Changing Climates, Changing Fisheries

Ken Lindeman
Professor, Program in Sustainability Studies
Dept. of Ocean Engineering & Marine Sciences
Florida Institute of Technology
- > 35 countries in the region
- Most with major fishery economies
($ Billions annual in ocean services)
Outline

- Climate change and oceans
  - Impacts on Florida and Carib. fisheries, now and future
  - What we can do
Core attributes of climate change

• Technically challenging to do carefully, includes geophysical sciences, such as: meteorology, atmospheric chemistry, geology, oceanography, ice sciences - current & paleo...

• Many effects are non-linear & co-vary: a change in A changes B (and H) in complex ways.

• Liquids & air behave physically as fluids. The Atmosphere is a fluid, like the ocean...
The Consensus on Climate Change among Leading Scientific Organizations & Societies (from NASA.climate)

Statement on climate change from 18 scientific associations

“Observations throughout the world make it clear that climate change is occurring, and rigorous scientific research demonstrates that the greenhouse gases emitted by human activities are the primary driver.” (2009)

American Association for the Advancement of Science

“The scientific evidence is clear: global climate change caused by human activities is occurring now, and it is a growing threat to society.” (2005)

American Chemical Society

“Comprehensive scientific assessments of our current and potential future climates clearly indicate that climate change is real, largely attributable to emissions from human activities, and potentially a very serious problem.” (2004)

American Geophysical Union

“Human-induced climate change requires urgent action. Humanity is the major influence on the global climate change observed over the past 50 years. Rapid societal responses can significantly lessen negative outcomes.” (Adopted 2003, revised and reaffirmed 2007, 2012, 2013)

American Medical Association

“Our AMA … supports the findings of the Intergovernmental Panel on Climate Change’s fourth assessment report and concurs with the scientific consensus that the Earth is undergoing adverse global climate change and that anthropogenic contributions are significant.” (2013)

American Meteorological Society

“It is clear from extensive scientific evidence that the dominant cause of the rapid changes in climate of the past half century is human-induced increases in the amount of atmospheric greenhouse gases, including carbon dioxide (CO2), chlorofluorocarbons, methane, and nitrous oxide.” (2012)

American Physical Society

“The evidence is incontrovertible: Global warming is occurring, if no mitigating actions are taken, significant disruptions in the Earth’s physical and ecological systems, social systems, security, and human health are likely to occur. We must reduce emissions of greenhouse gases beginning now.” (2007)

The Geological Society of America

“The Geological Society of America (GSA) endorses with assessments by the National Academies of Science (2005), the National Research Council (2008), and the Intergovernmental Panel on Climate Change (IPCC, 2007) that global climate has warmed and that human activities (mainly greenhouse-gas emissions) account for most of the warming since the middle 19th century.” (2006, revised 2010)

SCIENCE ACADEMIES

International academies: Joint statement

“Climate change is real. There will always be uncertainty in understanding a system as complex as the world’s climate. However, there is now strong evidence that significant global warming is occurring. This evidence comes from direct measurements of rising surface air temperatures and subsurface ocean temperatures and from phenomena such as increases in average global sea levels, retreating glaciers, and changes in many physical and biological systems. It is likely that most of the warming in recent decades can be attributed to human activities.” (IPCC 2001) (2005, 11 international science academies)

U.S. National Academy of Sciences

“The scientific understanding of climate change is now sufficiently clear to justify taking steps to reduce the amount of greenhouse gases in the atmosphere.” (2005)

http://climate.nasa.gov/scientific-consensus/
Burning of fossil-fuels produces inflows into the atmosphere of unprecedented megatons of carbon.

Unfortunately, carbon dioxide is not usually seen...
• Greenhouse gases (GHGs) in the atmosphere: carbon dioxide, methane, nitrous oxide, others.

• They trap extra heat while in the atmosphere (the Greenhouse Effect)

• With residence times of $\approx 110$ yr ($CO_2$) to 15 yr (methane) they build up...

