

Atmospheric transport of radionuclides emitted due to wildfires near the Chernobyl Nuclear Power Plant in 2015

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In 2015, two major fires in the Chernobyl Exclusion Zone (CEZ) have caused concerns about the secondary radioactive contamination that might have spread over Europe. The total active burned area was estimated to be about 15,000 hectares, of which 9000 hectares burned in April and 6000 hectares in August. The present paper aims to assess, for the first time, the transport and impact of these fires over Europe. For this reason, direct observations of the prevailing deposition levels of ^{137}Cs and ^{90}Sr , ^{238}Pu , ^{239}Pu , ^{240}Pu and ^{241}Am in the CEZ were processed together with burned area estimates. Based on literature reports, we made the conservative assumption that 20% of the deposited labile radionuclides ^{137}Cs and ^{90}Sr , and 10% of the more refractory ^{238}Pu , ^{239}Pu , ^{240}Pu and ^{241}Am , were resuspended by the fires.

We estimate that about 10.9 TBq of ^{137}Cs , 1.5 TBq of ^{90}Sr , 7.8 GBq of ^{238}Pu , 6.3 GBq of ^{239}Pu , 9.4 GBq of ^{240}Pu and 29.7 GBq of ^{241}Am were released from both fire events. These releases could be classified as of "Level 3" on the relative INES (International Nuclear Events Scale) scale, which corresponds to a serious incident, in which non-lethal deterministic effects are expected from radiation. To simulate the dispersion of the resuspended radionuclides in the atmosphere and their deposition onto the terrestrial environment, we used a Lagrangian dispersion model. Spring fires redistributed radionuclides over the northern and eastern parts of Europe, while the summer fires also affected Central and Southern Europe. The more labile elements escaped more easily from the CEZ and then reached and deposited in areas far from the source, whereas the larger refractory particles were removed more efficiently from the atmosphere and thus did mainly affect the CEZ and its vicinity. For the spring 2015 fires, we estimate that about 80% of ^{137}Cs and ^{90}Sr and about 69% of ^{238}Pu , ^{239}Pu , ^{240}Pu and ^{241}Am were deposited over areas outside the CEZ. 93% of the labile and 97% of the refractory elements ended in Eastern European countries (including the CEZ). Similarly, during the summer 2015 fires, about 75% of ^{137}Cs and ^{90}Sr and 59% of the refractory radionuclides were exported from the CEZ, of which the majority was deposited in Belarus and Russia. However, Central (11% for ^{137}Cs and ^{90}Sr) and Southern European countries (5% of ^{137}Cs and ^{90}Sr) also received smaller amounts of the radioactive fallout. A radiological assessment of the exposure to the European population showed that effective doses were above 1 mSv y^{-1} in the CEZ, but much lower in the rest of Europe. The fires contributed an additional effective dose for the European population, which is equivalent to a medical X-ray image at most.