

Risk to Aircraft From Space Vehicles Debris

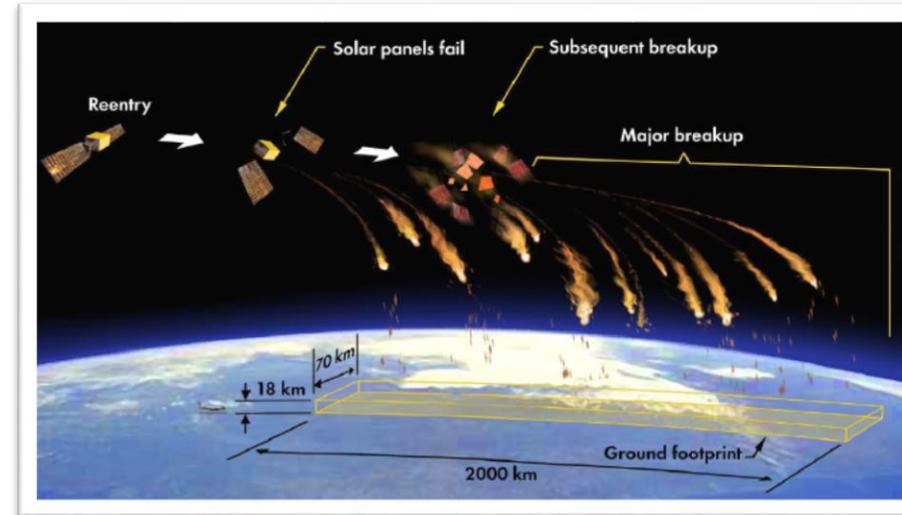
Matteo Emanuelli, Tobias Lips

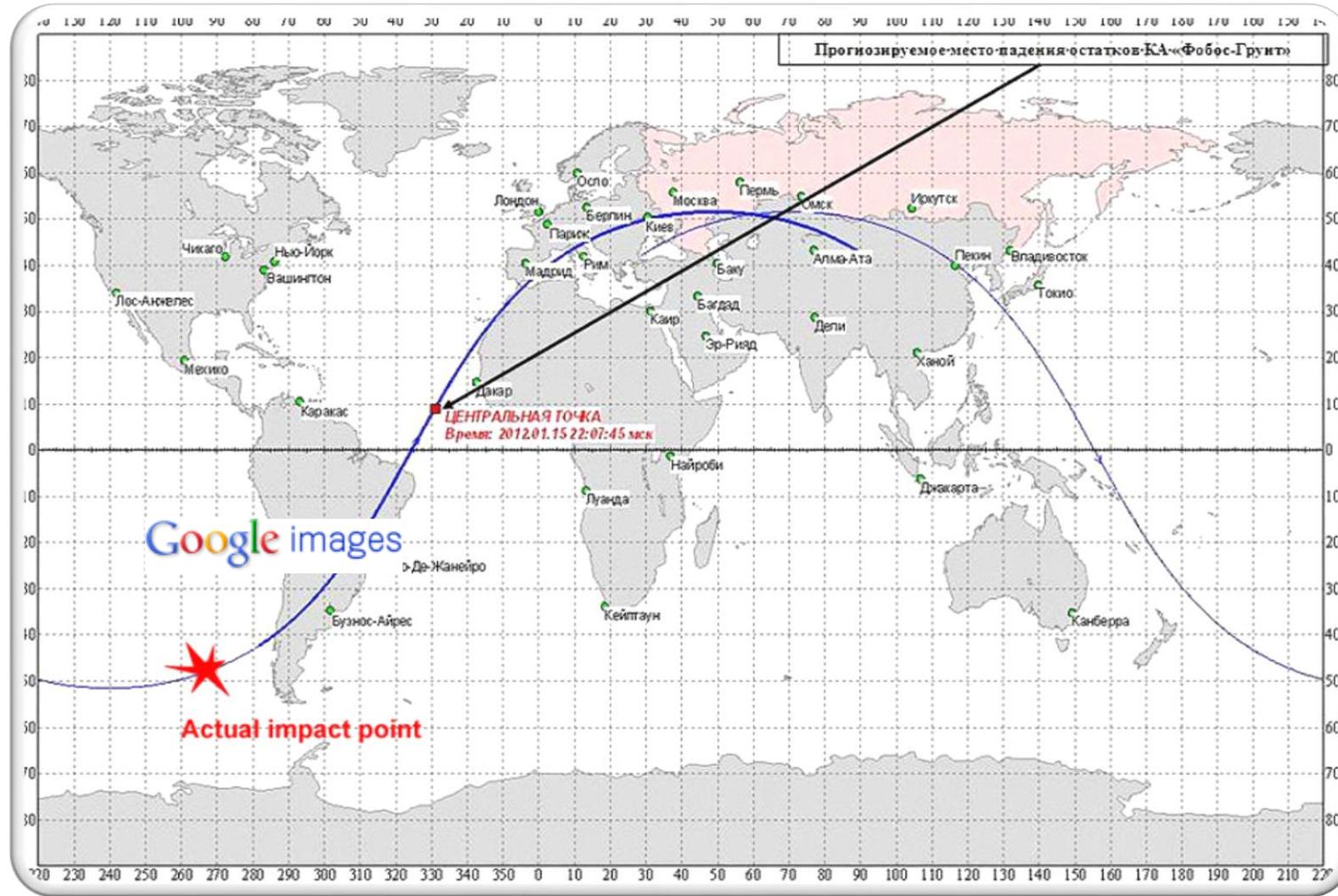


**UN COPUOS Scientific and Technical
Subcommittee: 2015
Fifty-second session
6 February 2015**

Background

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





- Impacts are under the track of the space object
- Precise location of fall back area along the track is impossible

Source: www.russianspaceweb.com/phobos_grun_reentry.html

Risk for Aviation

Risk for Ground

- Acceptable casualty expectation for controlled reentry
 - 1×10^{-4} for US
 - 2×10^{-5} for France
- Acceptable casualty expectation for uncontrolled reentry
 - 1×10^{-4} for US
 - Exceptionally acceptable in France

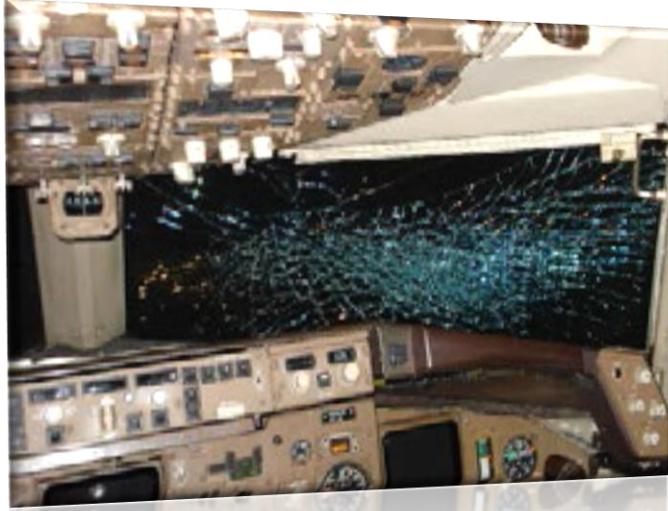
Calculated recurring to different factors:

- Footprint generated by debris fragmentation
