^{7}Be concentration in air surface over a long period of monitoring in the city of São Paulo, Brazil

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Beryllium-7 ($T_{1/2}$ = 53.3 days), a cosmogenic radionuclide produced continuously in the upper atmosphere by cosmic ray spallation reactions with oxygen and nitrogen can be found in different compartments of the environment and its concentration is influenced by several factors, such as, temperature, precipitation, air velocity, air masses, altitude as well as latitude. It is quickly attached to aerosols after its formation, becoming a useful tool to study the dynamics of aerosol particles in the atmosphere. Long-term measurements of the spatial and temporal variation of ^{7}Be allow assessment of the influence of these factors (Valles et al, 2009).

Its subsequent deposition on the land surface, therefore, occurs as both wet and dry fallout, although it has been demonstrated that ^{7}Be fallout is primarily associated with precipitation. About 70% of the ^{7}Be is produced in the stratosphere and the remaining 30% in the troposphere. The amount produced in the stratosphere usually stays there for about 1 year before entering the troposphere, where it remains for about 6 weeks. Its transfer to the earth´s surface is achieved by gravitational settling and precipitation (Lozano et al, 2011).

Cosmic radionuclide concentration in air at ground level can vary greatly according to latitude and altitude and generally the values measured at middle latitudes are higher than those at northern latitude (Cannizzaro et al, 2004). The production rate of ^{7}Be changes according to variations in flux of cosmic rays caused by the 11-year sunspot cycle. This phenomenon is one of the major parameters that cause the variation in ^{7}Be concentration in surface air (Papastefanou and Ioannidou, 2004).

Data of ^{7}Be concentrations in rainfall, air surface, soil and sediments is very well reported in the Northern Hemisphere; however these same results are limited in the Southern Hemisphere. Therefore, the aim of this work is to present results of the ^{7}Be concentration in air surface at the city of São Paulo, Brazil over a long period of time, from October 2001 to December 2014.

During this period ^{7}Be concentration was measured every 15 days at Instituto de Pesquisas Energéticas e Nucleares (IPEN), São Paulo, Brazil. The IPEN campus is located approximately 10 km west from downtown of the city of São Paulo, which is situated on a plateau in Southeastern Brazil, 23°33'58.27"S and 46°44'14.82"W and an average altitude of 760m above sea level. The climate in the area is temperate tropical with dry period in winter and rainy in summer. The annual average temperature is 21.5°C, showing minimum and maximum of 12°C and 31.4°C, respectively. The annual rainfall in the city, for the studied period, averaged from 921 mm to 2088 mm.

In the framework of an environmental radiological monitoring program carried out at IPEN facilities, due to their routine gaseous effluents releases, atmospheric air is sampled at 1.0 m above the ground. The air is continuously pumped by a high volume sampler and forced to pass through cellulose filters with 47 mm diameter with retention efficiency near 100%, for the collection of particulates. The air volume sampled every 15 days corresponds to a volume about 3,000 m^{3}.

Measurement of ^{7}Be was carried out by non-destructive γ-ray spectrometry using the 477.61 keV γ-ray. A coaxial Be-layer HPGe detector with 25% relative efficiency, 2.09 keV resolution at 1.33 MeV and associated electronic devices were used, with live counting time ranged from 100,000 to 300,000 s. The spectra were acquired by multichannel analyser Ethernim and, for the analysis, WinnerGamma software was used. The minimum detectable activity limits (MDA) was 0.31 mBq m^{-3}. The activity was corrected for decay of ^{7}Be to the date of collection. The associated uncertainty for one sigma confidence ranged from 10% to 30% from the obtained results.

The results obtained were correlated to seasons, rainfall, temperature and sunspot number. ^{7}Be concentration in air surface showed a good agreement with data from Northern hemisphere of similar latitude, in spite of the city of São Paulo being situated in low latitudes of Southern hemisphere. The concentrations clearly displayed seasonal variations with greater values in spring and summer time and with a higher amount of precipitation.

References

Cannizzaro, F., Greco, G., Ranelo, M., Spitale, M.C. and Tomarchio, E. (2004) *J. Environ. Radioactivity* 72: 259-271.

Papastefanou, C. and Ioannidou, A. (2004) *Appl. Radiat. Isot.* 61:1493-1495.

Vallés, A., Camacho, A., Ortega, X., Serrano, I., Blásquez, S., Pérez, S. (2009) *J. Environ. Radioactivity*, 100, 102-107.

Lozano, R. L., San Miguel, E. G., Bolívar, R. P., Baskaran, M. (2011) *J. Geophysical Research*, 116: 1-14.