Space science and astronomy awareness

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Abstract

The aim of this paper is to create awareness of space science and the quest for the knowledge of the universe including both the physical and chemical processes taking place in it among African youths. This paper was presented at a seminar early 2013 at the Lagos State Government Ministry of Science and Technology annual Youth Programme in Lagos, Nigeria. Space science has been a major driver of technological advancement in virtually all areas of human life ranging from socio-economic transformation to human capital development.

Keywords: Space science; Awareness; Development.

Resumen

El objetivo de este trabajo es crear conciencia de la ciencia espacial y la búsqueda del conocimiento del universo que incluye tanto los procesos físicos y químicos que tienen lugar en ella entre los jóvenes africanos. Este documento fue presentado en un seminario a principios de 2013 en el Ministerio de Estado de Programa Anual de Ciencia y Tecnología en Lagos para Jóvenes, en Nigeria Gobierno de Lagos. La ciencia espacial ha sido un gran impulsor de los avances tecnológicos en prácticamente todas las áreas de la vida humana, desde la transformación socio-económica para el desarrollo del capital humano.

Palabras clave: Ciencia espacial; conciencia; desarrollo.

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I. INTRODUCTION

This topic is very apt and timely. This is because space science and astronomy education is increasingly becoming the centre of attraction in Africa [1]. Mckinnell [2] pointed out that space science is an important driver for scientific enquiry, knowledge creation, technology development, human capital development and a vehicle for stimulating interest, awareness, understanding and appreciation of science among the youth and the general public. Space science will help African countries to develop and use science and technology for socio-economic transformation and full integration into the world economy.

For according to Doherty [3], the leading socio-economic problems that continue to cripple much of Africa include hunger, extreme poverty, erosion of natural resources and natural disasters.

II. THE VASTNESS OF THE UNIVERSE

We will use the simplest definition of space in the context of our interest and purpose.

SPACE is the region beyond the terrestrial earth. Thus SPACE SCIENCE can be defined as the quest for space knowledge.

The universe is very vast, it contains so many galaxies. Our own galaxy, the MILKY-WAY is one of a system of galaxies spread over a region of space with a linear diameter of about 3 million light years. A LIGHT YEAR is the distance it takes light to travel in a year. The speed of light is about 1 billion km hr^{-1}. Multiplied by the number of hours in a year, a light year gives us the diameter of this aggregation of galaxies, and there are many others. Each galaxy is made up of several stars and each star with its planet.

We certainly cannot fully understand all that this vast universe contains. But even in the space between our planet and our own star – the sun, there's a lot we need to be aware of. It is interesting to know that the quest to know about the sun and other stars has been with us many centuries back. The holy writ contains activities of astrologers in the days of the Lord Jesus Christ.

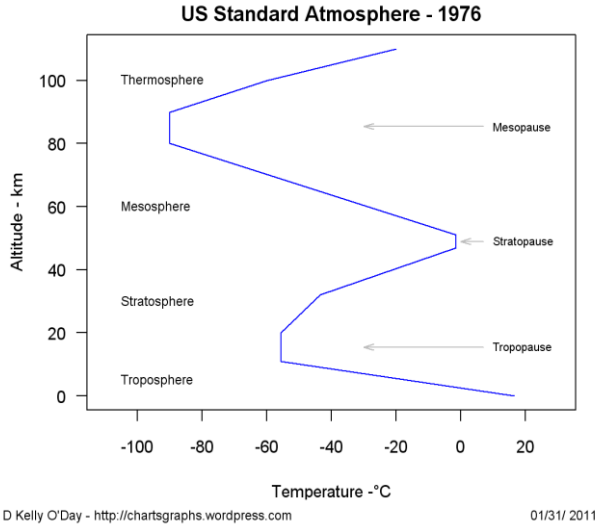

FIGURE 1. Variation of altitude with temperature in the atmosphere.

