Details of public comments and videos: Earthquake Light accompanying the Kaikoura November 2016 earthquake.

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This is for November 14 2016, the M7.8, Kaikoura earthquake, epicentre Culverden, South Island. It is a supplement to the submitted paper *Blue Sky at Midnight. Earthquake light in New Zealand*, and the details will be more easily followed with reference to that paper when eventually available on this site. Videos are at <https://www.youtube.com/channel/UCTZh_C2SyhVLcGmNLyNFzIg>, but are individually referenced in this compilation.

Earthquake light is predominantly blue-white flashes accompanying earthquakes usually M6 or greater, in the form of hemispheres on the ground, often reflected in the clouds. They were captured in many videos during the Kaikoura earthquake, mostly in Greater Wellington.

**Sources**

Useful material was obtained from Weather-Watch websites. Social media restricted to small areas in the Hutt Valley near the light produced many helpful comments, ([www.Neighbourly.com](http://www.neighbourly.com/); 5200 members at survey date in late November, 2016), as did other webpages acting as social media for very localized areas. Facebook pages mainly showed photos/videos and had little unique context. Urban Information Centres were slightly helpful. A few comments were from radio/TV news channels - viewers who called in. A community group in the rural North East of the South Island was helpful. Sites interested in UFO’s which note strange lights, were generally not helpful.

We asked two newspapers for earthquake light stories from readers, (Brown, 2016, (local paper in Lower Hutt ) repeated at [www.stuff.co.nz](http://www.stuff.co.nz/)), (Goble, 2017, Eastbourne, New Zealand). Other reports came from (Mills, 2016, Greymouth), (Coster, 2016, Taranaki), (Staff Reporters, 2016, Whanganui), (Staff Writers, 2016, Masterton), (Dawson, 2016, Rotorua), Neither of the main local papers for the Wellington region, the *Dominion Post* and *Hutt News*, directly reported the lights.

(Going Viral, (2016)) is a shortened version of Syrian Kiwi (2016) with each frame inverted left to right, thus adding no further information, but is far more web-accessible. In many cases flashes in videos are reflected from clouds in the sky and the ground emission cannot be seen directly. Names associated with the videos on YouTube are often pseudonyms and requests for contact via the comments sections were usually not honoured. The 300 reports gathered in New Zealand from all sources to July 2017 compare with Musya - 1500 accounts on the Idu peninsula, Japan in 1931 (Derr, 1973), 200 in Romania (Hedervari and Noszticzius, 1985), and 241 in Central Italy, (Fidani, 2010).

**Detailed notes on some observations**

**Historical**

The 1848 Awatere earthquake had light associated with it. This is fully documented in (Grapes, Downes, & Goh, 2003). The light is rather atypical in worldwide terms, being chiefly red glows rather than blue-white flashes. Pale streaks (?not red?) lasting tens of minutes were seen to the North from Wellington on the evenings of 16, 17 October, and from a ship near Kapiti Island “bright flames” to the NE. The interpretation is complicated by reported occurrences of *aurora australis* to the south also observed from Nelson on all nights 18-20 October. The latter occurrences lasted several hours. Unusually intense displays were seen in various places in the Northern Hemisphere as far south as St Croix in the Caribbean, and during October to November. It seems rather extraordinary that the earthquake in the Awatere and earthquake light, should coincide with the first occurrence of the aurora.

**Christchurch and North**

Near the epicenter some indirect light was recorded (Spewpree, 2016,), (This video was at Hanmer Springs) but the most intense displays were much further north, and not necessarily near faults which moved.

*Related observations:*

An observer in a web thread reported coseismic light for a post-2010 M5.3 event near Christchurch. Later, in contrast, in web threads at 21-Jul- 2013 and 16-Aug-2013, were reported two M6.5 NZ earthquakes near Seddon but no blue-white flashes. Around the time of the November 2016 Kaikoura quake, various ball lights were reported, but any relevance to blue-white earthquake light is not clear.

