

FEATURE ARTICLE

10.1002/2014SW001141

The Origin of “Space Weather”

William B. Cade III and Christina Chan-Park

Citation:

Cade, W. B., III, and C. Chan-Park (2015), The Origin of “Space Weather,” *Space Weather*, 13, 99–103, doi:10.1002/2014SW001141.

Accepted article online 18 JAN 2015
Published online 27 FEB 2015

Abstract Although “space weather” is a fairly recent term, there is a rich history of similar terms being used beginning in the middle to late 1800s. “Solar meteorology,” “magnetic weather,” and “cosmic meteorology” all appeared during that time frame. The actual first appearance of space weather can be attributed to the publication *Science News Letter* in 1957 (with the first modern usage in 1959) and was possibly coined by the editor at the time, Watson Davis.

This article is published in the journal *Space Weather*, but where did the term “space weather” come from? More broadly, from the earliest days how did humanity refer to the science that we now call space weather? Space weather came into popular use in the 1990s, but its origin is somewhat murky with no satisfactory attribution. It is therefore useful to explore its origin and the heritage of similar terminology. Kane [2006] reviewed some aspects of this question and attributed the term space weather to Thomas Gold in 1959. However, this attribution was made due to Gold’s discussion of how studying interplanetary gas is “the counterpart to meteorology on the Earth” [Gold, 1959], so while Gold did not actually use the term space weather he did discuss similarities between space environmental phenomena and terrestrial meteorology. We will show that this type of analogy, in fact, extends back much further to a full century before Thomas Gold. We will explore terminology very similar to space weather that can be traced back to the midnineteenth century and then present the earliest known usages of the exact term space weather from the 1950s.

What we now know as the field of space weather began as a collection of studies on seemingly unrelated phenomena—solar activity, the aurora, and magnetic disturbances. As these phenomena gradually became linked [see Cade, 2013], the bigger picture came into focus as a massive system of connected physical processes that manifested themselves as a myriad of disturbances in the Earth’s environment. As this system began to be studied more and more, new terminology came into use to try and describe the characteristics of this system.

The astronomer John Herschel, the son of William Herschel (the discoverer of infrared radiation and the planet Uranus), appears to be the earliest to use terms similar to space weather. Writing in 1847 of his observations of sunspots, he uses “solar meteorology” and makes an analogy to terrestrial meteorology [Herschel, 1847]. This term (and similar ones such as solar weather, “weather on the Sun,” etc.) is subsequently seen to be used throughout the late nineteenth century in discussions of sunspots, solar activity, and the conditions of the Sun’s atmosphere [e.g., Mackay, 1860; Youmans, 1872; Langley, 1878; Lockyer, 1881; Tacchini, 1884]. One notable example is from the solar physicist Norman Lockyer (a pioneer in the study of solar prominences who named the chromosphere) who writes “we know that we are dealing with the exterior portion of the solar atmosphere, and a large knowledge of solar meteorology is already acquired, which shows us the whole mechanism of these prominences” [Lockyer, 1871]. Similar references to solar meteorology continue throughout the twentieth century [e.g., Lockyer, 1905; Huntington, 1917; Duffield, 1920; Dingle, 1935; Ward, 1937; *New York Times*, 1960; *Time*, 1963; *New York Times*, 1966; *Boston Globe*, 1968], including in this statement in *Topics* by the U.S. Weather Bureau (the predecessor of the National Weather Service): “The Central Radio Propagation Laboratory has several programs of interest to the Weather Bureau, including clear air turbulence, infrared, and solar weather” [Weather Bureau, 1964a].

