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Supplement of

Frequency and intensity of nitrogen addition alter soil inorganic sulfur fractions, but the effects vary with mowing management in a temperate steppe

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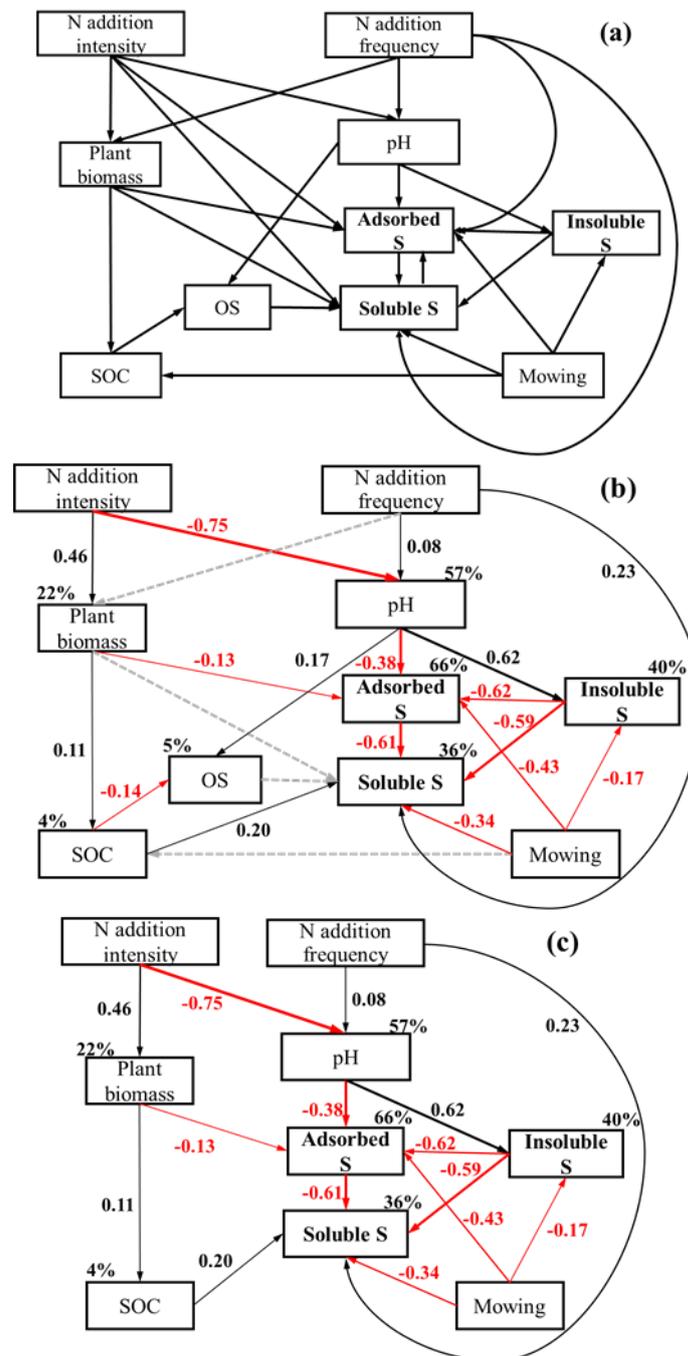


Figure S1 *A priori* structural equation models (SEM) used in this study. Panel (a) shows the *a priori* SEM including all potential pathways. Panel (b) shows the simplified SEM excluding most non-significant pathways. Panel (c) shows the most concise SEM excluding uninformative pathways associated with organic S (OS) that had no influence on the inorganic sulfur fractions. Black arrow denotes positive effect, red arrow for negative effect and dashed arrow for uncertain effect. For *a priori* model a, we expect that 1) increasing N addition intensity would enhance dissolution of insoluble S to elevate available S (soluble S and insoluble S) concentration due to