 Other white orbs were seen at 4 places in the north east of the South Island, which is notorious in New Zealand for video taken in late 1978 from an aeroplane, of unusual glowing aerial balls, their existence simultaneously confirmed by two radar traces (Maccabee, 1979) hence quite likely balls of ionized air, and it is possible current observers are particularly watching for these. Alternatively, there could be some connection with seismicity.

 There is sparse population between Kaikoura and Seddon, however there is a hearsay account of two people at Kaikoura seeing not flashes, but a glow over the 1500 m mountains near Kaikoura. Orange glows, rather than flashes, were reported historically for Wellington (Rogers, 2013), (Grayland, 1957), Inangahua (Pers. Comm. 2012, W. Ironwood) and Christchurch 2010 (Swinney, 2010). Others of the many international instances of this co-seismic orange glow include Japan (Terada, 1931), Italy (Fidani, 2010), Pakistan (Margottini, 2013), Iran (USGS, n.d.).

One eyewitness 44 km north of Kaikoura saw a coseismic white flash. There are two reports of precursory light-balls between Kaikoura and Seddon.

The only video at Blenheim is of an indirect flash

 (itvz 2016)).

*Nelson*: there were four observations including two very indirect videos

 (Kev, 2016), (Cato,2016)

**Wellington**

Some of the videos on the web had extensive comment lists, e.g. the 3700 for (Bell, 2016), (<https://youtbu.be/2yJgTnA61m8>) most of which were “like”s but the associated web-thread comments are now not available on line. Relevant ones were collected and archived. (For the 2017 Mexico September M8.1 quake, comments were about 200k in one day). (Video is <https://www.youtube.com/watch?v=2yJgTnA61m8>)

Many local comments were typically “I saw exactly what the video showed, but I was in New Plymouth/Blenheim (etc.) and I’m so relieved, I thought I was crazy”. These were noted here as location reports, but follow-up questions were usually not possible. Because of various computer limitations it also takes a very long time to retrieve every entry in such a long thread, and they are not always indexed by search engines.

*Petone*

An eyewitness of other events said the flashes she saw were in Petone on the ground, white only and individual ones progressively were to the north up the valley.

*Taita*

This outstanding webcam (Gracey, 2016, <http://www.youtube.com/watch?v=GZ4JJSrQXqI_2vs>) in Taita Drive, Lower Hutt was directed towards the western hills . The sequence records street light failure and eventual complete power loss (figure 1a). At the peak flash (figure 1b) during the power outage there are two very bright white areas in the sky and lower blue areas. The foreground is lit with blue light, (i.e. the webcam is probably inside the luminescing air), and the distant hills are lit almost to daylight intensity. Between some clouds to the top left is an area of blue, the same as would be observed in open sky during the day. (Hence we might describe this as literally blue sky at midnight). This is not a reflection on cloud, but luminescence of the air itself giving the same colour as sky-blue in daylight. On the bonnet (=hood (US)) of the car is a reflection of the sky in which may be seen a large white patch. Two eyewitness reports confirm the white light was well above ground.



Figure 1a Taita Blackout plus moon to R. out of frame, before flashes. Some speckled blue areas in clouds are due to earthquake light. After Figure 1b conditions in Figure 1a returned, but the sky was much darker before and after the seismicity (Gracey, 2016, <https://www.youtube.com/watch?v=GZ4JJSrQXqI> Contains segment 5x slower).



Figure 1b. Peak flash condition. Note lit hill and “daylight” sky. Sky; RGB 82, 83, 233. Darker sky blue. Blueish colour on cloud; 169, 255, 255. Sky blue.

This video does not seem to have parallels on the web.

*Eastbourne*

One eye-witness in Eastbourne saw green light emerging from sloping ground on the hills behind southern Eastbourne.

*Clouds*

 The attached photo on a mobile, also shows claimed earthquake light in the clouds at Taita.



Figure 2. The irregular patch of light, top left, is claimed earthquake light in the clouds (Farrell, 2016).

