Incorporating Blue Carbon Ecosystem Services into the Blue Economy and National Accounting

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IORA INDIAN OCEAN BLUE CARBON HUB

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Overview

- What are Blue Carbon Ecosystems and why are they important?
- Blue Carbon Ecosystems in national accounts
- Australia's progress in incorporating Blue Carbon
- Other ecosystem Services provided by Blue Carbon Ecosystems
- Measurement Challenges and Opportunities
- Summary and Outlook

Blue Carbon or Coastal Vegetated Ecosystems


Tidal marsh


Mangroves


Seagrass

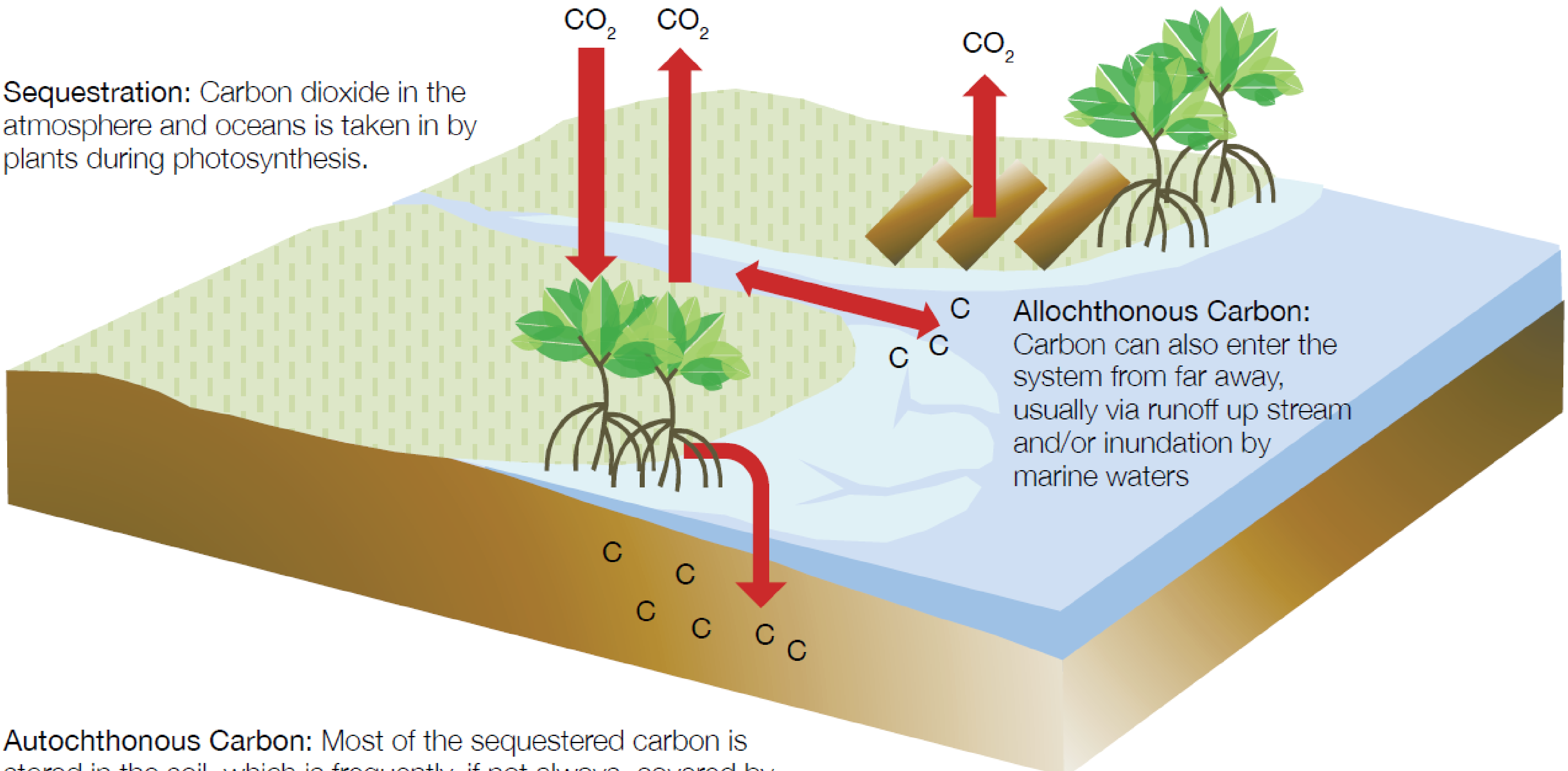
Blue Carbon: What it looks like and why it is Important?

- Blue carbon ecosystems are extensive and have high sequestration rates
- IPCCC models show that emissions reduction and avoidance not enough and sequestration is required
- B.C ecosystems provide multiple ecosystem services and support livelihoods
- B.C are threatened globally by development.
- Degradation of B.C. ecosystems could lead to significant **emissions** of carbon

Key Terms in Blue Carbon

Emissions: Carbon is lost back to the atmosphere through respiration or through oxidation as a result of land-use change (e.g., conversion to fish ponds)

Sequestration: Carbon dioxide in the atmosphere and oceans is taken in by plants during photosynthesis.

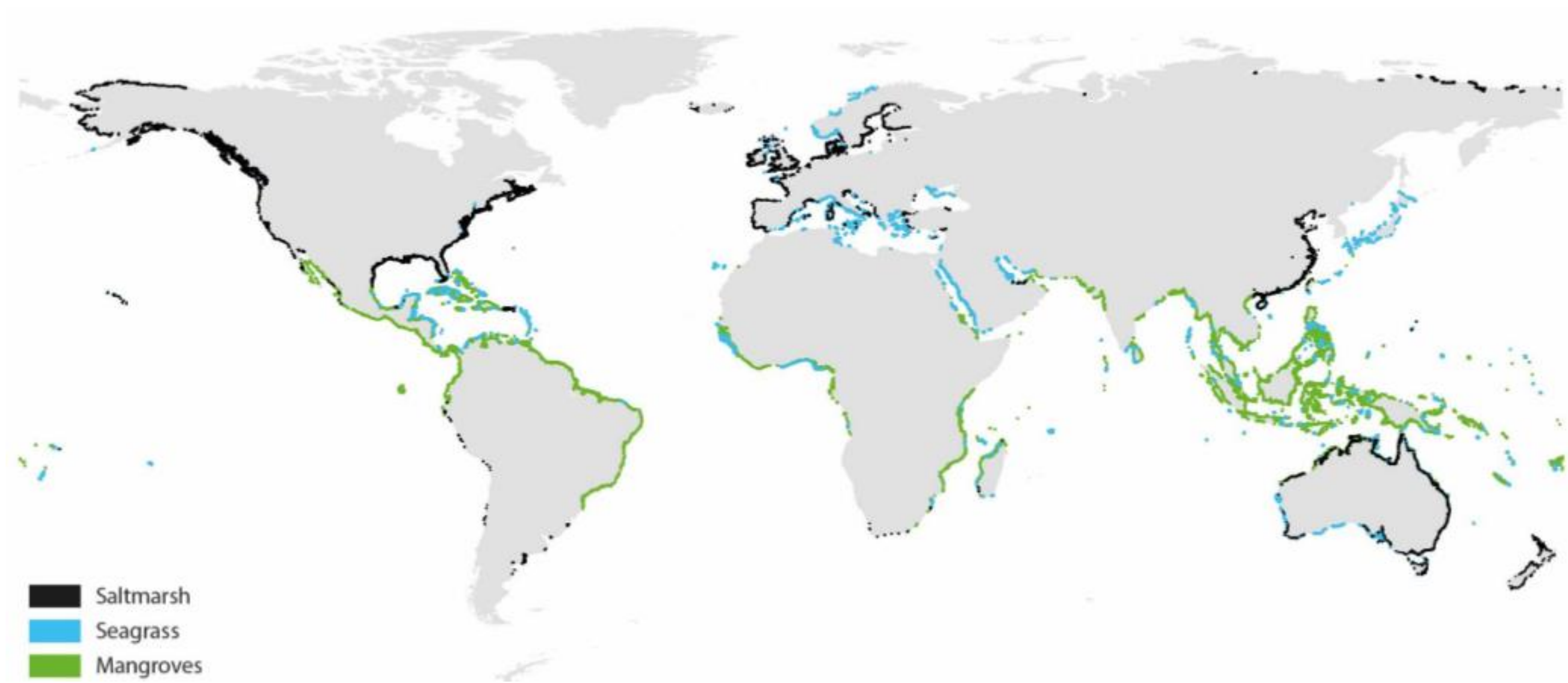


Allochthonous Carbon: Carbon can also enter the system from far away, usually via runoff up stream and/or inundation by marine waters

Autochthonous Carbon: Most of the sequestered carbon is stored in the soil, which is frequently, if not always, covered by tidal waters. This oxygen-poor environment causes plant minerals to break down very slowly, resulting in significant carbon storage.

Source: Conservation International (2013)

Blue Carbon extent and Rates of Change

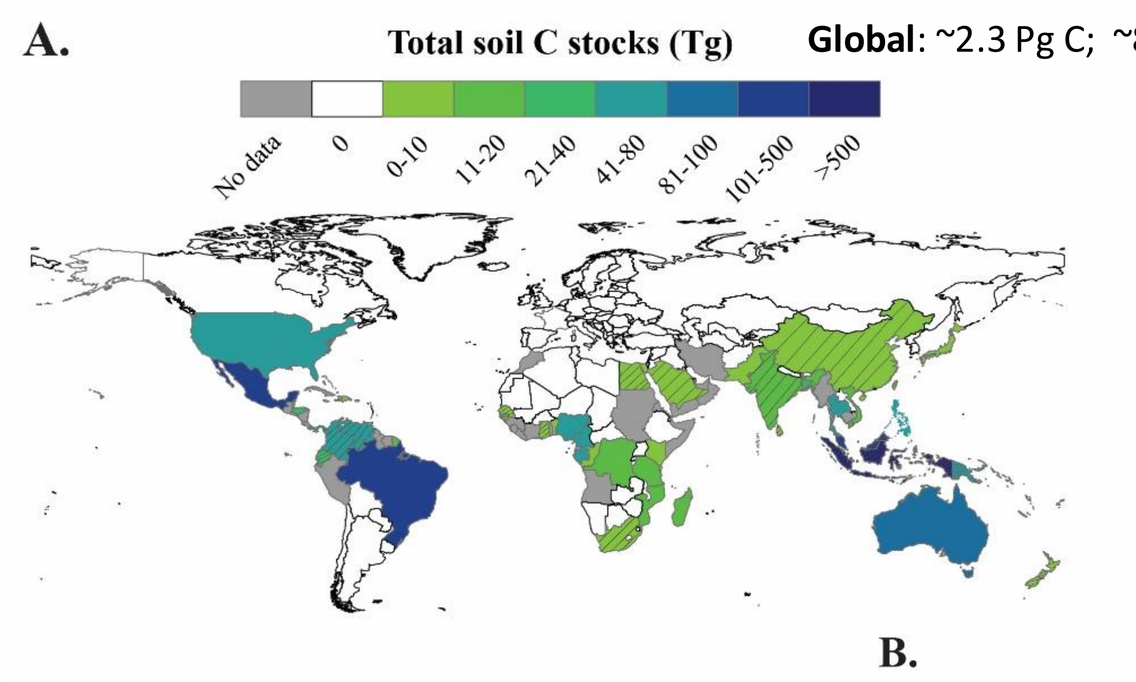


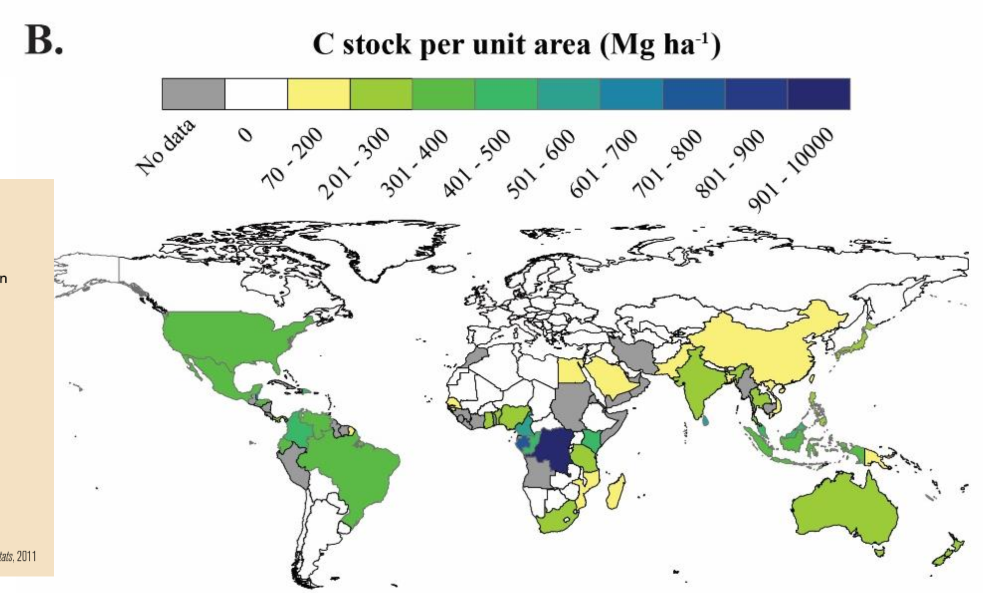
Global Extents (km^2)

