Socio-economic impacts of ocean acidification

Katrin Rehdanz

Department of Economics, University of Kiel

Kiel Institute for the World Economy (IfW)

Kiel Earth Institute

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GLOBAL CHANGE IGBP International Geosphere-Biosphere Programme

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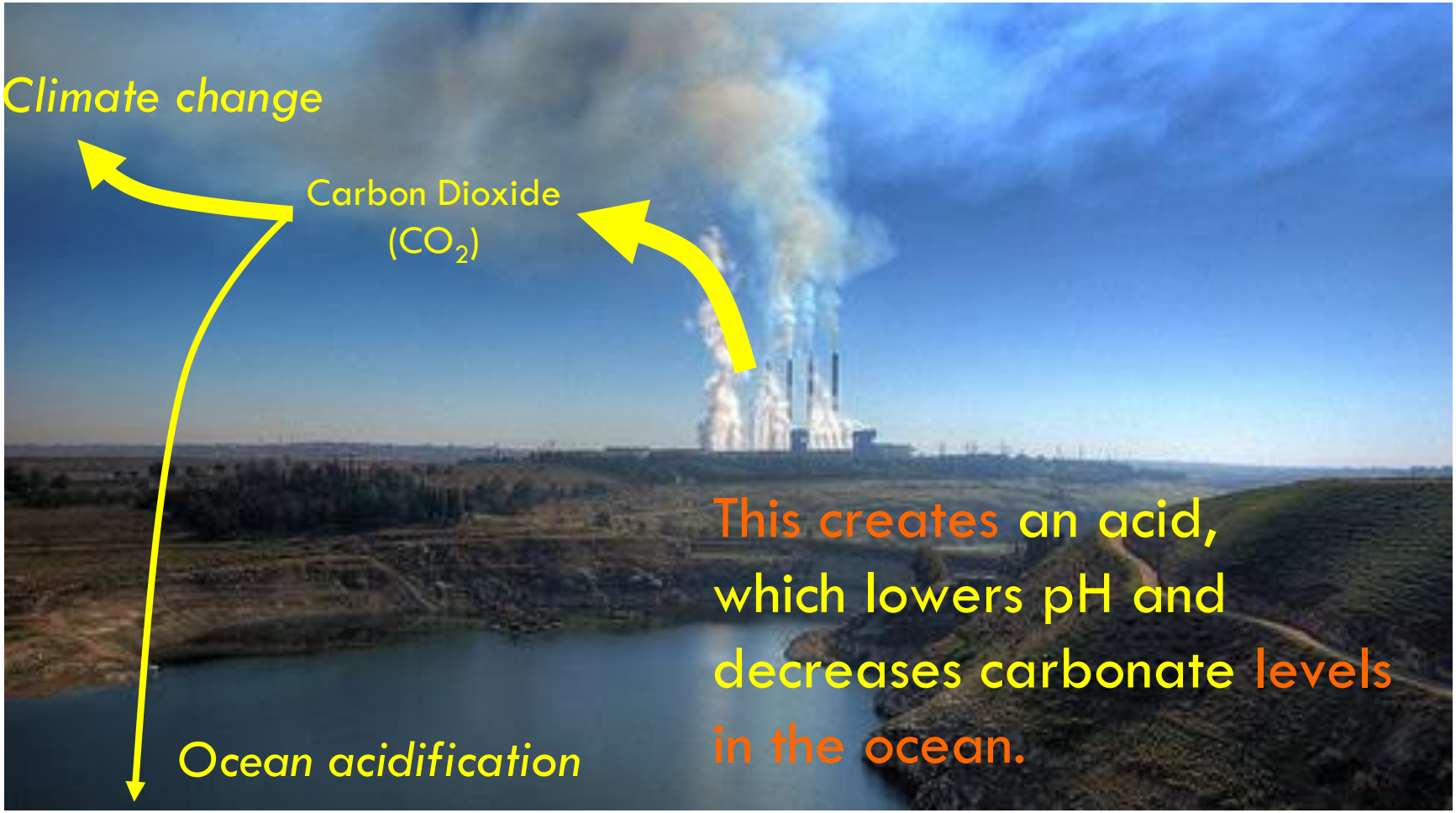
What is ocean acidification?



