

Figure S1. Same as Fig. 2 in the main article but for storms Unto (panels a, c, e and g) and Saima (panels b, d, f and h): panels (a-b) show wind speed (WS, shading starting from 30 m s^{-1}) and geopotential height at 250 hPa, (c-d) wind speed (WS, shading starting from 20 m s^{-1}) and geopotential height at 500 hPa, (e-f) specific humidity (q , shading) and geopotential height (black contours) at 850 hPa, and (g-h) temperature (T) at 850 hPa (shading) and mean sea level pressure (MSLP, black contours). In all panels, blue circles indicate the approximate location of the systems at the times of the analyses and arrows point to the approximate movement of the system during the following three hours.

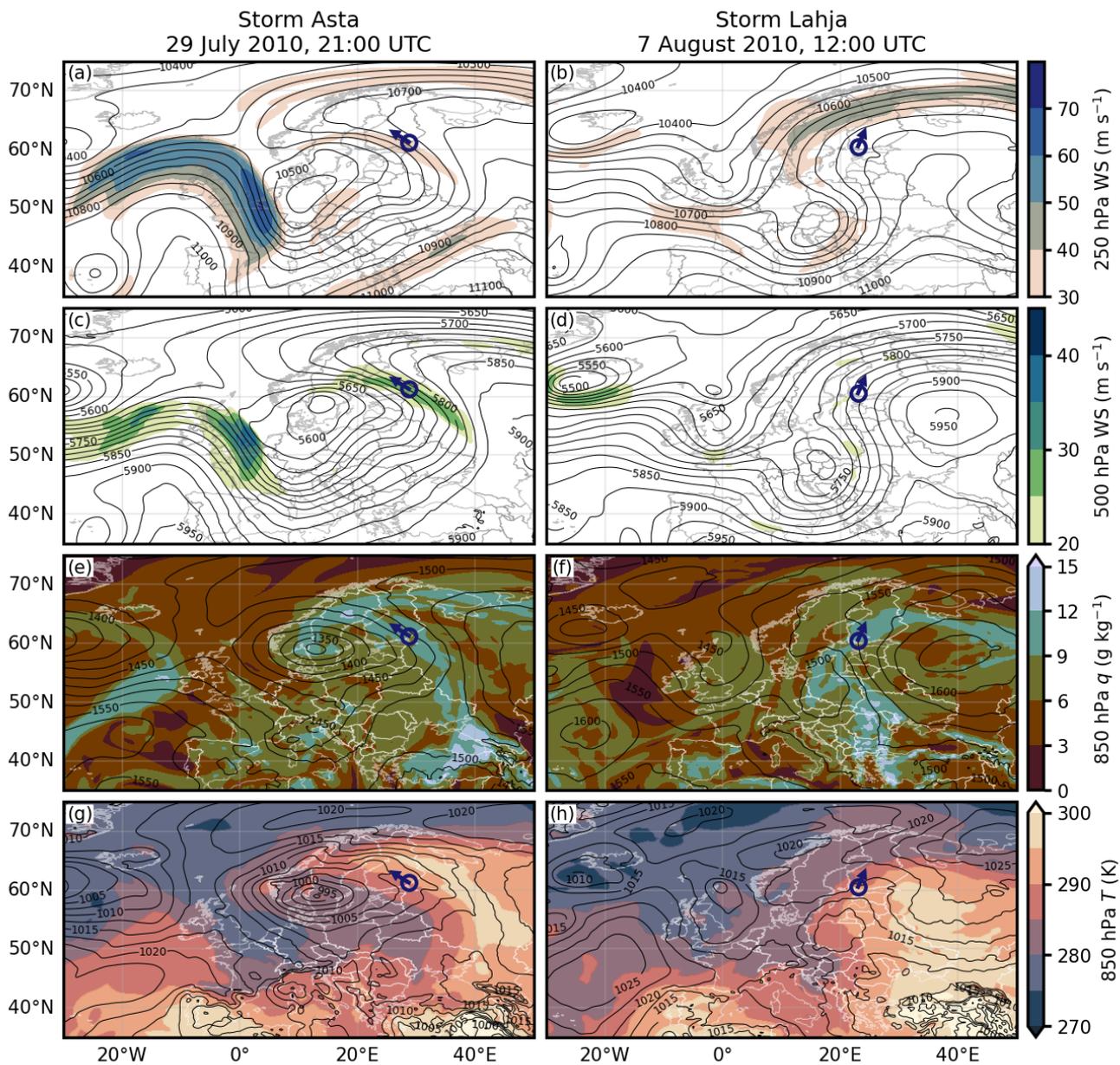


Figure S2. Same as Fig. S1 but for storms Asta (panels a, c, e and g) and Lahja (panels b, d, f and h).

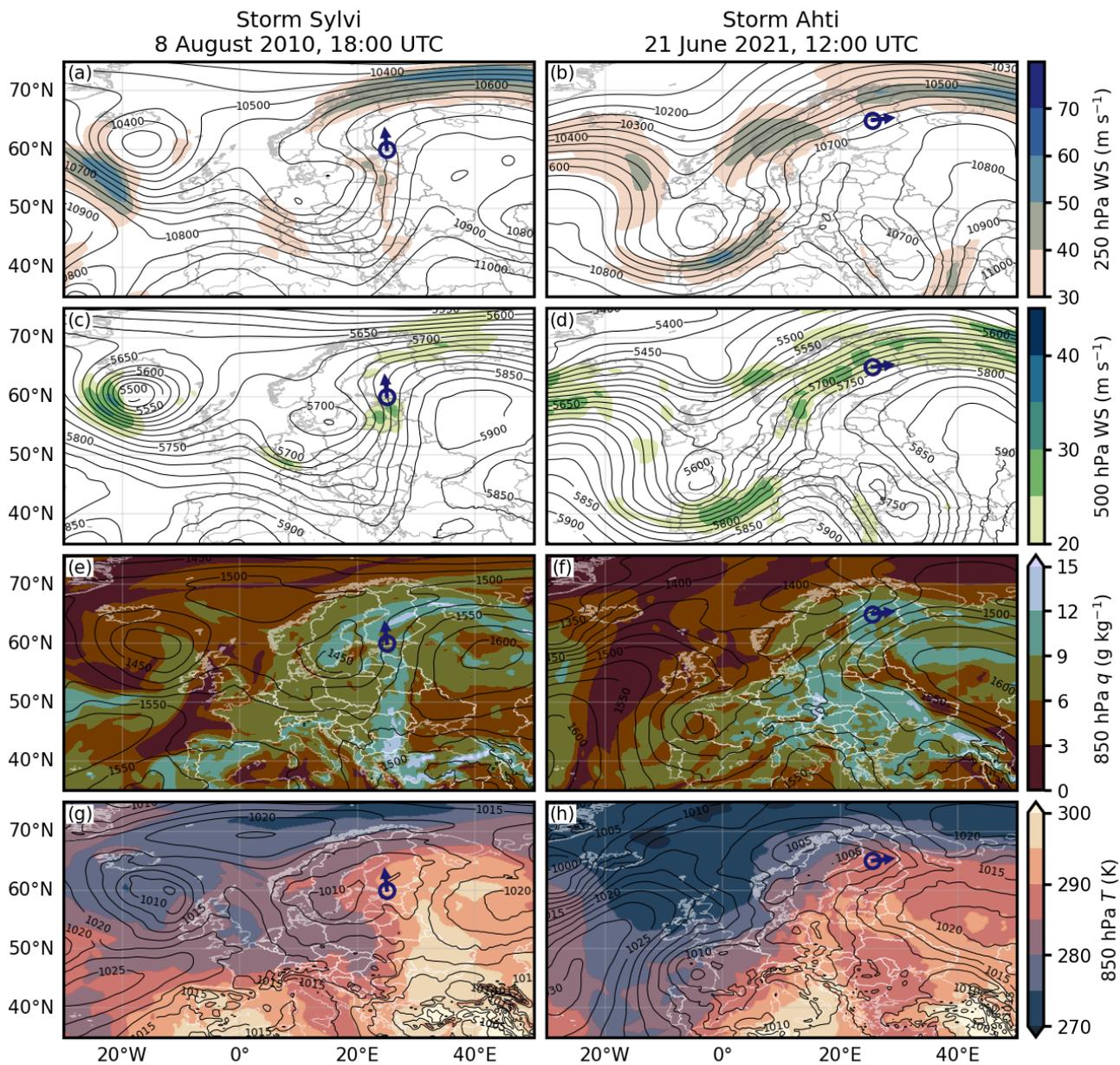


Figure S3. Same as Fig. S1 but for storms Sylvi (panels a, c, e and g) and Ahti (panels b, d, f and h).

