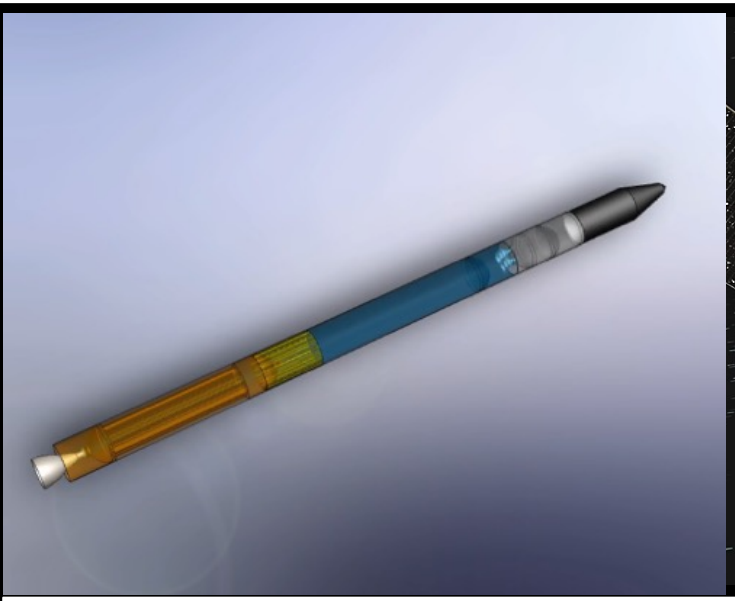
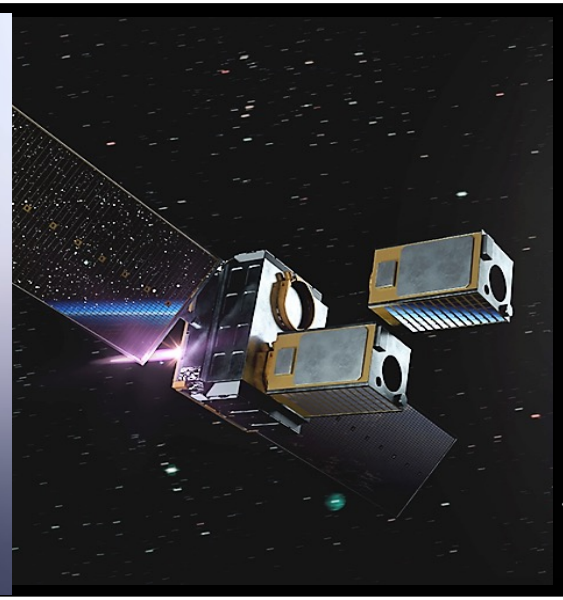

Space Debris Mitigation: Cloud Interceptor Method

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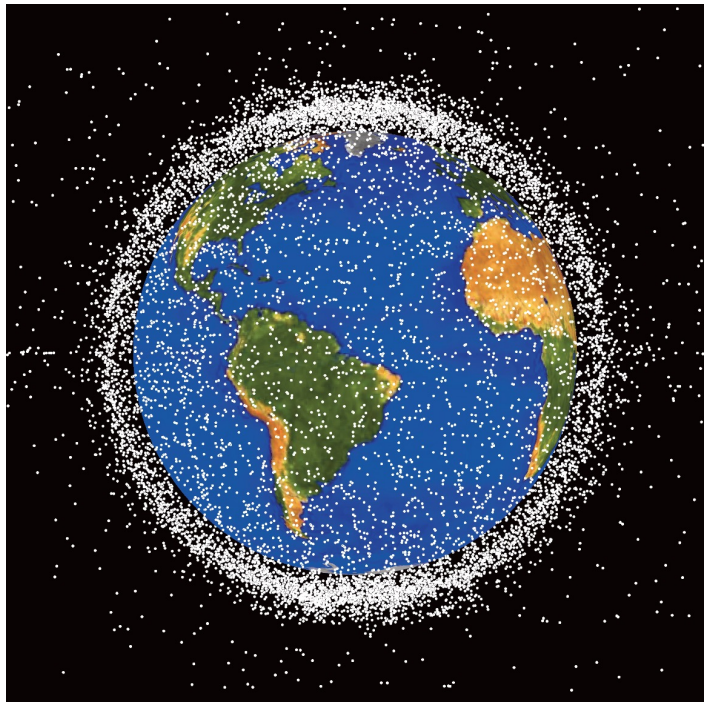
University of Arizona

