June 2015 • RadCom

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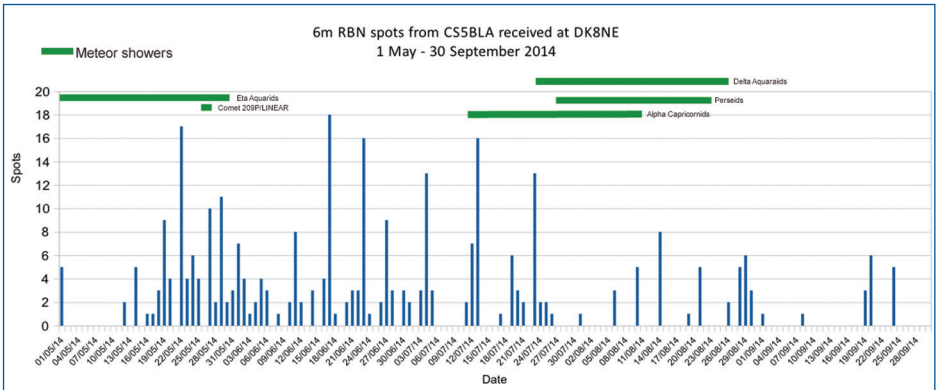
Studying the 2014 6m Sporadic-E season

Answering some questions on Sporadic-E



6m spots from CS5BLA as received at DK8NE.

INTRODUCTION. A lot has been written about Sporadic-E (Es) in *RadCom*. Jim, G3YLA penned a very informative feature some time ago that really outlined what we know about the phenomenon right now. But there are plenty more questions to be answered. To help with our understanding, I decided to embark on a study of Es on 6m (50MHz) over the summer 2014 season.

The main reasons for this were:

1. To establish a database of Es contacts that anyone could use for research.
2. To evaluate claims that Es can be periodic – that is, good Es conditions may repeat themselves over a finite period.
3. To look more closely at so-called Short Path Summer Solstice (SSSP) propagation, when stations in Japan (JA) are regularly heard in Europe around the time of the summer solstice (June 21).

The first task was to find a way to create a database of contacts on 6m. The decision I took was to use the Reverse Beacon Network (RBN). This is a fully automated system that uses CW skimmers to look for, decode and report signals on the amateur bands.

The plan was to analyse 6m beacons received by the skimmers in Europe. This would take out any human element and also give 24-hour coverage, as beacons operate continuously.

LARGE DATA FILES. So each day from 1 May to 30 September I downloaded the daily RBN logs, and pulled them into Microsoft Excel. Once there I was able to use Excel's 'Filter' command to leave just the 6m CW reports received in Europe. A final filter was applied to remove all contacts received in the same entity, for example DL >> DL. This reduced the file sizes tremendously.

What were left were certainly not all Es contacts. Only by later inspection would it be possible to look for potential contacts in a typical Es range of 800–2,200 km (500–1375 miles).

What I ended up with were monthly Excel files, ranging in size from 13.9MB in July 2014 to 1.5MB in September. By opening them in Excel it was then possible to use the 'Filter' command to look at specific paths. Ultimately, I tried to combine all five months into a single Excel file for others to use, but with more than 162,000 entries or lines the file wouldn't save correctly. All the individual monthly files are now available to download at http://tinyurl.com/nkjm48m

DATA. To look for any periodicity in Es openings, four paths were selected as received by Uli, DK8NE located at JN59FW in mid Germany. This RBN skimmer was chosen as it was in use over the whole six-month test period. There were two days when it was offline due to an internet failure, but Uli was able to e-mail me the missing data. The DK8NE 6m skimmer uses an M2 HoLoop at 45m AGL, which feeds two skimmers covering 50.000-50.190MHz (Perseus SDR) and 50.300-50.490MHz (SDR-IQ), both using a converter.

