Class 19: Climate Change Strategies, Mitigation and Adaptation

- What will we do to slow and or adapt to climate change?
- What are the challenges?

Learning Objectives

- Explain the difference between climate adaption and mitigation strategies
- List 2 climate adaption strategies that have so-far been proposed
- List 2 climate mitigation strategies that have so-far been proposed
- Predict two challenges (physical, social, or economic) facing a proposed climate adaption or mitigation strategy

Amelia Poch

The Vermont Youth Climate Congress

What is it?

A gathering of around 150 students across Vermont to press our leaders of Vermont for BOLDER action on climate!

We will be drafting a declaration of freedom from fossil fuels and solutions to present to our legislators to put into policy before it’s too late!

Why?

Our generation will be the one to face the effects of climate change, although we are the least responsible

The people currently in power haven’t done enough, so we must step up to the plate and do what we know is right to protect our planet!

The Goal

To send a strong message to our legislators that we are serious about demanding action to address the climate crisis

Have strong media coverage of the event to show Vermonters we will continue to fight for what is just until we get it

Have the youth more involved in politics that will impact their future

More Info

- It will take place at the State House in Montpelier this Sunday, November 17th from 12:30 - 4:30 pm
- If you are interested in volunteering as a scribe for the committee sessions or to check in people at the event please email Kate@vpirg.org
- Please visit out website at:
  - https://vermontyouthcongress.com

Registration week – Geology classes next semester

- GEOL 007 SU: Earth Hazards - Same teaching team - 11:40 12:55 T R
- GEOL 096 Extraterrestrial Life – 4 faculty - 12:00 12:50 M W F
- GEOL 055 Environmental Geology - 10:50 11:40 M W F

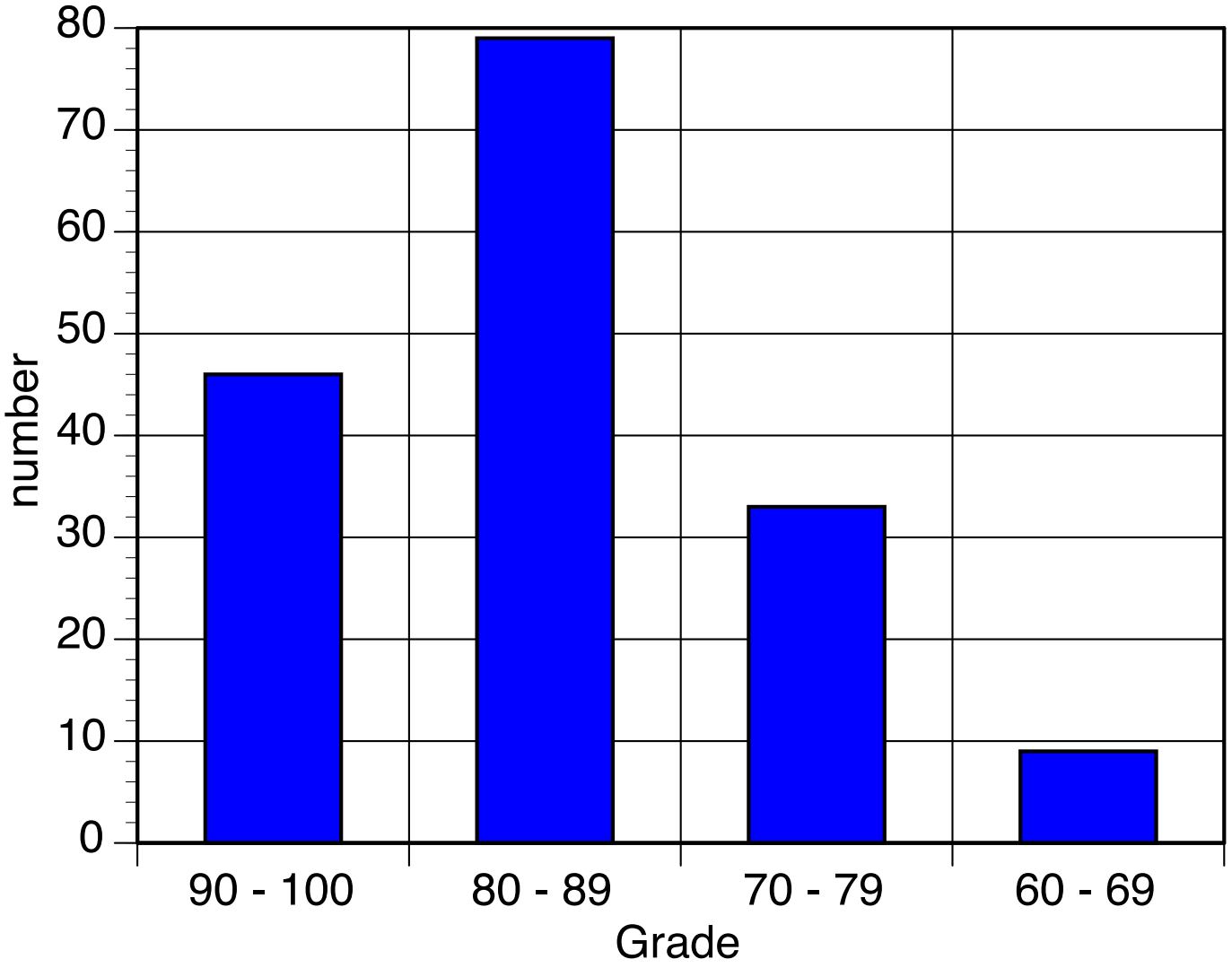
- GEOL 195 Human Health and Geology - 10:05 11:20 T R

- GEOL 235 Geochemistry of Natural Waters
- GEOL 234 Global Biogeochemical Cycles

- GEOG 143 Climatology - 02:50 04:05 T R

EXAM #2

Mean = 84.5
Median = 86.0



Climate in the News

E&E NEWS
EARTH

The Oceans Are Heating Up Faster Than Expected

The planet may be more sensitive to warming that previously thought, making climate goals more difficult to meet

REPORT

Marine Ice Sheet Collapse Potentially Under Way for the Thwaites Glacier Basin, West Antarctica

Ian Joughin, Benjamin E. Smith, Brooke Medley
+ See all authors and affiliations

Science 16 May 2014:
Vol. 344, Issue 6185, pp. 735-738
DOI: 10.1126/science.1249055

SUNDAY REVIEW

The New York Times

Opinion

How Scientists Got Climate Change So Wrong

Few thought it would arrive so quickly. Now we're facing consequences once viewed as fringe scenarios.

By Eugene Linden

Mr. Linden has written widely about climate change.

$306.2 billion

2017

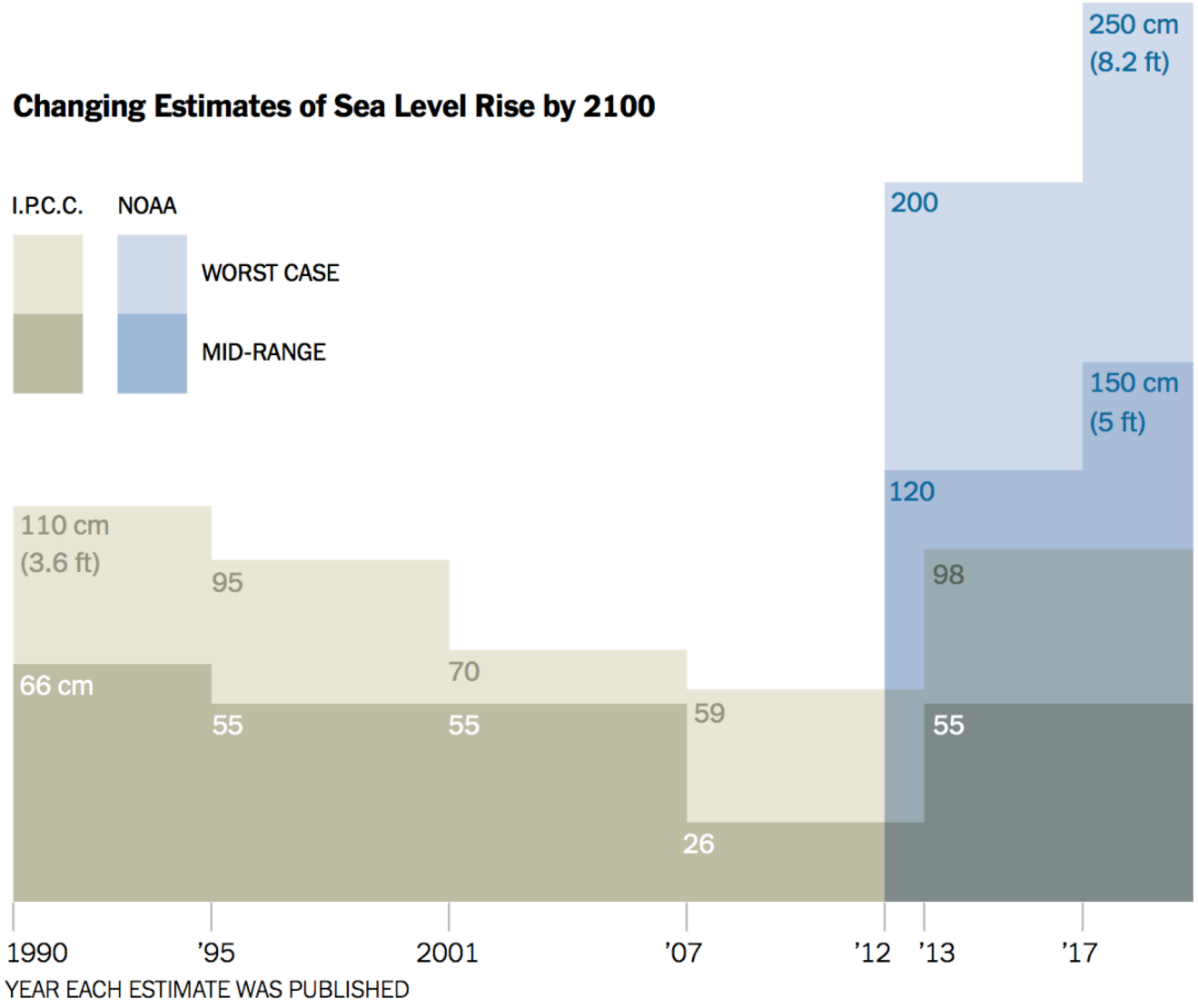
The cumulative cost of the 16 separate billion-dollar weather events in the U.S. in 2017 was $306.2 billion, breaking the previous cost record of $214.8 billion (2005).

REPORT

Volume loss from Antarctic ice shelves is accelerating

Fernando S. Paolo[1,*], Helen A. Fricker[1], Laurie Padman[2]
+ See all authors and affiliations

Science 17 Apr 2015:
Vol. 348, Issue 6232, pp. 327-331
DOI: 10.1126/science.aaa0940



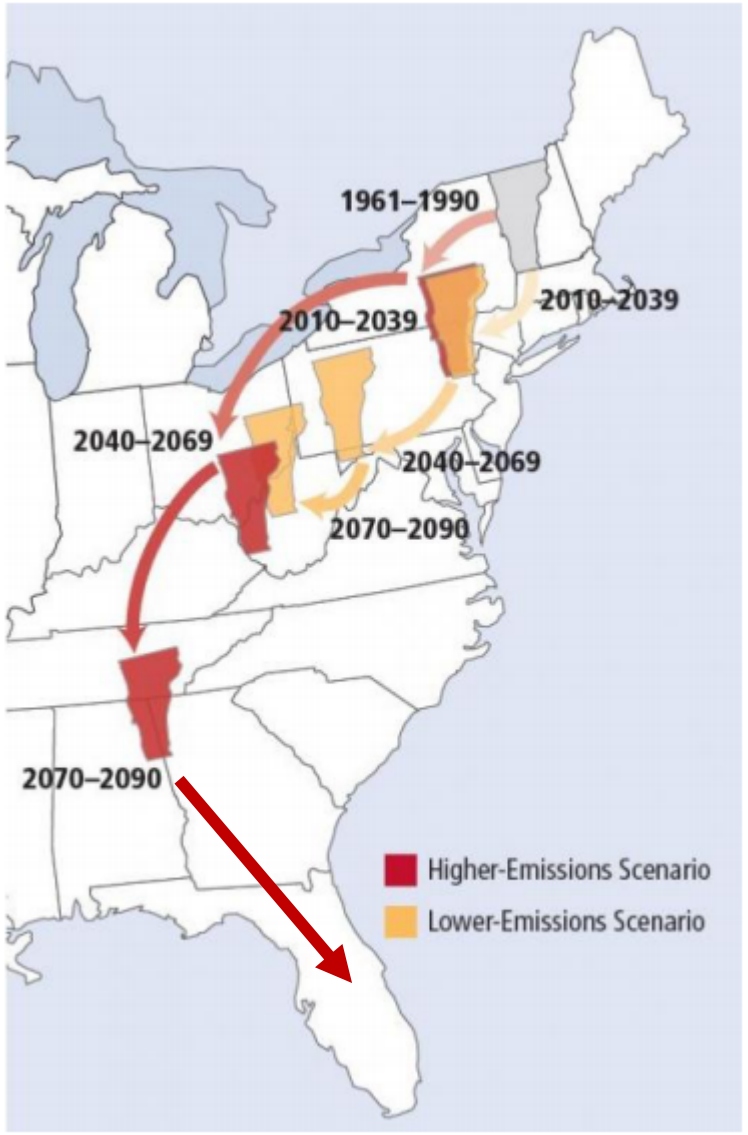
Note: The I.P.C.C.'s 2007 estimate of future sea level rise did not include satellite data on the contribution of melt water from Greenland and Antarctica because of disagreements among scientists.

"For decades, most scientists saw climate change as a distant prospect. We now know that thinking was wrong. This summer, for instance, a heat wave in Europe penetrated the Arctic, pushing temperatures into the 80s across much of the Far North and, according to the Belgian climate scientist Xavier Fettweis, melting some 40 billion tons of Greenland's ice sheet.

Had a scientist in the early 1990s suggested that within 25 years a single heat wave would measurably raise sea levels, at an estimated two one-hundredths of an inch, bake the Arctic and produce Sahara-like temperatures in Paris and Berlin, the prediction would have been dismissed as alarmist. But many worst-case scenarios from that time are now realities."

REVIEW - The Long View – 2300 CE

- How much will temperature increase by 2300?
  - Depends on emissions!
- With drastic emission cuts (RCP2.6), 1°C or less
- ‘Business as usual’ (RCP8.5), 4 - 12°C



REVIEW - The Longer View – 3000 CE

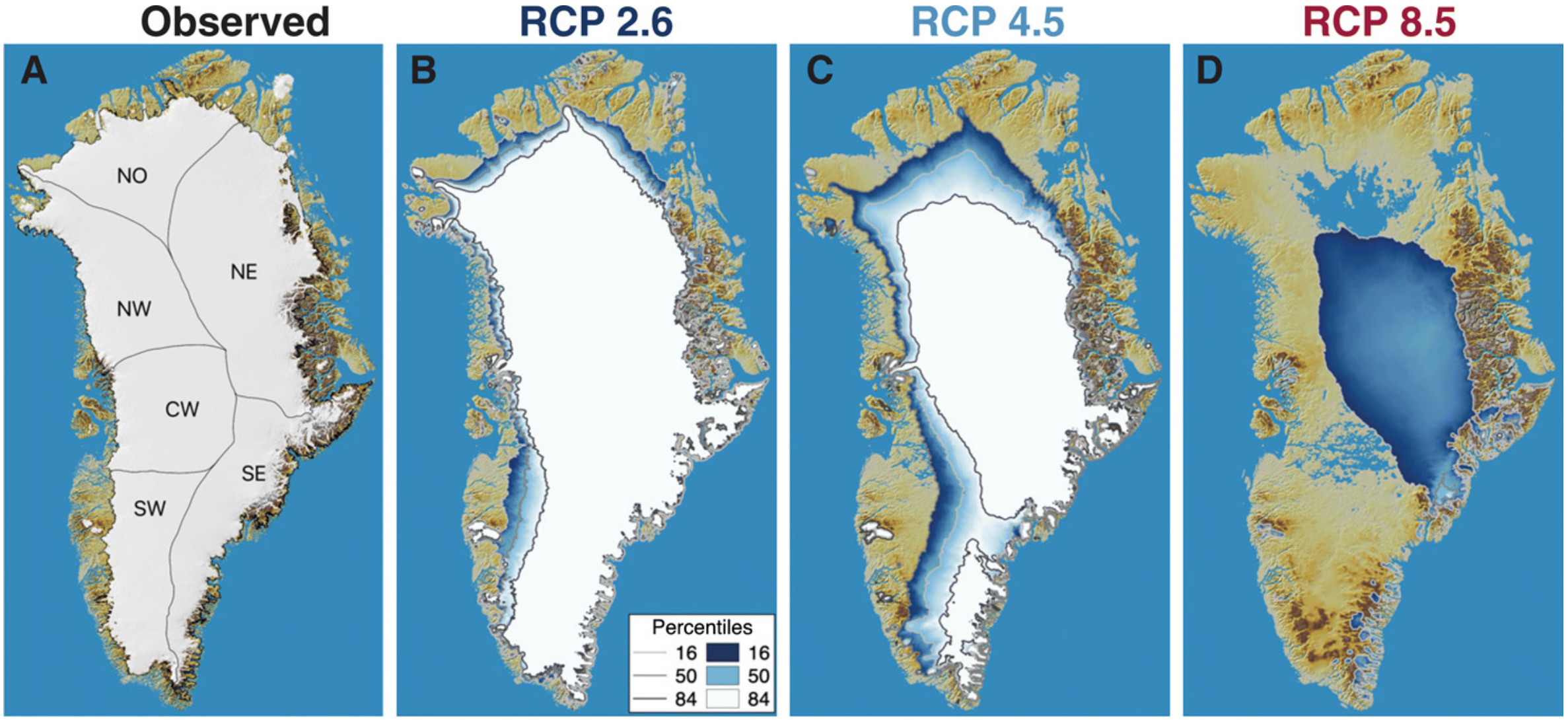
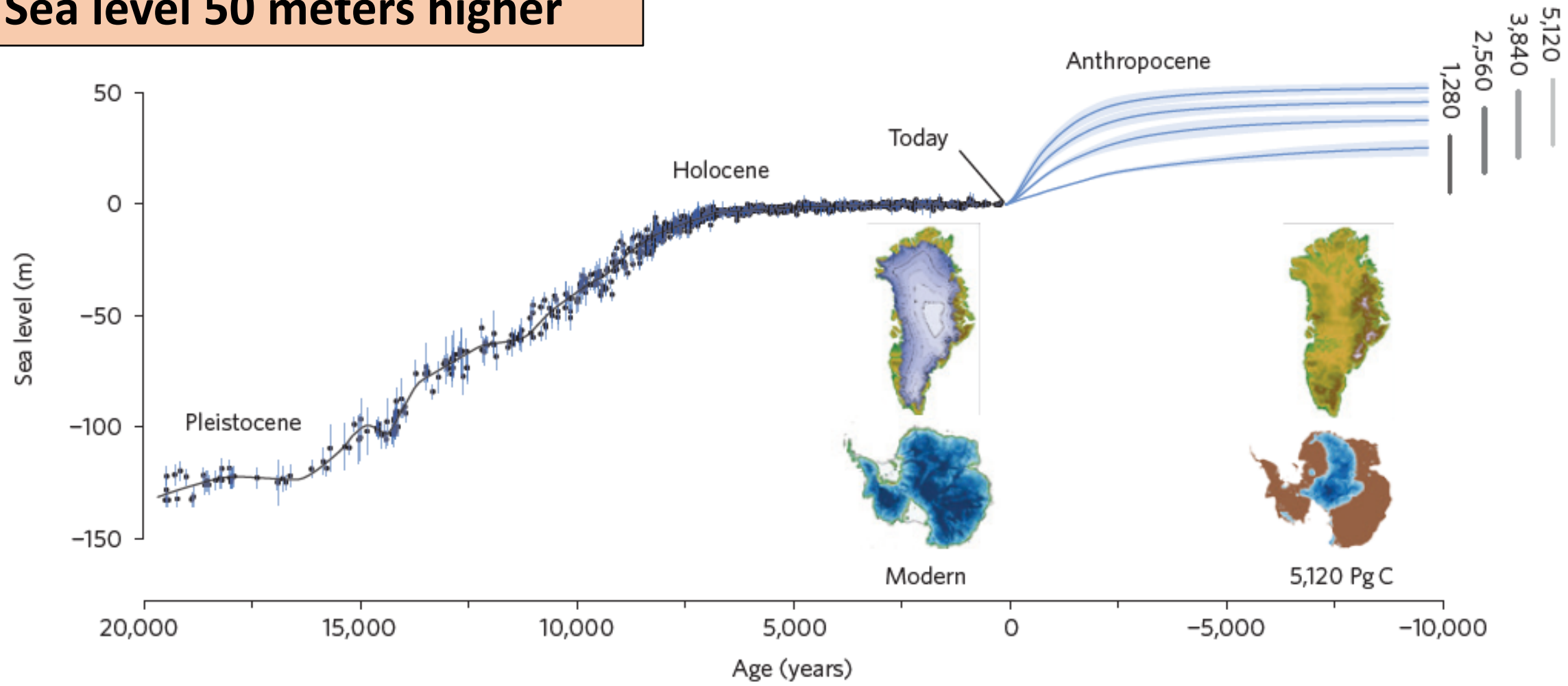


