

Moon Dialogs Salon 3

Safety Zones in Practice and Lessons from Earth

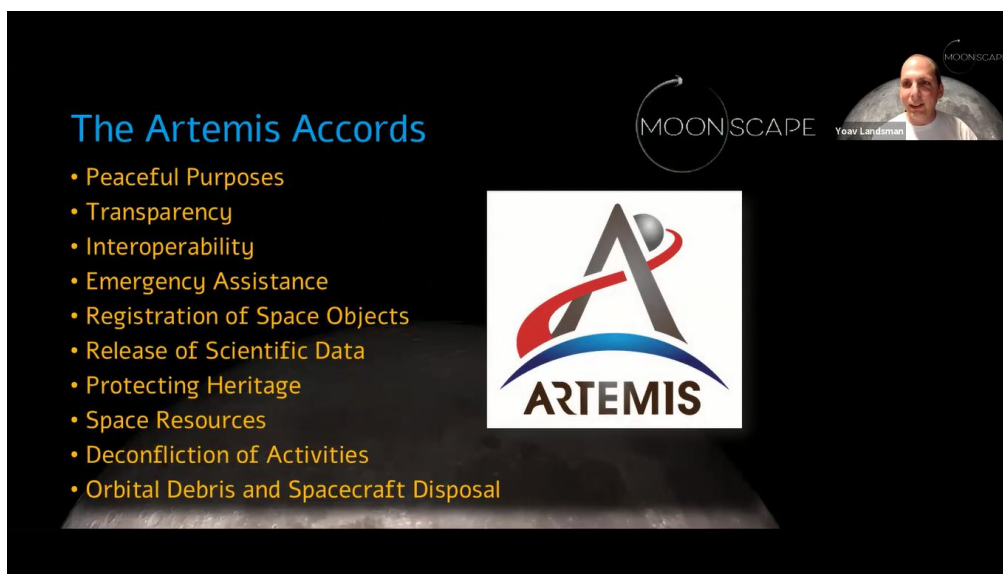
5 June 2020

The Moon Dialogs Research Salons seek to cultivate thought leadership on lunar surface coordination mechanisms to accelerate a peaceful and sustained presence on the Moon. The initiative will focus on advancing concrete approaches to operating standards, norms, and economic foundations, with an emphasis on applied and 'bottom-up' approaches, and creating opportunities for voluntary coordination between and amongst industry, government, and academia alike.

Presentations: Yoav Landsman & Timiebi Aganaba-Jeanty

The third edition of the Moon Dialogs Research Salon took place on Friday, June 5, with presentations from [Yoav Landsman](#), CEO and Co-Founder of MOONSCAPE and mission manager of the Beresheet Lunar Lander, and Professor [Timiebi Aganaba-Jeanty](#) of Arizona State University's School for the Future of Innovation, to discuss mission operator and international law perspectives on establishing safety zones on the lunar surface.

The third research salon began and ended with a poll for participants on the need for area-based safety zones and how they should be regarded. Yoav Landsman began his presentation by providing an overview of the operational sides of safety zones in the context of the Artemis Accords, and sharing his reflections as an engineer deeply involved in the elements of the recent Beresheet lunar mission.



The Artemis Accords

- Peaceful Purposes
- Transparency
- Interoperability
- Emergency Assistance
- Registration of Space Objects
- Release of Scientific Data
- Protecting Heritage
- Space Resources
- Deconfliction of Activities
- Orbital Debris and Spacecraft Disposal

