



On-Orbit Results from the CanX-7 Drag Sail Deorbit Mission

Brad Cotten

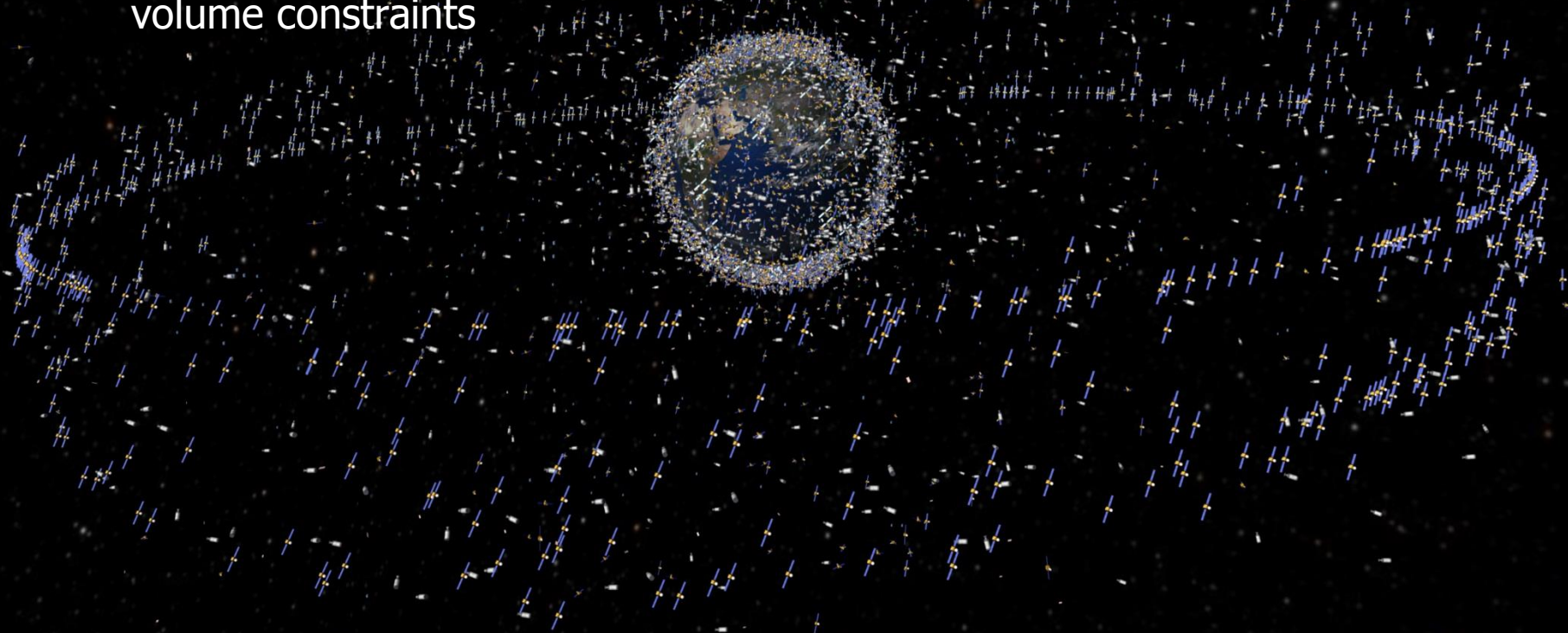
Aug 9 2017

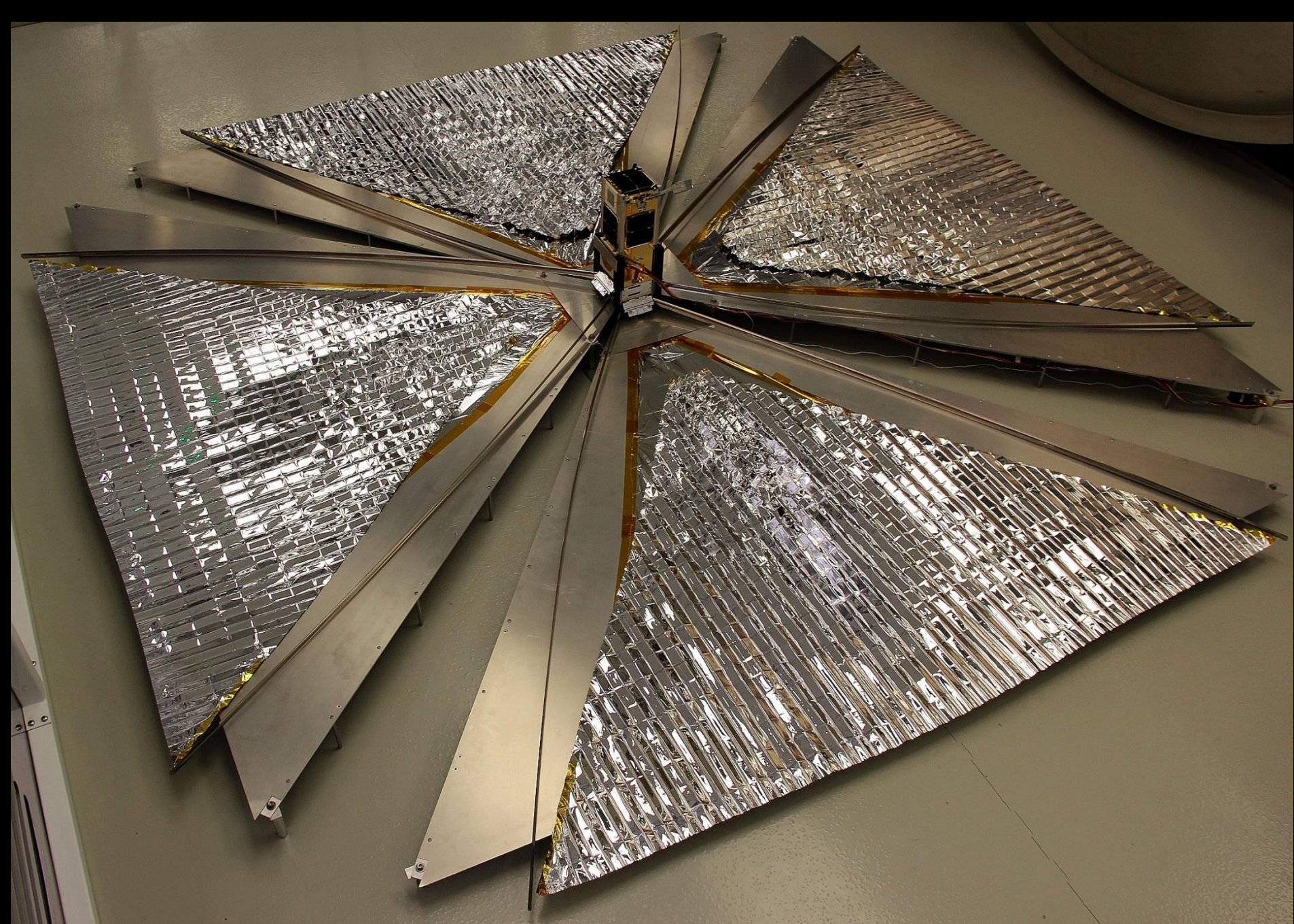
31st Annual Small Satellite Conference

Logan, Utah

Space Debris Problem

- Space debris poses a major threat to the future of space operations
- IADC recommends that all LEO satellites are deorbited within 25 years of end-of-mission
- Deorbiting is particularly challenging for small satellites due to mass and volume constraints





