

Some General Thoughts Regarding Commercialization and Militarization of Space Weather

Views presented here are my own:
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 American Geophysical Union (AGU)'s (outgoing)
 Editor-in-Chief for *Space Weather*



Commercialization

- ❁ NOAA has a fantastic document about this:
 - ❖ Supply Chain Risks [susceptibility to disaster, multiple customers or NOAA only, multiple suppliers]
 - ❖ Contractual Considerations [Pricing] “*middle ground between affordability for the government and viability for the vendor*”
 - ❖ Data Use and Sharing Rights [in US and internationally]
 - ❖ Data Quality
 - ❖ Data Management and Delivery

See: https://nosc-prod.woc.noaa.gov/public_docs/Guidance_for_NOAA_Commercial_Data_Buys-v1-final.pdf



U.S. Department of Commerce (DOC)



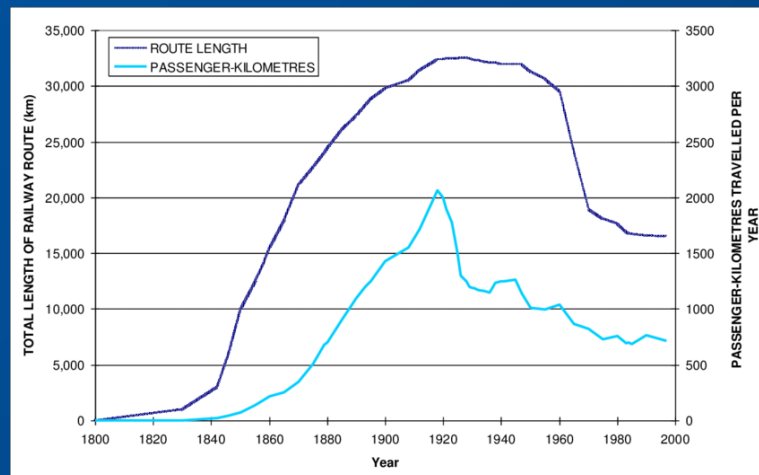
National Oceanic and Atmospheric Administration

**Guidance for NOAA
Commercial Data Buys**

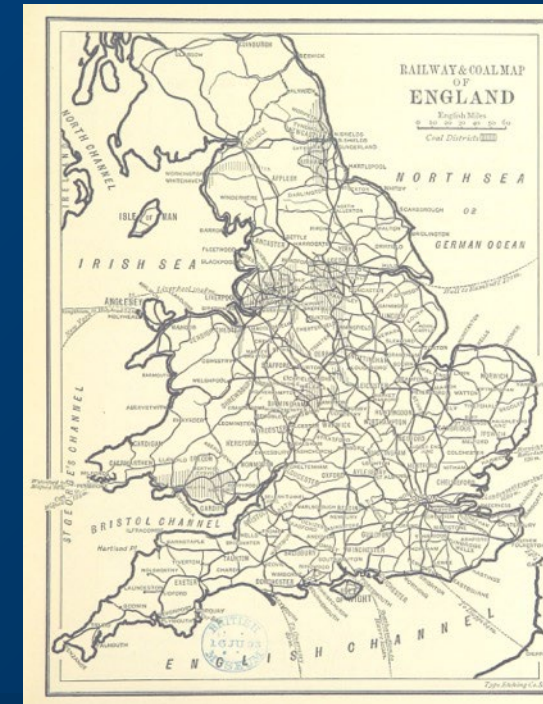
**NOAA Observing System Council
July 2024**

Example of Commercialization Gone “Wrong”

- 🌀 Railway Mania in UK in the 1840s
- 🌀 > 1000 new private railway companies in the 1840s.
 - ❖ 1840 “Act for Regulating Railways”: railway inspectors.
 - ❖ Call starting in 1844 to nationalize railways.
 - ❖ Fully stopped by the end of the 1840s as bubble burst.
- 🌀 But, it resulted in the railway system to go from 2000 miles of rail in 1840 to 8000 miles in 1855.
 - ❖ Issue is that market was not there yet.
 - ❖ Not that different from airlines outside of USA (private to 1930s, public to 1980s, private since).



