Estimating the atmospheric depositional flux of ^{210}Pb using the water column budget of ^{210}Pb in the ocean

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In order to determine the atmospheric depositional fluxes of ^{210}Pb (half-life = 22.3 yrs), we established the mass balance model of ^{210}Pb in the water column (0 – 1000 m) of the East Sea. The atmospheric input flux is assumed to be balanced by the in-situ production from ^{226}Ra (half-life = 1600 yrs), the in-situ decay to ^{210}Po (half-life = 138 days), and the settling to the deep ocean through 1000 m. The in-situ production and decay fluxes are estimated from the vertical profiles of ^{226}Ra and ^{210}Pb in the East Sea obtained in this (April 2015) and previous studies. The settling flux is estimated from the sediment trap data obtained in 1999. The in-situ ingrowth and decay fluxes were 0.40 and 0.24 dpm cm^{-2} yr^{-1}, respectively, and the settling flux is calculated to be 1.57 dpm cm^{-2} yr^{-1}. Then, the atmospheric depositional flux of ^{210}Pb is calculated to be 1.41 dpm cm^{-2} yr^{-1}. This value is consistent with the depositional fluxes of ^{210}Pb (1 - 2 dpm cm^{-2} yr^{-1}) observed on the land sites previously in this region. This atmospheric depositional flux of ^{210}Pb measured in the ocean may be useful for accurately estimating the atmospheric depositional fluxes of other chemical components (i.e., nutrients, organic matter, and trace elements) to the ocean.