

## HYPOTHETICAL EXERCISE ONLY

### PDC27 Epoch 1 Damage Risk Maps [EXERCISE ONLY]

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These maps represent asteroid impact damage estimates modeled for the **PDC27 Hypothetical Asteroid Impact Exercise**, as part of the 10th IAA Planetary Defense Conference (PDC 2027). This exercise assesses a realistic but fictitious hypothetical scenario, not a real asteroid threat.

#### DAMAGE RISK MAP OVERVIEW & CONTENTS:

These damage risk maps represent the potential range of local ground damage that could occur given the uncertain ranges of potential asteroid sizes, properties, and impact locations in the current scenario. This map set includes a damage risk swath covering the combined extent of regions that could potentially be at risk to damage, and examples of various damage footprint sizes over sample locations. These different swath and footprint examples can be displayed or hidden on the globe map by expanding and selecting different elements in the navigation panel folders. Information on each example set can be seen by clicking on the folder title in the navigation panel, which will display a pop-up text box.

\* **Tip:** These maps work most reliably using the freely available Google Earth Pro desktop app. Functionality may vary by browser, OS, or internet connection if using the Google Earth web app.

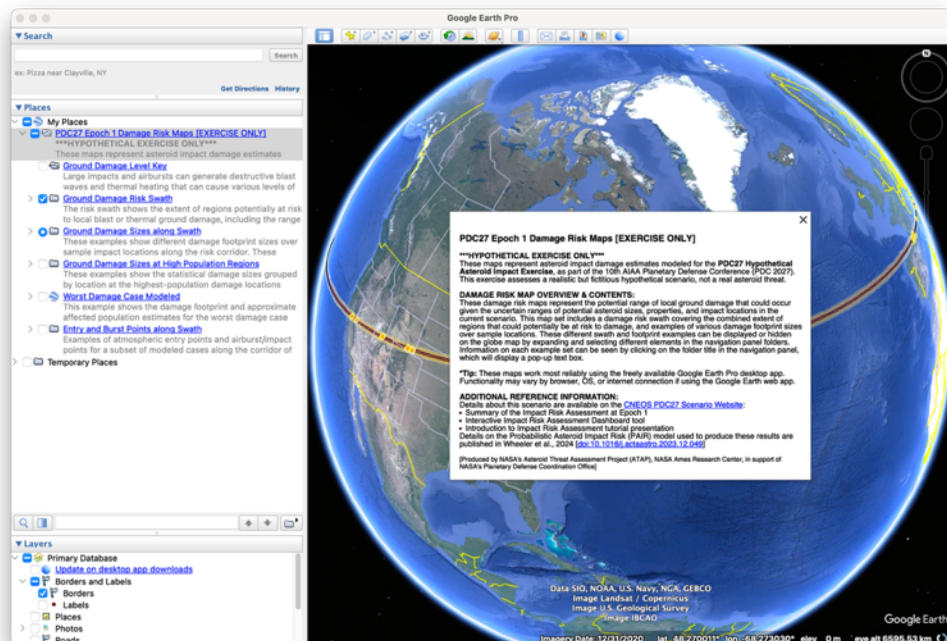
#### ADDITIONAL REFERENCE INFORMATION:

Details about this scenario are available on the [CNEOS PDC27 Scenario Website](#):

- Summary of the **Impact Risk Assessment at Epoch 1**
- Interactive **Impact Risk Assessment Dashboard** tool
- **Introduction to Impact Risk Assessment** tutorial presentation

Details on the Probabilistic Asteroid Impact Risk (PAIR) model used to produce these results are published in **Wheeler et al., 2024** [[doi:10.1016/j.actaastro.2023.12.049](#)]

\* Produced by NASA's Asteroid Threat Assessment Project (ATAP), NASA Ames Research Center, Lorien Wheeler (NASA Ames Research Center)

