Addressing Global Governance Gaps in Planetary Defense

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1 Introduction

Planetary defense deals with the threat of impacts by dangerous asteroids and comets, also named as near-Earth objects (NEOs), and the means of their discovery, monitoring, characterization, deflection, or impact disaster management. From the global governance perspective, it is a nascent and highly technical area. Notwithstanding, that is precisely the reason to look critically into the limits of its contemporary governance model. Besides the biannual Planetary Defense Conference, which allows scientists and public officials to practice scenarios of an incoming asteroid, in 2014 the United Nations General Assembly (UNGA) endorsed the creation of a dedicated international expert body, the Space Mission Planning Advisory Group (SMPAG), and the International Asteroid Warning Network (IAWN). SMPAG meets biannually to prepare processes for an international response in case of an asteroid threat and to "exchange of information, development of options for collaborative research and mission opportunities, and to conduct NEO threat mitigation planning activities."[1] The group has established a work plan, which deals with the selected communication, technical, policy, and legal issues of international planetary defense collaboration. Its membership is made of 17 national space agencies or authorities, and the expert group reports to the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). SMPAG works closely

[1] See "Terms of Reference V2.0 – SMPAG – Cosmos." https://www.cosmos.esa.int/web/smpag/terms_of_reference_v2

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with the IAWN, which coordinates NEO monitoring campaigns and shares information among 30 observatories and entities across the globe.

Within the SMPAG, nation-nominated experts are tasked with completing an adopted 11-item work plan. Although SMPAG's role is solely advisory, there are no established international decision-making mechanisms or governance frameworks for planetary defense. The SMPAG Legal Report discusses the international legal framework of planetary defense[2] and also mentions possible ad hoc decision bodies for planetary defense. The report cites the United Nations Security Council (UNSC), the United Nations General Assembly (UNGA), and the COPUOS as the potential existing bodies and also mentions the possibility of establishing an ad hoc decision-making body for planetary defense. Building upon the report, this chapter makes several arguments about the ill suitability of the existing UN framework for global governance of planetary defense. These failings are primarily due to its low effectivity, inclusivity, and thus sustainability. We then turn to suggest principles upon which an ad hoc decision-making body for planetary defense could be established and address the global governance gaps of the UN framework. Our proposal depends on the willingness of small states to become advocates of a change in which they join cosmopolitan and local responsibility together.

2 Global and Unpredictable Threat

Before taking on the governance discussion, we need to underscore some key characteristics that define the asteroid threat. We will focus on the description of two key aspects of planetary defense, its globality, and uncertainty. Firstly, the risk of large NEO of 1-km diameter or larger, which would cause a global catastrophe or even extinction, is generally considered low, with nearly 80%[3] of those circling our planet already discovered. The main risks lie in the estimated undiscovered NEOs that are unlikely to cause a global event but can essentially hit anywhere with significant local consequences. In the estimated total NEO population, the undiscovered objects account for 0.2% in the 1-km or larger category, 7% in the 300–1000-m category, and 54% in the 140–300-m category. From these estimates, the main threat of an asteroid impact is the undiscovered 140-m or larger objects that amount to 25,000.[4] Since asteroids are discovered by observing the sunlight reflection on their surface, this requires them to be in opposition of the Earth and the Sun to be observable.

[2] See Ad-Hoc Working Group on Legal Issues to SMPAG. 2020. "Planetary Defence Legal Overview and Assessment." https://www.cosmos.esa.int/documents/336356/336472/SMPAG-RP-004_1_0_SMPAG_legal_report_2020-04-08.pdf

[3] It is necessary to say that all the percentages are derived from statistical projections of total asteroid populations, which is causing discrepancies between projections. For example, the Minor Planet Center mentions 98% of discovered asteroids >1 km.

[4] These numbers were presented on behalf of the IAWN status report in March 2021.

Asteroids spending most of their time between the Sun and the Earth are nearly impossible to detect from the ground.

The second key characteristic is the difficulty of predicting the impact area of the objects. Even small uncertainty in an object's trajectory, rotation, size, or density makes predicting impact areas very difficult. Once a potentially dangerous NEO has been discovered, it requires follow-ups and additional observations to confirm its trajectory and rotation and estimate its size and shape. This can prove complicated without effective cooperation because the opportunity to observe it can pass quickly. Nighttime observation of sunlit NEOs can be disrupted by bad weather or air moisture or promptly deteriorate if the asteroid passes away from the Sun. Observing the reflected sunlight from the NEOs' surface on the night sky is not only a way to discover them but also for estimating their size. The measurements based on the absolute magnitude of their brightness (H) and the ratio of the surface's light reflection (albedo) only allow us to estimate their size only in wide ranges, which complicates further the impact prediction (Crowe, 2019).

