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Book review

Who Owns Outer Space? International Law, Astrophysics, and the Sustainable Development of Space, Michael Byers, Aaron Boley. Cambridge University Press, Cambridge (2023). 300 pp $37 paperback

Who Owns Outer Space? a book co-authored by astrophysicist Aaron Boley and lawyer and political scientist Michael Byers, provides an in-depth account of the grand challenges arising from human space activities. Winner of the 2023 Donner Prize for the best public policy book by Canadians, this book is written in lucid prose, making it widely accessible while maintaining the rigor of an excellent academic work. Switching between narrative and expository styles, the book gives a gripping account of humanity's fascination with space, its immense benefits, the problems arising from its overuse, and the role of multilateralism in overcoming these challenges. As the book suggests, outer space and Earth constitute a single interconnected environment, and with the 2025 International Court of Justice's advisory opinion on states' obligations regarding climate change, the time is ripe to renew dialogue on integrating space into global environmental politics.

Grounded in international space law, which provides that exploration and use of space is the province of all humankind and prohibits national appropriation of space, the book explores the grand challenges arising from the rapid expansion of human space activities. The authors examine in detail certain space activities: space tourism (Chapter 1), mega-constellations (Chapters 2–3), abandoned rocket bodies (Chapter 4), space mining (Chapter 5), planetary defence (Chapter 6), space security (Chapter 7), and anti-satellite weapons (Chapter 8). This forthright work also asks difficult questions. For instance, if the concept of safety zones in celestial bodies was incorporated in the US-led Artemis Accords merely for smoother coordination, why cannot states simply coordinate instead of creating such zones? Similarly, as the American company SpaceX controls large portions of the desirable low Earth orbit, should a single actor be allowed to occupy Earth's orbit to the extent that it effectively excludes other actors and prevents them from operating safely?

Unlike most existing related works, this book adopts a transdisciplinary approach, driven by the authors' conviction that understanding the grand challenges of outer space requires integrating diverse perspectives, including international law, international relations, and astrophysics. Any legal and policy solution for outer space activities must be grounded in a firm understanding of physics and an acknowledgement of the limits of human knowledge. The book debunks the myth that space is too big by drawing on an analogy with the plastic crisis in the oceans, noting that if enough pollutants are carelessly discarded, even the "largest environment will become overloaded" (p.7). Moreover, orbiting satellites continuously move through space, causing multiple opportunities for interactions with other space objects and potential conjunctions. Space is a classic case of "tragedy of the commons," where individual actors refuse to take responsibility for problems in a shared environment while expecting others to do so. The book argues that, amid the Russia-Ukraine conflict, growing tensions among major space powers, the impending retirement of the International Space Station, recent anti-satellite weapon tests, rising cyber-attacks on satellites, and increasing private space activities, space governance is at a critical juncture.

The book reemphasises that outer space is not the Wild West but is governed by treaties and international customary laws, supplemented by principles adopted at various United Nations fora, state practices, and scholarly writings. Yet, the current governance regime is ill-equipped to deal with the sudden spurt of human space activities, and tighter regulations are needed. These regulations should be reached multilaterally through the participation of all states, fostering cooperation and discouraging free-riding. The authors caution against unilateral decision-making and the dominance of one or a few actors, noting that future space regulations will emerge from negotiations in which space actors seek to establish "the strongest possible negotiating positions" (p.4). They also urge national space regulators to exercise adequate oversight over their private space activities, respect international laws, and ensure that decisions regarding space activities are made after careful deliberation and analysis of future implications. For example, they criticise the 2019 private Israeli mission that carried tardigrades to the Moon, introducing lifeforms in a celestial body without any clear purpose and potentially endangering humanity's search for extraterrestrial life.

The book underscores that while advanced technologies, such as autonomous collision avoidance systems, resilient satellite designs, and on-orbit servicing, can partially address certain grand space challenges, they cannot eliminate all risks. These technological "fixes" are neither entirely error-free nor do they fully address the additional challenges that arise with their use. In short, the book calls upon space actors to cooperate and act responsibly, emphasising that no technological solution can fully resolve the stress on the space environment or the fundamental problem of overuse. The authors believe that regulations, when designed effectively, do not restrict commercial enterprise and can maximise the potential for long-term growth of human space activities.

Despite its strengths, the book fails to address the problem it sets out to answer: *Who owns outer space?* The grand challenges identified and the solutions proposed are not centred on "ownership" of outer space, but rather on the freedoms and restrictions of its exploration and use. Another shortcoming is that certain deductions seem overly speculative, and even when informed by the authors' expertise, the reasoning behind some conclusions is not always clear to the reader. For instance, the authors suggest that SpaceX's decision to move a significant portion of its operations from California to Texas represented a subtle signal to the

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US government that the company could potentially relocate its operations abroad. While this observation is insightful, it also leans towards speculation. Similarly, the book suggests that Virgin Galactic does not provide pressurised spacesuits for crew or passengers on its sub-orbital flights, possibly to demonstrate that space travel is routine, as was demonstrated in the 1968 science fiction movie 2001: A Space Odyssey. Yet, Virgin Galactic's statements and documents do not explicitly suggest that the company deliberately compromised safety for aesthetics or optics. While space safety remains crucial, use of pressurised spacesuits should not be mandated solely because they have been traditionally used by astronauts. Although the authors' arguments here may reflect their extensive expertise, it is unclear how they concluded that Virgin Galactic's decision to forego such suits is irresponsible. Another significant omission in the book is the lack of perspectives from emerging space nations, including their state practices and specific challenges. The inclusion of perspectives of emerging space nations could have significantly improved this work, especially since it is rooted in the principle that exploration and use of outer space should be for the common benefit of all.

In conclusion, this meticulous work makes space studies accessible to a wide audience and is likely to spark the interest of many. By employing narrative elements in several places and connecting space research with popular culture—including films like *The Fifth Element*, *The Martian*, and *2001: A Space Odyssey*—the authors broaden the book's appeal beyond traditional academic audiences. However, incorporating cultural references from Asia, Africa, and Latin America could have further enhanced its resonance and inclusivity. While the book highlights the significant benefits of space, it also warns against underestimating the inherent dangers of human space endeavours. This book is a call for continued global cooperation and developing tighter multilateral regulations to govern increased human space activities.

Declaration of competing interest

The authors, hereby, declare that they do not have any known conflicts of interest or relationships that might affect the findings reported in this paper.

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