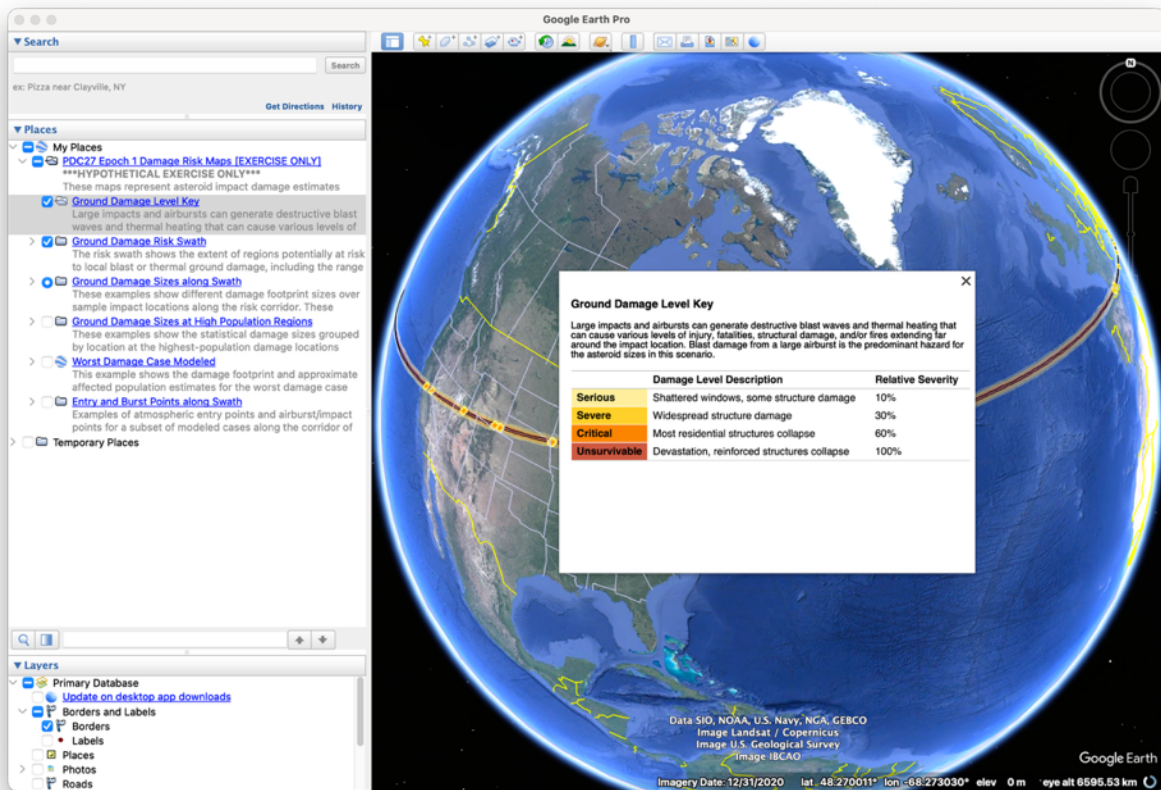


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### Ground Damage Level Key

Large impacts and airbursts can generate destructive blast waves and thermal heating that can cause various levels of injury, fatalities, structural damage, and/or fires extending far around the impact location. Blast damage from a large airburst is the predominant hazard for the asteroid sizes in this scenario. Damage sizes are estimated for four damage severity levels described below.

|                     | Damage Level Description                    | Relative Severity |
|---------------------|---------------------------------------------|-------------------|
| <b>Serious</b>      | Shattered windows, some structure damage    | 10%               |
| <b>Severe</b>       | Widespread structure damage                 | 30%               |
| <b>Critical</b>     | Most residential structures collapse        | 60%               |
| <b>Unsurvivable</b> | Devastation, reinforced structures collapse | 100%              |



