpenHPSDR mRX PS
GB3RAL 25 March 2016 (propagation: tropo, 58km obstructed path with aircraft scatter)
Signal strength in dBm, Black = RX1: horizontal, Red = RX2: vertical

An early observation



G8BCG (IO70RK) at G4IFX (IO91OD) via aurora 17 March 2015 2105z
RX switching between horizontal (first) and vertical antennas

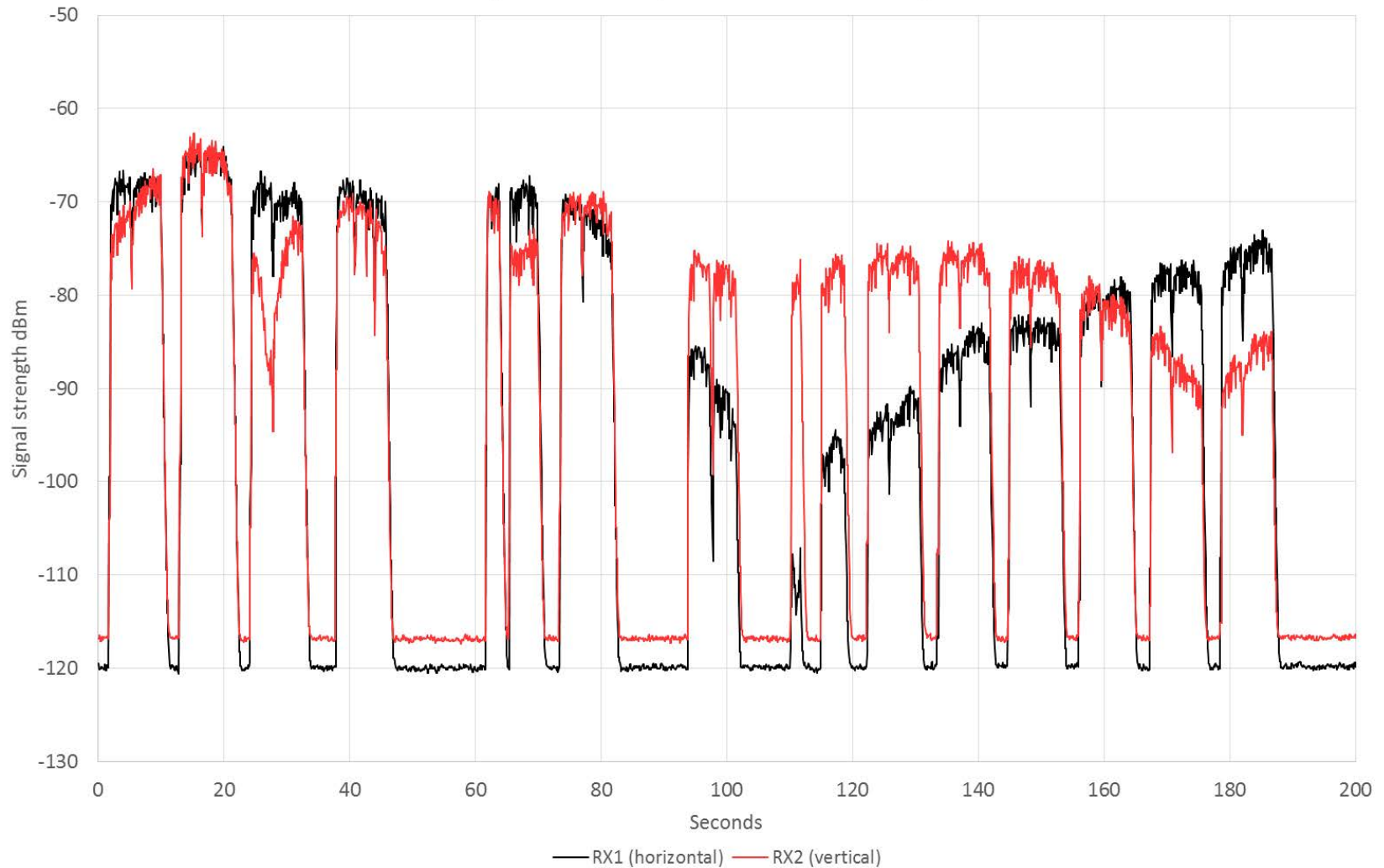
“The polarization of auroral echoes is mostly found to be closely identical with the transmitted polarization.”

“Radio Aurora”, Bengt Hultqvist and Alv Egeland; Space Science Reviews **3** (1964) 27-78