- Density of population
- Type of buildings

Risk for Aviation?

- For controlled reentries or space vehicles launches: closure of airspace areas **over the fall back areas where the risk is unacceptable**
- For uncontrolled re-entries: not currently quantified or controlled on event-basis
- Annual debris **catastrophic** collision risk for aviation **roughly** estimated* in 2006 to be $\sim 3 \times 10^{-4}$ (Air traffic double every 15 years)

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

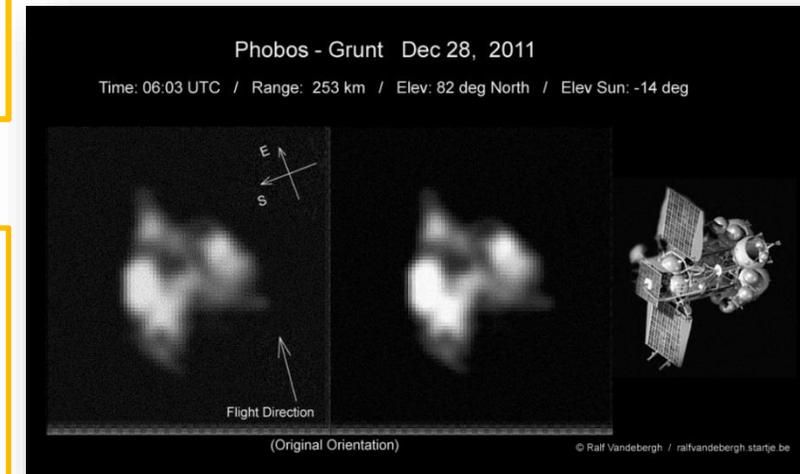


Risk for Aviation

December 1996. A Chinese Boeing 757-200 passenger plane flying from Beijing to Wuhan was forced to make an emergency landing after the exterior glass of the cockpit window was cracked by an unidentified flying object at 9,600m. The plane made a successful emergency landing at Beijing's Capital International Airport.

