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GEMAS: The continental scale influences on the pH of European agricultural and grazing land soil

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The pH($CaCl_2$) values of all GEMAS soil samples were measured in a single run at the NGU laboratory, Trondheim, between November 2009 and January 2010, thereby providing the most homogenous existing soil pH data set on the European scale. pH is a key variable for determining mobility and solubility of chemical elements in soil, and pH also controls the adsorption capacity of clays. On a global scale, soil pH closely mirrors climatic zonation, such that climate appears to be the predominant influence factor on this scale. On continental, national, and on smaller scales it is of crucial interest to assess the relative importance of geology, climate, soil formation, and human activities on soil pH. The new GEMAS pH data set provides detailed insight to the relevant processes in agricultural (Ap) and grazing land (Gr) soil on the European scale, and defines a dependable background to calibrate studies on smaller scales.

The European pH values show a bimodal distribution. A broad acidic mode with pH between 4 and 6, and a sharp alkaline mode with pH between 7 and 8 due to the Ca^{2+} buffer system, are clearly separated. The median pH is 5.8 for all GEMAS Ap soils and 5.5 for the GEMAS Gr soils. Both data sets show a distinct North-South gradient coinciding with the global climatic variation. Ap and Gr soil North of the European border of ice age glaciation have median pH values of 5.2 and 4.8, whilst the median values south of the border are 6.3 and 5.9, respectively. Although there is a systematic increase in pH from sub-polar to Mediterranian climate, the new maps of European soil pH indicate a close link between bedrock geology and soil pH. It therefore appears that geology is the dominant direct controlling factor for pH, while climate largely acts on large time scales by changing surface geology via erosion, and on smaller timescales by influencing the mineralization of organic matter.

In spite of the fact that pH is a strongly managed property in agricultural soil the GEMAS pH maps mainly reflect natural conditions on the European scale, and not anthropogenic impact.