

How to work more sporadic 'e' on 2m

Dave Edwards – G7RAU

(Including all notes for presenter)

NOTES

Introduction. Aim is to provide additional thought into why sporadic e happens, when it happens and how to be in the radio shack at the right time.

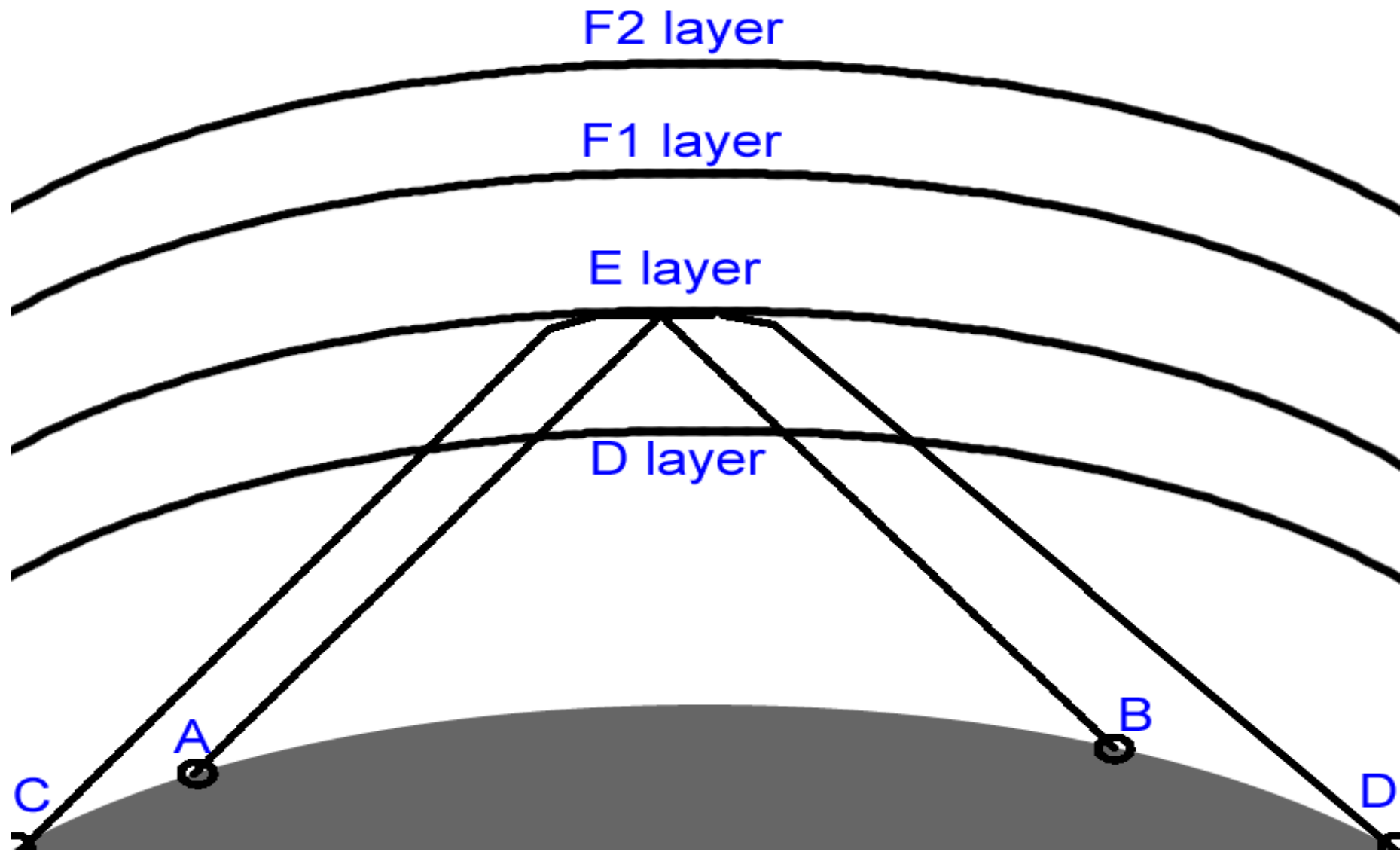
The ionosphere (1)

The ionosphere is broken down into 4 defined areas and a very rough guide follows.

1. D layer: 65 to 80km, average height 70. This absorbs signals at HF but can reflect signals at VHF (D layer 'iono-scatter' well documented on 6m)
2. E layer: 80 to 130km, average height ~108km. On HF useful for ranges around 2400km single hop, this can provide enough ionisation to reflect VHF and above!
3. F1 layer: 140 to 250km, average height 200km (seasonally variable). Provides HF long distance communication.
4. F2 layer: 250 to 450km, average height 350km (seasonally variable). Provides HF long distance communication.

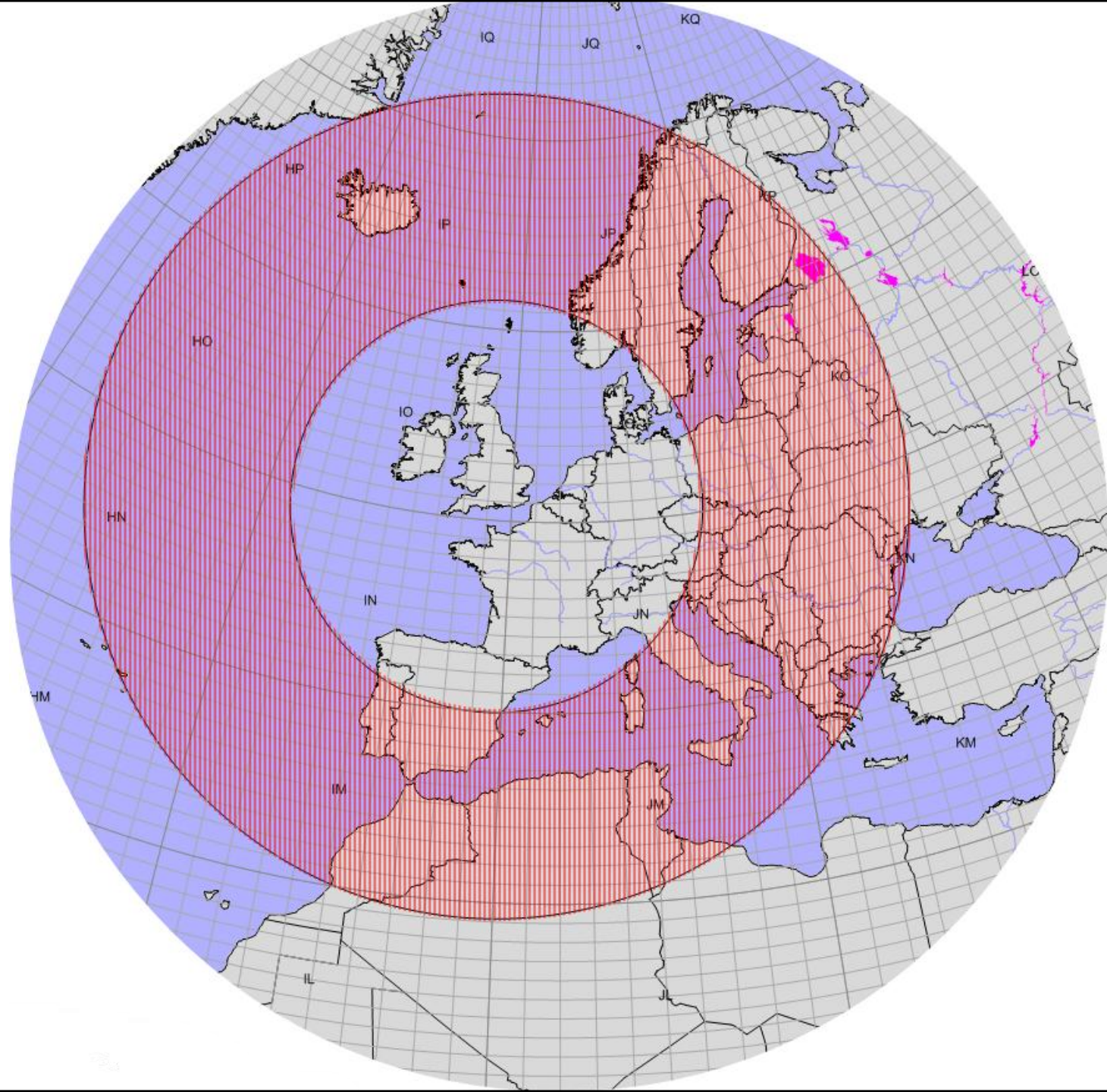
Note that F1 and F2 can combine after nightfall to a height ~250km (seasonally variable).

The ionosphere (2)



NOTES

Supporting naff image for previous data



NOTES

A “text book” range of what capture area is possible with sporadic e single hop

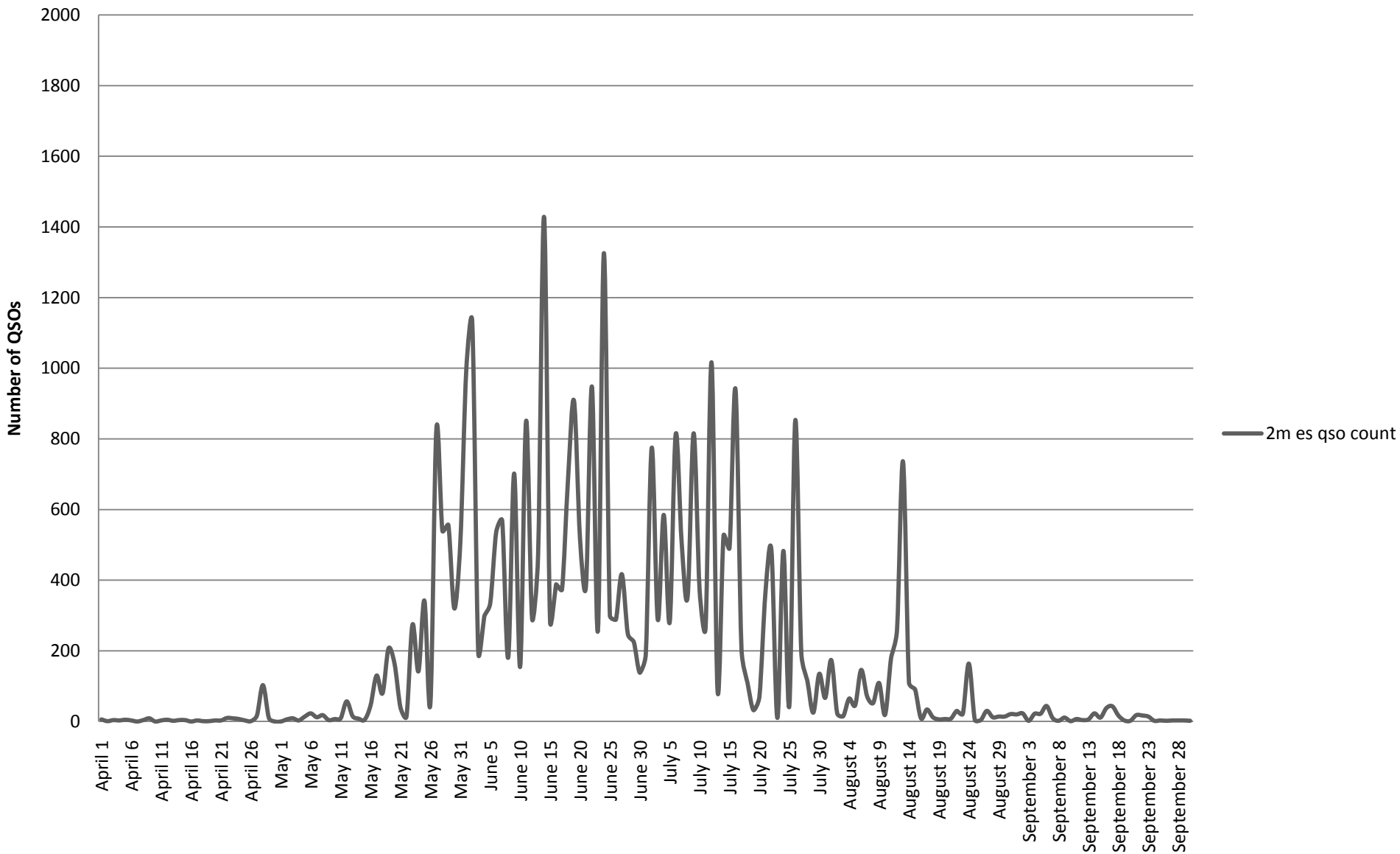
Sporadic 'e' (1)

- Sporadic 'e' is the result of sporadic clumpy ionised patches in the e layer region that enable much higher frequencies to be used for communication than the surrounding 'standard' e layer.
- These 'clumps' are likely caused by wind shear (winds in different directions) exciting ions (much of this from meteors) making a thin ionised layer suitable for reflecting signals at VHF.

Sporadic 'e' (2)

- Sporadic 'e' can occur at any time of the year but the main season in the northern hemisphere is between April and September (Peak June / July) with a minor season in December and January.
- There are a number of high density meteor showers in the summer and added sun intensity seem to be some of the core ingredients for sporadic 'e' to happen.

