Supporting Information for

Shortened intensification duration offsets the increase of tropical cyclone lifetime maximum intensity

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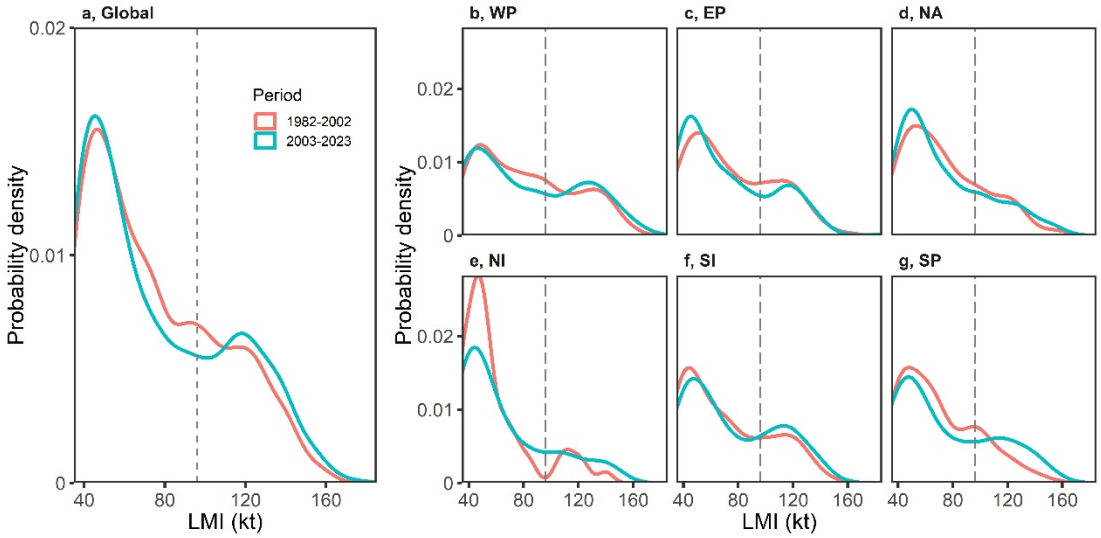

Fig. S1 The bimodal distribution of LMI across two periods. Probability density distributions of LMI (red: 1982-2002, blue: 2003-2023), derived using kernel density estimation. Vertical dashed lines mark LMI of 96 kt. WP: the western Pacific (**b**), EP: the eastern Pacific (**c**), NA: the northern Atlantic (**d**), NI: the northern Indian Ocean (**e**), SI: the southern Indian Ocean (**f**), SP: the southern Pacific (**g**).