An option to lower the uncertainty is a flyby or rendezvous mission to a NEO. Mission viability depends on rocket launch opportunities at the time the NEO passes through an area reachable by Earth-launched probes. Using standby prospecting satellites, either placed on a Lagrange point in space or prepared to be quickly deployed from Earth, can allow us to directly prospect a hazardous NEO. However, these options remain to be studied and would take years to prepare and deploy. The predicted area of impact remains to be mainly defined by the NEO's orbital plane of intersection with the Earth. Without sufficient knowledge about size and density, more detailed impact information is difficult to gather. This means that impact predictions are made in the form of an impact corridor that can span thousands of kilometers horizontally across Earth but be only hundreds of kilometers wide (Rumpf et al., 2019). Therefore, the underlying characteristic of planetary defense is that while all countries are threatened, the eventually predicted impact corridor will likely include only several countries, and the final impact will be at one area. This dynamic is essential to consider when looking at the contemporary global governance mechanisms in which several countries decide over the rest of the globe.

3 Global Governance Issues

The question of how humanity can manage itself in the face of complex planet-wide issues has no easy answer. Governance of any form is faced with complicated dilemmas. One of the most notable ones is the dilemma between effectivity (effective problem-solving) and inclusivity (inclusive participation) (Dahl, 1994). Exclusive governance of a small number of decision-takers can offer effective decisions and quick consensus. An epistemic authority can justify its decision upon scientific objectivity and claim it can deliver the most effective and evidence-based solutions. Yet effectivity or science themselves are not sole sources of legitimacy. They do not make up for inclusivity and representation. The trade-off in favor of

exclusive decision-making comes at the expense of ignoring the interests of the excluded and in effect undermining the acceptance of such authority, its decisions, and thus effectivity of such governance. On the other hand, inclusivity (meaning representation) can come at the costs of making consensus impossible and even lead to irrational but popular decisions in choice-insensitive areas, where personal preferences play little importance in choosing the right solution. The benefits of inclusive decision-making are that a person's true interest to decide in their own best interest does not guarantee they have the knowledge and capability to actually do so. These dilemmas are even more problematic to address on the global scale and highly technical field of planetary defense.

3.1 Governing by Criticality and Scientific Authority

Planetary defense is a highly technical area that encapsulates astronomical observations, orbital calculations, the geology of NEOs, space engineering, rocket science, and emergency management and disaster relief. Therefore, we could assume that to successfully detect and deflect a threatening NEO, so-called PHO – potentially hazardous object – science will give us all the answers and solutions. Another assumption comes from the idea that once humanity faces a global challenge of such astronomical proportions, we will pull together, throw away our differences, unite under our shared enemy, and realize our shared civilizational fate. Planetary defense thus ought to be governed by scientific objectivity and unbiased criticality to protect humanity. However, we should view these simple assumptions skeptically, especially in light of the recent pandemic. Criticality and scientific authority are not sufficient sources of legitimacy or best problem-solving, especially in the existing international political environment.

When a critical situation occurs, for example, the recent pandemic, a state of emergency or exception is declared in many countries, suspending normal political processes due to the crisis in favor of quick and effective problem-solving. Emergencies are generally viewed as acceptable circumstances to prioritize effectivity over deliberative and inclusive decision-making. This also happens on the international level. During the 2003 SARS-CoV-1 epidemic, the World Health Organization (WHO) relied on criticality and scientific justifications to extend their competencies. This included never before seen power moves by the WHO, namely, (a) public naming and shaming of countries that did not comply with the WHO guidelines in contrast with the previous WHO policy not to directly criticize its member states and (b) issuing explicit travel warnings for affected territories, in contrast to never been given such a mandate to do so in the past (Hanrieder & Kreuder-Sonnen, 2014). These developments have led some to a conclusion that scientific objectivity can in times of emergency provide the authority and justification for needed international measures that might go against national interests. States themselves retrospectively accepted and therefore legally validated such broadening of powers of an international organization at their expense, which

ultimately improved global governance. What certainly helped the case was the empirically widely shared recognition of the seriousness of the threat, the common interest in containing the virus, and the prevalent trust that the WHO was well equipped to deal with it (Maffettone & Ulaş, 2019).

