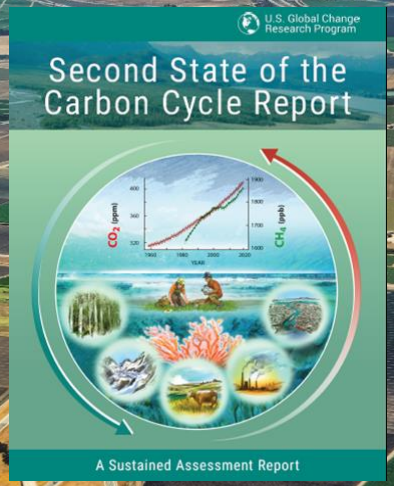
U.S. Carbon Cycle Science Program &
Carbon Cycle Interagency Working Group

Celebrating over 20 Years of Interagency Research Partnerships with the Carbon Cycle Science Community

CarbonCycleScience.us



Cows, Dirt, Smoke, Water: A State of Carbon Story

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Webinar #16 of Special NOAA & U.S. Carbon Cycle Science Program SOCCR2 Tuesday Series (Feb 26-June 11, 2019)
From Science to Solutions: The State of the Carbon Cycle

June 11, 2019

FIRST:
A PERSONAL CARBON STORY

Source:NPR

Source: FAO

Source: cookstovesproject.org

Source: The Guardian

A successful improved cookstoves project in 2002 (source: self)

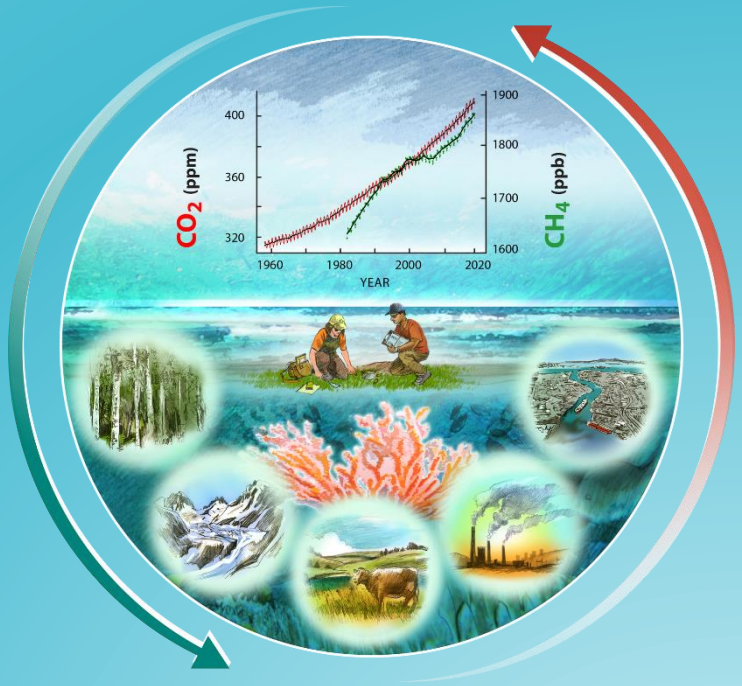
All Photo source: Gyami Shrestha unless stated otherwise.

SECOND STATE OF THE CARBON CYCLE REPORT

SOCCR2 is an authoritative decadal assessment of carbon cycle science across North America, developed by over 200 experts from the U.S., Canadian and Mexican governments, national laboratories, universities, private sector, and research institutions.

SOCCR2 is a Sustained Assessment Product of the U.S. Global Change Research Program.

