Overview of Integrated Climate Impact Modeling

Photo: Mark Holsman

Evaluating strategies under different climate futures

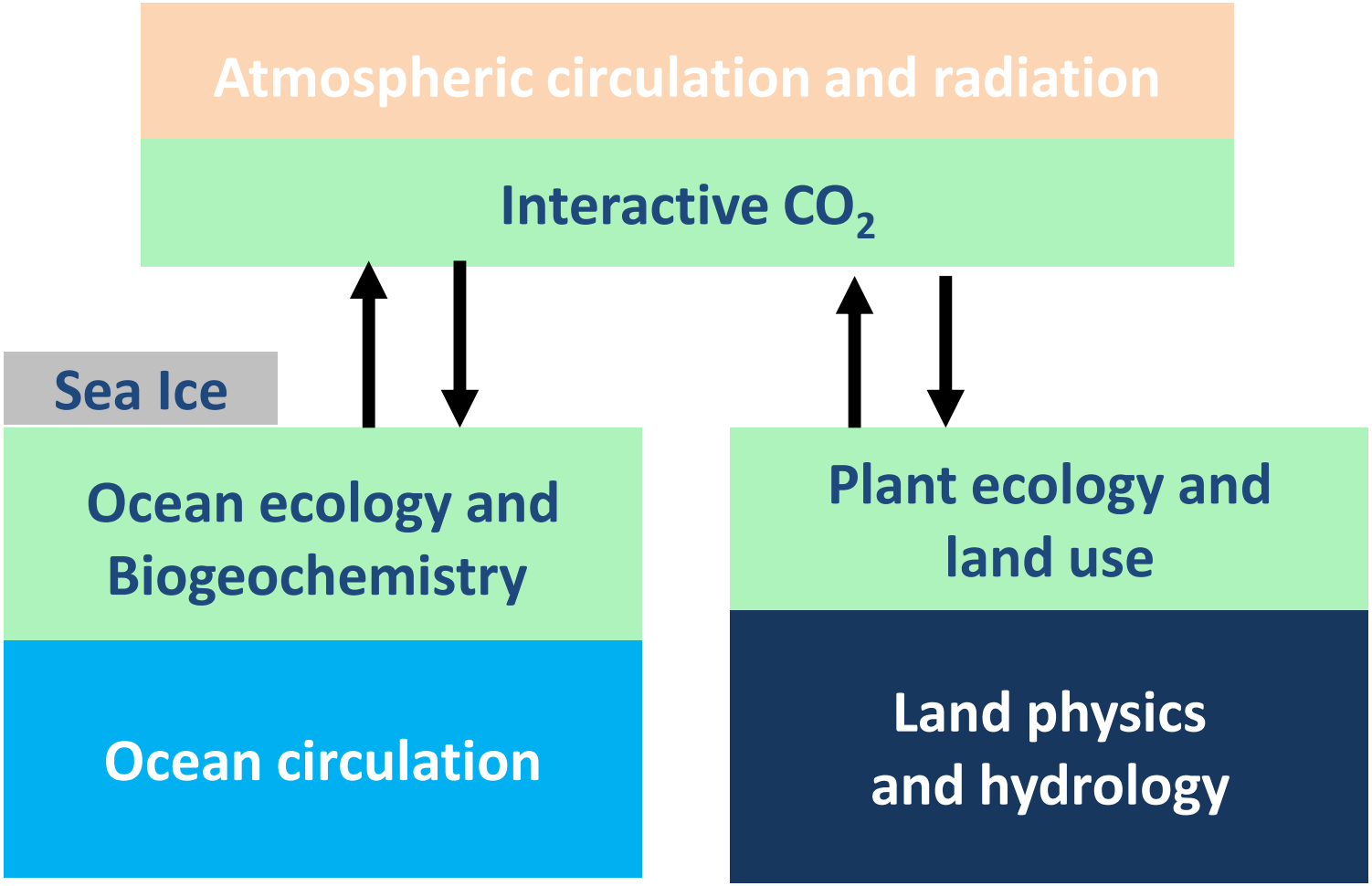
Anne Hollowed[1]

ACLIM PIs:
Anne Hollowed[1], Kirstin Holsman[1], Alan Haynie[1], Stephen Kasperski[1], Jim Ianelli[1], Kerim Aydin[1], Wei Cheng[2,3], Al Hermann[2,3], Trond Kristiansen[4], Andre Punt[5]

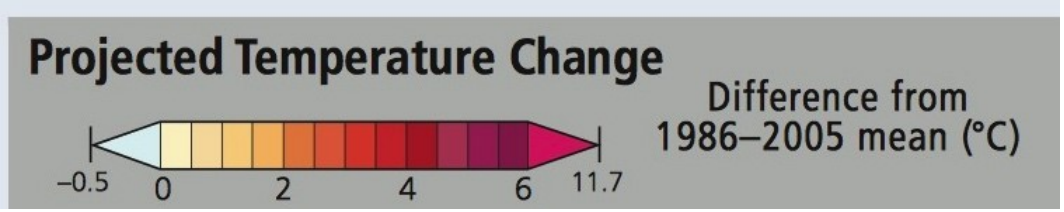
1. NOAA Fisheries, Alaska Fisheries Science Center
2. NOAA Office of Oceanic and Atmospheric Research, Pacific Marine Environmental Laboratory
3. Joint Institute for the Study of the Atmosphere and Ocean, University of Washington
4. Institute of Marine Research, Bergen Norway
5. School of Aquatic and Fisheries Science, University of Washington

NOAA FISHERIES

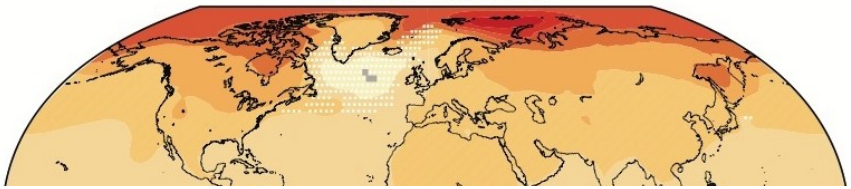
Earth System Models (Stock, GFDL)



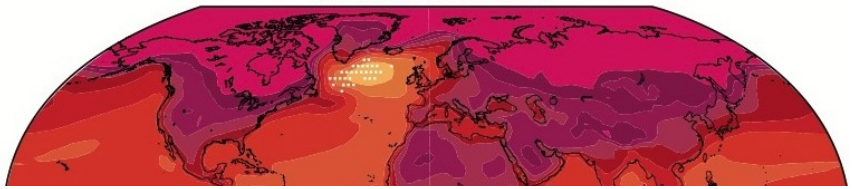
Intergovernmental Panel on Climate Change (IPCC)
5th Assessment Report (2013, 2014)



