Press Conference: May 15, 2020

Asteroid 2017 PDC Discovered to Be Binary and Confirmed to Be Headed for Impact Near Tokyo; Six Spacecraft on the Way to Deflect It

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2017 Planetary Defense Conference, Tokyo, Japan

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Results from the Fast Flyby Mission

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- Images provided key tracking data; IAWN has determined that 2017 PDC is on a course headed for impact near Tokyo on July 21, 2027
- The flyby revealed that 2017 PDC is a binary, consisting of a primary body about 270 meters in size and a moon ("secondary") roughly 100 meters across
- The orbital radius of the secondary is at least 1-2 km, considerably larger than the norm for binaries in this size range; orbital period on the order of a few days
- As a result, the secondary is only loosely bound to the primary
- Approach images from the spacecraft have provided enough data for IAWN to estimate an approximate mass for both components; the mass is 20% higher than had been assumed
- Size, shape and volume are now known much better; combination with the mass estimate yields a density of 1.9 g/cm^3
- For more info: **https://cneos.jpl.nasa.gov/pd/cs/pdc17/day3.html**

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Impact Location of 2017 PDC

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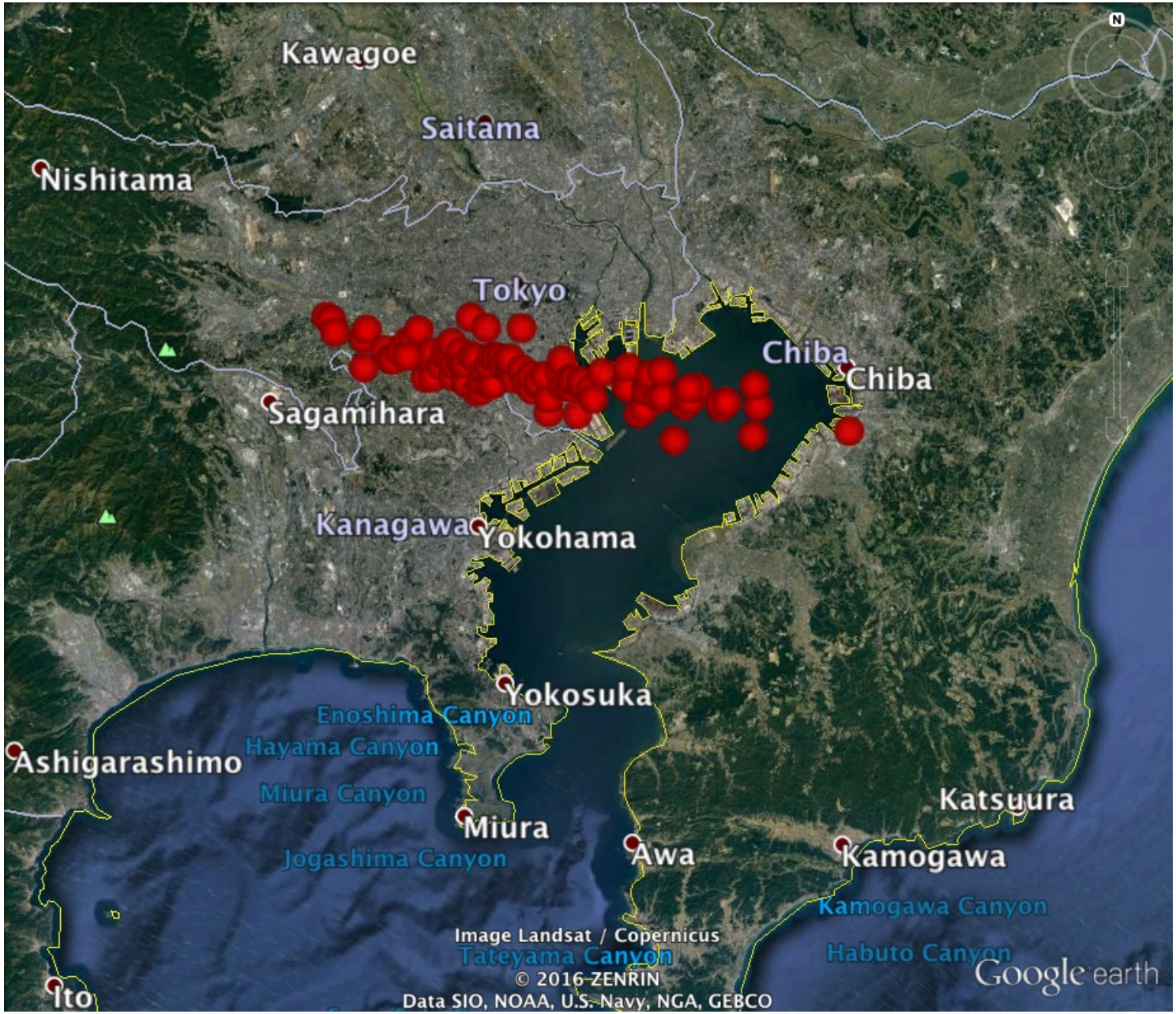

