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Blue Carbon: A transformational tool for marine management and conservation globally

Dr. Emily Pidgeon
Conservation International

the BLUE CARBON initiative

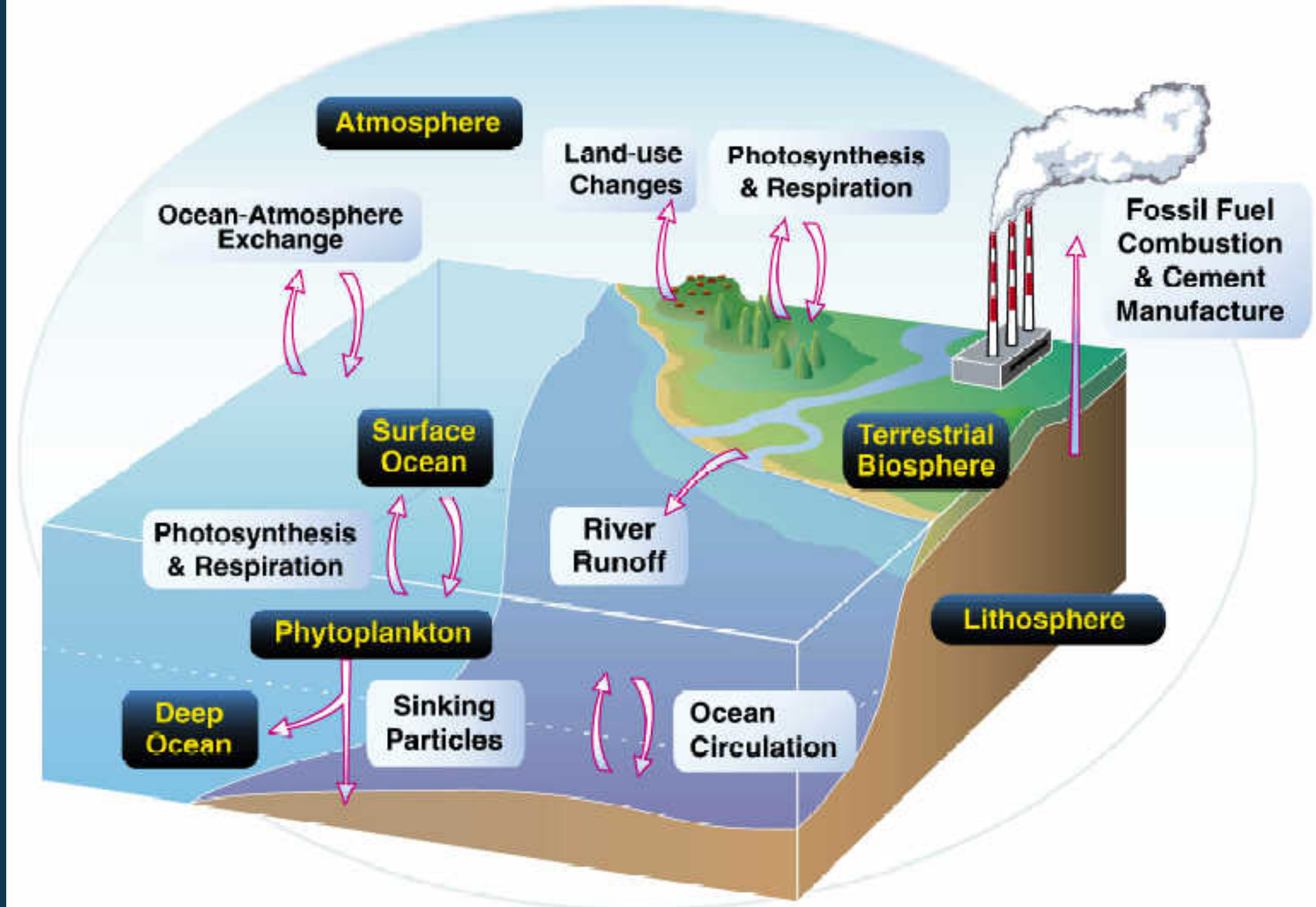
CONSERVATION INTERNATIONAL