At almost the same time solar meteorology appears, the term “magnetic weather” emerges. We believe Geologist John Phillips first uses the term in an 1850 report to the British Association for the Advancement of Science [Phillips, 1851]. Professor Phillips, in measuring the local magnetic field around Yorkshire, mentioned the need for “magnetic weather not unfavourable.” For the next hundred years, magnetic weather continues to appear. Balfour Stewart uses this term in 1879 in reference to variations in magnetic inclination [Stewart and Dodgson, 1879]. Later, he describes the as-yet-unknown physical phenomenon responsible for magnetic disturbances by writing in 1880: “I have shown by preliminary discussions the probability of a progress of magnetic phenomena from west to east just as we know

there is a progress of meteorological phenomena, only magnetic weather (if I may use the expression) appears to travel faster than meteorological weather" [Stewart, 1880]. In 1882, Stewart published an article titled "On a similarity between magnetical and meteorological weather" in which he discusses the similarity of the two phenomena in detail and even speculates on a possible connection [Stewart, 1882]. The 1884 edition of the *Encyclopedia Britannica* includes "terrestrial magnetism" as a subsection under the entry for "meteorology," where the term magnetic weather appears numerous times [Encyclopedia Britannica, 1884]. In the 1890s there are at least three mentions of magnetic weather: in a magnetic survey lecture by Arthur Rücker [Rücker and Thorpe, 1890], in Rücker's address to the British Association [Rücker, 1894], and in an 1894 magnetic storm report appearing in the *American Meteorological Journal* [Ward, 1894]. By the midtwentieth century, magnetic weather is part of the vernacular and is found in several newspaper and magazine stories [New York Times, 1951, 1955; Brooks, 1959]. Leading up to the International Geophysical Year (IGY) (1957–1958), a similar term "electrical weather" also becomes popular. This term refers to the dynamics of the ionosphere and resulting magnetic disturbances [Ewing, 1955] and is a term Sydney Chapman uses in his book summarizing the IGY [Chapman, 1959].

Although solar meteorology and magnetic weather were originally considered unrelated, two discoveries in the mid-1800s encouraged new thinking about the Earth's relationship with the Sun. The first was the linking of the sunspot cycle to magnetic disturbances in 1852 [Sabine, 1852]; and the second was the Carrington event in 1859. Two separate disciplines—solar physics and terrestrial magnetism—were merging, and new jargon began to arise as a result. Perhaps, the most interesting terminology, and what could be considered a direct ancestor of space weather, came from the Italian astronomer Giovanni Battista Donati, who originated the term "cosmic meteorology" (or in his original Italian "meteorologia cosmica"). Writing about the great auroral display of February 1872 and the search for physical causes of the aurora, he notes.

Because those connections definitely can't be found in old meteorology, it is necessary to investigate them in a new meteorology, which I would call Cosmic Meteorology. Phenomena like sunspots and all the other phenomena that occur on the solar globe are in fact out of the domain of old meteorology, and if the aurora borealis has a connection with those phenomena happening on the Sun, we are led to say that they depend not only on meteorological sources, but also on cosmic sources. [Donati, 1872, p. 30, translated by Ilaria Superti].

Donati goes on to discuss the possibility of electromagnetic currents between the Sun and the Earth as a possible mechanism for solar influence on the aurora. He not only introduces a term very similar to space weather but also discusses physical processes that today are considered a part of the science of space weather. Unfortunately, Donati died a year later and so was unable to further explore and popularize this new science of cosmic meteorology. Cosmic meteorology came into the English language largely through the writing of the French astronomer Hervé Faye, who wrote about "meteorologie cosmique" in 1874. However, the context of his usage was somewhat different: he argued for the influence of the Sun, Moon, planets, and stars on Earth's terrestrial meteorology [Faye, 1874]. Unfortunately, as cosmic meteorology gained a foothold in English, it took on this meaning of cosmic influences (other than the Sun's heat) on atmospheric weather [e.g., Broun, 1878; Bigelow, 1902, 1905] and never gained a footing because these ideas were not taken seriously [e.g., Abbe, 1906]. As a result, usage quickly died out in the early 1900s.

Interestingly, Lyman Spitzer introduces a phrase similar to cosmic meteorology in 1956 when he uses the term "interstellar meteorology" [Spitzer, 1956]. However, Spitzer's use of this term refers to interstellar medium rather than solar-terrestrial interaction, so the phenomena that he described would not fall under the auspices of today's space weather. However, as we show below, Spitzer's term is still important in the introduction of the term space weather.

