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Supplementary Information for

Global Increase in Major Tropical Cyclone Exceedance Probability Over the Past Four Decades

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This PDF file includes:

Information on the ADT-HURSAT data files
Figures S1 to S7

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ADT-HURSAT data file information[*]

There are data for 4,180 tropical cyclones (TCs) over the period 1978 to 2017. Each TC has data every 6 hours along its track. The maximum number of data along any track is 300 and each track is padded with NaNs.

There are 9 data files in csv format.

1. File name: Dataset S7
   Storm Identifier associated with the IBTrACS file "IBTrACS.ALL.v04r00.nc".
   Dimension: 4,180 rows, 1 column

2. File name: Dataset S1
   Ocean basin where each TC reached peak intensity. NA=North Atlantic, EP=Eastern North Pacific, WP=Western North Pacific, SP=South Pacific, SI=Southern Indian Ocean, NI=Northern Indian Ocean
   Dimension: 4,180 rows, 1 column

3. File name: Dataset S4
   Latitude of TC center
   Dimension: 4,180 rows, 300 columns

4. File name: Dataset S5
   Longitude of TC center
   Dimension: 4,180 rows, 300 columns

5. File name: Dataset S8
   Surface wind speed
   Dimension: 4,180 rows, 300 columns

6. File name: Dataset S9
   Year
   Dimension: 4,180 rows, 300 columns

7. File name: Dataset S6
   Month
   Dimension: 4,180 rows, 300 columns

8. File name: Dataset S2
   Day
   Dimension: 4,180 rows, 300 columns

9. File name: Dataset S3
   Hour
   Dimension: 4,180 rows, 300 columns

[*] It is important to note that the ADT-HURSAT record, particularly in light of the fact that it necessarily uses coarse (8 km) resolution satellite data, is *not designed to be a substitute for the best-track, nor is it designed to be used on a point-by-point or storm-by-storm basis*. The ADT-HURSAT should be considered a record that sacrifices some measure of absolute accuracy for homogeneity, and which allows more robust trend analysis, particularly in a large sample.

