

Carrington Events

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Multimessengers
Himawari wannabe
Carrington extreme!

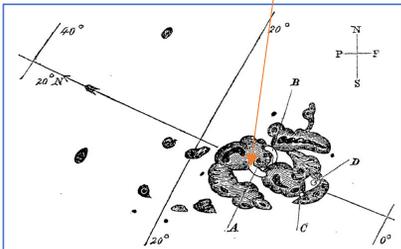
空を見る
向日葵の夢
カリントン

Sunflower = *Himawari*

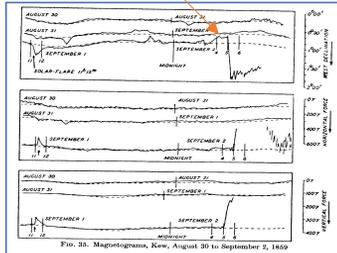
Background

The term “Carrington Event” refers to the 1859 flare/geomagnetic storm occurrence.

- This was the first multimessenger astronomical transient, because it set off geomagnetic signatures mediated by both photons and baryons.
- It is also taken to be a “superflare” and often is mentioned in that space-weather context.



Redhill Observatory (Carrington)



Kew Gardens (Balfour Stuart)

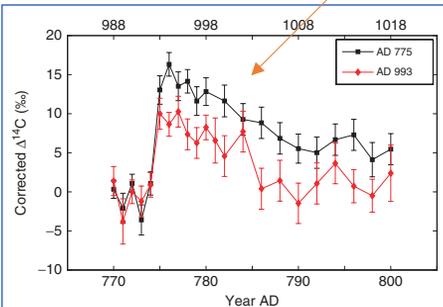
Was the 1859 event a “superflare”?

No; both its flare energy and geomagnetic influence lie near the top of any “all-time greatest” events, but not uniquely.

- The “Halloween” events of 2003 had comparable flare energies.
- The 1956 neutron-monitor event that launched the IGY had comparable space-weather effects.

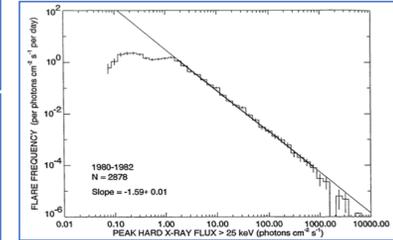
Have there been greater solar events?

Yes; Miyake et al. (2012, 2013) found two remarkable ^{14}C transients in Japanese cedar tree-rings, interpretable as major solar particle signatures. Trees around the world agreed, and so these events were likely solar but much more powerful than the Carrington event. But, the time scale for ^{14}C uptake allows time for multiple solar events to occur.

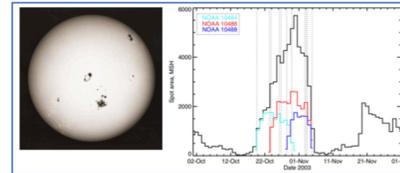


Miyake et al. 2012, 2013: Two of the three known radioisotope transients from the Holocene.

Solar “superflares” not needed?



Crosby et al. 1993: the power-law of flare energy distributions, by inference, rolls over just at the Carrington limit of 10^{32} erg.



October 2003: multiple simultaneous major spot groups; multiple X-class flares from three of them.

Literature and full discussion:
Please see review articles by the author (ARAA 2021) and by Cliver et al. (LRSP 2021).

Analysis

From the Carrington event observations alone:

- The total energy of the even approached 10^{32} erg.
- X-rays, the ionosphere, CMEs etc. needed to be invented or discovered.