CanX-7 Spacecraft

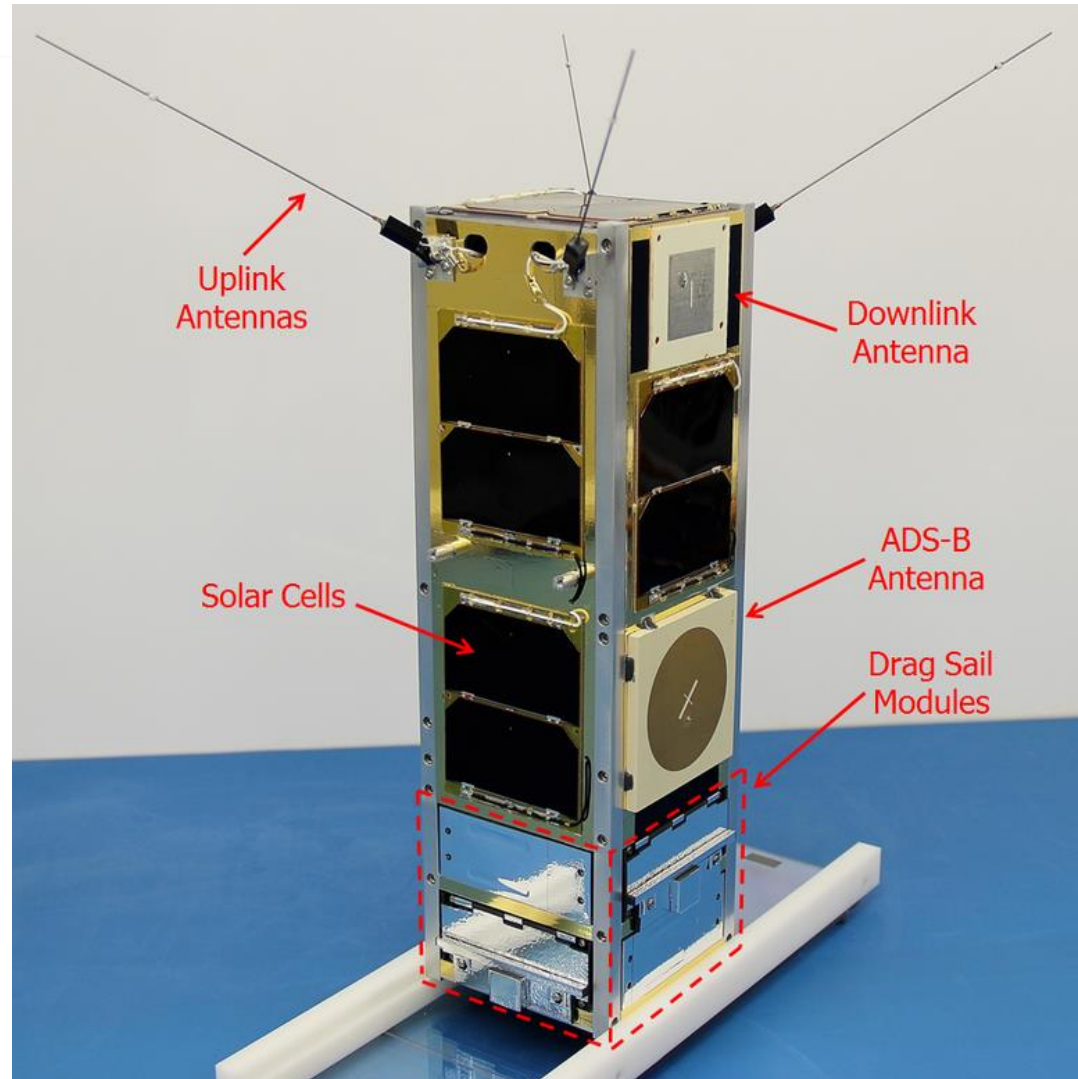
Payloads

Primary: Drag Sail

Secondary: ADS-B Receiver

Bus Characteristics

- 3.6 kg
- 10 x 10 x 34 cm



Launch

Launch Details

Launch Vehicle: PSLV-C35
Date: Sept 26, 2016
Orbit Type: SSO
Orbit Altitude: 680 km
Orbit LTDN: 09:30



