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Modifying the hydrological model SWAT+ to include ^{137}Cs dynamic processes

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Radioactive caesium (^{137}Cs) has been ejected into the atmosphere following accidents at nuclear power plants or because of nuclear weapon's testing in the 1950s, '60s, and '70s. It enters the environment either by wet or dry deposition, where the majority of the ^{137}Cs is adsorbed onto clay particles. Very limited movement of ^{137}Cs occurs after fixation, although weathering and erosion may remobilise the radioactive caesium which can then be transported in streams and rivers. Since climate change is projected to lead to increased temperatures and precipitation in northern latitudes, the potential for ^{137}Cs remobilisation increases. In this work, a model of ^{137}Cs erosion and transport will be set up and validated in SWAT+ using historical ^{137}Cs data. SWAT+ is a continuous time model allowing physical processes related to water and sediment transport as well as nutrient cycling and pesticide fate to be modelled. To simulate remobilisation and transport of ^{137}Cs, SWAT+ is modified to include the following ^{137}Cs dynamic processes: solid-liquid distribution, plant uptake, erosion, and transport in the hydrological network. The modifications largely follow SWAT-K, which was developed to simulate potassium fate at watershed scale [1]. The modelling efforts will be focused on the Kymijoki watershed in southern Finland, where Finland's Radiation and Nuclear Safety Authority have a radionuclide monitoring programme since the early 1960s. To set up the model, ^{137}Cs deposition and soil data will be used, along with ^{137}Cs data from stream water to calibrate and validate the model. The model can then be used to project the fate of ^{137}Cs anomalies in the environment under a changing climate and identify potential downstream areas of contamination, helping to manage the problems of radionuclide pollution and climate change.

[1] Wang, Jiang, Boithias, Sauvage, Sánchez-Pérez, Mao, Han, Hayakawa, Kuramochi & Hatano (2016), *Agricultural Water Management* 175, 91-104.