
Leading on Global Planetary Defense Efforts

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The threat of a devastating asteroid or comet strike somewhere on Earth’s surface is perhaps the ultimate “low probability, high impact” event. Large asteroid strikes are rare over short time spans, but over the long term, they are essentially inevitable. As the potential for damage and devastation is large, the sustained expenditure of time and resources towards asteroid or comet strike detection, forecasting, and mitigation and response efforts is warranted. The United States should continue to lead cooperative global efforts in searching for potentially hazardous objects and for planetary defense preparation.

Background

Near-Earth Objects (NEOs) are defined as any object coming within 30 million miles of the surface of the Earth.¹ NEOs are usually solid objects from the main asteroid belt (between Mars and Jupiter), but can also be comets originating in the outer solar system which head towards the Sun. The entire population of NEOs is large,² but it is only the larger, *potentially hazardous NEOs* (a subset of the entire NEO population) that warrant action.

In 2005, Congress directed the National Aeronautics and Space Administration (NASA) by 2020 to find and characterize 90 percent of the predicted population of NEOs 140 meters in size or larger, which would threaten national and regional catastrophic damage if they were to strike the Earth. NASA estimates there may be as many as 25,000 such NEOs. As of March

2025, NASA has only detected about 44 percent of these objects and estimates that it will take until 2050 to accomplish the task. This shortfall is mainly due to limited funding and technology: finding and cataloging all of the remaining predicted NEOs of this size requires space-based telescopes, which can observe the sky without blurring from Earth’s atmosphere, allowing them to detect fainter, darker asteroids, especially those near the Sun, which are obscured in its glare when viewed from the ground.

Current Policy and Gaps or Shortcomings

Defending the Earth from space-borne catastrophes enjoys broad bipartisan support, as well as interest—and concern—from the general public. There are essentially two main activities in planetary defense:

¹ For comparison, the Moon is about 238,000 miles away from the Earth.

² NASA Jet Propulsion Laboratory, “All Known Asteroids in the Solar System (1999-2018)”, YouTube, July 23, 2018, https://www.youtube.com/watch?v=vfvo-Ujb_qk.

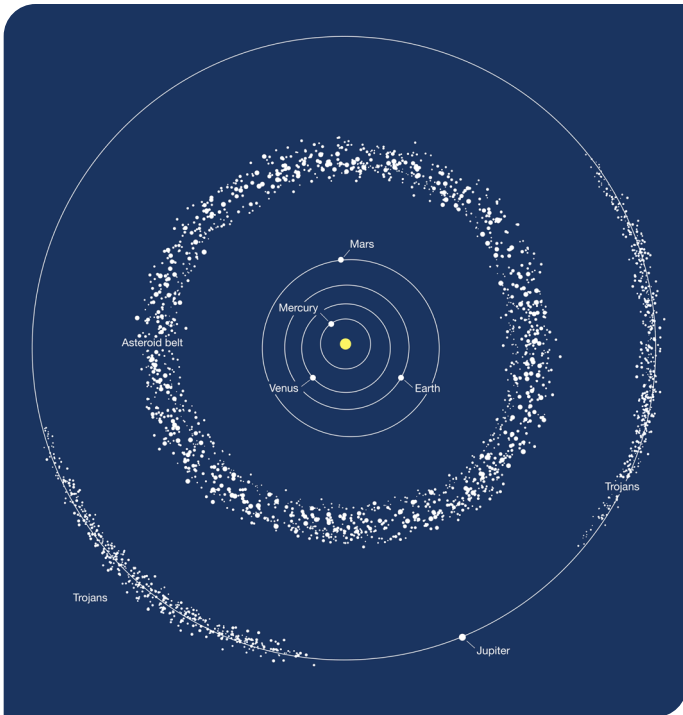


Figure 06 | This image depicts the two areas where most of the asteroids in the Solar System are found: the asteroid belt between Mars and Jupiter, and the Trojans, two groups of asteroids moving ahead of and following Jupiter in its orbit around the Sun.

Source: <https://sci.esa.int/web/hubble/-/59582-asteroid-belt>
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responding to impending threats from potentially hazardous NEOs. Once a NEO threat is found and predicted to come close to—or actually impact—the Earth with a certain degree of confidence, if there is sufficient lead time, action could be taken in space to divert the object. If diverting the object is not an option, actions could be taken on Earth to mitigate the effects of impact.

Space-based asteroid threat response requires international planning and coordination. The Space Mission Planning and Advisory Group (SMPAG) coordinates lines of communication and assessment of national capabilities for NEO threat response.⁶ Like the IAWN, SMPAG is merely a coordinating body. Active mitigation measures would be implemented by the countries that participate in IAWN and SMPAG. Apart from the technical challenges of diverting NEOs to avoid terrestrial impact, significant legal questions remain regarding any NEO redirect activities, including those of duties to warn and liability risks. In the case of large asteroids predicted to strike imminently and where there is insufficient time to mount a redirect mission, the only viable option may be to use a nuclear explosive device, although the international legality of such an option has yet to be agreed upon because of current restrictions on the placement of nuclear weapons in orbit.

potentially hazardous NEO threat detection and threat response. Detection of potentially hazardous NEO threats is the activity of detecting space objects and characterizing their orbits, trajectories, size, and composition.³ Threat detection is accomplished by observing the sky with both ground-based and space-based telescopes. The largest NEOs, which would threaten the most catastrophic damage, are also the easiest ones to detect and the majority have already been detected, but the catalogue of smaller NEOs is far from complete. NASA also coordinates with the Minor Planet Center,⁴ as well as with international partners at space agencies and observatories. Additionally, the International Asteroid Warning Network (IAWN) acts as a clearinghouse for new NEO discoveries.⁵

The second avenue of planetary defense deals with

³ NASA Jet Propulsion Laboratory, “How a Speck of Light Becomes an Asteroid,” June 30, 2017, <https://www.jpl.nasa.gov/news/news.php?feature=6888>.

