Near Earth Object Overview

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Secure World Foundation

Promoting Cooperative Solutions for Space Sustainability

- Private, non-profit foundation founded in 2004
- HQ just outside of Denver, official offices in DC and Brussels.
- Dedicated to the ***secure and sustainable use of space for the benefit of all humanity***
- We ***inform, facilitate,*** and ***advocate***
- Strong role in both the international and domestic policy communities, linking technical and policy/legal initiatives

WHAT IS THE NEO PROBLEM

Definitions

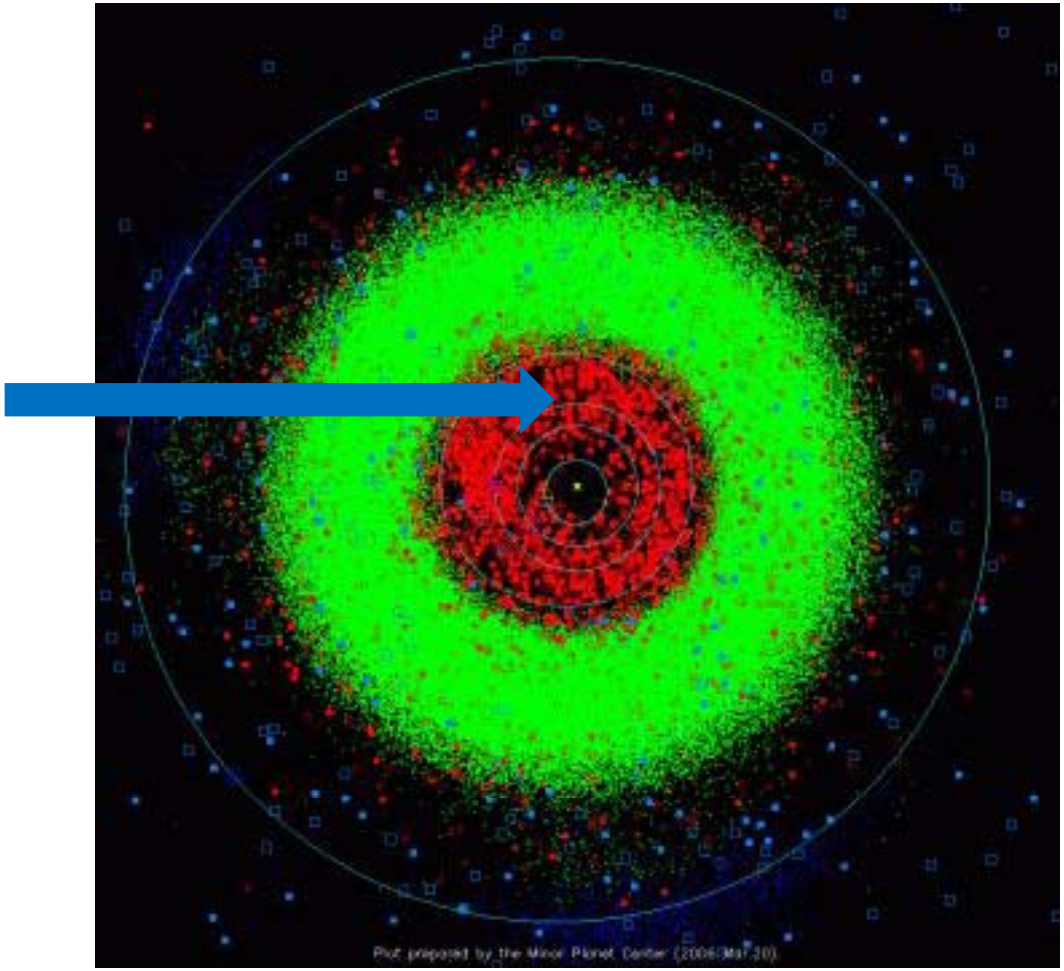
- Near Earth Objects (NEOs) are asteroids and short period comets whose orbits could potentially cross or come close to the Earth's orbit
  - Near Earth Asteroids (NEAs) are just the asteroids

