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Measurements of ionization radiation during one week of continuous drizzle period occurred in São Jose dos Campos, Brazil in January 2023.

Inacio Malmonge Martin[1] and Mauro A. Alves[1]
1–Technological Institute of Aeronautics –ITA–Physics Department–São Jose dos Campos-Brazil

Abstract – Between January 4th and January 10th, 2023 there was a very specific system of continuous and light rains during the day and night with the quite same intensity. Ionizing radiation measured with a Russian-made tube Geiger prepared with simple associated electronics providing counts per unit of time (minutes). During the above-mentioned period, it can be noted that, from the measured data, the intensity of this ionizing radiation decreased and remained constant during these days. This phenomenon was observed for the first time in the region and its procedure are explained in this work. Measurements show that in this continuous period of drizzle, the exhalation of radon gas from holes in the Earth's surface is impaired.

Key words: ionizing radiation, tube Geiger, continuous drizzles period.

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I. Introduction

In the interface ground/air of the Earth's surface, ionizing radiation is mainly composed of radon gas, ground telluric radiation, primary and secondary cosmic ray radiation. However, it is difficult to separate over time the intensity of ionizing radiation emanating from each component as the energies overlap. Telluric radiation is given by ^{238}**U,** ^{235}**U,** ^{40}**K** and ^{232}**Th** that is constant for each region [1]. Radon gas coming from the disintegration of ^{238}**U** on the earth's crust to ^{226}**Ra** and ^{222}**Rn** arrives in the ^{214}**Pb**, ^{214}**Po** and ^{214}**Bi** isotopes, generating alpha and gamma radiation [2]. Primary cosmic radiation consists mainly of galactic and extragalactic protons and those from the Sun, with very high energy that interacts with the Earth's atmosphere producing Extensive Air Showers (EAS) [3]. The efficiency of this interaction is maximum when it occurs at altitudes between 13 and 17 km in the tropics, which form secondary cosmic rays with muonic, mesonic and neutronic components that reach the Earth's surface in the region [4]. These radiations cause health problems for civil aviation crew and passengers and are present at the beginning of the stratosphere called the Pfotzer maximum. However, this component contributes less to the concentration of radiation on the earth's surface. Another possible source of ionizing radiation in the Earth's lower atmosphere is produced by lightning strikes between earth-clouds, clouds-earth and clouds-clouds. X-rays, gamma rays, neutrons and beta particles are formed by the lightning cone [5]. Other sources of ionizing radiation are those produced in medical, dental and hospital clinics, but these are mainly controlled in small areas. The objective of this work was to monitor low energy of ionizing radiation and rainfall every minute in surface of São Jose dos Campos, São Paulo, Brazil. The rains when intense and with short intervals of time causes a sudden increase in the intensity of the measured ionizing radiation, in that place [6]. This effect of the increase in ionizing radiation can be explained by the increase, with intense and rapid rains, in the greeter presence of local radon gas.

II. Material and Methods

According to Tell, I., et al. [7], more than 60% of the radon found in indoor environments comes from the soil of the foundation and the soils around the building. Based on this experimental claim and knowing that radon decays into particles **α** followed by gamma radiation, both of energy lower than 10.0 MeV, in this work, it was decided to monitor the variation of ionizing radiation at the site [8].

For the measurements, a Geiger with a type **STS-6** pipe, made in Russia, was used and a Geiger with a type **J305** from Radiation D-v1.1 (Cajoe-Electronics Co., Ltd.) made in China, both powered with high voltage using a circuit from the Arduino system . The same circuit of the Arduino system was used to acquire the measures of both Geigers with a unit of time of one minute between each measure. Fig. 1 shows this system is monitoring the environmental ionizing radiation in a room of the Department of Physics of ITA (Technological Institute of Aeronautics). The laptop seen in Fig. 1 is required to record and save measurements during long-running series of about 6 months or longer duration [9].