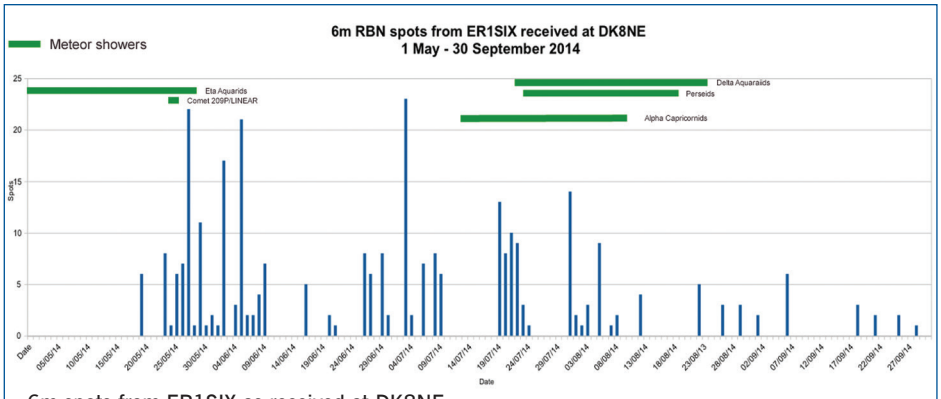
The four paths chosen to examine were selected to be in different directions from DK8NE.

The beacons chosen were:

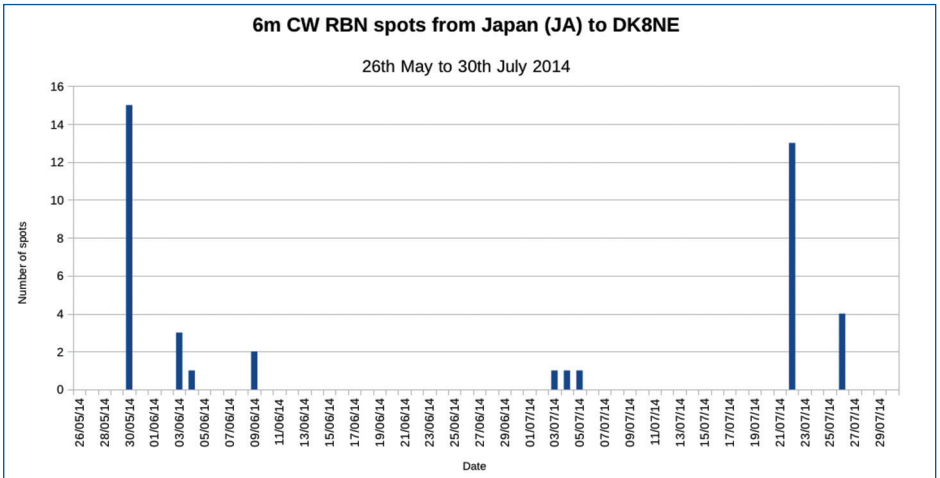
- **CS5BLA (2.5W on 50.0761MHz)** in Aldeia dos Chãos, near Santiago do Cacem, Portugal, locator (IM57PX). This is a distance of 2,020km (1,255 miles) on a bearing from DK8NE of 236°.
- **SV1SIX (25W on 50.040MHz)** near Athens, locator (KM17UX). Distance 1,697km (1,054 miles) on a bearing from DK8NE of 137°.
- **ER1SIX (10W on 50.0205MHz)** near Kishinev, the capital of Moldova (KN47IB). Distance 1,378km (856 miles) on a bearing from DK8NE of 96°.
- **OY6BEC (Power unknown on 50.402MHz)** at Torshavn on the Faroe Islands (IP62OA). Distance 1,710km (1,063 miles) on a bearing from DK8NE of 328°.

Once the data had been collected it was fairly easy to plot the number of RBN spots received per day from each beacon.

PERIODICITY AND OTHER RESULTS. The results showed that there seemed to be no sign of periodicity on any of the four paths. The contacts were more random, which is what you might expect from Es. The paths from CS5BLA, SV1SIX and ER1SIX to



6m spots from ER1SIX as received at DK8NE.



SSSP contacts into Europe, but not at the Solstice!

DK8NE showed maxima in May, June and July with activity falling off in August and September.

Looking closer, the paths from all four beacons showed enhanced activity on 3 July 2014. More than 20 RBN spots were received from ER1SIX, more than 30 from SV1SIX and more than 40 from OY6BEC.

The opening to OY6BEC started at 1843UTC on 2 July and continued right through the night until 2050UTC on 3 July.

Jim, G3YLA looked at the jet stream position by the Global Forecast System (GFS) model for 300mb winds and contour pattern for that period and noted that all the paths intersected with a portion of the jet stream.

The wind shear theory of Sporadic-E suggests that the colocation of the jet stream, high level winds and their intersection with mountain ranges can generate gravity waves that then propagate upwards.

