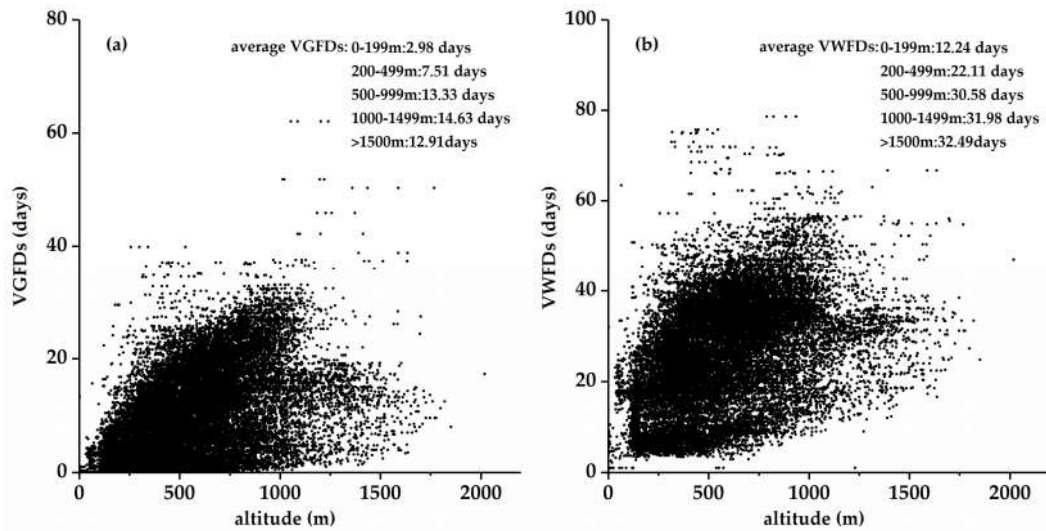
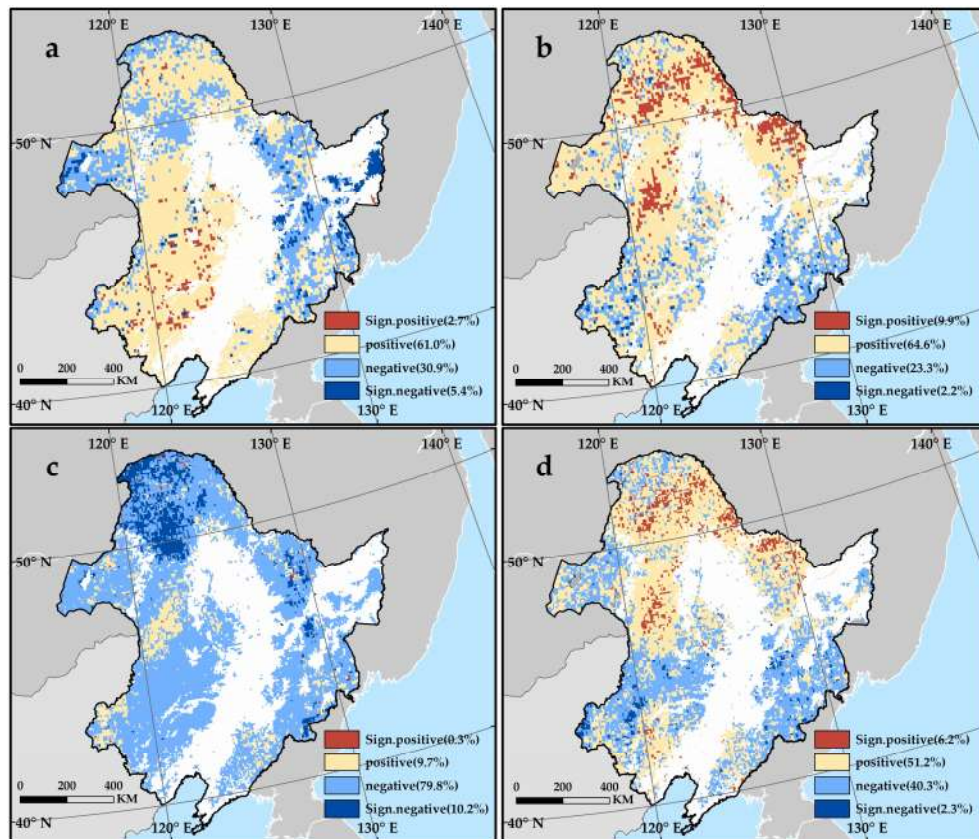