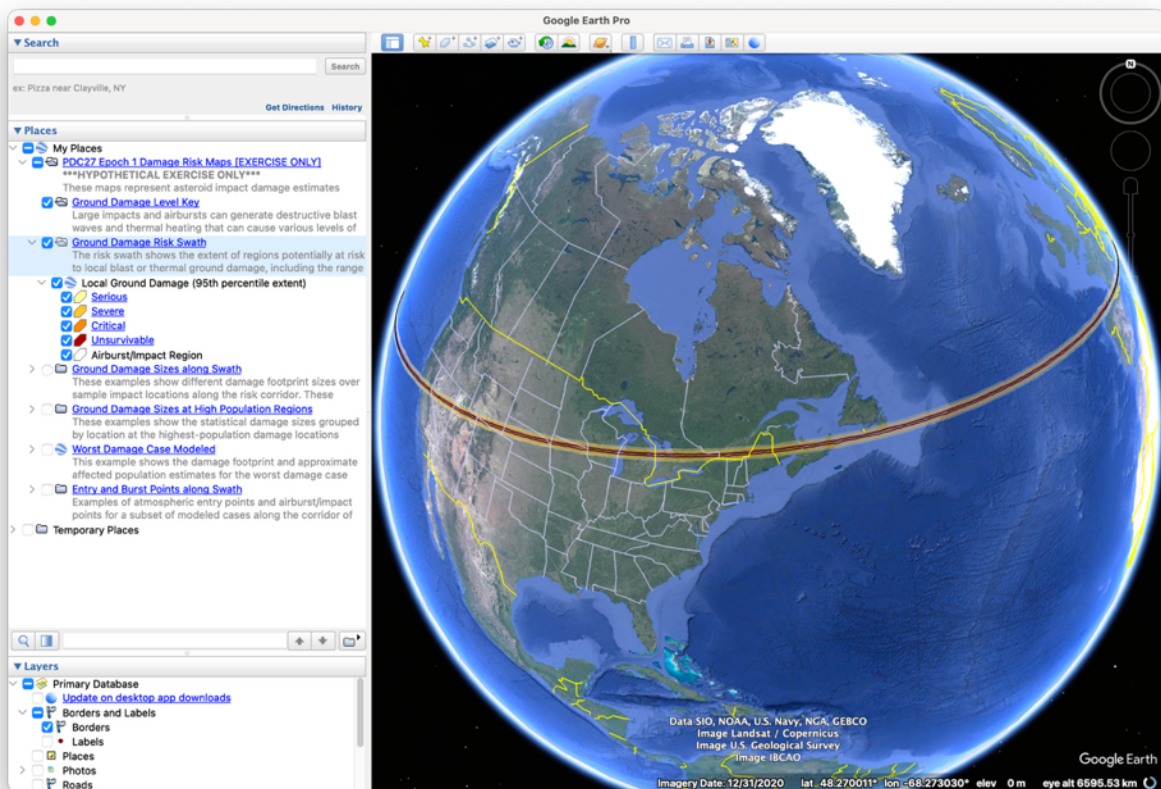
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### Ground Damage Risk Swath

The risk swath shows the extent of regions potentially at risk to local ground damage, including the range of possible damage sizes and possible airburst/impact locations. The black border bounds the range of airburst/impact locations modeled, and the shaded regions show the potential extent of damage around those locations, colored by the highest potential damage severity level. This risk swath shows the extent of local blast damage out to the 95th percentile of possible damage sizes within the regions.\*

\* These damage size percentiles represent the *relative* chance that the potential damage would be up to that size or smaller (i.e., the damage size that is larger than 95% of the possible range of cases) *if an impact were to occur in that region*. They do *not* indicate that damage is likely to occur in all the regions shown. The chance of impact occurring in any one region is a very small fraction on the total Earth impact probability (currently 19%).

Additional information on these damage risk swath maps is provided in the Introduction to Impact Risk Assessment presentation on the [CNEOS PDC27 Scenario Website](#).



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### Ground Damage Sizes along Swath

