Position Paper

Selected Space Environmental Sustainability Issues

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There is growing concern that expanding space activity could create adverse environmental effects on Earth and in space, including atmospheric pollution from rocket launches and spacecraft reentries. This paper addresses selected topics related to possible environmental impacts. Although the scale and long-term consequences remain uncertain, researchers and policymakers are increasingly examining whether these activities could affect the atmosphere, climate, and human health at a time when space activities are rapidly expanding. The NSS believes that a balance must be struck between regulations needed to protect against concrete harm and allowing space development to proceed without becoming ensnared in premature, unnecessary, or misguided laws.

A natural tendency exists to expand the purview of existing space regulatory agencies such as the FAA or the FCC, rather than assigning space regulations to a different or new entity that has the appropriate expertise. **The NSS urges that the FAA and the FCC focus on their current respective areas – launch/landing for the FAA, and radio bandwidth usage for the FCC.** Each of these agencies has deep knowledge in their current areas of work but are ill-suited as platforms for wide-ranging regulatory expansion.

A corollary of the above position is that if an agency already exists with responsibility for regulations related to atmospheric pollution, and with significant expertise in the regulation of both stationary and moving sources of atmospheric pollution, it should be

considered as a regulatory focus. A substantial similarity exists between atmospheric pollution from air transportation and pollution from rocket launches and reentries, suggesting that the EPA may be the appropriate agency for such regulations. Although the EPA has not dealt with the regulation of the upper atmosphere in the past, such as might result from the re-entry of space vehicles, the EPA still may be a better fit for such regulations than the FAA or FCC.

However, the NSS remains open to establishing the OSC or NOAA as the regulatory agency for upper atmosphere impacts resulting from both launch/reentry and satellite deorbiting. Congress should study this matter carefully before deciding. Additionally, Congress may wish to consider creating a new agency for all space environmental matters, the Space Protection Agency (SPA).

In calling for an agency to be the focus of the regulation of atmospheric pollution resulting from space activities, **the NSS is calling for a measured and deliberate process.** This regulatory process should be based on the following core principles:

- Rocketry and space technology are evolving rapidly. Regulations should be deferred until methods of reaching orbit either have stabilized in their evolution or reached such a scale that the impact of space flight has become significant relative to air travel. For instance, considerable energy has been expended studying the potential dangers of perchlorates in solid rocket booster exhaust in terms of atmospheric pollution, but it appears increasingly likely that methane/lox vehicles are the wave of the future while the usage of solid rocket boosters and "dirtier" rocket propellants such as RP-1 are declining in the U.S. **Due to this situation, the NSS recommends a defined period of scientific monitoring and regulatory preparation conducted by NOAA before imposing atmospheric-pollution limits on space vehicles, with Congress revisiting the question after ten years or sooner if launch activity creates a level of impact comparable to a large fraction of global air travel.** This may not be a sufficient period for space launch technology to stabilize, but it will at a minimum put us in a better position to establish useful regulations.

- Regulations should be based on reproducible scientific evidence. A great deal of speculation exists about potential harm to the ozone layer, the upper atmosphere, and so on, but at the current moment, it is difficult to point to verifiable dangers. **Thus, the NSS recommends that NOAA focus in the near to medium term on measurement, modeling, and monitoring programs capable of establishing whether future atmospheric regulations are needed and, if so, what thresholds should trigger them**.

- Rather than trying to expand the regulatory reach of existing agencies via creative interpretation of current laws, the NSS recommends that Congress provides new statutory authority to develop regulations related to atmosphere impacts by launch vehicles and re-entering vehicles. This will ensure that a degree of consensus stands behind the new regulations and will make their acceptance more likely. The NSS recommends that such legislation embody the following two directions. First, the regulation of atmospheric impacts by launch vehicles **should be deferred until either launch vehicle technology stabilizes, or space launch activity becomes a significant fraction of aircraft activity.** Second, regulations on launch vehicles **should favor both controlled re-entry leading to re-use and the eventual refurbishment or recycling of launch vehicles in-space,** as opposed to detailed regulation of the materials used in their manufacture or restrictions on launch rates.

