

Summary of EPA's Climate Change Indicators Workshop

Prepared: June 17, 2011



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**Summary of EPA’s Climate Change Indicators Workshop
March 1–2, 2011
Arlington, VA**

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Disclaimer

This workshop was funded by the U.S. Environmental Protection Agency under contract number EPW07067. This report summarizes discussions with and among invited attendees at the U.S. Environmental Protection Agency’s March 1–2, 2011 workshop. This report is presented solely for informational purposes. This report has not undergone a formal technical peer review and does not necessarily reflect the views of the Agency and no official endorsement should be inferred.

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Workshop Goals

- Solicit feedback on EPA's 2010 *Climate Change Indicators in the United States* report.
- Explore options to enhance future iterations of the report.
- Generate ideas regarding potential inclusion of new or revised indicators.
- Identify opportunities for collaboration on communicating climate change indicators.

A list of workshop participants can be found in Appendix A. Workshop presentations will be provided separately.

Executive Summary

In March 2011, the Climate Change Division (CCD) of the U.S. Environmental Protection Agency (EPA) organized a workshop with experts on various aspects of climate change. The workshop was intended to gather feedback on EPA's 2010 report, *Climate Change Indicators in the United States*, and to solicit suggestions for future versions of the report and its content. This report attempts to summarize participant feedback and reflect key discussions from the workshop. Active participation, feedback, and advance preparation from attendees was outstanding and voluminous, and EPA continues to ensure that these contributions receive due consideration.

Highlights of the workshop discussions are described in five main categories below.

Participant Feedback on the 2010 Report

- Virtually all workshop participants found the climate change messaging and visual appeal of the report to be excellent and engaging.
- Some participants suggested clarifying what the goals of the report are and who its intended audience is. In addition to communicating indicators, participants inquired about the policy context for this report (e.g., taking action on climate change).
- Some participants suggested strengthening the report by including additional indicators and telling a more complete story. Specifically, participants suggested incorporating vulnerability associated with climate change effects and impacts.
- Several participants suggested clarifying and more fully explaining the criteria used for selecting the current indicators from the larger original set of indicators. Some participants suggested revisiting the criteria to ensure that they capture a fuller range or balanced set of climate change effects (i.e., ecosystem, physical, and human dimensions).
- Several participants noted that the current indicators are primarily national and strongly suggested a general framework or established method for reporting regional-scale indicator information.

- Participants noted in various discussions that a conceptual framework (e.g., thematic diagram) could help readers understand the issues of climate change.
- Participants suggested improving the accessibility and utility of the report's technical support document (metadata). Many workshop participants were not aware of this document.

Matters of Scale

- Determining the appropriate scale for data presented in the report can have a major impact on how the report is interpreted and how people relate to the information.
- Several participants noted that more localized information communicates more effectively to state and local decision-makers, especially when climate change is considered among many other competing priorities for budget and resources.
- Decisions to scale down indicators to provide regional data should be made on a case-by-case basis.
- Regional information can be presented in various ways, such as by including case studies of impacts seen in specific locations or by establishing mechanisms to facilitate regional interpretation of certain indicators. Several participants noted that additional scaling could be done outside the report (e.g., expanded website capabilities).

New Indicator Discussions

- Through breakout sessions and full group discussion, the participants identified a list of potential indicators to explore. Appendix C presents this list.
- Suggestions for new indicators focused largely on societal and ecological impacts, which participants identified as the largest gaps in the 2010 report.
- Participants noted that it might be valuable to consider indicators that are "projectable" to potentially couple the observed data with associated projections.
- Other suggestions included indicators related to the hydrosphere (i.e., water resources), which could constitute an entirely new chapter.
- Experts noted that newer and improved datasets (and potentially new metrics) are available for some existing indicators, such as Arctic sea ice and heat waves.
- Indicators that relate to the public's everyday life, such as recreation and energy, would likely be of particular interest to readers.

Format and Delivery of Future Versions of the Report and Its Content

- Participants felt that EPA's indicators are ideally suited for a Web-based presentation, which would allow easy access to figures (and the data used to generate the figures) and would also facilitate more frequent updates to the indicators as new data become available.
- Participants suggested that some readers might find value in supplemental print materials, such as a highlights summary of the indicators report or perhaps focused material on individual indicators.