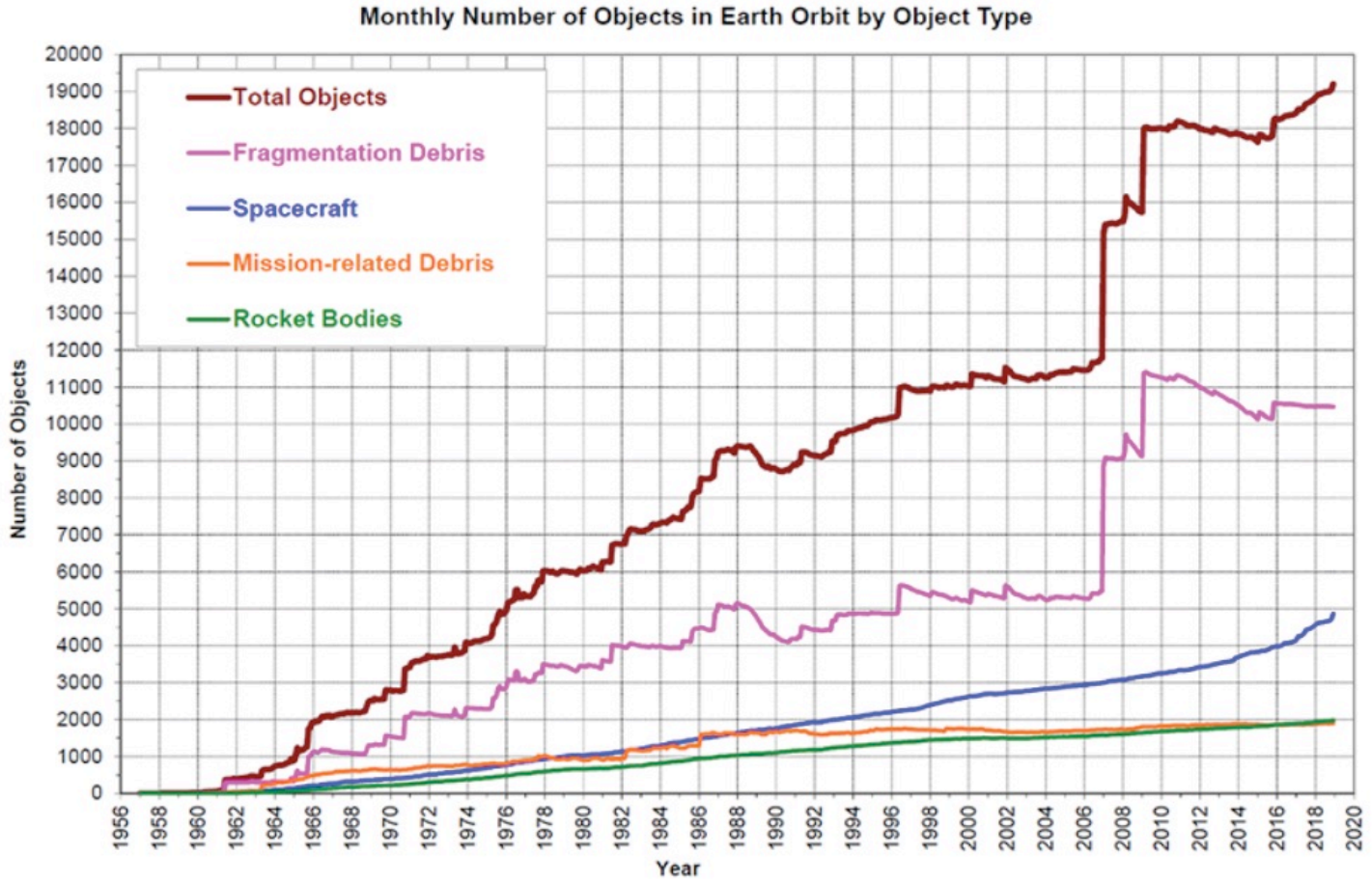
ISSC 2022 beyond LEO, San Luis Obispo, May 2022

Presentation Outline

- Motivation
  - Where we fit in
- Objective
- Method
- Analysis/Results
- Discussion
- Challenges
- Future Plans