RCP2.6 2081–2100

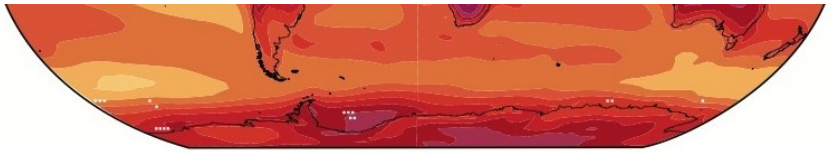


RCP8.5 2081–2100



Low CO_2 SCENARIO

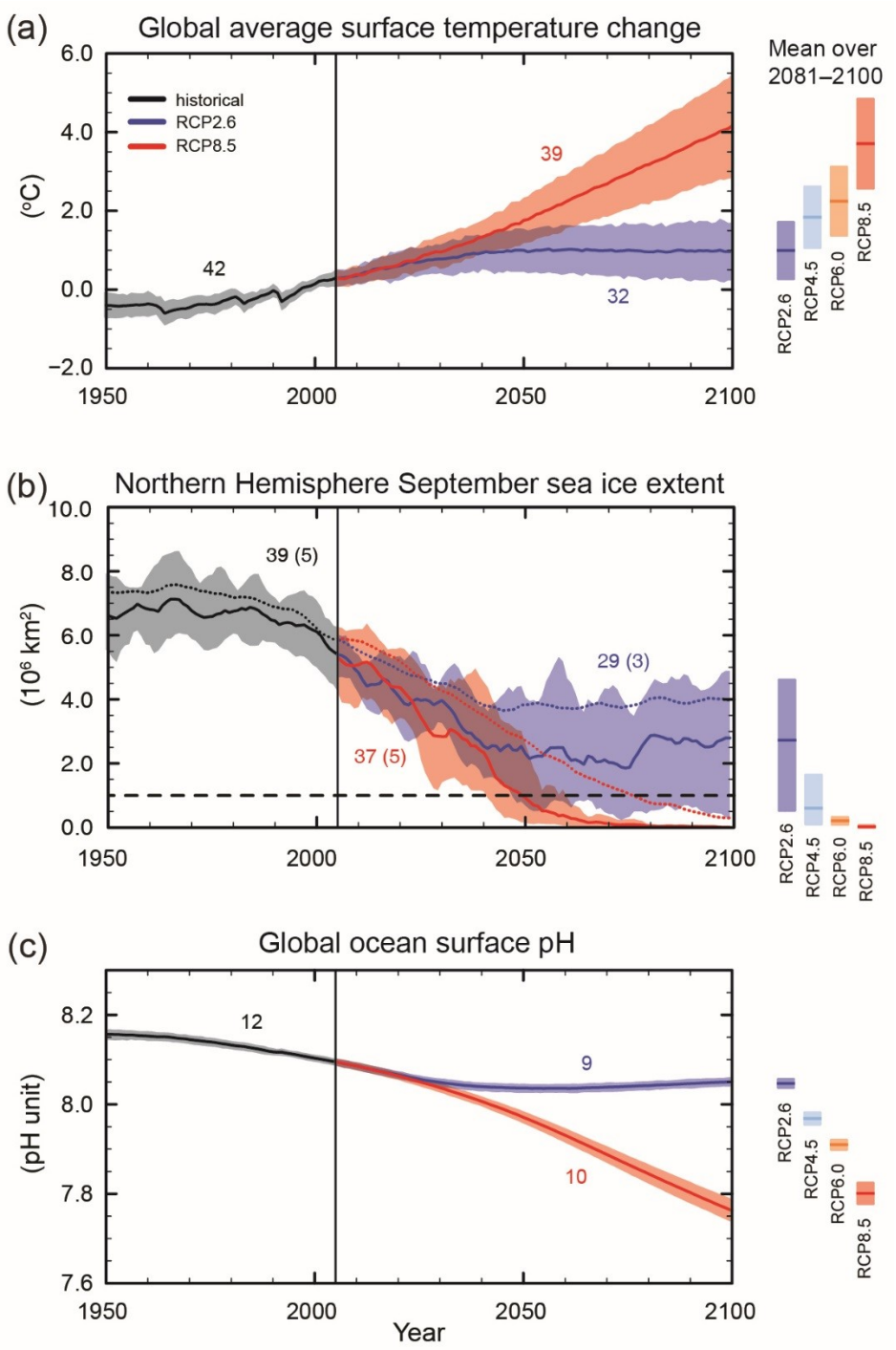
High CO_2 SCENARIO



"Paris COP21 agreement"

"Business as usual"