IUCN

UNESCO
United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

The Global Carbon Cycle



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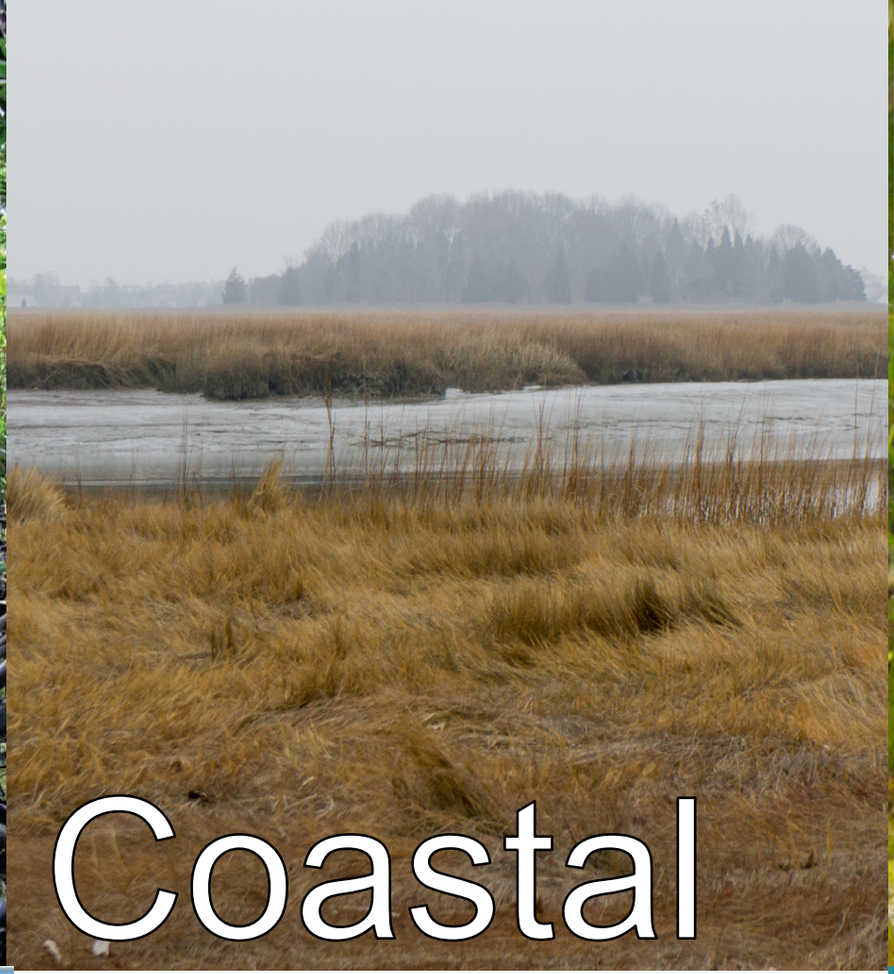
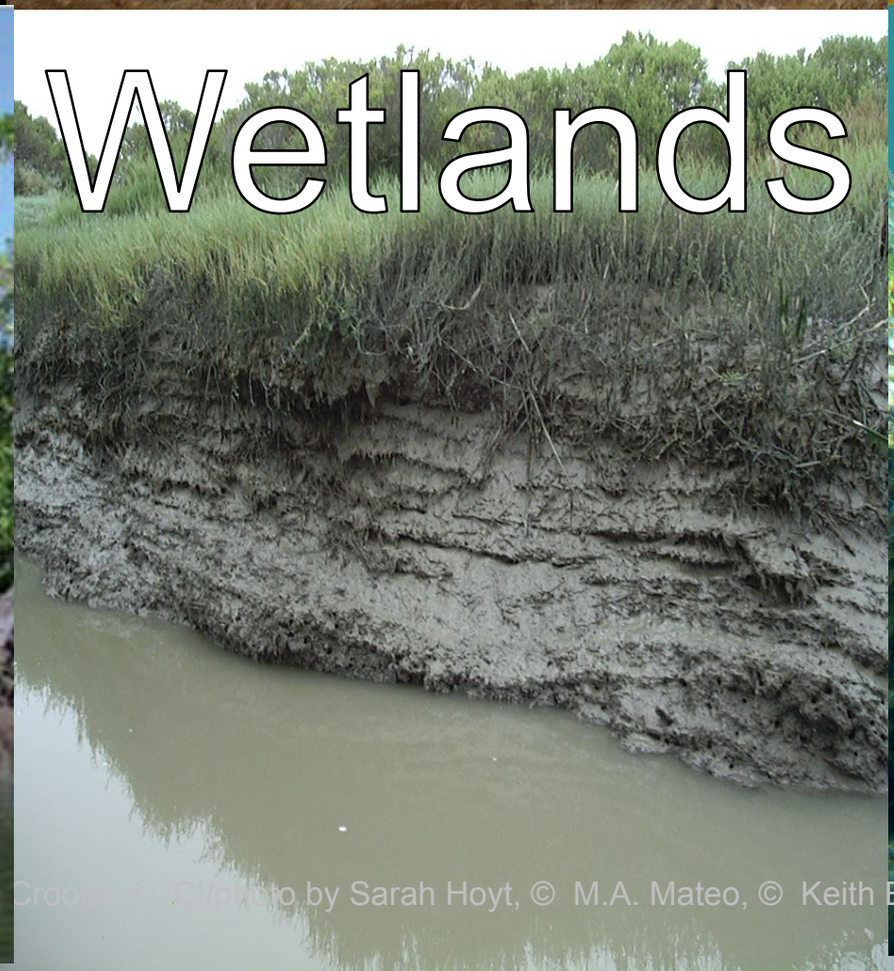
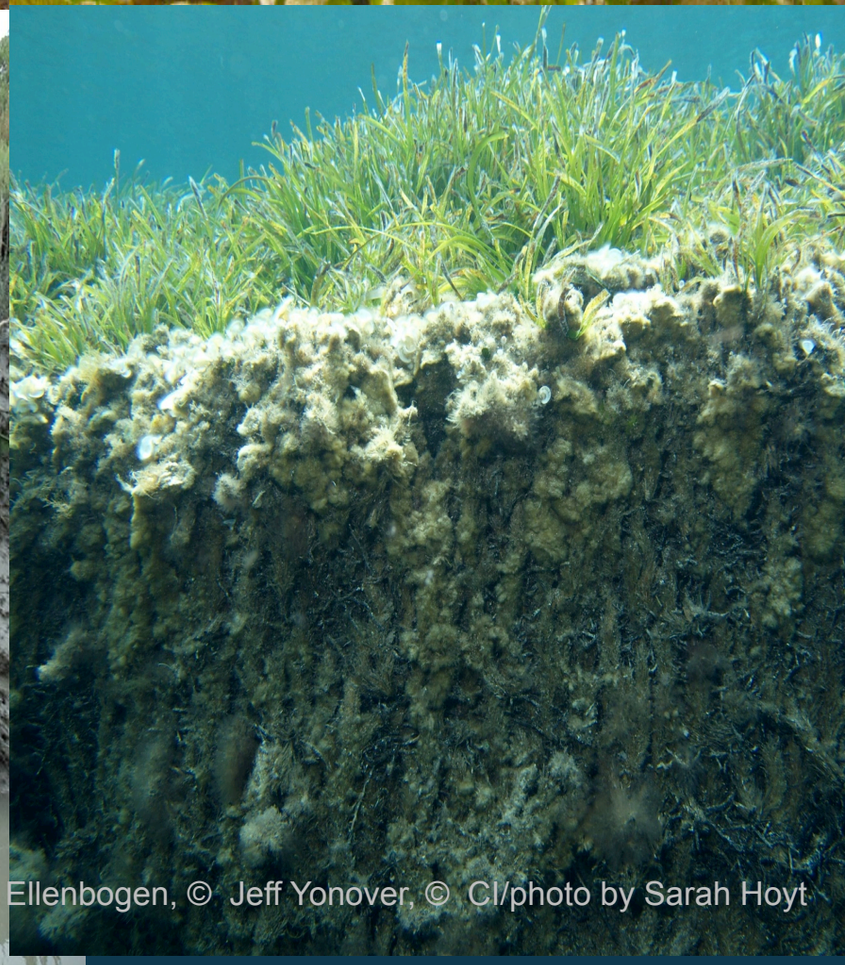


