Background: Plant and soil nitrogen stable isotope ($\delta^{15}N$) can integrate several fundamental biogeochemical processes in ecosystem nitrogen dynamics, and reflect characteristics of ecosystem nitrogen cycling.

Aims: We investigated how climate change influenced plant-soil nitrogen cycling by relating soil $\delta^{15}N$, plant $\delta^{15}N$ and $\Delta\delta^{15}N$ (difference between soil and plant $\delta^{15}N$) with climatic factors.

Methods: Field investigation was conducted in temperate grasslands in Inner Mongolia during August 2015. Plant $\delta^{15}N$, soil $\delta^{15}N$ and $\Delta\delta^{15}N$ were determined, and their relationships with climatic factors were examined by simple regression analyses and general linear models.

Results: Soil $\delta^{15}N$ was significantly higher than plant $\delta^{15}N$, and there was a positive linear correlation between them. Soil and plant $\delta^{15}N$ were negatively related with mean annual precipitation (MAP) and positively with mean annual temperature (MAT); conversely, $\Delta\delta^{15}N$ was positively related with MAP and negatively with MAT.

Conclusion: Soil $\delta^{15}N$ was dominantly controlled by MAT, while it was MAP for plant $\delta^{15}N$. Climate factors influenced plant $\delta^{15}N$ not only through their effects on soil nitrogen dynamics but also strategies of plant nitrogen acquisition. Thus, compared with plant $\delta^{15}N$, soil $\delta^{15}N$ can more accurately reflect soil nitrogen dynamics, while plant $\delta^{15}N$ may integrate soil nitrogen dynamics and plant nitrogen acquisition.