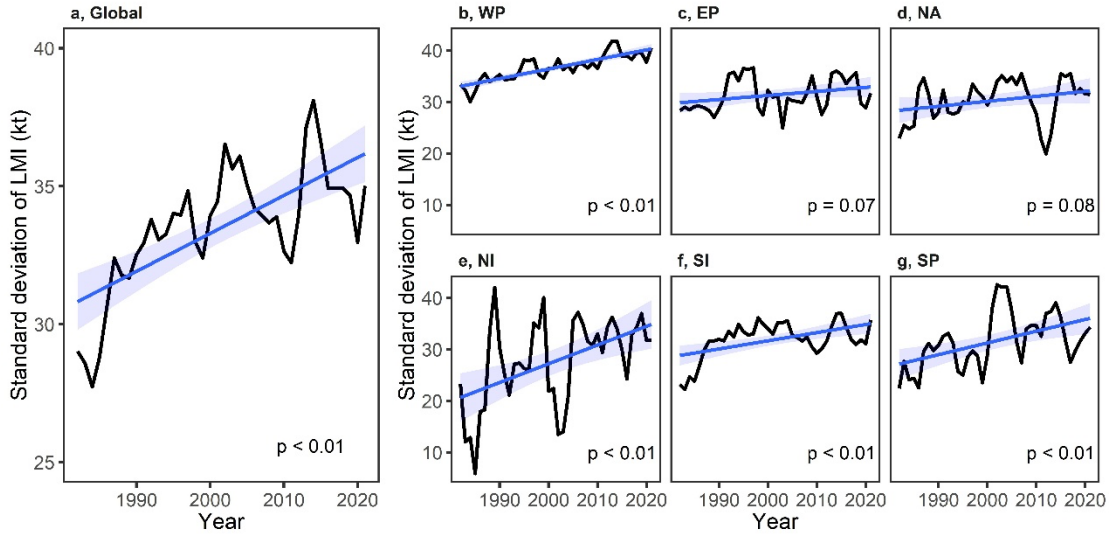

Fig. S2 Temporal evolution of LMI variability. Time series of LMI standard deviation globally (**a**) and in each basin (**b**-**g**). Values are calculated using 3-year running windows to account for interannual variations in TC frequency. Blue lines represent linear regression trends with 95% confidence intervals (shaded areas). Statistical significance (p-values) of each trend is indicated in the respective panels.

