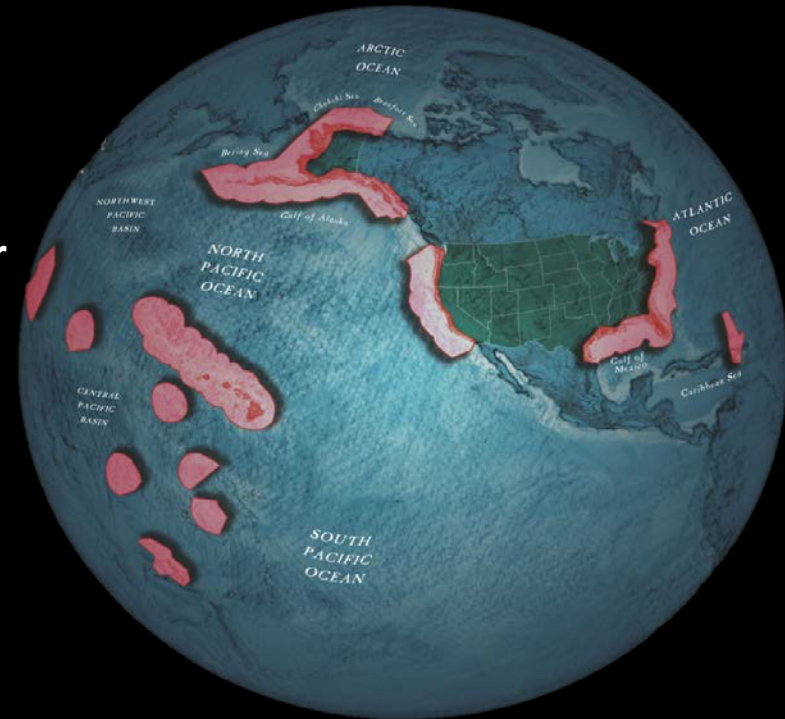


Oceans and Marine Resources in a Changing Climate

Roger Griffis¹, Jennifer Howard², Anne Hollowed³

1. NMFS, Science and technology
2. Conservation International
3. NMFS, Alaska Fisheries Science Center



**Technical Report
to the 2014 U.S. National Climate Assessment**

U.S. Global Change Research Act (1990)

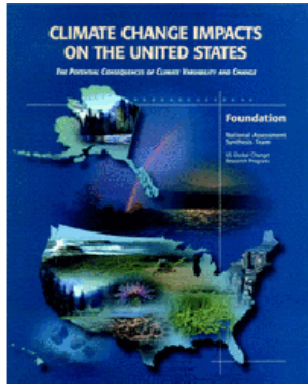
PURPOSE:

Develop and coordinate *a comprehensive and integrated United States research program* to assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change.

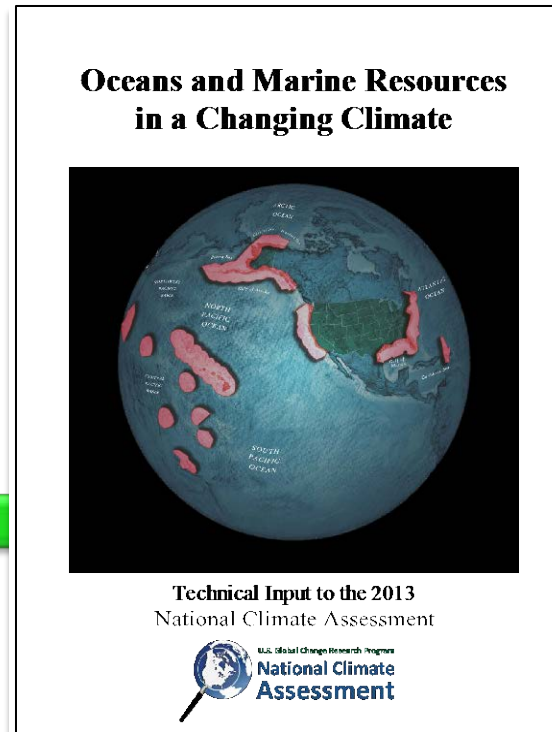
CHARGE:

Produce *a report on the environmental, economic, health and safety consequences of climate change* on the nation (= National Climate Assessments) every four years.