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Summary Deflection Campaign

- SMPAG has organized an extensive deflection campaign involving multiple space agencies and various launch vehicles
- A total of 8 spacecraft of various designs, all using Solar Electric Propulsion (SEP) have been under development for the last 2.5 years
- Only six spacecraft were completed on time
- The six launches occurred over a 3-week period in March (2 months ago) on Delta-IVH class vehicles; one launch failed, leaving a total of 5 KI spacecraft to carry out the deflection in February 2024
- The KI spacecraft use an intercept trajectory that will boost the velocity of the asteroid, thereby moving the asteroid's impact point eastwards into the Pacific Ocean
- The intercept trajectory is difficult to attain, requires a long flight time, and arrives at the asteroid at a relatively low velocity of 8 km/s

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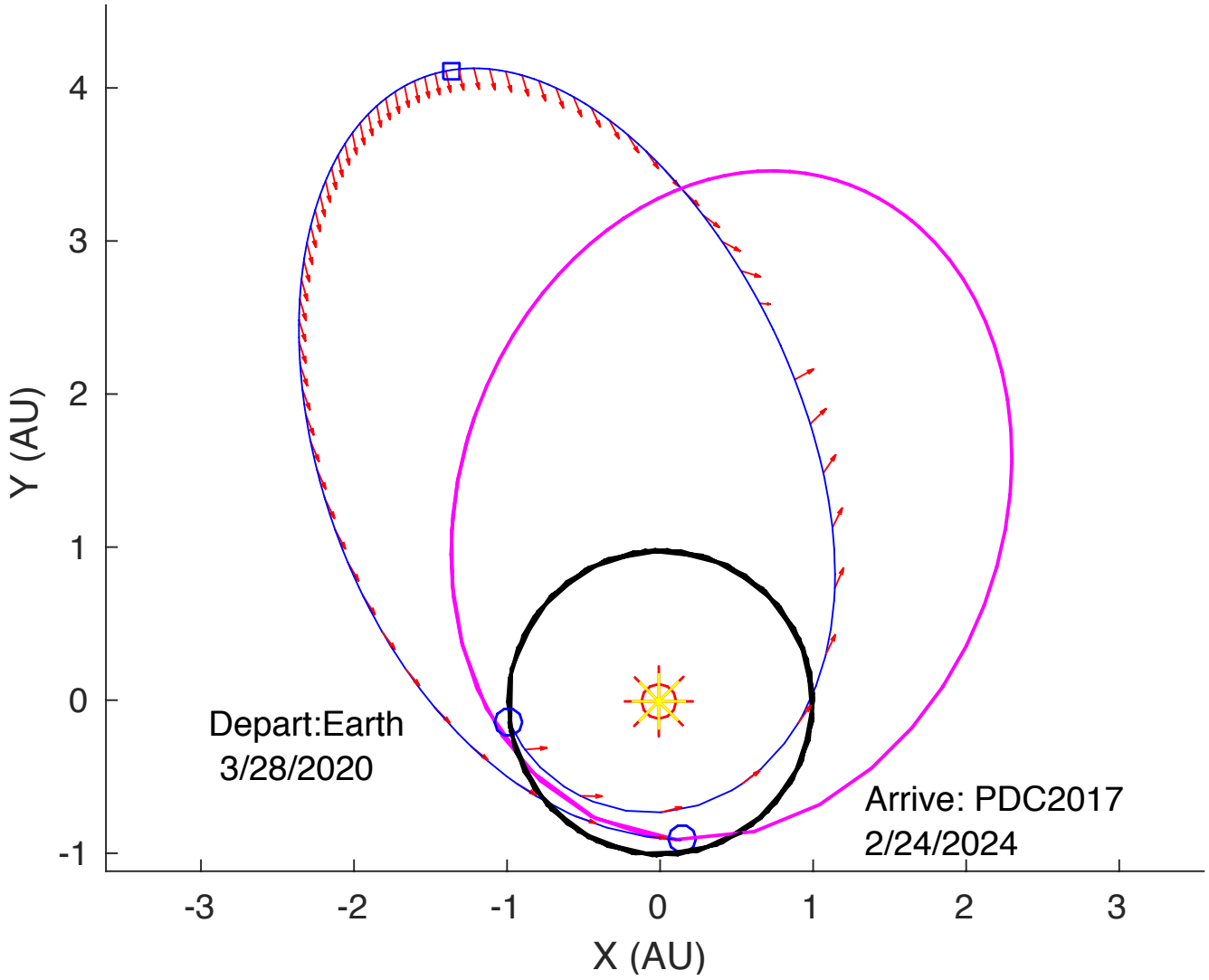
Trajectory for KI-East Campaign