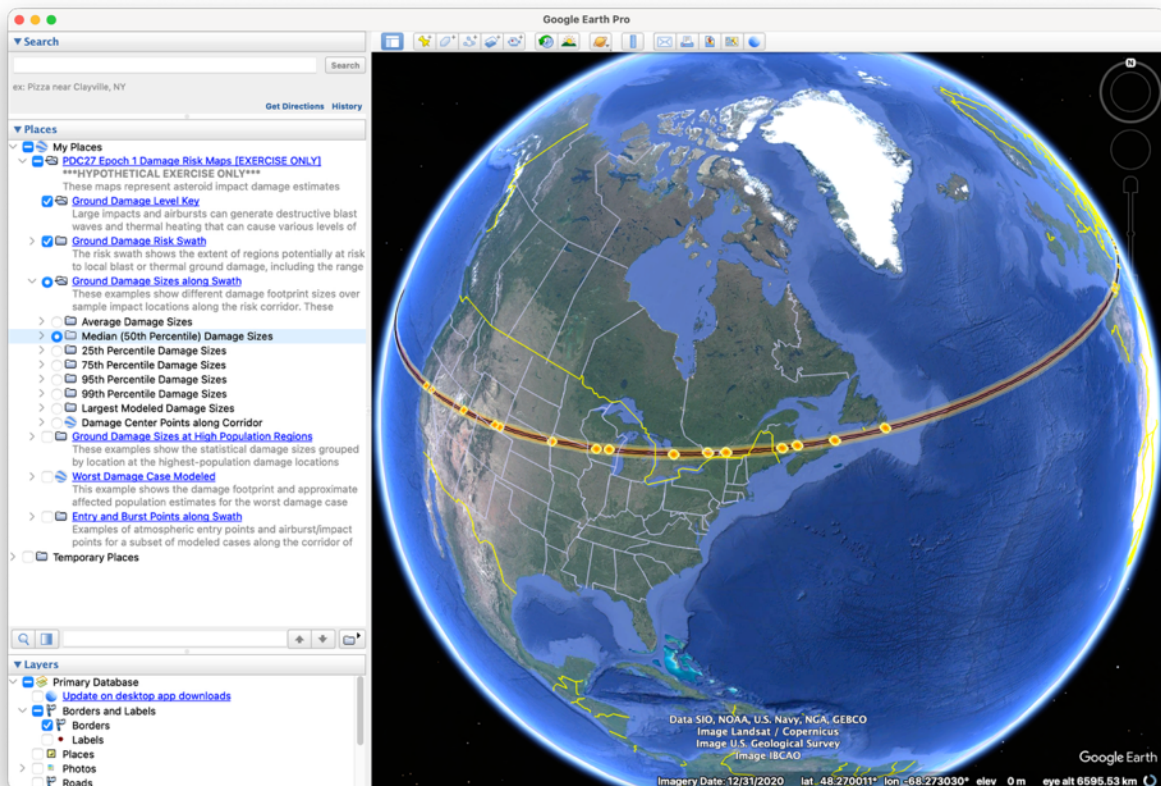
These examples show different damage footprint sizes over sample impact locations along the risk corridor. These sample damage footprints represent the generalized damage size statistics among the impact cases modeled within a given impact region, rather than damage from a specific impact case. Clicking on the footprint damage levels will display a textbox with information about the damage area sizes.

#### Statistical damage sizes:

Damage size percentiles indicate the likelihood that the damage could be up to the given size or smaller when considering all the potential impact cases modeled within a region (e.g., the 95th percentile footprints show damage sizes that are larger than 95% of the modeled cases and smaller than 5% of the modeled cases). The largest sizes represent the largest *damage* among the probabilistically sampled set of cases *modeled* (not necessarily theoretical maximums or largest asteroid sizes). The damage sizes and shapes vary between locations due to the different entry angles along the corridor.

#### Sample footprint locations:

The sample damage locations shown represent some of the higher-population damage locations within each region along the swath. The locations were selected based on the highest population damage estimated for a median-sized outer damage area within 5° longitude spans along the swath.