Courtesy R Feely (NOAA)

Motivation: OA and economics

- OA has been gaining increasing recognition in the policy circles recently
- Increasing number of studies on biological and ecological impacts of OA
- But few attempts of economic assessment yet
- Estimates of the socio-economic impact of climate change have largely ignored OA

➢ ***This causes several biases***

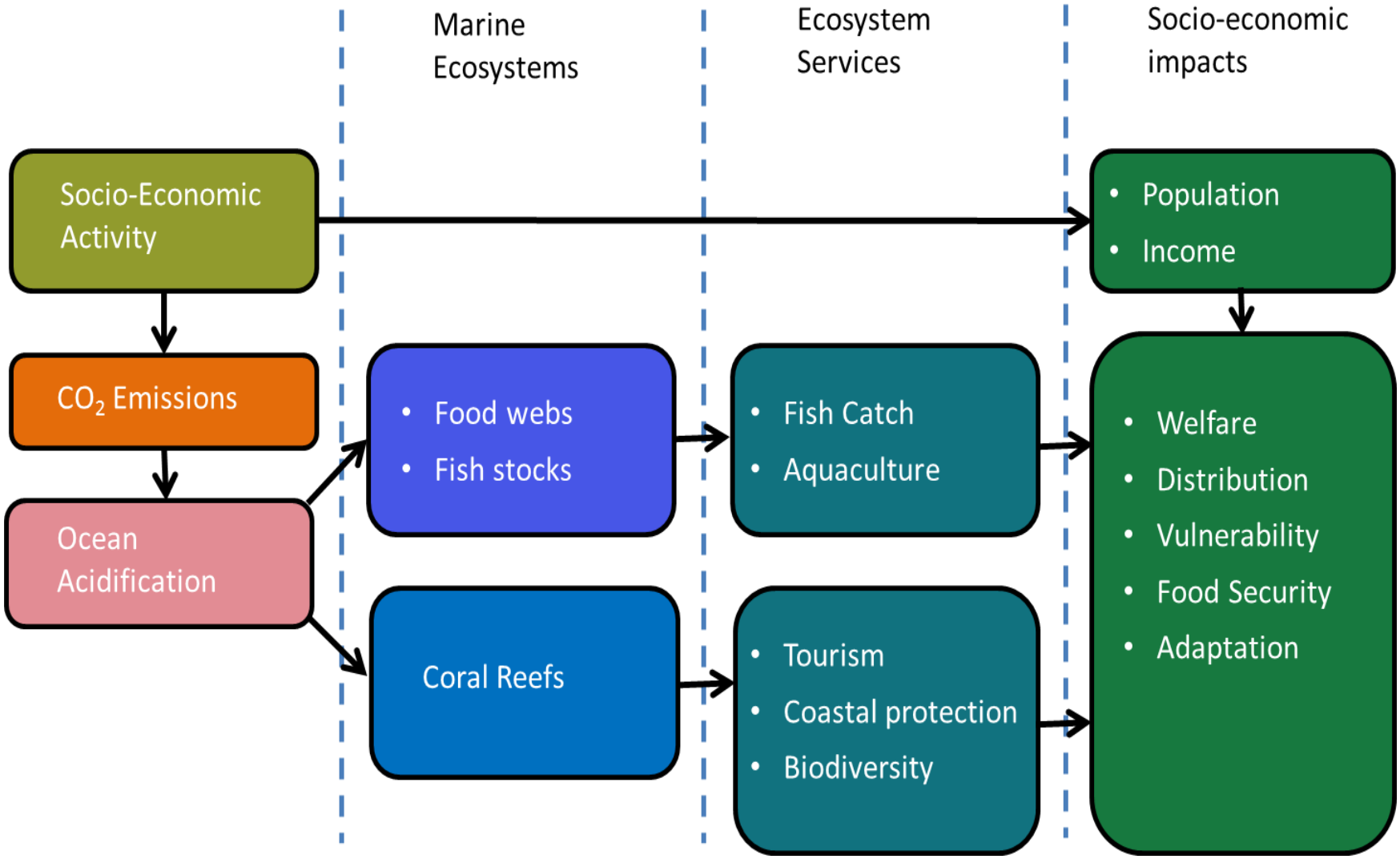
- Mitigation of climate change
- Socio-economic impact estimates and costs of adaptation

Economic assessments so far

- Major integrated assessment models based on the cost-benefit framework (FUND, DICE, etc.) haven't taken OA into account yet
- They also tend to justify weak climate policy (emission reduction), at least in the near term