soil acidification, higher plant residue return and organic S mineralization; 2) lower soil pH condition at low frequency of N addition would result in higher soil available S but lower insoluble S concentrations as compared to high N frequency; 3) mowing practice would decrease soil S fractions by reducing plant residue return. In this model, we included treatments of N addition intensity, N addition frequency and mowing, independent variables of plant biomass, soil pH, soil organic carbon (SOC), and dependent variables of soil soluble S, adsorbed S, insoluble S, and organic S concentrations. We constructed our structural equation models by taking into account all plausible correlations except for total inorganic nitrogen (TIN), because there is a strong multicollinearity among independent variables when taking N addition intensity and TIN into the model at the same time.

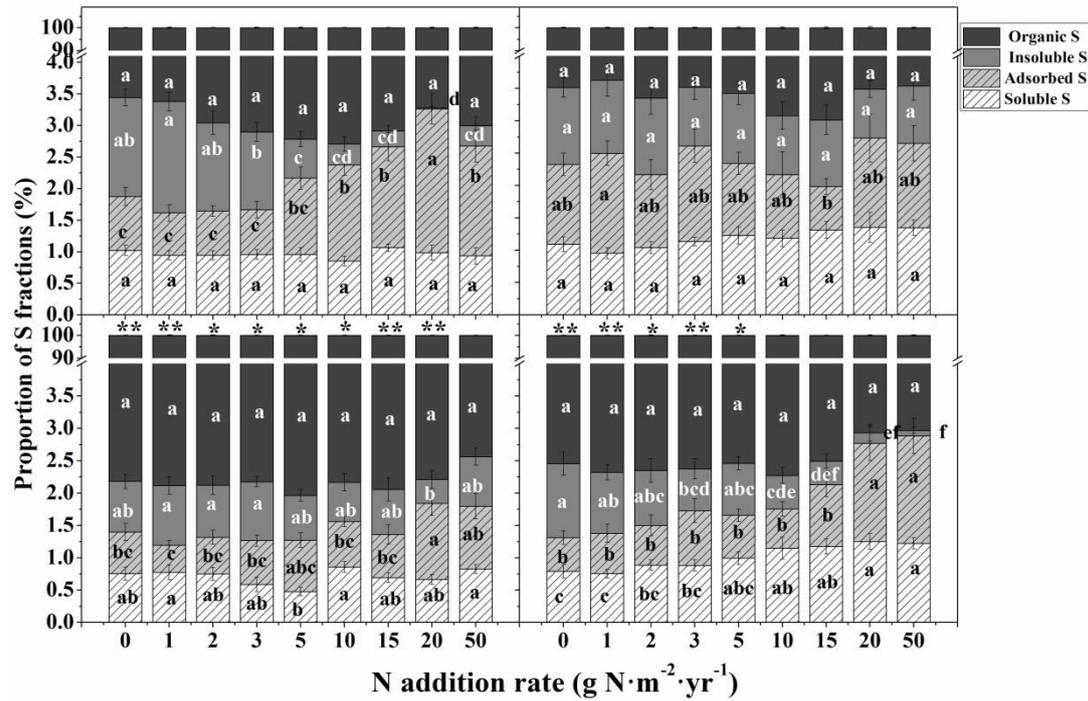


Figure S2 Proportion of inorganic sulfur fractions relative to total sulfur under low and high frequency of nitrogen (N) addition in unmown (a and b, respectively) and mown (c and d, respectively) plots. White and gray bars with slashes correspond to soluble S and adsorbed S, respectively. Gray (without slashes) and black bars represent insoluble S and organic S, respectively. Error bars indicate standard errors. Different letters represent significant difference among N addition rates for each inorganic S fraction. Asterisks indicate significant difference for total inorganic S proportion between unmown and mown plots within one N addition rate for low and high N frequency separately. * and ** represent significance level at 0.05 and 0.01, respectively.