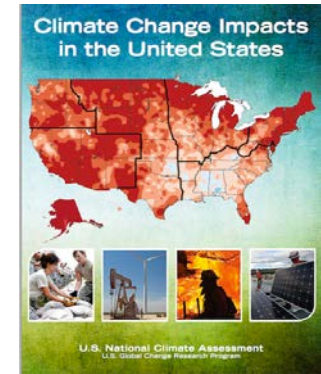
**2000:
1st U.S. National Climate
Assessment**



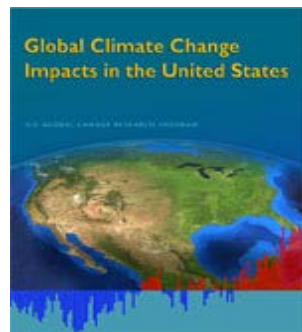
**2012:
Marine Technical
Input Report**



**2014:
3rd National
Assessment**



**1990:
Global
Research
Act**



**2009:
2nd National
Assessment**

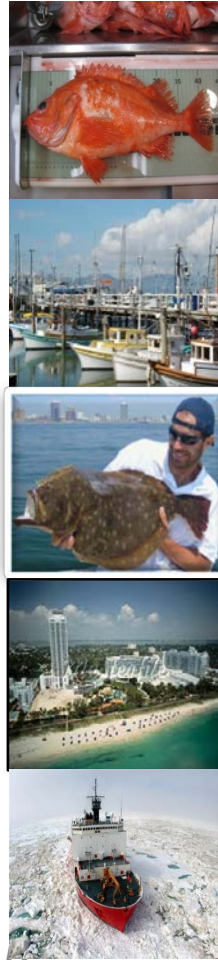
**2014-2017:
Sustained
Assessment
Activities
(e.g., National
Climate Indicator
System)**

US Marine and Coastal Ecosystems

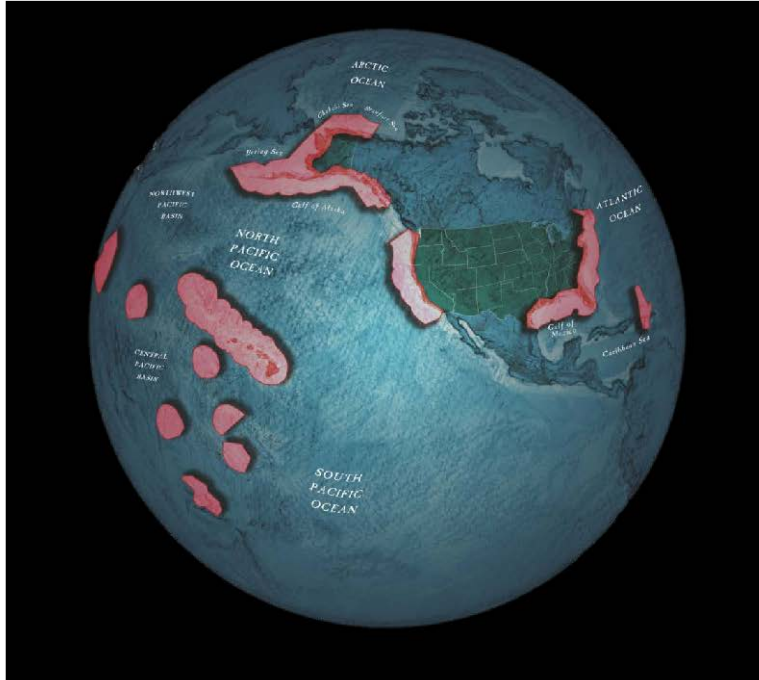


Why care about climate impacts on US ocean ecosystems?

