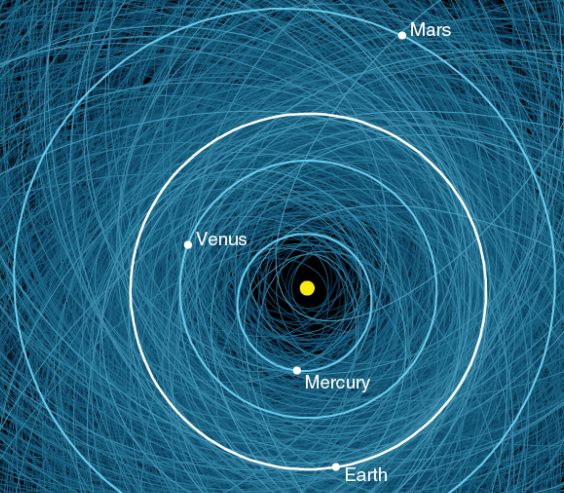


Press Conference: May 15, 2017

Newly Discovered Asteroid Poses Small Threat of Earth Impact

Paul Chodas (Jet Propulsion Laboratory/California Institute of Technology)

2017 Planetary Defense Conference, Tokyo, Japan

EXERCISE ONLY!!

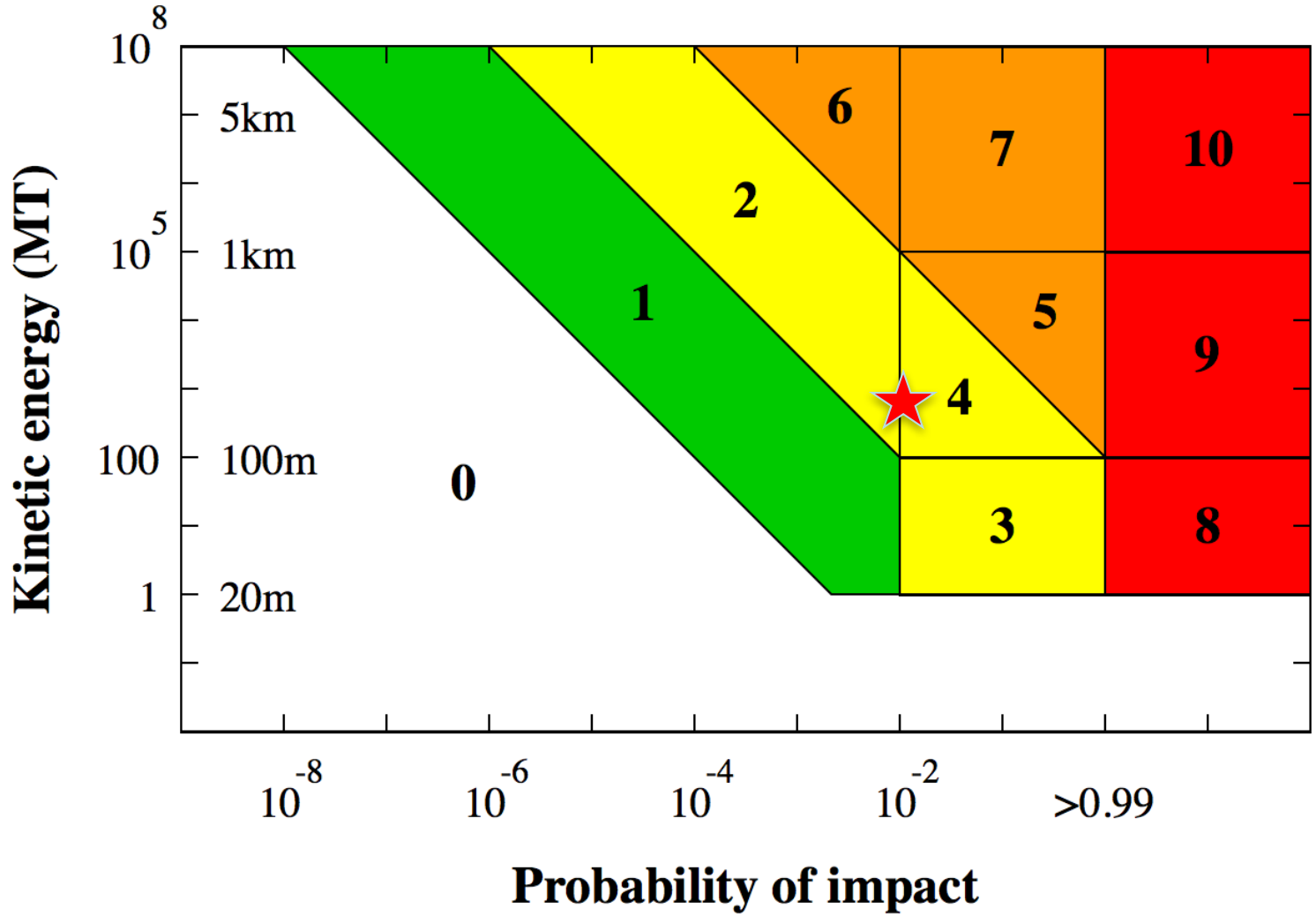
Asteroid 2017 PDC

Jet Propulsion Laboratory
California Institute of Technology

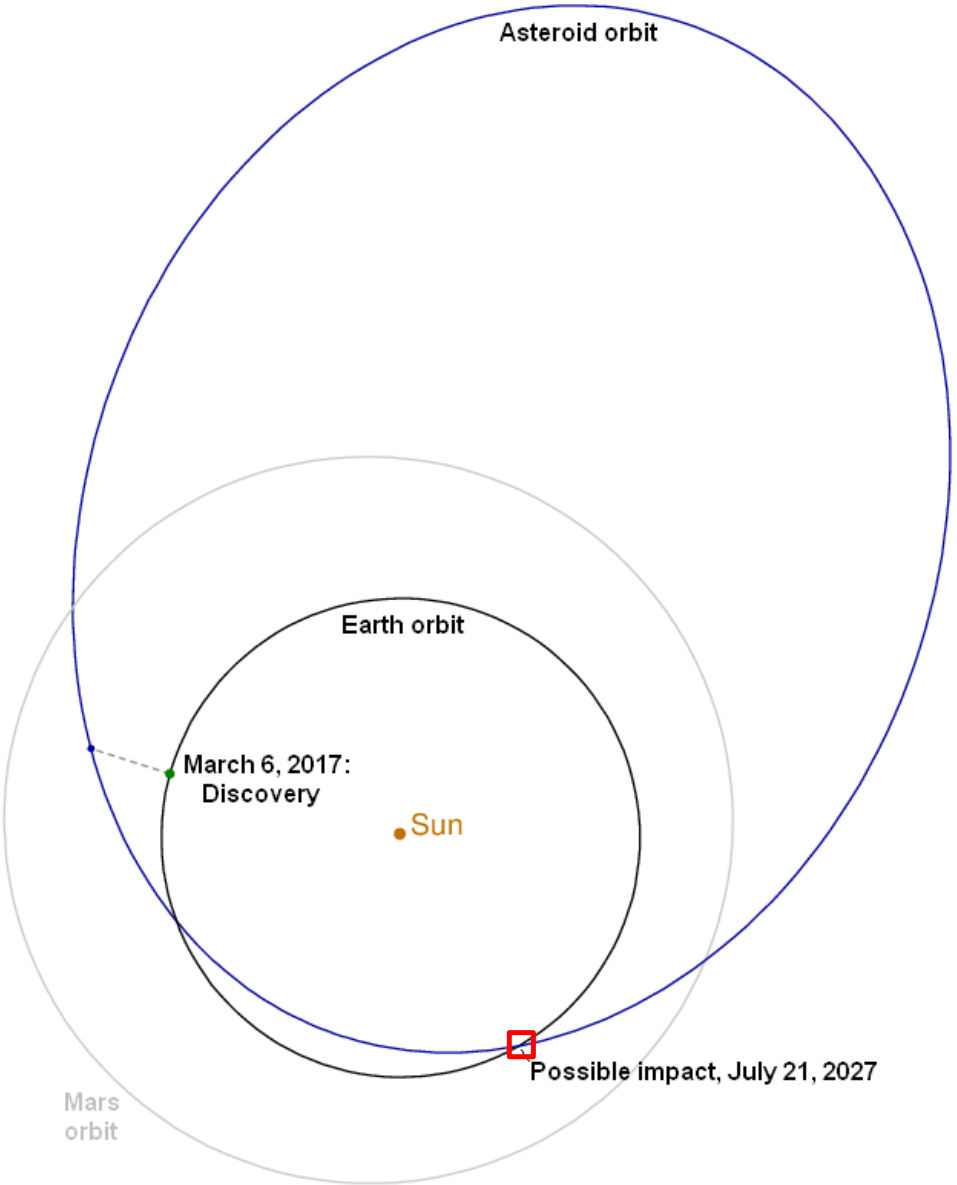
- Discovered on March 6, 2017 by Pan-STARRS; visual magnitude ~21.
- Designated "**2017 PDC**" by the IAU's Minor Planet Center
- Orbit comes within 0.05 au of Earth's orbit ➔ **Potentially Hazardous Asteroid (PHA)**
- Asteroid has been tracked almost every night since discovery, and IAWN has revised its estimate of impact probability almost daily
- Predicted to pass very close to Earth on July 21, 2027, at a distance of 120,000 kilometers (77,000 miles), about 30% of distance of the Moon
- Impact on that date is unlikely, but cannot be ruled; current likelihood of impact is 1% or 1 chance in 100
- Size of 2017 PDC is roughly **100 to 300 meters (300 to 1000 feet)** across, based on its brightness, but its albedo (reflectivity) is unknown
- Reached a rating of 4 on the Torino Scale (Yellow)
- More info: **https://cneos.jpl.nasa.gov/pd/cs/pdc17/day1.html**

EXERCISE ONLY!!