So what about the actual term space weather? There are several instances of the term being used in the 1950s with each instance having a slightly different meaning. We believe the distinction of the first appearance goes to Fred Hague, a junior high school teacher, in an article written for the *Journal of Geography* in 1953. In "Motivation Via Video," Hague writes about using a scenario of aliens visiting the Earth as a way of learning geography [Hague, 1953]. In discussing questions the aliens might ask, he writes "would the climate be suitable for us since we are used to outer space weather?" This is unlikely to

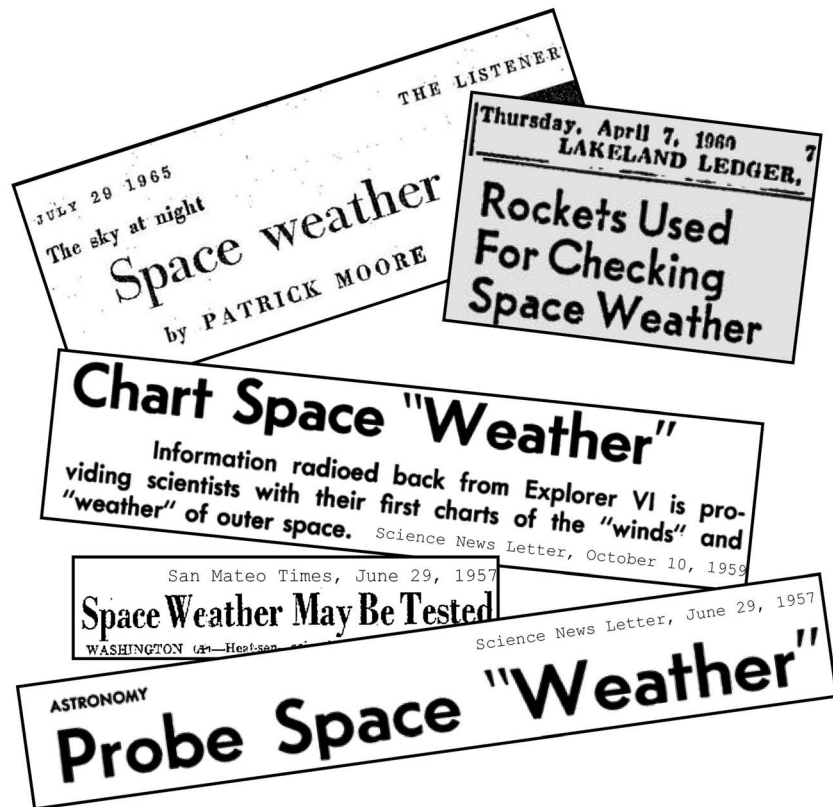


Figure 1. Article headlines from the 1950s and 1960s that use space weather.

have been widely read by the space science community, so it is doubtful that this is the source of space weather as we know it today.

In a more scientific context, our search shows space weather as first appearing in a *Science News Letter* article referring to astronomer Lyman Spitzer's studies of the interstellar medium and seems to be a paraphrasing of Spitzer's interstellar meteorology mentioned above (Figure 1) [*Society for Science and the Public*, 1957]. The next time space weather occurs in *Science News Letter* it has a slightly different context of solar-terrestrial relations. The 1959 article "Chart Space 'Weather'" discusses Explorer VI's measurements of the radiation belts (Figure 1) [*Society for Science and the Public*, 1959]. The third appearance in *Science News Letter* came in 1964 as a reference to "a team of scientists who are trying to set up a space weather bureau which could give astronauts advance notice of solar storms" [Wingo, 1964].

During the 1960s, space weather becomes more and more popular in both technical and mainstream venues (we do not include here the use of "space weather station" that appear in numerous newspaper reports in the 1960s as these invariably refer to the use of satellites for meteorological purposes). The U.S. Weather Bureau's *Topics* documents a 1964 address by Robert White, Chief of the U.S. Weather Bureau, to a joint American Meteorological Society-American Geophysical Union meeting where he discusses "the Weather Bureau and the Central Radio Propagation Laboratory are establishing a joint group at Boulder, Colorado, to work on the problems of space weather forecasting" [Weather Bureau, 1964b]. This group is a reference to the Space Disturbance Forecast Center, the forerunner of the Space Weather Prediction Center. Space weather also appears in a technical report of the newly created Environmental Science Services Administration (the forerunner to NOAA) in 1967 [Georges, 1967]. In popular media, an Associated Press article describes how rockets are used to check space weather [Lakeland Ledger, 1960]. In addition, the BBC television program *The Sky At Night* by Sir Patrick Moore featured a story on *Space Weather* on 25 June 1965 [Moore, 1965]. In the transcript of Moore's interview with astronomer Ken Fea, Fea states "the rather catchy phrase 'space weather' was coined I think by an American scientist. We used to call the same topic 'solar-terrestrial relations' prior to