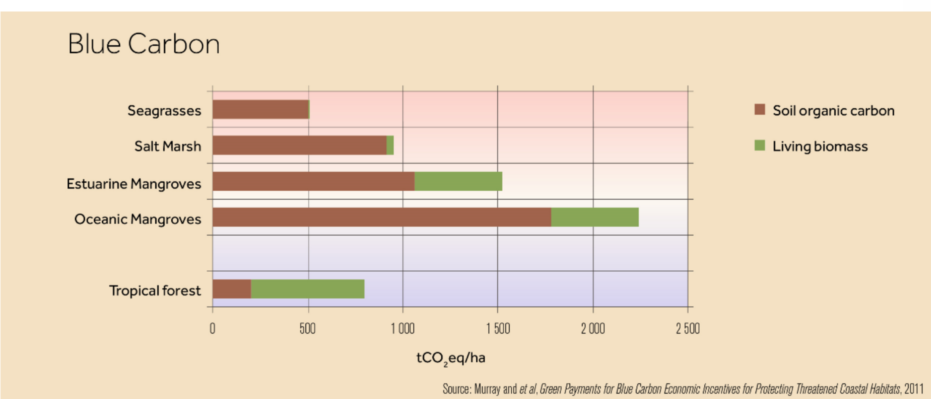
Mangroves	137,000
Saltmarsh	55,000
Seagrass	325,000
Tide Flats	128,000

Global Soil C stocks and Sequestration Rates

Global: ~2.3 Pg C; ~8.4 Pg CO_2





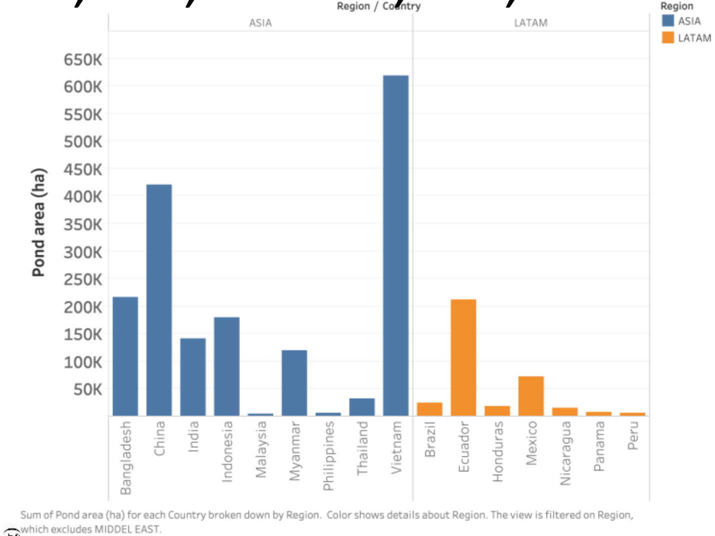


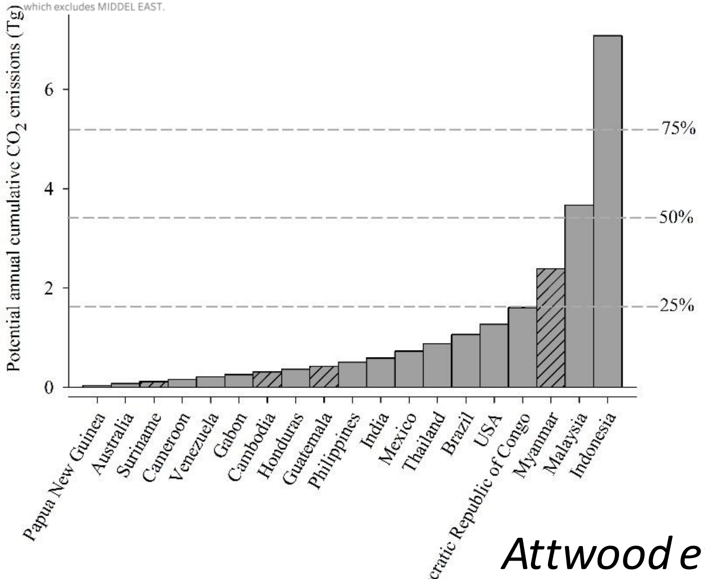
Source: *Atwood et al al in 2017. Nature Climate Change*

Loss of Mangrove and Potential CO_2 Emissions

Global Shrimp Pond Area:

1,750,000 – 2,250,000 ha



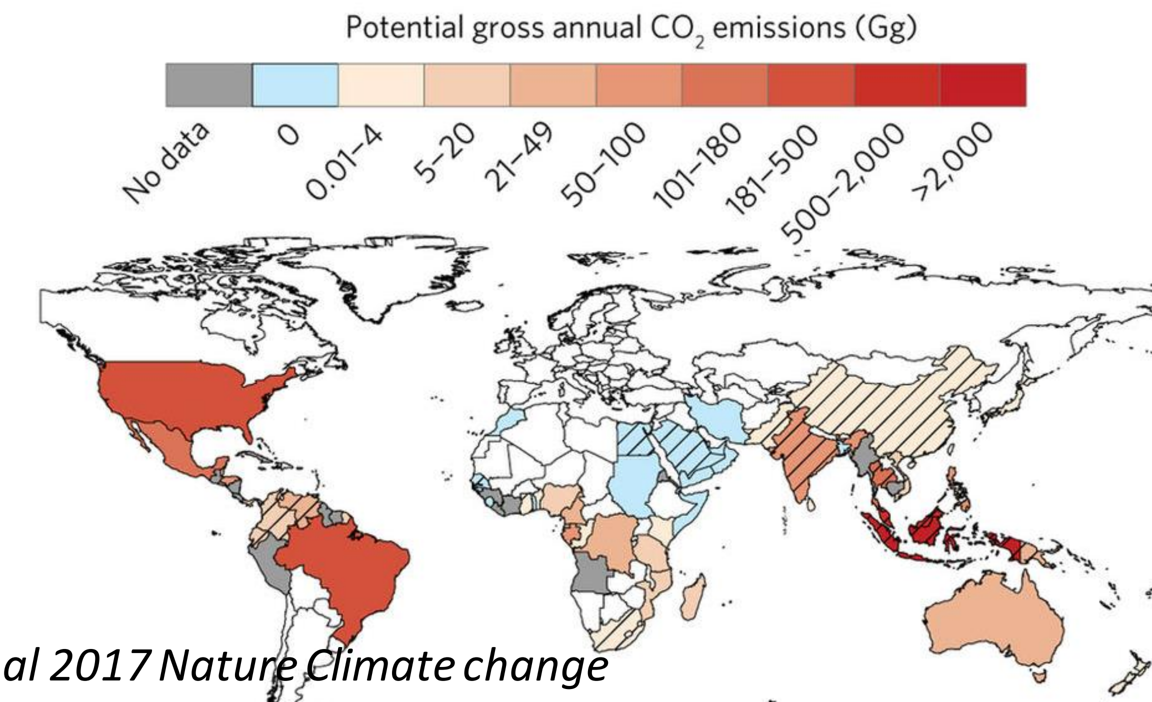


Annual Loss of Mangroves

- 0.26–0.66%
- >50% due to shrimp Pond conversion
- Less now than 90s

Potential Global Emissions:

~4.09 Tg OC yr^{-1} ; ~15 Tg of CO_2



Attwood et al 2017 Nature Climate change

Accounting and Financing of Blue Carbon

Most crediting schemes reward the owner for activities that will:

1. **Avoid emissions occurring**

   e.g. conservation of an area

2. **Enhance sequestration of carbon**

   e.g. restoring or creating new seagrass habitat

Regulatory markets

- mandatory or compliance based
- implemented to ensure adherence to regulations intended to reduce GHG
- Many forms:
  - Emissions Trading Schemes,
  - Other carbon taxes

Voluntary markets

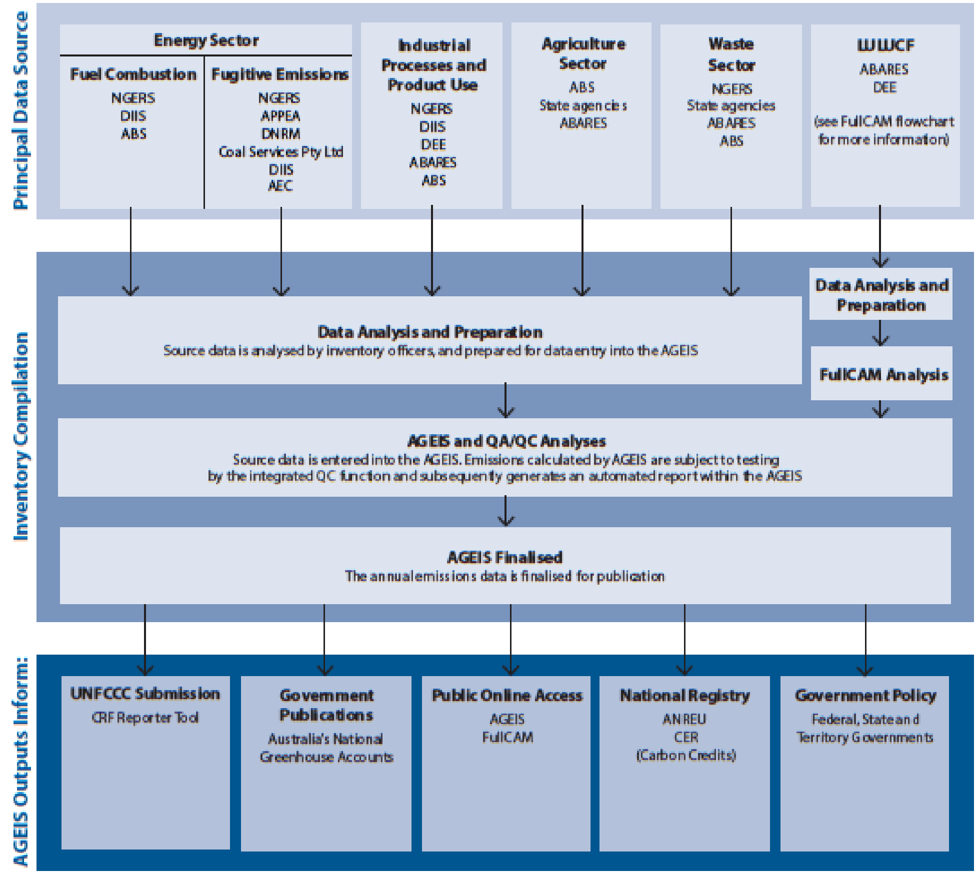
- seek to generate a broader suite of social or environmental benefits
- Payments for Services
  - a suite of benefits intended to arise from the broad overarching objective of ecosystem restoration or protection or Ecosystem Services