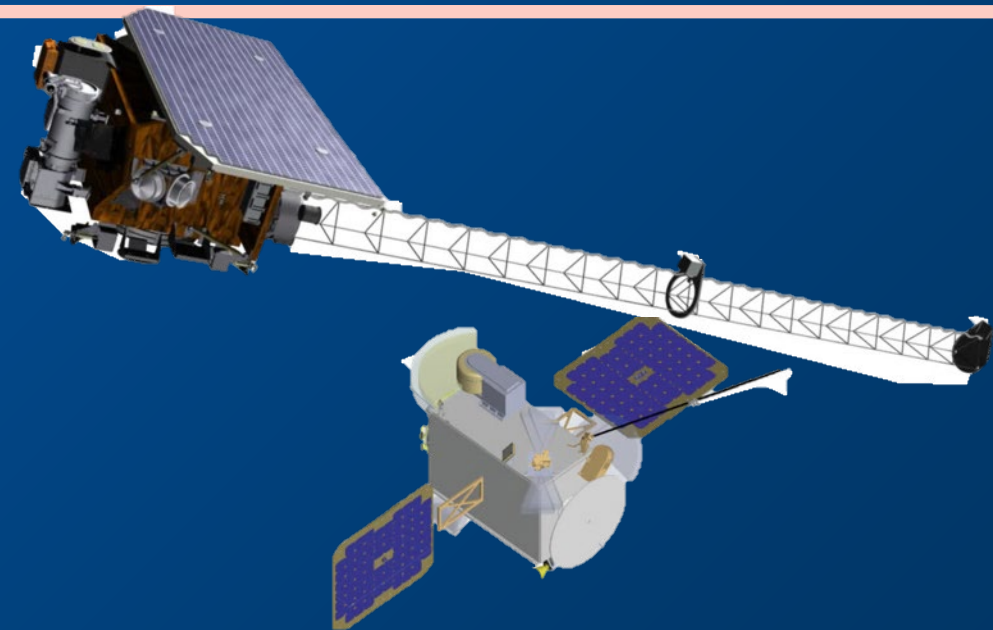
Mason, 1998



Two “Thought” Experiments

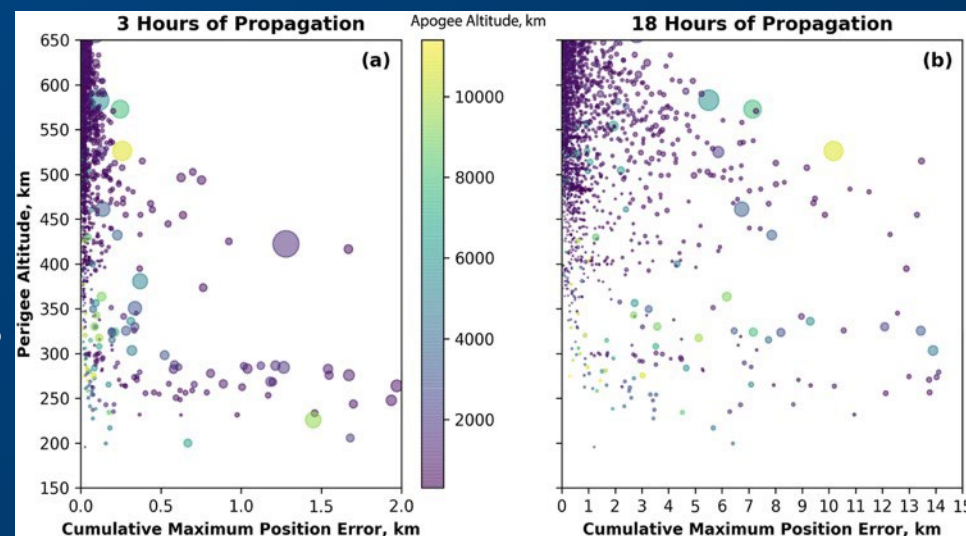
☉ Sun-Earth: Lagrangian point. Fundamental data

- ❖ Instruments are simple but mostly university/lab built – Not much market for interplanetary grade solar wind plasma detectors (*yet*).
- ❖ Is commercialization “*just*” using a commercial bus and commercial PMSEMA and operations?
- ❖ Sub-L1 (sunward of L1): commercial or hybrid NOAA/NASA cost capped call (what is cheaper/lower risk?)



☉ LEO atmospheric density. Fundamental and enhancement data

- ❖ In case of extreme geomagnetic event, what is the balance between collision avoidance and proprietary data?