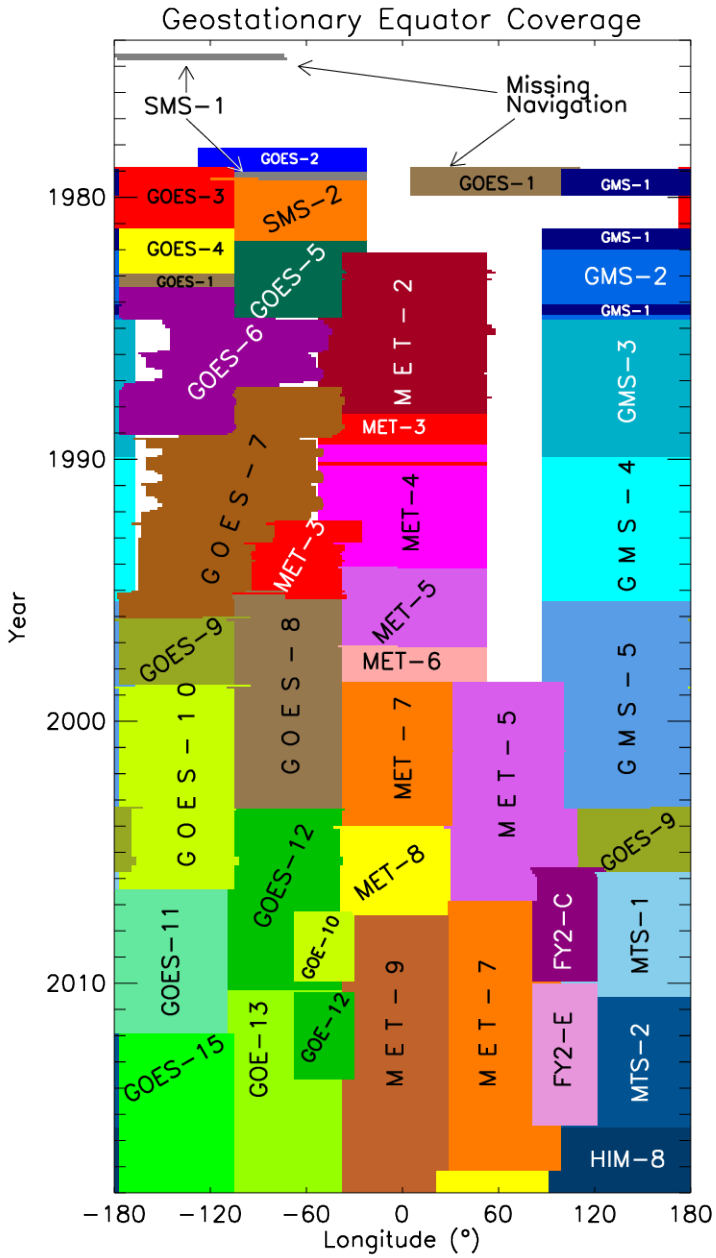

Fig. S1. Global HURSAT geostationary satellite coverage over the past 40 years. A gap in coverage centered over the region of the Indian Ocean (60°–120°E) was mitigated in 1998 with the introduction of Meteosat-5 and subsequent satellites into the region. For homogeneity, all data from these satellites (MET-5 after 1998, MET-7 after 2007, FY2-C and FY2-E) are removed from the HURSAT record prior to applying the ADT. The years 1978 and 1980 lack eastern hemisphere coverage.

