

# Status and Review of a New U.S. Carbon Cycle Science Plan



Anna Michalak<sup>1</sup>, Gregg Marland<sup>2</sup>,  
Rob Jackson<sup>3</sup>, Chris Sabine<sup>4</sup>  
CCS WG Co-Leads

1 The University of Michigan

2 Oak Ridge National Laboratory

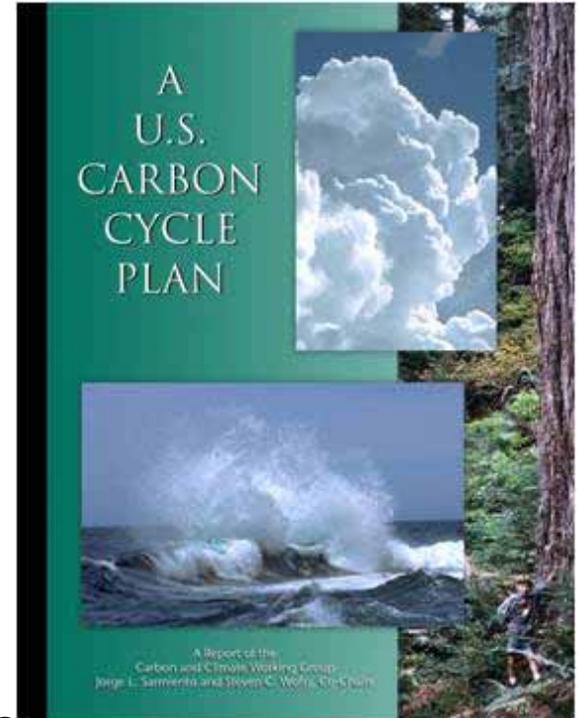
3 Duke University

4 NOAA PMEL

# Rationale

---

- ❑ “A U.S. Carbon Cycle Science Plan” was developed by a committee of researchers chaired by Jorge Sarmiento and Steve Wofsy in 1998, published in 1999, and is now 10 years old
- ❑ The Carbon Cycle Science Working Group (CCS WG) was recently established to develop an updated, revised, or new science plan for U.S. carbon cycle science
- ❑ The new plan will identify research challenges and priorities for the next decade (~2010-2020), with input from the broader community



# Timeline to Date

---

- June / July 2008: Co-leads of CCS WG appointed
- September / October 2008: Members of CCS WG appointed
- November 17-18 2008: First meeting of CCS WG
- December 9-10 2008: CCS WG co-leads report to CCSSG
- January 2009: CCS WG Meeting Report accepted for publication in EOS
- February 2009: Draft of scoping paper describing main thrusts of revised plan completed
- February 2009: NACP Investigators' Meeting and second meeting of CCS WG

# Working Group Membership

Rob Jackson – Co-lead (Duke U.)	Lisa Dilling (U. Colorado)	Brian O’Neill (NCAR)
Gregg Marland – Co-lead (ORNL)	Andy Jacobson (NOAA / U. Colorado)	Steve Pacala (Princeton)
Anna Michalak – Co-lead (U. Michigan)	Matthew Kahn (UCLA)	Jim Randerson (UC Irvine)
Chris Sabine – Co-lead (PMEL)	Steve Lohrenz (U. Mississippi)	Steve Running (U. Montana)
Bob Anderson (Columbia U.)	David McGuire (U. Alaska)	Brent Sohngen (Ohio State U.)
Deborah Bronk (Col. of William & Mary)	Galen McKinley (U. Wisconsin)	Pieter Tans (NOAA-ESRL)
Ken Davis (Penn State)	Charles Miller (JPL)	Peter Thornton (ORNL)
Ruth DeFries (Columbia U.)	Berrien Moore (Climate Central)	Steve Wofsy (Harvard)
Scott Denning (Colorado State U.)	Dennis Ojima (Heinz Center)	Ning Zeng (U. Maryland)

**Shaded: Members who attended first workshop**

# CCIWG Attendees at First Workshop

---

- Paula Bontempi (NASA)
- Nancy Cavallero (USDA)
- Emily Cloyd (CCSPO)
- Laura Gough (NSF)
- Roger Hanson (CCSPO)
- Carol Jones (USDA)
- Fred Lipschultz (NASA)
- Al Solomon (USDA)

# Goals of First Workshop

---

- Achieve consensus on extent to which 1999 U.S. CCSP should be updated
- Develop list of central, overarching scientific questions to be addressed by new U.S. CCSP
- Identify mechanisms for maximizing community input into the plan

# Fundamental Science Questions

---

- 1999 U.S. Carbon Cycle Science Plan:
  - What has happened to the carbon dioxide that has already been emitted by human activities (past anthropogenic CO<sub>2</sub>)?
  - What will be the future atmospheric CO<sub>2</sub> concentration trajectory resulting from both past and future emissions?
- Preliminary version for new Plan:
  - What processes and feedbacks control the dynamics of atmospheric CO<sub>2</sub> and CH<sub>4</sub>?
  - What are the impacts of the changing carbon cycle (and associated changes in climate) on ecosystems?
  - How will carbon stocks and fluxes respond to policy and carbon management strategies?