NEXT:
A STATE OF CARBON STORY

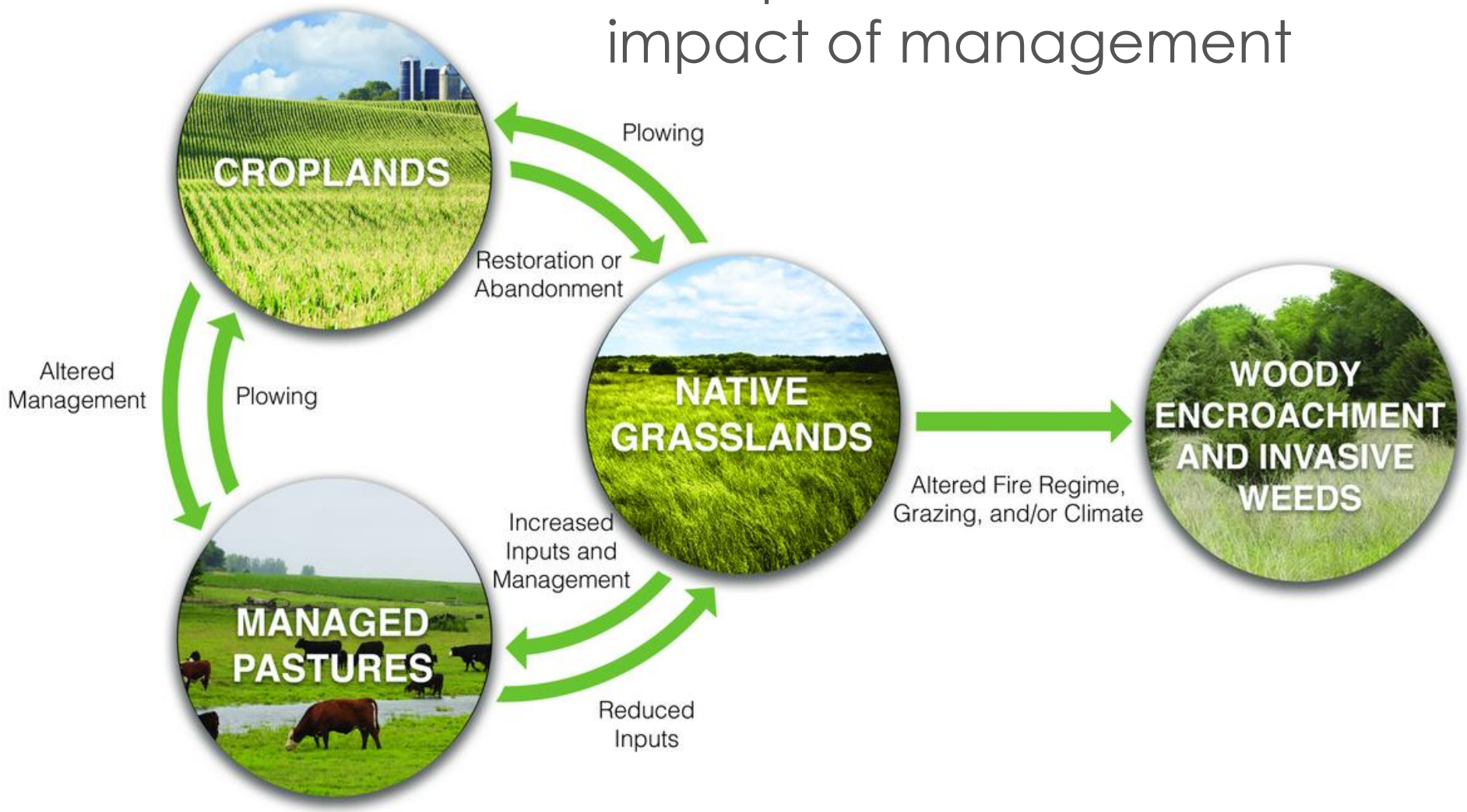


What role do cows, dirt (a.k.a. soil), smoke and water play in the carbon cycle?

Dig for answers in SOCCR2.