⁴ International Astronomical Union, Minor Planet Center, last accessed March 5, 2025, <https://www.minorplanetcenter.net/>.

⁵ International Asteroid Warning Network (IAWN), last accessed March 5, 2025, <http://iawn.net/>.

⁶ European Space Agency, The Space Mission Planning Advisory Group (SMPAG), last accessed March 5, 2025, <https://www.cosmos.esa.int/web/smpag/home>.

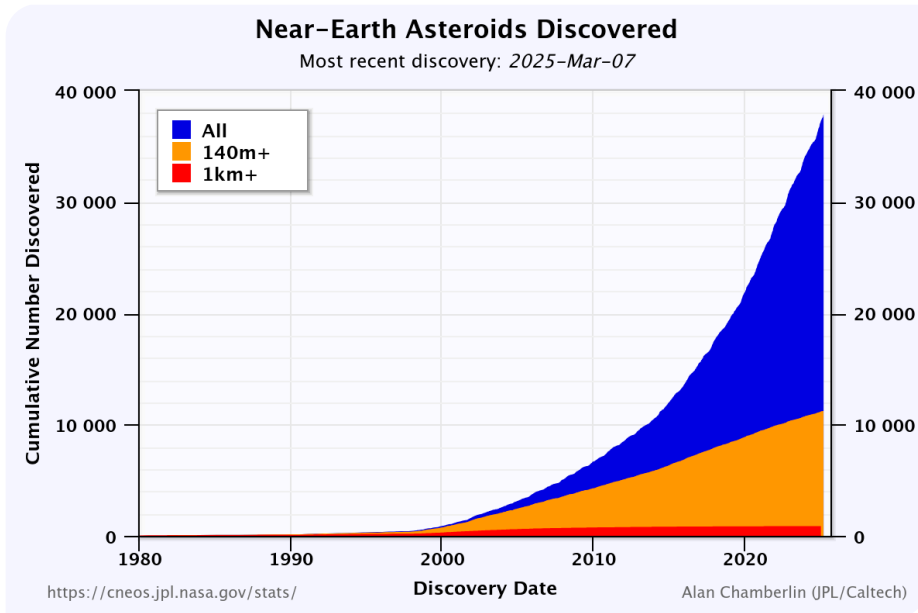


Figure 07 | Near-Earth Asteroids discovered as of March 7, 2025: 37,893 in total – a number which includes 11,232 objects larger than 140 meters in diameter and 873 objects larger than 1 km in diameter. ⁷

Source: <https://cneos.jpl.nasa.gov/stats/totals.html>

On the national level, evacuation of large areas where an asteroid strike is predicted may be required—a massive undertaking that requires engagement by regional, state, and local governments with a predetermined plan of action and allocated responsibilities.⁸ The 2018 *National Near-Earth Object Preparedness Strategy and Action Plan* outlines the coordination of roles and responsibilities of national agencies, including NASA and Federal Emergency Management Agency (FEMA) to strengthen and routinely exercise NEO impact emergency procedures and action protocols. These include protocols for coordinated communications and notifications regarding NEO threats and resulting emergency preparedness, response, and recovery protocols. These plans will need routine updating, and their incorporation into all-hazards response and recovery plans (e.g. Stafford Act, Post Katrina Emergency Management Reform Act). ●

⁷ NASA Jet Propulsion Laboratory Center for Near-Earth Object Studies, “Discover Statistics: Cumulative Totals”, last accessed March 5, 2025, <https://cneos.jpl.nasa.gov/stats/totals.html>

⁸ White House, Interagency Working Group for Detecting and Mitigating the Impact of Earth-Bound Near-Earth Objects, *National Near-Earth Object Preparedness Strategy and Action Plan* (2018), <https://www.nasa.gov/wp-content/uploads/2022/03/ostp-neo-strategy-action-plan-jun18.pdf>



Policy Recommendations

→ NASA and its national partners should be given the assets and resources to complete the task assigned by Congress of the cataloging and orbital characterization of NEOs 140 meters and larger.

The larger NEOs have been detected, but many smaller yet still potentially threatening NEOs remain undetected. Finding these remaining NEOs will be harder and space-based telescopes appear to be the best path forward. NASA should be funded to mount these space-based NEO threat detection missions.

→ Clarify the existing rules—including rights and responsibilities—for any mission to divert or destroy an impending NEO strike, as well as establish the legality of using a nuclear explosive device for eliminating imminent NEO impact threats where no other options exist.

Legal issues of asteroid redirect missions are currently uncertain under existing international space law rules, and coordination and agreement on an international level should be sought. Additionally, the legality of the use of a nuclear explosive device for the largest and most urgent NEO threats should be agreed upon by countries before the Earth is faced with such a situation that requires a swift and coordinated international response. Proactive and results-oriented discussions at the international level, including through SMPAG and at the United Nations Committee on the Peaceful Uses of Outer Space, to address these questions is needed. The United States is uniquely placed to provide leadership in such discussions.

→ Achieve the goals of interagency, federal, state, and local preparedness outlined in the 2018 Near-Earth Object Preparedness Strategy and Action Plan.

These include strengthening and routinely exercising the communication of threats, and response and recovery efforts by agencies such as the Federal Emergency Management Agency and the Department of Homeland Security. Sufficient training and resources to these agencies is required to accomplish this preparedness task.