Figure from Aschwanden et al. (2019)

REVIEW - The *Really* Long View – 12,000 CE

Under the highest emission scenario, Greenland gone, Antarctica smaller

Sea level 50 meters higher



Mitigation and Adaptation

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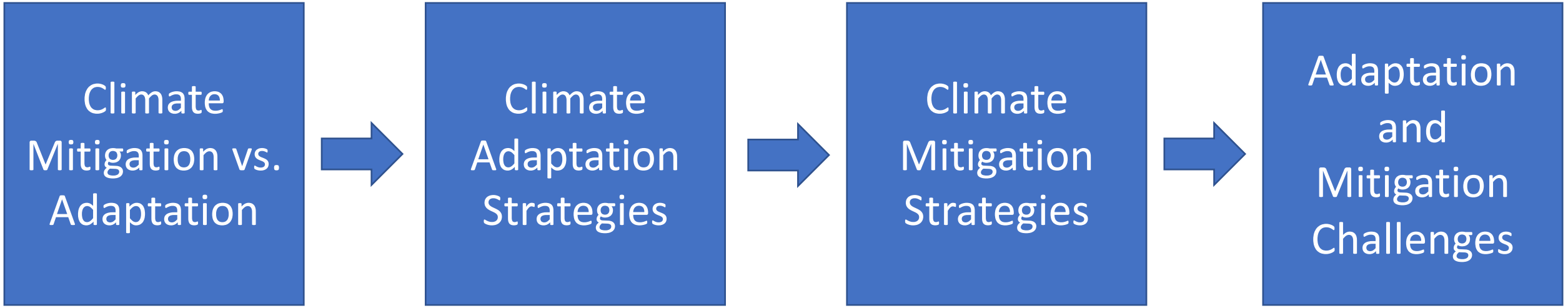
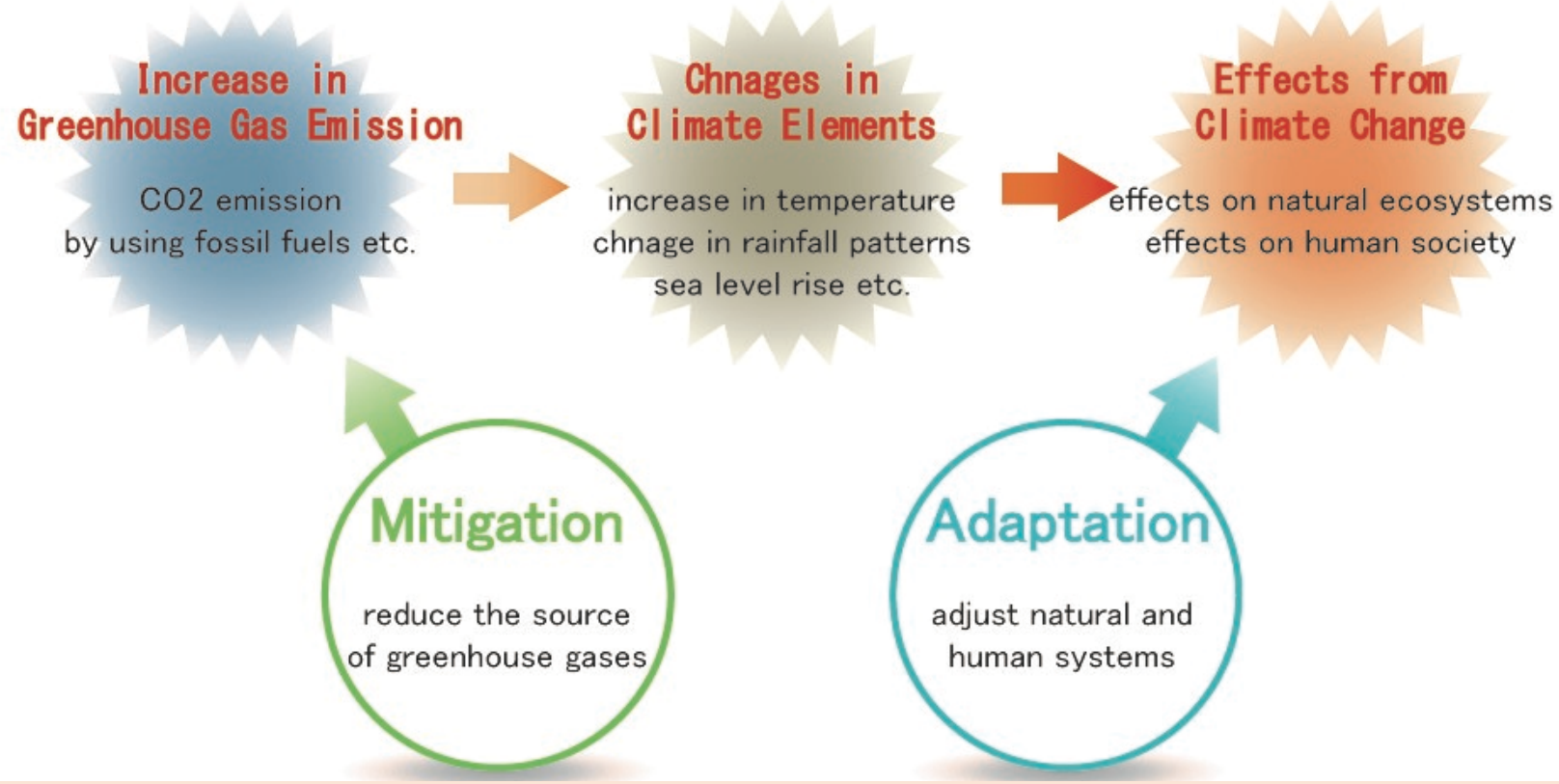
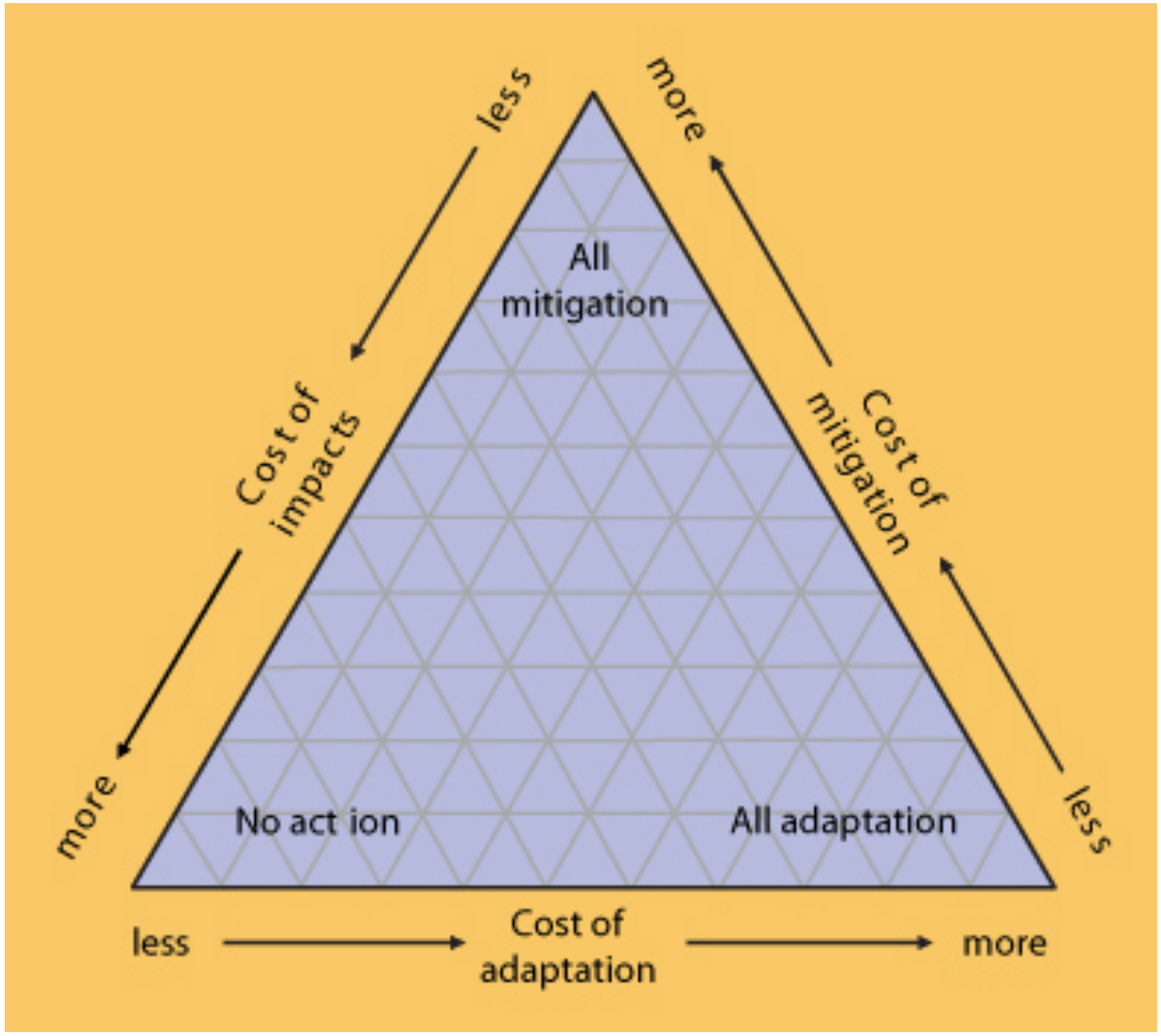


Think - pair - share

Two fundamental measures to address climate change:
Adaptation and Mitigation



Work with a partner: write down, and get ready to share, 3 mitigations and 3 adaptations to climate change (and rising CO_2 levels)



Doing nothing about the effects of CO_2 and climate change is not a “free ride”.

Dealing or not dealing with climate change will cost society – lives and money are on the line

Ambitious **GHG** mitigation = *Smaller* INCREASE **in global** temperatures = *Less* sea-level **RISE**

= *Less* **investment** in adaptation and **damage** to **coastal infrastructure**

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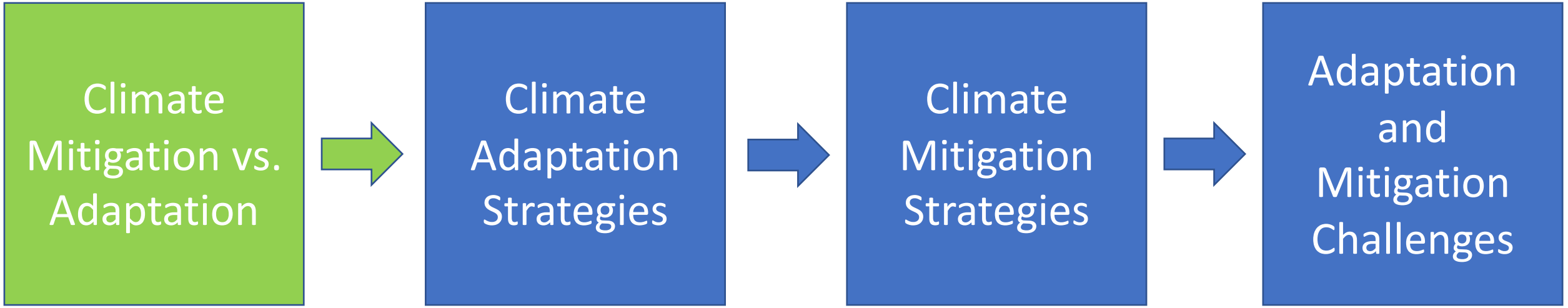
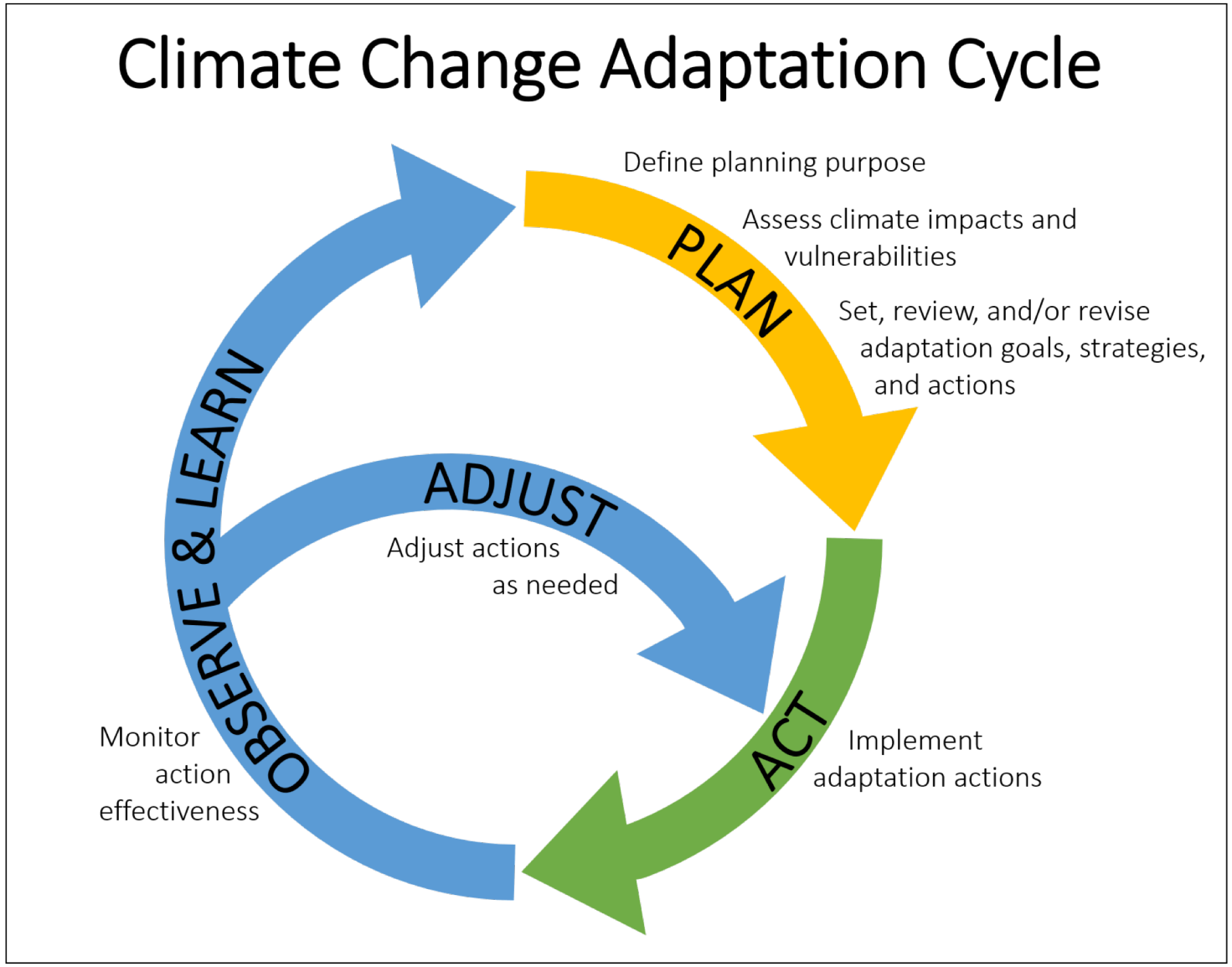
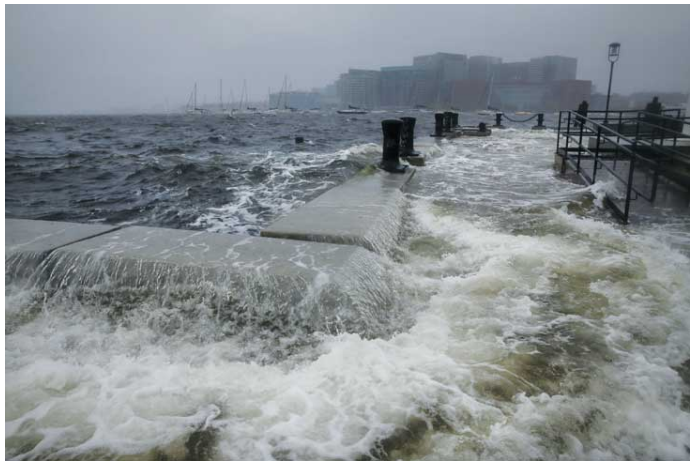


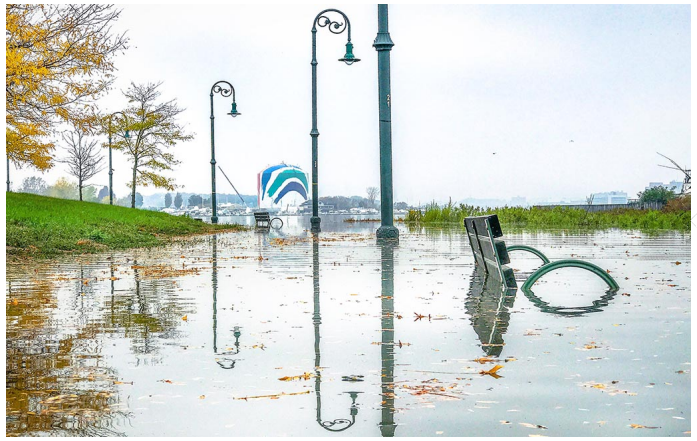
Adaptation Strategies (not geoengineering, next class)

Sea level
Water supply
Winter sports



Sea level is rising at an easily measurable rate; result is increasing nuisance flooding