But no known meteor showers were active during that period, so what was the source of the increased ionisation?

One current thought is that daily sporadic (non-shower) meteor activity can be enough to introduce enough metallic ions to produce Es openings, once wind shear is factored in to compress the ions into layers. As Earth travels around the sun, it sweeps up some 40,000 tons of interplanetary dust a year.

A Google search brought up video footage of a fireball that was witnessed by police over the West Country in the UK on 30 June 2014. There is no suggestion that the Es opening and the meteorite are linked, but it shows that there is certainly meteor activity outside of known meteor showers.

There was also a second peak from OY6BEC on 22-24 July, with activity tailing off over the next few days. The opening also coincided with a marked upper ridge over the North Sea that could have been a candidate for the Es event.

This also coincided with the Alpha Capricornids, Delta Aquarids and Perseid meteor showers. The Delta Aquarids only favour the southern hemisphere and tropical latitudes in the Northern Hemisphere.

We cannot draw any conclusions as to whether the July OY6BEC openings were linked to the meteor showers.

Another theory from G3YLA is that the OY6BEC opening was due to mixed-mode propagation or perhaps all tropo ducting.

The surface weather pattern was also a static ridge and there was much sea fog and low stratus cloud over the North Sea during that period, which is a sign of a strong inversion.

The radiosonde ascents at 1200UTC on 23 July from Ekofisk in the central North Sea show a very thin surface duct where the one from Lerwick was a bit deeper and more substantial.

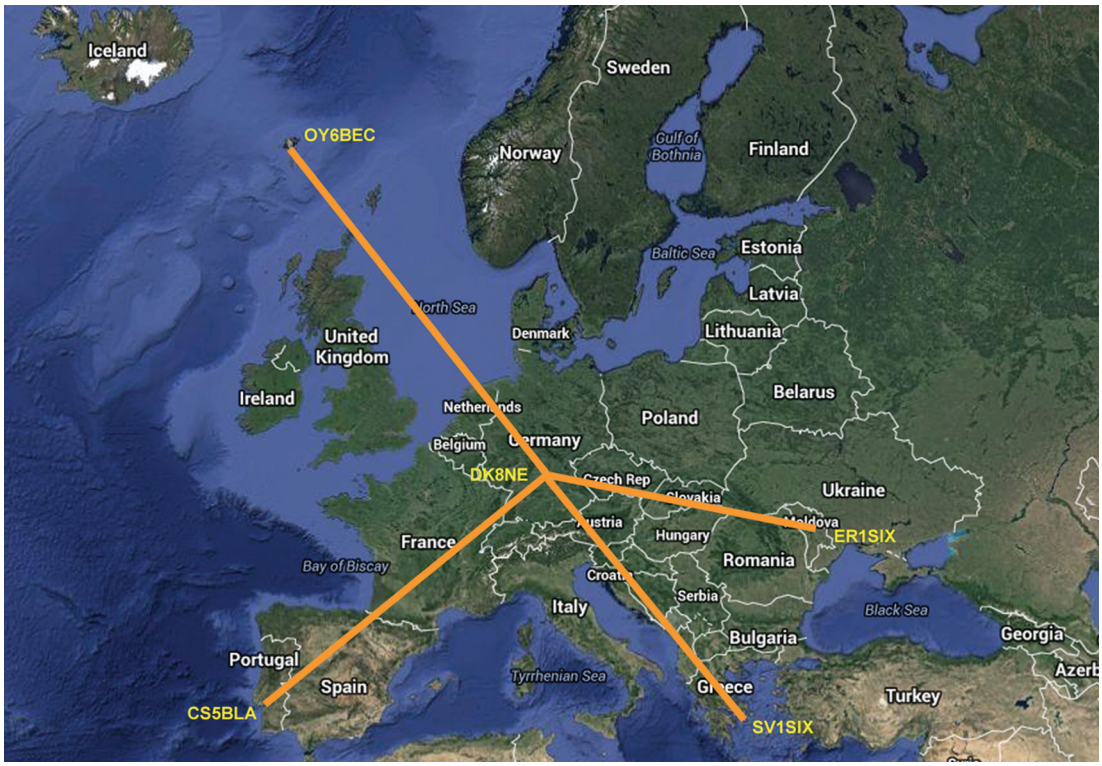
SUMMER SOLSTICE SHORT PATH (SSSP) PROPAGATION. The term SSSP might not quite be accurate. There were a total of 42 contacts recorded from JA to DK8NE during the period reviewed.