Launch: Mar. 28, 2020

Deflect: Feb. 24, 2024

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Implications of the Binarity of 2017 PDC

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- The fact that 2017 PDC is a binary adds an unanticipated complication to the deflection campaign
- The relatively large orbital radius of the secondary implies that it is only loosely bound to the primary
- Any deflection to the primary will affect the secondary as well through the mutual gravitational attraction: its orbit will change in a largely unpredictable way
- After the first KI deflection, subsequent spacecraft will impact at largely random configurations of the secondary in its orbit
- There is a chance that the secondary could escape the system and continue its own path, possibly continuing to pose a hazard of Earth impact

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Rendezvous Mission

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- Two spacecraft have been readied for launch one month from now on a mission to rendezvous with 2017 PDC in May 2023, 3 years from now
- Decision makers have discussed whether or not to install nuclear explosive devices on these spacecraft, but decided not to do so
- The spacecraft were designed to carry such devices, and currently carry a dummy mass that could be replaced by the nuclear device; there is still time to make the switch
- The spacecraft will arrive in time to observe the series of KI deflections scheduled for Feb. 2024
- The images sent back would be invaluable for assessing the results of the deflection and establishing new trajectories for both components of the binary asteroid

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Revisions to the Deflection Campaign

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- IAWN has estimated the approximate orbital period of the secondary, on the order of a few days
- This result allows scientists to estimate the approximate mass of the primary, an unexpected benefit from the flyby mission
- The mass of 2017 PDC is ~20% higher than assumed previously
- Shape and volume were also estimated from the images returned from the flyby mission, resulting in a density of 1.9 g/cm^3
- The worst case analysis ($\beta = 1$) suggests that successful deflection is required from all five KI impactors in order to divert the primary away from Earth

