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A GUIDELINE FOR THE DEVELOPMENT OF AN INTEGRATED AND DYNAMIC MODEL OF SOIL-PLANT SYSTEM EVOLUTION

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The interactions between soil and vegetation (e.g. root exudation, weathering and uptake or root growth, bioturbation and biomass production) are significant in the initial development of terrestrial ecosystems. Quantitative modelling of such interactions is needed to better understand and predict ecosystem evolution, especially in the context of derelict land restoration. However, in the current models of soil evolution, plant feedbacks on soil are still poorly taken into account. Numerous models have already been developed to reproduce individual processes involving soil and plant but they are not able to simulate the whole as a global, interactive, and complex system. Our objective is to propose a general guideline for a global dynamic model by integrating existing sub-models of individual processes. The focus is on soil under human-controlled vegetation as it is an important issue in ecosystem reclamation. The suggested guideline is based on a review of around 20 existing profile-scale quantitative sub-models which reproduce soil-plant processes. The sub-models are mainly based on a physical approach with laws of mass conservation but some rely on statistical and energy-conservation laws. At first a global soil-plant evolution model could be devised by integrating existing mass-conservation sub-models. However, adaptations are needed to reproduce interactions between processes as well as soil-plant feedbacks. Statistical and energy-based approaches could be proposed respectively for calibration and as a general metric combining various chemical or physical stresses. We assess our modelling guideline by confronting it to studies on rehabilitated ecosystems, particularly constructed Technosols as they are relevant experimental models.