https://www.ipcc.ch/report/ar5/

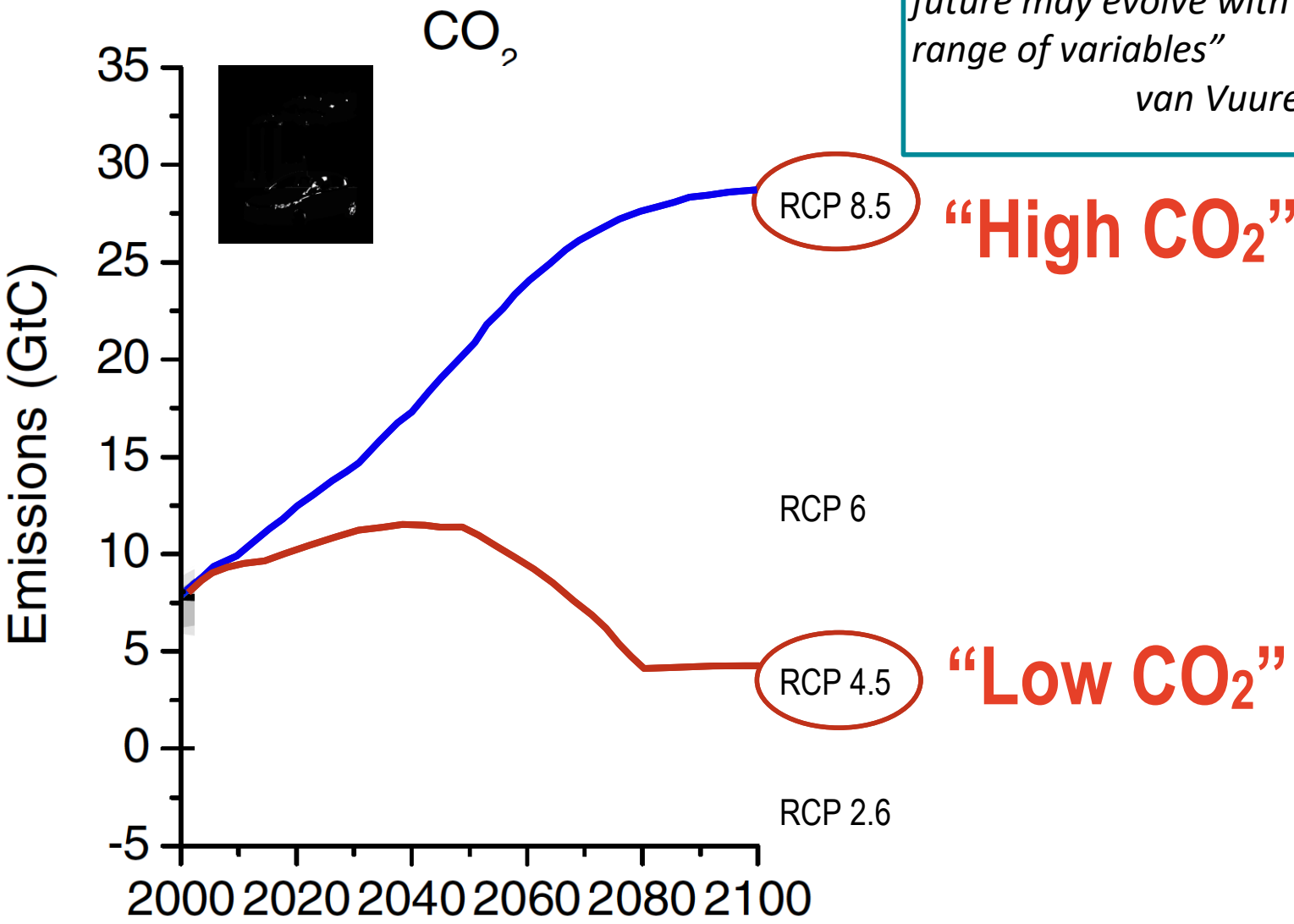


Intergovernmental Panel on Climate Change; 5th Assessment Report

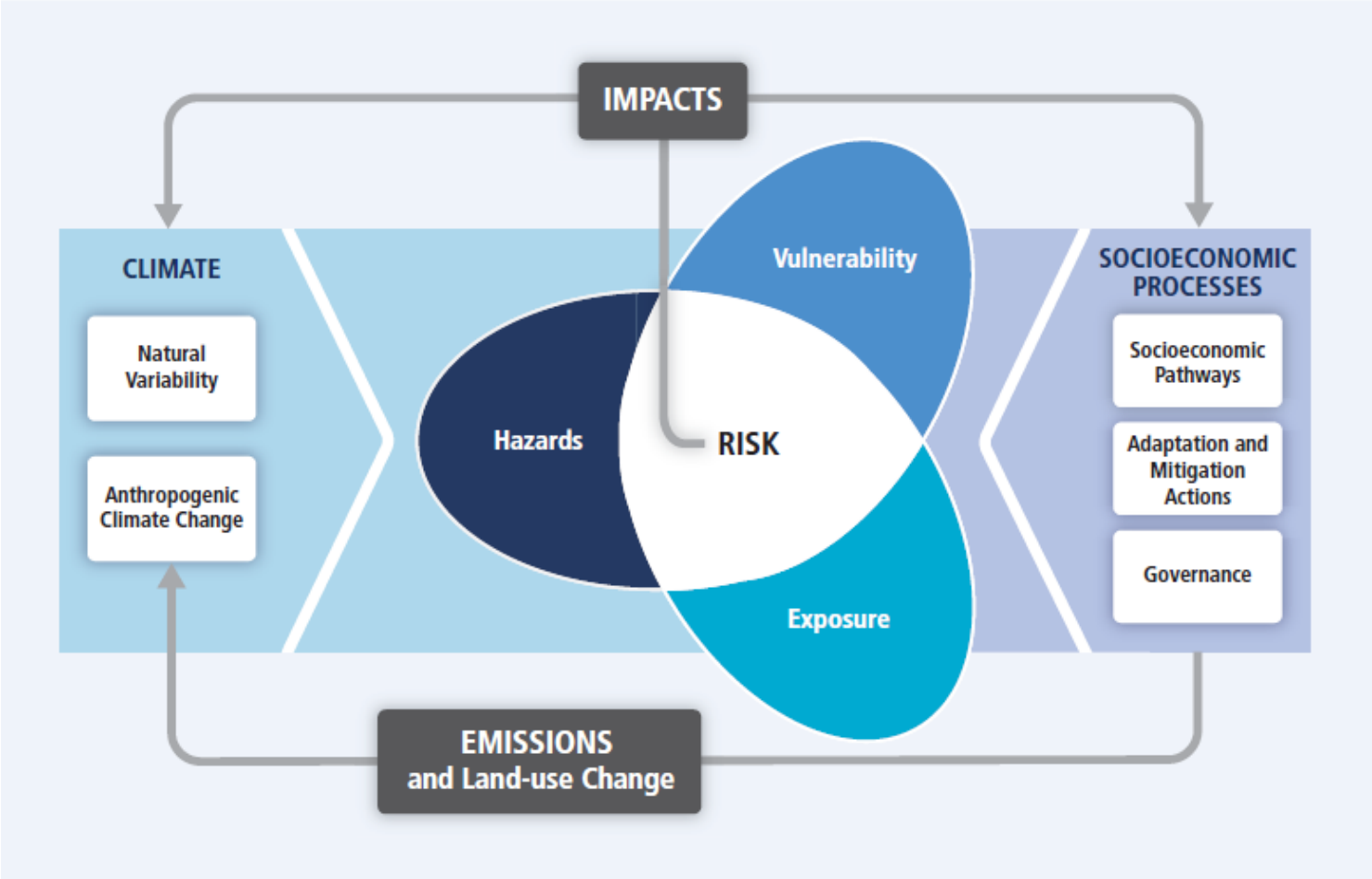
IPCC AR5 WG 1 synthesis report: https://www.ipcc.ch/report/graphics/index.php?t=Assessment%20Reports&r=AR5%20-%20WG1&f=SPM

Carbon Emission Scenarios

> *"**plausible descriptions** of how the future may evolve with respect to a range of variables"*
>
> *van Vuuren et al. 2011*