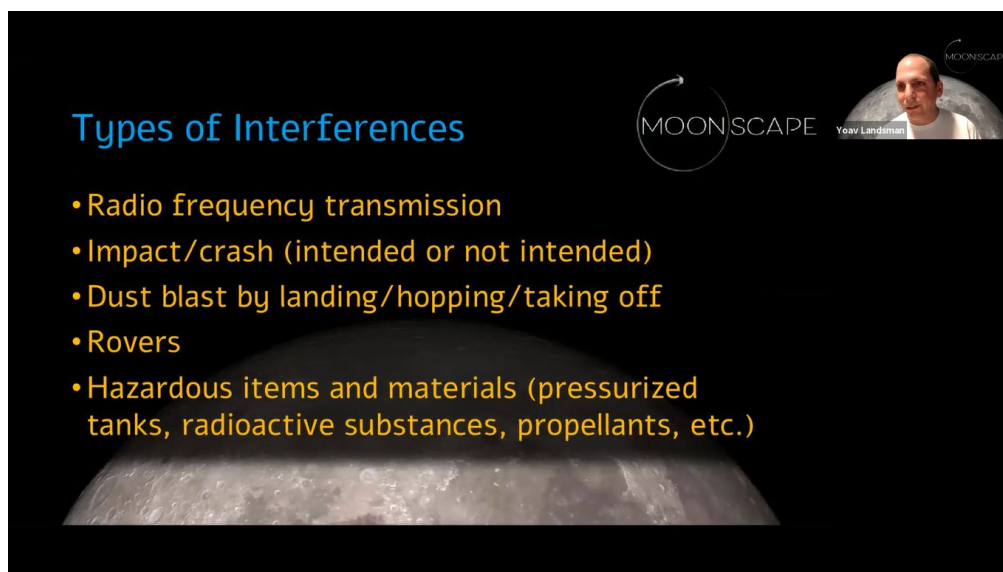
MOONSCAPE

Yoav Landsman

ARTEMIS

At first glance, the purpose of the Accords is the mitigation and avoidance of interference between different actors that will be on the Moon in the near future. While the Accords address space agencies and other government entities, there also seems to be a desire to have commercial companies in alignment also.

While at SpacelL during the Beresheet mission to the Moon, Yoav said that team members had concerns about the dust effect on the lunar surface toward the Beresheet lander, but they had not considered the possible damage to other potential nearby objects.



Types of Interferences

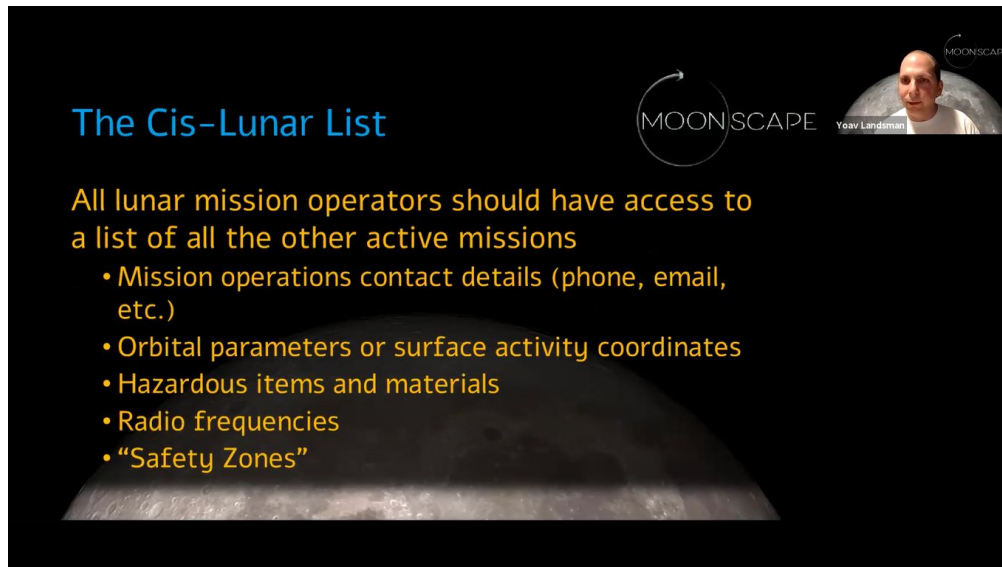
- Radio frequency transmission
- Impact/crash (intended or not intended)
- Dust blast by landing/hopping/taking off
- Rovers
- Hazardous items and materials (pressurized tanks, radioactive substances, propellants, etc.)

With the anticipated increase of lunar activities, this growing risk of harm will impact many companies and lunar programs unless some steps are taken. Yoav outlined the following types of interferences:

Radiofrequency transmissions appear to be the most immediate type of interference. And, just as the ITU has regulatory competency for radio frequencies on Earth, a comparable body might be necessary for regulating short range micro transmissions on the Moon.

