Influence of mineral dust on changes of ^{7}Be concentrations in air as measured by CTBTO global monitoring system

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The International Monitoring System (IMS) developed by the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) is a global system of monitoring stations, using four complementary technologies: seismic, hydroacoustic, infrasound and radionuclide. Data from all stations, belonging to IMS, are collected and transmitted to the International Data Centre (IDC) in Vienna, Austria. The radionuclide network comprises 79 stations, of which more than 60 are certified. The aim of radionuclide stations is a global monitoring of radioactive aerosols, radioactive noble gases and atmospheric transport modeling (ATM).

Beryllium-7 (^{7}Be) is one of key radioactive isotopes which concentration is measured on a daily basis by CTBT particulate stations. ^{7}Be is a natural radionuclide ($T_{1/2}$=53.3d), originating from the interaction of cosmic rays with terrestrial atmosphere. The amount of ^{7}Be that reaches the surface depends on the production rate which is a function of latitude, altitude and solar activity. ^{7}Be attaches predominantly to aerosol particles in the submicron size range (e.g. Ioannidou et.al, 2005) and is removed from the atmosphere by dry and wet fallout. Recent studies indicate that the effect of the air masses originated over Sahara on the activity concentration of ^{7}Be aerosols depends on the altitude at which the air masses arrive over a certain location (e.g. Piñero-Garcia et al., 2015). In case of arrival at high altitudes (≥ 3000 m), Saharan intrusions lead to increase in the activity concentration detected in the samples; in case of altitudes near the boundary layer (≤1500 m) the activity concentration of ^{7}Be decreases.

This study investigates the influence of mineral dust on changes in ^{7}Be concentrations in atmosphere. For that purpose, data collected during 2009-2015 for the IMS radionuclide station, MRP43 (see Figure 1), located in Nouakchott, Mauritania were used. This station is often affected by the mineral dust transported from Sahara, especially from the Bodélé depression in The Northern Chad, which is considered to be the most vigorous source for dust over the entire globe (Koren et al., 2006). Figure 1 illustrates such a situation.

To ensure that changes observed in ^{7}Be concentrations are caused only by the mineral dust, for the further analysis only data collected during dry periods (no precipitation) and originated over the Bodélé depression, as indicated by the analysis of air mass backward trajectories provided by FLEXPART, were selected. FLEXPART (e.g. Stohl et al. 2005) is a Lagrangian particle diffusion model, designed for calculating the long-range and mesoscale dispersion of air pollution assuming point sources.

To quantify the effect of dry deposition data collected by IMS stations affected by mineral dust were thoroughly analyzed.

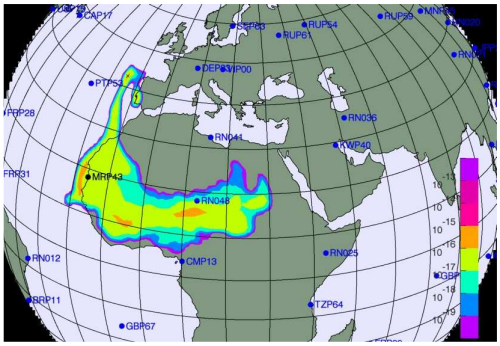

Figure 1. Air masses which arrived on 29 June 2010 at IMS station in Nouakchott, Mauritania (MRX43) needed only 4 days to transport mineral dust from The Bodélé depression in The Northern Chad.

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