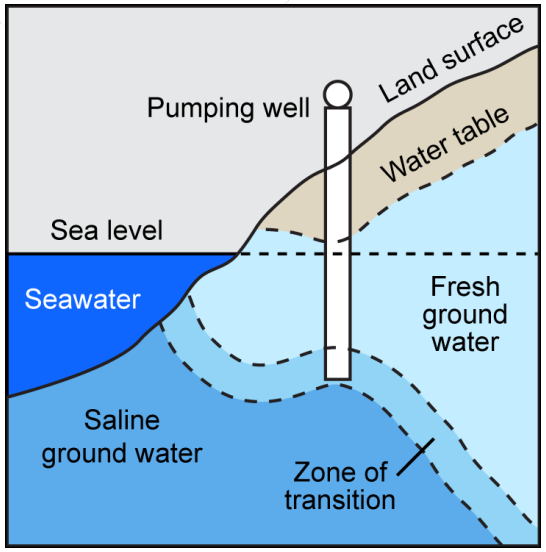


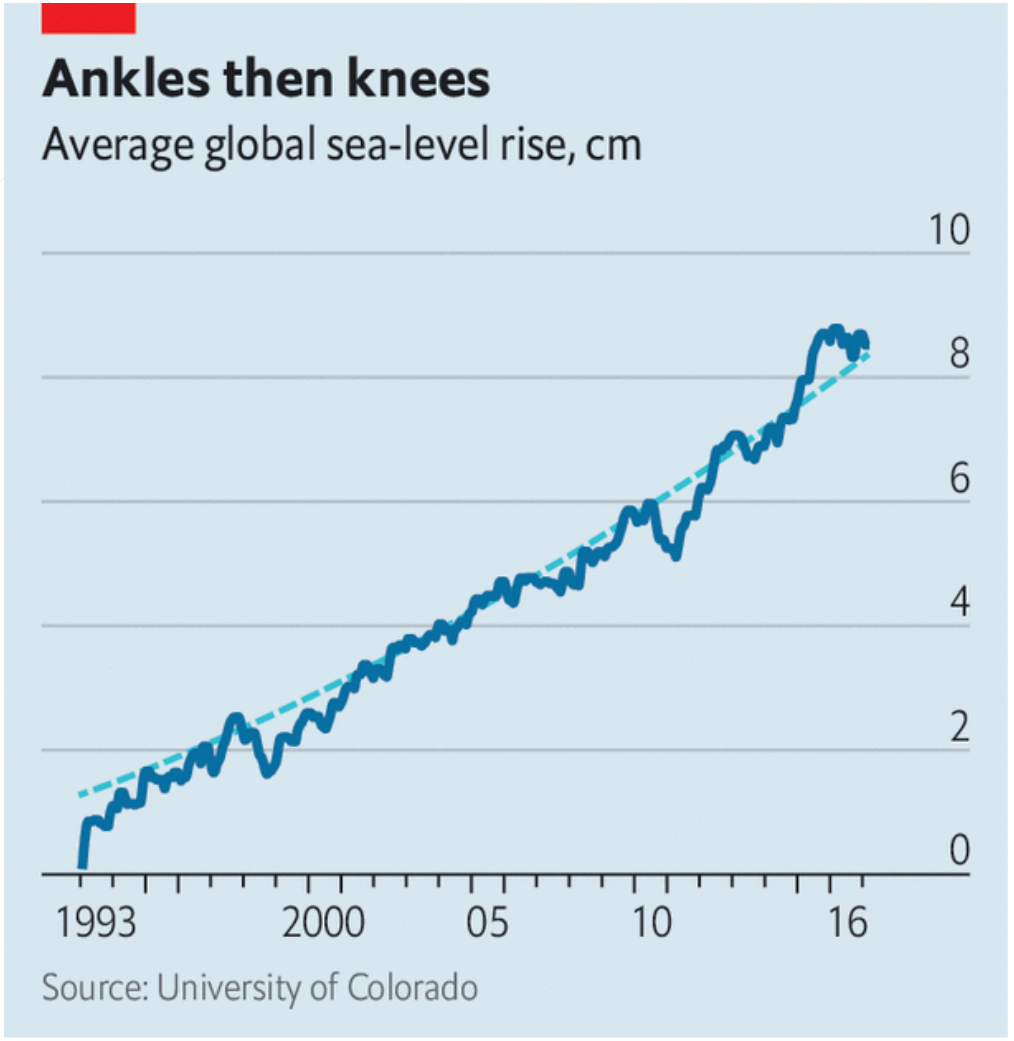
ScienceNews
INDEPENDENT JOURNALISM SINCE 1921

FEATURE SCIENCE & SOCIETY

With nowhere to hide from rising seas, Boston prepares for a wetter future

The coastal city is taking the hint from recent storms and floods

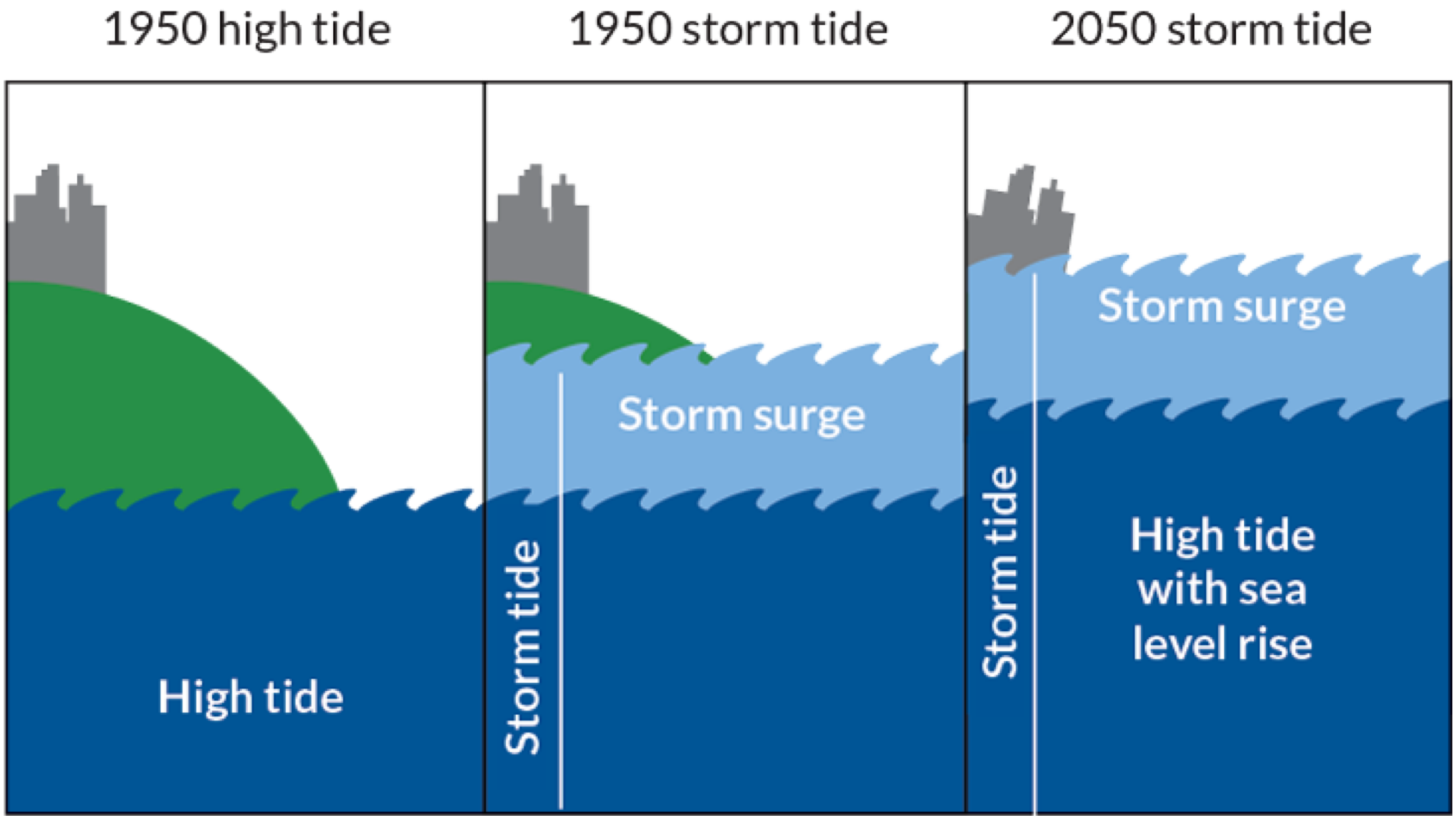




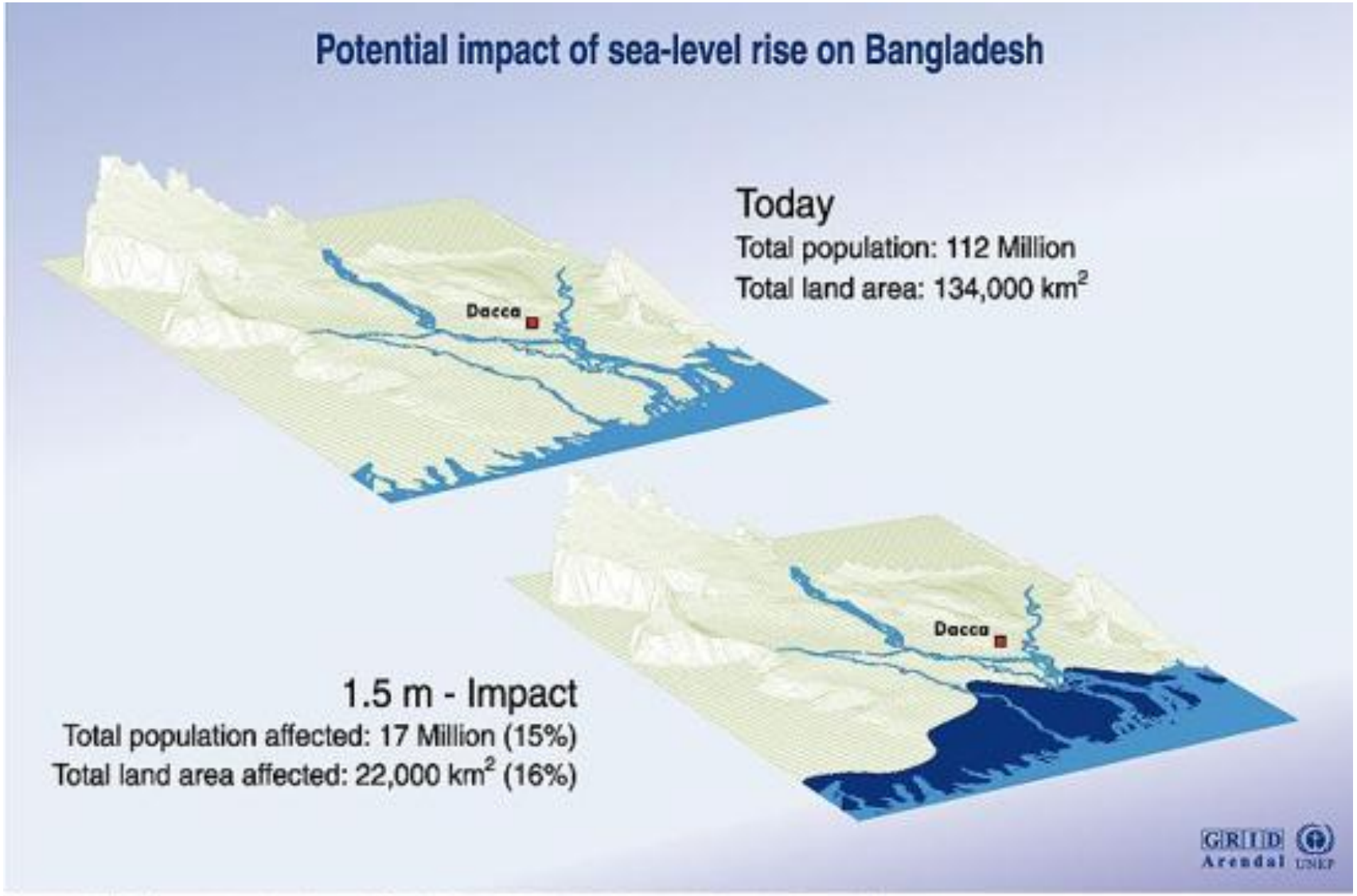
The Economist

Impacts first felt at high tides and with storms

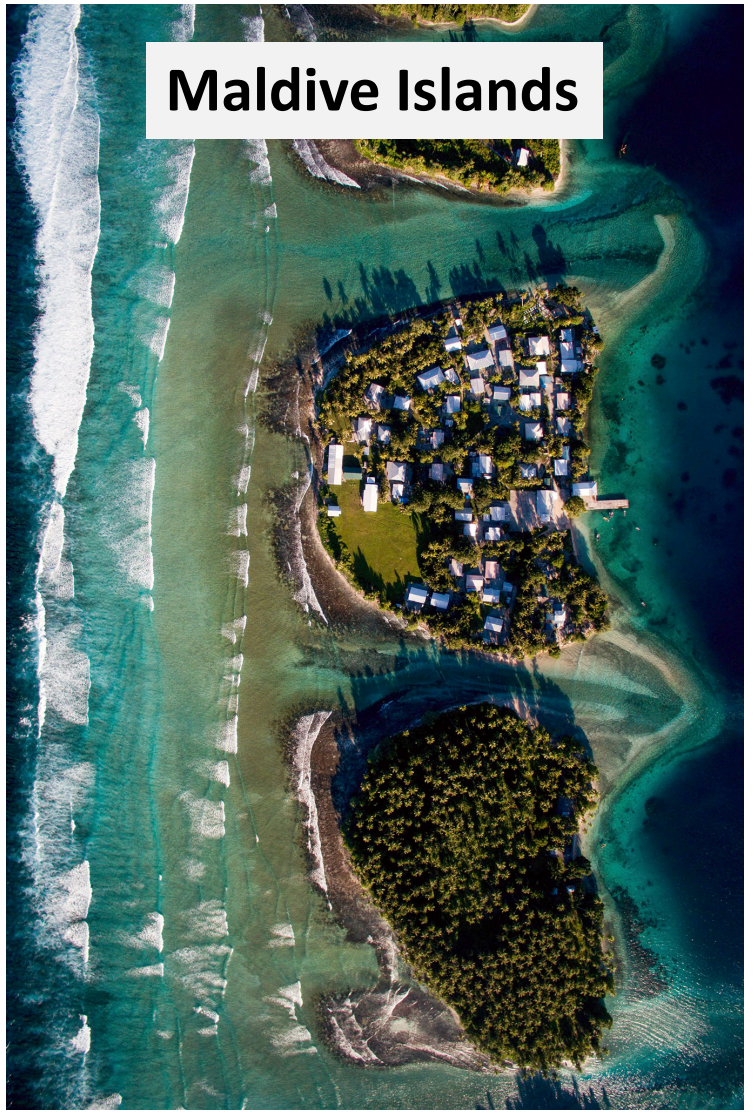
Impacts first felt at high tides and with storms



The impacts are more dramatic elsewhere – environmental justice issues



Source : UNEP/GRID Geneva; University of Dacca; JRO Munich; The World Bank; World Resources Institute, Washington D.C.



Dealing with rising sea levels there are choices

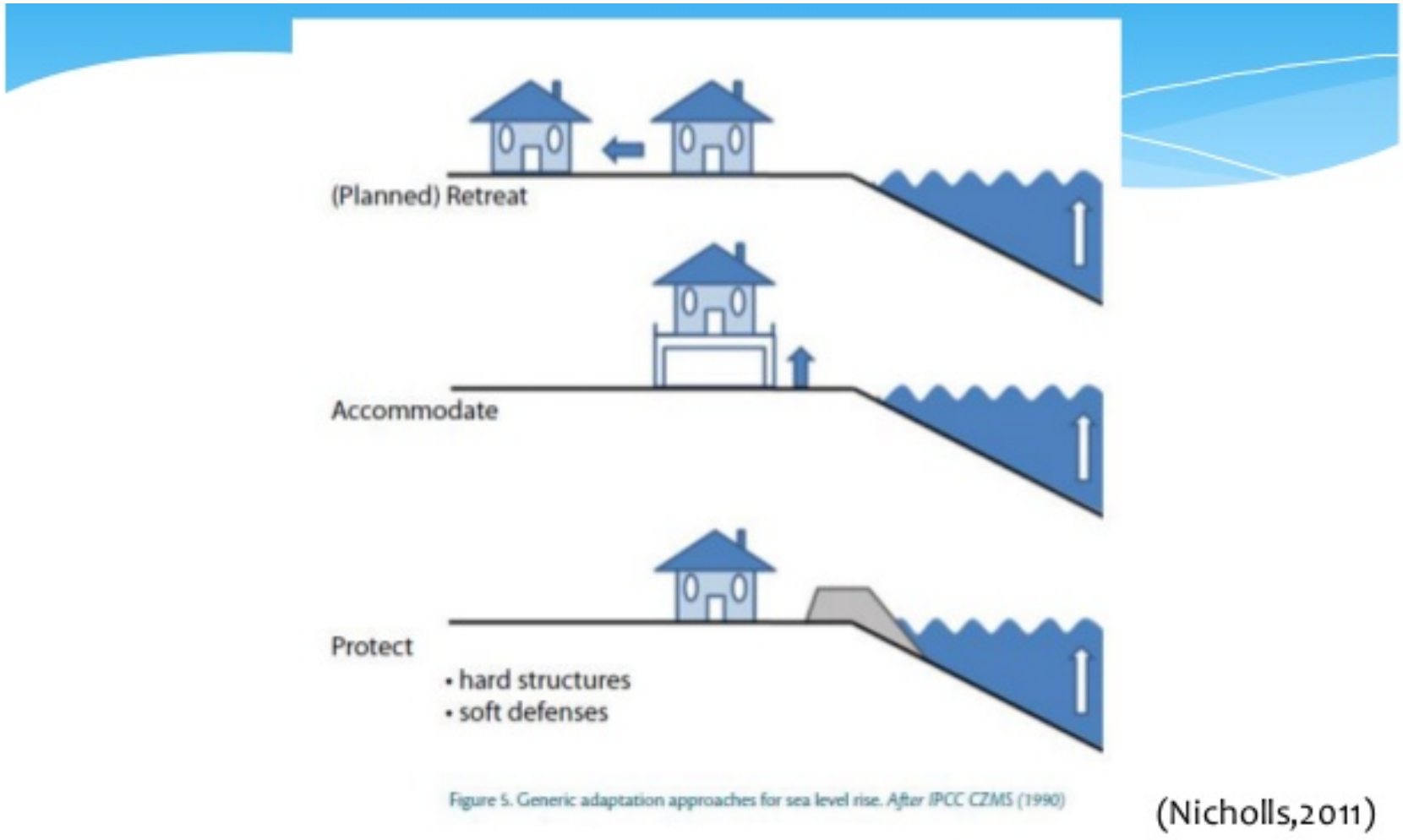


Figure 5. Generic adaptation approaches for sea level rise. *After IPCC CZMS (1990)*

(Nicholls,2011)

Raise your home and let floods happen - a short-term strategy

New Orleans, Louisiana

St Augustine, Florida

Amsterdam, Netherlands = floating homes (house boats)

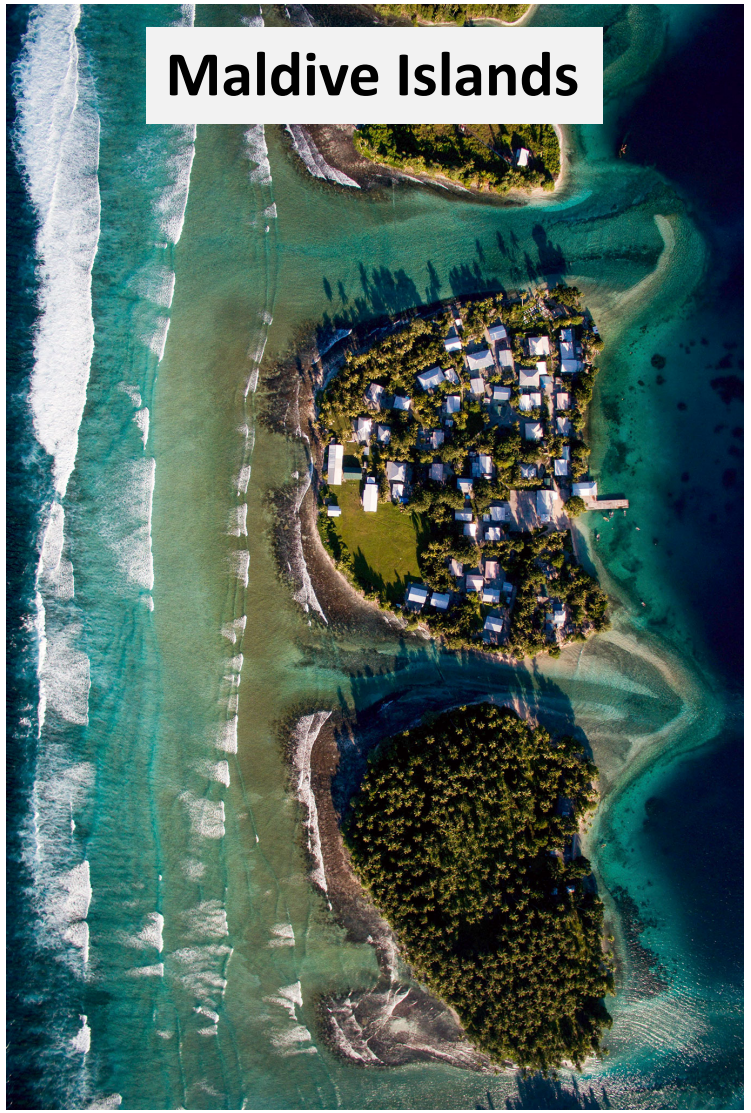
Hard and soft infrastructure adaptation – is it enough?

