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Cosmogenic isotope ^{7}Be: A case study of depositional processes in Rio de Janeiro in 2008–2009

A.A. Pacini [a,b,c,*], I.G. Usoskin [d], H. Evangelista [e], E. Echer [c], R. de Paula [e]

[a] Department of Physics, University of Oulu, 90014 Oulu, Finland
[b] IP&D, University of Vale do Paraiba, 12244-000, São José dos Campos, Brazil
[c] National Institute for Space Research, 12227-010, São José dos Campos, Brazil
[d] Sodankylä Geophysical Observatory (Oulu Unit), University of Oulu, 90014 Oulu, Finland
[e] University of Rio de Janeiro State, 20550-013, Rio de Janeiro, Brazil

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Abstract

We present here an investigation of the depositional processes of ^{7}Be-carrying aerosols in the troposphere through an analysis of the isotope concentration variability measured at Rio de Janeiro (Brazil) during 2008 and 2009, with weekly resolution. By adopting a simplified description of the equilibrium scenario in the troposphere and combining our isotopic data with regional meteorological parameters and numerical CRAC:Be7 model of cosmogenic production, it was possible to quantitatively reproduce the observed seasonal variability and estimate the typical ^{7}Be-aerosols residence time in the lower troposphere ($t_r \sim 1$ day) as well as the washout coefficient for each season (wet: $\Lambda = 0.029$; and dry: $\Lambda = 0.023\ h^{-1}$). These results allowed us to discuss the origin of the seasonal patterns of ^{7}Be concentrations, indicating that the wet deposition modulation, caused by changes in the regional weather condition, is the most important forcing in both seasons. Even an anomaly in isotopic short-term measured variability can be explained when a detailed air-mass dynamic is considered. Our results indicate that anomalous events of tropospheric dynamic, such as occurrence of strong downward air flux, imprint information about air masses 3-D movement in the near-ground air ^{7}Be data, making ^{7}Be a useful tracer of its peculiar dynamics at local and synoptic scales in the troposphere. This study, limited to a single location and one year time interval, illustrates the potential of the method. A more detailed general study is planned for the future.

Keywords: Cosmogenic isotopes; Atmospheric transport; Tropospheric depositional processes

1. Introduction

The cosmogenic isotope ^{7}Be is a product of spallation of atmospheric oxygen and nitrogen by cosmic rays and has half-life of 53.2 days. Atmospheric concentration of this cosmogenic radionuclide is highest around 20 km above the sea-level and decreases with the altitude.

After its production in the atmosphere, ^{7}Be gets attached predominantly to small aerosols and follows their transport and deposition process (Lal and Peters, 1967). In particular it is involved in exchange between atmospheric reservoirs distinguishing between stratosphere and troposphere (Dorman, 2004). Therefore, temporal variations of the near-surface atmospheric ^{7}Be is defined by a combination of different processes including air mass dynamics, stratosphere–troposphere coupling and cosmic ray variations. With the recent development of numerical methods, production of the isotope in the atmosphere can be precisely modelled (Webber et al., 2007; Usoskin and Kovaltsov, 2008; Masarik and Beer, 2009). Therefore, measured variability of ^{7}Be in air can provide information on the local/regional air mass transport and stratosphere–troposphere coupling (Dorman, 2004). Many authors have

* Corresponding author at: Departament of Physics, University of Oulu, Finland. Fax: +358 8 553 1303.
E-mail addresses: pacini@univap.br, apacinis@mail.student.oulu.fi (A.A. Pacini).

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studied details of ^{7}Be atmospheric transport near the ground level at different sites (Japan: Yoshimori (2005), Yamagata et al. (2010); Spain: Azahra et al. (2003); Australia: Doering and Akber (2008); Greece: Papastefanou (2009); and others), and have found multiple sources of its temporal variations. The relative importance of those different sources of ^{7}Be modulation (air mass movement – vertical and horizontal, wet scavenging, strato-tropospheric air exchange and cosmic ray modulation) is different at different scales. Several studies (Liu et al., 2001; Heikkilä et al., 2008; Usoskin et al., 2009) showed that the isotope variations measured in the lower atmosphere in time scales larger than synoptic can be well explained by the combined effect of production and large-scale atmospheric dynamics. However, their model appeared unable to reproduce the observed variations on the day-to-day scale, likely because of the smearing of local-regional atmospheric processes in the atmospheric general circulation models (Schmidt et al., 2006). For time scales shorter than synoptic (4–7 days), the small-scale atmospheric dynamics produces a not negligible impact on the cosmogenic isotopic concentrations near the ground, masking the production signal (Aldahan et al., 2008).