However, in 2020 the reactions to the next SARS outbreak, this time a SARS-CoV-2 pandemic, were different, and neither scientific authority nor criticality provided authority strong enough to prevail over national interests. The behavior of many states, including China and the USA, in defiance of the WHO guidelines or in an attempt to influence WHO communication during the ongoing SARS-CoV-2 pandemic, proved a different global dynamic. It was the nation-first approaches to vaccinations and personal protective equipment as well as abrupt border closures that characterized the international response. Nations and even alleged allies would compete between themselves to secure deliveries of the biggest amounts of vaccine productions, seize companies with valuable intellectual property, ban exports of vaccines to other places, or shield patents of life-saving vaccines from the worst-hit nations. Deliveries of scarce personal protection equipment, swab tests, and later vaccines have become tools of the geopolitics of the big powers. Vaccine diplomacy saw nations trying to gain political influence with exclusive deliveries, ultimately weaponizing knowledge and technology for national interests. The scientific discussion about the origin of the SARS-CoV-2 virus was overtaken by a war of accusing narratives between nations.

Such experiences cannot be overlooked and provide critical lessons for the discussion about planetary defense. Moreover, they illustrate the limits of the belief that scientific objectivity or global criticality can enable strong global action, strengthen the role of international institutions in solving global challenges, and tame the rival nationalistic nature of nation-states. Instead, scientific objectivity and criticality became geopolitical weapons. There is no reason to believe that an asteroid threat would produce different reactions, especially given the existing international coordination of planetary defense. The UN-mandated SMPAG and IAWN bodies provide a global epistemic authority for planetary defense, with exhaustive and excellent expertise on all aspects of planetary defense. Three threshold criteria warrant different actions from the SMPAG and IAWN bodies.[5] The first one is an IAWN notification for the SMPAG for all objects with an impact probability above 1% and diameter higher than 10 m or a measured brightness magnitude of 28. The second one warrants terrestrial preparedness and determination of an impact corridor in the case an object larger than 20 m or brighter than magnitude of 27 reaches impact predictability higher than 10% within the next 20 years. The third threshold triggers the SMPAG to plan characterization missions and actions for objects with impact predictability above 1% and larger than 50 m in diameter or brightness magnitude of 26 within the next 50 years. However, there are caveats.

[5] See Recommended Criteria & Thresholds for Action for Potential NEO Impact Threat. https://www.cosmos.esa.int/documents/336356/1879207/SMPAG-RP-003_01_0_Thresholds%26Criterion_2018-10-18.pdf/58eb84ae-e3b6-1b08-9465-d25c548c5c9b.

The IAWN body puts together only 30 participants, including mainly individual observatories and only five space agencies. The IAWN relies mainly on the data of the Minor Planet Center (MPC), the single worldwide database and analytical hub of NEOs, which falls under the International Astronomical Union. However, despite its high precision, excellent capabilities, and openness, the MPC is funded by NASA, the US space agency, and its data consists almost exclusively from the US observational sensors (Spahr, 2014). For example, Russia (only a SMPAG member) runs its own Planetary Defense office that produces authoritative NEO observations outside of IAWN or MPC. The lack of data sharing and integration can lead to the emergence of different epistemic realities, meaning that different sensors can produce slightly different observations. Such discrepancies can then be easily exacerbated by the security sensitivity of planetary defense and used for national purposes. Just as the data and science put forward by the WHO or top peer-reviewed medical journals did not provide fully credible and respected epistemic authority during the SARS-CoV-2 pandemic, any convincing scientific arguments proposed by the SMPAG, IAWN, or MPC can be challenged. Without an adequate representation and inclusivity, the recommendations of UN-mandated planetary defense scientific authorities in the form of SMPAG and IAWN can be either rejected by other observations or also subjected to the influence and interests of the dominant actors producing them.

Furthermore, in the case of fast-approaching objects, the absence of precise decision-making mechanisms opens the door for a complete suspension of any inclusive political process. The design and nature of prospecting or deflecting missions could become a tool for gaining political influence over most threatened areas. We could even assume that the specific trajectory of the threatening object could be blamed on a rival nation. Therefore, scientific objectivity nor criticality cannot be considered as sufficient sources of authority for global governance of planetary defense. An element of inclusivity, in terms of adequate representation, is required; it would be the existing exclusive and nationally oriented environment shaping the recommendations.