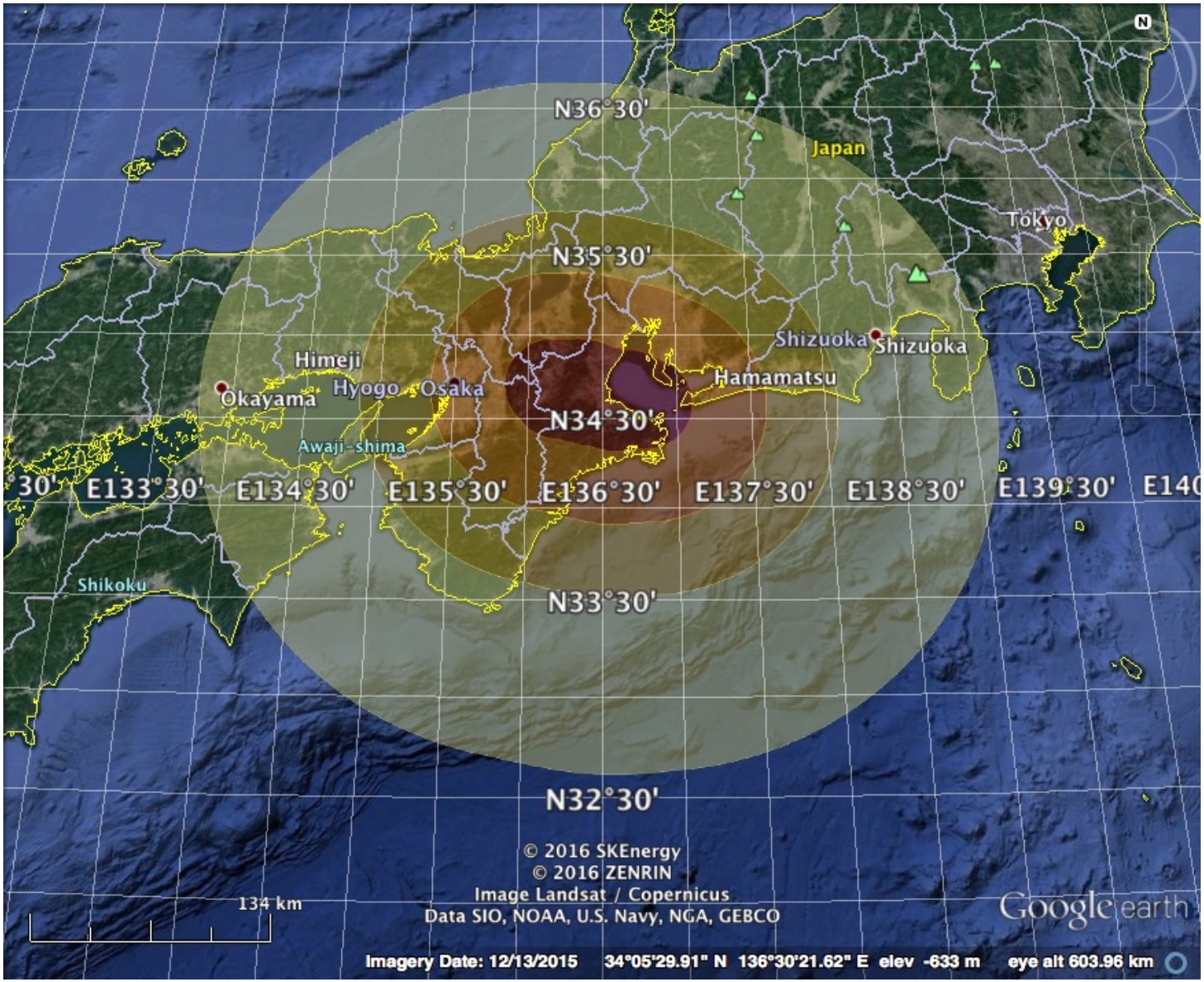
Impact Risk Assessment Summary

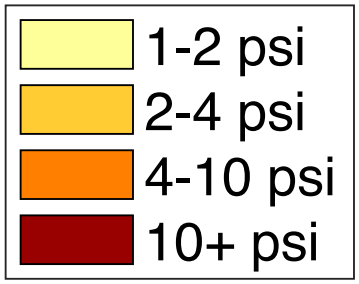
- Simulated 1000 impact cases for each swath point, sampling from uncertainty distributions of size (diameter or H-mag/albedo), density, and strength according to the given knowledge about the asteroid for each inject option.
- Local population affected by blast overpressure and/or tsunami is computed 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

