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Estimation of the time-dependent radioactive source-term from the Fukushima nuclear power plant accident using atmospheric transport modelling

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Several nuclear reactors at the Fukushima Dai-ichi power plant have been severely damaged from the Tōhoku earthquake and the subsequent tsunami in March 2011. Due to the extremely difficult on-site situation it has been not been possible to directly determine the emissions of radioactive material. However, during the following days and weeks radionuclides of 137-Caesium and 131-Iodine (amongst others) were detected at monitoring stations throughout the world.

Atmospheric transport models are able to simulate the worldwide dispersion of particles accordant to location, time and meteorological conditions following the release. The Lagrangian atmospheric transport model Flexpart is used by many authorities and has been proven to make valid predictions in this regard. The Flexpart software has first has been ported to a local cluster computer at the Grid Lab of INFN and Department of Physics of University of Roma Tre (Rome, Italy) and subsequently also to the European Mediterranean Grid (EUMEDGRID). Due to this computing power being available it has been possible to simulate the transport of particles originating from the Fukushima Dai-ichi plant site.

Using the time series of the sampled concentration data and the assumption that the Fukushima accident was the only source of these radionuclides, it has been possible to estimate the time-dependent source-term for fourteen days following the accident using the atmospheric transport model. A reasonable agreement has been obtained between the modelling results and the estimated radionuclide release rates from the Fukushima accident.