- **There is much at risk:**
 - Food: 1.5 billion people (world-wide)
 - Fisheries Jobs: 1.3 million (US)
 - Fisheries economies: \$200 B in sales/income impacts (US)
 - Coastal economies: 58 % US GDP
 - Coastal populations: 50 % US population (164 million)
 - Coastal infrastructure: harbors, roads, rail, airports, power etc
 - Public health: diseases, harmful algal blooms
 - National security: international stability, relations
- **Climate change is already impacting ocean ecosystems and services**
- **These impacts are expected to increase.**



Oceans and Marine Resources in a Changing Climate



Technical Input to the 2013
National Climate Assessment



U.S. Global Change Research Program
**National Climate
Assessment**

Climate Driven Physical and Chemical
Changes in Marine Ecosystems



Impacts of Climate Change on Marine
Organisms



Impacts of Climate Change on Human
Uses of the Ocean and Ocean Services



International Implications of Climate
Change



Ocean Management Challenges,
Adaptation Approaches, and Opportunities
in a Changing Climate

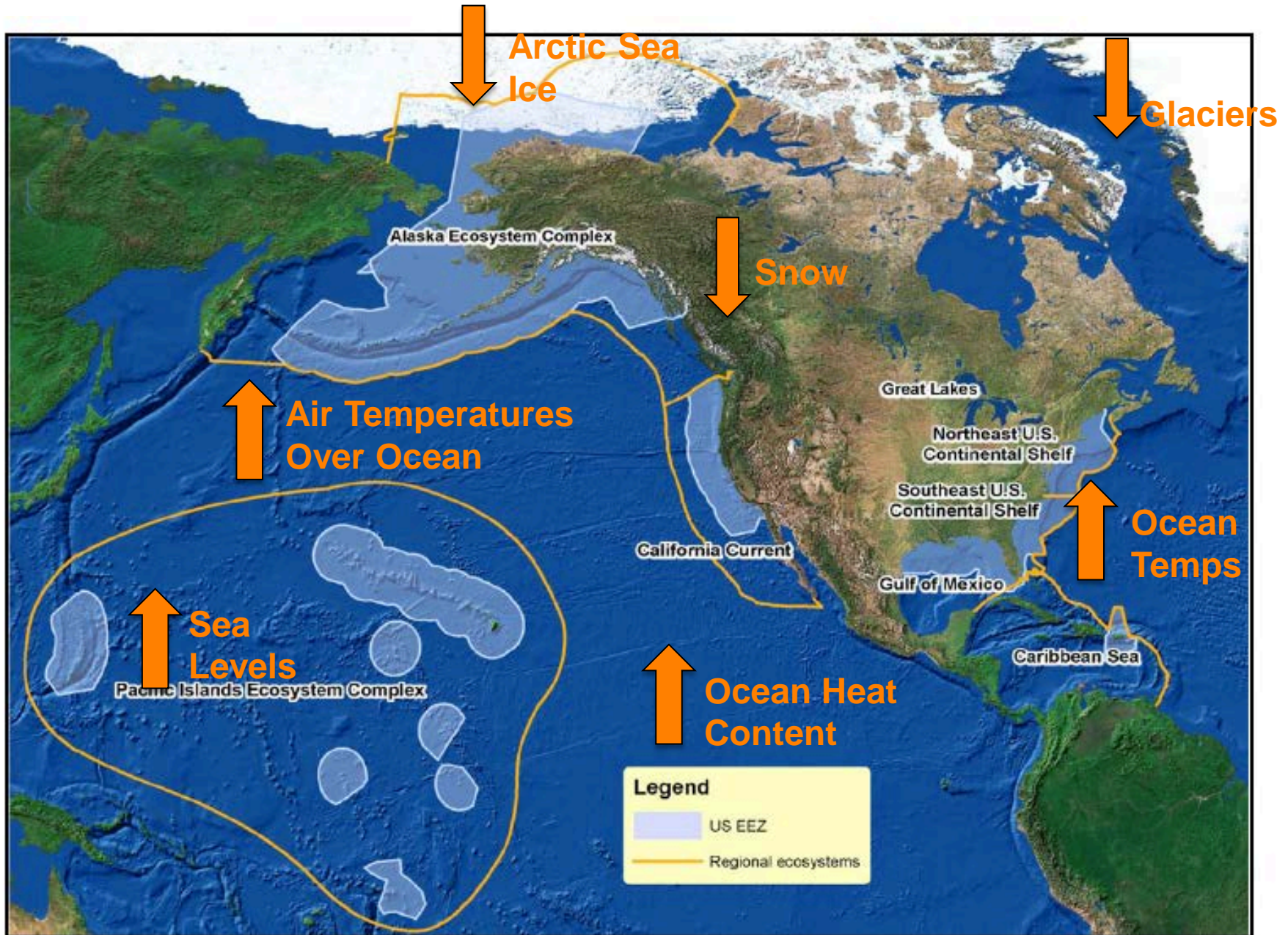


Sustaining the Assessment of Climate
Impacts on Oceans and Marine Resources

Author Team

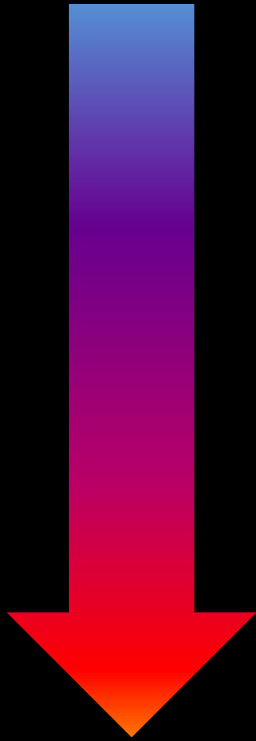
© ENLIGHTENED LIBRARY 192763

Impacts on U.S. Ocean Conditions



Ocean Acidification = the other CO₂ problem

pH



Decreased
30% in the
last century



Impacts on U.S. Marine Resources

Impacts on survival, growth, reproduction, health and phenology

Climate change interactions with non-climate stressors

Shifts in species distributions and ranges

Alterations in species interactions

Increased impacts seen in high latitude and tropical areas

Winners and Losers

Tipping points resulting in rapid ecosystem change

Impacts on Human Uses of the Ocean

1. Fishing (Commercial, Recreation, and Subsistence)

- Impacts on productivity
- Impacts on distribution

2. Possible impacts on oil and gas activity

3. Possible Human Health impacts

4. Possible Tourism Impacts



Impacts on U.S. International Activities



- Highly migratory species management
- Protected species conservation
- International partnerships
- Regional Fisheries Management Organizations (RFMOs)
- Opening of the Arctic
 - Transportation
 - Shipping
 - Pollution
 - Security
- Food security

Challenges for Ocean Resource Management

- Lack of institutional support, governance, and mandates to prepare for and respond to climate impacts (ie., take adaptation action).
- Lack of institutional capacity and guidance on how to take action.
- Lack of key information on locally and regionally specific climate projections.
- Lack of tools to support assessments and monitoring.
- Lack of awareness, stakeholder support, and engagement.
- Uncertainty about risk and vulnerability.
- Lack of economic resources and budgetary constraints

