

RECENT U.S. EFFORTS TO ADVANCE INTEGRATED CARBON CYCLE RESEARCH AND TO ASSESS THE STATE OF THE NORTH AMERICAN CARBON CYCLE



***Contact:**
gshrestha@usgcrp.gov
https://CarbonCycleScience.us



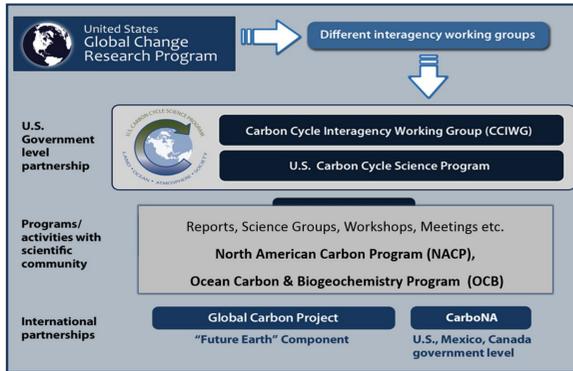
Gyami Shrestha^{1*}, Nancy Cavallaro², Zhiliang Zhu³, Karina V.R. Schäfer⁴, James H. Butler⁵

¹U.S. Carbon Cycle Science Program Office/UCAR, U.S. Global Change Research Program, Washington D.C.; ²U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington D.C.; ³U.S. Geological Survey, Reston, Virginia; ⁴National Science Foundation, Virginia; ⁵National Oceanic and Atmospheric Administration, Global Monitoring Division, Colorado

SUMMARY

The U.S. Carbon Cycle Science Program, led by the Carbon Cycle Interagency Working Group (CCIWG) and under the auspices of the U.S. Global Change Research Program (USGCRP), leads and supports peer-reviewed research of carbon cycle science across the federal government. CCIWG-led intensive, interagency coordinated field campaigns that unite in-situ, air-borne, and satellite-based observations as significant components of this research (U.S. National Academy of Sciences, 2017), as well as coordinated research support, have played a vital role in advancing integrated carbon cycle science. Here, we highlight recent efforts to catalyze, advance, and assess integrated and interdisciplinary U.S., North American and global carbon cycle research, made possible via sustained Program collaborations with U.S. and international science communities. Examples include recent CCIWG supported science thematic activities focused on:

- Sustained carbon cycle observations; carbon cycle predictions, science of blue carbon, soil carbon resilience and vulnerability, urban carbon and human interactions,
- methane, greenhouse gas measurements, and the 2nd State of the Carbon Cycle Report (SOCCR-2).



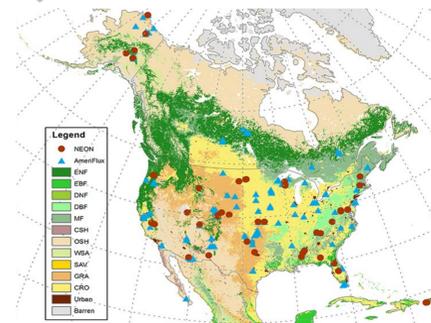
U.S. Carbon Cycle Science Program/CCIWG Mission

To coordinate and facilitate federally funded carbon cycle research and provide leadership to the USGCRP on carbon cycle science priorities.

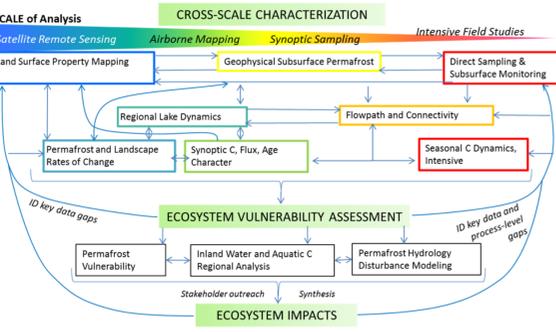
CCIWG Carbon Cycle Predictions Workshop Map Citation: Xiao, J., Y. Luo, and G. Shrestha (2016). Improving carbon cycle projections for better carbon management, *Eos*, 97, doi:10.1029/2016EO062341. Published on 02 November 2016.

From CCIWG Carbon Cycle Predictions Workshop:

This land cover map is based on the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument on NASA's Terra satellite. The land cover types include evergreen needleleaf forests (ENF), evergreen broadleaf forests (EBF), deciduous needleleaf forests (DNF), deciduous broadleaf forests (DBF), mixed forests (MF), closed shrublands (CSH), open shrublands (OSH), woody savannas (WSA), savannas (SAV), grasslands (GRA), croplands (CRO), urban, and barren.