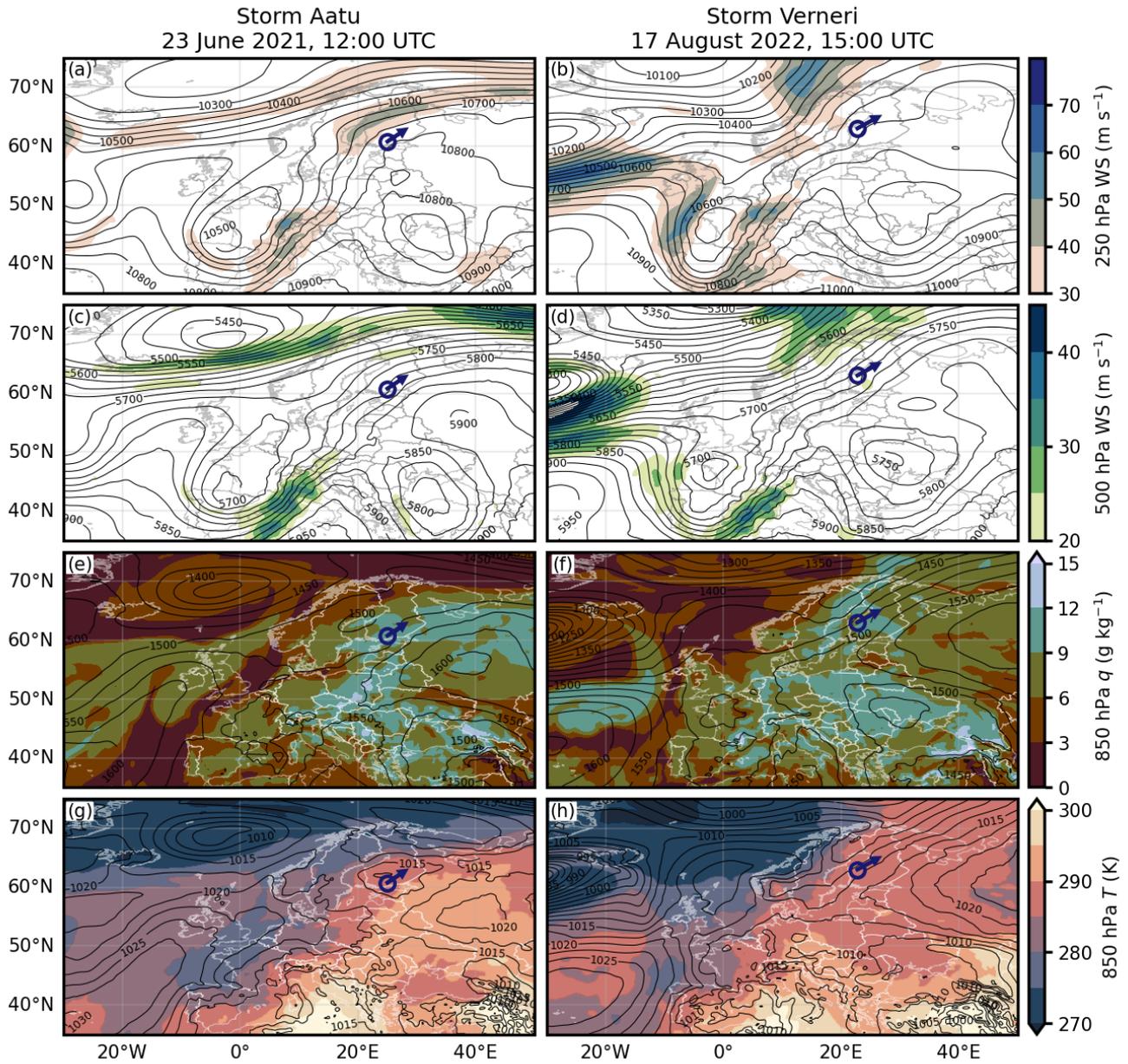


Figure S4. Same as Fig. S1 but for storms Aatu (panels a, c, e and g) and Vernerri (panels b, d, f and h).

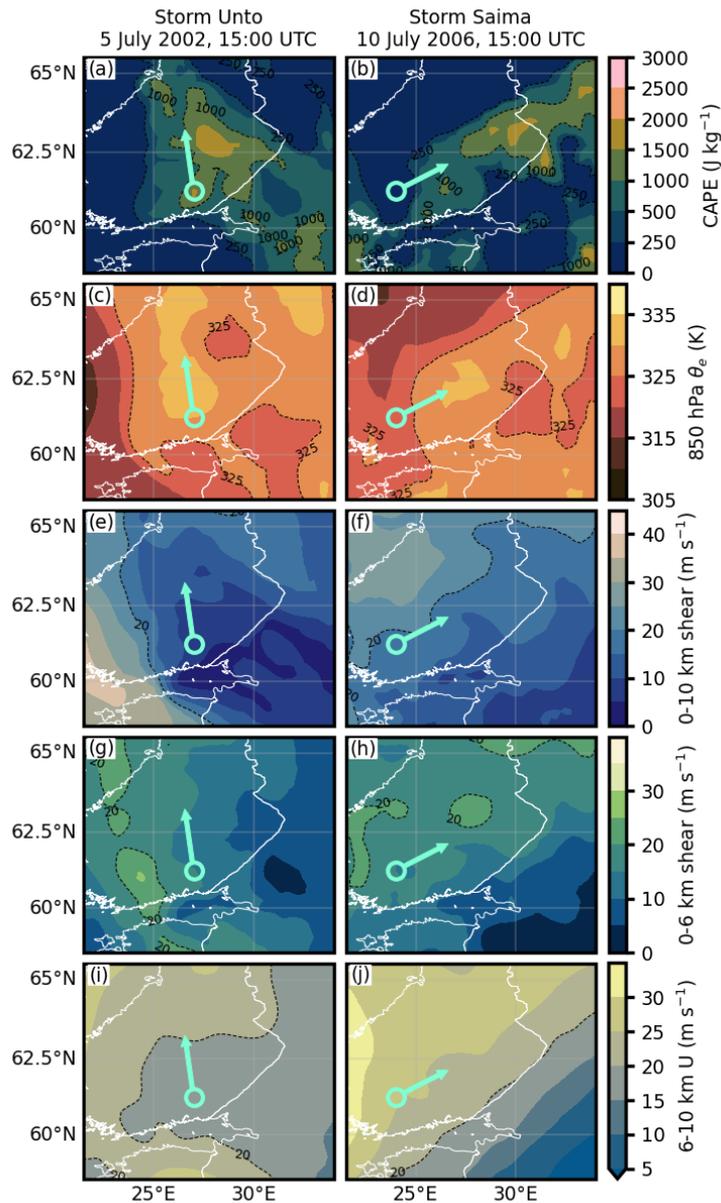


Figure S5. Same as Fig. 3 in the main article but for storms Unto (panels a, c, e, g and i) and Saima (panels b, d, f, h and j): panels (a-b) show CAPE (shading, isolines of 250 J kg^{-1} and 1000 J kg^{-1} are also drawn with black dashed contours to help readability), (c-d) equivalent potential temperature (θ_E) at 850 hPa (shading, 325 K isolines drawn with dashed black contours), (e-f) 0–10 km vertical wind shear (shading, 20 m s^{-1} isolines drawn with dashed black contours), (g-h) 0–6 km vertical wind shear (shading, 20 m s^{-1} isolines drawn with dashed black contours) and (i-j) 6–10 km layer mean wind speed (shading, 20 m s^{-1} isotachs drawn with dashed black contours). In all panels, aquamarine circles indicate the approximate location of the systems at the times of the analyses and arrows point to the approximate movement of the system during the following three hours.

