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

Class & Structure Distribution

- 

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)
- 

Cc (2%)  
Cc (6%)  
Cr (31%)  
Sc (13%)  
Sf (10%)  
Sr (39%)
Blast Damage Zones

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

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

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

![Graph showing probability distribution over affected population size.](image)
Damage Exceedance Risk

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

![Damage Exceedance Probabilities](image1)

![Conditional Damage Exceedance Probabilities](image2)

![Damage Exceedance Probabilities](image3)

![Damage Exceedance Probabilities](image4)
INJECT 2 S20: NOV 30, 2018
Swath Trajectory Parameters
Asteroid Parameter Distributions (1k realizations)
Blast Damage Zones

The diagram shows a world map with different zones color-coded as follows:

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

The map highlights specific areas with varying blast damage zones, indicating the extent of potential damage from an explosion.
Mean Affected Population
Damage Ranges (min/mean/max)
Damage Level Probabilities

Total Impact Damage Risk
PDC17 11/30/2018, 96% Impact Probability

Damage Exceedance Probabilities
PDC17 11/30/2018

Exceedance Probability

Affected Population Threshold
Swath Trajectory Parameters
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)
Blast Damage Zones

[Map showing blast damage zones with different pressure ranges indicated by color codes: 1-2 psi, 2-4 psi, 4-10 psi, 10+ psi.]

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

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

Damage Exceedance Probabilities
PDC17 5/20/2020
Swath Trajectory Parameters

[Graphs showing velocity and entry angle distributions for Inject 3 (s10)]
Asteroid Parameter Distributions

- Diameter Distribution, Inject 3 (s10)
- Density Distribution, Inject 3 (s10)
- Impact Energy Distribution, Inject 3 (s10)
Blast Damage Zones

![Map showing blast damage zones with pressure ranges: 1-2 psi, 2-4 psi, 4-10 psi, 10+ psi]
Mean Affected Population

Sources: Esri, HERE, DeLorme, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, TomTom, © OpenStreetMap, GIS User Comm.
Tiles Courtesy of Esri ArcGIS Online
Map: World Street Map
Mean Affected Population

Mean Damage Along Swath
PDC17 5/20/2020

Mean Affected Population

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Damage Ranges (min/mean/max)
Damage Level Probabilities

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

Damage Exceedance Probabilities
PDC17 5/20/2020

Graphs showing probability distributions for affected population.
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
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 as affected population and mean burst longitude.](image)

5/11/17

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Damage Level Probabilities

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

Damage Exceedance Probabilities
PDC17 2/25/2024, 100% Impact Probability
INJECT 4 S16E: FEB 25, 2024
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
Mean Affected Population
Damage Ranges (min/mean/max)

Damage Ranges Along Swath
PDC17 2/25/2024

Mean Burst Longitude

Affected Population

$10^0$ $10^2$ $10^4$ $10^6$ $10^8$
Damage Level Probabilities

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

Damage Exceedance Probabilities
PDC17 2/25/2024
Swath Trajectory Parameters
Asteroid Parameter Distributions

Diameter Distribution, Inject 4 (s16ld)

Density Distribution, Inject 4 (s16ld)

Impact Energy Distribution, Inject 4 (s16ld)
Blast Damage Zones

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