The first opening occurred on 30 May when a total of 15 spots were recorded between 0559 and 0645UTC. Stations heard were JE1BMJ, JH0INP, JL8GFB, JR1LZK and JN4MMO. All of these callsigns check out and they have one thing in common – they are all very well equipped for 6m in terms of antennas and power, 1kW not being uncommon.

There were six smaller openings of one to three contacts in June and early July. The next big opening came on 22 July when 13 spots were received from 0820 and 0927UTC. Four further spots were received on 26 July.

No JA beacons were heard during this time suggesting that it was only high-powered stations with beams that made it to Europe.

Interestingly, this period was also noted for the appearance of electric blue noctilucent clouds (NLCs). These float around 47 to 53 miles (76 to 85km)



The paths investigated for the 6m Es study.

overhead in a layer of Earth's atmosphere called the mesosphere. Typical high clouds, such as the cirrus we see on a summer's day, are four to eight miles high, about the same altitude as a transcontinental jet flight. Both cloud types are composed of ice crystals, but NLCs are thought to rely on dust left by meteors, although particulates from volcanic eruptions are also thought to play a role. Because of their great height, NLCs reflect light long after sunset, when other clouds have faded.

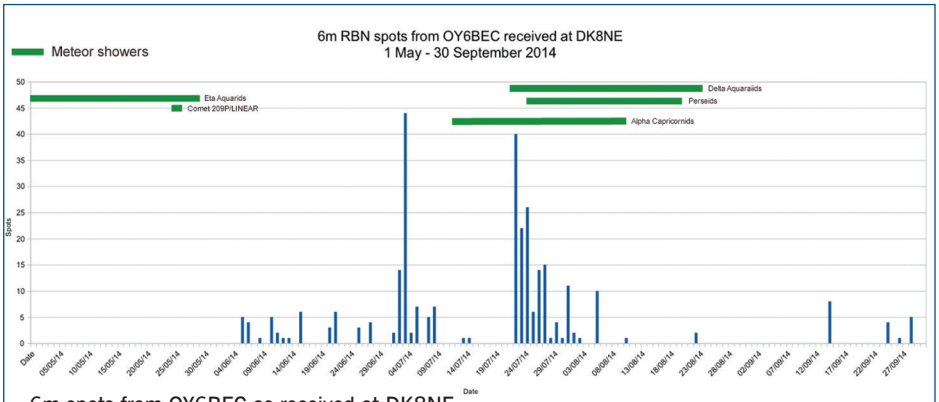
Using NLCNET, we can see that there were a number of sightings of NLCs from Germany, Russia, Wales and Scotland around May 30. There was another cluster of sightings around 21-23 July. While it would be easy to deduce that these clouds are the root of the JA openings we shouldn't jump to conclusions.

Jim Kennedy, K6MIO/KH6 and Carl Luetzelschwab, K9LA have both confirmed scientists have come to the conclusion that their mesospheric effects with NLCs are 'several orders of magnitude below' what is required for producing the observed long-distance communications paths on VHF. Instead, they say these kinds of openings can be well explained by known mid-latitude Es from JA to Europe, or mid-latitude Es linked to auroral Es from JA to far northern Europe (eg grid field KP).

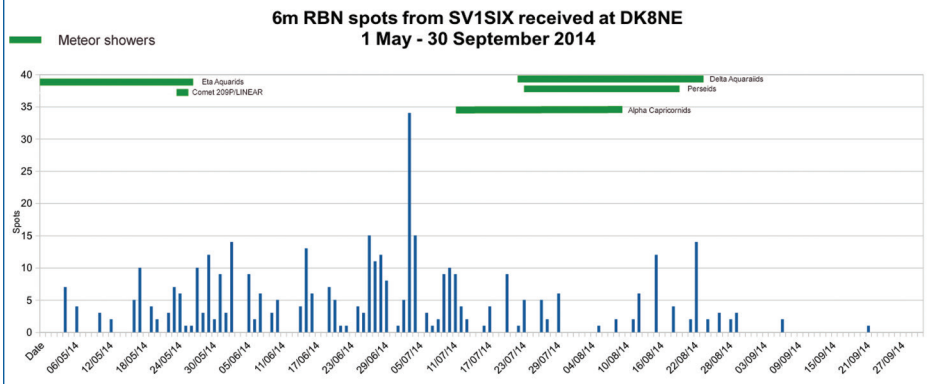
Carl said that from measurements by high ERP radars, the NLC ion densities are way too low to have an effect at 50MHz (other than very lossy scatter).