- Participants largely favored a hybrid approach to reporting indicators—i.e., creating a “splash” when new indicators and major publications are developed, along with a “trickle” of information as individual indicators are updated. The latter component will help keep climate change in the public consciousness.

Opportunities for Collaboration and Other Indicator Efforts

- Improved coordination among agencies conducting indicator efforts can help them avoid duplication of effort, gain access to the best data, and best serve their constituencies.
- Future collaboration with other indicator efforts should involve developing common criteria, standards, and methods for review and presentation of the data.

1. Introduction

EPA's workshop covered a range of issues related to the *Climate Change Indicators in the United States Report*. It featured a broad set of participants, including representation from EPA regions and other EPA offices, data providers, experts in climate-related sciences and communications, and various other stakeholders. Participants fully engaged in open, interactive discussions in addition to providing focused feedback through breakout groups and forms. This report summarizes the discussions, feedback, and presentations that occurred at the time of the workshop. Input EPA has received (and continues to receive) since the workshop may not be reflected here.

2. Purpose and Overview of the *Climate Change Indicators in the United States Report*

Rona Birnbaum and Kevin Rosseel of CCD opened the workshop with a presentation describing CCD's climate change indicator efforts. They emphasized that climate change communications are a top priority within EPA. The 2010 report contributes to and is coordinated with a larger body of EPA work on related topics, including EPA's *2008 Report on the Environment (ROE)*¹ and annual *Inventory of Greenhouse Gas Emissions and Sinks*.²

EPA explained that the 2010 *Climate Change Indicators in the United States* report brings together existing, peer-reviewed datasets to illustrate the causes and observed effects of climate change. The primary audiences of the report are policymakers and the interested public. The report presents 24 indicators of climate change, along with background text, simplified graphics, and indicator limitations to provide appropriate context for understanding each indicator. Since the report's publication in April 2010, it has been well-received and used by informed citizens, policymakers, and educators, among others.

3. Indicator Selection Process and Key Criteria

Mike Kolian of CCD explained the history behind the 2010 report and the criteria used to select indicators. In 2002, EPA began working on climate change indicators in conjunction with other agencies, primarily to support EPA's *ROE*. In 2004, with coordinated input from the National Academy of Sciences, EPA convened a workshop to provide additional perspectives for identifying a core group of indicators relevant to observed climate change. EPA recognized the need for compiling a set of compelling climate change indicators and publishing this information in an easy-to-read report.

EPA cast a wide net for initial consideration, then conducted additional research and applied screening criteria to narrow down the ideas to the current list of 24 indicators. General criteria considered in selecting the indicators for the 2010 report are listed in Appendix B.

Following the presentation, participants provided comments on EPA's selection process and suggested ways to enhance the report with regional information.

In general, participants encouraged EPA to further clarify the process for screening indicators to add to the report, and several urged EPA to consider revising or clarifying some of the selection criteria. Participants offered the following observations and suggestions:

¹ <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=190806>

² <http://www.epa.gov/climatechange/emissions/usinventoryreport.html>

- A few participants noted that EPA’s indicator selection criteria may create a systematic bias against ecological indicators because of the importance placed on a strong climate signal. Ecological processes are subject to multiple stressors and climate is not always the only or largest factor driving change.
- One participant suggested adding the criterion that an indicator be projectable, even if the report itself does not include projections.
- Another participant suggested relaxing the requirement that indicator data must be peer-reviewed. Participants noted there are some good existing datasets that show robust trends but have not necessarily been published in the peer-reviewed literature.
- Noting the importance of snowpack, snowmelt, and other regional concerns, participants encouraged EPA to frame its geographic criterion in terms of “issues of national significance” rather than “must have broad, national coverage” or “be nationally representative.”
- Noting the value of timely data, some participants felt that EPA should consider adding “frequency of update” to the selection criteria. This new criterion should clearly state that the indicator must be maintained and tracked over time (e.g., on an annual basis).
- At least one participant suggested adding a synopsis of the criteria to the report’s introduction.

