February 12, 2016

State of the Carbon Cycle Report-2 (SOCCR-2) - A Special Scientific Assessment of the State of the Carbon Cycle in the United States and surrounding North American Region
- A Draft Prospectus

Overview

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1. Overview

The U.S. Global Change Research Program (USGCRP)'s U.S. Carbon Cycle Science Program and Carbon Cycle Interagency Working Group (CCIWG) have initiated an Interagency Special Report entitled the 2nd State of the Carbon Cycle Report (SOCCR-2). The focus of SOCCR-2 will be on U.S. and North American carbon cycle processes, stocks, and flows in the context of and interactions with global scale budgets and climate change impacts in managed and unmanaged systems. Carbon stocks and fluxes in soils, water (including oceans), vegetation, aquatic-terrestrial interfaces (coastal/ estuaries/ wetlands), human settlements, agriculture and forestry are included. Relevant carbon management science perspectives and tools for supporting and informing decisions, as addressed in and related to the White House Climate Action Plan (2013), US Carbon Cycle Science Plan (2011), 3rd National Climate Assessment (2014), USGCRP Strategic Plan (2012), and the Global Change Research Act (GCRA) of 1990 will be considered. The status of and rising opportunities for improving measurements, observations and projections of stocks and fluxes in the carbon cycle, including uncertainty identification, will be part of this assessment. All agency members of the CCIWG will be the co-leads.

2. Proposed Focus Areas and Table of Contents

The proposed focus areas are inspired by the U.S. **Carbon Cycle Science Plan (2011**) which emphasizes global scale research on long-lived, carbon-based greenhouse gases, carbon dioxide (CO_2), and methane (CH_4), and the major pools and fluxes of the global carbon cycle. The questions framing the U.S. Carbon Cycle Science Plan (2011) inspire SOCCR-2 questions, with a focus on US and North America in the global context: 1) How have natural processes and human actions affected the global carbon cycle on land, in the atmosphere, in the oceans and in the ecosystem interfaces (e.g. coastal, wetlands, urban-rural)? 2) How have socio-economic trends affected the levels of the primary carbon-containing gases, carbon dioxide and methane, in the atmosphere? 3) How have species, ecosystems, natural resources and human systems been impacted by increasing greenhouse gas concentrations, the associated changes in climate, and by carbon management decisions and practices? (Note: US Federal Carbon Inventories are the responsibilities of USDA and EPA. This assessment does not seek to evaluate, critique, or validate those inventories but rather seeks to explore and present the current state of the science of carbon cycle. Any discussions of the current US Inventory are conducted within the broader context of the carbon cycle. Where there are any apparent discrepancies with the US inventories or otherwise where appropriate, the report will explain or show a crosswalk.)

Each chapter will cover the current status and near-term projections. If and where possible, including: Modeling of Carbon Cycle in CMIP5/post- SOCCR-1/multi-model syntheses, new Projections since CMIP5. Other cross-cutting themes in each chapter/as appropriate: Land use change, feedbacks, historical context, indicators and trends, societal impacts (also have a separate chapter), North American and Global Context, Research needs (refer to pertinent

sections in 2011 Carbon Science Plan). e.g. Each chapter/sub-chapter will contain the following sections: Introduction, Historical context (incl. socioeconomic drivers of carbon emissions), Current State of Carbon Cycle Understanding of Fluxes and Stocks, Indicators and Trends, Feedbacks, North American and Global Context, Regional Perspective (e.g. NCA 2014 regions), Societal Impacts, Carbon management and Decisions - what is out there and what do we know of the impacts, Research Needs. Below, we provide a high level draft table of contents with associated broad notional chapter outlines.

