# Flares, Fears, and Forecasts: Public Misconceptions About the Sunspot Cycle

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**Abstract** Among the disaster scenarios perpetrated by 2012 apocalypse aficionados is the destruction of humankind due to solar flares and coronal mass ejections (CMEs). These scenarios reflect common misconceptions regarding the solar cycle. This paper (based on an annual meeting poster) sheds light on those misconceptions and how the AAVSO Solar Section can address them.

## 1. Introduction

Despite the fact that the current 2012 end-of-the-world hysteria is usually (and correctly) disparaged for needlessly scaring members of the general public, the silver lining is that it offers a unique opportunity for educators and scientists to peer into the minds of the same science-phobic public. What is discovered is a plethora of misconceptions about science in general, and astronomy in particular. One of the most commonly touted apocalypse scenarios centers around the sunspot cycle; therefore a careful survey of the claims put forth by proponents of this "sun fries the earth" cataclysm affords solar observers and educators the opportunity to learn about what the public does and does not know about the sun and its cycles, and then attempt to turn those fears and misconceptions into a more healthy interest in and respect for our nearest star and its variability. This paper surveys some of the common misconceptions the public has concerning solar activity and offers suggestions as to how the AAVSO in general and the AAVSO Solar Section in particular could aid in the education of the general public in these matters.

## 2. Misconceptions, pseudoscience, and scientific illiteracy

Numerous studies have shown that the scientific literacy of the American public has stagnated at about 60% in recent decades—a grade of D-minus (National Science Board 2010). It is not merely a lack of knowledge that educators and scientific organizations have to worry about, however, but rather the prevalence of misconceptions about scientific concepts. These erroneous ideas are often deeply ingrained in a person's personal view of the world around them, and can be difficult to dislodge (Mestre 1991). Adding

to this is the general inability of many Americans to distinguish science from pseudoscience (explaining the tenacity of astrology in modern culture, for example) (Shermer 1997). Finally, the general public misinterprets the healthy professional debate that takes place between scientists (as they continue to investigate natural phenomena and the causal connections between them) as a sign of weakness: if science isn't absolutely certain, then any other suggested answer may be considered to be just as valid. The result is a general public that is easily swayed by purveyors of pseudoscience and conspiracies, especially in the age of the Internet. Without the ability or willingness to consider claims made by nonscientists with skepticism, the general public has fallen prey to a series of increasingly alarmist claims about the upcoming solar maximum, often perpetrated by adherents of the so-called 2012 apocalypse hoax—the claim that the end of the world (or at least the end of human civilization) will occur on December 21, 2012.

**3. Misconceptions about the sunspot cycle**

According to a lengthy list of astronomical misconceptions collected by University of Maine astronomy professor Neil Comins, the following are some of the misconceptions concerning the solar cycle:

- sunspots are regions of soot on the sun;
- sunspots occur on an Earth-based cycle;
- sunspots are places on the sun that have run out of fuel to burn;
- sunspots are hotter places on the sun;
- sunspots are permanent;
- sunspots are where meteors crashed (or are craters);
- sunspots are optical illusions due to staring at the sun;
- the sun does not rotate;
- the sun does not have a magnetic field;
- sunspots are volcanic in nature. (Comins, undated)

These misconceptions (and others) are addressed by Dooling and Kneale (1997), O'Neill (2008), International Solar Terrestrial Physics (ISTP) (Anon. 2012), and 2012Hoax (Anon. 2010). A related misconception that crops up in discussions of the 2012 apocalypse hoax is a belief that solar activity can affect volcanic activity on earth. For example, it appears in a thread of comments on the 2012Hoax webpage devoted to debunking a viral email/blog entitled "Seven Reasons Why the World Will End in 2012—Proven Scientifically." An example is an October 24, 2011, post by Cern: "What is this I hear about a

super-volcano forming in Bolivia? ...seems to coincide with the giant sun spots lately…. As the activity increases so will this volcanoes [sic]?" (Anon. 2009).

The existence of these misconceptions suggests that some among the general public lack basic knowledge concerning sunspots and their cycle. The result is that while members of the public may have heard of sunspots, they know little about them. Thus, when an item comes up in the press about sunspots, they may listen (after all, they know that sunspots must be somehow important because they have at least heard of them), but do they really hear what is being said? Unfortunately, the press capitalizes on the situation with sensational titles, such as:

- "Space Weather: Worse Than Hurricane Katrina" (New Scientist);
- "Huge Solar Flares Could Spell Catastrophe for Earth" (Forbes);
- "Sun unleashes huge solar flare towards Earth" (BBC).