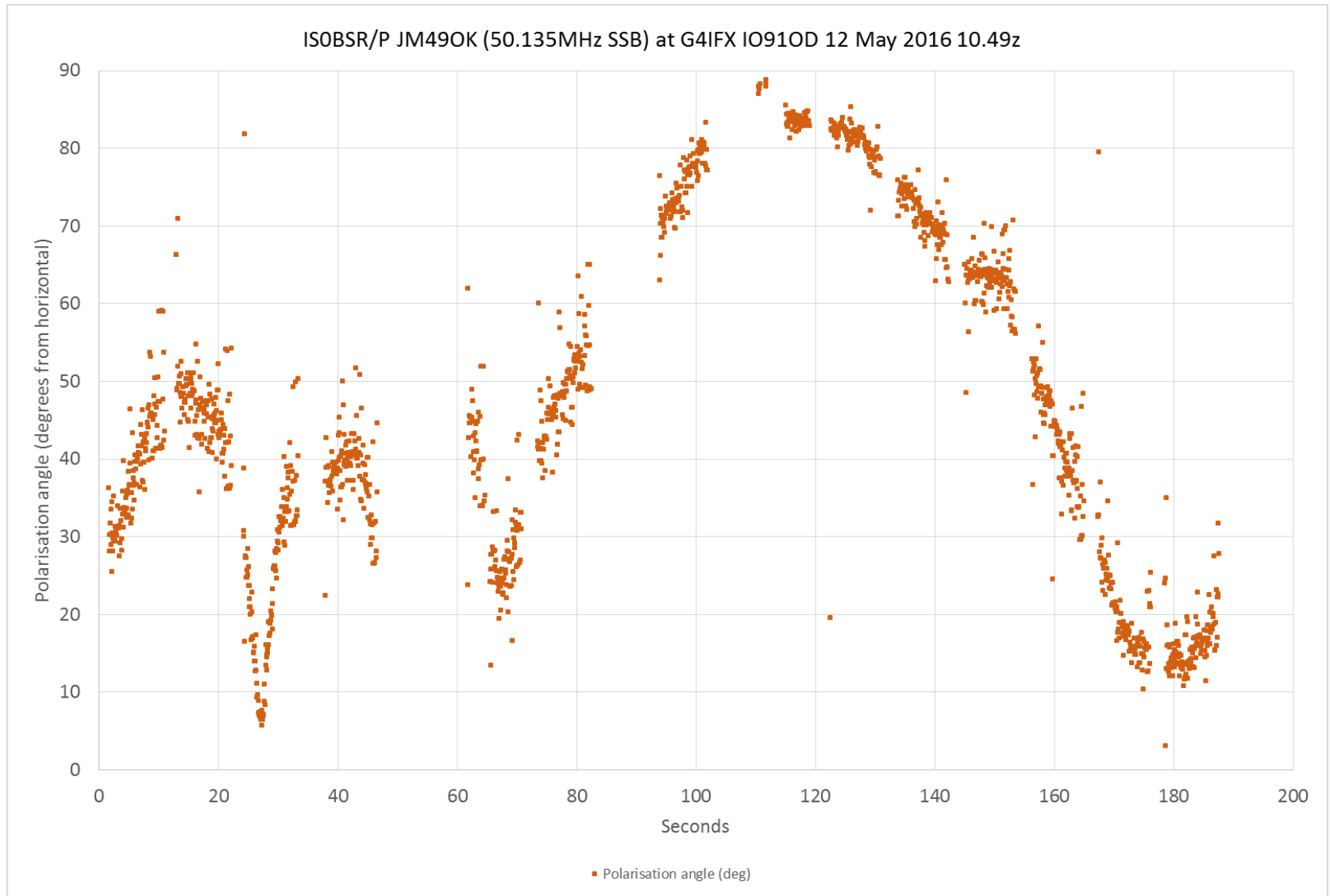
Sporadic-E single-hop

Transmitted polarisation: horizontal
Range: 1515km

ISOBSR/P JM49OK (50.135MHz SSB) at G4IFX IO91OD 12 May 2016 10.49z

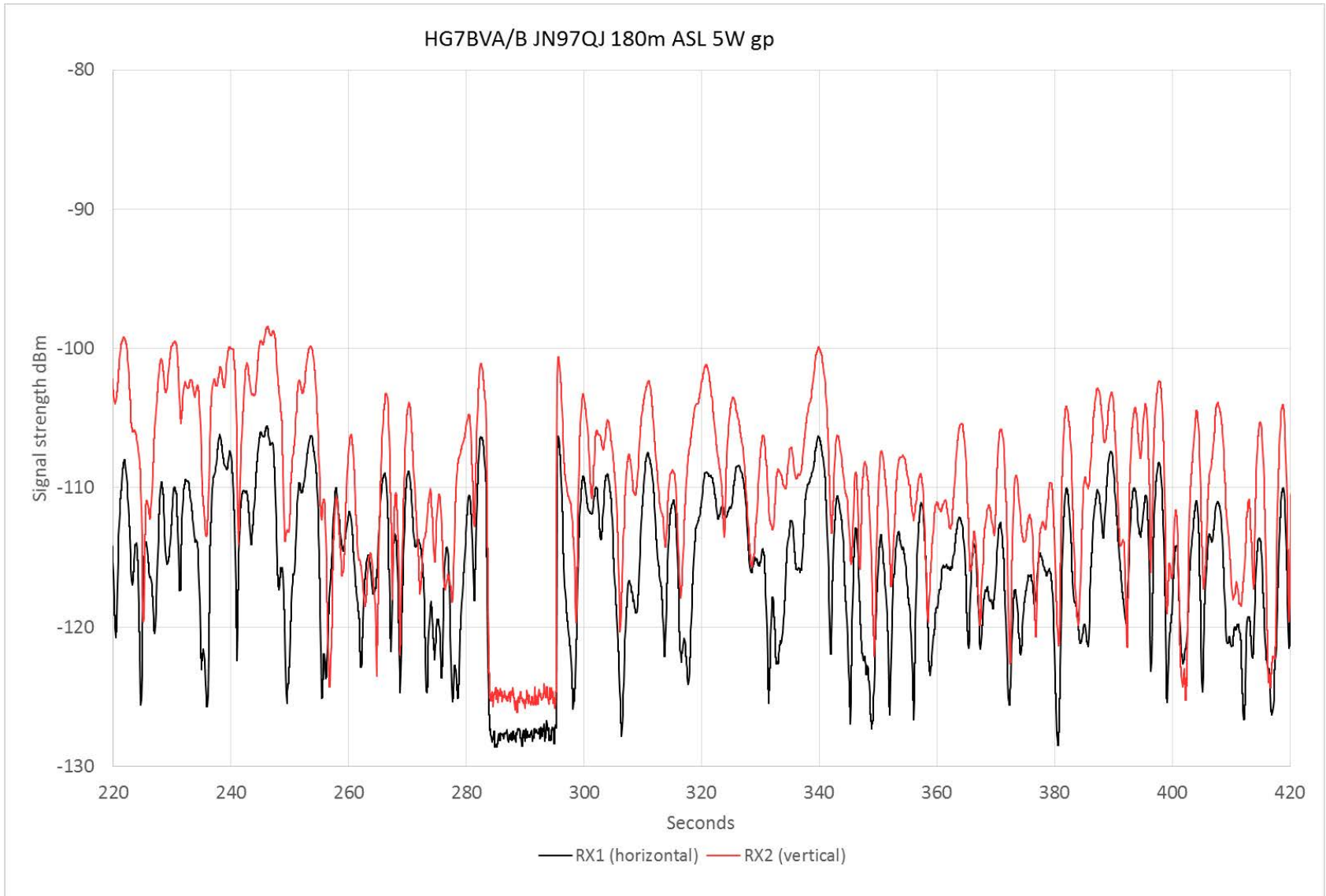


Calculated polarisation angle *Transmitted polarisation: horizontal* *Range: 1515km*