Recently, Leppänen et al. (2010) studied the relation between the measured ^{7}Be concentrations in air and its calculated production in the atmosphere and showed that ^{7}Be production variations can affect the measured signal at near-surface air data only in sites at high latitude (low geomagnetic cutoff rigidity) with relatively stable regional weather system. In other location, the regional air transport dominates the ^{7}Be variability in the near surface air. This is the case at the Brazilian southeast coast, where our measurements were conducted, making the atmospheric ^{7}Be measured at this location a potential proxy for atmospheric conditions which drive wet and dry deposition processes.

The aim of the present paper is to identify the potential of the use of ^{7}Be variability measured near surface at a tropical site to study atmospheric drivers of the regional air mass transport at a (sub-)synoptic time scale. We perform a case study, using near-surface air sampling performed by our team between August 2008 and September 2009, at Rio de Janeiro, Brazil. The variability of the obtained ^{7}Be time series is studied here in association with the corresponding regional/local meteorological data as well as numerical models (^{7}Be production model and atmospheric transport model), allowing for discussion of the role of different depositional processes on the near-surface isotopic data. This is a case study performed for a single location and only one year of data to investigate whether a simple method based on tracing the regional air mass transport and regional precipitation data is able to satisfactory explain the observed data of ^{7}Be.

2. Data measurements and analysis

During the period from August 2008 to September 2009, atmospheric aerosols were sampled nearly continuously with weekly resolution at the University of Rio de Janeiro State (UERJ), located at Rio de Janeiro City, Brazil (22°33'S 43°18'W; sea level; vertical geomagnetic cutoff rigidity Pc = 11.2 GV). We have used a high-volume air sampler (PM10 Wedding & Associates) installed on the roof of a 30 m high building inside the UERJ campus. This site is an urban area (far from the Rio de Janeiro downtown around 6 km) protected from the open Atlantic sea spray by an orographic barrier formed by the montains of the Tijuca Forest. Atmospheric aerosols smaller than 10 μm were collected for 25 h/week on a glass fiber filter. The collection was performed during working days and limited to the time (5 h a day, from 11 am till 4 pm LT) with lower local concentration of traffic-related aerosols to avoid the filter saturation due to pollutant particulate. After the collection, filters were sliced and placed into a Canberra hyper-purity gamma-ray coaxial germanium detector with extended energy range (HPGe), shielded by a lead castle and an inner copper cover to reduce the background radiation level. The detector's relative efficiency is 20% with the energy resolution being 0.85–1.8 keV. The MCA-Maestro II (multi-channel analyzer / EG& G ORTEC) and MCC / IRD-CNEN-Brazil software tools were used to provide the gamma-ray spectral data in counts. The counts were converted into units of Bq/m^{3} after consideration of the detector's efficiency at the ^{7}Be photopeak (477.6 keV), the total air volume sampled during the week and the decay of ^{7}Be between the sampling and the measurement times. Meteorological parameters, including the atmospheric pressure, p and air temperature, T, we monitored by an in situ meteo-station. Regional and