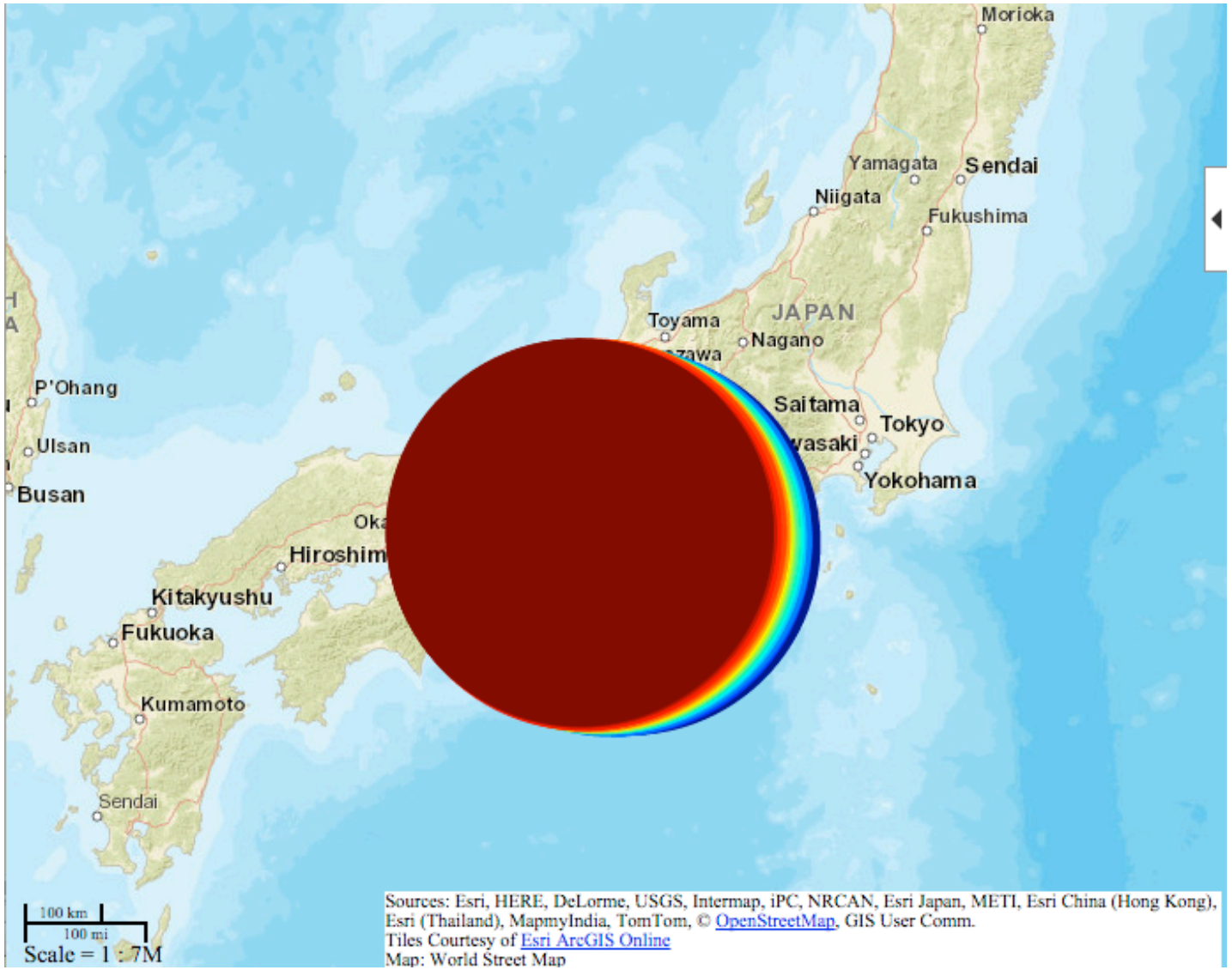
- Blast Damage Zone Plots
  - Google Earth plots showing blast overpressure zones along the swath (1-2 psi, 2-4 psi, 4-10 psi, and 10+ psi).
- Mean Affected Population Plots
  - Color map of mean affected population for each swath point.
  - Points are plotted at the mean impact coordinates for each 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.