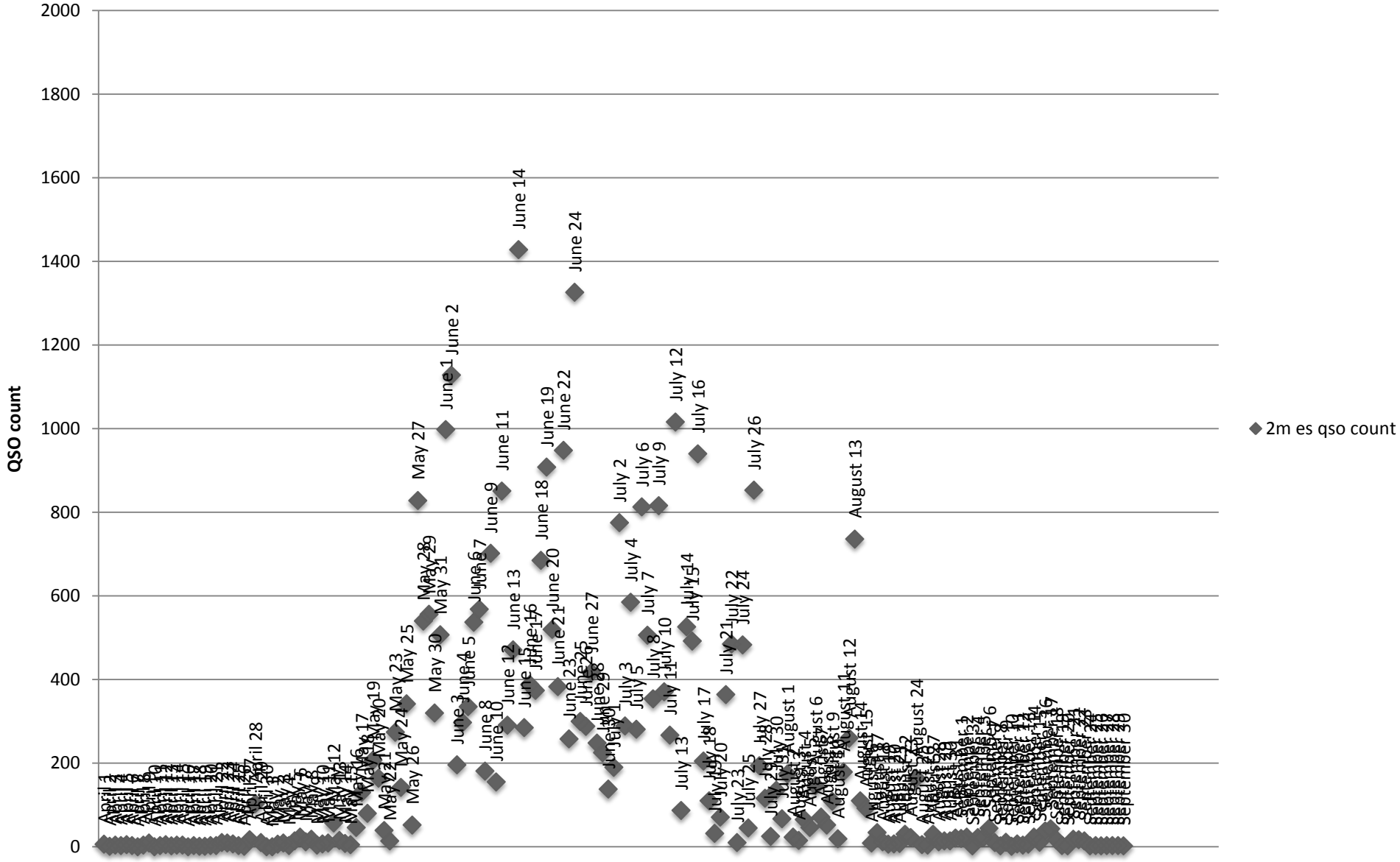
2m es qso count in Europe 1994 to 2009



NOTES

No of qsos on days over a 15 year span

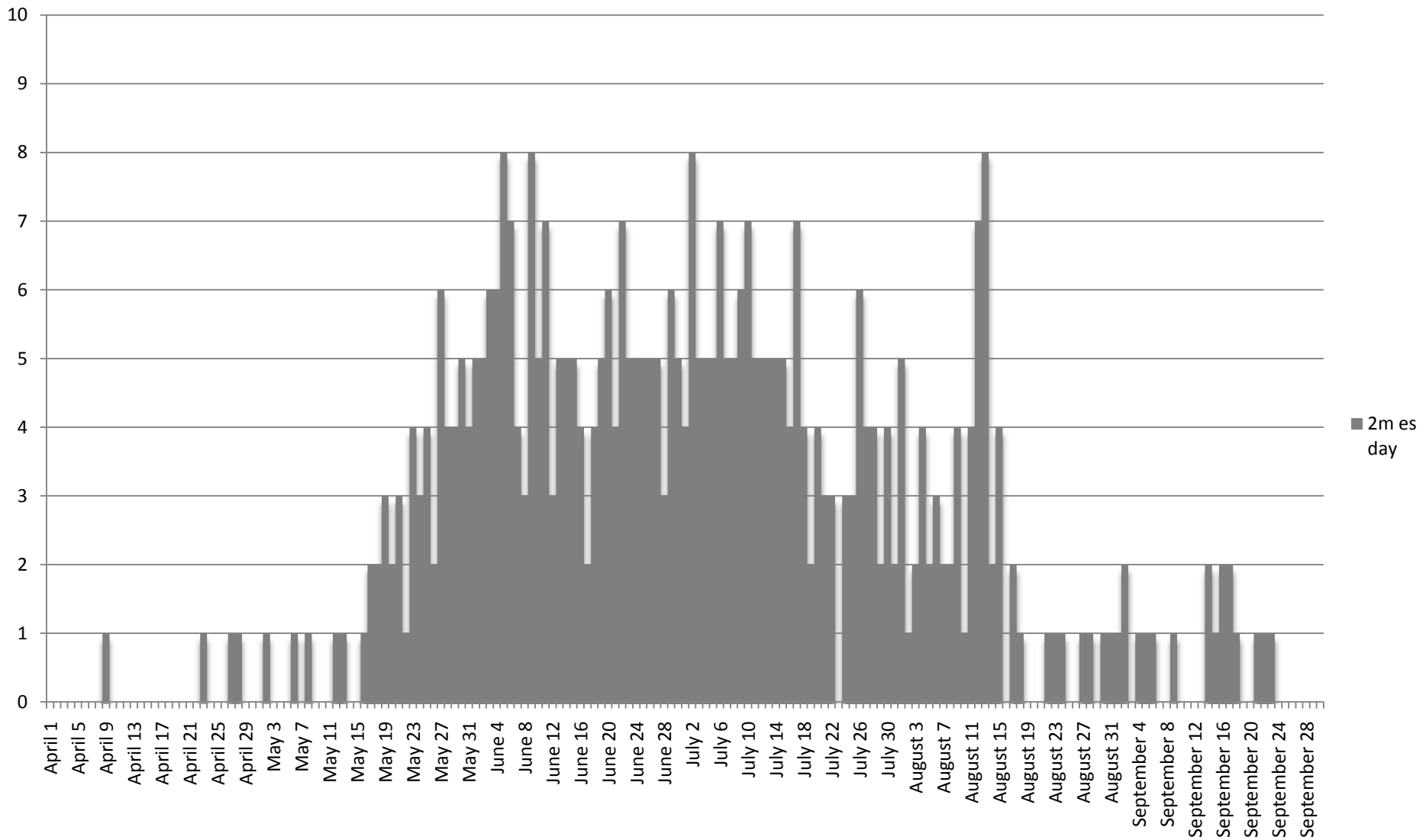
2m es qso count in Europe 1994 to 2009



NOTES

Again, no of qsos on days over a 15 year span

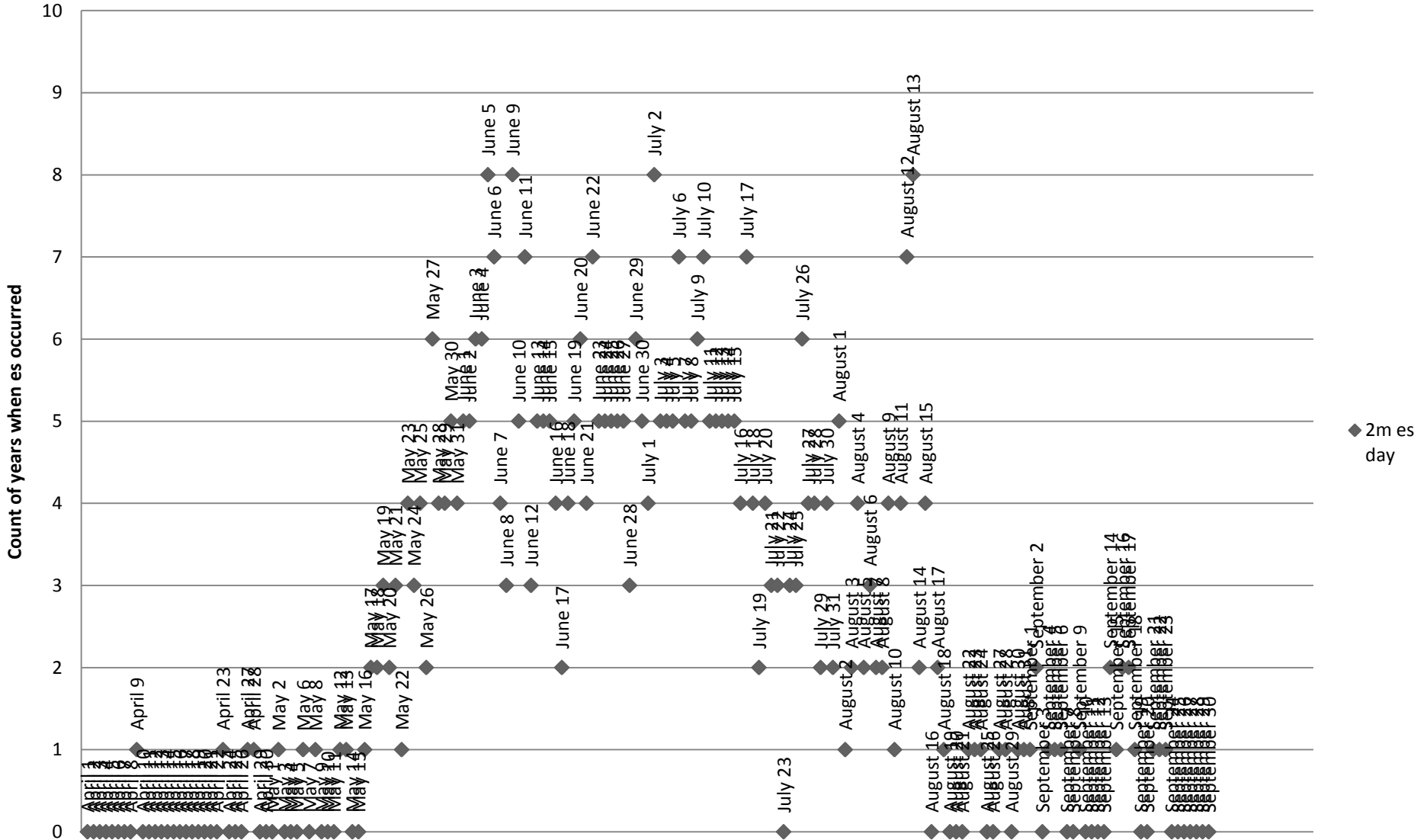
2m es count of daily occurrences in Europe 1994 to 2009



NOTES

More useful is es occurrences in Europe over 15 years

2m es count of daily occurrences in Europe 1994 to 2009

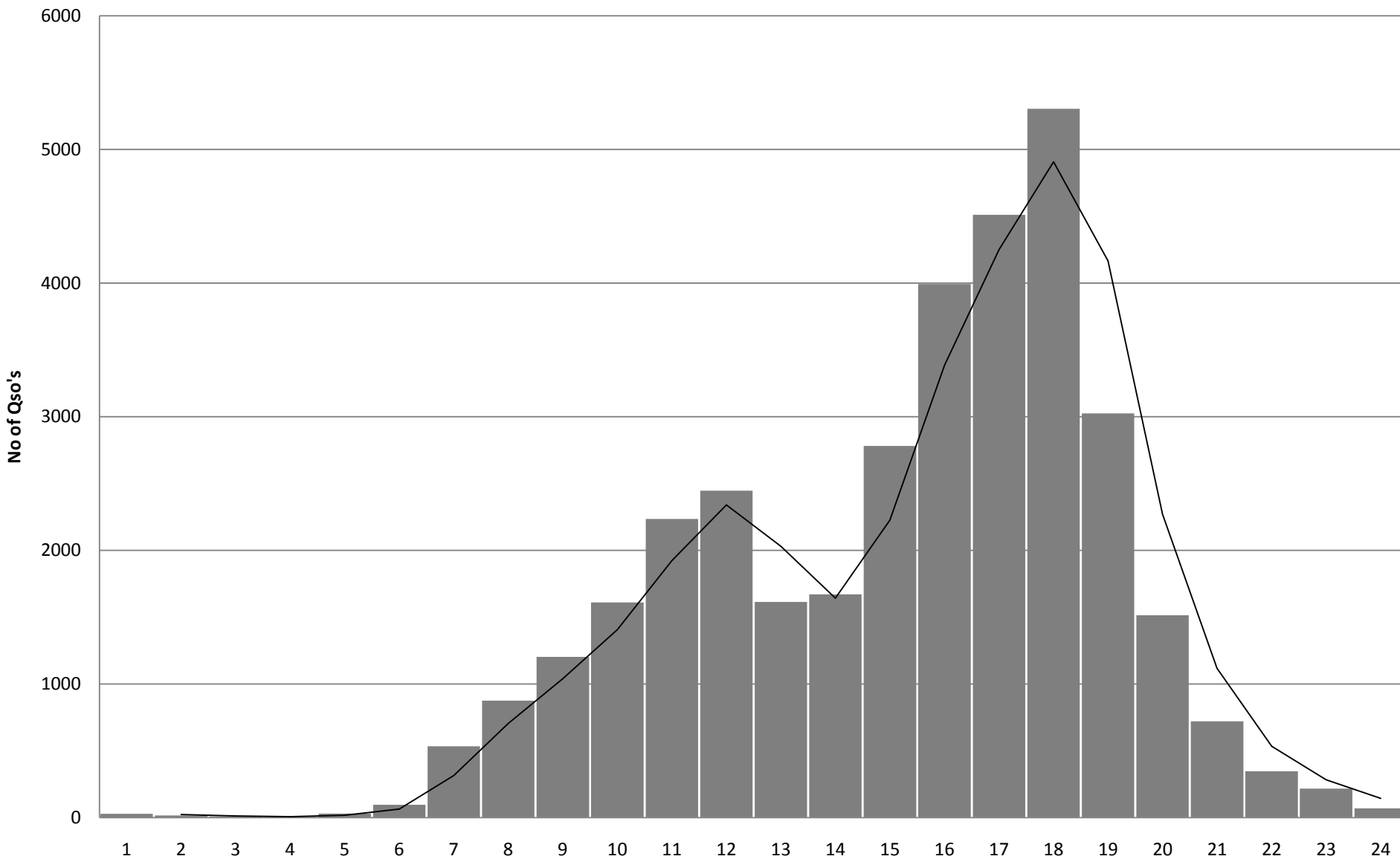


NOTES

Again, es occurrences in Europe over 15 years. June 5th, 9th and July 2nd es openings have occurred in Europe.

Note Aug 12th and 13th, es does occur on these days but with MS enhancement from the Perseids there maybe numerous 2 or 3 minute bursts that are just like es. They are normally easy to tell as the stations worked are over a large geographical area.