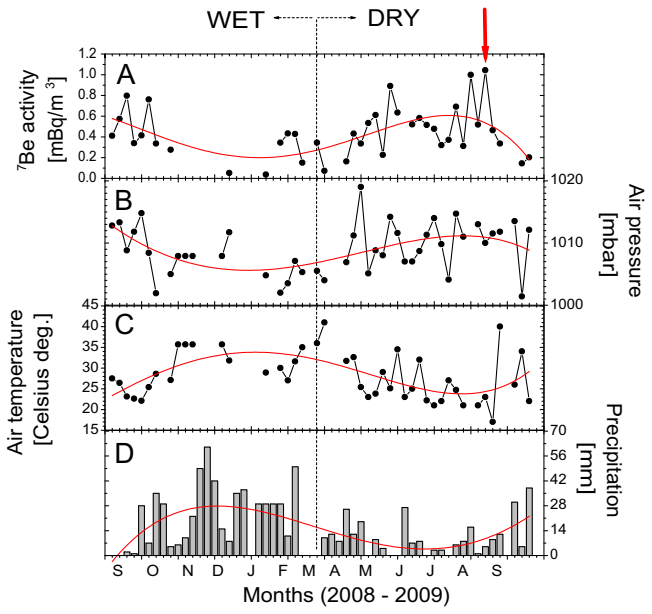

Fig. 1. Weekly data on near-surface air ^{7}Be activity (box A), local atmospheric pressure (box B), air temperature (box C) and precipitation in Rio de Janeiro (box D). A forth order polynomial fit was superimposed on each timeseries to show the data trend. The red arrow highlight the outlier datapoint studied in details in this work.

local precipitation data were obtained from the National Institute for Space Research (INPE) online database (available at the website: http://www.cptec.com.br).

Fig. 1 shows the ^{7}Be activity time series and the local meteorological data along with superimposed trends (represented by a forth order polynomial fit), allowing the discussion about the seasonal behavior.

3. Seasonal patterns in ^{7}Be data

Based on the seasonal modulation seen in Fig. 1, we separate the ^{7}Be data in two parts: data from wet season (September through March) and from dry season (April through August). Fig. 2 shows a histogram of the measured ^{7}Be activity values obtained for each season along with the best-fit normal distribution. One can see that the values are nearly normally distributed around the mean seasonal value ($Q_{DRY} = 0.5$ and $Q_{WET} = 0.3$ mBq/m^3) with a spreading within 2 standard deviations (indicated by the dashed vertical line). There is a single outlier, which appears beyond the 2σ limit during the dry season: $Q_{OUT} = 1.0$ mBq/m^3, highlighted by the red arrow in Figs. 1 and 2, which is studied in great details in Section 4.

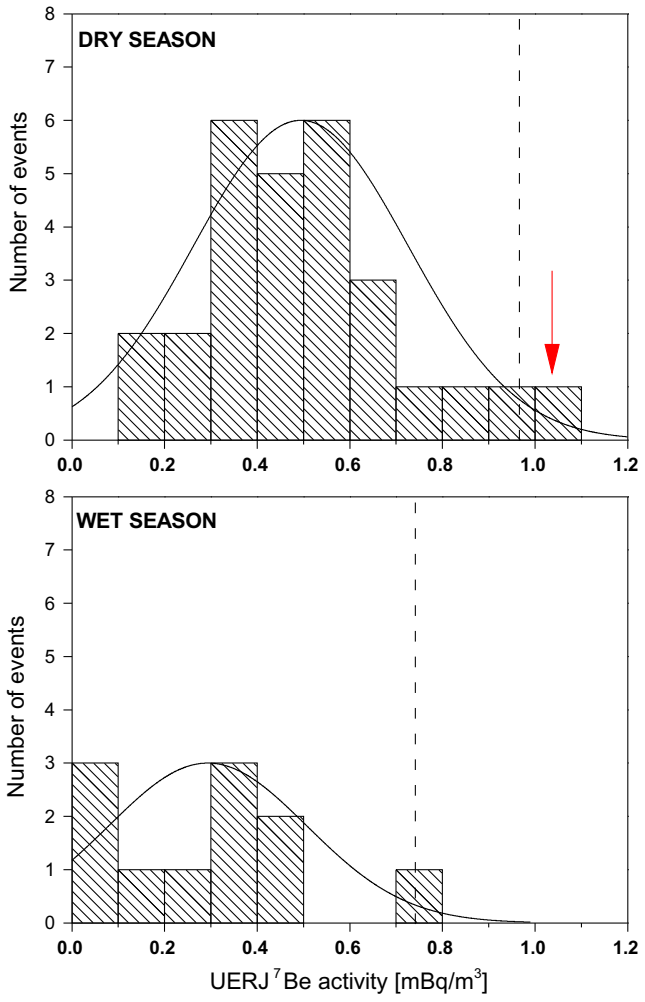

Fig. 2. Distribution histogram of ^{7}Be activity data for dry (Apr–Aug, upper panel) and wet (Sep–Mar, lower panel) seasons along with the best-fit normal distribution. The outlier value measured during the dry season is highlighted by the red arrow. The vertical dashed lines represents 95 percentile, or 2σ deviation.