Lunar orbiters will likely impact the Moon's surface at the end of their operation, putting other assets in orbit and on the lunar surface at risk of harm from the resulting spray of lunar dust. Rovers can collide with other structures, rovers, and people, and might put at risk the preservation of lunar heritage sites.

Next, spacecraft and other made objects such as passive Apollo landers still contain hazardous materials such as pressurized tanks that are at risk of exploding on impact or due to raised temperatures. Past and future spacecraft may possibly utilize radioactive materials and corrosive propellants which could also be ejected.



A Cis-lunar list detailing past and current missions might be used to mitigate potential interferences.

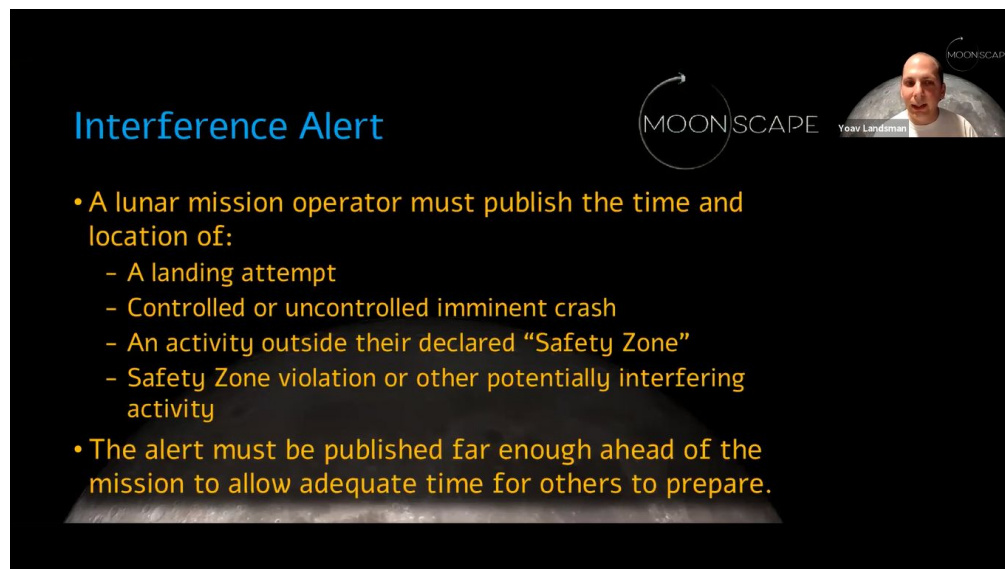
Integral to this list is the need to define safety zones. In that sense, a Cis-lunar list is congruence with the draft Artemis Accords. Yoav stressed that it is unclear to him whether safety zones are a soft or politically correct way to have a keep-out zone, and that the context would be very clear if safety zones were intended as a keep-out zone. However, if a safety zone is intended to mean “enter at your own risk”, this could become complicated.

Some criteria which would help to define the scope of those safety zones include the need to have different types of zones for static and dynamic activities. The size of any safety zone should be related to the scale of the activity performed within it, and the level of danger it poses to outsiders. However, who will determine these zones, and when? Yoav also stressed that, if possible, safety zones should be declared publicly, and well before launch.

In the situation where an actor anticipates potential interference with other missions, they would need to alert the affected operators directly and publicly, according to the variables on the above mentioned cis-lunar list. That is, prior to landing, operators should publish: 1) where/when they plan to make their landing attempt, and 2) whether it would be a controlled/uncontrolled imminent crash/activity outside the safety zone, and 3) any other violations or interference activities. Other operators must be alerted early if the scope of a safety zone changes, in order to provide adequate time to respond.

Moreover, human surface activities will need to have a way to directly communicate with each other in case of emergencies, and this necessitates the use of the same common

frequency and common language or codes, similar to what is applied in commercial aircraft communications.



Interference Alert

- A lunar mission operator must publish the time and location of:
 - A landing attempt
 - Controlled or uncontrolled imminent crash
 - An activity outside their declared “Safety Zone”
 - Safety Zone violation or other potentially interfering activity
- The alert must be published far enough ahead of the mission to allow adequate time for others to prepare.

