Long term lysimeter experiments about the influence of irrigation on phosphorus leaching

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It is well known that phosphorus (P) losses from soils, in combination with other nutrients, may cause severe eutrophication problems in adjacent water resources. Besides the surface-bound lateral transport of P via the erosion pathway, the vertical movement through the soil profile has been increasingly recognized as an important process. Long-term study of mineral fertilization and nutrient leaching started in 1991 at the present UFZ-Helmholtz lysimeter station at Falkenberg, Saxony-Anhalt. The objective of this lysimeter trial is to investigate the influence of irrigation on the P balance and especially the P leaching losses. The 24 lysimeters were manually filled from autumn 1981 to spring 1882; soil textures were sand (n = 6), sandy loam (n = 6), loam (n = 6), and silt (n = 6). The lysimeter depth is 125 cm, with an A-horizon from 0 to 30 cm, a subsoil from 30 to 100 cm and a drainage zone from 100 to 125 cm consisting of sand, gravel and stone gravel. Leachate was continuously collected at lysimeter bottom. The total volume of leachate was monthly determined, and an aliquot was taken for analysis of total P (P_t). Mineral fertilizer P was applied in three amounts – optimal fertilization (100%); reduced fertilization (50% of the optimal variant) and over supplied fertilization (150% of the optimal variant). The lysimeters have been used as grassland (each soil texture 3 lysimeters) and arable land (also each soil texture 3 lysimeters). Arable land use consists of a grain and feed-grain crop rotation clover/grass – winter wheat – winter barley – oats. After harvesting the winter barley, a mixture of corn and sunflowers was planted as an interim crop. Clover/grass was seeded between the oats. The soil P content (P_t and plant available P_{DL}) of each lysimeter was measured once per year. Furthermore, the P uptake by the biomass was also analyzed. A comparison between the intensive irrigation period from 1991 to 2003 and the non-irrigation period from 2004 to 2009 will be carried out. First results showed that the reduction of the leaching amount in the non-irrigation period was connected with reduced P leaching losses, lower yields and reduced P uptake by plants. Based on a statistical analysis recommendations will be given regarding a sustainable management of agricultural used areas to reduce P leaching losses and to evaluate climate change impacts on water and P balance in soils.