The Kp index for the period 21-23 July was just 1-3 (Ap 5-7). This is sufficient for visible aurora in northern latitudes so a combined Es/Auroral Es cannot be ruled out.

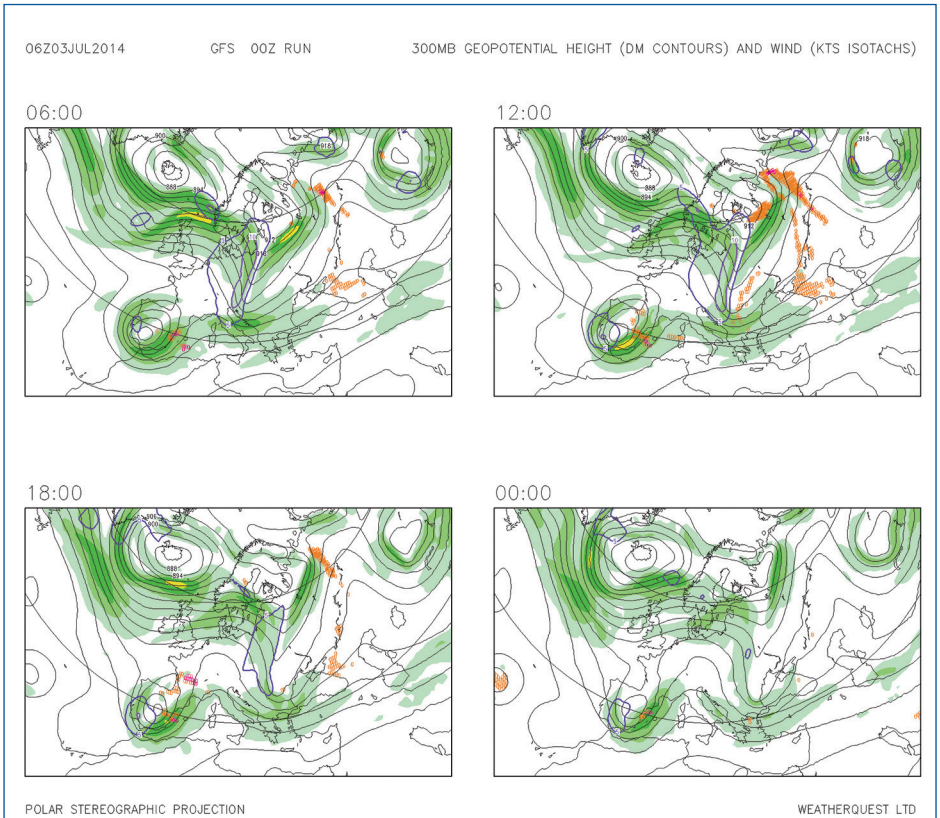
A closer look at the SSSP paths is planned for this year's season.



6m spots from OY6BEC as received at DK8NE.



6m spots from SV1SIX as received at DK8NE.



Map of 300mb high-level winds for 3 July 2014. Image: Weatherquest.

CONCLUSIONS. The main purpose of the 6m Es study was to produce a database (Excel file) of RBN contacts into Europe for anyone to download and interrogate using Excel's 'Filter' command. This was achieved and the whole five months worth of data can be downloaded from http://tinyurl.com/nkjm48m

Anyone is free to download it and use it as they wish.

The secondary purpose was to look for reported periodicity in Es events. This was not seen.

The database can also be used to look at other events, such as SSSP openings from JA to Europe. This showed that the openings were rare in 2014, mostly early morning-based (in EU) and likely to be only open to well-equipped stations. The term 'Summer Solstice' may also be misleading as the bigger openings occurred on 30 May and 22 July – around one month earlier and later than 21 June.

In any event, I would encourage any interested amateurs to conduct their own Es research. The RBN network is a useful, reliable tool, even if you don't have your own well-equipped station.