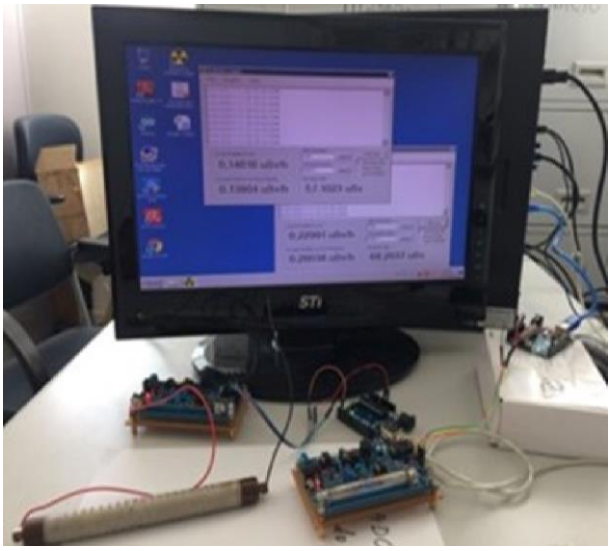

Fig. 1 - Russian and Chinese Geiger tube with Arduino electronics and PC (Personal Computer) (Author).

associated electronics of the photomultiplier power supply and data acquisition was bought at the Ludlum American Company with the channel versus energy calibration already performed. A laptop is attached to this system to record and save measurements in long series in the ITA experimental laboratory. In that part we considered only the STS-6 tube that is with better efficiency.

III. Results and Discussions

The series of ionizing radiation measurements integrated between 0.2 and 10.0 MeV during 04/01 and 18/01 in 2023, in intervals of minutes, with Geiger STS-6 can be seen in Fig. 2. In the Fig. 2 it shows measurements of ionizing radiation from 21 December 2022 to 18 January 2023 made with graph R. software. The same Fig.3 is made in the same period using software Origin 15. Both figures shown the week of continuous drizzles effects in ionizing low energy radiation.

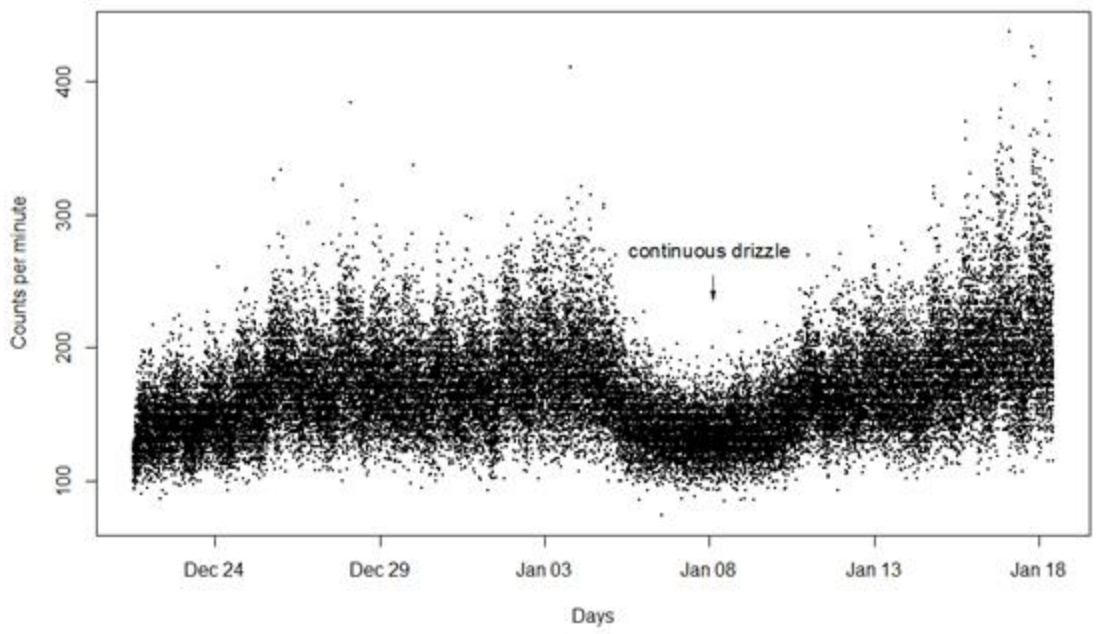

Fig. 2 – Variation of ionizing radiation from December, 21 of 2022 to January, 18 of 2023 made with software R (author).