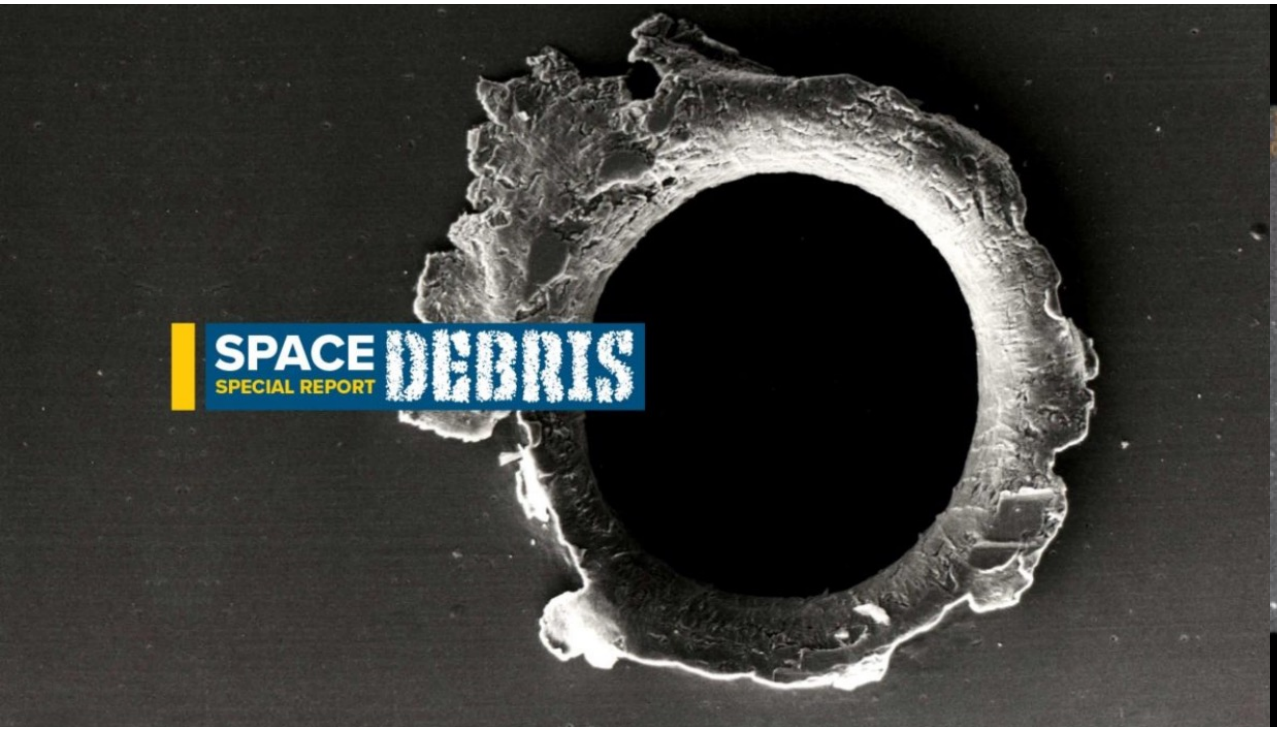
Big Picture - Motivation



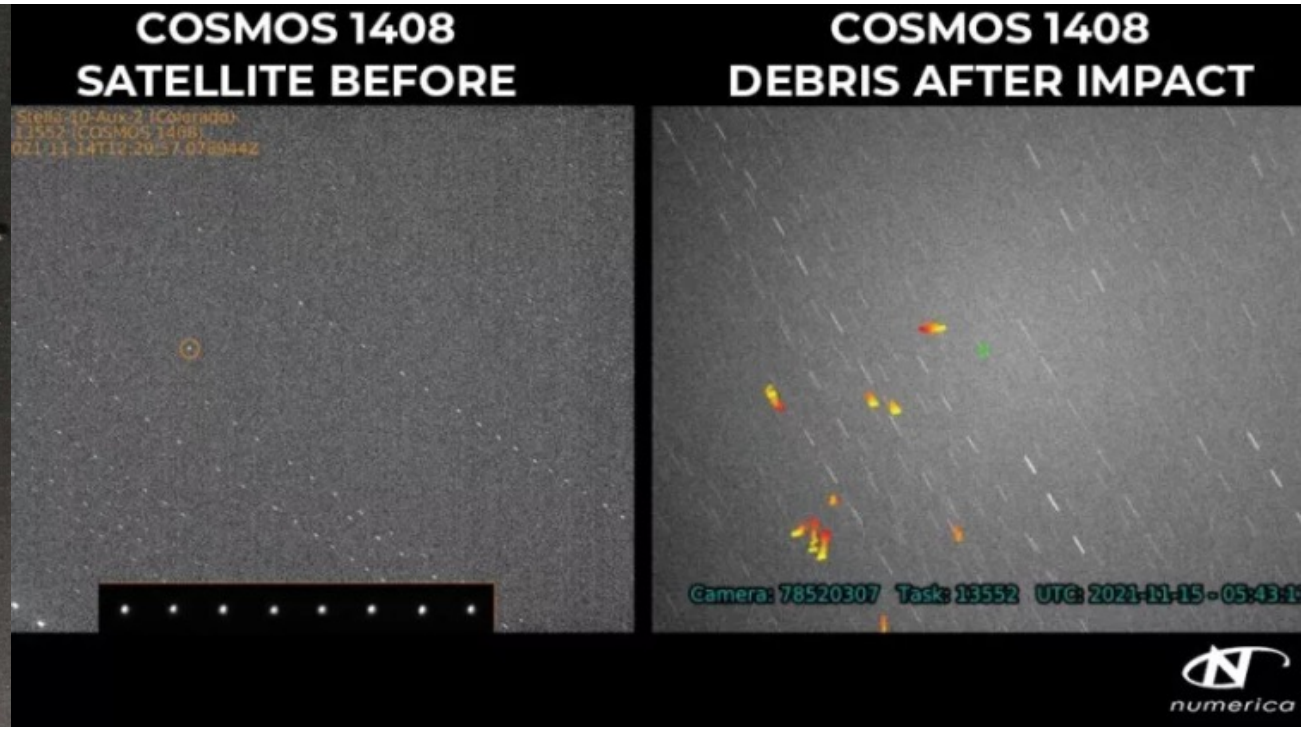
- Existing problem since 1957
- Exponentially increasing
- Accumulation could lead to the Kessler Syndrome