- Potentially Hazardous Objects (PHAs) are the subset of NEOs which present an actual risk of collision with the Earth

- Comets (both long and short period) are a potential impact risk but are very infrequent and essentially impossible to predict/detect
  - Represent less than 1% of the total NEO impact risk

The Shooting Gallery

We Are Here



- All Asteroids
- Potentially Hazardous Asteroids

2008, Minor Planet Center, Harvard University

Detection and Population

- Networks of optical telescopes around the world are used to detect asteroids

- 1992 SpaceGuard Survey was given the mandate to detect 90% of NEAs larger than 1 kilometer by 2008
  - Recently expanded to include 90% of all NEAs larger than 140 meters by 2020

- There are currently over 60,000 known NEAs
  - 1,132 are Potentially Hazardous Asteroids
  - Over 200 have a non-zero chance of impacting the Earth

- By 2025, we will have discovered more than 1 million
  - 300,000+ will be Tunguska-size or larger
  - 10,000+ will have non-zero chance of Earth impact

Impact Rates and Effects

- Very large asteroids have the potential to destroy all life but occur very infrequently on geologic timescales
  - 3 kilometer: extinction level event (100 million years)

- Medium sized asteroids cause regional devastation
  - 500 meter: destroys entire ozone layer, equivalent to 25 of the largest hydrogen bombs ever built
  - 300 meter: 5 kilometer crater if land impact, tsunamis from water impact (hundreds of thousands of years)

- Small asteroids can cause local devastation and occur fairly often
  - 40-80 meter: Tunguska event (every century)
  - 4 meter: blinding flash, explosion equivalent to twice Hiroshima (yearly)

Asteroid Deflection

- Deflection is the process of changing the orbit of an asteroid so that it no longer impacts the Earth
- We currently have the technology to deflect 99% of the existing NEO threats, given enough warning time (years to decades)
- Impulsive techniques
  - Impart a large amount of energy over a short period of time
  - Large NEOs or little warning time would probably require nuclear detonations

- Slow push techniques
  - Impart low thrust over a long period of time
  - Requires most amount of warning but potentially more reliable
  - Technologies: Gravity Tractor, Solar Sail

Asteroid Mitigation

- Mitigation is the disaster preparedness, response, and recovery that can be done in the event that an object hits the Earth

- In many respects, asteroid mitigation is no different than dealing with any other natural disaster (flood, Earthquake, hurricane, etc)

- The only difference is that with an asteroid impact we will have warning of at least months/years that it will happen and will have a chance to prepare

