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Carbon and ^{14}C distribution in tropical and subtropical agricultural soils

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Paddy soil management affects, through the alternating anoxic and oxic conditions it creates, the transport and stabilisation of soil organic matter (SOM). Irrigation water may percolate more organic materials – dissolved (DOM) and colloidal - into the subsoil during anoxic conditions. Yet a developed ploughpan tends to prevent C from going deeper in the subsoil and partly decouple C distribution in top and sub soil. We investigate the influence of different soil type and environment.

We observed the C and ^{14}C distribution in paddy and non-paddy soil profiles in three different soil types from four different climatic regions of tropical Indonesia, and subtropical China. Locations were Sukabumi (Andosol, ca. 850 m a.s.l), Bogor (clayey Alisol, ca. 240 m a.s.l), and Ngawi (Vertisol, ca. 70 m a.s.l) in Jawa, Indonesia, and Cixi (Alisol(sandy), ca. 4 – 6 m a.s.l) in Zhejiang Province, China. We compared rice paddies with selected neighbouring non-paddy fields and employed AMS ^{14}C as a tool to study C dynamics from bulk, alkali soluble-humic, and insoluble humin samples, and macrofossils (plant remains, charcoal).

Our data suggest that vegetation type determines the quantity and quality of biomass introduced as litter and root material in top and subsoil, and thus contributes to the soil C content and profile, which fits the ^{14}C signal distribution, as well as ^{13}C in Ngawi with C4 sugar cane as upland crop.

^{14}C concentrations for the mobile humic acid fraction were generally higher than for bulk samples from the same depth, except when recent plant and root debris led to high ^{14}C levels in near-surface samples. The difference in sampling, - averaged layer for bulk sample and 1-cm layer thickness for point sample - shows gradients in C and ^{14}C across the layers, which could be a reason for discrepancies between the two. High ^{14}C concentrations - in Andosol Sukabumi up to 111 pMC - exceed the atmospheric $^{14}CO_2$concentration in the sampling year in 2012 ($\sim$ 103 pMC) and reflect stored organic material from earlier years with a higher atmospheric bomb ^{14}C content.

Direct inputs of plant material into the subsoil is indicated by young organic remains with more than 103 pMC below 0.8 m depth. In combination with ^{13}C observation, it is quite obvious that introduction of young C took place in both paddy and non-paddy.