Appendix A. Climatic conditions and atmospheric N-deposition level in Newborough and Luchterduinen

Climatic conditions in Newborough and Luchterduinen and its effects on soil and vegetation in CENTURY model

Difference in meteorological data between Newborough (NB) and Luchterduinen (LD)

NB has warmer and wetter winter than LD, whereas LD has higher precipitation and higher potential evapotranspiration in summer than NB (Figure A.1). The ratio of precipitation to potential evapotranspiration in summer, which indicates the aridity, is slightly lower in LD than NB (i.e. LD experiences more drought stress in summer than NB) (Figure A.2).

Higher drought stress in LD compared to NB was also reflected in plant species composition. Average Ellenberg values for moisture were in general slightly higher for NB than LD (Figure A.3), indicating that LD has more species adapted for dry conditions.

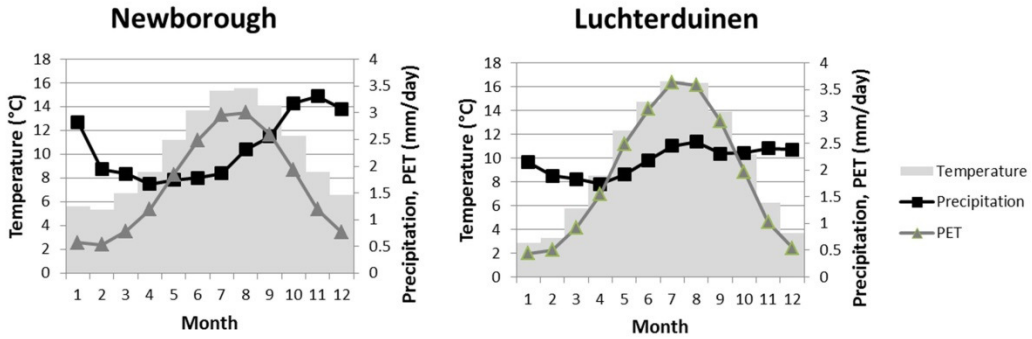

Figure A.1. Monthly average of temperature, precipitation, and potential evapotranspiration between 1931 and 2014.

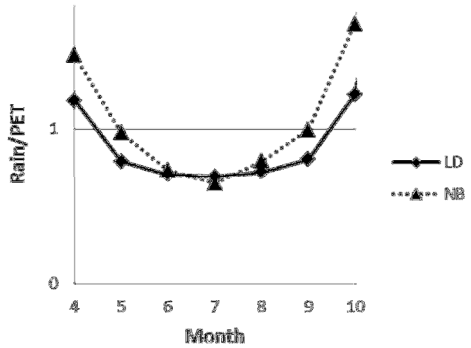

Figure A.2. Monthly average ratios of precipitation to potential evapotranspiration from April to October. Average values were calculated using the data of 1931 to 2014.

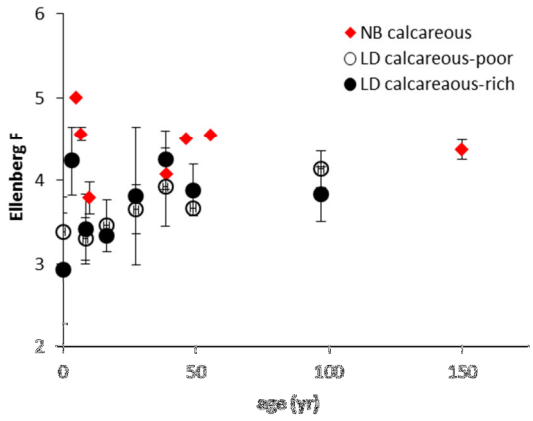

Figure A.3. Average Ellenberg value for moisture of the plant species recorded in the plots. For each vegetation record average values were calculated based on presence/absence data. Points indicate averages of vegetation records and bars standard deviation.

Effects of climate on soil and vegetation in CENTURY model

In the CENTURY model, soil moisture influences SOM decomposition, plant growth, shoot death, and root death, and soil temperature influences SOM decomposition and plant growth. On one hand, SOM decomposition and plant growth were reduced by low soil moisture content slightly more strongly in LD than in NB (Figure A.4 a&b) and shoot and root death rate were higher in LD than NB. On the other hand, SOM decomposition and plant growth were reduced by low soil temperature more strongly in NB than in LD (Figure A.4 c&d). Altogether, the influence of climatic factors (i.e. soil moisture and soil temperature) on SOM decomposition and plant growth was almost indifferent between LD and NB, and so was that on soil C and N accumulation.

Temporal changes in climate over years

In last decades annual precipitation was slightly increasing in LD (Figure A.5a) and therefore the difference in annual precipitation between LD and NB became smaller. Annual average temperature and potential evapotranspiration were increasing in last decades for both LD and NB (Figure A.5b, A.5c).