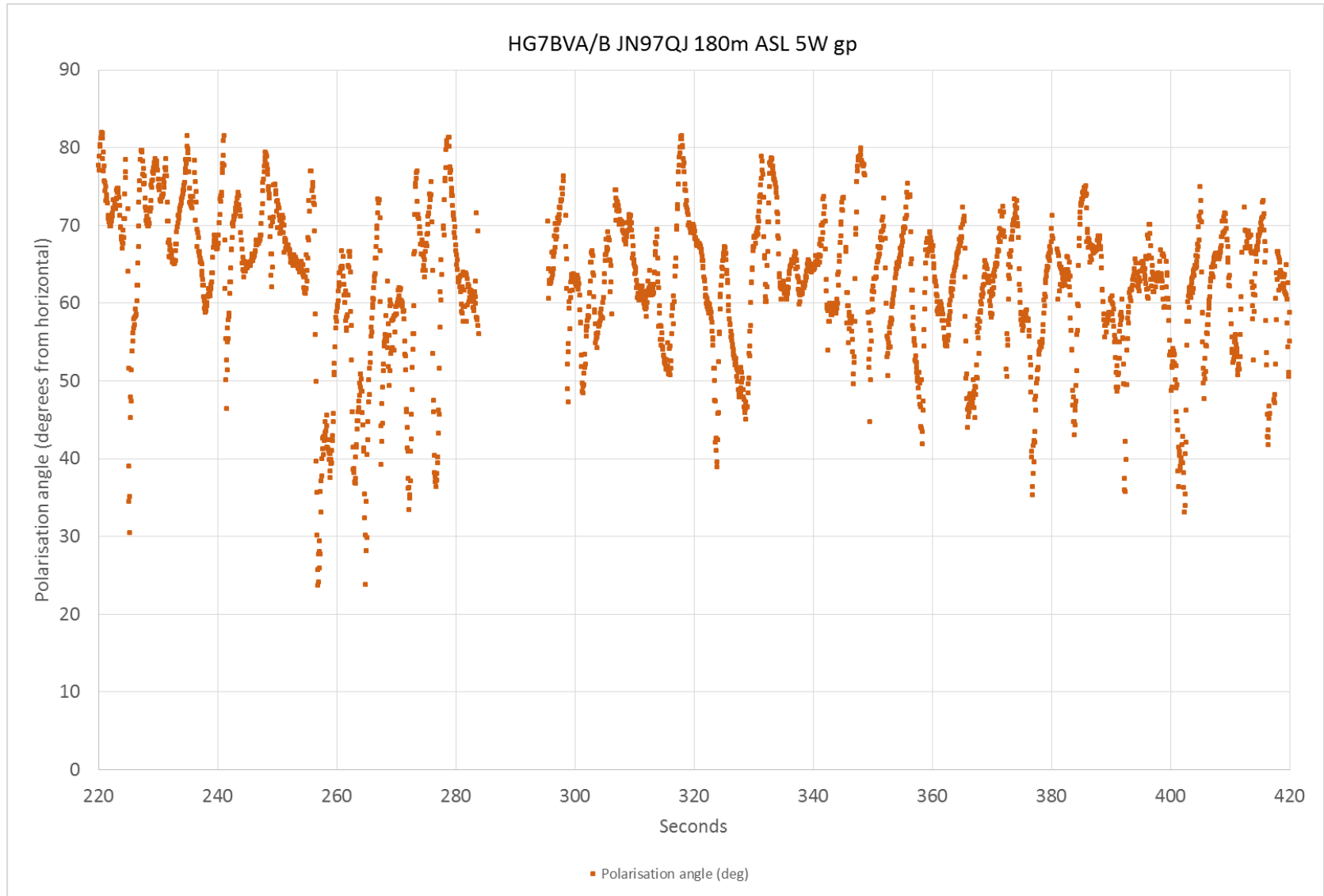
Sporadic-E single-hop

Transmitted polarisation: vertical
Range: 1515km



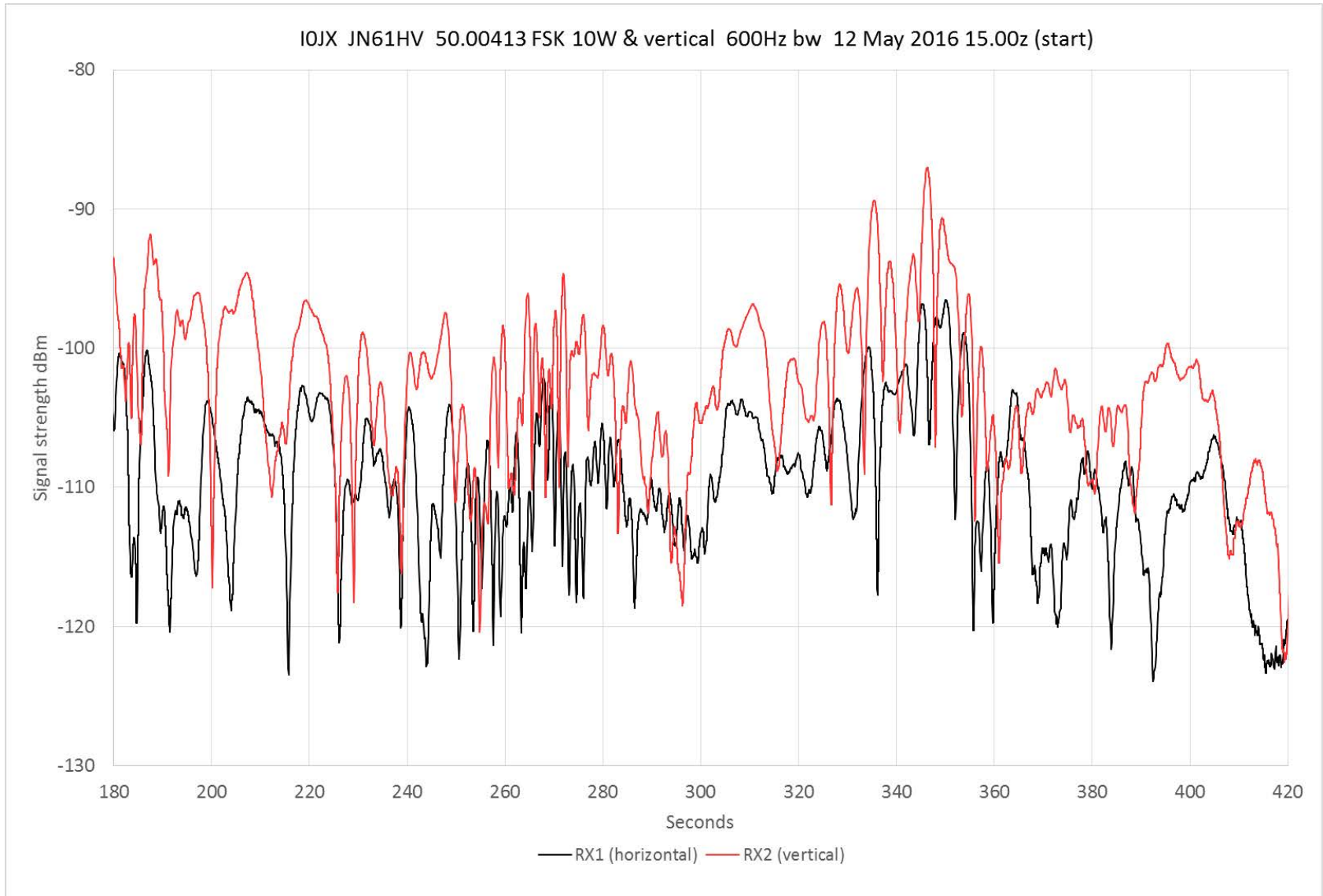
Sporadic-E single-hop

Transmitted polarisation: vertical
Range: 1515km



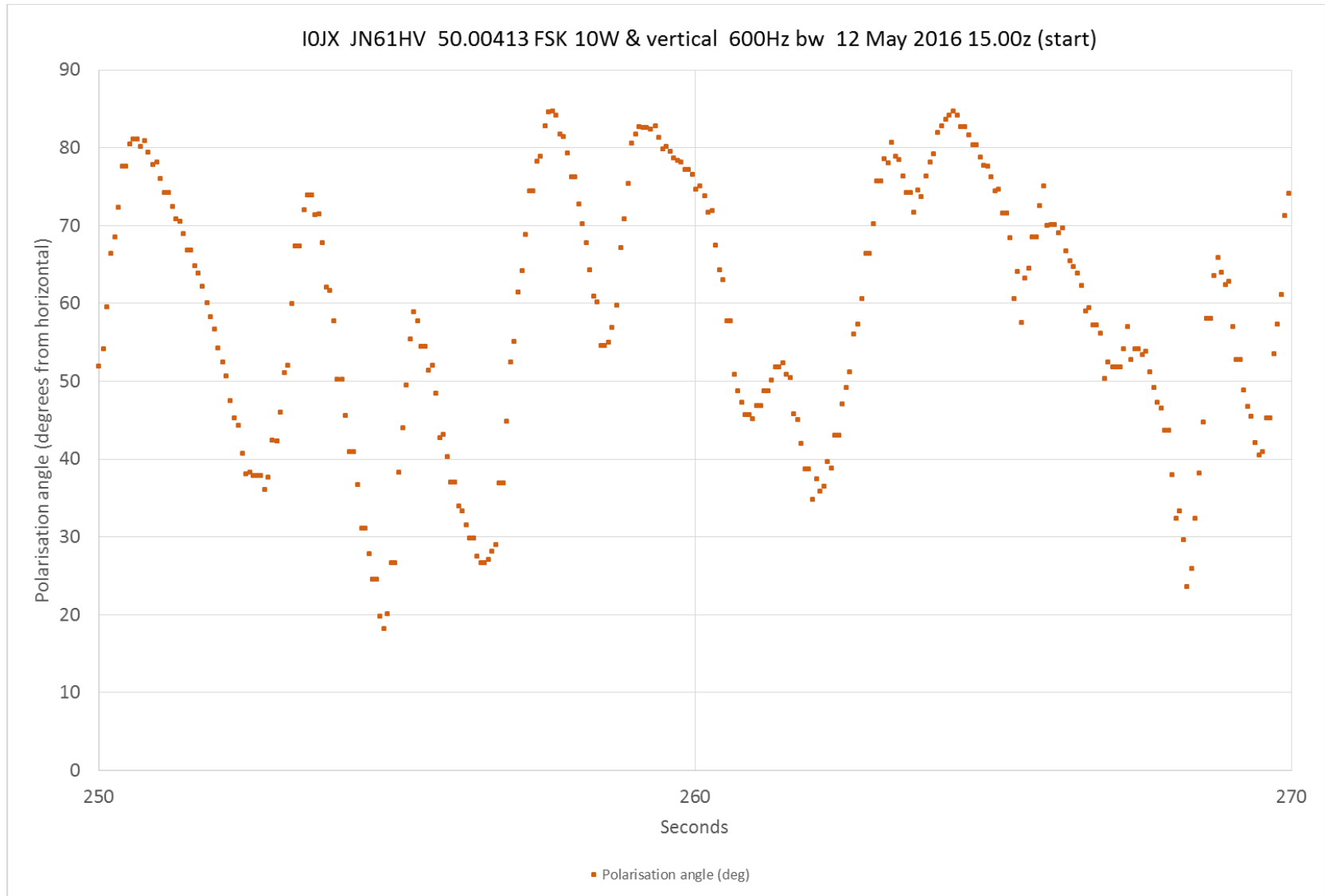