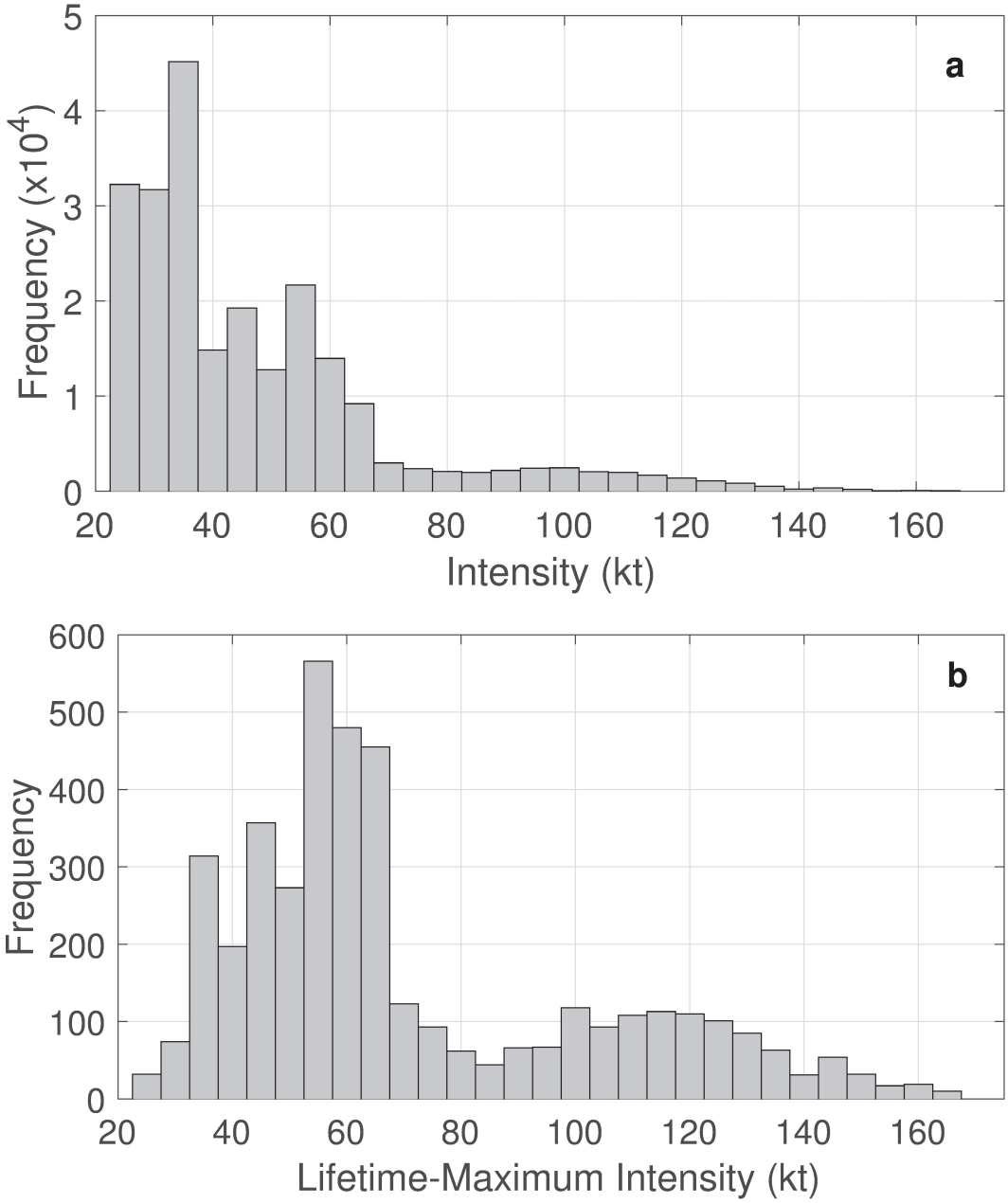

Fig. S2. Distribution of (a) all ADT-HURSAT intensity estimates worldwide (N ≈ 228,000) over the period 1978–2017 and (b) the distribution of LMI for each TC (N = 4,158).

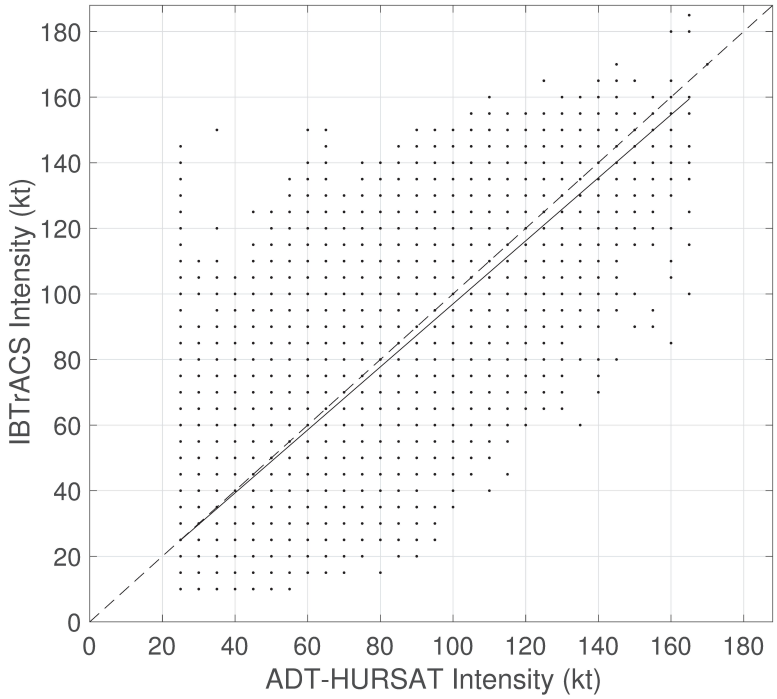

Fig. S3. Comparison of ADT-HURSAT and IBTrACS global intensity estimates (in their native units of knots and resolution of 5 kt, 1 kt = 0.514 m s^{-1}). The dashed line is the line of equality and the solid line is the ordinary least-squares line of best fit. The correlation between the two is 0.81.