4. Participant Feedback on EPA’s 2010 Report

To kick off this session, CCD provided a brief summary of the feedback it has received from various users of the report. Major themes included:

- The report is being used at international, national, state, and local levels.
- Users have expressed interest in the information in the report and in reproducing graphics from the report.
- The report has led to particular interest from “informed citizens” seeking to better understand climate change, as well as students looking for an authoritative source on the subject.
- The report and its figures have generated significant interest within the blogging community.

Overall Impressions

Participants generally agreed that the climate change message and visual appeal of the report are excellent and engaging. Nonetheless, participants had several suggestions for improvement including the following:

- Some participants suggested clarifying the rationale and goals of the report. For example, explain how EPA will use the report and describe the policy context.
- A few participants expressed concern that the data limitations were too prominent and consumed a lot of space, although others disagreed, noting that this content promotes climate literacy. Participants suggested that the title “Data Limitations” could be sending the message that the science is unclear. One participant suggested changing “Data Limitations” to “Indicator Confidence.”

- One participant suggested that the report clarify that the indicators reflect a compilation of data from multiple agencies and organizations. There was general agreement that EPA should clarify that it is not duplicating efforts by other agencies.
- A few participants suggested adding information to each of the indicators to help the general public understand how the indicator should be interpreted and to help scientists understand to what extent the indicator can be scaled down to a more localized level.
- Several participants suggested strengthening the visibility and availability of the technical support or metadata document, which currently appears in a single PDF posted on the Web page. Some noted that it was difficult to locate the metadata file, while others were unaware of its existence. Suggestions included making metadata available on an indicator-by-indicator basis, similar to the approach followed by the *ROE*.
- At least one participant suggested it is essential that EPA engage stakeholders and other report users before and after the report is released.
- Many participants thought it would be useful to provide downloadable figures on the Web to better allow users of the report to incorporate the figures into other presentations and publications.
- Participants encouraged EPA to consider explaining climate variability in the report to clarify public (and other readers') misconceptions. For example, explain how despite a warming climate, some areas can receive record snowfall.
- Several participants felt that the report needed more regional texture. Impacts shown throughout the report will have disproportionate effects on different regions. Without regional information, participants cautioned that some readers might infer that effects will be similar everywhere.
- One participant suggested highlighting in each indicator a section that focuses on "why it matters to me." While some of this information can presently be found in the background section of each indicator, it might help the lay audience drill down to what they find most important. Participants also suggested potentially including information on "what you can do" or "how to get involved" in the discussion of an indicator or a set of related indicators.
- A few participants remarked that the report is an important climate literacy tool and should be marketed that way. One individual suggested changing the title of the report to more closely reflect its role as an educational tool.

Identified Gaps and Areas for Improvement

Several participants felt that the report should provide more information on certain topics, most notably impacts on human well-being (particularly public health) and ecosystems. Participants also noted other potential gaps, including:

- Basic background information, such as how people create and use energy, why we have a climate change problem, who is affected, and why we should care.
- Information on what individuals can do to reduce the impacts of climate change.
- Indicators or other information to account for adaptation and preparedness measures.

- Integrated impacts, such as heat waves and air quality, rather than only reporting individual indicators.
- Climate variability and extreme events, which are highly relevant to readers and are often misunderstood. Participants suggested structuring the report story or discussions around events that people directly experience (e.g., floods, heat waves, and other climate-related extremes).
- Indicators related to costs or damages. These metrics tend to resonate with multiple target audiences, including the general public.
- Observed changes and impacts experienced by indigenous communities and other vulnerable populations (e.g., information on changes in Alaska and elsewhere in the Arctic).

For information about more specific indicator gaps, see the discussion on new indicators in Section 8.

5. “Matters of Scale” and Climate Change Indicators

Britta Bierwagen of EPA’s Office of Research and Development gave a presentation summarizing issues associated with scaling indicator data. She described several major challenges and considerations when scaling climate change indicators, including:

- Data availability.
- Data consistency (e.g., collection methods; spatial and temporal density; spatial and temporal autocorrelation and variability).
- Choice of boundary or spatial framework (e.g., political vs. environmental).
- Public engagement in data collection (e.g., distributed sensors and the corresponding data quality considerations).