Table 1. Summary of the First Uses of Various Terms Related to Space Weather

Year	Term	Usage	Originator
1847	Solar meteorology	Sunspots and the conditions of the Sun's atmosphere	John Herschel, <i>Herschel</i> [1847]
1850	Magnetic weather	Disturbances in the Earth's magnetic field	John Phillips, <i>Phillips</i> [1851]
1872	Cosmic meteorology	Solar-terrestrial interaction	Giovanni Donati, <i>Donati</i> [1872]
1953	Outer space weather	Fictional aliens, studying the Earth, might ask "would the climate be suitable for us since we are used to outer space weather?"	Fred Hague, <i>Hague</i> [1953]
1955	Electrical weather	Dynamics of the ionosphere and resulting magnetic disturbances	Ann Ewing, <i>Ewing</i> [1955]
1956	Interstellar meteorology	Motions and transformations of interstellar clouds	Lyman Spitzer, <i>Spitzer</i> [1956]
1957	Space "weather"	"The weather of interstellar space, the motions and composition of the vast clouds of matter in the void between stars"	Science News Letter, <i>Society for Science and the Public</i> [1957]
1959	Space weather	Refers to measurements of the radiation belts by Explorer VI	Science News Letter, <i>Society for Science and the Public</i> [1959]
1964	Space weather	Scientists are "trying to set up a space weather bureau which could give astronauts advance notice of solar storms."	Walter Wingo (editor, Science News Letter), <i>Wingo</i> [1964]
1968	Space weather (first appearance in peer-reviewed literature)	Space weather forecasting as a part of the new Environmental Science Services Administration	Walter Hahn, <i>Hahn</i> [1968]

the space era" [Cave, 1965]. By the latter half of the 1960s, space weather was in wide use [e.g., Hahn, 1968; *The Bulletin*, 1968; *The News and Courier*, 1968].

So who gets credit for originating space weather? There is no easy answer as both the terminology and the scientific field have evolved since the mid-1800s (see the summary of terminology in Table 1 and Figure 2). "Solar weather" and magnetic weather are similar terms that refer to studies that eventually merged into the discipline of space weather. Giovanni Donati was the first to assign a name to this science we now call space weather using cosmic meteorology. But credit for the exact term might belong to a science writer and not a researcher as the publication *Science News Letter*, which had the role of communicating science to the general public, appears to have played an important role in popularizing and possibly originating the term space weather. It seems likely that Lyman Spitzer's interstellar meteorology was the inspiration for someone writing for the *Science News Letter* to come up with the more public-friendly version space weather, but who was it? According to Walter Wingo, a former news editor for the Science Service who published *Science News Letter*, "My best guess is that the originator of 'space weather' was the late Watson Davis. He was the long-time director of Science Service and devoted his life to popularizing science. Watson often came up with handy terms and phrases that his writers picked up" (personal communication, 2014). This certainly makes sense as Watson was the editor of *Science News Letter* in 1957. We may never know for sure who is responsible but had it not been for Giovanni Donati's untimely death, we might well be reading an issue of *Cosmic Meteorology* instead of *Space Weather*.

