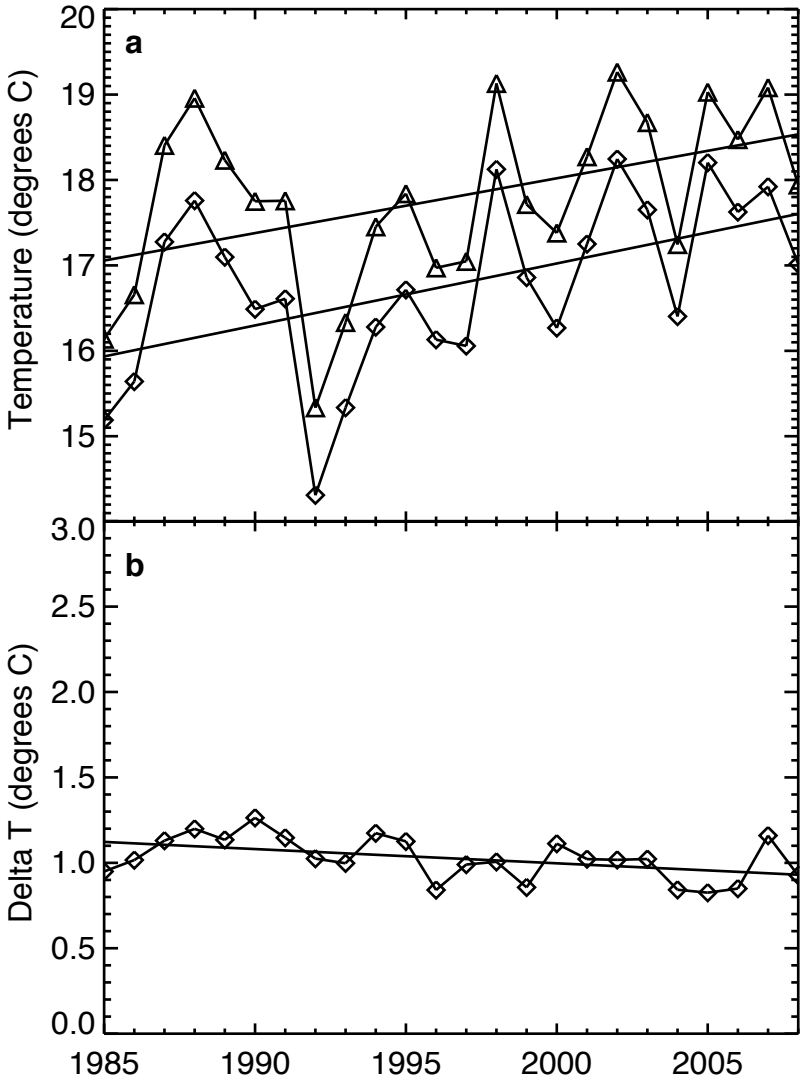
nature geoscience

SUPPLEMENTARY INFORMATION

DOI: 10.1038/NGEO693

Supp Figure 1 | **Trends in air temperature over land**. a, Reanalysis regional 2 m (diamonds) and surface (triangles) land temperatures during the summer season show warming trends with smaller magnitude (0.72 +/- 0.27 C decade-1 at 2 m, 0.64 C decade-1 at surface) than air temperature over the lake (1.05 +/- 0.53 C decade-1) and b, a weak, declining (stabilizing) trend (-0.08 +/- 0.03 C decade-1) in land-air temperature gradient.



