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Supplementary Information for

Changing available energy for extratropical cyclones and associated convection in Northern Hemisphere summer

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This PDF file includes:

Figs. S1 to S8

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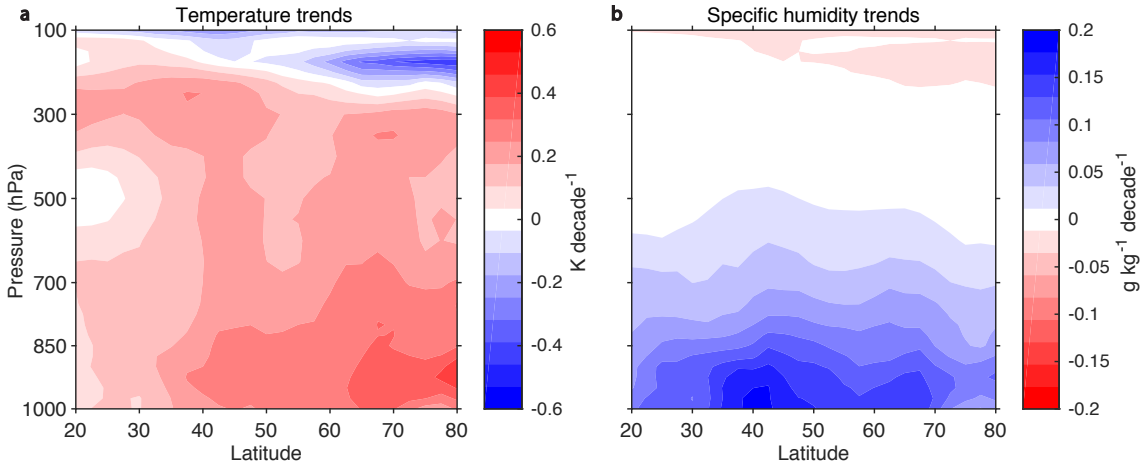

Fig. S1. ERA-interim changes in JJA temperature and moisture, 1979-2017. Trends in (a) zonal mean JJA temperature and (b) zonal mean JJA specific humidity, assuming constant JJA relative humidity.

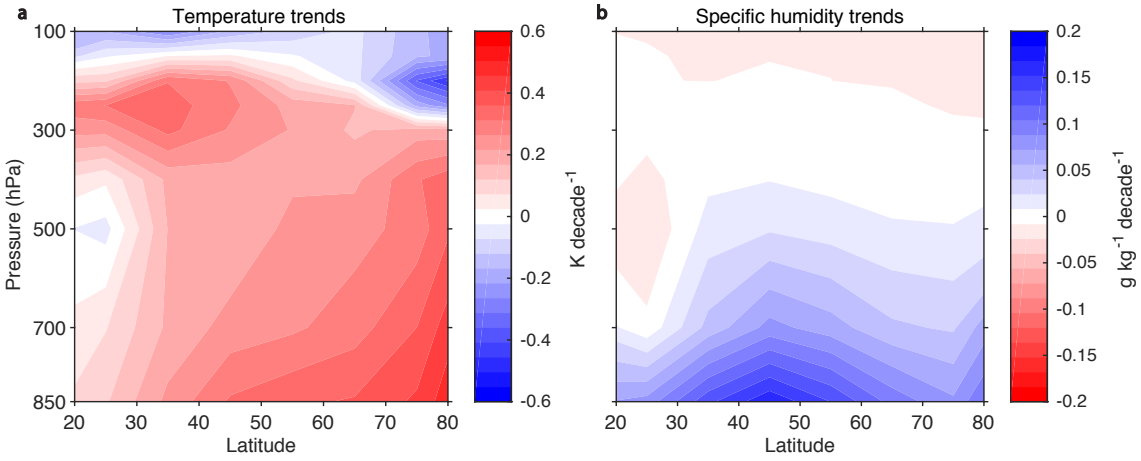

Fig. S2. Subsampled ERA-interim changes in JJA temperature and moisture. (a) Median JJA temperature trends in 10-degree latitude bands from ERA-Interim, subsampled to IUKv2 locations (1979-2015), and (b) median JJA specific humidity trends in 10-degree latitude bands from ERA-Interim assuming constant relative humidity and subsampled to HomoRS92 locations (1979-2010).