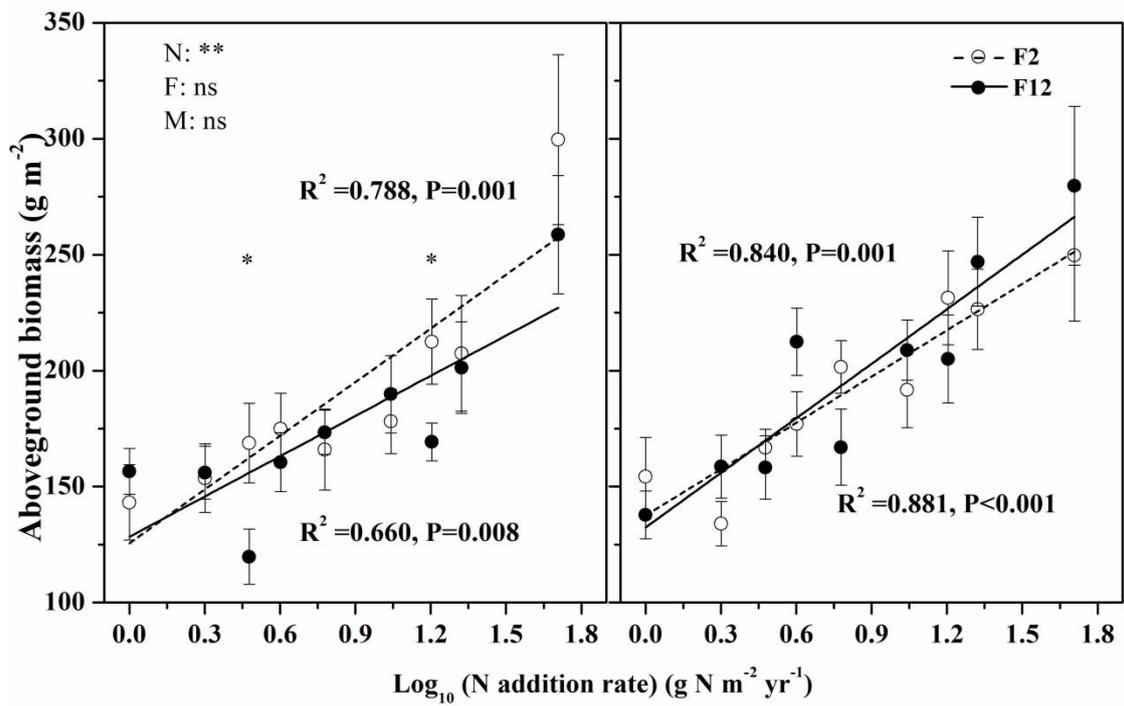


Figure S3 Effect of N addition intensity and frequency on aboveground biomass in unmown (a) and mown plots (b). Dashed and solid regression lines correspond to 2 and 12 N additions year⁻¹, respectively. Error bars indicate standard error. Asterisks indicate significant difference between low and high frequency of N addition within one N addition rate and mowing management.

