Impacts of Climate Change in the Mid-Atlantic

Illustrative Conclusions from the U.S. Climate Change Science Program’s Synthesis and Assessment Reports and Other Major Assessments

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U.S. Climate Change Science Program

**Vision**: A nation and the global community empowered with the science-based knowledge to manage the risks and opportunities of change in the climate and related environmental systems.

**Mission**: Facilitate the creation and application of knowledge of the Earth’s global environment through research, observations, decision support, and communication.

**Responsibility**: Coordination and integration of scientific research on global variability and change sponsored by 13 participating departments and agencies of the U.S. Government.
CCSP Assessments

• Complement IPCC; U.S.-focused
• Scientifically rigorous development and review process
• Full color fact sheets at www.climatescience.gov
• Overarching synthesis under development---addresses key regions/sectors; adaptation
Some Overarching Conclusions

• Climate changes are already affecting U.S. water resources, agriculture, land resources, and biodiversity (*very likely*).

• Climate change will continue to have significant effects on these resources over the next few decades and beyond (*very likely*).

• Many other stresses and disturbances are also affecting these resources (*very likely*)

See CCSP S&A Product 4.3
Causes of Global Warming

Chief contributors to the Greenhouse Effect:
- CO₂
- Methane

Suddenly, Bob realizes that he's "part of the problem".
Confirmation from Multiple Sources of Information

Bore Hole Temperature Reconstructions
Causes of Global Warming

“Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.” (IPCC, 2007)
Where are we headed?
The next 100 years compared to the last 1000
Temperature Projections for 2090-2099

3 Different Emission Scenarios

- **B1**
- **A1B**
- **A2**

N. America, Scenario A1B, in Summer & Winter

**Summer**

**Winter**

IPCC WG1 Ch11

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IPCC WG1 Ch11
Hot Days to Become Much More Common

Return frequency of 1-in-20-yr days by 2090-2099

See CCSP S&A Product 3.3
"Gully Washer" Rains Will Tend to Become More Common

Return frequency of 1-in-20-yr events by 2090-2099

See CCSP S&A Product 3.3
Runoff and evaporation changes likely to affect reservoir performance, water management effectiveness, etc.
  • However, increases in water-use efficiency likely to continue, which will help reduce impacts of climate change on water resources.

Water quality likely to be affected in future by climate change; however, to-date other factors have been more important
  • Increases in intense rains will increase sediment and pollutant loading
  • Saltwater intrusion into groundwater likely in some coastal regions
  • Changes could impose huge costs on water treatment infrastructure.

Less reliable water supplies likely to create challenges for managing urban water systems.

*Past not a good guide to the future!*
Climate is changing, rapidly…

See CCSP S&A Product 1.2
Accelerating Ice Sheet Discharge

**Blue** = slow thickening
**Red, yellow** = fast thinning

Krabill et al., 2004, GRL

Source: Prof. Konrad Steffen, Univ. of Colorado
See CCSP S&A Product 4.1
Response options for large near-term impacts include:
- Beach nourishment
- Enhancing vertical accretion
- Elevating homes
- Fortifying dikes

Low regret response options include:
- Home setback
- Building with higher floor elevation
- Designing new coastal drainage with larger pipes
- Rebuilding roads to higher elevation during routine reconstruction
- Designing bridges & other major facilities to account for sea level rise

Options that reallocate or clarify risks include:
- Concentration of development
- Rolling easements
- Insurance incentives/disincentives; clarification of coverage
Changing Climate Tends to Promote Oyster Diseases
(e.g., dermo and MSX)
Increasing Ocean Acidification Threatens Base of Food Chain
Energy Supply

• Direct impacts from increased intensity of extreme weather events
• Warming will affect efficiency of thermal power plant cooling
• Facility siting decisions affected by changing conditions
• Positive or negative impacts on production of biomass, wind power, or solar energy where climate conditions change.

Costs of proactive adaptation in vulnerable regions generally much less than the costs of reactive responses. (SAP 4.7)
Energy Demand

- Decreased energy consumed for space heating
- Increased energy consumed for cooling & refrigeration;
- Northern regions to reduce consumption of heating fuel more than increases in consumption of elec.; Reverse true in the south
- Increased electricity peak demand

See CCSP S&A Product 4.5
Transportation

Warmer / less snowy winters:
- improved ground & air transportation reliability
- decreased need for winter road maintenance

Summer heat waves:
- railroad track buckling/kinking
- road softening and traffic-related rutting
- decreased airplane lift