CanX-7

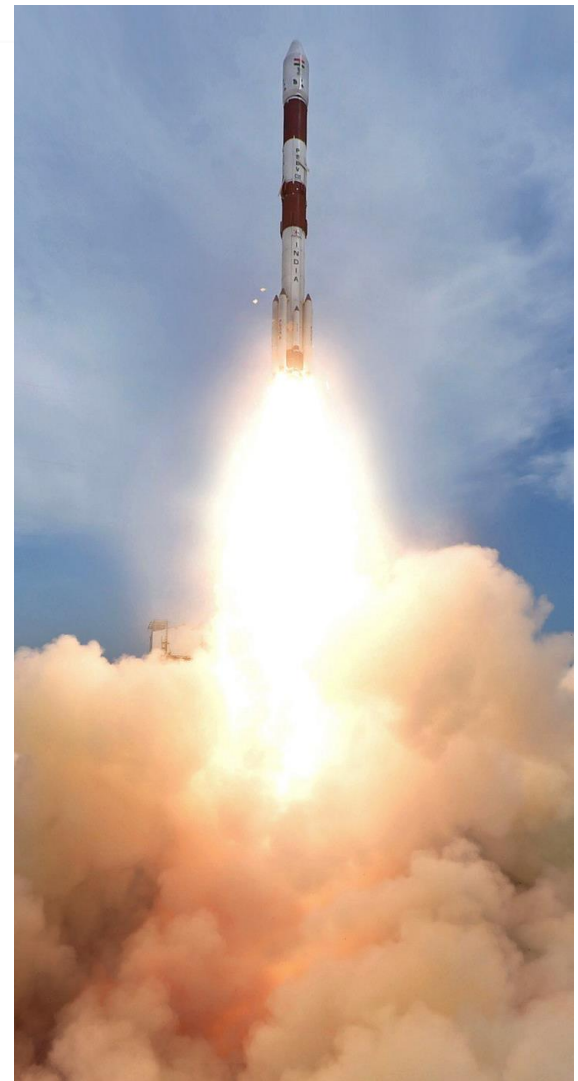
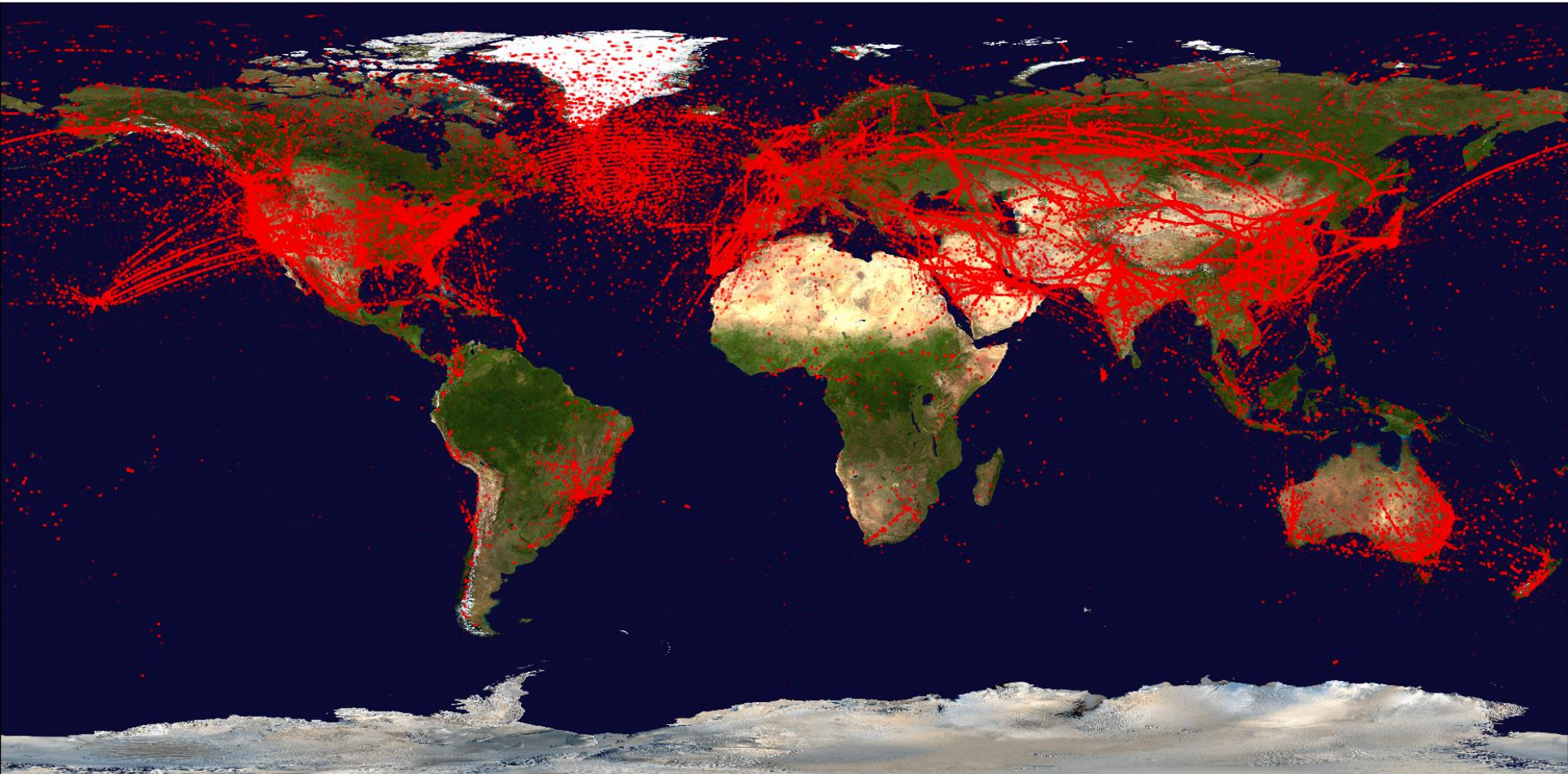