Policies, Programs Partnerships & Financing

Conventions	**UNFCCC** • REDD • NAMA • CDM	**CBD** Wetland biodiversity and conservation activities	**Ramsar** Wetland biodiversity and conservation activities
(1) Convention Specific Funds	LDCF SCCF FA Climate Change Adaptation Fund, Green Climate Fund	GEF FA Biodiversity FA Int. Waters Other FAs	Small Grants Fund Wetland for the Future Initiative Swiss Grant for Africa
(2) National Funds	National climate funds	National biodiv./environmental funds ODA	
(3) Other Funds	Multilateral development banks' climate funds	Multilateral development banks' biod funds	
(4) Other non-Market Mechanisms	Philanthropy		
	Debt swap/relief and conversion initiatives		
(5) Market Mechanisms	Voluntary Carbon Market Regulated Carbon Market		PES Disaster and climate risk sharing and insurance

National Emission Inventories -Greenhouse Accounts

- Under Paris Agreement mitigation actions formulated by the country **Nationally Determined Contribution (NDCs**).
- Countries prepare an inventory report according to the framework of rules under UNFCCC and the Kyoto Protocol.
- Emissions and removals are reported under six sectors defined by the IPCC:
    1. Energy
    2. Industrial processes and product use
    3. Agriculture
    4. Waste
    5. **Land use, land use change and forestry (LULUCF)**

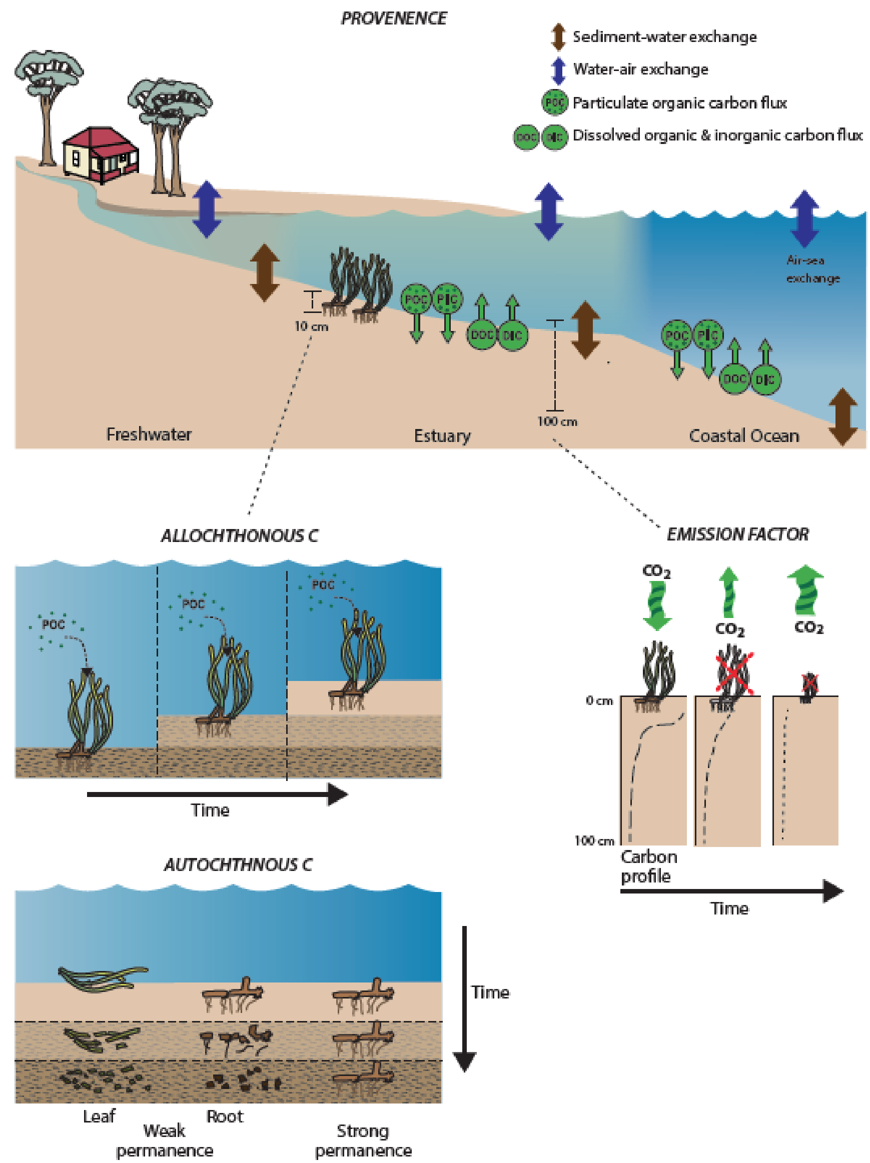


Climate mitigation efforts in coastal environments being incorporated or considered by several countries mainly in LULUC sector

Key Policy Concepts

Emission factor: portion of the remineralised carbon lost to the atmosphere after BC habitat is degraded or destroyed

- Establishing emission factors require new carbon accounting protocols
- Historical evidence of lost habitat can provide an opportunity to estimate seagrass emission factors



Permanence" of the carbon sequestered must be estimated and the risk of the loss must be minimised.
Carbon sinks must pass a 'permanency' test (e.g. 100 years in REDD) in order to qualify for carbon crediting systems

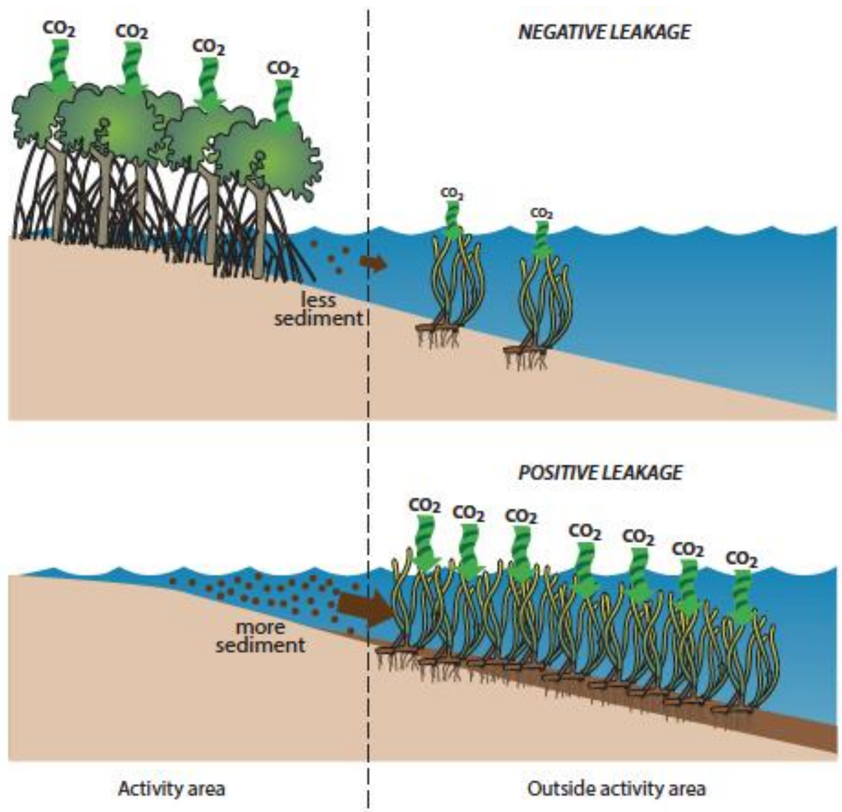
Key Policy Concepts

Additionality: requirement that the sequestration of carbon must be "in addition" to what would occur without offsets or policy action.

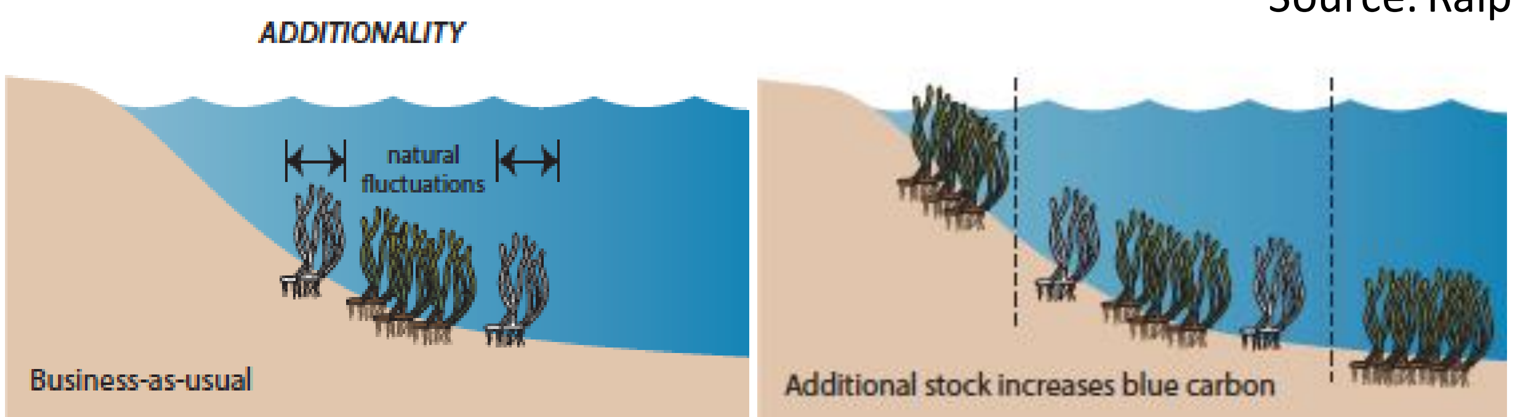
- must be greater than the business-as-usual scenario for the country

Leakage: occurs when activities within a project's accounting boundary affect regions outside of that boundary, and cause a change in the emissions of those external environments.

- often unanticipated and difficult to quantify, particularly in hydrologically-connected coastal ecosystems



Source: Ralph et al 2018



The Emissions Reduction Fund

Australian Government
Clean Energy Regulator

EMISSIONS REDUCTION FUND

- Australian Govt method of crediting reductions in emissions
- Direct Action' approach – rewards action that result in reduced CO_2-e emissions
- Public fund, ~AUD $2.55 billion AUD to fund low-cost carbon abatement projects in multiple sectors selected through reverse auctions.
- The first five auctions secured 189 million tonnes of emissions reductions at an average price of $11.83 per tonne.

Offsets integrity standards

The Emissions Reduction Assurance Committee must be satisfied each offset integrity standard has been met for a method to be made by the Minister.

Is the activity beyond business as usual?
Is the abatement unlikely to occur in the ordinary course of events?

Can the emissions reductions be measured and verified?
Can estimates be accurately measured and are they capable of being verified?

Is the abatement eligible?
Does the method align with Australia's greenhouse gas inventory approaches and international reporting obligations?

