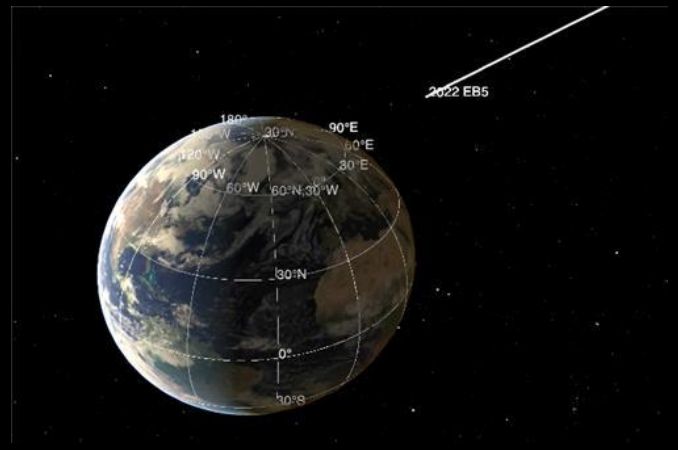
NASA Planetary Defense Activities Update to EU-ESA Workshop on NEO Imminent Impactors Warning Coordination

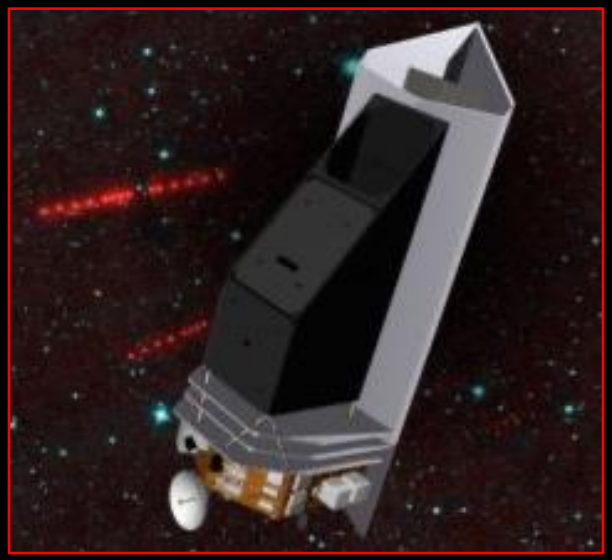
December 13, 2022

Planetary Defense Coordination Office
Planetary Science Division
NASA Headquarters
Washington, DC

Overview



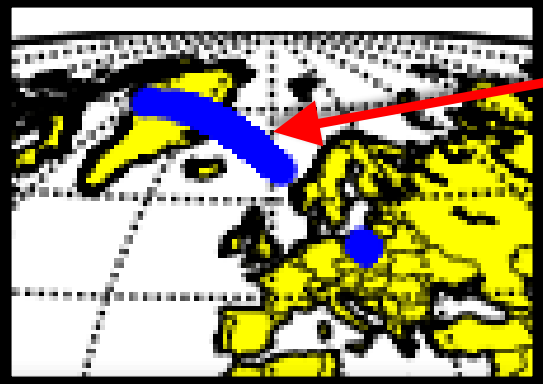
- Small Asteroid (2022 EB5) impact near Iceland
- Planetary Defense 4th Table Top Exercise (TTX4)
- DART Impact (26 September 2022)
- NEO Surveyor – confirmed (29 November 2022)



Asteroid 2022 EB5 – March 11, 2022
Small asteroid impact near Iceland

- First observed by Hungarian observatory GINOP-KHK (K88), Piszkéstető, and reported to the Minor Planet Center
  - The first observation was made at 19:24 UTC (2:24pm EST), 2 hours prior to impact
- By one hour prior to impact, enough additional observations had been reported and processed by JPL's Center for NEO Studies (CNEOS) Scout system to identify a potential impact and warn PDCO
  - ESA's NEO Coordination Centre (NEOCC) similarly identified a potential impact
- CNEOS continued to update PDCO as additional observations quickly allowed them to precisely narrow the impact location to northeast of Iceland, just south of Jan Mayen island, by 18 minutes prior to impact
- The impact was reportedly detected by a European weather satellite and by Comprehensive Test Ban Treaty Organization infrasound sensors

