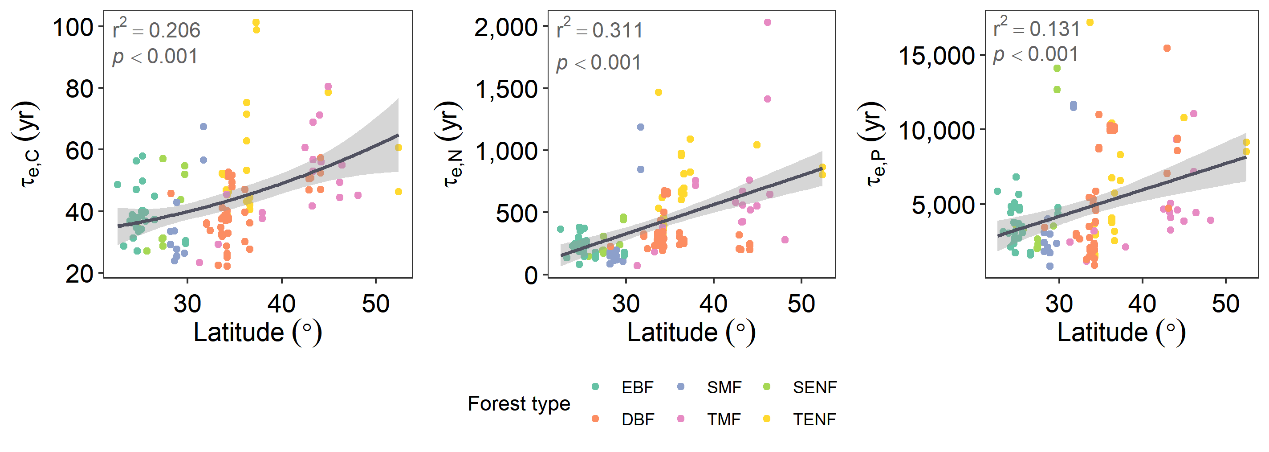
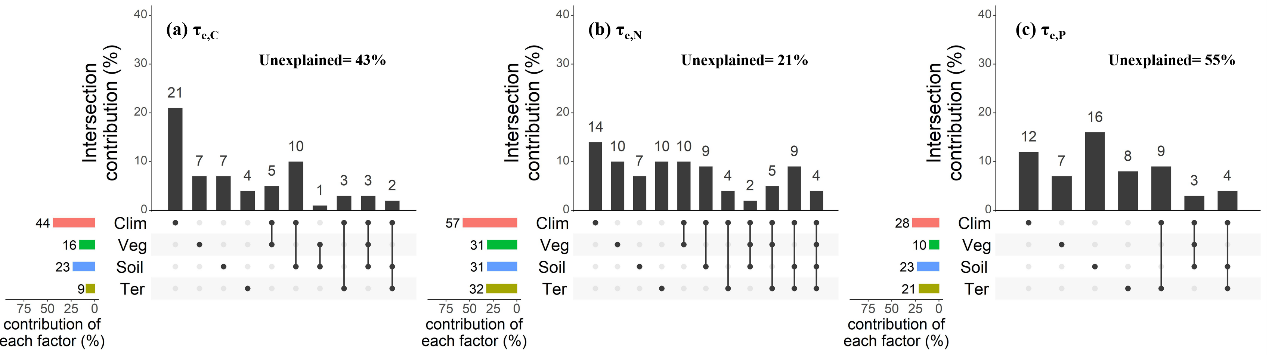