Table 1
Bivariate correlation coefficients with the corresponding 68% confidence intervals for ^{7}Be data series and the local meteorological parameters.

	Pressure	Temperature	Precipitation
^{7}Be activity	0.26 ± 0.09	-0.27 ± 0.08	-0.36 ± 0.02

Table 1 shows the bivariate correlation coefficients for the ^{7}Be data series and the weather parameters (air pressure, air temperature and precipitation), with the corresponding 68% confidence interval.

We note that this outlier in ^{7}Be data was not associated with any meteorological anomaly, including a thunderstorm, storm or unusual precipitation event. In addition, possible spikes in the local meteorological parameters are not accompanied by any unusual variations in ^{7}Be (Fig. 1). This implies that ^{7}Be concentration is affected not by very local but rather regional effects.

From the mean measured activity values, we can estimate the local seasonal ^{7}Be concentration (N_{DRY} and N_{WET}, in atom/g), simply applying the radioisotope decay ($\tau_s = 6.6 \times 10^6$ s) and adopting the typical atmospheric density at the ground level ($\rho = 1200$ g/m^3) through the relation:

$$N = \frac{Q \cdot \tau_s}{\rho}. \quad (1)$$

Taking into account also the decay of ^{7}Be during the 5 days sampling period, we have found: $N_{DRY} = 2.77$ and $N_{WET} = 1.64$ *atom/g.*

In order to identify possible atmospheric drivers of this seasonal modulation, we made a simple quantitative estimate of the ^{7}Be concentration expected to be found, in each season, in the near-surface air based on the equilibrium condition: production *versus* losses. We considered two sources of ^{7}Be production in the lower troposphere (the *in situ* cosmogenic production and sedimentation of ^{7}Be atoms from the upper layer), and two removal ways (radioactive decay and depositional flux). The wet deposition process in the below-cloud tropospheric layer, considered from surface level up to 4 km, for removal due to collisions between the aerosol and the raindrops is generally represented using the washout coefficient (Λ in h^{-1}), empirically defined for standard conditions as (Apsimon et al., 1985):

$$\Lambda = 0.18 \cdot R^{0.8}, \quad (2)$$

where R is the precipitation rate, in mm/h.

Fig. 3 shows a scheme of the equilibrium model involved in our calculations. It consists of the upper tropospheric layer (called Layer I, from 4 km a.s.l. to the tropopause) and the lower one (Layer II). When the orography corresponds to high mountains, the layer II is omitted. In Layer I, we assume the equilibrium between the cosmogenic