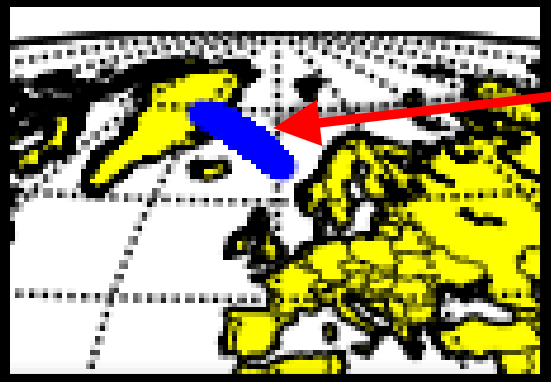
Asteroid 2022 EB5 – March 11, 2022
Evolution of JPL CNEOS Impact Solutions



20:26 UTC (3:26pm EST)

Impact minus 56 min

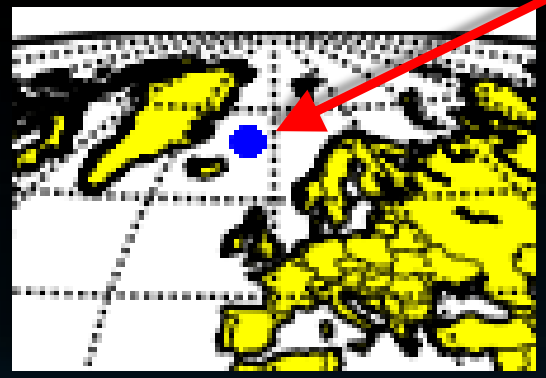
Potential impact locations from 14 observations of the asteroid over 33 minutes as reported to the Minor Planet Center



20:46 UTC (3:46pm EST)

Impact minus 46 min

…from 20 observations over 40 min



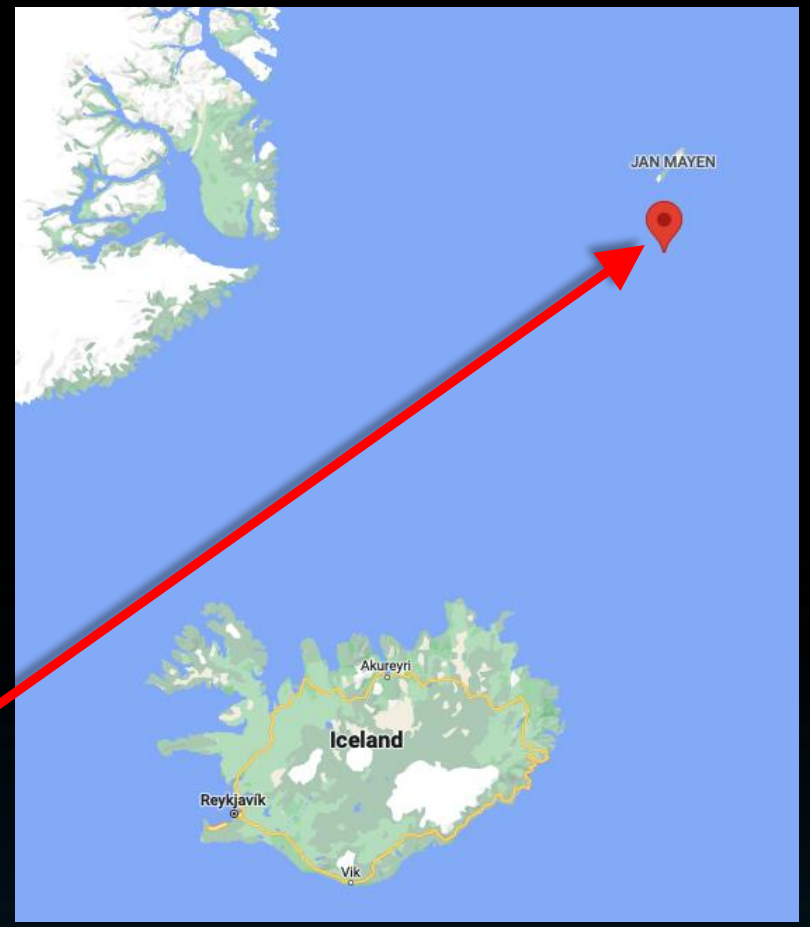
21:04 UTC (4:04pm EST)

