Supplement of Biogeosciences, 14, 4691–4710, 2017
https://doi.org/10.5194/bg-14-4691-2017-supplement

Biogeosciences
Open Access

Supplement of

Effect of soil saturation on denitrification in a grassland soil

Laura Maritza Cardenas et al.

Correspondence to: Laura Maritza Cardenas (laura.cardenas@rothamsted.ac.uk)

Supplement 1

The gravimetric soil water release characteristic for the soil, as given in Gregory *et al.* (2010) represents the assumed pore size distribution, and was fitted with a van Genuchten function (van Genuchten, 1980) with the Mualem (1976) constraint (m = 1−1/n):

$$\theta_h = \theta_r + \frac{\theta_s - \theta_r}{[1+(\alpha h)^n]^{1-\frac{1}{n}}} \qquad (1)$$

where θ_s, θ_r and θ_h are the saturated, residual (water content at permanent wilting point) and h matric potential gravimetric water contents (g g^{-1}), respectively; h is the matric potential (|kPa|, i.e. the absolute value), α is a fitted parameter approximating the inverse of h at the inflection point ($|kPa|^{-1}$), often linked to the air-entry point, and n is a dimensionless fitted parameter related to the shape of the function. The fitted values of θ_s, θ_r, α and n were 0.498, 0.236, 0.105 and 1.566, respectively.

The somewhat arbitrary saturation state known as "field capacity" represents the idealised condition UNSAT/sat, where the macropores have drained (air-filled) and the micropores have yet to drain (water-filled). As field capacity has typically corresponded to a matric potential anywhere between –5 to –33 kPa, we chose –20 kPa as our UNSAT/sat condition, where the threshold pores size between those water-filled and those air-filled is 15 µm. The matric potential corresponding to SAT/sat was obviously 0 kPa, to give full saturation of all the pores. To calculate the intermediate HALFSAT/sat condition, we took the mid-point gravimetric water content between 0 and –20 kPa from the water release characteristic, and calculated the corresponding matric potential using Eq. [1], which was –8.6 kPa. We also calculated the mid-point gravimetric water content between that at –20 kPa and θ_r, and found the corresponding matric potential (Eq. [1]) to be –78.1 kPa. We used this to represent the UNSAT/halfsat condition. As θ_r was non-zero (in fact it was 0.236 g g^{-1}), due to the fine-textured nature of the soil, we accept that at –78.1 kPa the micropores were not truly half-saturated but would have been in a wetter condition than this. However due to our method for equilibrating the soils prior to experimentation, we required a suitable matric potential not lower than –1500 kPa that we could control in the laboratory (see below). It could be argued that trying to attain a water content in the hygroscopic range (that held at potentials much lower than –1500 kPa, often in the vapour phase), where the true mid-point water content between that at –20 kPa and complete dryness in this soil lay, was not especially relevant to denitrification processes expected in such a soil. There was one final adjustment to make. The subsequent incubation experiment was to involve a 15 ml (3 × 5 ml) addition of solution (see below). Through knowing masses and volumes of the solid-water-air phases of our blocks, we therefore calculated revised matric potentials which would mean that the subsequent addition of solution would achieve the target potentials given above. The target matric potentials of 0 (SAT/sat), –8.6 (HALFSAT/sat), –20.0 (UNSAT/sat) and –78.1 kPa (UNSAT/halfsat) were revised to –4.1, –12.3, –27.3 and –136.9 kPa, respectively (see summary in Table 2).