

National Climate Assessment Indicator System: Proposed Implementation of a Pilot Indicator System

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This memo provides an overview of the proposed National Climate Assessment Indicator System, proposed Pilot Indicator System, linkages to existing federal priorities (including the President's Climate Action Plan), and the proposed decision and implementation process for the pilot and full launch of the indicators system.

THREE THINGS YOU MUST KNOW

- The USGCRP, with support from 9 of the 13 U.S. Global Change Research Program (USGCRP) agencies, is leading an effort to identify a first set of physical, societal, and ecological indicators that would inform and support decision-making about climate changes, impacts, vulnerabilities, and responses.
- This effort supports the following existing interagency federal priorities: the four pillars of the strategic plan of the USGCRP to address the requirements of the Global Change Research Act (GCRA), foundational product of the National Climate Assessment (NCA) sustained assessment¹; USGCRP Office of Management and Budget (OMB) priority for 2013, 2014, and 2015; an activity to fulfill one of the data initiatives and decision tool kit requirements of the President's Climate Action Plan (CAP); and Executive Orders (EO) 13653, 13514, and 13642². This effort also builds on existing or develops new indicator and information system design and products developed through the USGCRP agency programs, participation by agency scientists and managers, and inclusion of indicators in existing Request for Proposals (RFPs).
- The system is currently under development; it will be launched in two phases: a pilot is slated for summer 2014 and a full launch in 2015. Looking ahead, the Indicators Secretariat will require a modest number of dedicated staff, which could be largely drawn as detailees from the agencies themselves, in order to ensure that the system is up-to-date scientifically and continues to provide a useful information service to its audiences.

BACKGROUND

The USGCRP is leading an effort to identify a first set of physical, societal, and ecological indicators that would inform and support decision-making about our nation's changing climate and its consequences. This system has a strong focus on impact, vulnerability, and response indicators and thus is built around the concept of multiple stressors, where the indicators are related to variability and change in the climate system as described through the conceptual models. The targeted indicators are expected to be useful to the multiple audiences who draw on the NCA and USGCRP research and products to make decisions related to impacts, adaptation, vulnerability, and mitigation associated with climate and global change (e.g., Federal agencies engaged in place-based or sector-

¹ Buizer, James L., Paul Fleming, Sharon L. Hays, Kirstin Dow, Christopher B. Field, David Gustafson, Amy Luers, and Richard H. Moss, Report on Preparing the Nation for Change: Building a Sustained National Climate Assessment Process, National Climate Assessment and Development Advisory Committee, 2013.

² EO 13653 of November 1, 2013 "Preparing the United States for the Impacts of Climate Change" (Section 4: Providing Information, Data, and Tools for Climate Change Preparedness and Resilience), EO 13514 of October 5, 2009 "Federal Leadership in Environmental, Energy, and Economic Performance" (Federal Adaptation Plans), EO 13642 of May 9, 2013 "Making Open and Machine Readable the New Default for Government Information"

based decision-making). These indicators will be tracked as a part of ongoing assessment activities, with adjustments as necessary to adapt to changing conditions and understanding.

Over the past several months, over 150 scientists and practitioners across the federal, academic, and private sectors have been in conversations to develop the scientific basis for the selection of indicators using conceptual models. This is truly an interagency effort where different agencies have provided different kinds and levels of support. DOC NOAA, EPA, USDA, DOE, NASA, DOD USACE, HHS CDC, DOI, and NSF (9 of the 13 USGCRP agencies) have scientists and practitioners that are serving as team leads or team members on the NCADAC Work Group or one of the 14 technical teams. Additionally, we have had 24 volunteer science policy fellows, detailees, or student interns (ranging from mid-career Ph.D. scientists to honors undergraduates) that have worked with the indicators team to coordinate this effort or conduct research to support the development of the system.

INDICATOR SYSTEM LINKAGES TO CAP AND FEDERAL PRIORITIES

The National Climate Indicator System supports both the Climate Data Initiative and the Toolkit for Climate Resilience called for in the CAP. Specifically,

- in support of the Climate Resilience Toolkit, Indicators will provide decision-relevant information to support a range of adaptation and energy/mitigation decisions (EO 13653), including decisions in the agencies themselves (e.g., EO 13514), and
- in support of the Climate Data Initiative, Indicators will provide traceability and transparency of the data and indicator methods used across the federal agencies (EO 13642) to support the Indicator System.