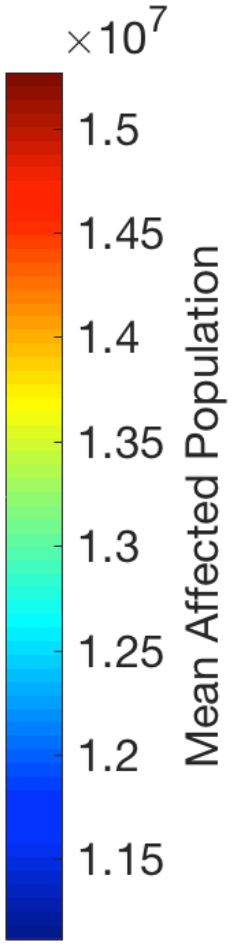
Blast Damage Zones



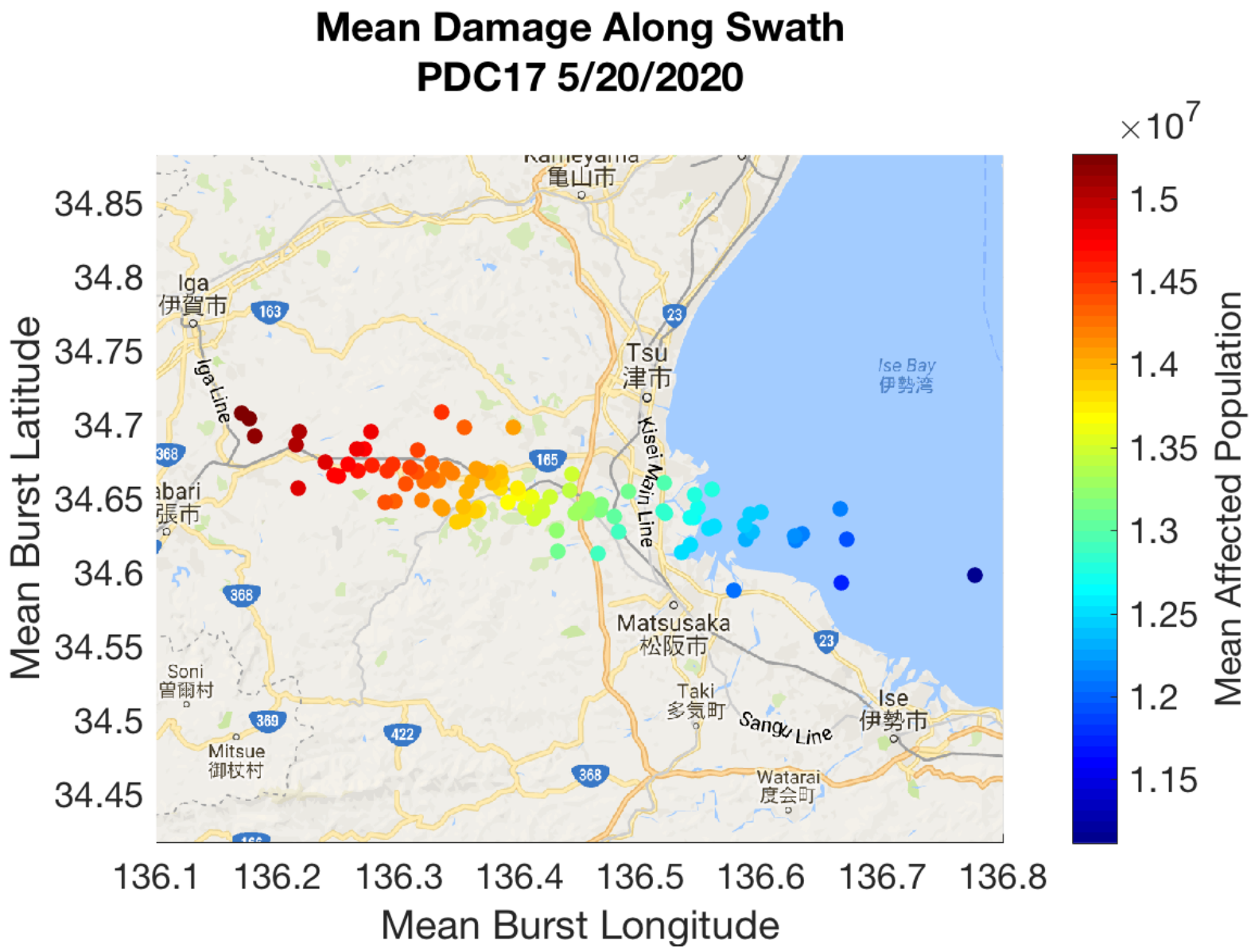


Mean Affected Population

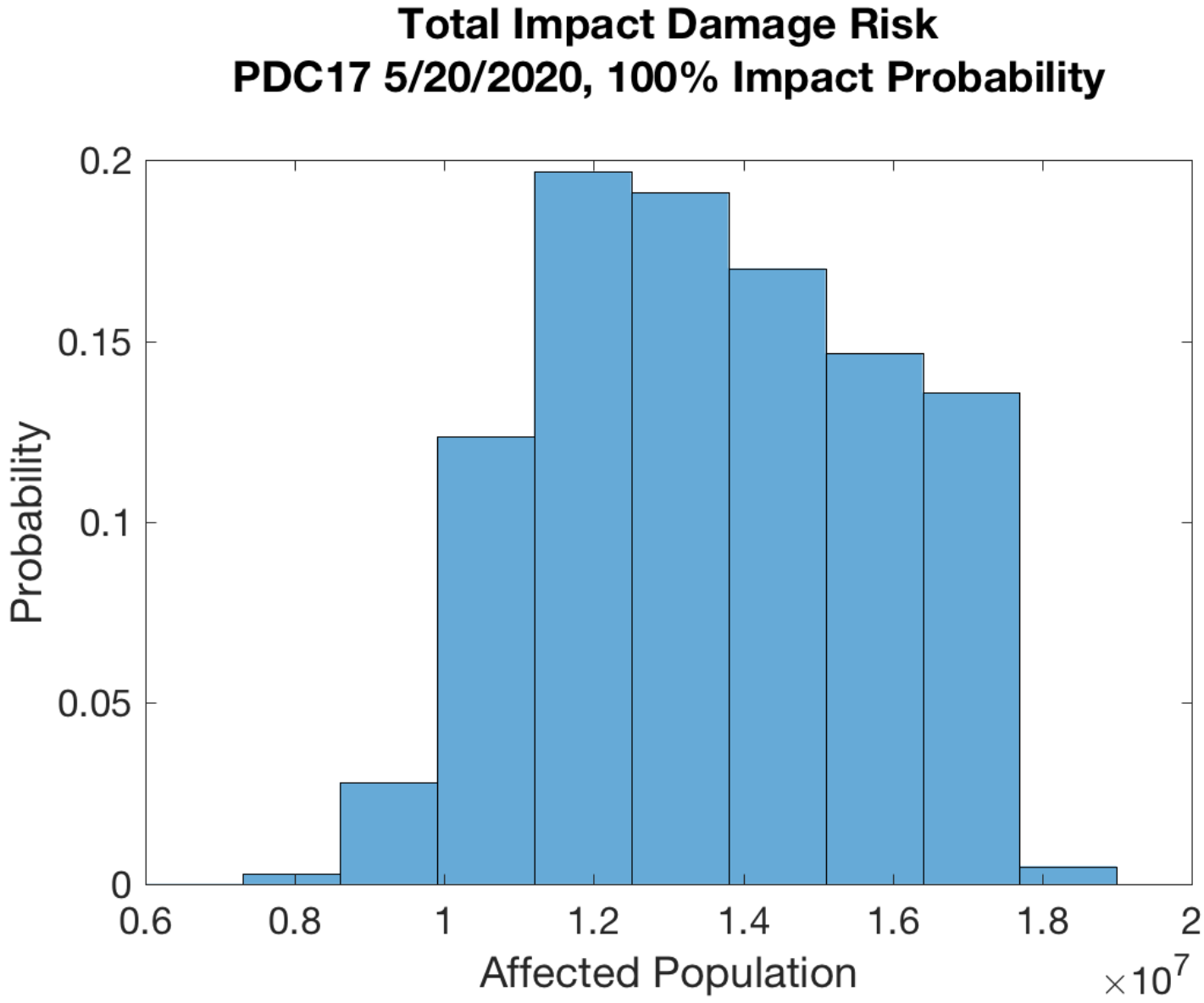