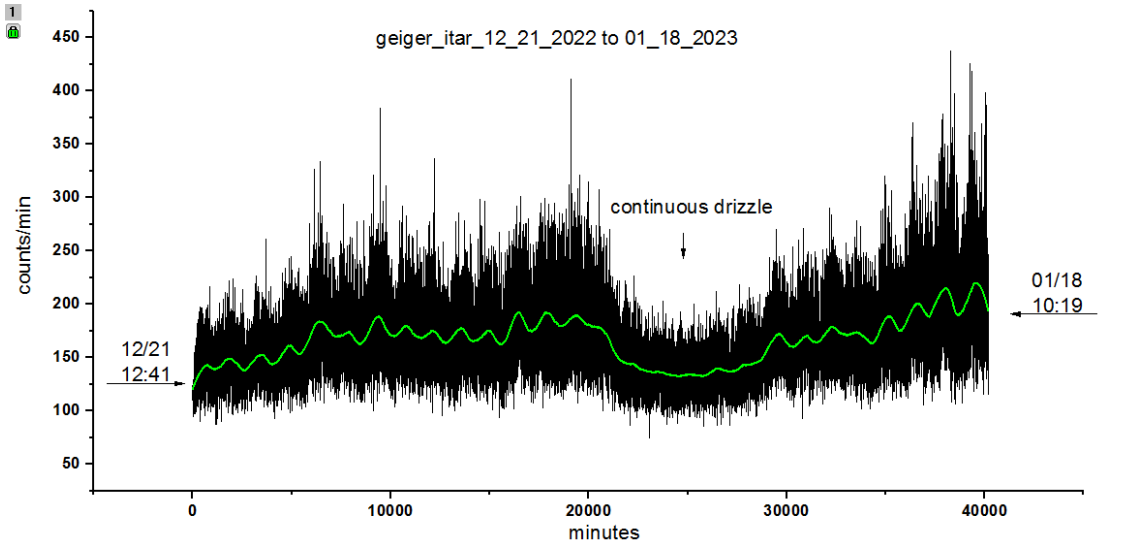

Fig. 3 - Variation of ionizing radiation from December 21 of 2022 to January 18 of 2023 made with software Origin 15(author).