- The EPA and NOAA lack the technical expertise to regulate in-space environmental impacts which by their very nature are quite different from pollution within the atmosphere and Earthly biosphere. **The NSS recommends that the responsibility for such regulations, which are fundamentally new in their nature, be assigned to the Office of Space Commerce (OSC)** as part of their responsibility for the supervision of new space activities.

The above discussion leaves open some questions related to in-space environmental impacts that might require clarification. The NSS recommends that the following principles guide the development of in-space environmental regulations:

- The scope of such regulations be limited, at this time, **to the Earth-Moon system.**

- Substantial in-space human activity will take place in the Earth-Moon system. **Regulations should not assume that space will or ought to retain a pristine character.** Substantially increased levels of space development within the confines of safe operations should be the goal.

- Regulations to protect areas of historical or great scientific sensitivity on the Moon are appropriate, **but not to the degree that a large percentage of the Moon is unavailable for commercial and scientific activity**.

- Regulations with regard to "visual pollution" i.e., large structures that can be seen from the Earth and are not functional, i.e., advertisements or art installations, should be based on unaided naked eye visibility. **In other words, objects on the Moon or in space, to be subject to "visual pollution" regulations must be visible to the unaided eye of an average human being**

on the surface of the Earth. This principle suggests a threshold beneath which regulation related to visual pollution will not apply.

- It should be noted that as we continue to develop space to benefit humanity, we can expect that an increasing number of large functional objects such as the ISS will be naked eye visible. **The NSS does not believe that there should be any non-collision related attempt to regulate the numbers or sizes of such functional space objects.**

- Regulations **must not be based on the idea that if I can see something from the Earth, I have a right to control how it is used**. Some claim that because they can see the Moon in the night sky, they have the right to forbid any habitation or burials on the Moon. This kind of "I looked at it so I control it" view privileges the desires of a tiny group over the great bulk of humanity, and well as everyone who in the future will live—and die—on the Moon and in space.

- The control of where and how landings occur on the Moon to minimize interference with other parties should be one of the key goals of lunar environmental regulations. **The major phenomenon for consideration is the creation of flying lunar regolith via take-offs and landings.** Such regulations should also extend to lunar mining or construction via explosives or other means that create projections of harmful debris.

- Planetary protection should be risk-based, target-specific, and proportional to actual scientific value, rather than applying traditional COSPAR-style contamination concerns uniformly throughout the Earth-Moon system. Given the Moon's well-established lack of indigenous life and the fact that human missions have already introduced terrestrial biological material to the lunar environment, traditional planetary protection frameworks developed for potentially habitable worlds should not serve as the basis for lunar environmental regulation. Planetary protection policies for the Moon system should be proportional to actual scientific and operational risks. Measures intended to preserve the integrity of specific scientific investigations, such as studies of permanently shadowed regions or other unique environments, may be appropriate. However, planetary protection should not be used as a justification for broad restrictions on exploration, settlement, resource utilization, or commercial activity across large portions of the Moon.

In addition to regulation of environmental issues on the lunar surface, the OSC should address space debris. The NSS recommends that the preferred approach to larger space debris is its collection and re-use in space, including establishing salvage law for space

debris. **The NSS urges that Congress passes new legislation empowering private parties to seize and re-use all abandoned space debris other than sensitive military/intelligence assets.** The NSS acknowledges that not all space debris would be appropriate for collection and re-use, and that deorbiting via various technical means can be a suitable direction.

Any salvage regime should be designed to respect international obligations while creating incentives for debris removal and resource recovery.

- The U.S. should start by issuing a statement via Executive Order or legislation that clearly states the nation's position on the questions of abandonment, definitions of debris, and salvage rights and compensation in outer space.
- The U.S. should formulate and publish a list of civil and commercial space objects that are available for salvage.
- The U.S. should adopt a definition of "space debris" along with a standard for when a space object is considered abandoned.
- The U.S. should consider issuing bounties to encourage the salvage of civil space assets.
- The U.S. should facilitate discussions between States regarding space salvage.