3.2 Inclusivity and Effectivity in the UN Framework

While we cannot assume that scientific authority and criticality will provide the necessary authority for planetary defense governance, we need to consider whether the inclusivity of the UN would provide acceptance and legitimacy for such governance or in other words sustainability, resilience, and geopolitical stability. However, the problematic nature of the global security architecture and the related shortfalls of the UNSC and UNGA are rather a significant source of geopolitical instability. An asteroid threat can exacerbate the growing irrelevance and instability of the UN framework challenged by the tectonic shifts of power in the world. This shift is represented by the weakening of the post-WWII Western dominance, overall power shift from the West to the East, the proliferation of powerful technologies (space,

nuclear, cyber, AI, biotech) that undermine the exclusive legal possession of a nuclear weapon as the ultimate source of the power of the UNSC permanent members, and the increasing geopolitical multipolarity (with the rise of new state and non-state actors). This section thus critically looks at whether the existing UN framework can provide the necessary inclusivity and effectivity for planetary defense decision-making.

3.2.1 United Nations General Assembly

The United Nations General Assembly (UNGA) consisting of all 193 member states can be considered the most representative body in the UN framework for decisions of planetary proportions. In the dilemma between inclusivity and effectivity, the tilt is clearly towards the former. The UNGA resolutions are not binding. Theoretically, UNGA decisions' legitimacy is compensated by the more inclusive and representative nature of the body.

An essential part of decision-making is informed consent. The complexity of planetary defense means that if presented with information, not all member states would have the capacity to unpack the issue, analyze their situation, and decide what position is in their best interests. In cases of uneven access to information, countries can be heavily influenced by bigger powers. In the area of space activities, the UNGA's Committee on the Peaceful Uses of Outer Space (COPUOS) serves as a specialized expert forum. This is where the SMPAG would warn the international community and recommend adequate measures to address an asteroid threat, should it cross defined thresholds warranting an action, according to the thresholds described above. With the COPUOS consisting of only 95 members states, without the participation of wide regions of sub-Saharan Africa, Southeast Asia, or the Balkans and the Baltics, the access to this critical knowledge and development of national capabilities to understand such threat is certainly limited, hard to be considered inclusive or accessible. And suppose the COPUOS puts forward such warnings and recommendations to the UNGA plenary. In that case, decision-making processes in the UNGA would also be problematic due to the disproportionate distribution of votes across the global population.

The disproportionate distribution of votes in the UNGA between different parts of the world results in an inappropriate representation among populations within the contemporary nation-state system. Since votes of countries like China, India with their billion-plus populations, and small Pacific, Caribbean, or European nation-states with populations in tens of thousands, are given equal weight, security interests or even survival of all areas and peoples are simply not included equally across the globe. Issues of general nature require a simple majority approval; resolutions concerning security require a two-thirds majority to pass. A simple majority in the UNGA can be formed by small states representing only 3.5% of the world population, and two-thirds can be made up only by 8.6% of the world population. While such a scenario is rather theoretical, big powers are very skilled in garnering the support of small countries for their interests at the UN, and given the large

disproportion, the vast majority of the world population can be simply outvoted by the majority of some states at the UNGA.

As a result, the areas most threatened by a potential asteroid impact can be by design outvoted in this body. This systematic neglect of some of the most populous parts of the world undermines the legitimacy of the multilateral world architecture, in which such a small portion of the world population can outvote the vast majority. More dangerously, it means that some portions of the world can be outright ignored in case of an asteroid threat, resulting in the globally limited resources, space capabilities and planetary defense missions, and efforts to protect only the areas with stronger voice and representation in the UNGA. This carries serious risks of geopolitical instability on which we deliberate later on. In the question of effectivity, the UNGA produces only non-binding resolutions unlike the UNSC that could therefore have more direct power in planetary defense governance.

3.2.2 United Nations Security Council

Despite the clear trade-off between effectivity and inclusivity in favor of exclusivity, the UNSC can hardly be considered an effective decision-making body on international security topics. And even though UNSC resolutions are legally binding and could supersede any international treaty or international legal obligations, finding consensus among the five permanent members (P5) of the UNSC or specifically, among their diverse interests, is unique.

