CMIP5 land carbon modification to account for nutrient limitation in NPP

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N and P pools were tracked throughout the simulation. We assumed that the CMIP5 simulations were at equilibrium at the start of the *historical* simulation, thus initial pools were calculated from the starting NPP using proscribed biome specific N:P:C ratios. New N and P were added at proscribed rates over the *historical+RCP 8.5* simulation time and were allowed to accumulate in a vegetation nutrient pool.

We explored the possibility of soil nitrogen being returned to the vegetation pool during decomposition (ie for ever carbon respired a biome specific proscribed N was returned to the vegetation pool).

Three limitation scenarios were run (N, P, and N+P). N and P limitations for NPP were calculated using biome specific stoichiometric ratios. In the N+P scenario there were three possible limitations for a given grid cell: 1) a site was only P limited, resulting in the P determining NPP, 2) a site was only N limited, resulting in the N determined NPP, or 3) a site was both P and N limited, in that case the ratio between N:P pools was taken, if it was below 16 then the site was considered N limited, above or equal to 16 was P limited.

If N limited or then, otherwise . Where and . The influxes were calculated from change in nutrient supported NPP.

We then took the ratio between the simulated and limited NPP and applied this as a correction factor in both the carbon loss rate from the vegetation pool and carbon input to the soil pools. These two fluxes were slightly different in some models due to LUC/fire/grazing or other fluxes.

We assumed that the simulations had a modern NEE target and modified the decomposition rate accordingly for the *historical* timeline. The mean ratio of the last 10 years of this modified decomposition rate to the original decomposition rate was then applied to the *RCP 8.5* time line over the last 100 years considered.

Carbon stocks for both vegetation and soil pools were recalculated each year based on the described flux and decomposition rate adjustments.

We explored the upper and lower bounds generated by uncertainties in inputs and C:N:P ratios. In ‘lowerIn’ we reduced the N and/or P nutrient flux by 20% and similarly raised it by 20% for ‘upperIn’. In ‘lowerRatio’ we reduced the C:N:P ratio by 20%, similarly raised it by 20% for ‘upperRatio’. Changing the relative inputs and C:N:P ratios had similar effects on NPP productions. For ‘upperInRatio’ and ‘lowerInRatio’ we changed both the inputs and ratios by 20%.