Managed retreat – abandoning properties and perhaps entire cities and even nations to rising waters

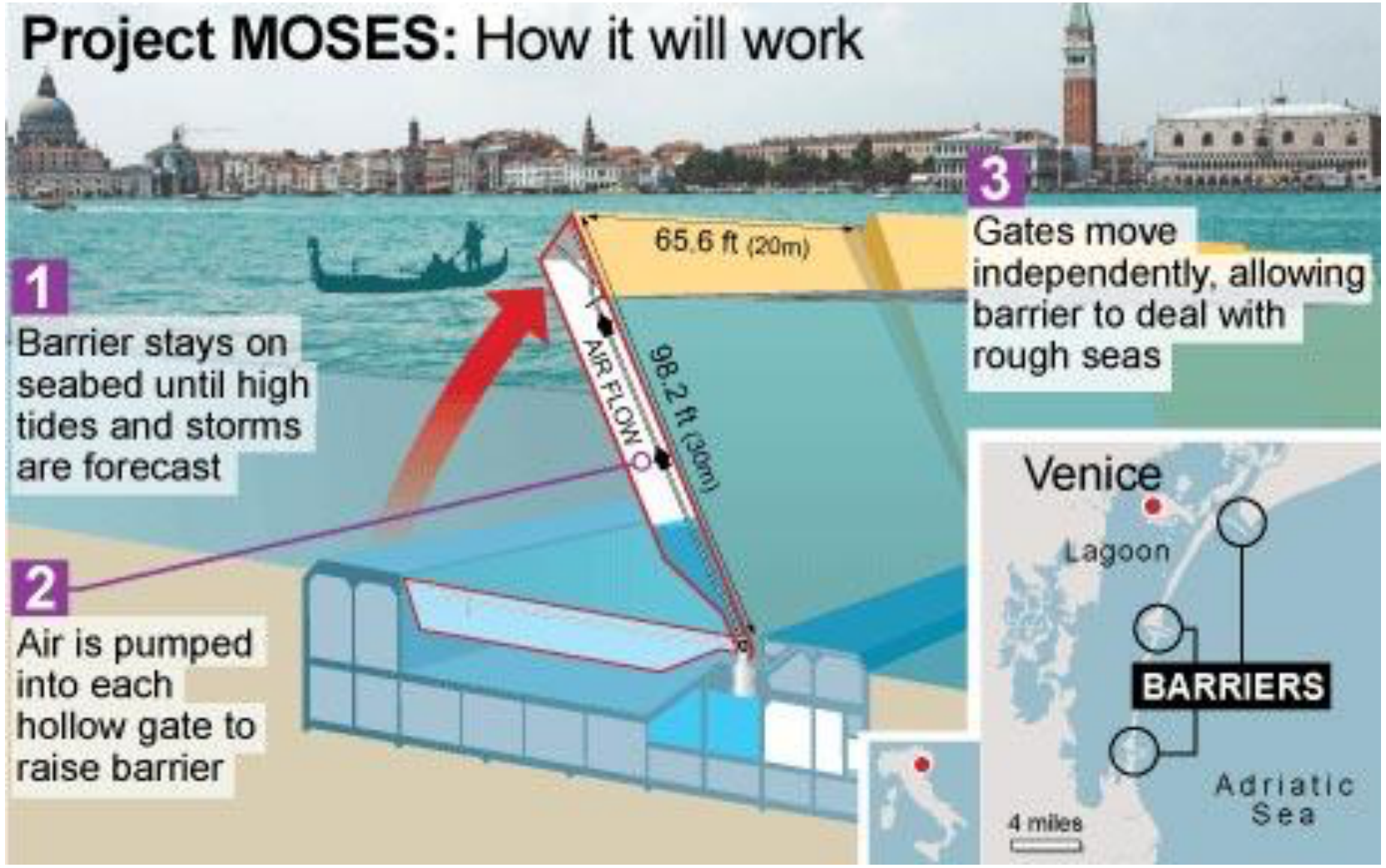
ENVIRONMENT

Rising seas give island nation a stark choice: relocate or elevate

"This strategy is a political quagmire. It involves tremendous legal and equity issues, because not all property owners are willing sellers."

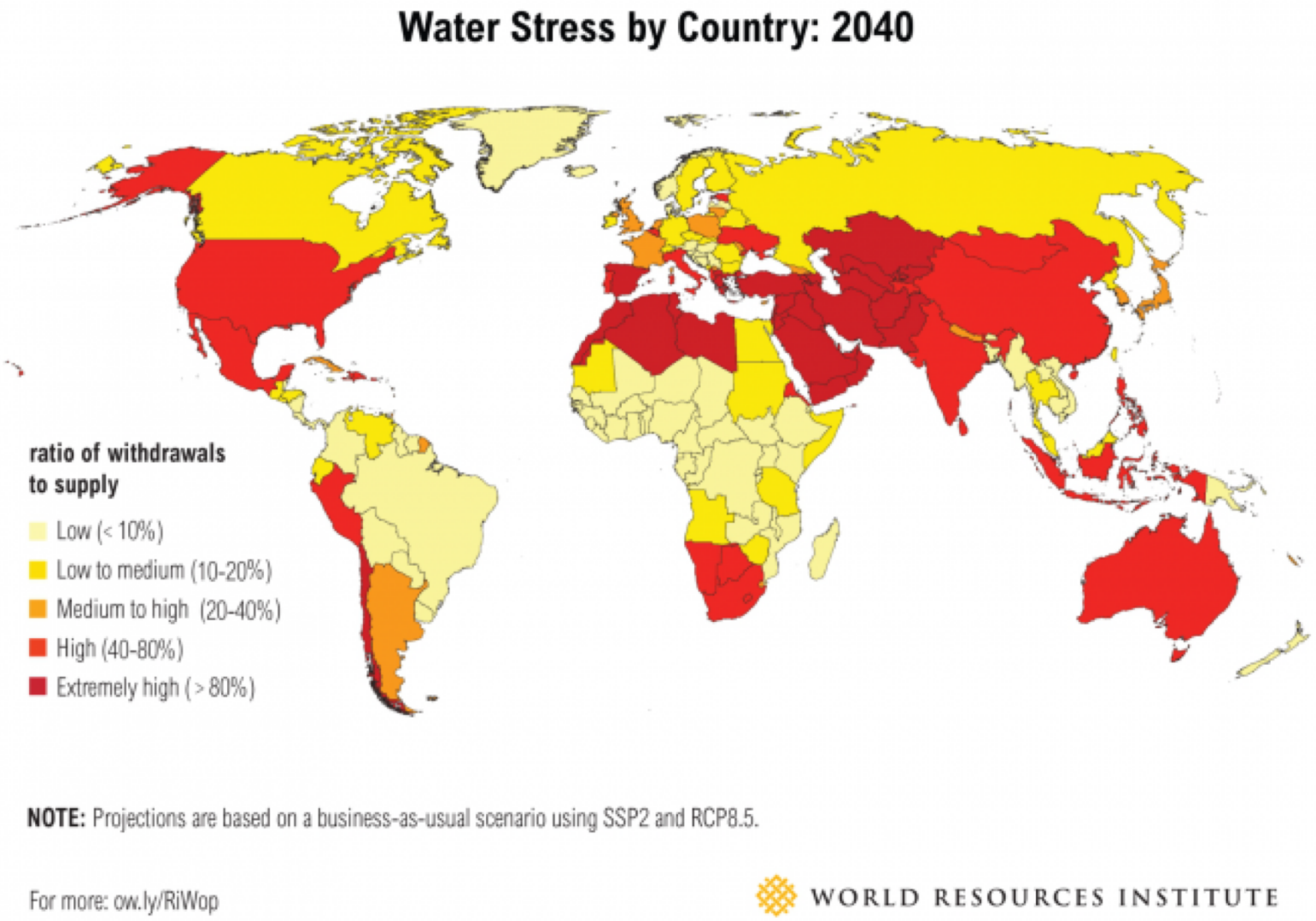


Build big – barriers to hold back rising seas



A $6.5 billion sea wall to stop Venice from flooding. The Mose project remains unfinished and so in 2018, most of the city was again underwater. London is doing the same on the River Thames.

Will need to waste far less water as climate warms




5

Skiing in a challenge when there's no snow – enter man-made and stored snow

Craftsbury Vermont, fun course

Dresden, Germany, world cup race course

Climate adaptation by UVM in Vermont

http://www.uvm.edu/~snowstor/

APPLY SEARCH MYUVM

The University of Vermont

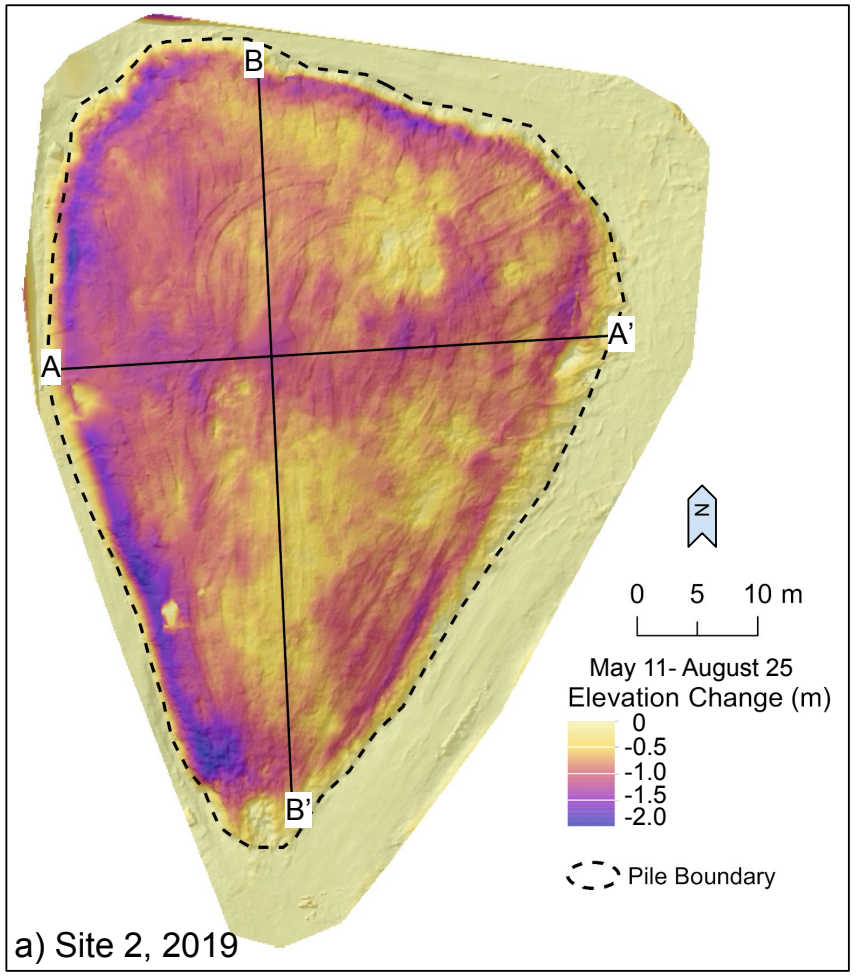
A 2018 snowpile after it was covered in chips. NSF-supported LIDAR is collecting hundreds of thousands of survey points in just minutes while we wait. This is hov we measure snow loss from the piles over time. Project supported by UVM Gund Institue for Environment, Rubenstein School for the Environment and Natural Resources, College of Arts and Sciences, and Geology Department.

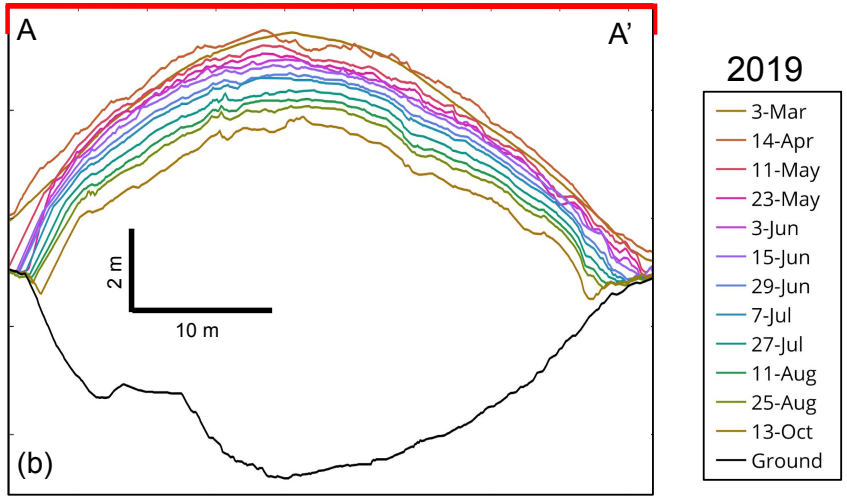
- UVM Home
- UVM Summer snow storage
  - What are we doing?
  - Science Behind Snow Storage
  - Snow Storage Elsewhere
  - Updates, Our Blog
  - 2017/2018 Photo Gallery

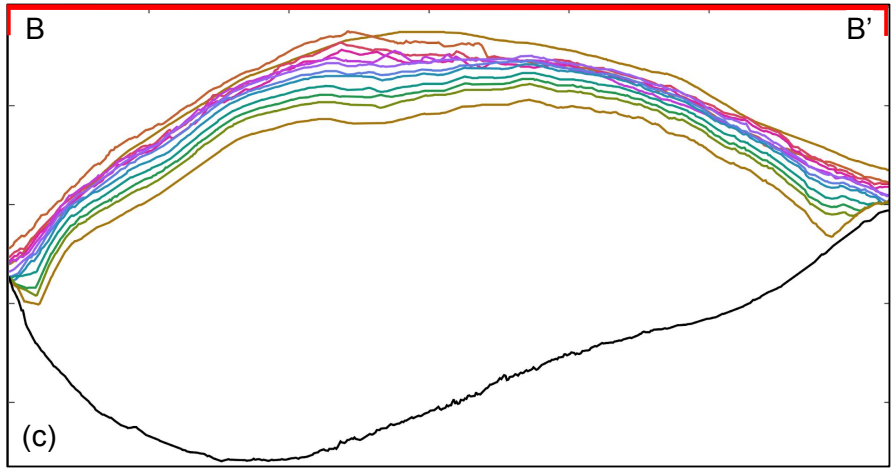
UVM Summer Snow Storage at the Craftsbury Outdoor Center

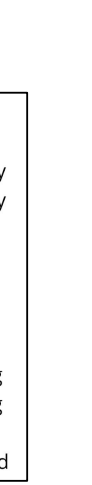
Remember icehouses where winter ice was stored under sawdust for use in the summer? Faculty and students from UVM are working with the Craftsbury Outdoor Center to test and refine methods of oversummer snow storage to see if we can do the same with thousands of cubic meters of snow! The goal is reliable nordic skiing in late fall and early winter winter while at the same time reducing energy costs and carbon emissions from snow making. And, as you can see in this video, it's just plain fun to ski in July.

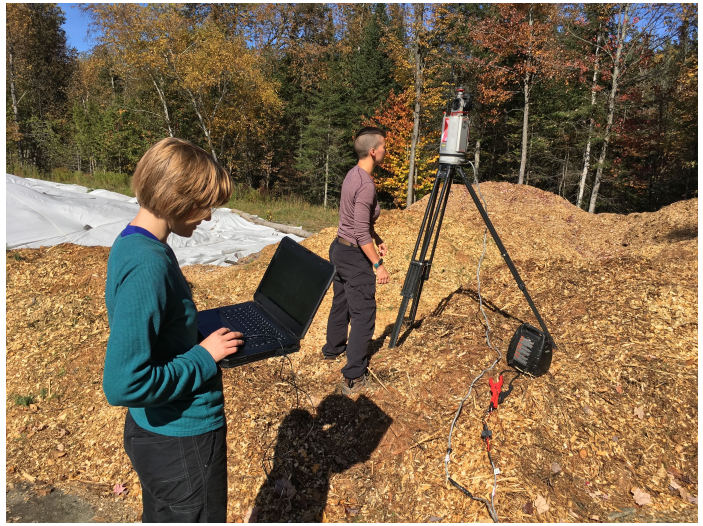
More than 60% of the stored snow survived over the summer!