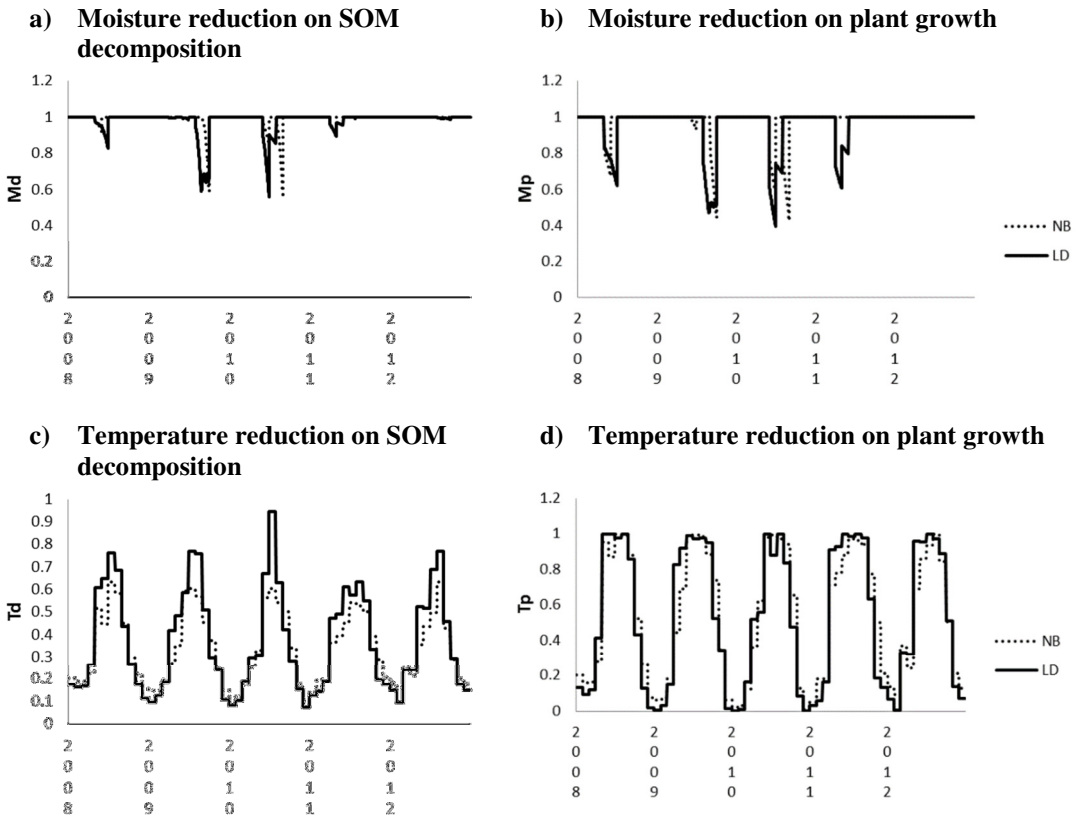

Figure A.4. Soil moisture reduction term on soil organic matter decomposition (a) and on plant growth (b) and soil temperature reduction term on soil organic matter decomposition (c) and on plant growth (d) in the CENTURY model. The reduction terms were computed from a 5-year simulation (from 2008 to 2012) with low atmospheric N deposition level and no symbiotic N fixation (thus the difference between NB and LD is caused merely due to climate). Value 1 means there is no reduction due to soil moisture or temperature, whereas value 0.5 means that soil moisture or temperature reduce SOM decomposition or plant growth to 50 %.

