11A.2 INVESTIGATING PATTERNS AND CHANGES IN GLOBAL TROPICAL CYCLONE STORM FREQUENCY AND INTENSITY

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1. INTRODUCTION

Understanding fluctuations in tropical cyclone activity along United States shores and abroad becomes increasingly important as coastal managers and planners seek to save lives, mitigate damage, and plan for resilience in the face of changing storminess and sea-level rise. Tropical cyclone activity has long been of concern to coastal areas as they bring strong winds, heavy rains, and high seas. Given projections of a warming climate, current estimates suggest that not only will tropical cyclones increase in frequency, but also in intensity (maximum sustained winds and minimum central pressures). An understanding of what has happened historically is an important step in identifying potential future changes in tropical cyclone frequency and intensity.

The ability to detect such changes depends on a consistent and reliable global tropical cyclone dataset. Until recently no central repository for historical tropical cyclone data existed. To fill this need, the International Best Track Archive for Climate Stewardship (IBTrACS) dataset was developed to collect all known global historical tropical cyclone data into a single point-source for dissemination. With this dataset, a global examination of changes in tropical cyclone frequency and intensity can be performed. Caveats apply to any historical tropical cyclone analysis however, as the data contributed to the IBTrACS archive from various tropical cyclone warning centers is still repleat with biases that may stem from operational changes, inhomogeneous monitoring programs, and time discontinuities. A detailed discussion of the difficulties in detecting trends using tropical cyclone data can be found in Landsea et al. 2006.

The following sections use the IBTrACS dataset to show the global spatial variability of tropical cyclone frequency and intensity. Analyses will show where the strongest storms typically occur, the regions with the highest number of tropical cyclones per decade, and the locations of highest average maximum wind speeds.

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2. TROPICAL CYCLONE FREQUENCY

The IBTrACS dataset contains name, date, location and intensity information for storms in the world's seven ocean basins affected by tropical cyclones: North Atlantic (NA), Eastern Pacific (EP), Western North Pacific (WP), Northern Indian Ocean (NI), Southern Indian Ocean (SI), South Pacific (SP) and South Atlantic (SA). The IBTrACS period of record by ocean basin is shown in Figure 1. Data for some basins are available from as early as 1848. After combining data from the available sources, the resulting IBTrACS dataset can be used to describe the climatology of global tropical cyclones, at least since global records began in 1945.

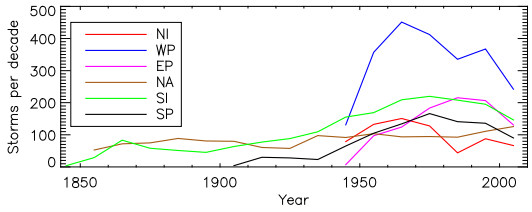

Figure 1 – IBTrACS inventory of tropical cyclones per decade sorted by genesis basin

Analyzing the spatial variability of all storm tracks in IBTrACS for the years 1945 – 2007 shows the observed frequency of tropical cyclones at any location. Tropical cyclone data is typically recorded at 6-hour intervals. Figure 2 was constructed by taking each storm track in IBTrACS, connecting the locations of the 6-hour observation points into a storm path, then expanding the width of each storm path to 1º latitude (111 km). A grid superimposed over the ocean basins was then analyzed by decade to identify which grid points had a storm pass within 55 km. The resulting analysis represents the frequency of a tropical cyclone passing within 55 km of any point.

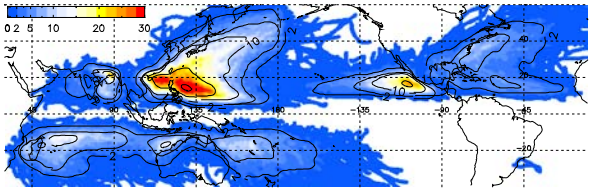

Figure 2 – The frequency of tropical cyclones within 55km of any grid point for 1945-2007 from IBTrACS contoured at 2, 5, 10, 20 and 30 storms per decade.

The highest concentration of storms exists in the WP basin, where the peak frequency is more than 30 storms occurring per decade (i.e., three storms per year near a grid point). A secondary peak in frequency appears in the EP, where more than 20 storms occur each decade. The NI basin also has a maximum of 20 storms per decade in the Bay of Bengal. The remaining basins have lower frequencies, with the maxima near 10 per decade in the SI and five per decade in the NA and SP basins.

2. TROPICAL CYCLONE INTENSITY

Tropical cyclone intensity at a given 6-hour interval is typically measured using the minimum central pressure or the maximum sustained wind speed (MSW). The maximum MSW of all storms passing near a grid point on the globe is shown in Figure 3, whereas the average MSW is depicted in Figure 4. The highest average MSW is just east of the Asian continent. While the average MSW in the NA is not as concentrated as the WP, its areal extent of average MSW greater than 45 kt is much larger than any other basin. In the Southern Hemisphere, the winds tend to be strongest near the 20th parallel in both the SI and SP basins.

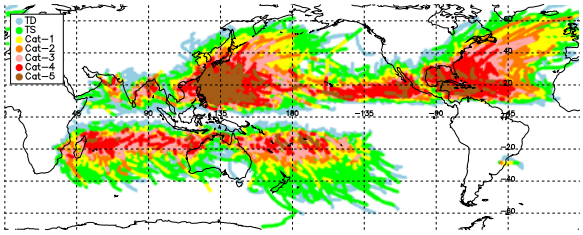

Figure 3 – The maximum storm intensity for tropical cyclones within 55km of any grid point during the IBTrACS period of record (1848-2007).

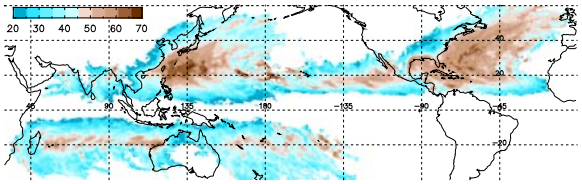

Figure 4 – The average MSW (10-min. winds in knots) of all tropical cyclones within 55km of any grid point with three or more nearby storms during the IBTrACS period of record (1848-2007).

3. CONCLUSIONS

This work uses the IBTrACS dataset to show the spatial variability of tropical cyclone frequency and intensity, including during El Niño and La Niña episodes, for the world's seven ocean basins affected by tropical cyclones. Analyses show where the storngest storms typically occurr, the regions with the highest number of tropical cyclones per decade and the locations of the highest maximum wind speeds.

REFERENCES

Knapp, K. R., M. C. Kruk, D. H. Levinson, H. J. Diamond, and C. J. Neumann, 2010: **The International Best Track Archive for Climate Stewardship (IBTrACS): Unifying tropical cyclone best track data.** *Bulletin of the American Meteor. Society*, **91**, 363-376. doi:10.1175/2009BAMS2755.1

Landsea, C., B. Harper, K. Hoarau, and J. Knaff, 2006: Can We Detect Trends in Extreme Tropical Cyclones? Science, **313**, 452.