Torino Scale



Orbit of Asteroid 2017 PDC



Distance from Sun varies from 0.9 au to 3.6 au

Orbit period: 3.35 yr
Inclination: 6.3 deg

H = 21.85
Size: ~100 – ~300 m

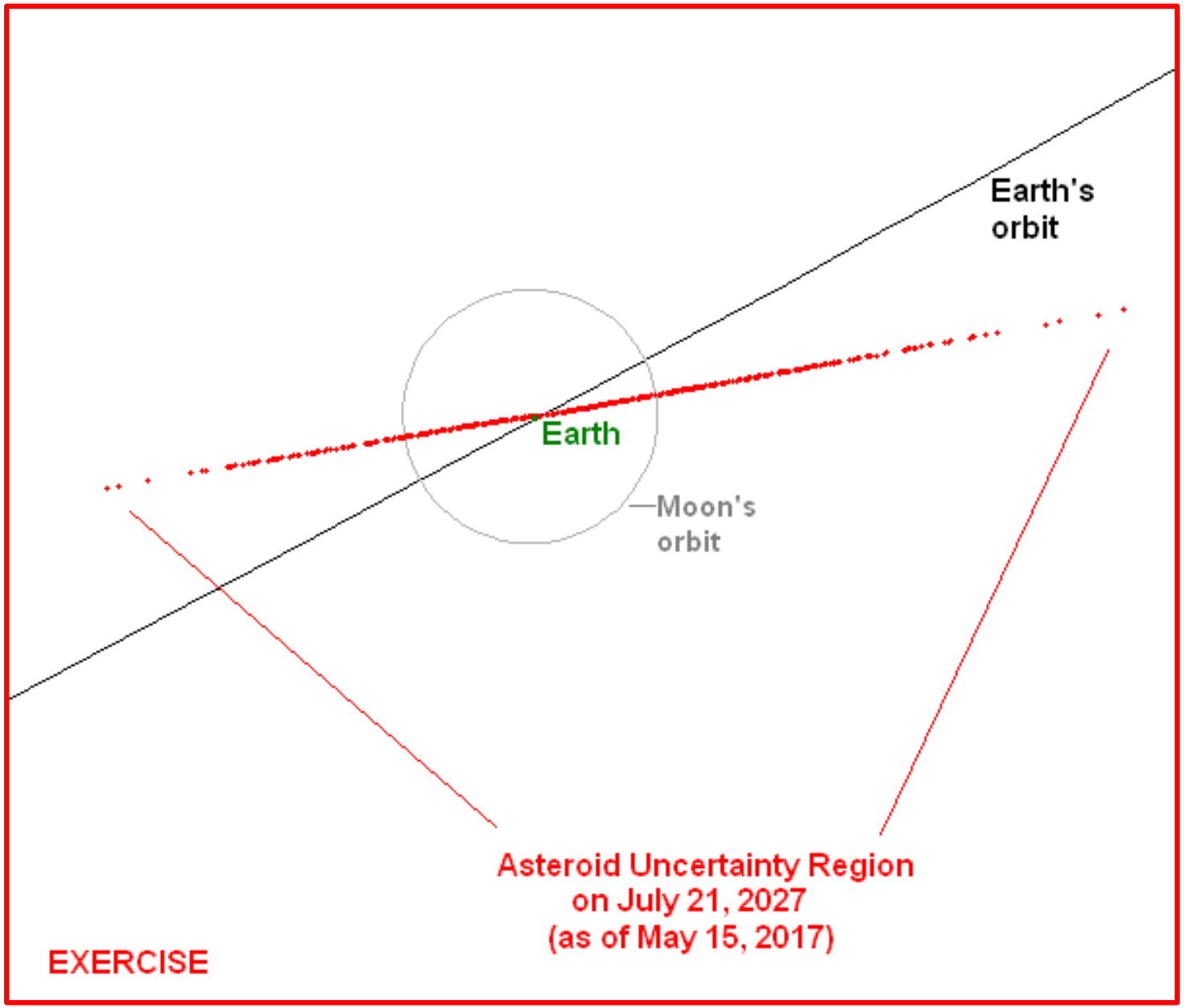
Possible impact 3.2 orbits after discovery, on July 21, 2027

EXERCISE

EXERCISE

2017 PDC Position Uncertainty on July 21, 2027

Jet Propulsion Laboratory
California Institute of Technology



Red dots show uncertainty region on July 21, 2027, calculated using data available on May 15, 2017

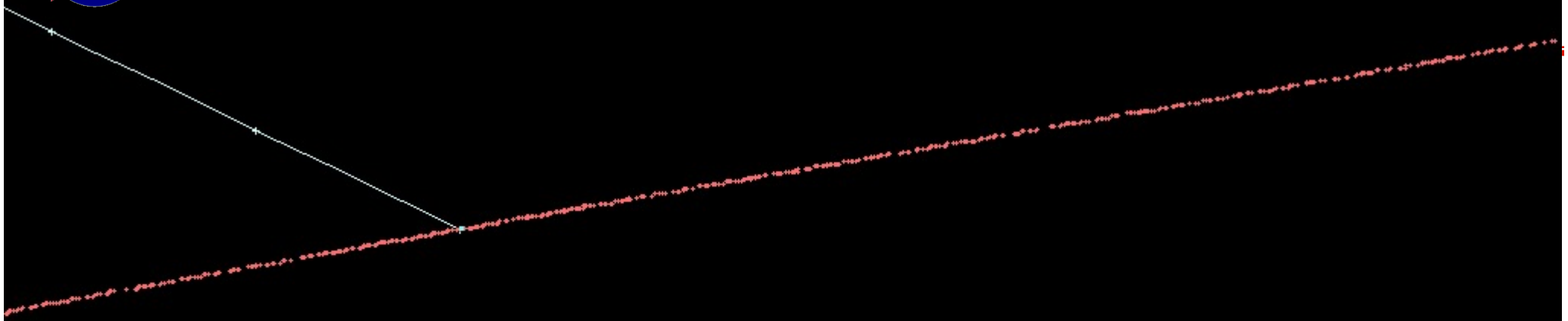
Uncertainty region aligns along the asteroid's orbit about the Sun

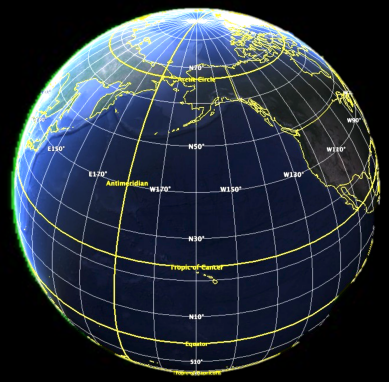
Uncertainty region will shrink as more observations are added

EXERCISE ONLY!!

PDC17: Uncertainty Region in 2027

Jet Propulsion Laboratory
California Institute of Technology

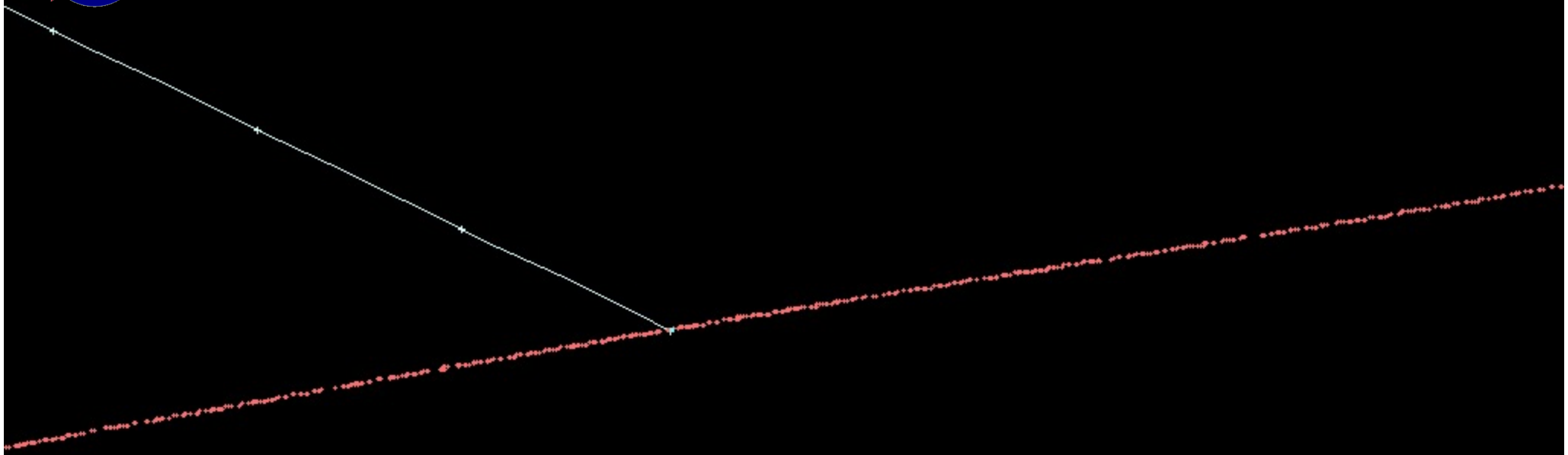


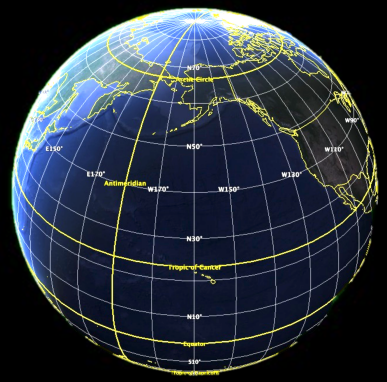


EXERCISE ONLY!!

PDC17: Uncertainty Region in 2027

Jet Propulsion Laboratory
California Institute of Technology

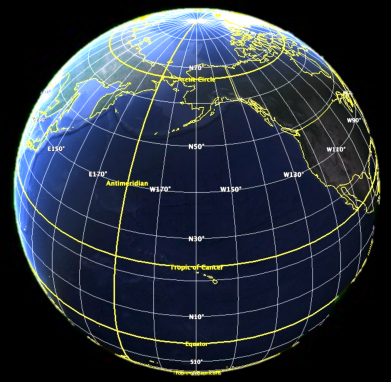




EXERCISE ONLY!!

