Modifying A Soil Carbon Turnover Model Considering Unique Properties of Andisols

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We modified the Rothamsted carbon model (RothC, Coleman and Jenkinson 1996), which is one of leading soil organic matter turnover models in the world, to adopt it to Andisols, because it could simulate the changes in soil organic carbon (SOC) adequately in non-volcanic soils in Japan (Fig. 1, Shirato and Taniyama 2003) while it could not simulate well in Andisols (thin line in Fig. 2). Among several options to modify the model, we decided to change the decomposition rate constant of the humus (HUM) pool, which is one of five SOC pools that the RothC contains, because the presence of Al- or Fe- humus complexes in Andisols gives HUM strong stability (Shirato et al. 2004). In addition, the inert organic matter (IOM) pool was set at zero, because the soil did not contain carbon when it was formed from fresh volcanic ash. H(f) was defined as the factor required to divide the decomposition rate constant of the HUM pool so that the modeled SOC level matched the measured level. H(f) was calculated for 32 Japanese Andisols, and the relationships between H(f) and soil properties such as contents of acid-oxalate-extractable Al, Fe, and Si (Alo, Feo, and Sio) or pyrophosphate-extractable Al (Alp) were analyzed. The equation H(f) = 1.20 + 2.50Alp(%), (r^2=0.52) was selected to divide the decomposition rate constant of HUM. The modified model was tested for four long-term experimental data sets on Andisols under various climatic conditions, soil textures, and management techniques from north to south across Japan. We obtained considerably improved fits between the contents of modeled and measured SOC by using the modified RothC model (thick line in Fig. 2) instead of the original model. Use of this modified model may contribute to the improvement of the performance of existing SOC models in modeling Andisols. It can be used for estimating CO_2 emission from soils, as well as for planning suitable organic matter management in Japanese Andisols.

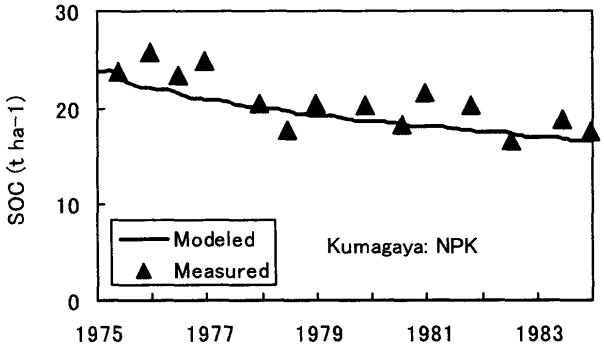

Fig 1. Modeled vs. measured SOC on non-volcanic soils. Example from Gray lowland soils in Kumagaya, Saitama prefecture.

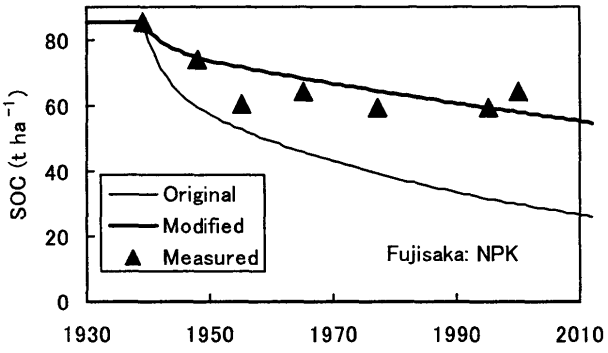

Fig 2. Modeled vs. measured SOC on Andosols by original RothC and modified model. Example from Fujisaka, Aomori prefecture.

References

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