During the Cold War period of geopolitical bipolarity, consensus could be achieved by power balancing between the USA and USSR and their shared interest of preventing dominance by the other. The brief period of unipolarity following the fall of the Soviet Union and the Communist block did open up possibilities for a more active UNSC. The tragedies in the Balkan Wars or the Rwandan genocide have tilted the balance between sovereignty and human rights as the building blocks of the UN system towards the latter. Yet the resulting new international doctrines with global good and human rights protection at their core, such as the Responsibility to Protect (R2P), remained to be governed and decided on by the national interests of the permanent member states of the UNSC. This is a design flaw of the system built on nation-states. The prime example of this is the abuse of the R2P norm in the case of the 2011 Libyan intervention, in which a globally accepted humanitarian goal to protect civilians in Libya was used for a specific political goal of the intervening UNSC permanent members – the regime change in the country.

Without adequate global inclusivity, even globally good intentions fall prey to particular interests, as was the case with the R2P. Even a global norm for a global good cannot be truly pursued in an environment defined by national interests. Even universalistic norms, however noble they are, depend on the surrounding political dynamic. In the UNSC, this dynamic is characterized by the privileged permanent members, who will continue to maintain their privilege at any cost. The P5, representing roughly 25% of the world population, remains the ultimate decision-makers of the body thanks to their veto powers and also superior knowledge of the system

and its processes and procedures. The exclusivity of the UNSC decision-making is not limited to the veto power itself; it also extends to operating procedures, where the elected UNSC members do not possess the procedural, practical, negotiating, and institutional experiences and knowledge in the Council (Tourinho et al., 2016).

Further, the UNSC members define what the exceptions to the normal political process are through strategic negotiations between their national interests (Rychnovská, 2014). The exclusivity of the United Nations Security Council in its effect leaves up security and survival of all nation-states in the hands of the five permanent members. The securitization in the UNSC is defined by its legal and institutional setup, thus by the P5 countries. Suppose a globally beneficial intention to deflect a NEO on an impact trajectory with Earth is to be decided on in the UNSC. It will be subject to dominant national interests represented at the UNSC during the event. Those systemic forces would trump any honest effort that would genuinely, most effectively, and legitimately protect states and peoples within the impact corridor but outside of the UNSC.

Despite its exclusivity, it is the UNSC that remains the main global decision-making body on security issues, whose resolutions are binding. National interests and constituting national politics of permanent UNSC members are the deciding factors over global security. All parts of the world outside the P5 constituency and territory are thus left without their voice, importance, and equal consideration. This setup, combined with the changing geopolitics, global distribution of power, and the rise of new state and non-state actors, risks creating instability instead of successfully defending the planet from NEOs.

3.2.3 Sources of Geopolitical Instability

The exclusion of some actors from the process can leave decisions over the planetary defense to be viewed as a threat to those left out from the process since they would not possess any means to affect the decisions taken. With the absence of any guaranteed direct participation over questions of the nation's survival, areas along the impact corridor will seek to ensure their survival through different means and ways if the situation occurs, especially since every country has the responsibility, obligation, and right to protect its own territory, population, and sovereignty. Without participation, the endangered left-out actors are stripped of any tools within the realm of the international rules-based order to protect themselves from harm and in the case of small or centralized countries possibly even an existence due to the asteroid threat. States left out from the decision-making process would seek to create or find new means through which their vital interests would be protected.

In the past, the consequences of exclusion from decision-making over global issues affecting all could be mitigated within the bipolar or unipolar geopolitical environment. The contemporary multipolar division of power is much less stable and is more vulnerable to such turbulences. An exclusion from planetary defense decision-making of any country subject to serious asteroid threat along the impact corridor would invite aspirants for more global power to cater to those excluded.

Regional powers with space-faring capabilities that are left out of the UNSC system or underrepresented within the UN could seek to formalize their global status and pursue their own planetary defense mission. The motivation would be to seek the legitimization of their global weight and gather international support by catering to the disenchantment of other left-out nations. Nascent regional space-faring powers with global aspirations could guarantee planetary defense protection to those left out. Similarly, nuclear-armed nations guarantee protection to other like-minded non-nuclear states. The dual-use nature of deflection technology, including launching capability, rendezvous, and proximity operations or kinetic impacts, would make this a question of military strength.

