Uses of Amateur Meteor Data in NASA Spacecraft Operations and Design

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How NASA handles space debris

Earth-approaching asteroids

Near Earth Object Office (JPL)

Meteoroids and meteors

Meteoroid Environment Office (MSFC)

Man-made orbital debris

Orbital Debris Program Office (JSC)
MEO Overview
History

- Established by NASA Headquarters Office of Safety and Mission Assurance (OSMA) at beginning of FY05 as the NASA organization responsible for meteoroid environments pertaining to spacecraft engineering and operations.
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• Located at Marshall Space Flight Center in Huntsville, Alabama.
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Web site:  http://meo.nasa.gov
Who cares?

Navy Transit Satellite
(before being shot with a 5 cm Aluminum ball moving at 6 kilometers per second)
Who cares?

The Aftermath

Monday, September 27, 2010
Meteor shower forecasting
Stream Modeling

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  - Multiple peaks; times and intensities of shower maxima can be obtained.
  - Shower durations difficult to derive.
2004 Perseids

Particles ejected hourly proportional to $r^6$ while Swift-Tuttle is inside 2.5 AU

Earth's Path
- 9 rev (826 AD)
- 7 rev (1079 AD)
- 6 rev (1212 AD)
- 5 rev (1348 AD)
- 4 rev (1479 AD)
- 3 rev (1610 AD)
- 2 rev (1737 AD)
- 1 rev (1862 AD)

60° cap angle
• Output for past years compared to IMO ZHR profiles or other historical observations. “Calibrates” the model and enables ZHR predictions for future.
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• ZHRs converted to fluxes using visually-determined population/mass indices.
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- Penetrating fluxes are generated at 1 hour intervals for entire year.
Why these sizes?

Potential Shuttle Damage

Window Replacement
- EVA Suit Penetration
- Radiator Penetration
- RCC Penetration
- TPS Tile Penetration
- Cabin Penetration
- Cargo Bay Damage

Spacecraft Surface Inspections
- Patrol Radars (CMOR)
- ALTAIR/Arecibo Radars

Lunar Impact Monitoring

Atmospheric Optical (Visual, Video, Intensified Video)

Meteoroid Diameter in Centimeters

Bill Cooke/Nick Johnson

Monday, September 27, 2010
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- 6-hour fluences also calculated for EVA risk.
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• A few weeks are allowed for the numbers to be revised. We do not use the “real-time” ZHRs unless there is an anomaly investigation with tight deadlines.
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- Analysis showed Perseid radiant was visible from satellite at time of loss of control - Perseid strike possible.
Pros and Cons of Visual Observations

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Perseids from Space

STS-105
August 10-22, 2001
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