DEALING WITH THE THREAT TO EARTH FROM ASTEROIDS AND COMETS

Synopsis of a NEO study by

THE INTERNATIONAL ACADEMY OF ASTRONAUTICS (IAA)

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THE INTERNATIONAL ACADEMY OF ASTRONAUTICS (IAA)

•The International Academy of Astronautics is a premier expert non-governmental organization, created in 1960. It is recognized by the UN

•Its purposes are to:

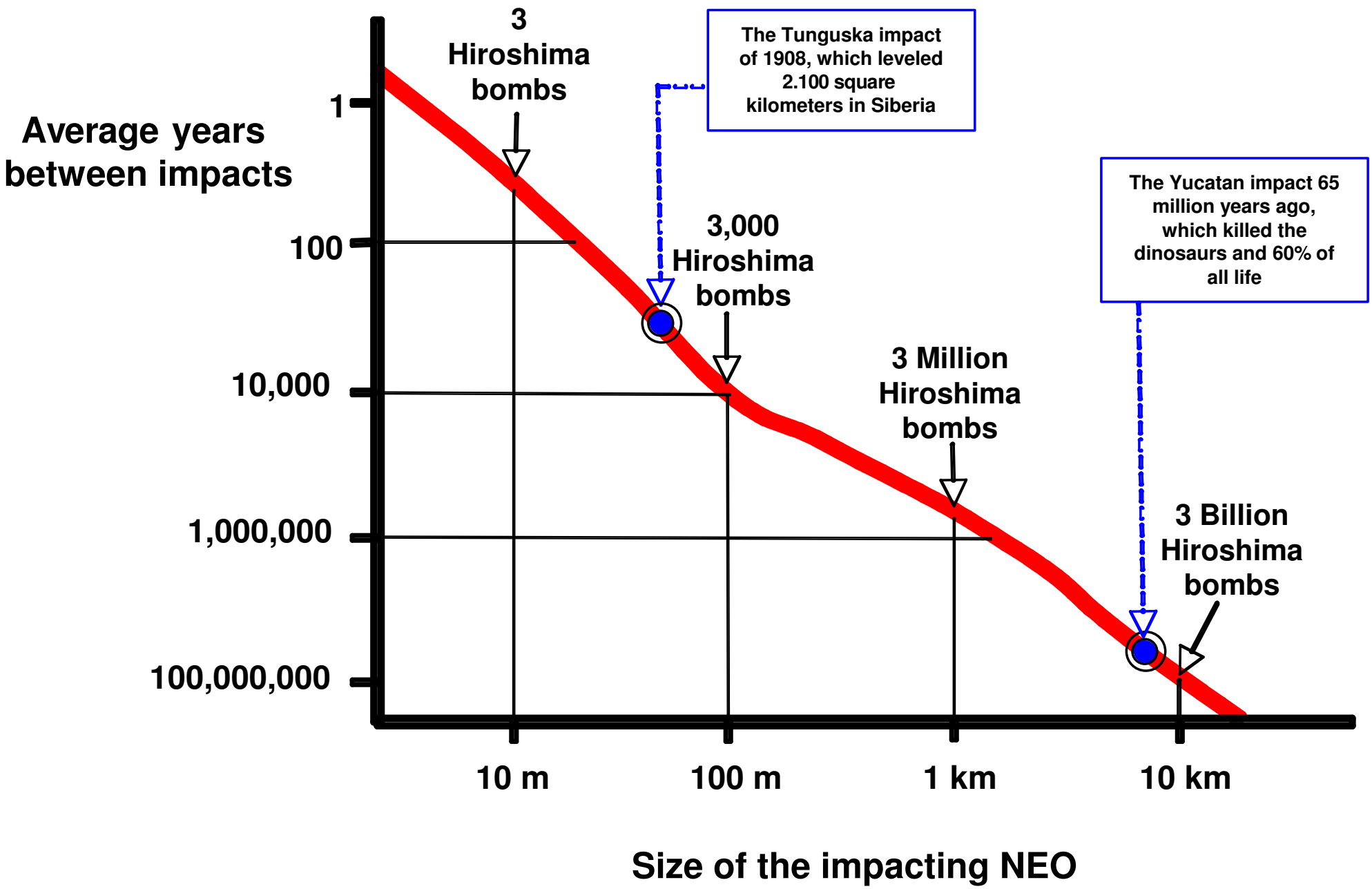
- •Foster the development of astronautics for peaceful purposes
- •To recognize individuals who have distinguished themselves in areas related to astronautics
- •Contribute to international endeavors and cooperation
- •Contribute to the advancement of aerospace activities