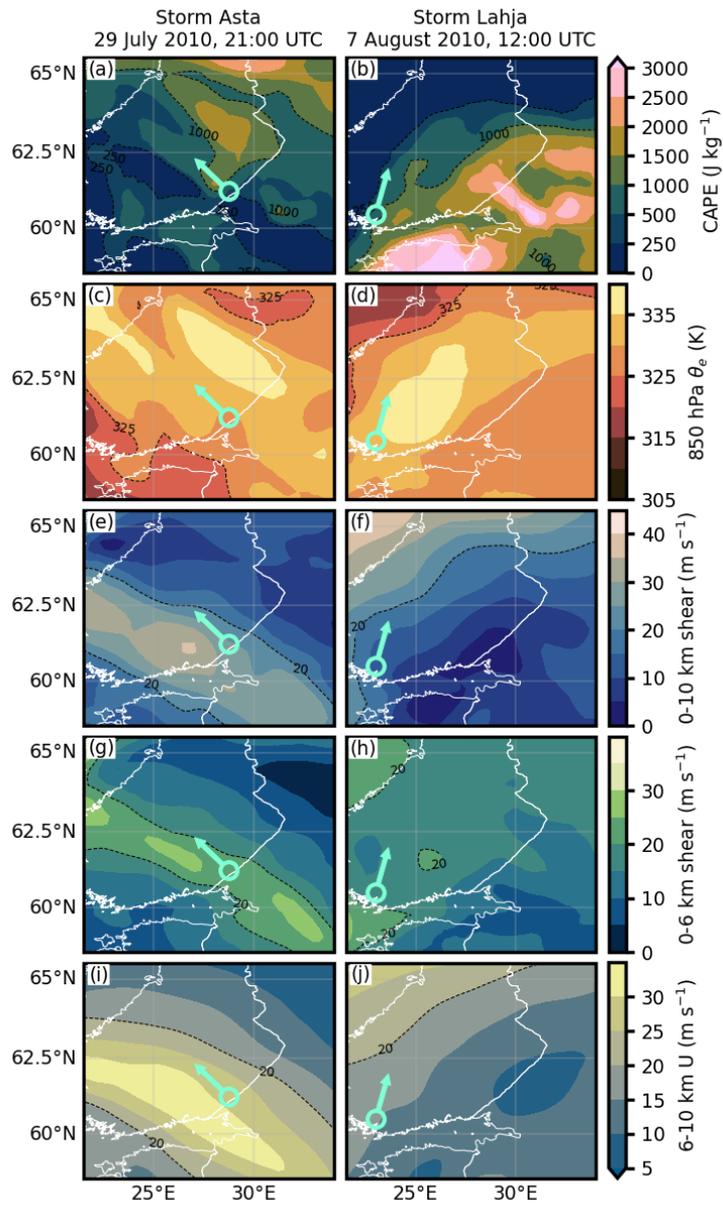


Figure S6. Same as Fig. S5 but for storms Asta (panels a, c, e, g and i) and Lahja (panels b, d, f, h and j).

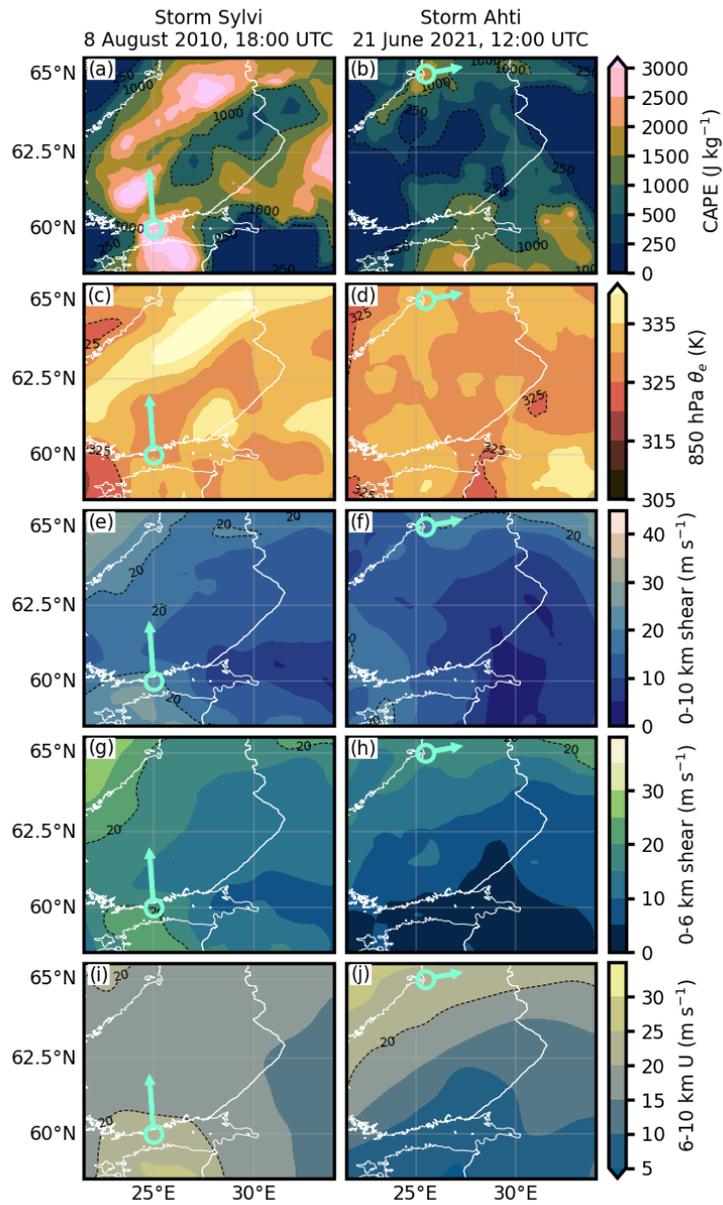


Figure S7. Same as Fig. S5 but for storms Sylvi (panels a, c, e, g and i) and Ahti (panels b, d, f, h and j).

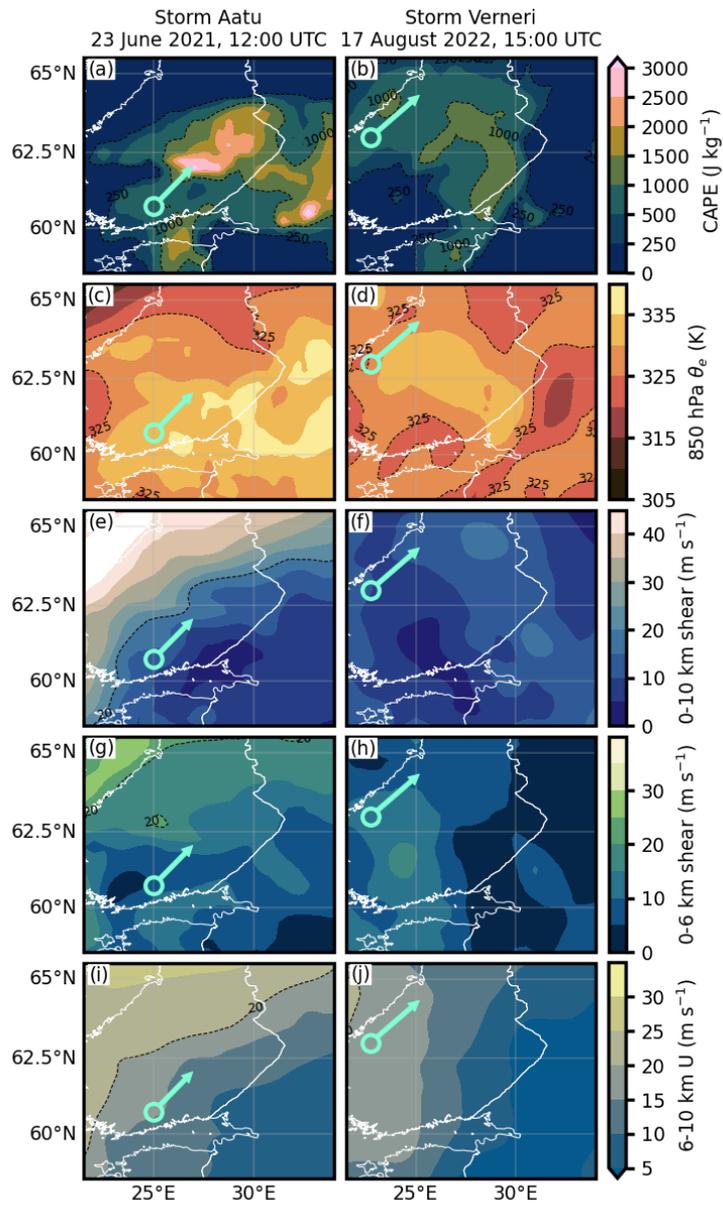


Figure S8. Same as Fig. S5 but for storms Aatu (panels a, c, e, g and i) and Verner (panels b, d, f, h and j).

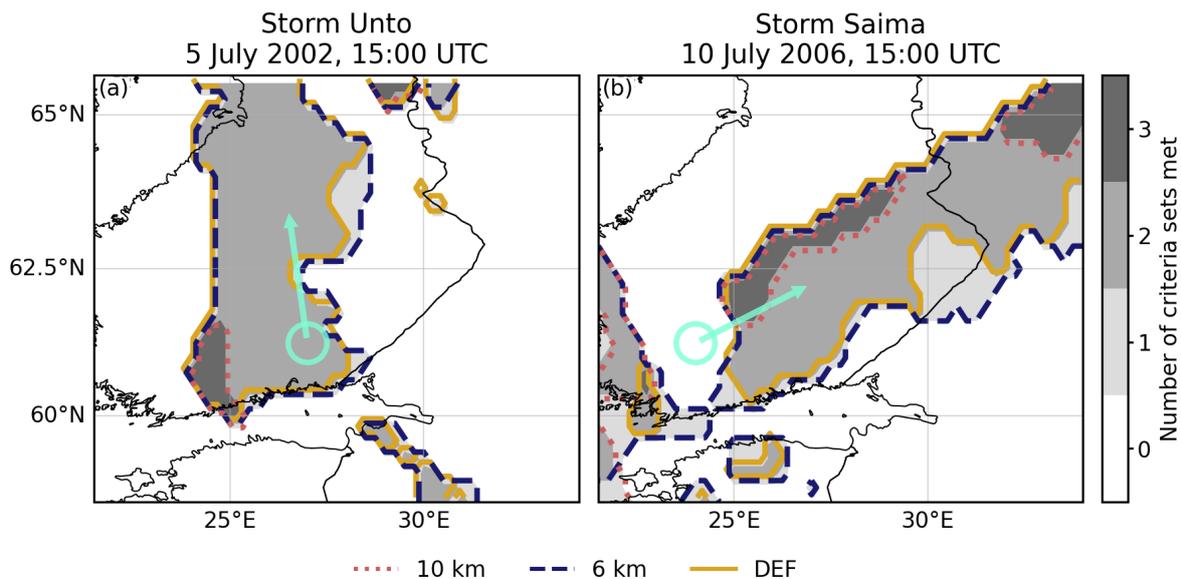


Figure S9. Same as Fig. 4 in the main article but for storms Unto (a) and Saima (b): shades of gray indicate how many of the three criteria sets are met in each grid cell. The areas satisfying the 10 km criteria set are outlined with red dotted lines, the 6 km criteria set with blue dashed lines and the DEF criteria set with gold solid lines. Aquamarine circles indicate the approximate location of the systems at the times of the analyses and arrows point to the approximate movement of the system during the following three hours.