• The result is a rapidly warming Earth.
Global Carbon Dioxide Inputs since 1850

Carbon Dioxide Information Analysis Center, 2016
For 650,000 years, atmospheric CO₂ has never been above this line ... until now. *current CO₂ level*  

YEARS before today (0 = 1950)  

* as of July 2013
Trends in Atmospheric Carbon Dioxide Over Past 1,200 Years

Level is now above 400 ppm

~2.7 °F rise over past 130 years

Copenhagen Diagnosis, 2009; many review documents
• Global temperatures have increased 2.7 deg F (1.5 deg C) since 1880.

• The last five years were the hottest recorded in 139 yr of data (NOAA, 2019).

• 17 of the last 18 years were the hottest ever.

• 2015 was the hottest year on record for the City of Melbourne (National Weather Service)
NUH-UH. SOME GUY ON TWITTER JUST SAID YOU'RE WRONG.
Indicators of a Warming World

- Glaciers
- Snow Cover
- Spring coming earlier
- Tree-lines shifting poleward and upward
- Species migrating poleward and upward
- Sea Ice
- Ice Sheets
- Sea Level
- Ocean Heat Content
- Temperature Over Land
- Temperature Over Oceans
- Air Temperature Near Surface (troposphere)
- Humidity
- Sea Surface Temperature
Outline

- Climate change and oceans

- Impacts on Florida and Carib. fisheries, now and future

- What we can do
Influential Sources include: (the list is Not comprehensive)

US and Global
NOAA Climate Science Strategy. 2015; IUCN. 2016. CC Planning Guidelines; Short et al. 2016; Morley et al. 2018; Asch and Erisman. 2018...

Southeast U.S
SAFMC Fishery Ecosystem Plan: CC. 2017; SECOORA-NOAA. 2015. Climate Variability and Fisheries Workshop Rept....

State of Florida and IRL
Lorenzen et al. 2017. CC and FL Fisheries; ECFRPC. 2018. Regional Resiliency Action Plan; Parkinson & Siedel. 2018. IRL CC Vulnerability Assessment...

Discussions with experienced commercial and recreational fisherfolk
Drivers of Climate Change Impacts and Confounding Factors in Florida

Key drivers of climate change impacts on Florida’s fisheries and aquaculture sectors include (Carter et al. 2014):

- Temperature increases (Carter et al. 2014)
- Moderate increases in average rainfall and increases in variability (Carter et al. 2014; Moser et al. 2014)
- Altered hydrology with an increase in average and variability of river flows, lake water levels, groundwater recharge, and freshwater outflow into coastal systems (Georgakakos et al. 2014; Obeysekera et al. 2015)
- Changes in large- and meso-scale circulation features in the Gulf of Mexico (Liu et al. 2012)
- Changes in ocean stratification (Doney et al. 2014)
- Changes in the frequency and intensity of harmful algal blooms (Moore et al. 2008)
- Greater frequency and severity of storms (Carter 2014)
- Sea level rise; Florida is highly vulnerable and this is perhaps the single most important driver of climate change impacts in the state (Carter et al. 2014)
- Salt water intrusion (FWC 2009; Barlow & Reichard 2010)
- Ocean acidification, although higher latitudes tend to face a greater challenge (Ekstrom et al. 2015)
- Changes in coastal and riparian geomorphology (Glick 2006; FWC 2008; Moser et al. 2014)
- Changes in infrastructure (e.g. boat ramps, docks, roads; Moser et al. 2014)
- Mitigation policies (e.g., a carbon tax on fuel or carbon credits for sequestration in shellfish farming)

Some Categories of Climate Stressors/Impacts

Ocean & Estuary Heating

Extreme Weather Events, Rainfall & Storms

Sea Level Rise

Ocean Acidification

Surprises
Ocean Heating...

- We often focus more on increases in air temperature, understandably, while paying less attention to increasing ocean temperatures...

- Ninety percent of heat trapped by GHGs since the 1950s is stored in the oceans rather than in air.