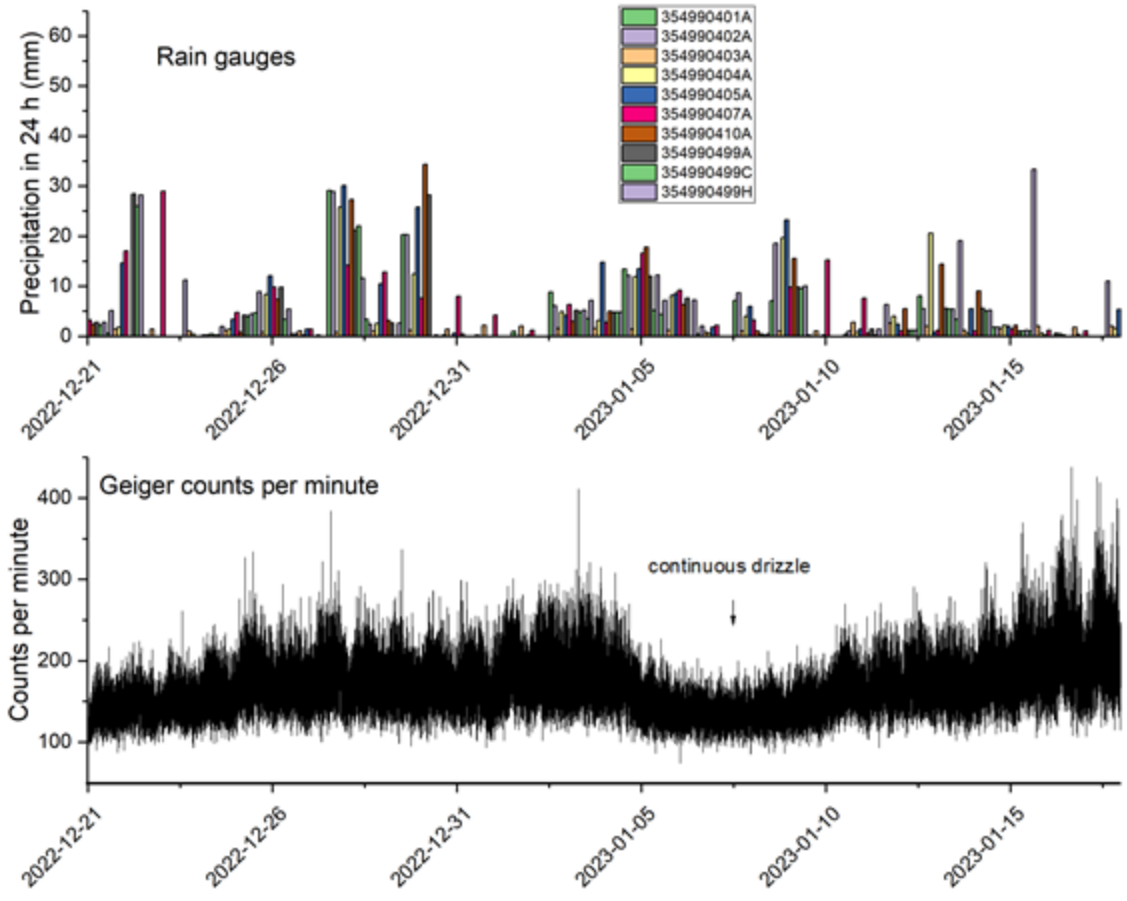

Fig. 4 – Geiger counts per minutes and precipitation in 24 hours mean of all 10 pluviometers near the region of ITA (author).

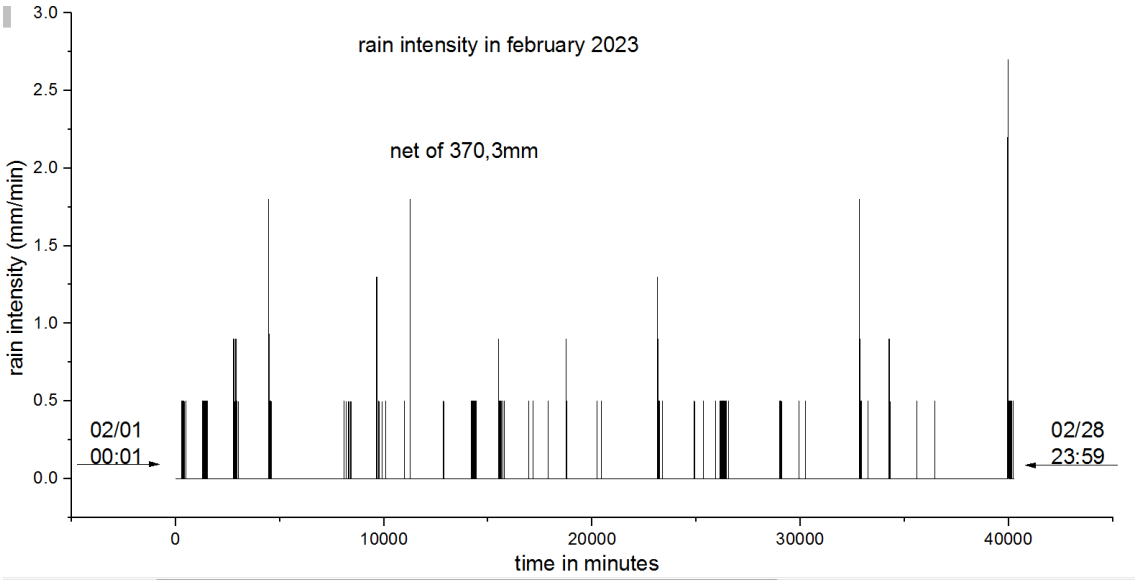

Fig.5 – Precipitation rain measurements in (mm/min.) near of Geiger counter system, (Author).

It can be seen in figures 3 and 4 above that in the period 04/01 to 12/01 January 2023 the Geiger counter does not show data containing (day/night) variation and presence of more intense or weaker Sun. The author's own visual observation confirms that these days were with uninterrupted drizzle and with the same weak intensity. This was the main reason for comparing data from local rain, regional rain and measurements of ionizing radiation at the site, during the entire time and at intervals of 1 minute.

IV. Conclusion

The measurement of local ionizing radiation close to the ground was monitored during the months of December 2022 until January 18, 2023 every minute at the ITA, DCTA campus in São José dos Campos, SP. Brazil. Also in the same place, the intensity of rainfall (mm/min) in the region and at the location of the measurements was monitored. It was also observed the intensity of rainfall each day in several existing stations in the regions of Vale do Paraiba. In the period from 01/04 to 01/12, 2023, in the region of the ITA campus, the sky was completely overcast without sun and with light rains with the same intensities during that period. The intensity of local ionizing radiation and its variation over time were analyzed, showing a decrease in intensity and remaining practically constant throughout this period. The analysis shows that the ionizing radiation coming from the radon gas at the site is interfered with by this type of drizzle. This observation was seen for the first time in all Brazilian territory.

Acknowledgments

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