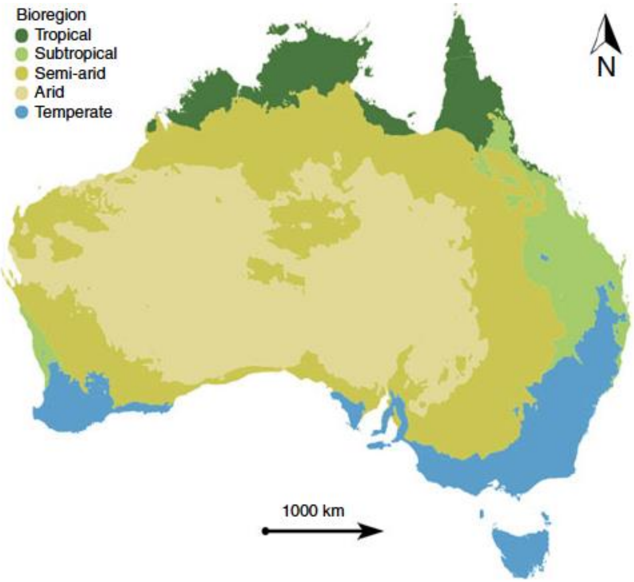
Is it supported by evidence?
Is the method supported by clear and convincing evidence?

Are material emissions from the activity deducted?
Are emissions that would occur as a result of the activity deducted when working out the estimated abatement from the project?

Are the estimates conservative?
Is there evidence to demonstrate estimates, projections and assumptions are conservative?

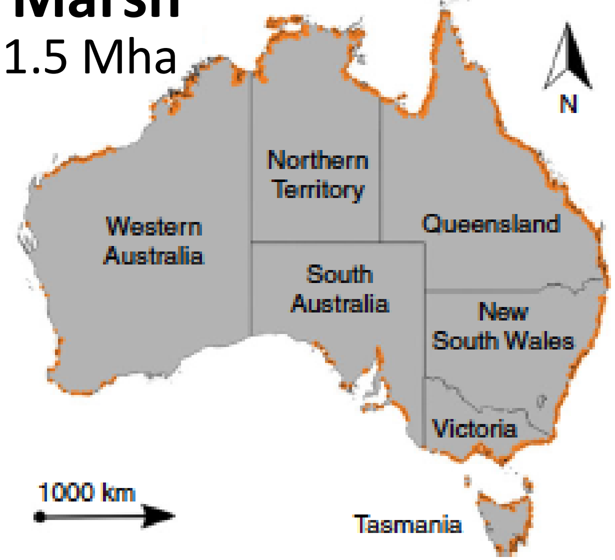
Australia's Vegetated Coastal Ecosystems are Globally Significant

Climate Regions



Tide Marsh

1.4 – 1.5 Mha

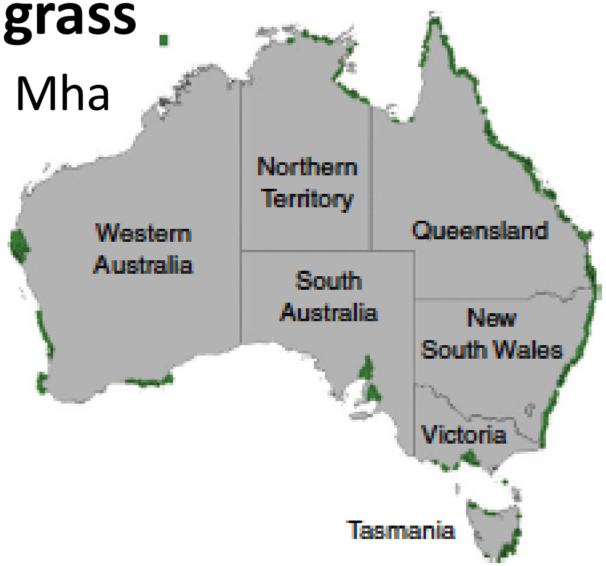


9–32% Global VCE Extent

11–15 M ha

Seagrass

9–13 Mha



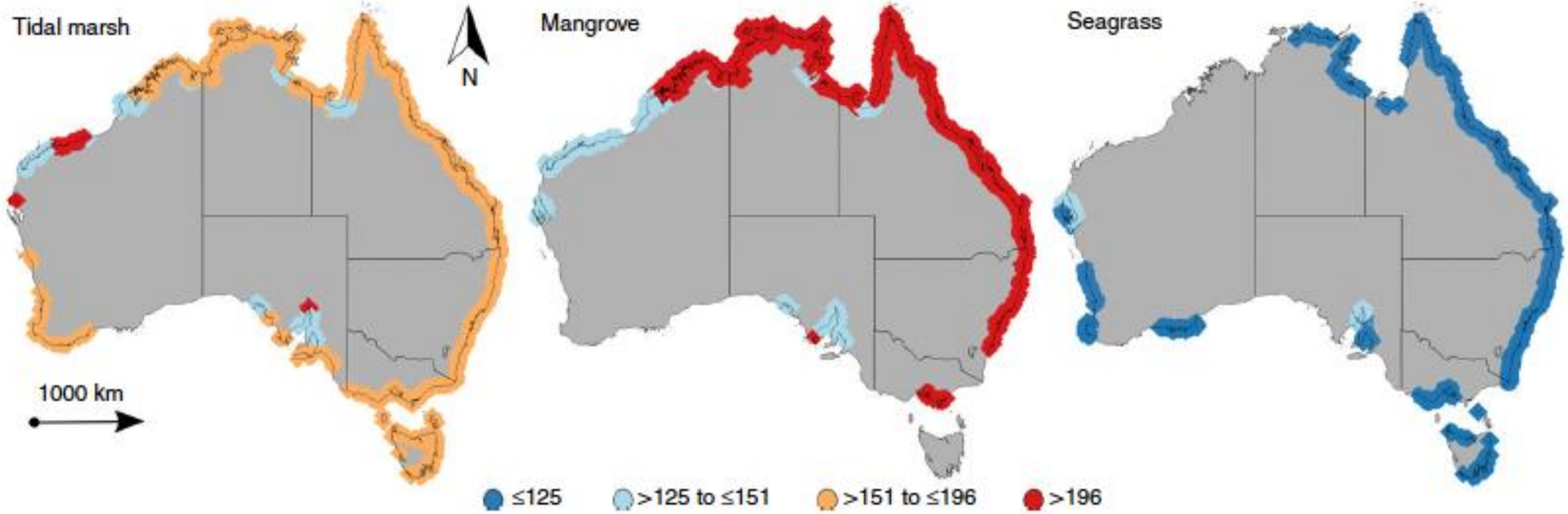
Mangrove

1.1 Mha

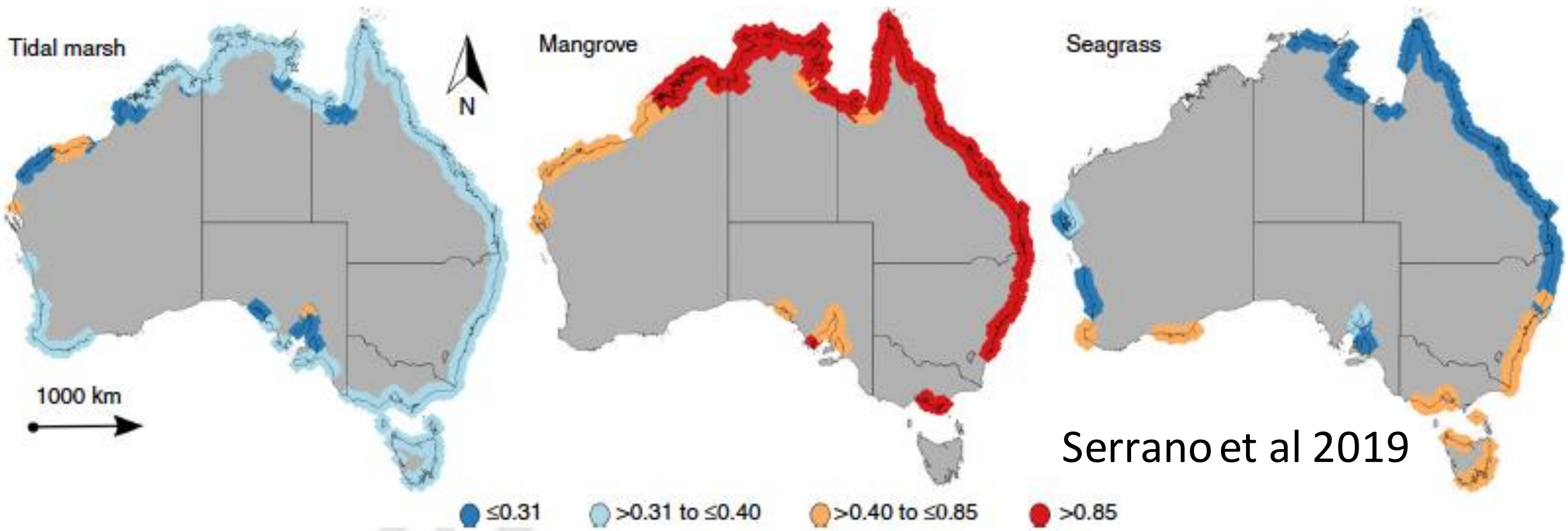
Serrano et al 2019

Australia-wide stocks and Sequestration Rates

Soil C stock (Mg C ha^{-1})



Soil C sequestration rate (Mg C ha^{-1} yr^{-1})



Serrano et al 2019

Key Findings

- Australia contributes 5-11% of the C stored in VCE globally

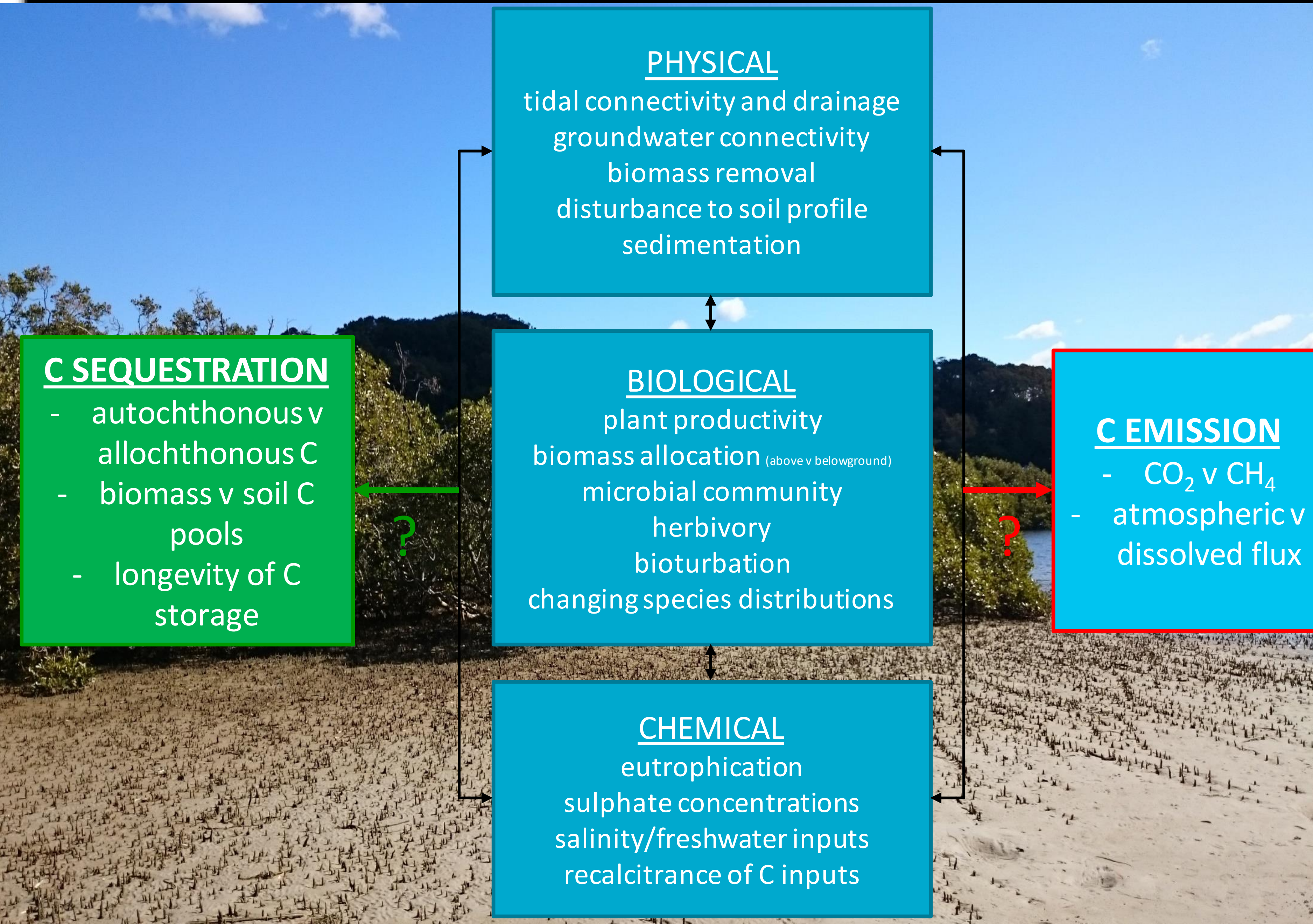
- Australian VCE absorb 20 million tonnes of CO_2 each year,
  - = **~4 million cars**

- Losses of Australian VCE (~1% of area yr^{-1}) is causing 2 to 3 million tonnes CO_2 emissions per year
  - = **12-21% increase in annual emissions from land use change**.