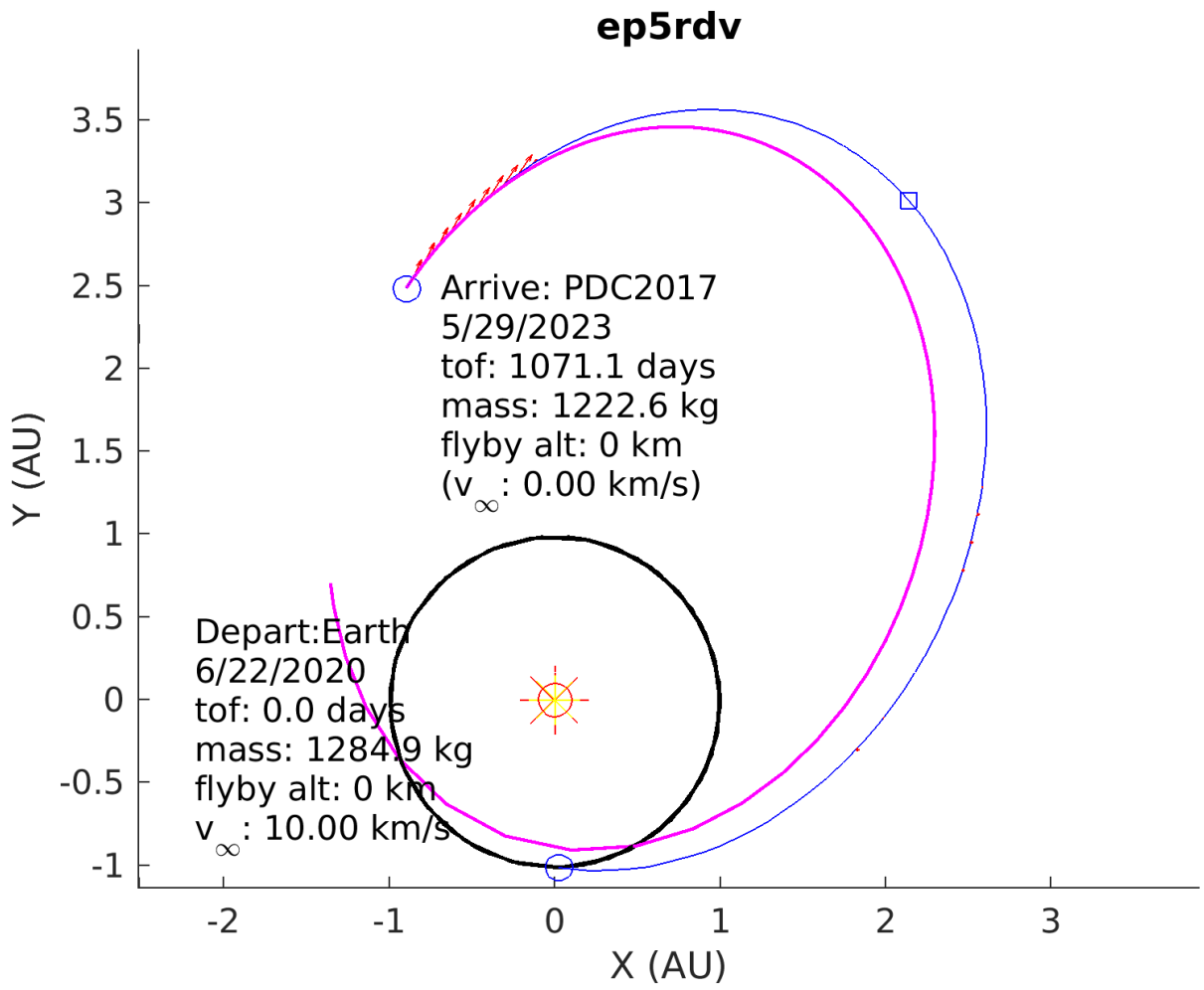
Mean Affected Population



Damage Level Probabilities



Trajectory for Rendezvous Mission



Launch:
June 22, 2020

Arrive:
May 29, 2023

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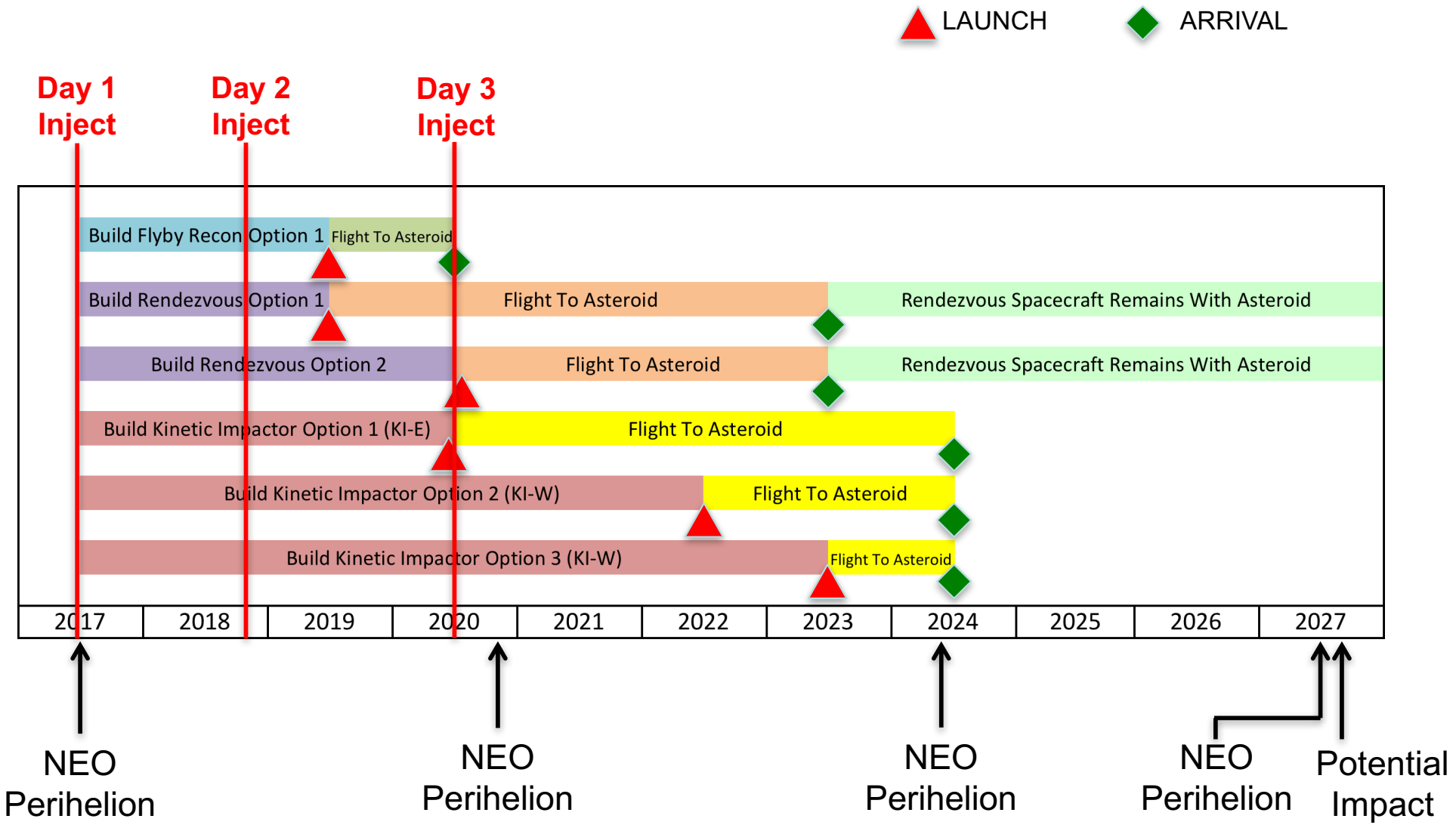
Summary of Key Dates



Courtesy of Brent Barbee (NASA/GSFC)