Lastly, as radiofrequency silence is needed on the far side of the Moon for radio observatories to work properly, spacecraft should be capable of temporarily ceasing all transmission when needed, and therefore a transmission time-sharing mechanism should be developed.

Following Yoav’s presentation, Prof. Timiebi Aganaba-Jeanty discussed the legal context of safety zones and questions posed by their inclusion in the Artemis Accords. Timi first began by noting that there was a paucity of literature about lunar safety zones out there, which due to the novelty of the topic should not be a surprise. She mentioned a [related LLM thesis from McGill on safety zones in outer space](#),¹ as well as an [Open Lunar policy piece on analogs](#) which showed the limited natures of terrestrial for analogs in outer space.²

For Timi, the discussion should begin with Article VIII of the Outer Space Treaty and its treatment of jurisdiction and control, and how the state of registry has jurisdiction and control over its space object in outer space. But, does that jurisdiction extend beyond that space object? Doesn’t the surroundings of that space object also have to be under the jurisdiction of that State also? This is because effective jurisdiction and control over a

¹ Ted Newsome, The Legality of Safety and Security Zones in Outer Space: A Look to Other Domains and Past Proposals, LLM Thesis (2017), McGill Institute of Air and Space Law, available at: <https://escholarship.mcgill.ca/concern/theses/p5547v064?locale=en>

² Jessy Kate Schingler and Eliot Kemper, *Policy Analogs and Creating Lunar Futures*, available at: <https://www.openlunar.org/library/brief-policy-analogs-and-creating-lunar-futures>

spacecraft really require powers a bit *beyond* that space object. This will be an issue that will be debated.

However, Timi stressed that what will ultimately address these issues is essentially State practices. States are going to choose what rules work for them and their, especially as the current rules are so bare and minimal. What will the rules be for static activities, versus moving activities. Of course, first movers will have a major impact on what develops.

Safety zones can be compared to the Exclusive Economic Zones (EEZ) in the international law of the sea. EEZ have been standardized and codified in treaty law, but they developed organically. In fact, the [Exclusive Economic Zone](#) can be traced to the so-called “Cod Wars” between Iceland and the United Kingdom from the 1940s to the 1970s. There, the 200 nautical miles was developed and finally settled upon after numerous smaller zones were expanded upon in unilateral fashions by States. Timi posited that, just like this 200 nautical mile zone grew from earlier boundaries, so might a lunar safety zone also increase and grow ever larger. Could this ever creep to the level of appropriation?

Timi also wondered whether there are analogies to glaciers, which move, and where the rights and obligations attached to those glaciers move with them. Could safety zones move like the zones around glaciers? So, in addition to maritime law, glacier law might be looked into.

There are also interesting analogies to zoning, including domestic zoning laws around construction and commercial buildings. She stressed that zoning rights seem to be ever creeping and growing, and that is just a general trend in how governments and regulators do zoning. Actors tend to creep beyond boundaries, and therefore how do we prepare for inevitable “zone creep” in the lunar context? In terrestrial environments, some communities have required that any zone creep [is matched with some benefits to the community](#). Could this also be transposed to the space domain?

To conclude, Timi stressed that it will be hard to have a legal solution beforehand, and that actors will be acting in their best interest, even when their actions are not in the best interest of everyone. We think that the Moon is big, but we already know that locations will be rivalrous and that people will coalesce around valuable sites.

**The Video Recording of Yoav Landsman and
Timiebi Aganaba-Jeanty’s presentation is at:**
<https://vimeo.com/429441514>

Discussion Amongst Participants

The Research Salon then went into the discussion segment to discuss the following questions:

- 1. Are area-based safety zones the best way to foster deconfliction?
— why or why not, and what are the alternatives?**
- 2. Should safety zones confer formal rights, or be informational and recommendatory?
— which information, or which rights, should be included?**

Defining and Determining Safety Zones

In breakout groups, debris mitigation came up as a natural impetus for safety zone usage. However, it is clear that the implications or potential applications for safety zones are vastly greater than debris mitigation. Additionally, the fact that lunar dust has both local as well as 'global' effects on the Moon complicates the notion that safety zones could ever be merely local areas.