Sporadic-E single-hop

Transmitted polarisation: vertical
Range: 1448km



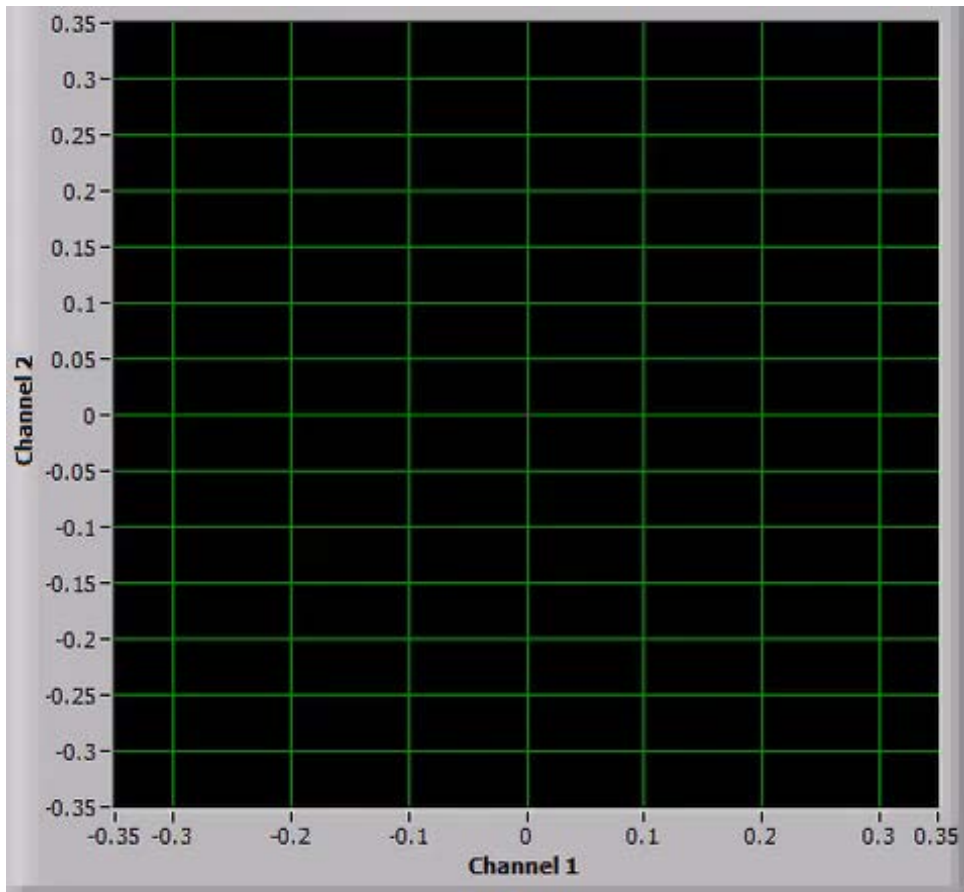
Sporadic-E single-hop

Transmitted polarisation: vertical
Range: 1448km

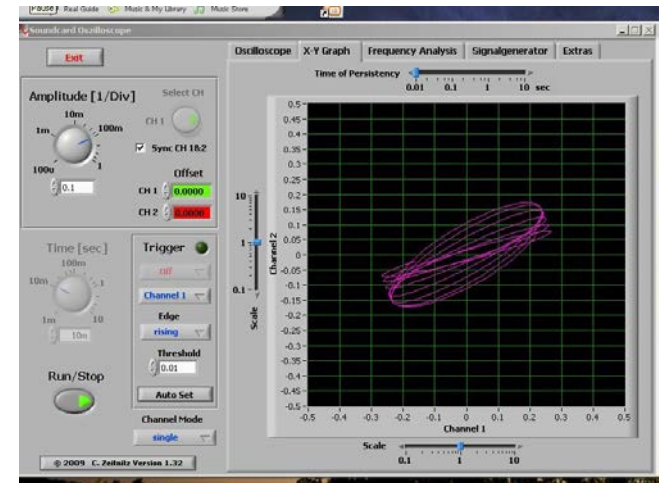


What's really happening?