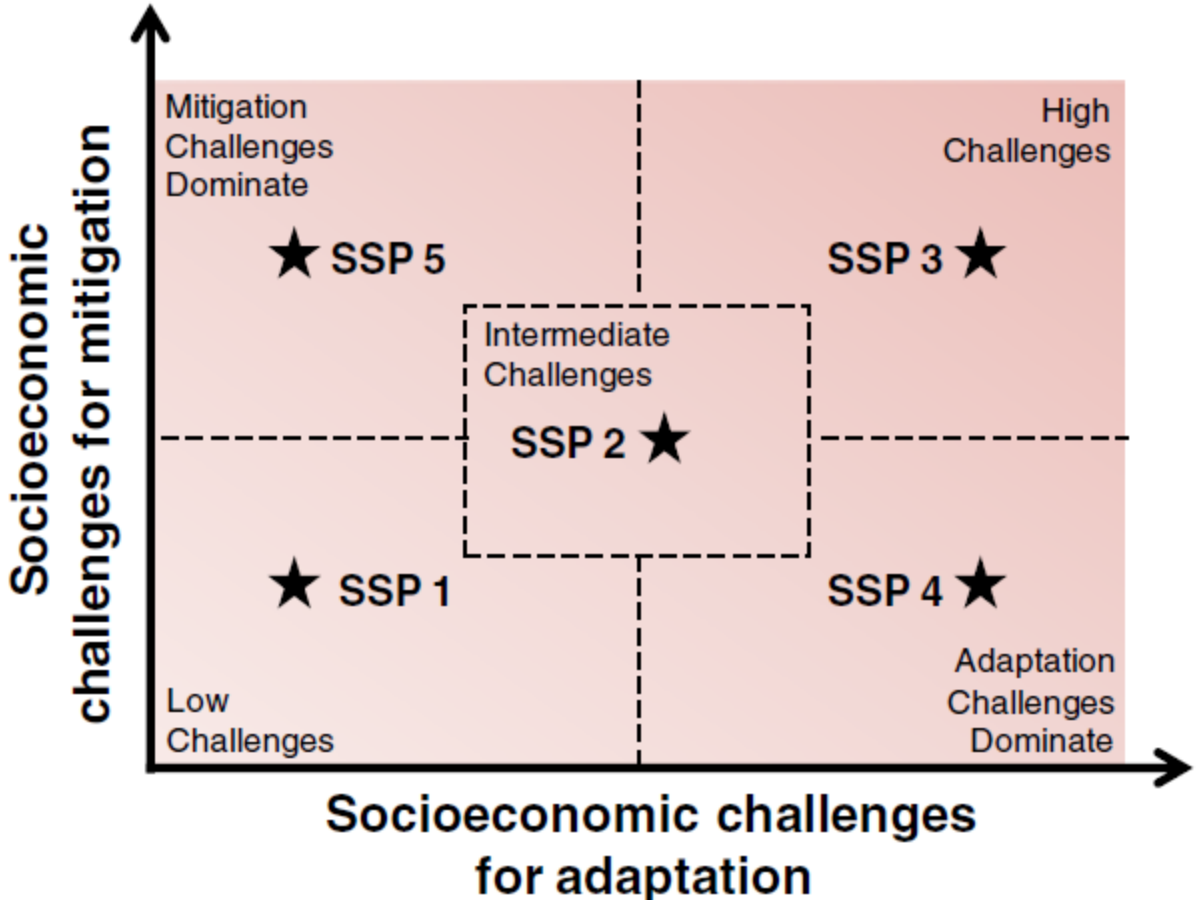
Climate Change Assessment
(IPCC - WGII Summary for Policy Makers)



http://www.ipcc-wg2.gov/AR5/images/uploads/WG2AR5_SPM_FINAL.pdf

Climate Change Assessment (IPCC - WGII Summary for Policy Makers)

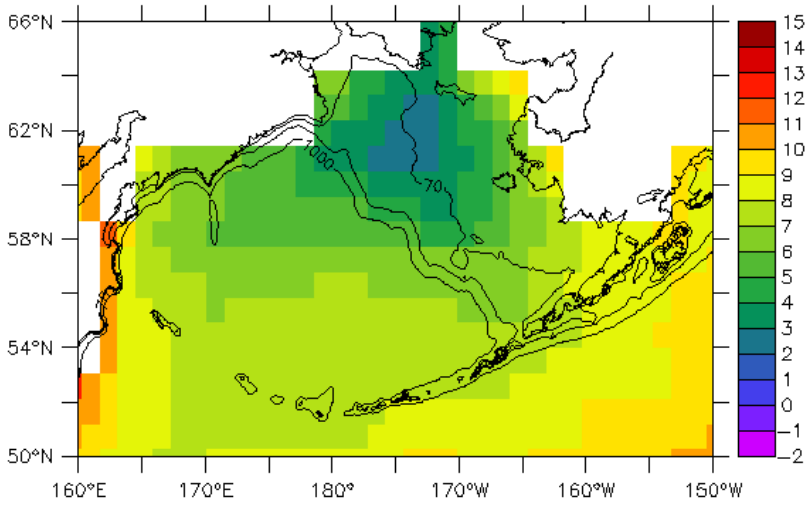
https://www.ipcc.ch/report/graphics/index.php?t=Assessment%20Reports&r=AR5%20-%20WG1&f=SPM



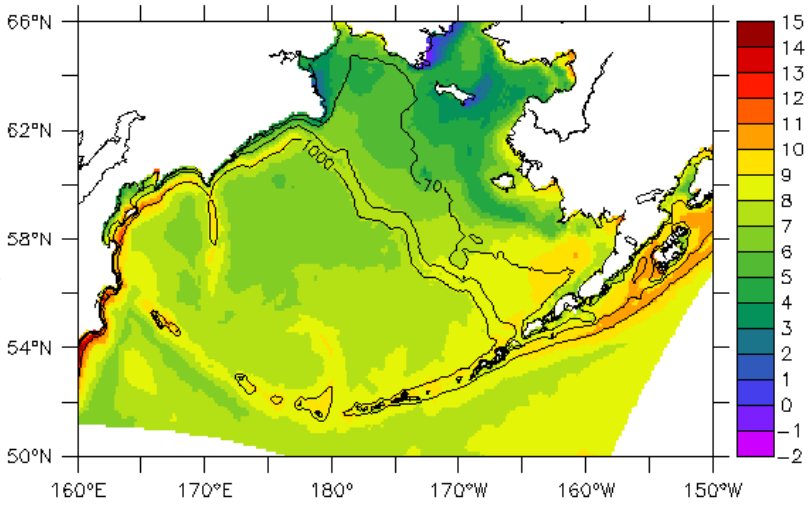
O' Niell et al. 2014. Climate Change 122:387-00; Bauer et al. 2017 http://dx.doi.org/10.1016/j.gloenvcha.2016.07.006

IPCC global projections drive regional model (*dynamical downscaling*)

IPCC model (MIROC)



Regional model (Bering10K)