Adaptation Approaches

Long term monitoring

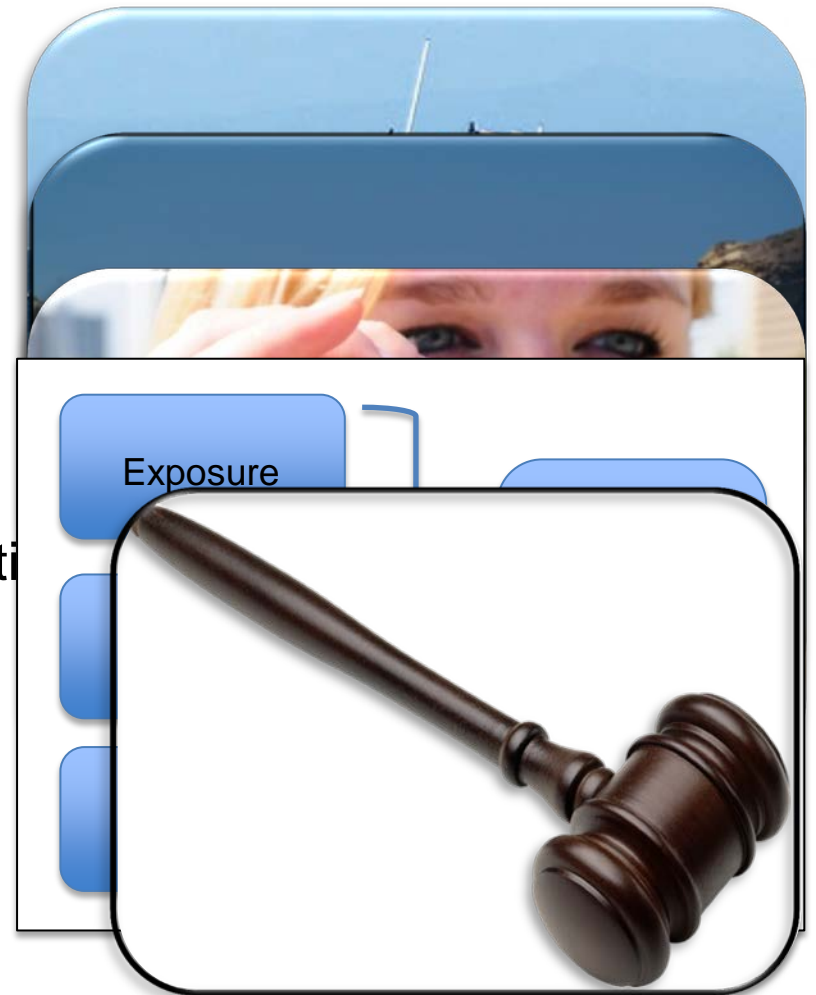
Marine spatial planning (MPAs)

Regulation of non-climate stressors

Climate Ready Fisheries management

Incorporation of climate-related information into ocean and marine resource management activities:

- Water quality protection
- Protected Species Conservation
- Fisheries Management
- Habitat protection and restoration



Opportunities and Emerging Frameworks

National / Federal

- President's Council on Climate Resilience
- National Fish, Wildlife, and Plant Climate Adaptation Strategy
- National Ocean Policy

Regional / State

- West Coast Governors Alliance on Ocean Health
- State of California Climate Adaptation Strategy
- Massachusetts Climate Change Adaptation Report