Development and implementation of this Indicator System becomes an information service, which features both access to data from known and vetted measurement programs, and access to tools to manipulate data for particular user communities. The next section describes in more detail the elements of the Indicator System that support these federal priorities.

PILOT INDICATOR SYSTEM DESIGN ELEMENTS

The Indicator System is designed for those decision-makers who want to use the best scientific information to make climate-informed decisions, not to convince someone that climate change is happening. Thus, the Indicator System is designed specifically to provide decision support information and tools. Additionally, because these efforts rely on science that crosses the federal agencies, the Indicator System has been designed to give full credit to all the agencies that provided data, analysis, or the indicator product via logos and links to the supporting agency programs on the USGCRP Global Change Information System (GCIS). Below are a few features of the pilot system that are particularly noteworthy:

Vision and Goals for the Indicator System: One of the elements of the vision for the sustained National Climate Assessment (NCA) process is to create a system of indicators that communicate key aspects of the physical climate, climate impacts, vulnerabilities, and preparedness for the purpose of informing both decision makers and the public with scientifically valid information that is useful for decision-making. These indicators will be tracked as a part of ongoing assessment activities, with adjustments as necessary to adapt to changing conditions and understanding.

The goals of the indicator system are to:

- Provide meaningful, authoritative climate-relevant measures about the status, rates, and trends of key physical, ecological, and societal variables and values;
- Inform decisions on management, research, and education at regional to national scales;
- Identify climate-related conditions and impacts to help develop effective mitigation and adaptation measures; and
- Provide analytical tools by which user communities can derive their own indicators for particular purposes.

Goals for the Pilot Indicator System: The Pilot Indicator System will have several specific goals.

- It will provide a low-cost proof of concept for evaluation purposes. Before making more significant investments in the development of a robust end-to-end, interagency Indicator System, we want to evaluate how this system can be created to have the greatest utility for a wide-range of decision-makers.
- The Pilot Indicator System also allows us to engage stakeholders through the NCA roll-out engagement activities to informally assess what kinds of indicators or capabilities that stakeholders would like to have in an Indicator System.
- Additionally, because many of these indicators are multi-stressor, i.e., climate is only one of the stressors that impact the indicator, it is important to rigorously test and evaluate how to best present and communicate the scientific information so that it is useful and appropriately used by decision-makers.

The proposed pilot system includes a few global context indicators and 2-3 indicators for each of the 12 systems and sectors addressed by the technical teams. Thus, we anticipate the pilot will include approximately 30-35 indicators that have been well-vetted through agency peer-review processes and manuscripts. If we discover during the pilot implementation phase that indicators recommended are not ready, they will not be included. The Pilot System will include static images and supporting text; dynamic updates and customization will be added as we evaluate the system and identify those features as needs requested by the decision-maker user communities.

Decision Criteria: The NCADAC Indicator Work Group developed a set of decision criteria to detail the overall focus of the system and kinds of indicators that would be considered for inclusion in the system. Summarized these criteria include:

- Scientifically defensible
- Link to conceptual framework
- Defined relationship to climate
- Useful for decision-making
- Spatially and temporally scalable indicators
- Build on or augment existing agency efforts
- Current and leading indicators

For the pilot, an additional criterion was imposed which is to focus on those indicators that are already established and scientifically vetted, so that we could develop a low-cost pilot system for evaluation purposes.

How is this Effort Different from Existing Indicator Efforts: This effort is different from existing indicator suites, such as Climate.gov, NASA Key Climate Indicators, and the EPA Climate Indicator Report, because it is designed, in collaboration with 150+ scientists and practitioners, to provide an interagency information system, using indicators, to support decision-making. The use of conceptual models provides a novel approach to identifying key linkages between climate and other stressors upon impacts and vulnerabilities of concern to the nation. Thus, it explicitly focuses on indicators that move beyond traditional physical climate indicator dashboards to additionally include natural and societal indicators. Additionally, this effort is designed to explicitly provide information to decision-makers who need to make climate informed decision across a range of contexts, instead of being designed for communication purposes (i.e., trying to convince people that climate variability and change is happening). Thus, this indicator system helps to translate rigorous scientific information in a format and with the analytical tools to support a range of decision context important to the nation.