Photo Credit: ISRO

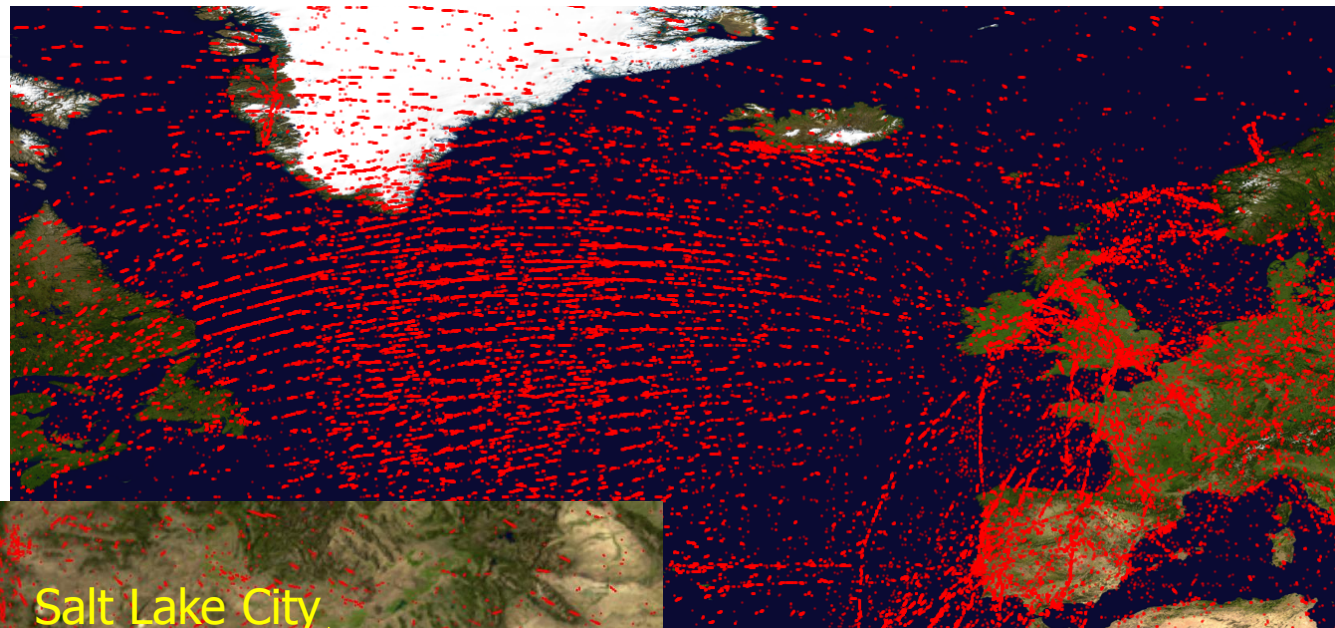
Global ADS-B Data Collected by CanX-7

Aircraft tracked between Oct 2016 and April 2017 – 4.6 million messages

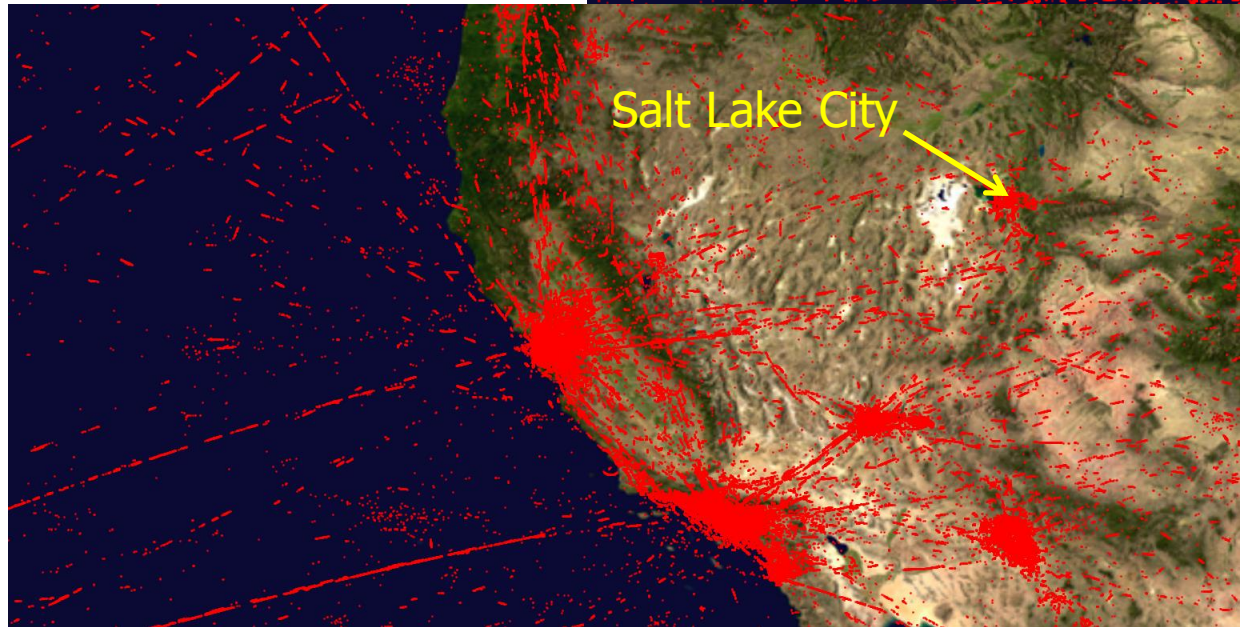


Regional ADS-B Data