- Restoring just 10 per cent of VCE lost in Australia could generate more than **$US 11 million per year in** C credits.

- Conserving VCE under threat could be worth $**US 22-31 million per year in carbon credits.**

INFLUENCING FACTORS



Risk Framework for Policy Adoption

Carbon Stock

Remineralisation Rate

Description	*Mineralization Score*	*Low C_{org} stock (< 50 Mg ha^{-1})*	*Low-Moderate C_{org} stock (50 – 100 Mg ha^{-1})*	*Moderate C_{org} stock (100 – 250 Mg ha^{-1})*	*Moderate-high C_{org} stock (250 – 500 Mg ha^{-1})*	*High C_{org} stock (> 500 Mg ha^{-1})*
Remineralization is theoretically possible but not expected to occur	*1-4*	**1 (Low)**	**2 (Low)**	**3 (Low)**	**4 (Low)**	**5 (Mod)**
Moderate rates of C_{org} remineralization	*5-9*	**2 (Low)**	**4 (Low)**	**6 (Mod)**	**8 (Mod)**	**10 (Mod-High)**
Moderate-High rates of C_{org} remineralization	*10-14*	**3 (Low)**	**6 (Mod)**	**9 (Mod)**	**12 (Mod-High)**	**15 (High)**
High rates of C_{org} remineralization	*15-19*	**4 (Low)**	**8 (Mod)**	**12 (Mod-High)**	**16 (High)**	**20 (Extreme)**
Remineralization expected to occur at very high rates	*20-25*	**5 (Mod)**	**10 (Mod-High)**	**15 (High)**	**20 (Extreme)**	**25 (Extreme)**

Source: Lovelock et al (2016)

Supporting An Emissions Reduction Fund Method for Blue Carbon

2017

CSIRO OCEANS & ATMOSPHERE
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Technical review of opportunities for including blue carbon in the Australian Government's Emissions Reduction Fund

Final Report

Prepared for the Department of the Environment and Energy

1. Reintroduction of tidal flows
2. Land use planning for sea level rise to allow inland migration
3. Avoidance of seagrass loss from direct physical disturbance
4. Avoidance of seagrass loss & reestablishment or creation of new seagrass
5. Avoided clearing (mangroves) and avoided soil disturbance (mangroves and tidal marsh

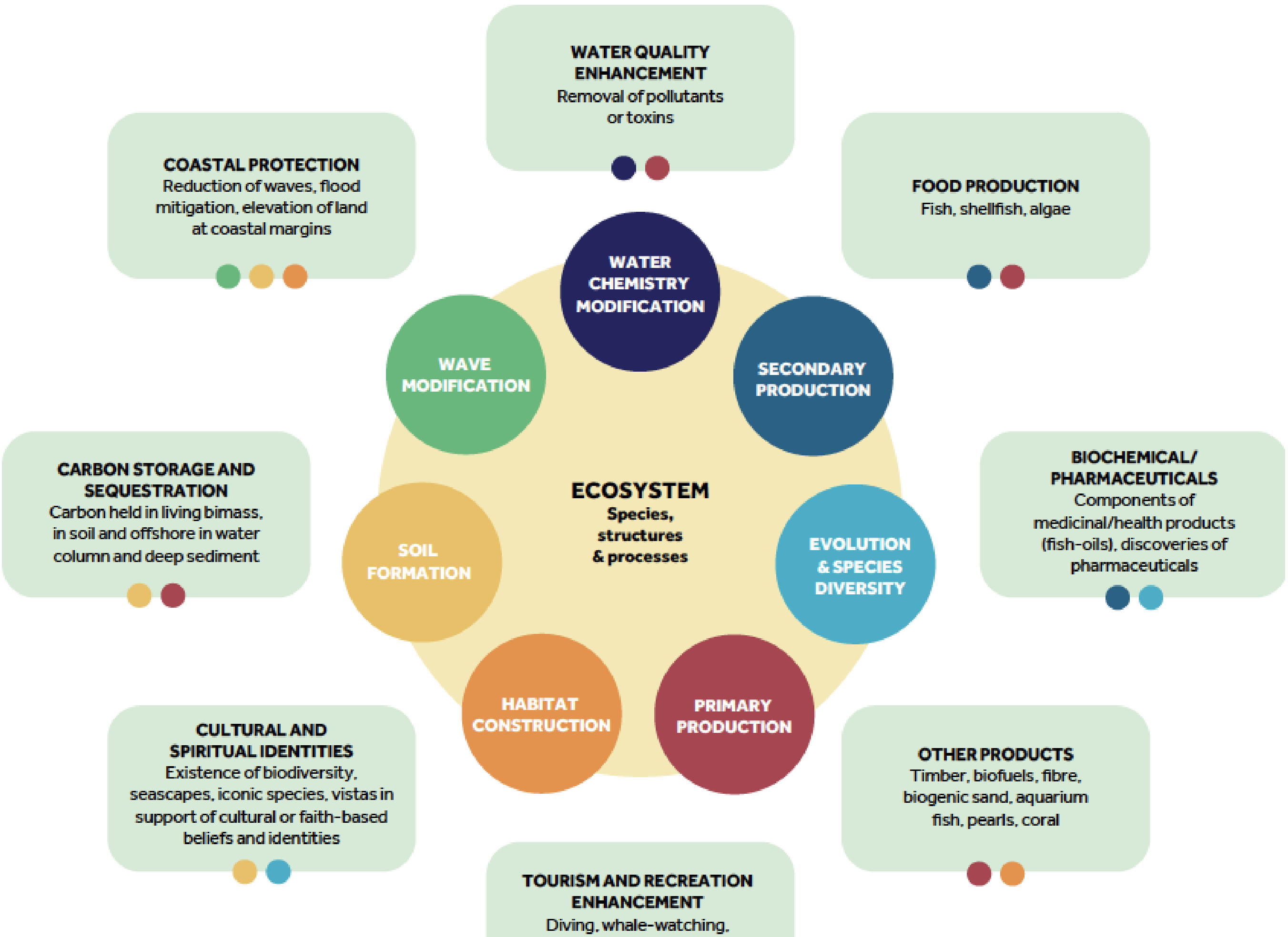
2019

CSIRO OCEANS & ATMOSPHERE

Technical assessment of the Verified Carbon Standard – "VM033 Methodology for Tidal Wetland and Seagrass Restoration"

- Reintroduction of tidal flow to restore mangrove and tidal marsh ecosystems
- VM0033 methodology mostly consistent & a basis for an for Australian ERF method
- Modifications and Alternatives to VM0033 recommended:
- Direct measurement versus Australian national default emission factors to be considered

