The Alaska Climate Integrated Modeling Project (ACLIM)

Goal: The ACLIM project represents a comprehensive, collaborative effort by NOAA Fisheries and partners to characterize and project climate-driven changes to the Bering Sea ecosystem, from physics to fishing communities. The goal is to provide decision-makers with information on how different fisheries management approaches might attenuate or amplify climate-driven changes to fish and shellfish populations.

NOAA FISHERIES
Alaska Fisheries Science Center

Summary

ACLIM is a interdisciplinary collaboration to project and evaluate climate impacts on marine fisheries in the Bering Sea, AK. It connects research on downscaling global climate and socioeconomic projections to regional circulation, climate-enhanced biological models, and socio-economic and harvest scenarios in order to inform management of the risks of climate change on fish and fisheries as well as evaluate the performance of a range of adaptation strategies. It is a collaboration between 20+ scientists including physical oceanographers, ecosystem modelers, socioeconomic analysts, and fishery management experts from NOAA AFSC, NOAA PMEL, and the University of Washington.

ACLIM provides a proof-of-concept implementation of a Management Strategy Evaluation (MSE) framework, or management "stress-test", for evaluating the performance of resource management strategies under different future climate scenarios. As part of the project, MSEs will be conducted on several fish and invertebrate species from the Eastern Bering Sea (EBS), for which changes in productivity have been linked to climate variability. The MSEs are designed to address the following questions:

1. Are current fishery management approaches robust to climate-driven changes, or should additional alternative harvest control rules and management measures be used?
2. What is the range of expected change in future fishable biomass and recommended harvest rates under various future climate scenarios?

Primary target species:

Walleye pollock (*Gadus chalcogrammus*)

Pacific cod (*Gadus macrocephalus*)

Arrowtooth flounder (*Atheresthes stomias*)

Northern rock sole (*Lepidopsetta polyxystra*)

Snow crab (*Chionoecetes opilio*)

Human fishing fleets and communities

Approach

ACLIM uses results from multiple models to evaluate climate-driven changes and potential management solutions. This includes a suite of 11 future climate scenarios dynamically downscaled to the Bering Sea through a coupled ocean circulation and lower trophic level model called the "Bering10K" model. The downscaled Bering10K model scenarios are used to drive 5 classes of ecosystem models with varying levels of food-web complexity including climate-enhanced single-species and multispecies assessment models, a size-spectrum model, an ecopath with ecosim model, and a fully coupled spatially-explicit end-to-end model (FEAST). The ACLIM biological models are also linked to socioeconomic models through 5+ fishing scenarios in order to test the performance of alternative management approaches.

ACLIM is supported by the following NOAA Fisheries programs: Fisheries and the Environment (FATE), Stock Assessment Analytical Methods (SAAM), Climate Regimes and Ecosystem Productivity (CREP), Economics and Human Dimensions, the NOAA Integrated Ecosystem Assessment program, and the NOAA Research Transition Acceleration Program (RTAP).

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Global Climate Models (x 11)
AR4 A1B Projection Scenario
- ECHO-G
- MIROC3.2 med res.
- CGCM3-t47

AR5 RCP4.5 and AR5 RCP8.5 Projection Scenarios
- CCSM4-NCAR- PO
- MIROCESM-C- PO
- GFDL-ESM2M*- PO
- GFDL-ESM2M*- PON

Physical downscaling

ROMS

Biological downscaling

NPZ

Bering Sea 10K Model

Socio-economic / harvest scenarios (x 6+)
- No fishing
- Status quo
- By-catch changes
- Price changes
- MSY
- MEY

Climate Enhanced Biological models (x 5)
- CE- single species assessment models
- CE- multispecies model (CEATTLE)
- CE - Size spectrum model
- CE- Ecopath with Ecosim
- End-to-End model (FEAST)

interacting pressures

lower trophic

biogeochemical habitats

Coupled Socio-ecological System

communities of practice

communities of place

upper trophic

JISAO

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