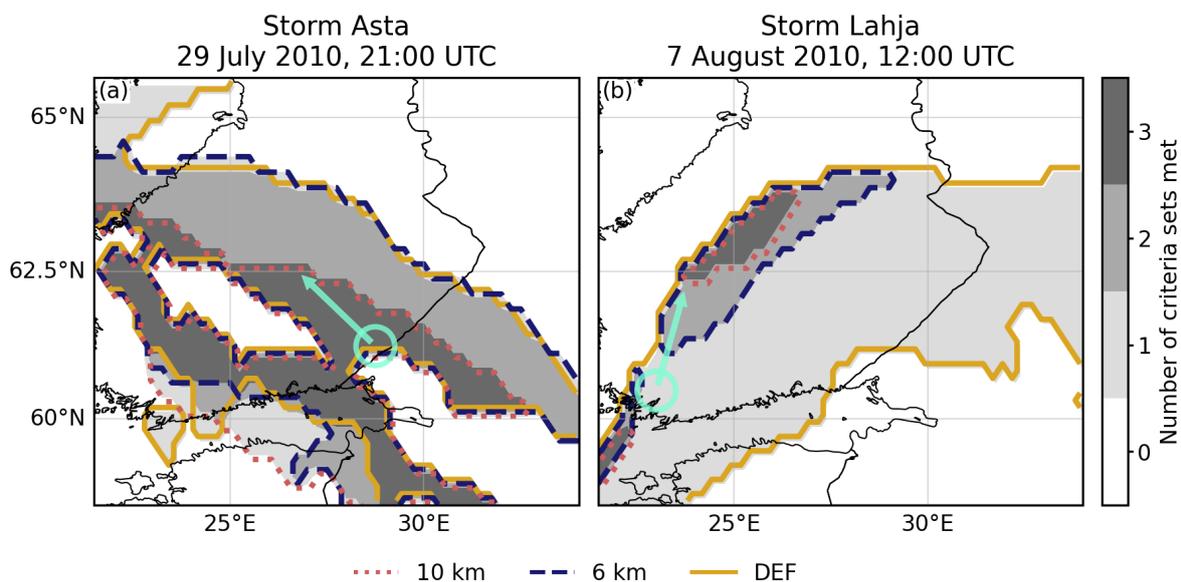


Figure S10. Same as Fig. S9 but for storms Asta (a) and Lahja (b).

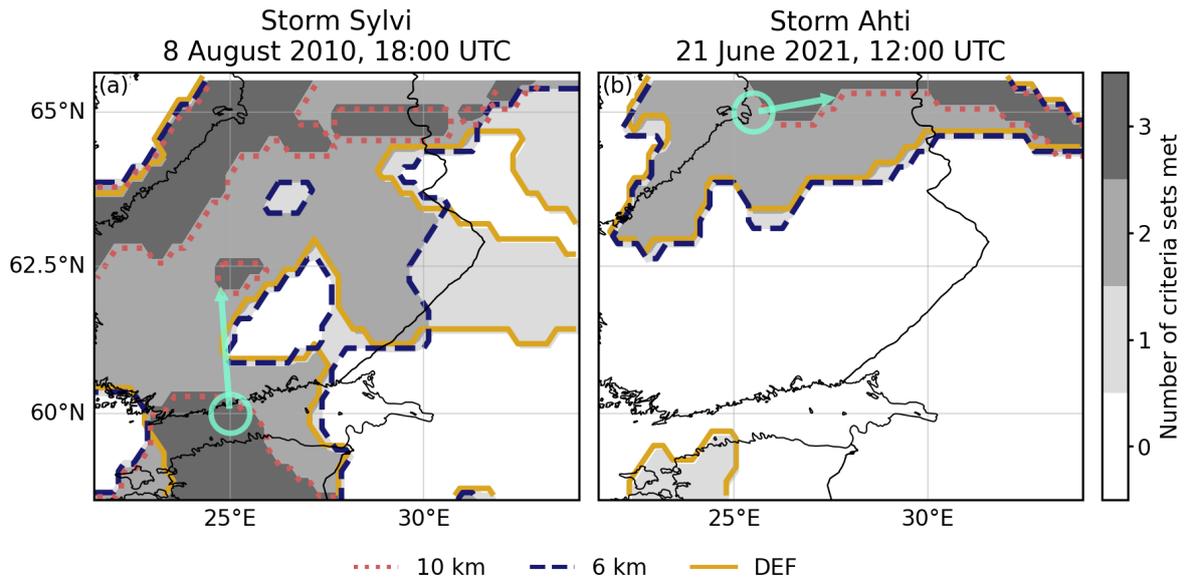


Figure S11. Same as Fig. S9 but for storms Sylvi (a) and Ahti (b).

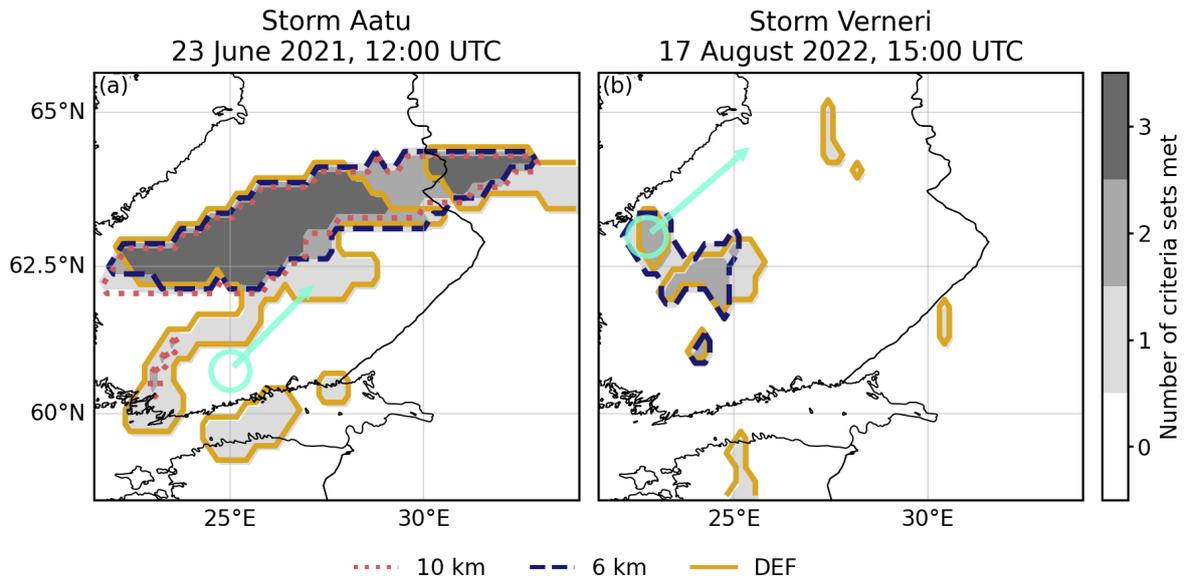


Figure S12. Same as Fig. S9 but for storms Aatu (a) and Vernerri (b).