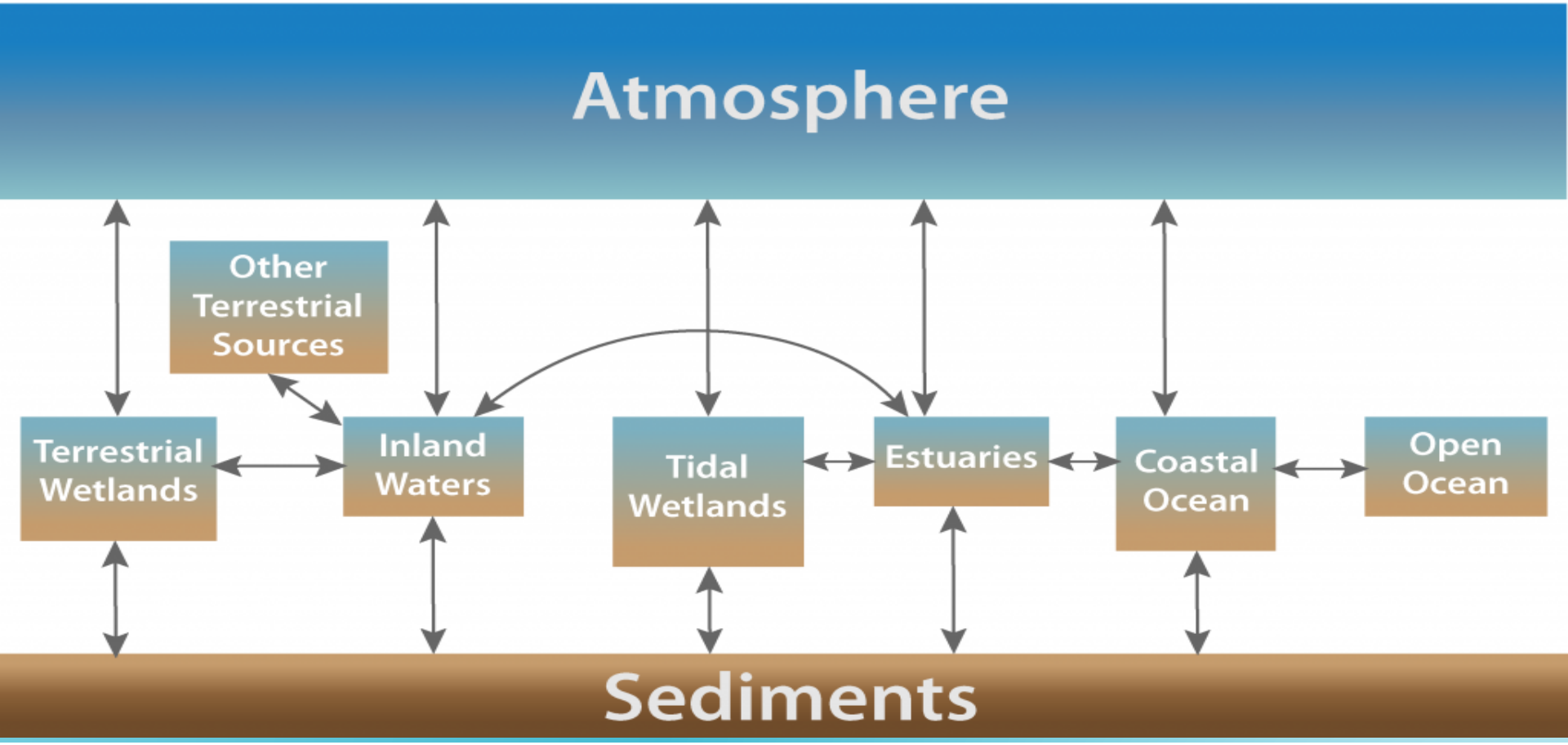
https://carbon2018.globalchange.gov

Example 1: Grasslands and impact of management



Reduced fire frequency in mesic native grassland has allowed woody vegetation such as Juniperus virginia to expand and has been associated with rapid increases in carbon stocks in vegetation and soils (McKinley and Blair 2008). Other observed management impacts include lower carbon density in agricultural lands compared with grasslands (Zhu et al., 2011) and the rapid accumulation of soil carbon in intensively managed pastures in the southeastern United States (Machmuller et al., 2015). In addition, the rate of carbon uptake by croplands in the Great Plains is 30% lower than that of grasslands (Wylie et al., 2016) [Source: SOCCR2 Grasslands Chapter]

Example 2: Carbon Cycling Across the Air-Land-Water Interfaces in Aquatic Ecosystems



Carbon exchanges with the atmosphere are limited to carbon dioxide (CO2) except for terrestrial wetlands, which include CO_2 and methane. Arrows leading from the atmosphere to different aquatic ecosystem compartments imply a loss of atmospheric carbon from the atmosphere to the ecosystem (a carbon sink). Arrows leading from the ecosystem to the atmosphere imply a loss of carbon from the ecosystem to the atmosphere (a carbon source). Horizontal arrows refer to transfer of carbon between ecosystems. [Figure source: OCB, modified from SOCCR2 Exec Summary]

Example 3: Emissions from cows (From SOCCR2 Ag chapter)

en·ter·ic / - relating to or occurring in the intestines

Enteric and manure fermentation sources of livestock methane (CH_4) emissions.

Larger uncertainty regarding manure CH_4 emissions and net effects of different intensities and types of grazing.

Also, depends on type of storage facility, duration of storage, and climate.

Temperature increase - decrease dry matter intake of dairy cows due to heat stress - reduction in enteric CH_4 emissions

Temperature increase - increase manure CH_4 emissions as microbial decomposition of manure, producing CH_4, is sensitive to temperature.

