Exploring NJ Climate Variability and Change

Presentation to the Pinelands Commission

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Overview

1. Pinelands weather and climate
2. Climate change, past, present…..future?
3. Impacts and potential actions
Climate or Weather???

Weather refers to the short-term phenomena

Climate refers to the long-term patterns
Better yet!

Climate is your personality…..

Weather is your mood…….
The big picture: a NJ squeeze play
Diversity: Local Controls

Altitude
Latitude
Surface Conditions
Land-Water Contrasts
A precipitation rich state......

......most often
Sometimes
 too much......
And sometimes far too much

Irene rainfall
Burlington County deluge
12 July 2004
Sometimes too little....
A season for everyone
7 July 2010
4:00 PM
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Is climate presently changing in NJ & elsewhere?

Preponderance of evidence suggests climate change is occurring and humans are responsible for a significant portion of recent changes

1. Theory
2. Observations
3. Models
Climate regimes have changed dramatically on many time scales in the past.
The Greenhouse Effect

SUN

Some solar radiation is reflected by the Earth and the atmosphere.

Solar radiation passes through the clear atmosphere

ATMOSPHERE

Most radiation is absorbed by the Earth's surface and warms it.

EARTH

Infrared radiation is emitted from the Earth's surface.

Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.
Global land-ocean temperatures: 1880-2014
Trends in annual mean south Jersey temperature: 1895-2014

- Long-term upward trend of approx. 3°F per 100 years
- More rapid warming since 1980
- The three warmest years have occurred since 1998
- 2012 was the warmest year on record

Data source: National Climatic Data Center

\[ y = 0.1873x - 5.9441 \]

\[ R^2 = 0.1506 \]
Trends in annual mean south Jersey precipitation: 1895-2014

Long-term upward trend of 4.1” per 100 years

Large decadal variability (early 1960s drought, wet 1970s, very wet in last decade)

data source: National Centers for Environmental Information
Hopewell, Mercer County August 20, 2010
Sea level rise: global and regional: 1880-present

- Local sea level rise along the NJ coast has been more rapid than the global rise due to land subsidence (combination of post-glacial movement of earth’s crust and compaction of coastal plain sediments)

Purple: Church & White (2011) GSL
Blue: Tide gauge data
Green: Long-term sea-level signal

~1.3 mm/y GIA 1.7 mm/y NJ
An additional ~1 mm/y on the shore
Coupled Climate Model Schematic
Natural and anthropogenic forcings and 20\textsuperscript{th} century temperatures

Meehl, G.A., et al., 2004
Pineland's future climate

- Rising temperatures
- Steady or increasing precipitation
- Increasing variability and extremes - storms, flood, drought, heat
- Rising sea level
Changing Annual and Seasonal Temperatures

2041-2070 minus 1971-2000

North American Regional Climate Change Assessment Program

Kunkel et al. NOAA Tech. Report NESDIS 142-9, 2013
Changing Annual and Seasonal Precipitation

2041-2070 minus 1971-2000

North American Regional Climate Change Assessment Program

Kunkel et al. NOAA Tech. Report NESDIS 142-9, 2013
A change in extremes?

Manville

17 September 1999
# 2 crest 21.0’ (nearby Blackwells Mills: 1921-present)

16 April 2007
# 3 crest 19.2’

14 March 2010
# 6 crest 16.2’  (1 May 2014 #7 crest 15.9’)

28 August 2011
# 1 crest 21.2’
Future sea level in NJ: Miller & Kopp

<table>
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<th>Total sea level rise projections for New Jersey.</th>
<th>Total cm</th>
<th>Total inches</th>
<th>Total feet</th>
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<td>2050 best</td>
<td>40</td>
<td>16</td>
<td>1.3</td>
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<tr>
<td>2050 low</td>
<td>23</td>
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<tr>
<td>2050 high</td>
<td>60</td>
<td>24</td>
<td>2.0</td>
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<tr>
<td>2100 best</td>
<td>96</td>
<td>38</td>
<td>3.1</td>
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<tr>
<td>2100 low</td>
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<tr>
<td>2100 high</td>
<td>147</td>
<td>58</td>
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All values with respect to a year 2000 baseline.

Based in the slightly lower melting figures of Shepherd et al. (2012), subsidence rates of 1-2 mm/yr in excess of global, and dynamic oceanographic effects
Seaside Heights

1 foot (likely by ~2040)

3 feet (likely by 2090s)

6 feet (~5% chance by 2100)

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Potential climate change impacts

Climate Changes
- Temperature
- Precipitation
- Sea Level Rise

Health Impacts
- Weather-related Mortality
- Infectious Diseases
- Air Quality-Respiratory Illnesses

Agriculture Impacts
- Crop Yields
- Irrigation Demands

Forest Impacts
- Forest composition
- Geographic range of forests
- Forest health and productivity

Water Resource Impacts
- Water supply
- Water quality
- Competition for water

Impacts on Coastal Areas
- Erosion of beaches
- Inundation of coastal lands
- Additional costs to protect coastal communities

Species and Natural Areas
- Loss of habitat and species
Is there something we should be doing about this climate dilemma?
• **Knowledge**: Develop a better understanding of the details of future climate change.

• **Mitigation**: Reduce emissions of carbon dioxide and other greenhouse gases.

• **Adaptation**: Increase the resilience of society to climate change.

• **Leadership**: Raise public awareness of the challenges posed by climate change and the need to mitigate and adapt.
New Jersey Weather & Climate Network

http://njweather.org
NJWxNet stations measure:
Air temperature
Wind speed and direction
Dew point/Relative Humidity
Precipitation
Barometric pressure
Solar radiation
Soil temperature
Soil water content

Solar power

Cellular communications

Ability for expansion built into station design
Berkeley Twp., NJ
RJ Miller Air Park

Latest NWS Forecast
Today
Sunny, with a high near 58. West wind 7 to 15 mph.

Latest Conditions
46°F

Sunny

58 °F

Tonight
Clear, with a low around 38. West wind around 8 mph.

Clear

38 °F

Monday
Sunny, with a high near 64. West wind 7 to 9 mph.

Sunny

64 °F

Monday Night
Mostly clear, with a low around 42. North wind 5 to 11 mph becoming northeast after midnight.

Mostly Clear

42 °F

Tuesday
Mostly sunny, with a high near 52. East wind 10 to

RUTGERS NJclimage.org
<table>
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<tr>
<th>Site</th>
<th>Air Temp</th>
<th>RH</th>
<th>Wind Sp</th>
<th>Peak Gust</th>
<th>Wind Dir</th>
<th>10hr Fuel Moisture</th>
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</table>

**Legend:**
- Relative Humidity: < 40% < 30% < 20%
- Wind Speed/Gust: > 15 > 20 > 25
- Fuel Moisture: < 20 < 15 < 10
Augmenting automated weather observations

Daily observations by trained volunteers of all ages
Community Collaborative Rain, Hail and Snow Network:

7AM 20 Aug – 7AM 21 Aug 2015

www.cocorahs.org

NJclimate.org
Summing up:

Be it weather moodiness or long-term climate personality changes, a dull moment is rare to find in the Pinelands, throughout southern NJ and beyond.

There is abundant evidence that the atmosphere, oceans and continents are primed to produce even more action, more variability, and more change in the decades ahead on local to global scales.

Continued vigilance is required to monitor, understand and predict the future behavior of the climate system.