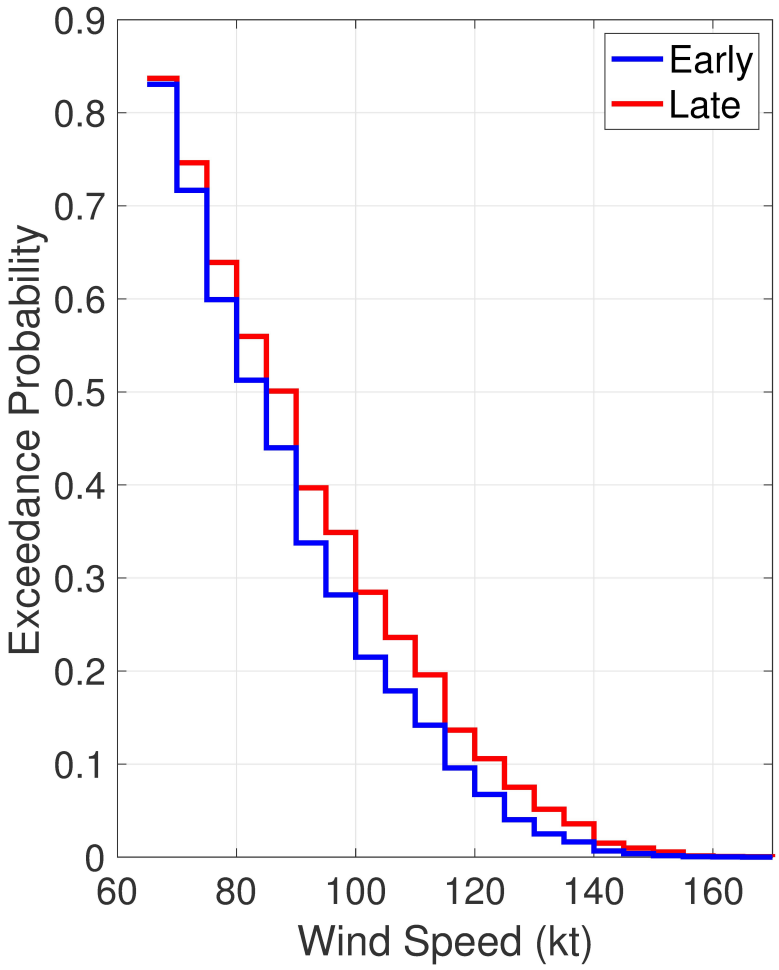

Fig. S4. As in Fig. 1, but for the global best-track (IBTrACS) data.