WRAPPING UP THE SOCCR2 WEBINAR SERIES

- Completed webinars
- Snapshot of all chapters
- Major themes
- Carbon Management
- Trade-offs & co-benefits
- Production Facts
- Future Opportunities?

carbon2018.globalchange.gov

SOCCR2 ABOUT ▾ CHAPTERS ▾ DOWNLOADS ▾ ORDER REPORT IN BRIEF ▾

New v2 site released on Earth Day features:

- *Full GCIS metadata is now accessible for graphics*

Full report content now viewable and searchable from site and on the web

- *Sections and figures include links for direct sharing via social media*
- *Better site analytics incl. chapter specific data*

Wrapping up SOCCR2 major themes & decadal North American carbon budget findings

How Is the Global Carbon Cycle Changing?

Carbon Sources, Sinks, and Stocks in North America

Effects of Carbon Cycle Changes on North Americans and Their Environments

A Systems Approach to Linking the Carbon Cycle and Society

Projections of the Future Carbon Cycle, Potential Impacts, and Uncertainties

Carbon Management and Mitigation

Based on assessment of science from the last decade, SOCCR2 finds that:

Fossil fuels are still the largest source of carbon in North America but can be reduced through dedicated effort.

Aquatic systems are both sources and sinks of carbon in North America (depending on type and conditions).

Land and coastal waters are sinks of carbon in North America, though some sinks at risk to diminish or become sources in the future.

Boiling down major SOCCR2 highlights for North America

The energy sector and transportation continue to be the largest source of carbon emissions

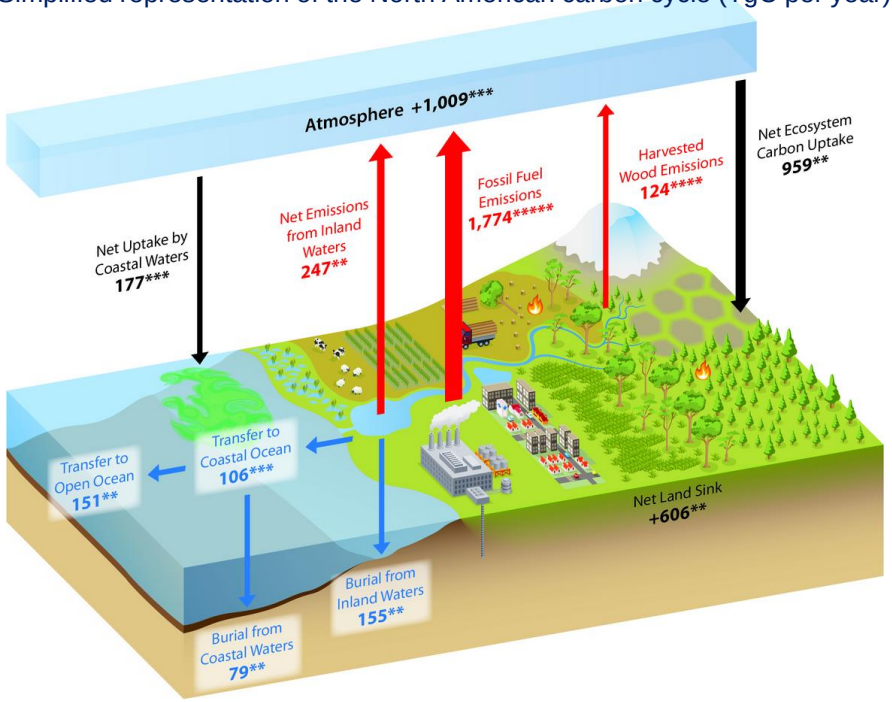
Annual fossil fuel CO_2 emissions decreased by 1% - Market, technology, and policy drivers

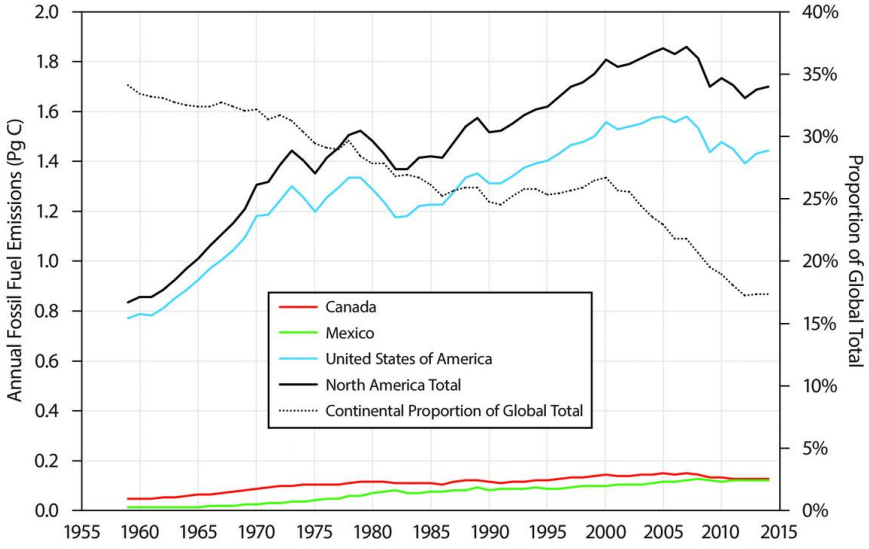
Net economic growth over same decade.