The OSC's Traffic Coordination System for Space (TraCSS) is a key initiative for addressing the growing challenges to the space environment such as space pollution and orbital congestion. The system provides basic space situational awareness (SSA) data and services to satellite operators and nation-states. The TraCSS system complements the growing ecosystem of commercial SSA and space traffic management (STM) providers. The **NSS urges that the OSC TraCSS system be permanently funded and brought to operational status.**

The area of so-called "dark and quiet skies" should be approached carefully. The NSS has a paper on this topic. The NSS suggests that concerns about radio emissions from spacecraft fall under the domain of the FCC. Such concerns are not new, and the FCC is best positioned to resolve disputes over spectrum usage. At the current time some astronomers are concerned about the growing visibility of satellites and their potential to interfere with ground-based astronomy. Although the NSS welcomes efforts by companies to minimize the visual impact of their constellations, in the long run astronomy must largely move into space. **The NSS urges Congress to double spending on space-based astrophysics and heliophysics within NASA.**

The NSS notes the recent proposal by the FAA to relax environmental regulations related to various space activities. The NSS observes that rapidly increasing launch rates are incompatible with multi-year environmental investigations into every mission or every increase in launch rates. There are three areas of consideration:

- Licensing of launch and landing
- Licensing of increased launch rates or other expansions of existing spaceports
- Licensing of new spaceports

Without endorsing the details of the FAA proposal, some of which are unclear, **the NSS endorses the relaxation of environmental reviews of launches and landings at an already approved site within the context of a previously approved launch rate.** For such routine operations, any environmental investigations should be incident based rather than part of a process imposed on every launch/landing event.

With regard to the licensing of increased launch rates or expansions of existing spaceports, environmental review should be limited to the direct and immediate impact of the proposed changes, and review periods should be strictly limited. Care should be taken to ensure that environmental regulations cannot be used as a tool to unfairly harass commercial enterprises, and harm the competitive posture and national security of the United States. Regulation should be modeled on airports, where, for example, adding more flights to an existing airport does not require any environmental review. However, adding a new launch pad would involve some environmental review of a limited scope. Currently, every increase in launch rate requires action by the FAA (a federal action) and the National Environmental Policy Act (NEPA) is invoked for all federal actions. The most needed regulatory change is to break this connection so every increase in launch rate, even by one launch, does not require federal approval and thus invokes NEPA. Some may suggest that the Outer Space Treaty requires federal approval of all launch-related activity. **The NSS argues that the OST requires "supervision" which is undefined in the treaty and hence might involve state and local regulation as approved via the legislative or regulatory process of the launching state.**

With regard to the licensing of new spaceports, which are strongly needed, caution should be exercised in the relaxation of environmental reviews. Such reviews are essential for new spaceports, but at the same time, limits must be placed on the length of the reviews, and the scope of impacts considered. **The scope of environmental impacts of the new spaceport examined should be limited to those directly and immediately associated with launch operations and should not include speculative concerns about possible future increases in launch rates.**

CONCLUSION

The NSS recommends a two-track approach to addressing space-related environmental concerns: near-term scientific monitoring of the atmospheric impacts of space launches and reentries, paired with a separate space-domain framework for lunar activity, debris, and other in-space environmental concerns. The two categories should not be regulated through the same institutional framework.

Four conditions should be met before regulations are proposed: a reproducible body of evidence identifies a concrete environmental harm; the regulatory agency has clear statutory authority; the proposed rule is proportional to the demonstrated risk; and the rule preserves practical pathways for continued launch to, settlement of, research in, and commercial activities in space.

The approach suggested here would preserve U.S. leadership in space development while ensuring that regulation is assigned to agencies with the appropriate expertise and grounded in evidence rather than speculation.

About the National Space Society (NSS): NSS is an independent non-profit educational membership organization dedicated to the creation of a spacefaring civilization. NSS is widely acknowledged as the preeminent citizen's voice on space, with over 50 chapters in the United States and around the world. The Society publishes *Ad Astra* magazine, an award-winning periodical chronicling the most important developments in space. To learn more, visit www.nss.org.