Benefits from Coastal Blue Carbon Ecosystems



Overview of ecosystem services provided
ean. Source: The Nature Conservancy/

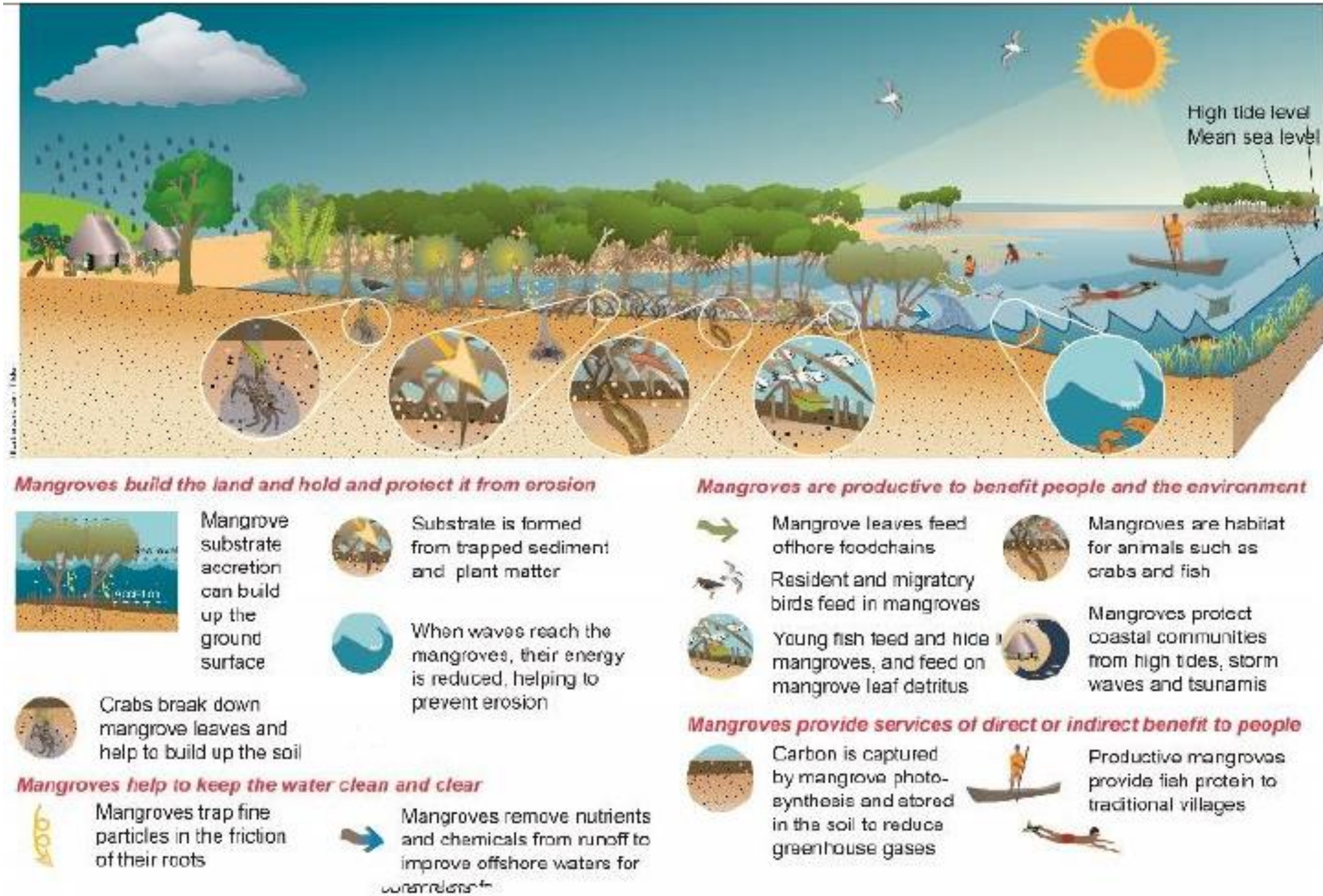
Climate

Livelihoods

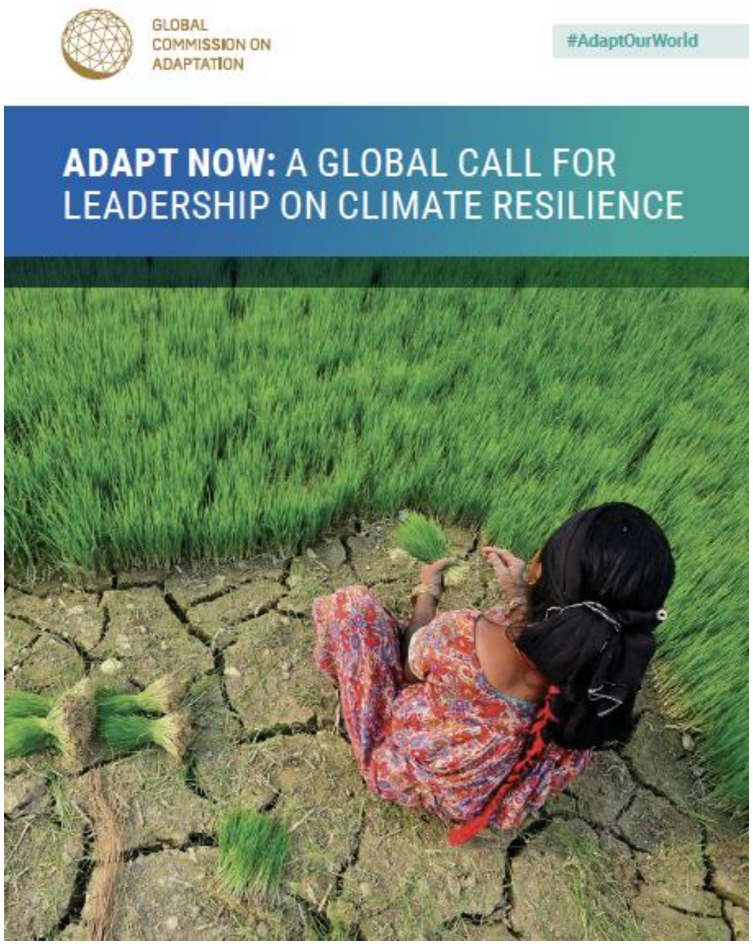
Disasters

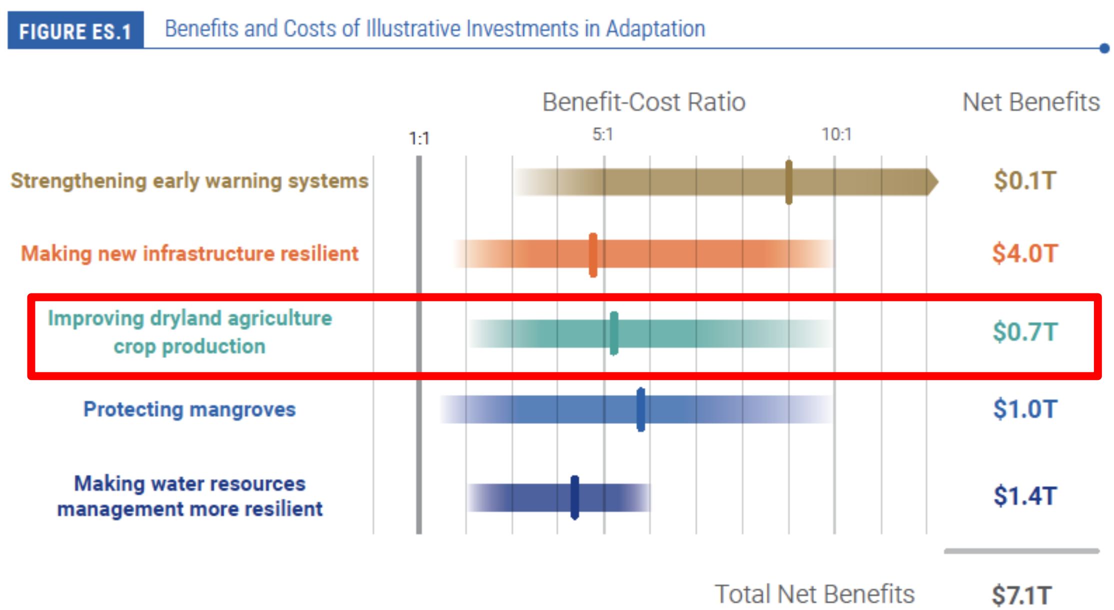
Mangroves contribute US$ 40 - 50 B per annum in non market benefits associated worth fisheries, forestry and restoration

Benefits from Mangroves



Coastal ecosystems for climate resilience





Mangroves provide more than $80 B per annum coastal flooding and protect 18 m people

Benefits from mangrove preservation and restoration are up to 10 times the costs

Value of Mangrove Ecosystem Services

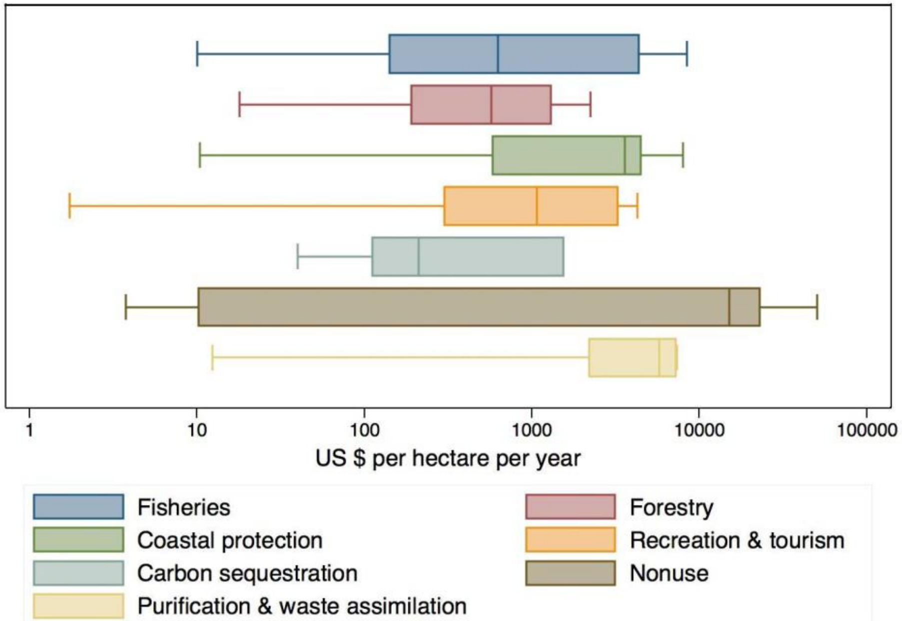
Distribution of *mangrove* valuations by type of service (in US\$ ha^{-1}·yr^{-1}).

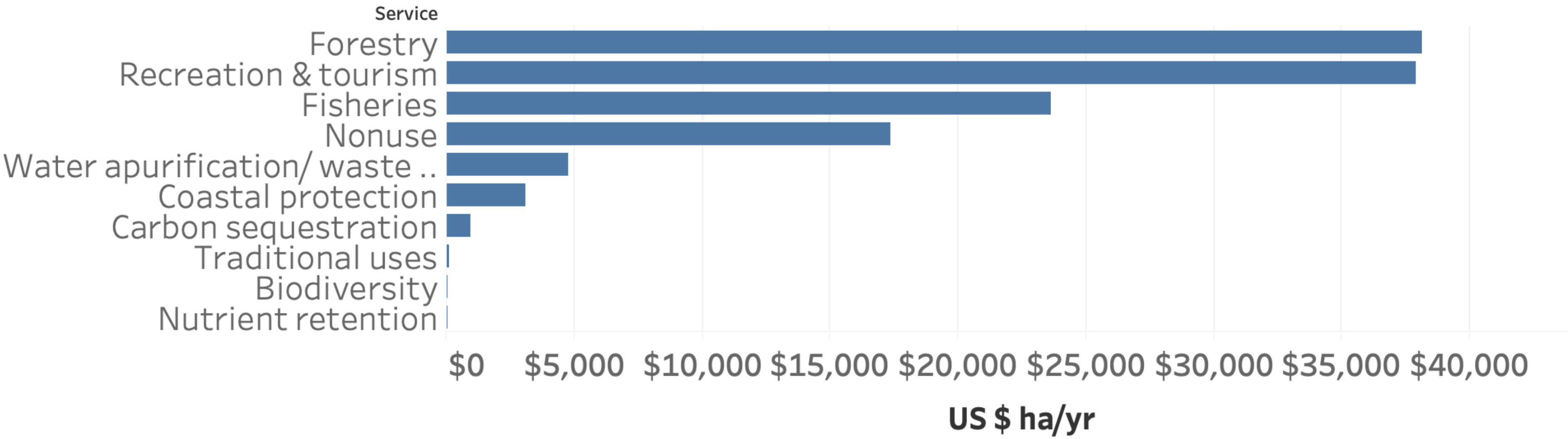
Salem and Mercer 2012

Average Value (US\$ ha^{-1}·yr^{-1})

Mean \$28,662

Median \$3,847





Emerging Blue carbon ecosystems

Coral reefs

Bivalves

Kelp or other seaweed

Microalgae

Carbon Capture and Storage (CCS)

CCS in numbers

17 large-scale CCS facilities operating globally, four coming on stream in 2018

these 21 facilities have a CO_2 capture capacity of 37 million tonnes per annum (Mtpa)

The equivalent of 8 million cars removed from the road each year

220 million tonnes of man-made CO_2 has been injected deep underground to date

CCS is the only technology able to decarbonise the industrial sector

To reach the Paris 2°C target...

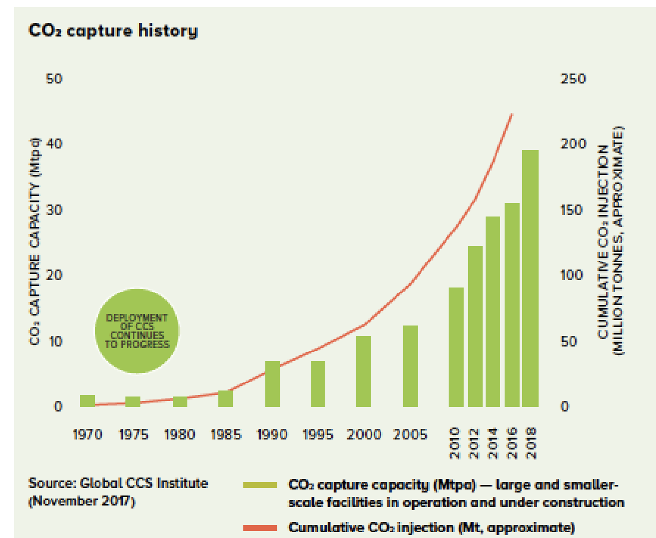
2,500

CCS facilities operating in 2040

(Based on a CCS facility with a CO_2 capture capacity of ~1.5 Mtpa)