Cities largest emitters.

The United States is still currently responsible for 80% to 85% of fossil fuel emissions from North America.

Simplified representation of the North American carbon cycle (TgC per year)





On Carbon Loss & Sequestration (removal)….SOCCR2 SHOWS

Soils in croplands, rangelands, grasslands, and forests have strong potential for carbon sequestration with improved land-management practices;

e.g. afforestation, reduced deforestation, restoration of coastal areas and terrestrial wetlands;

Some carbon sinks are diminishing in strength, many are at risk due to

increasing disturbance in forests
(e.g. fire, pests, invasive species)
increasing land use pressure on ecosystems.

Conversion of peatland soils accounts for the largest emissions from soils.

Accelerated warming in Arctic regions creates vulnerability of large stores of carbon in permafrost soils.

Future Projections: Changes in climate, human activities, and ecosystem responses may alter future long-term removals of carbon by current land and ocean system sinks.

Carbon management: Options to reduce increased benefits of a well-managed carbon cycle

… SOCCR2 demonstrates significant human capacity to affect the carbon cycle.

Understanding the mechanisms and consequences of these effects offers opportunities to use knowledge of the carbon cycle to make informed and potentially innovative carbon management and policy decisions…

Approaches that are people-centered and multidisciplinary emphasize that carbon-relevant decisions often are not about energy, transportation, infrastructure, or agriculture, but rather style, daily living, comfort, convenience, health, and other priorities….

Energy Sector

Urban Areas

Carbon Capture and Storage

Land Use and Land Management Changes

Grazing and Livestock Management

Agriculture Cropland and Waste Management

Wetland Restoration or Creation

Tribal Lands

Estimated cumulative cost over 35 years of reducing GHG emissions to meet a 2°C trajectory by 2050 ranges from $1 trillion to $4 trillion (US$2005) in the United States.

Annual cost of not reducing emissions is conservatively estimated at $170 billion to $206 billion (US$2015) in the United States in 2050.

Trade-offs, Co-benefits (examples)

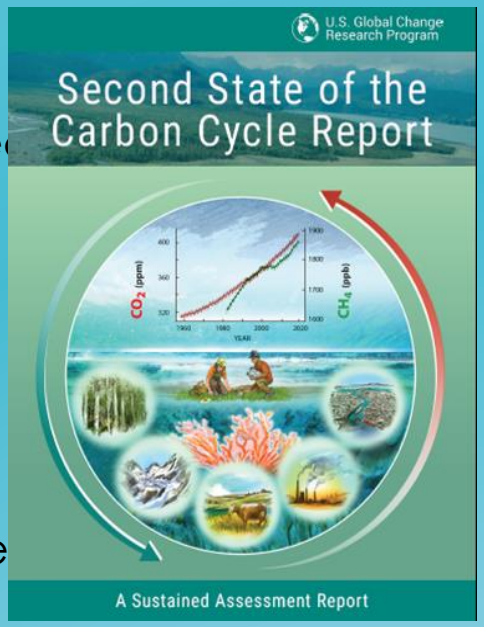
Management strategies to reduce the risk of severe wildfires in fire-prone areas - intentional, short-term reductions in ecosystem carbon stocks - to reduce the probability of much larger carbon reductions over the long term (Ch. 9: Forests)

Management of wildfire regimes in vegetated landscapes can influence soil carbon storage via management effects on productivity and input of recalcitrant, pyrogenic (fire-produced) or black carbon in soils (Ch. 12: Soils).