Hourly 2m es QSO's from 1994 to 2009

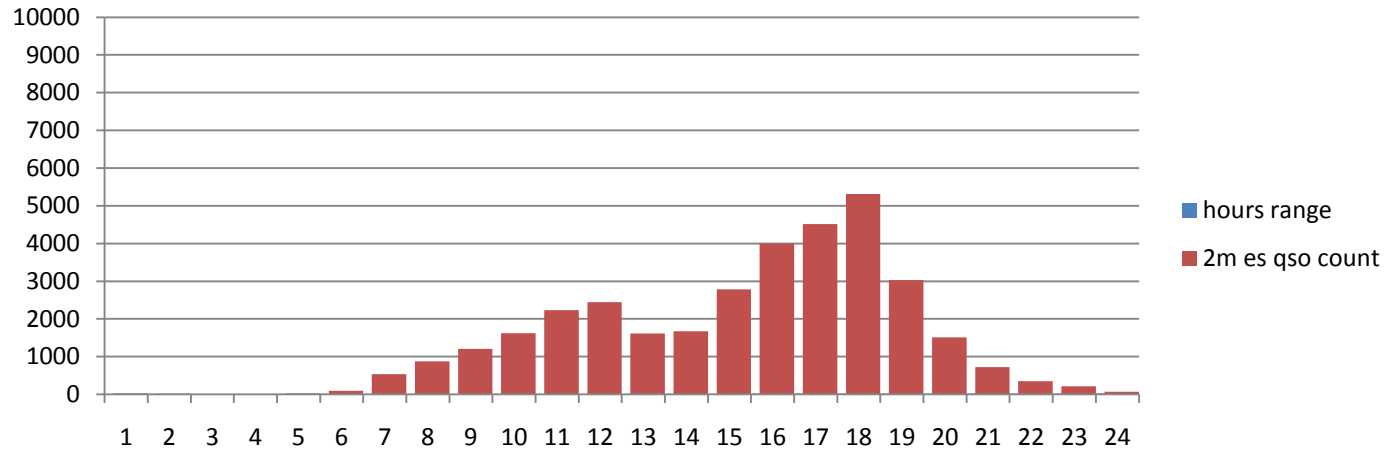


NOTES

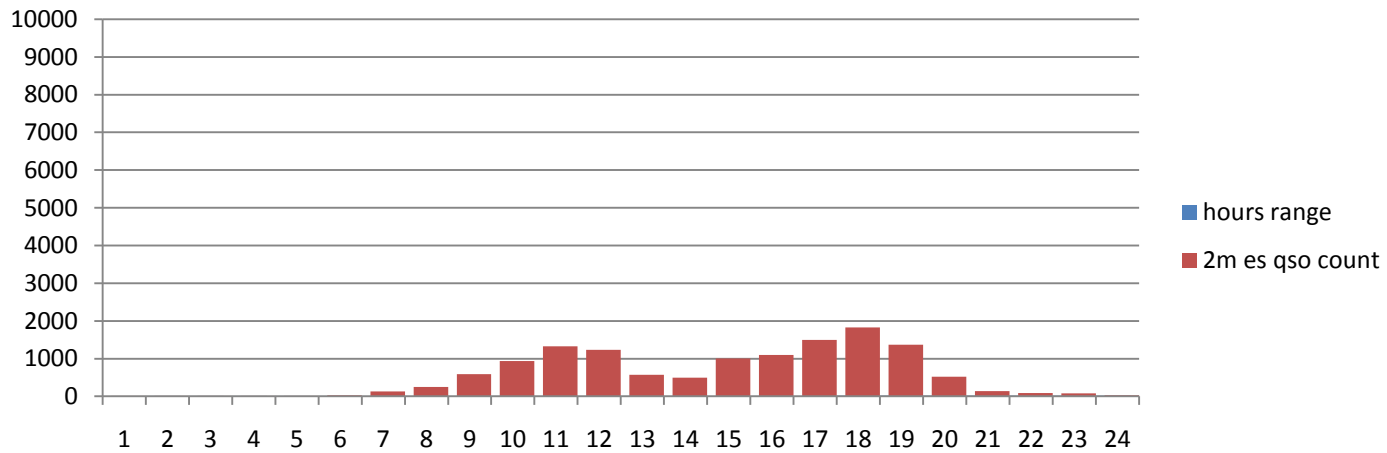
This shows occurrences by the hour. The 2 peak times are quite similar but there are always less spots during the daytime in the week as most of us are at work.. Peak around 12utc and 18utc for qsos but openings start before the qso peak rates. 10am for es start times and 15:30 for the afternoon but as you can see they can appear anytime. I remember an opening in the 90s that started at 05utc to EU3, luckily for me it reappeared at 07utc as I was in bed and never heard the telephone!

Hourly 2m es full week to weekend comparison

Hourly 2m es full week



Hourly 2m es Saturday and Sunday



NOTES

Gordon – MM0GPZ asked at the convention if I could look at the weekend to see if my presumption on the morning being as good as the afternoon peak was correct. The data shows still that the afternoon peak is slightly better but is inconclusive on the 15 years of data.

Sporadic 'e' (3)

Single hop sporadic 'e' on 2m in general enables short term contacts to be made with stations between 1200km and 2400km (there are exceptions to this) and some of the factors to consider are:

1. Activity
2. E layer height
3. Maximum Usable Frequency
4. Station(s) ERP and location.
5. Your distance from the reflection point

I want to work more e's on 2m..

- A large number of hams are only aware that something is happening on 2m when they hear the DX rolling in on 144.300 or they see the spots arriving on the DX Cluster. For inexperienced hams it is hard to tell what propagation mode is happening. If you are one of these people then the following 15 minutes will be of interest (I hope!).

NOTES

DX Cluster. A world wide communication system for hams to input DX or interesting information . The information can then be used by other hams to 'zone' in on the DX.

1: Start at 'the bottom'

To get a better understanding of how sporadic 'e' patches intensify we need to start at HF.

- Quiet Day, no es?
- Can 14MHz shed any light?
- 10m beacons as useful indicators?

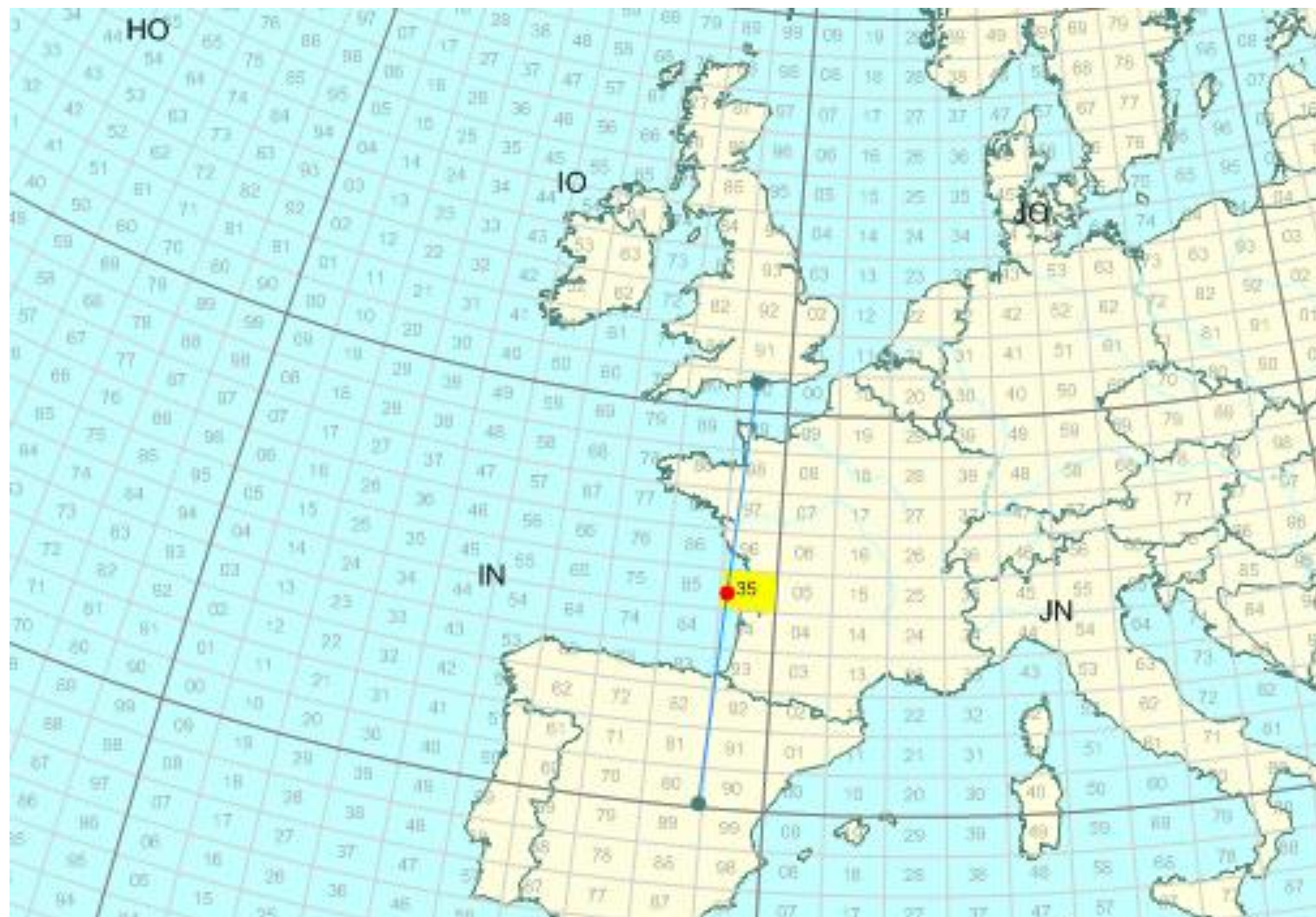
NOTES

To get a better understanding of how sporadic 'e' patches intensify we need to start at HF.

Often early morning you will not find any signs of sporadic 'e' on VHF but this does not mean that it is going to be a quiet day.

One of my 1st checks on these type of days is to look at 14MHz. If the band is full of stations under 2000km at strong signals I will normally jump straight up to 28MHz.

10m has many propagation beacons between 28.180 and 28.340 and lists of these are readily available on the internet. I check for signs of these beacons and pay extra attention to the signal strength. If say the EA4 beacon (near Madrid) is strong then it indicates to me that the MUF is likely to be at least at 50MHz.



NOTES

EA4/b on 10m

2: Moving up

- Signal strengths on beacons are useful
- Strong beacons on 10m so time to check 50MHz
- EA4 beacon on 10m 589, on 6m 549, coincidence?
- Keep records or a mental note on strengths to see the correlation.

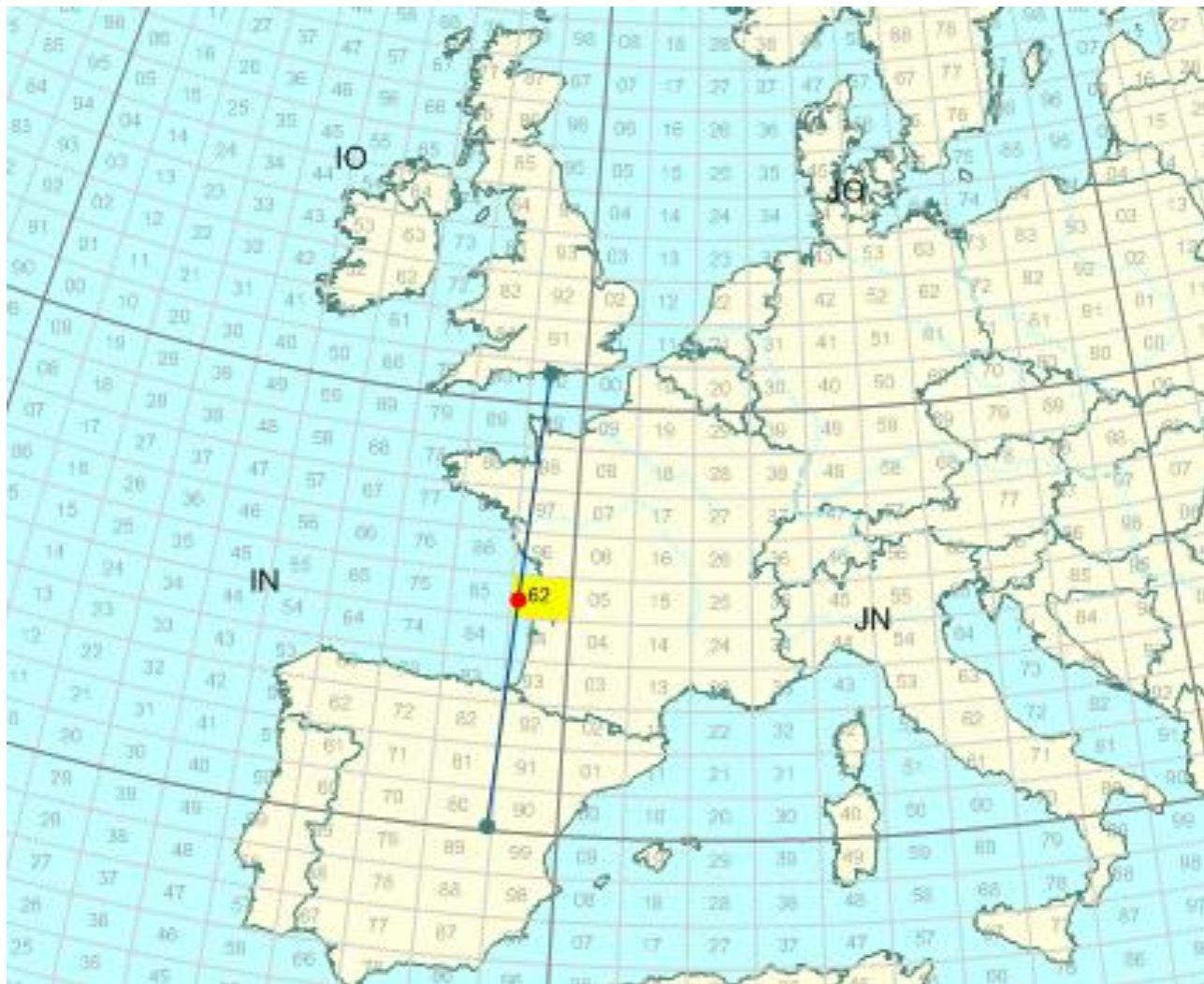


NOTES

So we have now established that signal strengths on beacons in the potential e layer range of communications on HF. As I stated before pay special attention to the signal strength of beacons as this bears a direct relationship to the potential MUF possible between you and the beacon. You will find in time that you become very experienced in guesstimating the MUF purely based on the signal strengths.

Now we jump up to 50MHz. Check the band for beacons. Take a mental note of what you are hearing and does this correlate with what you were recording at 28MHz. After doing this a number of times you will see the correlation. So for example the EA4 beacon on 10m was 589 qsb and on 50MHz it is 549 qsb.