Coastal



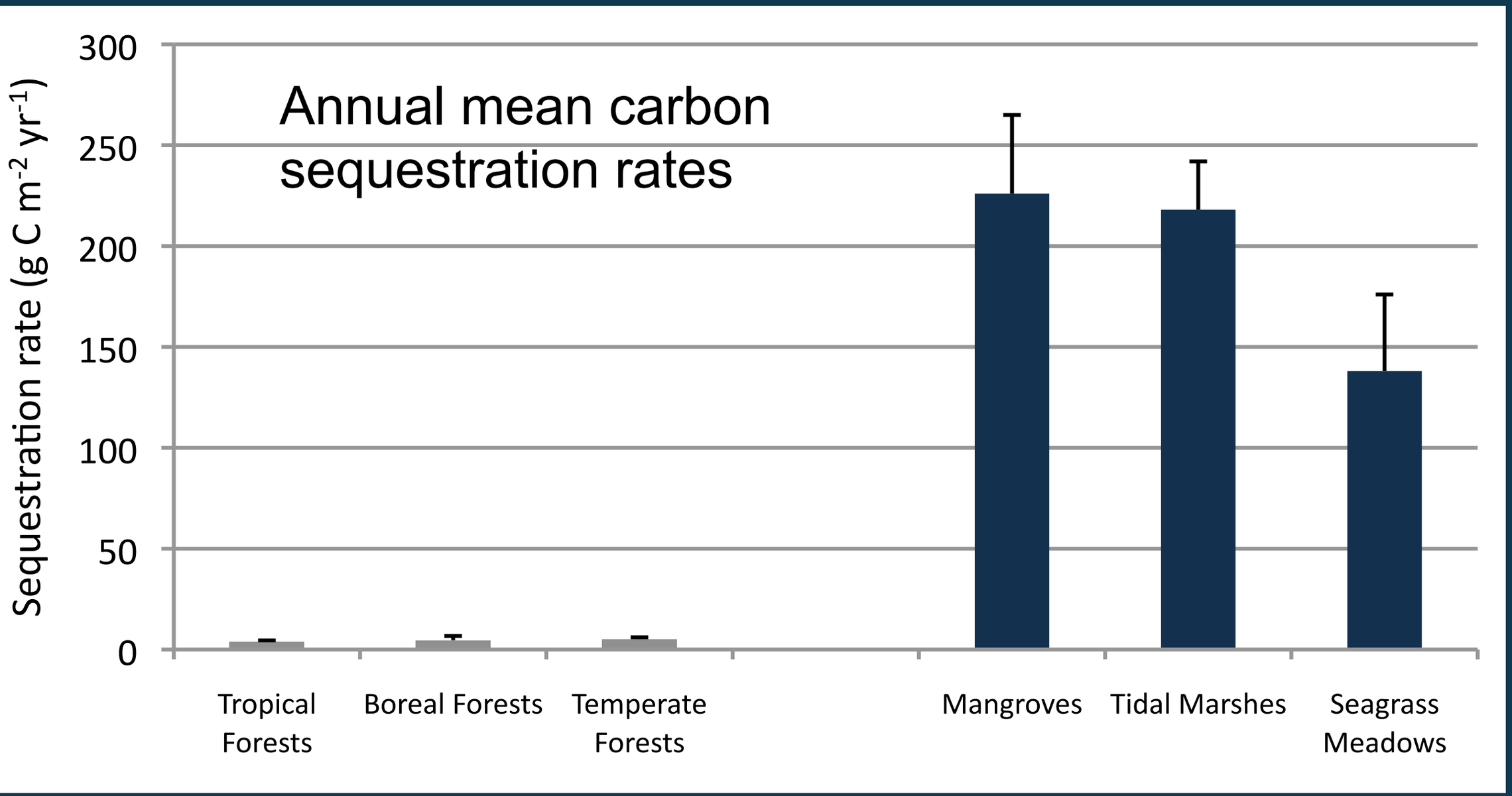
Wetlands



Coastal Ecosystems – many critical ecosystem services

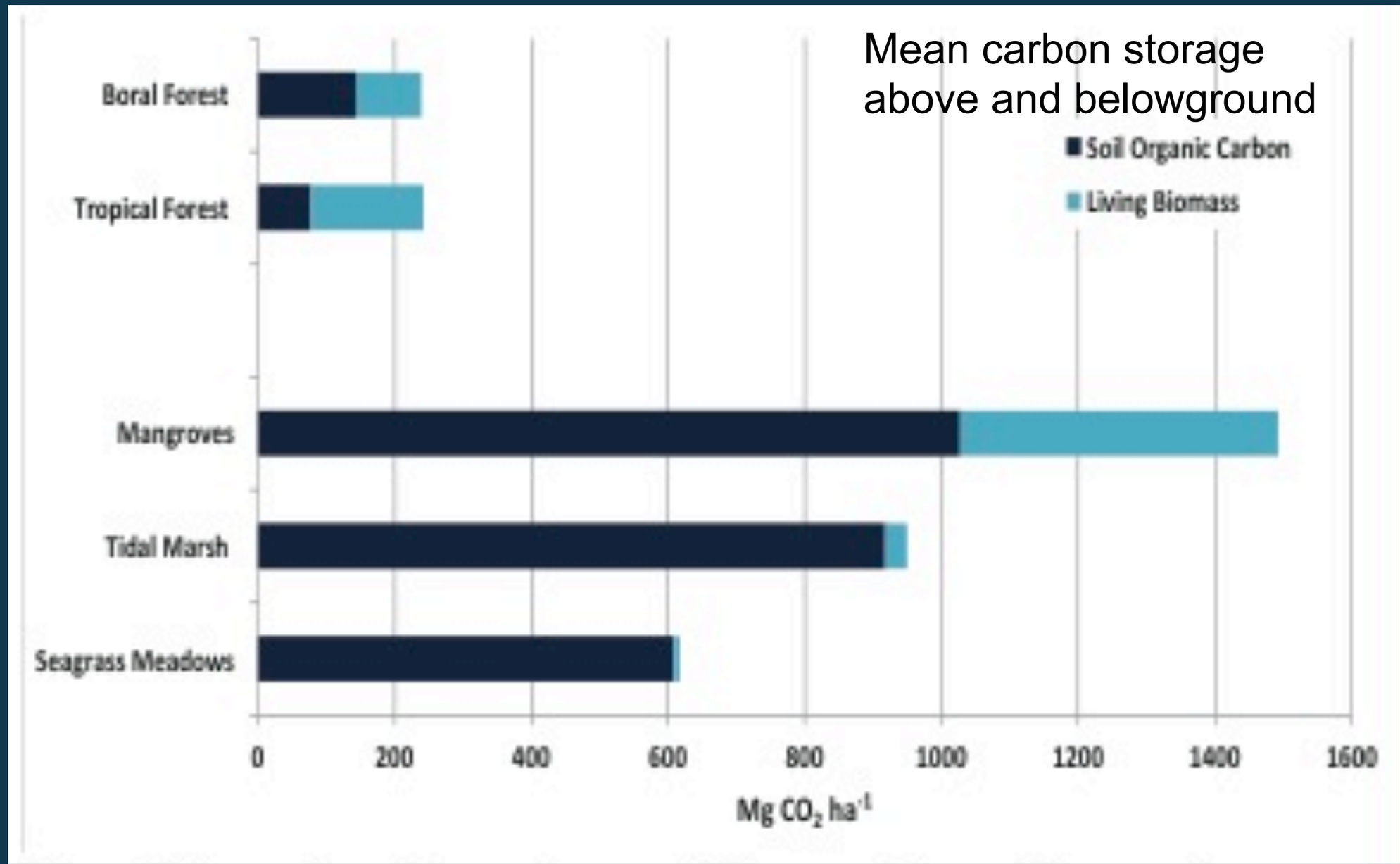
Fisheries
Coastal protection & erosion control
Coastal Water Quality
Livelihoods (tourism etc.)
Cultural value
Food
Biodiversity
Carbon sequestration and storage

Costal Ecosystems Highly Efficient at Carbon Sequestration



Modified from McLeod et al. 2011

Coastal Ecosystem Have Rich Carbon Stores



(Fourqurean et al. 2012; Pan et al. 2011; Pendleton et al. 2012)

These ecosystems are being rapidly lost

Ecosystem	Global extent (Mha)	Current conversion rate (% yr^{-1})
Mangroves	13.8-15.2 (14.5)	0.7-3.0 (1.9)
Tidal Marsh	2.2-40 (5.1)	1.0-2.0 (1.5)
Seagrass Meadows	17.7-60 (30)	0.4-2.6 (1.5)
Total	33.7-115.2 (48.9)	

(Modified from Pendleton et al. 2012).

Globally significant emissions from Coastal Ecosystems

Ecosystem	Global extent (Mha)	Current conversion rate (% yr^{-1})	Near-surface C susceptible (top meter sediment+biomass, Mg CO_2 ha^{-1})	C emissions (Pg CO_2 yr^{-1})
Mangroves	13.8-15.2 (14.5)	0.7-3.0 (1.9)	373-1492 (933)	0.09-0.45 (0.24)
Tidal Marsh	2.2-40 (5.1)	1.0-2.0 (1.5)	237-949 (593)	0.2-0.24 (0.06)
Seagrass Meadows	17.7-60 (30)	0.4-2.6 (1.5)	131-522 (326)	0.5-0.33 (0.15)
Total	33.7-115.2 (48.9)			0.15-1.02 (0.45)

For comparison:
Tropical deforestation net emissions = 4.8 Pg CO_2 y^{-1}

(Modified from Pendleton et al. 2012; Pan et al. 2011).

Can coastal “blue” carbon leverage better management, conservation and restoration of coastal ecosystems?

- Increase recognition of mitigation value
- Improve management and regulation
- Provide basis for incentives to conserve or restore

the BLUE CARBON initiative

Increased conservation, restoration and sustainable management of coastal blue carbon ecosystems

http://thebluecarboninitiative.org/

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United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

Coastal ‘Blue’ Carbon: Science to Policy and Management

International Climate Change Actions
- GHG emissions reporting
- UNFCCC mechanisms
- Funding

National Actions
- Climate Change Policy
- Other Policy

Site/Project Actions
- Financing
- Management

Synthesize the Science…..

Science International Blue Carbon Scientific Working Group

the BLUE CARBON initiative

nature geoscience
LETTERS
PUBLISHED ONLINE: 3 APRIL 2011 | DOI: 10.1038/NGEO1123

Mangroves among the most carbon-rich forests in the tropics

Daniel C. Donato[1]*, J. Boone Kauffman[2], Daniel Murdiyarso[3], Sofyan Kurnianto[3], Melanie Stidham[4] and Markku Kanninen[5]

Mangrove forests occur along ocean coastlines throughout the tropics, and support numerous ecosystem services, including fisheries production

Overlooked in this discussion are mangrove forests, which occur along the coasts of most major oceans in 118 countries, adding

extent of mangrove
past half century a
culture expansion a
resulting from man
a lack of broad-sca
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quantified whole-ec
and dead wood bion
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region—spanning 3
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we estimate that ma
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just 0.7% of tropical

Deforestation and
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agreements highlight
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Tropical wetland
organic soils up to se
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disproportionate im
climate change has re
peat fires associated
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fossil fuel emissions
specifically address
change mitigation str