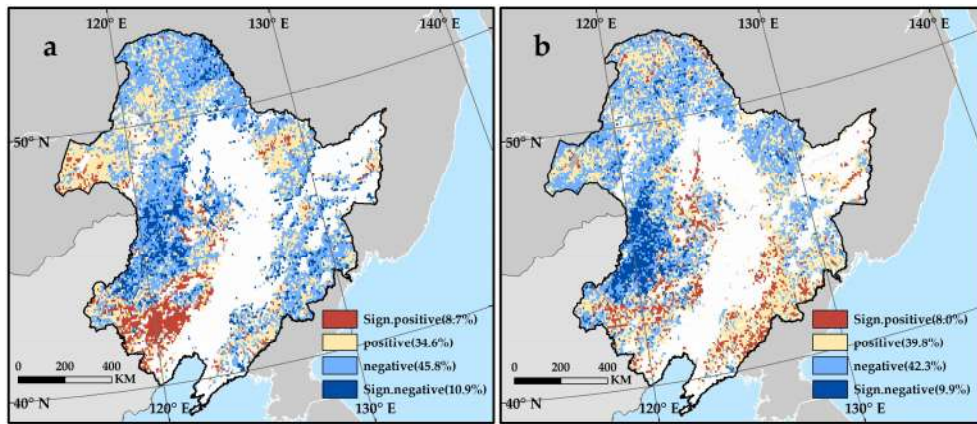
**Figure S1.** Sensitivity of  $V_{greenup}$  and  $V_{withering}$  to frost intensity under different temperature thresholds: (a) 2 °C during vegetation greenup; (b) 2 °C during vegetation withering; (c) 1 °C during vegetation greenup; (d) 1 °C during vegetation withering; (e) 0 °C during vegetation greenup; (f) 0 °C during vegetation withering; (g) -1 °C during vegetation greenup; (h) -1 °C during vegetation withering; (i) -2 °C during vegetation greenup; and (j) -2 °C during vegetation withering.



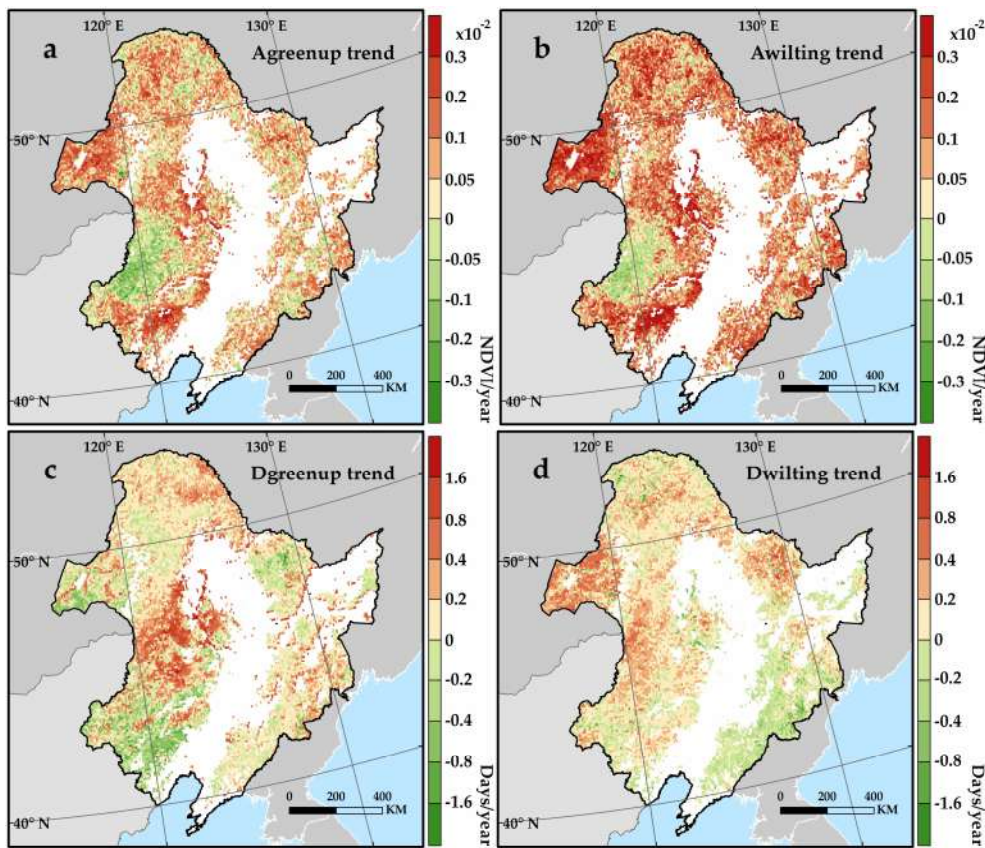
**Figure S2.** The relationship between altitude and (a) the number of frost days during the vegetation greenup (VGFDs); and (b) the number of frost days during vegetation withering (VWFDs).