From this simple exercise we have already begun to increase our knowledge of how we get a very rough indication of what is happening.



NOTES

EA4/b on 6m

3: Getting a feel for things

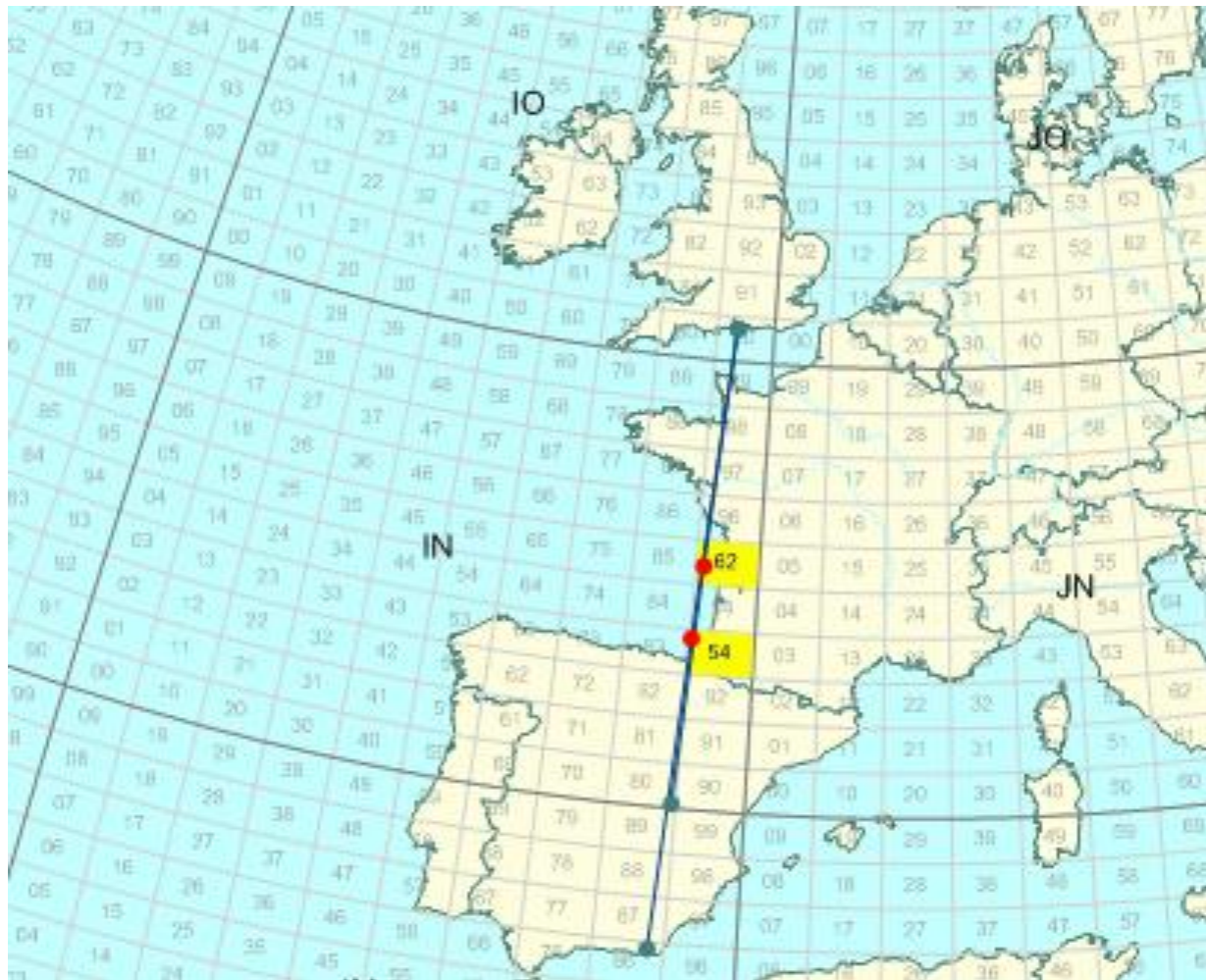
- Including distance as well as signal strength in mental notes.
- Use HAM stations in your MUF analysis
- EA7 on 6m 59+10, straight to 144.300 and CQ SPORADIC or is there more we need to know about the EA7....



NOTES

We are still on 50MHz and have now scanned the band listening to beacons and stations in QSO. You will now have a feel for what is workable on 50MHz from your location and what kind of signal strengths stations and beacons are. Now the tricky bit. Beacons are fixed erp, you can find out the antenna gain and the power they operate at very easily and their location and therefore distance is known but hams erp and QTH can vary significantly.

We have established a correlation with MUF and signal strength so when you hear an EA7 station at s9+10 on 50MHz why don't you jump straight on 144.300 and start shouting "CQ SPORADIC E"?



NOTES

EA4/b and an EA7 on 6m

4: Stagnated?

- Consider all together gained information:
- QRB
- Heard stations ERP
- Signal strengths
- Distance, special consideration to what is possible on higher bands due to intensity needed from the es patch



NOTES

So let us consider the EA7 station and in general what is happening. We have listened to the EA7 station and he is running a 5 element high gain yagi and 1kw. He is 59+10 but some qsb and is working stations in my area. His QRB is 1800km from me. The EA4 beacon is 549qsb now at 1100km but otherwise the band seems quiet. How high is the MUF? From experience I would say that the MUF is probably around 65MHz over south west France so the likely-hood of me working anything on 2m is remote. The path to the EA7 is more likely an MUF around 55MHz, this is a high erp station so he is strong as he is delivering more to the ionosphere and therefore more is being reflected back.

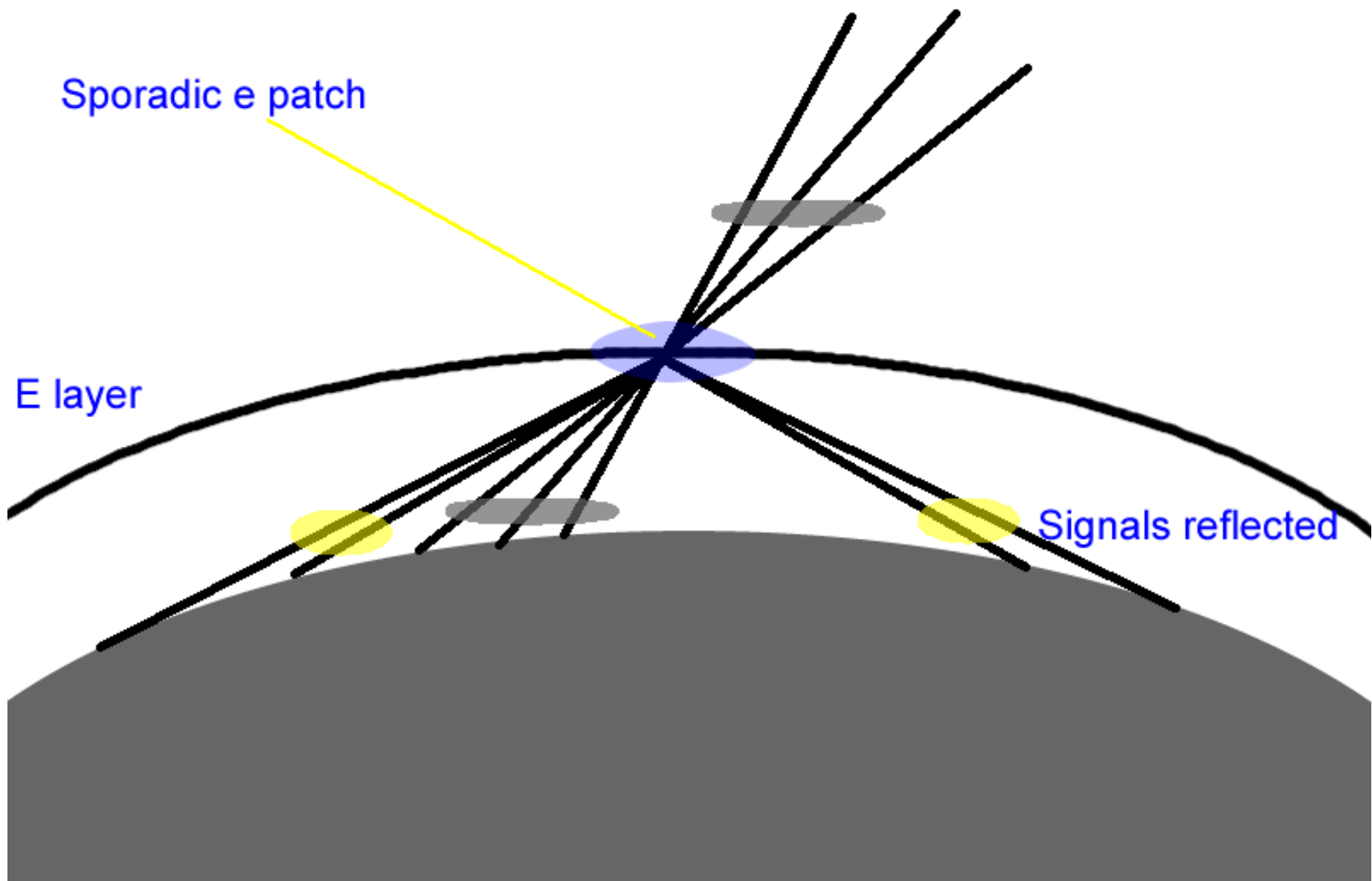
We have already discovered that signal strength and erp play a part but also now we need to understand that distance from the reflection area is critical. The closer you are to the centre-point (reflecting area) the higher the MUF needs to be for you to make contacts as the angle is steeper. If the level of ionisation is not intense and you are close to the centre-point then your signals will travel into space and not be reflected back.

Signals pass through into space

Sporadic e patch

E layer

Signals reflected



NOTES

Too close then doomed, too far away then below horizon. Not dense enough then an interstellar flight also coming up.

5: On the move again

- Is there es DX being spotted on the DX Cluster?
- Does it look interesting for us?
- Do any of the spots look like there might be high MUF patches?

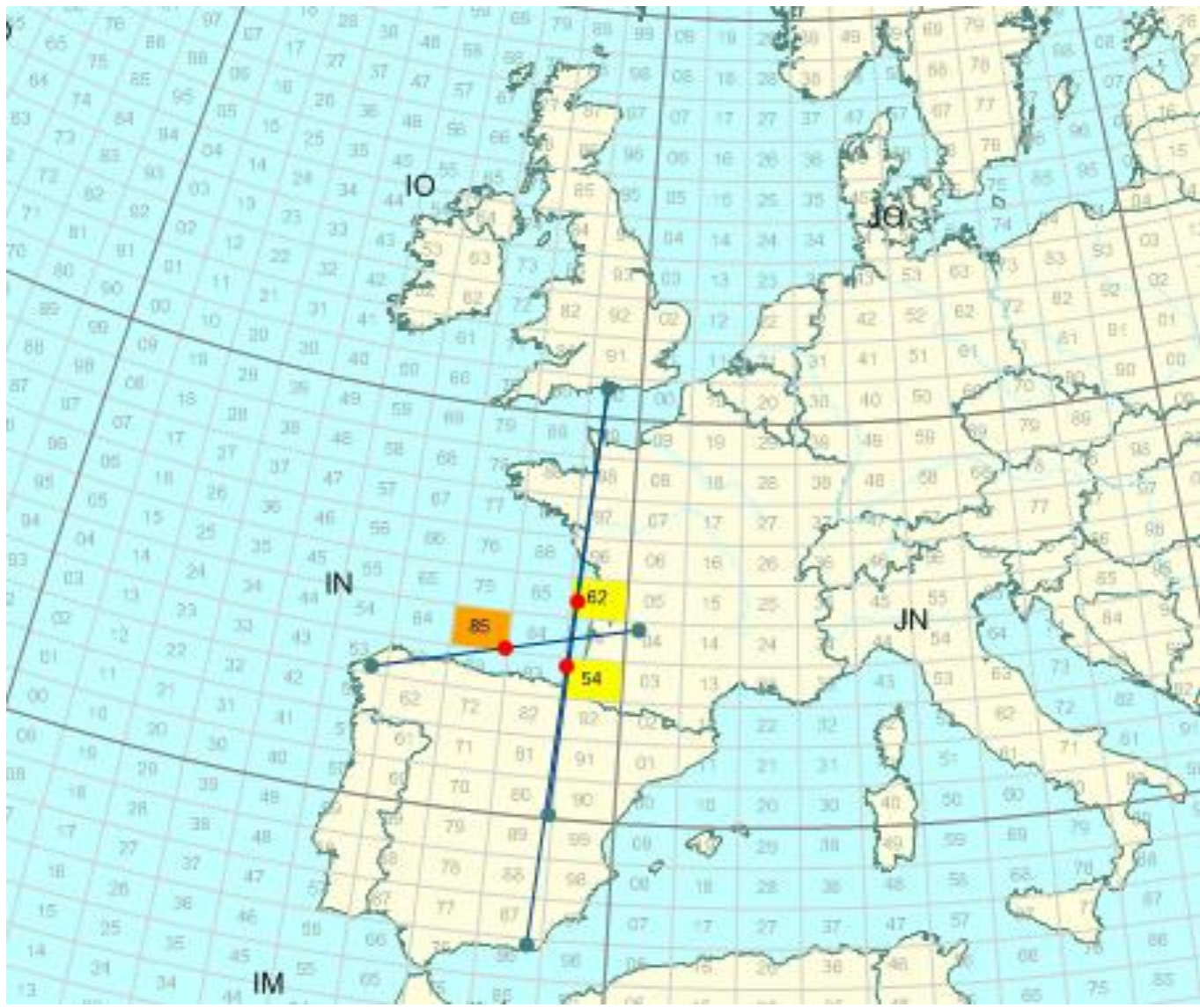


NOTES

OK, we have soaked a lot of information of what is possible based on our own investigations and now it is time to consider what other stations are hearing / working and this is where the DX Cluster comes into play.

Looking at the DX Cluster we see from a good DX spot (with locators and propagation mode in the DX info part of the spot) that a station in N.W. Spain is working a station in S.W France on 50MHz. The QRB is 820km and signals in the spot indicated at s9++. We cannot hear either side of the QSO but *if* the information is accurate then it is starting to look very interesting for the MUF.

With a little experience and thought into this scenario you will after a while get a good feeling about spots like this. You are around 800km from the centre-point and as the qso is over a short QRB the MUF over the centre-point looks like it will be quite high. From memory a similar spot enabled me to work CT on 70MHz so off I go up to 4m to see what I hear...