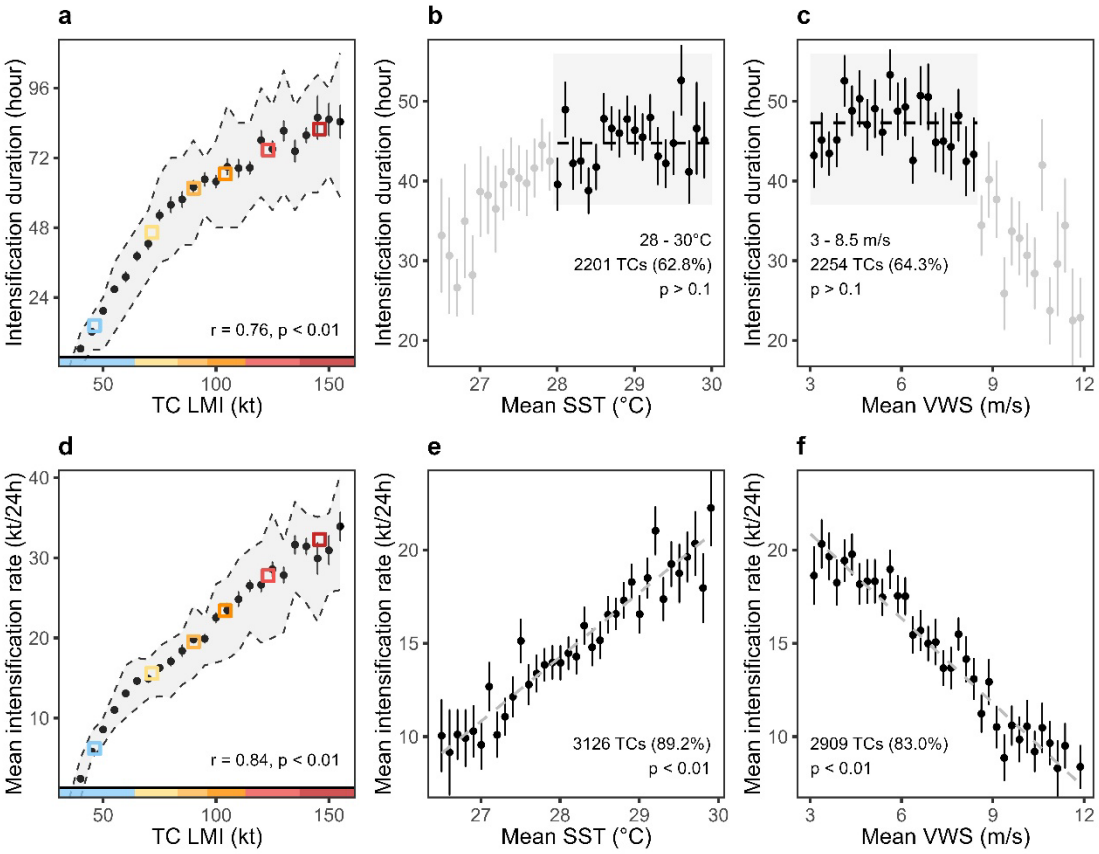

Fig. S3 Relationships between TC intensification metrics, LMI, and environmental conditions. **a**, Intensification duration versus LMI, binned in 5-kt intervals. Colored squares indicate TC categories (consistent with Fig. 1), and dashed lines denote the 25th-75th percentile range. Correlation coefficients with associated p-values are provided. **b-c**, Intensification duration as a function of mean SST (**b**) and mean vertical wind shear (VWS) (**c**) experienced by TC during intensification (see Methods). Gray points represent bins outside the range, which are highlighted in shaded boxes. Black dashed lines indicate the average duration. Inset text indicates the sample size, coverage percentage, and p-values within the shaded ranges. **d-f**, Same as (**a-c**) but for the mean intensification rate. In all panels, black dots represent binned means with standard deviation error bars; data in **b, c, e, f** are binned by 0.1 °C for SST and 0.25 m/s for VWS.

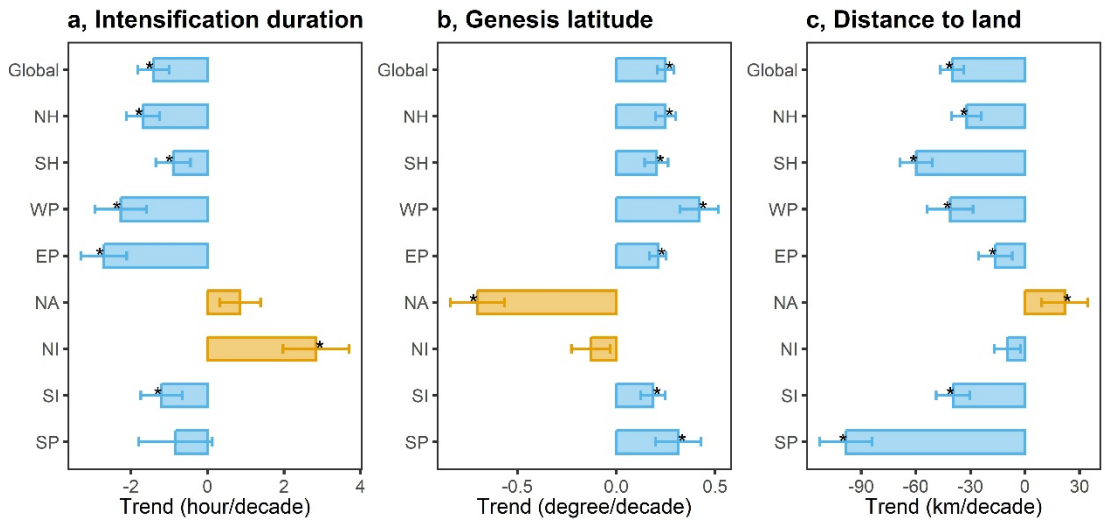

Fig. S4 Decadal trends of TC intensification duration and genesis locations over recent decades. a-c, Linear trends of TC intensification duration (**a**), genesis latitude (**b**), and distance to land at genesis (**c**), based on TC data from 1982 to 2023. Decadal trends are computed for the globe, hemispheres, and individual basins, using 5-year rolling averages to smooth interannual climate variability. Error bars represent the standard deviation from the linear regression analysis, and asterisks denote statistically significant trends ($p < 0.05$). Blue bars indicate trends associated with a shortening of intensification duration, while orange bars highlight basins with distinct or opposing trends.