Participants discussed that significant ambiguity currently exists around what safety zones are and are not. Many participants raised a variety of questions about transfer of ownership, rights over resources, and priority access – none of which are explicitly mentioned in the Deconfliction principle of the Artemis Accords, but which nonetheless typically come part and parcel with discussions of “zoning” and “safety” on Earth. Although the formal terminology used in the Accords is “safety zones,” many fluidly moved between referring to them as safety zones, keep out zones, and non-interference zones.

Participants noted that the size and duration of safety zones will determine if they are useful. Participants stressed that the use and adoption of safety zones may hinge on the initial implementation. Some felt that these factors would also dictate whether or not they incentivize a race between actors to define, claim, and assert them.

One participant noted that “any good urban planner will tell you that public input is essential to the zoning process. There can be a lot of inherent bias built into zoning policies. There will be a problematic power dynamic if safety zones are just one actor telling others what to do. If we are hoping that folks will adhere because it's in their interest, then we need to have more people be a part of those conversations.” Another participant also felt that safety zones feel “full steam ahead” right now, with a big emphasis on commercial activity – but this risks leaving out a lot of people, and *that* is what's going to cause conflict. They stressed that if we can include more people now and take more of an urban planning approach, we can head off that conflict. “There's no reason we can't do a better job of making the conversation more inclusive, and including people from other fields to have a say as well.”

Forums for Discussion

One understanding of a safety zone is that the request for due regard (as per OST Art. IX) stems from those who declare a safety zone, and that others are expected to exercise this due regard in (and because of) that declaration. Will the international community be consulted on the character and extent of that regard?

Should [UN COPUOS](#) take up safety zones on the Moon? Many have argued against that for practical reasons, but others have said that we need to have many voices represented, stating that “the question is whether we want to rely on the US alone to set these rules, or rely on other countries to do that?”

Others mentioned that, there are *fora* such as [CONFERS](#), [COMSTAC](#), and other public-private advisory committees which are available for operators to discuss and influence the government on how to regulate and structure rules and norms.

It was understood that, on the space security side, the discussions have collapsed many times in the past number of years. So, success on this topic will depend on the critical mass, and in consultation with civil society.

Not Limited to Area-Based Measures

Participants also realized that safety zones need not be limited to area-based measures. This is because the “value” of what's being protected (and whether there are protective actions besides keeping your distance) also are factors in the conception of a safety zone. As mentioned above, lunar dust caused in one location might have repercussions across the entire Moon.

One participant questioned how safety zones are to be physically drawn. For example, fire zones are defined according to a radius but on Earth zoning also proceeds by “offsets”, and for example, an offset from a lawn means you might get irregularly-shaped zones.

One participant pointed out that the definition of ‘safety’ will be important, asking whether we mean *physical* safety or *economic* safety? Several participants brought up analogies with Exclusive Economic Zones (EEZs) on the high seas, both as an example of area-based measures that do not involve territorial appropriation, and in some cases suggesting that safety zones on the Moon could also include such a feature. Some areas might also involve more risk than others – a crater vs. an open plain create very different debris risks and mitigation requirements.

Another commenter made the point that “the scope of the rules will be dictated by the physics of the environment,” and that we have a difficult time conceptualizing the counter-intuitive nature of lunar activities. They stressed that “it seems like the rules around zones will need to be flexible as we begin to learn more about how the surface reacts to different impacts from landers and movements.’ Using an example, they further stressed “that A 90 mile per hour ‘fastball’ would go a kilometer on the surface of the Moon,” and that

a lot of the rules we've been talking about that reference the terrestrial context actually cannot be translated from Earth to the Moon."

Many raised, implicitly or explicitly, the question of whether safety zones might be used for activities that do not reference the safety of other actors, but rather act as a kind of protectionary mechanism for heritage sites or environmental protection (such as unique scientific sites), and zoning writ large (eg. radio quiet zone).

Normative Force of Safety Zones

Questions of authority – including who would be the arbiter of safety zones – was another issue which arose amongst participants. Some felt that we need COPUOS to play the role of coordination and development of resolutions. However, the view was expressed that any committee or entity making rules would have a huge amount of power over resources and territory. Another participant wrote: "In my opinion, there is not even remotely enough trust between nations, citizens, and companies to find agreement on who a Central Committee would be that has that kind of power." Another participant expressed that questions of planning go right to community input and power dynamic.