6: Getting exciting

- 4m Open to CT
- 3m open to EA and CT
- VOR open to Madrid
- It is looking GOOD!



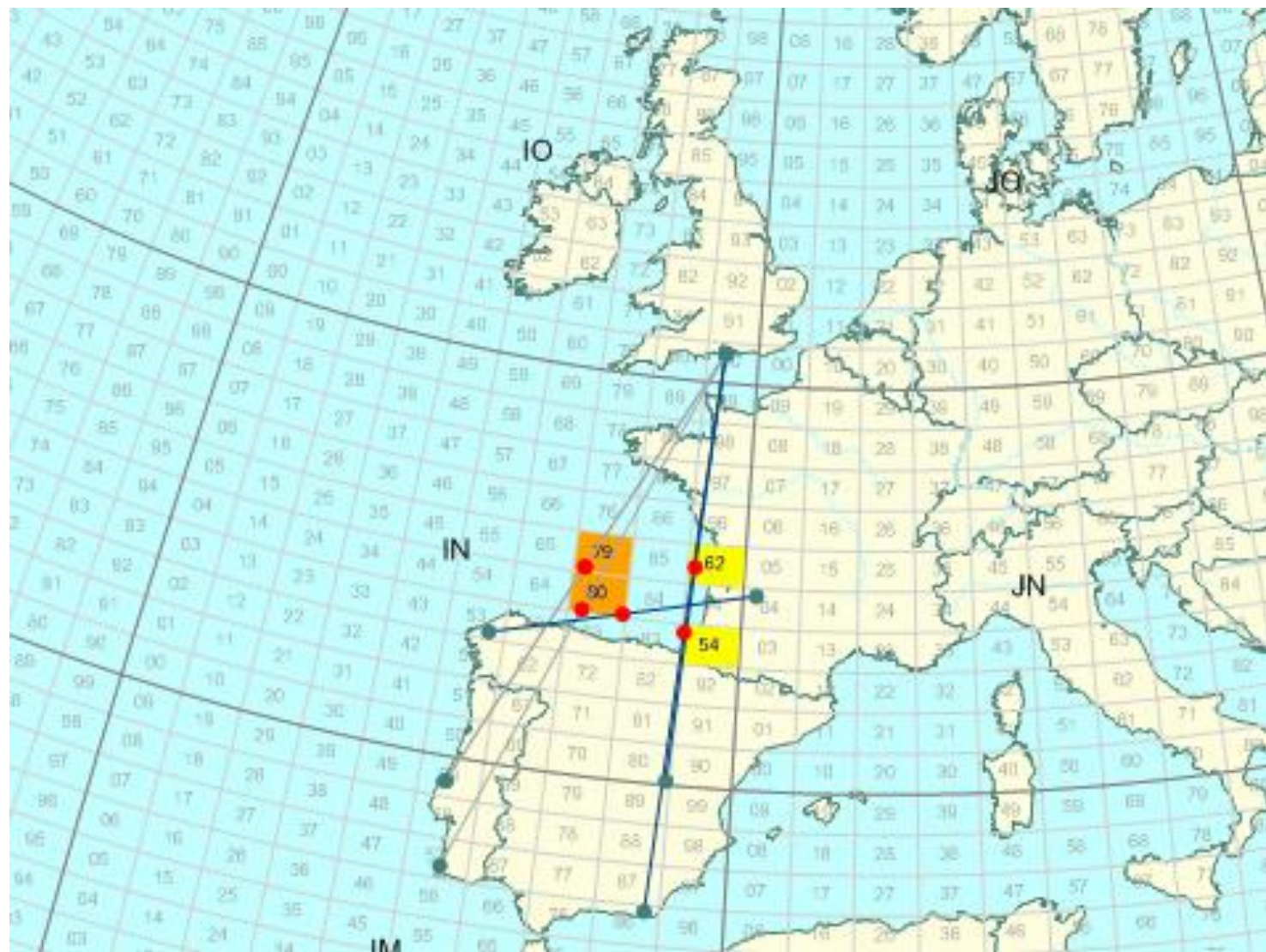
NOTES

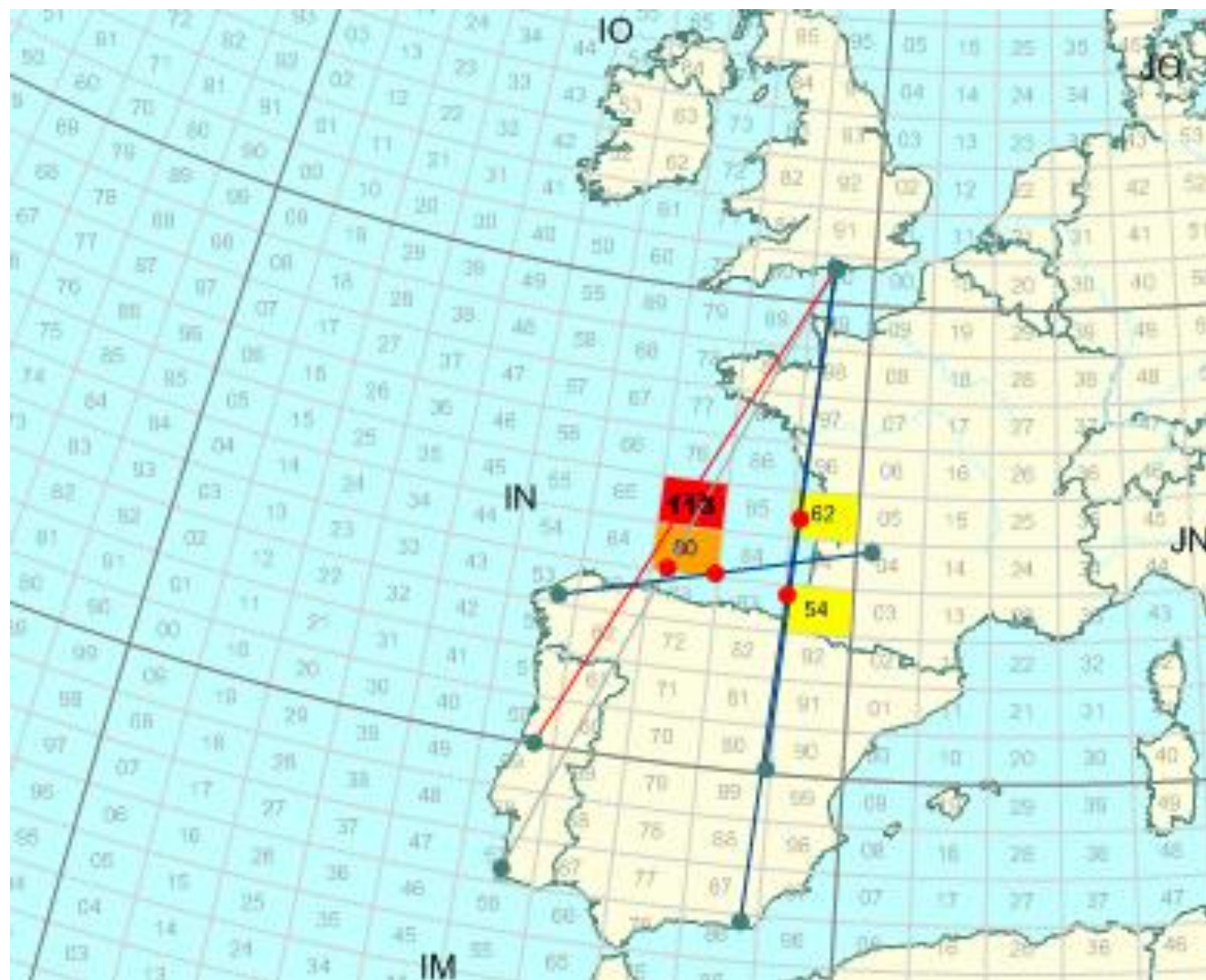
So a quick scan around 4m and I find the CT beacon at 559qsb and a few stations at S9 level but increasing all the time. Within 5 minutes of listening on the band the beacon has climbed to 599+40 with some minor qsb..

I grab my portable FM broadcast receiver and tuned around 87 and 88MHz and to my amazement I find Spanish and Portuguese broadcast. It is not very stable at 1st but as I extend my search upwards I find more of these stations and now some of them are stronger than the UK broadcast stations. My radio is on 144.300 in the background but as yet nothing heard.

Now 88 to 108MHz is full of stations so I switch on my VHF receiver and tune between 108 and 118MHz for VOR airport beacons. I find the Lisbon VOR beacon on 114.8 (callsign LIS in cw txed in AM) so I now know that the MUF has exceeded 114MHz and there is a good opportunity for 2m sporadic e.

VOR lists are available from the internet. VOR stands for VHF Omni-Directional Radio-Range/Distance-Measuring Equipment used by airplanes.





7: Does it always happen?

- Sometimes the MUF never reaches high enough for 2m even though it looks great
- Sometimes it drops and then rises again later
- On the bright side we have learned a lot about tracking the rising es MUF.
- Using simple methods and applying some thought nearly paid off.



NOTES

We have now followed the MUF up beyond 114MHz and this is where the hope begins. There is a strong possibility that a sporadic e opening will occur on 2m but not always. I have noted many days when the MUF has stayed above 70MHz but not reached 2m.

Using simple methods and applying some thought into the information we have gathered we have already ascertained that although we cannot say for definite that a 2m opening will happen we have put ourselves in a very good position to work some DX via es if it does occur.

8: 2m is open and I am in the opening!

- At last, MUF continued up and 2m open!
- I cannot break the pileups on 144.300..
- Look around as not all the DX is on 144.300.
- Use seek and pounce sometimes or find a quiet frequency and CQ
- Check on 145MHz FM, you might be surprised!



NOTES

So after a few false alarms all your careful monitoring has paid off. 2m is open, 144.3 is full of I/9A/YU stations but nobody can hear you 😊. Yes, this happens, you will find lots of huge signals on the calling frequency and all but the big guns are working these. On these occasions don't waste your time and look around 2m. Maybe there is a 9a calling on 144.315 at s7 but as he has no takers you will easily bag him.

Worth noting as well is what other more experienced hams do during an opening. At times it is best to do seek and pounce. If there is a big contest on in the area that is open you will find stations popping out of the noise all across 2m. Other times it pays off to find yourself a clear frequency away from 144.300 and cq.

Don't forget FM.. In openings (especially the big ones) you will often find some rare dx on 145MHz. In places like Morocco or Western Russia / Ukraine you will find more stations on FM than you will on SSB so remember to take a look.

What if I am not in the shack..

It would be great if you could give up work for the summer and 'Move In' to the shack but for most of us this is never going to happen. So how can we keep in touch with how the es MUF is doing so if an opportunity arises we can get on air?

1. Buddy phone system. Get a small group of ham friends to pass each others phone numbers and if anything exciting happens you can alert each other.
2. Utilise your FM car radio when mobile. Leave the receiver on 87.6MHz, if the MUF is high enough you might hear stations via es coming in and depending on what you are out mobile for you might be able to head home at short notice.
3. Keep an eye on the DX cluster if you have a PC available at work. Unless you are very restricted in access or have a draconian boss who expected you to concentrate 110% on work you can normally sneak a quick look at what is happening on VHF and maybe able to get home if it looks like opening.
4. If the MUF gets high over an area in the morning it will often repeat in the afternoon. Similarly if high MUF in the afternoon this can repeat the following morning so if you are not in the shack for 'phase 1' you might be able to make it for 'phase 2'.
5. If you have no way of knowing what is happening then forget it and enjoy whatever you are doing instead. 2m will open again and it is not worth worrying about, life is too short..

Demystified?

- With a little effort you can learn a lot.
- Receivers or a multiband rig needed, no great outlay
- Don't get too cocky, you will get caught out!



NOTES

Hopefully from this brief tour you have a better understanding of sporadic E and it has highlighted to you that with a little knowledge and effort you can improve your chances of working DX on 2m without the need of a degree in Physics or a huge outlay on spectrum analysing hardware.

A simple all band radio such as an FT847 or similar covers all apart from FM broadcast which a simple portable FM radio can be used.

Using tools to help – DX Cluster

We have already mentioned using the DX Cluster to assist in helping gather information but remember it is a two way affair that is needed if we are all to help each other work more DX on 2m via ES. Here I believe are a few useful pointers (and not just for es spots):

1. SPOT wisely; tell people the propagation mode, locators and rst for the contact.
2. Do not spot 'cannot hear' or 'nil es', these are junk and a waste of space
3. Do not advertise using the DX Cluster, it is for spotting not selling a product even if the product is free.
4. DX Cluster spots are not for chatting, use KST, DXC Talk or if you have an announcement that you feel is useful to other hams then use DX Cluster announcement.
5. Spot the DX, don't spot you on your QRG working the DX, this is unfair as people will look your frequency for the DX.. Odd circumstances excluded i.e. you just worked RA6 on es and you want others to know it is open.
6. If you feel you need to spot MUF @ 144 then use a Q in front of the call, i.e. QMUF144M = DXCC entity of nothing whereas MUF144M = MU/Guernsey
7. If you make a mistake with a spot then correct it with a good spot. Don't leave people wondering if you really did work a W5 on 144.300 via multi-hop es...
8. An example of a good spot: **DX de G7RAU: 70251.3 OM3DA IO90IR<ES>KN09DB 599qsb gl!**

Es Statistics based from processed DX Cluster data for 2009

- 77 UK stations spotted 2m 'es'
- Top was G4LOH-Tim who spotted 88 2m 'es' occurrences
- 14 of the top 20 2m 'es' spotters are active Live MUF users (3 more possibly...)
- 45 days of 2m 'es' were recorded in Europe
- 628 2m es qso's spotted by UK stations on 30 separate days (*top year was 2006 where 819 UK spots for 2m es on 47 separate days*)
- 477 UK stations spotted sporadic e qso's on 50,70 and 144MHz, world-wide excluding UK was 6485 stations.
- Special thanks to Dirk Koopman - G1TLH for all his hard work with DX Spider, the backbone of the DX Cluster network

Using tools to help – Internet

The internet has a wealth of information and tools to assist in all types of propagation studies. Just to recap:

- Web Based DX Clusters
- Beacon frequency and information lists
- VOR airport beacon frequencies (108MHz to 118MHz)
- OIRT Frequencies (Eastern European FM broadcast 65.84 to 74MHz)
- VHF TV Audio frequencies
- VHF related chat pages
- Stacks of information about sporadic e, some very good, some not so good and even some which will take you for a trip into fantasy land to meet the elves...

Live MUF – What is it

Live MUF is a DXC (cluster) telnet client which attempts to resolve propagation modes from spots and also attempts to calculate sporadic e possibilities purely based on incoming data from the cluster.

