TODAY

TOMORROW?
Future Recruitment of Bering Sea Walleye Pollock: Part II: Ranges in Key Environmental Parameters from Global Climate Model Forecasts

Nick Bond¹, Franz Mueter², Anne Hollowed³
Muyin Wang¹, Carol Ladd⁴

¹ Joint Institute for the Study of the Atmosphere and Ocean, UW
² School of Fisheries & Ocean Sciences, UAF
³ Alaska Fisheries Science Center, NOAA
⁴ Pacific Marine Environmental Laboratory, NOAA
Uncertainties and Errors in Projections

Physical Sources
- Human factors (e.g., CO$_2$ emissions)
- Global mean climate
- Regional climate (seasonality, variability, etc.)
- Local conditions (specific parameters of importance)

Procedural Issues
- Multi-model ensembles
- Model selection and weighting
- Bias correction
- Use of empirical relationships
- Combining sources of error
**BSIERP Integrated modeling**

- Economic/ecological model
- FEAST Higher trophic level model
- NPZ-B-D Lower trophic level
- ROMS Physical Oceanography
- Climate scenarios

**BSIERP** Integrated modeling

- Observational Data
- Nested models
- BEST

**UNDERSTANDING ECOSYSTEM PROCESSES IN THE Bering Sea**
Spring conditions

- Timing of ice retreat
- Spring SST
- Spawning
- Early larvae (spring)

(Late) summer conditions

- Summer SST
- Stability
- Wind mixing
- Late larvae (fall)
- Age-1 recruits

Predation

- Biomass
- Consumption rate
- Prey composition

Spatial distribution
Bering Sea SST (JAS) - B1 Scenario

Mean SST (JAS)

2000 2010 2020 2030 2040 2050
Principal Component Analysis of Time Series of Summer SST from IPCC Models
Modeling Oceanic Conditions on the Bering Sea shelf

**Summer**
SST and Stratification
- Sensitive to small-scale, processes such as turbulence and cloud microphysics
- Difficult to model properly

**Winter**
Ice Cover
- Closely related to large-scale dynamics and radiative forcing
- More tractable to model
Summer SST vs. Winter Ice from IPCC Model Hindcasts

Mar-Apr Ice Coverage (1949-1999)
Summer SST vs. Winter Ice from Observations

Observed Mar-Apr Ice Coverage (1963-1999)
Flatfish in the SE Bering

Larval Transport
&
Recruitment

Surface currents April 1-June 30
1980-89

Surface currents April 1-June 30
1990-97
Final Remarks

• Trying to provide complete information on future climate pertaining to Bering Sea pollock

• Considering the various sources of uncertainty and error (global mean climate, regional trends and variability, crucial local parameters)

• Accounting for the multiple sources of uncertainty a complicated business

• Studying further the merits of using empirical techniques for projections of particular parameters, and evaluating and weighting individual model simulations

• Goal: Projections for MSE and other purposes
The Effects Of Global Warming

Scientists say global warming is on the rise. What adverse effects do they predict will occur within the next decade?

- It will always feel like the lights are on
- Led by circus-educated seals, wild seals will rise up and rule earth
- A whole lotta biomes are gonna get all messed up
- Start of 10,000-year Steam Age, which will cleanse planet’s pores
- Even fewer opportunities for snowmen to magically come to life
- World’s population will turn against scientists, forcing them to flee planet several years earlier than originally planned
- If water levels rise more than 10 feet, Tom DeLay will admit global warming not just some crackpot theory
- When depicted in cartoons, sun will have angry face instead of smiling face