The main negative consequence here is the emergence of rival planetary defense efforts. The exclusion of any actors in combination with the shifting distribution of power and ill-representation of the UN framework would simply lead them to seek another way to secure their vital interests. The dual-use nature of the planetary defense technology needs to be considered here. Heavy launch vehicles for space exploration during the Cold War were a tool to develop the most powerful intercontinental ballistic missiles, and planetary defense technology also has significant dual-use potential. The risk is not necessarily that North Korea or Iran would find further legitimization of their development of ballistic missile or nuclear device technologies; the risk is that other countries would be pushed to follow in that direction if they were serious about ensuring safety for their own population. Such a development in the area of planetary defense would lead to the ultimate weaponization of space.

Overall, the exclusivity but also ineffectiveness of both the UNSC and UNGA make the existing frameworks very problematic for planetary defense decision-making. Given the direct linkage to national security and even nation's survival can lead to an emergence of rival planetary defense missions, their ineffective overlapping, mutual disruptions of deflection or prospecting missions, and in general severe geopolitical instability with wider global implications in all areas. Groups of nations lying along an impact corridor but without adequate space-faring capabilities would invite actors to tame them into their own planetary defense protection. Due to the uncertainty over the impact areas for a long period of time, possibly decades until either observation opportunities arise or a prospecting mission is deployed, this process can be very gradual. Furthermore, the exclusive nature of the UNSC rests not only on the results of the Second World War but also on the only legal but arguably illegitimate possession of nuclear weapons by the P5. This itself carries serious consequences for the prospects of using nuclear weapons for deflection, which due to the inequality in their possession represent a clear limit for the global capability to defend humanity from NEOs.

3.2.4 Existing Governance Barrier for Planetary Defense

One of the areas where the gap in the global governance of planetary defense already limits our ability to defend the Earth from dangerous asteroids and comets is the use of a nuclear explosive device (NED) as means for deflection. While the question of technical benefits and negatives of NED deflection of rocky and often porous asteroids remains the subject of rigorous scientific debates, the utility of NED lies especially in its potential to deflect fast-approaching comets, for which we have fewer tools to address. However, the use of a nuclear explosive device to deflect a NEO could be a source of much more negative consequences on global security and the international order than the impact of a non-extinction size object. While the legal use of nuclear explosive devices for planetary defense is prohibited under international law according to the SMPAG Legal Report, in particular circumstances of consent, distress, and necessity, non-compliance with these treaties could be potentially accepted. Despite this potential loophole in the legal framework for the use of NED for planetary defense, there are no loopholes in the normative framework of the non-proliferation regime. A failure to either immediately reject the use of a NED within the existing global governance framework or adopt a new globally inclusive treaty that approve its use, risks causing negative consequences that could further complicate cooperation of space-faring nations on the ground as well as on the Earth's orbit and cause larger societal and economic instability or disruption of global supply chains.

The reason is that a declaration of the intent to use a NED or its mere possibility risks a dismantlement of the current arms control and non-proliferation regime. It sends a signal that nuclear weapons are a legitimate and indispensable tool for ensuring the security, survival, and sovereignty of nation-states. In this regard, Smetana has put forward several arguments (Smetana, 2018). Firstly, the use of a NED would leave out states to be dependent on only five legally nuclear-armed nations – the five permanent members of the UNSC. Moreover, the use of nuclear NED not only carries the danger of political dependency on the group of five countries (the P5) but also undermines the global nuclear disarmament regime. The development and use of NEDs could undermine the fragile arms control and disarmament regime. Firstly, the peaceful use of nuclear technology described under the Non-Proliferation Treaty (NPT) Article V has never materialized. The principle was eventually dismissed by the NPT Review conferences and the 1996 Comprehensive Test Ban Treaty. Secondly, a NED would require testing, development, and production of new warheads, whose prohibition represents the cornerstone of the non-proliferation regime. The third key point made by Smetana concerns the way the NPT, as the main base of the global nuclear order, was made as a time-limited transformative regime with the goal of its permanent future extension from "nuclear equity" to "equality" of zero state in nuclear armaments (Smetana, 2015, 2018). The inherent conflict within the NPT between nuclear-weapon states and non-nuclear-weapon states would be exposed and demonstrated should the use of nuclear weapons be sanctioned for planetary defense. Despite its technical benefits, the associated risks exposed by international relations scholars beg the question of whether the use

of a NED for planetary defense would have more destabilizing effects than the impact itself. The severe consequence of the NED legitimization is that any state could justify the development and possession of nuclear weapons for the purpose of the protection of their sovereignty – as the building block of the international system – and the security and safety of their populations. Representation itself has a critical value for the resilience, diversity, and overall sustainability of the system. The implied negative consequence is that to ensure these essential interests of nation-states, the development and acquisition of nuclear explosive devices would be perceived as legitimate and required. The above-described perils and the potential breakdown of the non-proliferation regime and de-stigmatization of nuclear weapons testing, development, production, and use without a proper new normative regime represent serious negative consequences for the pre-launch preparation period. Yet, the effect of the use of a NED can be mitigated by inclusive and global decision-making free of other negative consequences described above.