Preface -

Importance of carbon cycle to climate, why we care about the carbon cycle
Scope and Rationale for SOCCR2, developments, tools & improved understanding since SOCCR-1
The near-term future outlook/time frame (e.g. NCA time frame)

Chapter 1 - Global Carbon Cycle Overview

- Major Elements of the Global Carbon Cycle
- Global CO2 Emissions Budget
- Global Methane Budget
- Other Carbon containing climate forcers. Include N and interactions with carbon cycle
- Highlights of new evidence/understanding since SOCCR-1 [*not necessarily separate section*]

Chapter 2 - Carbon Cycle at Scales (North American Carbon Cycle within the Global Context)

Start at global relationship/interaction and then progressively zoom down to major regions in the US:

- Global Perspective
- North America Perspective
- US Perspective
- Regional Perspective (e.g., US Regions such as NCA-2014 regions)
- Description of global carbon cycle, regional processes within in a global context, and connections/interactions with North America and adjacent ocean basins
- Description/examples of U.S land and coastal processes, U.S. perspectives, and interactions with regional or state-level actions, management and impacts
- Description of changes at local or municipal scales and interactions with larger scale events
- Temporal scales- rates of change, new understanding/models/tools at seasonal to decadal scales
- Carbon stocks and flows by state/region and between states/regions past and present (across sectors)

Chapter 3 - Carbon in natural and anthropogenic systems—major stocks, flows (within and between), uncertainties, broader social drivers, carbon decisions

Vegetation, Soils, Inland water systems, Terrestrial-aquatic interfaces (including Wetlands and riparian and Coastal and estuarine), Ocean, Atmosphere, Fossil resources, Others (e.g. fossil fuel emissions, cement production).

Example Focus Areas that may be incorporated in the above

-Urban carbon : Carbon implications of urbanization and urban areas as socio-ecological systems; focus on carbon flows, demographics, income, urban form, economic function, economic growth policies and other decisions.

--Arctic Carbon

--Livestock and wildlife

Chapter 4 - Interactions/disturbance: impacts to the carbon cycle

Climate and disturbance impacts on carbon stocks and flows in ecosystems/biomes (e.g. ocean acidification, fires, major pathogens). Response and feedbacks to disturbance including examples of threshold changes.
How future disturbance regimes may influence projections (managed and unmanaged systems, CMIP). e.g. Fire, Pests, Disease
How Carbon Cycle feedbacks may influence projections (e.g. Clathrates, Permafrost, Ocean CO_2 uptake)
Role of Current and Future Management for Managed Systems

Land management and land use change (e.g. Agriculture and grazing lands; Forestry activities including Recreational; parks and reserves and Urban and suburban landscapes; Inland water and Coastal zone management such as Energy/Dams, Navigation/dredging, Development, Fisheries and aquaculture, Fertilization/Farming, Destruction of natural vegetation/storm protection, Blue Carbon)

Chapter 5 - Carbon cycle information, management practices, tools and needs at various scales

Carbon information (what is needed to make decisions)

Data—international, national, state, local, tribal, corporate, sectors (including monitoring and observation systems)

Monitoring systems (to collect data listed above)

Benchmarks (for testing models and predictions - e.g. US contribution to ILAMB http://ilamb.org/repos/)

Accounting and aggregating tools available

State of the art of methods

Examples of Tools for calculating carbon budget at different scales: for global, for continental, for regional, for state, for county, for land managers, for sectors

Case Studies: Carbon management decisions at a range of scales

Carbon actors and interactions

Goals, Actions and Outcomes

Addressing the gap between Goals and Outcomes

Technological, institutional and cultural lock in: barriers to and opportunities for carbon management

Limits and opportunities for informing trajectories towards lower carbon pathways at multiple scales (scenarios etc.)

Chapter 6 - Synthesis, conclusions, gaps in knowledge, (near) future outlook (NCA timescale)

3. Process

A. Audience, and Communicating

The audience includes scientists, decision-makers in the public and private sectors and the general community across the US, extending to North American and global regions. Updated information on the observed status and trends in the carbon cycle as influenced by natural and anthropogenic changes will be disseminated to this audience. The report will inform policies but will not prescribe or recommend them. In that respect, it will help inform mitigation and adaptation decisions related to the carbon cycle, supporting improved coordination for pertinent research, monitoring and management activities for responding to global change.