Sources: Multiple journal articles, and NOAA and NASA summaries.
Since 1955, more than 90 percent of the excess heat retained by the Earth as a result of increased greenhouse gases has been absorbed by the oceans, leaving ocean scientists like Eric Leuliette at the National Oceanic and Atmospheric Administration feeling that 90 percent of the climate change story is being ignored.

**Estimated Heat Accumulation**

<table>
<thead>
<tr>
<th>Year</th>
<th>Ocean</th>
<th>Ice Melt</th>
<th>Land</th>
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<tr>
<td>2010</td>
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</tbody>
</table>

Amounts in zettajoules, or sextillions of joules, relative to 1971 levels.
Impacts of Higher Temps, Hotter Water

Algal Blooms and Fish Kills

Other Fishery Habitats
  Seagrass
  Mangroves
  Corals
  Sargassum

Changing Distributions of Fishery Species

Habitat Shifts
Increasing Sea Surface Temperatures

Warmer water means *less oxygen* in the water = A

Warmer water means *faster algal growth* = B

\[ A \times B \text{ (especially with too many nutrients)} \approx \]

*Harmful Algal Blooms and Fish Kills*
Ocean Heating: Seagrasses

Major review by Short et al. (2016):
- Hotter waters will be important stressors affecting plant physiological processes, growth, reproduction, and geographic distributions.

- Temperature stresses are most obvious at the edges of species ranges...

- Higher temperatures increase extreme weather events, which can include more rain, more runoff and turbidity, and reduced salinity as well as direct physical damage.
Ocean Heating and Mangroves

- There is evidence that mangroves are showing northward shifts in distribution.
- Complex effects on mangrove forests co-vary with sea level status and extreme rain and wind events.
- Extreme weather will add stress through direct physical damage and hydrological changes.

Both “losses and gains” to marine plants can result from ocean heating, with increases in productivity due to higher CO2 levels, yet, yet negative consequences from other physiological and hydrological stressors.
Ocean Heating and Coral Reefs

• Corals are animals that build calcium carbonate skeletons.

• Resulting reefs have high ecological and $$ value.

• Corals co-exist with photosynthetic algae. They are co-dependent = they need each other.

• Bleaching occurs when warmer water causes the coral to release the algae partners.
Contemporary white-band disease in Caribbean corals driven by climate change

C. J. Randall* and R. van Woesik

Over the past 40 years, two of the dominant reef-building corals in the Caribbean, Acropora palmata and Acropora cervicornis, have experienced unprecedented declines. That loss has been largely attributed to a syndrome commonly referred to as white-band disease. Climate change-driven increases in sea surface temperature (SST) have been linked to several coral diseases, yet, despite decades of research, the attribution of white-band disease to climate change remains unknown. Here we hindcast the potential relationship between recent ocean warming and outbreaks of white-band disease on acroporid corals. We quantified eight SST metrics, including rates of change in SST and contemporary thermal anomalies, and compared them with records of white-band disease on A. palmata and A. cervicornis from 473 sites across the Caribbean, surveyed from 1997 to 2004. The results of our models suggest that decades-long climate-driven changes in SST increases in thermal minima, and the breach of thermal maxima have all played significant roles in the spread of white-band disease. We conclude that white-band disease has been strongly coupled with thermal stresses associated with climate change, which has contributed to the regional decline of these once-dominant reef-building corals.

Acropora palmata and Acropora cervicornis emerged as dominant framework-building corals in the Caribbean in the middle of the Pliocene epoch, some 3.5 million years ago, when ocean temperatures were cooling. Since then, these two coral species have been among the most dominant Caribbean reef builders. Yet over the past 40 years their populations have declined by >90% in many localities throughout the Caribbean. This decline has been partially attributed to outbreaks of a syndrome known as white-band disease. Consequently, A. palmata and A. cervicornis are now listed as critically endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, and are listed as threatened under the US Endangered Species Act of 1973 (ref. 9). With the exception of a few localized areas, the recovery of Acropora in the Caribbean has been uncommon, and the disease persists on reefs that still support Acropora populations (Supplementary Fig. 1).