Impact minus 18 min

…from 33 observations over 65 min

Observation arc now long enough for CNEOS to precisely identify impact location

Impact at 21:22 UTC (4:22pm EST)



Asteroid 2022 EB5 – March 11, 2022
Small asteroid impact near Iceland

- At ~2 meters in size, this was a much smaller object than NASA is tasked to detect and warn about
- Such a small asteroid easily disintegrates in Earth's atmosphere as a fireball and can only be discovered when near Earth; a larger asteroid with potentially hazardous impact consequences would be discoverable much further from Earth, preferably many orbits about the Sun (years) ahead of a potential impact
- This real-world event allowed us to exercise capabilities and gave some confidence that the impact prediction models are adequate to inform response to the potential impact of a larger object

Asteroid 2022 EB5 – March 11, 2022
Small asteroid impact near Iceland

- 5th asteroid observed in space that is associated with an impact with Earth*
- 4th asteroid discovered with an impact solution calculated prior to impact

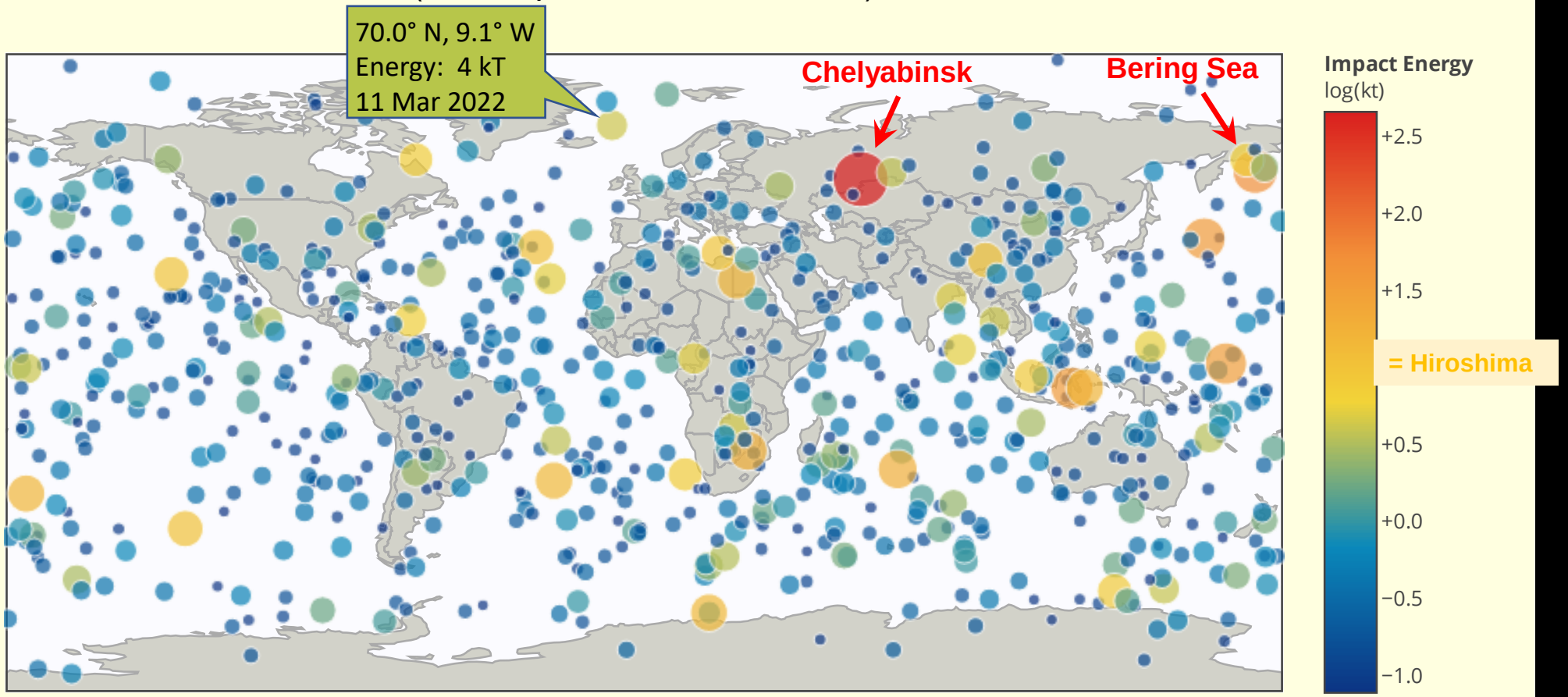
Asteroid	Discoverer	Impact location
2008 TC3	Catalina Sky Survey (G96)	over Sudan
2014 AA	Catalina Sky Survey (G96)	middle of the Atlantic Ocean
2018 LA	Catalina Sky Survey (G96)	over Botswana
2019 MO	ATLAS (T08)	south of Cuba (unwarned)
2022 EB5	GINOP-KHK, Hungary (K88)	northeast of Iceland, south of Jan Mayen
2022 WJ1	Catalina Sky Survey (G96)	over southern Ontario

