The Hurricane Future

Science and Policy

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Global Warming Is Real

- The devil is in the details of the impacts
- A recent survey reported in the New York Times indicates that the US public (at least those surveyed) identify increased tropical cyclones and associated damages as the number one impact of global warming.
In this talk I shall

1. Discuss items meteorologists care about
2. Frame the current debate
3. Explain areas of scientific concern
4. Suggest research strategies for Hawaii’s piece of the problem
5. Discuss policy options
Terminology

- A generic term – Tropical Cyclone
- Actually terms are basin dependent
- For US purposes
  1. Depressions are numbered
  2. Tropical Storms are “named” (winds > 39 mph)
  3. Anything above 74 mph - Hurricane
A Question of Scale

1980 Winter Storm vs. Hurricane Iniki
Radar Image of Andrew Eye
## Saffir-Simpson Scale

<table>
<thead>
<tr>
<th>Category</th>
<th>Wind Speed Range</th>
<th>Surge</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>74- 95 mph</td>
<td>3- 5 ft</td>
</tr>
<tr>
<td>2</td>
<td>96- 110 mph</td>
<td>6- 8 ft</td>
</tr>
<tr>
<td>3</td>
<td>111-130 mph</td>
<td>9-12 ft</td>
</tr>
<tr>
<td>4</td>
<td>131-155 mph</td>
<td>13-18 ft</td>
</tr>
<tr>
<td>5</td>
<td>156 + mph</td>
<td>19+ ft</td>
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Meteorologists Care About

- 1. Genesis - When and where do they form?
- 2. Intensity - How strong will they be?
- 3. Track - Which way will they go?
Key Questions for the Future

1. Will there be “more intense” TC’s

2. Will there be more “intense TC’s”

3. Will there be more TC’s overall

(Too date little concern over track??)
History

- The storms of 1992 Miami, Hawaii, Guam
- The insurance crisis and the rise of risk modeling
- Climate connection first raised
- 2004 4 Major Hurricanes – Florida
- 2005 Katrina
- Worsening Insurance crisis
2005 Two key papers in Nature and Science

- What did they say?
- Emanuel: Increased duration of intense TC’s in Atlantic and Northwest Pacific
- Curry et al: Increased frequencies in CAT 3-5 storms in all basins globally, correlated with SST rise
Subtlety

- Intergovernmental Panel on Climate Change cut-off for recent report was 2005.

No later literature could be used.
Rebuttals

- Some were reasoned, some were nasty and personal
- Landsea (2006) showed some weaknesses in the global claims of Curry et al. Serious debate ensued over quality of global databases.
- Most parties have now focused the debate on trends in the North Atlantic
- STORM WORLD
Emanuel (1986, 1988) developed theory of

MAXIMUM POTENTIAL INTENSITY or MPI

Basically MPI is function of temperatures of surface inflow air and upper-level outflow air.
MPI (Cont)

Increased SST (proxy for Surface air) and

Decreased lower-stratospheric temperatures

Increase MPI

Global Warming scenario produces both results thus theory suggests increased MPI
Current Status

- Predicted change in MPI under a CO2 doubling scenario is ~ 5%
- To date should be ~ 2%

PRETTY SMALL NUMBER!!!
Detectable???
MOST TC’s NEVER ACHIEVE MPI

Nature Conspires to repress TC’s

To generate a TC we must pile a lot of warm air in a vertical column

Hydrostatics lead to pressure fall and spin-up.

A number of conditions must be met, no one of which is sufficient
A Brief Discussion of Genesis

- Tropical cyclones are rare
- Roughly 80 per year worldwide
- Assume a one week life span
- Result – 1-2 storms any day in an area half the surface area of the planet
- Reason – you need to bring 6 factors together to produce a storm
Requirements for Genesis
All must be met

- Warm waters (~ 80 deg F or more)
- Low variation of winds with height (shear)
- Latitude high enough for “spin”
- Deep moist atmospheric layer
- Instability to allow thunderstorms to develop
- A pre-existing disturbance
Observational Issues

1. How well do we assess intensity?
2. How have techniques changed?
3. Are the data statistically homogeneous?
4. How long are the time series?

Consensus: Only the North Atlantic data are considered robust. However debate continues even on that one. (3 recent EOS papers).
Political/Observational
Issues

The mystery of “existence” of a TC.

Ex. TS Winona (1988)
Ex. Non-event of May 1997
Ex. TD 4C (2006)
Science and Policy

Often science takes longer than policy makers would like.

In the Hurricane case a number of factors are in play already… especially insurance issues. Florida and Hawaii since 1992 but now even Massachusetts. Develop of “short-term” risk models.
The Hawaii Case

Relatively few storms annually and historically.

Serious Infrastructure issues.

How can we project the future:

1. General Circulation Models may or may not simulate “storms”
2. Analysis of GCM outputs for the key genesis factors
3. No one has considered “track” but GCM’s and regional climate models should be able to produce steering winds.

The capabilities to do the analyses above reside within SOEST, esp. IPRC
Climate change notwithstanding we have a problem:

1. Coastal populations expanding
2. New Orleans was identified as “at risk” long before any climate change issues
HAWAII REALITY

1. Sea level is rising.


3. We can’t shelter our current population

IT IS PRUDENT TO ACT TO MITIGATE THE IMPACTS OF CURRENT EVENTS
Conclusions

1. MPI theory is sound, increased MPI a logical future
2. Number changes at best indefinite
3. For Hawaii we really should look at track
4. Many policy responses are prudent even in the absence of climate change
5. If the current furor promotes responsible, necessary societal responses.. GOOD!!