It has great circle mapping (GCM) built in to the app for live mapping of spots.

Live MUF also can be used as a world wide converse telnet client, ON4KST telnet client and DXC at the same time.

For DXC it has it's own built in telnet server so 1 connection to the internet and all intranet connections via this, as used by some contest stations.

Live MUF in operation in my shack

MUF @ 20.35MHz Live MUF calculator V7

File Windows Misc Zoom x 2.75 + Settings Show QRA Box Show Search Load Squares Load Loc Pairs Multi-Map 12m up Sun Help Exit

MUF @ 20.35MHz, try to EC59AQ (qtf 222 / qrb 14624) FOT @ 20.4MHz (Below horizon, multi/chordal?) (18:34z)

Log01 | DX Eye | GB7RAU-HOME | ON4KST-144 | ON4KST-50 | ES data | VHF+ data | HF data | AU data | ES MAP | eu es | 12m+ | all modes | avg map | Call/Log | Beacons | QRA Calc | Analysis | DXCC | Hand MUF | wb1 | MUF Updates | DATE MAP |

RAU Logger 01

Start Time... Finish Time...
 2009-08-30 16:04:58

Call sign... Op Name

RST> Nr< RST< Nr< Loc... ctestextra?

DXCC... Itu Cq Don't QSL?
 1: Q QSL Req?

NO DXCC

IOTA... County... State...
 NONE NONE 1:NONE

Freq CAT? Prop? Mode? Mode 2?
 50.09729 AU A1A

Pwr WAB X Band Operator
 80 0 2: G7RAU-I090IR87BS

Rig 9: FT847+4el Eagle

QSO OK? Manager? CtestID? 1

QSO to DXC QSL Txed QSL Rxed

Remarks

CQ? Next QSO? Clear? Quit?

DX Cluster Qsos Band Settings Log Search Contests IOTA DXCC D | < >

DX de EA7YY: 28435.0 PY2MTV Very stron signal
 DX de RX3AGD: 28405.6 PU5SIA CQ concurso
 DX de DL2RDT: 28434.9 PY2MTV Andy 59 100W verti

G7RAU de GB7RAU 30-Aug-2009 18292 dxspider >
 DX de OE7FMH: 28410.0 PU2LEP Vas
 To ALL de GB7CGL-1: DX Spider Cluster: GB7CGL-1 telnet gb
 DX de RN3DY: 28466.5 PU2WDX Tnx Celso !
 DX de K3MN: 28442.0 PY3UEB
 DX de ON5QRP: 24901.0 ZP6CW 589 - Up 2
 DX de DK2EA: 50130.0 EA8CDJ 1138cw<ES>jo50uf h
 DX de F43KN: 28427.0 I28OGR
 DX de EA7YY: 28435.0 PY2MTV correction frequen
 DX de EC7DTQ: 50150.0 G8BQK
 DX de EA3GHZ: 24891.5 CT1BWW TNX MARQ !!!
 DX de I2PJA: 50138.0 I2PJA jn45pb dir. CT EA
 DX de RN3DY: 28450.0 PY6HD CQ
 DX de PP5KE: 24940.0 I2JBS
 DX de RX3AGD: 28410.0 PU2LEP Vas Cqn in concurs
 DX de W1DQ: 24900.9 P43JB 599 tnx

G7RAU de GB7RAU 30-Aug-2009 18342 dxspider >

18192 G7RAU de G4LOH: xyl calls now
 18192 G7RAU de G4LOH: see how D44TD worked CT1H2E station
 almost every day for weeks now ... cul
 18202 T G4LOH cul

DXC

DX Call? Freq? DX Loc? Prop? RST / Info? Add Spot
 144265 cfm TR hrd 57. gl

QRB QTF LP QTF

New Call New Dxc New Loc New Cnty New Iota New State

all time Dxc

User Map (eu es)

VHF and Up Data

PROPAGATION MODE ~ **ES** on (6m)
 FROM JO50UF TO IL38CW: QTF=232, QRB=3191km
 FROM IO90R TO JO50UF: QTF=89, QRB=921km (DK2EA)
 FROM IO90R TO IL38CW: QTF=208, QRB=2639km (EA8CDJ)

18:31z [DX de EC7DTQ: 50150.0 G8BQK] 30 Aug
 PROPAGATION MODE ~ **ES** on (6m)
 FROM IM78RS TO JO00GU: QTF=13, QRB=1616km
 FROM IO90R TO IM78RS: QTF=191, QRB=1574km (EC7DTQ)
 FROM IO90R TO JO00GU: QTF=084, QRB=128km (G8BQK)

18:32z [DX de I2PJA: 50138.0 I2PJA jn45pb dir. CT EA] 30 Aug
 PROPAGATION MODE ~ **UNKNOWN** on (6m)
 FROM JN45OB TO JN45OB: QTF=0, QRB=0km
 FROM IO90R TO JN45OB: QTF=125, QRB=1004km (I2PJA)
 FROM IO90R TO JN45OB: QTF=125, QRB=1004km (I2PJA)

Logger DXC Spot Watcher

Select watch bands Number in list? Data to log No?
 ALL 20 01
 LF
 HF
 12m up
 Ignore Spotter? Ignore HF locs?

Pause Clear Exit

Bnd	Call	Loc	Spotter	Lox	n	C	freq
10m	KG4GVV/B	EM93...	Y	Y	N	N	28.275...
	SX8DI		?	Y	Y	Y	708.725
2m	LZ2QA	KM43...	Y	N	Y	N	144.3
	SV9/WB2...		?	Y	Y	Y	101.188
6m	SV1SIX	KM17...	Y	N	N	N	50.04

K2 ON4KST-50 Connected

1804Z IZ8DWF Frank> ea8ey should really set his keyer better
 1804Z G7RAU 50/70 MHz chat>
 1807Z GBHYV Graham 4-6M> Frank band open Hr to EA noe no I stations now I worked
 5 IT9 stations earlier (-)
 1807Z IZ8DWF Frank> r Graham, too bad I wasn't home
 1810Z IZ8DWF Frank> ct3 <@ is allowed on 110? :-)
 1819Z G7RAU 50/70 MHz chat>
 1823Z PA5JS John> GE all...
 1832Z G7RAU 50/70 MHz chat>
 1834Z G7RAU 50/70 MHz chat>

now: <<<
 1653Z DL8YE Chris> ok dave lets see what will happen, good luck
 1702Z >>>DL8YE I am the cook and must serve up dinner, save the au for an hour ;)
 <<<

KST ON4KST-144 Connected

1807Z F6FXP Bertrand> Hi Roman yes for few minutes Dinner time
 1807Z SP6NVN Janusz> Hi Nikos
 1809Z G7RAU 144/432 MHz chat>
 1810Z SW4LRJ2 NIKOS> ****Anyone try fsk with me?****
 1813Z OZ6ABA Leif jo57> 181200 18.5 80 2 16 -150 58P CQ 58P C
 1814Z S58P Roman> GE Leif tnx rpt
 1816Z F0EPM Eric> Cq. cq beam 70° JN28WQ 144.310...
 1819Z G7RAU 144/432 MHz chat>
 1821Z G8DX Jack CW/SSB> GE Papa
 1829Z G7RAU 144/432 MHz chat>

Welcome Dave G7RAU on this 144/432 MHz amateur chat (by ON4KST)
 1014Z SV2JL Foti> Tom du brauchst keine Meteoer. Kleine Flugzeuge reichen vollkome
 aus!

19:35

NOTES

Windows for quick view

ES Data

VHF data

HF data

12+, VHF, average es Maps

Average es graph

Beacon list

QRA calc

Hand MUF calculator

Web browser

KST chat

Live MUF – Development

Live MUF started life back in 1997 with the primary goals to collect locators for as many hams as possible and to produce MUF information based on cluster data. There are over 1500 users worldwide of the latest version and still a fair number using Live MUF V6.

Live MUF is still intended as a tool to help visualise what is happening but it will never replace the need for the user to actively investigate conditions through listening on their radios.

The maps in Live MUF are probably the most useful feature giving a visual side to what is happening. These are all GCM and have some interaction features with users.

The application was written by me with help from many hams. Special thanks to Keith G4FUF and Geoff G3NAQ for correcting most of my maths and being inspirational in many of the features. Thanks to all hams (too many to list!) who have taken an active part in this project.

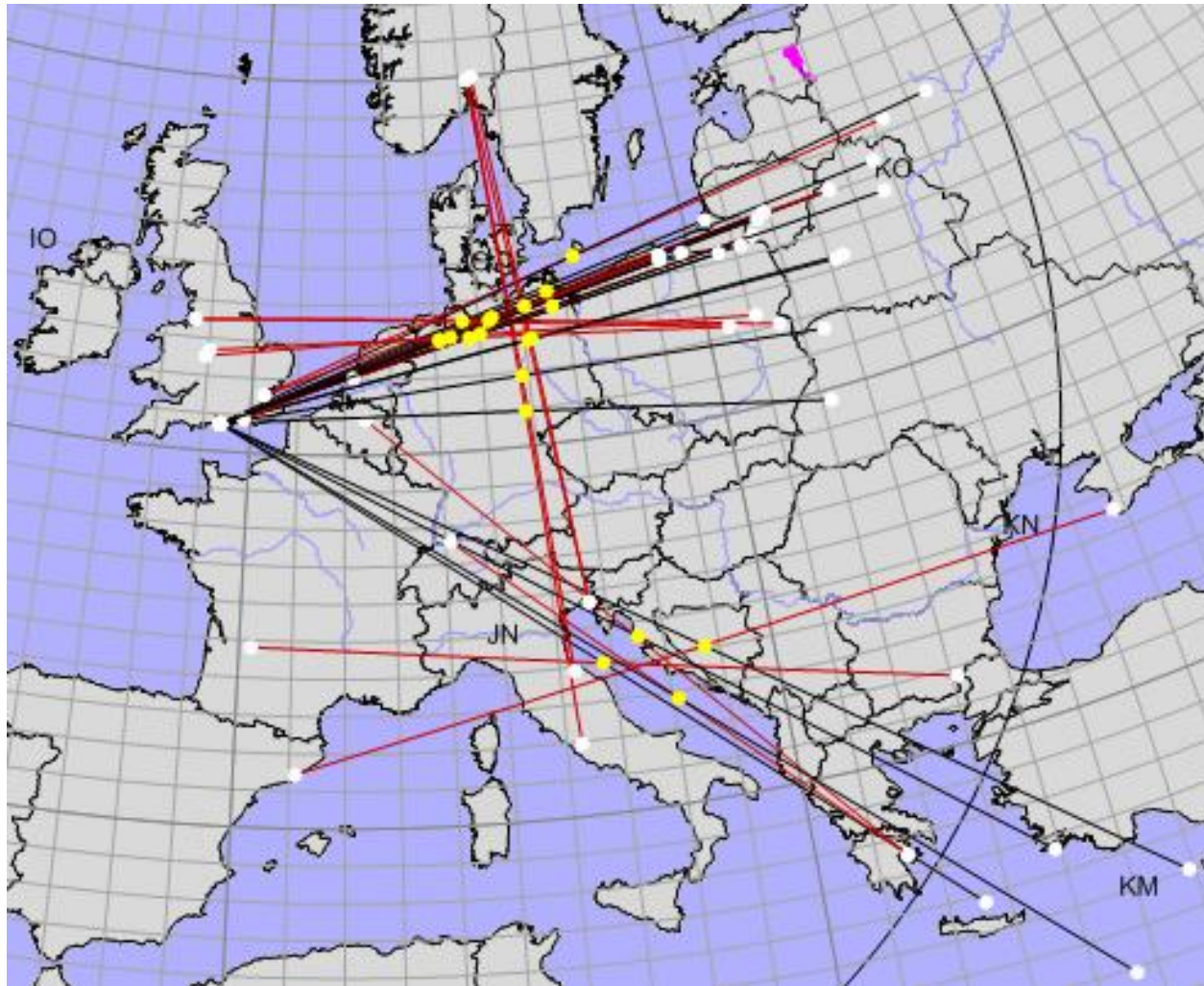
NOTES

Comment on using china-graph pencil and laminated map to work out centre-point. Also on G4PCS dos app and Live MUF V0.1 done in a spread sheet

Live MUF maps and scenarios

Next we are going to look at a real sporadic E event and some maps from 17th June 2003. This will be followed by looking at normal to extreme possibilities that can happen in a 2m sporadic 'E' event.

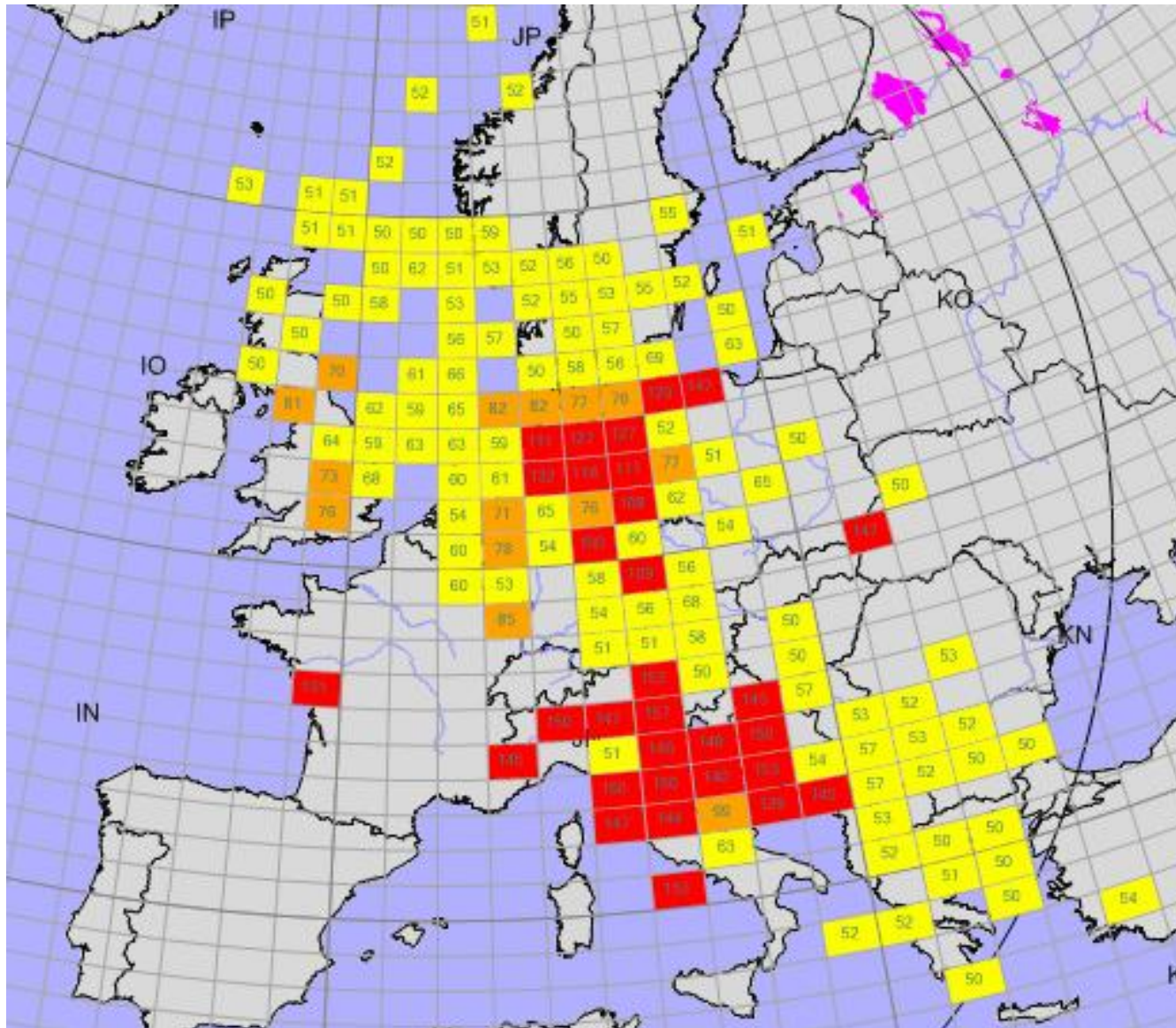
Live MUF – Maps (1)



NOTES

Comment on this is an opening on 17th June 2003. Black lines are my likely path, red lines are real sporadic e contacts. Look at south east opening, I was not in it, reason outside of maximum qrb possible over the centre-point.