Prior work by Graham Kimbell, G3TCT



GB3LER 5 August 2010 via sporadic-E, range 1059km



See Graham's website (<http://g3tct.co.uk/diversity.html>) for an extensive set of 50MHz diversity recordings

BBC research report 1975



RESEARCH DEPARTMENT

BBC RD 1975/17



REPORT

Ionospheric propagation in v.h.f. television Band I

L.F. Tagholm, M.B.E., F.I.E.E.
C.P. Bell, B.Sc.(Eng.)
P. Knight, M.A., Ph.D., M.I.E.E.

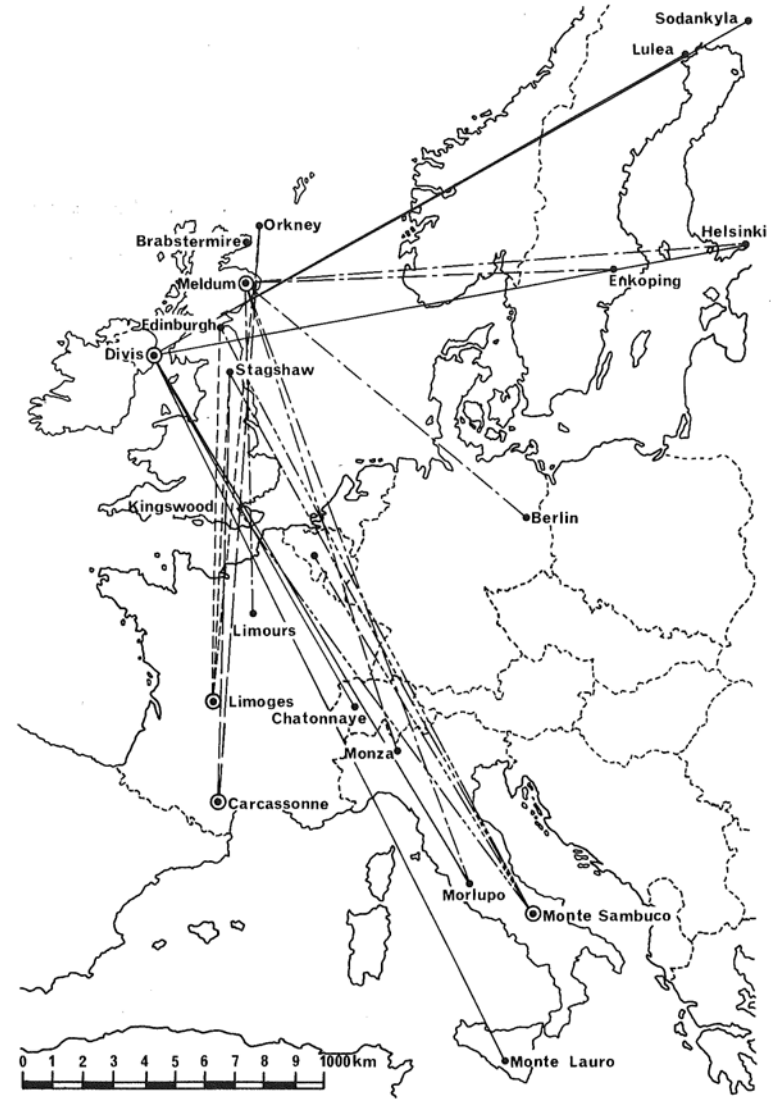


Fig. 1 - Propagation paths

● Transmitting stations ● Receiving stations

Average received vs transmitted polarisation:

Table 4

Polarization Ratio

Transmitter Frequency and Polarization	Receiver	Radiation angle, degrees	Year	Polarization ratio, dB	Average Polarization ratio, dB
Limoges 41.28 MHz H	Orkney	4.7	1970	6.7	7.4
			1971	8.6	
Divis 41.465 MHz H	Helsinki	2.0	1968	-0.9	-0.1
			1969	-0.3	
			1970	0.1	
			1971	0.4	
			1972	0.3	
Monte Sambuco 49.30 MHz H	Kingswood	4.0	1966	5.8	5.0
			1967	3.5	
Carcassonne 54.43 MHz V	Kingswood	11.0	1966	2.2	3.0
			1967	3.6	
	Orkney		1970	4.6	
Meldrum 58.215 MHz H	Helsinki	4.0	1970	3.4	4.4
			1971	4.2	
			1972	7.1	

Polarisation ratio = the ratio of the signal strength for the transmitted polarisation to the signal strength for the orthogonal polarisation (dB)

Using WSJT-X for bulk data collection

The image displays two instances of the WSJT-X software, labeled RX1 and RX2, running on a Windows operating system. Each instance shows a list of received calls, a control panel, and a wideband graph.

WSJT-X - RX1 v1.8.0-rc1 by K1JT

Call Log (Left):

Time	Offset	SNR	Power	Call	Mode
125145	-3	0.9	1596	~ MWOBYS W1AEAZ R-11	
125145	-11	0.8	2340	~ SMONKZ N3XX EM73	
125215	-4	0.3	497	~ CQ DX R1TOL FN44	
125215	-12	0.8	718	~ GM4WA N2GHR FN30	
125215	-5	0.3	769	~ CQ MWOLGE IO81	
125215	-12	0.8	855	~ EI4DQ KALQBO R-13	
125215	-12	0.3	979	~ MMOAMW NY2NY -18	
125215	-11	0.3	1481	~ CQ DX W3CP EM74	
125215	-2	0.9	1593	~ MWOBYS W1AEAZ R-11	
125215	-11	0.2	2059	~ KCL1GWX AA4V -13	
125215	-9	0.8	2335	~ SMONKZ N3XX R-06	
125245	-15	0.3	498	~ CQ DX R1TOL FN44	
125245	-7	0.3	771	~ CQ MWOLGE IO81	
125245	-13	0.4	980	~ MMOAMW NY2NY -18	
125245	0	0.9	1595	~ MWOBYS W1AEAZ R-11	
125245	-4	0.4	1947	~ CQ DX R4PI EM73	
125245	-11	0.7	2061	~ KCL1GWX AA4V RRR	
125245	-7	0.9	2338	~ SMONKZ N3XX 73	
125315	1	0.3	772	~ CQ MWOLGE IO81	
125315	-1	0.9	1602	~ MWOBYS W1AEAZ 73	
125315	-6	0.3	1864	~ CQ DX W3CP EM74	
125315	-2	0.4	1950	~ EI7IX R4PI -07	
125315	-12	0.2	2062	~ KCL1GWX AA4V 73	