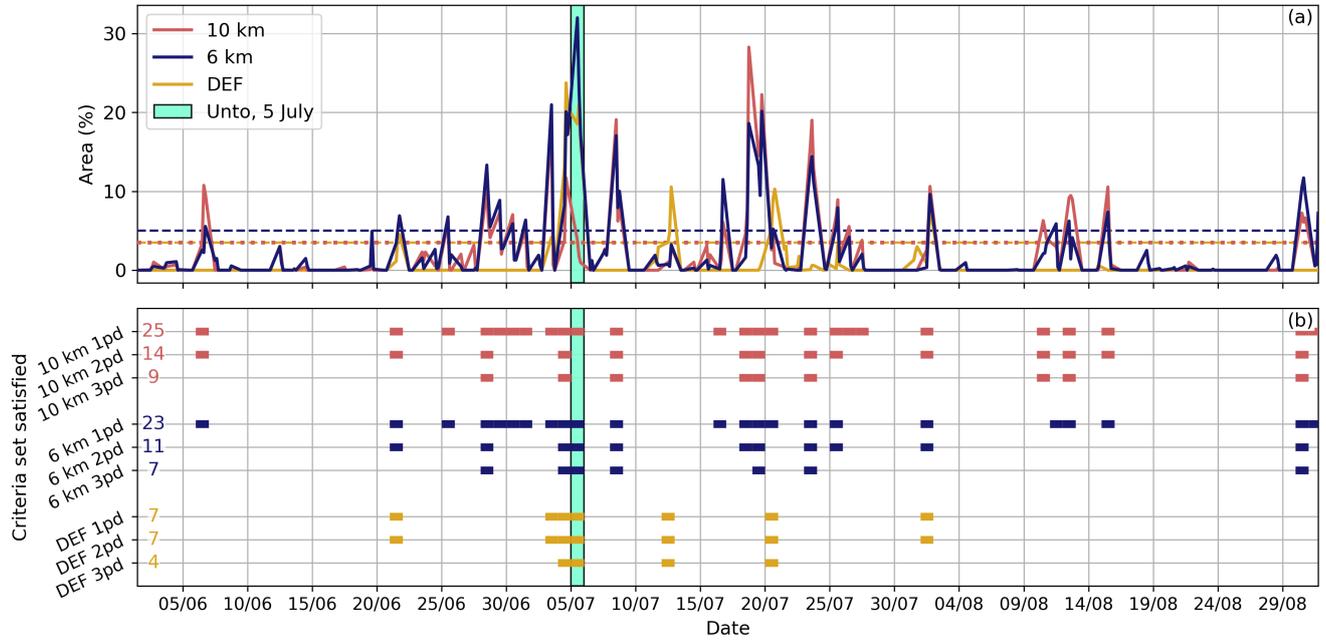


Figure S13. Same as Fig. 5 in the main article but for summer 2002: vertical bar(s) in both panels indicate day(s) when derechos occurred. Panel (a) shows the fraction (%) of the grid area where each criteria set is satisfied. The red line represents the 10 km criteria set, the blue line the 6 km criteria set and the gold line the DEF criteria set. Data includes three time steps per day (12, 15, and 18 UTC), as described in the main article in Sect. 2.4. Horizontal lines illustrate the area demands for each criteria set: 5 % for the 6 km criteria set (blue, dashed) and 3.5% for both the 10 km (red, dashed) and DEF criteria sets (gold, dotted). Panel (b) presents the favorable days throughout the summer for each criteria set, with conditions satisfied once per day (1pd), twice per day (2pd) and at all three times per day (3pd), illustrated with bold lines. Total number of favorable days for each category is indicated on the left side of the panel.

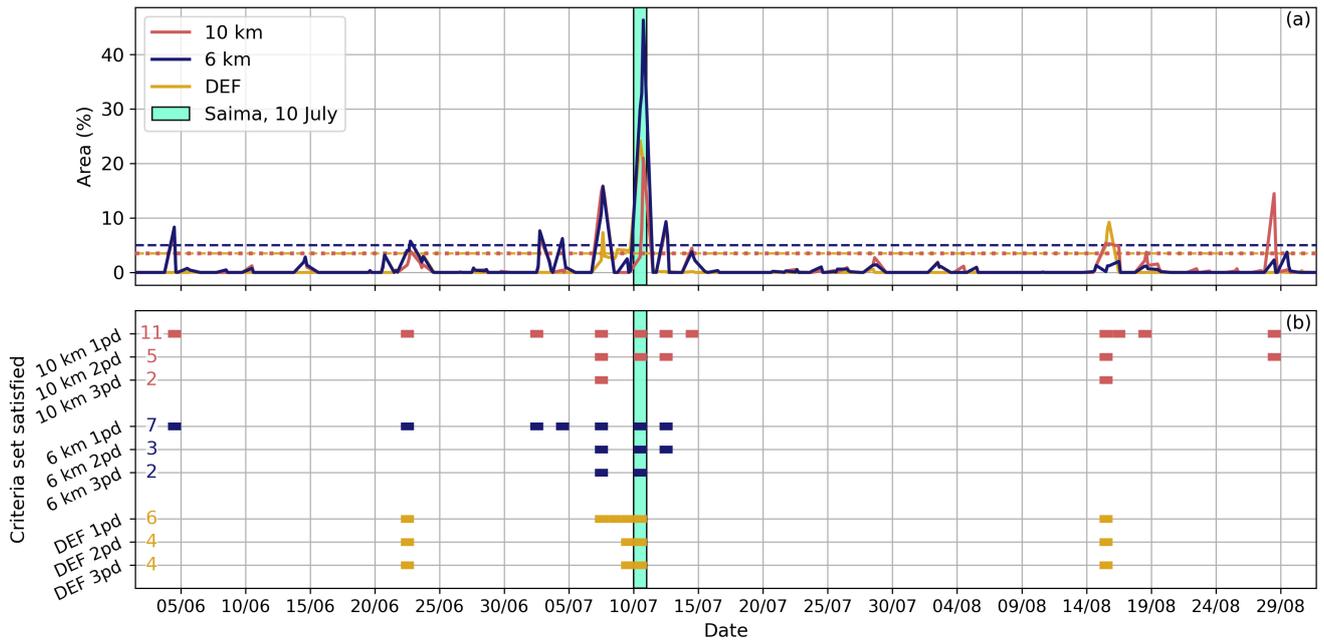


Figure S14. Same as Fig. S13 but for summer 2006.

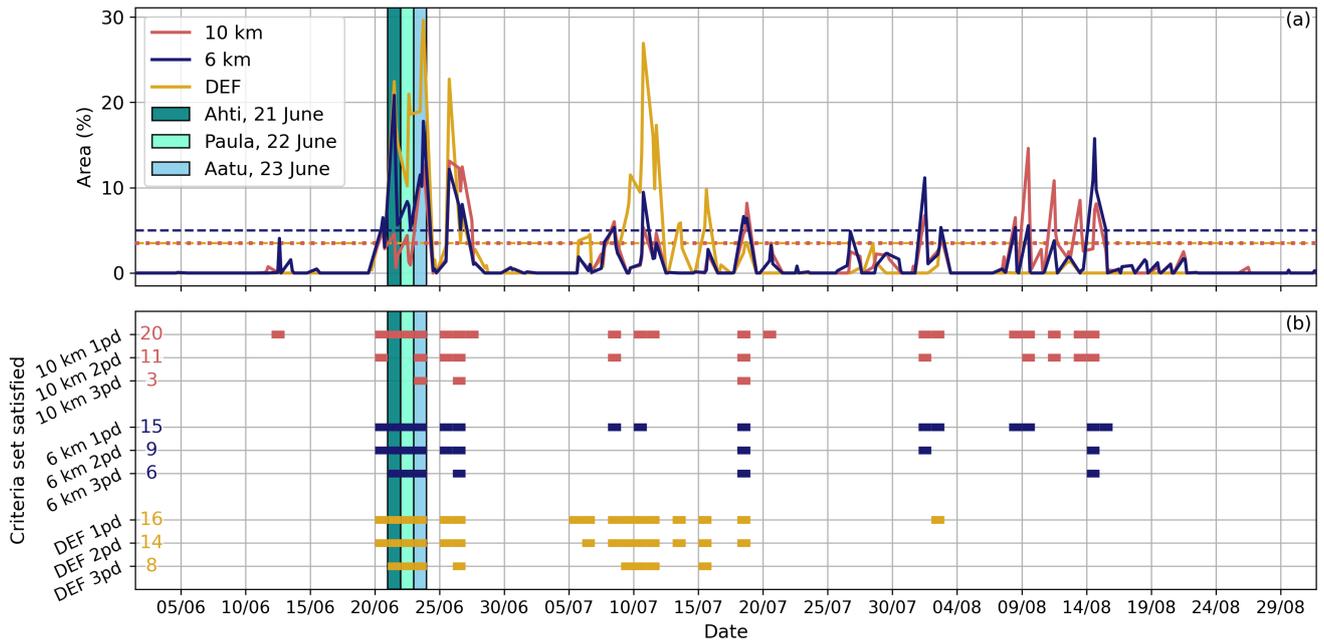


Figure S15. Same as Fig. S13 but for summer 2021.