4 Principles for Ad Hoc Planetary Defense Body

Given the criticism presented above of the existing global governance framework, the option of an ad hoc body for planetary defense mentioned in the SMPAG Legal Report should be explored in more detail. When and how and under what principles should the body be established needs to be clearly defined. Such topics ought to be subject to globally inclusive discussions, conferences, expert deliberations, and further research. Notwithstanding, we put forward some ideas on a way it could be approached.

We pointed out that the underlying source of the possible geopolitical destabilization in the current governance framework of planetary defense is the possible emergence of rival planetary defense efforts. This originates in the fact that the existing governance mechanisms underrepresent those affected by asteroid strikes. The impact corridor is unlikely to include only countries with space-faring capabilities or capacity to contribute to the planetary defense observations or deflection missions. Yet that would not justify their exclusion from the decision-making over the efforts. At the same time, member states with planetary defense capabilities cannot be expected to simply turn over their high-tech, dual-use, and expensive resources to those that are the most threatened.

A possible way around this is to have the most capable nations carry out the planetary defense efforts but for those efforts to be finally managed, governed, and sanctioned by an ad hoc body made up of the most affected areas. This would mean areas along the impact corridor or threatened coastal areas in case of an impact in the ocean. With the main NEO hazard being in asteroids between 140 and 1000 m, or so-called city killers, the most affected areas would be cities and urban areas. For this reason, the ad hoc body should be made of areas represented proportionately based on their population along the impact corridor or potential impact wave to truly represent the affected populations. This stands in conflict with the UN

representative system based on "one nation, one vote." But because this underrepresentation is precisely the source of geopolitical instability, it needs to be addressed.

However, the complicated predictability of the impact area makes the question about who should have what to say in the topic very tricky. The predictions about the precise extent of impact corridors would decide about the inclusion of a certain area in the decision-making. What the magnitude of impact warrants an area to be included needs to be defined. An ad hoc body would have to be established based on the impact corridor estimates by the UN-mandated SMPAG and IAWN bodies, which have their own limitations mentioned above. The impact corridor estimates would define what areas and populations will get a say over the planetary defense efforts and which not. They can still be subject to intense geopolitical pressures. But if the parties involved in the ad hoc body would be based on the area's population size and not countries, the political play motivated by national interests would have significantly lower logic. With clear definitions at what point, based on what impact corridor estimates and with what proportional representation an ad hoc planetary defense decision-making body is established, planetary defense governance can be improved to avoid geopolitical instability and failure in defense of the planet Earth.

5 Cosmopolitan Metamorphosis

The globalized reality created by the rise of global risks and challenges is not a source of world's transformation but of its metamorphosis. Ulrich Beck describes it as not only a change of some parts of human civilization but as a complete change of its metaphysics (Beck, 2016). Ideas on how to react to it range from the rise of inward-looking nationalist populism to ideas of Cosmopolitan responsible states. In this regard, Anthony Burke as one of the key Cosmopolitan political scientists points out that the nation-state can never be truly good from the cosmic perspective, but it can at least do good (Burke, 2013). Acknowledging the limits of Cosmopolitan outlook on behalf of a country, whose authority as a political unit is defined by its service to territorially defined interests, is critical. It links directly with Ulrich Beck's Cosmopolitan vision and its principle stating that Cosmopolitanism without provincialism is empty, and provincialism without cosmopolitanism is blind (Beck, 2006).

