Probabilistic Asteroid Impact Risk Assessment for the Hypothetical PDC17 Impact Exercise

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Impact Risk Assessment Summary

  • Impact scenarios and trajectories are developed and provided by NASA’s Near Earth Objects Office at JPL (Paul Chodas).
  • These results represent purely *hypothetical* impact scenarios, and do *not* reflect any known asteroid threat.

• Risk assessment was performed using the Probabilistic Asteroid Impact Risk (PAIR) model developed by the Asteroid Threat Assessment Project (ATAP) at NASA Ames Research Center.

• This presentation includes sample results that may be presented or used in discussions during the various stages of the impact exercise
  • Some cases represent alternate scenario options that may not be used during the actual impact exercise at the PDC17 conference.
  • Updates to these initial assessments and/or additional scenario assessments may be performed throughout the impact exercise as different scenario options unfold.
INJECT 1 (S05): MAY 15, 2017
Swath Trajectory Parameters
Asteroid Parameter Distributions

Diameter Distribution, Inject 1 (s05)

H-mag Distribution, Inject 1 (s05)

Albedo Distribution, Inject 1 (s05)

Density Distribution, Inject 1 (s05)

Impact Energy Distribution, Inject 1 (s05)

Class & Structure Distribution

Cc (2%)

Cf (6%)

Cr (31%)

Sc (13%)

Sf (10%)

Sr (39%)
Blast Damage Zones

![Map showing blast damage zones with pressure levels: 1-2 psi, 2-4 psi, 4-10 psi, 10+ psi.]

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Mean Affected Population
Mean Affected Population

Mean Damage Along Swath
PDC17 5/15/2017

Mean Burst Latitude

Mean Burst Longitude

Mean Affected Population

Mean Burst Latitude

Mean Burst Longitude

Mean Affected Population

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Damage Ranges (min/mean/max)

Damage Ranges Along Swath
PDC17 5/15/2017

![Graph showing affected population vs mean burst longitude.](Image)
Damage Level Probabilities

Total Impact Damage Risk
PDC17 5/15/2017, 1% Impact Probability

Probability

Affected Population
Damage Exceedance Risk

- Probability of an impact causing at least a given damage level or greater.
- Complementary cumulative distribution function (CCDF)

Damage Exceedance Probabilities
PDC17 5/15/2017

Conditional Damage Exceedance Probabilities
PDC17 5/15/2017

Damage Exceedance Probabilities
PDC17 5/15/2017, 1% Impact Probability
INJECT 2 S20: NOV 30, 2018
Swath Trajectory Parameters
Asteroid Parameter Distributions
(1k realizations)
Blast Damage Zones
Mean Affected Population
Damage Ranges (min/mean/max)
INJECT 3 S08: MAY 20, 2020
Swath Trajectory Parameters

Inject 3 (s08)

Velocity Distribution, Inject 3 (s08)

Entry Angle Distribution, Inject 3 (s08)
Parameter Distributions

- Diameter Distribution, Inject 3 (s08)
- H-mag Distribution, Inject 3 (s08)
- Albedo Distribution, Inject 3 (s08)
- Density Distribution, Inject 3 (s08)
- Impact Energy Distribution, Inject 3 (s08)
Mean Affected Population
Damage Level Probabilities

**Total Impact Damage Risk**

PDC17 5/20/2020, 100% Impact Probability

- Probability vs. Affected Population

**Damage Exceedance Probabilities**

PDC17 5/20/2020

- Exceedance Probability vs. Affected Population Threshold
INJECT 3 S10: MAY 20, 2020
Swath Trajectory Parameters
Asteroid Parameter Distributions

- Diameter Distribution, Inject 3 (s10)
- Density Distribution, Inject 3 (s10)
- Impact Energy Distribution, Inject 3 (s10)
Mean Affected Population
Mean Affected Population

Mean Damage Along Swath
PDC17 5/20/2020

Mean Burst Latitude

34.85
34.8
34.75
34.7
34.65
34.6
34.55
34.5
34.45

Mean Burst Longitude

136.1 136.2 136.3 136.4 136.5 136.6 136.7 136.8

Mean Affected Population

×10^7

1.5
1.45
1.4
1.35
1.3
1.25
1.2
1.15
Damage Ranges (min/mean/max)

Damage Ranges Along Swath
PDC17 5/20/2020
Damage Level Probabilities

Total Impact Damage Risk
PDC17 5/20/2020, 100% Impact Probability

Damage Exceedance Probabilities
PDC17 5/20/2020
INJECT 4 S16W: FEB 25, 2024
Swath Trajectory Parameters
Asteroid Parameter Distributions

Diameter Distribution, Inject 4 (s16w)

Density Distribution, Inject 4 (s16w)

Impact Energy Distribution, Inject 4 (s16w)
Blast Damage Zones

- 1-2 psi
- 2-4 psi
- 4-10 psi
- 10+ psi

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Mean Affected Population
Damage Ranges (min/mean/max)

Damage Ranges Along Swath
PDC17 2/25/2024

Affected Population

Mean Burst Longitude
Damage Level Probabilities

Total Impact Damage Risk
PDC17 2/25/2024, 100% Impact Probability

[Bar chart showing probability distribution for affected population]

Damage Exceedance Probabilities
PDC17 2/25/2024, 100% Impact Probability

[Graph showing exceedance probability vs. affected population threshold]
INJECT 4 S16E: FEB 25, 2024
Swath Trajectory Parameters

[Diagrams showing inject 4 (s16e) with plots of entry angle distribution and velocity distribution.]
Asteroid Parameter Distributions

Diameter Distribution, Inject 4 (s16e)

Density Distribution, Inject 4 (s16e)

Impact Energy Distribution, Inject 4 (s16e)
Blast Damage Zones

- 1-2 psi
- 2-4 psi
- 4-10 psi
- 10+ psi

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Mean Affected Population
Damage Ranges (min/mean/max)

Damage Ranges Along Swath
PDC17 2/25/2024

[Graph showing damage ranges along a swath with axes labeled 'Affected Population' on the y-axis and 'Mean Burst Longitude' on the x-axis.]
Damage Level Probabilities

Total Impact Damage Risk
PDC17 2/25/2024, 100% Impact Probability

Damage Exceedance Probabilities
PDC17 2/25/2024
INJECT 4 S16LD: FEB 25, 2024
Swath Trajectory Parameters
Asteroid Parameter Distributions

Diameter Distribution, Inject 4 (s16ld)

Density Distribution, Inject 4 (s16ld)

Impact Energy Distribution, Inject 4 (s16ld)
Mean Affected Population
Damage Ranges (min/mean/max)
Damage Level Probabilities

Total Impact Damage Risk
PDC17 2/25/2024, 100% Impact Probability

Damage Exceedance Probabilities
PDC17 2/25/2024