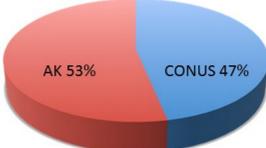
Vulnerability of Boreal Inland Waters – USGS and NASA ABoVE



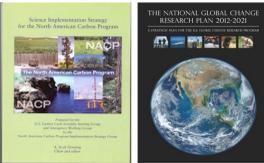
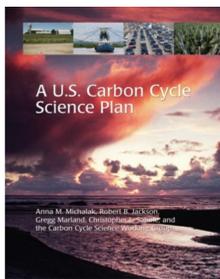
U.S. total area



Total U.S. carbon stock¹

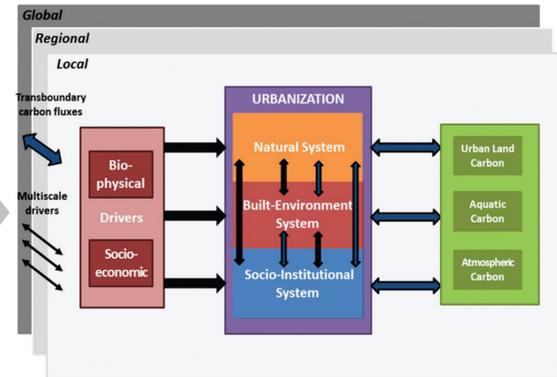


¹USGS LandCarbon assessment



From CCIWG Urban Carbon Human Interactions Workshop:

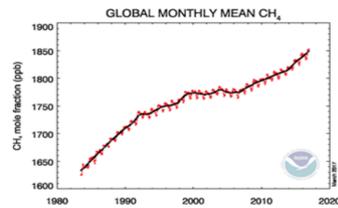
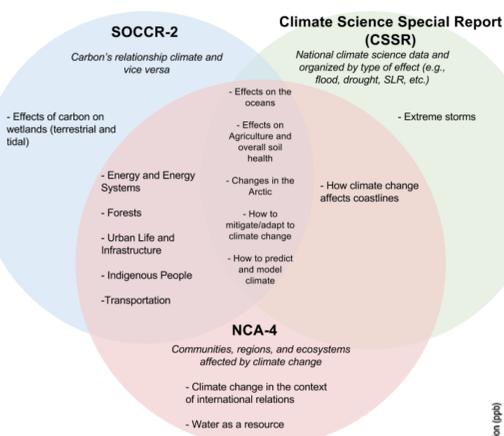
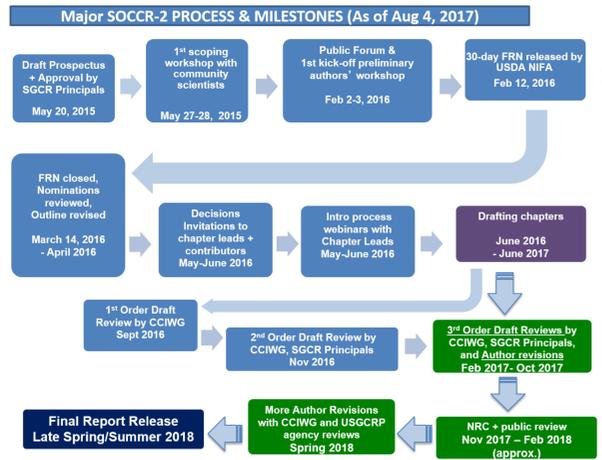
Conceptual framework depicting the key dynamic relationships for an improved understanding of urbanization, urban areas, and the carbon cycle. Note: Blue arrows depict links between systems and components. Citation: Romero-Lankao et al (2014). A critical knowledge pathway to low-carbon, sustainable futures: Integrated understanding of urbanization, urban areas, and carbon. *Earth's Future*, 2: 515–532. doi:10.1002/2014EF000258



THE 2ND STATE OF THE CARBON CYCLE REPORT (SOCCR-2)