*There have now been six (6) asteroids discovered, confirmed, and impact locations predicted

Asteroid Impacts

Fireballs Reported by US Government Sensors

(1988-Apr-15 to 2022-Nov-20)



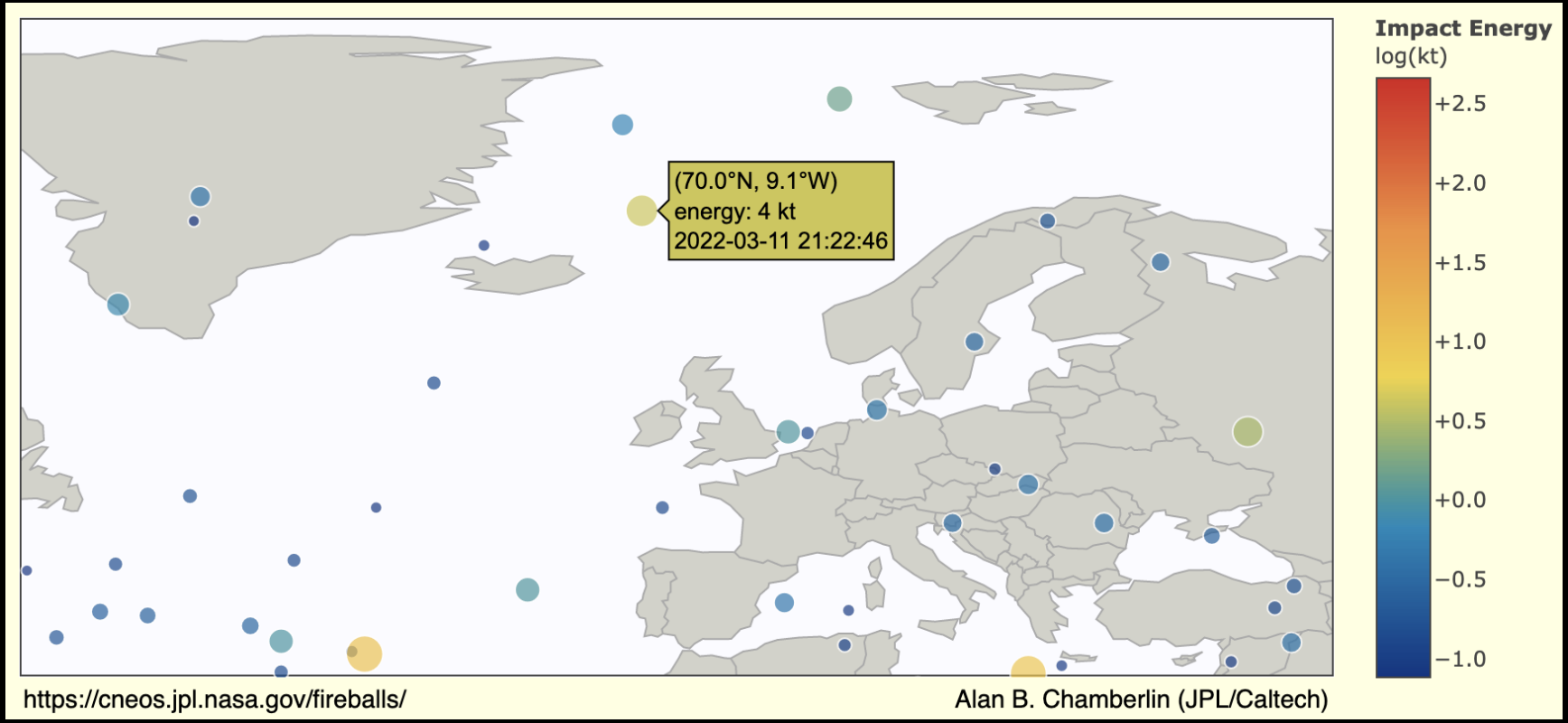
https://cneos.jpl.nasa.gov/fireballs/

Alan B. Chamberlin (JPL/Caltech)

Impact of small asteroid 2022 EB5 over the Norwegian Sea near Iceland – March 11, 2022

Fireball data (impact of natural objects) from U.S. government sensors