*Manawatu*

This area had many verbal reports. One witness reported light both north and South of Palmerston North, parallel to the Main Divide Hills and occurring at times of maximum stress. One video probably from Feilding NW of Palmerston North is (HiTide Leaked Footages, 2016, <http://www.youtube.com/watch?v=n2262CXbKig>).

*Napier/Hastings*

There is a Napier video (422 km N from Kaikoura) of distant flashes, to the south (Napier Port, 2016, <https://www.youtube.com/watch?v=f4IOLXQA3Y4> ) towards Hastings.

*I was in Hastings at the time and there were hundreds of small flashes all around the sky like dim sheet lightning and then there were 4 or 5 huge flashes that lit up the entire sky. One actually lasted for about 5 seconds and shot up almost like a blue explosion. The colors were predominantly blue and green but there were shades of red. it was a massive blue light to the south of Hastings, like massively huge blue light towards mount Erin.* [490 m ASL, due south of Hastings] (Pers. Comm. A. Coates)

 There is one claimed sighting of flashes in Kerikeri which is about 950 km north of the epicentre.

*Other reports*

There are always minor atypical reports of earthquake lights as noticed previously (Whitehead & Ulusoy, 2015). In the present case one careful observer in Korokoro, Hutt Valley (Pers. Comm.) noticed two beams of light sequentially emerging from the west wall of a bedroom, a meter above the floor, and parallel to the bed but on opposite sides, and about a meter horizontally from the bed.

The first was a blue cylinder/narrow fan of blue light bright enough that one could not see through it, which coincided with a felt earthquake impulse. There was a booming sound, perhaps on the valley floor. The second had structure; the top was white, the blue was in the middle, and was curved while at the bottom was another white layer. The blue seemed to travel faster than the white. The angle of the white rays was less than 45 degrees, but the first, entirely blue, was almost parallel to the floor. This portrays something able to pierce walls and produce directional light. She selected as best match Pantone colour 2718C which corresponds to Photoshop RGB 105, 134, 213, sky blue. The account is paralleled by (Terada, 1931) and see (Thériault, France, Freund, & Derr, 2014). This cannot be the same as some of the streaks in videos which are known to be due to optical effects within webcam optics of street lights just out of frame.

One observer living at a height of about 140m slightly south of Seaview (observing outside), found a kind of curtain of blue-white light between her and the opposite side of the street, which lasted about one minute, while the shaking continued. It is therefore much longer than the typical flash, although there is literature precedent (Yasui, 1968), (Tsukuda, 1997). The light was rooftop-height and failed electricity lines were not causing this.

One observer in Seaview very near the hills, near the light hemisphere near the Waiwhetu Stream, saw inside his house a blue light like a layer of mist over his carpet.

One artist observer at the northern edge of Lower Hutt saw a 2 m radius light 2 m away with white top and blue-green, electrically discharging and moving, banded structure below it, unable to pierce a grounded very coarse wire mesh fence, perhaps acting as a kind of Faraday cage. The display may have lasted as long as 7 second. Colour matching showed this was RGB 0, 255,154, so predominantly green and technically Aquamarine.

One observer on the western hills reported orange orbs outside her house and a brief orange-red glow some indeterminate distance and direction away

*Marine reports*

There were no observations of light within the Wellington Harbour waters, (personal communication: Department of Conservation (DOC) ranger on Matiu/Somes island) confirmed by several negative eyewitness accounts elsewhere.

*Greymouth*: One observer (Comment in a web-thread) saw offshore what looked like “magnesium bombs” i.e. brilliant white eruptions at the sea-surface, and relatively regular for the several observed. This resembles the ones seen on land, but is rarely reported in the literature.

*Runanga*: A couple spotted blue and purple light in the sky from the sea, during the swarm of earthquakes while the shaking was going on. One man said he went outside as the ground was still shaking. The sky out to sea was full of flashing lights, purple, blue and white. “It was almost like explosions of light.” A woman said she saw two very distinct, purple flashes, while a third and final light saw “the sky lighting up” (Mills, 2016). The purple colours probably result from a combination of blue and red emissions.