March 27, 2007. wreckage from Russian Progress 23P cargo was spotted by an Airbus A340 of LAN Airlines, travelling between Santiago, Chile, and Auckland, New Zealand, carrying 270 passengers. The pilot estimated the debris was within 8 km of the aircraft, and he reported hearing the sonic boom as it passed.

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

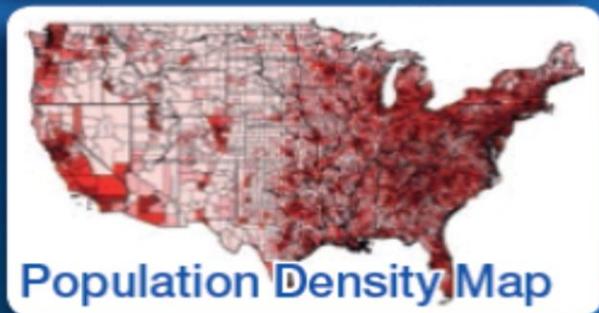
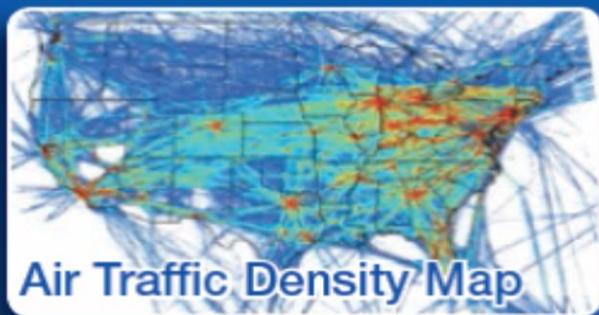


ADMIRE

AVIATION - DEBRIS AND METEOROIDS INTEGRATED RISK EVALUATION

- 1) Estimate of annual integrated debris and meteorites impact risk for aviation (globally and locally for regions of highest air traffic).
- 2) Assessment of new space systems compliance with applicable reentry risk safety requirements, taking into account densities and vulnerabilities of ground population and aviation traffic.
- 3) Real-time risk management of space debris reentries in support of decision making by civil protection and air traffic control authorities.

*Estimate of annual integrated debris and meteorites impact risk for aviation
(globally and locally for regions of highest air traffic)*



Flux of Space Debris

Flux of Meteorites

INPUT



OUTPUT

Assessment of new space systems compliance with applicable reentry risk safety requirements, taking into account densities and vulnerabilities of ground population and aviation traffic



New Space Systems

Fragmentation Model
(Input)

Air Traffic Density

Population's Density on Ground

Assessment of compliance with applicable reentry risk safety requirements

Real-time risk management of space debris reentries in support of decision making by civil protection and air traffic control authorities



WP PM - IAASS
Project Management

WP 0
State of the Art

WP 0.1 - ACTA
Re-entry risk

WP 0.2 - ASTOS
Air Traffic Density Map

WP 0.3 - ACTA
Aircraft Vulnerability

WP 0.4 - CNES
Meteoroids

WP 0.5 - Paul Wilde
Space Debris

WP 0.6 - HTG
Fragmentation

WP 0.7 - CNES
Fragmentation

WP 0.8 - ACTA
Patera's Methodology

WP HTG
Fragmentation and Survivability

WP CNES
Meteoroids

WP ISTI-CNR
Real-Time risk assessment

WP ASTOS
Air Traffic Density Modelling

WP ACTA
Aircraft Vulnerability

WP UNI-HANNOVER/SALZSBURG
Real-Time risk warning

ADMIRE Study Logic

WP ACTA
ADMIRE Annual Risk Report

WP ACTA
ADMIRE Individual Event Risk Report

WP ACTA
ADMIRE Real-Time Risk Assessment Module

THANK YOU FOR YOUR ATTENTION



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