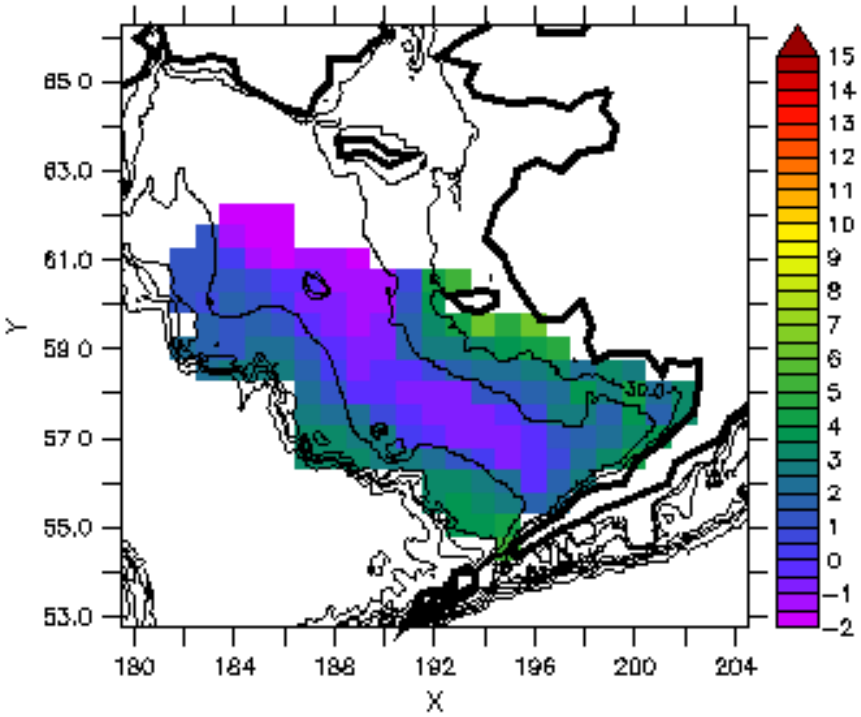


IPCC global atmosphere provides *surface forcing*

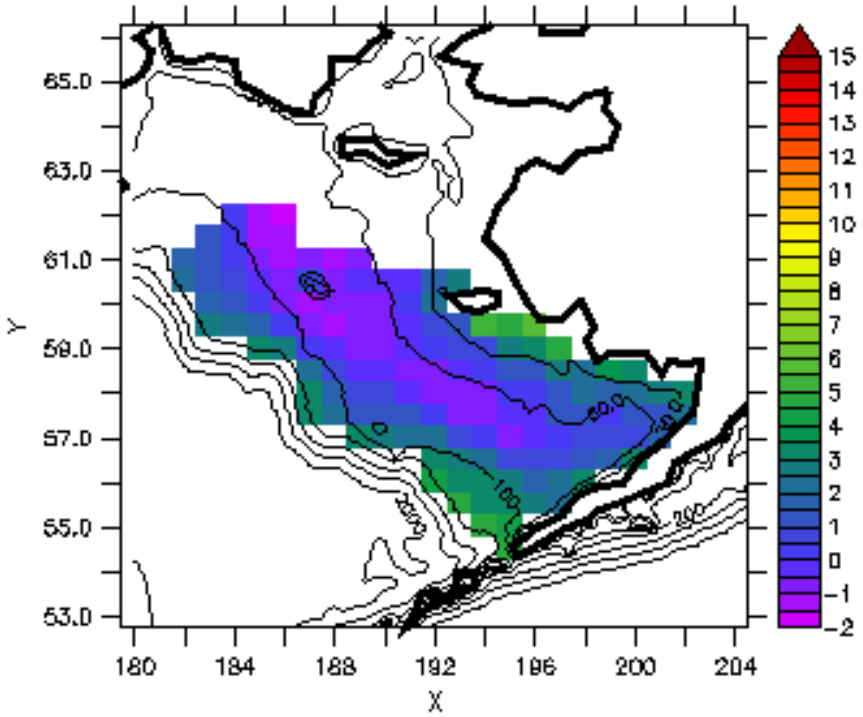
IPCC global ocean provides *boundary conditions*