Despite the severity of the syndrome, and its early detection in the 1970s (ref. 3), the aetiology of white-band disease remains poorly understood. Molecular studies have identified significant differences in the microbial communities on tissues with and without white-band disease. This suggests that environmental conditions, specifically ocean temperature and salinity, have an influence on the expression of white-band disease, with the potential to drive outbreaks in warm periods. This hypothesis is supported by recent observations of increased disease incidence during warmer episodes in the Caribbean. Our findings further highlight the need for continued monitoring of ocean temperature and its impact on coral health.
PROJECTING SHIFTS IN THERMAL HABITAT FOR 686 SPECIES ON THE NORTH AMERICAN CONTINENTAL SHELF

James W. Morley, Rebecca L. Selden, Robert J. Latour, Thomas L. Frölicher, Richard J. Seegra...in Marine Sciences, University of North Carolina, United States of America

Abstract

Recent shifts in the geographic distribution of marine species and preferred thermal habitats. These shifts in distribution are driven by changes in ocean temperature and marine resource management, and there is a strong correlation between the two. Therefore, it is important to understand the potential impacts of future changes in ocean temperature on marine species distribution.

THE EFFECT OF OCEAN WARMING ON BLACK SEA BASS (Centropristis striata) AEROBIC SCOPE AND HYPOXIA TOLERANCE

Emily S. Steinger, Alyssa Andres, Rachael Young, Brad Siebel, Vincent Saba, Beth Phelan, John Rosendale, Daniel Wieczorek, Grace Saba

Abstract

Over the last decade, ocean temperature on the U.S. Northeast Continental Shelf (U.S. NES) has warmed faster than the global average and is associated with observed distribution changes of the northern stock of black sea bass (Centropristis striata). Mechanistic models based on physiological responses to environmental conditions can improve future habitat suitability projections. We measured maximum, standard metabolic rate, and hypoxia tolerance (%TMR) of the northern adult black sea bass stock to assess performance across the known temperature range of the species. Two methods, chase and swim-flume, were employed to obtain maximum metabolic rate to examine whether the methods varied, and if so, the impact on absolute aerobic scope. A subset of individuals was held at 35°C for one month (30°C base) prior to experiments to test acclimation potential. Absolute aerobic scope (maximum-standard metabolic rate) reached a maximum of 367.21 mgO$_2$ kg$^{-1}$ hr$^{-1}$ at 24.4°C while $S_{O_2}$ continued to increase in proportion to standard metabolic rate up to 30°C. The $S_{O_2}_{30°C}$ group exhibited a
Changes in the Experiences of Fishing

- Right now - *Fouled Hooks*....
  Lure or bait hits the water, the hook is algal-slimed by retrieval (inshore) or algal obstructed (offshore).

- Fish kills of course.

- Some species distributions will show substantial change by mid to late century. More prominent patterns seen in species at their current thermal maxima.

- Changes in spawning seasons.

- Other issues... What else?
Extreme Weather Events: Rainfall & Storms

Dozens to hundreds of connected geo-physical systems...
As they get more out of balance:

The outer boundaries of trends can get more extreme.

More drought but, also, more flooding; increased storminess

More pulse runoff. Various hydrological responses. More erosion. More run-off... (With SLR = sunny day flooding)
Sea Level Rise

East Central Florida Regional Resiliency Action Plan (2018): Recommendations of the Sea Level Rise Sub-committee:

Lower range: 5.15 ft. Upper range: 8.48 ft by 2100. (From 2013 USACE high estimate and 2017 NOAA high estimate, respectively).
SLR and Land Use, Florida Keys

- *Heavy development at low elevations.* Very vulnerable to SLR... Also, reefs replaced by macro-algae.
Potential Low Island Issues, Caribbean and Pacific