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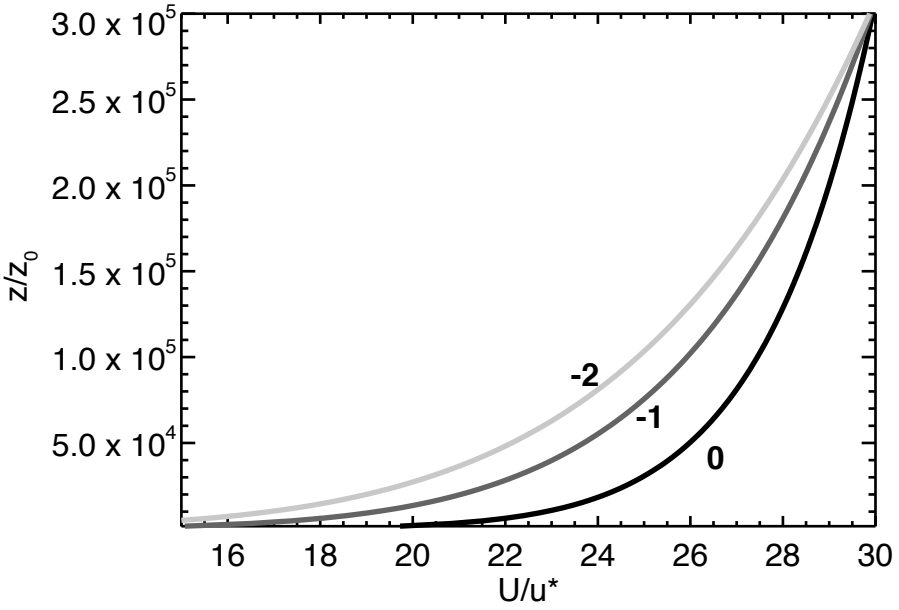
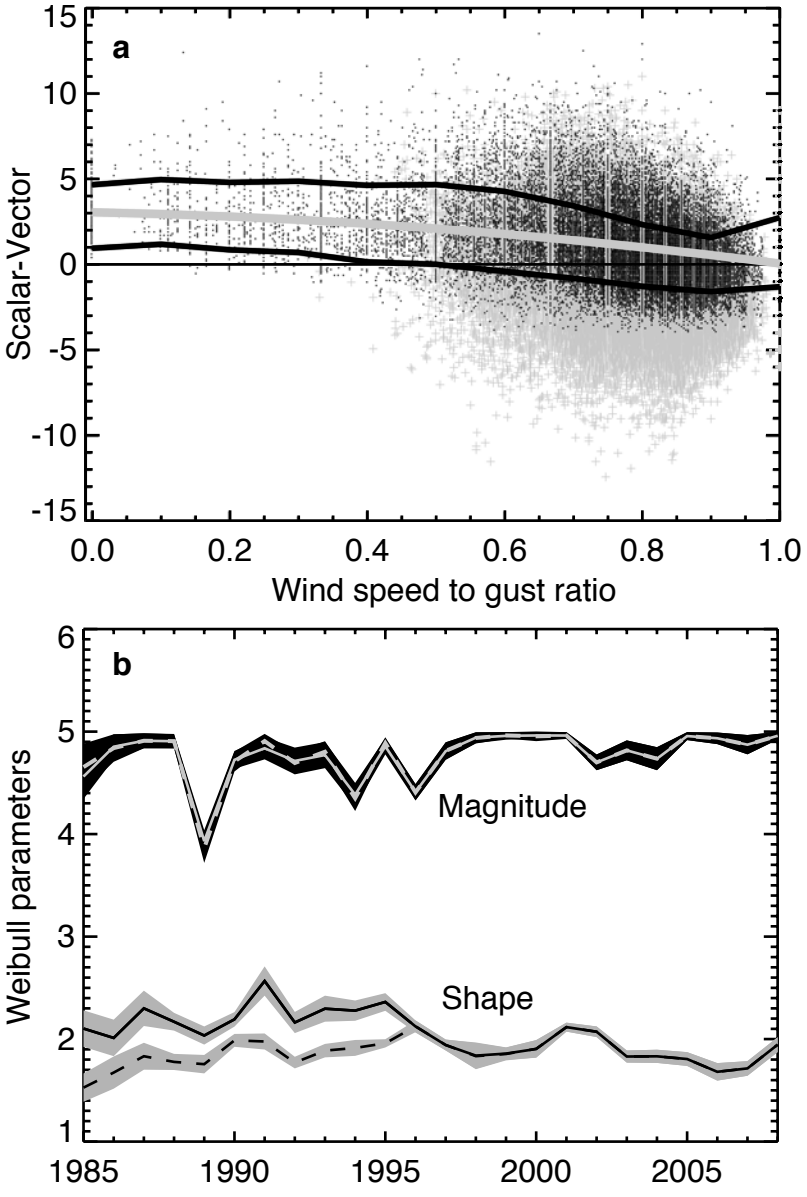
Supp Figure 2 | **Model predictions of stable layer wind profiles.** Parameterized non-dimensional power-law wind profiles from the simple boundary layer model for 0 C (black), -1 C (dark gray) and -2 C (light gray) lake-air temperature gradients. Increasingly stable (more negative) wind profiles inhibit the downward transfer of momentum to the surface for a given wind speed. The effect is non-linear since surface drag coefficients and heat fluxes are functions of both wind speed and temperature gradients.



Supp Figure 3 | **Correction to vector averaged winds**. Wind observations over Lake Superior in the early part of the record rely on a vector averaging instrument package, which is shown to be low-biased against more recently used scalar averaging systems, especially during light and variable winds. a, An empirical correction was applied to light vector-averaged winds < 4 m s-1 (black stars and gray lines showing bin-averaged one standard deviation) as a function of wind variability, which was estimated using a proxy of wind speed to gust ratio. The fit (white line) was applied to records when vector wind sensors were used. b, Histograms of the uncorrected and corrected hourly wind speeds for each summer were fit to a Weibull distribution. Compared to uncorrected winds (dotted lines), corrected wind speeds (solid lines) only slightly alter the Weibull magnitude parameter (gray lines on black), while leading to a more consistent and expected shape parameter (black lines on gray) across the years.



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Supp Figure 4 | **Wind and temperatures distributions**. Histogram of hourly stratified season observations of a, wind speed, b, wind gust, c, wind direction, and d, air-lake temperature difference for the first ten years (1985-1994, dotted lines) compared to the last ten years (1999-2008, solid lines). Distributions show that the increasing in wind speeds and temperature differences were due to a shift in the central tendency of the distribution, and less likely due to a change in gustiness, an increase very high winds, or a shift in wind directions.