North Atlantic



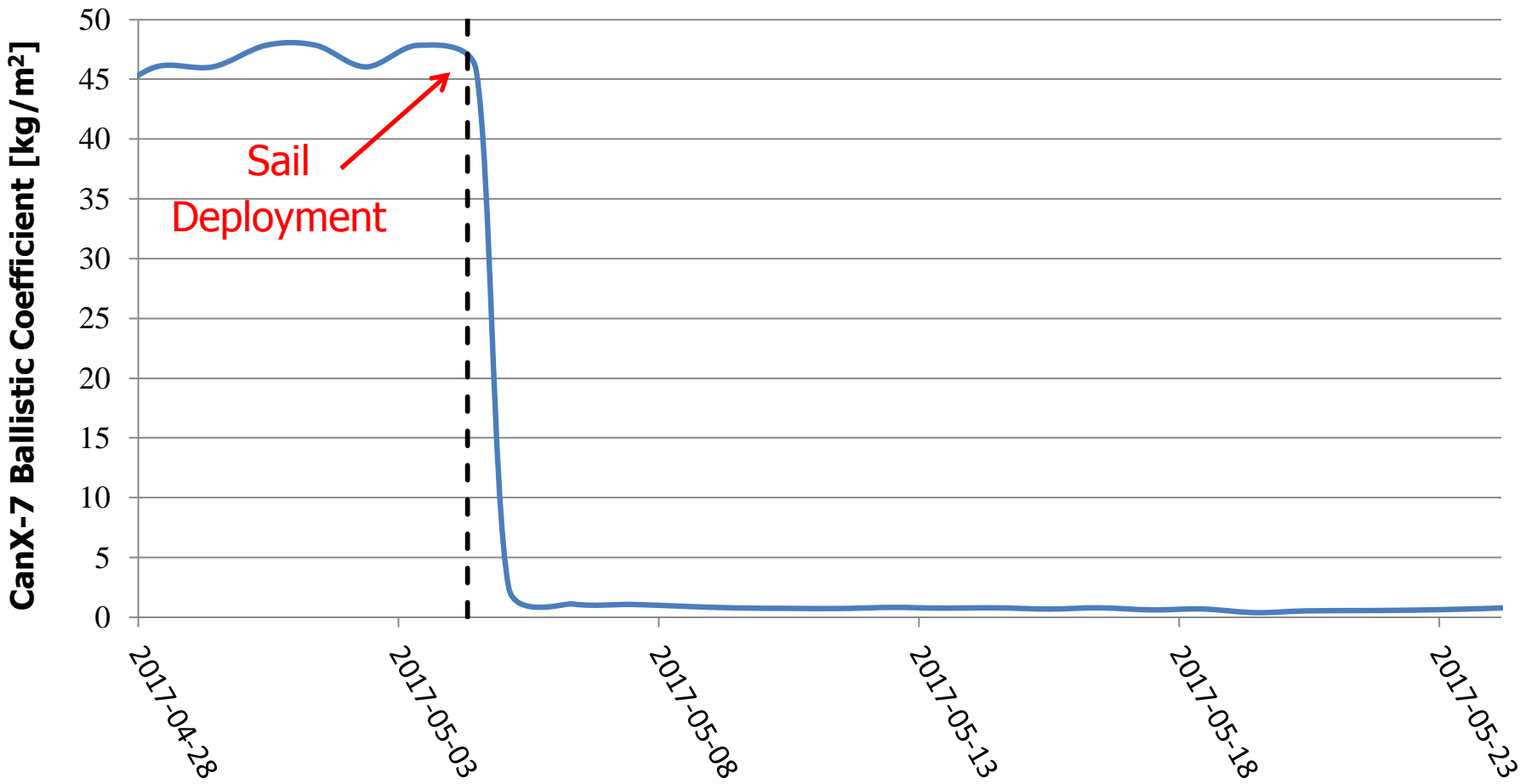
Salt Lake City



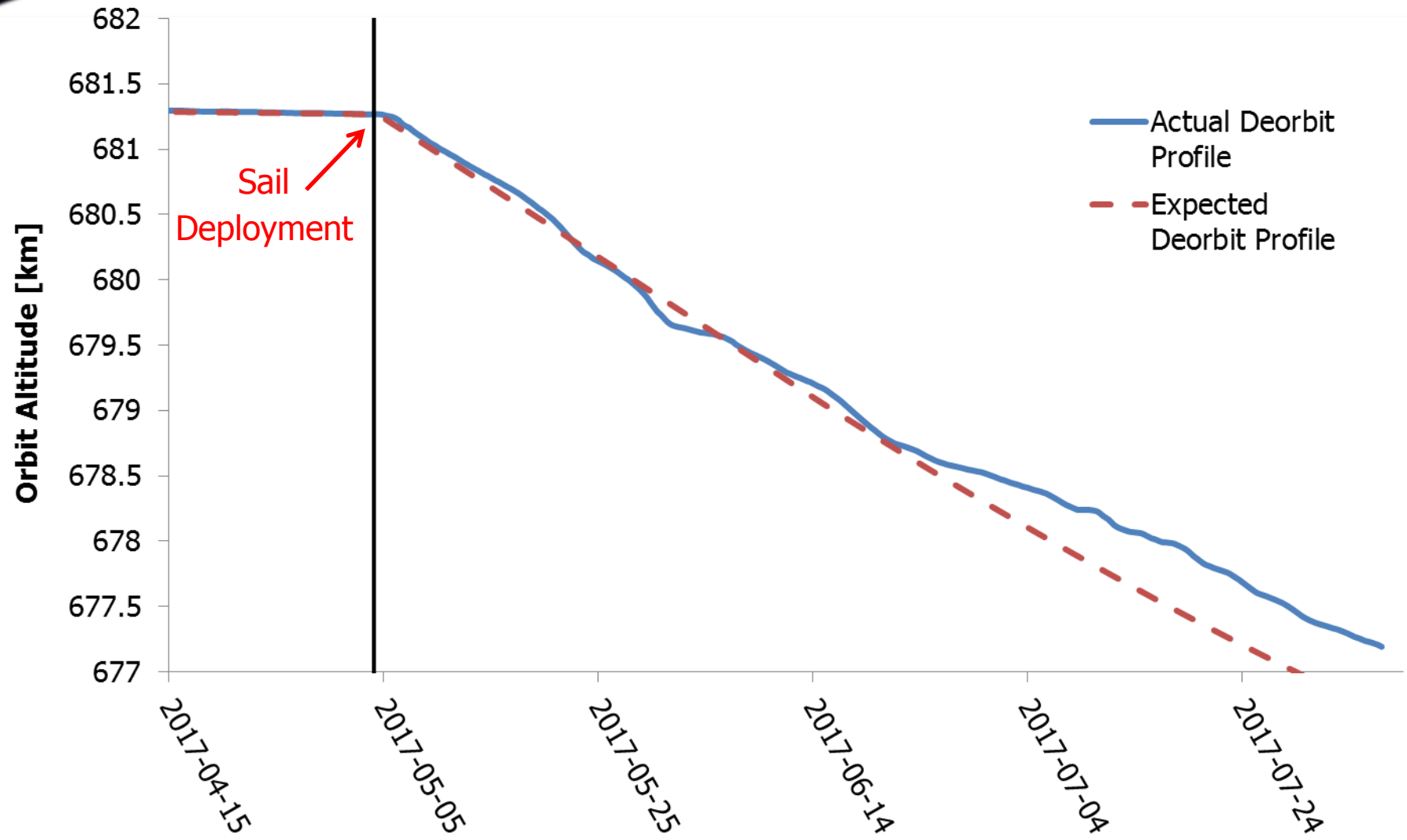
West Coast - USA



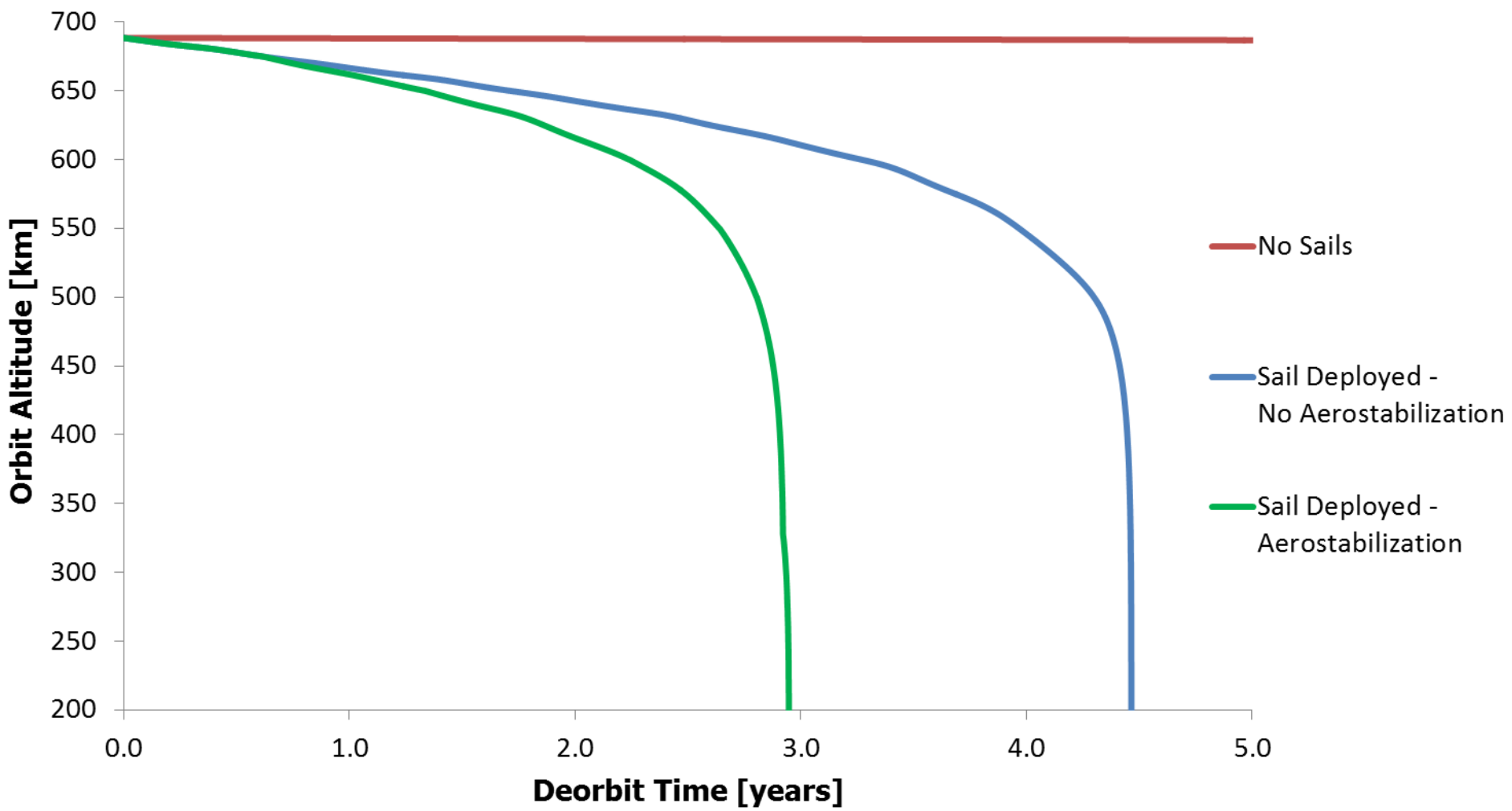
CanX-7 Ballistic Coefficient Before & After Sail Deployment