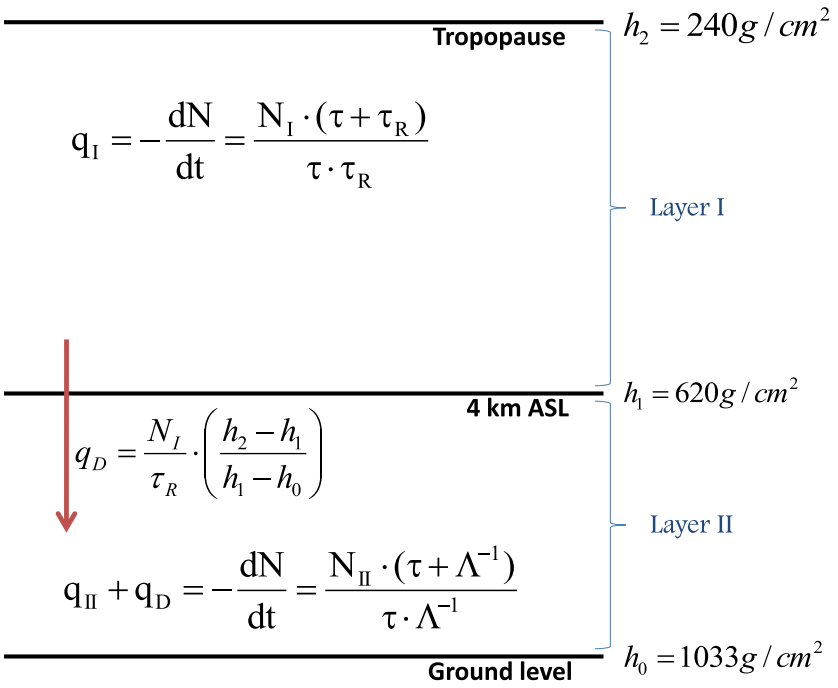

Fig. 3. Two-layer model adopted here for the study of tropospheric deposition processes involved in the ^{7}Be dynamics. The lower tropospheric layer (from ground level up to 4 km) is called here Layer II, and the upper layer (from 4 km up to the tropopause) is called Layer I. The indicated h_0, h_1 and h_2 values correspond to the atmospheric depth in each border. In each layer, the equilibrium condition between the ^{7}Be production and losses is indicated by the equations. A detailed description of the equations can be found in Section 3.

production and losses due to radioactivity decay and the depositional downward flux. The *in situ* cosmogenic production for each layer is represented by q_I and q_{II}, respectively, and in both cases the radioactivity decay was considered (represented by the ^{7}Be life time τ). The mean residence time in the troposphere, τ_R (28.8 days, according to Papastefanou (2009), was considered to compute the depositional flux of ^{7}Be atoms from the Layer I to the Layer II .

Using the distribution maps of precipitation accumulated along each season over the South America, we estimated the seasonal value of R ($R_{WET} = 0.102$ mm/h and $R_{DRY} = 0.076$ mm/h) which were applied to compute the related washout coefficients: $\Lambda_{WET} = 0.029\ h^{-1}$ and $\Lambda_{DRY} = 0.023\ h^{-1}$.

The q_I and q_{II} values (6.4×10^{-5} and 5.2×10^{-6} atom g^{-1} s^{-1}, respectively) were computed using the numerical production model CRAC:7Be (Usoskin and Kovaltsov, 2008) and represent the mean production rate of ^{7}Be in each layer between 0 and 60 degrees of latitude. This latitudinal range was chosen because Rio de Janeiro is located at the convergence area of two atmospheric circulation cells (Hadley and Ferrel), receiving influence from a wide range of latitudes.

The depositional rate from Layer I to Layer II, $q_D = 1.6 \times 10^{-5}$ atom g^{-1} s^{-1} was computed as shown in Fig. 3. Here we neglect more detailed consideration of the atmospheric horizontal diffusion, but for the aims of this paper our simplified assumptions is sufficient. Comparing the values obtained for both ^{7}Be production and depositional rates in Layer II, one can see that the depositional process is the dominant source of ^{7}Be atoms in the lower troposphere, since q_D is 3 times larger than q_{II}. Considering the equilibrium condition in Layer II (see Fig. 3), it is possible to estimate the seasonal values of ^{7}Be concentration in the lower troposphere expected in this simple model. We found that $N_{II}(DRY) = 3.2$ and $N_{II}(WET) = 2.6$ atoms/g. Converting these values in units of Bq/m^3 (following Eq. (1)), we have found the activity expected from our theoretical approach to be $Q^*_{DRY} = 0.6$ and $Q^*_{WET} = 0.5$ mBq/m^3. We note that this purely theoretical expectation, not normalized for the actual measurements, is significatively close to the measured activities within 1 standard deviation (see Table 1).

By comparing the computed ^{7}Be production rates in the Layer II (q_{II} and q_D) with the measured seasonal ^{7}Be concentrations ($N_{SEASONAL}$, that could be N_{DRY} or N_{WET}), one can also estimate the residence time (t_r) of the ^{7}Be-carrying aerosols in the lower troposphere. For that, the equilibrium condition between ^{7}Be production and losses should be considered, through the relation:

$$q_{II} + q_D = \frac{N_{SEASON} \cdot (\tau_s + t_r)}{\tau_s \cdot t_r}. \quad (3)$$

The residence time found for each season (wet: 0.9 day; dry: 1.5 day) can be compared to the ^{7}Be removal time due to washout process (calculated from the Λ coefficients), which is smaller than 2 days in both cases. These values are much smaller than the ^{7}Be radioactive decay time, showing that wet deposition is the dominant ^{7}Be losses process in the lower troposphere, even during the dry season. This

is in agreement with the simulation results of Field et al. (2006) that wet deposition is dominant for ^{7}Be in this region. However, with this simple approach we are not able to disentangle different wet deposition models (e.g., Liu et al., 2001; Rastogi and Sarin, 2008). Another simplification comes from the fact that our precipitation data are related to the land but are extrapolated to the ocean region. A possible effect of sea spray on the deposition in ocean and shore regions is also neglected (e.g., Arimoto et al., 1987).

