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Assessing the last decade of carbon cycle science & strategies for the next decade

https://CarbonCycleScience.us

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United States Carbon Cycle Science Program *Providing a coordinated & focused scientific strategy for conducting federal carbon cycle research*
An Interagency Partnership

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SUMMARY

The **2017 Decadal Strategy for Earth Observation from Space (U.S. National Academies of Sciences 2018), is a 10-year plan** prioritizing research areas, observations, and notional missions to make those observations for NASA, NOAA, USGS and cross-agency programs. It calls for efficient and effective use of Earth Observations (EO) resources from space, and some of the scientific missions and goals focus on understanding of the sources and sinks of carbon dioxide and methane, and potential future changes in response.

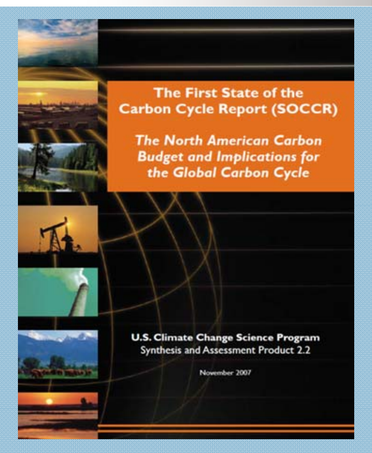
The **2nd State of the Carbon Cycle Report (SOCCR2, due for release mid-2018**) is a report that **assesses the last decade of carbon cycle science focused on North America** in the context of global changes and interactions. Over 200 scientists and program managers from the U.S., Mexico and Canada compiled the report, which includes projections for both human- induced and natural changes. Space-based observations have been critical in facilitating the last 10 years of carbon cycle science advances across North America, leading to consequent science-based actions that have shaped decisions across multiple stakeholder levels in the region, and have enabled the development of SOCCR2. The **U.S. Carbon Cycle Interagency Working Group (CCIWG)** leads this assessment.

Here, reflecting on SOCCR2, we highlight the observations that have facilitated the last 10 years of carbon cycle science advances across North America; addressing connections with pertinent future cross-agency priorities, research needs and **capabilities addressed in the 2018 U.S. National Academy of Sciences Decadal Strategy for Earth Observations**.