Increased frequency of extreme precipitation, river, and coastal flooding events may contribute to:
- increased accident rates
- more road closures due to flooding and landslides (single point failures)
- more frequent short-term flooding and bridge scour
- more culvert washouts
- exceedence of storm drain capacity

See CCSP S&A Product 4.7
Health Impacts

- Very likely that heat-related death and illness will increase over the coming decades.
- There will likely be an increase in spread of several food- and water-borne diseases among susceptible populations.
- Range of many vectors (e.g., insects, rodents) likely to extend northward.
- Higher urban temps in urban and likely associated increases in tropospheric ozone concentrations can contribute to cardiovascular and pulmonary illness if current regulatory standards are not attained.
- Hurricanes, extreme precipitation resulting in floods, and wildfires also have the potential to affect public health through direct and indirect health risks.

See CCSP S&A Product 4.6
Agriculture Impacts

- Life cycle of grain and oilseed crops will likely progress more rapidly. But, as temperature rises, these crops will increasingly begin to experience failure.

- Horticultural crop yields – e.g. tomatoes, onions, fruits – very likely to be more sensitive to climate change than grain and oilseed crops.

- Climate change likely to lead to northern migration of weeds. Many weeds respond more positively to increasing CO₂ than most cash crops, particularly C3 “invasive” weeds.
  - Recent research also suggests that glyphosate, the most widely used herbicide in the United States, loses its efficacy on weeds grown at the increased CO₂ levels likely in the coming decades.

- Disease pressure on crops and domestic animals will likely increase with earlier springs and warmer winters, due to proliferation and higher survival rates of pathogens and parasites.

- Higher temperatures will very likely reduce livestock production during summer. For ruminants, current management systems generally do not provide shelter to buffer the adverse effects of changing climate.

See CCSP S&A Product 4.3
Heat Influence on Dairy Cattle Milk Production. Thermal Heat Index >72 production

Flea Beetle. Yellow and orange indicates expansion of overwintering and mod-sev. beetle pressure.

Wolfe et al, 2008
Ecosystems Changes
(e.g., Future Oriole Incidence)

http://www.nrs.fs.fed.us/atlas/bird/RFbirdmod_5070.html
Two Responses to a Changing Climate

**Mitigation:** reduce emissions; energy efficiency; alternative energies, etc.

*Impacts on climate change:* 50-100 yrs.

**Adaptation:** planning ahead; incorporating likely future climate states into regular planning;

*Impacts on community:* Now and in Future.
We can plan ahead … or we can react.

We can anticipate, plan, act.

Or we can just respond.
Adaptation Planning: Many Timeframes

- New irrigation projects
- Large dams
- Bridge design life
- Whole farm planning
- Tree crops
- Transport infrastructure
- Plant breeding cycles
- New irrigation projects
- Major urban infrastructure
- Protected areas
- Election cycles/profit & loss
- Intergenerational equity
- Forest succession
- Generational succession
- Annual crops
- Protected areas
- Intergenerational equity
- Bridge design life
Adaptation options include: management, technology, institutions, monitoring, R & D

- Prioritize lands to preserve
- Design of migration corridors
- Emergency response plans
- Early warning alert systems / surveillance
- Infrastructure to withstand new “extremes”
- Linking of reservoirs to enhance supply
- Seed banks, mass propagation techniques
- Incentives / disincentives / insurance

Source: R. Bierbaum, Coping with Climate Change: National Summit, May 8-10, 2007
Guidebooks and Frameworks

Adapting to Global Warming — a Guidebook

Climate Safe Communities Campaign

Cities Preparing for Climate Change
A Study of Six Urban Regions

May 2007

Coastal Hazards and Climate Change
A guidance manual for local government in New Zealand

May 2006

Climate Change Risk and Vulnerability
Promoting an efficient adaptation response in Australia

Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies

Editors:
Jay F. Fennstra
Ian Hargreaves
Joel B. Keith
Richard S.J. Tol

Version 2.0
October 1998

UNEP
United Nations Environment Programme
Institute for Environmental Studies
We Need to Hear From You

What major climate-related challenges or questions are you facing?
  • What state- and local-level issues might the federal climate science program not have on its radar screen?

How can climate change science and information needed to support your decisions and discussions be better provided?
  • Observations, models, tools?
  • Format, access, interpretation, localization, training, etc.?

Do you find scientific assessments related to climate change (e.g., IPCC reports, CCSP Synthesis and Assessment Products) useful in helping you make informed decisions?
  • Are you aware of these reports?
  • What improvements for future assessments would you suggest?

What do you feel are the roles and responsibilities of the federal government in addressing climate change?
  • Is there a need for a central federal coordinating entity?
Thanks