Participant Discussion

Following the presentation, participants discussed ways to provide regional texture to enhance the report. Suggestions included:

- **Develop case studies.** Focus on regional data in a text box or as part of a Web version of the report.
- **Regionalize only selected indicators.** Some indicators lend themselves to regional data better than others. For example, the global trend in sea level rise may increase gradually, but there is also important regional variation along U.S. coasts. In addition, indicators that are more uniformly representative across the United States (e.g., measurements or metrics of temperature) have potential for regional scaling. One participant emphasized the importance of communicating what can and cannot be downscaled. In some cases, people may misuse the data and inappropriately apply downscaling methods.
- **Develop composite indicators broken out by region.** For example, if the data allow, a composite indicator on infectious diseases could highlight Lyme disease risk in New England and dengue fever risk near Mexico.

- **Feature sub-national indicators where data may be of national significance or particularly useful.** For example, the report currently includes an indicator for “Snowpack,” which has important water resource implications for particular regions of the United States.
- **Explain mechanisms.** Discuss the modes of climate extremes and the factors that cause regional variability in indicators, even if it is not possible to actually provide regional data.

One EPA regional representative explained that the regions may not have the time or resources to create their own indicators from scratch, but suggested that CCD create a systematic mechanism and “how-to” guide to allow them to access the underlying data and produce their own regional versions of the indicators. For a model, EPA might look to the regional services provided by the drought monitoring community, which has had success with this type of approach. Several others supported this idea. It is important for the process to be the same across the country to report indicators at smaller scales where feasible.

One participant noted that many people need a clear (very localized) frame of reference for understanding climate change information. The public is often more familiar with information aggregated at the county level or by zip code rather than by aggregated watersheds (Hydrologic Unit Codes). It was noted that downscaling could be done outside of the report itself (e.g., in a separate analysis or on the website).

6. Recent Updates on Observed Changes and Indicators

Dr. Kristie Ebi of the Carnegie Institution for Science gave a presentation summarizing characteristics of and recent developments in climate change indicators. Dr. Ebi noted the recent NRC Report: *Monitoring Climate Change Impacts* (2010), which mentions characteristics of useful metrics. She discussed how to look at impacts of climate change as functions of exposure, vulnerability, and hazard. She explained that vulnerability, in particular, varies over time and space, and that some impacts may be more important than others when considering the locations of various vulnerable populations.

Dr. Ebi noted the importance of examining the interactions among indicators and considering potential cascading impacts. She also noted the importance of information on attribution when discussing the effects of climate change.

In summary, Dr. Ebi emphasized that indicators play an important role in:

- Measuring who or what is exposed.
- Tracking how vulnerabilities change over spatial and temporal scales.
- Detecting changes in a broad range of impacts and determining if the changes could be attributed to climate change.
- Facilitating assessment of interactions of impacts (e.g., water, agriculture, health, energy).

Participant Discussion

- Several participants agreed that attribution is a key issue to address in an indicator report.
 - Some participants felt that each indicator should show clear attribution to climate change for the trend shown. Other participants, including Dr. Ebi, felt that attribution

need not be a primary criterion for all indicators, but rather should be an important consideration for the report as a whole because providing clarity is important.

- One participant noted that attribution can happen at multiple levels. Some observed effects can be attributed to a changing climate, while a smaller set of effects can actually be attributed to *anthropogenic* climate change.
- Another participant reported that the public is especially interested in attribution of health issues to climate change.
- One participant pointed out that regional variability can play an important role in vulnerability. For example, the report makes it look like the risk of heat-related deaths is the same across the country, whereas it actually varies widely by region. A national trend line can mask important regional variation.

7. Approach for Adding New Indicators to the Report

Mike Kolian of EPA provided a brief opening presentation to frame the discussion about new indicators. EPA only provided suggestions for thinking of new indicators and did not provide a list of indicators for participants to consider. EPA's general goals for adding new indicators include:

- Expanding the report by approximately 10 to 15 new indicators.
- Improving the report without making it a clearinghouse for all indicators.
- Keeping the report up-to-date with the most recent science.
- Establishing and maintaining a balanced array of indicators.
- Exploring indicators that have linkages across sectors and systems.
- Addressing clear gaps in the current report.
- Continuing to evaluate new indicators against the selection criteria and continuing to meet data quality objectives.

