Governing without precedent? Lessons for space from other commons

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Overview

- **What is a “commons”?**
- **The three commons: Atmosphere, Oceans, Space**
- **Governance instruments – what worked and what didn’t**
  - Atmospheric commons
  - Oceanic commons
- **Summary of lessons from other commons**
- **Applications to space governance**
- **Conclusion**

What is a “commons”?

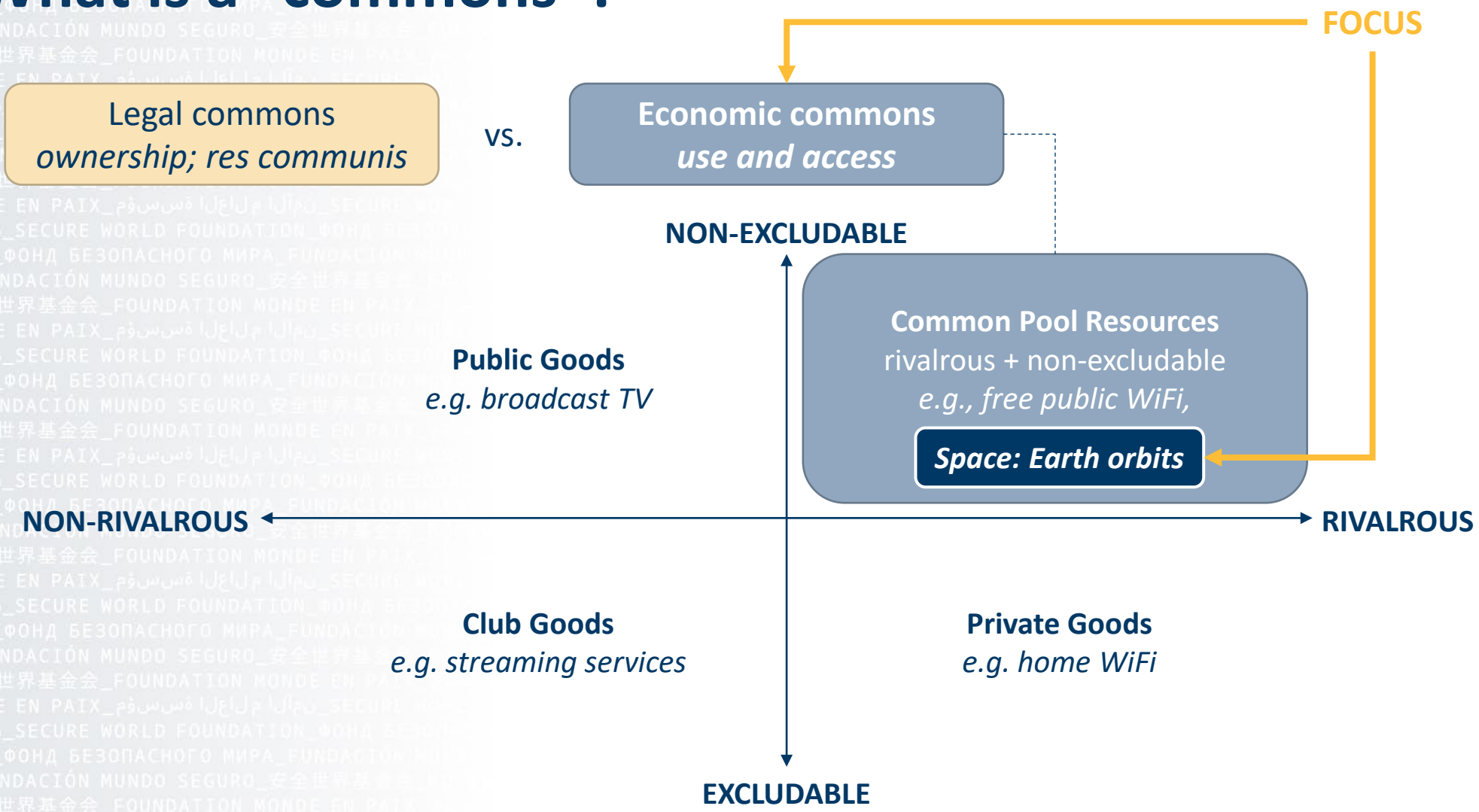
Legal commons
ownership; res communis

vs.