- Courtesy of U.S. Space Force's Space Operations Center
- Maintained by the JPL Center for Near-Earth Object Studies



The impact was also detected by Comprehensive Test Ban Treaty Organization infrasound sensors

PLANETARY DEFENSE
INTERAGENCY
TABLETOP EXERCISE 4

Planetary Defense TTX4
After Action Report Briefing

27 April 2022

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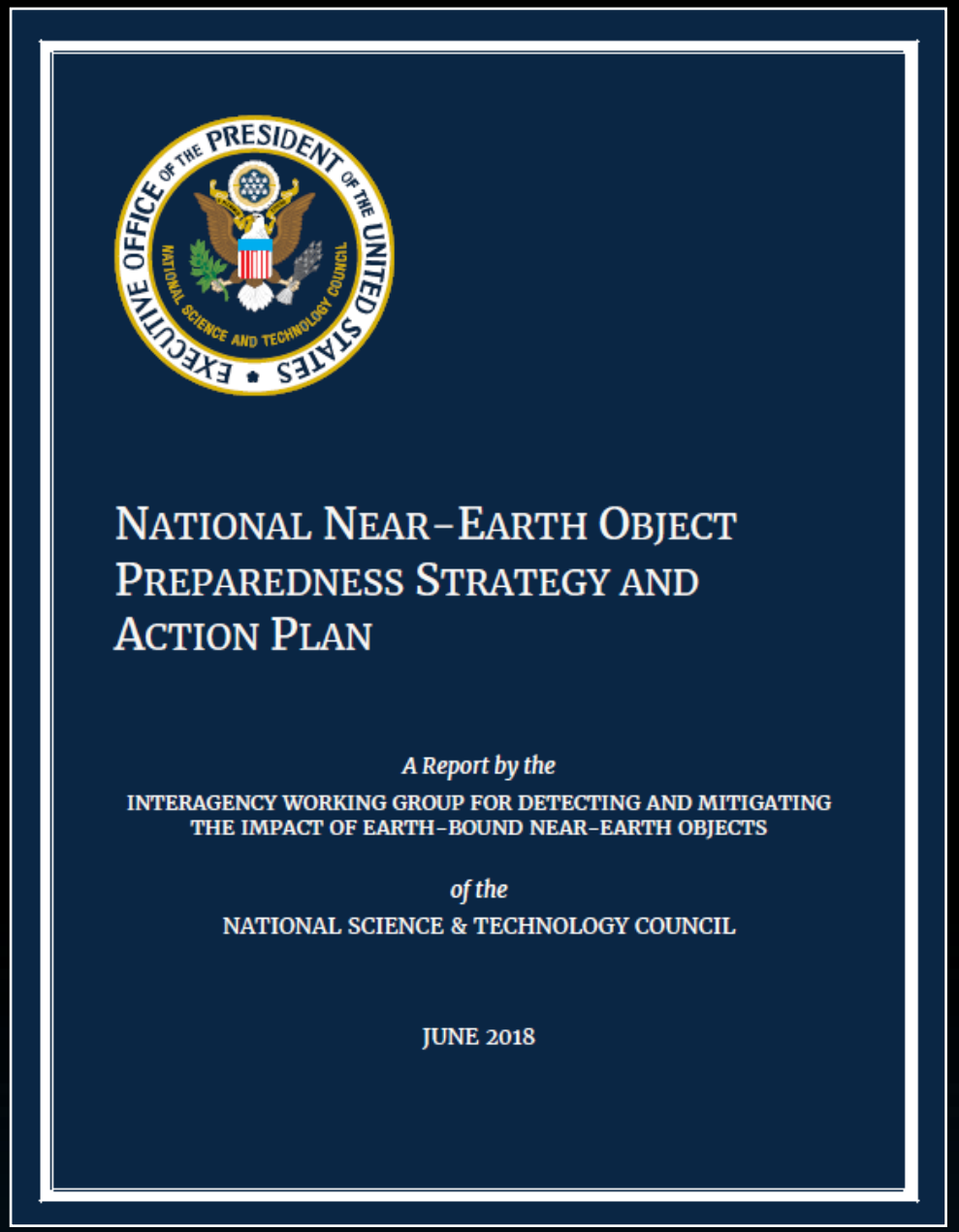
New White House Guidance released on 20 June 2018