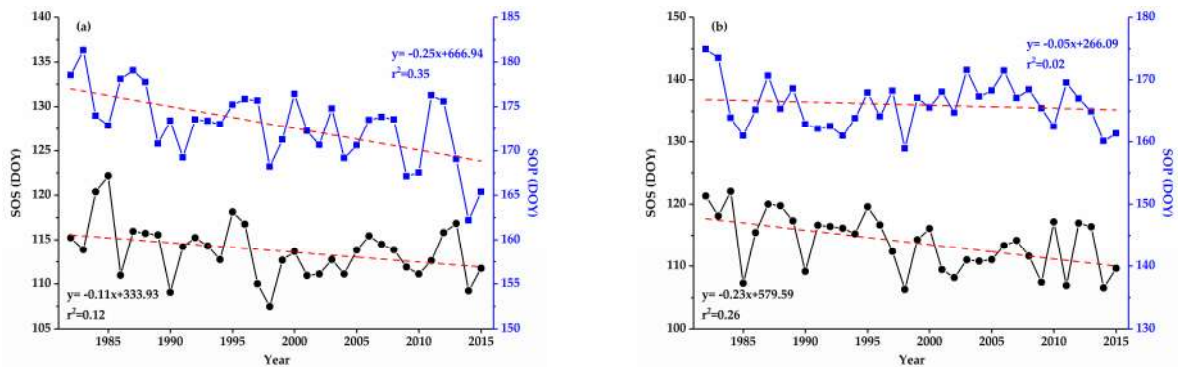
**Figure S3.** Spatial distribution of the significant trends in frost days and frost intensity in Northeast China from 1982 to 2015 during different periods: (a) frost days during vegetation greenup (VGFDs); (b) frost days during vegetation withering (VWFDs); (c) average accumulated frost degree days during vegetation greenup (AFDD<sub>VG</sub>); (d) average accumulated frost degree days during vegetation withering (AFDD<sub>VW</sub>) from 1982 to 2015.

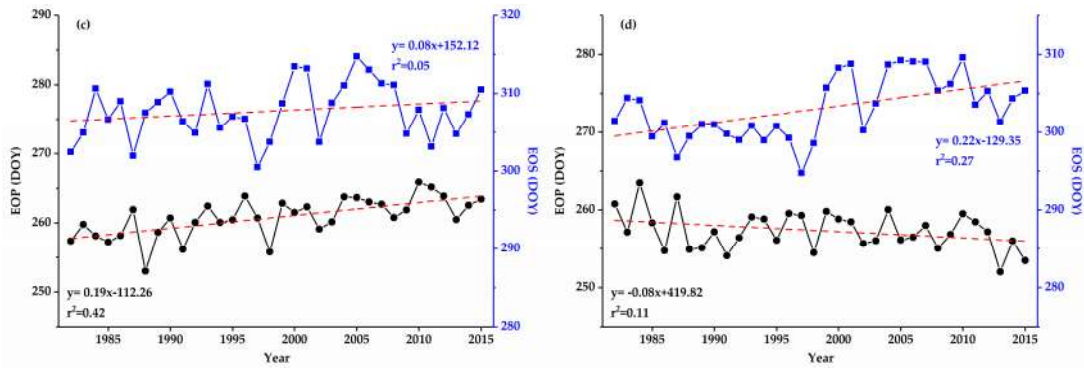


**Figure S4.** Spatial distribution of the significant trends in: (a) Vgreenup and (b) Vwithering in Northeast China during 1982–2015.