Economic commons
use and access

- **RIVALRY:** Is the resource finite? Does using it reduce accessibility by others?
- **EXCLUDABILITY:** Can the use and access of the resource be controlled by one or more entities?

What is a “commons”?



The three commons

	Atmosphere	Oceans	Space
Resource at risk	Absorptive capacity *(greenhouse gases, ozone-depleting substances)*	Living and mineral resources *(fish stocks, seabed minerals, oil & gas)*	Orbital capacity *(access to Earth orbits)*
Externality	Emissions	Pollution, overfishing, overextraction	Orbital debris, orbital congestion
Failure mode	Climate change Ozone depletion	Stock spoilage or depletion	Catastrophic collisions Kessler syndrome

- **Ostrom's eight design principles:** Useful benchmark generalizing features of successfully managed commons – all 3 satisfy most principles to some degree [3]

Defined boundaries	Local congruence	Collective choice	Monitoring
Graduated sanctions	Conflict resolution	Rights recognition	Polycentric governance

- We go a step further – to examine **why specific instruments succeed or fail** based on **problem characteristics** and **governance design**

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Atmosphere: key international governance instruments

Ozone depletion

Climate change

Law/agreements	Institutions	Processes	Market instruments
• **Vienna Convention (1985):** Framework agreement establishing principles of cooperation to mitigate ozone depletion	• **WMO:** Scientific body facilitating international exchange of meteor data and research	• **MOP:** Annual Meeting of the Parties supporting Montreal	• **Multilateral Fund:** Finances ODS phase-outs in developing countries
• **Montreal Protocol (1987):** Operational agreement to tackle ODS	• **IPCC:** Scientific asse body feeding into C negotiations	**Widely regarded as most successful global environment treaty to-date: parties phased out 99% of ODS and ozone hole expected to close by 2060.**	• **Green Climate Fund, Adaptation Fund:** Finances climate adaptation and mitigation in developing countries
• **UNFCCC (1992):** Framework agreement to address climate change	• **TEAP:** Technical advisory panel to Montreal	• **NDC reporting:** Reporting of Nationally Determined Contributions (targets + actions)	• **Carbon tax:** Direct price per tonne of CO2 at point of production/import
• **Kyoto Protocol (1997):** Climate treaty with binding targets	• **Implementation Co** Compliance review Montreal	**Successful on paper, limited real impact: exceeded 5.2% emissions reduction target but emissions continued to rise (44% from 1997-2012) as largest emitters not bound**	• **EU ETS:** First international emissions trading system
• **Paris Agreement (2015):** Climate treaty with binding reporting requirements	• **Ozone Secretariat** supporting Vienna/Montreal	• **Global Stocktake:** 5-year review to assess collective climate action progress	• **CDM:** First international carbon finance scheme under Kyoto
	• **UNFCCC Secretariat** supporting UNFCCC, Kyoto, and Paris	• **Technology Mechanism:** Formal UNFCCC process for identifying and facilitating technology transfer to developing countries	• **Paris Article 6:** Paris carbon trading mechanism intended to replace CDM
			• **REDD+:** Forest conservation financing for developing countries

Atmosphere: Montreal Protocol vs. Kyoto Protocol

	Ozone depletion: Montreal Protocol	Climate change: Kyoto Protocol
	(Vienna Convention, MOP, TEAP, Implementation Committee, Multilateral Fund)	*(UNFCCC, COP, IPCC, MRV Cycles, CDM, Adaptation Fund)*
SCOPE	**How well-defined are the problem and governance scopes?**	
LEVERAGE	**Are sources of externality easily traceable and controllable?**	
NON-COMPLIANCE COSTS	**Does non-compliance carry real costs?**	
INCENTIVE ALIGNMENT	**Are incentives structured so that compliance is economically rational?**	
ADAPTABILITY	**Can governance instruments evolve quickly to keep pace with challenges?**	