PDC17: Uncertainty Region in 2027

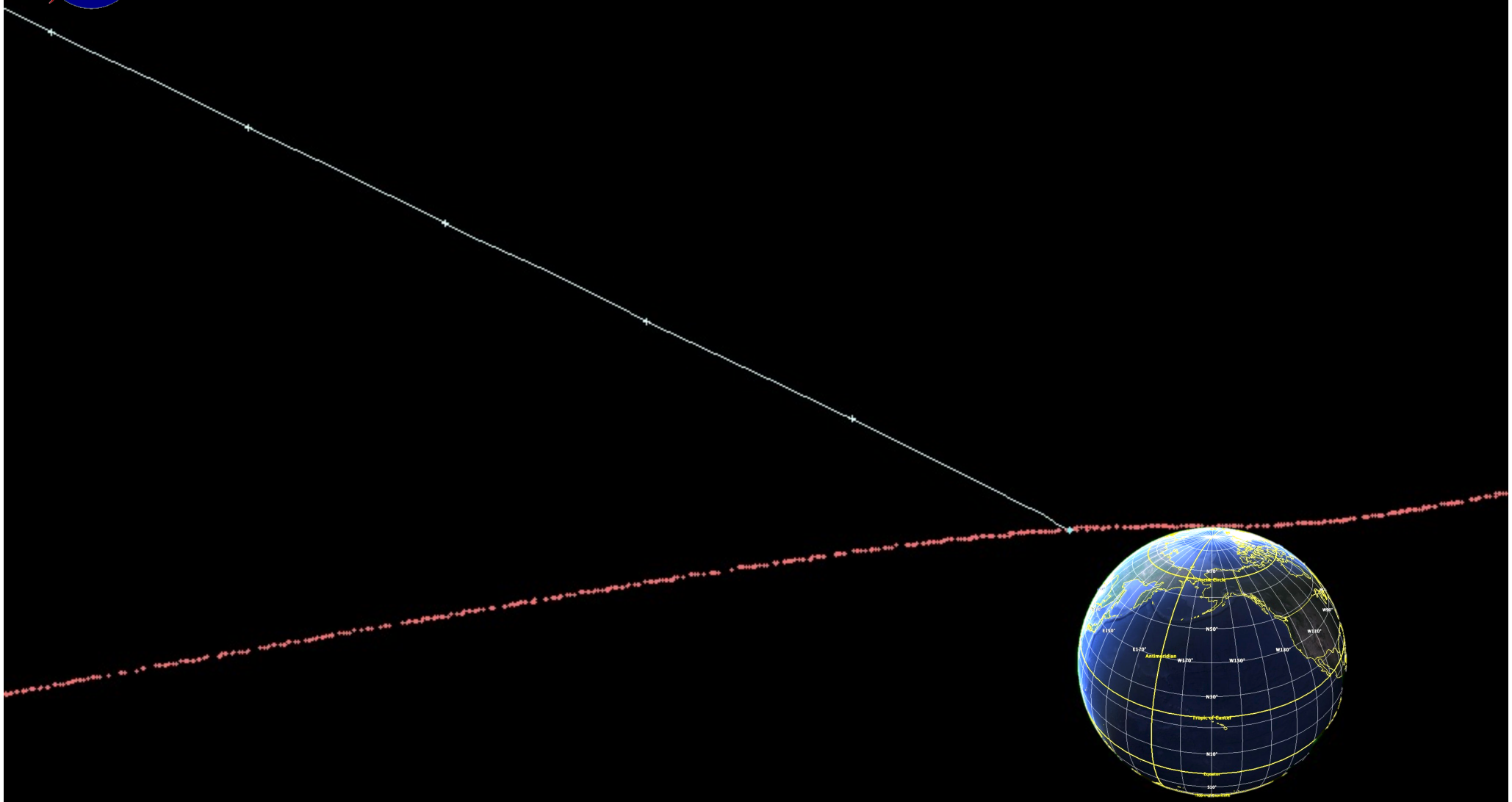
Jet Propulsion Laboratory
California Institute of Technology



EXERCISE ONLY!!

PDC17: Uncertainty Region in 2027

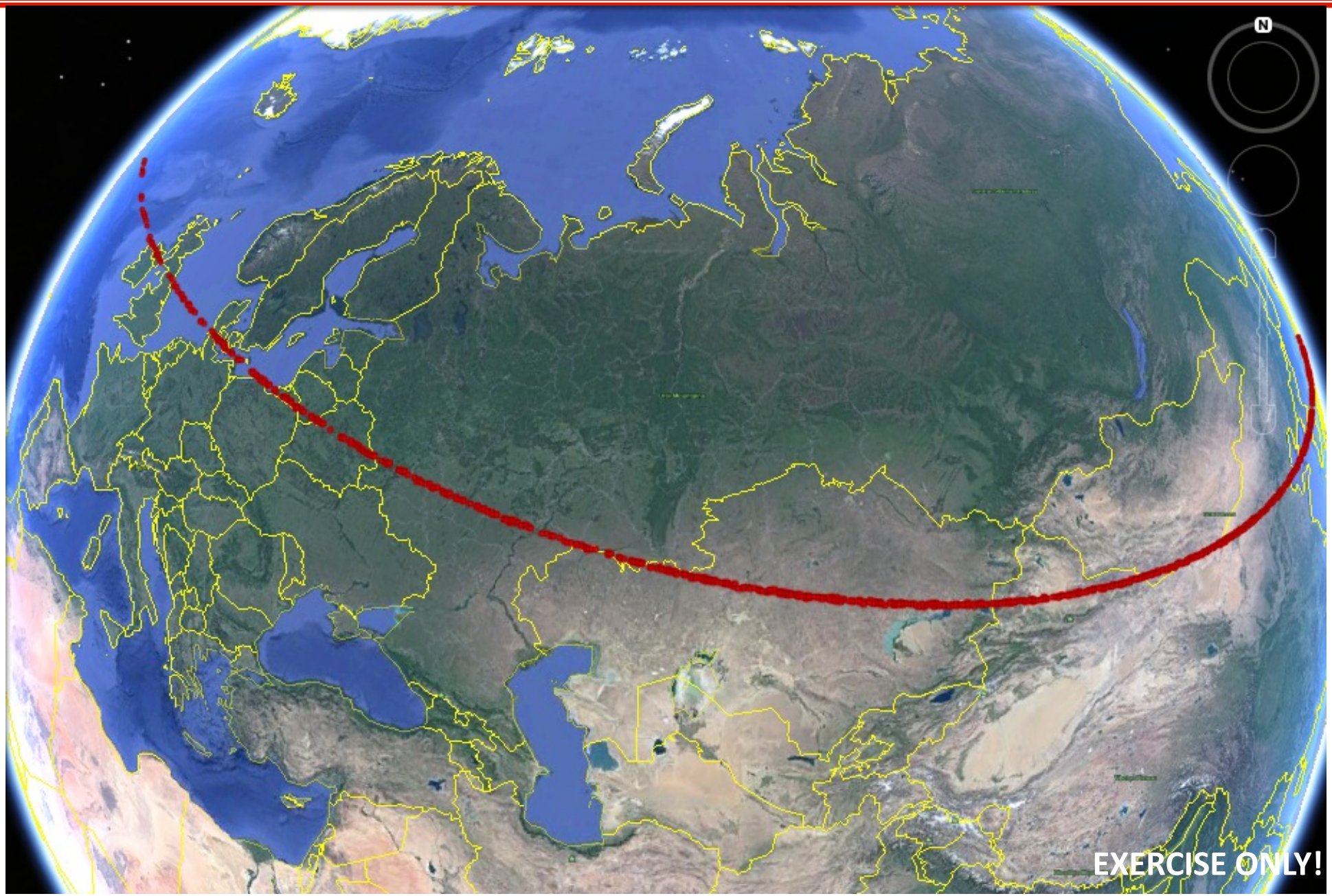
Jet Propulsion Laboratory
California Institute of Technology



EXERCISE ONLY!!

