Multivariate Statistical Analysis of Denitrification in the Vadose Zone

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Abstract. Denitrification has been researched extensively over the last several decades. However, progress in quantifying denitrification has been limited by the lack of unified measuring methods, consistency in reported units, and an understanding of the soil properties controlling the rate. Additionally, the current knowledge of vadose zone denitrification is site specific; thus limiting its use for making nitrate removal predictions on a watershed scale. The objectives of this work were (1) to demonstrate the variability in denitrification rates due to different soil properties, (2) to determine the most important factors controlling denitrification, and (3) to establish how soil texture influence denitrification rates. The goals were obtained by performing a rigorous literature review, where denitrification rates and soil characteristics from 601 unique soil experiments from 40 different sources were collected. Cumulative frequency diagrams proved useful for quantifying the variations in denitrification rates. Principal component analyses determined the relative importance of different soil properties on denitrification, while cluster analyses established the similarity level between variables. In addition, three-dimensional graphs illustrated the relationships between denitrification rate, soil textural class and soil properties. Denitrification rates were found to range from non-detectable to 157 kg N ha^{-1} day^{-1}. Soil moisture, organic carbon content and pH level were determined to be the most important soil properties controlling denitrification. In addition, clayey soils and silty clays were found to have the highest rates, while sandy soils typically have low rates.

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