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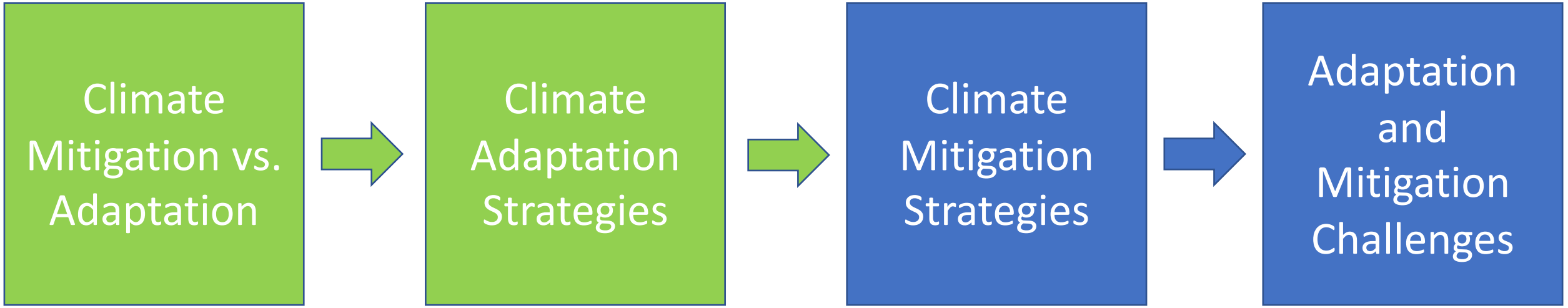
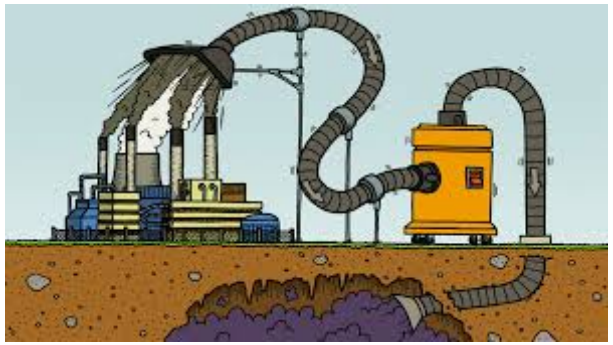
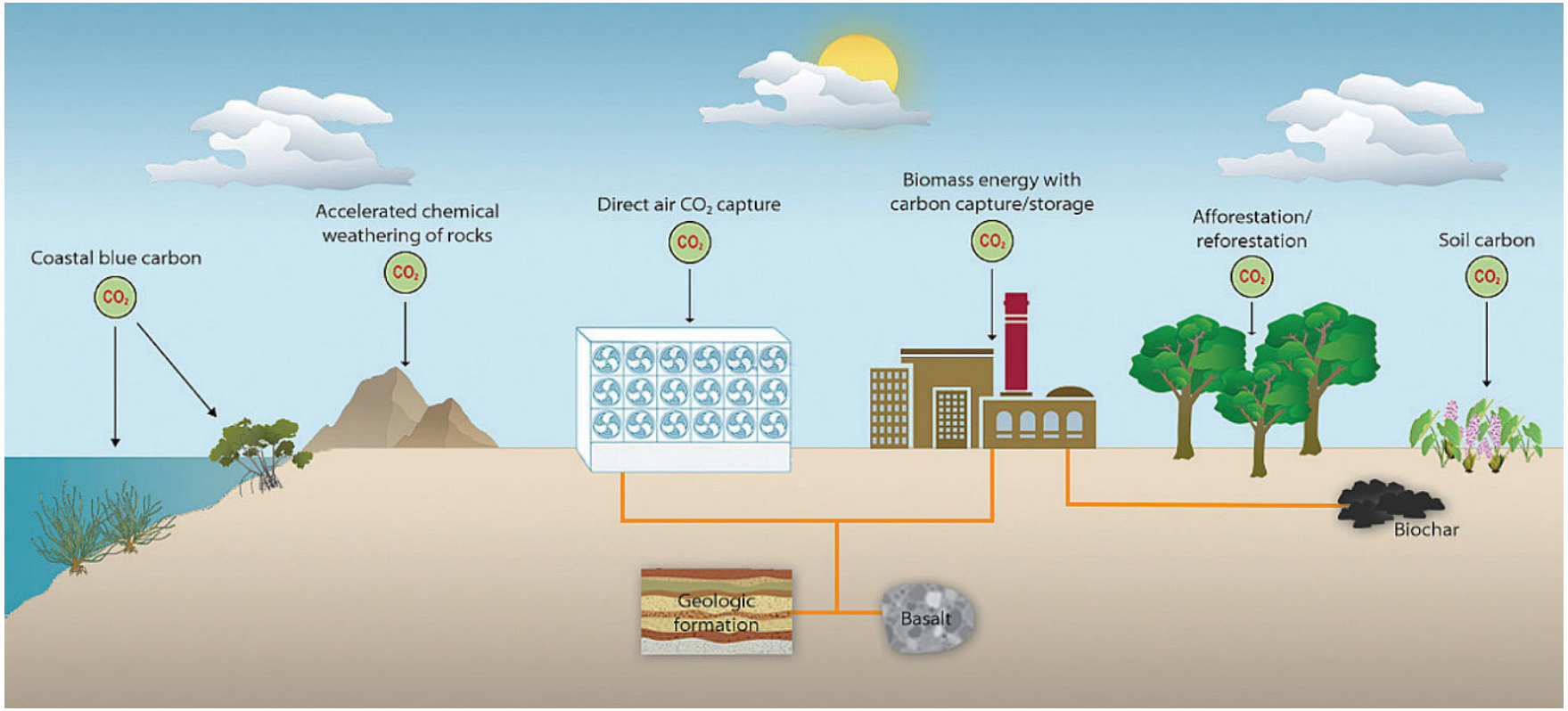


Climate Change Mitigation – some proposed ideas

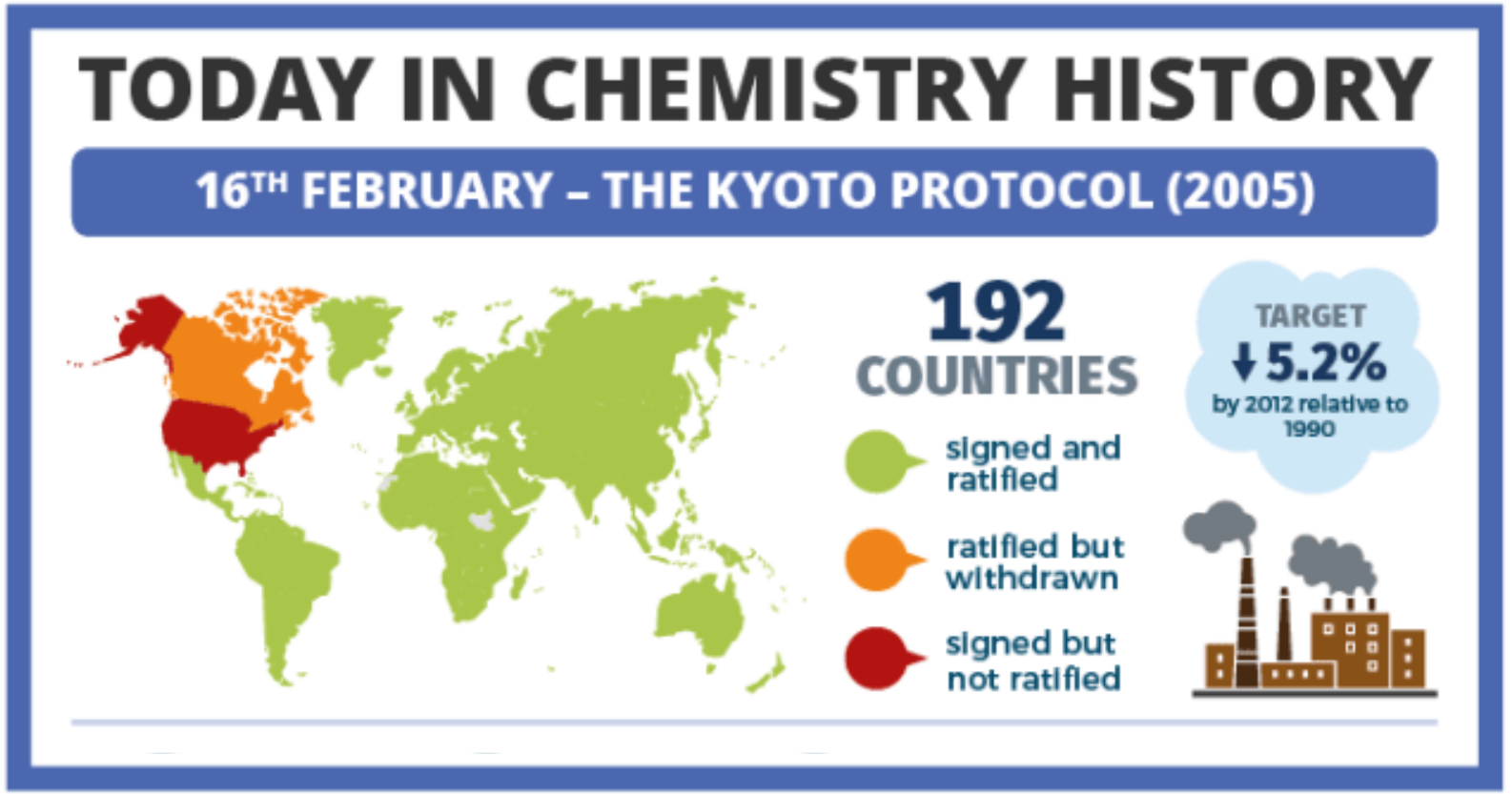


Goal = Get CO_2 out of the atmosphere

1. Carbon capture and storage
2. Enhanced chemical weathering– almost geoengineering
3. Ecosystem protection and enhancement
4. Decarbonizing our energy system



Emission Reduction Policies/Pledges

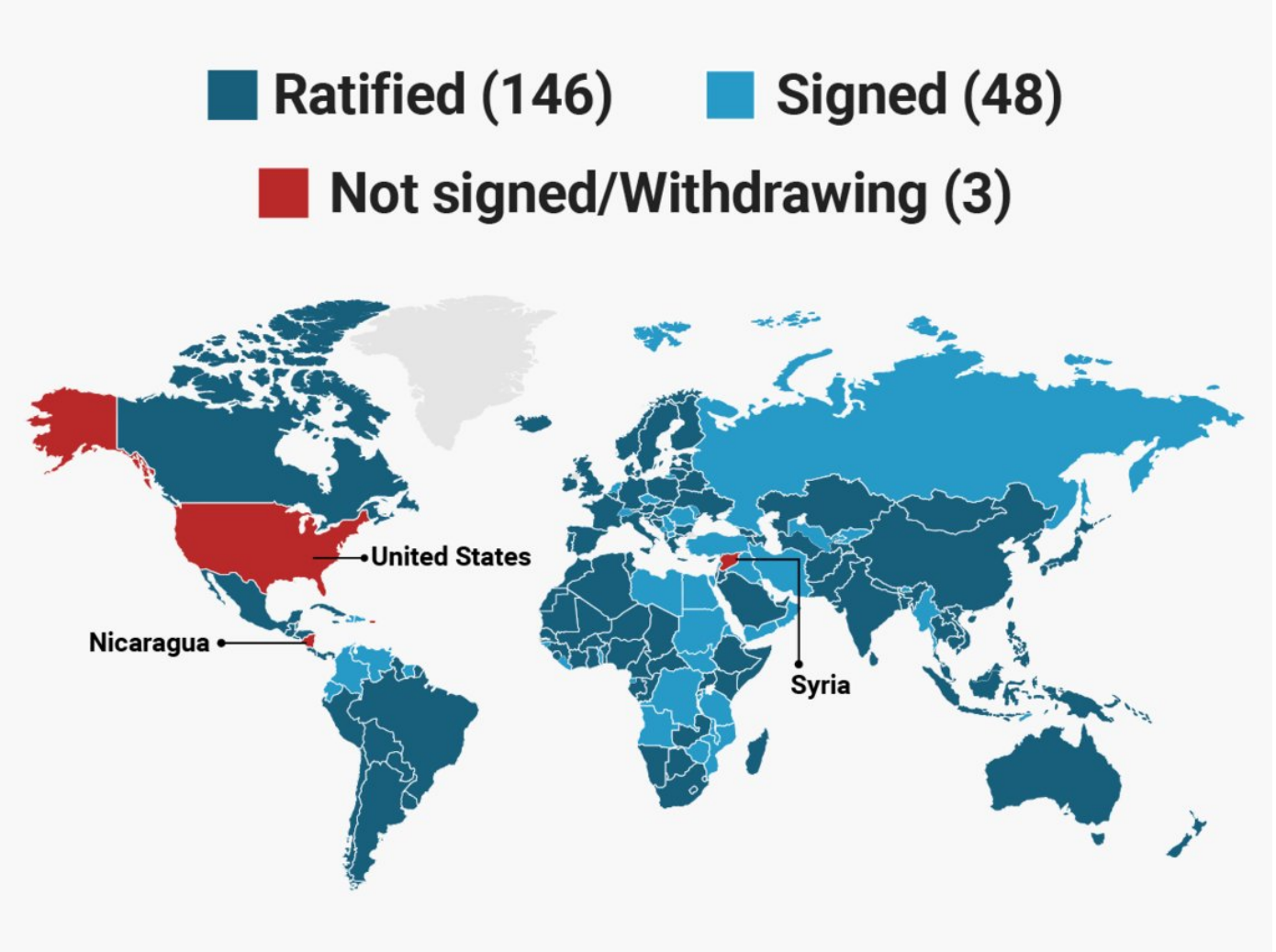


Kyoto Protocol – First signed in 1997 by 193 countries. President Bush withdrew the US in 2001. Aim was to reduce greenhouse gas emissions, but the biggest emitters (US, China, India) did not reduce and emissions continued to rise

Emission Reduction Policies/Pledges

Paris Climate Agreement – Signed in 2016. Goal is to keep global temperature increase below 2°C, ideally below 1.5°C.

No mechanism to force any country to reduce emissions by a certain time. Voluntary emissions targets, not legally bound



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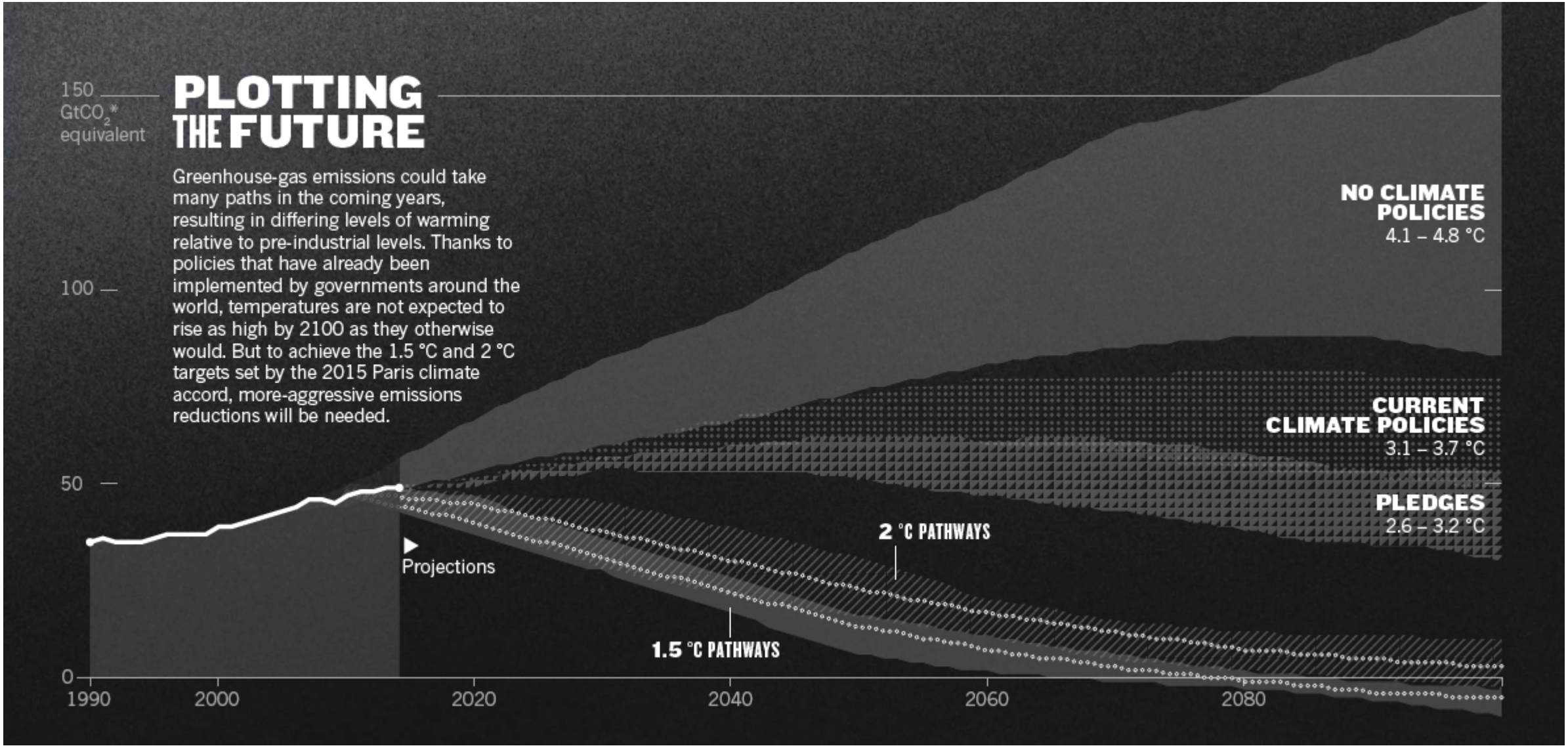
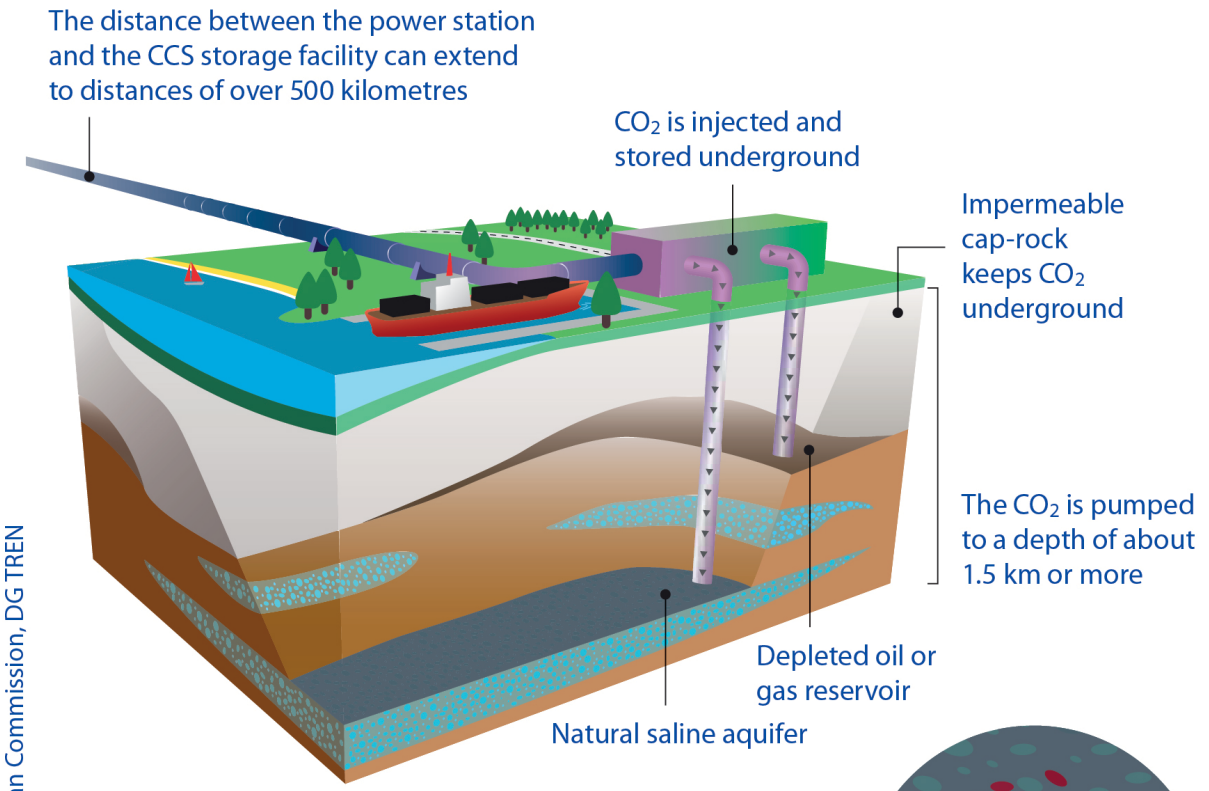
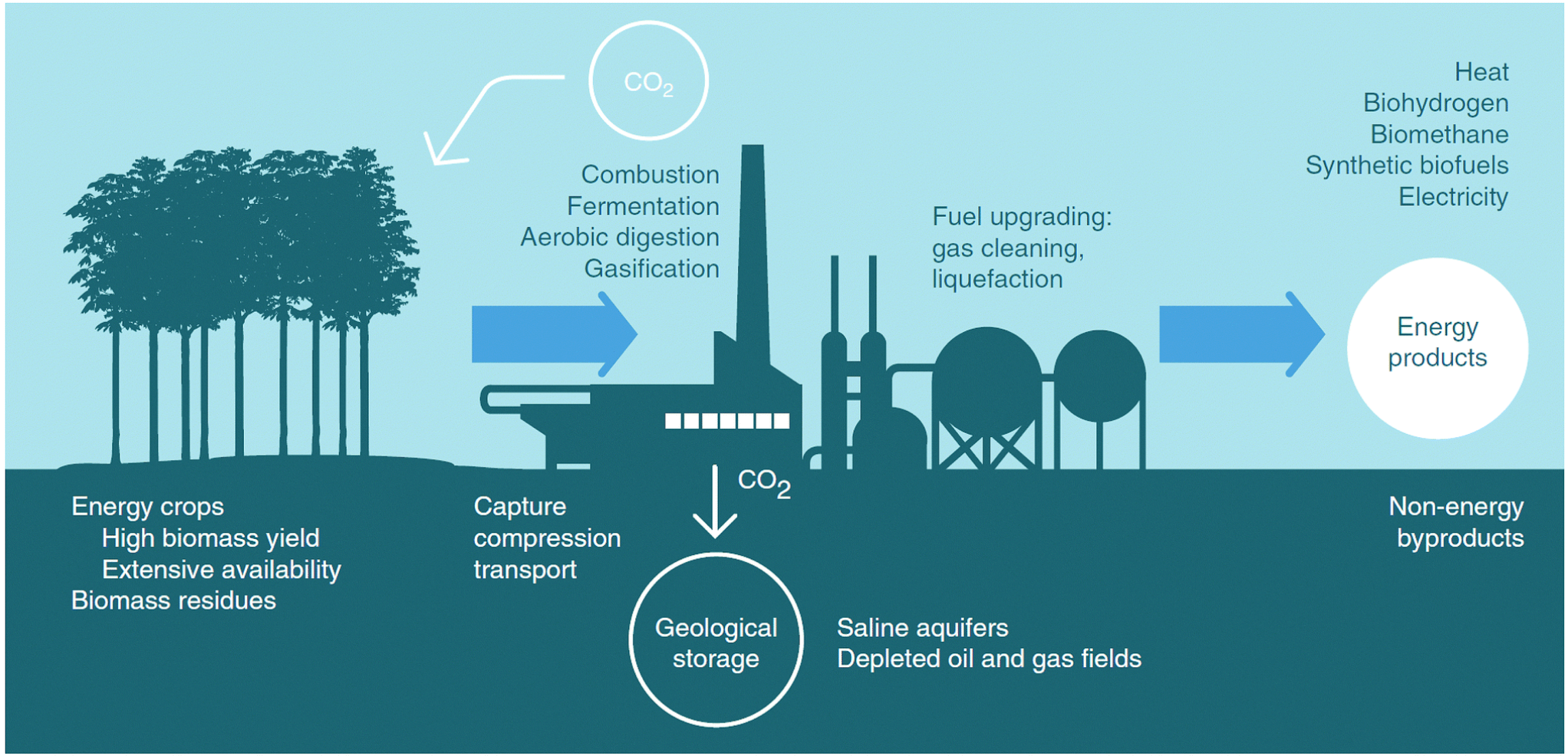