General Comments

- Several participants agreed that adding indicators that the general public can easily understand and relate to should be a priority.
- A few participants noted that there may be other ways of presenting the current indicators to make them more relatable. For example, rather than just presenting temperature highs and lows, the report could also include the number of nights per year with temperatures below a particular threshold.
- Participants suggested that other easily relatable indicators might include energy use or energy demand, water supply, and water use.
- A few participants suggested that the report include socioeconomic indicators that show the types of climate change mitigation and adaptation activities undertaken by EPA or within different regions. Socioeconomic indicators could include demographic, cultural, behavioral, economic, public health, and policy components relevant to impacts, vulnerabilities, and

adaptation to climate change as well as both proactive and reactive responses to climate change.

- Participants expressed interest in the original set of indicators that EPA screened for the current report and whether any suggestions for new indicators had been received through the website.

8. New Indicator Suggestions

Based on expertise and interest, participants broke into three groups—Earth Systems, Landscape/Ecosystems, and Society—to discuss ideas for adding new indicators to the report. After the breakout session, all of the workshop participants reconvened, and a representative from each breakout group reported the results of its discussion. Collectively, the participants offered approximately 50 ideas to explore for new indicators; a compiled list can be found in Appendix C. In addition, EPA received several specific ideas from participants including suggestions submitted on worksheets handed out at the workshop, which may not be explicitly reflected below.

The breakout groups did not explicitly use EPA’s selection criteria in their deliberations.

General Comments

The report-out session was followed by a broader conversation about the opportunities and challenges associated with adding new indicators to EPA’s report. Participants offered their observations on a variety of topics related to the development of new indicators. Key points included:

- **Report length.** Most participants felt that keeping the report to a manageable length (without too many indicators) would best serve the intended purpose and audience. One option would be to replace some of the existing indicators with alternatives.
- **Reorganization to accommodate new indicators.** Ideas for reorganization included:
 - Separating ecosystems and society into two chapters.
 - Redesigning the document to allow for a more complex web of indicator interactions. This might be most easily accomplished through a Web-based report, which would enable users to explore how different indicators affect one another.
 - Address indicators that overlap across disciplines, impact sectors, or chapters, such as water resources and forest health.
 - Add a chapter on hydrologic indicators, such as soil moisture, winter-spring center of volume, ground water quality, and metrics related to streamflow.
- **Complexity of indicators.** Members of the “Society” breakout group suggested that EPA consider a more complex composite indicator of both heat illness and mortality. However, another participant cautioned that complex indicators could make the report less accessible to key segments of the audience.
- **Improved data for existing indicators.** A few participants mentioned that improved datasets have recently become available for some existing indicators—specifically, heat waves and Arctic sea ice—and suggested revising these indicators accordingly.

- **Availability versus importance.** Participants noted that several relevant indicators are “ready to go” (e.g., data on wildfire area burned) and EPA could use them as a starting point for choosing which new indicators to add to the report. However, several others emphasized that the indicators for which data are readily available are not necessarily the indicators that are the most important to show. They suggested that EPA maintain a “wish list” of potentially useful indicators and encourage others to collect data that will allow these indicators to be developed in the future.
- **“Nested” indicators.** In some situations, EPA might find it useful to create an umbrella indicator that encapsulates multiple datasets. For example, participants in the “Landscape/Ecosystems” group suggested an ecosystem services indicator that includes datasets on carbon stocks and net primary productivity.

9. An Environmental Health Perspective

Dr. Paul English of the California Department of Public Health gave a presentation to provide additional background on indicators related to human health. Dr. English explained that heat is the greatest human health burden resulting from climate change. In addition to the effects of high temperatures on vulnerable populations, heat also leads to harmful algal blooms and increased pollen counts and wildfire risk. Dr. English made the following key points:

- EPA’s report could present human health data in several ways, and many additional datasets are readily available.
- Health indicators could look at the disproportionate effects of climate change health impacts on low-income communities.
- EPA could create useful human health indicators by using composite data and looking at areas of particular health risk, such as locations with a high proportion of the elderly living alone or those with a high risk of flooding.
- Changes in the adaptive capacity of populations can significantly influence human health indicators.