[1]USDA Forest Service, P
Mast Rd., Durham, New
[4]USDA Forest Service, I
Resources Institute (VIT

nature geoscience
ARTICLES
PUBLISHED ONLINE: 20 MAY 2012 | DOI: 10.1038/NGEO1477

Seagrass ecosystems as a globally significant carbon stock

James W. Fourqurean[1]*, Carlos M. Duarte[2,3], Hilary Kennedy[4], Núria Marbà[2], Marianne Holmer[5], Miguel Angel Mateo[6], Eugenia T. Apostolaki[7], Gary A. Kendrick[3,8], Dorte Krause-Jensen[9], Karen J. McGlathery[10] and Oscar Serrano[6]

The protection of organic carbon stored in forests is considered as an important method for mitigating climate change. Like terrestrial ecosystems, coastal ecosystems store large amounts of carbon, and there are initiatives to protect these 'blue carbon' stores. Organic carbon stocks in tidal salt marshes and mangroves have been estimated, but uncertainties in the stores of seagrass meadows—some of the most productive ecosystems on Earth—hinder the application of marine carbon conservation schemes. Here, we compile published and unpublished measurements of the organic carbon content of living seagrass biomass and underlying soils in 946 distinct seagrass meadows across the globe. Using only data from sites for which full inventories exist, we estimate that, globally, seagrass ecosystems could store as much as 19.9 Pg organic carbon; according

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REVIEWS REVIEWS REVIEWS

A blueprint for blue carbon: t improved understanding of t vegetated coastal habitats in s

Elizabeth Mcleod[1*], Gail L Chmura[2], Steven Bouillon[3], Rodney Salm[1], M
Catherine E Lovelock[7], William H Schlesinger[8], and Brian R Silliman[9]

Recent research has highlighted the valuable role that coastal and m
bon dioxide (CO_2). The carbon (C) sequestered in vegetated coastal
seagrass beds, and salt marshes, has been termed "blue carbon". Alth
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- Despite th ecosystems disproport when com
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- These "blu action is urgently required to prevent further degradation and loss
- Improved scientific understanding of the factors that influence carbon sequestration in these ecosystems is needed to identify sites that are high priorities for restoration and/or conservation management

[1]*The Nature Conservancy, Honolulu, HI* *(emcleod@tnc.org);

mechanism by
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OPEN ACCESS Freely available online
PLOS | ONE

Estimating Global "Blue Carbon" Emissions from Conversion and Degradation of Vegetated Coastal Ecosystems

Linwood Pendleton[1☯], Daniel C. Donato[2*☯], Brian C. Murray[1], Stephen Crooks[3], W. Aaron Jenkins[1], Samantha Sifleet[4], Christopher Craft[5], James W. Fourqurean[6], J. Boone Kauffman[7], Núria Marbà[8], Patrick Megonigal[9], Emily Pidgeon[10], Dorothee Herr[11], David Gordon[1], Alexis Baldera[12]

1 Nicholas Institute for Environmental Policy Solutions, Duke University, Durham, North Carolina, United States of America, **2** Ecosystem & Landscape Ecology Lab, University of Wisconsin, Madison, Wisconsin, United States of America, **3** ESA Phillip Williams & Associates, San Francisco, California, United States of America, **4** United States Environmental Protection Agency, Research Triangle Park, North Carolina, United States of America, **5** School of Public and Environmental Affairs, Indiana University, Bloomington, Indiana, United States of America, **6** Department of Biological Sciences and Southeast Environmental Research Center, Florida International University, North

er for
Spain,
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study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: Appointment funding for one author (SC) comes from ESA Phillip Williams & Associates, a commercial source. This does not alter the authors' adherence to all the PLoS ONE policies on sharing data and materials.

* E-mail: ddonato@wisc.edu

☯ These authors contributed equally to this work.

Introduction

tidal marshes, mangroves, and seagrass beds. These coastal carbon stocks are increasingly referred to as "blue carbon" [2,3]. The

How much carbon? Where? What are the potential emissions?

Outreach & Communication

United Nations Framework Convention on Climate Change (UNFCCC)

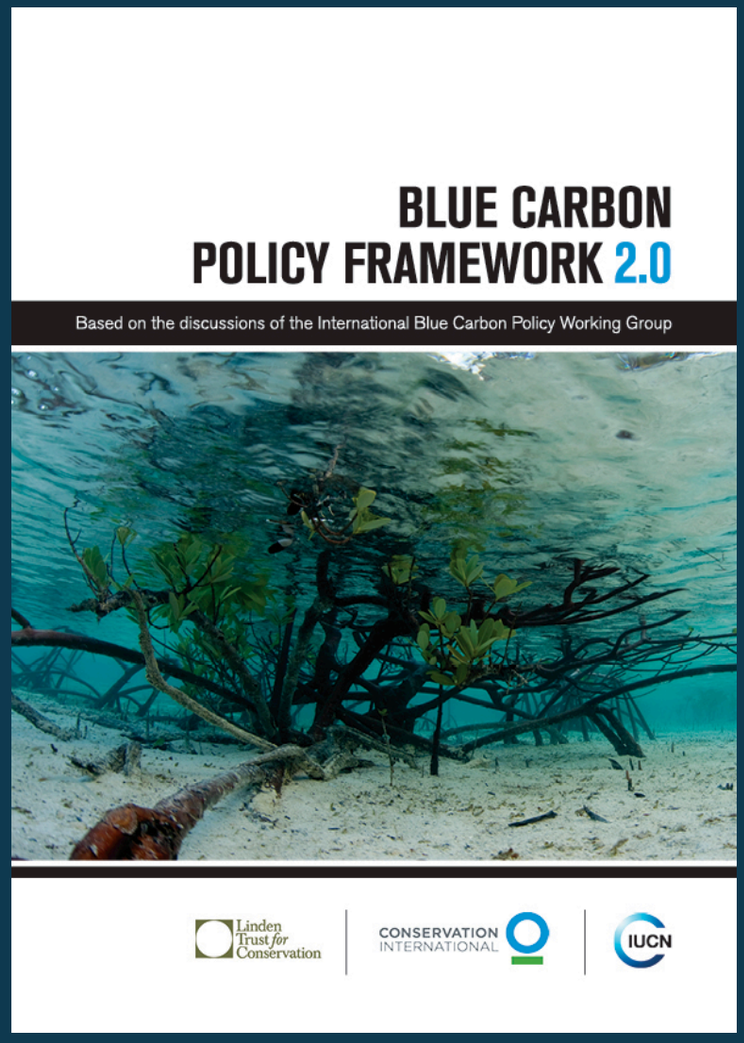
"stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (1992)

Overarching framework for other treaties or protocols (e.g. Kyoto Protocol, Bali Action Plan……)

How to integrate coastal ecosystems?

International Blue Carbon Policy Working Group

- Provide guidance for blue carbon policy development
- Build integrated blue carbon community



2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands

Chapter 4
Coastal Wetlands

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Coastal Ecosystems in UNFCCC mechanisms

Nationally Appropriate Mitigation Actions (NAMAs)

- Measurable, reportable and verifiable nationally appropriate mitigation commitments or actions
- Funding through multi-/bilateral initiatives providing fast-start finance
- *Coastal Carbon projects should be eligible*

Reducing emissions from deforestation and forest degradation (REDD)

- Mechanism for recognizing the climate mitigation value of forest management within developing countries
- Climate mitigation value must be measured, monitored and verified
- Numerous funding sources support readiness activities including improving data on carbon content and drivers of deforestation and degradation
- *Mangrove systems are eligible (generally)*

Climate Change Mitigation Funding

Funds exclusively supporting REDD+ (USD millions)

Fund / Initiative	Pledged	Deposited	Approved	Disbursed	No of projects approved
Amazon Fund	1032.44	102.79	168.71	45.94	33
Forest Carbon Partnership Facility - Carbon Fund (FCPF-CF)	218.3	138.1	0.57	0.2	1
Forest Carbon Partnership Facility - Readiness Fund (FCPF-RF)	239.4	212.59	31.03	11.46	27
Forest Investment Program (FIP)	612	446	50.96	3.59	24
Norway International Climate and Forest Initiative (ICFI)	1,607.82	1,607.82	533.21	276.44	13
UN-REDD	151.49	118.89	116.13	97.93	18
Australia's International Forest Carbon Initiative (IFCI)	216.27	67.06	125.54	31.7	9
Congo Basin Forest Fund (CBFF)	165	165	95.38	18.59	37

