Manomet

Mission: Applying Science and Engaging People to Sustain our World

Programs:

• Shorebird Recovery
• Landbird Conservation
• Sustainable Economies
• Climate Services
Climate Science Overview
Antarctic Ice Core Data

The graph shows the concentration of CO2 (ppm) over time, with Years before 1950 on the x-axis and CO2 (ppm) on the y-axis. The graph includes a point labeled "Today," another point indicating 470 ppm concentration in 2050, and a trend marked as "IPCC 2001."
Observed Change: Temperature

Animation of Global Surface Temperature Anomalies from 1880-2015. Source: NASA/GSFC Scientific Visualization Studio
Observed Change: Temperature

(compared to 1901 – 1960 average)

NCA 2014
Projected Change: Temperature

Projected change in average surface air temperature in the later part of this century (2071-2099) relative to the later part of the last century (1970-1999) under a scenario that assumes substantial reductions in heat trapping gases (B1, left) and a higher emissions scenario that assumes continued increases in global emissions (A2, right).
Annual total precipitation changes for 1991-2012 (compared to 1901-1960 average)  

NCA 2014
Projected Change: Precipitation

% Change in Seasonal Precipitation by end-of-century (compared to 1970-1999) under Higher Emissions Scenario

Adapted from NCA 2013, Fig. 2.14
Changing Extremes: Temperature

Animation of Northern Hemisphere Summer Temperature Anomalies, compared to 1950-1980 base period.
Source: NASA/GSFC Scientific Visualization Studio
Changing Extremes: Precipitation

Observed Change in Very Heavy Precipitation (1958-2012)

Percent changes in the amount of precipitation falling in very heavy events (the heaviest 1%) for each region.

Percent changes:
- 11%
- 12%
- 16%
- 5%
- 37%
- 71%
- 27%
- 33%
- -12%
Certainty & Uncertainty
What We Know and What We Don’t about the Climate System
What We Know

- Greenhouse gases are warming the planet
- Other pollutants are cooling the planet
- Planet will warm while energy imbalance persists
- Regional differences in warming
  - Poles warming more rapidly than lower latitudes
- Changing precipitation patterns
  - General “wet get wetter, dry get drier” pattern
- Increasing probability of extreme heat and precipitation events
- Rising sea levels
Uncertainty: The Climate System

- Emissions
- Feedbacks
- Tipping Points
- Downscaling
Uncertainty: The Climate System

• **Emissions**
  - Future emissions depend on:
    - World population
    - Economic development
    - Energy technology

Source: IPCC AR5 WGI, Chapter 12, Fig. 12-5
Uncertainty: The Climate System

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  - Amount of warming depends on positive (warming) and negative (cooling) feedbacks in the climate system, such as:
    - Snow-/ice albedo (+)
    - Water vapor (+)
    - Clouds (+/-)
    - Forests (+/-)
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  - Thresholds that can push the earth’s climate into a new state, even if we reduce emissions, such as:

Source: Potsdam Institute for Climate Impact Research
Uncertainty: The Climate System

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• **Tipping Points**
  - Thresholds that can push the earth's climate into a new state, even if we reduce emissions, such as:
    - Run-away loss of arctic sea ice
    - Melting permafrost

• **Downscaling**
  - Extrapolating higher-resolution local or regional climate data from the results of global climate models

Source: cal-adapt.org
Climate Change and Cranberry Agriculture
Climate Change Impacts

• Chilling Requirements
  • Chilling requirements will likely be met for the next 50 years
  • Beyond 50 years, under high emissions scenarios, chilling hours may be insufficient
Climate Change Impacts

• Frost Damage
  • Abnormally warm periods in late winter and early spring increase window when frost damage can occur
Climate Change Impacts

• Scald
  • Heat stress injury that occurs when plants can’t transpire quickly enough to keep fruit cool
  • Primary adaptive response is to insure sufficient soil moisture prior to onset of heat stress conditions
A conceptual figure illustrating the effect of increased VPD on the biophysical factors that influence tree physiology, drought stress, and survival. Higher temperatures increase VPD non-linearly (A), higher VPD will generally both deplete soil moisture (B) and increase plant stress though changes in transpiration (C, based on data from Eamus et al. (2008)), all of which are projected to contribute to non-linear increases in forest stress [highlighted by the Forest Drought Severity Index (FDSI), with more negative values corresponding to increased stress] and resultant widespread regional mortality (D; Williams et al., 2013).
Climate Change Impacts

• Changing Precipitation Patterns
  • Increasing annual precipitation but with important seasonal differences
  • Continued biasing towards heavy precipitation events
Climate Change Impacts

• Rot
  • Increasing stress associated with scald and changing precipitation patterns may increase vulnerability to fungal damage
Likely Climate Change Impacts

• Changing Insect Pressure
  • Insect ranges are expanding northward as average temperatures warm
Climate Change Opportunity

• Productivity
  • Carbon rich atmosphere and longer growing season can enhance growth if other stressors can be successfully managed
Resources from the CSLN

• Storm Water & Stream Crossings
• Climate Change, Wind, & Forest Mgmt
• Ecologically- Relevant Changes in Temperature Variability
• Global Temperature *Observed Trends; Projections*
• Global Precipitation *Trends & Projections; Ecosystem & Mgmt Implications*
• Certainty & Uncertainty *The Climate System; The Forest Response*
• Forest Pests & Climate Change
• El Niño Update & Implications for Forestry
• Climate Change & Extreme Weather *Trends & Projections; Forest Impacts*
• Wildlife & Biodiversity Impacts *Overview; Examples*
• Modeling Future Forests
• Carbon Markets & Forests: What Does the Future Hold?
• Climate Change & Forest Productivity
• Wildfire in a Warming World
Stay Alert and Keep Learning
Thank You

Eric Walberg

Climate Services Director
508-224-6521 / ewalberg@manomet.org
manomet.org