Still, the need for change in global governance mechanisms in face of global threats is becoming imperative not only from the non-Western part of the world but also among the Western societies who have as the architects of the existing multilateral world order benefited from it the most. The recent tide of nationalism, populism, and strong resentment towards international cooperation and organizations has been correlated with the negative effects of globalization (Bearce & Scott, 2019). While global inequality has been decreasing, national inequality has been growing, explains Francois Bourguignon (Bourguignon, 2016), noting that the Gini coefficient in 1990–2010 rose by two points for all countries on average and by five percent in the USA only between 1990 and 2013. The vote against economic

globalization by some sectors of society that depend on it might seem to some as irrational, especially since it resulted in the election of politicians whose policies will be even more damaging to their voters negatively affected by globalization. But it is a representation of a very rational and substantial problem – the problem that globalization and technological progress does not bring equal benefits to everyone. Bruno Latour (2018), a renowned science and technology studies (STS) researcher, summarizes the issue by underlining the tensions between scientific decision-making and the demand of the popular voice by calling it "the habitual vice of epistemology, which consists of attributing to intellectual deficits something that is quite simply a deficit in shared perceptions." Unless there is an adequate element of inclusivity, scientific authority or criticality does not provide sufficient global legitimacy but also is subject to misuse. They can also be viewed as unjust and illegitimate, inviting wider social disturbance, incompliance, and instability. Basing representation on the specific details of the asteroid threat would be a step towards inclusivity in global decision-making.

The ad hoc governance model, which would give political representation and decision-making power over planetary defense to the affected areas and populations along the impact corridor rather than to established nation-states, could be seen as disadvantaging mainly small states that enjoy the same level of representation as the biggest ones in the UN. In a situation an impact corridor crosses small states but also populated areas of a large state, the representation of a bigger state would increase and lower the decision power of the smaller state relative to the "one state-one vote" principle. But it is precisely small states that mostly rely on (a) a functioning international rules-based order in their independence, political autonomy, and sovereignty and (b) geopolitical stability, so they do not become a mere battleground of competing influences of global powers. Developing functioning global decision-making mechanisms based on more inclusive representation would follow their long-term interests in preventing geopolitical instability or weakening of the international rules-based order. Therefore, the model of impact corridor-based representation is not built on the idea that countries can become enlightened and effectively globally responsible, as such expectation goes directly against the core logic of nation-states as territorially defined political units. Given the big voting strength of small nations in achieving any meaningful change, this approach depends on their ambition to pursue their own interests in the changing globalized world by ensuring global governance mechanisms remain stable and functional. Unlike world powers, small states realize more directly the dependence of their own interests on others and the entire world society. They are more directly affected by many global challenges, including the asteroid threat, and possess growing political, financial, and technological power due to growing urbanization. Small states pursuing their own interests are thus the embodiment of the provincialism becoming the main substance of cosmopolitanism in reaction to the metamorphosis of the world towards the global.

6 Conclusion

Scientifically complex questions or global issues are not excused from the need for representation and inclusiveness just because it is difficult. Quite the opposite. Representation is critical for both the effectivity and sustainability of global governance, to ensure that large swaths of the world population are not left out or that scientific authority is not used as a tool for advancing particular interests. The challenge here is not how to eliminate these considerations from the decision-making but how to ensure they translate into rational and justifiable decisions. Planetary defense is no different in this.

On the global level, the absence of inclusivity in addressing global challenges can easily backfire, especially as the global governance architecture based on the centuries-old system of nation-states meets the fragile modernity. The fast proliferation of technologies and empowerment of non-state actors or new non-Western powers as well as the rise of new global challenges meet the complete lack of effective or legitimate governance mechanisms, creating an explosive combination. An asteroid threat has the potential to inflate these factors out of proportion, leading to an overall uprooting of what we consider as a given world order. As a solution, this chapters hint towards an ad hoc decision-making model based on the actually affected populations and areas by the threat of asteroids. Conceptually, this means substituting nationality for impact as the main principle of representation in global decision-making. Small states are the suitable drivers of such change. They represent the decentralization of the international system towards more local political units amid increasing urbanization. Cosmopolitanism in this sense comes from the local in a bottom-up manner, not the other way around. Small states also possess significant voting strength in the international system. Lastly, an asteroid impact represents the biggest threat to densely populated urban centers. Simply put, just as we couldn't successfully deflect an asteroid based on the seventheenth-century physics and astronomy, we cannot deflect it based on the seventheenth-century political system of nation-states. In this regard, we put a heavy focus on inclusivity and representation that is not based on the old territorial categories of nation-states but on reality and functionality. The automatic creation of the ad hoc decision-making body for planetary defense based on the predicted impact corridor does not have to be always perfectly inclusive. It does, however, shift the decision-making away from the powerful towards those affected and offers a governance mechanism built on reality, functionality, sustainability, and not on history or pure distribution of power. Failure to settle these issues now will result in them being solved in an undesirable manner with undesirable consequences in the situation of an actual crisis.

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