Schalatek et al 2012

Nationally Appropriate Mitigation Actions (NAMA) Facility
- Initial funding $100 million (UK and Germany)

Green Climate – 2020 Fundraising Goal
- $100 billion per year

UNFCCC recognition of coastal ecosystems

October 2013 Workshop

"Ecosystems with High-Carbon Reservoirs Not Covered by Other Agenda Items under the Convention"

- Current scientific knowledge sufficient to include coastal systems in UNFCCC efforts
- Support developing countries to include coastal systems in GHG inventories

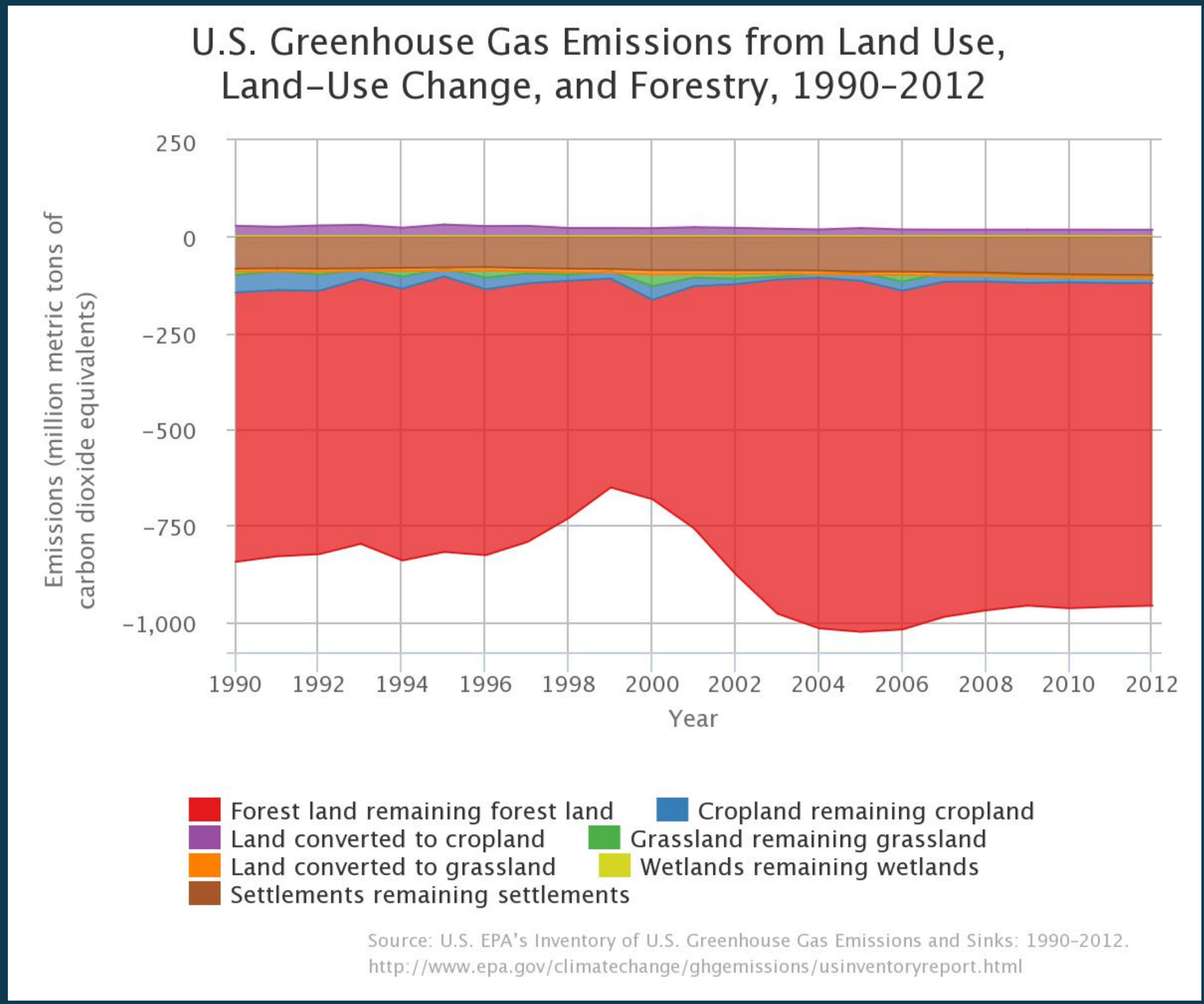
December 2014

- Endorsed IPCC guidelines on GHG accounting in wetlands

June 2014

- General Recognition of mangroves in REDD
- Increasing recognition of coastal ecosystems generally

US EPA - inclusion of wetlands in National GHG inventories



Coastal Management, 41:439–456, 2013

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DOI: 10.1080/08920753.2013.822294

Taylor & Francis
Taylor & Francis Group

Considering "Coastal Carbon" in Existing U.S. Federal Statutes and Policies

LINWOOD H. PENDLETON,[1,2] ARIANA E. SUTTON-GRIER,[2] DAVID R. GORDON,[1] BRIAN C. MURRAY,[1] BRITTA E. VICTOR,[1] ROGER B. GRIFFIS,[2] JEN A.V. LECHUGA,[2] AND CHANDRA GIRI[3]

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[2]The National Oceanic and Atmospheric Administration, Silver Spring, Maryland, USA
[3]U.S. Geological Survey, USGS Earth Resources Observation and Science (EROS) Center, Sioux Falls, South Dakota, USA

Coastal ecosystems such as mangroves, salt marshes, and seagrasses provide important ecosystem services, including nursery habitat for fish, shoreline protection, and the recently recognized service of carbon sequestration and storage. When these wetland ecosystems are degraded or destroyed, the carbon can be released to the atmosphere, where it adds to the concentration of greenhouses gases (GHGs) that contribute to climate change. Many federal statutes and policies specifically require that impacts on ecosystem services be considered in policy implementation. Yet, no federal statute, regulation, or policy accounts directly for the carbon held in coastal habitats. There are a number of federal statutes and policies for which coastal carbon ecosystem services could reasonably be added to environmental and ecosystem considerations already implemented. We look at a subset of these statutes and policies to illustrate how coastal carbon ecosystem services and values might affect the implementation and outcomes of such statutes generally. We identify key steps for the inclusion of the ecosystem services of coastal habitats into the implementation of existing federal policies without statutory changes; doing so would increase the degree to which these policies consider the full economic and ecological impacts of policy actions.

Both Pendleton and Sutton-Grier contributed equally to this article.

This article was only possible with the help of many individuals at several federal agencies who provided their expertise via interviews. The following individuals provided extensive time and insight in support of this analysis. Their contributions to this article do not indicate any action or recommended action by any federal agency. Inclusion on this list only recognizes contribution of facts regarding federal statutes and policies and does not imply individual or agency approval of any of the recommendations listed in this article. Aileen Smith, NOAA; Charley Chesnutt, U.S. Army Corps of Engineers; Dwight Trueblood, NOAA; Marie Bundy, NOAA; Steve Kokkinakis, NOAA; Robyn Colosimo, U.S. Army Corps of Engineers; Peter Edwards, NOAA; Carolyn Currin, NOAA; Alison Leschen, Waquoit Bay National Estuary Research Reserve; Tibor Vegh, The Nicholas Institute for Environmental Policy Solutions, Duke University. We also thank Megan Jungwiwattanaporn for her help formatting the article. The ideas and opinions contained in this article represent those of the authors and not those of the National Oceanic and Atmospheric Administration.

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National Environmental Policy Act

Includes a mandate to consider impacts on coastal habitats and **ecosystem services in planning federal actions**

Clean Water Act

Requires compensatory mitigation for unavoidable impacts

Impacts to carbon stores not currently considered

Coastal Zone Management Act

Programs could consider including carbon

Priority Agenda

Enhancing the Climate Resilience of America's Natural Resources

COUNCIL ON CLIMATE PREPAREDNESS AND RESILIENCE

Prepared by the

COUNCIL ON CLIMATE PREPAREDNESS AND RESILIENCE CLIMATE AND NATURAL RESOURCES WORKING GROUP

The Departments of Defense, Interior, and Agriculture, the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, the Federal Emergency Management Agency, and the U.S. Army Corps of Engineers.