B. Report Leads, Lead Authors, Contributing Authors, and Required Expertise

The SOCCR-2 will be a federal interagency report. In alignment with federal requirements, the writing team will comprise federal employees, contractors or affiliates from non-federal community. The team will be selected based on their scientific expertise, demonstrated accomplishments, academic interests and knowledge in the thematic areas specified in the draft outline, time availability and technical capability to work in this type of broad interdisciplinary and cross-cutting scientific assessment setting constrained by demanding timelines, typical to USGCRP/NCA reports. The writing team of Report Leads, Chapter Leads and Contributing Authors will comprise members of the CCIWG, North American Carbon Program (NACP), Ocean Carbon and Biogeochemistry Program (OCB), broader PI networks of the CCIWG, and other federal employees and affiliates identified through existing networks and collaborations, encompassing U.S., Canadian and Mexican carbon cycle research scientists. Additional contributing authors with pertinent subject matter expertise and scientific background will be selected from suggestions and nominations received from members of the CCIWG, broader scientific networks and the general public through this federal register notice, calling for Contributing Author Nominations. Additional subject matter experts may also be selected as needed, during the report writing and review process.

The main roles and responsibilities of the Report Leads, Chapter Leads and Contributing Authors include the preparation of the report drafts: compiling the necessary background literature; synthesizing, analyzing and interpreting the existing science; contributing intellectual and technical input.

The team of Report Leads (Lead Report Authors) will comprise up to 5 members representing pertinent fields of carbon cycle science. The roles of the will include:

- Establish scope of SOCCR-2 process and products ensuring GCRA requirements and coverage responsive to the 2011 Carbon Cycle Science Plan and other documents highlighted in this Prospectus;

- Ensure balance and consistency of information across and within topics and chapters;
- Ensure emphasis on new information since the first SOCCR (2007);
- Ensure clear organization of report, with a unified structure and narrative;
- Develop higher level synthesis and overarching key findings, ensuring the report covers broad understanding of what is known, not known, and associated uncertainties.
- Responding to review comments on scope, emphasis, balance, overarching key findings etc. coordinating response to specific content with chapter authors.
- Produce guidance for author teams by establishing foundational assumptions such as for scenarios and data, and ensuring that the report meets the Information Quality Act (IQA) requirements.

Organize the chapters, ensure connectivity with community engagement (via conferences, workshops, stakeholder events, websites, etc.) as well as develop the Executive Summary and related high level summary documentation of the report.

The Chapter Leads (Lead Coordinating Authors or LCAs) team and Contributing Authors (CAs) team will comprise 10-15 authors from the broad carbon cycle science research community. Lead Coordinating Authors will include a selection federal employees and affiliates identified through existing agency collaborations and networks. Contributing Authors will include scientists with relevant subject matter expertise nominated by lead authors, the CCIWG or other interagency members, and the general public (through this public federal register notice calling for Contributing Author nominations). Where needed to fill gaps in expertise, additional subject matter experts will be selected to be Contributing Authors based on expertise such as peer-reviewed publications and other pertinent criteria.

The collective role of the Lead Coordinating Authors (Chapter Leads) and Contributing Authors encompasses (i) the preparation of the initial draft of the report, including the text and any analysis required to synthesize the underlying studies from the existing peer-reviewed literature that serves as the basis for the report and (ii) the review of relevant literature or technical input/information submissions made through this Federal Register Notice Call for Information (see section E below) and for responding to public comments on the draft report. All authors should be accomplished scholarly writers and have demonstrated technical expertise and academic proficiency in at least one of the carbon cycle science topics outlined in this prospectus, including the human dimensions of carbon cycle sciences. The Chapter Leads will decide how best to organize their respective chapter teams, including division of responsibility and time requirements among the Contributing and Chapter Leads.

