

Science Communication Efforts in Space Weather: Benefits and Challenges of the “Weather” Analogy



**Cherilynn Morrow
James Harold
Paul Dusenbery**

**Space Science Institute
www.space-science.org**

**AMS Space Weather
Symposium
San Diego, CA
11 January 2005**

Space Science Institute (SSI) Boulder, Colorado



SSI's Space Weather Outreach Program (SWOP)

- ★ SWOP is a multi-faceted education & public outreach program that has thus far included:
 - ★ development & evaluation of a space weather traveling exhibit
 - ★ public talks and teacher workshops at exhibit host sites
 - ★ development & preliminary testing of a Family Guide to the Sun
 - ★ creation of an innovative, interactive public website:
www.spaceweathercenter.org
- ★ SWOP has been jointly supported by research divisions of both NSF and NASA. NSF is now renewing its support for further development and translation into Spanish.

The Space Weather Center



A 700 sq. ft. traveling exhibit developed in collaboration between the Space Science Institute of Boulder, CO and several Sun-Earth Connection missions based at NASA/GSFC.



SSI's Space Weather Center Website

NEW
SPACE WEATHER CENTER

AMAZING PLASMAS | LIVING WITH A STAR | **PROTECTIVE SHIELD** | STORM ALERT! | RESEARCH

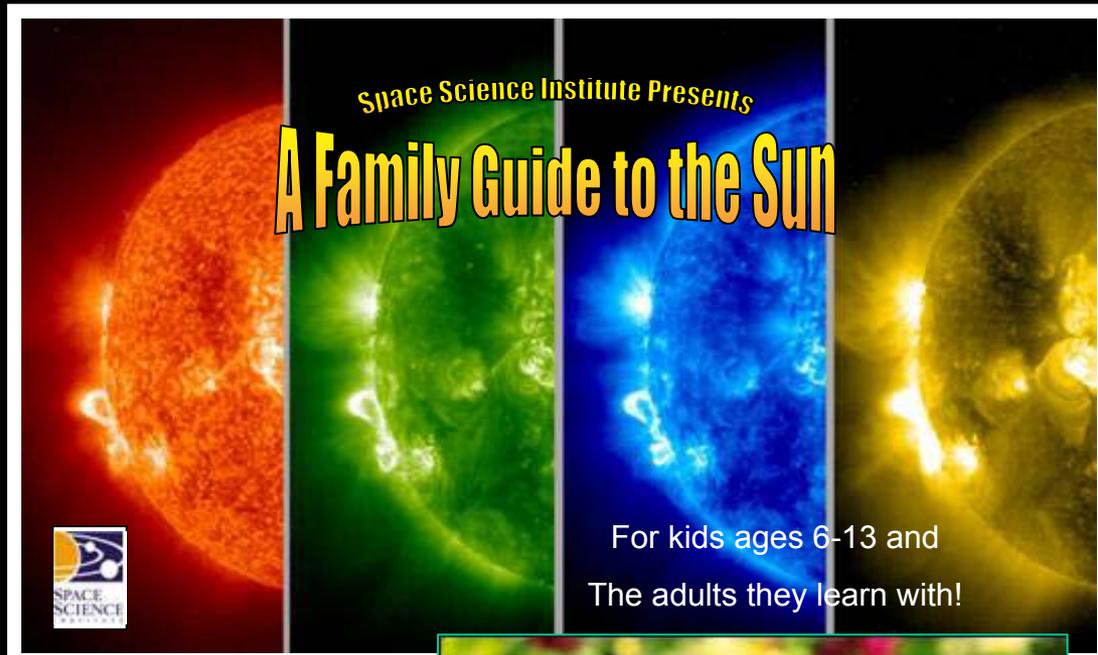
RESOURCES | GLOSSARY | ABOUT US

FOR THE OLD SPACE WEATHER SITE - [CLICK HERE!](#)

[Click here to find Magneto Golf Interactive at bottom of page](#)

Family Guide to the Sun

Field-test version available at www.space-science.org



✦ An educational product designed to stimulate curiosity and enjoyable co-learning experiences between children aged 6-12 and the parents or other adult facilitators of learning in informal or after-school settings.

✦ An innovative collection of puzzles, pictures, poetry, and projects intended to be of value where kids and adults are together and excited about finding out new things.

The Space Weather Center



A 700 sq. ft. traveling exhibit developed in collaboration between the Space Science Institute of Boulder, CO and several Sun-Earth Connection missions based at NASA/GSFC.