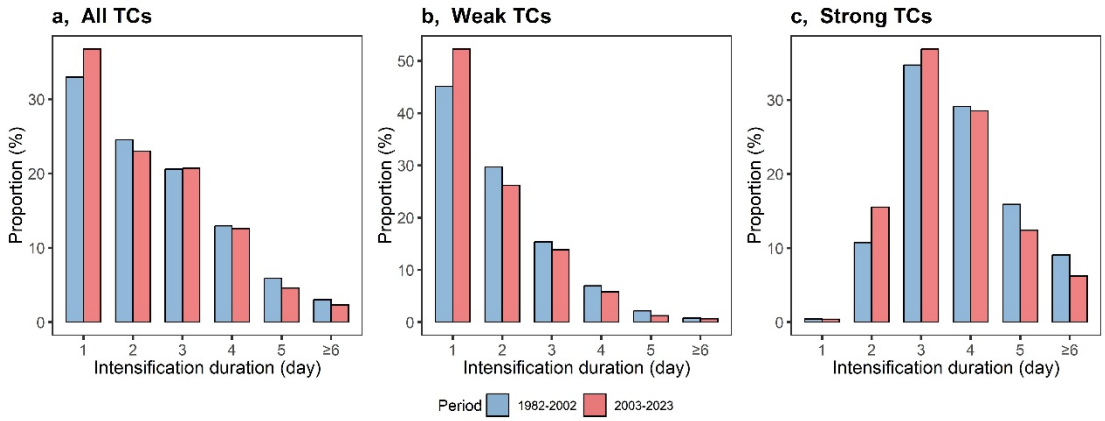

Fig. S5 Distribution of intensification duration for all, weak, and strong TCs during two periods. Histograms show the proportion of TCs as a function of intensification duration for (**a**) all TCs, (**b**) weak TCs, and (**c**) strong TCs. Data are presented for two periods: 1982-2002 (blue) and 2003-2023 (red).