C. Agency Roles

The CCIWG will be responsible for leading the compilation and synthesis of report contributions from all the authors. A Federal Steering Committee of the USGCRP's 2nd State of the Carbon Cycle Report has been established to provide guidance and coordination to the report staff and authors. This Committee comprises a sub-set of members from the CCIWG and other pertinent federal programs or divisions, including interagency entities. The agency co-leads are all the CCIWG member departments and agencies including NOAA, NASA, DOE, USDA, USGS, NIST, EPA and NSF. They will provide staff support including, where appropriate, contractor support. The USGCRP's US Carbon Cycle Science Program Office will serve a coordinating function to include providing leadership, support and facilitation for workshops and other engagement activities to assemble CCIWG members, federal agency experts, and supporting contractors, as appropriate. The workshops and other engagement activities will facilitate the scoping and development of report outlines and drafts, including where needed, the identification of model analyses and/or data retrieval needed for the assessment. The US Carbon Cycle Science Program Office also organizes the periodic meetings of the Federal Steering Committee of the USGCRP's 2nd State of the Carbon Cycle Report. This Office will provide this committee, the CCIWG, the USGCRP and associated federal and community partners with regular progress updates, in coordination with the Report Leads. The primary responsibility for legal oversight and legal support of the assessment process, including submission of Federal Register Notices, will be assumed by USDA.

D. Information Quality and Peer Review

The USGCRP 2nd State of the Carbon Cycle Report will follow the third NCA (2014) guidelines for preparing USGCRP products, with referenced materials derived primarily from the existing peer-reviewed scientific

literature and consistent with guidance regarding use of non-peer-reviewed literature. Like the NCA, this report will follow the Office of Management and Budget (OMB) federal information quality, transparency, and accessibility guidelines appropriate for a Highly Influential Scientific Assessment (HISA) (See Appendices 1 and 2 of the third NCA for more details). The report will undergo peer review by the National Research Council of the National Academy of Sciences, public review, and final interagency clearance.

The following cut-off dates will be applied for publications to be included in the USGCRP 2nd State of the Carbon Cycle Report:

- For all papers being assessed and cited in the 2nd State of the Carbon cycle Report:
  - October 31, 2016: Deadline for papers to be *accepted* in a peer reviewed journal
  - Papers that are published after October 31, 2016 AND are submitted during the public comment process or NRC peer review may be assessed and may be cited.

E. Process for Public Engagement and Publication

A SOCCR-2 planning and scoping workshop was organized on May 28, 2015. A public forum was organized on February 2, 2016 to facilitate engagement with stakeholders, including federal and non-federal subject matter experts, and the interested public. Additionally, the CCIWG has provided/is providing several opportunities for public engagement with the scientific community throughout the report scoping, planning and writing process via special presentations, sessions, town hall meetings and side-events at national and international scientific conferences, including the 2015 American Geophysical Union Meetings, the 2015 Ecological Society of American Meeting, and the 2015 and 2017 North American Carbon Program Principal Investigators' Meeting. This first federal register notice issued by USDA on behalf of the USGCRP and CCIWG announces the following:

(i) Request for Comments on this Draft Report Prospectus: A 30-day call for comments on the objectives, proposed topics/table of contents, and process as outlined in the Draft Prospectus.

(ii) Call for Scientific Information/Technical input: A 30-day call for submissions of recent, relevant, scientific and/or technical research studies including observed, modeled and/or projected carbon cycle science information that have been peer-reviewed and published or accepted for publication in scientific journals and/or government reports.

(iii) Nominations for Contributing Authors: A 30-day call for nominations of Contributing Authors to assist chapter author teams in the development of the USGCRP 2nd State of the Carbon Cycle Report chapters or sections. Interested parties are invited to submit nominations of subject matter experts, with descriptions of relevant expertise and publications.