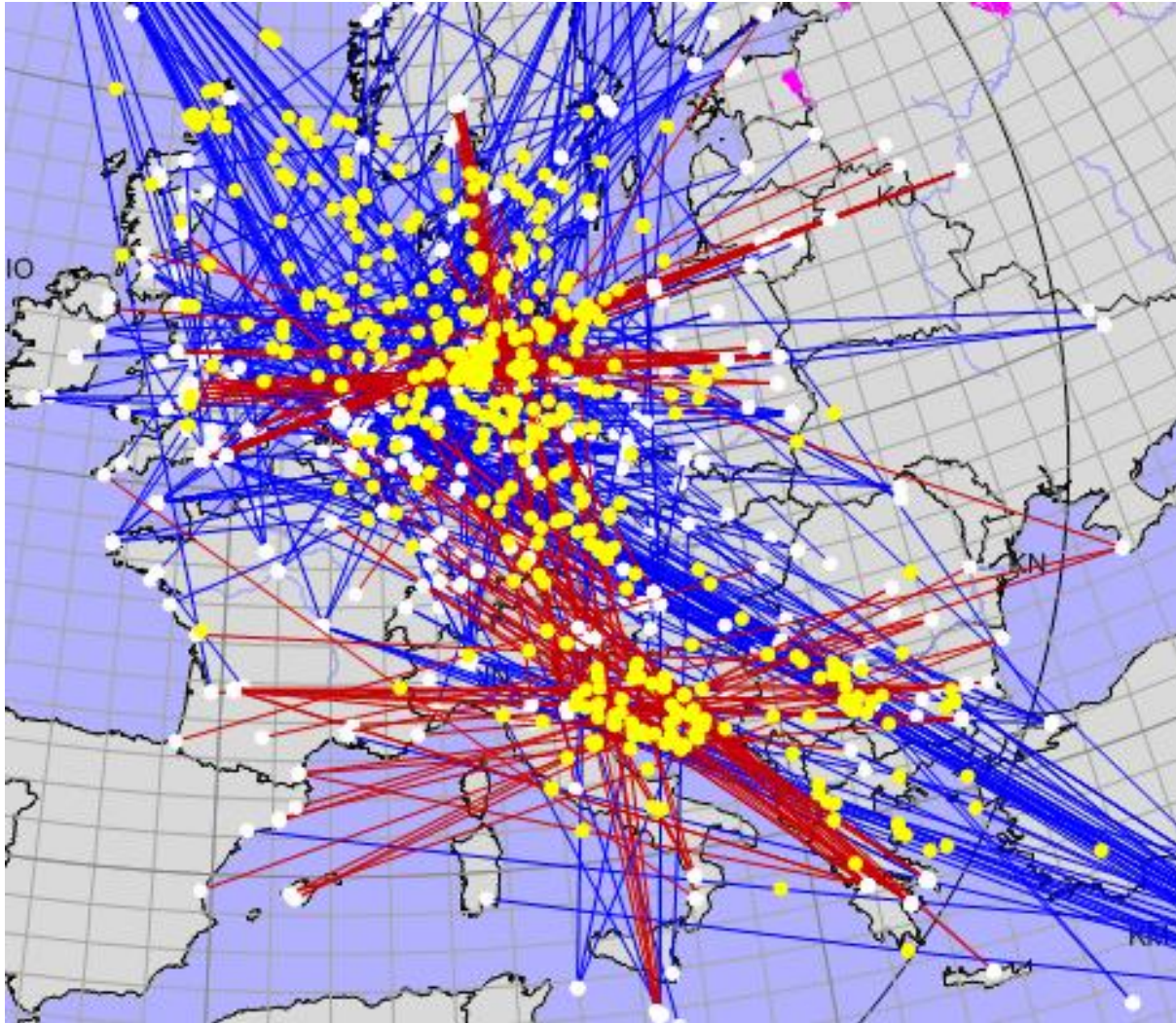
Live MUF – Maps (2)



NOTES

3 hr average same day 17th June 2003

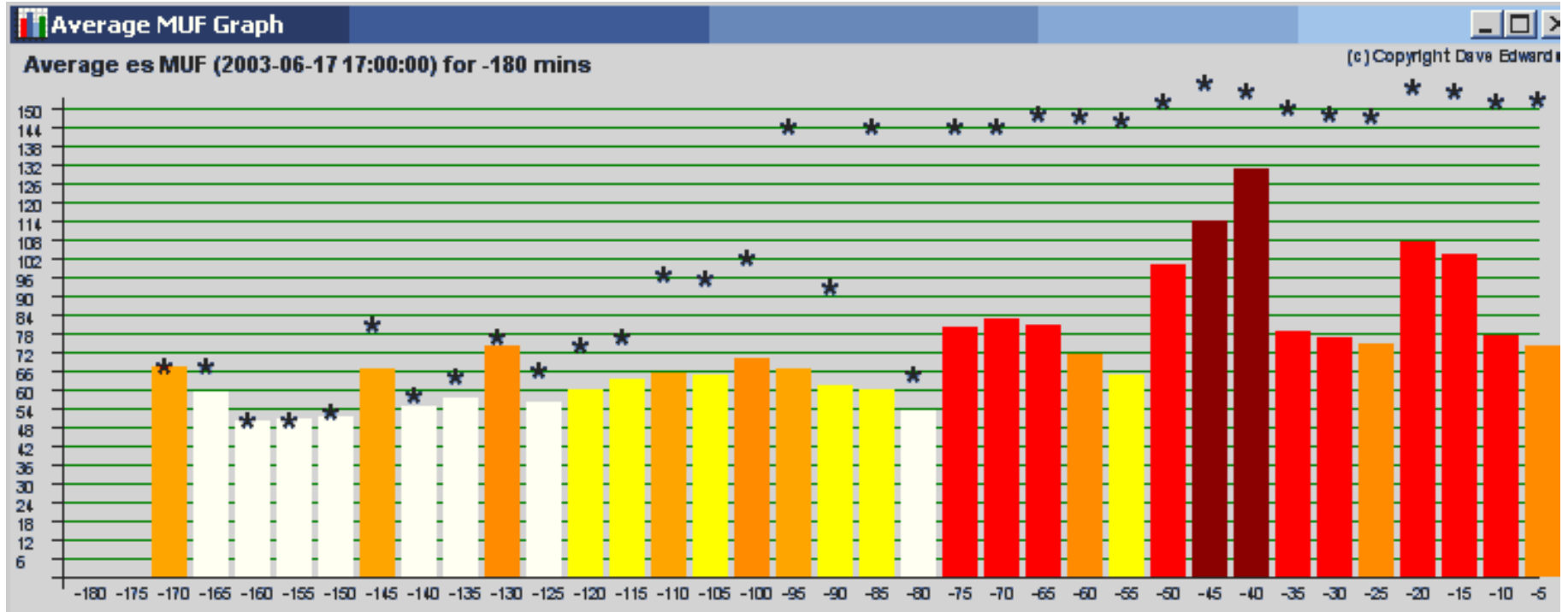
Live MUF – Maps (3)



NOTES

3 hour activity same day 17th June 2003

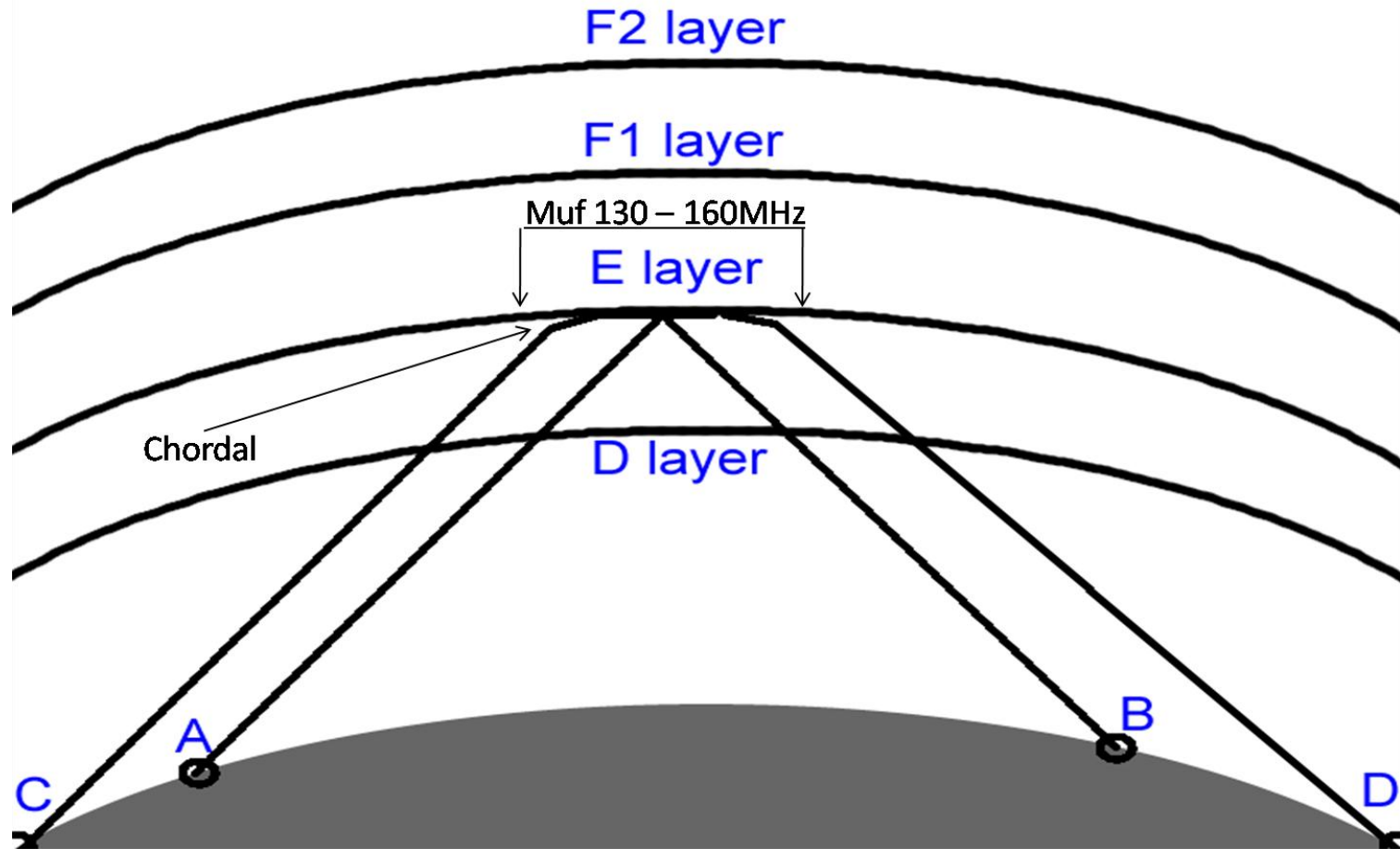
Live MUF – Average



NOTES

Overall averages in Europe on the run up to the 'es' opening 17th June 2003

The ionosphere (revisit)

