Genesis Potential Index for Tropical Cyclones in the Nested Climate Model (NRCM) Experiments

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National Center for Atmospheric Research
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What do we know about North Atlantic Basin Hurricanes?
Available Data

IPCC-AR4

<table>
<thead>
<tr>
<th>Year</th>
<th>1950</th>
<th>1975</th>
<th>2000</th>
<th>2025</th>
<th>2050</th>
<th>2075</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCSM</td>
<td>~150 km</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

WRF - 36 km

1995-2005

2020-2030

2045-2055

Bruyere Statistical Downscaling 0610
Track Density and Genesis Locations

Observation 1995-2005

NRCM 1995-2005

NRCM 2020-2030

NRCM 2045-2055

Contour from 0.2 to 1 by 0.2

Bruyere Statistical Downscaling 0610
Genesis Potential Index

\[ GP = \left| 10^5 \eta \right| \left( \frac{RH_{700}}{30} \right)^3 \left( \frac{V_{pot}}{70} \right)^3 \left( 1 + 0.1V_{shear} \right)^{-2} \]

\( \eta \) = absolute vorticity
\( V_{pot} \) = potential intensity
\( V_{shear} \) = shear between 850hPa and 200hPa

Emanuel and Nolan (2004)
Camargo (2007)
GP from NNRP compared with Observations

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Max GP</td>
<td>0.34</td>
</tr>
<tr>
<td>ASO GP</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Annual Max GP

Nº Storms

NA Basin

cor=0.91
GP from NNRP compared with Observations

Frequency Distribution of Genesis Location for Observed Storms

Genesis Potential Index

Bruyere Statistical Downscaling 0610
GP from NNRP compared with Observations
GP - A Different Approach

<table>
<thead>
<tr>
<th></th>
<th>NA Basin</th>
<th>Gulf</th>
<th>Dev</th>
<th>All Basin Storms corr GP in Dev</th>
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</thead>
<tbody>
<tr>
<td>Max GP</td>
<td>0.34</td>
<td>0.23</td>
<td>0.60</td>
<td>0.60</td>
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<tr>
<td>ASO GP</td>
<td>0.40</td>
<td>0.35</td>
<td>0.61</td>
<td>0.61</td>
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</tbody>
</table>
Zonal Average ASO GP
Zonal Average ASO GP

*cor: 0.83*

Bruyere Statistical Downscaling 0610
Zonal Average ASO GP

CCSM - A2

<table>
<thead>
<tr>
<th>Current observation</th>
<th>Model 1995-2005</th>
<th>Model 2020-2030</th>
<th>Model 2045-2055</th>
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</thead>
<tbody>
<tr>
<td>7.8</td>
<td>7.6</td>
<td>8.5</td>
<td>10.4</td>
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</tbody>
</table>
Conclusions and Future

- NA basin wide average GP has little value as a genesis predictor
  - GP in the NA basin has a flat trend for both NNPR and CCSM data, while number of observed storms had an upward trend for the last 50 years
- GP in development region is a better measure of storm genesis
- GP in NNRP and CCSM models indicate an increase in GP in the lower latitudes
  - i.e., genesis region seems to be shifting south
- NRCM time-slice experiments compare well with GP predictor.
- More work is needed to develop a better index which can also be used effectively in the Gulf