Atmosphere: Montreal Protocol vs. Kyoto Protocol

	Ozone depletion: Montreal Protocol *(Vienna Convention, MOP, TEAP, Implementation Committee, Multilateral Fund)*	Climate change: Kyoto Protocol *(UNFCCC, COP, IPCC, MRV Cycles, CDM, Adaptation Fund)*
SCOPE	✓ **Problem scope focused:** Targeted elimination of specific ODS; later added HFCs ✓ **Governance scope comprehensive:** Covered major ODS producers and consumers (through ODS trade control); binding schedules applied to all parties	✗ **Problem scope much broader:** All GHGs and carbon emitting activities ✗ **Governance scope narrow:** Binding targets on developed countries only; largest emitters (US, China, India) either unbound or non-ratifying
LEVERAGE	✓ ODS manufacture and trade provided **accessible leverage points** for control and enforcement actions	✗ **No clear leverage point** identified as emissions were economy-wide
NON-COMPLIANCE COSTS	✓ **Real and expansive**: ODS trade restrictions with non-parties affected non-participants; loss of Multilateral Fund access penalized non-compliant parties	✗ **No real costs:** Irrelevant for non-ratifying parties and no penalty for not ratifying (US) or subsequent withdrawal (Canada, Japan)
INCENTIVE ALIGNMENT	✓ **First-mover "protection":** Trade restrictions on non-parties eliminated forum shopping; Multilateral Fund gave financial incentive for developing countries to join	✗ **First-mover disadvantage:** Developed countries with binding targets risked raising economic costs for domestic industries; no Multilateral Fund equivalent
ADAPTABILITY	✓ MOP **tacit consent** procedure enabled nimble updates without full renegotiation	✗ COP **consensus arrangement** is slow, gives every party veto power, and sensitive to geopolitical turbulence

Oceans: key international governance instruments

Living resources

Minable resources

Both

Law/agreements	Institutions	Processes	Market instruments
• **ICRW (1946):** Founding agreement for IWC to manage whaling • **CITES (1973):** Treaty regulating trade of threatened species • **UNCLOS III (1982):** Constitutional framework establishing maritime zones and regulatory focus areas • **1994 Agreement:** Modified common heritage concept in UNCLOS Part XI • **UNFSA (1995):** Operational agreement to manage straddling fish stocks • **PSMA (2009):** Treaty requiring states to apply control measures to foreign vessels suspected of illegal fishing • **ISA exploration contracts (2001):** Bilateral agreements governing exploration (not exploitation) of deep sea mineral resources • **BBNJ Agreement (2023):** Operational agreement to ensure sustainability of marine biodiversity beyond national jurisdictions	• **ISA:** Intergovernmental body for deep seabed mining beyond national jurisdiction • **RFMOs:** Regional fishery organizations managing high seas stocks • **IWC:** Intergovernmental body regulating commercial whaling • **FAO:** UN agency tackling hunger; also provides fisheries data, technical standards, and guidelines for responsible fishing • **ITLOS:** Permanent judicial body for ocean disputes • **ICJ:** Principal judicial organ of UN	• **EEZ licensing:** Coastal state process for authorizing and regulating resource ext… within EEZ • **ISA licensing** for state-… entities to explore spec… areas for mineral resou… • **IWC assessment cycles** to assess whale stock status and review sustainable catch levels • **RFMO assessment cycl…** assess fish stock status… review recommended … • **Total Allowable Catch setting:** Annual quota setting process used at various governance levels (e.g., RFMOs, EU Council of Ministers)	• **ITQ:** Individual transferable quotas that enables fishing capacity-building and technical assistance for non-…

31 exploration contracts issued, but exploitation regulations unfinished despite decade-long discussions and a legally mandated 2023 deadline

Saw some initial success, but effectiveness waned as major actors subsequently pulled out or insulated themselves from binding obligations

Oceans: IWC

Overfishing (Whaling): International Whaling Commission

(ICRW, UNCLOS, CITES, IWC assessment cycles, ITLOS, ICJ, EEZ licensing)