Bering10K validation:
Bottom Temp (deg C) summer 2009

Model

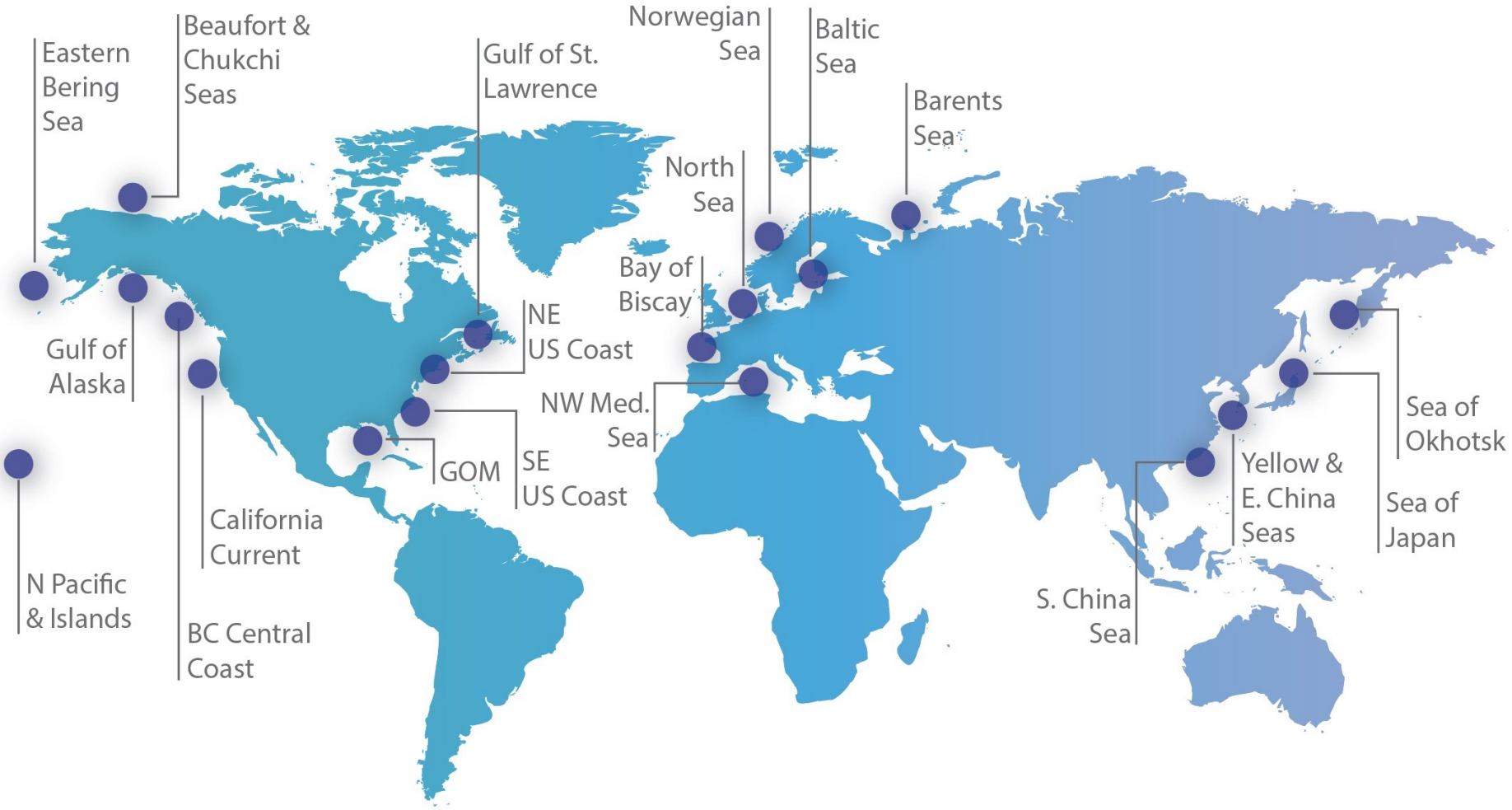


Data



SICCME/S-CCME

Regional Modeling Nodes



ICES-PICES Strategic Initiative on
Climate Change Effects on Marine Ecosystems

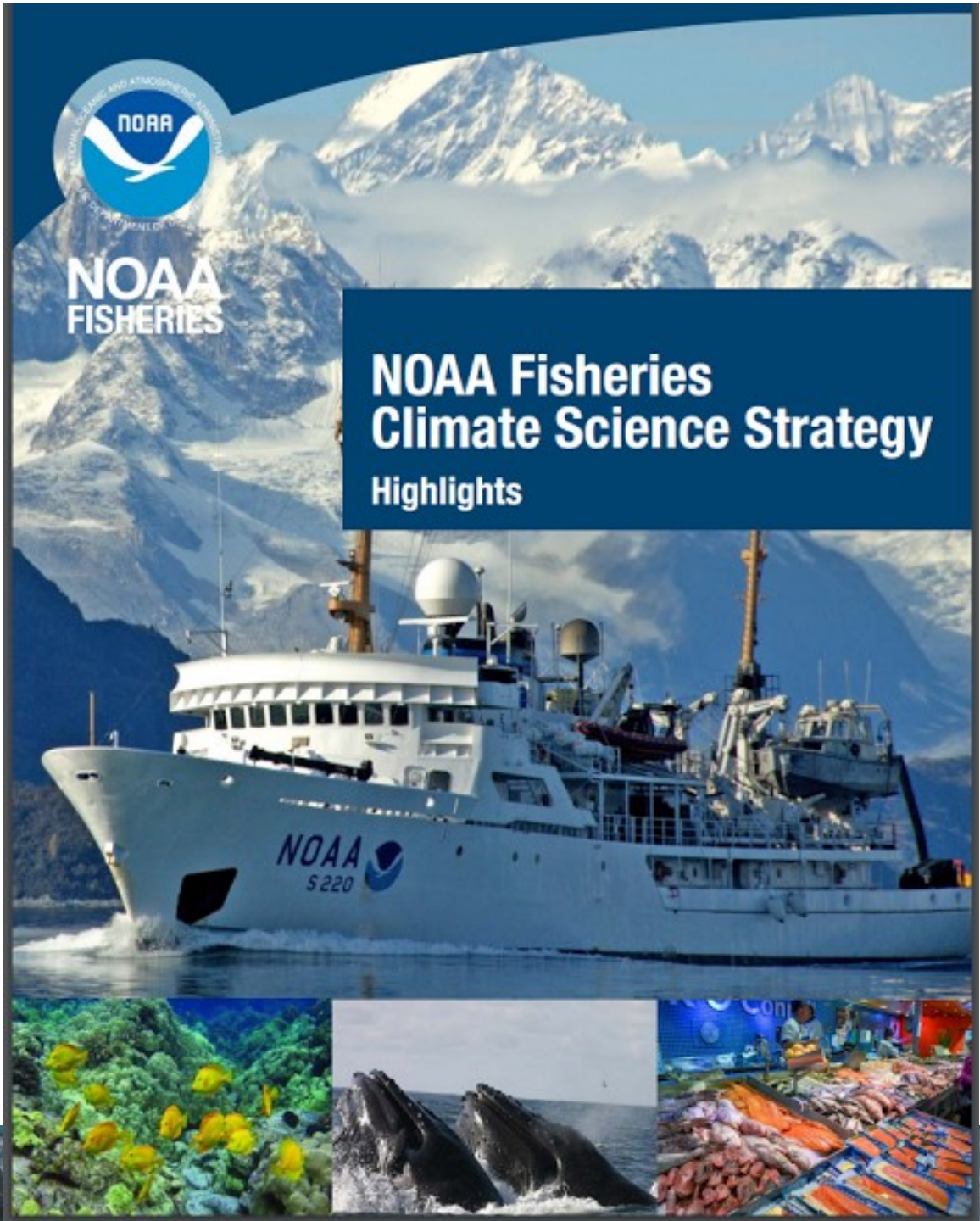
Link, J. S., R. Griffis, S. Busch (editors) (2015) NOAA Fisheries Climate Science Strategy. NOAA Tech. Memo. NMFS-F/SPO-155.