https://www.nasa.gov/sites/default/files/atoms/files/ostp-neo-strategy-action-plan-jun18.pdf



Planetary Defense Interagency Tabletop Exercises build on previous outcomes

PLANETARY DEFENSE INTERAGENCY TABLETOP EXERCISE 4

2013: TTX 1

Acquaint FEMA with the nature of an asteroid impact & how warning of an impact might evolve if the object were detected a short time prior to possible impact.

Warning time: 1 month

2014: TTX 2

Acquaint agencies with the nature and evolution of an impending asteroid impact; assess whether & how current processes & procedures for disaster warning & response might be employed.

Warning time: 7 years

2016: TTX 3

Acquaint disaster response planners with the nature & evolution of information available for, and inherent challenges of, a potential impact emergency.

Warning time: 4 years

2022: TTX 4*

Increase understanding of the roles of agencies in mitigating asteroid impact threats; exercise post-impact protocols, including state & local governments; test communication methods.

Warning time: 6 months

?

TBD: TTX 5

*First TTX since release of the *National NEO Preparedness Strategy and Action Plan.*

Key participants came from a variety of Federal, State, and Local agencies

PLANETARY DEFENSE INTERAGENCY TABLETOP EXERCISE 4

- **OSTP** (EOP): Matt Daniels, Assistant Director for Space Security and Special Projects
- **National Space Council** (OVP): Madi Sengupta, Director, Civil Space Policy
- **National Security Council** (EOP): Chris Cannizzaro, Director of Critical Infrastructure
- **NASA**: Bhavya Lal, Assoc. Administrator for Technology, Policy, & Strategy; Lori Glaze, Division Director for Planetary Science
- **FEMA**: Erik Hooks, Deputy Administrator
- **US Space Command**: Lt Gen John E. Shaw, Deputy Commander
- **US Northern Command**: LTG A.C. Roper, Deputy Commander
- **NSF**: Debra Fischer, Director of Division of Astronomical Sciences
- **Dept. of State**: J. R. Littlejohn, Principal Deputy Secretary
- **North Carolina** Dept .of Public Safety and State Emergency Operations Center (SEOC)
- Nearly 200 **state and local** public safety personnel

High-level outcomes from North Carolina Participants, Grouped by Emergency Support Function (ESF)