SOCCR-2 #	SOCCR-2 State of the Science – Chapters - Draft	Required sections for each chapter
1	Preface/motivation for the report/ advances since SOCCR-1	i. Key Message/ Findings/Highlights (incl. traceable accounts - see examples from Health and NCA supporting evidence)
2	Governmental, intergovernmental and interagency context	ii. Introduction
3	Executive Summary	iii. Historical context (incl. socioeconomic drivers of carbon emissions)
4	Part I: Synthesis	iv. Current State of Carbon Cycle Understanding of Fluxes and Stocks
5	Part II: Human Dimensions of the C Cycle	v. Indicators, Trends, Feedbacks
6	Urban Systems (incl. Transportation)	vi. North American and Global Context, Regional Perspective
7	Agriculture	• NCA regions
8	Societal Perspective on Carbon	• U.S., Mexico, Canada
9	Tribal Lands	• Arctic, Tropics, RECCAP
10	Part III: State of Air, Land and Water	vii. Societal drivers and impacts, carbon management and decisions
11	Atmosphere	viii. Synthesis, conclusions, gaps in knowledge, and (near) future outlook
12	Forests	• overarching synthesis of the current state of the carbon cycle
13	Grasslands	• key knowledge gaps/ opportunities and near-term outlook on the North American carbon cycle
14	Arctic/Boreal/Permafrost regions	
15	Soils	
16	Terrestrial Wetlands	
17	Inland waters	
18	Tidal wetlands and estuaries (incl. blue carbon)	
19	Oceans and continental Shelves (oceans, methane hydrates etc.)	
20	Part IV: Consequences and ways forward	
21	Consequences of rising atmospheric CO ₂ (e.g. ocean acidification)	
22	Decision-support (social, behavioral, economic)	
23	Future projections and associated climate change in North America	

- The U.S. CCIWG has been leading the development of SOCCR-2 in collaboration with over 200 scientists from the U.S., Canada, and Mexico since 2015. The focus areas for SOCCR-2 are inspired by the U.S. Carbon Cycle Science Plan (2011), which emphasizes global scale research on long-lived, carbon based greenhouse gases and the major pools and fluxes of the global carbon cycle.
- Three aspects frame the SOCCR-2 focus areas: (i) Impact of natural processes and human actions on terrestrial, atmospheric and oceanic carbon cycle; (ii) Impact of policy and management decisions on the levels of CO₂ and CH₄ in the atmosphere; (iii) Impact of increasing GHG concentrations, associated changes in climate, and carbon management decisions on ecosystems, species, and natural resources.
- Relevant carbon management science perspectives and tools for supporting and informing decisions, as addressed in and related to the U.S. Global Change Research Act (1990), the National Climate Assessment (2014, 2018), are considered.



METHANE CYCLING WITHIN THE CARBON CYCLE FRAMEWORK (FY17 + 18)

USGCRP interagency research priorities draw from the breadth of the Program's capabilities in observations, integrated modeling, process research, and actionable science to address emerging research opportunities and key scientific gaps and respond to critical decision-support needs. Methane Cycling within the Carbon Cycle Framework is a new focal area – but reflects an area of ongoing Program interest. USGCRP will spotlight its work on the carbon cycle over the next several years.

SOCCR-2 Federal steering committee and liaison: Nancy Cavallaro (Administrative Lead Agency POC + CCIWG co-chair) (USDA-NIFA), Zhiliang Zhu (CCIWG co-chair) (USGS), Dan Stover (DOE), Erica Ombres (NOAA), Tom Wirth (EPA), Kathy Hibbard (NASA), Marlen Eve (USDA-ARS), Carolyn Olson (USDA-OCE), Noel Gurwick (USAID), Gyami Shrestha, (U.S. Carbon Program Office Director), Karina Schafer (NSF), Anne Marsh (USDA FS), Laura Lorenzoni (NASA), Jim Butler (NOAA), Eric Kasischke (NASA), Kathy Tedesco (NOAA), Libby Larson (NASA/SSAI); **Science Leads:** Rich Birdsey (USDA FS), Melanie Mayes (ORNL), Ray Najjar (PSU), Sasha Reed (USGS), Paty Romero-Lankao (UCAR/NCAR); **Chapter Leads:** Vanessa Bailey, Lori Bruhwiler, David Butman, Wei-Jun Cai, Sarah R. Cooley, Grant Domke, Katja Fennel, Kevin Robert Gurney, Daniel J. Hayes, Alexander N. Hristov, Deborah N. Huntzinger, Andrew R. Jacobson, Jane M. F. Johnson, Randy Kolka, Kate Lajtha, Elizabeth L. Malone, Peter Marcotullio, Maureen I. McCarthy, Emily McGlynn, Dave McGuire, Anna M. Michalak, John B. Miller, David J. Moore, Elise Pendall, Stephanie Pincetl, Vladimir Romanovsky, Paty Romero-Lankao, Ted Schuur, Carl Trettin, Rodrigo Vargas, Tristram West, Christopher A. Williams, Lisamarie Windham-Myers + **ORNL Editing Team** + **All 200+ SOCCR-2 author team members**

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