http://www.st.nmfs.noaa.gov/Assets/ecosystems/climate/documents/NCSS_Final.pdf

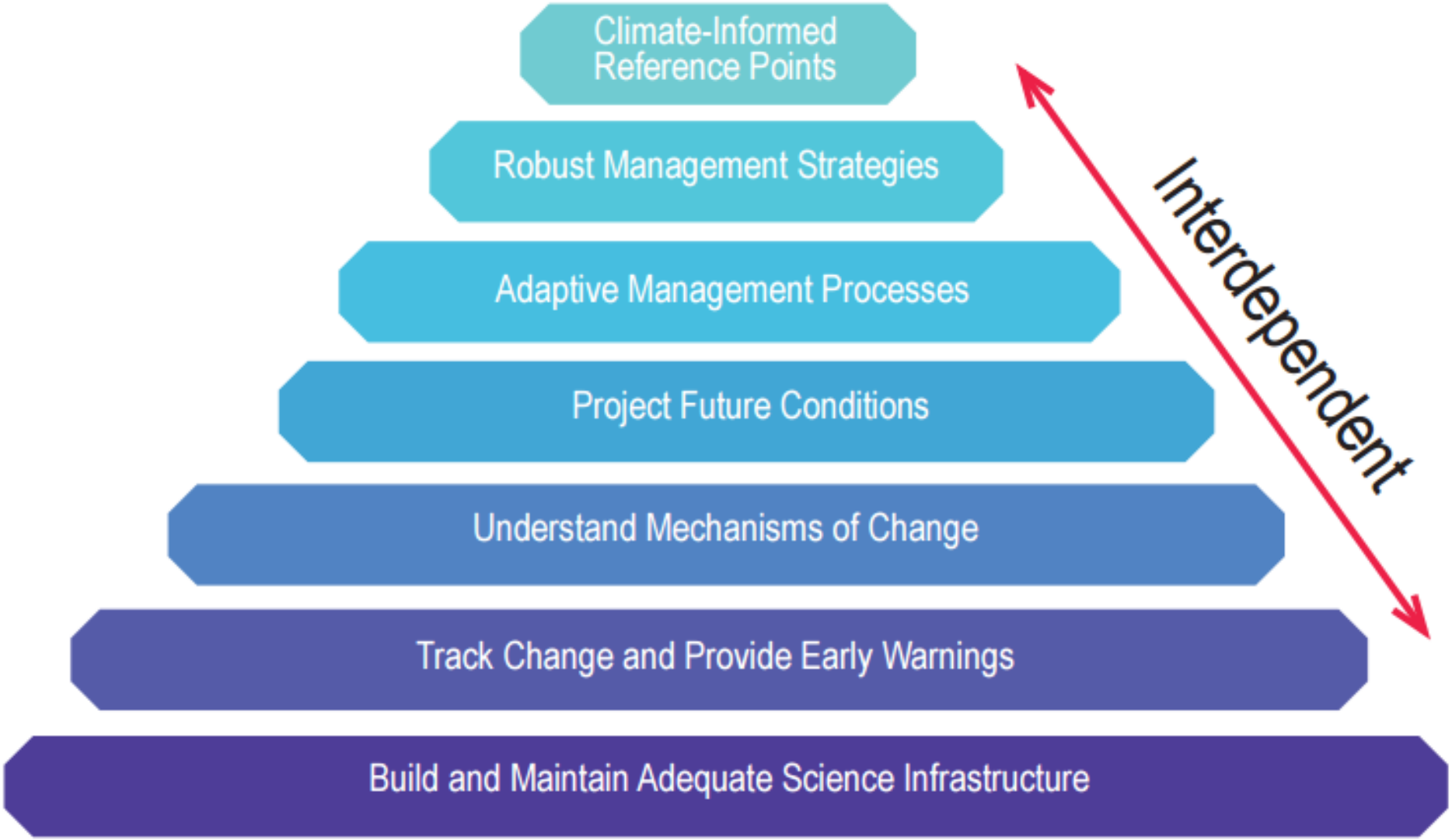
Busch, D.S. et al.**. 2016. Climate science strategy of the US National Marine Fisheries Service.** Marine Policy 74:58-67

Sigler, M., (2017). **Bering Sea Regional Action Plan .** NOAA Tech. Memo.

http://www.st.nmfs.noaa.gov/ecosystems/climate/rap/afsc-rap



Climate Science Strategy Objectives



NCSS Key Objectives for Workshop

- Objective 1: Identify appropriate, climate informed reference points for managing living marine resources (LMRs).
- Objective 2: Identify robust strategies for managing LMRs under changing climate conditions.
  Objective 3: Design adaptive decision processes that can incorporate and respond to changing climate conditions.

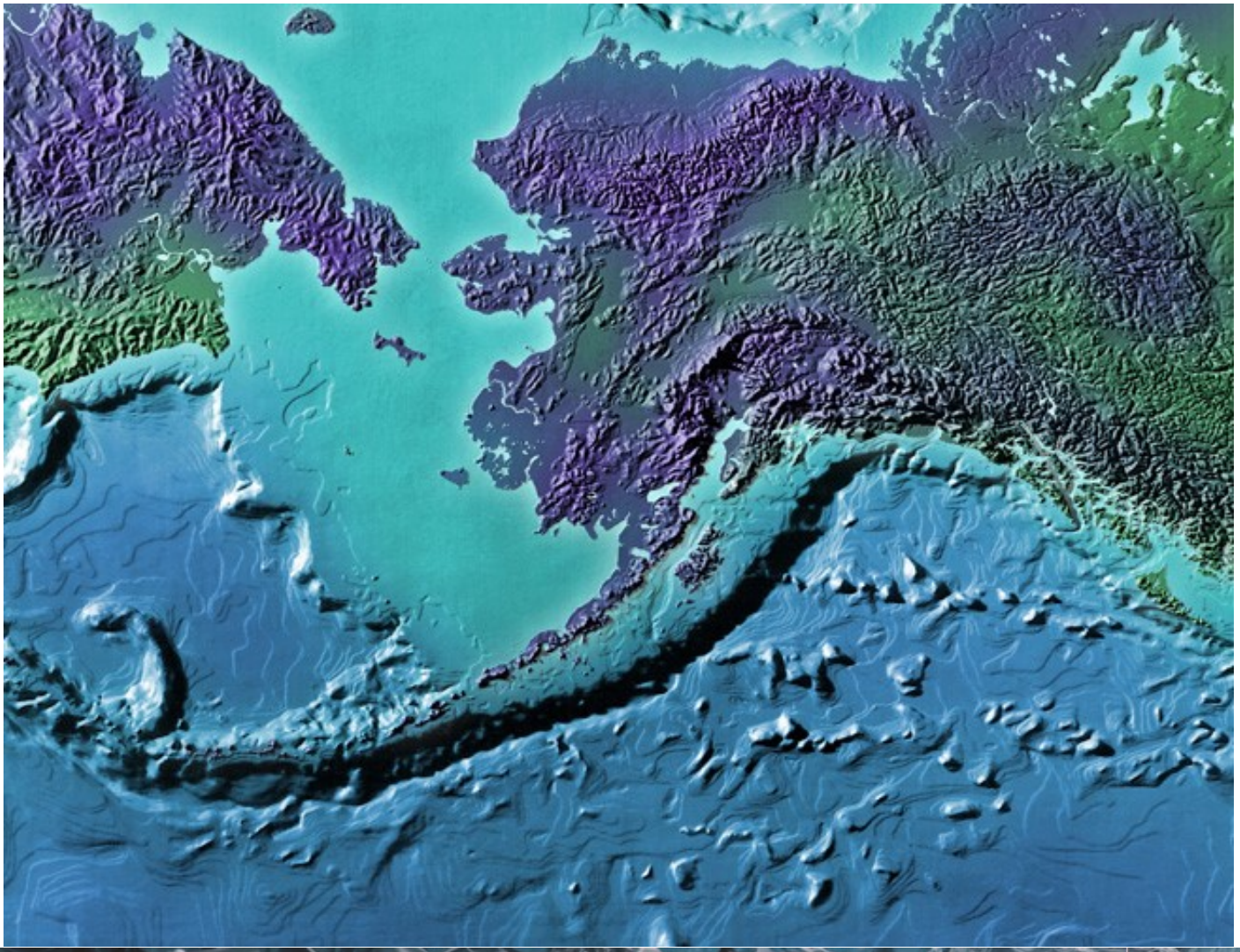
Management Strategy Evaluation

Smith et al. 1999. ICES JMS 56:967-979

- Assess consequences of a range of management options
- Focus on trade-offs
- Not seeking an “optimal” strategy
- Decision-makers can weigh options and consider risks
- Specify clear management objectives
- Develop quantifiable performance measures for each objective
- Identify alternative management options
- Evaluate performance of each option: across range of objectives
- Account for uncertainty
- Communicate results to decision-makers.