Reesman, 2021

Recent News Headlines

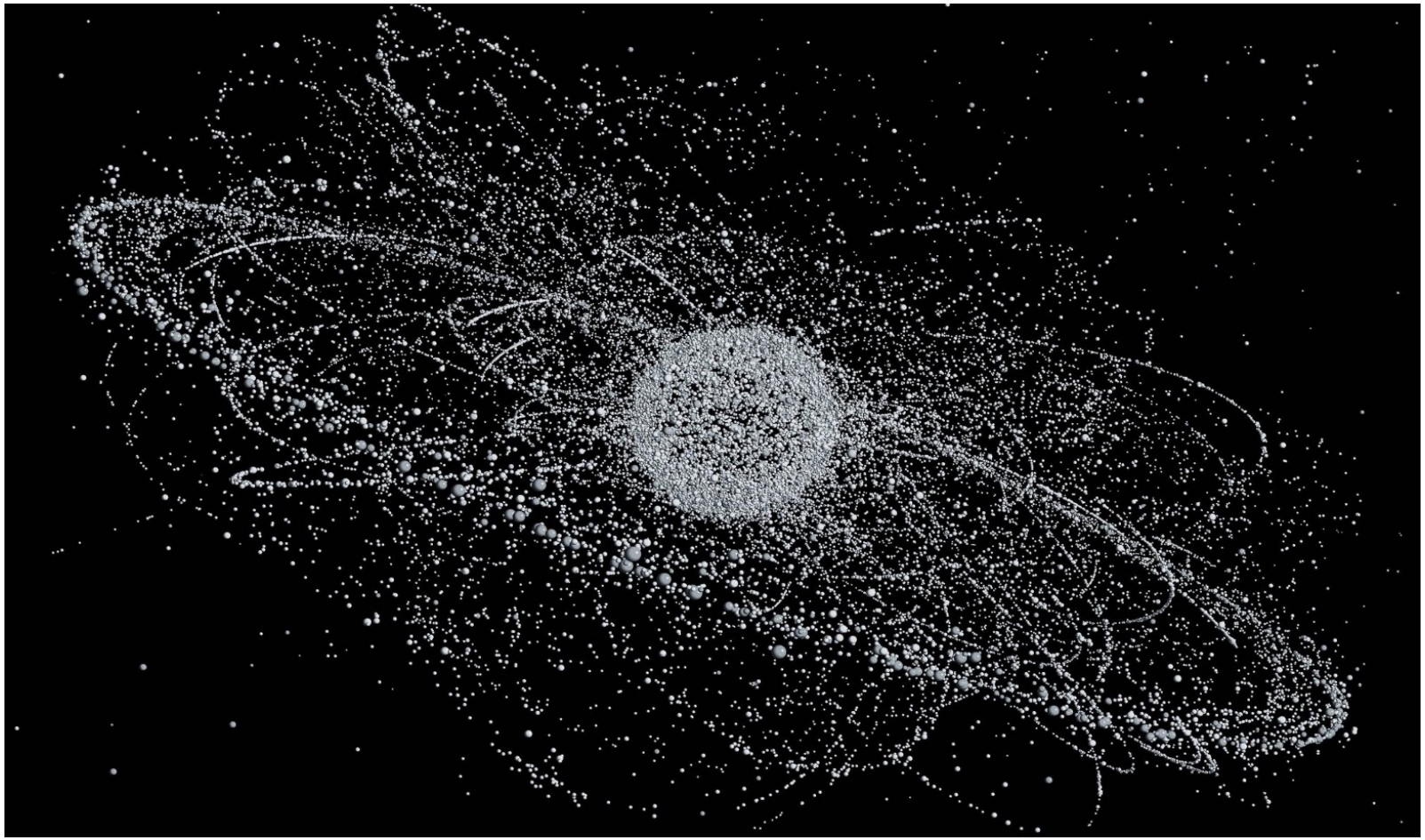


O'Callaghan, 2022



Gohd, 2021

Visualizing Space Debris

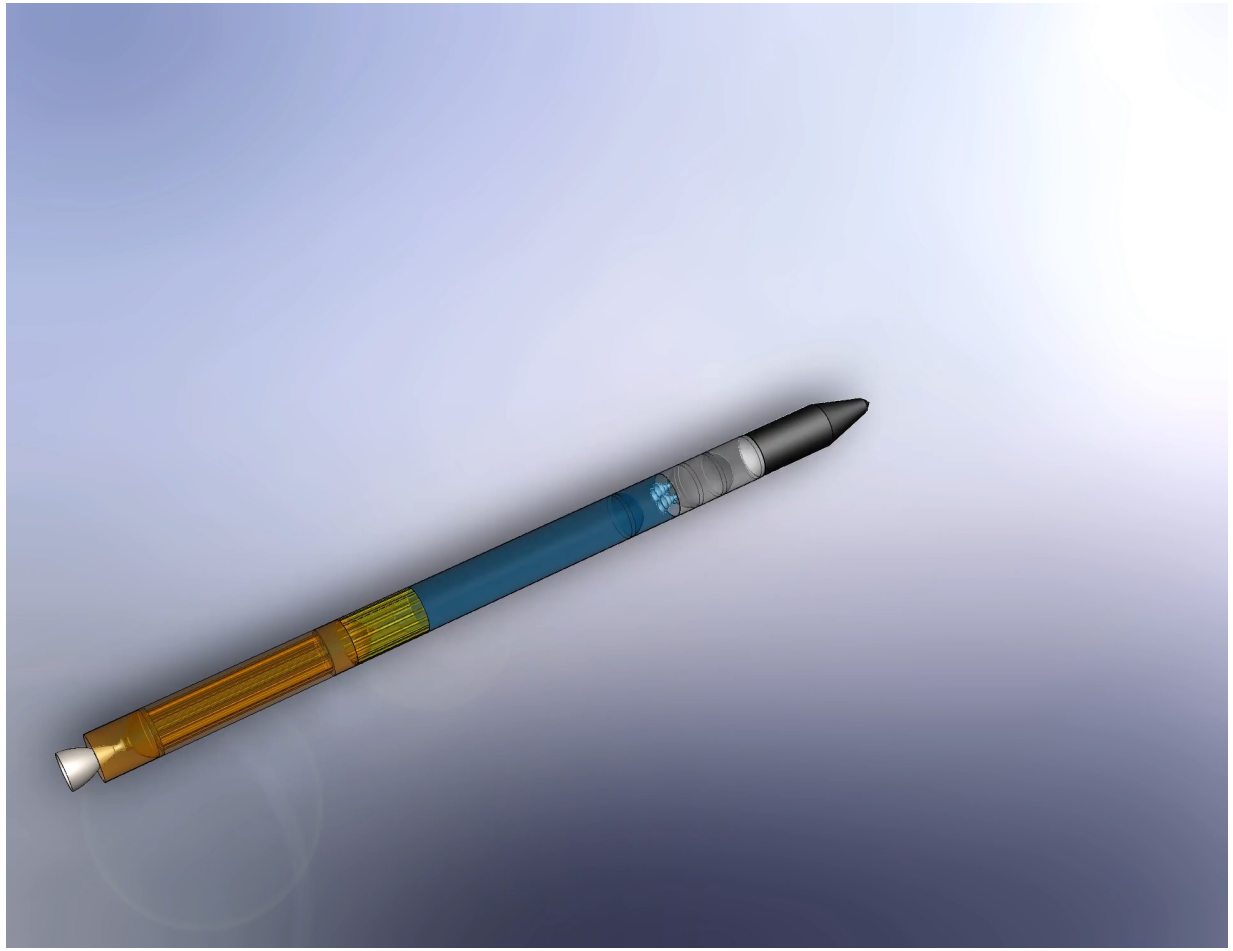


Visualization of space debris in 2012.
(Michael Najjar, 2012)