SCOPE	✓ **Problem scope focused:** Targeted specific species (great whales), activities (commercial whaling), and actors ✗ **Governance scope contained loopholes and eventually eroded:** Initially covered all major commercial whaling nations, but formal objection procedure allowed members (Norway, Iceland) to evade 1985 moratorium; exemption for "scientific whaling" created loophole for commercial-scale whaling under research cover (Japan)
LEVERAGE	✗ **No accessible leverage point:** Whaling supply chains are mostly domestic so limited external leverage points; bulk of international trade is between countries (Iceland to Japan) who have legally insulated themselves from binding requirements through objections or reservations
NON-COMPLIANCE COSTS	~ **Weak**: No penalties for IWC withdrawal (Iceland, Japan) from IWC; following 2014 ICJ ruling, Japan paused "scientific whaling" program for a year before updating its ICJ declaration to explicitly exclude disputes about "living resources of the sea"; following 2018 CITES censure, Japan restricted whaling to its EEZ
INCENTIVE ALIGNMENT	✗ **No explicit design to align incentives:** Initial success happened because commercial whaling was already economically marginal for most member states; no market instrument to incentivize responsible action
ADAPTABILITY	~ **Limited**: Three-quarter requirement for amendments less strict than full consensus, but still operationally difficult to get to a draft text acceptable by majority for substantive changes → negotiations on inspection and observation scheme for catch limits ran for 12 years before acknowledging impasse

Oceans: ISA

Overmining (deep seabed): International Seabed Authority

(UNCLOS, 1994 Agreement, ISA exploration contracts, ITLOS, ICJ, EEZ licensing, ISA licensing, ISA revenue sharing)

SCOPE	✖ **Problem scope unclear:** While specific resource categories have been identified, technical gap in acceptable mining/environmental thresholds due to lack of data presents challenges in setting quantifiable limits ~ **Governance scope near-complete:** All major potential mining nations have ratified UNCLOS except the US, which has operated on its domestic framework since 1980 (Deep Seabed Hard Mineral Resources Act, EO 14285)
LEVERAGE	~ **Possible:** ISA licensing *could* provide leverage to track and control mining activity for identified resource categories, but no rules on resource exploitation have been agreed upon despite continuing discussions for over a decade
NON-COMPLIANCE COSTS	✖ **None at the moment**: No rules = no non-compliance costs; no penalty for non-participation
INCENTIVE ALIGNMENT	✖ **Principle established but mechanism unresolved:** Mechanism for equitable benefit-sharing obligations under UNCLOS still being deliberated
ADAPTABILITY	✖ **Chamber blocking system** gives every coalition veto power over decisions threatening their interest; dual mandate (enable equitable extraction + protecting the environment) without hierarchy slows decision-making as every decision comes back to resolving the same tension

A summary of lessons from other commons

1. Focus on discrete risks and limits; governance scope should at least match problem scope

- Discrete **limits tied to specific risks and actors** enable monitoring, leverage, and enforcement
- Needs to be informed by **credible scientific infrastructure** and assessment cycles
- Governance scope should cover **major actors**
- Need to evaluate and address **loopholes** (exemptions, reservations etc.)

2. Identify and focus on traceable and controllable leverage points

- Effective monitoring and enforcement exploits **accessible leverage points** in activity chains (e.g., trade, market entry) – especially for private actors
- If supply chains are mostly domestic or diffuse (i.e., economy-wide), targeted external leverage becomes structurally limited

3. Design for incentive correction, as incentive misalignment is central to collective action problems

- **First-mover disadvantage should be explicitly addressed**
- **Non-compliance costs should be real** to deter actors with capacity to comply but may defect if cost-benefits favor the latter
- Positive incentives for participation/capacity-building should be tied to **trackable and verifiable outcomes**

4. Ensure institutional processes are designed for adaptation

- **Consensus-dependent institutional setups** are sensitive to geopolitical shifts and **favor inaction**
- **Conflicting mandates without clear hierarchy** tend to produce **structural paralysis/impasse**
- Goes back to **scope** – easier to update governance instruments that serve tight mandates than treaties that cover everything

Potential applications to space (orbital congestion & debris)

1. Focus on discrete risks and limits; governance scope should at least match problem scope

- Need to **quantify limits/thresholds** for specific objects and regions, as well as in-aggregate
  - Cumulative collision risks, re-entry risks
  - Orbital capacity
  - Debris generation rates
  - Mandatory deorbit timelines
  - Trackability, SSA info sharing, etc.
- Thresholds must be informed by independent **scientific assessment capacity**, with periodic **monitoring, review, and update cycles**
- **Pre-empt potential loopholes** – would spectrum-based coordination/regulation suffice if optical-link based satellite communications take off?