M. Jones Presentation National SSC Jan 2018, San Diego, CA

ACLIM: Alaska Climate Integrated Modeling Project (https://www.afsc.noaa.gov/REFM/REEM/ACLIM.htm)



Outgrowth of Bering Sea Project.
3 yrs 2015-2017
Continuation NOAA – 2018-2020

Source: NOAA (FATE, SAAM, NPCREP, IEA, RTAP)

Institutions JISAO, SAFS, PMEL, AFSC

NOAA FISHERIES

Project changes in Bering Sea ocean conditions and fish populations

Physical, biological, & socioeconomic change; now - 2100

Evaluate how management can adapt to minimize negative impacts of future changes

gradual change & sudden shocks; test existing & new tools; estimate risk

The ACLIM team


Anne Hollowed


Kirstin Holsman


Alan Haynie


Albert Hermann


Wei Cheng


Andre Punt


Darren Pilcher


Kerim Aydin


Jim Ianelli


Andy Whitehouse


Stephen Kasperski


Cody Szuwalski


Amanda Faig


Jonathan Reum


Michael Dalton


Paul Spencer

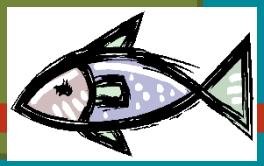

Tom Wilderbuer

William Stockhausen

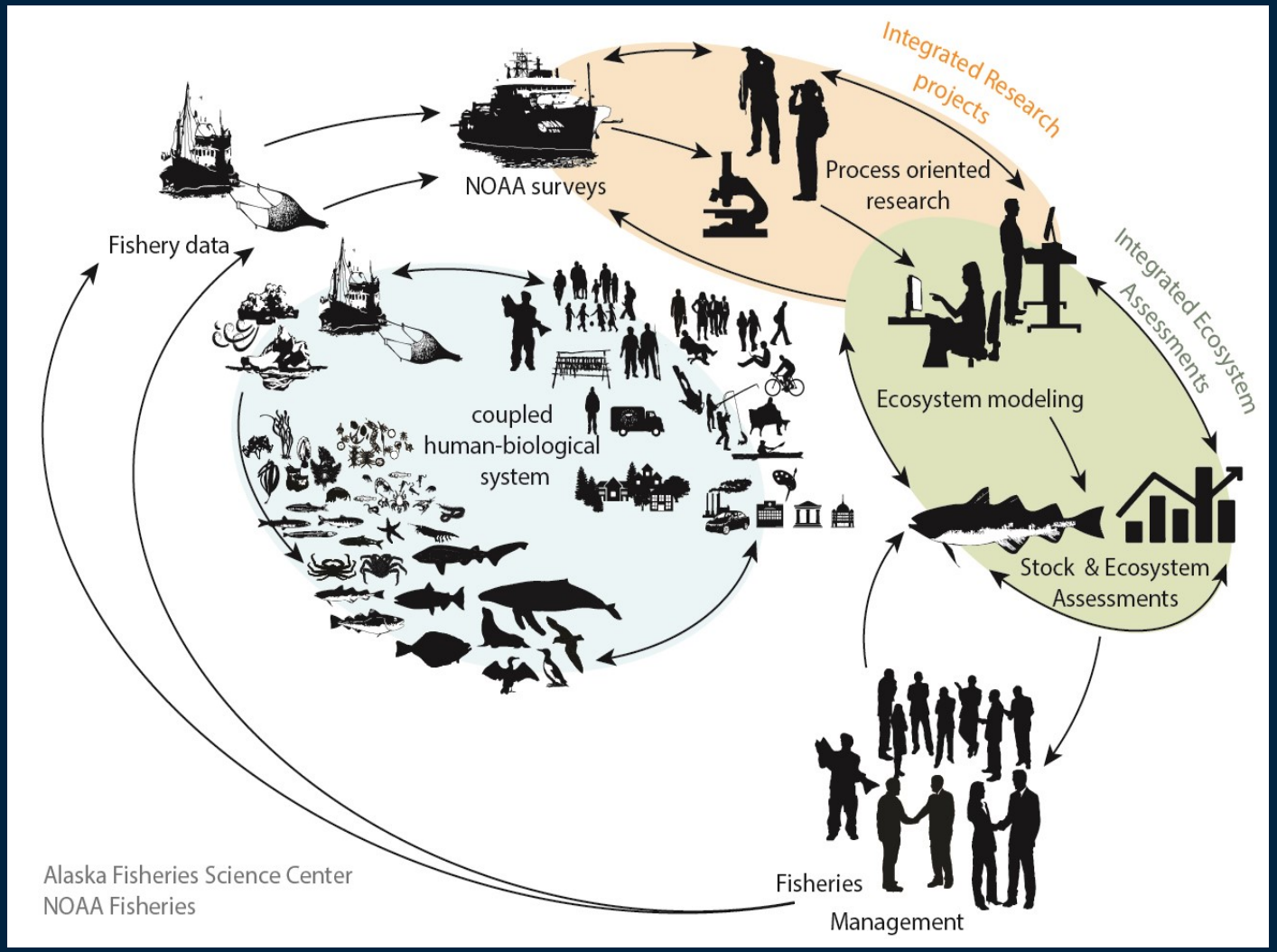
NOAA FISHERIES

Possible Impacts of a Changing Climate

Climate Changes	Physical Chemical Impacts	Biological Impacts	Social Economic Impacts
↑ Temperature	↑ Ocean temperature	Δ Productivity	Δ Fishing activities
Δ Precipitation	↓ Sea ice	Δ Phenology & survivorship	Δ Revenues & economies
↑ Atmospheric Carbon Dioxide	↑ Sea level	Δ Species distribution	Δ Industries
	Δ Freshwater	Δ Species abundance	Δ Subsistence use
	↑ Ocean Acidification	Δ Community composition	Δ Community health



Fish and Fisheries Integrated Approach



NOAA FISHERIES

Projection modeling tools inform public and managers

Evaluation of risks and trade-offs requires integrated approach

NMFS NCSS is designed to encourage MSEs for Large Marine Ecosystems to inform decision makers

This workshop is designed to engage stakeholders in identifying integrated socio-economic pathways and management scenarios.

Photo: Mark Holsman

International Planning for Next IPCC Cycle

- 4th Effects of Climate Change on the World's Oceans Symposium, June 2018
- FAO report - 2018
- IPCC Special Reports:
  - Special Report on Global Warming of 1.5°C (SR15)
  - Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC) - 2019
  - Special Report on Climate Change and Land (SRCCL)
- IPCC 6th Assessment Report 2020 - 2021

Acknowledgements

Thanks to FATE, SAAM, IEA, NPCREP, and RTAP
and
the Bering Sea Project PIs (NPRB, NOAA, NSF)