Proposed Solution – Cloud Interceptor Method

- We are proposing a cloud interceptor to deorbit large pieces of debris
- Through contact with the material cloud, the orbital mechanics of the debris will be altered enough to deorbit it through atmospheric contact

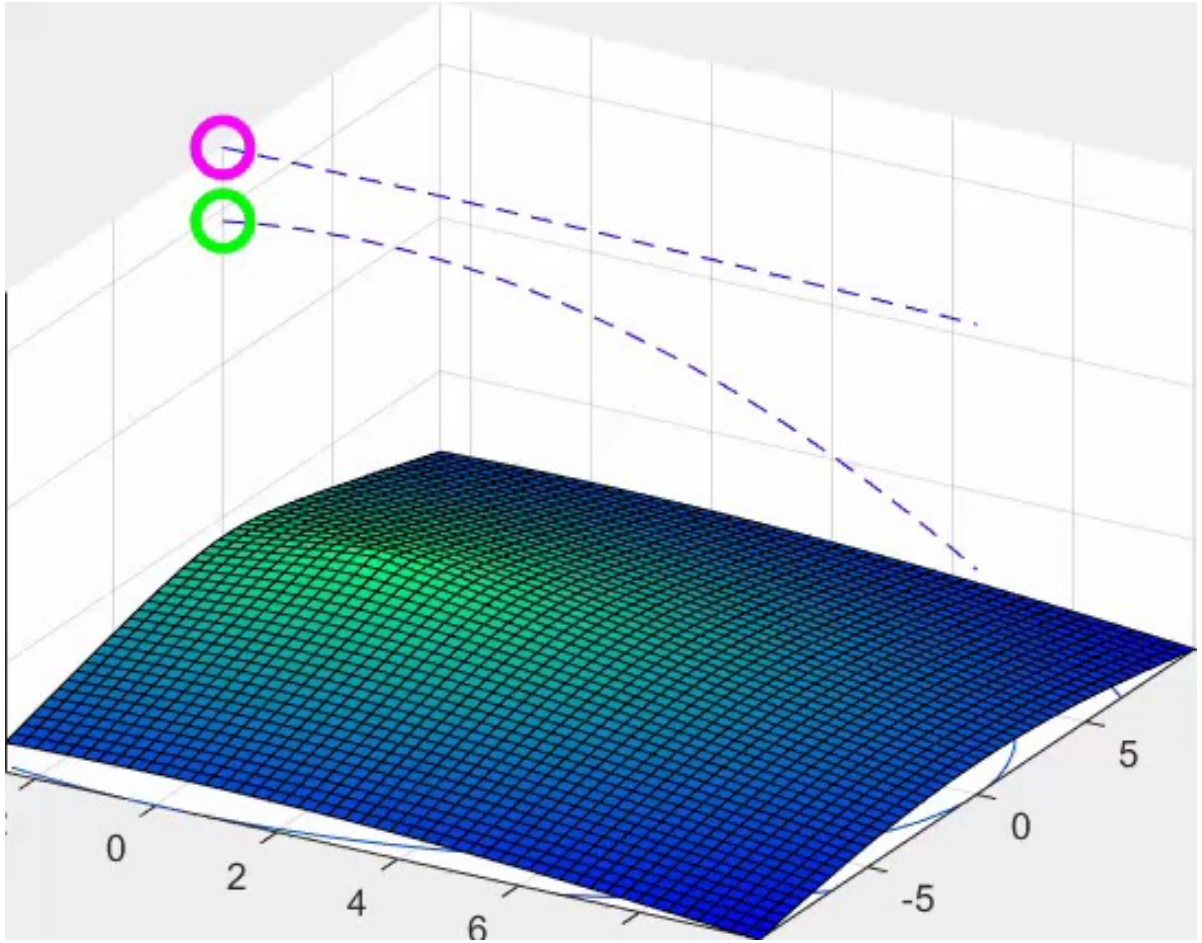
R3 Rocket Assembly



- Consisting of:
  - First stage solid rocket motor
  - Support ring
  - First stage LOX fuel tank
  - Second stage fuel tank
  - Second stage booster
  - Nose cone

Objectives – Con Ops

1. Track debris using open-source software
2. Determine threat level
3. Launch rocket from TX
4. Deploy second stage and spray material cloud
5. Intercept debris with cloud and deorbit
6. Recover rocket bodies in Gulf of Mexico