Participant Discussion

- Several participants suggested links that can be made between health indicators and other indicators. For example, vector-borne diseases are closely related to certain ecosystem indicators.
- CCD inquired about health indicators that are established in the literature, noting that the Agency is interested in keeping up with the literature, but not necessarily publishing findings that are ahead of the literature.
 - One participant said that attribution of certain health effects to climate change has yet to be firmly established in the literature.
 - Another participant reported that some connections between climate change and health impacts have been made in the literature, particularly connections related to ground-level ozone and other short-term impacts.

- A few participants wondered if it would be possible for the report to use data that are not yet widely published in the literature. A participant from another EPA office pointed out that the Agency confronted this problem with the *ROE* and in that case, determined that unpublished data can be used as long as they are used transparently.
- The data used in the “Heat-Related Deaths” indicator could be made more robust by adjusting for changes in population over time and making other statistical corrections. A few participants suggested rethinking this indicator entirely.

10. Round-Table Discussion: Other Indicator Efforts Tracking Observed Changes

Participants provided some background information about other indicator efforts conducted by their respective organizations. The following is a brief summary of a wealth of valuable information provided by participants in presentations, remarks, and handout materials.

- The [Forest Health Monitoring Program](#) of the U.S. Department of Agriculture Forest Service has been examining several forest health indicators linked to climate change, such as lichens and tree mortality. Good data are available across several regions for these indicators.
- CCD collects other information on climate change metrics through efforts such as the [Greenhouse Gas Reporting Program](#) and the [Inventory of U.S. Greenhouse Gas Emissions and Sinks](#).
- The National Oceanic and Atmospheric Administration’s (NOAA’s) Climate Monitoring Branch currently has 68 families of products related to climate change and/or indicators. Many of these products are atmospheric in nature, but some include data related to the cryosphere and hydrosphere. NOAA produces a family of 10 to 12 reports in its [State of the Climate](#) series.
- The U.S. Global Change Research Program (GCRP) plans to publish the National Climate Assessment report in 2013. It is also establishing a process for creating indicator products in addition to putting together individual reports. The program is interested in creating a coordinated set of 15 to 20 national climate-related physical, ecological, and societal indicators that take the pulse of key aspects of the climate and climate impacts for the United States. The intent is to consider indicators that are cross-cutting or integrated metrics (e.g., an index), easily communicated, and inform decision-making—including mitigation measures.
- The National Snow and Ice Data Center is attempting to put together a combined sea ice concentration dataset. Other organizations are developing additional sea ice products, and data are now available for surface melt of the Greenland ice sheet.
- The U.S. Geological Survey, EPA, the Forest Service, and the National Park Service (NPS) are developing a national reference watershed network. This project will help support hydrologic indicators that use data from undisturbed watersheds (i.e., watersheds without confounding signals associated with human activities such as damming, agriculture, or development).
- The USA National Phenology Network (USA-NPN) has several products available that integrate biological observations with timing. USA-NPN is currently organizing a national database and collaborating with NPS and the U.S. Fish and Wildlife Service. USA-NPN also provides standardized protocols for plant and animal observations.

- Some EPA regions have created their own region-specific indicators and websites for climate change-related information. EPA Region 8 is developing a set of physical, ecological, and societal indicators specific to its region.
- EPA’s Office of Research and Development (ORD) is continuing to maintain the 85 indicators in the [ROE](#). ORD plans to launch a new version of the *ROE* in 2012, most likely in the form of an enhanced website framed around the three pillars of sustainability: economy, society, and the environment.
- Several other EPA offices are working on climate change products. For example, ORD is partnering with the Office of Water to produce information about how highly sensitive parts of ecosystems are reacting to climate change. In addition, the Office of Air Quality Planning and Standards is considering opportunities for incorporating information on climate–air quality interactions into EPA’s air quality trends report.

11. Format and Delivery of Future Versions of the Report and Its Content

Kevin Rosseel and Erin Birgfeld of CCD provided background on presentation methods for the report. They explained that in 2010, EPA published a print version and posted a PDF of the full report (and for each section) on the Web. They noted that some users of the report have already expressed an interest in an HTML-based version of the report rather than PDFs. EPA provided a few future presentation ideas and factors to consider before soliciting feedback from participants. Future presentation ideas include a print version, a Web version, and a combination of print- and Web-based components. Factors to consider include the timing and frequency of updates—to some extent, a choice between an infrequent “splash” and a frequent “trickle” of publicity. Overall, EPA encouraged participants to think about how EPA can best meet users’ needs.