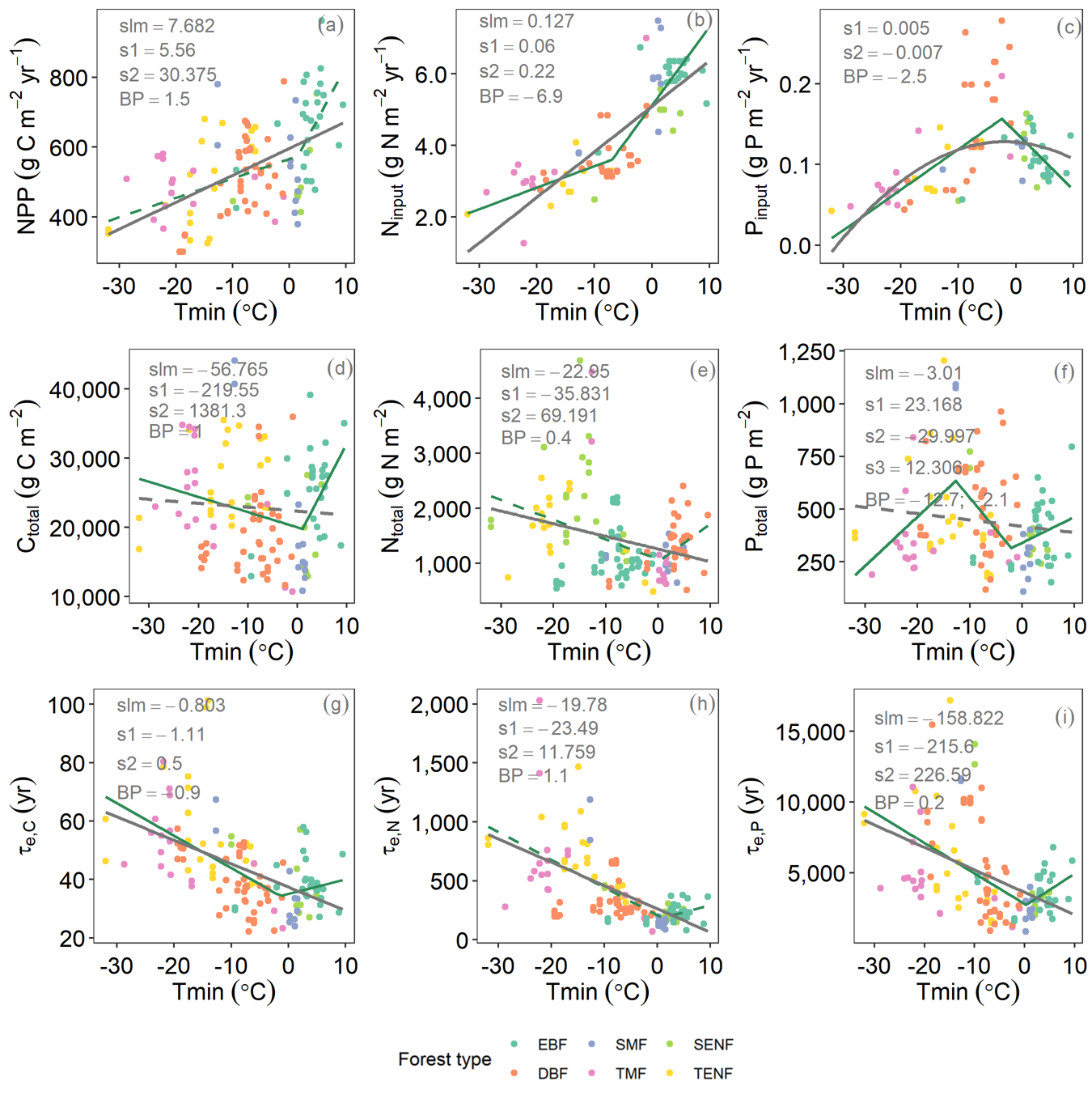
**Fig. 1** Locations of the 127 forest sites used in this study. There are 6 different forest types: 1: subtropical evergreen needle forests (SENF, 9 sites), 2: subtropical mixed forests (SMF, 11 sites), 3: evergreen broadleaved forests (EBF, 28 sites), 4: temperate evergreen needle forests (TENF, 22 sites), 5: temperate mixed forests (TMF, 17 sites), 6: deciduous broadleaved forests (DBF, 40 sites) across temperate and subtropical area based on the classification by Institute of Geographic Sciences and Natural Resources Research, CAS (http://www.resdc.cn/). The bioclimatic regions in China include: subtropical forest region (STF), temperate vegetation region (TEV), and tropical monsoon forest-rainforest region (TRF), Qinghai-Tibet alpine vegetation region (QTV), temperate desert region (TED).