PLANETARY DEFENSE INTERAGENCY TABLETOP EXERCISE 4

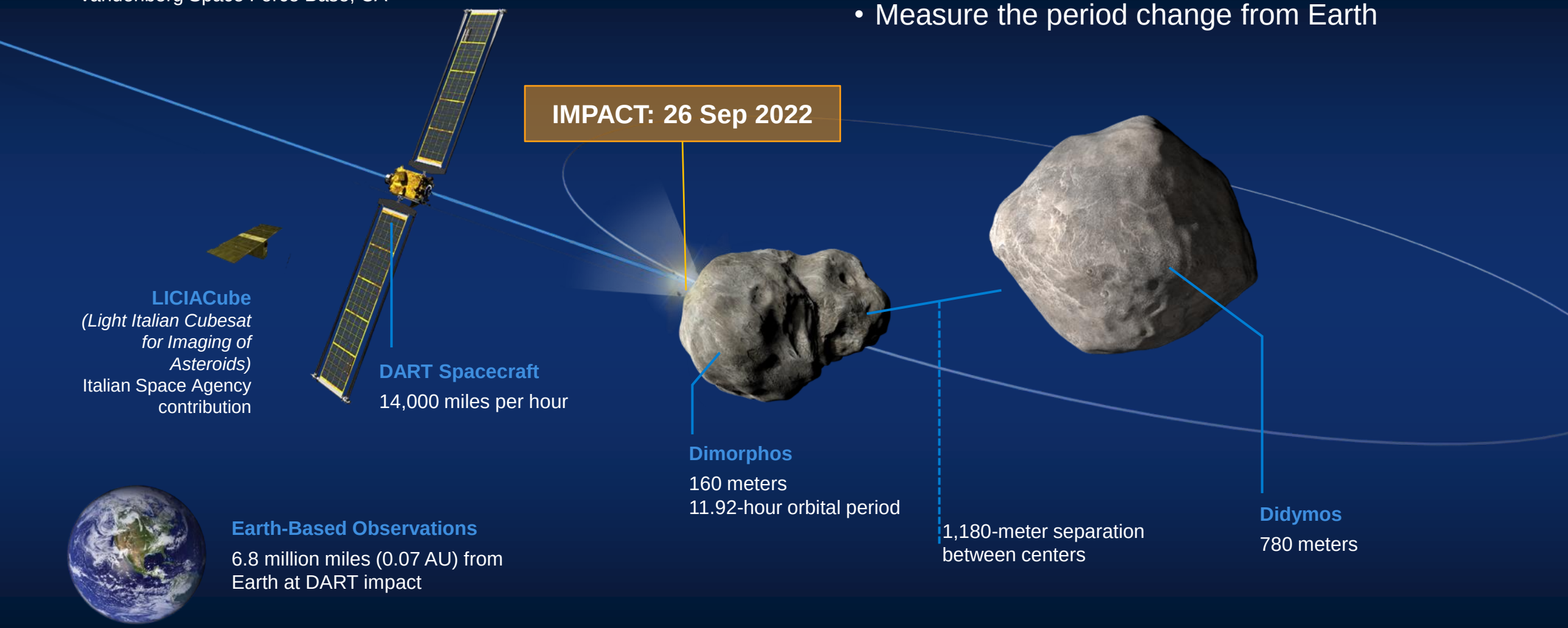
- **Healthcare:** Evacuation discussions would need to start early to include relocation of patients.
- **Public Information:** Public Information Officers (PIOs) need to be in the decision-making discussion as early as possible.
- **Incident Management Teams/Emergency Management:** Using all the same concepts we use on a day-to-day basis, just on a much larger scale. Learned a lot from our partners during this event.
- **Critical Infrastructure:** Successful collaboration between the MapForsyth team, NASA ATAP, and APL to use data to develop relevant critical infrastructure maps.
- **Public Safety:** A percentage of folks will not leave. First responders expressed concerns regarding air quality hazards.
- **Support (including Safety/Risk Management):** Participants understood the important of ensuring the identification and utilization of all resources available.
- **Schools:** We also now know that we can teach remotely (not ideal, but we can).
- **Human Services - Health Department:** Long Term Care centers would require attention. Already required to have evacuation plans, but their evacuation sites would likely be their sister campuses and possibly still in the impact area – so where would they go?
- **Liaisons:** Neighboring (e.g., regional) emergency management partners would need to be looped in as soon as feasible.

Launched on Nov. 24 EST

SpaceX Falcon 9
Vandenberg Space Force Base, CA

DART Mission:

- Target the binary asteroid Didymos system
- Impact Dimorphos and change its orbital period
- Measure the period change from Earth



NEO Surveyor

- Preliminary Design Review (PDR) took place in September 2022
- The Project passed KDP-C and entered Phase C on Nov. 29, 2022

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nasa.gov/planetarydefense