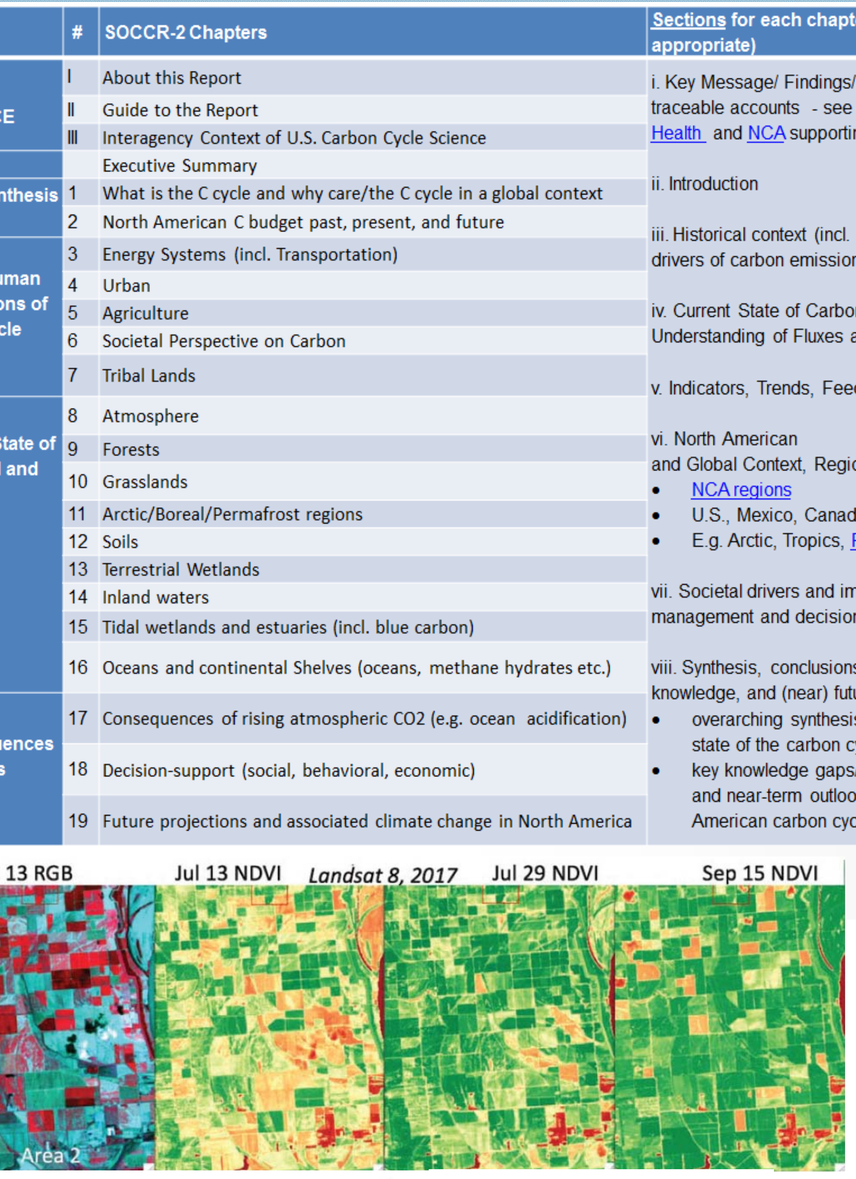
CARBON CYCLE SCIENCE & OBSERVATIONS : LAST DECADE, NEXT DECADE

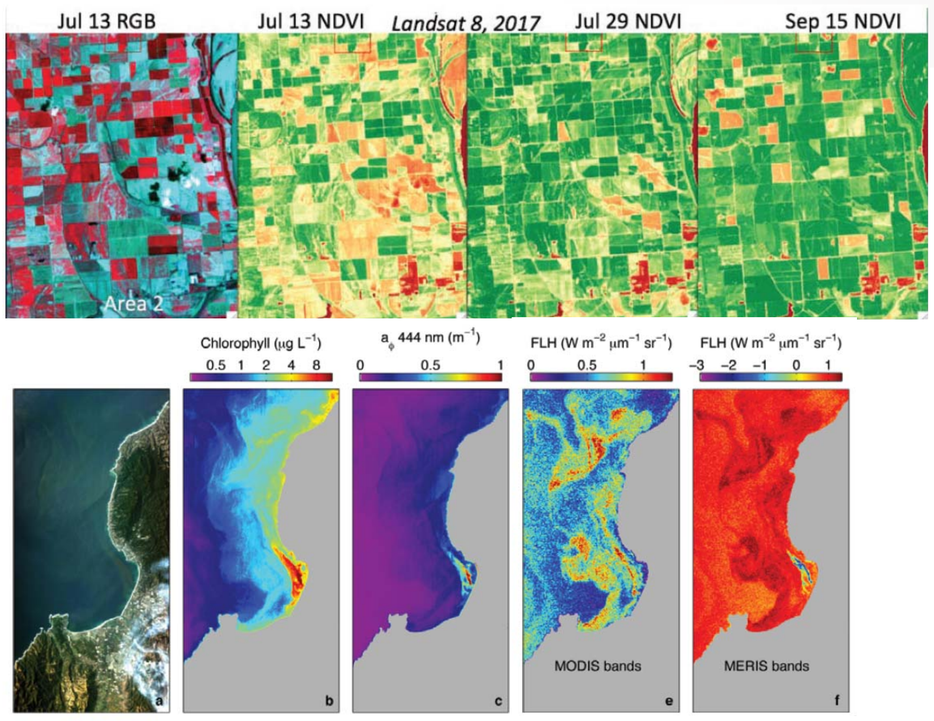
Updating SOCCR1 (2007), SOCCR2 significantly advances our understanding of carbon (C) in the atmosphere, aquatic and terrestrial environments. From quantifying increases in atmospheric CO_2 (43% since pre-industrial times), CH_4 (130% since pre-industrial times) to characterizing natural C sinks in North American land and adjacent coastal ocean, C fluxes across ecosystems, and the slow down in global fossil fuel emissions of CO_2 over the current decade. Critical advances in SOCCR2 come also in the identification of knowledge gaps, and reduction of uncertainties in estimated C fluxes.

Many of these assessments would have been impossible without satellite remote sensing and other observational data; some of the priorities identified in the 2017 Decadal Survey focus on the challenge of observing carbon across ecosystems and specifically understanding sources and sinks of CO_2 and CH_4 and the processes that will affect their concentrations in the future.



	#	SOCCR-2 Chapters	Sections for each chapter (as appropriate)
PREFACE	I	About this Report	i. Key Message/ Findings/Highlights (incl. traceable accounts - see examples from Health and NCA supporting evidence)
	II	Guide to the Report	
	III	Interagency Context of U.S. Carbon Cycle Science	
		Executive Summary	ii. Introduction
Part I Synthesis	1	What is the C cycle and why care/the C cycle in a global context	
	2	North American C budget past, present, and future	iii. Historical context (incl. socioeconomic drivers of carbon emissions)
Part II Human Dimensions of the C Cycle	3	Energy Systems (incl. Transportation)	
	4	Urban	
	5	Agriculture	iv. Current State of Carbon Cycle Understanding of Fluxes and Stocks
	6	Societal Perspective on Carbon	
	7	Tribal Lands	v. Indicators, Trends, Feedbacks
Part III: State of Air, Land and Water	8	Atmosphere	
	9	Forests	vi. North American and Global Context, Regional Perspective • NCA regions • U.S., Mexico, Canada • E.g. Arctic, Tropics, RECCAP
	10	Grasslands	
	11	Arctic/Boreal/Permafrost regions	
	12	Soils	
	13	Terrestrial Wetlands	
	14	Inland waters	vii. Societal drivers and impacts, carbon management and decisions
	15	Tidal wetlands and estuaries (incl. blue carbon)	
	16	Oceans and continental Shelves (oceans, methane hydrates etc.)	viii. Synthesis, conclusions, gaps in knowledge, and (near) future outlook • overarching synthesis of the current state of the carbon cycle • key knowledge gaps/ opportunities and near-term outlook on the North American carbon cycle
Part IV: Consequences and ways forward	17	Consequences of rising atmospheric CO2 (e.g. ocean acidification)	
	18	Decision-support (social, behavioral, economic)	
	19	Future projections and associated climate change in North America	