Excerpts from an Email on the Origins of the term "Space Weather"

From: **Burke William J** Civ AFRL/VSXP
Sent: Wednesday, December 15, 2004 1:14 PM
To: Ginet Gregory P Civ AFRL/VSBX
Subject: RE: Origin of the term "space weather"

Hi Greg,

As far as I know, I was the first to use the phrase "Space Weather" to describe what we (AFGL) do. Back, sometime in the mid-1980s, I was asked to give a talk at a meeting in Kyoto on M-I coupling....My assigned topic was "Why the Air Force Interested in Space Research". At the time spacecraft charging was a local hot item and we had been looking at the various circumstances in which it occurred...I pitched my talk around developing an ability to identify storms on-the-way and give AF operators some warning. This struck me as analogous to what meteorologists do, hence "space weather."

Two critical things then happened:

(1) **George Siscoe** was in the audience. The phrase really grabbed him. "This is what we really do!" Incidentally, during his graduate student years, George had been in the Meteorology Dept at MIT. It was not uncommon for meteorologists to take space and plasma physics courses in the 1960s. George is the one who really deserves credit for publicizing the phrase as a unifying concept for geospace research and sold it as such to George Withbroe and Ernie Hildner.

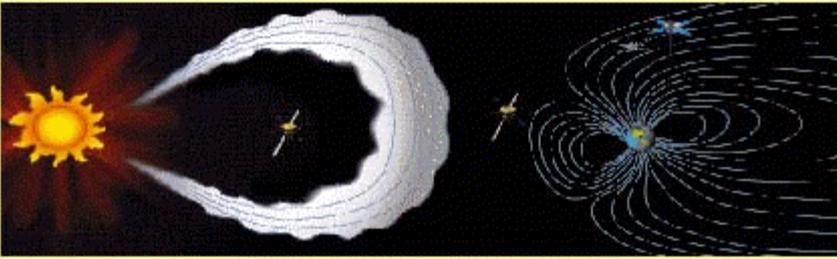
(2) **Air Force Weather Service** became interested in predicting the operational environments of various space systems...

Bill

NOTE: terms like magnetic storm and solar wind had already been in use

Evaluator Reports

- ★ *Space Weather Center Exhibit Evaluation* conducted at the Denver Museum of Nature & Science, prepared by Judy Koke, May 2000. [\[SWC Report\]](#)
- ★ *“Electric Space: The Sun-Earth Environment” – Visitor Responses to a Front-end Evaluation* conducted at the National Air & Space Museum, prepared by Randi Korn & Associates, March 1992. [\[ES Report\]](#)



Magnetic Cloud Event October 18-20, 1995

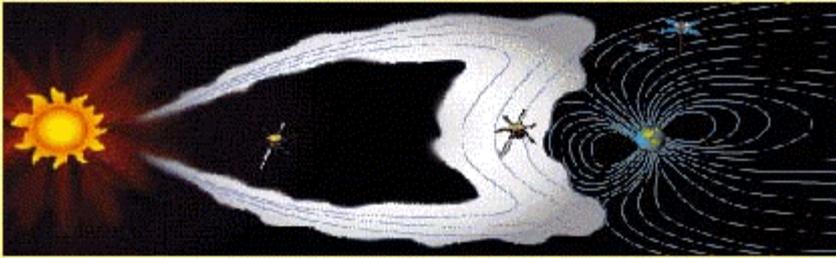


Figure courtesy of NASA Goddard Space Flight Center

ES Report:
Virtually no visitor could identify Earth
when shown images like these...



What We Know about Space Weather: Visitor Pre-Entry Survey for SWC Report

- ✦ A researcher stationed at the entrance to the exhibit solicited people to complete a survey before they entered the exhibit. Age ranged from 12-62 years, average of 31.
- ✦ As a part of the survey they were asked whether 10 terms were related to space weather, not related to space weather, or if they didn't know

Comments on Misconceptions

- ✦ Common pre-visit beliefs included that clouds, thunderstorms, and El Nino are related to space weather. Although the exhibit made some progress, many people interviewed by phone after their visit continued to believe that these phenomena are related.
- ✦ Once introduced, misconceptions are tenacious and difficult to dislodge without directly confronting them.
- ✦ 100% in the SWC Report replied that “solar wind” was related to space weather, but based on the ES report, their ideas of what “solar wind” means are suspect. “Solar wind” can also connote wind ON the Sun, or wind on Earth that is caused by the Sun.

Nature's "solar wind-sock"



To make matters worse:
The solar wind does NOT
propel a solar sail...alas.