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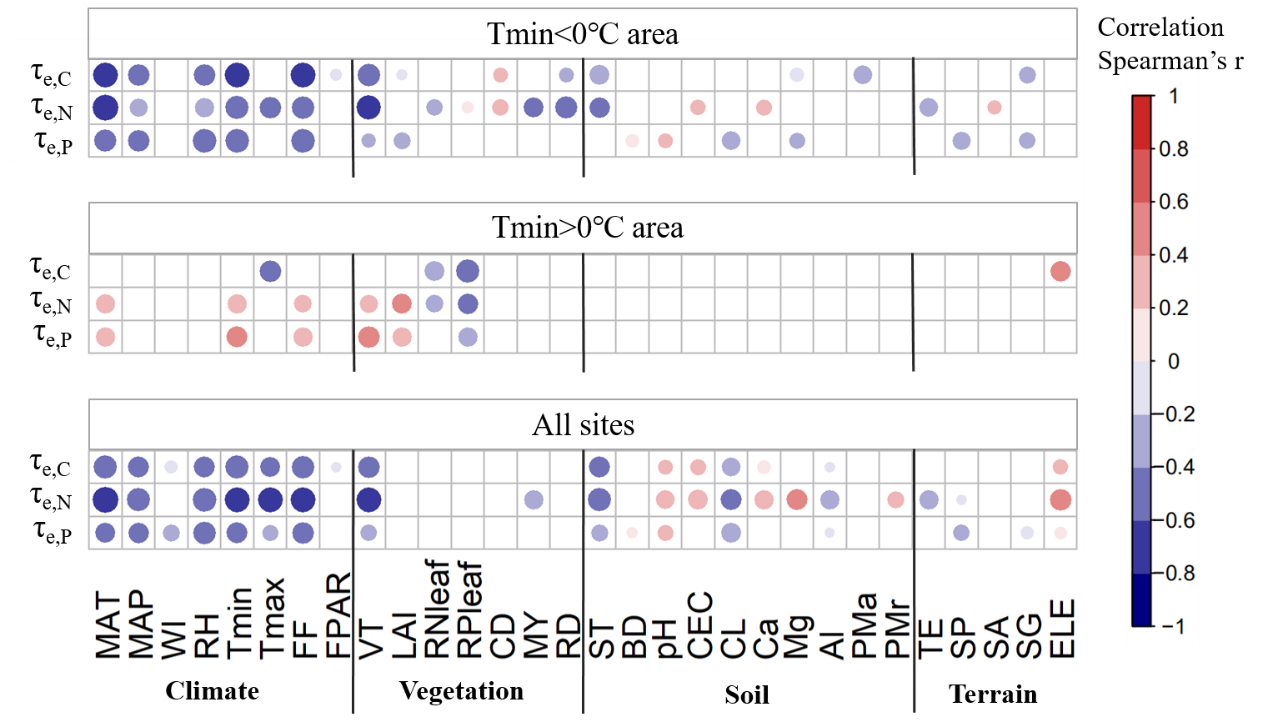
**Fig. 2** Variations of ecosystem residence times of C (a), N (b) and P (c) with latitude. Lines and shaded areas represent the best fitted regression and their 95 % confidence intervals, respectively. r2 and *p*-value are also shown for each regression. Different colors of symbols represent different forest types. EBF, MF, DBF and ENF represent evergreen broadleaf forest, mixed forest, deciduous broadleaf forest and evergreen needle leaf forest, respectively. MF and ENF distributed across temperate and subtropical area, so we classfied them as temperate mixed/neddle forest (TMF/TENF) and subtropical mixed/needle forest (SMF/SENF).

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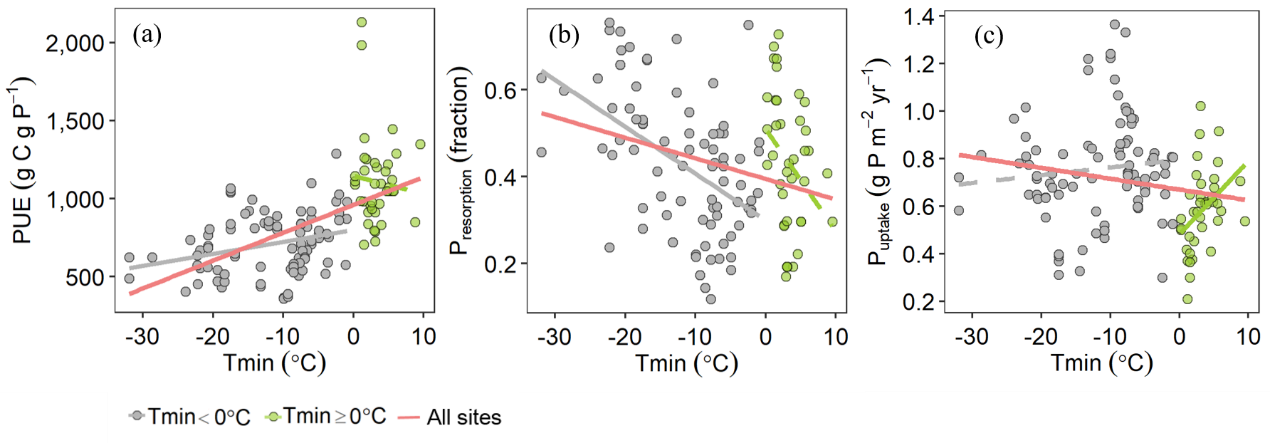
**Fig. 3** Contributions of climate- (Clim), vegetation- (Veg), soil-, and terrain- (Ter) related vartiables to the variance of the estimated ecosystem residence time of C (a), N (b), and P (c) across 127 mature forests. Direct effects of climate, vegetation, soil or terrain are represented by the first four bars from the y-axis above the x-axis, and other bars represent the interactions of two or three groups of factors as indicated by the lines linking solid black points below the x-axis. Total contributions (individual and interactive effects) of climate, vegetation, soil or terrain are shown by the horizontal colored bars besides each variable group. The amount of unexplained variance is also shown in each panel.