1. Carbon capture and storage – with fossil fuels – reduce CO_2 rise



1. Carbon capture and storage – with biomass – net CO_2 reduction



Scientist Profile: Dr. Doris Hamill, NASA

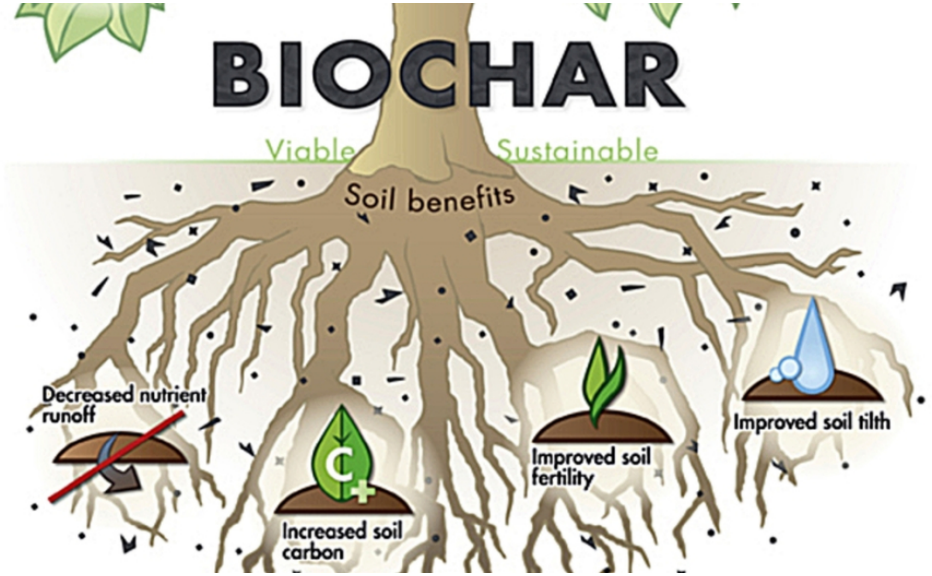
Hamill has degrees in physics and biophysics. She began as an Air Force officer and became a program manager with the Defense Advanced Research Projects Agency. Since 2003, she has been with NASA Langley in several technology management roles. She has promoted biochar to various interest groups in the Hampton Roads region for 10 years.

“It hadn’t broken down, it hadn’t rotted or degraded or anything,” said Hamill, a physicist with a deep interest in green technologies. “And that made people say, ‘Hmmm, you know, if biochar can be put in soils and not break down for hundreds of years, this could be a real solution to global warming.’ ”

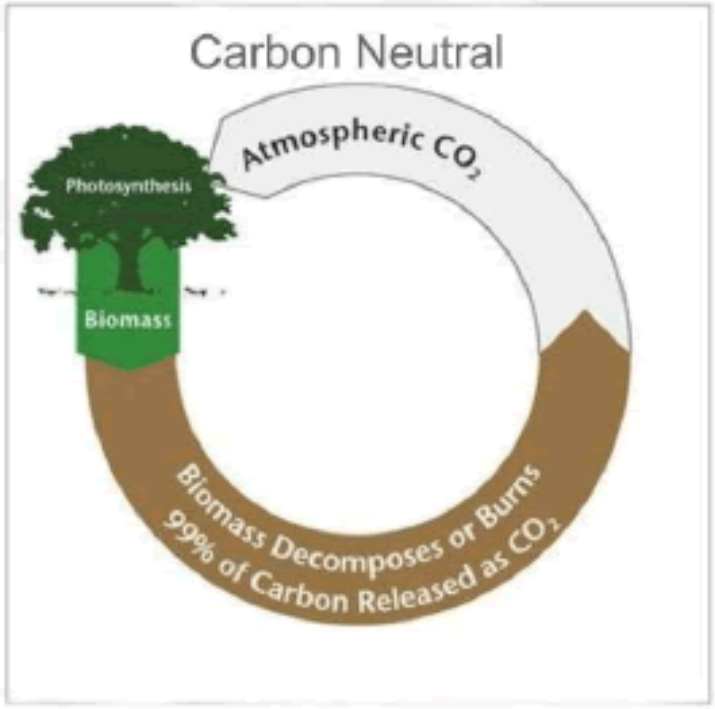
Biochar is an old idea

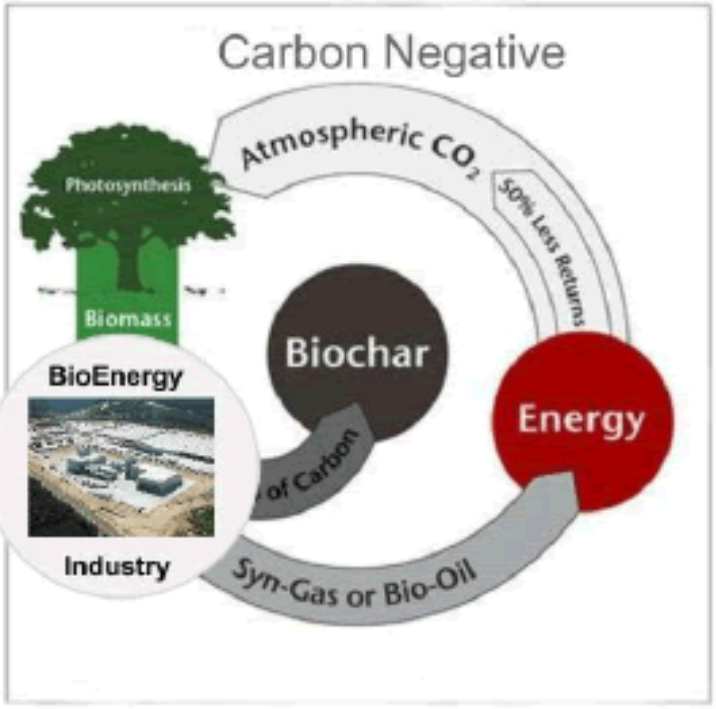
Terra preta (Black earth in Portuguese) is black because of charcoal content. It's human made and improves infertile Amazonian soils.

Charcoal is stable in soil for thousands of years, binding and retaining minerals and nutrients.



Adding Biochar to soils has multiple benefits – both for climate and plants





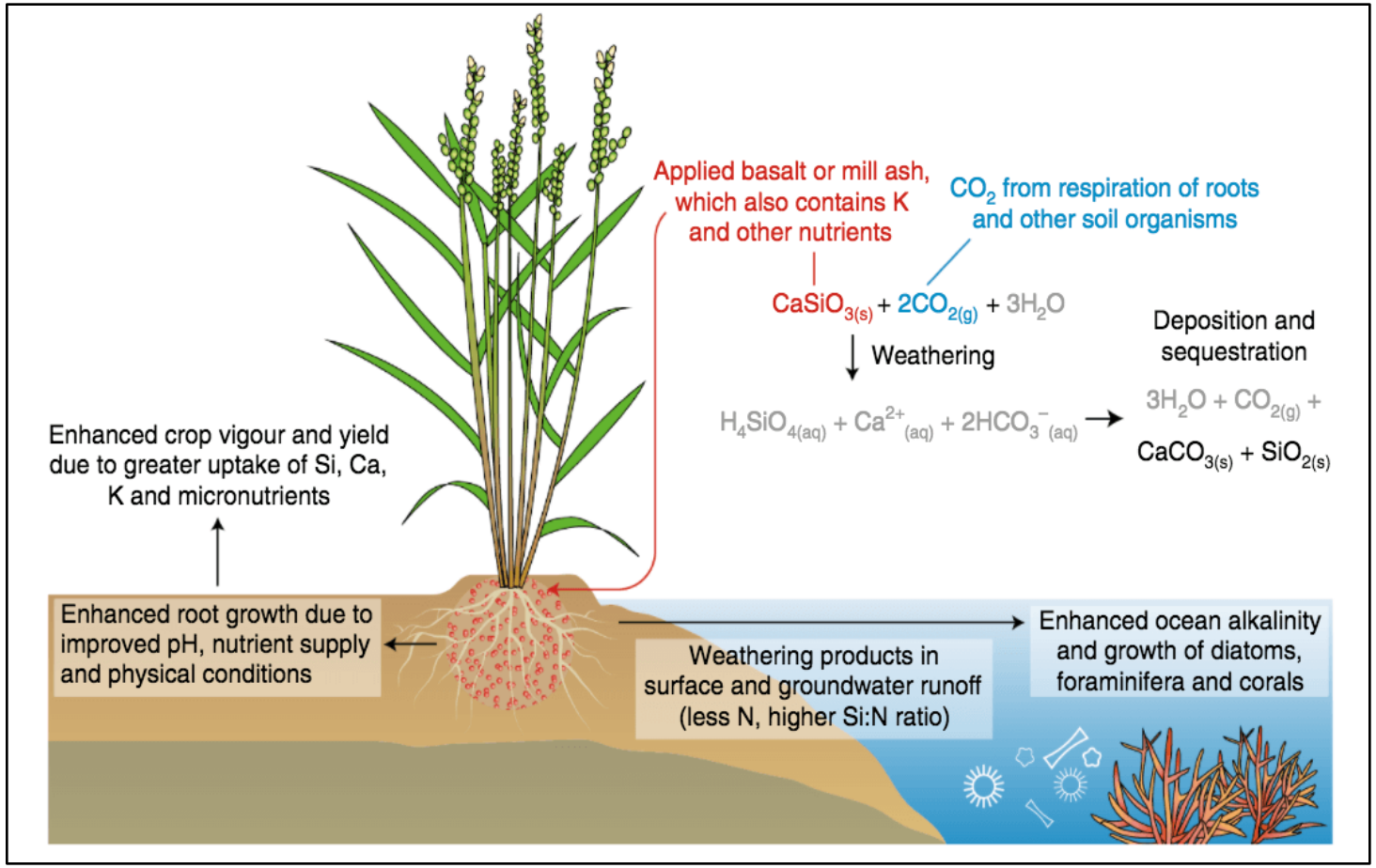
How Crushed Volcanic Rock in Farm Soil Could Help Slow Global Warming — and Boost Crops

A new study explores how planet-warming carbon dioxide could be absorbed using 'enhanced rock weathering,' a natural process sped up to fight climate change.

BY GEORGINA GUSTIN Follow @georgina_gustin

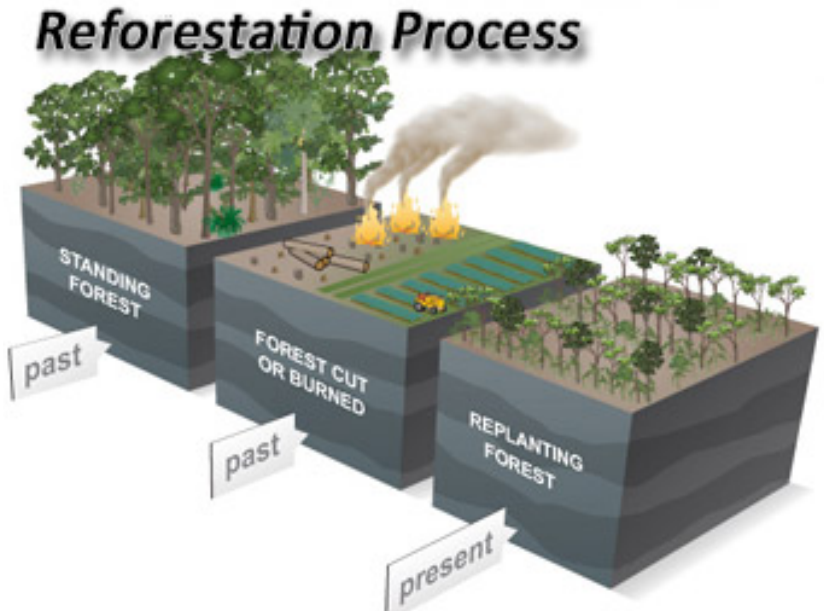
FEB 20, 2018

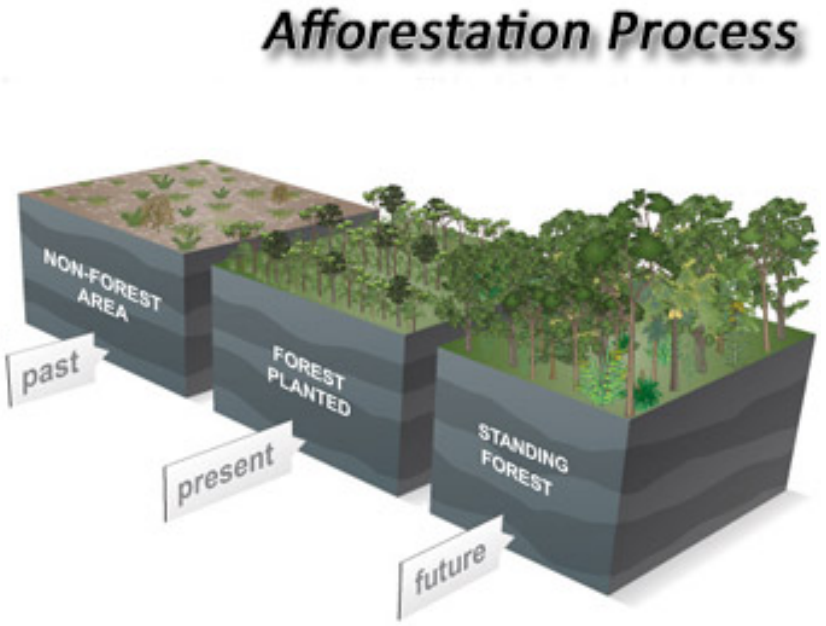
2. Enhance natural weathering systems

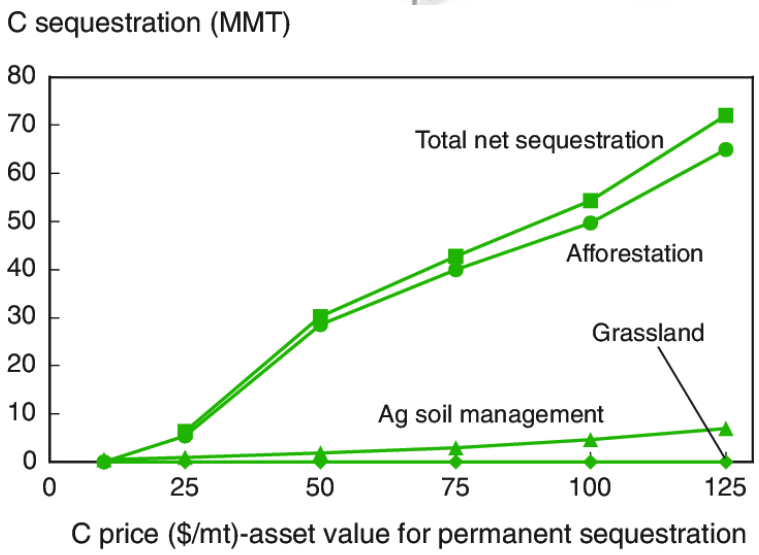


3. Climate Change Mitigation – bring on the trees

Growing and re-growing forests (and their soils) can sequester lots of carbon.







Source: Economic Research Service, USDA.

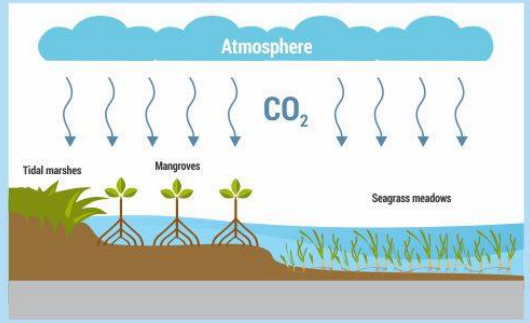
3. Well managed coastal zones hold large amounts of Carbon

What is Coastal Blue Carbon?

