Geophysical Research Abstracts
Vol. 15, EGU2013-11054, 2013
EGU General Assembly 2013

Modeling the downward transport of 210Pb in mires and repercussions on the derived chronology: Initial Penetration (IP) model

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The vertical distribution of 210Pb is widely used to date sediments and peat profiles accumulated over the last 100-150 years. However, several studies have raised concern about the reliability of this method when dating peat cores because of an apparent downcore translocation of 210Pb from the peat surface. In this study we introduce a new dating model, the Initial Penetration (IP) model that takes into account an initial washout of 210Pb from the peat surface and its redistribution into deeper layers. We hypothesize that correct chronologies can be derived using the IP-model despite significant downcore vertical translocation of deposited 210Pb. We test our hypothesis by applying the IP model to peat cores collected in NW Spain and in Northern Sweden both argued to have anomalous 210Pb records in previous studies. The outcome of the model is validated against independent chronological markers and the consistency of the derived results with typical peat growth rates and historical monitoring. We found that the IP model generated valid chronologies despite significant washout of 210Pb from the peat surface. That this latter mechanism was prominent in the analyzed peat cores was further demonstrated by a multivariate statistical analysis. The results of this analysis for one of the cores indicated that, besides radioactive decay, 210Pb distribution was controlled by density, suggesting the downwash or smearing of 210Pb as main processes controlling its vertical distribution.