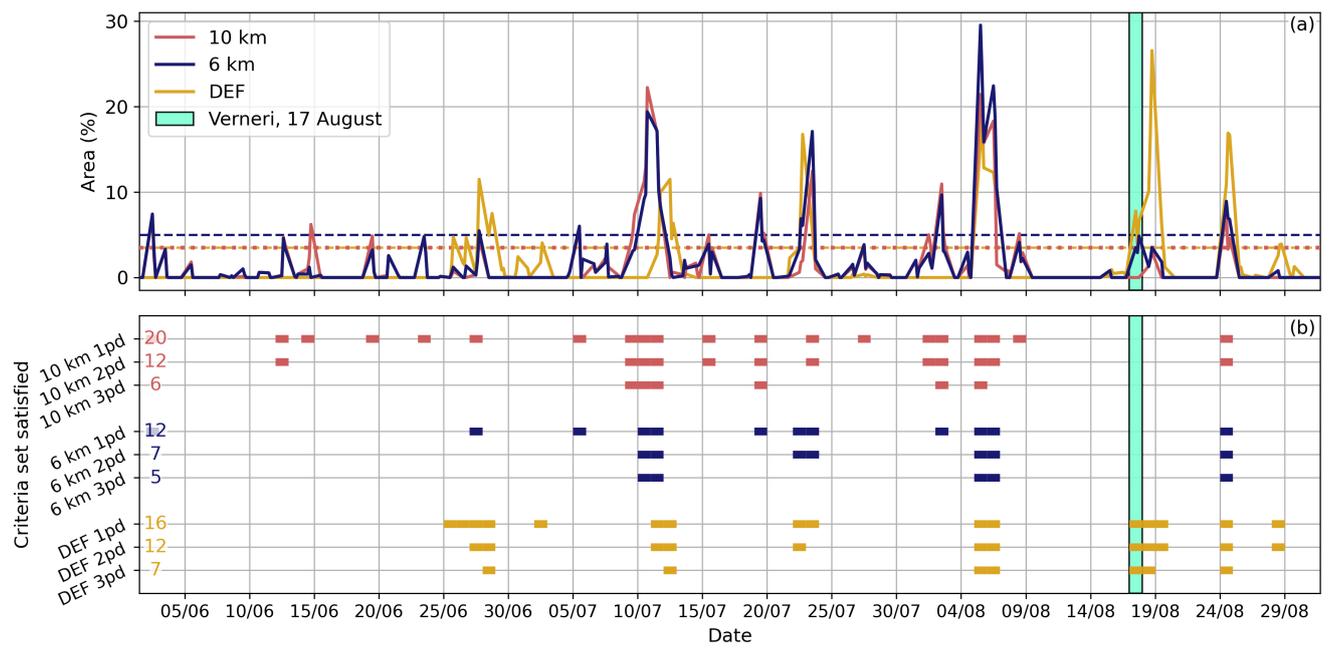


Figure S16. Same as Fig. S13 but for summer 2022.

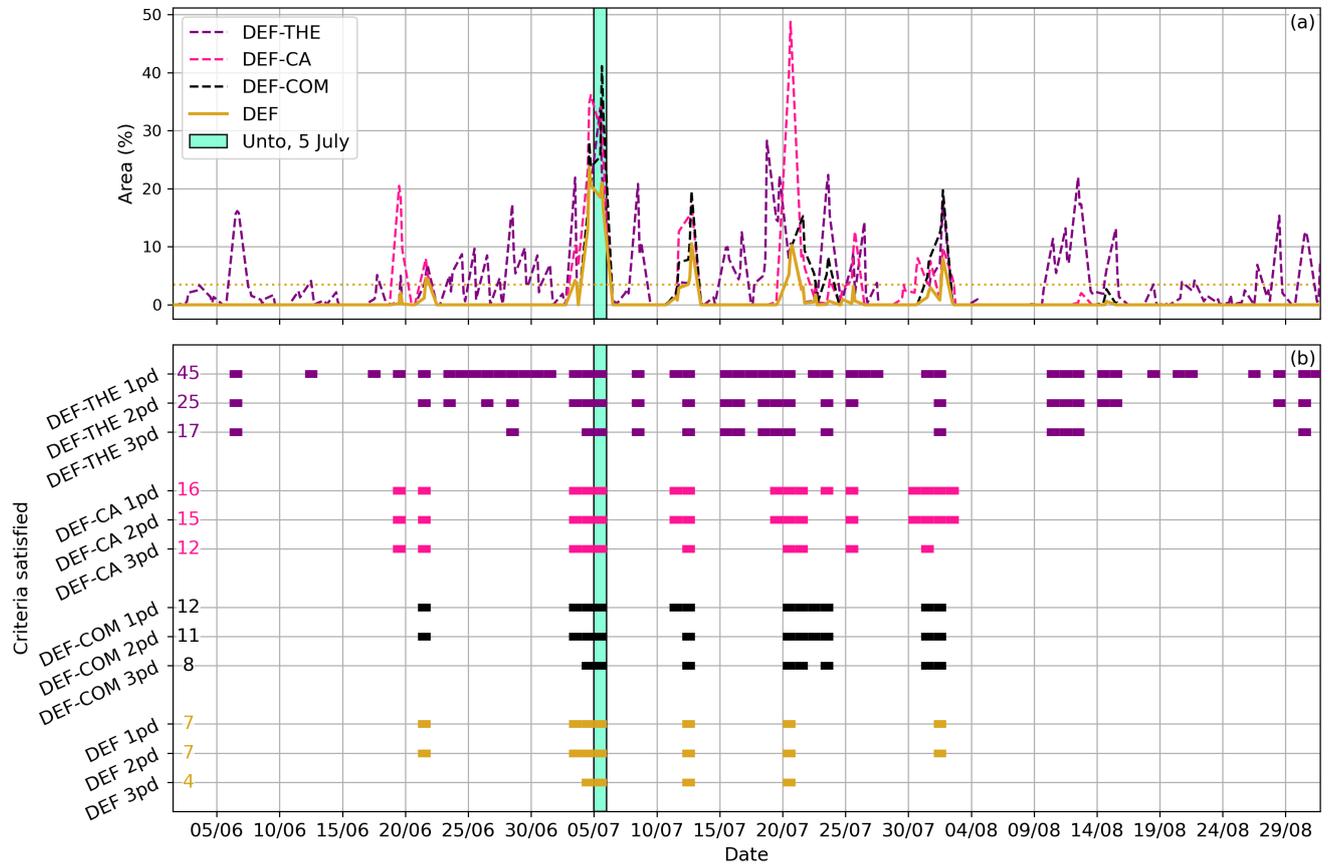


Figure S17. Same as Fig. 6 in the main article but for summer 2002: As in Fig. S13 but for combinations of criteria within the DEF criteria set, with the dashed lines representing the DEF criteria set excluding the 850 hPa $\theta_E \geq 325$ K condition (DEF-THE, purple), CAPE ≥ 250 J kg^{-1} condition (DEF-CA, pink) and combined shear condition (DEF-COM, black). The gold solid line shows the full DEF criteria set (DEF) as a reference.



Figure S18. Same as Fig. S17 but for summer 2006.

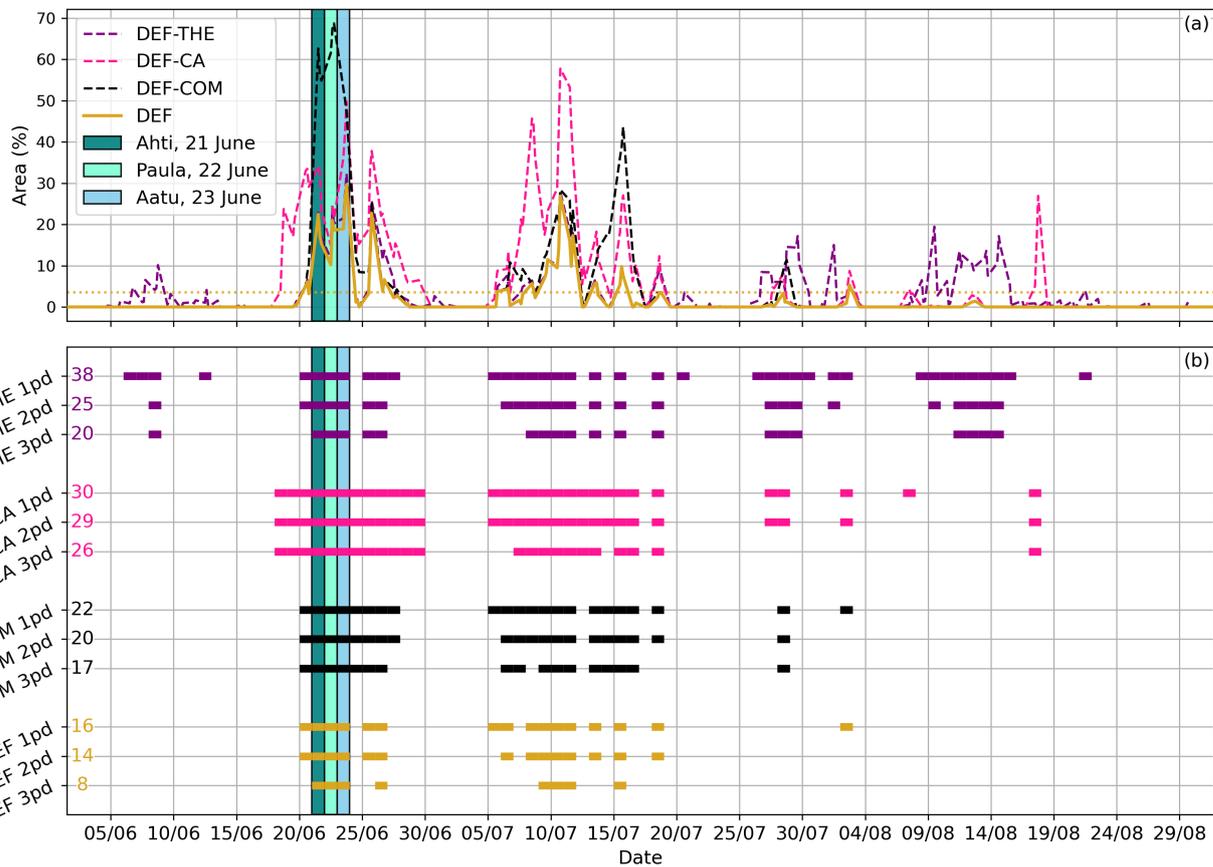


Figure S19. Same as Fig. S17 but for summer 2021.