III. QUEST FOR KNOWLEDGE OF SPACE IN MODERN TIMES

The quest to conquer the space beyond the earth, in modern times, started with the flying of kite to measure the pressure above the earth surface. Next came the use of balloons to measure not only pressure but also temperature and humidity of the atmosphere. A look at the variation of altitude with temperature (Figure 1) reveals why it is thought that the higher you go, the cooler it becomes.

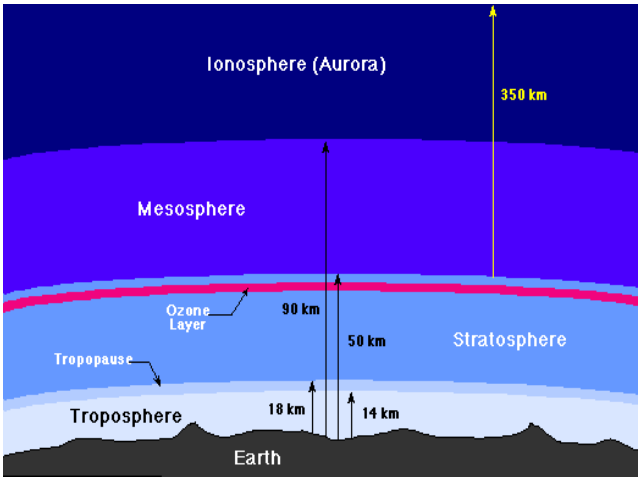

FIGURE 2. Layers of the atmosphere.

In the 19th century, observations of the variation of earth's magnetic field made Schuster and Stewart to suggest that current flow around 100km. In the early 20th century Marconi succeeded in transmitting radio signals across the Atlantic. Kennedy and Heaviside adduced the reason for this to the conducting layer in the upper atmosphere. The decisive experiments that confirmed the existence of this conducting layer are those of Appleton and Barnet and Breit and Tuve in 1925. While Appleton and Barnet used continuous waves, Breit and Tuve used pulse signal.

Thereafter the equipment of Breit and Tuve called the IONOSONDE was used to probe the upper atmosphere. But the ionosonde is limited to an altitude of 400 km.

In the mid 20th century, satellite was launched and placed right there in the atmosphere. We are familiar with natural satellite of our planet *i.e*. the moon which revolves round the earth in about 28 days.

When Arthur C. Clarke initially had the idea of an artificial satellite being put in the atmosphere, it was thought to be impractical. The geostationary satellite which is the most common of artificial satellites is the one that has the same period of rotation around the earth. This period determines its height by Newton's law of gravitational attraction. Satellites are used for different purposes like communication, monitoring of weather, observation or research, intelligence report. For example, the Canadian satellite ''ALOUETTE'' was launched in September 1962.

This satellite was placed in a nearly circular orbit at a height of just over 1000km [4] for the purpose of observing the upper atmosphere above 300 km.

IV. SOME OCCURENCES IN THE SPACE BETWEEN EARTH AND THE SUN

It is the purpose of this paper to intimate the youth with the benefits derivable in the vast space above us. For instance, in the space between the earth and the star closest to us i.e. the sun, there is a lot more than the visible ray and the warmth that emanate from it. And this star is just one of the aggregate of stars that make up our own galaxy i.e. the MILKY WAY. The X-ray and Ultraviolet ray responsible for the ionization of the upper atmosphere are radiations from the sun. This makes the upper atmosphere a conducting layer as a result of which HF radio signals are reflected to distant places. Also, from the sun flow streams of charged particles at an alarming rate. They are referred to as SOLAR WIND. When there is a sudden brightening of the sun, a phenomenon called SOLAR FLARE, there is a greater intensity of charged particles from the sun, the ionization of the upper atmosphere is affected and in the D region, absorption increases leading to fade out of radio signals.