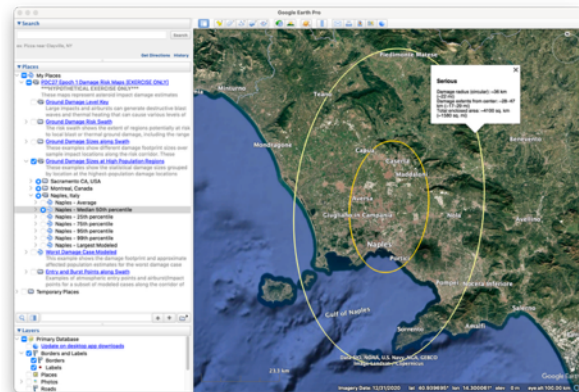
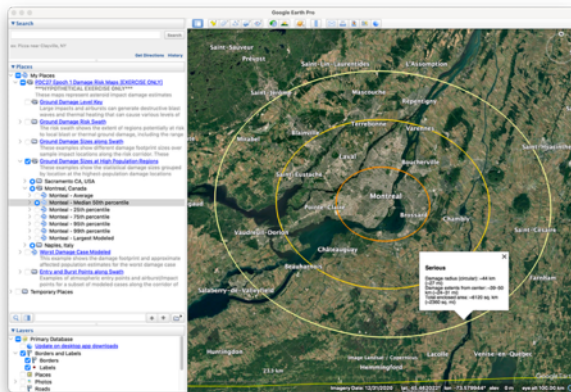
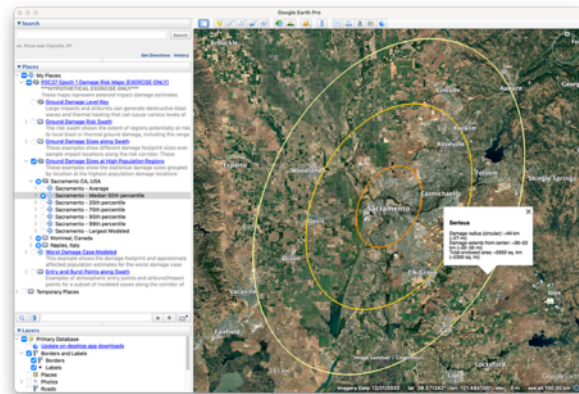
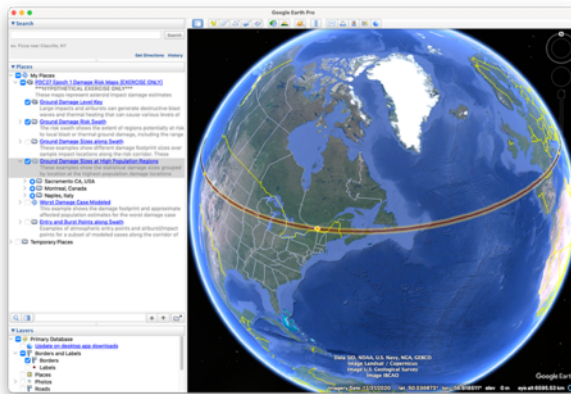


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## Ground Damage Sizes at High Population Regions

These examples show the statistical damage sizes grouped by location at the highest-population damage locations within several main geographic regions along the swath:

- Western United States (Sacramento, CA)
- Eastern Canada (Montreal, QC)
- Mediterranean (Naples, Italy)



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### Worst Damage Case Modeled

This example shows a damage footprint and approximate affected population estimates for the worst damage case modeled in the current scenario set. Additional details can be seen by clicking on each damage level or airburst/entry point marker on the map or navigation pane. (Tip: hiding the risk swath layer can make it easier to click on specific damage footprint areas).

#### Damage estimates:

- Total estimated population in damage area: ~5.5M people
- Affected population damage estimate: ~3.1M people
- Damage area: ~26,600 sq. km (~10,300 sq. mi)
- Damage level radii: serious ~90 km, severe ~50 km, critical ~30 km, unsurvivable ~11 km