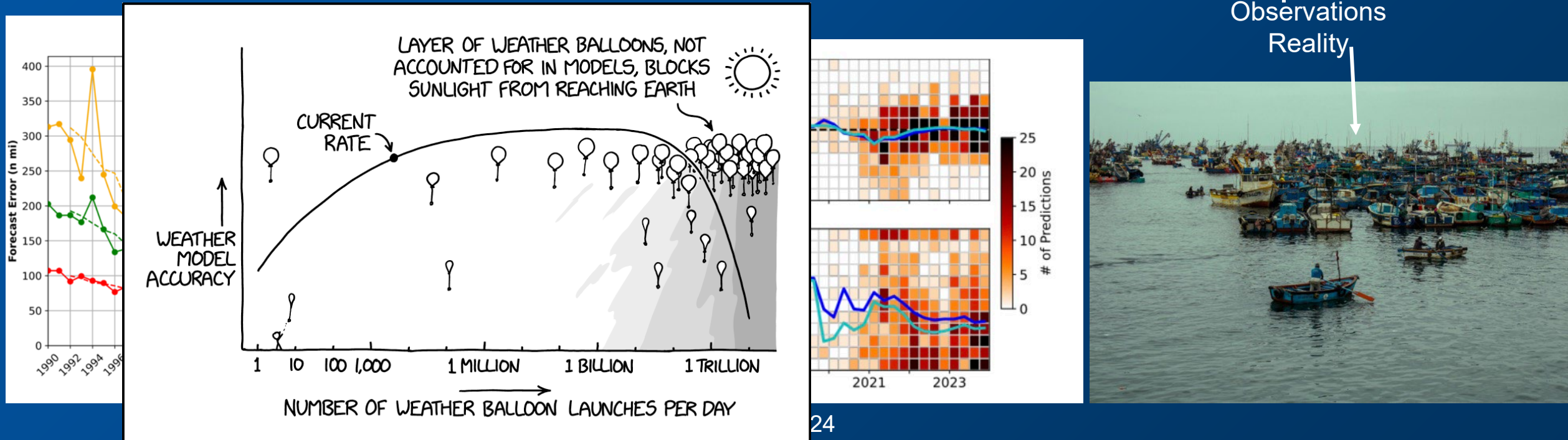
Berger et al., 2020

How does Space Weather Differ from Weather?

- Simulation poor (physical understanding is not there yet).
- Different impacts:
 - Extreme weather has primarily “personal” effects.
 - Extreme space weather has global effects, and it is like maritime collision avoidance (oil spills). See Traffic Collision Avoidance Systems.
- Very data poor.



↑ Observations
Reality ↓



Militarization

- There is a role for forecasts and observations to support military.
- Same overall issues as for commercialization but enhanced.
 - Knowing about GNSS interference/radio blackout in advance can be a tactical advantage.
 - This is balanced by the overall benefit for this to be gained from publicly shared data and widespread warning and mitigation.
 - A sub-L1 monitoring platform could provide significant tactical advantage.
 - Same could be said for many natural hazards.
 - Space weather consequences can be global.

Space Weather®

EDITORIAL

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Key Points:

- The Editor in Chief poses questions about the impact of tightening Heliophysics and space weather research to military endeavors

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For All Humankind: Peaceful, Ethical, Cooperative, and Curiosity-Driven Space Science and Space Weather Research

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Abstract Are we moving into a new reality where the next human stepping onto a different world will utter “*That’s one small step for me, a giant leap for my country*”? Is further tightening Heliophysics and space weather research to military endeavors the solution to the decrease in federal funding for Heliophysics in the US and the worldwide increase in military budget? I invite researchers to take the time to contemplate those issues and to continue pushing for an ethical, peaceful, cooperative, and curiosity-driven space science and space weather research.

“That’s one small step for a man, a giant leap for the United States of America.”

This sentence does not have the same ring as the one Neil Amstrong proclaimed in 1969, as he became the first person to set foot on the Moon. *The next* time a human being returns to the Moon or set foot on Mars, if the emphasis is the advancement of an individual nation, a private company or maybe even some armed forces, instead of the advancement of “humankind,” will it have the same long-lasting influence as that famous quote?