*Westport*: Two members of a family saw green-blue flashes rising from the sea (personal communication).

*Kapiti*: One marine report from 50 km north of Wellington and on the West coast, was light of a royal blue colour from the sea, and an observer 44 km north saw 2 white flashes to the south west from the sea.

The marine reports confirm that earthquake light from the sea can be similar to that on land which suggests it is unwise at this stage to seek an independent cause. According to (Institute of Geological and Nuclear Sciences Limited, 2002) the sea depth within the visible horizon for the marine reports on the West Coast of the South Island is about 150m. The Freund model predicts emergence of positive ions charge from underlying strata and given their speed, (perhaps several hundred meters per second) could fairly easily reach the sea surface, in spite of the highly conducting nature of sea-water; also the density of water is lower than rock.

These are all different from the submarine fast-moving pale blue streaks reported previously near Christchurch. (Whitehead & Ulusoy, 2015). They could be compared with rather similar historical accounts (Terada, 1931).

*Static Electricity*

As in previous work (Whitehead & Ulusoy, 2013), enhanced static electricity was present:

*… the air was almost electric. I can only describe the feeling like when you’re around high electricity storm or transformer. Kept getting electric shocks off things like trolleys and random items. During the flashes it almost made a fuzzy feeling go through your body…. But even before large aftershocks in the days after, me and several people got a fuzzy feeling again about 10 mins before quakes. (T. Olliver, Pers. Comm.)*

There were the usual reports of excessive static on radio channels and TV interference, commonly and independently noted since the 1995 Kobe (Hanshin) earthquake and in this case near Blenheim.

*Clouds.*

There is video evidence of light generated within clouds for the New Zealand data, but not the Mexican 2017 data, which show only reflections in the clouds, always synchronized with the ground emissions. Cloud earthquake lightning was part of the historic classification by (Galli, 1910) and one of the most recent reports is (Fidani, 2010), however few previous videos show clouds or their involvement.

There are five reports of white colours in clouds above the observer. Colours in the Taita clouds from below seemed to be white only, with no blue halo, but the surrounds at ground level were blue. Some of the cloud light is due to saturation of sensors, but also as discussed where this is not the case (Whitehead & Ulusoy, 2015), the white coloursare a mixture of all colours, and should be attributed to non-specific air ionization caused by moderate voltages, rather than an unlikely carefully balanced combination of primary colours.

The normal electrostatic gradient in the atmosphere gives rise to charge separation even in clouds which are not storm clouds, (Takahashi, 1972) found by measurement in Hawaii that negative charge is at the cloud base and positive at the top. Positive ions from the ground flashes may combine with these and give a white colour flash because the energy involved has many values, due to varying charge distribution in the clouds. This means there is light both from the ground, and sometimes from clouds, and earthquake light in clouds seems to be a new low-voltage classification of lightning. However the clouds may not be higher than 200m above the ground, judging by the present observations.

Electrical problems

Transformer and short circuit problems may account for some reported earthquake lights, but not for many in this study. However one eyewitness mentioned a clear blue flash from a very close transformer.

Many observations contemporaneous and historical were far from electrical supply: Inangahua, rural Christchurch, one observation near Blenheim, Abel Tasman National Park (nearest to Nelson); six observations were towards the open sea, many in an uninhabited area behind Eastbourne, also one area in Wainuiomata, one area in Maungaraki, one above Seaview with no electrical fault, and Naenae/Taita after power failure.

For the Taita light this is not substation failure; the two nearest substations were not affected, and the major flashes were not close to substations. A general explanation would demand multiple substation failure all over the valley which far from, the case. However the implication is that the power levels in the flashes are about equivalent to the power in a substation, which is tens of MW. The similarity to electric grid problems and the common ionization of air confirm that the origin of earthquake light is electrical.

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