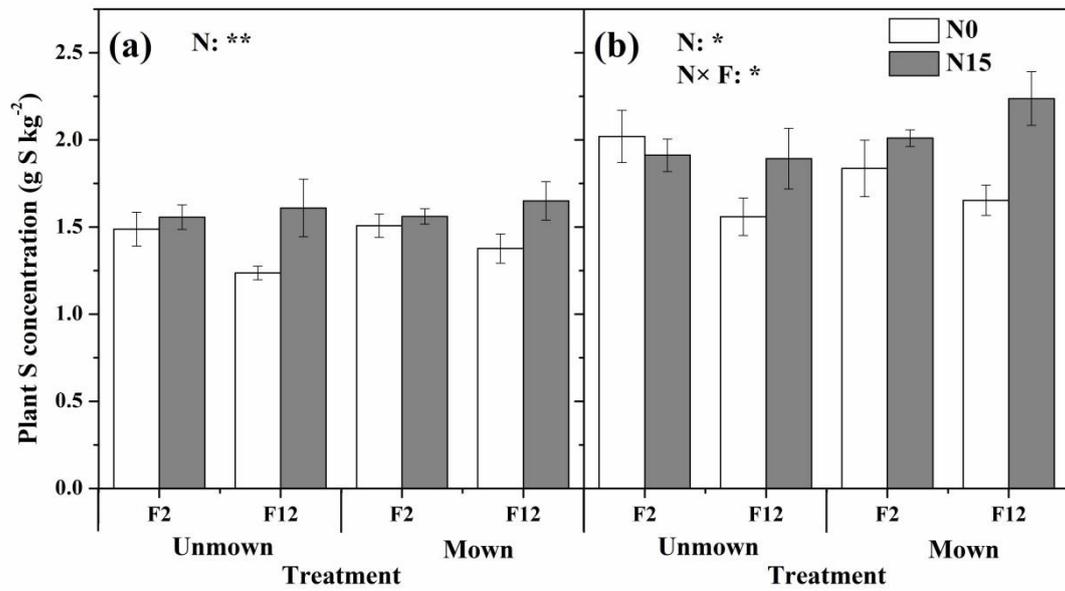


Figure S4 Effect of N addition intensity and frequency on plant S concentration in dominant species of *Leymus chinensis* (a) and *Stipa grandis* (b) without and with mowing (only plant samples in 0 and 15 g N m⁻² year⁻¹ were measured). Error bars indicate standard error. * and ** represent significance levels ($P \leq 0.05$ and 0.01, respectively).

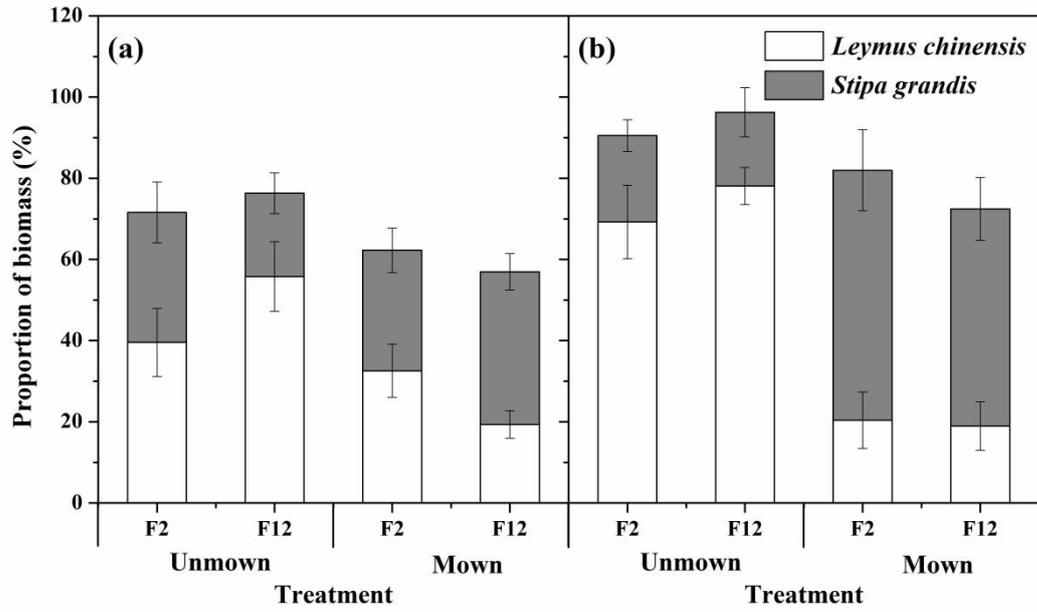


Figure S5 Effect of N addition intensity and frequency on biomass proportion of dominant species of *Leymus chinensis* and *Stipa grandis* without and with mowing (only plant samples in 0 (a) and 15 (b) g N m⁻² year⁻¹ were measured). Error bars indicate standard error.