# 1999 U.S. CCSP Goals

---

1. Quantify and understand the Northern Hemisphere terrestrial carbon sink
2. Quantify and understand the uptake of anthropogenic CO<sub>2</sub> in the ocean
3. Determine the impacts of past and current land use on the carbon budget
4. Provide greatly improved projections of future atmospheric concentrations of CO<sub>2</sub>
5. Develop the scientific basis for societal decisions about management of CO<sub>2</sub> and the carbon cycle

# 1999 U.S. CCSP Program Elements

---

- ❑ Expanded flux network
- ❑ Airborne CO<sub>2</sub> observation program
- ❑ Global CO<sub>2</sub> monitoring network
- ❑ Global terrestrial carbon and land use inventories
- ❑ Reconstruction of historical CO<sub>2</sub> emissions
- ❑ Regional observational experiments
- ❑ Long-term terrestrial observations
- ❑ Terrestrial process studies and manipulations
- ❑ Global ocean measurements (surveys, time series, remote sensing)
- ❑ Ocean process studies and manipulations
- ❑ Modeling and synthesis

# Broad Consensus of First Workshop

---

- ❑ Significant progress had been made on many of the 1999 Plan objectives
- ❑ Revised Plan should include
  - a more explicit recognition of the fact that humans are an integral part of the carbon cycle
  - more detail concerning the research required for decision support, carbon management, and to improve prediction of the future carbon cycle.
- ❑ Scope should include the direct effects of the carbon cycle on ecosystems (e.g. ocean acidification)
- ❑ Coordinated research across disciplines is of prime importance

# Fundamental Science Questions

---

- 1999 U.S. Carbon Cycle Science Plan:
  - What has happened to the carbon dioxide that has already been emitted by human activities (past anthropogenic CO<sub>2</sub>)?
  - What will be the future atmospheric CO<sub>2</sub> concentration trajectory resulting from both past and future emissions?
- Preliminary version for new Plan:
  - What processes and feedbacks control the dynamics of atmospheric CO<sub>2</sub> and CH<sub>4</sub>?
  - What are the impacts of the changing carbon cycle (and associated changes in climate) on ecosystems?
  - How will carbon stocks and fluxes respond to policy and carbon management strategies?

# Themes to be Addressed by New Goals

---

- Understand how:
  - ocean processes
  - terrestrial biosphere processes
  - human processes
  - policies and management decisionsaffect carbon stocks and flows (CS&F)
- Monitor CS&F
- Understand how carbon cycle changes, both directly and indirectly (with climate), impact ecosystems
- Understand the uncertainty in our analyses of CS&F and the value of reducing uncertainty
- Integrate and synthesize fundamental information on CS&F
- Improve projections of future CS&F
- Understand, inform, and respond to stakeholder interests in CS&F

# Objectives for 2020

---

- ❑ Provide public with explanation for observed inter-annual variations in atmospheric CO<sub>2</sub> and CH<sub>4</sub> up to and including the present
- ❑ Design and implement an optimal carbon-cycle observation network, including socio-economic factors, that provides a baseline for scientists to evaluate trends and surprises for the next 50 years
- ❑ Quantify which processes, ecosystems, and carbon pools are most vulnerable to changes in carbon cycle and climate interactions, and large-scale disturbances
- ❑ Develop hindcast and prognostic models able to quantify carbon fluxes at a specified resolution and precision, with a rationale for defining the desired resolution and precision; and an understanding of the magnitude, role, and importance of uncertainty
- ❑ Develop observational models with the integrated assessment community that are capable of verifying regional carbon budgets and contracts, and improving climate projections at scales approaching 100 km x 100 km
- ❑ Prioritize the socio-economic, biological, and physical variables that will most determine whether the ocean and terrestrial biospheres will be a source or sink for carbon and methane in the future
- ❑ Determine efficacy of carbon management policies and technologies and their most important ecosystem consequences

# Future Timeline

---

- ❑ Spring / Summer 2009: Third meeting of CCS WG
- ❑ June 3-4, 2009: CCS WG co-leads report to CCSSG
- ❑ July 20-24, 2009: Discussion of Plan at Ocean Carbon and Biogeochemistry (OCB) annual workshop
- ❑ September 13-18, 2009: CCS WG co-leaders present draft plan at ICDC
- ❑ Fall 2009: CCS WG meeting with stakeholders
- ❑ Fall 2009: Full outline of revised U.S. CCS Plan
- ❑ Fall 2009: CCS WG Writing team appointment / meeting
- ❑ Spring / Summer 2010: Writing of the next U.S. Carbon Cycle Science Plan completed

# Is There Broad Consensus?

---

- ▣ Some points of consensus from the first workshop:
  1. A major re-framing of the 1999 Plan is not required
  2. The 1999 Plan remains sound both intellectually and structurally
  3. Considerable progress has been made on some objectives in the 1999 Plan
  4. Many questions are never fully answered so a key is to understand uncertainty and the value of reducing uncertainty
  5. Some new directions should join a list of continuing objectives (e.g. ocean acidification)
  6. Human activities are an important part of the global carbon cycle.
  7. The need is to embrace new objectives without further subdividing a static budget pie
  8. The boundaries of the global carbon cycle program are not absolute and the program needs to be responsive to and interactive with other research programs
  9. It is desirable to have broad community and stakeholder input into a new Plan

# Discussion Topics

---

- ❑ Are there research areas that were not properly addressed in the 1999 Plan? Are there new insights/directions that might get overlooked now?
- ❑ What is the proper balance between expanding the global observation networks and promoting basic carbon cycle science?
- ❑ How do we implement a better coordination of carbon cycle research and an integration of human dimensions into carbon cycle research?
- ❑ To what degree should we be addressing the issues of carbon mitigation strategies as part of this science plan?
- ❑ How do we balance an expanding scientific imperative with the likelihood that there will be minimal new money (i.e. how do we prioritize)?