Thus, the seasonal variation observed in ^{7}Be activity data collected in near-ground air in Rio de Janeiro was well reproduced by the simplified numerical approach presented in this section. Although the model is very simple and neglects many details, the results obtained indicate that the basic assumptions made for the calculations are valid, and the washout mechanism is the most important forcing to the ^{7}Be seasonal modulation at the studied site.

4. The outlier

There was, however, an outlier measurement value during the dry season (Q_{OUT}, indicated in Figs. 1 and 2) that can not be explained by the above two-layers equilibrium scenario. For this case, a detailed study was performed aiming to infer the contribution of air-masses dynamics to this peculiar ^{7}Be activity value. We have investigated the origin of the air-masses reaching Rio de Janeiro during the sampling period corresponding to the outlier datapoint corresponding to week 34 of 2009. For that, we have used the NOAA/HYSPLIT transport and dispersion model (Hybrid Single-Particle Lagrangian Integrated – available at http://ready.arl.noaa.gov), which computes air-mass back trajectories starting at any tropospheric height, with hourly resolution. The use of HYSPLIT for ^{7}Be-aerosols tracing was validated, e.g., by Yamagata et al. (2010). We have used the default meteorological dataset of HYSPLIT which is the NCAR / NCEP reanalysis database to perform a 120 h back tracing for each of the five collection days (starting at 00 UTC of the specific collection day and at UERJ's location) during the correspondent week. This time limit (120 h) for the back trajectories was chosen after a test of the robustness of the HYSPLIT model results for the Rio de Janeiro location. For that, we have compared the back tracings obtained in same conditions (starting time and coordinates) but for different starting altitudes (500 m, 1000 m and 2000 m), and we found that at this time scale, the results obtained diverge from each other. Although this back-tracing period is much shorter than the ^{7}Be life-time, it is in fact longer than the local residence time estimated above. Thus, we expect that the 5 day back-tracing period is sufficient for our purpose.

We consider the starting point of the back-trajectory of the air mass located at the top of the sampling site atmospheric boundary layer (1000 m).

The results obtained with HYSPLIT model (latitude/longitude and altitude of the air-masses) are shown in Fig. 4, along with the precipitation map for the corresponding collection week.

One can see that during those collection days, the air-masses which reached Rio de Janeiro came from different areas, both continent and ocean ones. This result reinforce the suggestion of a peculiar conditions during the outlier week sampling, because, for this site, the air masses comes preferentially from the Atlantic Ocean in both seasons (from the equatorial region, during the wet season, and from the polar region, during the dry one), and usually travels less than 15 degrees in lat/long.

In two anomalous cases observed during the outlier week sampling (indicated in Fig. 3 by black and green colors), the traced air-masses came from latitudes higher than 40°S and from altitudes higher than 5 km.

For every hourly sampled location of the air back-tracing obtained with HYSPLIT model, we have computed the ^{7}Be production rate using the numerical production model CRAC:7Be (Usoskin and Kovaltsov, 2008). The input parameters for the model are the local geomagnetic cutoff rigidity (Pc [GV]), the atmospheric depth corresponding to the current location (h [g/cm^2], which is linearly proportional to the barometric pressure p) and the solar activity function (ϕ[MV]), which accounts for the temporal variability of the production. Using the HYSPLIT results for each point along the back-trajectory of the air-mass, we could prepare a set of input parameters for CRAC:7Be model, following two main steps:

- Calculating the Pc values for each geographical coordinate of the air-mass back-trajectory according to the eccentric dipole approximation following the algorithm described in the Appendix of (Usoskin et al., 2010), and using the IGRF-10 coefficients (http://www.ngdc.noaa.gov/IAGA/vmod/igrf10coeffs.txt);
- Adopting $\phi = 300$ MV as a typical value for solar minimum period (according to Usoskin et al. (2005), since for the studied period (2008-2009) the solar activity cycle was still on its minimum.