The earth's magnetic field is increased suddenly, it decreases over about a period of 24 hours before returning to normal. These occurrences have attendant effects, some of which are damaging of satellites and disabling of power grid on the earth. This is more prominent during high solar activity. A magnetic index of observing solar activity is the sunspot that appears on the surface of the sun. The sunspots are sometimes many and sometimes few. The year in which the maximum numbers exist over a period of 11 years is known as the year of maximum SOLAR ACTIVITY. The

study of solar activity is necessary in order that warning can be given in advance.

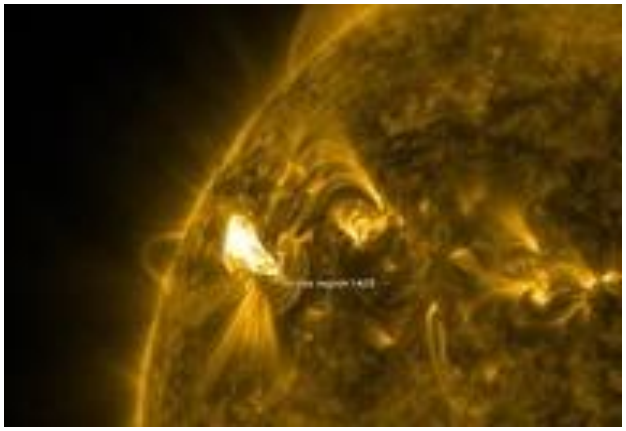

FIGURE 3. Huge solar flare of 2012.

In Figure 3 is shown the dissipative tendencies of solar flares. According to Joseph Kunche, a space weather scientist at the National Oceanic and Atmosphere Administration (NOAA) in the U.S, the massive solar flare eruption of March 6, 2012 is a solar tempest that was capable of interfering with satellites in orbits and power grids when on reaching the earth. Some high precision GPS users could also be affected. It is also capable of affecting communications on airplanes that fly over the polar caps. Powerful solar storms can be hazardous to astronomers in space.

The only palatable thing in the phenomenon of solar flare as seen in Figures 4 is the aurora. Aurora is a spectacular display of coloured lights in various complicated forms, often moving and changing rapidly [5].

Aurora actually means dawn, so named because it is of a reddish color like when the sun is rising at dawn. It occurs near the geographic poles. The one in the Northern hemisphere is called AURORA BOREALIS and the one in the Southern hemisphere AURORA AUSTRALIS. They are caused by burst of charged particles from the sun, the same phenomenon responsible for magnetic storms.

FIGURE 4. A predominantly red aurora astralis.

It is also possible that the occurrence of magnetic storm and other atmospheric events may be linked to the phenomenon of earthquakes. Pullinets *et al*. [6] carried out some research on the possible link between day-to-day variability of upper atmosphere and earthquake occurrences.

VI. BENEFITS OF SPACE SCIENCE

OTHER BENEFITS of space science include, but are not limited to:

1. Location of earth resources of food, water and marine life;
2. Use of satellites to monitor weather conditions. Weather forecast is made possible by the use of thermometer and barometer since there is a high correlation between pressure and weather. The instruments have to be placed in-situ i.e. in the place of occurrence which is in space. The use of satellites facilitate weather forecast.
3. Improvement of communication signals through the use of satellites. Signals which are obstructed by houses, hills, forests as well as the curvature of the earth are transmitted over a wider coverage area through satellites from where they are amplified and transmitted back to earth.
4. Tracking devices such as GPS devices are used to retrieve stolen automobiles. They can be built into items such as cell phones, laptops computers etc. The GPS is a satellite based navigation system. This system consists of 24 satellites in 6 orbital planes i.e. 4 satellites in each orbital plane. They operate in circular orbits at a height of about 20,200km and an inclination angle of 55^0. Each satellites orbit the earth twice in a day. In this way they can locate where each GPS in being used – that the satellite can actually find the location of the device anywhere in the world since the satellite is able to read the GPS signal;
5. Accurate survey of land. The coordinates of the corner points of a land is accurately determined;
6. Expansion of knowledge;
7. Exploration of the unknown;
8. Providing a driving force for technological advancement and hence improve earth based productivity;
9. Development and occupation of new frontiers with access to extra-terrestrial resources and unlimited energy;
10. Strengthening of national prestige, self-esteem;
11. Security: reconnaissance satellites are used for military/intelligence purposes such as observing enemy locations or troop movement [7];
12. Providing opportunity for international cooperation and understanding;
13. Helps to monitor how green house gases and pollutants deplete the ozone layer that shield us from fatal rays. This has led to a great deal of global warming. Oladiran (2010) reported a rise of about 0.80^0C in the temperature of earth surface. Rise in temperature is causing ice cap melting around the polar regions. As a result there is a rise of about 0.2 m in sea level. This in turn causes flooding. We are witnesses of the magnitude of flooding that occur in our nation last year;