Call Log (Right):

Time	Offset	SNR	Power	Call	Mode
124430	Tx	306	~	CQ G4IFX IO91	
124500	Tx	306	~	CQ G4IFX IO91	
124515	0	0.8	305	~ G4IFX MWOLGE IO81	
124530	Tx	305	~	MWOLGE G4IFX +00	
124545	-7	0.4	306	~ G4IFX MWOLGE R+00	
124600	Tx	306	~	MWOLGE G4IFX RRR	
124630	Tx	306	~	MWOLGE G4IFX RRR	
124645	-3	0.8	305	~ G4IFX MWOLGE 73	
124700	Tx	305	~	MWOLGE G4IFX 73	
124730	Tx	305	~	CQ G4IFX IO91	
124800	Tx	305	~	CQ G4IFX IO91	
124830	Tx	305	~	CQ G4IFX IO91	
124900	Tx	305	~	CQ G4IFX IO91	
124915	-15	0.4	310	~ G4IFX W4Y2J EM64	
124930	Tx	305	~	W4Y2J G4IFX -15	
125000	Tx	305	~	W4Y2J G4IFX -15	
124945	-10	0.4	305	~ G4IFX W4Y2J R-10	
125000	Tx	305	~	W4Y2J G4IFX RRR	
125015	-10	0.4	306	~ G4IFX W4Y2J 73	
125030	Tx	305	~	W4Y2J G4IFX 73	
125100	Tx	305	~	CQ G4IFX IO91	
125130	Tx	305	~	CQ G4IFX IO91	
125200	Tx	305	~	CQ G4IFX IO91	
125230	Tx	305	~	CQ G4IFX IO91	
125300	Tx	305	~	CQ G4IFX IO91	
125330	Tx	305	~	CQ G4IFX IO91	

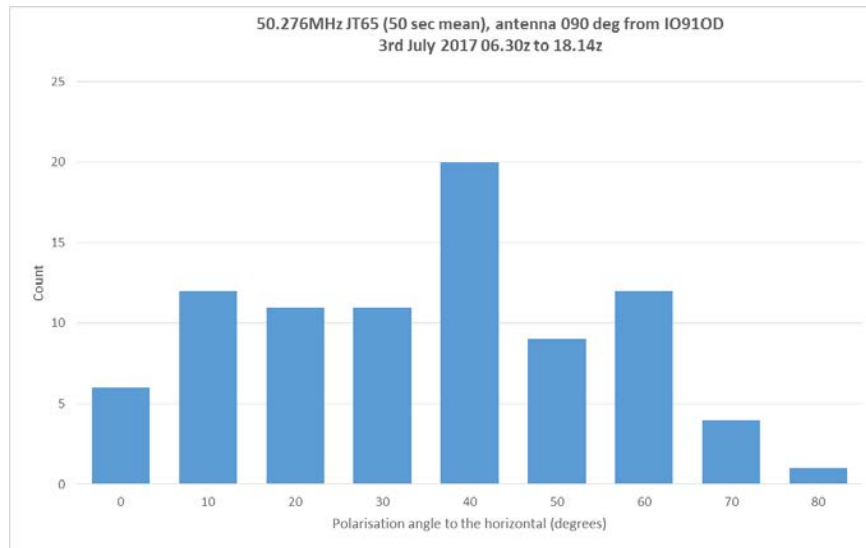
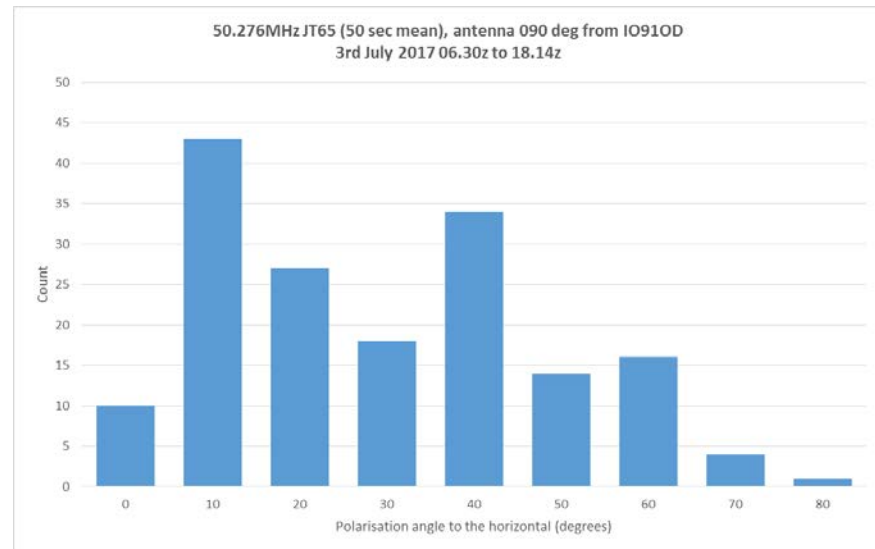
Control Panel (Left): 50.313 000, 31 dB, 2017 Jul 28 12:53:58, Report -10, Call 1st, CQ G4IFX IO91.

Control Panel (Right): 50.313 000, 32 dB, 2017 Jul 28 12:53:58, Report -15, Call 1st, CQ G4IFX IO91.

Wideband Graphs: WSJT-X - RX1 - Wide Graph and WSJT-X - RX2 - Wide Graph showing frequency (500-3500 Hz) vs time (12:53:15-12:53:45).