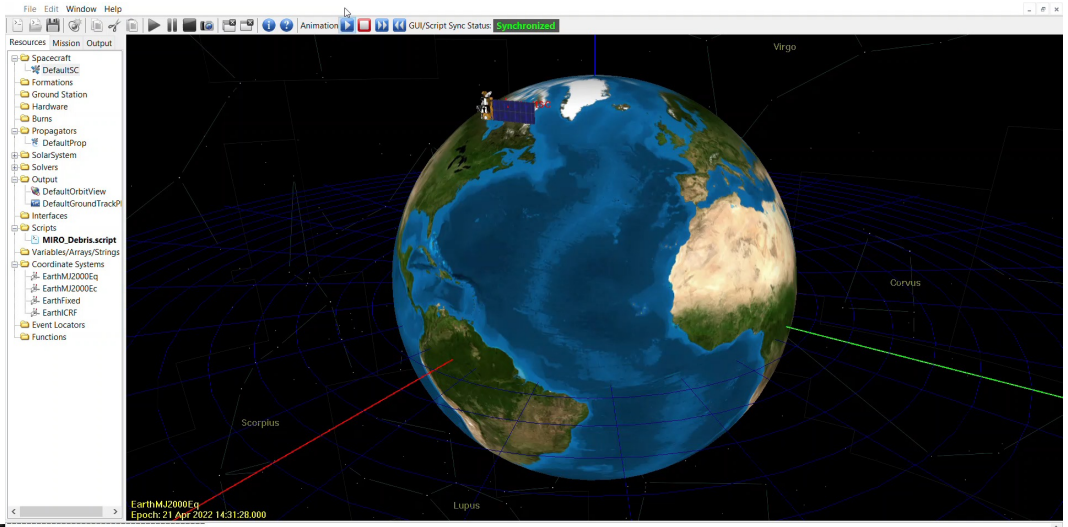
First Stage

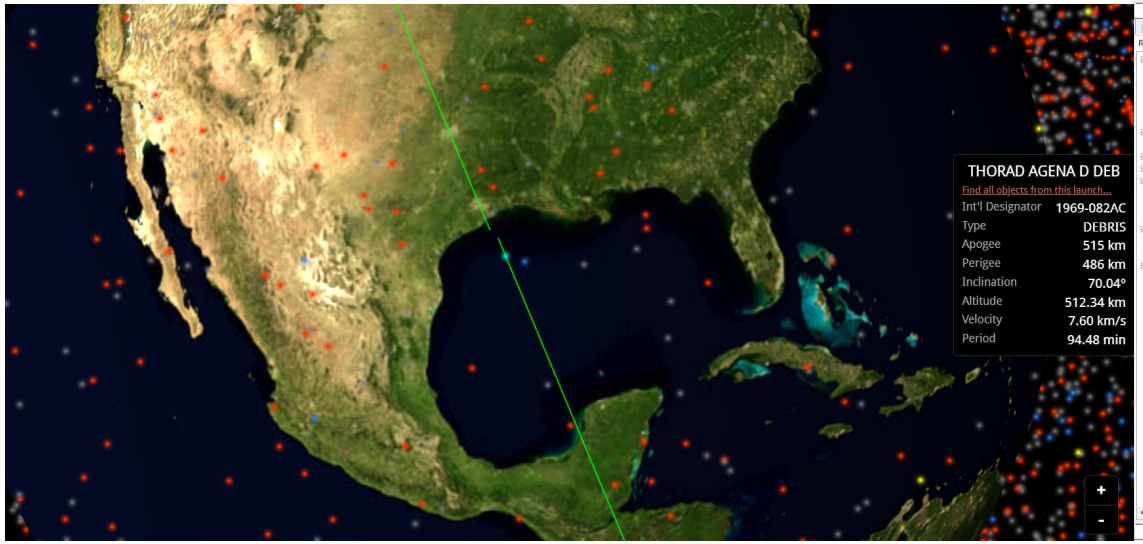
Second Stage / Interceptor

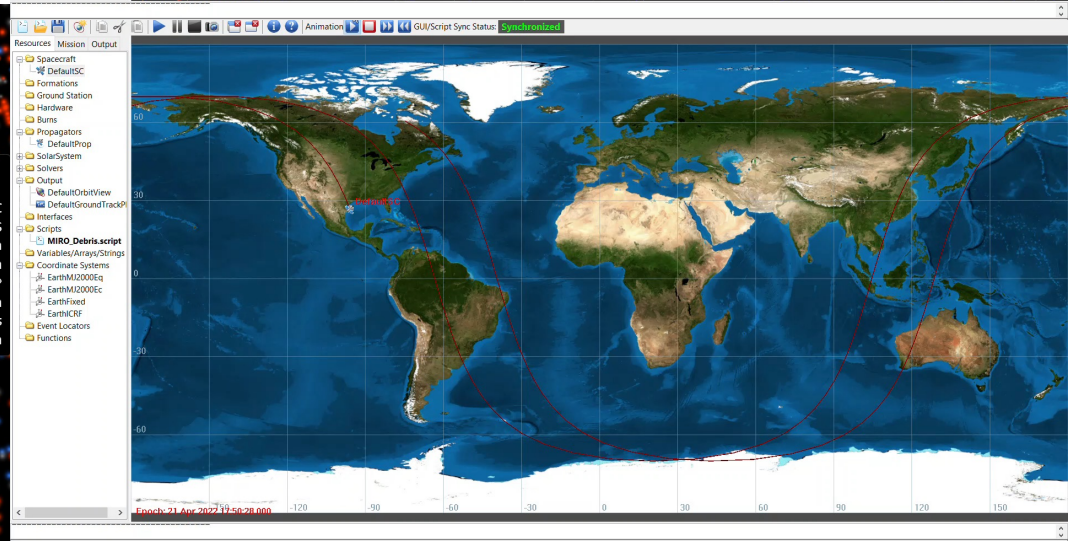
Debris

Debris Path Modeling

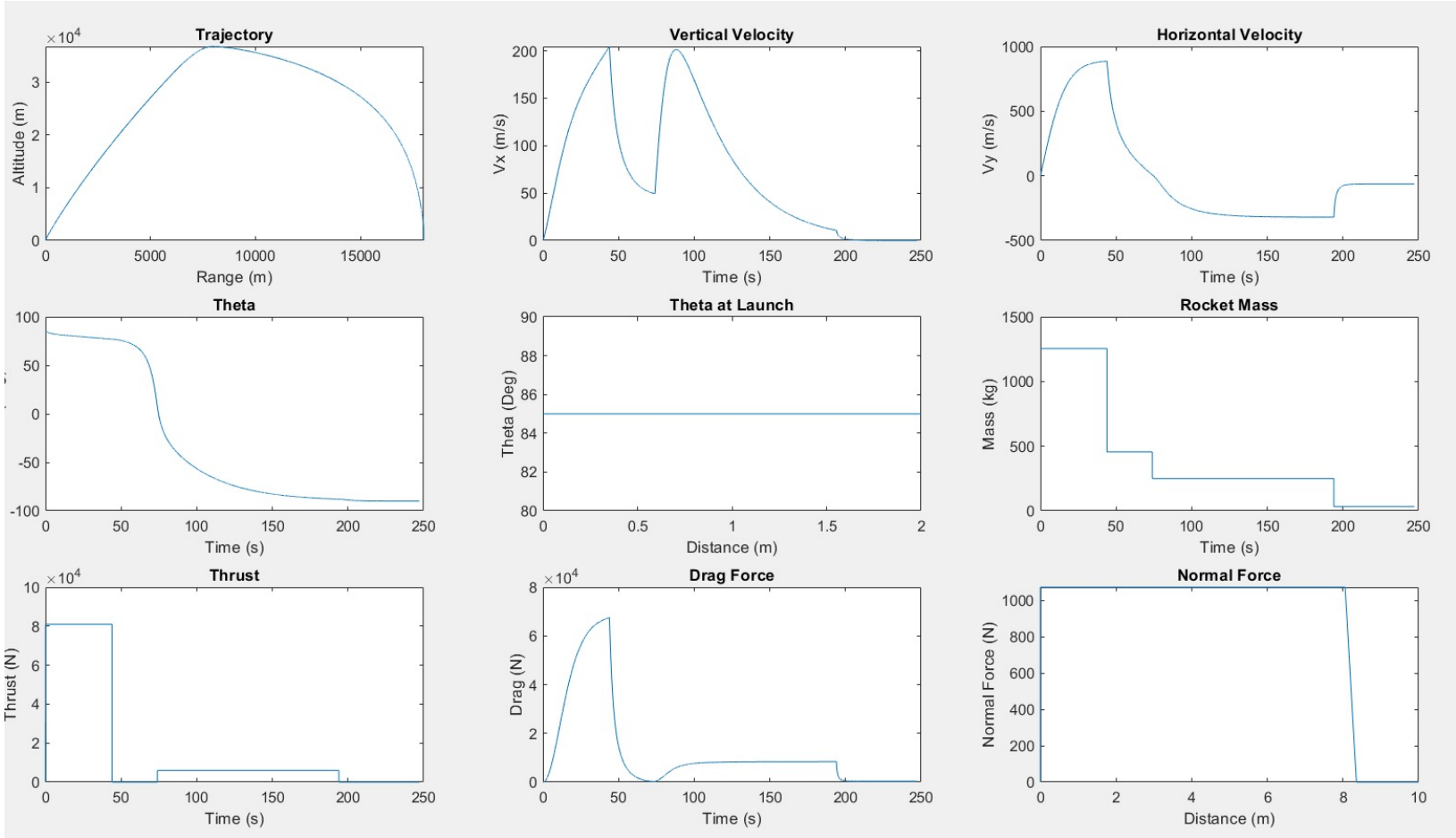
