

Pedoturbation by tree uprooting: the key pattern-forming factor in the forest soil

Maxim Bobrovsky (1) and Sergey Loyko (2)

(1) Institute of Physico-Chemical and Biological Problems in Soil Science of RAS, Pushchino, Russia (maxim.bobrovsky@gmail.com), (2) Tomsk State University, Tomsk, Russia (s.loyko@yandex.ru)

Treefalls with uprooting are the most powerful and ubiquitous biotic factor changing the structure of forest soil under free forest development. Practically every soil profile in a forest has a number of soil horizons anomalies which are located within the limits of the potential depth of treefall-related pedoturbations and these anomalies are indeed a result of treefalls in most cases. It is important to recognize signs of treefalls with uprooting in a soil profile even when signs of treefalls on the ground surface (pit-and-mound topography) are erased. Numerous field studies of forest soil in the European part of Russia and in the Western Siberia allowed us to generalize signs of treefalls in a soil profile, which can be used to distinguish the patterns of old treefall-related pedoturbations.

We distinguish two main types of uprooting of a fallen tree: hinge and rotational tree uprooting (treefall). The signs of treefalls with uprooting in a soil profile are as follows: (1) treefall pits (cauldrons); (2) spotty or streaky structures of different degrees of contrast; (3) blocks of “buried material” from the upper soil layers; (4) washed (bleached) material depositing at the bottom of pits and filling soil pores and channels of various origins; (5) signs of hydrogenous changes of soil material resulting from water stagnation in the pits; (6) root channels at the bottom of the pit and (7) inclusions of litter and charcoal. We cleared that treefall-related pedoturbations affect soil profiles at a depth larger than the depth usually described by the soil horizons A, E, Bhs, etc. Therefore in most forest soils, the middle and lower parts of the profiles have patterns originating from the transfer of soil material upon treefalls. Age since the tree uprooting can be determined by dating of organic matter or charcoal located in old pits. We dated several tens of old tree uprooting pits by charcoal in sandy soil in the center and the east of the Russian Plain: they showed from a few hundreds to 4500 cal years BP. We also dated tens of old tree uprooting pits by mull humus in Luvic Phaeozems on loams in the center of the Russian Plain: they showed from 2500 to more than 8000 cal years BP.

Discerning of old treefall-related patterns in soil profile significantly improves our understanding of the forest soil formation and leads to the necessity of serious corrections of pedogenesis concepts.

This study was partly supported by the Russian Science Foundation (Grant 16-17-10045).