Global Tropical Cyclone Climatology using IBTrACS

Carl Schreck¹
Jim Kossin²
Ken Knapp ²
Paula Hennon¹

1 Cooperative Institute for Climate and Satellites
North Carolina (CICS-NC)

2 NOAA’s National Climatic Data Center (NCDC)
Gray (1968)

- First Global Climatology of Tropical Cyclones
  - Combined data from numerous sources
- Today, we have more complete coverage with satellite data
- But the literature hasn’t revisited the global climatology

**Table 1.** Areas where tropical storms develop

<table>
<thead>
<tr>
<th>Area no.</th>
<th>Area location</th>
<th>Average percentage of global total</th>
<th>Average number of tropical storms per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>NE Pacific</td>
<td>16 (?)</td>
<td>10 (?)</td>
</tr>
<tr>
<td>II</td>
<td>NW Pacific</td>
<td>36</td>
<td>22</td>
</tr>
<tr>
<td>III</td>
<td>Bay of Bengal</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>IV</td>
<td>Arabian Sea</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>V</td>
<td>South Indian Ocean</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>VI</td>
<td>Off NW Australian coast</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>VII</td>
<td>South Pacific</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>VIII</td>
<td>NW Atlantic (including W. Caribbean and Gulf of Mexico)</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100</td>
<td>62</td>
</tr>
</tbody>
</table>
IBTrACS: The International Best Track Archive for Climate Stewardship

- 14 sources
- 31,002 total tracks
- 500,000+ observations

Number of sources for each storm (Kruk et al. 2010)

~11,774 storms
6757 TCs with MSW>30
How can we get ONE answer?

• NHC + JTWC

• Average all available sources
  - IBTrACS stopped doing this after v.2

• “IBTrACS-MAX”
  - Use the strongest intensity from any available source

• WMO Subset of IBTrACS
WMO Subset of IBTrACS

Motivation
Methodology
Results
Summary
Methodology

• Focus on period 1981-2010
  ▣ Roughly corresponds to satellite era
  ▣ Better documentation
  ▣ Matches NCDC’s new climate normals

• Annual and Monthly Normals
  ▣ Tropical Storms (10-min wind ≥ 30 kts)
  ▣ Hurricanes/Typhoons/Cyclones (10-min wind ≥ 60 kts)
  ▣ Major Tropical Cyclones (10-min wind ≥ 90 kts)
  ▣ Accumulated Cyclone Energy (ACE)
  ▣ Others?
Methodology

• Convert 1-min to 10-min winds using a 0.88 factor
  - Based on modifications to Dvorak from other agencies
  - No adjustments to 2-min (CMA) or 3-min (IMD) winds

• Omit:
  - Subtropical or Extratropical
  - Non-synoptic times
  - No Wind Data
  - Tracks other than “Main”
How many storms is this?
Global

- Medians:
  - 81 – 90 for ≥ 30 kts
  - 42 – 47 for ≥ 60 kts
  - 17 – 22 for ≥ 90 kts
  - 515 – 686 × 10⁴ kts for ACE

- Distributions for each dataset overlap
Western Pacific

- JTWC has more storms ≥ 90 kts
  - Esp. 1997-2004
South Indian

- Large differences in
  - ≥ 90 kts
  - ACE
Australia

- BoM did not have wind data until 1984/1985
- All variables are much lower in BoM than JTWC for 1996-2002
WMO Genesis Locations (>30 kts)

**Figure 9.** Frequency of initial location of disturbances which later became tropical storms per 5° lat.-long. area per 25 yr. The lack of any initial disturbance genesis in the South China Sea may not be representative.
### Annual Mean Tropical Storm Count

<table>
<thead>
<tr>
<th>Region</th>
<th>Gray (1968)</th>
<th>WMO</th>
<th>NHC+JTWC</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlantic</td>
<td>7</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Eastern Pacific</td>
<td>10 (?)</td>
<td>17</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Western Pacific</td>
<td>22</td>
<td>25</td>
<td>26</td>
<td>29</td>
</tr>
<tr>
<td>North Indian</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>South Indian</td>
<td>6</td>
<td>10</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Australia</td>
<td>2*</td>
<td>8</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>South Pacific</td>
<td>7*</td>
<td>8</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>62</strong></td>
<td><strong>79</strong></td>
<td><strong>85</strong></td>
<td><strong>91</strong></td>
</tr>
</tbody>
</table>

*Gray’s Australian region only included the Indian Ocean side*
Annual Cycle of WMO Genesis Locations
Summary

• Median global number of tropical storms is 80–90 annually

• JTWC and the WMO dataset diverge in the 1990s
  ▪ See upcoming talk by Knapp/Knaff/Sampson
  ▪ Not just in Western Pacific!

• Adjustments to Gray (1968)
  ▪ More storms in Eastern Pacific, South China Sea, and South Pacific
  ▪ Fewer in Bay of Bengal
Extra Slides
Genesis Locations (30 kts)

**WMO Genesis**

**NHC+JTWC Genesis**

**MAX Genesis**

![Maps showing Genesis Locations](image)

**Figure 9.**—Frequency of initial location of disturbances which later became tropical storms per 5° lat-long. area per 25 yr. The lack of any initial disturbance genesis in the South China Sea may not be representative.
Atlantic

• 2005 was an outlier for named storms and hurricanes
Eastern Pacific

- All years in the upper quartile for were before 1995 (except for >90 kt storms)
North Indian

• IMD data in IBTrACS starts in 1990
South Pacific

- Planning to include SPEArTC dataset (Diamond et al. 2012)
Goals

• Update the Gray (1968) Global climatology using IBTrACS

• Provide a baseline climatology for future studies

• Identify differences between sources