Long term measurements or radioactive tracers in Athens

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Since March, 2011 an atmospheric sampling program by means of High Volume samplers has been established at Demokritos urban background station (GAW-DEM, 2007) located at the North East part of the Greater Athens Metropolitan Area and at an altitude of 270 m.a.s.l. Measurements were conducted using a six-stage high volume cascade impactor (nominal 50% cutoff sizes: 10.1, 4.2, 2.1, 1.4, 0.73, 0.41, 0.05 μm). Concentrations of radioisotopes were measured after weekly sampling. Each sample was collected after approximately 84h of sampling (Air Vol. 2500 m^3) while since September 2014, continuous weekly sampling was applied (Air Vol 4600 m^3). Cellulose Filters and impaction substrates were used (Whatman), cut in a diameter of 70mm. Gamma-spectroscopy was conducted and the radioisotopes of concern were detected by their photopeaks. The detector used is a coaxial HP 30% Germanium detector, with energy resolution of 1.93keV for ^{60}Co (1332keV) and a 8k multichannel analyzer, with energy resolution 0.25 keV/channel. The spectra produced, were then analyzed using the software Interwinner 4.1. In this study, ^{137}Cs and ^{40}K concentrations' time series and parameters from their calculated size distributions were studied with respect to atmospheric conditions during the last 4 years.

^{137}Cs is a technogenic radionuclide, with half life of 30.17y, and is of great concern for long- and short-term exposure. Traces of ^{137}Cs are originating from fallout, from atmospheric nuclear weapon tests, and nuclear accidents e.g. Chernobyl, Fukushima. ^{137}Cs levels depend on meteorological conditions and long range transport. Sahara dust events tend to carry soil particles with attached ^{137}Cs, originating from global fallout (Masson et al., 2010). This can easily lead to increased airborne activity levels something which is visible in the graph of ^{137}Cs time series (*Figure 1*). High peaks have been identified to coincide with air mass transport from North Africa. Air mass origin was calculated by means of 7 days HYSPLIT back trajectories. Typical activity levels are below the detection limit ($6.3*10^{-4}$ mBq/m^3). However, large quantities of Sahara dust soil with higher burdens can increase ^{137}Cs levels.

^{40}K has a half life of $1.248 \cdot 10^9$ yr. The ambient levels are very low compared to the literature (Korontzi, S., 2006) something that is visible in the time series (*Figure 2*), but it has also some maxima over the years. These maxima (> 0.1 mBq/m^3) are due to the ^{40}K's origin, which is local or regional biomass burning, and soil dust. Studies so far reveal that croplands currently occupy about 17 million km^2. At the global scale, agricultural fire activity shows two peaks, the first occurring during April to May, and was associated primarily with burning in the croplands of Eastern Europe and European Russia and the second in August from burning mainly the croplands across central Asia and Asiatic Russia. During spring and summer months the high ^{40}K concentrations are associated with air masses from the NE, carrying aerosol from biomass burning most probably agricultural fires in Eastern Europe/Ukraine. Also high ^{40}K concentrations occur during Sahara dust events identified with relatively high ^{40}K activities.

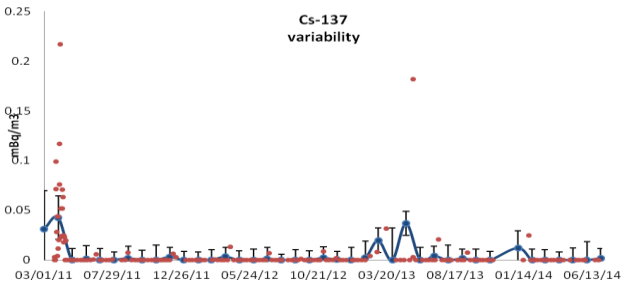

Figure 1. ^{137}Cs time series; blue line depicts monthly running mean, red dots depict weekly values.

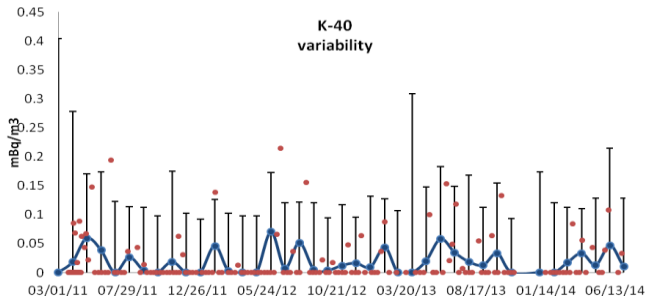

Figure 2. ^{40}K time series; blue line depicts monthly running mean, red dots depict weekly values.

References

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