Sensitivity to Uncertainty in Planetary Defense Risk Assessment

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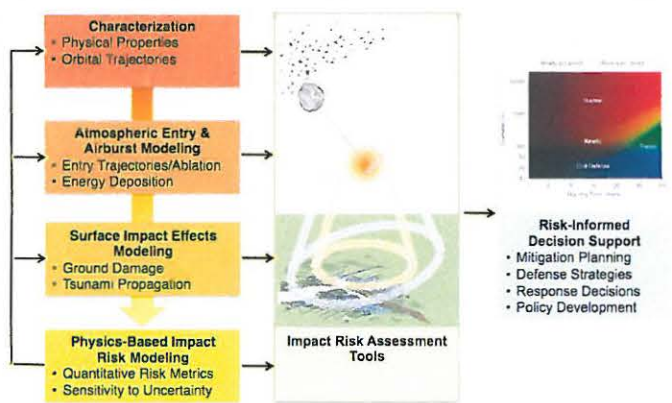
Tasks, Products, and Interactions



Credit: Tim Warchocki

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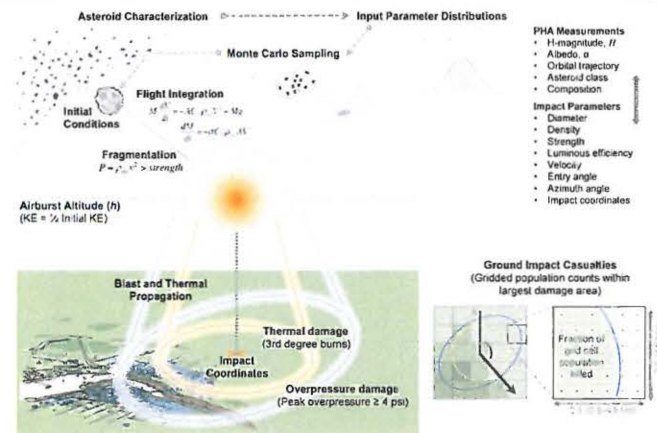
Physics-Based Impact Risk Model



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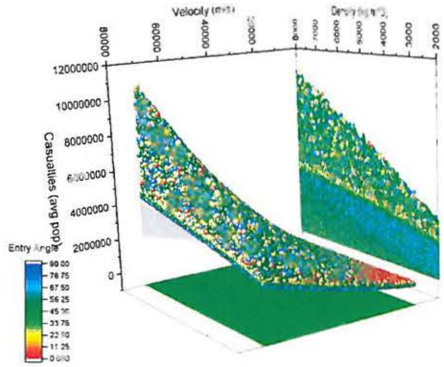
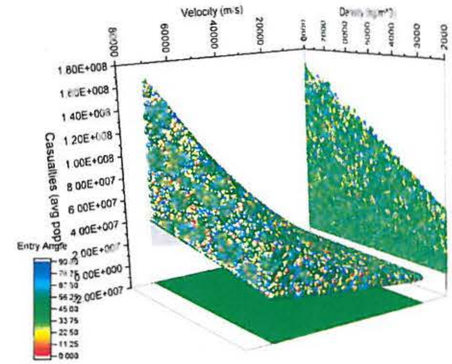
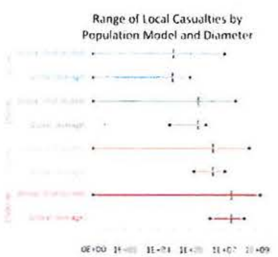
Casualty Sensitivity for 500m Impact