Scientific Rigor of the Indicator System and the Indicators Included in the System:

Consistent with the recommendations of the National Research Council (NRC), the indicator system has been developed using a conceptual models approach, which provides a systematic basis for development of the system and the inclusion of indicators within it. The Indicator System has both a conceptual model for the entire system (see Figure 1) to identify which kinds of indicators will be include in the system and for each of the physical, natural, and social systems and sectors. The latter was developed by the indicator technical teams to provide a clear scientific justification for the inclusion or exclusion of indicators within the system.

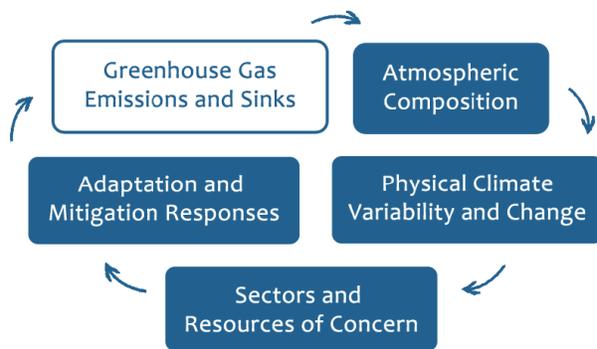


Figure 1. Conceptual Model for the National Climate Indicator System.

The pilot Indicator System proposal includes only those indicators that are established and well vetted through the agencies and scientific community. Indicators that are based on a single peer-reviewed paper or those that are more experimental in nature have *not* been included for the pilot. Throughout the process to move from recommendations to implementation, the scientists who are experts in those indicators will be involved in the development of the GCIS back-end traceability documentation, vetting the graphical representations that will be included in the pilot, and assuring that the

text supporting the graphics are scientifically accurate and include the appropriate caveats and assumptions to help decision-makers appropriately apply the information to their particular decision contexts.

Access to Data and Methods: One of the goals of the Indicator System is to provide access to data for decision and policy-making pulling from efforts across the federal agencies, in support of the Open Data Initiative (EO 13642). For the pilot, the indicators will use data that are vetted by agencies or are well-established and reviewed by scientific communities. Though the pilot will include static images and supporting text, for the launch of the system we are developing methods through the GCIS that would allow for dynamic updating of indicators as new information is available and to build on existing decision support tools to partition data regionally as well as

sectorally so that it is useful for a range of decision contexts. The development and access to these analytical tools allows diverse audiences and users from various sectors and interest areas to derive indicators for their own purposes and in support of their decisions.

Evaluating the Indicator System: The Indicator System will have the ability to support several types of evaluation, including evaluation of the Indicator System and objective analysis of climate policies, adaptation actions, and mitigation measures.

- The evaluation of the Indicator System will assess which data are actually useful for decision-making audiences, for either mitigation decisions or adaptation decisions. Both “top down” and “bottom up” approaches will be used to improve the Indicator System. Top down approaches include using web analytics and surveys will provide a broad assessment of the effectiveness of individual indicators and the system. Bottom up case studies will be used to engage with decision-makers to better understand how these indicators can be useful in their decision processes and how the system can be modified to better support climate-informed decisions in a range of contexts. This evaluation data will be used to adjust the system accordingly.
- Procedures are being developed to robustly evaluate the pilot system so that data can be used to inform the decision about how to move forward after this first phase of the Indicator System.
- Over time, the Indicator System will be in place to do program evaluation, so it can objectively assess progress of the adaptation and mitigation goals of the CAP, goals of preparing the nation for climate change in EO 13653, and agency adaptation planning in EO 13514.