OCTOBER 2014

Key Themes and Commitments Moving Forward:

This *Agenda* identifies four priority strategies to make the Nation's natural resources more resilient to a changing climate. For each strategy, the *Agenda* documents significant progress and provides a roadmap for action moving forward. Highlights of the key actions agencies will undertake in the near term to implement each of the four strategies are described below and in Table 1.

1. Foster climate-resilient lands and waters – Protect important landscapes and develop the science, planning, tools, and practices to sustain and enhance the resilience of the Nation's natural resources.

Key actions include the development of a Resilience Index[1] to measure the progress of restoration and conservation actions and other new or expanded resilience tools to support climate-smart natural resource management. Agencies will identify and prioritize landscape-scale conservation opportunities for building resilience; fight the introduction and spread of invasive species; and partner internationally to promote resilience within the Arctic. Throughout, agencies will evaluate resilience efforts to inform future actions.

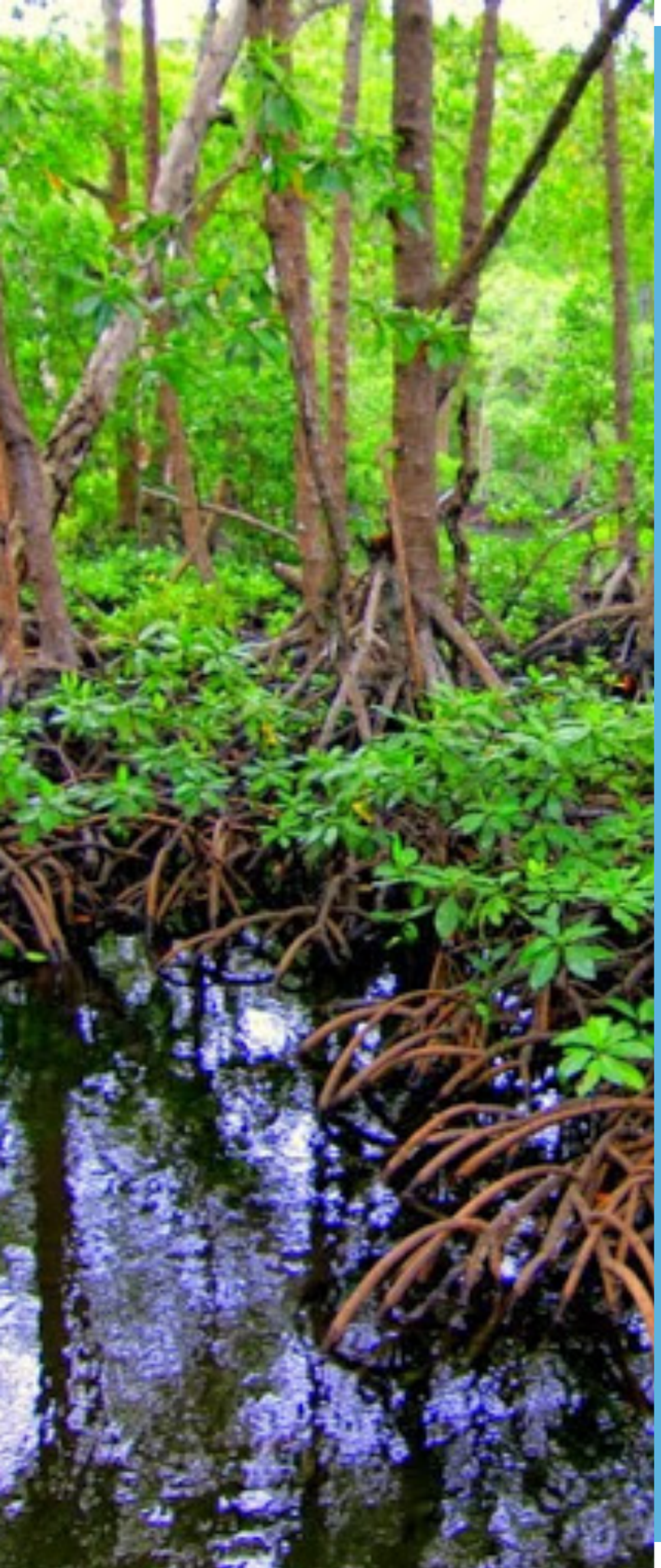
2. Manage and enhance U.S. carbon sinks – Conserve and restore soils, forests, grasslands, wetlands, and coastal areas that store carbon. Maintain and increase the capacity of these areas to provide vital ecosystem services alongside carbon storage such as clean air and water, wildlife habitat, food, fiber, and recreation.

Key actions include the development of improved inventory, assessment, projection and monitoring systems for important carbon sinks and the development of estimates of baseline carbon stocks and trends to inform resource management. A number of actions will secure the continued health of the Nation's natural resources that provide carbon biosequestration, including forests, agricultural lands, and inland and coastal wetlands.

3. Enhance community preparedness and resilience by utilizing and sustaining natural resources – Harness the benefits of nature to protect communities from harm and build innovative 21st century infrastructure that integrates natural systems into community development.

Federal agencies will take action to encourage investment in natural infrastructure to improve resilience and enhance natural defenses through new federal guidance on ecosystem services assessment, an actionable research agenda, rigorous program evaluation, and expanded decision support tools and services. Federal agencies will increase assistance to states, tribes and localities interested in pursuing green stormwater management solutions and will expand partnerships that reduce wildfire risk and protect critical drinking water supplies, promote irrigation efficiency and water efficiency,

1 See page 19.



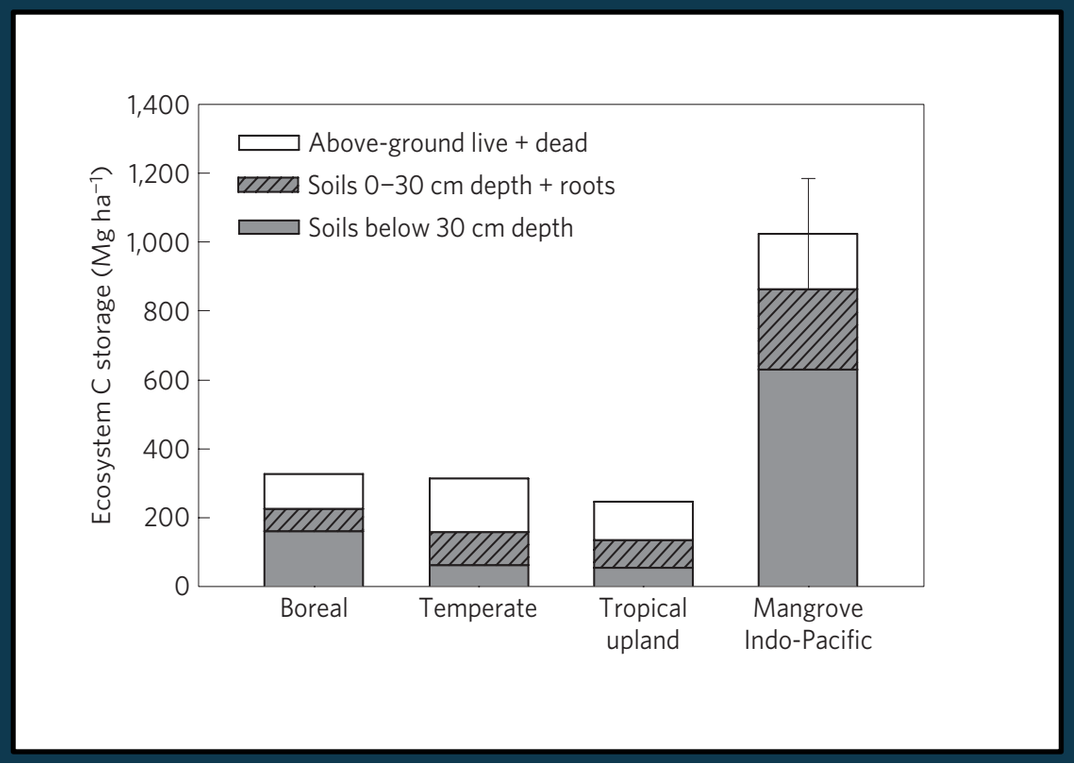
Indonesia – Richest Coastal Carbon Country?