#### Asteroid Properties:

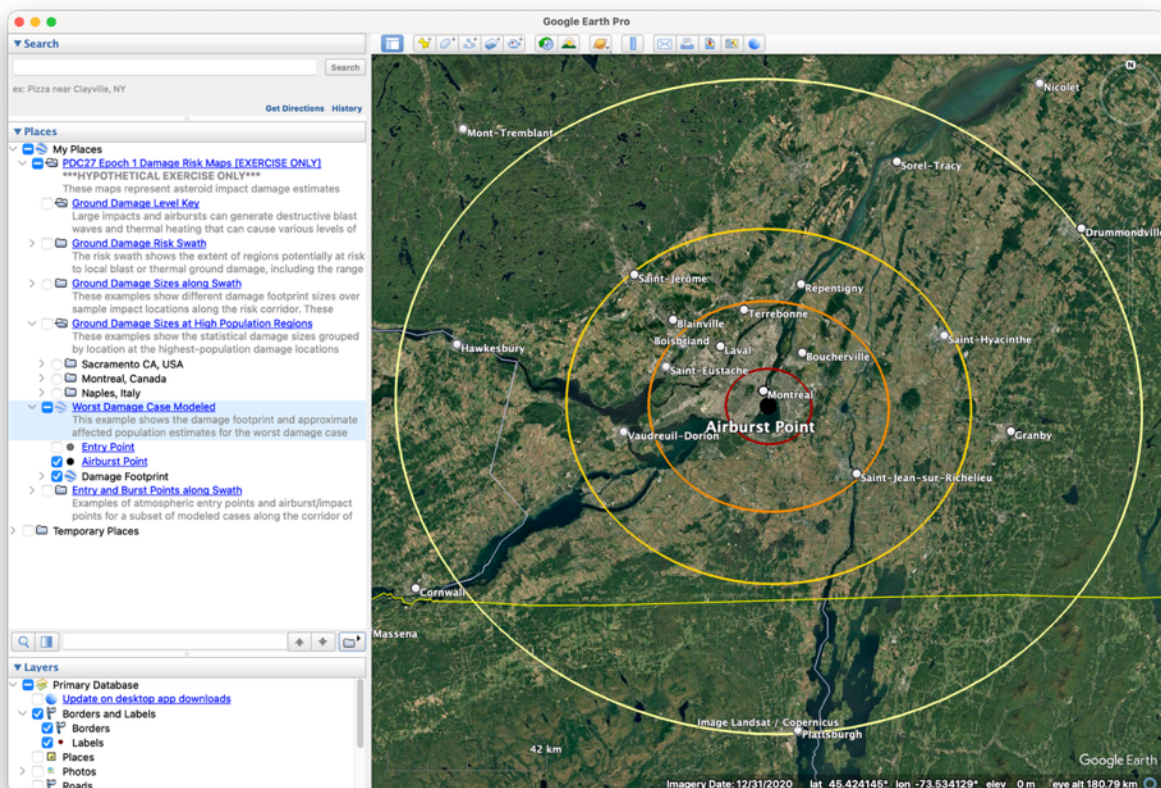
- Diameter: 85m
- Energy: 43 Mt
- Mass:  $1.1 \times 10^9$  kg

#### Entry Properties:

- Entry angle:  $56^\circ$
- Entry velocity 17.97 km/s
- Entry flight heading  $5^\circ$  (northward)

#### Effective Airburst Estimate:

- Altitude ~8.6 km
- Yield energy 43 Mt



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### Worst Damage Case Damage Level Subfolders:

#### Serious Damage

Serious Blast Level: 1-2 psi overpressure,  
10% affected population severity

Damage radius (circular): ~92 km (~57 mi)  
Damage extents from center: ~86–98 km  
(~53–61 mi)

Total enclosed area: ~26,630 sq. km

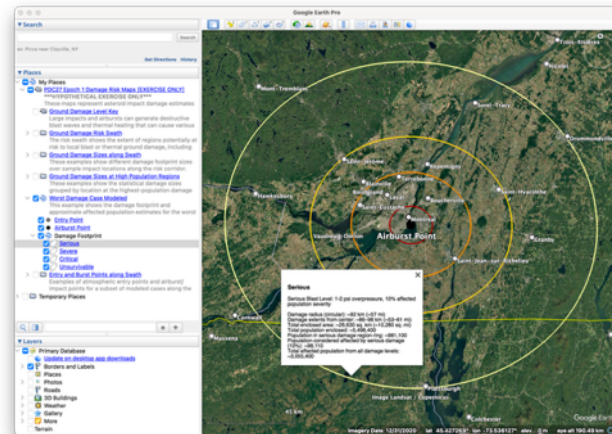
(~10,280 sq. mi)

Total population enclosed: ~5,498,400

Population in serious damage region ring:  
~981,100

Population considered affected by serious  
damage (10%): ~98,110

Total affected population from all damage  
levels: ~3,055,400



#### Severe Damage

Severe Blast Level: 2-4 psi overpressure,  
30% affected population severity

Damage radius (circular): ~50 km (~31 mi)  
Damage extents from center: ~47–53 km  
(~29–33 mi)