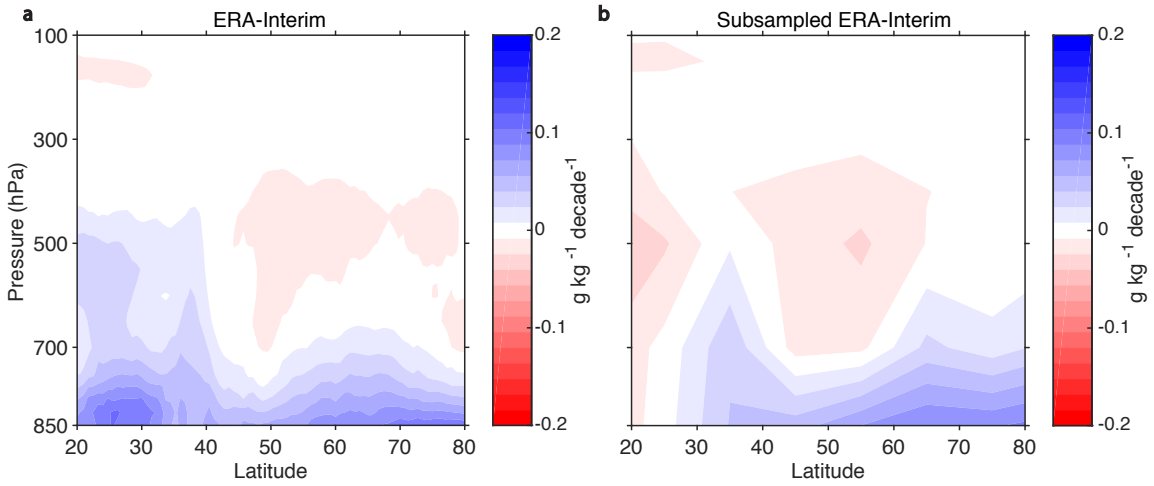

Fig. S3. ERA-Interim changes in JJA specific humidity with time-varying relative humidity. (a) Trends in zonal mean JJA specific humidity from ERA-Interim with time-varying relative humidity (1979-2017) and (b) median JJA specific humidity trend in 10-degree latitude bands from ERA-Interim with time-varying relative humidity and subsampled to HomoRS92 locations (1979-2010).

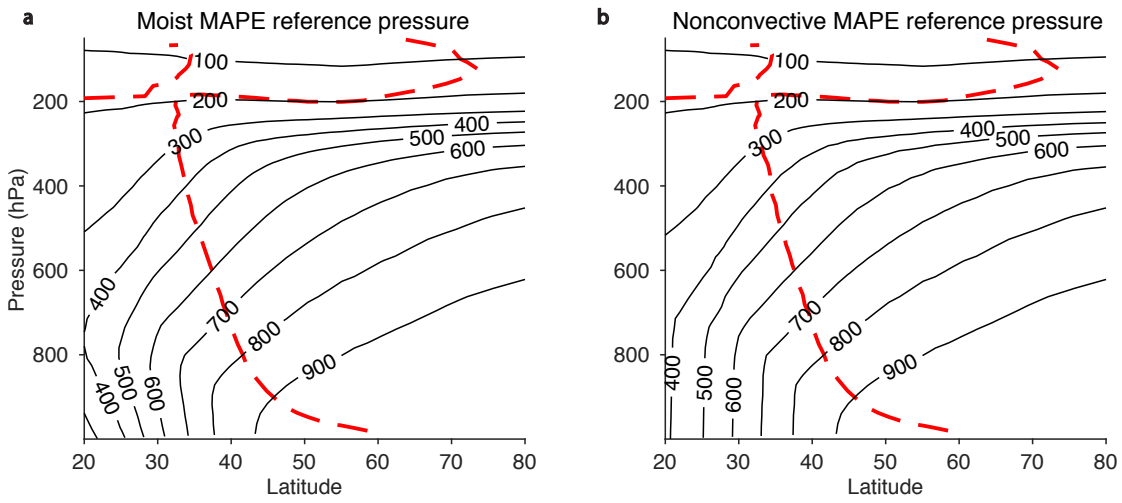

Fig. S4. As in Fig. 2 but for DJF. There is no discontinuity in the reference pressure distribution for the DJF rearrangement shown in panel a. Based on climatological temperatures and humidities, the convective MAPE as a percentage of moist MAPE is roughly 1% for DJF as compared to 16% for JJA.