Discussion

Nearly all participants agreed that CCD should provide a Web version of the report. Participants noted the following advantages to a Web-based format:

- The ability to easily make a “splash” every time an indicator is updated, rather than more infrequently promoting an entire new report.
- The ability to make figures, text, and other pieces of the report available to people for embedding directly into presentations, blog posts, websites, and other products.
- The ease of incorporating links to source data or regional data within each indicator.
- The flexibility to compile a larger set of indicators.

Noting the value of keeping climate change messaging in the public eye, participants generally expressed an interest in seeing frequent updates of the report or an “evergreen report” approach. One participant suggested that CCD take a “splash and trickle” approach by releasing timely updates on the Web but also periodically issuing a complete report with a strong public outreach campaign.

Members of the group offered the following additional suggestions related to format, delivery, and outreach:

- On the Web, give each indicator its own page with downloadable figures and metadata.

- Compile a set of children’s health indicators as an educational package for schools.
- Create printed fact sheets for each indicator.
- Design or market the report to reach important sectors or communities. For example, several participants suggested sharing this report with the business community. New indicators on infrastructure and worker health might help business leaders to better appreciate the relevance of climate change to their interests.
- Consider how to use social media to communicate with a wider audience.

12. Opportunities for Collaboration

Participants highlighted the need for continued collaboration among EPA and other agencies and organizations to ensure that indicator efforts are as efficient as possible and work is not being duplicated. In addition, it was noted that collaboration is particularly important for outreach and consistent messaging.

- One participant suggested that www.climate.gov should ultimately become an interagency portal.
- While several participants agreed that overlap among indicator efforts at different agencies could suggest an inefficient use of resources, at least one participant felt that showing similar results from different sources helps to demonstrate consistency in climate change science.
- Because the public can become overwhelmed with climate change information, it is important for agencies to define their roles in climate change communication. Some agencies have convened meetings in an attempt to designate roles and contacts. A few participants agreed that regional coordination on climate change messaging might provide a good model for coordination on a higher level.
- One participant mentioned the value of communicating or collaborating with the American Public Health Association’s Climate Health Literacy Consortium and the EPA group that publishes the *America’s Children and the Environment* report.
- Some participants noted that EPA’s climate change indicators report can serve as a valuable resource for the U.S. GCRP’s National Climate Assessment.
- One participant noted they or their organization would benefit from funding to continue work in the area of climate-related indicators to support EPA and others’ efforts.

13. Conclusion

Rona Birnbaum and Kevin Rosseel of CCD concluded the workshop by thanking participants for their valuable discussion, presentations, handouts, and other contributions. They also summarized key points made during the meeting that the Agency will take into consideration when developing future reports. These items included:

- Clarifying the goals and purpose of the report (i.e., the report is a presentation of others’ peer-reviewed data and it serves as a communications document).

- Revisiting the criteria used to select indicators for the report to ensure they are clear and not too limiting.
- Providing more information on data quality and making the technical support document (metadata) more prominent.
- Ensuring that the report continues to tell a compelling story.
- Including indicators that relate to the public's everyday life.
- Scaling the data down where appropriate to provide regional highlights.
- Developing a process to choose additional indicators, and then using this process to determine the best new indicators to add to the report, particularly in the areas of human health and ecosystems.
- Keeping messaging simple and easy to understand.
- Continuing to track the utility of the report.
- Keeping the presentation and delivery of the report nimble to provide easy access to key indicators.
- Continuing to coordinate with other agencies and organizations to the extent possible to avoid duplication of effort, gain access to the best data, and help one another to best serve their constituencies.

Appendix A: Participant List

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Appendix B: Workshop Goals, Indicator Definition, and General Selection Criteria



United States
Environmental Protection Agency
Climate Change Division

2011 EPA Climate Change Indicators Workshop

Workshop Goals

The workshop will build on EPA's efforts to communicate observed impacts of climate change to the public and to evaluate appropriate indicators to serve policy-relevant purposes moving forward. More specifically, the workshop will:

- Solicit feedback from experts and stakeholders on EPA's 2010 *Climate Change Indicators in the United States* report.
- Explore options to enhance future iterations of the report.
- Generate ideas regarding potential inclusion of new or revised indicators.
- Identify opportunities for collaboration on communicating climate change indicators.