•It does so by

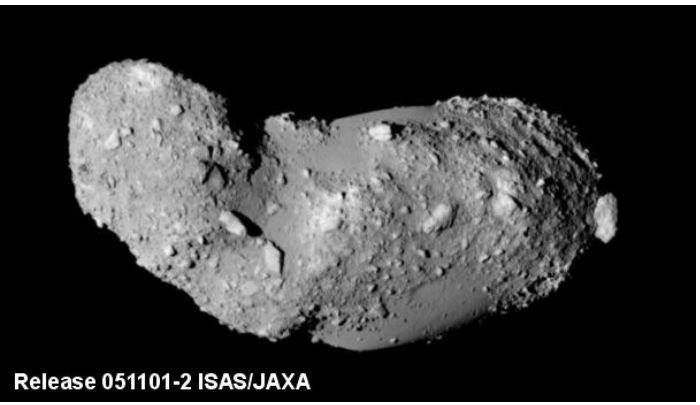
- •organizing symposia and workshops on topics of astronautical interest
- •Preparing and disseminating Cosmic Study reports prepared by its members of many nations
- •Participating in workshops and study groups to lend the expertise of its members

•It thus promulgates independent international technical, social, and policy knowledge without dependence on national sponsors or their viewpoints

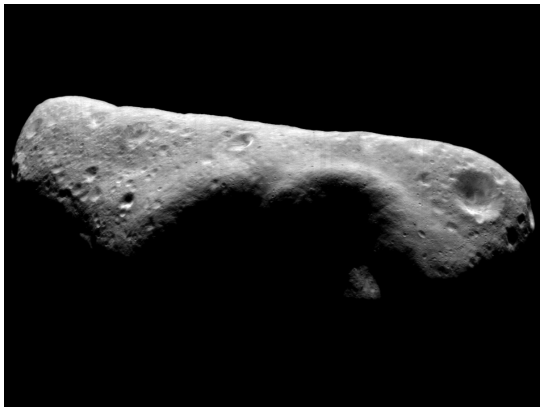
THE NEO PROBLEM



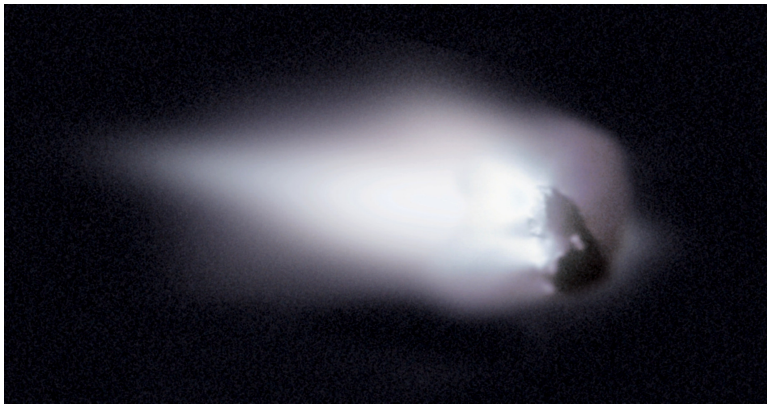
DETECTION, IMPACT PREDICTION, AND WARNING



Itokawa: Japan



Near: USA



Halley: ESA

NEO Asteroid population*

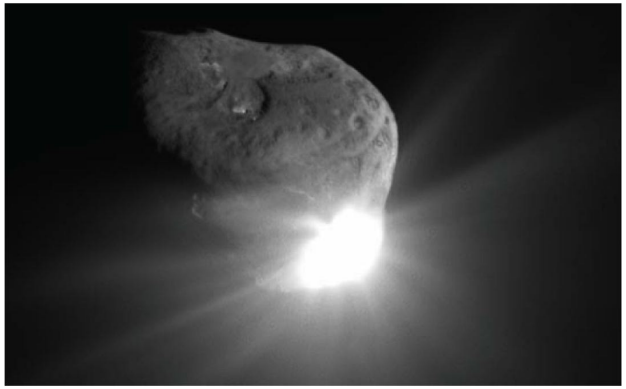
- **Number of asteroids discovered to date: 5,900**
- **Of those: 1000 - 1,200 are probably larger than 1 km**
- **Discovered to date: 761 larger than 1 km**
- **Discovered and Potentially Hazardous: 1,001 larger than 150 m**

NASA estimated cost of discovering 90% of potentially hazardous asteroids >140 m by 2020: about $1 Billion USD