The reader who ventures no further than the title will certainly be left with serious misconceptions. However, even those who read the entire article may leave with little more than a lingering impression from the title. Hence this author encourages science journalists and scientific agencies to think long and hard as they craft press releases and articles on the solar cycle that will be seen by the general public. The point is not that the information is being released, but rather how it is released. For example, Somerville and Hassol (2011) note that "Scientists typically fail to craft simple, clear messages and repeat them often…. We encourage them to speak in plain language and choose their words with care." They also offer that "By failing to anticipate common misunderstandings, scientists can inadvertently reinforce them." Their article also includes a useful chart that shows the differences between scientific terms and the way the public interprets them.

**4. Misuse of scientific information: 2012**

Like other scientific discoveries, those surrounding the sun have been used by groups and individuals to foster their own agendas. For example, earnest scientific studies as to the impact of solar activity on Earth's climate have routinely been used by global warming deniers to attempt to exonerate humanity from responsibility for changes in the environment. However, pseudoscience and conspiracy theory proponents have gone even further, using science in service to their desire to scare the general public into buying their survival guides or subscribing to their for-profit websites. The most important recent example is, of course, the 2012 apocalypse hoax.

For those few fortunate astronomers who have not yet come face to face with this rampant pseudoscience, in a nutshell (pun intended) the idea is that the Maya calendar (and/or Nostradamus, the Bible Code, etc.) predicts that the world will end on December 21, 2012, by asteroid impact, creation of an earth-

sucking black hole by the Large Hadron Collider, alignment with the black hole at the center of the Milky Way, flipping of Earth's poles (magnetic or otherwise), solar flares, or other catastrophe. The viral email/blog message "Seven Reasons Why the World Will End in 2012—Proven Scientifically" summarizes much of this hysteria, with the following in particular said about the sun:

> Solar experts from around the world monitoring the sun have made a startling discovery: our sun is in a bit of strife. The energy output of the sun is, like most things in nature, cyclic, and it's supposed to be in the middle of a period of relative stability. However, recent solar storms have been bombarding the Earth with so much radiation energy, it's been knocking out power grids and destroying satellites. This activity is predicted to get worse, and calculations suggest it'll reach its deadly peak sometime in 2012. (Anon. 2008)

A probable source of this exaggeration is a 2006 study by the National Center for Atmospheric Research (NCAR 2006) that suggested that the next solar maximum would be "30–50% stronger than the last one" and posited a peak in 2012.

A number of 2012 apocalypse proponents have twisted this prediction into a certain prophecy of doom, declaring that the largest solar flare on record will fry Earth (along with the electric grids and satellites). This is why NASA and other organizations should be mindful of the wording of their statements when releasing scientific data on the interactions between the sun's magnetic phenomena and terrestrial systems—the pseudoscientists are lurking in the shadows, ready to say "See! We told you!" As the Social Issues Research Centre/Amsterdam School of Communication Research (SIRC/ASCOR 2006) report on communicating science to the general public warns, "While there are numerous examples of how the media have 'hyped' science stories…there are equal examples of where scientists have communicated, say, data relating to risks in such a manner that public misunderstandings have been almost inevitable." As is commonly the case with pseudosciences, subsequent evidence provided by scientists attempting to clarify or update the situation is either ignored, or declared part of a conspiracy to withhold the truth from the general public. Thus subsequent announcements from various scientists about updated predictions for the peak of Cycle 24 (now to occur in 2013, after the world will have presumably ended) have largely gone ignored in the 2012 hoax community.

## 5. What the general public is reading and saying

One can rightly ask just how widespread these misconceptions and misrepresentations of the solar cycle are on the Internet. The answer is that they are far too prevalent. For example, Mitch Battros, an acupuncturist and trauma resolution therapist, asserts in the books *Solar Rain* and *Cosmic Rain* (and their

promotional websites) that the following original "equation" explains what we will expect to see in 2012:

> Sunspots → Solar Flares → Magnetic Field Shift → Shifting Ocean and Jet Stream Currents → Extreme Weather and Human Disruption (Battros, undated)

In his mind, since extreme weather is presumed to be caused by sunspots, the coming apocalypse will center around sunspots triggering weather catastrophes on Earth.

