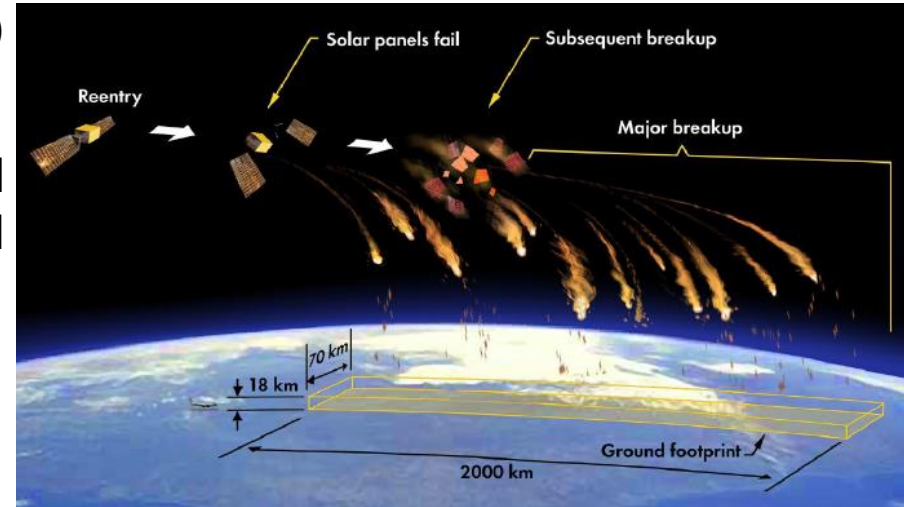


Development of a Tool for Aviation Risk Assessment Due to Space Debris and Meteoroids



Background

- ~40 large space debris objects (>800 kg) reenter randomly each year
- 10 to 40% of mass survives reentry and impacts the Earth's surface posing hazard to people and property
- Debris impacts in long, thin ground footprint
- Location of uncontrolled reentries is unpredictable



Risk for Aviation

Risk for Aviation?

- For controlled reentries or space vehicles launches: closure of airspace areas where the risk is unacceptable
- For uncontrolled re-entries: not currently quantified or controlled on event-basis
- Annual debris collision risk for aviation estimated* to be $\sim 3 \times 10^{-4}$

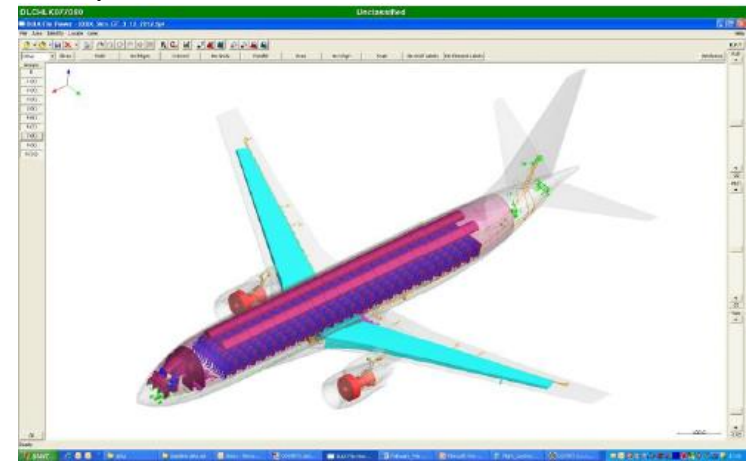
January 2012, Russian Phobos-Grunt uncontrolled re-entry. EUROCONTROL received a NOTAM from Russian authorities, requesting to close Europe airspace for 2h (calculated cost \sim €20 Million)

IAASS has decided to fill the gap by developing a tool to assess the risk for Aviation due to re-entering space debris and meteoroids

*Risk to Commercial Aircraft from Re-entering Space Debris-R. Patera <http://www.scientificamerican.com/>

Study Logic

- Consider fragmentation models an input (generic available)
- Adapt single-event methods used for ground population
- Evolve method for annual aviation risk assessment*
 - Add model for space debris re-entry flux
 - Add model for meteoroids entry flux
 - Add commercial transport air traffic density map for major regions (Europe, US, Japan, Middle East, China)
 - Improve aircraft vulnerability models
- **Outputs for single re-entry or annual risks**
 - Probability of impact
 - Probability of accident
 - **Collective risk of casualties**



*Risk to Commercial Aircraft from Reentering Space Debris - R. Patera

Study Phases



- First phase set for completion in Fall of 2013:
Multiple organizations assess state-of-the-art in each area



- Air-traffic density mapping
- Aircraft probability of impacts computation
- Aircraft vulnerability to debris impact



- Later phases

- Algorithm development
- Database development
- Improvement of aircraft vulnerability models
- Software design: requirements, specification, architecture, coding, testing, validation