Storlazzi et al. 2018.
Low Island and High Island Issues, in addition to SLR

- Extreme Events Changing
- Surface Air Temperature Rising
- Carbon Dioxide Concentrations Rising
- Rainfall Changing
- Winds and Waves Changing
- Ocean Currents and Circulation Changing
- Marine Habitats and Species Distributions Changing
- Sea Level Rising
- Sea Surface Temperature Rising
- Ocean Chemistry Changing
- Ocean pH Decreasing
- Terrestrial Habitats Species Distributions Changing
- Baseflow in Streams Decreasing

Hawaii Climate Adaptation Portal
The primary Intergovernmental Fishery Management Organizations in the Caribbean, all are doing CC planning.
Ocean Acidification

More C02 in the ocean creates chemical changes in calcium carbonate cycles making the ocean water more acidic.
Surprises are Guaranteed

Atmospheric and Ocean subsystems can be highly nonlinear and co-vary along many important parameter trajectories.

Via emergence processes as predicted for any complex and adaptive system, especially at these scales, surprises can be expected to arise (e.g., Meadows, 2008).

National Research Council, 2013
Some Categories of Stressors/Impacts

Ocean & Estuary Heating

Extreme Weather Events, Rainfall & Storms

Sea Level Rise

Ocean Acidification

Surprises
Outline

- Climate change and oceans

- Impacts on Florida and Carib. fisheries, now and future

- What we can do
Compassion fatigue among physiotherapist and physical therapists around the world

Susan G. Klappa\textsuperscript{1,2}, Lois E. Fulton\textsuperscript{2}, Lauren Cerier\textsuperscript{2}, Alexa Peña\textsuperscript{3}, Andrew Sibenaller\textsuperscript{2} and Scott P. Klappa\textsuperscript{1}

\textsuperscript{1}Davenport University, Doctor of Physical Therapy Program, 6191 Kraft Ave, SE Grand Rapids, MI 49512
\textsuperscript{2}1813 Arthur Circle, Ames, IA 50010
\textsuperscript{3}University of Saint Mary, Stetson Doctor of Physical Therapy Program, 4100 South 4th Street, Leawood, KS 66236
\textsuperscript{4}Rosalind Franklin University of Medicine and Science, Department of Psychology, 3333 Green Bay Road, North Chicago, IL 60064

Accepted 20 October, 2015

Physiotherapists work in a variety of settings around the world and exhibit great satisfaction in their work. Challenges of everyday practice may be a contributing factor to compassion fatigue (CF) and lower professional quality of life. The purpose of this study was to investigate CF among physiotherapists (PTs) around the world and discuss coping strategies utilized. Mixed methods included a survey and phenomenological interviews. Participants (n=116) completed the Professional Quality of Life (PROQOL) survey and nine participants engaged in phenomenological interviews. The PROQOL was used to assess the level of compassion satisfaction (CS), burnout (BO), and secondary trauma (STS) experienced by PTs around the world. CF was considered a combination of STS and BO. Group mean CS, BO, and STS scores were lower compared to normal populations of caregivers. CS and BO were negatively correlated ($r = -0.535, p < .001$), and BO and STS were positively correlated ($r = 0.330, p < .001$). Three main themes emerged from interviews and included work environment stress, protective coping strategies, and the effects of compassion satisfaction. Better understanding CS, as well as CF in healthcare environments may help therapists develop better coping strategies for mitigating CF.

Keywords: Compassion fatigue, compassion satisfaction, physiotherapist

ABBREVIATIONS
Professional Quality of Life (PROQOL)
Compassion Satisfaction (CS)
Burnout (BO)
Secondary Traumatic Stress (STS)
Compassion Fatigue (CF)
Physiotherapist/Physiotherapy (PT)

INTRODUCTION
The healthcare field is characterized by dynamic environments, evolving research, and patients with complex diagnoses. Physical therapists are challenged to provide patient-centered care in an efficient and effective manner while embracing evidence-based practice and meeting clinic productivity standards. These challenges in healthcare may become a struggle for clinicians leading to a decreased quality of life for care providers.