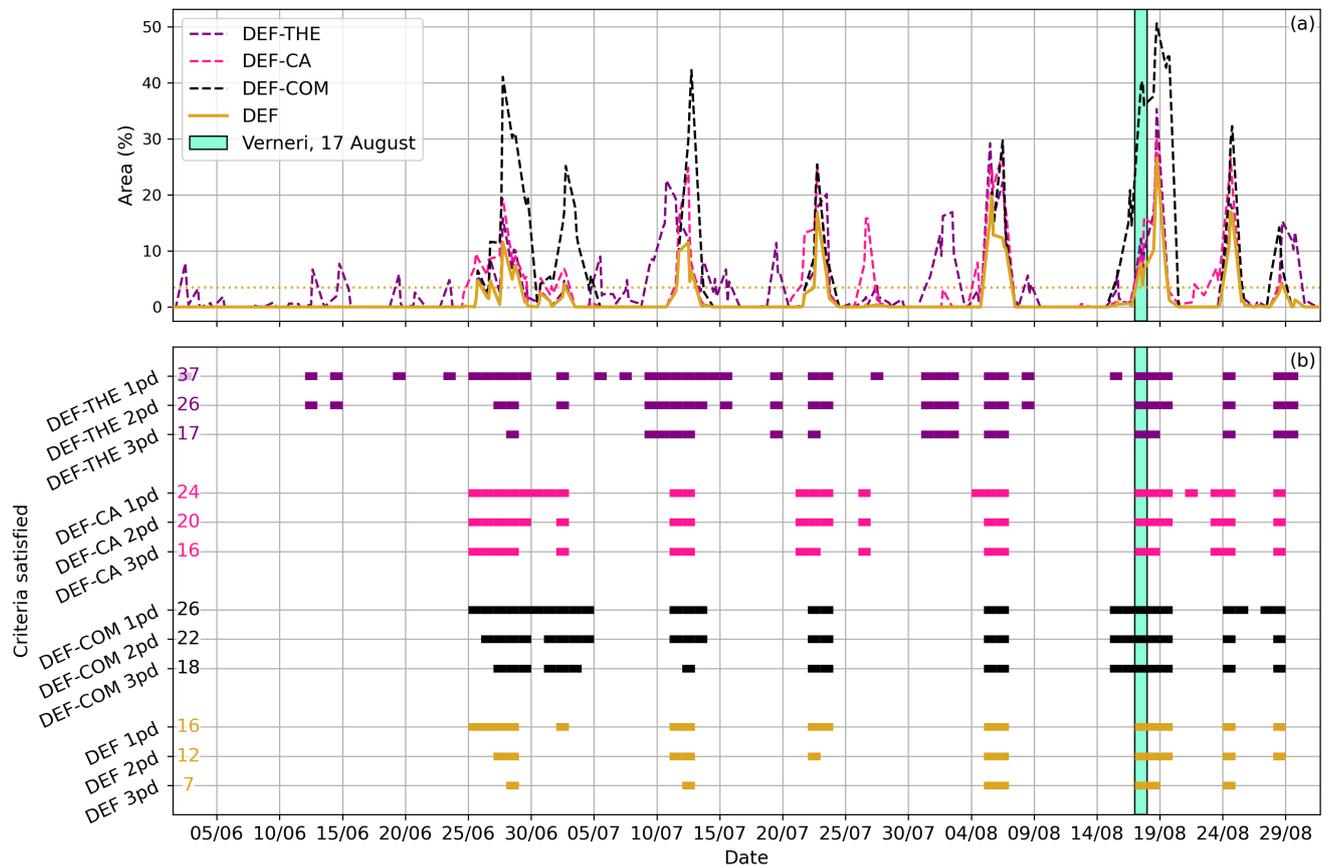


Figure S20. Same as Fig. S17 but for summer 2022.

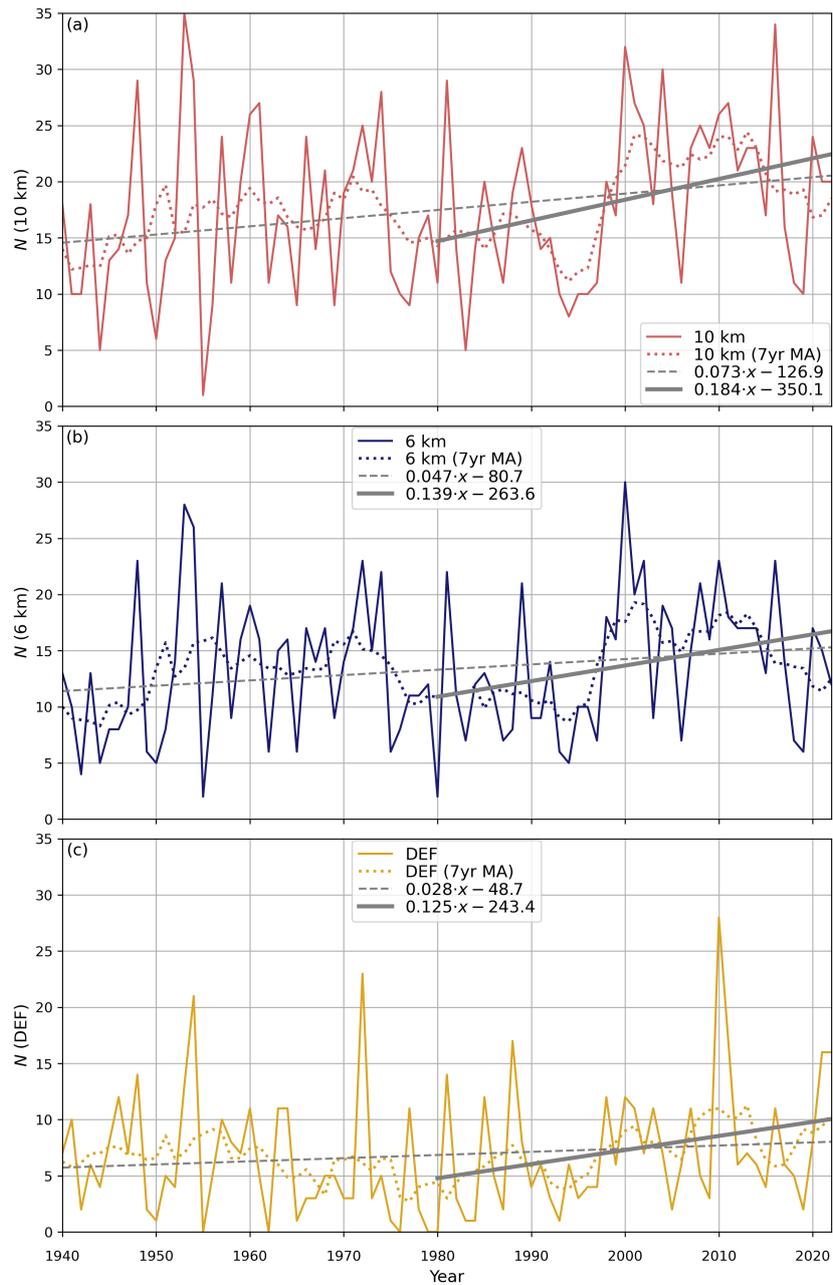


Figure S21. Same as Fig. 7 in the main article for the number of favorable days (N) per year but with conditions satisfied at least once per day (1pd), obtained with the 10 km criteria set (a, solid red line), 6 km criteria set (b, solid blue line) and DEF criteria set (c, solid gold line). Linear regressions are fitted to each panel for both the 1940–2022 time range (gray dashed lines) and 1980–2022 time range (solid gray lines). The dotted lines represent 7-year moving averages (7yr MA).