From the computed ^{7}Be production rate q_i in each i hours of the air mass trajectory (from 1 to 120), we have calculated the correspondent concentration (N_i in atom/g) as $N_i = q_i \cdot \Delta t$, where Δt is the total time that the air-mass spends at the same position: considered here as 3600 s. After that, we calculated the total ^{7}Be amount, N'_j (in atoms/g), expected to be found in the filter due to the arrival of the traced air-mass on the specific collection day j (j stands for the collection day, from 1 to 5). For that, we applied the radioisotope decay ($\tau_H = 1842.67$ h) and the additinal losses rate, T_L (in hours). The value of T_L was considered as Λ_{DRY}^{-1} for the periods the air-masses spent in Layer II (where the washout process is dominant), and as τ_R when the air-masses were in Layer I (where the deposition process is dominant). The calculations can be summarized in the following sum:

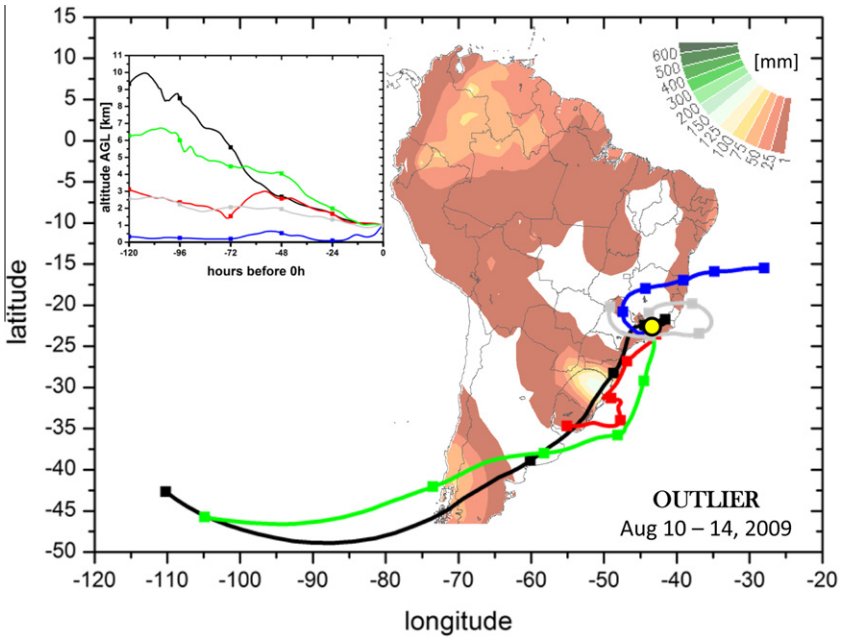

Fig. 4. Back-traced paths of the air-masses that were related to the outlier data points are shown along with the distribution map of accumulated precipitation over the South America during the correspondent period. Different colors denote air sampling days: Gray, blue, green, red and black for the first through fifth day, respectively. The tropospheric altitudes of the back-tracing are shown in the incut. The yellow circle indicates the Rio de Janeiro position. The color scale (upper right corner) is related to the precipitation level (in mm of rain).

$$N'_j = \sum_{i=0}^{120} N_i \cdot exp\left(-\frac{(120-i)\cdot(\tau_H + T_L)}{\tau_H \cdot T_L}\right). \quad (4)$$

Note that the sum starts from $i = 0$, because we are considering the ^{7}Be concentration found in the equilibrium scenario before the beginning of the traced air-mass movement. The N_0 value was adopted according to the altitude position of each air-mass when the traced movement was initiated. For those which were in the lower troposphere (between the ground level and 4 km), $N_0 = N_{DRY}$, and for the two air-masses which came from Layer I (the back-traced paths in black and green in Fig. 3), $N_0 = N_I$. It is important to note that, when the air-masses crossed the hypothetical border between Layer I and Layer II, the dilution term was applied, as described in the previous section.

Thus, considering the mean ground-level local density (ρ) and applying the radioactivity decay occurred during the sampling period, it was possible to compute the expected ^{7}Be activity, Q^*_{OUT} [in Bq/m^3], as a sum of the total amount reaching the filter during the five collection days:

$$Q^*_{OUT} = \frac{1}{5\cdot\tau_D}\cdot\sum_{j=1}^{5}\rho\cdot N'_j\cdot exp\left(-\frac{(5-j)}{\tau_D}\right). \quad (5)$$

Note that the decay factor is expressed here in days, $\tau_D = 76.8$ days.