- Debris trajectory can be modeled from parameters taken from free tracking sources







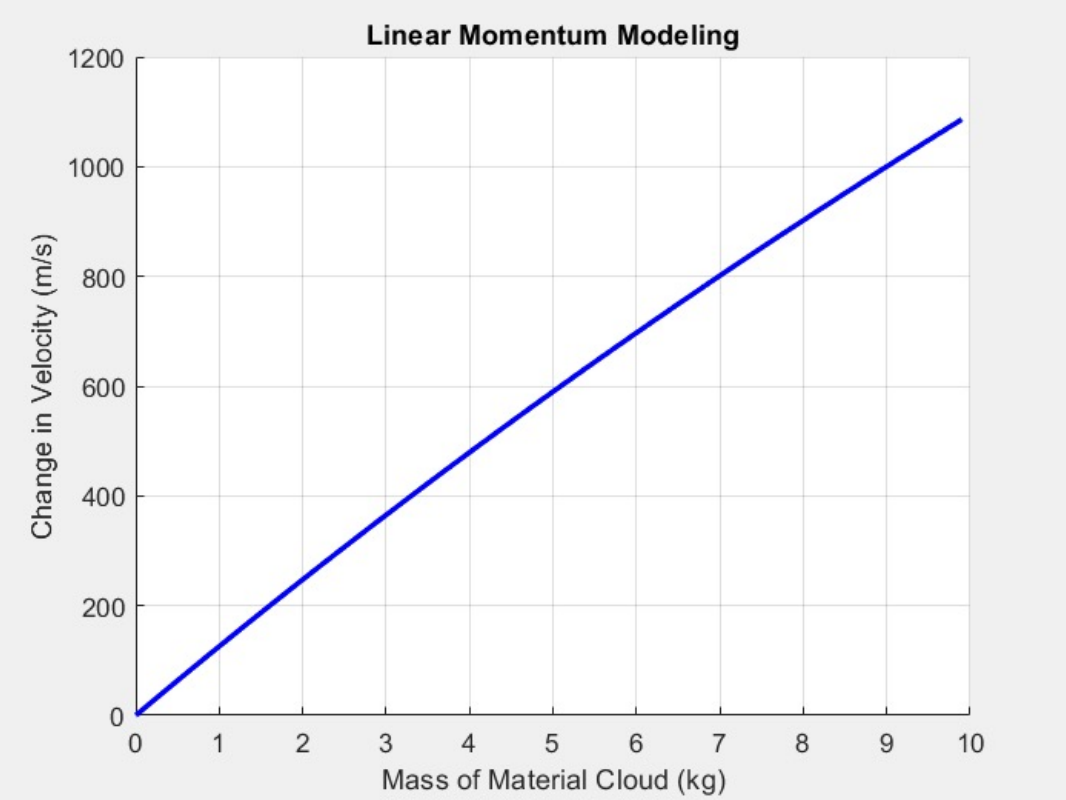
Trajectory Modeling



- Preliminary modeling for the two-stage interceptor rocket
- Shows two distinct burns and loss of boosters