2. Identify and focus on traceable and controllable leverage points

- Consider **embedding safety and sustainability requirements** (e.g., info sharing, debris management) **into existing leverage points**
  - Spectrum licensing
  - Launch licensing requirements
  - Export controls, market access, etc.
- But need to ensure **mandate alignment** and **adequate institutional capacity**
  - Expand mandate/capacity of existing institutions?
  - Establish dedicated international body to manage access to and use of orbital resources?

Potential applications to space (orbital congestion & debris)

3. Design for incentive correction, as incentive misalignment is central to collective action problems

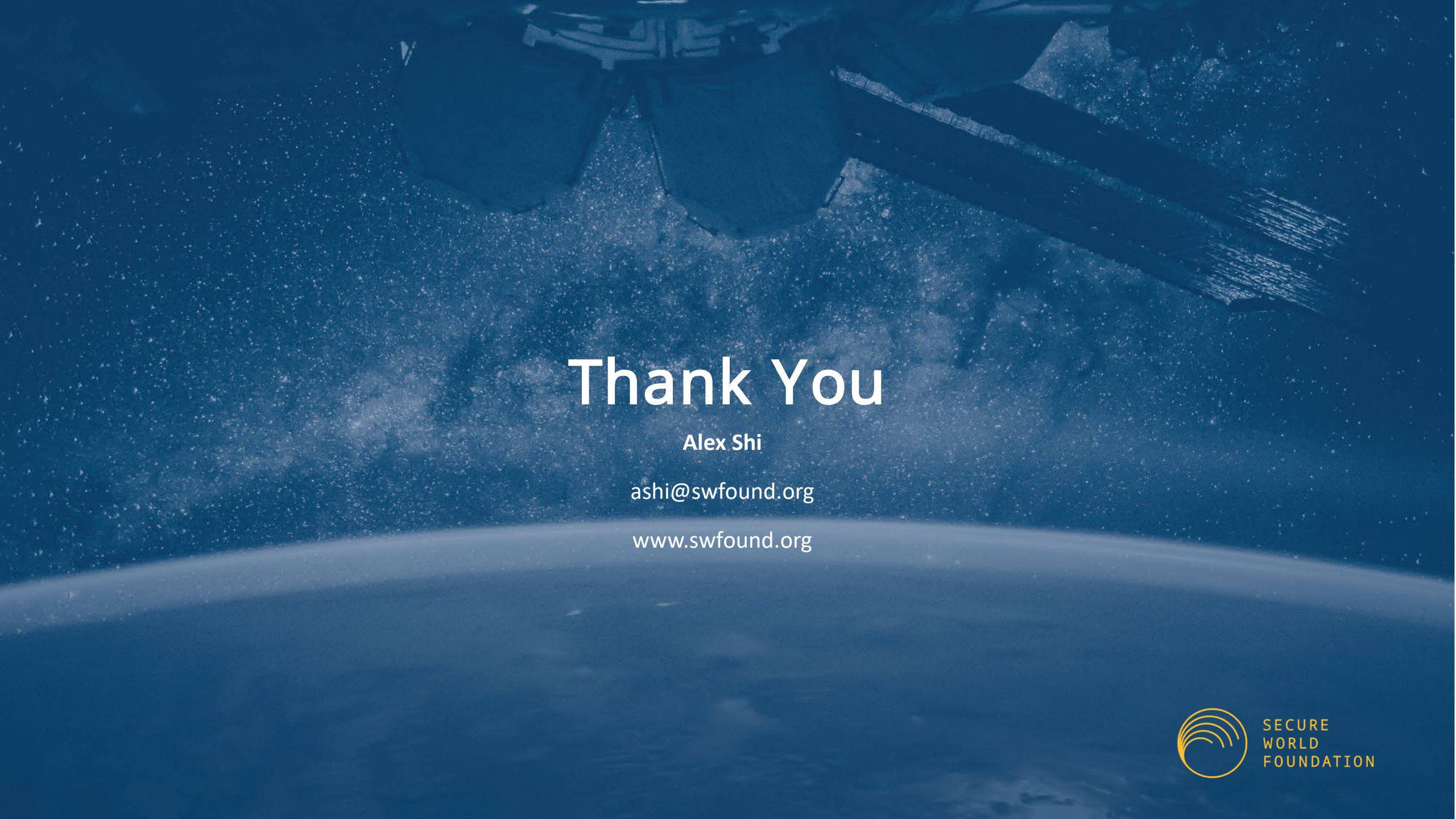
- Need to **address first-mover disadvantage** and design real non-compliance costs
  - Condition market access on meeting minimum standards/requirements
  - Reciprocal recognition of national standards may build convergence more quickly
- Establish **policy/funding mechanisms for beneficial activities** not yet commercially viable at scale, e.g.,
  - "Basic" SSA services
  - Debris remediation (need to consider jurisdictional limits)
- Role of **insurance** as a market instrument? Need policy backing