Comments on Misconceptions

- ✦ Similarly, the term “solar storm” is used inconsistently in our communications and may introduce confusion: storm ON the Sun (like a flare or prominence), storm FROM the Sun (like a CME), storm ON EARTH caused by the Sun (like a magnetic substorm, or some also think of thunderstorms).
- ✦ We must take care when we use expressions like the “hurricanes of space weather”, “solar tornadoes”, “solar storms” to explain what is the same and what is different between space and terrestrial weather.
- ✦ Practitioner experience in workshops and informal conversations with non-specialists reveals that first thoughts of “Space weather” include ideas like:
 - ✦ Earth weather observed from space;
 - ✦ weather on Earth caused by the Sun;
 - ✦ space where weather occurs;
 - ✦ weather in space, perhaps with Earth-like ideas about weather

Comments on Misconceptions

- ✦ There is a natural tendency to define a new and unfamiliar term like “space weather” or “solar wind” by using components of the term that may be familiar in another context. So anything related to space and/or weather can be construed as being related to “space weather”.
- ✦ For example, in the SWC study a significant number of visitors answered that Andromeda Galaxy and Earth weather phenomena were each related to space weather. People had prior associations with these terms as either related to space or to weather on Earth.
- ✦ As another example, the ES Study reported visitor ideas about sunspots such as: “spots where the Sun hits the Earth” or “where the Sun hits you and burns you” or “areas of intense heat.”
- ✦ “Space Weather may be a topic about which explicit discussion of erroneous assumptions actually may help teach the major points. It might be effective to face misconceptions head on and explain that clouds and thunderstorms are not related to space weather (e.g. signage that says: Guess what is NOT related to Space Weather?)”

- Quote from the SWC Report

Conclusions

- ✦ Terms like “space weather”, “solar wind”, and “solar storm” naturally and intentionally generate associations to the more familiar terrestrial weather: these associations are both a help and a hindrance to effectively communicating a scientific understanding.
- ✦ We have evidence from research and evaluation associated with the activities of our Space Weather Outreach Program (SWOP) that in the minds of non-specialists, the association between terrestrial weather and space weather can conjure a variety of reasonable but wrong ideas (i.e. introduce misconceptions).
- ✦ Modern research on how people learn tells us that misconceptions rooted in everyday experience are very difficult to change and must be confronted directly to have a chance of resolving them.
- ✦ Use of the “weather” metaphor in communicating about “space weather” can be powerful, but only if the distinctions between terrestrial weather and space weather are addressed very directly.
- ✦ Scientists, educators, and journalists who care about effective science communication with the public should be guided by the results of basic educational research on misconceptions & how people learn.

Can You Feel a Solar Wind?



Visitor Pre-Entry Responses

SWC Report by Judy Koke

TERM	Related to Space Weather	Not related to Space Weather	Do not know
weather satellites (A)	13 (59%)	8 (36%)	1 (5%)
sunspots (B)	19 (86%)	2 (9%)	1 (5%)
Andromeda Galaxy	15 (34%)	10 (23%)	19 (43%)
Changing mag fields	37 (84%)	1 (2%)	6 (14%)
Aurora Borealis	19 (43%)	14 (32%)	11 (25%)
plasma	14 (32%)	15 (34%)	15 (34%)
coronal mass ejection	19 (43%)	8 (18%)	17 (39%)
power outages (A)	9 (43%)	7 (33%)	5 (24%)
clouds (B)	14 (64%)	5 (23%)	3 (14%)
El Nino	24 (54%)	15 (34%)	5 (11%)
thunderstorms	24 (54%)	14 (34%)	5 (11%)
sunspot cycle (A)	18 (82%)	1 (5%)	3 (14%)
solar wind (B)	22 (100%)	0	0

Name 2 Effects of Space Weather on or near Earth

Post-visit telephone interviews

- * Global temperature; the weather that we get.
- * Global heating.
- * Lightning; wind.
- * El Nino; thunderstorms (probably introduced by the survey itself)
- * Aurora Borealis; power interruptions or outages
- * Aurora Borealis; solar mass ejections harm astronauts
- * Aurora Borealis; satellite & electronic communications
- * Aurora Borealis: affects weather somehow, but can't remember how
- * Satellite disruption; communication disruption (cell phones)
- * Radio interference, satellite TV interference; auroras
- * Weather balloons, weather stations
- * Weather patterns like El Nino and El Nina; our magnetic fields
- * Aurora Borealis; power outages. Sun...moon controls the tide.
- * Sun – affects our weather; meteors