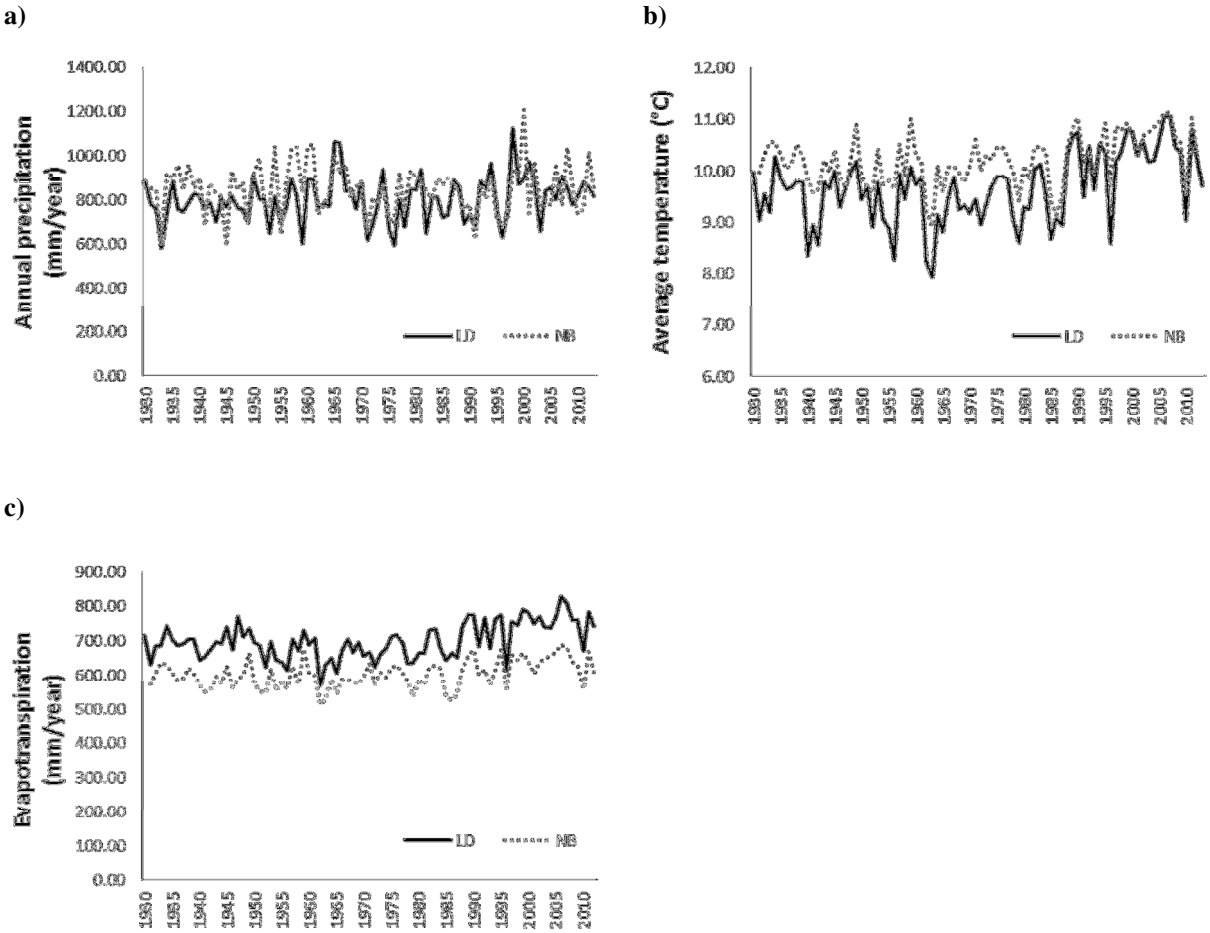

Figure A.5. Annual average values of precipitation (a), daily temperature (b), and potential evapotranspiration (c) of LD and NB from 1931 to 2012.

Atmospheric N deposition

Historical atmospheric N deposition levels in NB and LD are shown in Figure A.6. See Section 2.6 for the source of the data. Atmospheric N deposition level was similar between LD and NB till ca. 1920's. After that LD had higher levels (except during the World War II period), with a peak around 1970-1990 reaching almost 40 kgN ha^{-1} yr^{-1}. NB had only slightly elevated levels of atmospheric N deposition in the last decades, ranging between 5-10 kgN ha^{-1} yr^{-1}.

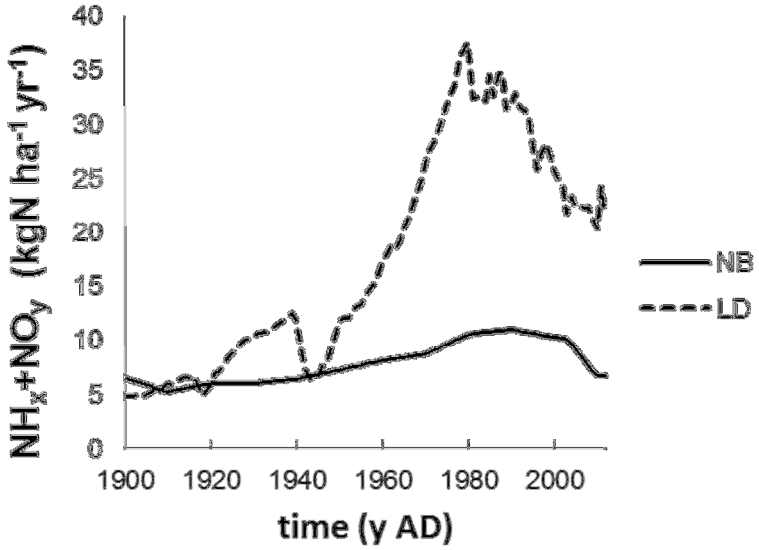

Figure A.6. Atmospheric N deposition (wet plus dry, NH_x plus NO_y) of NB and LD from 1900 to 2012.