4. Ensure institutional processes are designed for adaptation

- Difficult for international governance – few successes
- Not realistic to change COPUOS consensus model; consider **separating technical and political tracks**
  - Identify specific areas for standard-setting / assessment and delegate to expert bodies
  - Focused/single-issue expert groups move faster (e.g., update post-mission disposal timeline) – SSA Expert Group model is promising
- **Polycentric** governance: Outside COPUOS, more targeted processes may address some bottlenecks
  - **Minilateral/bilateral arrangements** between willing states – avoids "lowest common denominator" problem
  - **Private frameworks, industry CoC** – reaches commercial operators directly

Conclusion: Is space governance without precedent?

- Not entirely – some **principles of governing other commons transfer well** (e.g., scope, leverage, incentive alignment)
- But space shares challenges present in other commons that are not fully resolved
  - **Defection by powerful or structurally insulated actors** (e.g., sufficient domestic market) remains a persistent vulnerability
  - **International governance** instruments and processes **take time**
  - **Commons are becoming more coupled** – e.g., impact of climate change on fisheries, or spacecraft re-entry on the atmosphere – introducing new complexities
- And some challenges *are* unique to space
  - **Pace** of commercial growth
  - **Dual-use** potential of space technology – difficult to separate civil sustainability considerations from **security** interests; some conversations harder to initiate
- No panacea from experience governing other commons, but some actionable takeaways



Thank You

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Acronyms

BBNJ	Biodiversity Beyond National Jurisdiction
CDM	Clean Development Mechanism
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CoC	Code of Conduct
COP	Conference of the Parties
EEZ	Exclusive Economic Zone
EO	Executive Order
EU ETS	European Union emissions trading system
FAO	Food and Agriculture Organization
GHG	Greenhouse gases
ICJ	International Court of Justice
ICRW	International Convention for the Regulation of Whaling
IPCC	Intergovernmental Panel on Climate Change
ISA	International Seabed Authority
ITQ	Individual transferable quota
ITLOS	International Tribunal for the Law of the Sea
IWC	International Whaling Commission
MOP	Meeting of the Parties (to the Montreal Protocol)
MRV	Measurement, reporting, and verification
NDC	Nationally Determined Contributions
ODS	Ozone-depleting substances
PSMA	Port State Measures Agreement
REDD+	Reducing emissions from deforestation and forest degradation in developing countries
RMFO	Regional Fisheries Management Organization(s)
SSA	Space Situational Awareness
TEAP	Technology and Economic Assessment Panel
UNCLOS	United Nations Convention on the Law of the Sea
UNCOPUOS	United Nations Committee on the Peaceful Uses of Outer Space
UNFCCC	United Nations Framework Convention on Climate Change
UNFSA	United Nations Fish Stocks Agreement
WMO	World Meteorological Organization
WTO	World Trade Organization

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