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Relic periglacial features on cultivated lands of the Western European Russia: spatial distribution, types and impact on modern processes of soil degradation

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For the last several decades, presence of the relic periglacial features (RPF) in topography and soil structure far beyond the present southern limits of the permafrost has been widely acknowledged (Pewe, 1966; Velichko, 1975; Kolstrup, 1986; Jetchik and Allard, 1990; Sycheva, 2012; Bertran et al., 2014). It is presently accepted that most of such features were formed under the most severe climatic and landscape conditions of the last stage of the Late Pleistocene glaciation (Velichko, 1982; Vandenberghe et al., 2014; Andrieux et al., 2016). Recent progress in studies of the RPF has been largely achieved due to latest development of the remote sensing (RS) techniques and especially increasing availability of high-resolution satellite imagery for the Earth scientists. In most cases, such features are discovered by visual interpretation of satellite images for cultivated areas, simply because their visibility is best under conditions of bare soil or low and uniform crop cover. By present time, several morphological classifications of the RPF has been proposed (Velichko, 2015; Andrieux et al., 2016) and specifics of their zonal distribution more or less established for the Eastern European Plain (Velichko, 1982, 2015). Significant progress has also been achieved in investigations of role of the RPF in structure of modern soils (Duchaufour, 1951; Makeev, 2009; Alifanov, 2010, Sycheva, 2012). However, there are several problems still lacking detailed scientific considerations, namely relationships between different types of the RPF and modern hillslope processes, soil degradation processes, sediment export from hillslopes into fluvial network in areas of dominant agricultural land use. Impact of the RPF on spatial structure and intensity of human-accelerated soil erosion on agricultural land and its detrimental effects such as decreased soil fertility, small river degradation, reservoir siltation and water quality deterioration is not commonly taken into account for soil erosion mapping and designing soil- and water-conservation measures.
The research reported here is concentrated on establishing and evaluating relationships between different types of the RPF and morphological and geochemical differentiation of soils, intensity and spatial distribution of soil erosion and deposition processes on cultivated slopes. The approaches employed include analysis of the RS data, application of several independent techniques for quantitative assessment of soil redistribution on cultivated slopes and in small catchments, high-quality geodetic surveys and airborne photo (by unmanned aerial vehicles), morphological and geochemical investigation of soil properties and georadar sounding. Characteristics and first stage results for the three case study sites located in southern boreal forest, forest-steppe and steppe zones of the Western European Russia will be discussed, including the RPF types and morphological characteristics, zonal soil types, morphological and morphometric characteristics of cultivated slopes, density and structure of stream network, detailed-scale local topography soil morphology variability, modern soil redistribution rates and spatial patterns.

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