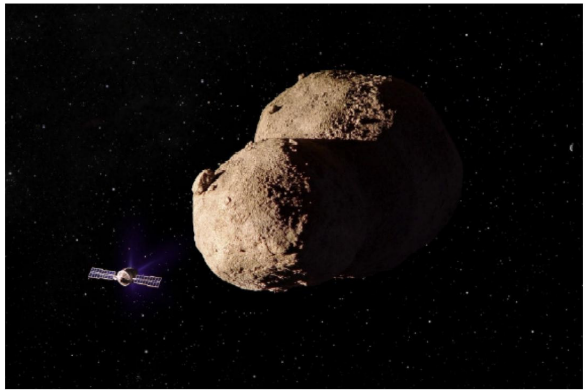
- **Asiago**-DLR (German Aerospace Center) Asteroid Survey (ADAS) near Asiago, Italy
- **Campo Imperatore -** Astronomical Observatory near Rome, Italy
- **Catalina Sky Survey (CSS)** - Mt. Lemmon Survey, Arizona, USA+Siding Springs Survey, Coonabarabran, Australia
- **Japanese Spaceguard Association (JSGA) -** observational facility near Bisei, Japan
- **Lincoln Near-Earth Asteroid Research (LINEAR) -** in New Mexico, USA
- **Lowell Observatory Near-Earth Object Search (LONEOS) -** in Flagstaff, Arizona, USA
- **Near-Earth Asteroid Tracking (NEAT) -** at the Maui Space Surveillance Site in Hawaii, USA
- **Spacewatch -** at the University of Arizona in Tucson, Arizona, USA
- **Klet -** Observatory, Czech Republic
- **Calculations: NASA JPL and Univ. of Pisa NEO DyS. Coordination and dissemination: IAU's Smithsonian MPC**

* As of December, 2008

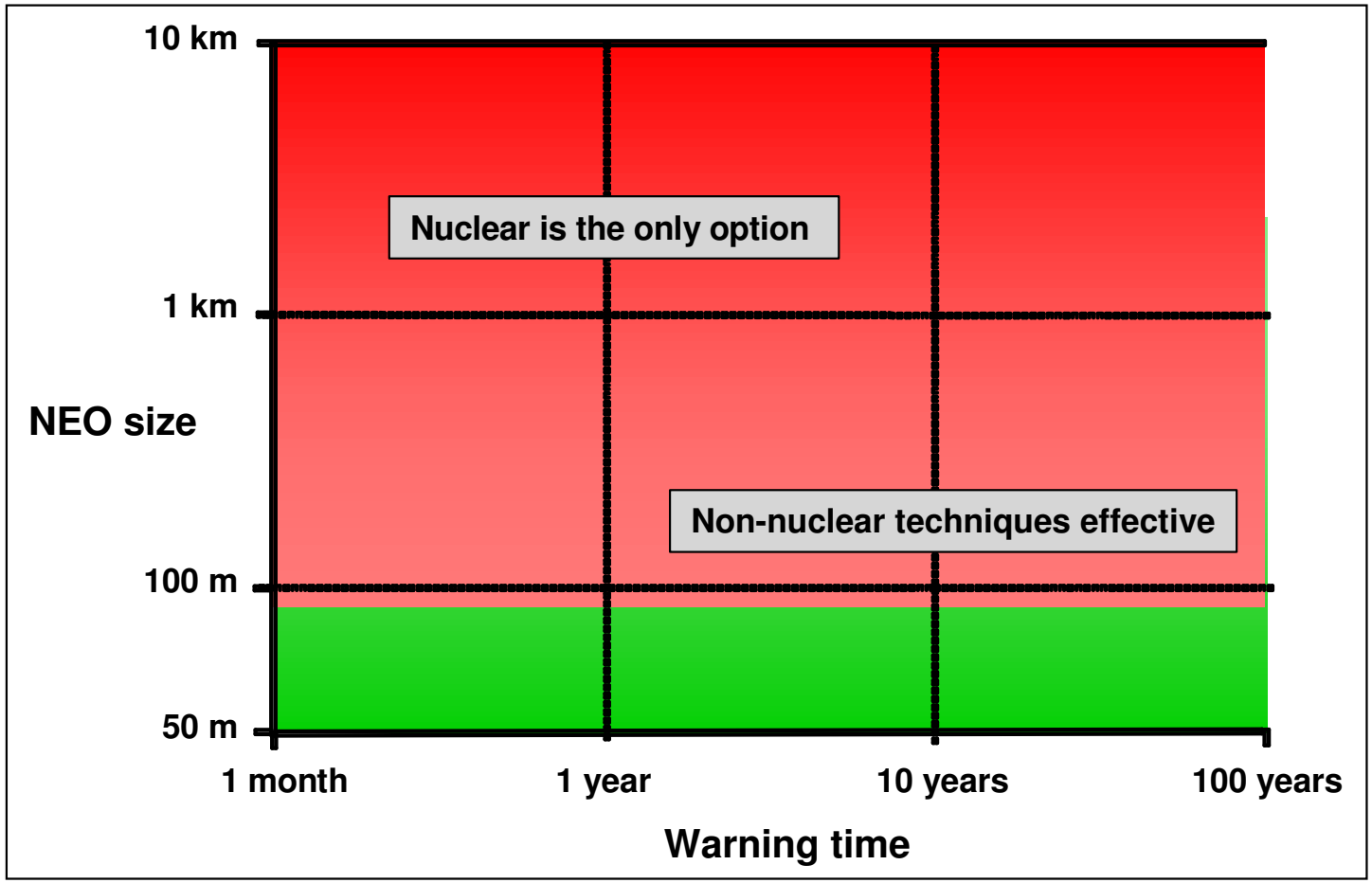
PREVENTING OR MITIGATING A NEO IMPACT ON EARTH