14. Global Navigation Satellite Systems (GNSS), such as Global Positioning System (GPS) can be used to increase food security, manage natural resources, provide efficient emergency location services, improve surveying and mapping, and provide greater precision and safety in land, water and air navigation systems;
15. Observations of (i) birds capable of disrupting flight (Ajewole, 2011) (ii) ash plume hazardous to aircraft due to the 2010 eruptions of EYJAFJALLAJOKULL in Iceland. The eruption occurred beneath glacial ice. The cold water from the melting ice chilled the lava quickly causing it to fragment into very small particles of glass (Silica) and ash, which were carried into the eruption plume. Due to the extremely fine structure of the ash particles and the large volume of stream produced from the glacial meltwater and ash plume was rapidly sent into the upper atmosphere (Wikipedia).

VII. SUGGESTIONS ON THE WAY FORWARD

1. Awareness of space science should be created by different arms of government of African countries just as the ministry of Science and Technology of Lagos State of Nigeria is creating.
2. Astronomy/space science should be included in the curriculum of both primary and post primary education;
3. Training of professionals in astronomy/space science and related fields;
4. Astronomy and space science observatories which should be equipped with (a) magnetometer (b) ionosondes/digisondes (c) GPS receivers (d) powerful optical telescopes (e) back scatter and forward scatter radar (f) winds equipment.

   We cannot afford to continue to pay lip-service to the necessity of space technology.

REFERENCES

[1] Tessema, S. B., Tsidu, G. M., Wandemagegn, T. W., Bedri, K., Damtie, B., Yizengaw, E. and Fekade, G. A., *The experience of space science and astronomy education and research in Ethiopia*. AGU CHAPMAN Conference on Hemispheric Dependence of Space weather, Addis-Ababa, Ethiopia, `12 – 16 November, (2012).

[2] Mckinnell, L. A. 2012. *An overview of South African space agency*. AGU CHAPMAN Conference on Hemispheric Dependence of Space weather, Addis-Ababa, Ethiopia, `12 – 16 November, (2012).

[3] Doherty, P. H., *Scientific Exploration using GNSS systems in Africa*. AGU CHAPMAN Conference on Hemispheric Dependence of Space weather, Addis-Ababa, Ethiopia, 12 – 16 November, (2012).

[4] Rishbeth, H. and Garriot, O. K., *Introduction to Ionospheric Physics*, (Academic Press, New York, 1969).

[5] Ratcliffe, J. A. and Weekes, K., *The ionosphere*, In ''Physics of the upper atmosphere'' (J. A. Ratcliffe eds., Academic press, New York, 1960), Ratcliffe, J. A., *Sun, Earth and Radio: An introduction to the ionosphere and magnetosphere*, (World University Library, 1970).

[6] Pullinets, S. A., Kotsarenko, A. N., Ciraolo, L. and Pullinets, I. A., *Special cases of ionospheric day-to-day variability associated with earthquake preparation.* Adv. Space Res. **39**, 970 – 977 (2007).

[7] Ndu, F. O. C., Ndu, L. O. Olanrewaju, A. O. and Somoye, Femi. 2007. *Basic Science: An integrated science course for junior secondary school 1*, Longman Plc, Nigeria (2007).