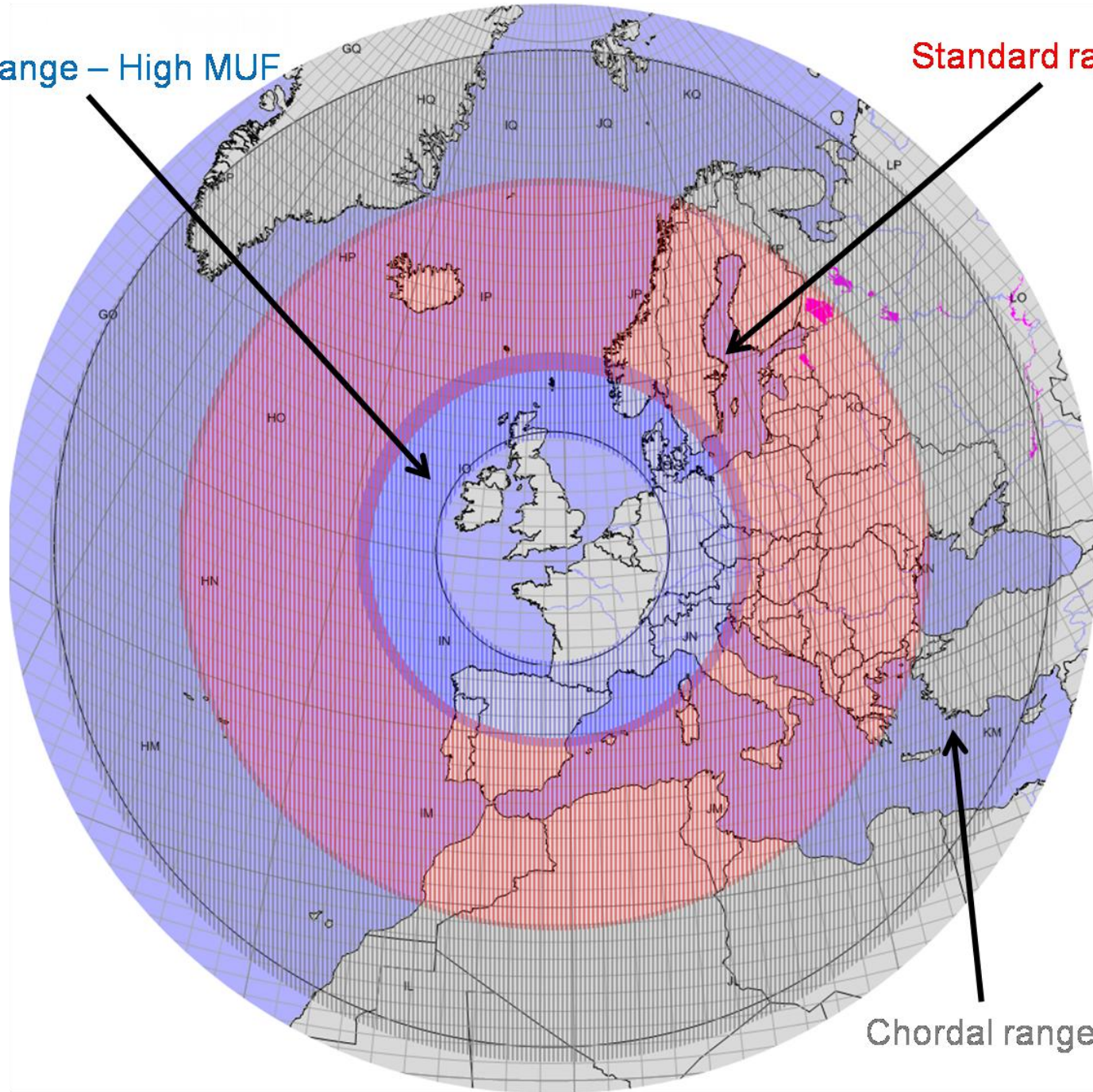


NOTES

Discuss small chordal hops when a large area supports around 2m. Possible answer to extended qso's in nearly all openings (between 2400 and 3100km). Expect controversy and general rowdiness 😊. The 2003 opening had qso's in excess of 2550km from EA3 to UT and G to UA3.

Short range – High MUF

Standard range



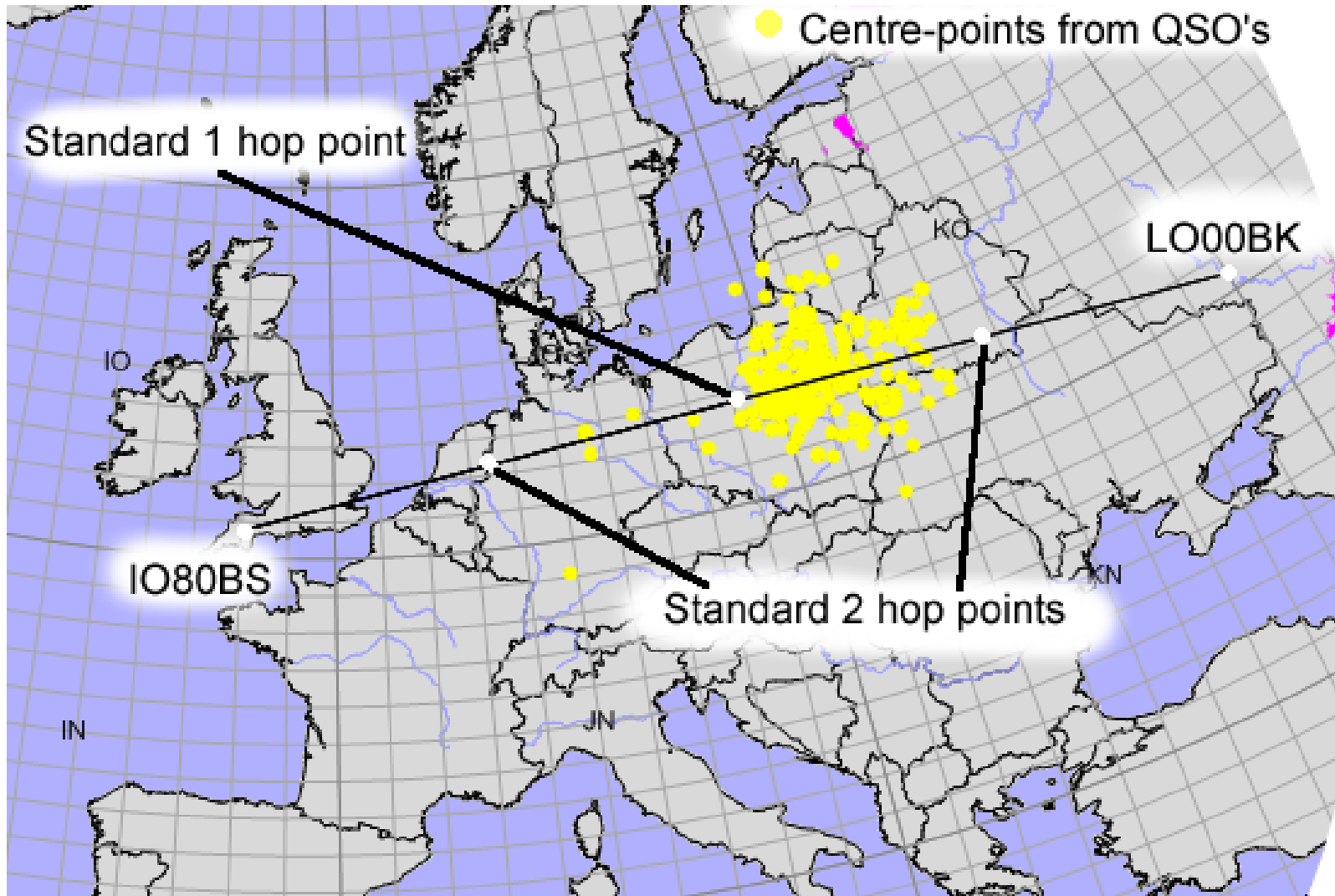
Chordal range

NOTES

A visualisation of what can be worked on 2m and what types of scenarios are required. This is supported by qso evidence. Chordal range can be much shorter and may well happen on many es openings within the standard range.

1st June 2005 ~18:08.

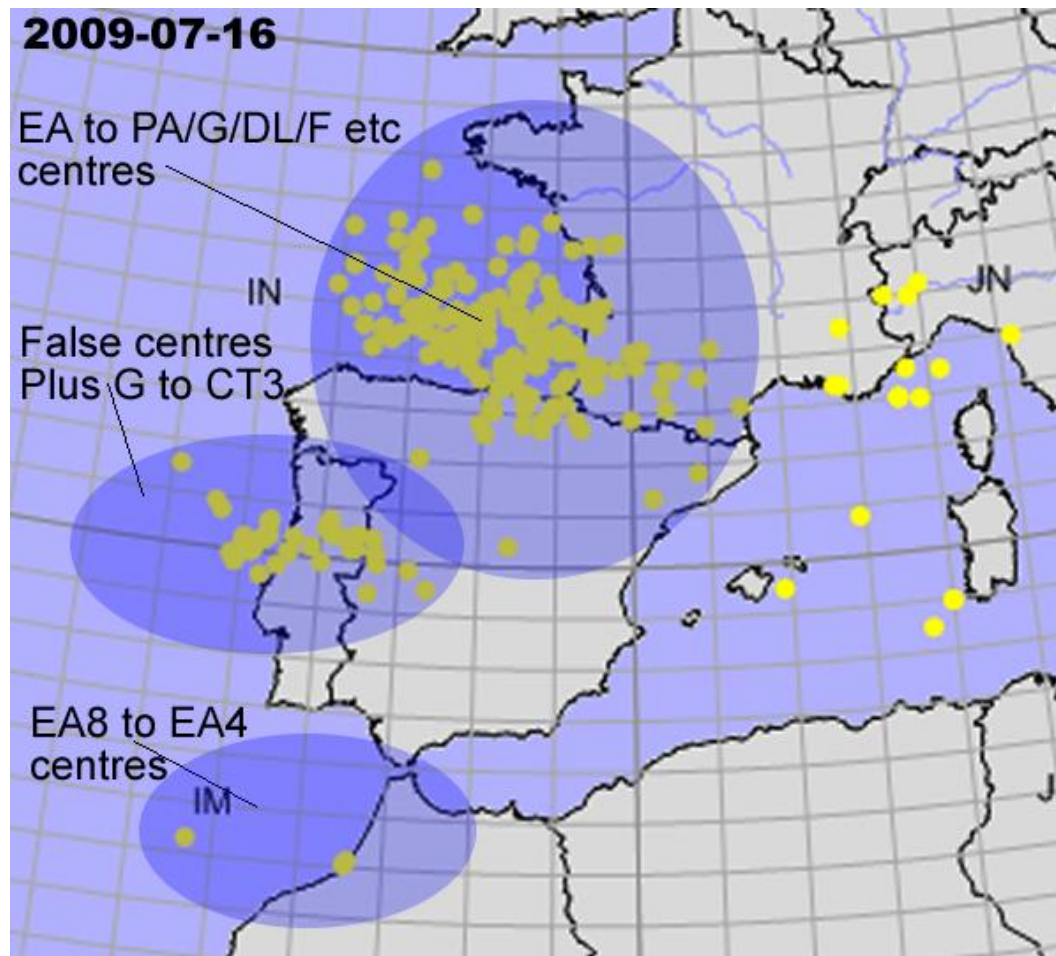
G4RRA – RN3QR e's QSO 3060km



NOTES

Discuss how these types of qso's are not so rare. A lot to do with activity. Why does this seem more likely to be chordal (refraction rather than reflection). Many dismiss this as tropo link in but I want people to consider chordal as possibly a more viable option.

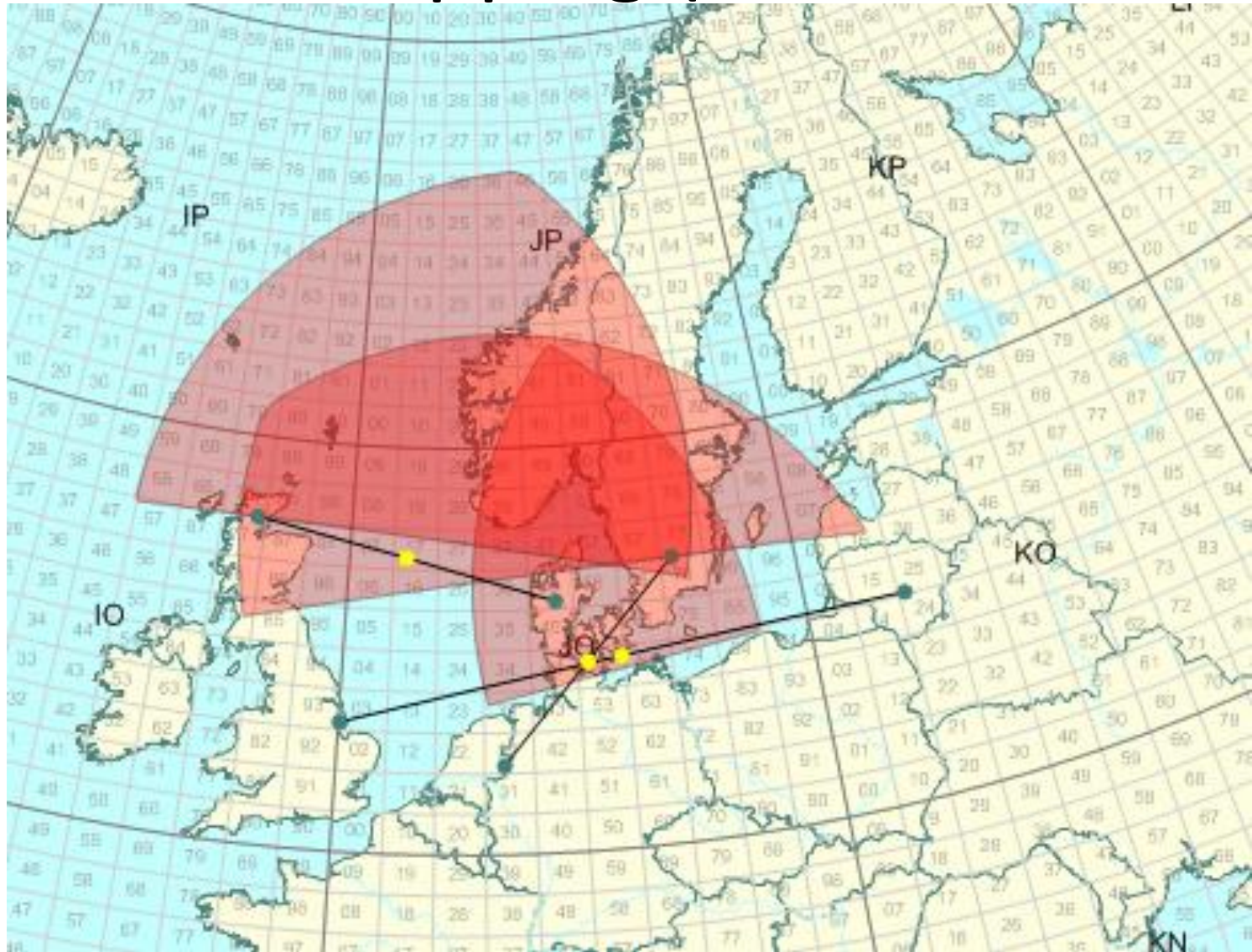
16th July 2009 17:00 to 18:00 on 2m.
PA/DL/G/F/EA1/EA4 to EA8 and CT3



NOTES

Discuss how these types of qso's where chordal rather than tropo link could be an answer. Probably patch much bigger than this, many inter-EA short spots on 6m inc. EA6 to CT/EA1, IN86 to CT and so on.

Aurora mapping (future feature)



NOTES

These are spherical triangles of possibilities, next add the geomag data and can show most probable reflection areas in auroras. Already with stacked spherical triangles it is possible to see probable hot area and work out if aurora is possible from your qth.

What does Live MUF V7 look like?

Hopefully my laptop will behave itself and we will have a brief look at what it does.

Followed by Questions / discussions. Especially interested on how we encourage 'new blood' into chasing 2m sporadic e as a common issue lately is always the same stations seem to be aware and QRV....

A few links

- [Mid-Latitude Sporadic-E \(Es\) - A Review by Michael Hawk](#)
- [Live MUF by G7RAU - Dave Edwards](#)