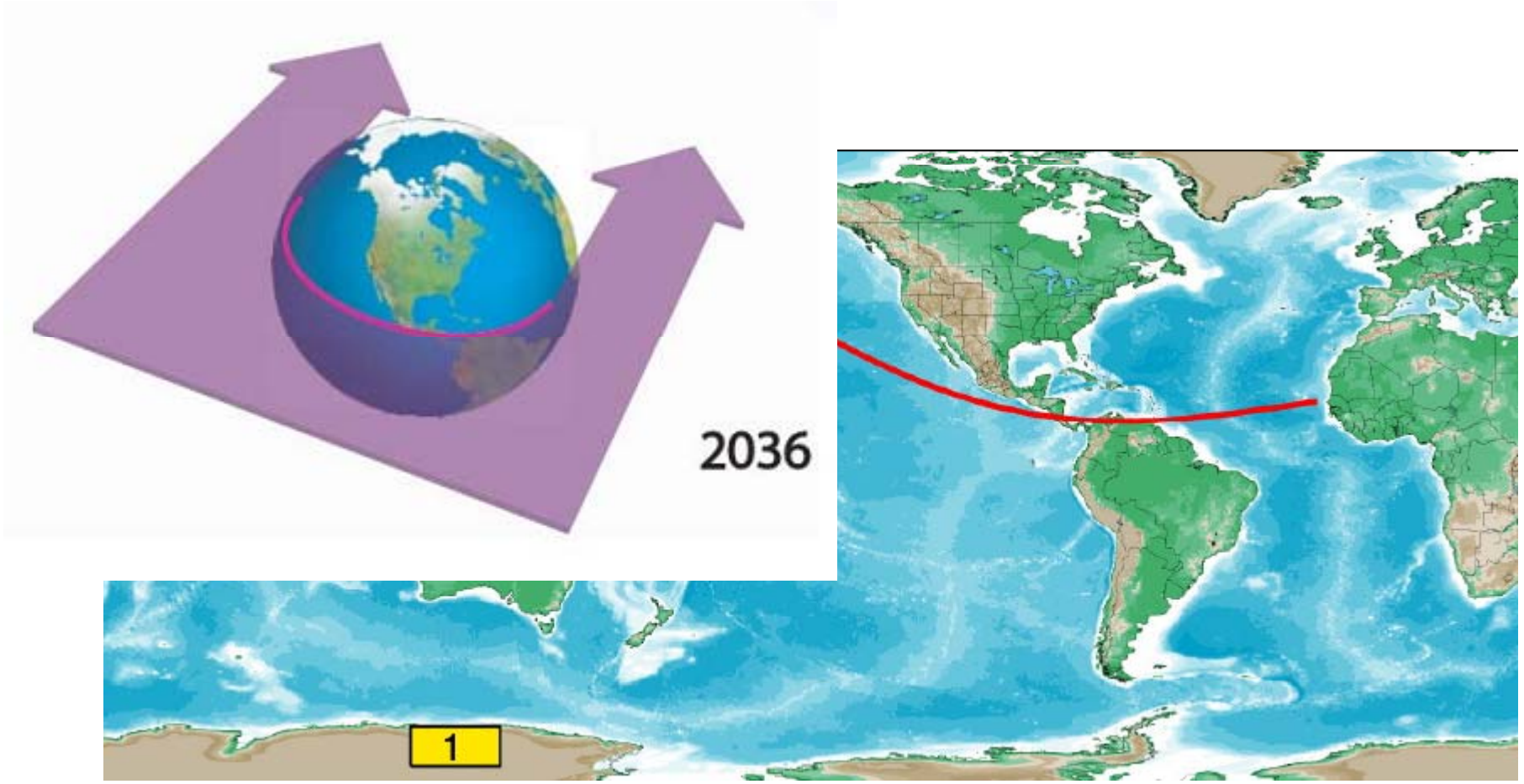
AN EXAMPLE

Apophis

- Discovered in June 2004
  - 300 meters in diameter
  - An ocean impact would be comparable to the 2004 Indonesian Tsunami
  - Land impact would create 5 kilometer crater, devastation over small country

- Caused concern in December 2004 when astronomers announced it had a 2.4% chance of impacting the Earth in 2029
  - Later more observations ruled out chance of impact in 2029 but left a chance of impact in 2036
  - Current data reveals very low chance of 2036 impact (1 in 250,000)

Original risk path for Apophis



Association of Space Explorers, Presentation to UN COPUOS, Feb 2008

Risk paths for all known possible NEO impacts

Association of Space Explorers, Presentation to UN COPUOS, Feb 2008

ROLE OF THE INTERNATIONAL WORLD

Why NEO Impacts Are a Concern

- Human Security
  - "The Big One" could end human civilization (and we know it's happened before)
  - Impacts of even relatively small objects (~40 meter) can cause severe local trauma

- Mistaken Identity
  - Small asteroids hitting the Earth's atmosphere look very much like nuclear explosions and re-entry of warheads
  - Could cause flashpoints in regions with instability and little to no communication between parties
    - June 6th 2002: 9 meter asteroid caused atmospheric explosion twice the size of Hiroshima over Eastern Mediterranean
    - 6 hours later it would have occurred over Kashmir

NEO Governance Issues

- Who decides what a threat is and when to mitigate?
- Who decides the best way to mitigate?
- Who's responsible when a mitigation fails?

- Reporting of possible collisions
  - How to convey probability to a math-poor society and headline hungry media?
  - Warning saturation and definition of "orange"

- Public Perception
  - The misrepresentation done by movies and sci-fi
  - General paucity of knowledge about orbital mechanics and physics

Original Apophis Risk Path

How many people and conflict areas are below that line?