Evolution of the Indicator System: Indicators can evolve over time as the scientific understanding improves, decision-making needs change, and evaluation data identifies approaches to improve the system. Such evolution in support of improved scientific understanding to support decision-making, highlights the need for research on indicators for both natural and human systems. This approach also allows for incremental development – strategic expansion of the system as the system is shown to be useful and successful, or as agencies want to prioritize and support the development of particular indicators for inclusion in the system.

PROPOSED INDICATOR SYSTEM DECISION AND IMPLEMENTATION PROCESS FOR THE PILOT SYSTEM

The Indicators are being implemented in two phases. The first phase, launched in spring of 2014, is a pilot, with a limited number of indicators for each sector and for global context. The pilot serves in an evaluation mode, to improve our understanding of how indicators are being used by different audiences and how we can more effectively present the indicators and the system. There is a small secretariat, funded by a NOAA CPO CICS-MD grant to Dr. Kenney, to manage the process, work with the agencies on indicator development and documentation, and do the evaluation studies. The implementation of the indicator graphics will be supported through a contract to the National Environmental Modeling and Analysis Center (NEMAC) funded by the NOAA Technical Support Unit (TSU). The NCADAC approves the recommended pilot to the agencies, but the USGCRP must decide what they are able to implement.

To support the research mission of the Indicators program, NASA developed a competitive research opportunity to use NASA-produced data and/or modeling products, in concert with other

data sources, to develop and test indicators; June 2013 they announced the support of 14 projects with a total funding of approximately \$2.5M for a period of 12-18 months. NOAA has also released an RFP this year focused on data and indicators for ocean indicators, that was motivated, in part, through the discussions of the Oceans and Coasts Indicators Technical Team.

The second phase is a more complete launch of the Indicator network, with more indicators, and a continual evaluation process so that indicators can be added or removed from the system and we can use a data-driven process to improve the indicator system's utility for decision-makers. Scientific papers describing the Indicators system will be published in a special issue of a journal, and the oversight of the system will need to transition away from the NCADAC to the USGCRP for the long term. Active collaboration with the USGCRP agencies will be critical for continuation of the Indicators network, for updating indicators with new data, for documenting and making data available, and for establishing longer-term continuity. Beyond the first pilot phase, the Indicators Secretariat will require a modest number of dedicated staff, which could be largely drawn as detailees from the agencies themselves, in order to ensure that the system is up-to-date scientifically and continues to provide a useful information service to its audiences.

WEBLINKS TO ADDITIONAL MATERIALS

- 1) Briefing Memo (this document)
- 2) Indicators Milestones and Participants
<https://www.dropbox.com/sh/zg2jbiyg44kexp/ENfdilNuLk>
- 3) Table of Proposed Indicators for the Pilot Indicator System; Pilot System Report
<https://www.dropbox.com/sh/0h6icm2pb9kosjc/djTggMe2z3>
- 4) Indicator Technical Input Report (submitted to NCA 3/2012)
<http://downloads.usgcrp.gov/NCA/Activities/NCA-Indicators-Technical-Input-Report-FINAL--3-1-12.pdf>
- 5) NASA RFP funding:
<http://nspires.nasaprs.com/external/viewrepositorydocument/cmdocumentid=371409/solicitationId=%7B8AC220BE-64D7-415C-C527-AE3E843C8D12%7D/viewSolicitationDocument=1/INCA12selections2.pdf>
- 6) NOAA RFP (current):
http://cpo.noaa.gov/sites/cpo/GrantsandProjects/2014/ClimateMonitoring-FY14InformationSheet_July10.pdf
- 7) *Draft* article in revision to *Nature Climate Change*
[https://www.dropbox.com/s/r5fxm5mf3yt79bu/Janetos and Kenney Nature Climate Change Submitted Feb 2013.pdf](https://www.dropbox.com/s/r5fxm5mf3yt79bu/Janetos%20and%20Kenney%20Nature%20Climate%20Change%20Submitted%20Feb%202013.pdf)
- 8) All Indicator Documentation (i.e., Vision, Decision Criteria, Peer-reviewed Manuscripts and Reports, Draft Technical Team reports, Pilot Indicator System Proposal)
<https://www.dropbox.com/sh/nlnhywkfulaqf98/sOpy2tqeWH>