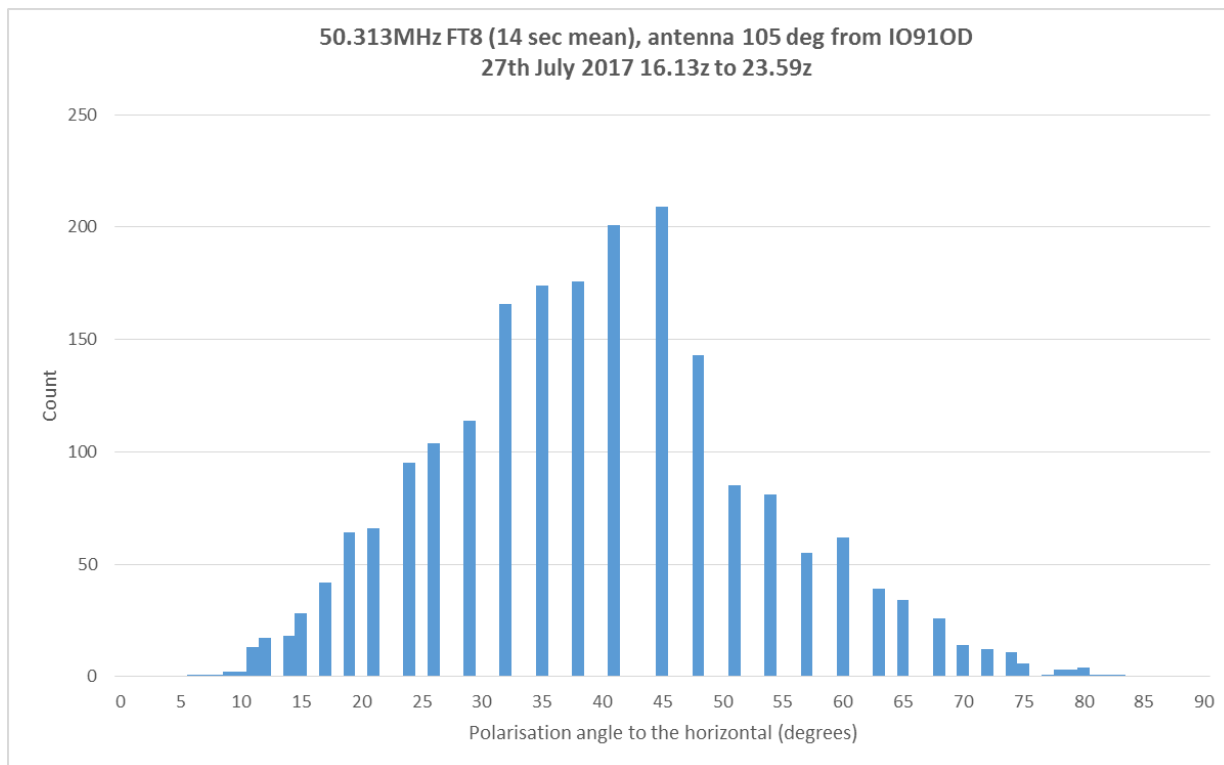
Initial results using JT65

As logged ->



< - Minus the tropo

Polarisation distribution using FT8



Polarisation Angle

Mean = 39.8

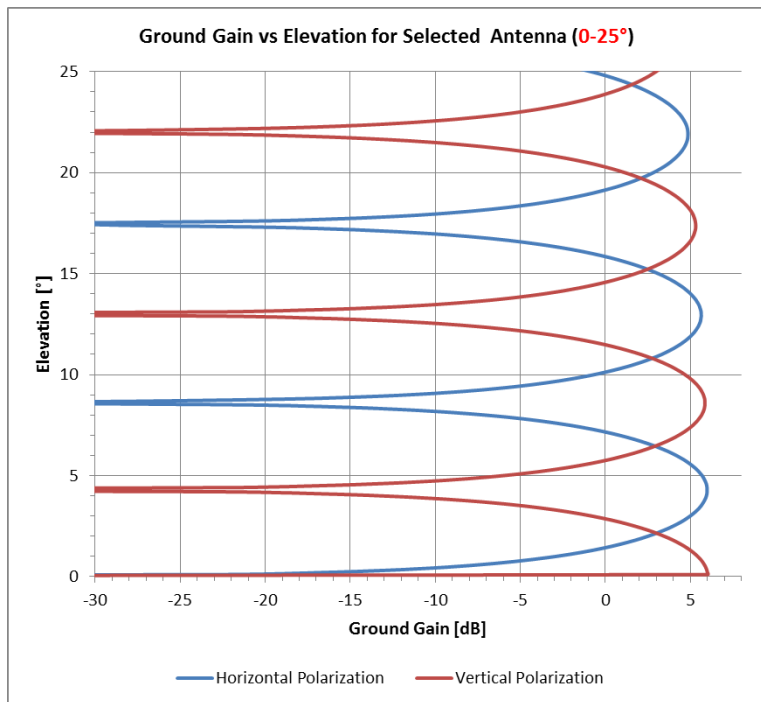
Median = 38.5

Std Dev = 14.2

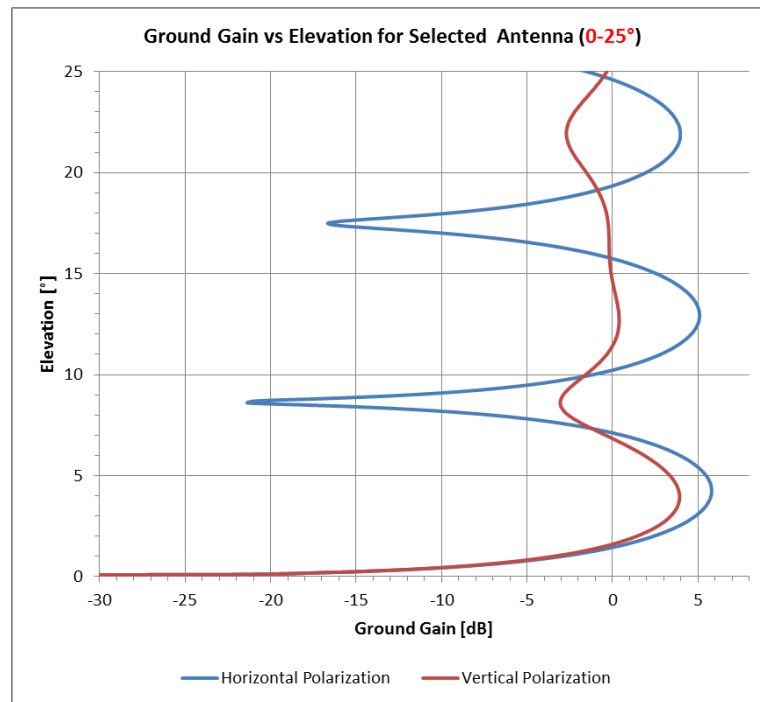
Single-hop sporadic-E only, 750km -2500km range

Ground gain v/s polarisation

Calculated ground gain, five-element yagi at 20m ,
perfect ground



Calculated ground gain, five-element yagi at 20m ,
average ground



Ground Gain in Theory and Practice By Gaëtan Horlin, ON4KHG
Dubus 3/2011 (September 2011)

BBC research report 1975 (again)