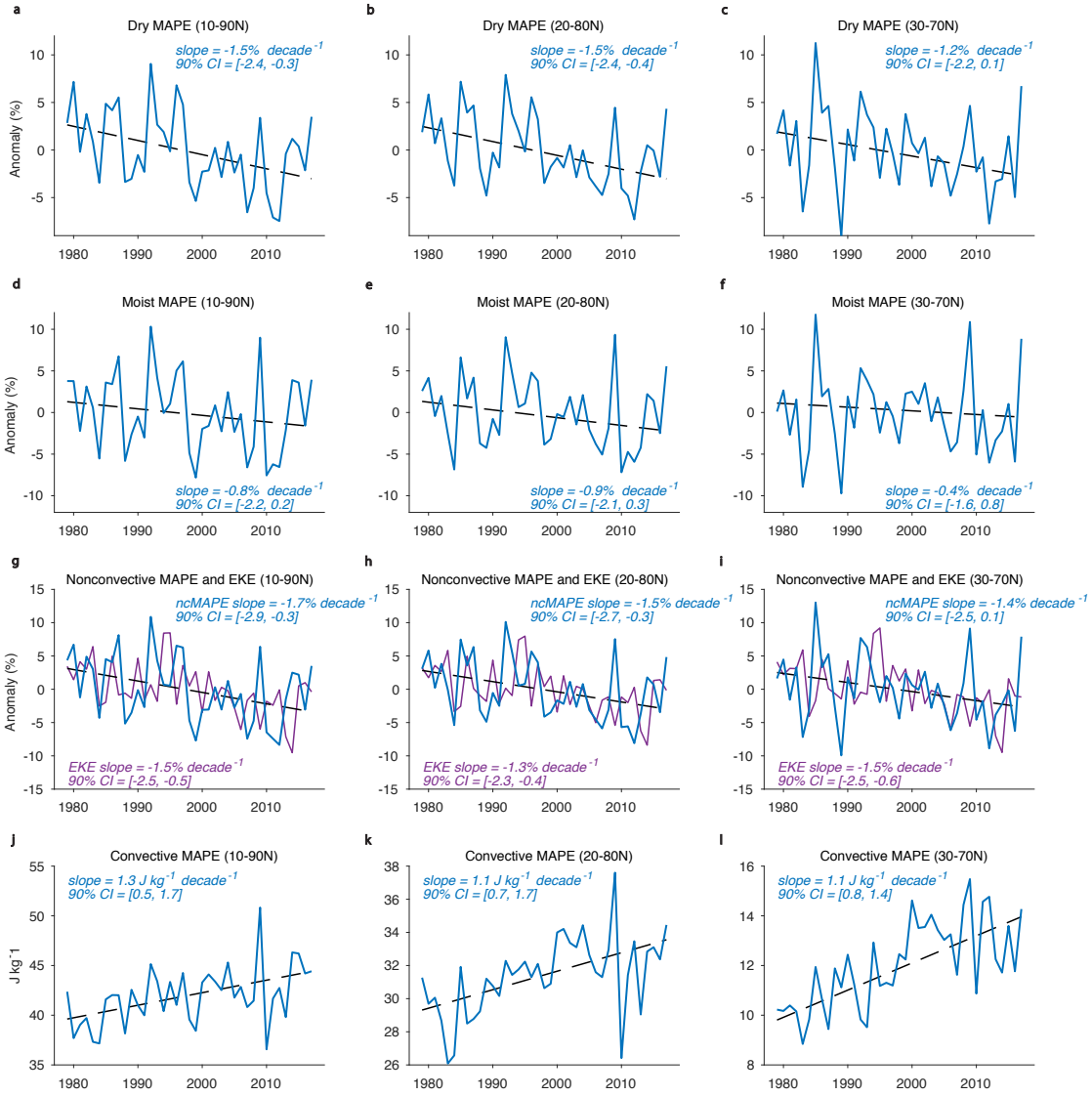

Fig. S5. Time series and trends of energetic reservoirs for JJA in the Northern extratropics for different latitude bands. (a-c) Dry MAPE, (d-f) moist MAPE, (g-i) nonconvective MAPE and EKE, and (j-l) convective MAPE over (a,d,g,j) 10-90N, (b,e,h,k) 20-80N, and (c,f,i,l) 30-70N. All results are based on ERA-Interim reanalysis. Trends and associated 90% confidence intervals are given in each panel. The dashed black lines show the linear best-fits for (a-c) dry MAPE, (d-f) moist MAPE, (g-i) nonconvective MAPE, and (j-l) convective MAPE.

