What factors affect climate?

Dr. Michael J Passow
Energy from the Sun (mostly light and heat) **radiates** to Earth

Challenge: If the speed of light is 300,000 km/sec, show how to calculate the time it takes sunlight to reach Earth.
Important Terms
Do you know what each means?

• Energy
• Radiation
• Convection
• Conduction
• Latitude
• Longitude
• Evaporation
• Condensation
Earth is a 3-D sphere

• How does the intensity of insolation change as latitude increases?

• Why does the intensity of insolation change as latitude increases?
Lower concentration of Sunlight at poles than at the equator
Most regions outside the Tropics have warm and cold seasons because Earth’s axis is tilted and receive different amounts of insolation
Regions within the Tropics often have climates with wet and dry seasons

- **Summer monsoon**—“rainy season”
- **Winter monsoon**—“dry season”


http://www.cse.unsw.edu.au/~andrewt/i/dry_season_fire_full.jpg
Atmospheric Circulation

Variations in heating and cooling, and Earth’s rotation (Coriolis effect) produce three general climate zones in each hemisphere.
The atmosphere is actually more complicated than the simple model (and even than this model)
Elevation

• The higher the elevation, the cooler the temperature

• Even in low latitudes (near the equator)
  --Andes
  --Himalayas
  --Kilimanjaro (Africa)

• Snow-capped peaks in Peru, near the equator

Topography

- As air rises up the **windward** side of a mountain, it cools and becomes **saturated**. As it sinks down the **leeward** side, it warms and dries. Some areas where this occurs are the Cascades in the Pacific Northwest and the Sierra Nevadas. Behind these are “rain shadow deserts.”
Water Bodies

- Proximity (nearness) to ocean
- The Jersey Shore and similar places have cooler summers and warmer winters (smaller range) because they are near the ocean
- Greater range inland (middle of the continent)
- Proximity to large lakes (Great Lakes)
- “Lake-effect snow”

Classifying Climates – The Koppen System

Köppen Climate Classification

Individual Climatic Zones Classified by Type

Type A
Tropical humid
- Af, Am
- Aw

Type B
Dry
- Bsk, BSh
- BWh, BWk

Type C
Humid subtropical
- Cf
- Cfa
- Cw, Cwa, Cwb

Type D
Humid continental
- Dfa
- Dfb
- Dwa
- Dwb

Type E, H
Continental subarctic
- Dfc
- Dfd
- Dwc
- Dwd

Polar
- ET-Tundra
- EF-Snow and Ice
- Highland
- H

http://www.britannica.com/EBchecked/media/95795/The-major-climatic-groups-are-based-on-patterns-of-average
What kind of climate do we have in NY and NJ?

- Mild winters with coldest month below 18°C but above -3°C
- We are described as “Humid mid-latitude with mild winter”
- Koppen system: Cfa

- Climatologists study “normals” and “anomalies” (how far away values are from the expected value)
- Good for “Big Picture,” but we need to look more closely for the “good stuff”
National Climate Data Center

www.ncdc.noaa.gov

- Official US government climate source
- “New” Normals posted 1981 – 2010

http://ggweather.com/normals/
NOAA's National Centers for Environmental Information (NCEI) is responsible for preserving, monitoring, assessing, and providing public access to the Nation's treasure of climate and historical weather data and information. Learn more about NCEI.

**How may we assist you?**

- I want to search for data at a particular location.
- I want quick access to your products.
- I want to see your monthly climate reports.
- I want to find a specific dataset.
- I want to know about climate change and variability.

**Assessing the U.S. Climate in September 2016**

The September temperature averaged across the contiguous U.S. was 67.2°F, 2.4°F higher than the 20th century average.