Reducing carbon emissions - improvements in air quality, energy-use efficiency, increased revenues, economic savings to taxpayers, greater crop productivity, and enhanced quality of life (Ch. 4: Urban)

Can *carbon cycle science inform management options to produce sustained co-benefits, considering the vulnerability of forests to wildfires and focusing development of carbon sequestration activities in low-disturbance environments*? (Exec Summary)

Solutions-oriented perspectives based on improved observations over last decade



Enhanced integration of natural sciences and sustainability perspe
promoting solutions-oriented science
- social science and tribal chapters
- carbon management sections in each chapter

Thanks to improved decadal carbon observations, SOCCR2 shows:

Increased high-latitude data collections and synthesis

Coastal wetlands, estuaries and coastal waters included in the de
budget for the first time

Lateral carbon transports more consistently determined over space and time. Compares different types of wetlands carbon, previously often lumped together.

More complete and better attributed carbon budget in North America

Convergence between top-down (atmospheric observations) and bottom-up (in-situ and inventories) estimations

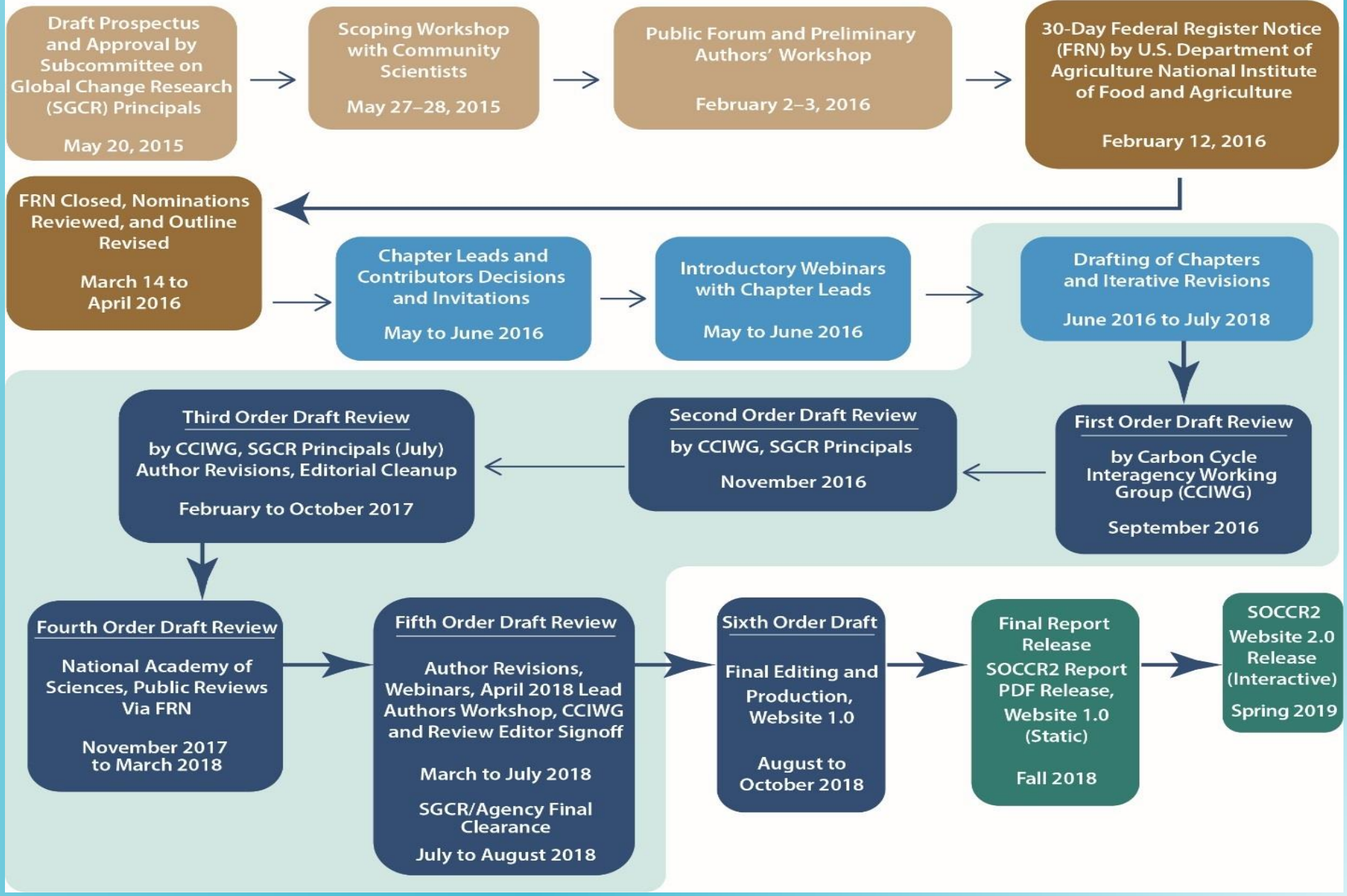
Future projections more robust with enhanced observations and tools for their interpretation