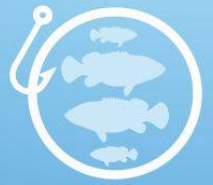
Coastal blue carbon is a term that recognizes the role of coastal ecosystems in the global carbon cycle. Mangroves, tidal marshes and seagrass meadows, collectively called coastal blue carbon ecosystems, extract carbon dioxide from the atmosphere and coastal waters over thousands of years.

Carbon Sequestration

"***Carbon sequestration***" refers to the removal and storage of CO_2 extracted from the atmosphere. "Blue carbon" refers to sequestered CO_2 stored in the form of organic carbon in vegetation (biomass) and soils.



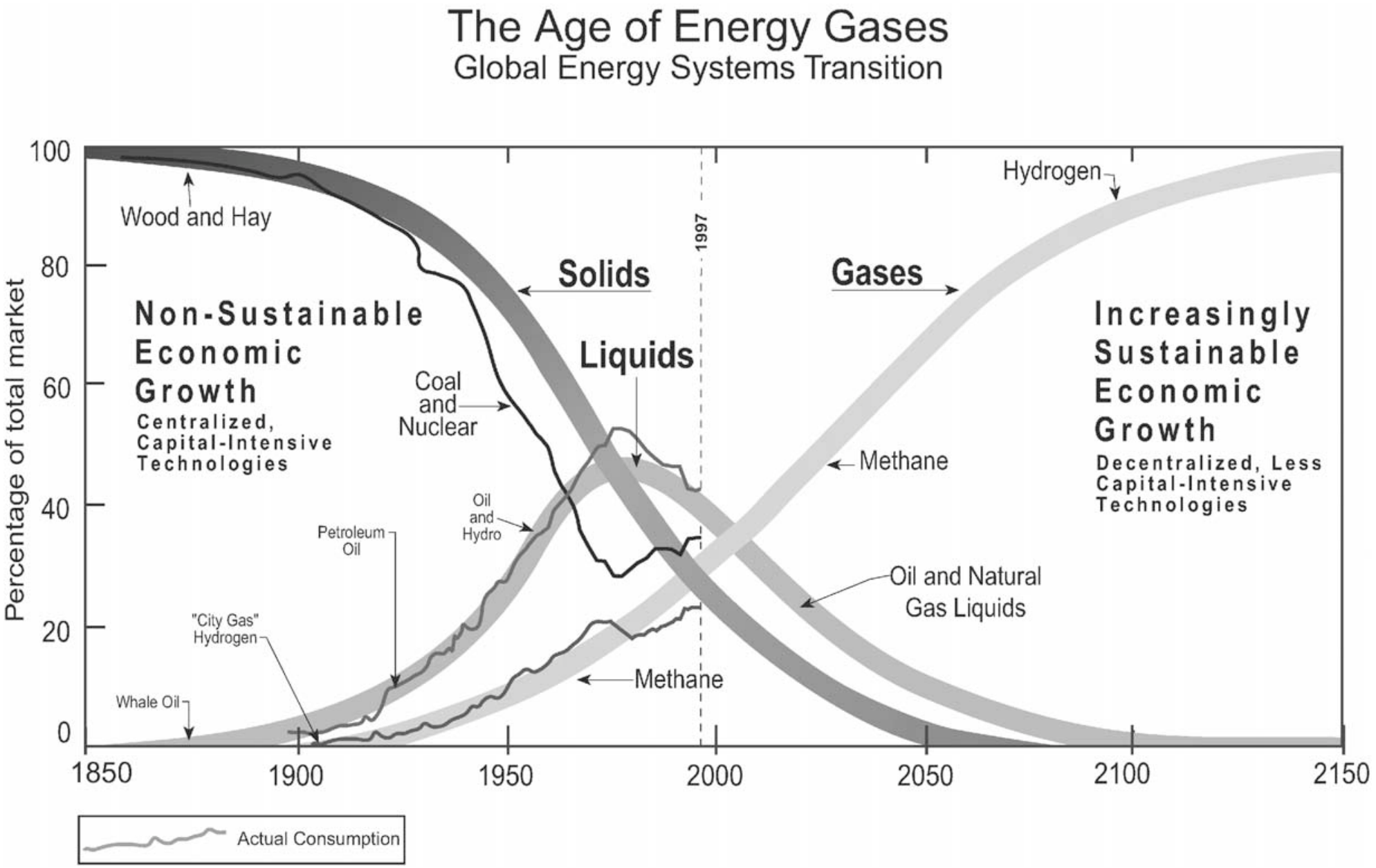
Approximately **48%** of carbon sequestration to long-term sediment storage across the entire ocean occurs within just 2% of the area hosting blue carbon ecosystems.



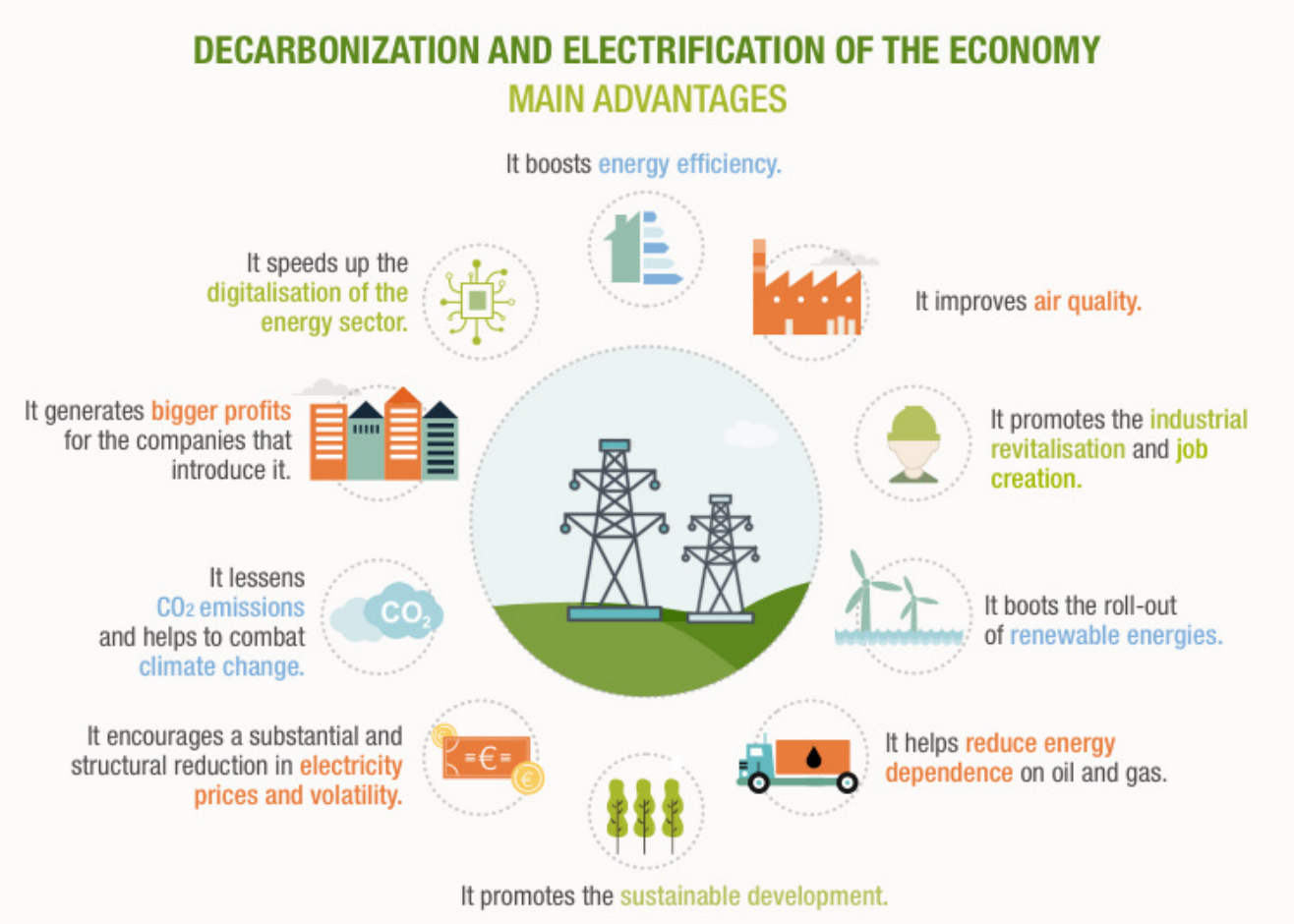
Aside from their climate regulating benefits, coastal blue carbon ecosystems provide an array of other ecosystem services including support of healthy fish stocks for maintaining food security, filtration of sediment protecting coral reefs and defense against erosion and flooding in populated coastal lowlands.

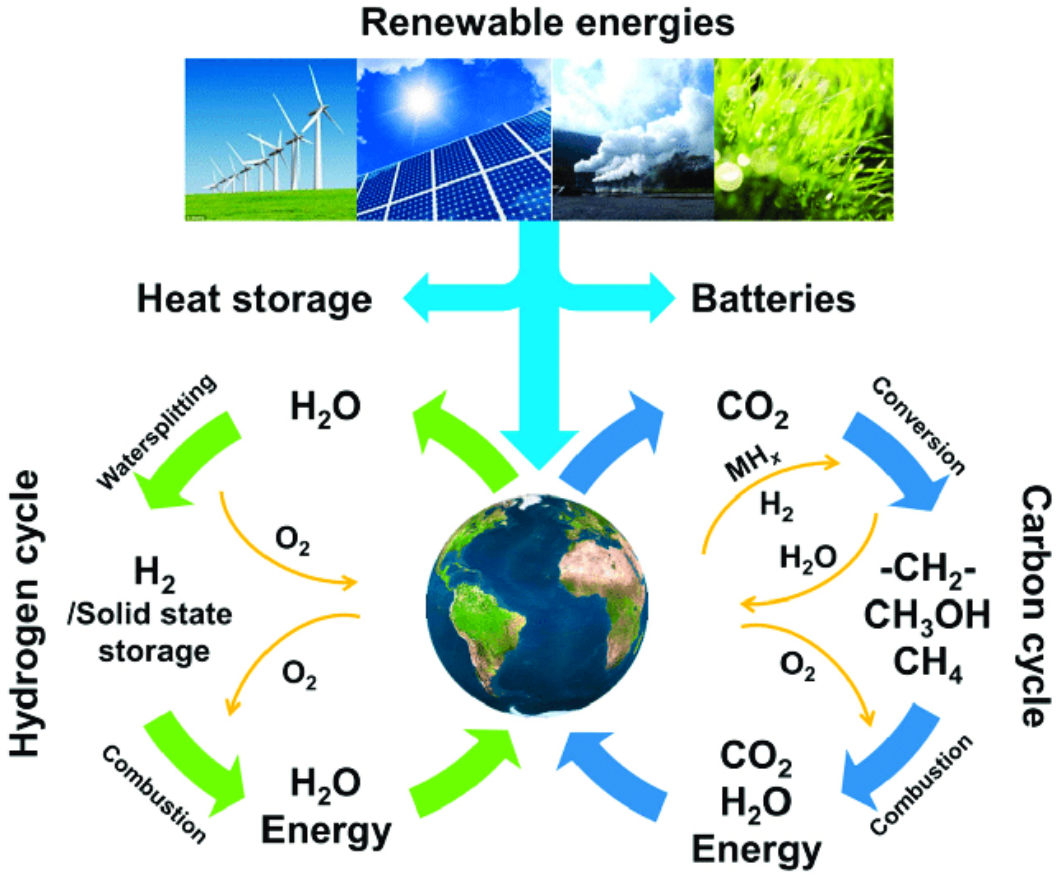
More than half of the world's population lives within 200 km of the coast, drawn to the environmental and economic services provided by these ecosystems.

4. Decarbonizing the global energy system – tough road



Electrification is likely; hydrogen is possible and linked to electricity (for water splitting)





Which of the following is NOT a climate change adaptation?

A. Raising houses so they flood less often
B. Armoring the coast to prevent flooding and erosion
C. Carbon capture and storage
D. Storing snow over summer so you can ski in the fall
E. Managed retreat from coastal zones

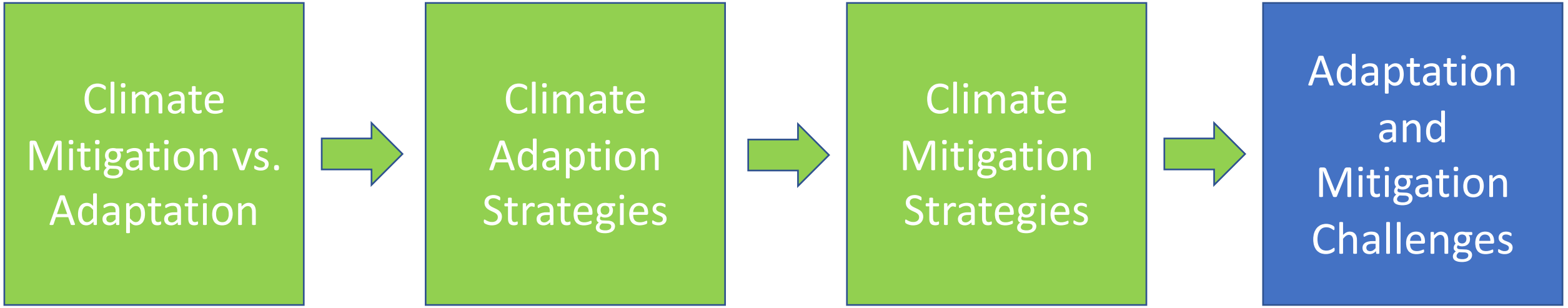
Which of the following is NOT a climate change mitigation?

A. Reforestation and afforestation
B. Biochar addition to soils
C. Drip irrigation
D. Enhanced chemical weathering of rock
E. Biomass burning and carbon capture

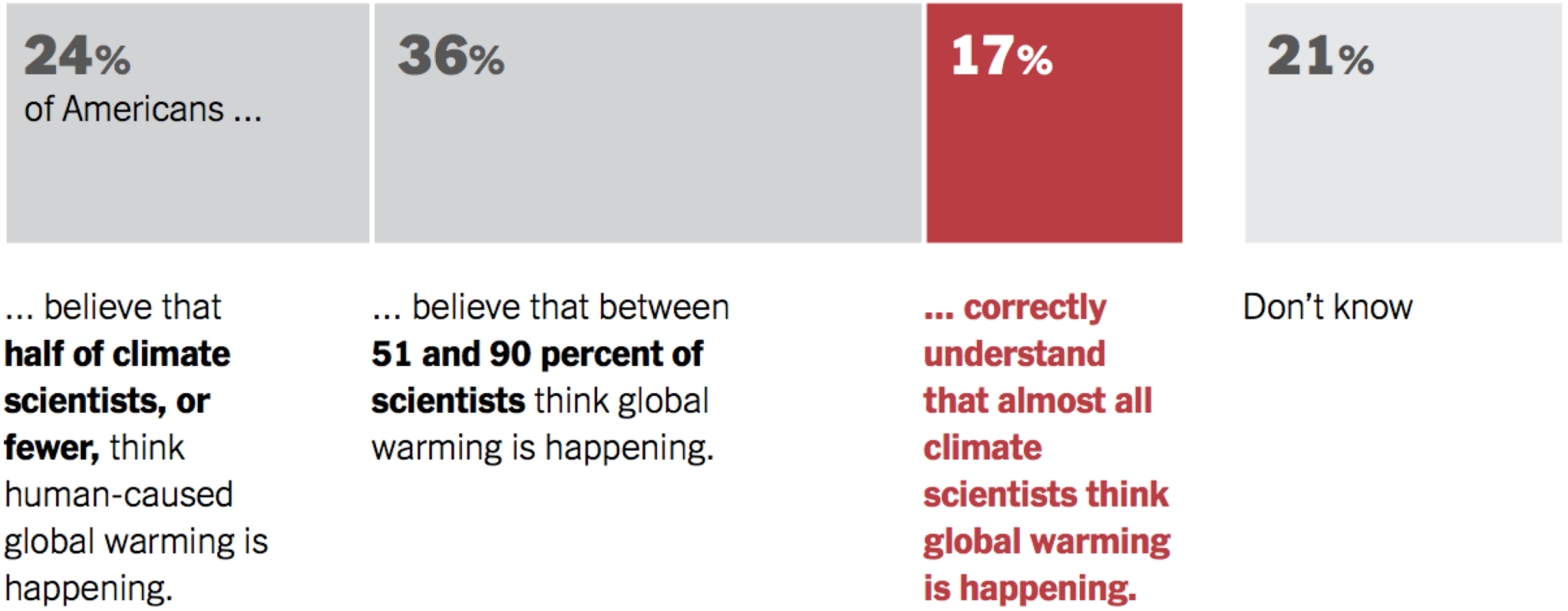
Mitigation and Adaptation

Learning Objectives

- Explain the difference between climate adaption and mitigation strategies
- List 2 climate adaption strategies that have so-far been proposed
- List 2 climate mitigation strategies that have so-far been proposed
- Predict two challenges (physical, social, or economic) facing a proposed climate adaption or mitigation strategy