Mangrove Cover

SN	Country	Area (ha)	% of global total
1	Indonesia	3,112,989	22.6
2	Australia	977,975	7.1
3	Brazil	962,683	7.0
4	Mexico	741,917	5.4

Giri et al (2011)

2000 - 2005 Rate of loss: 50 000 ha/year (1.6%) (FAO 2007)



Donato et al (2011)

Indonesia – National Activities

Indonesia National Science Plan of Action on Blue Carbon (Jan 2014)

Expanding science program (domestic and international)

Indonesian National Council on Climate Change

The National GHG emissions scheme under development, will include coastal carbon

Ministry of Marine Affairs and Fisheries

Blue Carbon is an official activity

Not included in National GHG inventories….

Australia

CSIRO Coastal Carbon Cluster

Blue Carbon Field Projects

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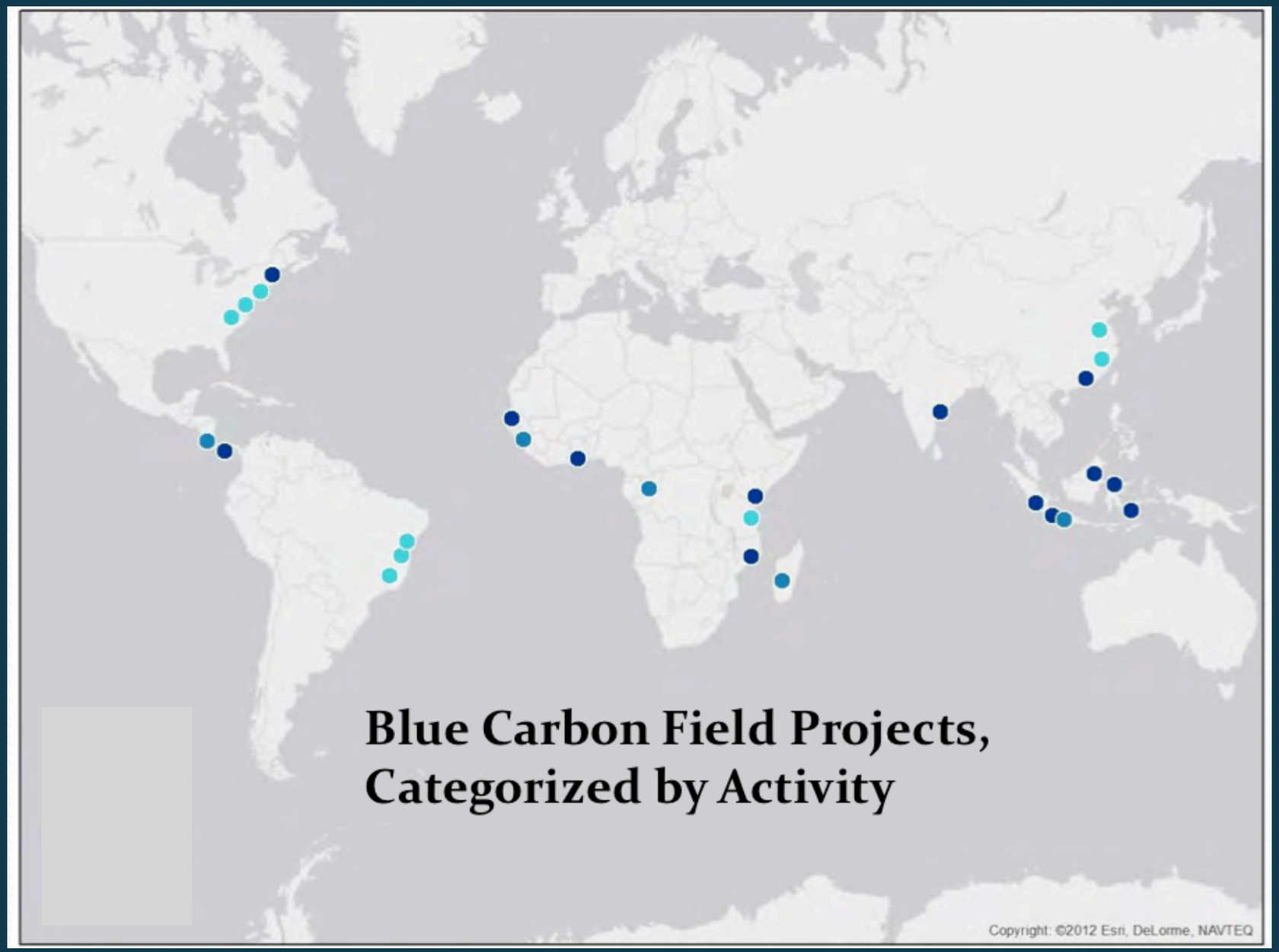
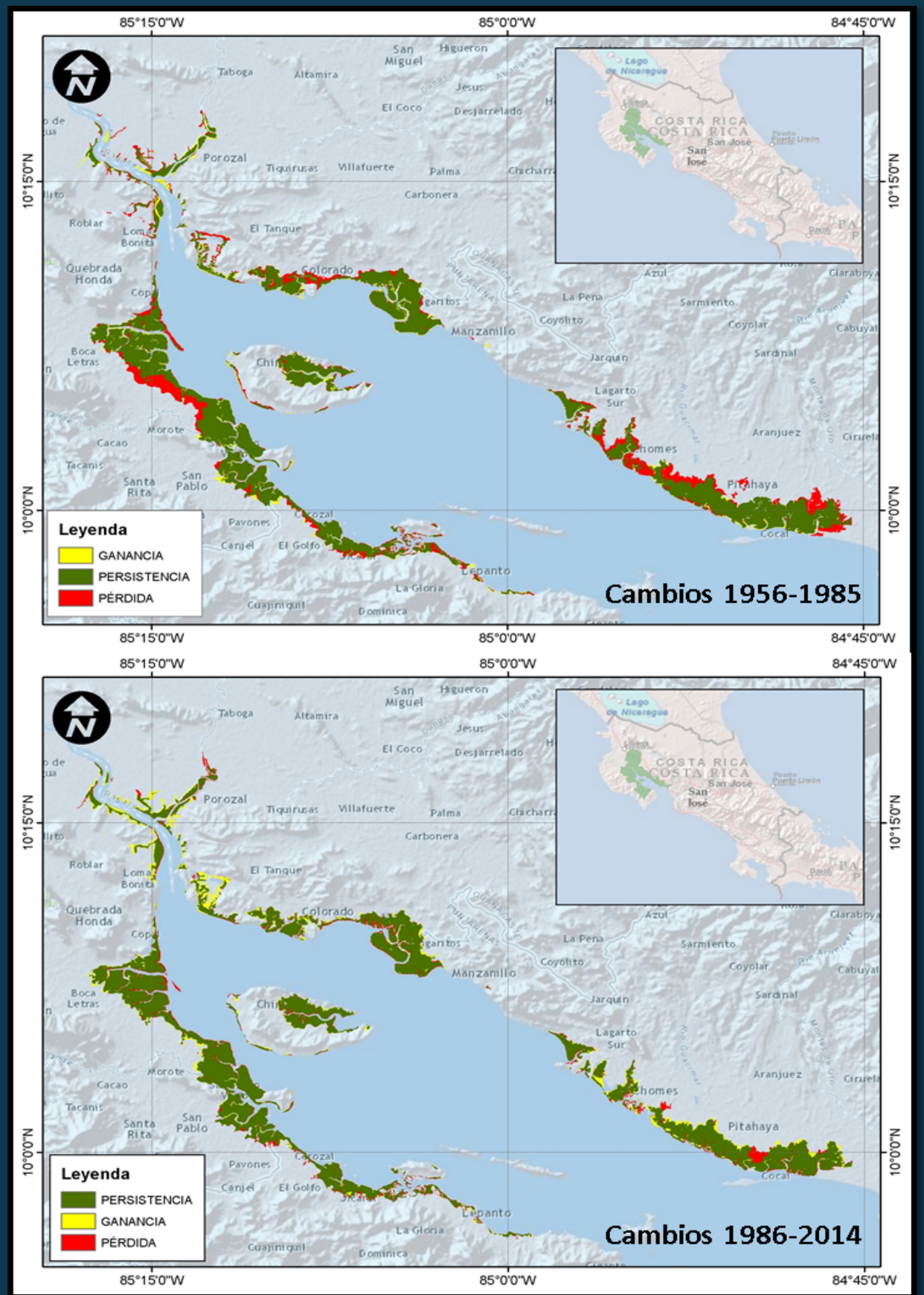


Gulf of Nicoya - Costa Rica

CONSERVATION INTERNATIONAL

Develop and support policy and management that conserves and promotes sustainable use of the mangroves.