Initial Deorbit Performance



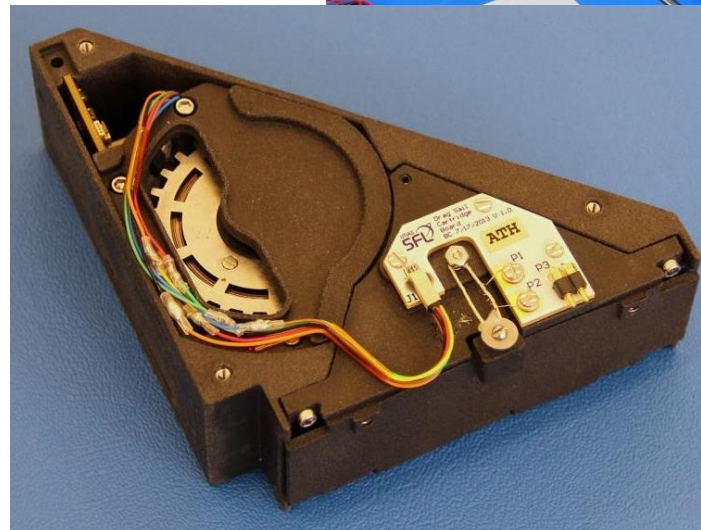
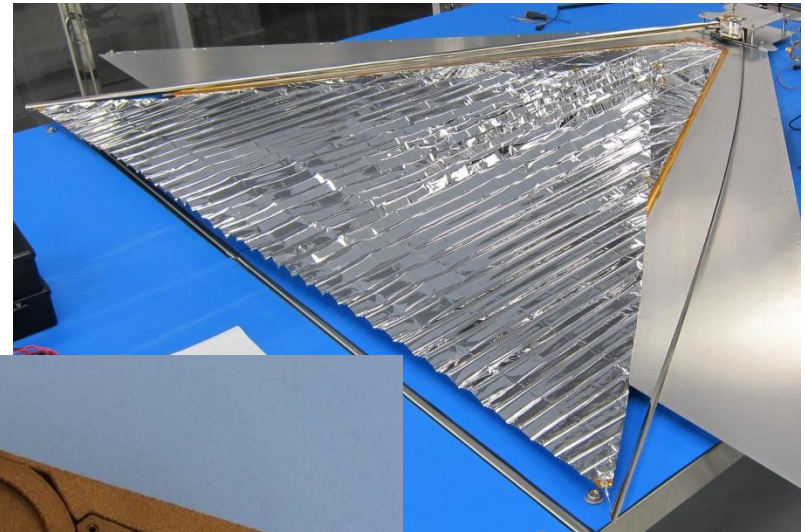
Expected Deorbit Profile