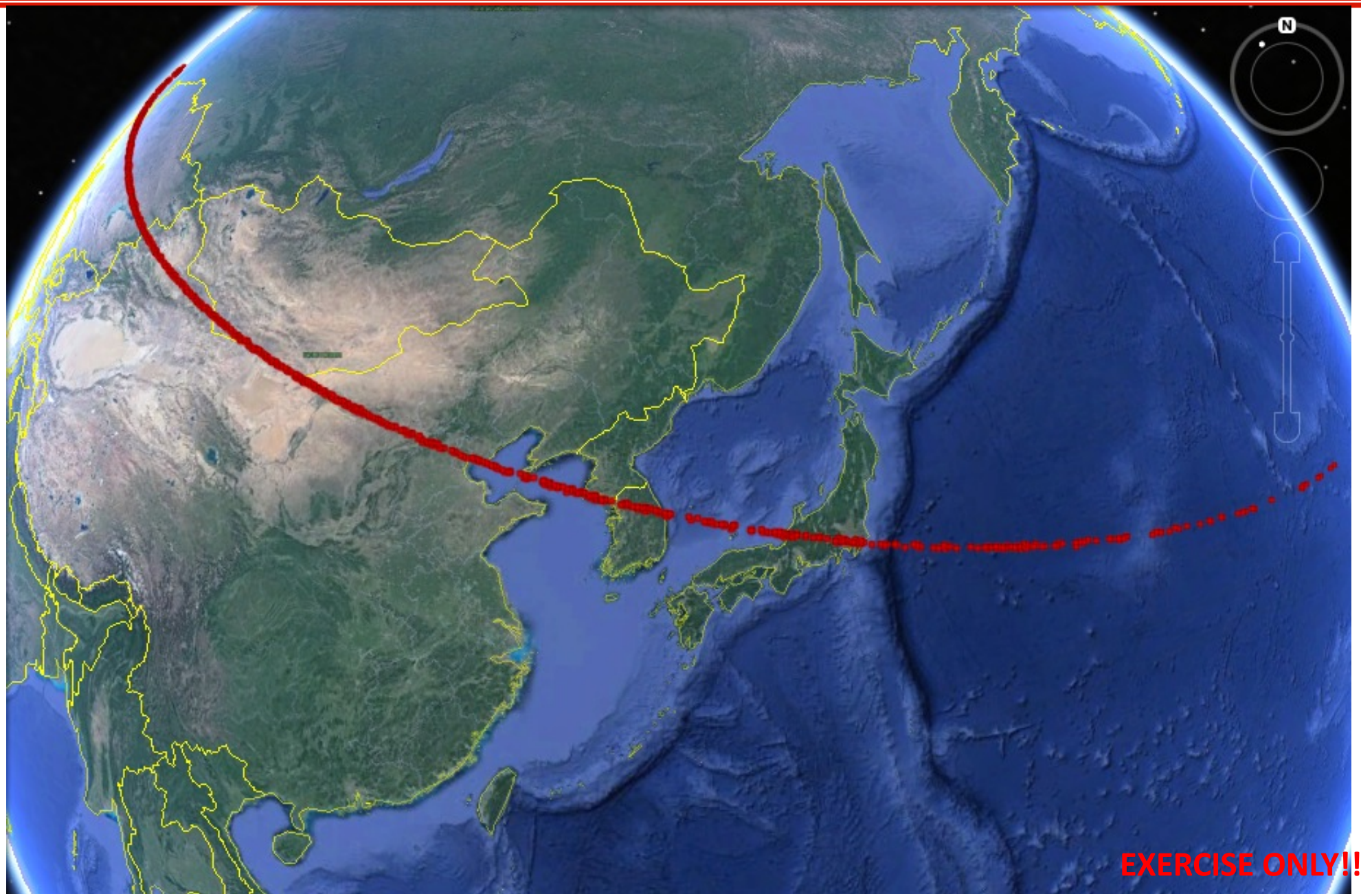
2017 PDC Risk Corridor - West

Jet Propulsion Laboratory
California Institute of Technology



2017 PDC Risk Corridor - East

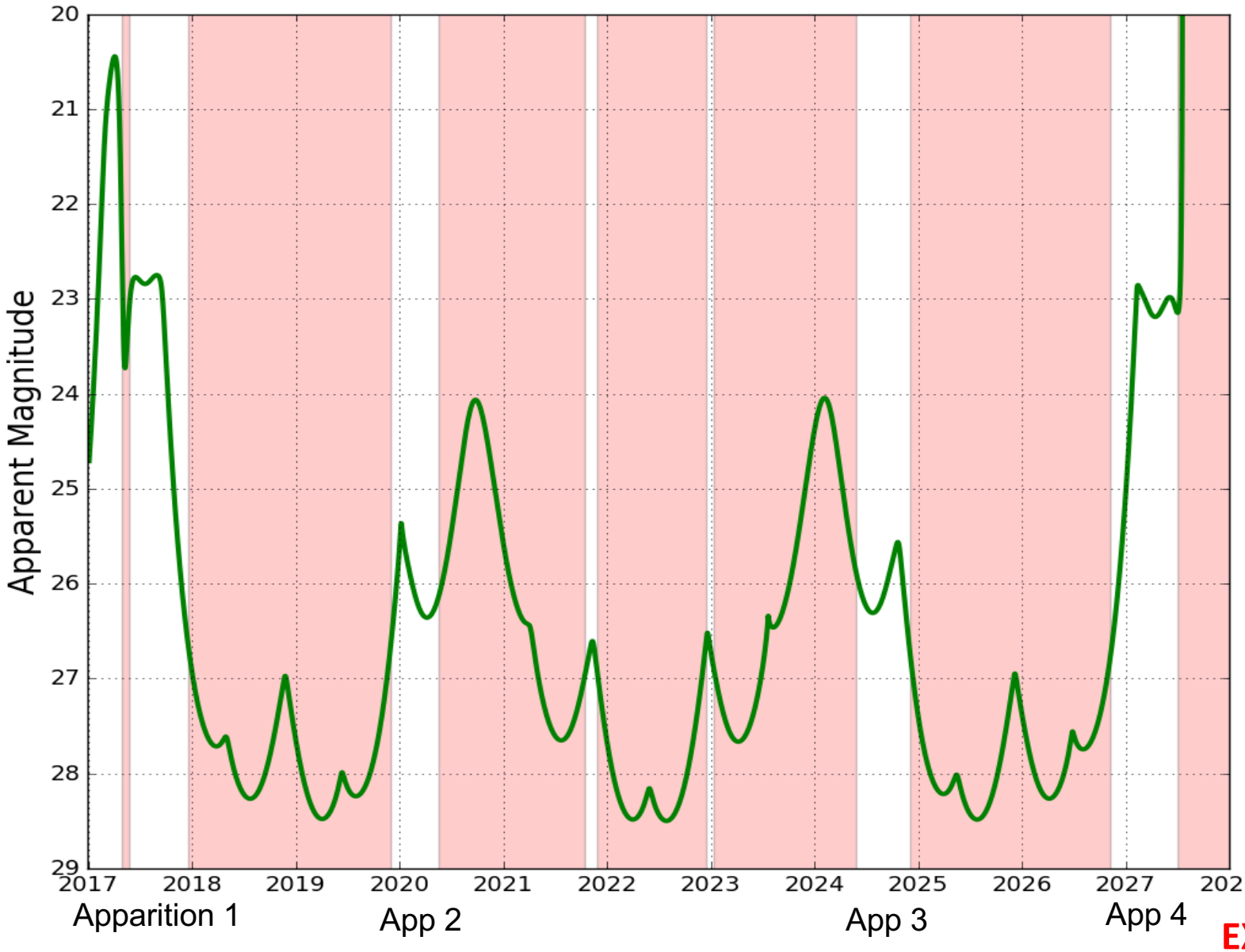
Jet Propulsion Laboratory
California Institute of Technology



When Is 2017 PDC Visible from Earth?

Jet Propulsion Laboratory
California Institute of Technology

Not visible during shaded times (AppMag > 26.8 or solar elongation < 45 deg)



Telescope Category:

1 m

2 m

4 m

8 m

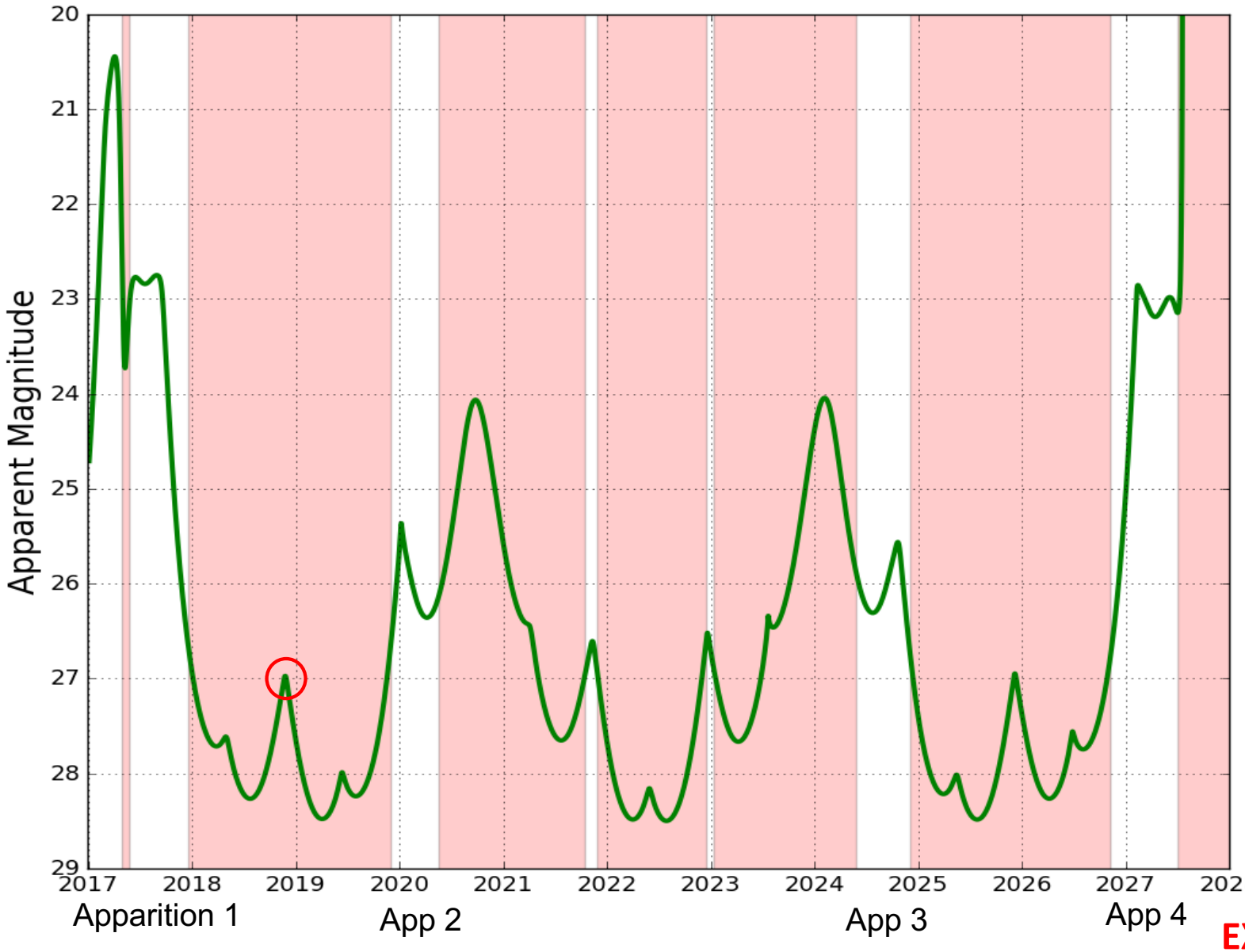
HST

EXERCISE ONLY!!

When Is 2017 PDC Visible from Earth?

Jet Propulsion Laboratory
California Institute of Technology

Not visible during shaded times (AppMag > 26.8 or solar elongation < 45 deg)



Telescope Category:

1 m

2 m

4 m

8 m

HST

EXERCISE ONLY!!

2017 PDC: Impact Probability vs. Time

Jet Propulsion Laboratory
California Institute of Technology

- Since we can predict when 2017 PDC will be observable, we can also predict how the impact probability will evolve with time, assuming the worst case, namely that the asteroid is on an impact trajectory
- Impact probability will reach no higher than 10% in July 2017, and no higher than 26% by the end of the first apparition (December 2017)
- Space agency officials are considering funding a special observing campaign to observe 2017 PDC at Vmag = ~27 in November 2018, perhaps using HST or VLT
- If the late-2018 observations aren't made, the impact probability will remain frozen at no higher than 26% until the second apparition begins in November 2019

EXERCISE ONLY!!