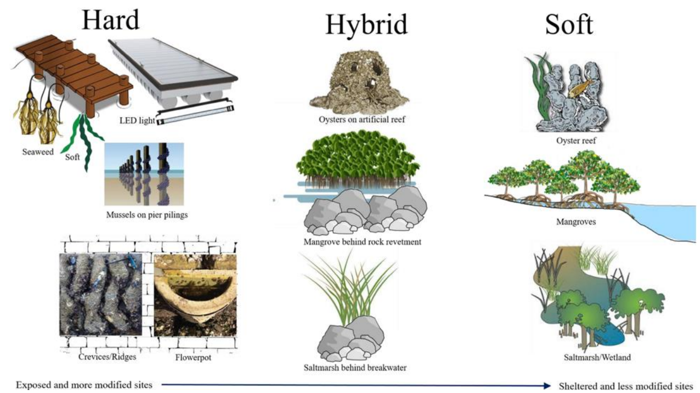
14%

of cumulative emissions reductions must be derived from CCS

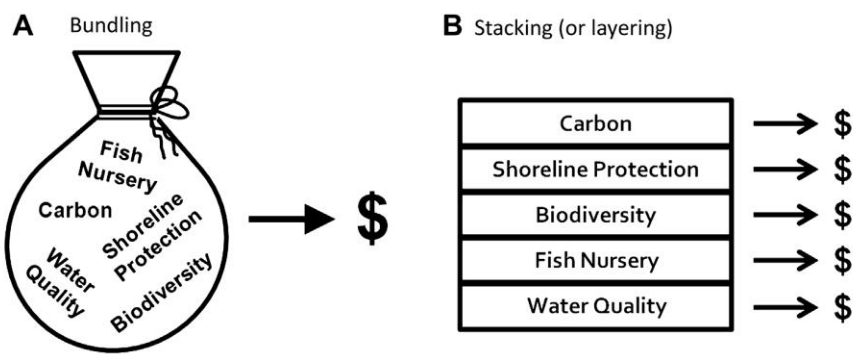


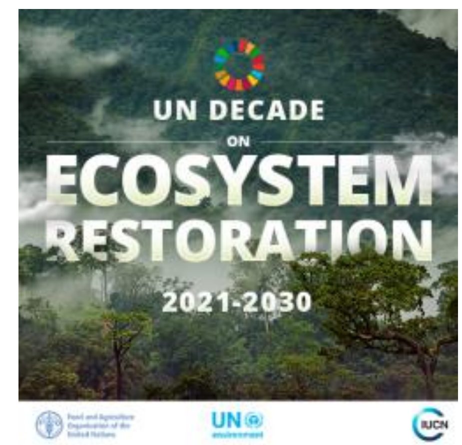
- **CCS market in 2016 USD 2.5 billion in 2016**
- **45% of CCS market applied to the oil and gas industry**
- **Market projected to surpass USD 6 billion by 2024.**

Repair an Restoration of Coastal Ecosystems



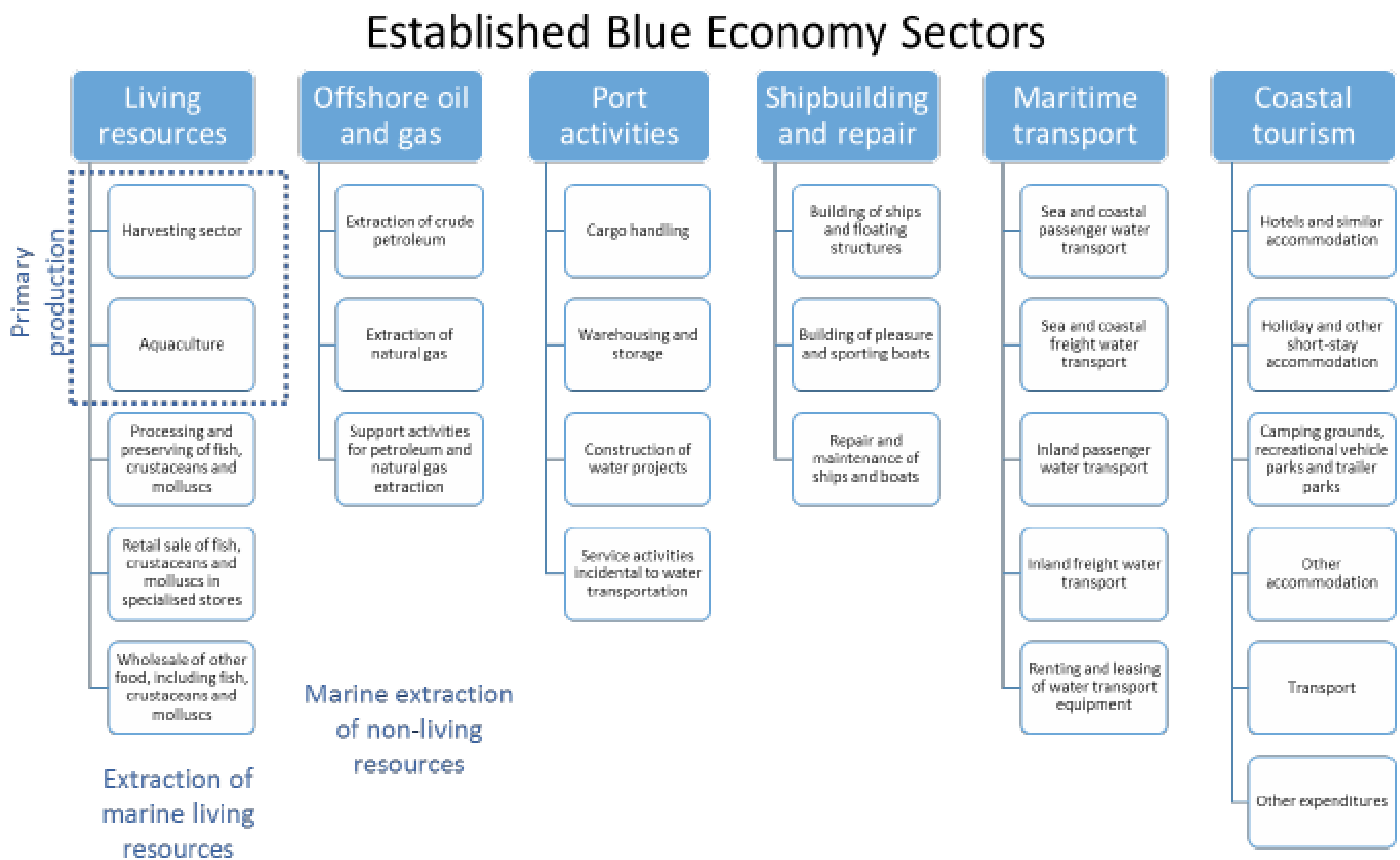
- Major political and industry interest in coastal restoration and Nature Based Solutions:
  - International conventions &target commitments
  - Insurance de-risking
  - Corporate Stewardship and Carbon neutrality
  - Carbon trading & Payment for Ecosystem services





- Marine habitat restoration is recognized as a 'jobs intensive' industry and strong driver of economic growth creating immediate employment in transport, construction, marine engineering, project management, science and aquaculture.

Classifying Blue Carbon in Ocean Accounts and the Blue Economy

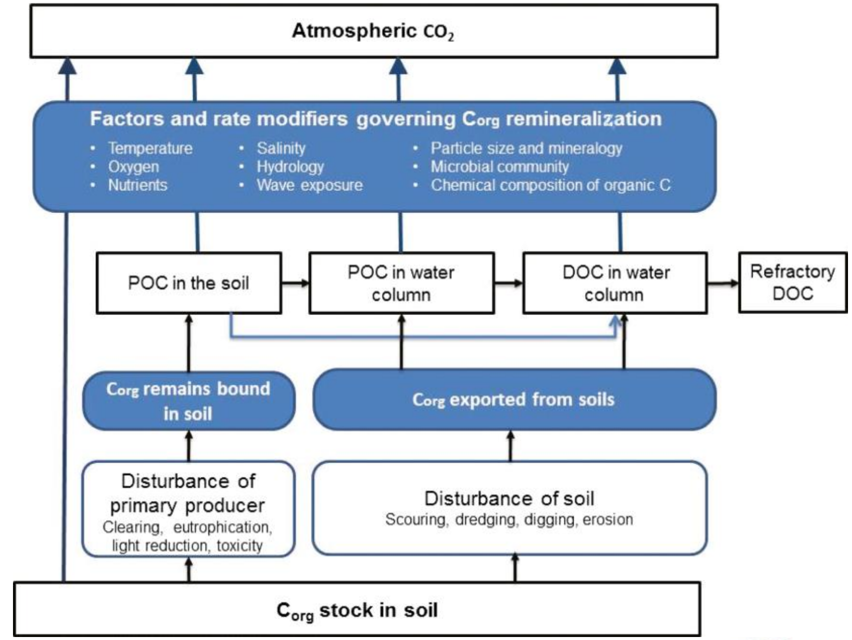


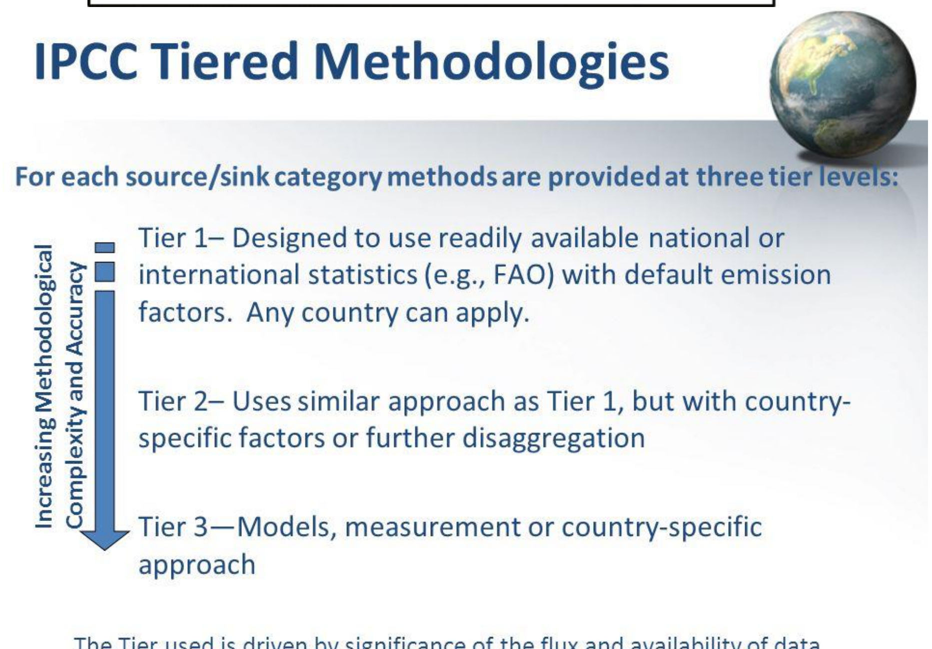
Alternative Classifications of Blue Economy Sectors

Type of activity	Ocean service	Established industries	Emerging industries	New industries	Drivers of future growth
Harvesting of living resources	Seafood	Fisheries	Sustainable fisheries		Food security
			Aquaculture	Multi-species aquaculture	Demand for protein
	Marine bio-technology		Pharmaceuticals, chemicals		R&D in healthcare and industry
Extraction of non-living resources, generation of new resources	Minerals	Seabed mining			Demand for minerals
			Deep seabed mining		
	Energy	Oil and gas			Demand for alternative energy sources
			Renewables		
	Fresh water		Desalination		Freshwater shortages
Commerce and trade in and around the ocean	Transport and trade	Shipping			Growth in seaborne trade
		Port infrastructure and services			International regulations
	Tourism and recreation	Tourism			Growth of global tourism
		Coastal development			Coastal urbanisation
			Eco-tourism		Domestic regulations
Response to ocean health challenges	Ocean monitoring and surveillance		Technology and R&D		R&D in ocean technologies
	Carbon sequestration		Blue carbon (i.e. coastal vegetated habitats)		Growth in coastal and ocean protection and conservation activities
	Coastal protection		Habitat protection, restoration		
	Waste disposal			Assimilation of nutrients, solid waste	

