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Long term stability of magnetic signal measured on surface of artificially contaminated test fields

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Environmental magnetism represents significant part of research of anthropogenic pollution in various ecosystems. Analysis of atmospheric pollution is based on detecting of anthropogenic ferrimagnetics and /or their vertical distribution in different collectors (e.g. modern soils or sediments). Simple in situ mapping of concentration dependent magnetic parameter (low-field magnetic susceptibility) can be used as a proxy of spatial distribution of pollution only if short time migration of anthropogenic ferrimagnetics in topsoil layers is not significant.
Model open-air test fields (sand, soil, grass) were used for long term (more than one year) monitoring stability of magnetic signal measured on surface. Surface layers were artificially contaminated by fly ashes from coal-burning power plant, or by Fe3O4 (grain size < 20 μm). Surface magnetic susceptibility was repeatedly measured on a stable network of measuring points evenly distributed on the test fields using the Bartington MS2D sensor and more precisely by SM 30 kappameter (ZH Instruments). For both sensors the intensity of the surface magnetic signal, depending on the depth of accumulation of the deposited contaminants, was systematically investigated in the laboratory. Additional measurements of the time changes in the depth distribution of anthropogenic ferrimagnetics were determined at selected points in test fields using the SM 400 kappameter.
Experiments carried out on contaminated soil, sand and grass indicate that changes in depth of the peak magnetic susceptibility (corresponding to maximum concentration of fly ashes) are a few centimeters per year, with higher dynamics during winter (snow) season. Mean surface susceptibility is a critical parameter for quantification of the degree of contamination of a given site or locality. In the test fields it changes relatively radically during the one-year period, and in some environments (e.g. fly ash in sand) it almost approach reference uncontaminated values. In general, in all environments higher stability were observed for fine-grained magnetite than for fly ash.