Progress in documenting key elements of the CH4 budget

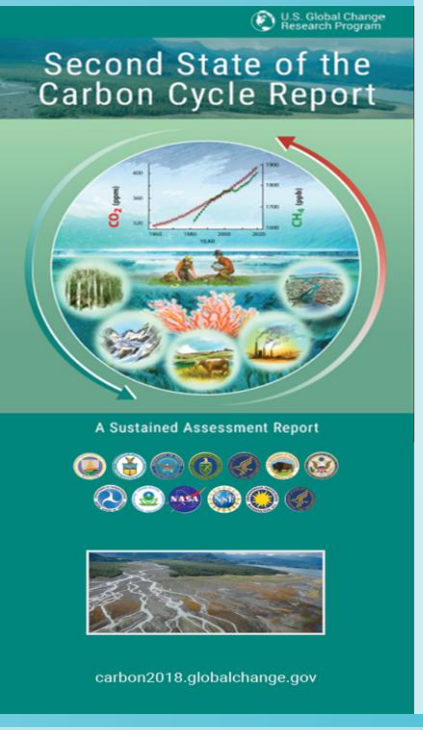
BUT gaps & research needs remain – for instance for Arctic and boreal regions, grasslands, tropical ecosystems, urban areas, methane….

A three-year journey with 200+ top international experts…Let's remember….It's not over ☺

Major SOCCR2 Process Highlights, Reviews, and Timeline



PRODUCTION FACTS …So we don't forget.



Decadal U.S. Government Assessment of Carbon across North America – science, data, society, management – in global context

The full decadal assessment contains 878 pages
- Highlights (plain language) & Executive Summary (technical)
- 4 sections (1. Synthesis, 2. Human Dimensions of the Carbon Cycle, 3. State of Air Land and Water, 4. Consequences and Ways Forward)
- 19 chapters
- 7 appendices

Developed by 200+ diverse cross-sectoral experts from U.S., Mexico, Canada, Australia, Cyprus, Hong Kong
3764 publications cited
33 Chapter Leads
200 Contributing Authors
5 Science (cross-chapter section) Leads
11 Review Editors
3 years formulation & production (2015-18)
Over 6 Drafts reviewed over 6 times incl. by Public, U.S. National Academy of Sciences, expert external reviewers, 21 Federal Steering Committee members.
Final clearance by 13 U.S. Government Agencies and Departments leading to Friday Nov 23, 2018 Release

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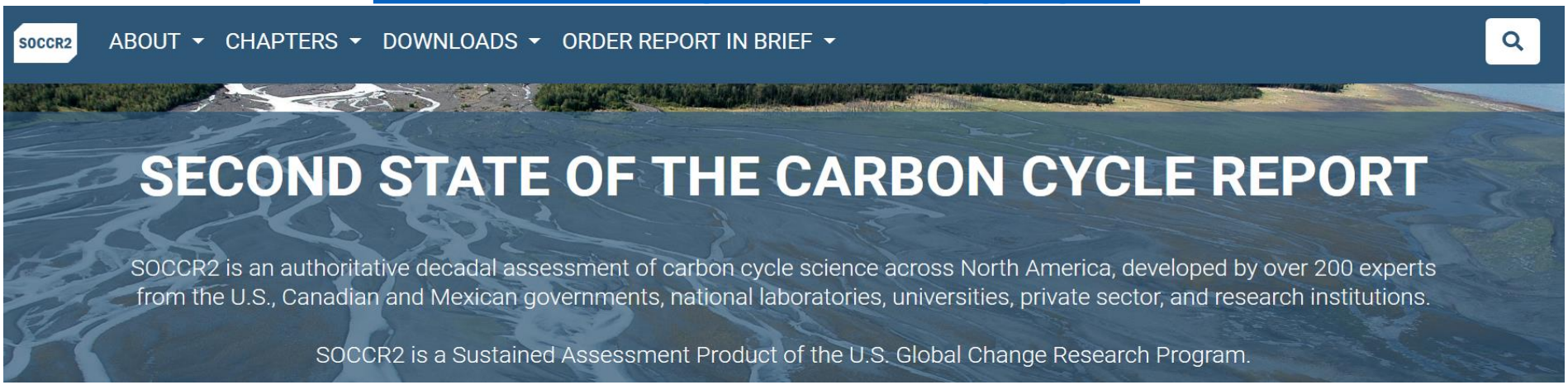
carbon2018.globalchange.gov



Thanks to all SOCCR2 Team Members, Collaborators, Federal Sponsors.

