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Spatio Temporels Variability of Cesium Fallout in One High Altitude Catchment Basin

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The rainfall episodes over the eastern part of the French territory during the first week of May 1986 led to a strong deposition of Chernobyl radioactive fallout onto land surface. Since few weeks after the fallout up to now, ^{137}Cs activity higher than expected from a simple deposition calculation based on the rainfall amount, have been measured in soil samples of high altitude alpine catchment basins. The ^{137}Cs accumulations are distributed as patch of some m^2 of soil surface. The aim of this work is first of all, to understand at the scale of a small natural workshop zone, the processes of formation of these high ^{137}Cs activity areas and then to evaluate the proportion of the initial deposit still retained in soil.

Workshop zone settings: The studied workshop is located in one watershed (1.35 km^2 large) from Mercantour mountains, south-eastern part of Alps. The top of the catchment basin is at 2700 m high whereas the outlet is at 1950 m high. From an ecological point of view, the catchment is divided in three main parts, according to the altitude: (1) fans zone above 2250 m, (2) one moraine, between 2250 and 2200 m, which is covered by pasture soil and (3) a pine and larsh forest bellow 2200 m. In situ distribution of ^{137}Cs soil radioactivity was studied at the scale of the catchment basin. Thus catchment radioactivity mapping shows that the fan zone where no soil occurs contains almost no ^{137}Cs, whereas forest and especially pasture soils contain ^{137}Cs. Such observations suggest specific mechanisms of retention of radionuclides in pasture and forest soils and further specific biogeochemical cycles of ^{137}Cs in each ecosystem.

The workshop zone (2125 m^2 large) is located 2200 m high, on moraine pasture soil. The northern part of the working area is a depression (about 10 m deep), strongly deepening to the east and west (30-35) and slowly deepening to the north (5). Whereas the southern part is almost flat, slowly deepening to the north.

Results: Correlation between amount of precipitations in the eastern part of France, just after the Chernobyl accident (May, 1986), and ^{137}Cs soils activities (Renaud, 2000), allows us to calculate workshop ^{137}Cs activity, where 30 mm precipitation occurs, to be 15 kBq.m^{-2} . However, ^{137}Cs activity map of the workshop area shows a strong spatial contrast between northern and southern part of the area. In the southern part, which is almost flat soils ^{137}Cs activity ranges between 5 and 10 kBq.m^{-2}. ^{134}Cs activity of those deposits shows that Cs is related to nuclear atmospheric bomb tests. On the other side, in the bottom of the northern depression, the strongest ^{137}Cs activity, ranging between 50 and 170 kBq.m^{-2}, is related to Chernobyl accident fallout.

Thus ^{137}Cs budget allow us to calculate total amount of ^{137}Cs trapped in the soil of the workshop area. "Hot spots" of radioactivity, corresponding to only 2-3% of the surface of the workshop area, strongly suggest hydrologic concentration processes of cesium fallout.

We used the present day natural atmospheric radionuclides input onto the workshop area to trace the behaviour of atmospheric Cs fallout, since "hot spots" soils also contain strong excess natural radionuclides ^{210}Pb and ^{7}Be activities. Thus measured ^{210}Pb excess activity, related to atmospheric inputs, is higher than theoretical soil activity calculated with mean regional ^{2} flux (Pourchet et al., 2000). Furthermore, the quantity of short living ^{7}Be (half life is 53 days) is high in "hot spot" soil and its covering grass. That's the reason why, snow passive collector of ^{210}Pb and ^{7}Be atmospheric input was used to make the budget of winter atmospheric radionuclides supply to the soil. Natural radionuclides approach show that (1) natural atmospheric radionuclides short scale concentration processes also occurred and (2) those processes occurred faster than ^{7}Be decay. This illustrates that, at the beginning of May, surface snow melting on workshop steps and occurrence of neve in the depression enables radionuclides migration and "hot spots" cesium formation in the depression.

Renaud Ph, *In Prep.*, (2000).
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