Michael E. Sallas, Ph.D. (who neglects to inform readers of his website that his degree is in Government Studies, not Astronomy) claims on his "Zero Sunspots, Global Consciousness, Solar Activity and 2012" website that not only is Battros's "theory" correct, but that he can use the model to explain the unusually low sunspot counts seen until recently as "due to changes in global consciousness brought about by the harmonizing of human interests and activities through the internet" (Sallas 2008). Thus, he reasons, Cycle 24 will be "unremarkable" as "changes in global consciousness produce greater planetary cooperation and harmony" over the next few years. If this is true, then why is self-described "student of consciousness and libertarian decentralist pacifist activist, writer, songwriter, and video producer" Carol Moore (2011) claiming on her website "Sunspot Cycles and Activist Strategy" that the upcoming cycle maximum will coincide with "mass demonstrations, riots, revolutions and wars"? The answer, of course, is that none of this is scientific. However, with all involved using the same sunspot cycle charts from NASA and NOAA, and "equations" to bolster their cases, does the general public understand the difference? Unfortunately not. The following are a handful of posts from the "Seven Reasons" website posted at buburuza.net (typos original):

> "the sun is dieing as we know it and by the tie there is the storm it wont be big enough."
>
> "yes the sun is becoming closer…."
>
> "No, the world will end after 1 billion years because the hydrogen at the sun will disappear."
>
> "volcanoes are going to happen because of the sun storms."

Clearly more needs to be done to educate the general public concerning the sunspot cycle, solar activity, and its influence on Earth. This certainly falls within the purview of the AAVSO's Mission Statement.

## 6. Conclusion

Various authors have sounded the call to action for a number of communities to come forward and aid in the debunking of the 2012 hoax, including AAS

members (Manning 2009), ASP members (Morrison 2009), amateur astronomers (Larsen 2010a, 2010b), geologists (Larsen 2010c), science teachers (Larsen 2010d), planetarium professionals (Larsen 2010e), and the AAVSO in general (Larsen 2009). Astrobiologist David Morrison has been an eloquent leader in the effort to debunk the 2012 apocalypse hoax, as have archaeoastronomer E. C. Krupp (2009), solar physicist Ian O'Neill (2008), and amateur astronomer Bill Hudson and his army of volunteers at the 2012Hoax website (Anon. 2009, 2010). In this spirit, this author makes the following claim: the AAVSO's Solar Section has a unique opportunity to join in the stamping out of misconceptions surrounding solar activity, and at the same time possibly generating interest in solar observing. Some of those who are interested in solar activity (and think that scientists are "hiding" information) may be motivated to take part in safe solar observing; thus effort should be taken to educate these individuals on solar activity and how they could gather more data for the AAVSO Solar Section. An encouraging development in this vein can be seen on the comments section to the 2012Hoax webpage on solar flares, where posters have discussed following the current solar cycle on the www.spaceweather.com website. For example, in a March 5, 2011, post, DieselHorseLAW admits, "I have become somewhat addicted to www.spaceweather.com and I notice the day to day sun spot number fluctuates a lot." Elsgeorge answers the following day: "So have I, I even downloaded their 3D Sun app" (2012Hoax, Anon. 2010).

On the down side, others may decide to take matters into their own hands and unsafely observe the sun. Well-meaning individuals can also convey erroneous information, opening up the possibility of unsafe observing. For example, a reply by obaeyens to DieselHorseLAW dated March 6, 2011, correctly advises that a pinhole projector could be safely used to see sunspots, as well as using binoculars to project an image. The author also correctly warns the readers to never look at the sun directly using a telescope or binoculars. However, the author incorrectly adds, "You can also look at the sunspots when the sun is about to go below the horizon for a short time." Therefore it is recommended that the AAVSO Solar Section capitalize on the current interest in the solar cycle and provide a valuable public service by both publicizing the need for new solar observers AND stressing the proper methods of solar observing. Having public demonstrations of the use of sunspotters and simple projection methods would serve dual purposes. It is also recommended that the AAVSO Solar Division be a model of best practices in terms of communicating with the general public, both through its website and bulletin, and as individual members discuss their solar observing (and its importance) with the general public. Campbell (2008) warns that "We may believe that data speaks for itself, but data is also subject to interpretations, including by laypersons, that are completely valid though not in line with the conclusions of scientists." Collecting sunspot data for the scientific community is an important function of the AAVSO Solar Division. Explaining to the general public how we collect these data, what value the data

have, and what is and is not predicable about the solar cycle despite the amount of data collected should also be central to the Solar Division's mission.

David Morrison (2009) has often noted that one of the "worst long-term consequences of the 2012 doomsday hoax" could be what he terms "cosmophobia," a fear of "astronomy and the universe." This can be seen in a January 4, 2001, post by Andrew Maxwell to the buburuza.net "Seven Reasons Why the World Will End in 2012—Proven Scientifically" webpage: "i'm terrified of the sun." Rather than merely trying to get rid of the lemons of misconceptions, solar observers can use the interest in solar activity spawned by purveyors of the 2012 apocalypse hoax to create lemonade, in the form of new solar observers (and interest in solar observing in general). As Manning (2009) notes, "This is a teachable moment. So let us teach." Let's change fear to awe, respect, and knowledge, one prospective solar observer at a time.

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