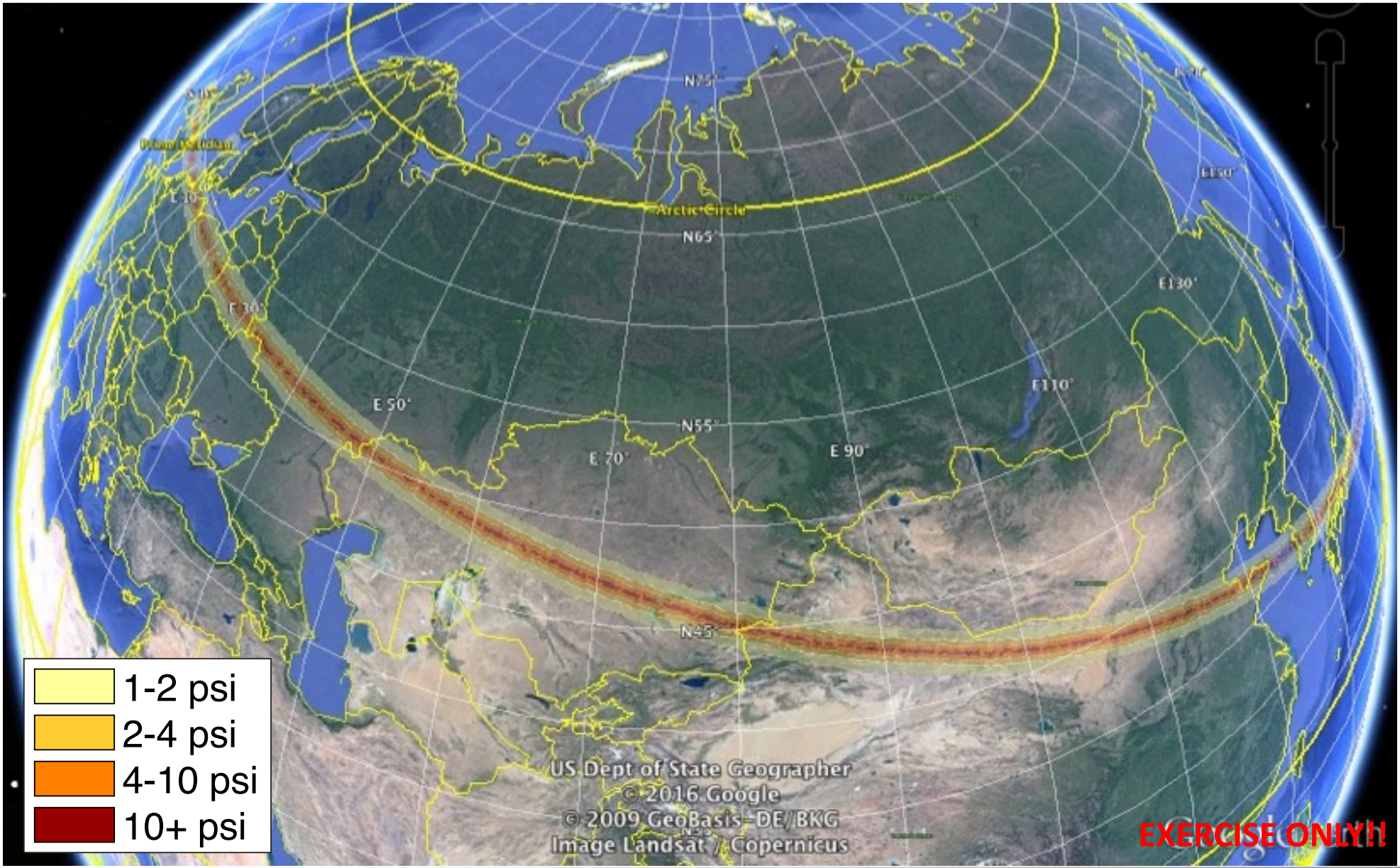
Impact Risk Assessment Summary

- Simulated 1000 impact cases for each swath point, sampling from uncertainty distributions of size (diameter or H-mag/albedo), density, and strength according to the given knowledge about the asteroid for each inject option.
- Local population affected by blast overpressure and/or tsunami is computed for each sampled impact case.
  - For blast overpressure, different fractions of the population are counted as affected depending on the blast overpressure level: 10% of people within the 1-2 psi zone, 30% within the 2-4 psi zone, 60% within the 4-10 psi zone, and 100% within the 10+ psi zone.
  - For tsunami, fractions of the inundated population are counted as casualties depending on flood depth (averaging to about 10% of the inundated population).
  - The maximum affected population from blast or tsunami is taken as the affected population for each sampled impact case.

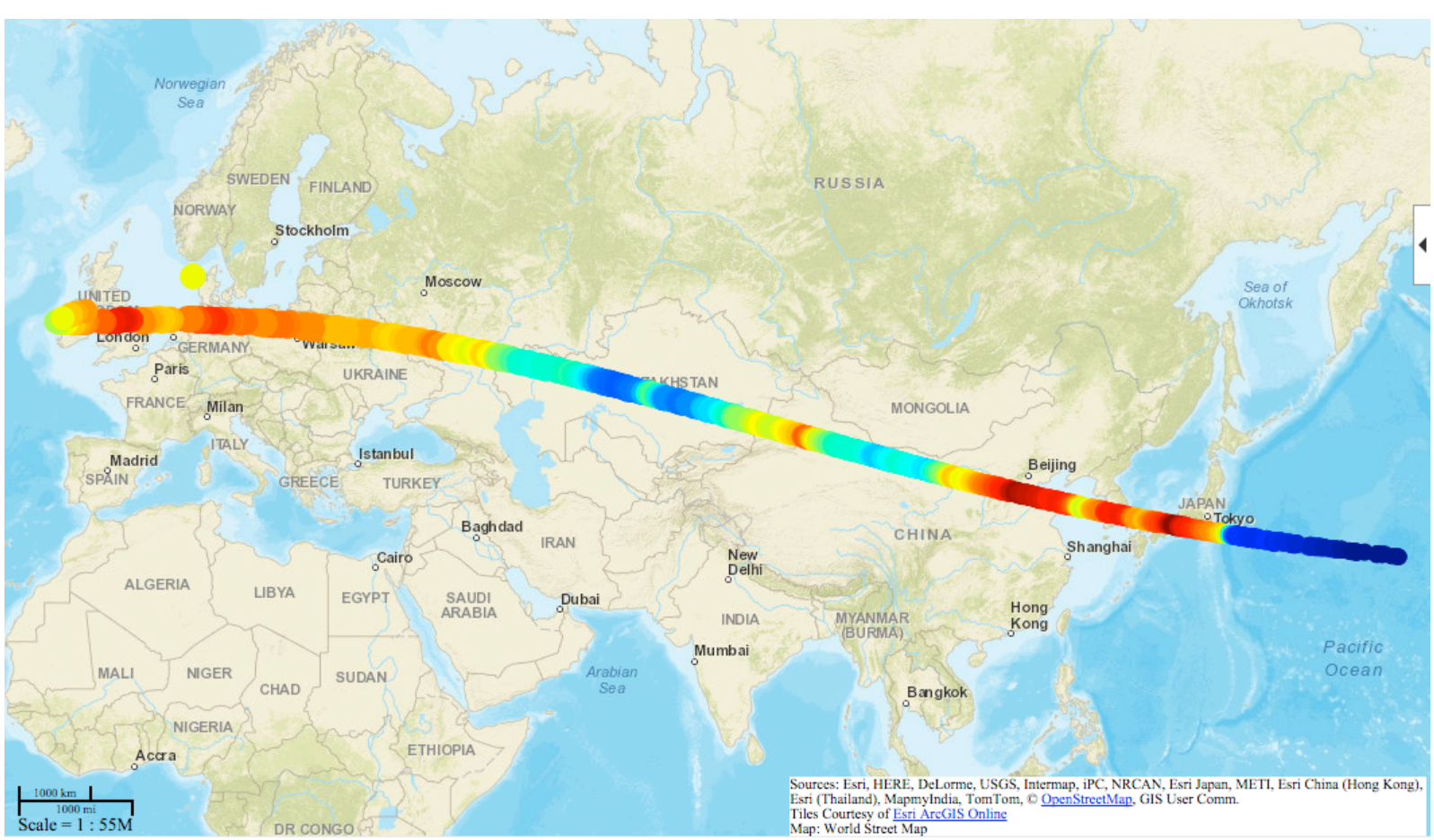
Result Plot Summary

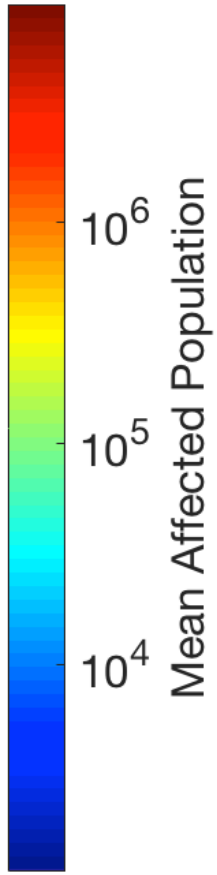
- Blast Damage Zone Plots
  - Google Earth plots showing blast overpressure zones along the swath (1-2 psi, 2-4 psi, 4-10 psi, and 10+ psi).
- Mean Affected Population Plots
  - Color map of mean affected population for each swath point.
  - Points are plotted at the mean impact coordinates for each swath point (which varies for each realization depending on where it bursts along the trajectory).
  - Points are sized by the mean 1-psi damage area.
  - For small/tight footprints, also included an alternate version of this plot that small points (rather than sizing them to the 1-psi region).
- Damage Level Probabilities
  - Histograms showing the probability of various damage levels.