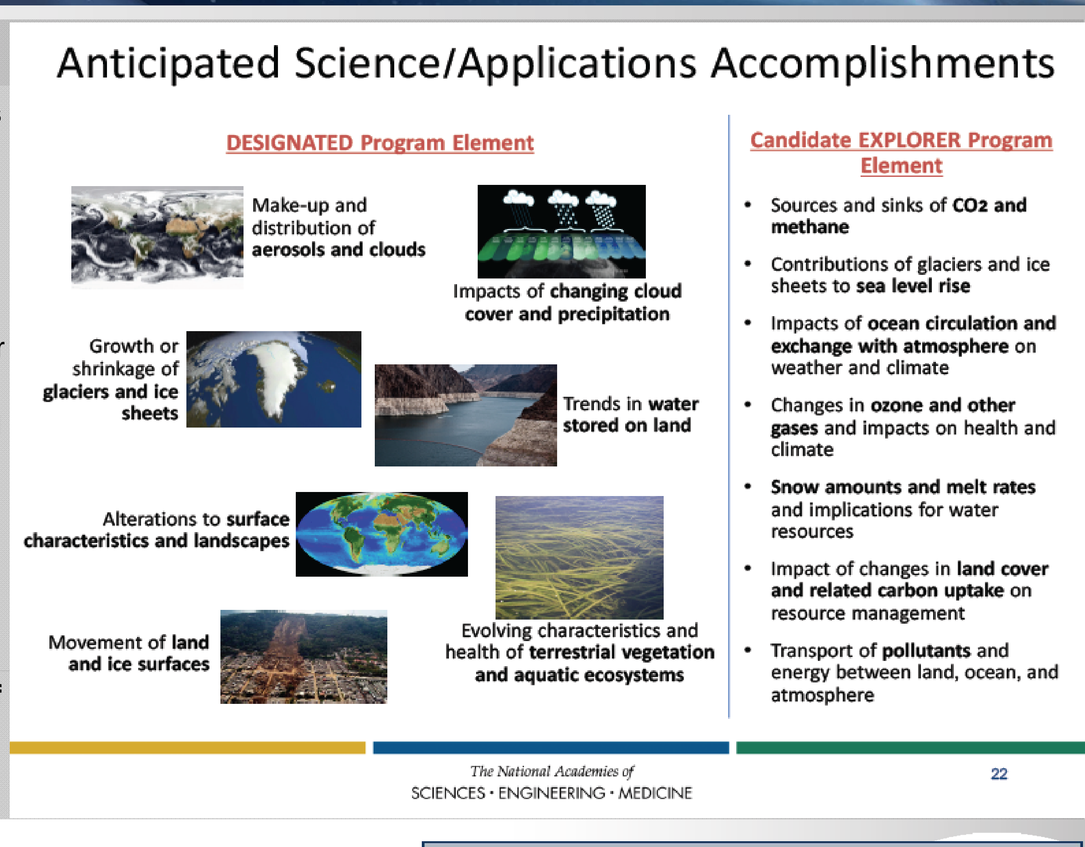


Examples of satellite data to determine C and ecosystem changes; top: Landsat-8 Operational Land Imager images of Central Arkansas from July 13, July 29, and September 15, 2017. Individual fields can be discriminated and crop type determined from multi-temporal acquisitions during the growing season. SOURCE: Landsat-8 Project Office, NASA/Goddard Space Flight Center; National Academies of Sciences 2018. Bottom: Phytoplankton characterization from a suite of algorithms using a HICO hyperspectral image acquired on 6 November 2012 over Monterey Bay, CA. SOURCE: Ryan et al., 2011; U.S. National Academies of Sciences 2018.

The 2017 Decadal Strategy for Earth Observations addresses 35 key science and applications questions; with six categories prioritized:

- Coupling of the water and energy cycles.
- Ecosystem Change.
- Extending and Improving Weather and Air Quality Forecasts.
- Reducing Climate Uncertainty and Informing Societal Response.
- Sea Level Rise.
- Surface Dynamics, Geological Hazards and Disasters.

These priority categories are pertinent to carbon & SOCCR2 assessed science of the state of the carbon cycle in North America.



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CREDITS