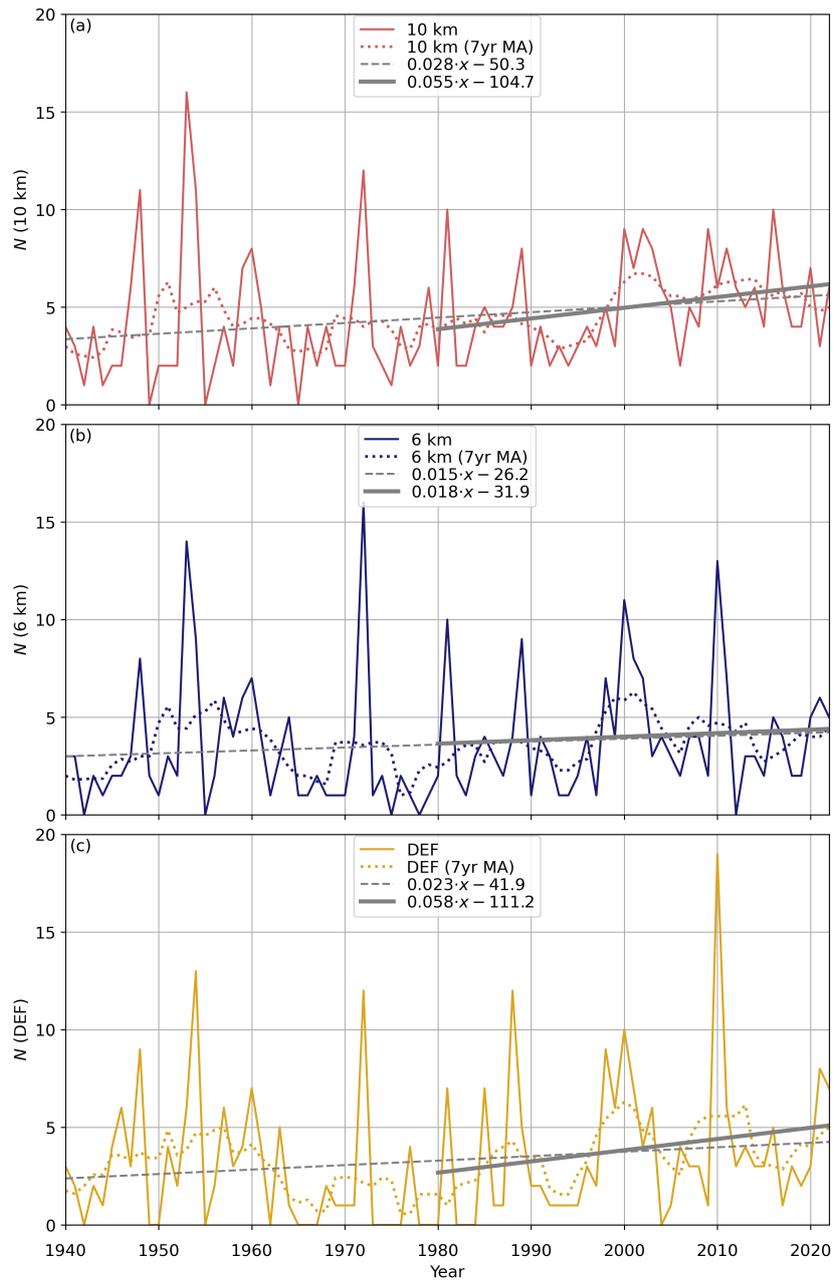


Figure S22. Same as Fig. S21 but with conditions satisfied at all three analyzed times (3pd).

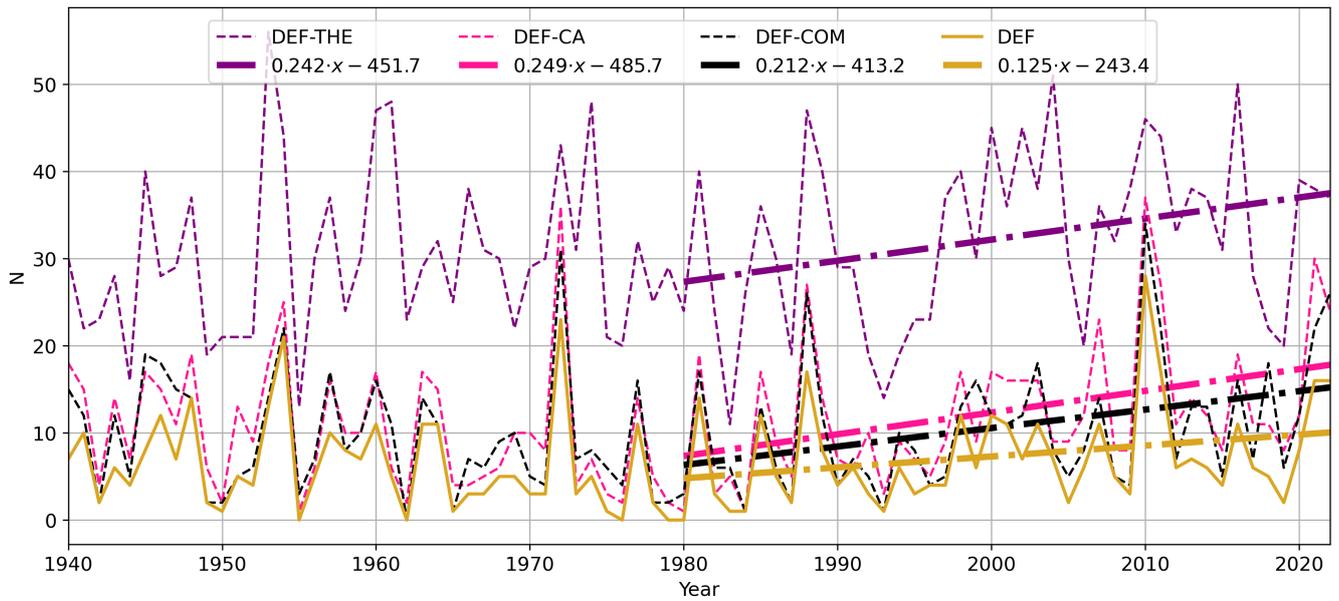


Figure S23. Same as Fig. 8 in the main article but with conditions satisfied at least once per day (1pd): the figure is similar to Fig. S21, but for the same criteria combinations within the DEF criteria as in Fig. S17. The corresponding linear regression lines for the 1980–2022 period are drawn with dash-dotted lines.

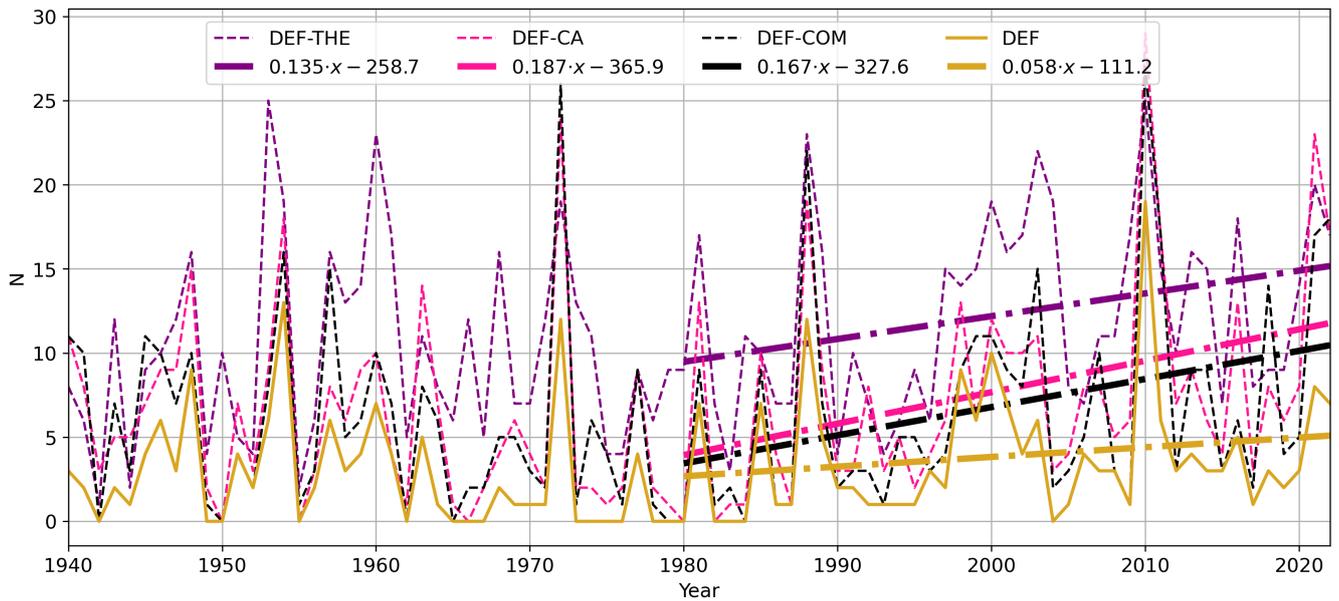


Figure S24. Same as Fig. S23 but with conditions satisfied at all three analyzed times (3pd).