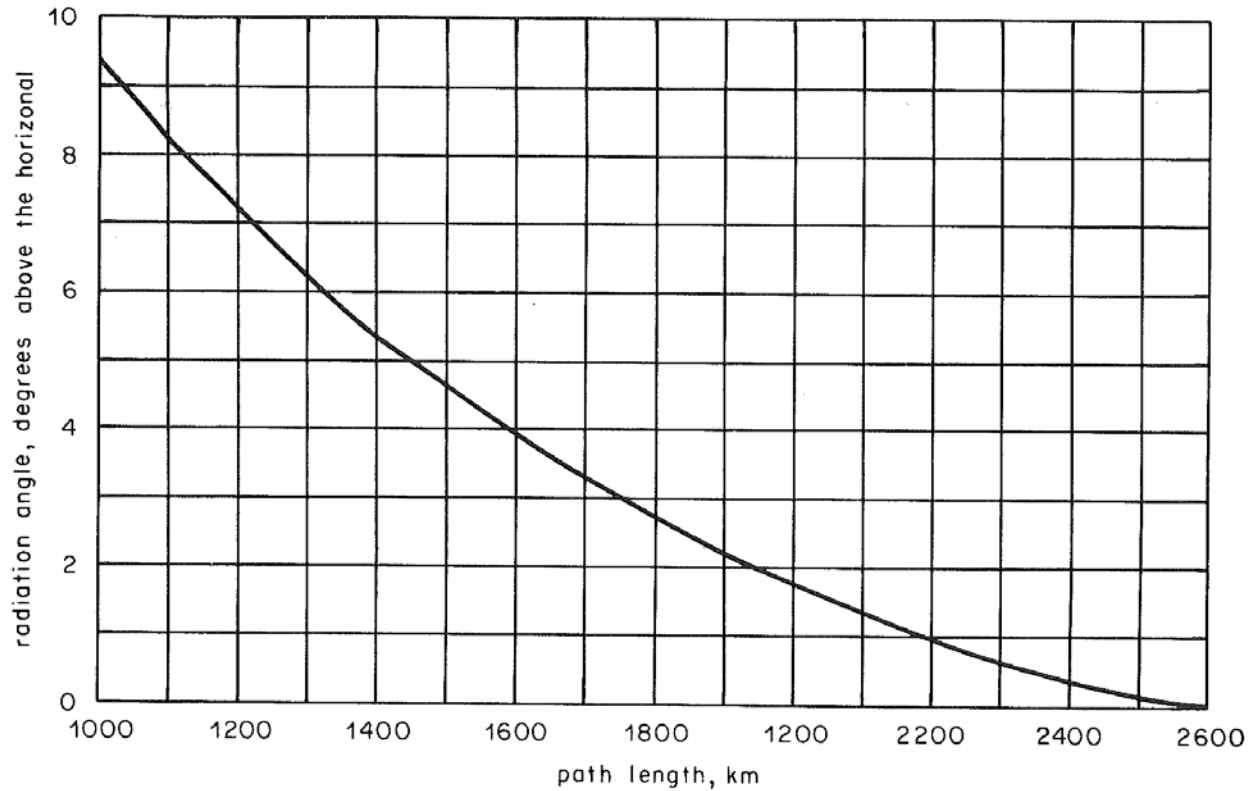
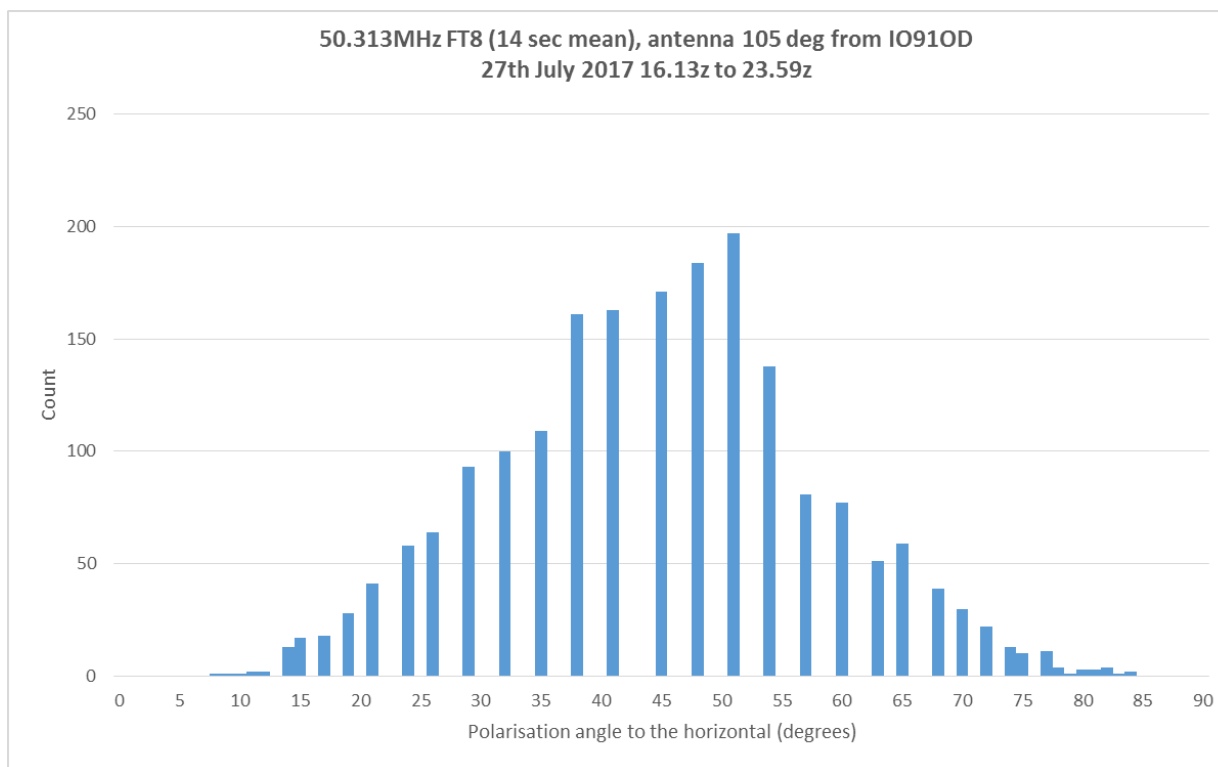


Fig. 11 - Median radiation angle for propagation via the sporadic-E layer

Polarisation distribution, corrected for ground gain



Polarisation Angle

Mean = 45.3

Median = 45.0

Std Dev = 14.4

Single-hop sporadic-E only, 1200km -2500km range

Ground gain correction = +2dB on vertical

Conclusions so far

- Sporadic-E signals, on a short timescale, tend to have a strong net polarisation which rotates over periods of seconds to minutes
- This polarisation rotation is observable in single-hop, two-hop and three-hop Es
- Averaged over longer periods, average polarisation tends to 45 degrees once differential ground gain is compensated for
- But the frequent short-term variation seems to indicate that the incident wave is at the very least strongly elliptically polarised - otherwise such wide short-term variations in net polarisation would not be observed
- Less formal observation shows that it's not uncommon for an Es signal transmitted from a horizontal antenna to arrive more or less vertically polarised for long periods of time (and vice versa)
 - Sometimes signals from a given direction will *all* be tilted the same way
- Auroral signals seem generally to retain their original polarisation
- The received polarisation of tropo signals is frequently far from 'pure' horizontal or vertical

■ Find out more...

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www.uksmg.org

<http://rsgb.org/main/about-us/committees/propagation-studies-committee/>

www.rsgb.org