Thank you. Merci. Danke.
धन्यवाद. Gracias. 谢谢.

Questions?
Ideas for outreach, derivatives, collaborations?

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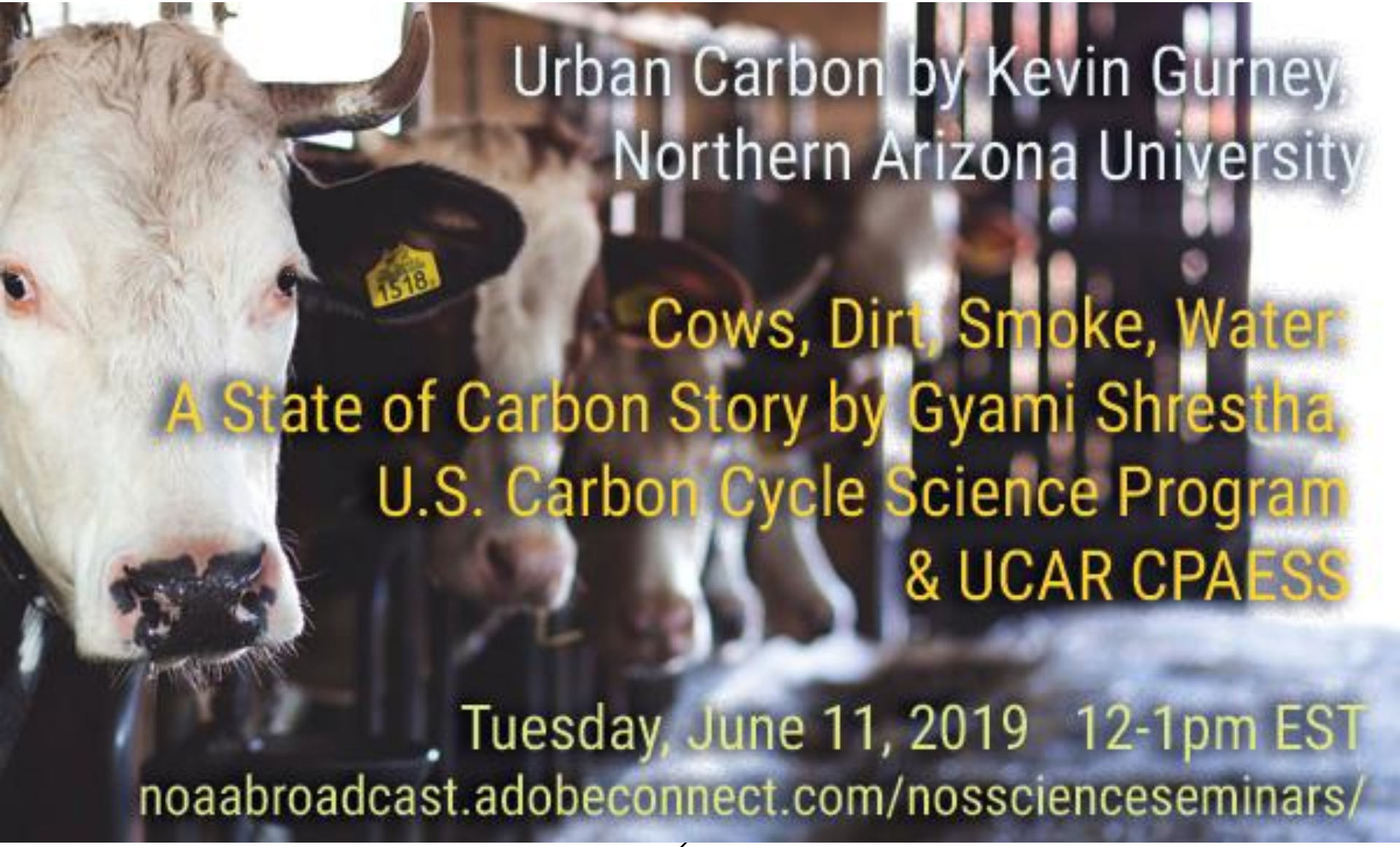
Segundo Reporte sobre el Estado del Ciclo del Carbon O Mensajes Clave

北美 第二期碳循环现状报告 主要重点

Le Deuxième Rapport Sur l'Etat du Cycle du Carbone: Faits saillants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Tuesday, June 11, 2019 12-1pm EST
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