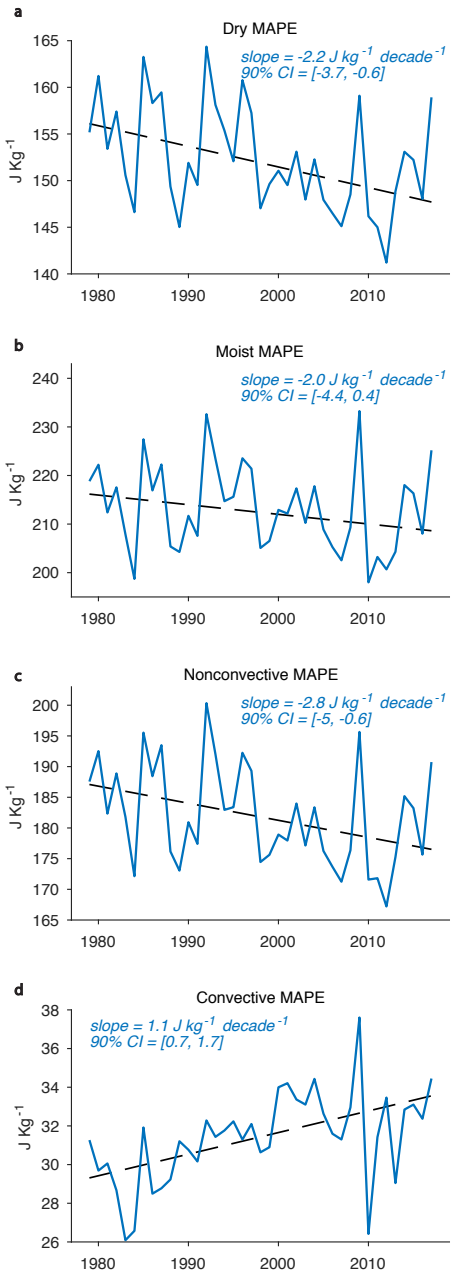

Fig. S6. Time series and trends of energetic reservoirs for summer in the Northern extratropics showing absolute values rather than percentage anomalies. (a) Dry MAPE, (b) moist MAPE, (c) nonconvective MAPE, and (d) convective MAPE. All results are for JJA over 20-80N based on ERA-Interim reanalysis. Trends and associated 90% confidence intervals are given in each panel, and the dashed black lines show linear best fits.

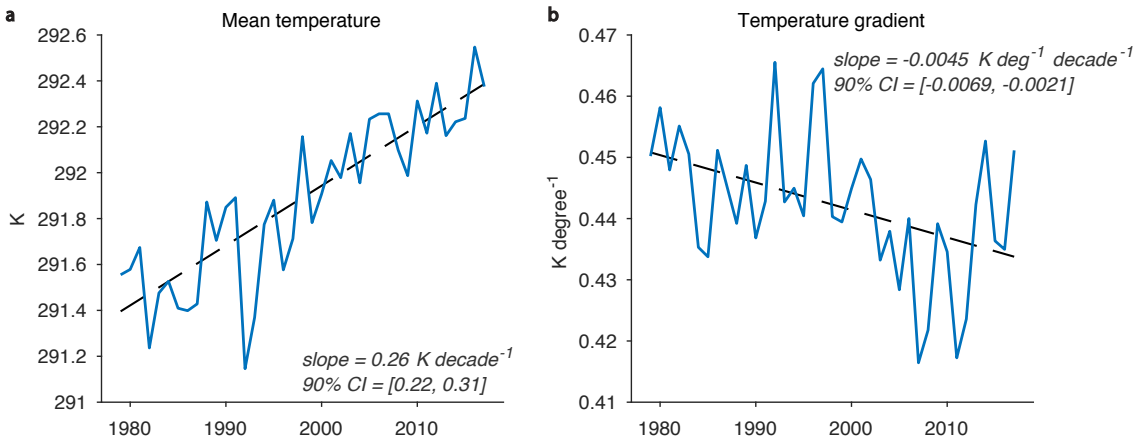

Fig. S7. Time series and trends of 1000 hPa temperatures and meridional temperature gradients for the northern extratropics in JJA based on ERA-Interim reanalysis. (a) Mean 1000 hPa temperature over 20-80N and (b) mean meridional temperature gradient at 1000 hPa over 20-80N. See methods for details of calculation.

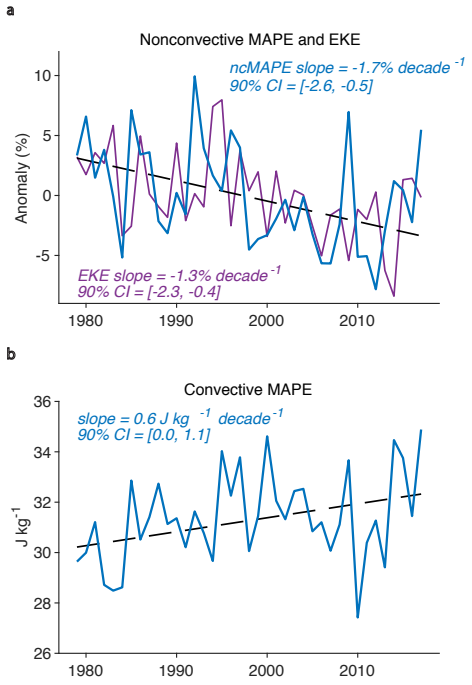

Fig. S8. As in Figure 3, but MAPE is calculated using time-varying relative humidity from ERA-Interim.