Long-term prediction models of atmospheric concentration of Cs-137 and their comparison with AIC

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In the Fukushima Daiichi nuclear power plant accident, a large amount of radioactive nuclides were released. Ceasium-137 is one of the most significant radionuclides which were released in large amount to the atmospheric and has a half-life of thirty years; the Cs-137 pollutes the atmosphere for a long term. Some models which can predict the concentration of Cs-137 for long term have been proposed.
In this study, first, I evaluate the seasonal variation in the concentration change of Cs-137. Analyzing the residuals between the measured data and the models, we reveal periodic fluctuations with the period of one year. We found that the changes of the concentration is in the form the sine curve of the one year period, which reaches at the maximum value in the summer and minimum in the winter. Adding such a sine curve in long-term models, we propose a new model considering seasonal variation. Second, we compare the accuracy of the models. Some models to reproduce the atmospheric concentration of Cs-137 have been proposed, but they are not evaluated quantitatively with regard to which model is the best. We evaluate some models using Akaike's Information Criterion(AIC). AIC evaluate some models on consistency and number of free parameters. At first, we evaluate which is good, considering seasonal variation or not. As a result, model considering seasonal variation is better. Second, I evaluate some proposed models. As a result, the best model is $C(t)=Aexp(-\lambda_{decay}t)t^{-\alpha}$ (then C(t) is concentration of Cs-137, λ_{decay} is decay constant of Cs-137, A and αare free parameter). This is conclusion that $C(t)=Aexp(-\lambda_{decay}t)t^{-\alpha}$ and considering seasonal variation is the best model.

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