Fast techniques



Slow techniques



ORGANIZING FOR A RESPONSE

1. **The threat is inherently international, and so the response must be international**

2. **Disaster response planning must occur well before a predicted impact, and include also actions needed during and after the impact**

3. **Assess the risk: Response depends on the threat**

   a. **Likely magnitude of destruction**
      - Local?
      - Regional?
      - Global?

   b. **Impact location**
      - Very precisely known?
      - Known only within a region?
      - Known only within a hemisphere?

   c. **Time-dependent action**
      - Months: Prevention not possible. Massive evacuations
      - Few years: Mitigation possible but requires heroic efforts
      - Many years: Orderly, measured mitigation possible

4. **A global coordinated response plan is needed:**
   - **UN managed?**
   - **UN coordinated international consortium?**
   - **Coordinated national efforts?**
   - **Other?**

PSYCHOLOGICAL AND SOCIOLOGICAL FACTORS

- **Different cultures respond differently to disasters, and must be taken into account in planning**

- **Low probability events far in the future generate little worry--planning is extremely difficult**

- **Pre-impact phase**
  - Planning and rehearsals of actions are crucial
  - An effective warning system must be in place
  - The media must be involved
  - Adequate communications must be established

- **During the impact phase**
  - There may be huge numbers of casualties, both physical and emotional trauma
  - Disaster workers will as affected as those they seek to help
  - Psychological support must be available for both victims and disaster workers

- **Post-impact, recovery phase**
  - Triage on a massive scale will be needed
  - Psychological support and therapy should be available
  - Long term psychological effects should be expected and prepared for

- **Five core values will be paramount in dealing with a NEO impact (or the threat of one)**
  - Empathy, Trust, Sensitivity to differences, Openness, Flexibility

NEO POLICY IMPLICATIONS

•Several nations/consortia already have programs for discovery and characterization, and some have active international components

•The existing international policy is limited to recommendations which call on states to adopt some voluntary measures with respect to NEOs

- •1996. Council of Europe: ESA should contribute to international strategy and planning
- •1999. Unispace III: International planning for detection; common strategy for future
- •2003. OECD: Governments should explore strategies for mitigation; form advisory panel
- •2007. UN COPUOUS Action Team 14: Address smaller asteroids, augment Minor Planet Center, and prepare NEO deflection protocol and international procedures.

•These efforts are exemplary, but are only a small start toward a needed <u>binding international policy</u>

PRINCIPAL RECOMMENDATIONS

1. Detection, orbit prediction, impact warning

- **Expand Spaceguard Survey to detect and characterize 90% of asteroids 140 m diameter by 2020**
- **Augment ground telescopes with meter-class space telescopes**
- **Begin to seriously address the threat from comets, with large space telescopes**

2. Preventing a NEO impact on Earth

- **Start planning and mission design for both kinetic impact and gravity tractor deflection techniques**
- **Start separate planning and mission design for a potential nuclear deflection technique**

3. Organizing for a response

- **NEO disaster planning must be carried out for the before, during, and post-impact phases**
- **A global coordinated plan must be developed. UN managed? UN coordinated? National efforts?**

4. Psychological and sociological aspects

- **Low probability events far in the future generate little worry--planning is difficult**
- **Psychological support will be needed for very large numbers of both victims and disaster workers**

5. Policy implications

- **A coordinated international plan for dealing with NEOs is needed**
- **An international binding protocol must be the ultimate product**
- **An analogue of the Interagency Space Debris Coordination Committee could be a start**

POTENTIAL ROLE OF THE INTERNATIONAL ACADEMY OF ASTRONAUTICS

1. **Facilitate the promulgation of comprehensive, accurate information about the NEO threat to Earth and how to deal with it**

   - A report on the NEO issue is complete and will be published this April

2. **Organize international workshops to examine any or all technical, social, or policy aspects of the NEO problem**

   - An IAA/ESA “Planetary Defense Conference” is scheduled for April 27-30, 2009 in Granada, Spain

3. **Volunteer its expert members to serve on UN-sponsored and other working groups and committees addressing all aspects of the NEO threat**

4. **Serve as a pool of impartial, non-national expertise available to the UN and its committees**