Working Definition of an Indicator

As stated in EPA's 2010 *Climate Change Indicators in the United States* report, "[An] indicator represents the state of certain environmental conditions over a given area and a specified period of time." The report presents a suite of 24 indicators, each describing trends in some way related to the cause and effects of climate change. The indicators focus primarily on the United States, but in some cases global trends are presented in order to provide context or a basis for comparison. The indicators span a range of time periods, depending on data availability.

General Selection Criteria for Indicators

EPA selected indicators for the report based on the following criteria:

- **Trends over time.** Indicators should represent several (multi-decadal) continuous years of data that have been collected using consistent or comparable methodologies.
- **Actual observations.** The indicators should focus on observed changes and be derived (directly or indirectly) from observational data or from instrumental records.
- **Broad geographic coverage.** To the extent possible, indicators should be national in scope and/or representative of a relevant domain or scale that is within the limits of what the science can support. Indicators that are derived from uniformly distributed data across the United States may also allow for regional representation.
- **Peer-reviewed data available.** Indicators should present data collected using scientifically sound methods that have been subject to a peer review process. Ideally, the data themselves will also have been peer reviewed or widely used and accepted within the scientific community. The data should be publicly available to allow for any analysis or interpretation to be reproduced.
- **Usefulness and relevance to climate change.** All indicators should have a straightforward interpretation in terms of the trend in observed changes and have a clear and easily explained connection to climate change.

Appendix C: List of Potential New Indicators and Ideas to Explore

* = identified in more than one group

Earth Systems Group

- Alternate heat wave metric
- Wildfires*
- Drivers of climate change
- Soil moisture
- Length of ice season; ice-covered days for rivers, lakes
- Snowfall (snow-water equivalent)
- Sea level
 - Ice sheet volume (including volume of water contributed to the oceans)
 - Changes in regional global sea level trend
- Black carbon and albedo
- Hydrologic indicators*
- Enhancements and additional sea ice indicators/metrics
- State of the Climate: extreme and severe phenomenon

Landscape/Ecosystems Group

- Wildfires* -e.g., timing and duration of fire season; frequency and extent
- Water indicators*
 - Streamflow - e.g., timing of spring snowmelt
 - Water quantity
 - Water quality - e.g., temperature
- Ecosystem services: carbon stocks, green-up, and net primary productivity
- Coral condition/bleaching
- Coastal processes and productivity
- Fish landings
- Extent of coastal wetlands
- Phenology-linked indicators

- Phenomena tied to temperature thresholds - e.g., migratory patterns
- Onset of spring
- Emergence from hibernation
- Insect emergence
- Amphibians
- Community composition
- Species shift (range; composite index)
- Mortality and range shift of iconic flora and fauna (e.g., sugar maple)
- Regional vulnerability assessments: extinction and extirpation
- Changes to cold water fisheries
- Timing of anadromous fish runs
- Palustrine wetlands
- Sensitive regions (high elevation); community-level changes
- Broader landscape-scale changes (loss of grassy tundra, changes in permafrost/frozen ground)
- Other biotic indicators
 - Harmful algal blooms
 - Invasive species s
 - Disease
 - Pest outbreaks(native vs. non-native)

Society Group

- Changes in ozone and fine particulates (aerosols) and resulting health effects
- A refined and broader suite of heat-related indicators (i.e., rate metrics, hospitalizations)
- Pollens and aero-allergen diseases
- Environmental infectious disease
 - Water- and vector-borne diseases -e.g., salmonella, Lyme disease

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- Mapping of Vector-borne diseases
- Observations from indigenous populations, particularly in Alaska
- Infrastructure-related indicators – e.g., outcomes related to extreme events
- Coastal land loss
- Floods
- Adaptation
- Wildfires*
- Recreational impacts; recreational opportunities lost; illnesses
- Public awareness of climate change
- Agriculture and food production, including the influence of the length of the growing season
- Change in nighttime temperature and its relationship to health
- Financial effects—e.g., cost of insurance in flood-prone areas
- Drivers of GHG Emissions