Blast Damage Zones



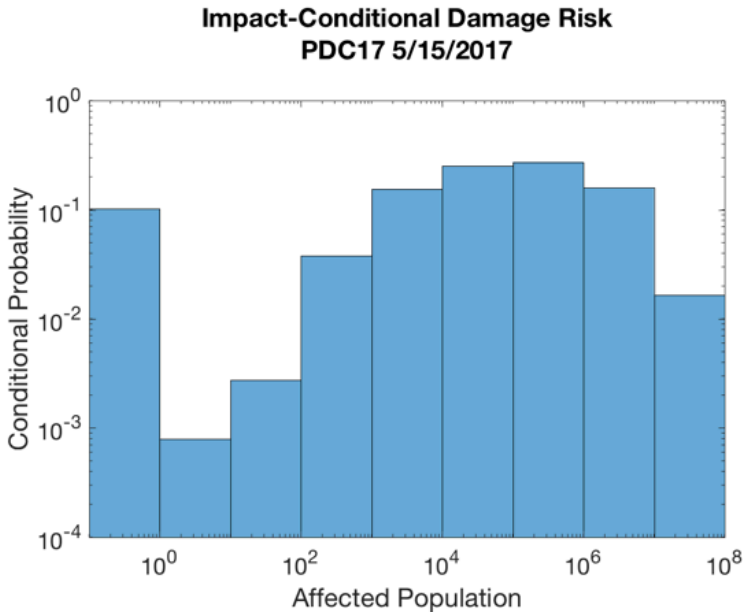
Mean Affected Population

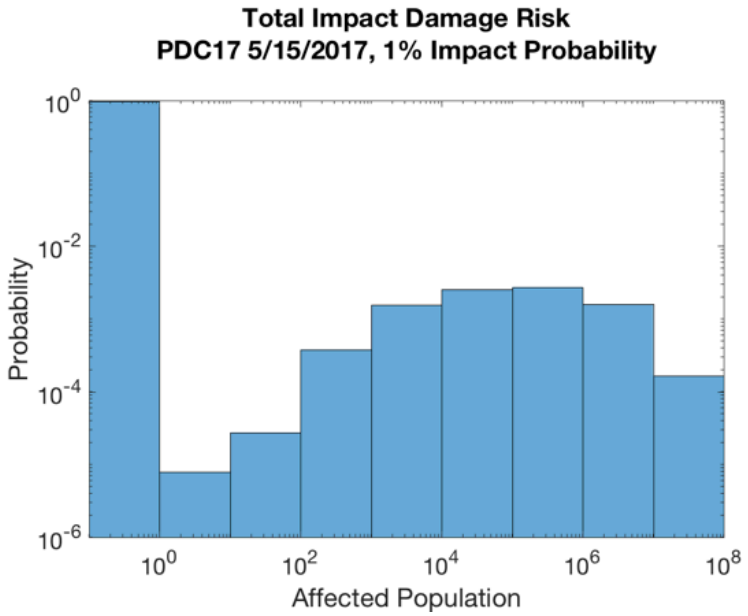


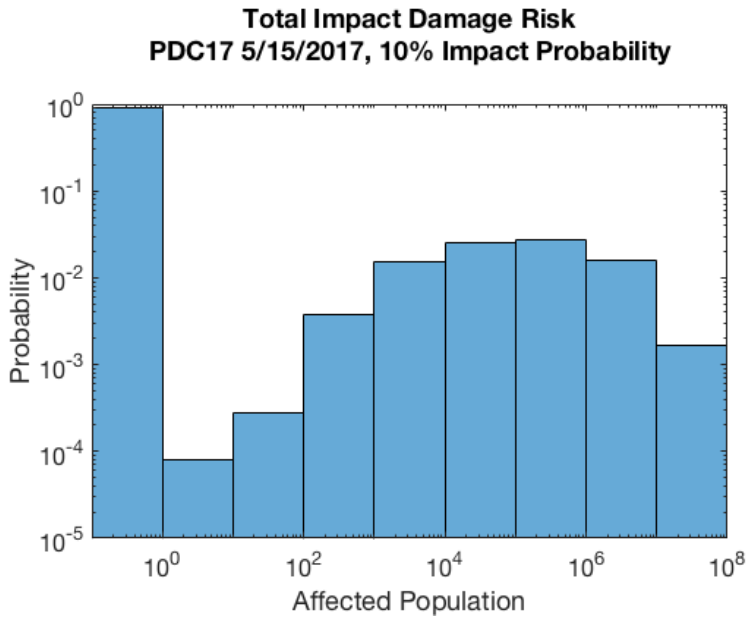


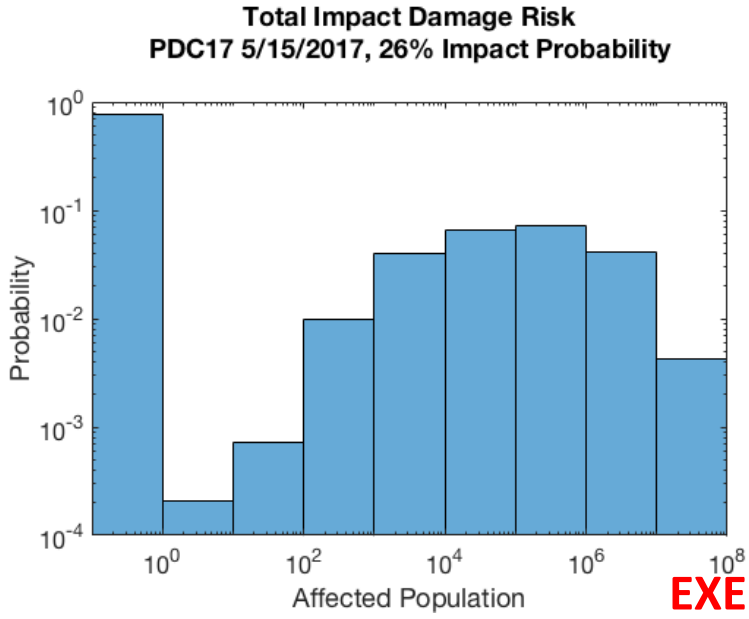
EXERCISE ONLY!!

Damage Level Probabilities







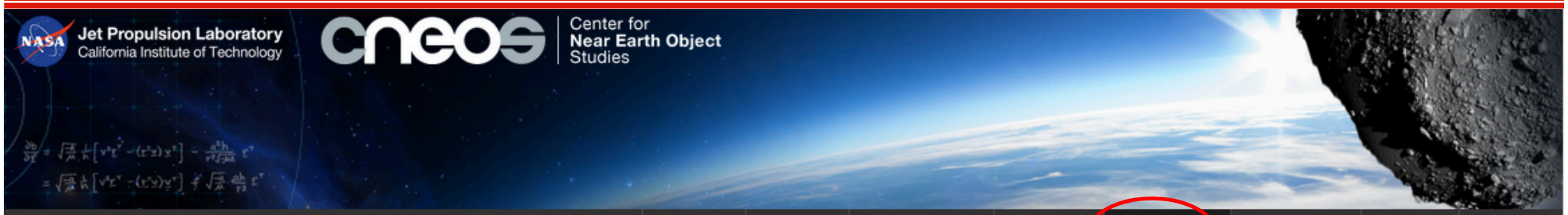


EXERCISE ONLY!!

CNEOS Home Page

https://cneos.jpl.nasa.gov

Jet Propulsion Laboratory
California Institute of Technology



Home | About | Orbits | Close Approaches | Impact Risk | Planetary Defense | Discovery Statisics | Tools | Extras

- Introduction
- NEO Deflection App
- Impact Scenarios
- NASA Planetary Defense Coordination Office

CNEOS is NASA's center for computing asteroid and comet orbits and t…pact.

Lookup NEO designation

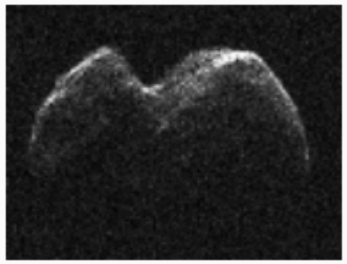
Quick Links

- NEO Basics
- NEO DB Query
- Sentry (impact risk)
- Fireballs
- Accessible NEAs
- NASA PDCO
- Asteroid Watch
- FAQ

Next NEO Close Approach within 10 Lunar Distances (LD)

Object:	2017 JX1
Date:	2017-May-11 02:50 ± < 00:01 (hh:mm)
Dist:	3.71 LD (min: 3.70 LD)
H:	26.0

Top News Stories

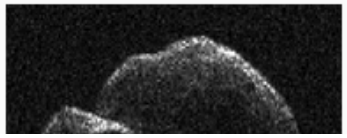


[full story]

Initial Results from the Close Approach of Asteroid 2014 JO25

2017-05-05

A relatively large asteroid called 2014 JO25 approached within 4.6 lunar distances (within 1.1 million miles or 1.8 million kilometers) of the Earth on April 19, 2017. This was the closest approach by an asteroid at least 600 meters in size since 4179 Toutatis, a 3 mile (5 kilometer) sized asteroid, approached within four lunar distances in September 2004. The close approach provided an outstanding opportunity to study the physical properties of the asteroid, and the images obtained by ground-based radars are comparable in resolution to those that could be obtained by a spacecraft flyby.



NASA Radar Spots Relatively Large Asteroid Prior to Flyby

2017-04-18

Radar images of asteroid 2014 JO25 were obtained in the early morning hours on Tuesday, with

PDC 17 Scenario Home Page

Planetary Defense Conference Exercise - 2017

Day 0 | Day 1 | Day 2 | Day 3 | Day 4 | Day 5

This webpage does not describe a real potential asteroid impact. The information on this page is fictional and provided only to support an emergency response exercise conducted during the International Academy of Astronautics (IAA) [2017 Planetary Defense Conference](http://pdc.iaaweb.org/) in Tokyo, Japan, May 15-19, 2017. This is only an exercise.

The 2017 PDC Hypothetical Asteroid Impact Scenario

- Initial Press Release

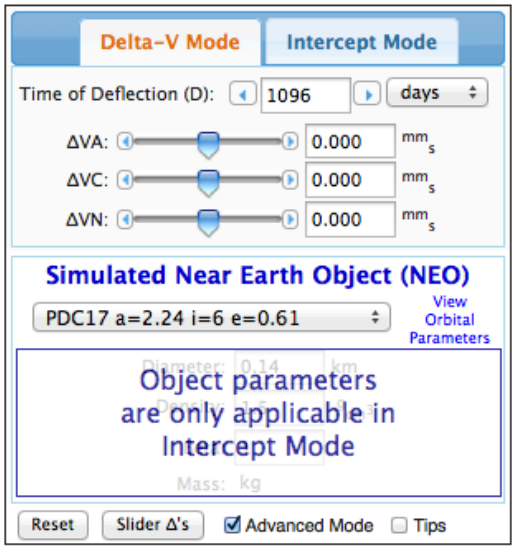
A hypothetical asteroid impact scenario will be presented at the 2017 IAA Planetary Defense Conference (PDC), to be held in Tokyo, Japan, May 15-19, 2017. Although this scenario is realistic in many ways, it is completely fictional and does NOT describe an actual potential asteroid impact. The scenario is as follows:

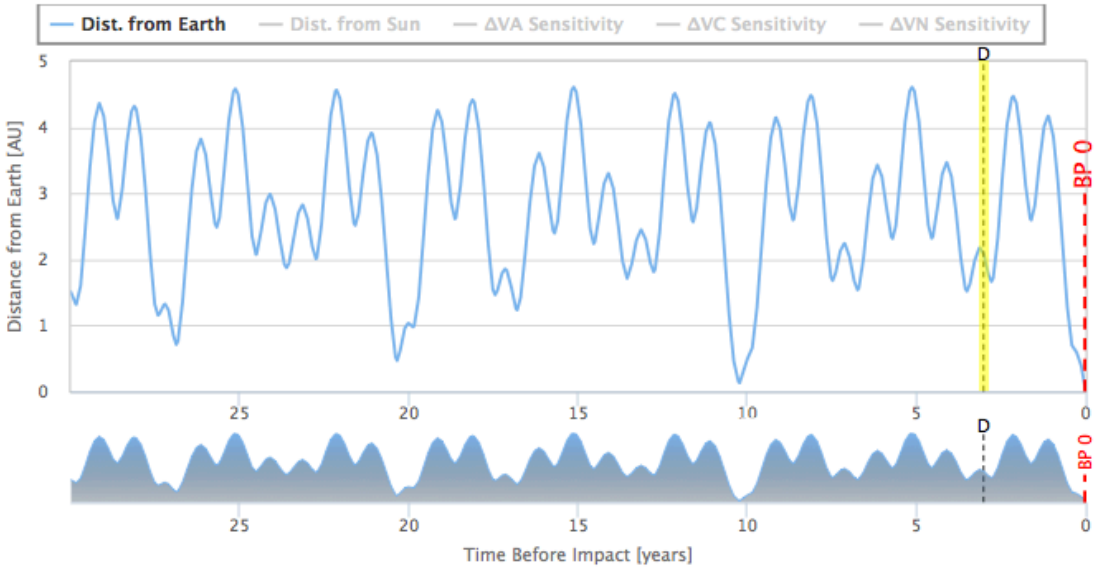
- An asteroid is discovered on March 6, 2017, at magnitude 21.1, and confirmed the following day. It is assigned the designation "2017 PDC" by the Minor Planet Center. (To reinforce the fact that this is not a real asteroid, we are using three letters in the designation, something that would never be done for an actual asteroid.)