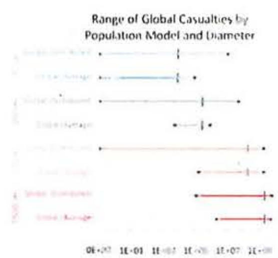


Casualty Sensitivity for 1500m Impact

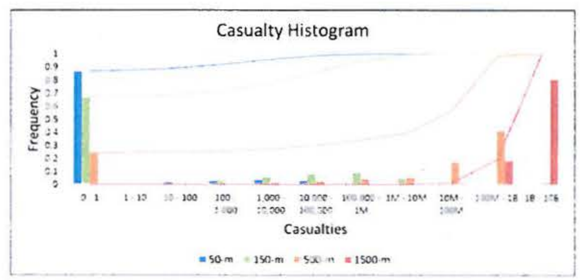


Population Distribution and Global Effects

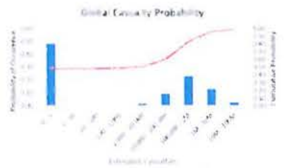


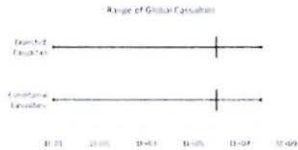


Beyond Estimated Casualties (E_c)

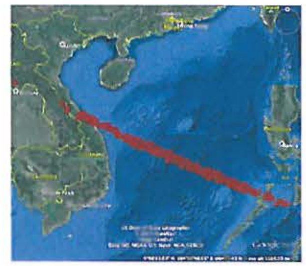


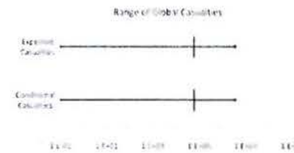
PDC2015 Scenario – Day 3



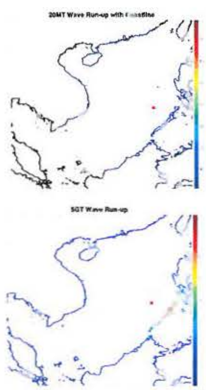


PDC2015 Scenario – Day 4



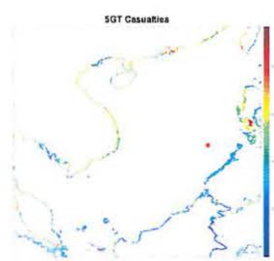


Tsunami Modeling

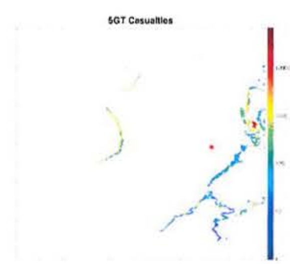


- Added simple tsunami model, Toon et al.
- Assume wave generated depends on
  - Impact energy
  - Local bathymetry
- Wave decays with distance from impact
- Casualties computed from wave run-up
  - No local terrain
  - 10% of affected population
  - Two run-up threshold values tested

Tsunami Casualties
5 Gigaton Impact Energy



1 km run-up threshold



10 km run-up threshold

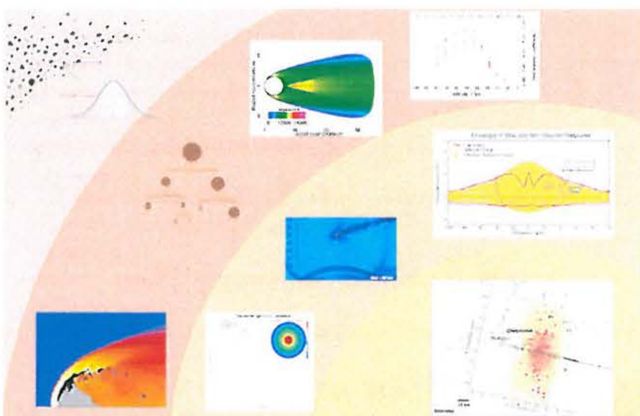
Example 3: Problem Overview

- Goal
  - Assess inherent assumptions with literature airburst models
- Task scope
  - Define single, fixed-parameter impact scenario
  - Compare literature model results with those anchored in high-fidelity simulations?
- Questions
  - Are traditional meteoroid physics models sufficient for energy deposition prediction?
    - Ablation
    - Pancaking
    - Point-source airburst
  - How sensitive are ground damage estimates to these assumptions?

Demonstration Case

- Test case parameters
  - Size = 20 m diameter
  - Density = 3 g/cc
- Flight path integration based on assumed initial state
  - 20 km/s
  - 20° entry angle
- Mass loss computed using high-fidelity simulation-generated relations
- Progressive fragmentation model used for breakup and energy deposition curve
- Blast footprint from spherical point source + CFD corrections
- Results compared with Chelyabinsk damage

Simulation Elements



Results