Low-level reference size distributions of ^{137}Cs and naturally occurring radionuclides at a low dusty rural site, France

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The size distribution of airborne particulate radionuclides is of major concern since it influences the inhalation dose (Haddrell, 2015). Additionally it allows better assessment of radionuclide dry deposition velocity used for modelling purpose (Zhang 2001). Cesium-137 originates from global fallout (after the nuclear test era) and accidental releases (Chernobyl, Fukushima). It is still measurable at trace levels in the atmosphere, on the European-wide scale. Thanks to its rather long half-life (30.05 y.) and a strong affinity with clay minerals in top soil layers, it can be resuspended by wind erosion or dusty activities as well as biomass burnings after integration in plants similarly to potassium. Previous work has focused on the size distribution of radionuclides in the vicinity of nuclear facilities or after nuclear accident (Mala, 2013) but there is a lack of information about what can be expected in terms of background size distributions that could help assessing the impact of an accident release or routine release.

A field study was performed in May 2015 using a battery of 5 high-volume impactors. Each one was equipped with 5 stages having decreasing cut-off points at 7.2; 3.0; 1.5; 0.95 ; 0.49 µm plus a back-up filter (<0.49µm) and was running at a flow rate of about 67 m^3/h. The place was chosen for its low dust level since it corresponds to an astronomic observatory (Observatoire de Haute-Provence, OHP) located in a rural area, southeast of France. Aerosol sampling and dust measurements were performed at 2.8 m above the ground, respectively on a flat terrace and on a mast. Sampling lasted for 15 days. The average Particulate Matter dust parameters (PM_{10} and $PM_{2.5}$) were 12.9 and 6.8 µg/m^3, respectively. After integration of all stages, the total ^{137}Cs average concentration was 0.22 µBq/m^3. All samples were measured on a well-type detector installed in the underground measurement laboratory of Modane (LSM) dedicated to ultra-trace levels.

The activity deposited on the backup filter represented 43% of the total airborne activity. This is rather surprising since it is usually considered that most of the ^{137}Cs in the atmosphere comes from resuspension that produces coarse particles. Apart from the backup filter the rest of the distribution shows an increasing trend with the aerosol diameter. Computation of the Activity Median aerodynamic Diameter gave 0.94 µm. The coarse fraction (i.e. > 7.2 µm) represents only14% of the total ^{137}Cs activity. In spring, many plants are emitting pollens thus a deeper insight onto the aerosol type and content remains to be investigated to check for the presence of pollens or even secondary biogenic aerosols.

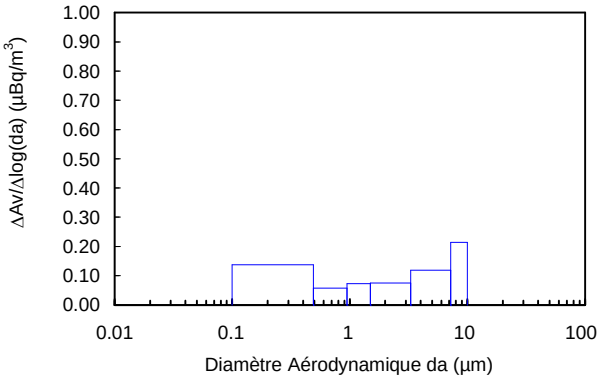

Figure 1. ^{137}Cs size distribution

Reference size distributions for naturally occurring radionuclides such as ^{7}Be, ^{40}K, ^{22}Na, ^{228}Ac, ^{234}Th and ^{210}Pb will be also presented.

References

Leiming Zhang, Sunling Gong, Jacob Padro, Len Barrie. A size-segregated particle dry deposition scheme for an atmospheric aerosol module. Atmospheric Environment 35 (2001) 549-560.

Allen E. Haddrell, James F. Davies, and Jonathan P. Reid. Dynamics of Particle Size on Inhalation of Environmental Aerosol and Impact on Deposition Fraction. Environ. Sci. Technol. 2015, 49, 14512−14521.

Helena Malá, Petr Rulík, Vera Becková, Ján Mihalík, Miriam Slezáková. Particle size distribution of radioactive aerosols after the Fukushima and the Chernobyl accidents. Journal of Environmental Radioactivity 126 (2013) 92-.98