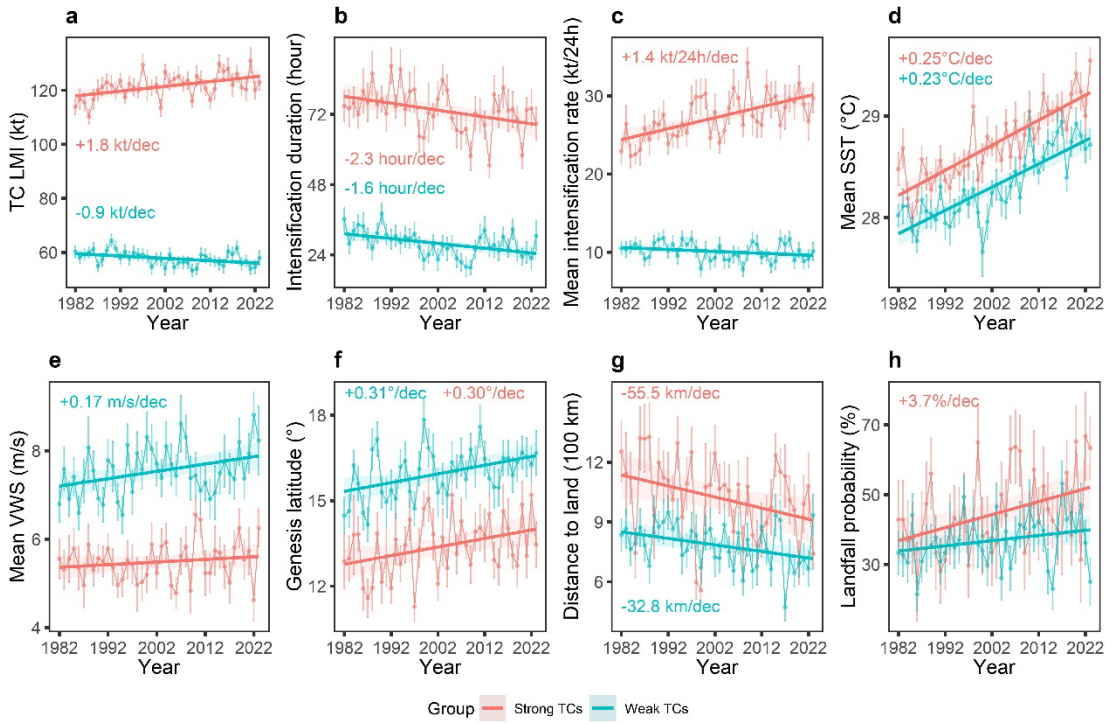

Fig. S6 Trends of TC intensification metrics and key factors influencing LMI. Global time series of TC LMI (**a**), intensification duration (**b**), mean intensification rate (**c**), mean SST (**d**), mean VWS (**e**), genesis latitude (**f**), distance to land (**g**), and landfall probability (**h**). TCs are classified into two groups based on a 96 kt threshold (strong TCs in red, weak TCs in blue). Solid lines represent linear regression trends, with shaded 95% confidence intervals. Error bars represent the standard deviation of the mean. Statistically significant trends ($p < 0.05$) are annotated.

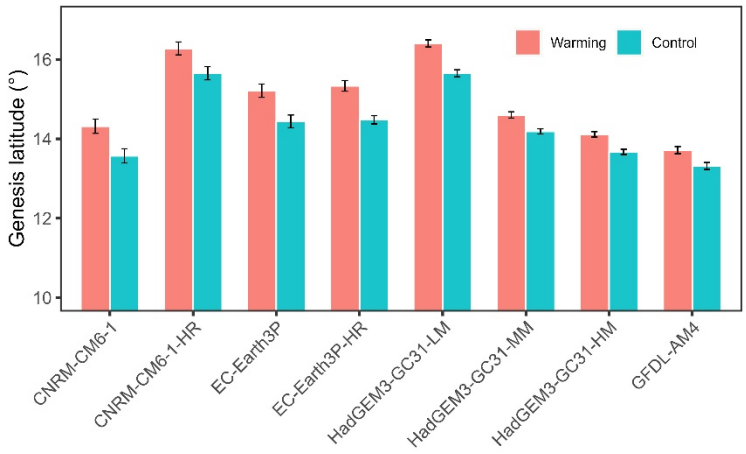

Fig. S7 Mean TC genesis latitude across climate models. This bar chart illustrates the mean genesis latitude for control (blue) and warming (red) scenarios across eight models (Same as Fig. 4). Error bars indicate the standard deviation of the mean values.

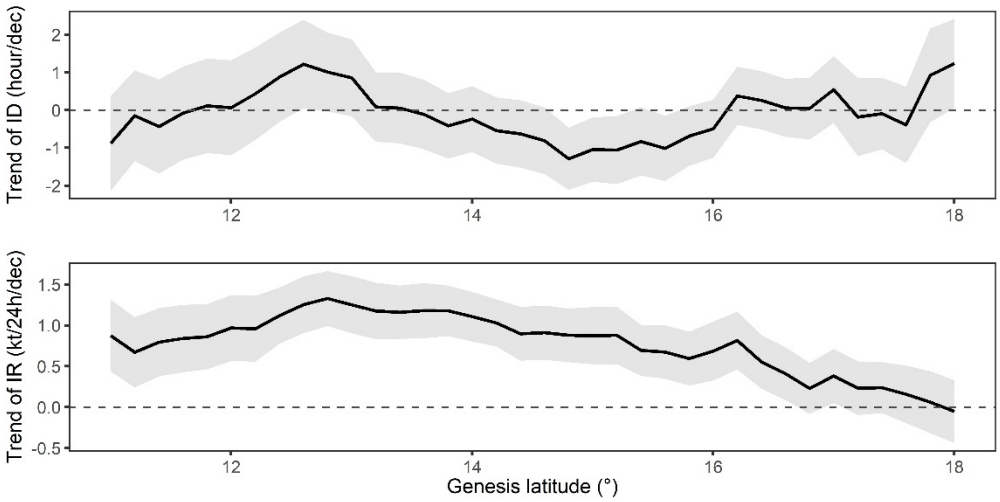

Fig. S8 Decadal trends of TC intensification duration (ID) and mean intensification rate (IR) by genesis latitude. Solid black lines show the decadal trends calculated from linear regressions of annual means within a moving 3° latitudinal window. Shaded areas represent the standard error of the trend estimate. The dashed horizontal line indicates a zero trend.