Total enclosed area: ~7,780 sq. km

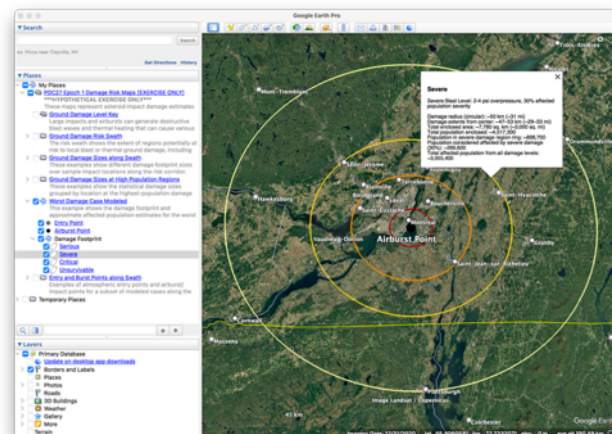
(~3,000 sq. mi)

Total population enclosed: ~4,517,300

Population in severe damage region ring:  
~898,700

Population considered affected by severe  
damage (30%): ~269,600

Total affected population from all damage  
levels: ~3,055,400



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### Critical Damage

Critical Blast Level: 4-10 psi overpressure, 60% affected population severity

Damage radius (circular): ~29 km (~18 mi)

Damage extents from center: ~28–32 km (~17–20 mi)

Total enclosed area: ~2,730 sq. km

(~1,050 sq. mi)

Total population enclosed: ~3,618,600

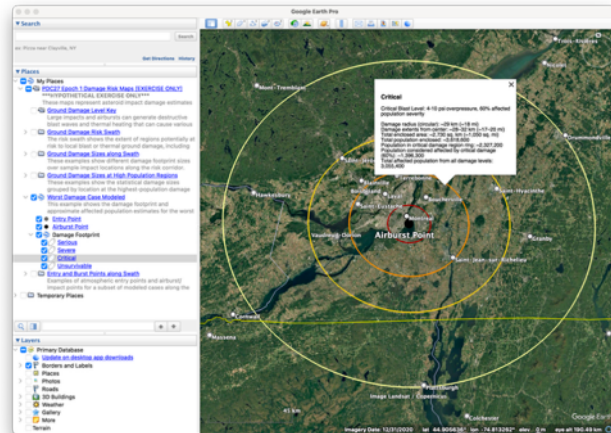
Population in critical damage region ring:

~2,327,200

Population considered affected by critical

damage (60%): ~1,396,300

Total affected population from all damage levels: 3,055,400



### Unsurvivable Damage

Unsurvivable Blast Level: >10 psi overpressure, 100% affected population severity

Damage radius: ~11 km (~11 mi)

Total enclosed areas: ~350 sq. km (~140 sq. mi)

Population in unsurvivable damage region:

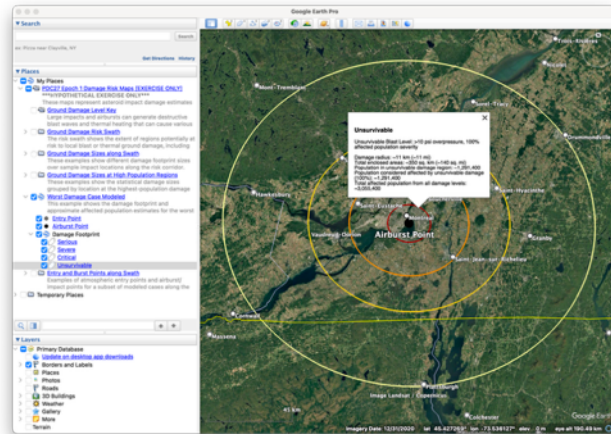
~1,291,400

Population considered affected by

unsurvivable damage (100%): ~1,291,400

Total affected population from all damage

levels: ~3,055,400



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## Entry and Burst Points along Swath

Examples of atmospheric entry points and airburst/impact points for a subset of modeled cases along the corridor of potential Earth-impact locations. The entry points show the set of 5000 sampled atmospheric entry points modeled in this assessment, and the burst points show the airburst/impact damage location for one nominal asteroid case (not all damage points for all asteroid cases modeled).