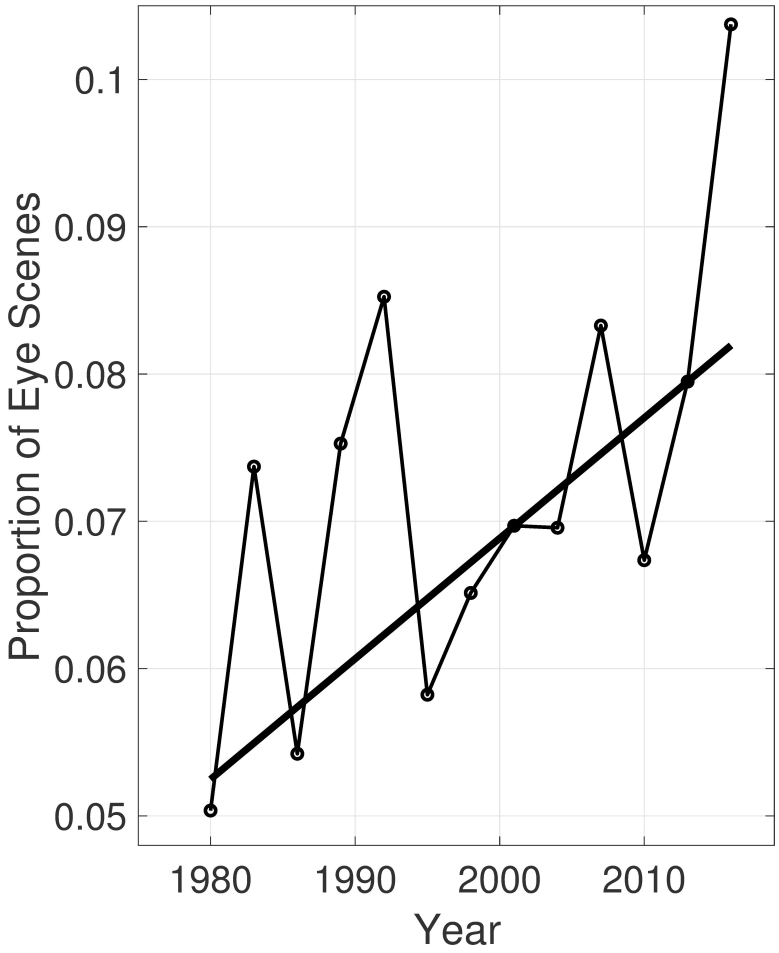

Fig. S5. Similar to Fig. 2, but for the global fractional proportion of eye-scenes to all points in the ADT-HURSAT data. The proportion increases by 56% in the 39-year period (P-value = 0.06).

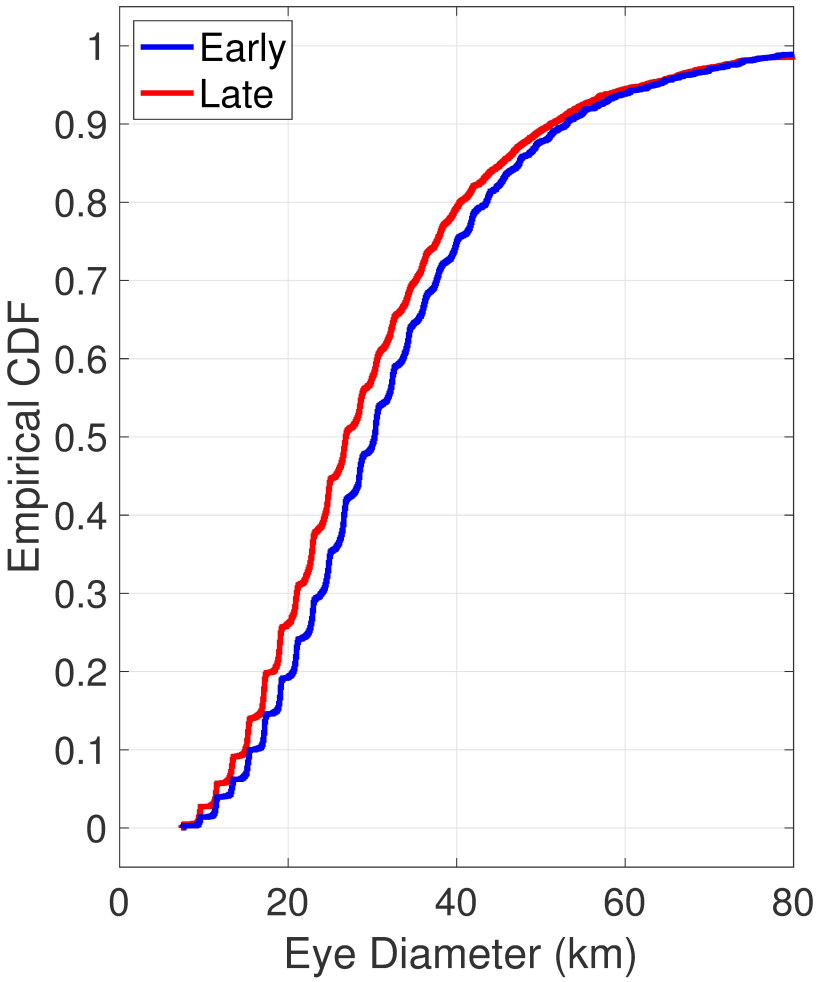

Fig. S6. Cumulative distribution functions of hurricane eye diameter calculated by the ADT in the early and latter halves of the period. The probability of finding an eye diameter less than 20 km increases by 36%, from 0.19 to 0.26.