Most felt that zoning requires a sovereign. Others suggested a common system or institution substituting for sovereignty, and still others felt that "much of zoning only needs community agreement, and I believe that leads to more successful outcomes." It was also pointed out that enforcement can be a separate decision-making process.

Turning to the safety zones mentioned in the Artemis Accords, participants felt it was not clear who will have access to safety zones, and that the Artemis Accords emphasize "global benefits." Might these benefits be used as an incentive to observe due regard?

Implementation

One participant suggested that "lunar corporate social responsibility," could be another route to effective implementation. For example, the US national team (Blue Origin, Draper, etc.,) could get together and discuss compliance and norms, and that "would be far more impactful and efficient as opposed to international treaties."

Adherence to norms, whether hard and enforceable, or simply best practices, comes down to incentives by actors to adhere to those norms. To that end, a few participants mentioned that we haven't talked much about incentives yet. They said that while enforceable mechanisms are perhaps not a reasonable solution, it's worth exploring whether we can design a protocol that is in the interest of actors to adhere (to as a voluntary mechanism), and not merely or solely because there's an enforcer behind that norm. They asked "what are the tools available to us to create these incentives?" They felt that registration and transparency is one incentive, as actors sharing information about what would make operations safe around them could be shared through a registration mechanism.

Communications and Duty to Consult

Participants stressed that the most important thing about safety zones is notification and consultations”, and that this transparency is going to be at the core of how we think about safety zones. Even though the concept is new, the execution of concepts through behaviour (how do you talk, how do you consult) is not new.

A participant mentioned that, in their view, the International Court of Justice (ICJ) has “hung its hat” on the principle of “good neighbourliness.” This includes the obligation to talk, give notice, and negotiate in good faith. They went on to say that this principle is one of the few areas of international environmental law where we have seen any “teeth” (or enforcement) and it is possible that this could carry over into extra-terrestrial resource management. The obligation might be along the lines of “Did you put in a good faith effort to talk to each other?”

Conflict Resolution and Deconfliction:

Conflict resolution and deconfliction actions for safety zones were also discussed by participants. There may very well be competing interests and views over who has access to certain areas of the Moon. At what point will we address these competing interests? Some wondered whether the idea of safety zones was an attempt to depoliticize the very real challenges involved in making these tradeoffs. A few participants recalled the recent move by the United States to assert outer space is *not* a global commons, and wondered whether this would lead to conflicting interests and approaches. Does this make discussions regarding deconfliction more pressing?

Another idea was put forth, namely that competing interests and uses might not just be between state actors, but between non-state actors, such as companies. Or, between a state actor and a company. This makes the discussions on deconfliction even more nuanced.

On this topic, one participant reflected on the importance of clear and knowable rules for expected behaviour, as well as clear and knowable safety zones, noting the saying: “good fences make good neighbors.”

Reflections and Calls to Action

The big questions regarding safety zones center around three broad areas. The first is how they should be defined. Are they area-based or conceptual? For example, the exosphere and radio interference are both physical, but not necessarily area-bound; whereas economic safety or priority access might be area-based, but involve a much broader definition of safety. Similarly, are they limited to interaction between actors, or can they be used to protect the natural environmental and man-made artifacts?

Secondly, what body or bodies (if any) will have authority to define and manage safety zones?

And thirdly, what are the key incentives for actors to participate?

Participants drew repeatedly from analogs in terrestrial environmental law and urban zoning. The role of physics and circumstance were widely discussed, though, surprisingly the complicating factor of mobility did not really come up. The role of transparency was mentioned in passing, but the mechanics of this were not explored, and this seems like an important practical detail of implementation.

Clearly, there are a wide variety of interpretations – as well as potential applications – of the concept of safety zones and deconfliction. Discussions on the implementation of safety zones may be further along than other related topics, but significant speculation remains on all topics.

Discussions about implementation have the potential to touch on a wide variety of legal, economic, territorial, environmental, and engineering considerations. Many folks see safety zones through their own particular lens, but there is a shared concern that we could try and do too many things with safety zones on the Moon. Even focused on a specific application, we may create unintended consequences without more detailed examination.