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GLOBAL COSMIC RISK ASSESSMENT STUDY (COSRAS) BY THE IAASS

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ABSTRACT

There is currently an effort in the U.S. to create a systematic review of various types of cosmic hazards — natural and manmade — that could create significant harm to vital infrastructure on which the U.S. citizenry now depends for commerce and daily life. This paper proposes that a systematic global assessment of critical infrastructure that is subject to cosmic hazards also be undertaken by the International Association for the Advancement of Space Safety in cooperation with the U.N. Committee on the Peaceful Uses of Outer Space and other potential partners such as the International Academy of Astronautics, COSPAR, and the International Space University.

The purpose of this study would be not only to identify the nature of these various global risks to vital infrastructure by cosmic hazards, but also to identify measures that might be undertaken to lessen these vulnerabilities. The cosmic hazards to be assessed would include coronal mass ejections, solar flares, changes to the earth’s protective magnetosphere and Van Allen Belts, asteroid strikes, electromagnetic pulses, orbital debris, as well as other hazards that the study team might identify.

1. INTRODUCTION

There is little general public awareness that we all inhabit a common spaceship that is hurtling through space at over 100,000 kilometer per hour. Further there is little comprehension that life could not exist on planet Earth were it not for a protective but thin atmosphere (proportionately less than the skin of an apple) plus a global magnetosphere that shields us from solar storms. These key protective systems, however, and particularly the geomagnetosphere and the Ozone layer that protect us from solar storms, shift in their protective shielding capabilities over time.

In the United States there are current efforts to enact a “Critical Infrastructure Protection Act” that would assess dangers to U.S. critical infrastructure that might come from solar storms, electromagnetic pulses (EMPs) or other natural or man-made space events that might threaten U.S. electrical grids, computer and telecommunications networks, key satellite networks, etc.

This paper sets forth a process whereby a global critical infrastructure protection study might be undertaken to systematically identify the nature and the possible severity of these hazards and in the second part of the study to characterize preventive or partially protective systems that could be employed to minimize these risks.

2. REVIEW OF THE VARIOUS TYPES OF COSMIC HAZARDS

The most difficult aspect of this ambitious global cosmic risk assessment study (COSRAS) is that there are so many different types of potential risks to be considered and that the scientific and engineering expertise needed for such a study are quite varied. Thus as a first step it might be most useful to identify the various hazards and then form teams suited to consider each of these separately before seeking to integrate the findings into a single unified report. The following sections thus sets forth the various risks that might be considered in a COSRAS global effort.

3. CORONAL MASS EJECTIONS

The most destructive solar events in terms of power and information networks as well as possible damage to satellites are coronal mass ejections. The Carington event of 1859 is the most well-known, but the Montreal event of 1989 and the Halloween solar storms in Scandinavia of 2003 are powerful reminders that not only are these event destructive, but their occurrence are with considerable frequency. The study would provide the latest information about the nature of CMEs, but what might be done to protect power grids, pipeline systems, Supervisory Control and Data Acquisition (SCADA), and vital satellite systems against such solar events. This study would be also give consideration to the earth’s weakening magnetosphere, the movement of the magnetic poles, and the reduced protective capability of the Van Allen Belts.[1]
4. **SOLAR FLARE**

The radiation from solar flares, especially during solar max, has the potential to do damage to satellites, electronic systems, and information networks that are vital to transportation systems, global commerce and safety, police, fire, rescue and defense related systems, as well as global commerce in general. The more intense flares can also give rise to genetic mutations to all life forms and also lead to elevated risks of cancer. Space missions such as the NASA Solar Dynamic Observatory (SDO) provides useful information on solar flares. Although solar flares and CMEs are closely related they involve different types of physical events (powerful radiation vs. ionic bombardment). The studies on CME, Solar radiation flares and changes to the geomagnetosphere are closely related and should be carried out in tandem.

5. **CHANGING PROTECTIVE GEOMAGNETOSPHERE**

Space probes by NASA and ESA in recent years have noted that the Earth’s protective geomagnetosphere that helps to prevent the worst damages that can come from solar storms is weakening. ESA’s Project Swarm [2] and NASA’s Magnetospheric Multi-Scale (MMS) Mission are designed to provide more information about the changes that are occurring as the Earth’s magnetic poles shift. These probes are also designed to solve the mystery of how magnetic fields around Earth connect and disconnect and in the process explosively release energy. This process is known as magnetic reconnection.[3] The fact that the Earth’s protective magnetic field has weakened and that the magnetic poles have shifted both downward from the North and upward from the South are of serious concern. The reduced protection from solar radiation and ion particles from the Sun’s coronal mass ejections seems to indicate that the world’s electrical grids, pipelines, satellites and communications networks are now at increasing risk. Even more importantly these risks seem likely to increase significantly in the decades immediately ahead. Understanding these changes in the Earth’s geomagnetosphere is one of the key objectives of this COSRAS effort on a global scale.

6. **ASTEROID IMPACT**

The NAVSTAR Global Positioning Satellite System include sensors that are designed to detect nuclear explosions, but they can also detect asteroid impact with Earth. This monitoring system has indicated that meteoroids, bolides and asteroids impact earth with four to ten times greater frequency that was previously thought to be the case. In short there is increasing data that show that asteroid threats are greater than previously thought.

Programs such as NASA’s NEOWise Infrared telescope, ground observatory observations and proposed new infrared observatories like NASA’s NEOCAM and the B612 Foundation’s Sentinel satellite can help identify potentially threatening asteroid impacts with earth. The current NASA guidelines of location asteroids that are 140 meters in diameter as set by the U.S. Congress has not yet been achieved. The fact that 30 meter asteroids traveling at sufficient velocity could be a city-killer and that there are perhaps 500K to a million of these size potentially hazardous asteroids (PHAs) represents a very large risk element. Clearly greater efforts to locate PHAs and dangerous comets and more consideration of planetary defense systems are needed. The UN authorized “NEO WARN” and the “Space Mission Planning Advisory Group” are significant steps forward but much more needs to be done.

7. **ORBITAL DEBRIS**

The increasing amount of orbital space debris is yet another concern that is being addressed by the Inter-Agency space Debris Committee (IADC) and the UN COPUOS Working Group on the Long Term Sustainability of Outer Space (as well as solar storms).

The projection by former NASA Scientist Don Kessler, who originally warned of the possibility of orbital debris cascading out of control seems to be an increasingly valid space threat concern. His current projection is that with the current environment that there will be a major on-orbit collision every ten years. This projection was made in advance of currently announced plans for new large-scale constellations by One Web, Planet Labs and others such as Space X. Clearly the risk of increasingly orbital debris is one of the key elements of this global COSRAS effort.

8. **CONCLUSIONS**

The above areas of potential cosmic risks are briefly summarized. The first step is to develop a clear statement of specific areas of cosmic risk to planet Earth and its flora and fauna in coming years. An international committee should be formed, perhaps initially within the IAASS, but also with other international partners that would agree to cooperate in this coordinated multi-year effort. The next step would be to form a coalition of or-
ganizations that would undertake this Cosmic Risk Assessment Study (COSRAS) with assigned responsibility for each one of the identified cosmic risks in step one of this effort. A coordinated plan would then need to be developed to undertake detailed studies in each of these areas in terms of not only of the projected level of risk, but also to devise concepts for protective or ameliorative programs that can lessen the level of these risks to infrastructure and to human, animal and vegetative life forms. It is proposed that the Executive Committee of the IAASS add this topic to its agenda for specific discussion as to whether the IAASS in cooperation with other international agencies could agree to formally undertake the COSRAS effort as outlined above.

9. REFERENCES


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