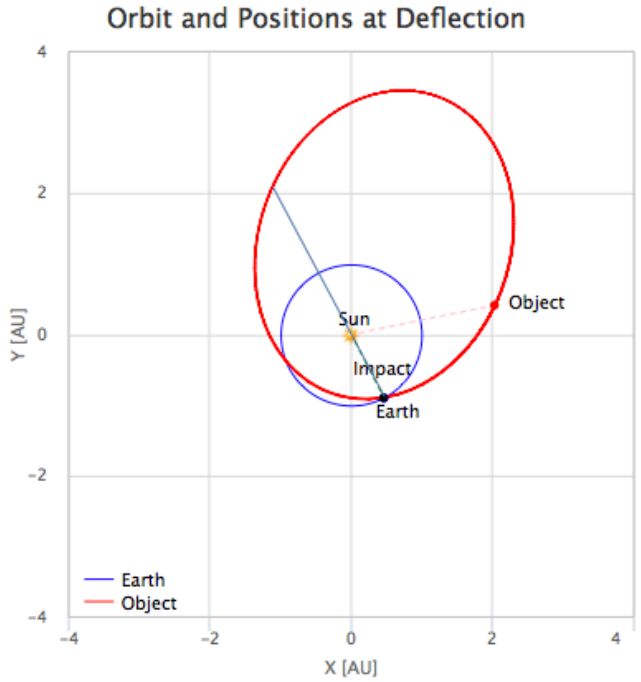
- Initial calculations indicate that 2017 PDC's orbit approaches well within 0.05 au to that of the Earth, and it is therefore classified as a Potentially Hazardous Asteroid (PHA). (The unit "au" stands for "astronomical unit", which is the mean distance of the Earth from the Sun, 149,597,870.7 km, or 92,955,807 miles.) The orbit is eccentric, extending from a distance of 0.88 au from the Sun at its closest point to 3.60 au at its farthest point. The asteroid's orbital period is 1225 days (3.35 years), and its orbital plane is inclined 6.3 degrees to the orbit of the Earth.

CNEOS NEO Deflection App (NDA)

Jet Propulsion Laboratory
California Institute of Technology





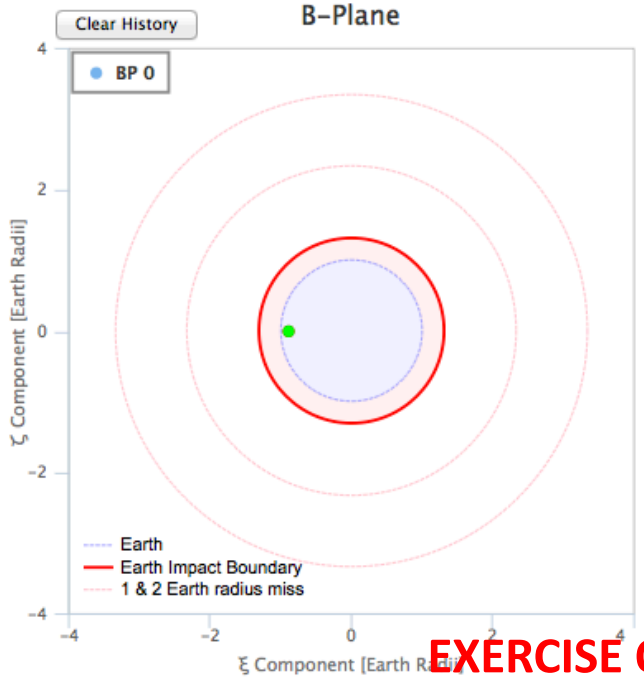


Orbit Changes
ΔVA: 0.000 mm/s
ΔVC: 0.000 mm/s
ΔVN: 0.000 mm/s
Total ΔV: 0.000 mm/s
Period at D: 1225.063 d
Δ Period: 0.0000 s

B-Plane Values
ζ (zeta): 0.001 R_e
ξ (xi): −0.880 R_e
B magnitude: 0.880 R_e
Capture Rad.: 1.310 R_e
Perigee Dist.: 0.592 R_e
IMPACT
V_∞: 13.210 km/s

* R_e = Earth Radii

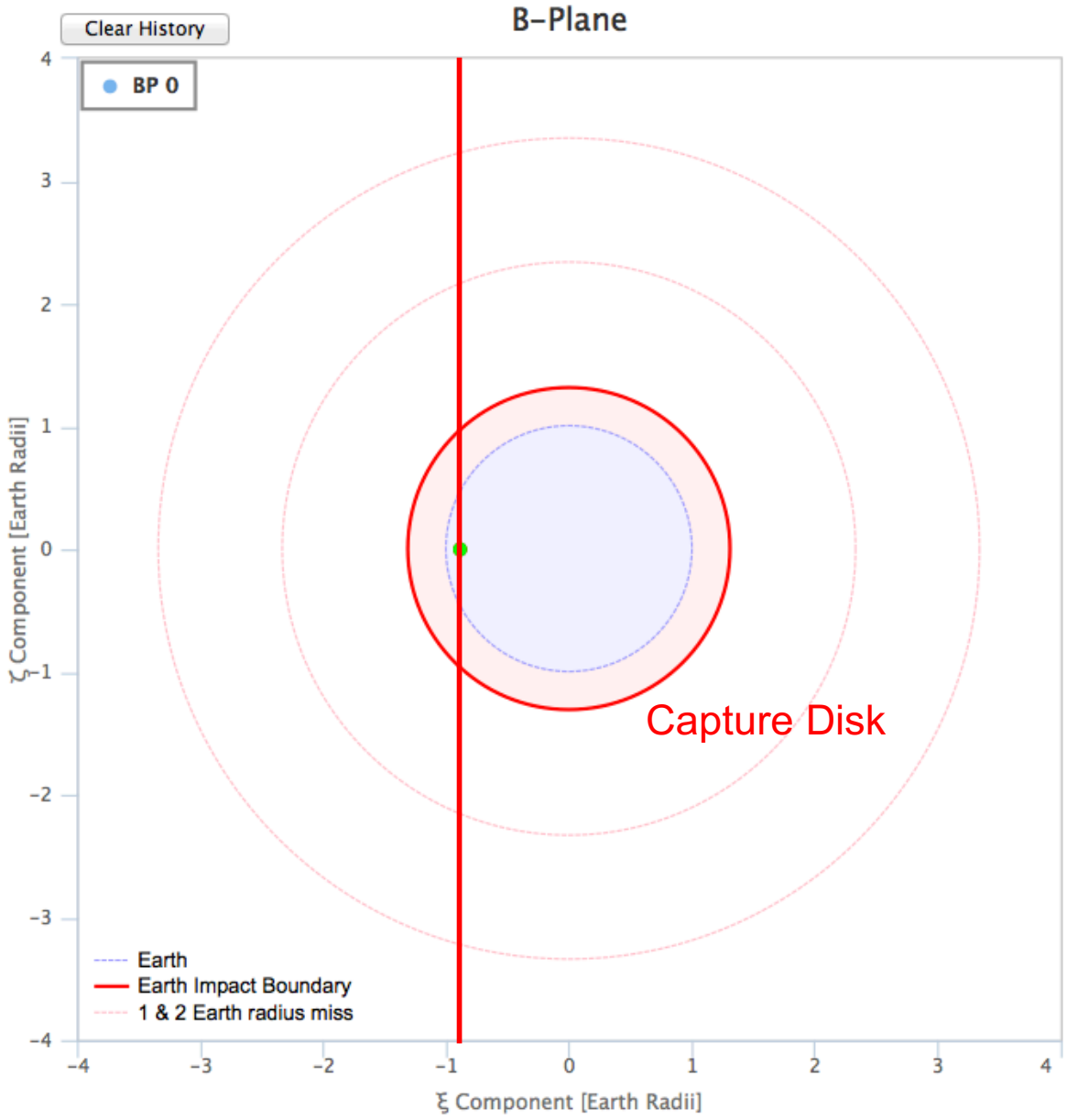
Save Current Session
Restore Session
Deflection Map



EXERCISE ONLY!!

2017 PDC: B-Plane in NDA

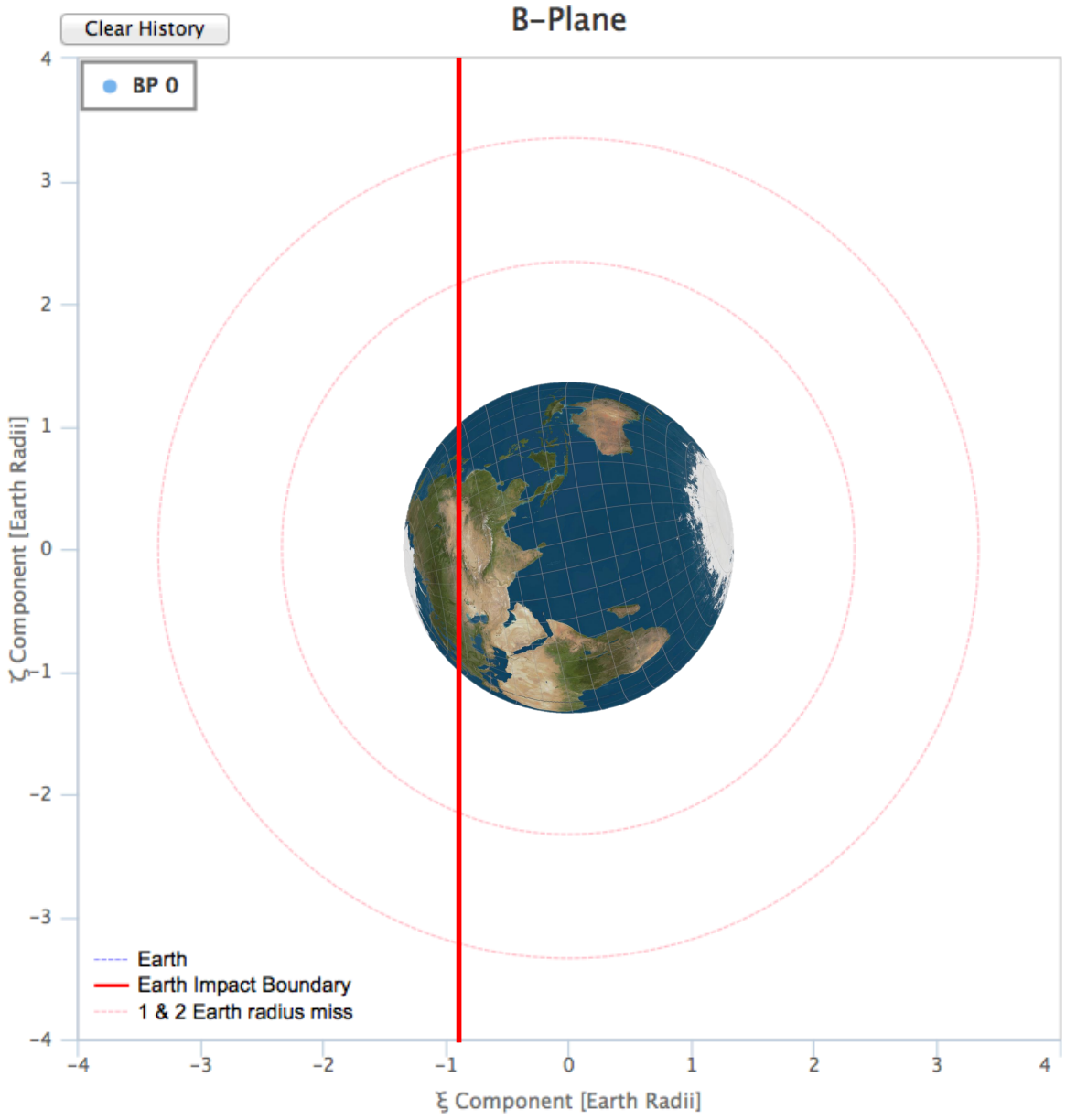
Jet Propulsion Laboratory
California Institute of Technology



EXERCISE ONLY!!