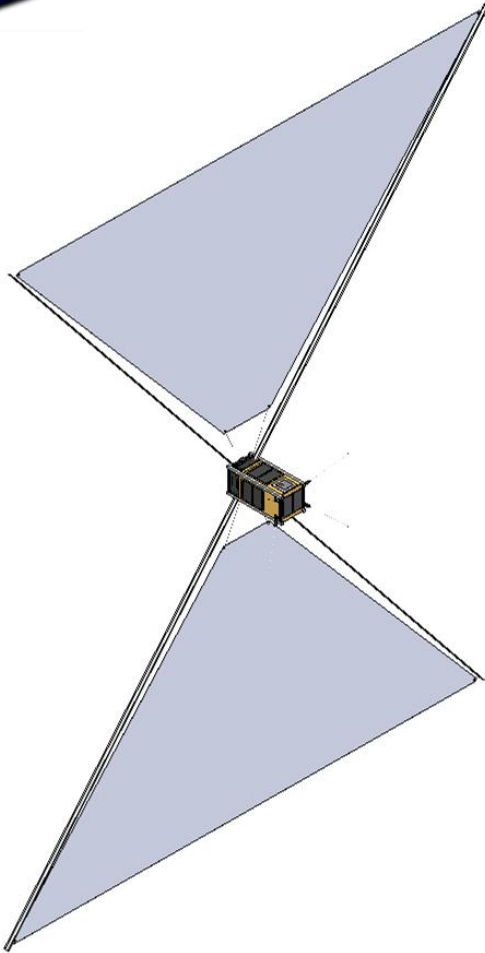
Drag Sail Technology

Design Characteristics

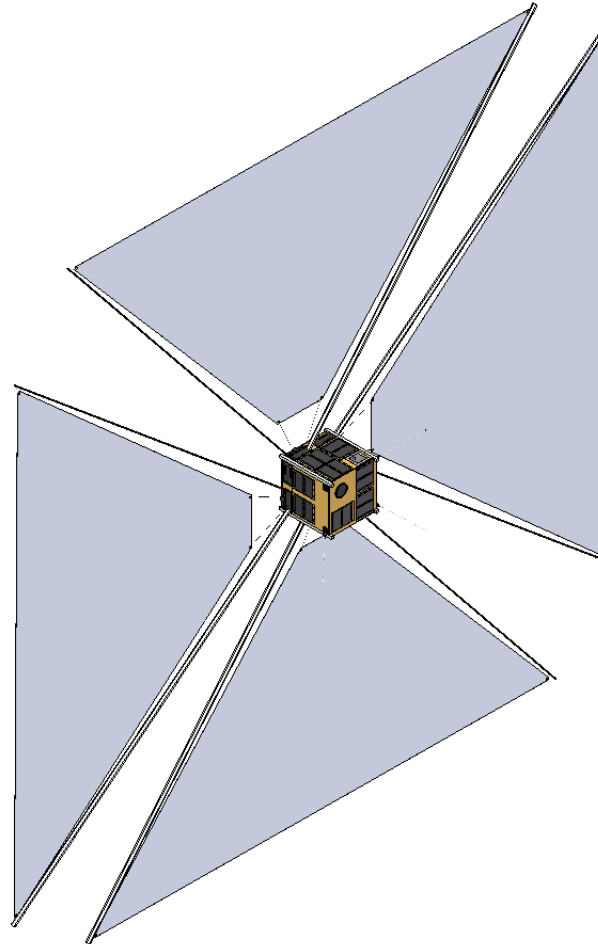
- Total mass: 200 g
- Dimensions: 10 x 10 x 3 cm
- 1 m² trapezoidal sail segment
- Aluminized polyimide thin film sail membrane
- Custom formed copper beryllium tape spring booms
- Built-in electronics and burn-wire release mechanism



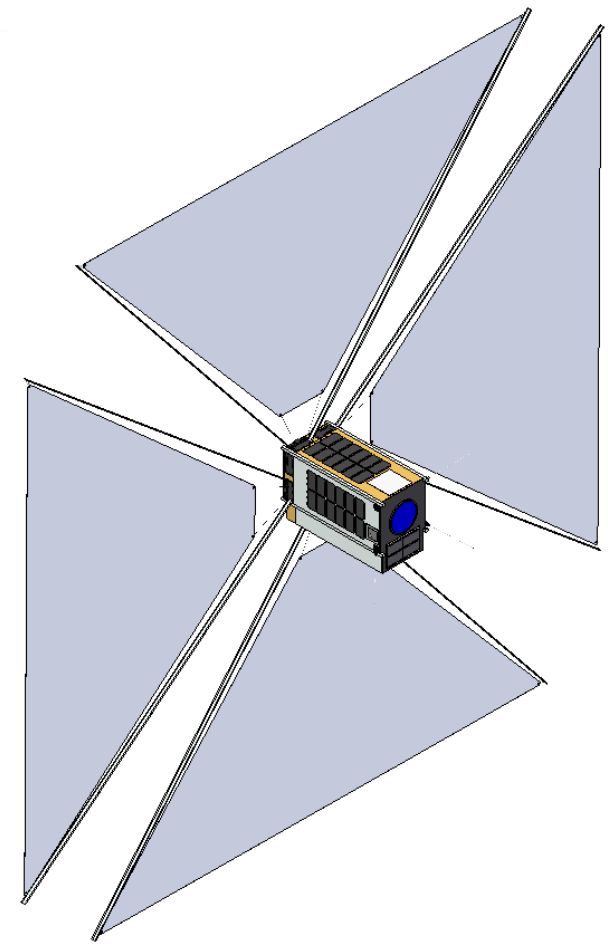
Future Potential



2U CubeSat



SFL Generic
Nanosatellite Bus

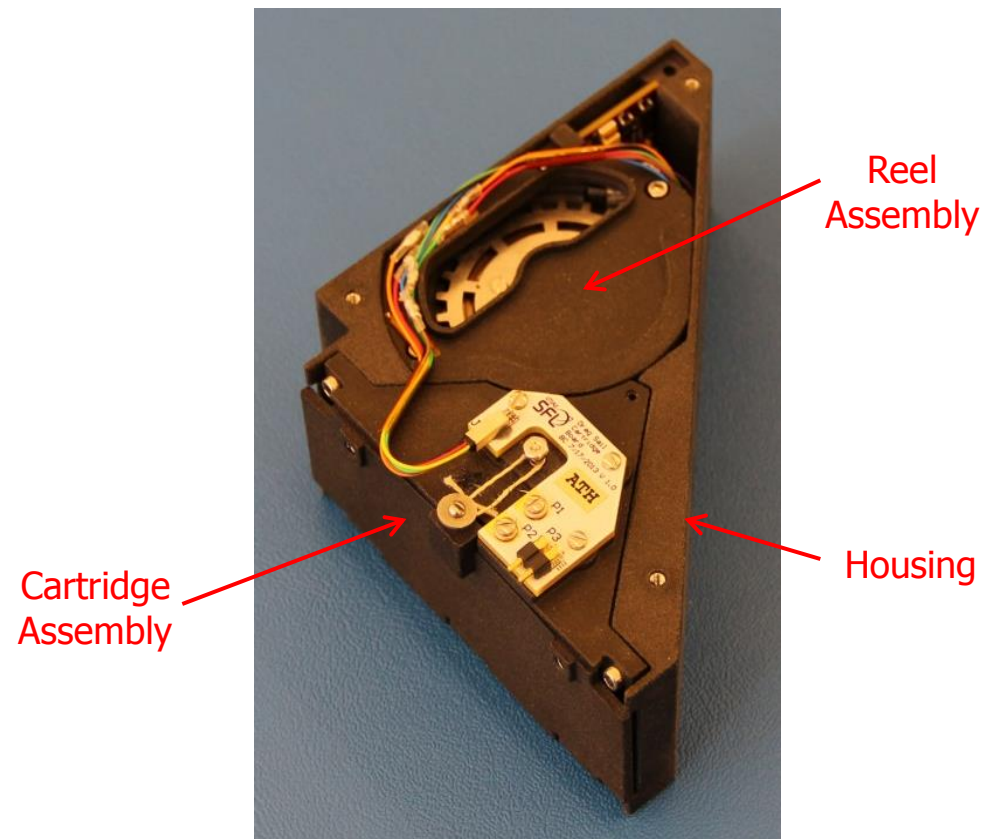


SFL Next-Generation Monitoring
and Observation Bus



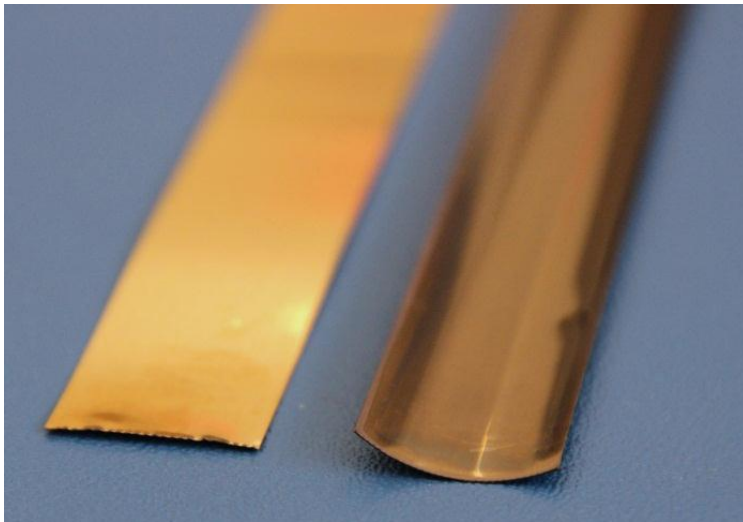
Mechanical Design

- Additively manufactured using *Windform XT 2.0*
 - Allows for a lightweight product
 - Allows for intricate features
- During secondary payload operations, the sail remains stowed within the cartridge assembly and the tape spring booms remain coiled around the reel assembly
- When a deployment command is received, the cartridge door is released allowing the booms unwind and unfurl the sail