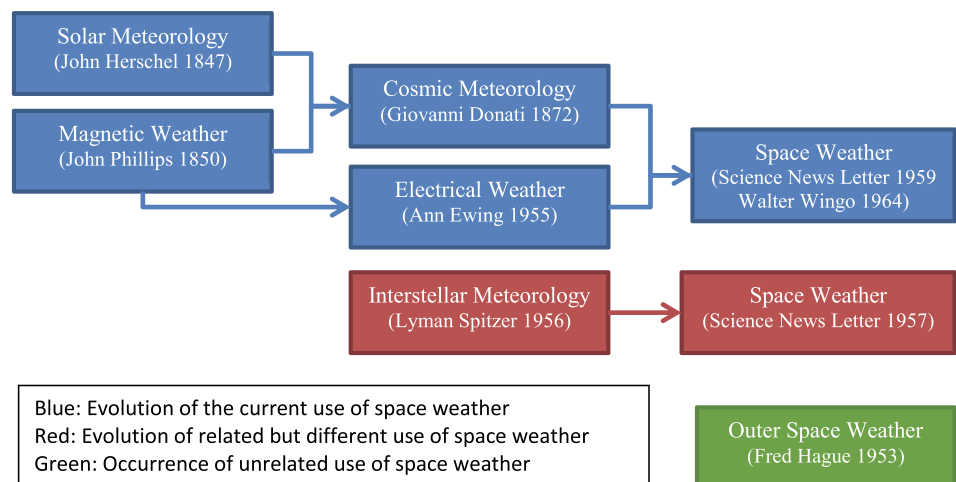


Figure 2. The space weather "Family Tree" (see Table 1 for details).