- ***Does OA significantly raise the existing damage estimates of climate change?***
- ***In other words, does inclusion of OA justify stricter climate policy?***

Framework for assessing the economic impact of OA



Brander et al. (forthcoming)

1. OA will change marine ecosystems

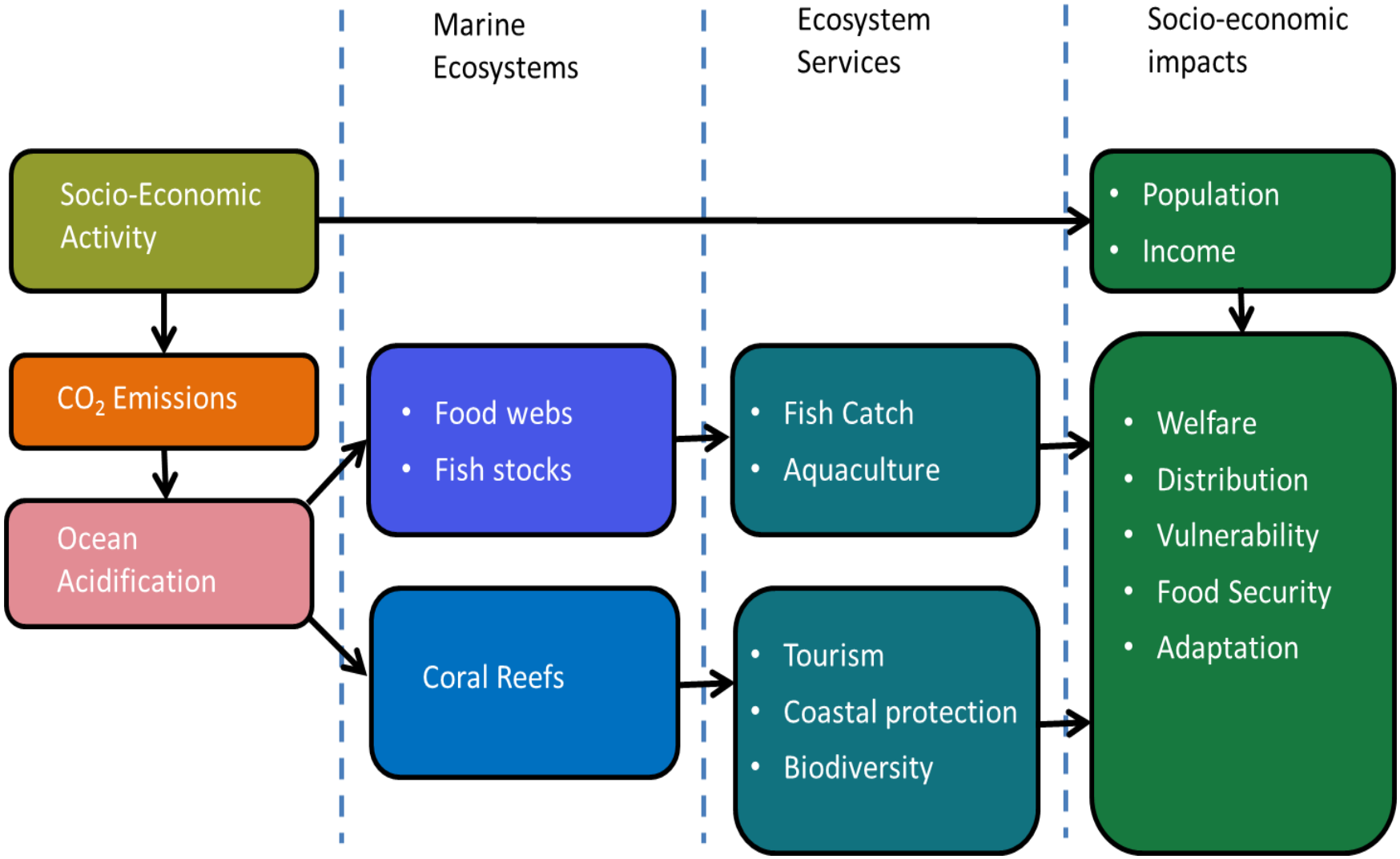
- Organisms react differently to ocean acidification
- Corals and shell builders expected to generally decline
- Seagrasses may increase, some at expense of corals
- Some fish become disoriented under high CO_2