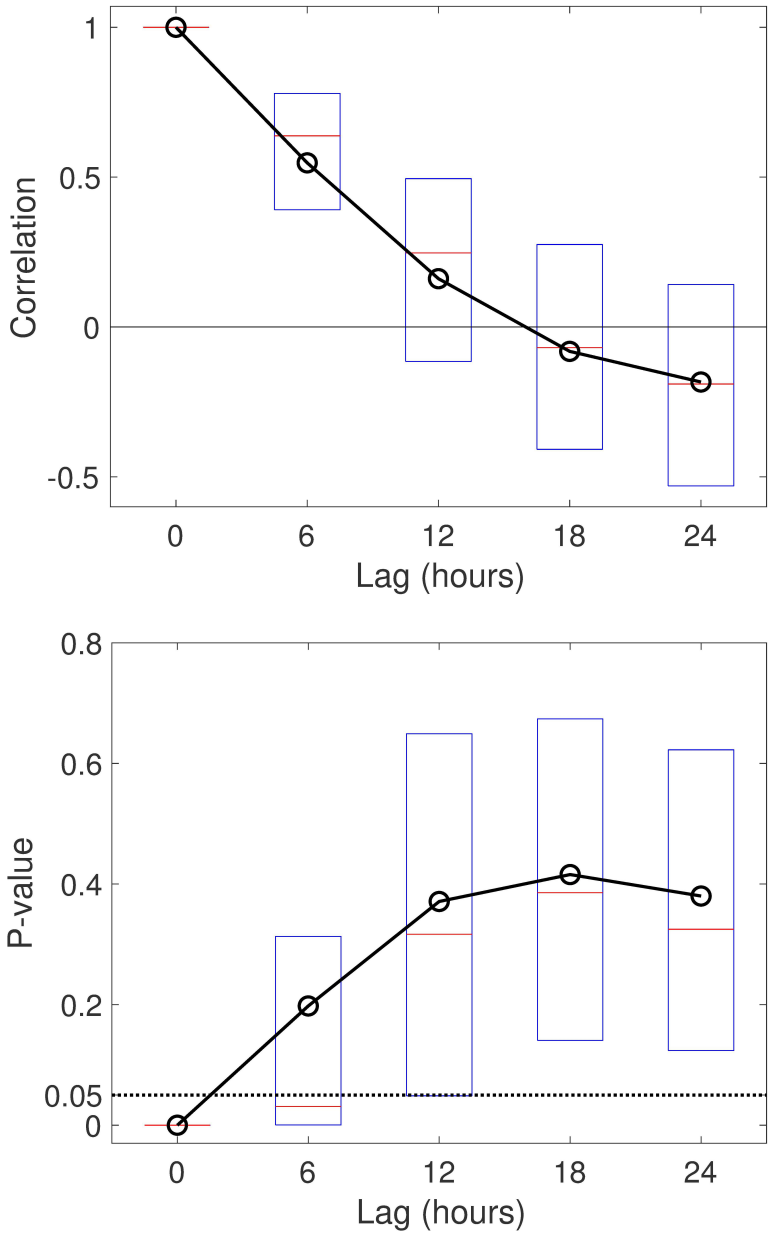

Fig. S7. Lagged autocorrelations (top panel) and P-values (bottom panel) averaged over the periods of hurricane intensity in the individual ADT-HURSAT tracks. Boxplots show the distributions of the autocorrelations and P-values (red lines are medians, blue boxes show 25th and 75th percentiles). The lower dotted line in the bottom panel shows the 95% confidence bound that the correlation is significant (P-value = 0.05). The mean de-correlation time between hurricane estimates along the tracks is 12–18 hours.