\textsuperscript{1}Corresponding author. E-mail: sklappa@davenport.edu, Phone: 616 871 0196
Author(s) agreed that this article remain permanently open access under the terms of the Creative Commons Attribution License 4.0 International License.
Local organizations with climate interests include:

- Citizens Climate Lobby
- League of Woman Voters
- Marine Resources Council
- Parkinson Consulting
- Rethink Energy Florida
- IRL NEP
- Central Florida Green Cities Coalition
- Space Coast Electric Vehicles
- Florida Solar Energy Center
- Sierra Club
- Space Coast Progressive Alliance
- Energy Florida
- Southern Alliance for Clean Energy
- New and future City Sustainability Boards

(not comprehensive)
**Table 5. Number of potential risks to IRL management goals posed by five climate change stressors.**

<table>
<thead>
<tr>
<th>Goal</th>
<th>Warmer temperature</th>
<th>Changes in precipitation</th>
<th>Increasing storminess</th>
<th>Acidification</th>
<th>Sea level rise</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
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<td>Sediment and Water Quality</td>
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<td>Wastewater</td>
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<td>Surface water</td>
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<td>3</td>
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<td>3</td>
<td>0</td>
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<td>Legacy nutrient pollution</td>
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<td>3</td>
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<td>Wetlands and impounded marshes</td>
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<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>8</td>
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<td>Rare, threatened, endangered species</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
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<td>Fisheries</td>
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<td>1</td>
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<tr>
<td>Biotoxins, infectious agents, etc.</td>
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<td>2</td>
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<td>1</td>
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<td>Exotic and invasive species</td>
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<td>Living shorelines</td>
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<td>Archeological resources</td>
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<td><strong>Sum</strong></td>
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<td>Stakeholder Engagement</td>
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<td><strong>Sum</strong></td>
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<td><strong>4</strong></td>
<td><strong>3</strong></td>
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<td><strong>Grand Total</strong></td>
<td><strong>39</strong></td>
<td><strong>35</strong></td>
<td><strong>36</strong></td>
<td><strong>10</strong></td>
<td><strong>34</strong></td>
<td><strong>154</strong></td>
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</tbody>
</table>

- IRL NEP website has more info on EPA Climate Ready Estuaries
Hundreds of American cities and counties are actively planning for coastal change.

Many cities apply science and web based planning resources including:
- NOAA's Digital Coasts
- Georgetown Climate Center
- Virtual Climate Adaptation Library
- Surging Seas
- Ecosystem Based Management Tools
- Climate Adaptation Knowledge Exchange

It makes sense to plan for the future.
In Florida, Cities should evaluate Adaptation Action Areas

<table>
<thead>
<tr>
<th>Planning Based Tools:</th>
<th>Market Based Tools:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Comprehensive Planning Documents</td>
<td>- Community Rating Systems</td>
</tr>
<tr>
<td>- Zoning and Overlay Zones</td>
<td>- Capital Improvement Programs</td>
</tr>
<tr>
<td>- Floodplain Practices and Incentives</td>
<td>- Acquisitions and Buyout</td>
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<tr>
<td>- Building Codes with Resilient Design</td>
<td>- Development Incentives</td>
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<tr>
<td>- Setbacks/Buffers</td>
<td>- Coastal Real Estate Disclosures</td>
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<tr>
<td>- Conservation and Rolling Easements</td>
<td>- Transferable Development Rights</td>
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</tbody>
</table>

(Adapted from [Georgetown Climate Center, 2011](https://research.fit.edu/ccal/))
Global Carbon Dioxide Inputs since 1850

Carbon Dioxide Information Analysis Center, 2016
Trends in Atmospheric Carbon Dioxide Over Past 1,200 Years

Trends in Atmospheric Temperature Over Past 2,000 Years

Level is now above 400 ppm

~2.7 °F rise over past 130 years

Copenhagen Diagnosis, 2009; many review documents
Republicans and Democrats working together in Congress

The Climate Solutions Caucus is a group of Republican and Democratic U.S. Representatives who have volunteered to meet regularly, discuss issues and work together on solutions relating to climate change. The caucus is chaired by Francis Rooney (R-FL-19) and Ted Deutch (D-FL-22).