The new administration has already radically reduced federal funds for research; fiscal year 2026 starting 2025

Militarization

TREATY ON PRINCIPLES GOVERNING THE ACTIVITIES OF STATES IN THE EXPLORATION AND USE OF OUTER SPACE, INCLUDING THE MOON AND OTHER CELESTIAL BODIES

The States Parties to this Treaty,

Inspired by the great prospects opening up before mankind as a result of man's entry into outer space,

Recognizing the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes,

Believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development,

Desiring to contribute to broad international co-operation in the scientific as well as the legal aspects of the exploration and use of outer space for peaceful purposes,

Believing that such co-operation will contribute to the development of mutual understanding and to the strengthening of friendly relations between States and peoples,

Recalling resolution 1962 (XVIII), entitled "Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space", which was adopted unanimously by the United Nations General Assembly on 13 December 1963,

Recalling resolution 1884 (XVIII), calling upon States to refrain from placing in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction or from installing such weapons on celestial bodies, which was adopted unanimously by the United Nations General Assembly on 17 October 1963,

Taking account of United Nations General Assembly resolution 110 (II) of 3 November 1947, which condemned propaganda designed or likely to provoke or encourage any threat to the peace, breach of the peace or act of aggression, and considering that the aforementioned resolution is applicable to outer space,

Convinced that a Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, will further the purposes and principles of the Charter of the United Nations,

ARTICLE I

The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.

Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.

There shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation.

ARTICLE II

Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

ARTICLE III

States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding.

ARTICLE IV

States Parties to the Treaty undertake not to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner.

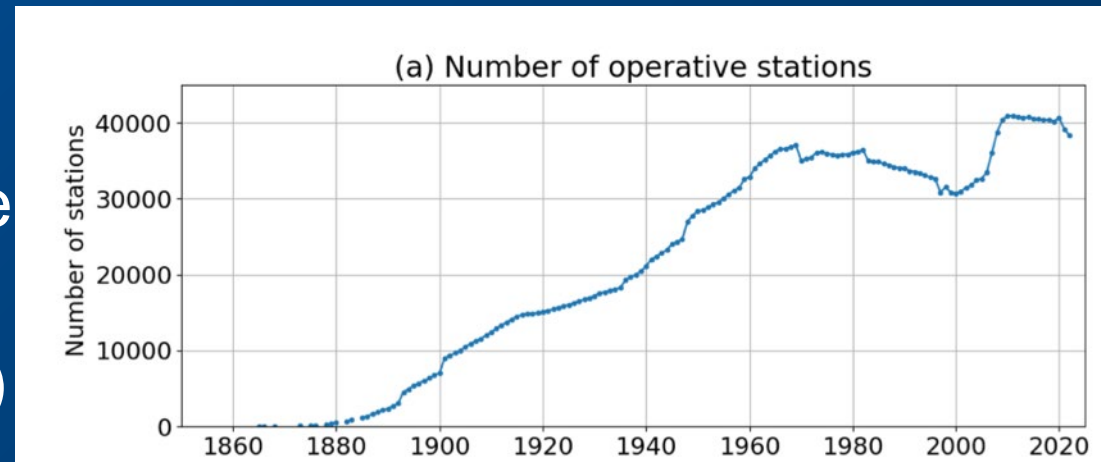
The moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the moon and other celestial bodies shall also not be prohibited.

Outer Space Treaty, 117 countries are parties, including USA (1967), Russia (1967), China (1984), North Korea (2009).

Summary

- 🌀 Space weather is still a field in its infancy.
 - ❖ In terms of data, it is not weather research 20-30 years ago but weather research 120 years ago.
 - ❖ But for LEO data, this is changing rapidly (as it did for weather in the late 1890s).
- 🌀 Data and models need to be made public to:
 - ❖ Build forecasting tools including AI-based ones.
 - ❖ Advance research and physical understanding.
- 🌀 Data on the results (ground current, satellite anomalies) are already “hard” to get by.
- 🌀 Space weather has global (and unintended) consequences.

González-Cervera & Duran



AGU requires that the underlying data and/or software or code needed to understand, evaluate, and build upon the reported research be available at the time of peer review and publication. Additionally, the code (e.g. Python, Jupyter Notebooks, R, MATLAB) used to perform any data analysis and to produce the manuscript's figures should be made available in a free and open platform (e.g. Github) and preserved in a repository (e.g. Zenodo).