After completion of a Public Review Draft of the USGCRP 2nd State of the Carbon Cycle Report, USDA on behalf of the USGCRP, will issue a second Federal Register Notice to announce a public comment period for the draft report. The public will be able to view the draft and submit comments to an online docket available on the USGCRP's website. The Federal Steering Committee of the 2nd State of the Carbon Cycle Report will also work to schedule sessions, town halls and presentations at relevant conferences, and webinars to further engage the community of experts and the general public. Public comments received on the draft will be evaluated and used to inform the final report.

The CCIWG and USGCRP will publish the final report electronically with an interactive web interface, including hard copy publications produced (e.g., edited, layout, etc.) and published through DOE's Oak Ridge National Laboratory. The CCIWG and the USGCRP will also explore online integration of the report with future phases of the USGCRP's Global Change Information System (GCIS). A full communications plan for dissemination of the USGCRP 2nd State of the Carbon Cycle Report findings will be developed by the U.S.

Carbon Cycle Science Program and CCIWG agencies along with designated authors, with input and assistance from the USGCRP communications team.

F. Proposed Timing

This 2nd State of the Carbon Cycle Report is an interim report, designed to be released before the quadrennial fourth National Climate Assessment. A draft of the Special Report is expected to be made available for public comments by late 2016, with final publication expected by mid-2017.

Appendices

TABLE 1: GCRA (1990) Mandates, and goals of 2011 Carbon Cycle Science Plan Goals and 2012 USGCRP Strategic Plan

Mandates for USGCRP in 1990 Global Change Research Act: Assist the Nation and the world to --	**Goals of the US Carbon Cycle Science Program / 2011 Carbon Cycle Science Plan**	**Goals of the 2012 USGCRP Strategic Plan**
1. UNDERSTAND, 2. ASSESSS*, 3. PREDICT, and 4. RESPOND to human-induced and natural processes of global change. *Section 106. Scientific Assessments - Not less frequently than every 4 years, prepare and submit to the President and the Congress an assessment which: 1. Integrates, evaluates, and interprets the findings of the USGCRP and discusses the scientific uncertainties associated with such findings; 2. Analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; 3. Analyzes current trends in global change, both human- induced and natural, and projects major trends for the subsequent 25 to 100 years.	1. Variations and Uncertainties Assessment and Communication: Provide clear and timely explanation of past and current variations observed in atmospheric CO2 and CH4, and the uncertainties surrounding them.	1. Advance Science: Advance scientific knowledge of the integrated natural and human components of the Earth system to understand climate and global change. 2. Inform Decision: Provide the scientific basis to inform and enable timely decisions on adaptation and mitigation. 3. Conduct Sustained Assessments: Build sustained assessment capacity that improves the Nation's ability to understand, anticipate, and respond to global change impacts and vulnerabilities. 4. Communicate and Educate: Advance communication and education to broaden public understanding of global change and develop the scientific workforce of the future.
	2. Socio-economic Drivers, Monitoring, and Verification: Understand and quantify the socioeconomic drivers of carbon emissions, and develop transparent methods to monitor and verify those emissions.	
	3. Ecosystem Vulnerability Evaluation: Determine and evaluate the vulnerability of carbon stocks and flows to future climate change and human activities, emphasizing potential positive feedbacks to sources or sinks that make climate stabilization more critical or more difficult.	
	4. Scenarios and predictions: Predict how ecosystems, biodiversity, and natural resources will change under different CO2 and climate change scenarios.	
	5. Carbon Management assessment: Determine the likelihood of success and the potential for side effects of carbon management pathways that might be undertaken to achieve a low-carbon future.	
	6. Decision-making support and communication: Address decision maker needs for current and future carbon cycle information and provide data and projections that are relevant, credible, and legitimate for their decisions.	

Figure 1: Notional USGCRP/CCIWG SOCCR-2 Road Map representing tentative timeline (2014-2018)