Discovery of fragments from 2008 TC3 in Sudan

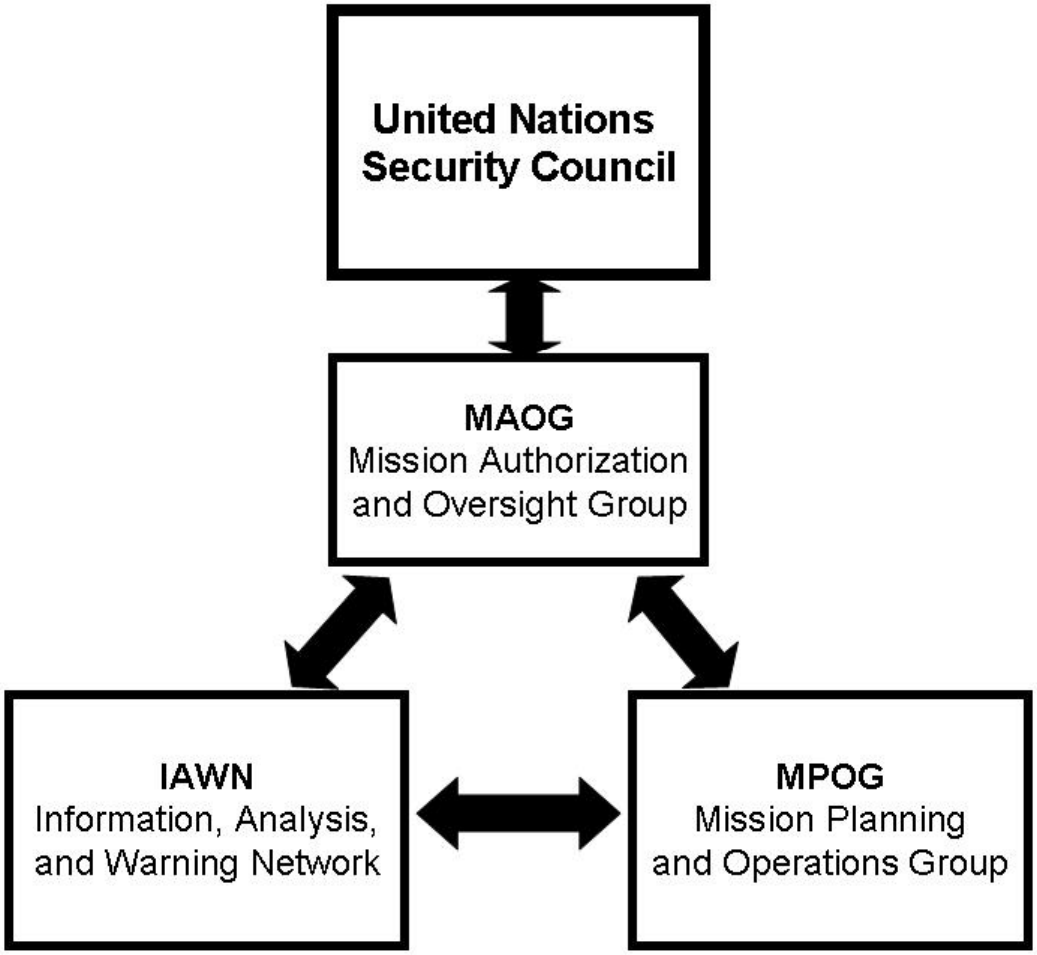
Discovery of TC_3 fragment by University of Khartoum students led by Dr. Muawia Shaddad with data supplied by NASA

CURRENT ACTIVITES

UN COPUOS

- In 2001, the Scientific and Technical Subcommittee of UN COPUOS established Action Team 14 (AT-14) to work on the NEO problem
- In 2009, AT-14 accepted the conclusions of a report by the Association of Space Explorers (ASE) recommended that the UN should explore establishing three bodies to deal with NEO warning and deflection
- In 2013 AT-14 will conclude its work and will send its report to the UNGA.

ASE Recommendations



Thank you