Pollution of and from space

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Overview

Introduction

- Have you ever wondered about space?
- Should we worry about what is happening in space?
- Short answer: Yes
- Long answer: Pollution of space is becoming a very serious problem caused by humans by sending our satellites to space causing production of debris.
- Also, meteorites from space also cause pollution in our environment.
- Hence, we should actually care about what is happening in space.

What is space debris?

- Space debris is the collection of defunct man made objects in space.
- Old satellites
- Spent Rocket Stages
- Fragments from disintegrations
- Erosions and collisions

Statistics

As of July 2013, the following statistics have been recorded:

- 170 million debris smaller than 1 cm
- 670 thousand debris of range 1 to 10 cm
- 29 thousand larger debris

Sources of Space Debris

The primary sources of space debris are:

- Dead spacecrafts: Was extremely high in the 1970s and the 1980s when the Soviet Union space program was at its peak
- Lost equipment: Equipment lost by astronauts also comprises space debris.
- Boosters: Boosters of rockets and other parts of space ships.
- Anti-Satellite Weapons: Testing of anti-satellite weopans by the US and the Soviet Union was a major source of space debris

Threats due to Space debris

Space debris poses threats to the following:

- Unmanned spacecrafts
- Manned spacecrafts: Major event was the collision of debris with Challenger a few years ago leading to a pit in the space craft, over 1 mm wide
- The Earth
- International Space Station: The solar panels of the ISS cannot be protected easily from space debris

The Kessler effect is another problem that we may have to face if space debris remains uncontrolled.

Mitigation of Space debris

The greatest reason why mitigation has not been implemented effieciently is not technical but economic. There is no commercial incentive for anyone to dedicate resources to the cleaning up of space debris. There are a number of techniques for mitigation of space debris and there are policies in place for organizations, so that production of space debris is minimized.

Kessler Effect

- A scenario in which the density of space debris is so high that a collision may cause a "cascading effect"
- Will lead to the production of a large amount of debris

Meteorites

- A meteorite is a piece of debris that enters the earth's surface and survives its journey in the atmosphere and the impact with the earth.
- Meteorites can also cause pollution as they collide with the earth's surface leading to air pollution etc.

Radiation

Radiation from space is of two types:

- Ionizing Radiation: Radiation carrying enough energy to ionize an atom
- Non ionizing radiation: Radiation carrying relatively low amount of energy.

Radiation Pollution

- Excess radiation in the atmosphere is radiation pollution.
- Sources of radiation pollution are mainly from space.
- Cosmic Rays containing highly energetice particles reach the surface of the earth causing pollution
- The intensity of cosmic rays is maximum at the poles and minimum at the equator.

Effects of Radiation Pollution

Radiation pollution from space has numerous effects on the health of living organisms on the earth.

- Causes mutations in the DNA
- Causes cancer of the blood cells (leukemia)
- Excess exposure leads to skin burns

Protection from radiation by the atmosphere

- The atmosphere protects us from the cosmic rays as the high energy particles collide with the oxygen and nitrogen molecules in the air and slow down.
- Similarly, the atmosphere prevents high energy Gamma rays and Ultraviolet radiation from reaching the earth
- Also, the atmosphere protects us from solar flares

Solar Flares

Sometimes a sudden, rapid, and intense variation in brightness is seen on the Sun. That is a solar flare. A solar flare occurs when magnetic energy that has built up in the solar atmosphere is suddenly released.
The amount of energy released is the equivalent of millions of 100-megaton hydrogen bombs exploding at the same time!
Solar Flares are a major source of cosmic radiation.

Solar Winds

The solar wind is a stream of charged particles released from the upper atmosphere of the Sun.
This plasma consists of mostly electrons, protons and alpha particles with energies usually between 1.5 and 10 keV.
The solar wind varies in density, temperature and speed over time and over solar longitude

Effects of solar winds

Solar winds affect the earth by the intense clouds of high energy particles that they often contains which are produced by solar storms. When these clouds make their way to the Earth in 3-4 days, they collide with the magnetic field of the Earth and cause it to change its shape. The particles then leak through the magnetic field of the Earth, causing radiation pollution.

Contributions

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Thank you

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