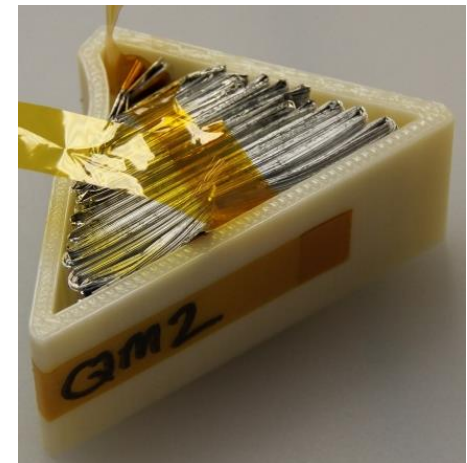
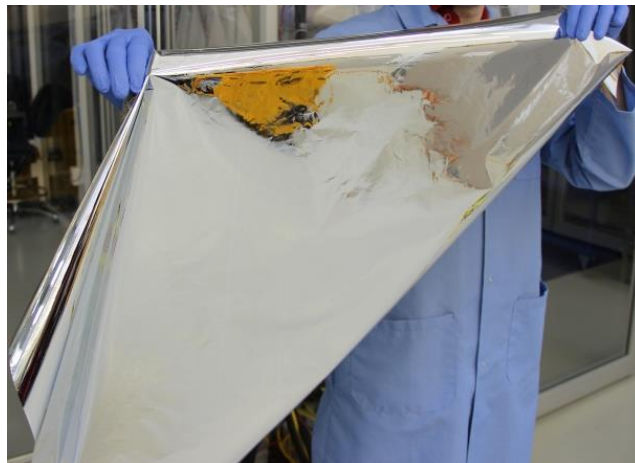
Deployable Tape Spring Booms

- Copper beryllium tape spring booms are manufactured in-house
- The boom profile is controlled to achieve the desired unwinding torque
- Use of a non-magnetic material alleviates concerns regarding spacecraft magnetic cleanliness

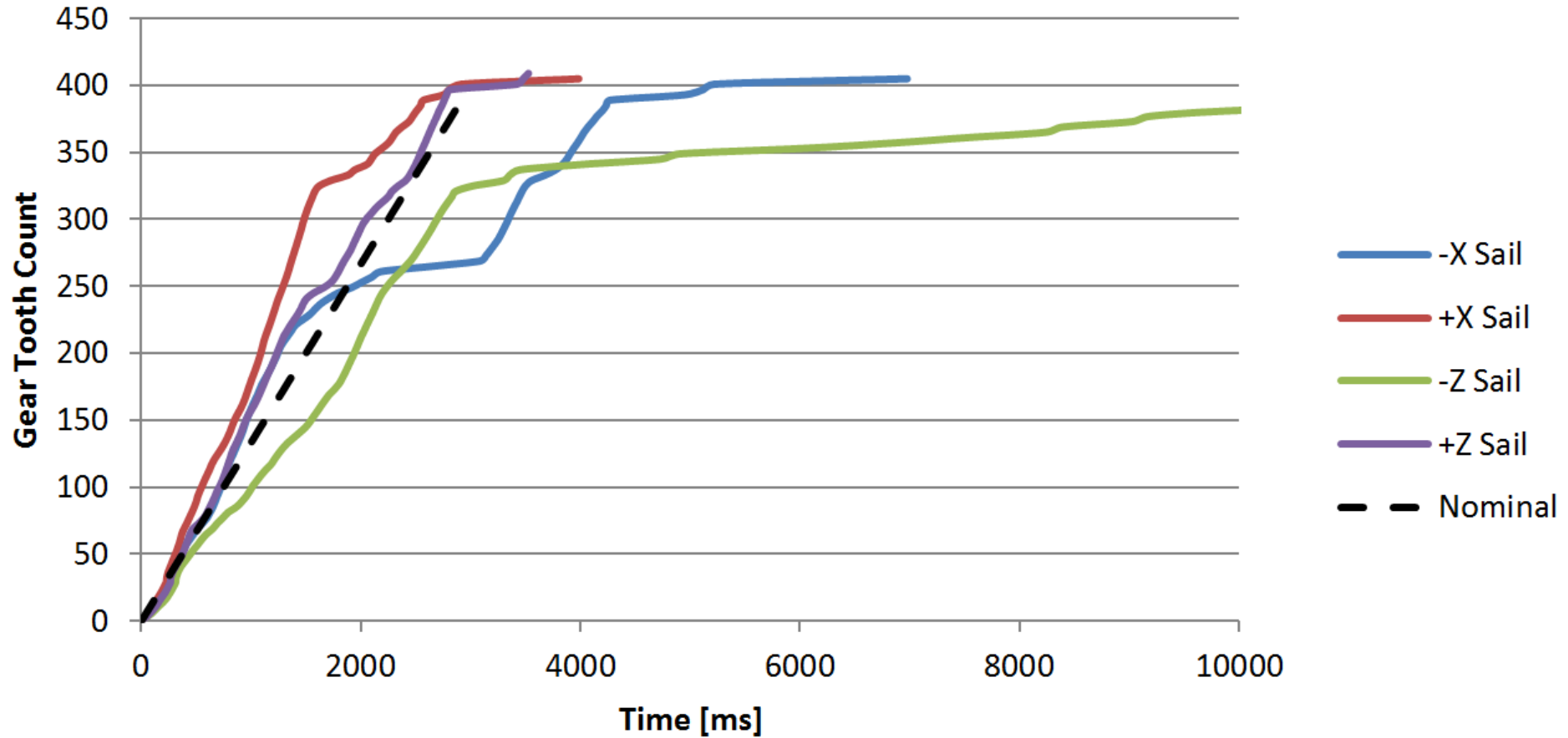


Drag Sail Membrane

- The sail membrane is made from a 12.5 μm thick aluminized thin film polyimide
- Each 1 m^2 sail segment is packed into a 31 cm^2 volume



Deployment Telemetry



Drag Sail Deorbit Performance (4 m² Sail)