Results

- Target mass to interact with: 0.58 kg
- Total energy transfer:
  - One droplet: 0.002 J
  - Target mass: 16.15 MJ
- Energy/A_{debris}: 3457 kJ/m^2

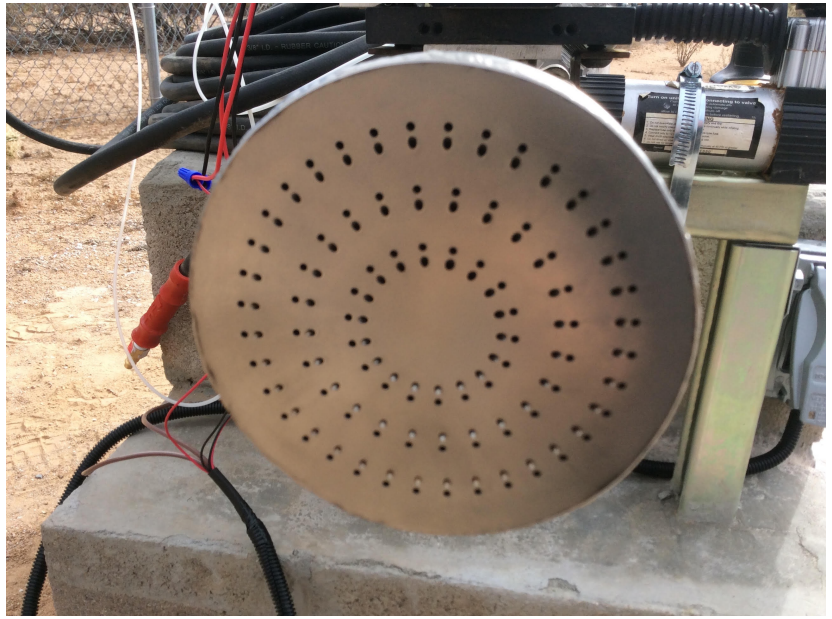


Challenges

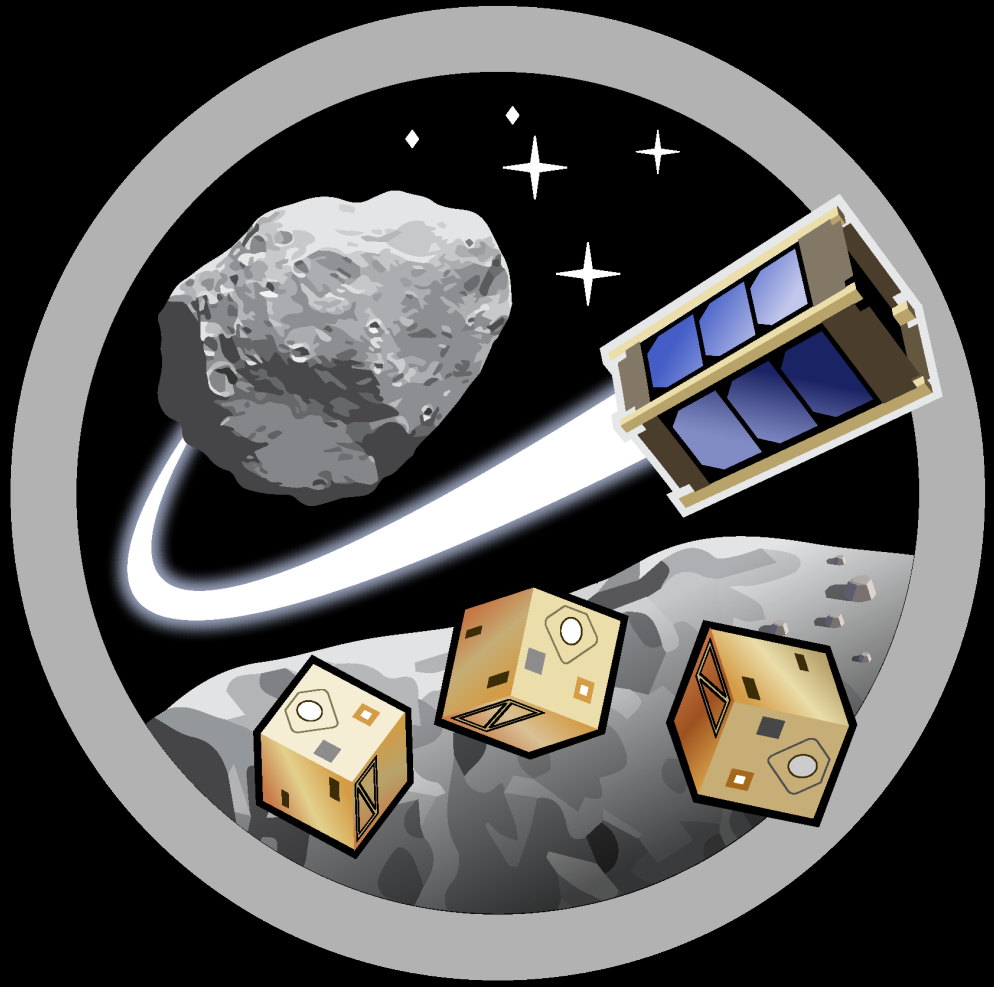
- Being in Puerto Rico
  - Not being able to work as a team in person
- Accessing high-fidelity software
- Field is constantly changing

Future Plans

- Simulate the nozzle flow and resulting cloud shape
- Working to increase capability between trajectory simulations
- Write white paper



Questions?



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