Gulf of Nicoya

Since 1950

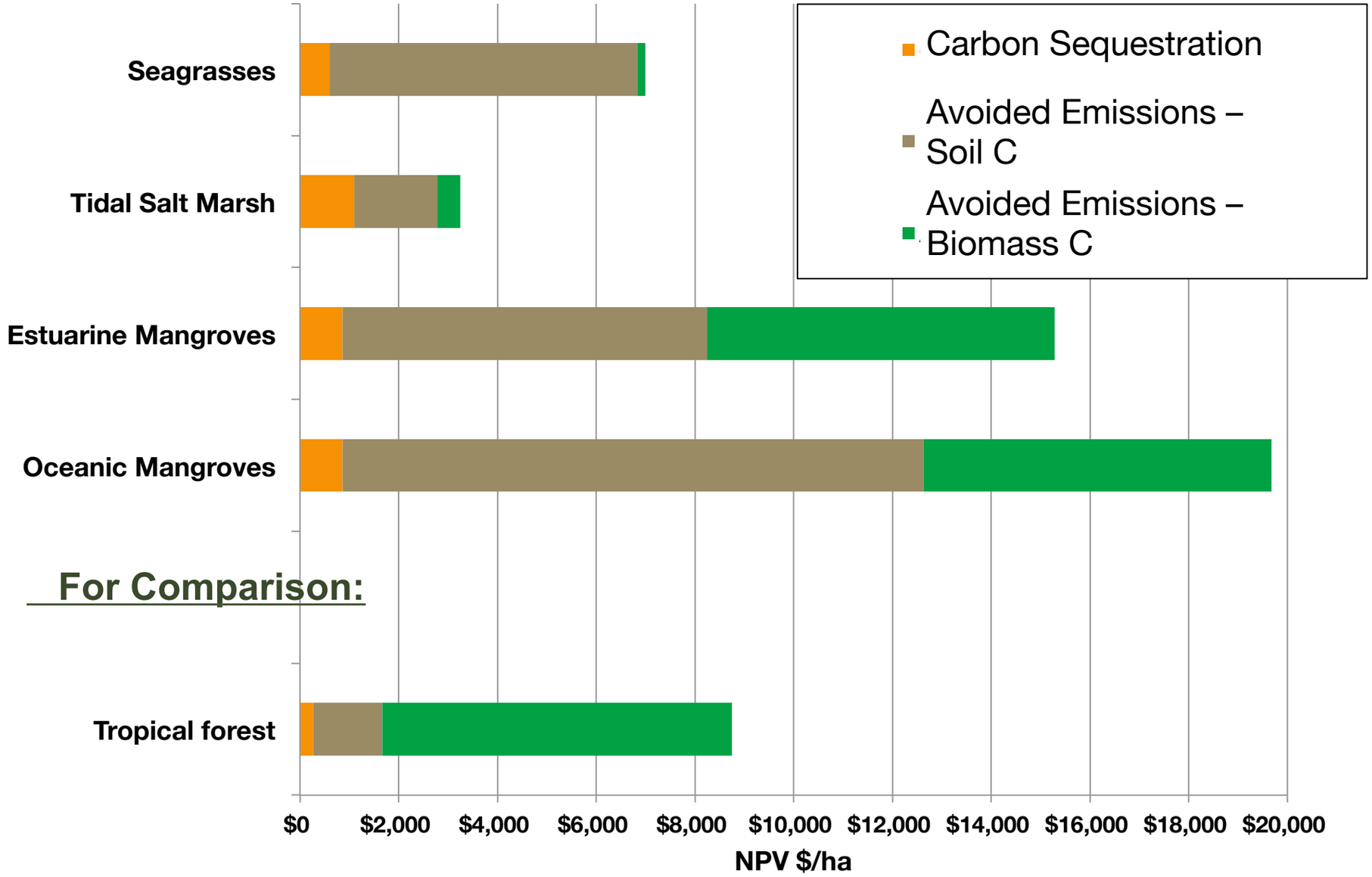
- 16% loss of mangroves,
- 2.2 million tonnes of CO2 (eq) emissions

Project:

- Mangrove restoration and conservation
- Sustainable management
- Community Education

(Cifuentes, personal comm)

Potential Carbon-Credit Values



For Comparison:

Carbon Markets

To be able to submit carbon project to a carbon registry:

1. Develop Project
2. Project Validation (Does the project follow the rules of the registry?)
3. Project monitoring and carbon credit verification
4. Issuance of carbon credits

Wetlands Projects need:

Standardized Methodologies for Carbon Accounting in wetlands:

- Restoration Projects
- Conservation Projects

RESTORE AMERICA'S ESTUARIES

VCS | VERIFIED CARBON STANDARD

A Global Benchmark for Carbon

VCS VERIFIED CARBON STANDARD
A Global Benchmark for Carbon

THE VCS PROJECT DATABASE

Search For Projects

Keyword Name, ID, or Proponent

Country

All
Argentina
Australia
Belize
Bolivia

Sectoral Scope

10. Fugitive emissions from fuels
11. Fugitive emissions from industrial
12. Solvents use
13. Waste handling and disposal
14. Agriculture, Forestry, Land Use

SEARCH

Project Search Results

CSV TXT PDF

Project ID	Project Name	Project Proponent	Country	Sectoral Scope	Estimated Annual Emission Reductions	Additional Certifications
961	'El Arriero ' Afforestation on degraded grasslands under extensive grazing project	El Arriero' S.A.	Uruguay	14. Agriculture, Forestry, Land Use	18271	
959	'Guanaré' Forest Plantations on degraded grasslands under extensive grazing	Guanaré SA	Uruguay	14. Agriculture, Forestry, Land Use	127416	
960	"Weyerhaeuser Uruguay" Forest Plantations on degraded grasslands under extensive grazing	Weyerhaeuser Uruguay	Uruguay	14. Agriculture, Forestry, Land Use	56019	
981	ADPML PORTEL-PARA REDD PROJECT	Avoided Deforestation Project (Manaus) Limited ("A	Brazil	14. Agriculture, Forestry, Land Use	482845	
872	Afognak Forest Carbon Project	MULTIPLE PROJECT PROPONENTS	United States	14. Agriculture, Forestry, Land Use	40451	

What Policy Needs Now……

Global and local scale mapping of mangroves, salt marshes, seagrasses

- extent
- carbon
- monitoring

Emissions from healthy and degraded systems

- measurements
- Models (carbon change, ecosystem shifts…)
- Estimates of storage and emissions from priority regions (Indonesia …)

Globally accessible, quality controlled, Coastal Carbon Data Archive

Seagrasses!

- Distribution, carbon estimates, rates of loss, monitoring techniques…….

Standards and methodologies for carbon accounting, emissions estimates

Thank you

Dr. Emily Pidgeon
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http://thebluecarboninitiative.org/

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the BLUE CARBON initiative