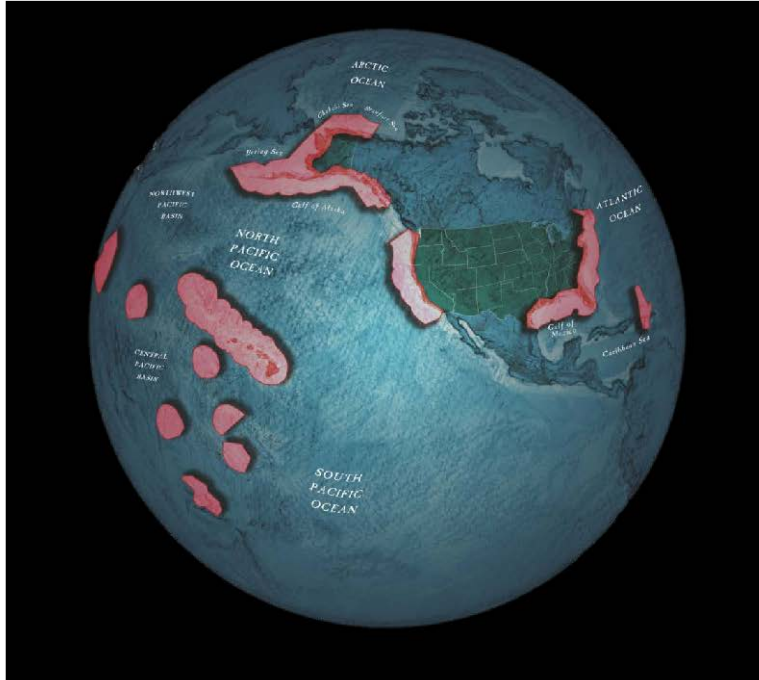
Non-Governmental

- Alaskan Marine Arctic Conservation Action Plan for the Chukchi and Beaufort Seas (TNC)
- A Climate Change Action Plan for the Florida Reef System (The Florida Reef Resilience Program)

How to Sustain and Improve the Assessment?

- **INDICATORS:** *Establish a core set of indicators to track climate impacts on marine ecosystem conditions.*
- **ASSESS ECOSYSTEM CHANGES:** *Conduct regional-scale assessment of current and projected impacts of climate change.*
- **INCREASE THE PRODUCTION, DELIVERY AND USE OF INFORMATION:** *Increase the productions, delivery and use of climate-related information in marine resource management.*
- **STRENGTHEN PARTNERSHIPS:** *Strengthen domestic and international collaborations to track, project, and respond to climate impacts on ocean ecosystems.*
- **ASSESS MANAGEMENT EFFECTIVENESS:** *Track the effectiveness of mitigation and adaptation efforts over time at regional to national scales.*

Oceans and Marine Resources in a Changing Climate



Technical Input to the 2013
National Climate Assessment



U.S. Global Change Research Program
**National Climate
Assessment**

Climate Driven Physical and Chemical
Changes in Marine Ecosystems



Impacts of Climate Change on Marine
Organisms



Impacts of Climate Change on Human
Uses of the Ocean and Ocean Services



International Implications of Climate
Change



Ocean Management Challenges,
Adaptation Approaches, and Opportunities
in a Changing Climate



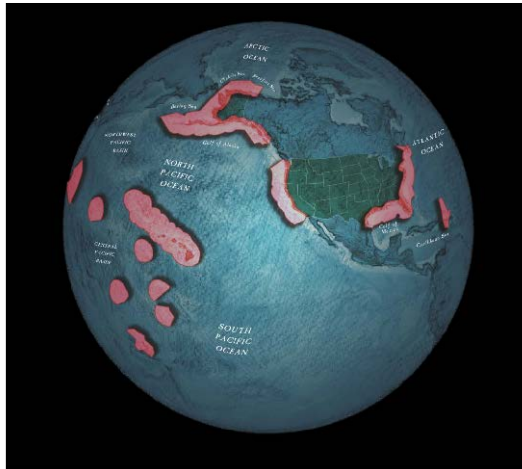
Sustaining the Assessment of Climate
Impacts on Oceans and Marine Resources

For more information:

2014 U.S. National Climate Assessment

<http://www.globalchange.gov/ncadac>

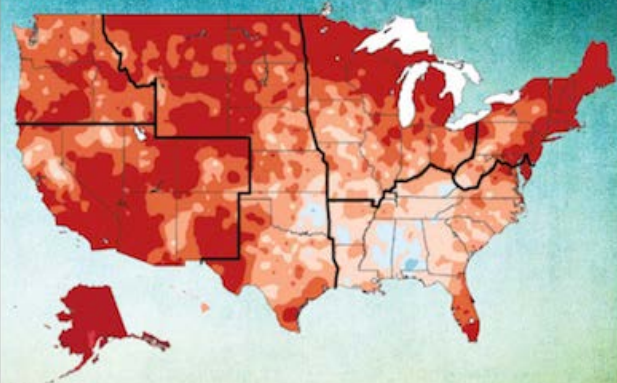
Oceans and Marine Resources in a Changing Climate



Technical Input to the 2013
National Climate Assessment



Climate Change Impacts in the United States



U.S. National Climate Assessment
U.S. Global Change Research Program