2017 PDC: B-Plane in NDA

Jet Propulsion Laboratory
California Institute of Technology

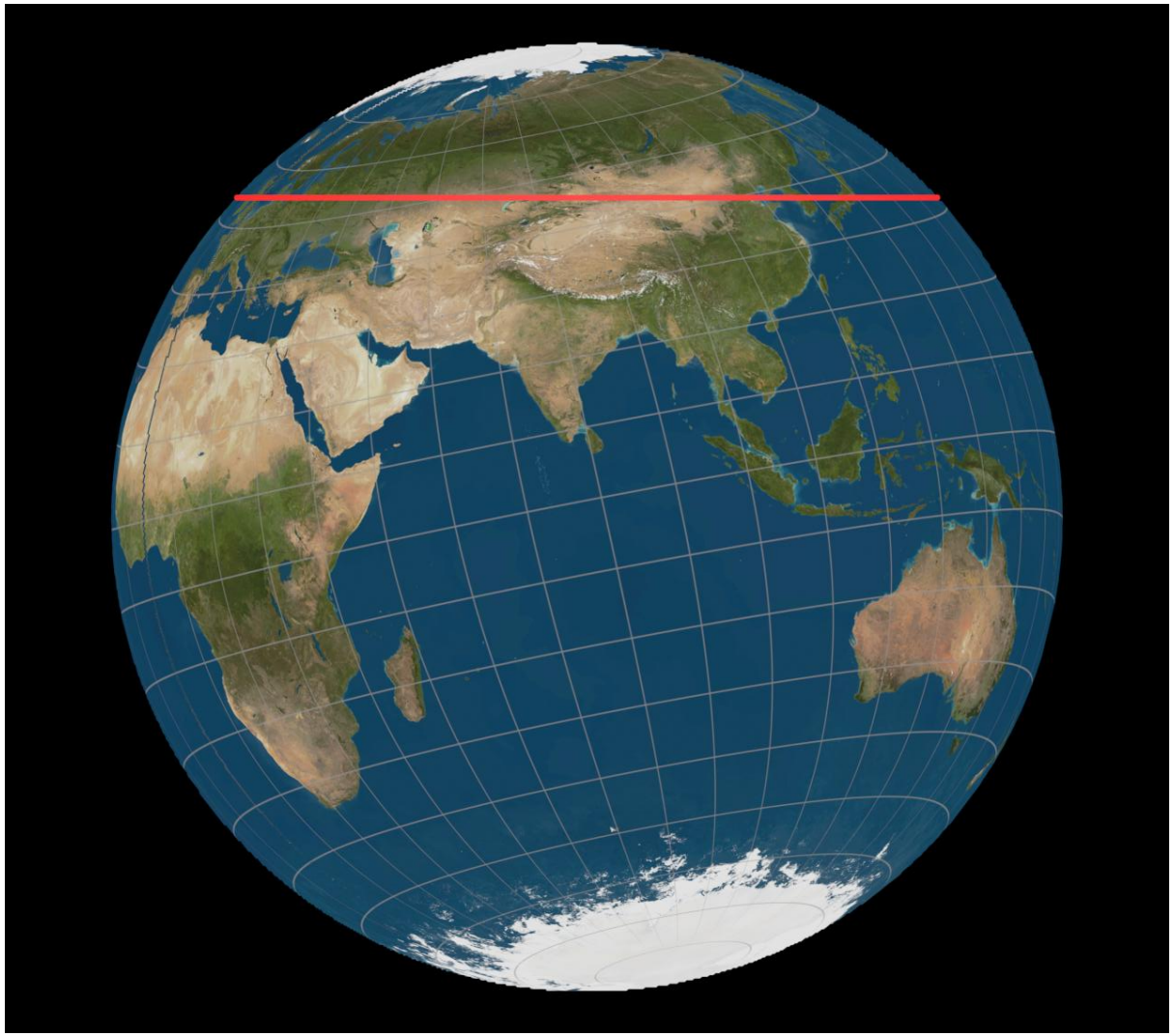


EXERCISE ONLY!!

Risk Corridor and Earth Features in B-Plane

Jet Propulsion Laboratory
California Institute of Technology

Chord length in b-plane: 12,330 km



Easier direction for Kinetic Impactors

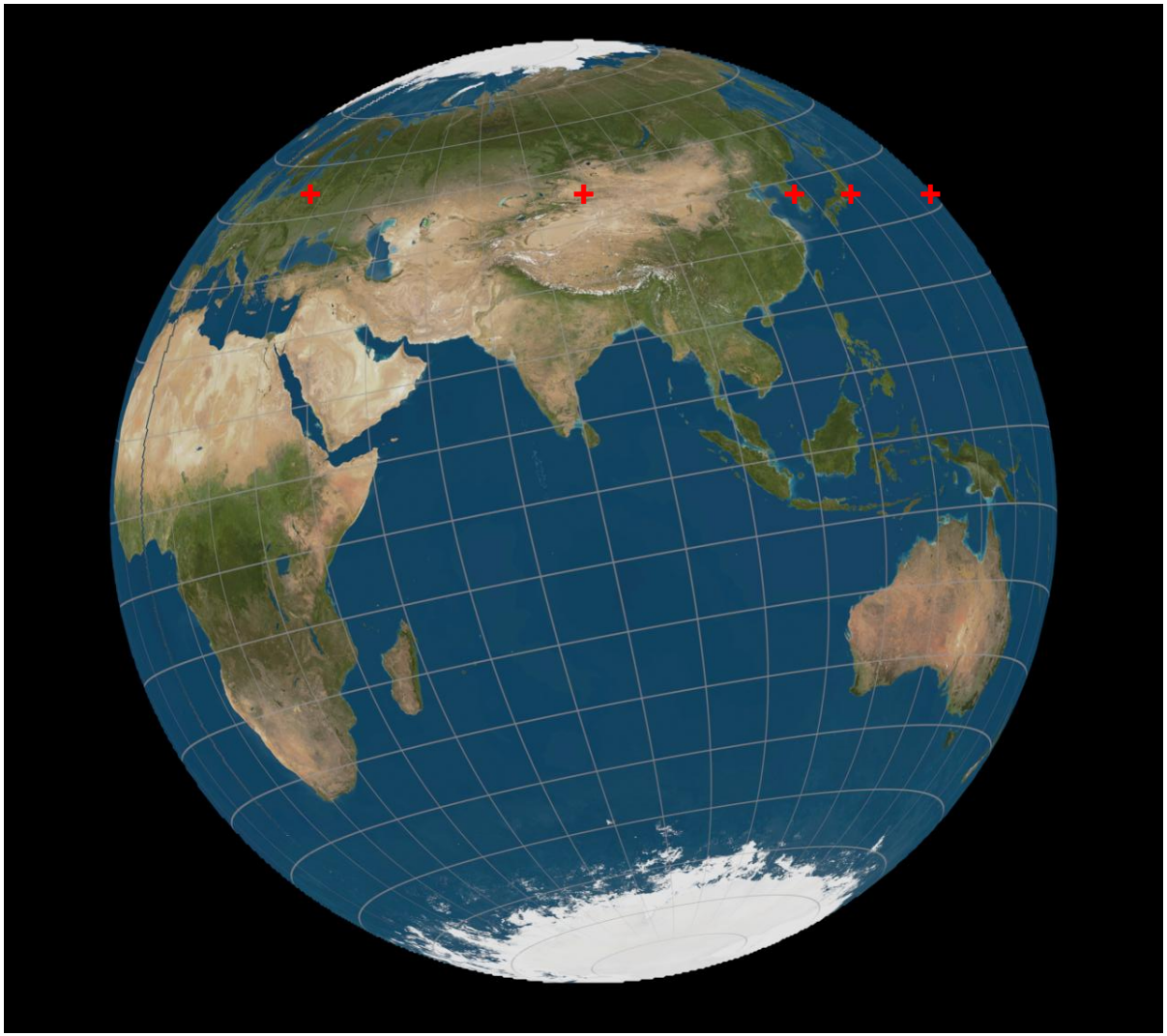
Difficult direction for Kinetic Impactors

Required vs. Achievable Deflection

Jet Propulsion Laboratory
California Institute of Technology

2940 km ← 250m: 0.46 cm/s

26,600 km ← 120m: 4.14 cm/s



Atlas V,
TD = 2024-Jan-23,
ρ = 1.5 g/cc, β=1

To avoid disruption,
$\Delta v < 0.1\ v_{esc}$

D = 250m:
Δv_{max} = 1.14 cm/s

D = 120m:
Δv_{max} = 0.55 cm/s

Uncertainties in Deflection Campaign Design

Jet Propulsion Laboratory
California Institute of Technology

- Low impact probability early on hampers decision to build missions
- Even when impact is nearly certain, the true ζ position is uncertain
- Thus, the minimum required $\Delta\zeta$ to move off Earth is uncertain
- Without characterization, the mass *M* of the asteroid is uncertain by an order of magnitude or more, perhaps a factor of 30?
- Without a close-up look at the asteroid, *M* is still uncertain by an order of magnitude
- Even with in-situ characterization, β may be uncertain by a factor of 2-3
- The $\Delta\zeta$ achievable for any given mission design is uncertain by a factor of several
- Even with in-situ characterization, the **number** of kinetic impactor missions required to move the trajectory off the Earth is very uncertain