The computed value (Q^*_{OUT}=2.0 mBq/m^3) is 2 times larger than the measured one (Q_{OUT}=1.0 mBq/m^3). This difference can be associated with the rough assumptions presented in our numerical approach (like the adoption of the dilution coefficient instead of a more realistic diffusion parameter). Besides that, our results indicate that the role of the air-mass dynamics in the anomalous ^{7}Be activity measured in near-surface air samples is important. In this outlier case, two air-masses that reached the filter during the collection week came from the south of the continent, and rised up to 9000 above the ground (see Fig. 3) induced by the orography of the Andean Cordillera. This fact explains the high ^{7}Be activity found on that week, since the cosmogenic production is very efficient at high altitudes and high latitudes, and the removal rate at higher altitudes is less efficient compared to the washout process occuring in the lower troposphere (in which the most part of the air-mass dynamic occur).

The ^{7}Be activities computed in this work (Q^*) are compared to their corresponding measurements (Q) in Table 2.

Table 2
^{7}Be activity (units of mBq/m^3) for each sampling period: measured Q and expected Q^* from the model considered in this work.

	WET	DRY	Outlier
Sampling period	09/2008–03/2009	08/2008 & 04–08/2009	10–14/08/2009
Week number	5–30 (2009)	0–4 (2008) & 31–56 (2009)	34 (2009)
Q [mBq/m^3]	0.3 ± 0.2	0.5 ± 0.2	1.0 ± 0.1
Q^* [mBq/m^3]	0.5	0.6	2.0

5. Discussion and conclusions

The atmospheric ^{7}Be activity measured along one year at Rio de Janeiro, Brazil, shows a seasonal variability, with high values during the dry season and low values during the wet season (see Figs. 1 and 2). These seasonal patterns can be reproduced by a basic theoretical approach, based on a simplified description of the depositional process of ^{7}Be in the troposphere (Fig. 3). For that, we considered a simple two-layer model to study the ^{7}Be equilibrium (production versus losses) in the troposphere, and combined meteorological parameters with a numerical CRAC:Be7 model of cosmogenic production. To explain one anomaly measured in ^{7}Be short-term variability patterns, we combine the production model with an atmospheric transport model (HYSPLIT). Our results show that in this tropical location, the depositional flux and the air-mass transport are the dominant sources of ^{7}Be in the lower troposphere, overwhelming changes on the *in situ* cosmogenic production. This is in accord with earlier studies for other regions (e.g., Rastogi and Sarin, 2008; Leppänen et al., 2010).

Considering a simple two-layer tropospheric model, local/regional meteorological parameters and computed isotope's production rate, we empirically estimated the typical ^{7}Be-aerosols residence time in the lower troposphere ($t_r \sim 1$ day) and the washout removal time for each season (wet: ~1.4 days; and dry: ~1.8 days). This roughly explains the seasonal patterns of ^{7}Be concentrations, indicating that the wet deposition is the most important forcing of the near-ground atmospheric ^{7}Be seasonal variability, even in the dry season period. This is in agreement with other earlier studies, both empirical focused on different tropical regions (Arimoto et al., 1987; Rastogi and Sarin, 2008) and global climate model simulations (Liu et al., 2001; Field et al., 2006; Heikkilä et al., 2008; Usoskin et al., 2009).

This study is limited to a single location and only one year of data collection. The model employed is very simple and neglects many detailed processes as discussed in Section 3. Notwithstanding, the fact that this simplified model, considering only the precipitation and short-scale air mass tracing, is able to satisfactory explain the observed ^{7}Be variations, suggests that the dominant processes are caught correctly. Of course, full detailed global or regional modeling is needed to understand the details, but this confirms a possibility of making quick-n-dirty rough estimates based on the measured ^{7}Be in air (at least for the East coastal Brazil).

Thus, we can conclude that ^{7}Be activity measured in near-surface at Rio de Janeiro, Brazil, mainly reflects the regional precipitation condition, but is also sensitive to changes on the air-masses patterns, could been used as an indicator of the occurrence of anomalous events of tropospheric dynamic.

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