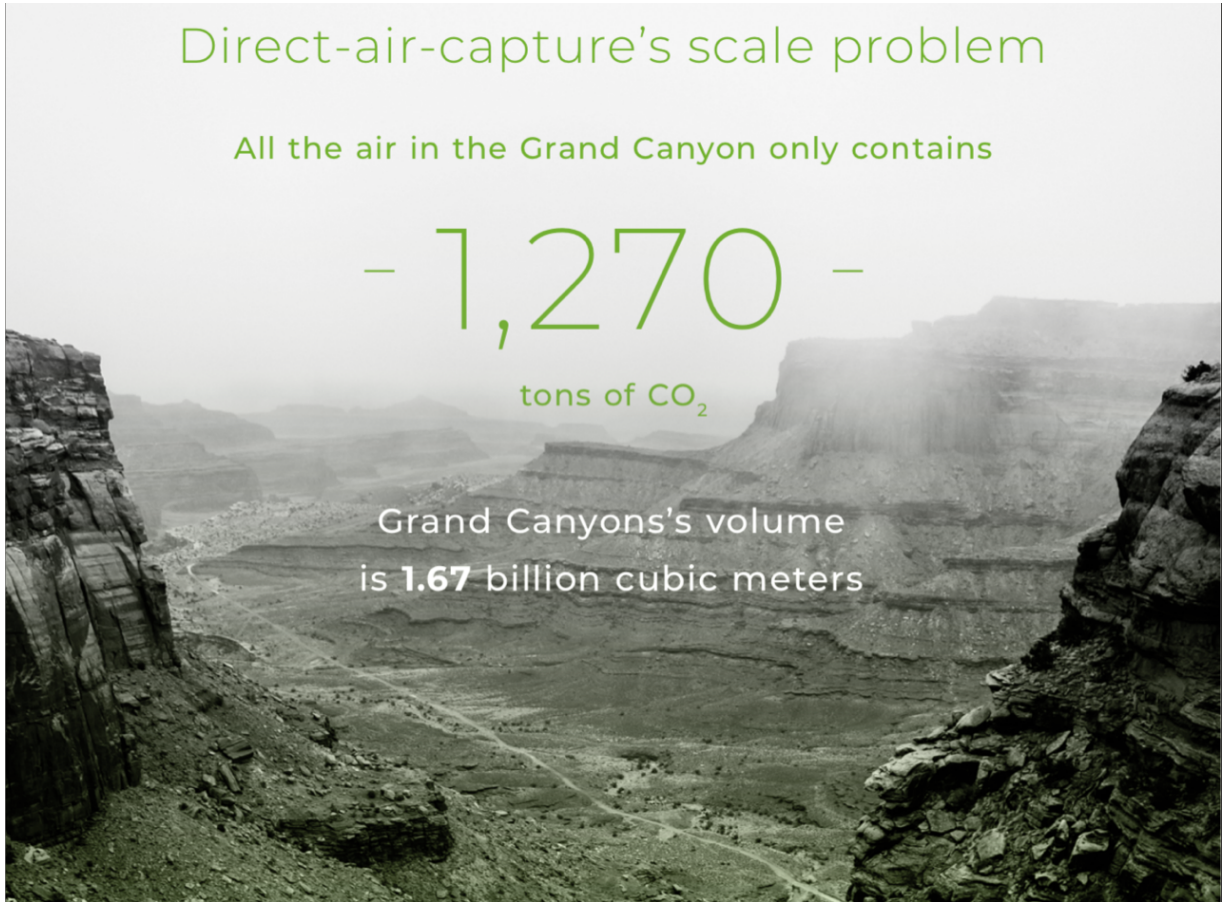


The biggest challenge and why we are teaching this class

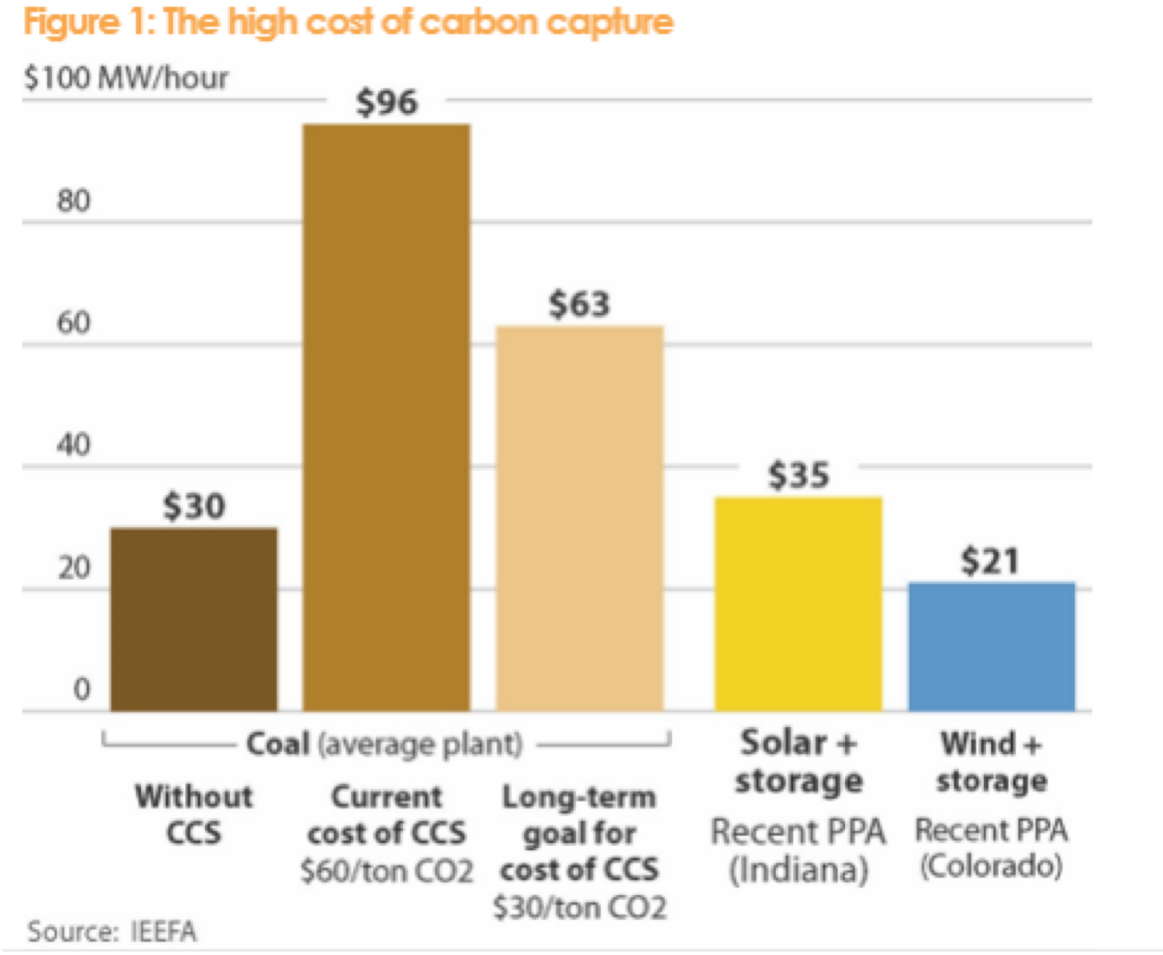


Source: Yale Program on Climate Change Communication survey conducted in April; figures do not add up to 100 percent because of rounding

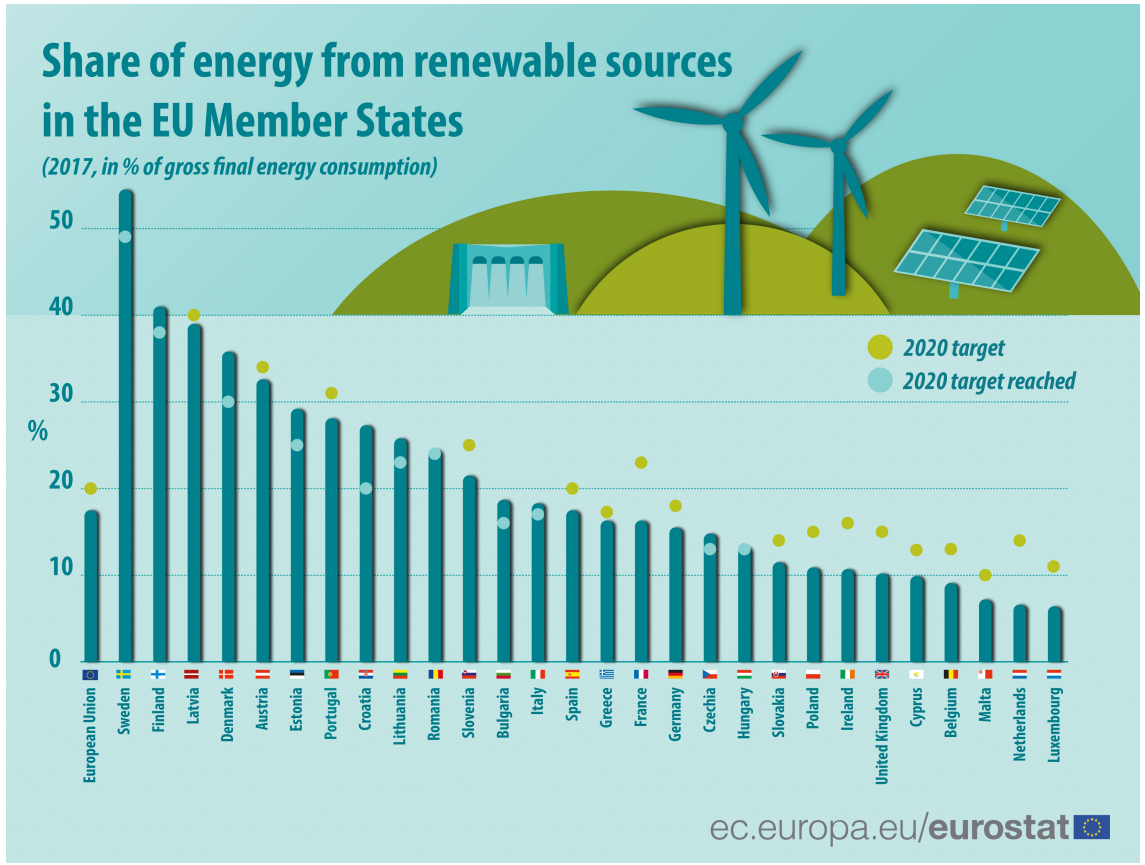
Carbon capture and storage does NOT come cheaply nor is the technology mature

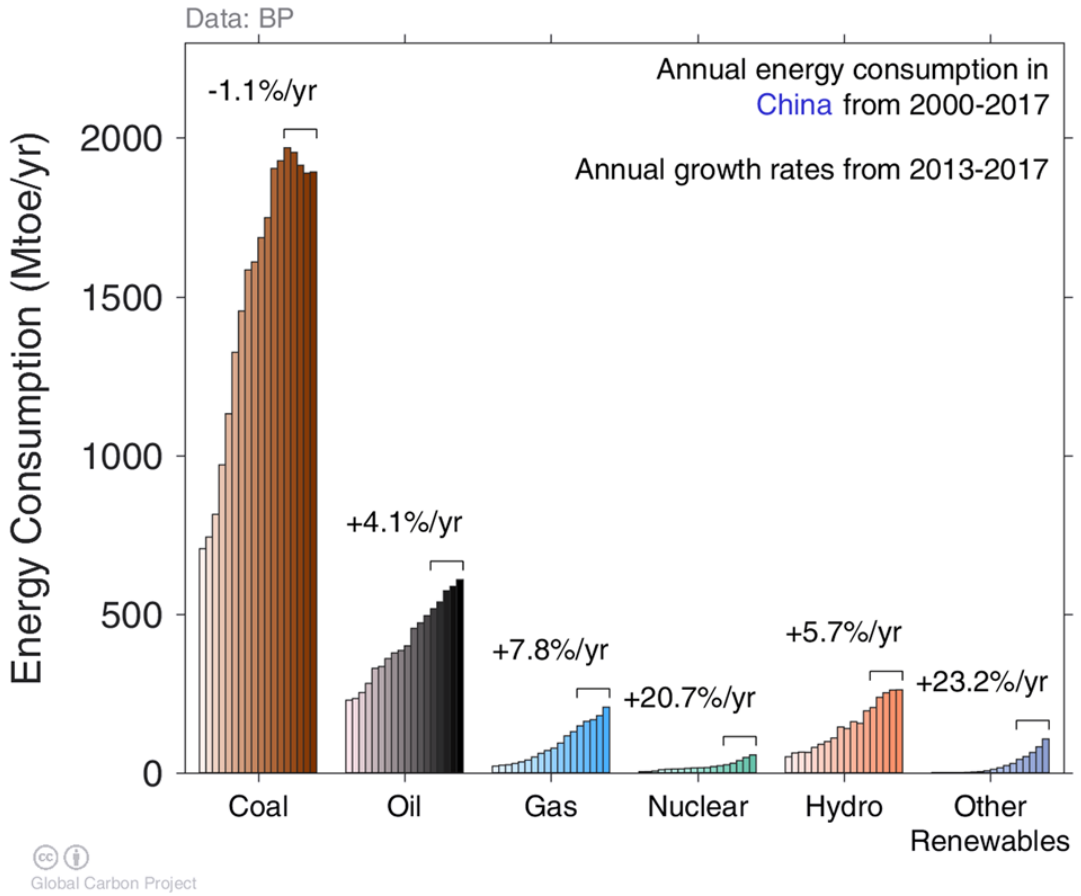


Energetically tough to get low levels of CO_2 from a BIG atmosphere



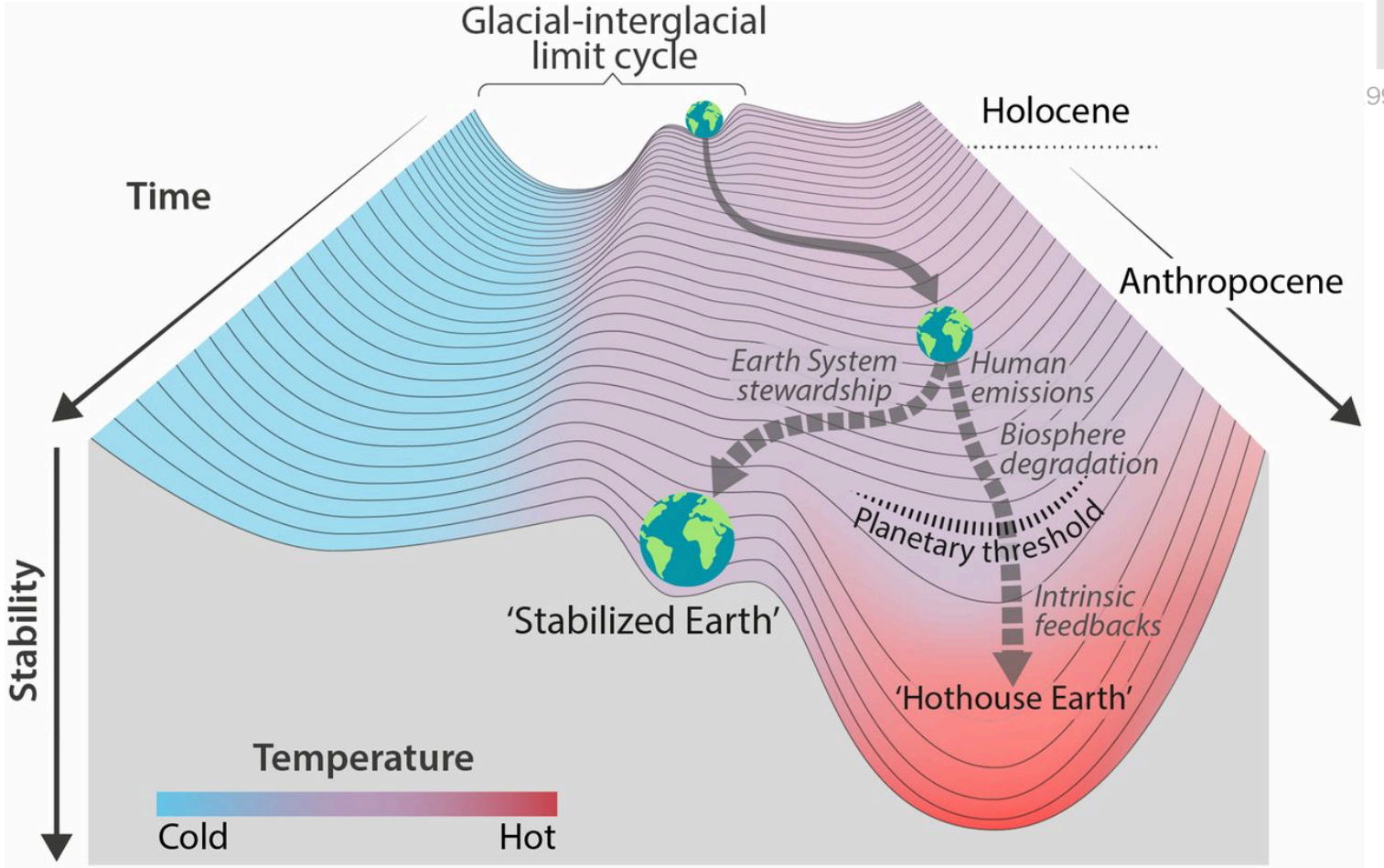
Getting off fossil fuels takes time but we may **not have much time** before the system flips…and we cross tipping points

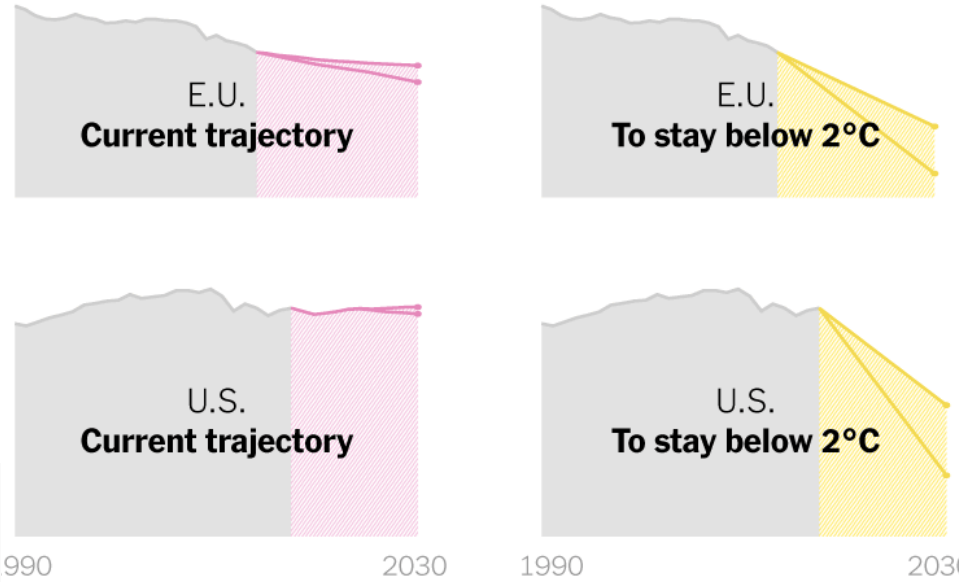


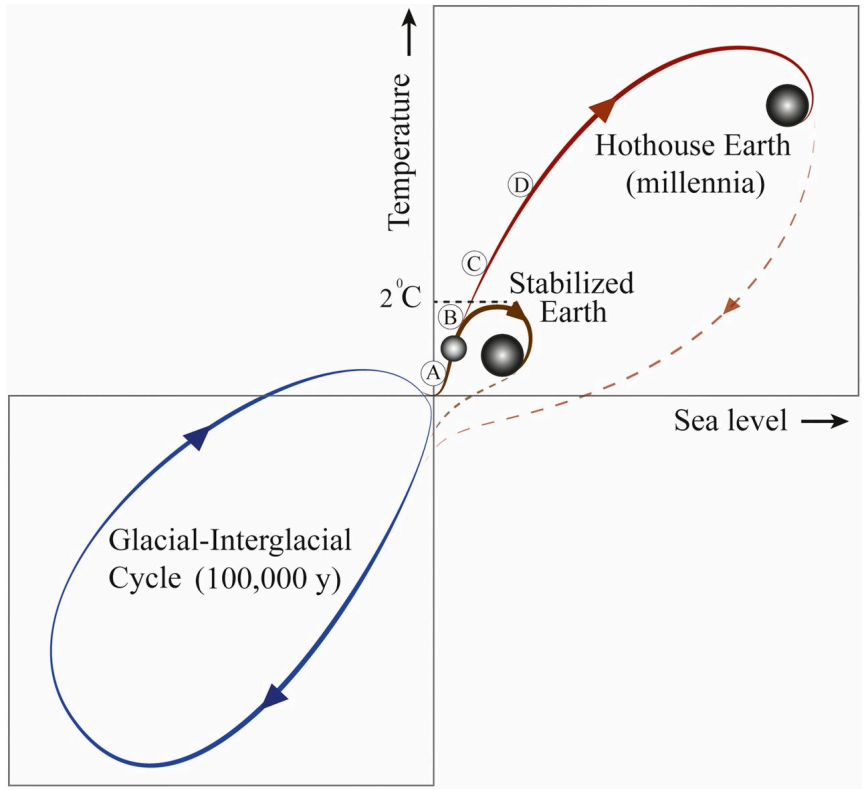


Trajectories of the Earth System in the Anthropocene

We explore the risk that self-reinforcing feedbacks could push the Earth System toward a planetary threshold that, if crossed, could prevent stabilization of the climate at intermediate temperature rises and cause continued warming on a "Hothouse Earth" pathway even as human emissions are reduced.







Summary

Mitigation – reducing carbon levels in the atmosphere to reduce impacts

Adaptation - the process of adjustment to actual or expected climate and its effects

Decarbonization is real solution

The **biggest challenge** is public awareness