**NEWSROOM**

September 2016 Regional Climate Impacts and Outlooks

We're announcing the release of the Regional Climate Impacts and Outlooks summaries for September 2016.
Northeast Drought Update

October 13, 2016

WEBSITE HIGHLIGHTS

Northeast Drought Update

The Northeast Drought page offers a weekly update of the current drought conditions, including conditions and impacts, as well as precipitation anomalies.
The Ithaca Climate Page

<table>
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<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
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<tr>
<td>Max Temperature (°F)</td>
<td>31.3</td>
<td>34.0</td>
<td>42.0</td>
<td>55.5</td>
<td>67.4</td>
<td>76.0</td>
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<tr>
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<td>16.5</td>
<td>23.1</td>
<td>33.9</td>
<td>43.5</td>
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<td>Avg Temperature (°F)</td>
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<td>32.6</td>
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<td>68.8</td>
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<td>85</td>
<td>148</td>
<td>120</td>
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<td>Precipitation (inches)</td>
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<td>2.64</td>
<td>3.29</td>
<td>3.19</td>
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<tr>
<td>Snowfall (inches)</td>
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</tr>
</tbody>
</table>

These normals are based on data for the period 1981-2010. Normals are updated every five years. For more information, visit the [National Climate Data Center](https://www.ncdc.noaa.gov) for Environmental Information.

We appreciate any feedback: nrcc@cornell.edu
Latest from the NJWxNet

Frequently Updated Climate Data

Monthly and Annual Statewide (1895-Present)

Monthly Station
Monthly Maps
Winter 2010-2011 Snow Event Totals

Latest News

A backyard deck with furniture floats up onto a fence behind a pool destroyed by flood waters during flooding in Lincoln Park (Morris County) on September 8. Photo by Jerry McCrean/Star-Ledger
Examples of annual climate patterns, shown with bar charts “discontinuous data”

http://climate.rutgers.edu/stateclim/
What Are Some Natural Processes That Can Affect Climate?

- Volcanic eruptions
- Solar Activity
- Earth Motions (very long term)
- Ocean Circulation
  > General current patterns
  > El Nino-La Nina conditions
The “Greenhouse Effect” – Natural, but enhanced by Human Activity

Solar Radiation absorbed by Earth: 235 W/m²

Directly radiated from surface: 40

Thermal radiation into space: 195

Heat and energy in the atmosphere: 324

Greenhouse gas absorption: 350

Earth's land and ocean surface warmed to an average of 14°C

The Greenhouse Effect

http://www.bing.com/images/search?q=greenhouse+effect+image&view=detail&id=67609E9E8C9DB151116F25228DA8FC8541FE8AEA&first=0
What Human Impacts Can Affect Climate?

- Release of “Greenhouse Gases”
- “Urban Heat Islands”
- Pollution

- IPCC (Intergovernmental Panel on Climate Change) and National Climate Assessment reports on potential impacts on Society
The decision to prepare a Fifth Assessment Report (AR5) was taken by the members of the IPCC at its 28th Session (09-10 April 2008, Budapest, Hungary). Following the election of the new IPCC Bureau at the 29th Session of the IPCC (31 August - 04 September 2008, Geneva, Switzerland) and discussions about future IPCC activities at the 30th Session of the IPCC (21-23 April 2009, Antalya, Turkey). A Scoping Meeting was held (13-17 July 2009, Venice, Italy) to develop the scope and outline of the AR5. The resulting outlines for the Working Group contributions to the AR5 were approved by the 31st Session of the IPCC in Bali (26-29 October 2009).
National Climate Assessment

Highlights

Explore highlights of the National Climate Assessment including an Overview, the report’s 12 overarching findings, and a summary of impacts by region.

→ EXPLORE HIGHLIGHTS

Full Report

Explore the entire report covering different aspects of the changing climate, regions, cross sectoral topics, and response strategies in full detail.

→ EXPLORE THE REPORT
Takeaway Points

• Climates result from many factors, some permanent (such as elevation) and some changing cyclically (such as seasonal insolation)
• Climates can be described and classified by annual temperature and moisture patterns
• Natural and human-induced factors impact climate over short- and long-time scales
• Global climate will change in this century, with major impacts on society, including you!