**Fig. 4** Segmented regression analysis of the dependence of input fluxes (panels a to c), ecosystem pool sizes (panels d to f), and ecosystem residence time (panel g to i) of C, N or P on mean annual minimum temperature (*T*min in oC). Green lines show relationships fitted by segmented regression, grey lines show relationships fitted by ordinary linear regression. Solid and dashed lines of the segmented regression represent statistically significant (*p*<0.05) or not significant (p>0.05) slopes from the slope of ordninary regression. In the legend for each panel, “s1” and “s2” represent the slopes of segmented regression before and after the break point, repsectively. “slm” represents the slope of linear regression. “BP” represent *T*min breakpoint. Colored points represent different forest types, and details can be found in Fig. 2.

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**Fig. 5** Spearman correlation coefficients (r; shown in color bar) between ecosystem residence times of C, N, and P and **climate variables** — mean annual temperature (MAT), mean annual precipitation (MAP), Wetness index P/PET (WI), Minimum annual temperature (Tmin), Maximum annual temperature (Tmax), frost free days (FF), fraction of photosynthetically active radiation (FPAR), **vegetation variables** —vegetation type (VT), max leaf area index (LAI), N resorption coefficient of leaf (RNleaf), P resorption coefficient of leaf (RPleaf), canopy density (CD), Mycorrhiza type (MY), max rooting depth (RD), **soil physiochemical properties**—soil type (ST), bulk density (BD), pH(pH), cation exchangeable capacity (CEC), clay content (CL), exchangeable Ca2+ (Ca)，exchangeable Mg2+ (Mg), exchangeable Al3+ (Al), parent material acidity (PMa), parent material P richness (PMr), and **terrain variables** — terrain type (TE), slope position (SP), slope aspect (SA), slope gradient (SG), elevation (ELE). Insignificant correlation (*p*>0.05) is displayed as a blank box.



**Fig. 6** Variations of P use efficiency (a, PUE), resorption fraction (b), and uptake (c) with mean minimum annual temperature (*T*min). Grey point represents pools and fluxes for the forest sites with *T*min < 0 ℃, green ponit represents pools and fluxes for the forest sites with *T*min > 0 ℃. Solid and dash lines represent statistically significant (*p*<0.05) or nonsignificant (*p*>0.05) regression lines, respectively.

Table 1 Mean pool sizes and fluxes of C, N and P of different forest types in China. Different letters represent significant differences at *p*< 0.05 among different forest types.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | TENF | TMF | DBF | SENF | SMF | EBF |
| NPP  (g C m-2 yr-1) | 502 b | 483 b | 501 b | 503 b | 551 b | 669 a |
| Biomass C  (g C m-2) | 8067 ab | 8814a | 7101 b | 8075 ab | 7801 ab | 9964 a |
| Soil C  (g C m-2) | 17480 a | 14823 abc | 11505 d | 11412 bcd | 12042 cd | 15335 ab |
| *τ*e,C (yr) | 56 a | 50 a | 39 b | 40 b | 36 b | 39 b |
| External input (g N m-2 yr-1) | 3.0 c | 3.1 bc | 3.5 b | 4.4 b | 5.7 a | 6.0 a |
| N uptake (g N m-2 yr-1) | 7.1 c | 7.9 bc | 8.9 b | 6.5 c | 9.1 b | 12 a |
| Biomass N  (g N m-2 ) | 76 ab | 79 a | 64 b | 75 ab | 87 ab | 96 a |
| Soil N  (g N m-2 ) | 1949 a | 1535 ab | 1032 c | 1005 c | 1286 bc | 1235 bc |
| *τ*e,N (yr) | 710 a | 645 a | 325 b | 269 bc | 299 c | 226 c |
| External input (g P m-2 yr-1) | 0.10 ab | 0.09 b | 0.13 a | 0.11 ab | 0.11 a | 0.11 a |
| P uptake (g P m-2 yr-1) | 0.68 a | 0.74 a | 0.75 a | 0.69 a | 0.47 b | 0.72 a |
| Biomass P  (g P m-2 ) | 8.6 ab | 11.5 a | 7.8 bc | 12.2 a | 5.8 c | 8.3 ab |
| Soil P  (g P m-2) | 456 ab | 324 b | 504 a | 406 ab | 412 b | 383 b |
| *τ*e,P (yr) | 5619 a | 4528 a | 5291 a | 5148 ab | 4047 a | 3724 a |