Taxa	Response	Mean Effect
Calcifying algae	Survival	
	Calcification	
	Growth	
	Photosynthesis	−28%
	Abundance	−80%
Corals	Survival	
	Calcification	−32%
	Growth	
	Photosynthesis	
	Abundance	−47%
Mollusks	Survival	−34%
	Calcification	−40%
	Growth	−17%
	Development	−25%
	Abundance	
Echinoderms	Survival	
	Calcification	
	Growth	−10%
	Development	−11%
	Abundance	
Crustaceans	Survival	
	Calcification	
	Growth	
	Development	
	Abundance	
Fish	Survival	
	Calcification	
	Growth	
	Development	
	Abundance	
Fleshy algae	Survival	
	Calcification	
	Growth	+22%
	Photosynthesis	
	Abundance	
Seagrasses	Survival	
	Calcification	
	Growth	
	Photosynthesis	
	Abundance	

Not tested or too few studies
Enhanced <25%
95% CI overlaps 0
Reduced <25%
Reduced >25%

Kroeker et al. (2013, *Glob. Change Biol.*)

Framework for assessing the economic impact of OA



Brander et al. (forthcoming)

2. Impact on ocean ecosystem services

- The oceans provide goods and services which are used directly and indirectly by humans
- OA is likely to have a range of impacts on biological and ecological systems including economically important marine resources like fish stocks, shellfish and coral reefs

➢ ***The impact on human societies depend on …***

… the vulnerability, resilience and adaptation capacity of specific communities

… but little is currently known

3. Socio-economic impacts

- Little quantitative information exists on the impact of ocean acidification on the lower trophic levels
- Very little information exists on the higher trophic levels that directly matter to us, such as commercial fish but also other species
- More is known on coral reefs

➢ **This limits economic assessments**

Study	Impacts	Geographic scope	Emissions scenario	Period of analysis	Welfare measure	Annual val. (US$; bil.
Armstrong et al. (2012)	Fisheries	Norway	pH decrease 0.5	2010 – 2110	Revenue	0.01
	Carbon storage	Norway	pH decrease 0.5	2010 – 2110	Damage Cost	3
Brander et al. (2012)	Coral reefs	Global	SRES A1B	2000 - 2100	Mixed	1,093
Cheung et al. (2011)	Fish and invertebrates	N-E Atlantic	SRES A1B	2005 - 2050	-	-
Cooley and Doney (2009)	Mollusks	United States	IPCC A1F1	2007 - 2060	Revenue	0.07
Cooley et al. (2012)	Mollusks	Global	CCSM3	2010 - 2060	-	-
Finnoff (2010)	Fisheries; non-use values	Baring Sea	-	-	-	-
Harrould-Kolieb et al. (2009)	Coral reefs; fisheries	Global	SRES A1B	2009 - 2050	-	-
Hilmi et al. (2012)	All	Global	-	-	-	-
Kite-Powell (2009)	Coral reefs; fisheries	Global	IS92a	-	-	-
Moore (2011)	Mollusks	United States	RCP8.5; RCP6	2010 - 2100	CV	0.31
Narita et al. (2012)	Mollusks	Global	IS92a	2000 - 2100	CS, PS	139
Rodrigues et al. (2013)	Use and non-use values	Mediterranean	-	-	-	-
Sumaila et al. (2011)	Capture fisheries	Global	-	-	-	-

Brander et al. (forthcoming)

3. Socio-economic assessments so far

- Only partial assessment of the total impacts so far
  - Focus on use values
- Of the 13 existing studies only five provide monetary estimates of the costs of OA
  - 3 focus on mollusk fisheries
  - 1 covers impacts on fisheries and carbon storage
  - 1 is for impacts on coral reefs
- Impacts to coral reefs dominate
- Reduced carbon storage also a potentially important impact category

Gaps in current knowledge

1. Understanding the relationship between changes in the marine environment and socio-economic impacts
2. The ecosystem services that have been assessed
3. The distribution of impacts
4. The vulnerability of different populations

Discussion and conclusion

- Quantitative insights are preliminary and incomplete
- OA is different from, but related to climate change
  - OA is caused by CO_2 only
  - OA is expected to occur more rapidly

- Impact on optimal mitigation policy

Thank you!