References

- Abbe, C. (1906), Pressure and rainfall over the Indian monsoon area, *Mon. Weather Rev.*, **34**, 161.
- Bigelow, F. W. (1902), A contribution to cosmic meteorology, *Mon. Weather Rev.*, **30**, 347.
- Bigelow, F. W. (1905), Studies on the diurnal periods in the lower strata of the atmosphere, *Mon. Weather Rev.*, **33**, 188.
- Boston Globe (1968), Experts forecast 'solar weather', Boston, 6 Nov.
- Brooks, J. (1959), The subtle storm, *The New Yorker*, **39**, 7 Feb.
- Broun, J. A. (1878), Cosmic meteorology, *Nature*, **18**, 126.
- Cade, W. B., III (2013), The first space weather prediction, *Space Weather*, **11**, 330–332, doi:10.1002/swe.20062.
- Cave, J. (1965), Space weather, *The Sky at Night*, BBC-1, London.
- Chapman, S. (1959), *IGY: Year of Discovery*, Univ. of Michigan Press, Ann Arbor.
- Dingle, H. (1935), Modern spectroscopy: Lecture III: Applications of spectroscopy, *J. R. Soc. Arts*, **83**, 283.
- Donati, G. B. (1872), I fenomeni luminosi della grande aurora polare, in *Memorie del R. Osservatorio di Firenze ad Arcetri*, vol. 1, pp. 30, Le Monnier, Florence.
- Duffield, W. G. (1920), Relativity and the displacement of Fraunhofer lines, *Nature*, **104**, 659.
- Encyclopedia Britannica (1884), *Terrestrial Magnetism*, 9th ed., vol. 14, J.M. Stoddard Co., Philadelphia, Pa.
- Ewing, A. (1955), International look at Earth, *Sci. News Lett.*, **67**, 42.
- Faye, H. (1874), La constitution physique du soleil, in *Annuaire pour l'an 1874*, pp. 407–490, Bureau des Longitudes, Paris.
- Georges, T. M. (1967), Ionospheric effects of atmospheric waves, *ESSA Tech. Rep. IER 57-ITSA 54*, ESSA, Boulder, Colo.
- Gold, T. (1959), Plasma and magnetic fields in the solar system, *J. Geophys. Res.*, **64**, 1665–1674, doi:10.1029/JZ064i011p01665.
- Hague, F. (1953), Motivation via video, *J. Geogr.*, **52**, 377.
- Hahn, W. A. (1968), Providing environmental science services, *Publ. Adm. Rev.*, **28**, 326.
- Herschel, J. F. W. (1847), *Results of Astronomical Observations Made During the Years 1834, 5, 6, 7, 8, at the Cape of Good Hope*, Smith, Elder, and Co., London.
- Huntington, E. (1917), The geographical work of Dr. M. A. Veeder, *Geogr. Rev.*, **3**, 188.
- Kane, R. P. (2006), The idea of space weather, *Adv. Space Res.*, **37**, 1261.
- Langley, S. P. (1878), The Sun, *Sci. Am.*, **39**, 80.
- Lakeland Ledger (1960), Rockets used for checking space weather, Lakeland (Florida), 7 Apr.
- Lockyer, J. N. (1871), On the recent solar eclipse, *Nature*, **4**, 248.
- Lockyer, J. N. (1881), Solar physics—The chemistry of the Sun, *Nature*, **24**, 296.
- Lockyer, W. J. N. (1905), Our Sun and "weather", *Sci. Am. Suppl.*, **1531**, 24,537.
- Mackay, C. (1860), The spots on the Sun, *London Rev.*, **1**, 107.
- Moore, P. (1965), Space weather, *Listener*, **74**, 159.
- New York Times (1951), Direct relationship between Earth's magnetic storms and planet positions discovered, New York, 15 Apr.
- New York Times (1955), Sun spots or the planets?, New York, 14 Mar.
- New York Times (1960), Sun storm puts echo off course, New York, 23 Dec.
- New York Times (1966), Pioneer studies solar weather, New York, 18 Aug.
- Phillips, J. (1851), On isoclinical magnetic lines in Yorkshire, in *Report of the Twentieth Meeting of the British Association for the Advancement of Science, Vol. II Notices and Abstracts of Communications to the British Association for the Advancement of Science*, p. 14, John Murray, London.
- Rücker, A. W. (1894), Opening address, *Nature*, **50**, 343.
- Rücker, A. W., and T. E. Thorpe (1890), A magnetic survey of the British Isles for the epoch January 1, 1886, *Philos. Trans. R. Soc. London, Ser. A*, **181**, 53.
- Sabine, E. (1852), On periodical laws discoverable in the mean effects of the larger magnetic disturbances—No. II, *Philos. Trans. R. Soc. London*, **142**, 103–124, doi:10.1098/rstl.1852.0009.
- Society for Science and the Public (1957), Probe space "weather", *Sci. News Lett.*, **71**, 403.
- Society for Science and the Public (1959), Chart space "weather", *Sci. News Lett.*, **76**, 229.
- Spitzer, L. (1956), Interstellar matter, in *New Horizons in Astronomy, Smithsonian. Contrib. Astrophys.*, vol. 1, edited by F. L. Whipple, pp. 139–140, Smithsonian Institution, Washington, D. C.
- Stewart, B. (1880), On some points connected with terrestrial magnetism, *Nature*, **22**, 202.
- Stewart, B. (1882), On a similarity between magnetical and meteorological weather, *Nature*, **26**, 488.
- Stewart, B., and W. Dodgson (1879), Preliminary report to the Committee on Solar Physics on the evidence in favour of the existence of certain short periods common to solar and terrestrial phenomena, *Proc. R. Soc. London*, **29**, 303–324.
- Tacchini, P. (1884), *Meteorologia Solare*, Tipografia Metastasio, Rome.
- The Bulletin (1968), US fires spacecraft towards Sun, Bend (Oregon), 8 Nov.
- The News and Courier (1968), NASA clears delta rocket for two-satellite shot, Charleston (South Carolina), Nov. 8, 1968.
- Time (1963), The space condition forecasters, **82**(5), 50.
- Ward, R. D. (1894), The magnetic storm of Feb. 20 to March 1, 1894, *Am. Meteorol. J.*, **11**, 18.
- Ward, H. B. (1937), The Atlantic City meeting of the American Association for the Advancement of Science and associated societies, *Science*, **85**, 129.
- Weather Bureau (1964a), Briefs from the CO staff conferences, *Weather Bur. Top.*, **23**, 4.
- Weather Bureau (1964b), Dr. White addresses Joint AMS-AGU Meeting on 'organization of environmental sciences', *Weather Bur. Top.*, **23**, 95.
- Wingo, W. (1964), Flares menace astronauts, *Sci. News Lett.*, **85**, 99.
- Youmans, E. L. (1872), The spots on the Sun, *Pop. Sci. Mon.*, **1**, 144.

Trey Cade is the Director of the Institute for Air Science and an Assistant Research Professor in the Center for Astrophysics, Space Physics, and Engineering Research (CASPER); both are located at Baylor University, Waco, Texas. Email: William_Cade@baylor.edu.

Christina Chan-Park is a geophysicist and the Science Librarian at Baylor University, Waco, Texas.