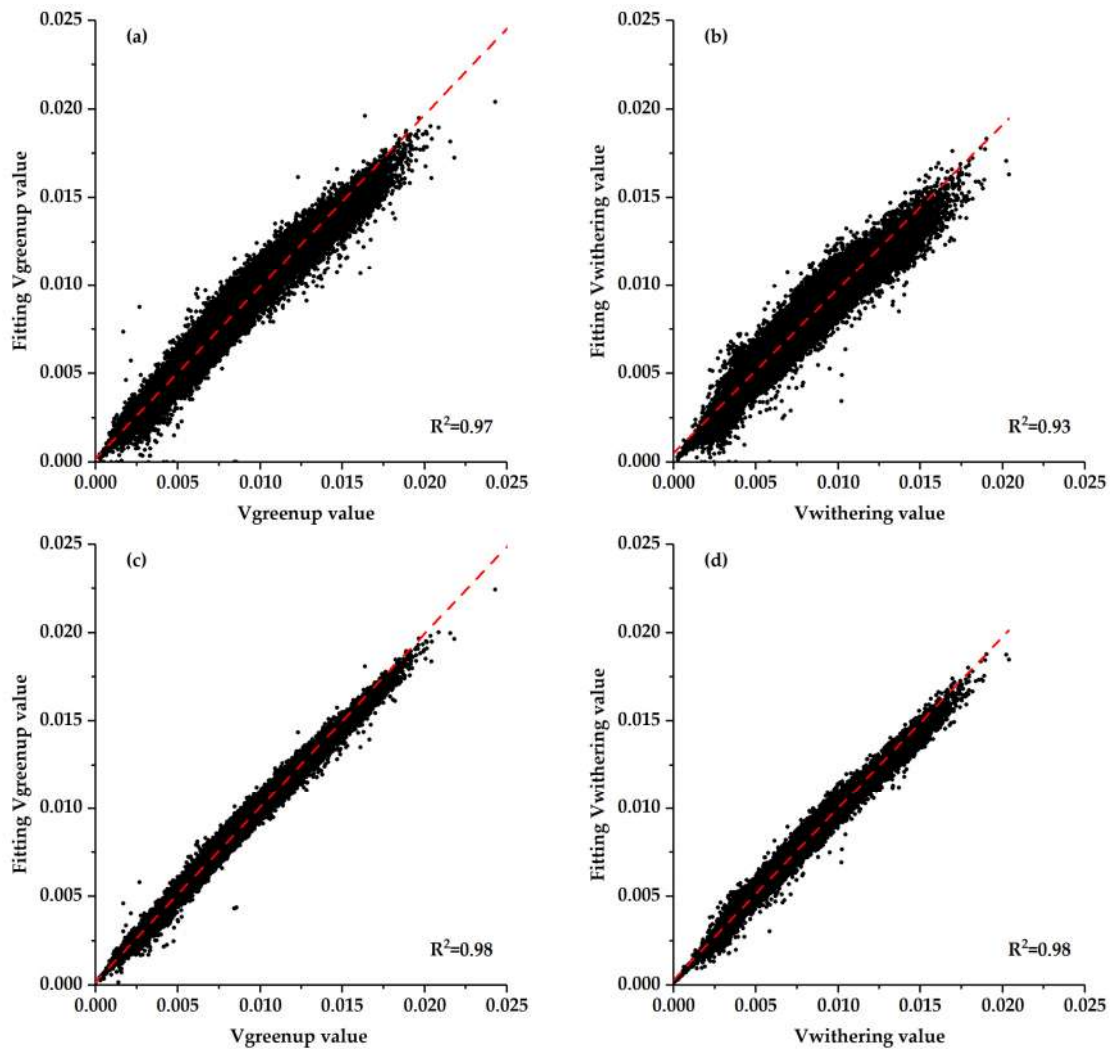


**Figure S5.** Spatial distribution of trends in (a) Agreenup; (b) Awithering; (c) Dgreenup; (d) Dwithering in Northeast China during 1982–2015.





**Figure S6.** Temporal trends of the start and end dates of the greenup period (or withering period) under: (a) positive trend in Vgreenup; (b) negative trend in Vgreenup; (c) positive trend in Vwithering; and (d) negative trend in Vwithering during 1982–2015.



**Figure S7.** Verification of multiple linear regression results: (a) and (b) temperature, precipitation and solar radiation and frost days were used as independent variables; (c) and (d) temperature, precipitation and solar radiation and average accumulated frost degree days were used as independent variables.