It’s increasingly clear that climate change will impact us all, no matter where we live or who we voted for. We must find a way to move forward with solutions, despite our differences. The Climate Solutions Caucus is a way for our representatives to do the essential work of democracy, understanding each other and finding common ground. The work done by the caucus is foundational for future climate policy that will be stronger, more broadly supported, and more durable.

The Climate Solutions Caucus was initially formed in February 2016 by former Representative Carlos Curbelo (R-FL-26) and Representative Deutch. It has already played an important role in climate change discussions and the introduction of bipartisan legislation.
# Current Climate Solutions Caucus members

**Republicans**

<table>
<thead>
<tr>
<th>Name</th>
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<tr>
<td>Francis Rooney (R-FL-19) – Co-chair</td>
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<tr>
<td>Rep. Lee Zeldin (R-NY-01)</td>
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<td>Rep. Mark Amodei (R-NV-02)</td>
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<td>Rep. Brian Fitzpatrick (R-PA-01)</td>
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<td>Rep. Elise Stefanik (R-NY-21)</td>
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<td>Rep. Brian Mast (R-FL-18)</td>
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<td>Rep. Don Bacon (R-NE-02)</td>
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<td>Rep. Rodney Davis (R-IL-13)</td>
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<td>Rep. Peter King (R-NY-02)</td>
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<td>Rep. Tom Reed (R-NY-23)</td>
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<td>Rep. Mike Gallagher (R-WI-08)</td>
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<td>Rep. David Joyce (R-OH-14)</td>
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<td>Rep. Jack Bergman (R-MI-01)</td>
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<td>Rep. Matt Gaetz (R-FL-01)</td>
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<td>Rep. Fred Upton (R-MI-06)</td>
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<td>Rep. Amata Radewagen (R-AS-00)</td>
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<td>Rep. Jennifer Gonzalez-Colon (R-PR-00)</td>
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<td>Rep. Bill Posey (R-FL-08)</td>
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<td>Rep. Brett Guthrie (R-KY-02)</td>
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<td>Rep. Adam Kinzinger (R-IL-16)</td>
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<td>Rep. Rob Woodall (R-GA-07)</td>
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<td>Rep. David Schweikert (AZ-06)</td>
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**Democrats**

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<tr>
<td>Ted Deutch (D-FL-22) – Co-chair</td>
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<td>Rep. Alan Lowenthal (D-CA-47)</td>
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<td>Rep. Brendan Boyle (D-PA-02)</td>
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<td>Rep. Seth Moulton (D-MA-06)</td>
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<td>Rep. Scott Peters (D-CA-52)</td>
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<td>Rep. Peter Welch (D-VT-00)</td>
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<td>Rep. Jim Himes (D-CT-04)</td>
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<td>Rep. Suzanne Bonamici (D-OR-01)</td>
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<td>Rep. Don Beyer (D-VA-08)</td>
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<td>Rep. Earl Blumenauer (D-OR-03)</td>
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<td>Rep. Charlie Crist (D-FL-13)</td>
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<td>Rep. Juan Vargas (D-CA-51)</td>
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<td>Rep. Jerry McNerney (D-CA-09)</td>
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<td>Rep. Anna Eshoo (D-CA-18)</td>
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<td>Rep. Daniel Lipinski (D-IL-03)</td>
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<td>Rep. Thomas Suozzi (D-NY-03)</td>
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<td>Rep. Ann Kuster (D-NH-02)</td>
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<td>Rep. Salud Carbajal (D-CA-24)</td>
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<td>Rep. Mike Thompson (D-CA-05)</td>
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<td>Rep. Jimmy Panetta (D-CA-20)</td>
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<td>Rep. Stacey Plaskett (D-VI-00)</td>
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<td>Rep. Matt Cartwright (D-PA-08)</td>
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