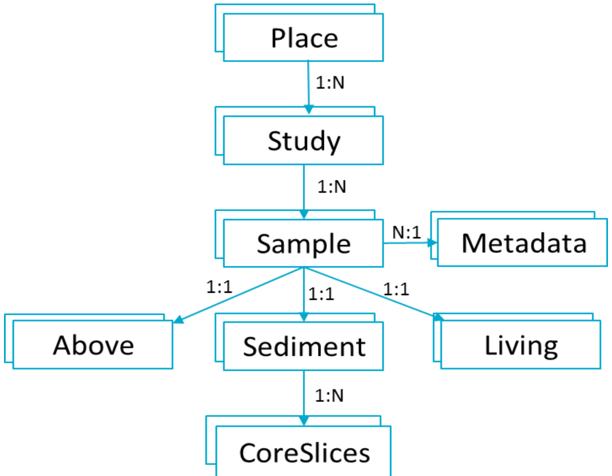
The Science Behind Blue Carbon

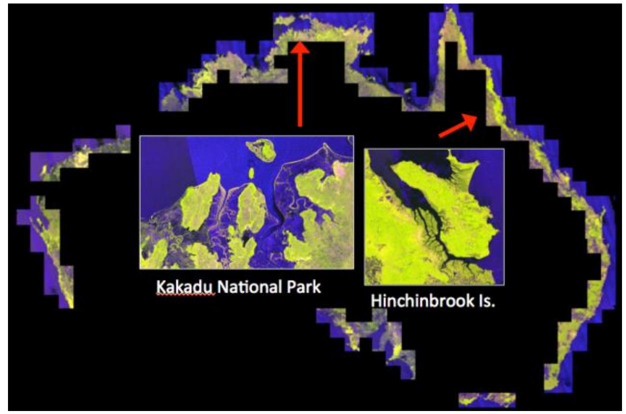
- **Why?**
  - Science reduces the Risk for investment and policy outcomes
- **How**
  - Two key metrics
    - Point measurement of C stocks
    - Scaling up; mapping of habitat inventory on a regular basis
- **Gaps**
  - Reasonable conceptual understanding (Howard et al 2017)
  - Paucity of data of C stocks in many countries- need to get to IPCC Tier 2
  - Standardise mapping methodology and build capacity to do national inventories

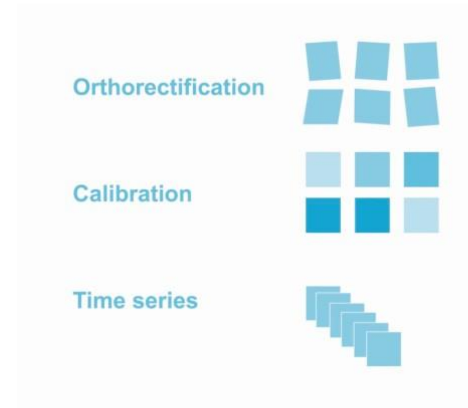




Keys Steps in the Science of Blue Carbon







DESIGN

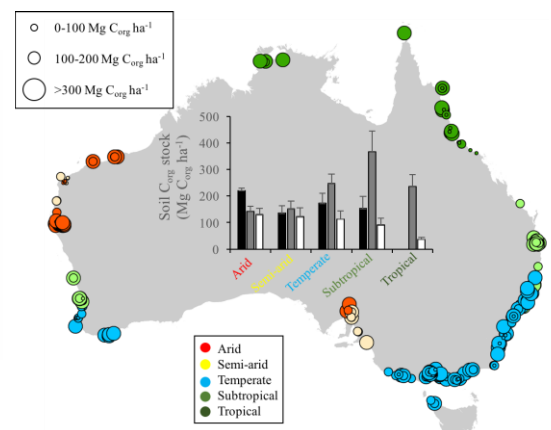
MAPPING & MODELLING

DATA MANAGEMENT
& ANALYSIS

SAMPLING

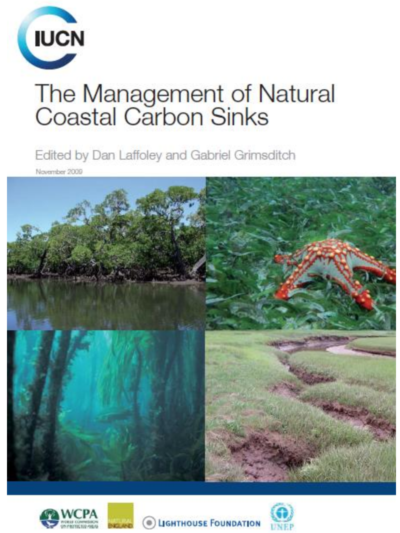
MEASURING CARBON

PRODUCTS

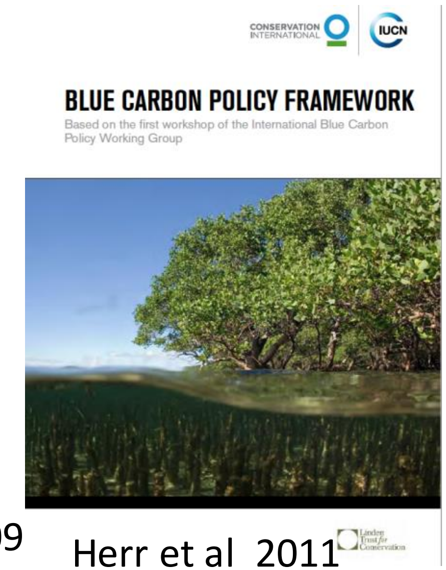


BC Policy, Projects & Measurement Documents

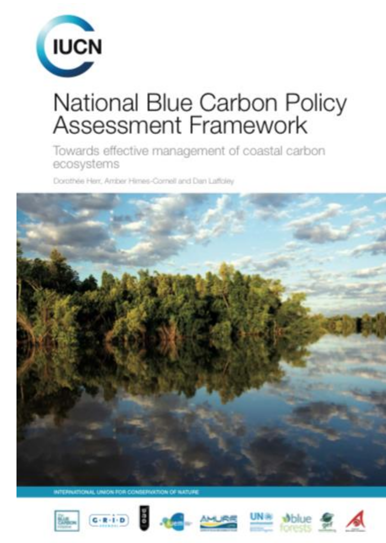
Nelleman et al. 2009



Laffoley & Grimsditch 2009

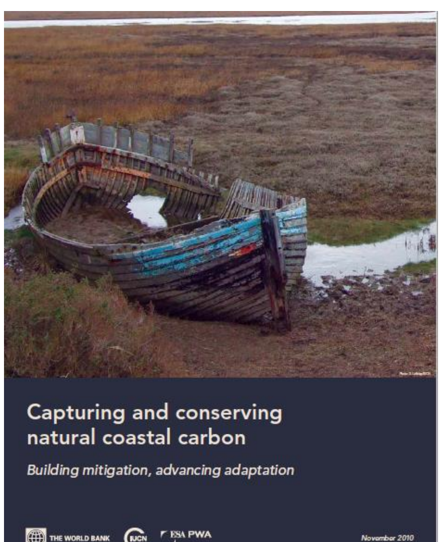


Herr et al 2011

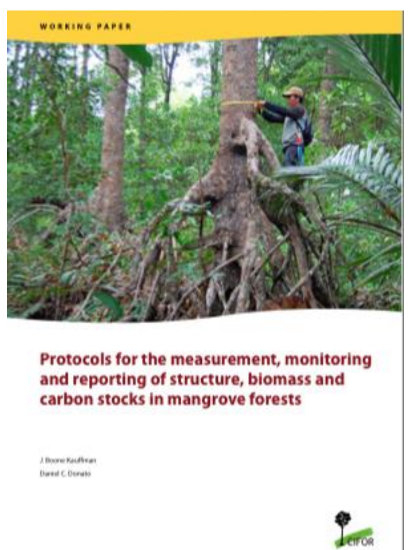


Herr et al 2016

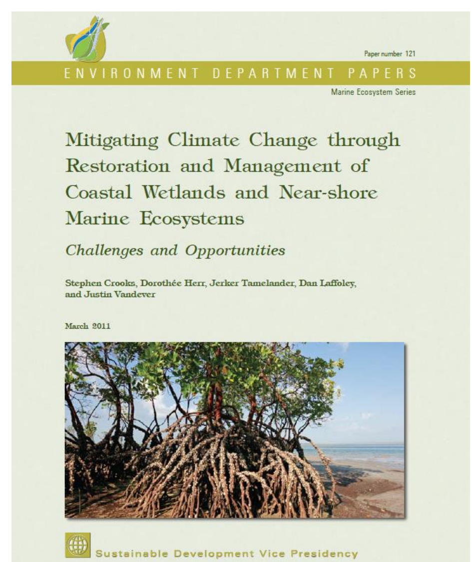
Word Bank /IUCN 2010



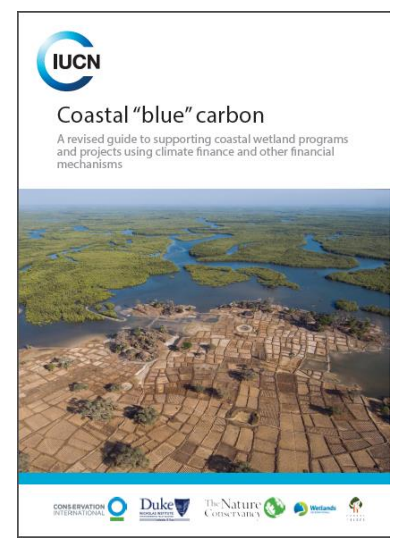
Kaufmann & Donato 2009



Crooks et al 2011



Howard et al 2014



Science Priorities for BC Research

Challenge	Needs
Mapping blue carbon ecosystems	• Accurate national and subnational estimates of VCE extent • Calculation of national rates of deforestation • Methods for estimating seagrass in optically and turbid waters including the use of models • Agreed mapping protocols including digitisation and uncertainty estimates • Simple user guide of methods for blue carbon mapping • More efficient data processing for change detection
Measuring blue carbon soil stocks and fluxes	• Collection of subnational data to enable Tier II IPCC estimates of carbon stock • Models that allow carbon stock to predicted reliably across large areas • Calculation of nationally relevant emission factors for specific land-uses and activities

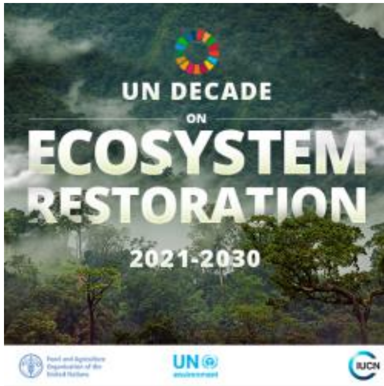
Source: Vanderklift et al. (2019)

Policy and Livelihood Priorities

Challenge	Needs
Blue carbon policy development and implementation	• Analysis of environmental factors and human activities influencing carbon sequestration/ emissions • Criteria & options for inclusion of mangrove and seagrass in national emissions inventory & NDCs • Suitability assessment and adoption of international carbon verification standards • Options for integrating blue carbon policies with other environmental & climate management policies • Understanding of land tenure, including customary rights, and what this means for protection and restoration options
Abatement activities	• Define abatement and avoided emission criteria • Test and quantify the efficacy of proposed abatement activities • Analysis of suitability of restoration methods and testing at scale
Financing blue carbon	• Development of reliable default values for application of methods to generate carbon offsets • Development of low cost methods for blue carbon restoration • Development of robust finance instruments to support blue carbon protection and restoration • Demonstration sites to develop best practice • Guidelines and tools for investors to understand blue carbon options
Ecosystem services and livelihood opportunities	• **Methods for quantifying and mapping ecosystem services** • Tools for local communities to value ecosystems services • **Establish Valuation and accounted methods**
Capacity development	• Creating a network of practitioners mapping and carbon stock assessment • Establish a clearing house of best practice information for the IORA region including across to data, models and success stories • Provide cross-disciplinary development across technical, policy, financing and livelihood aspects of blue carbon.

Summary

1. Blue Carbon is beginning to be included in national emission accounting.
2. There is growing recognition of other blue carbon direct and indirect ecosystem services and interest from industries in achieving carbon neutrality and nature based approaches to coastal protection.
3. The methodology and systems for carbon emission reporting and trading should be expanded to recognize other market and non market services.
4. Coastal Carbon ecosystems as well as other emerging components of “Blue Carbon” as well as CCS should be recognized explicitly with evolving Blue Economy Paradigm and the policy level narrative simplified.




Banar Fil Ardhi