Science, Service, Stewardship

Evidence of climate-driven ecosystem reorganization in the Gulf of Mexico

NOAA Southeast Integrated Ecosystem Assessment Team

AOML/SEFSC collaboration workshop
May 29th, 2014

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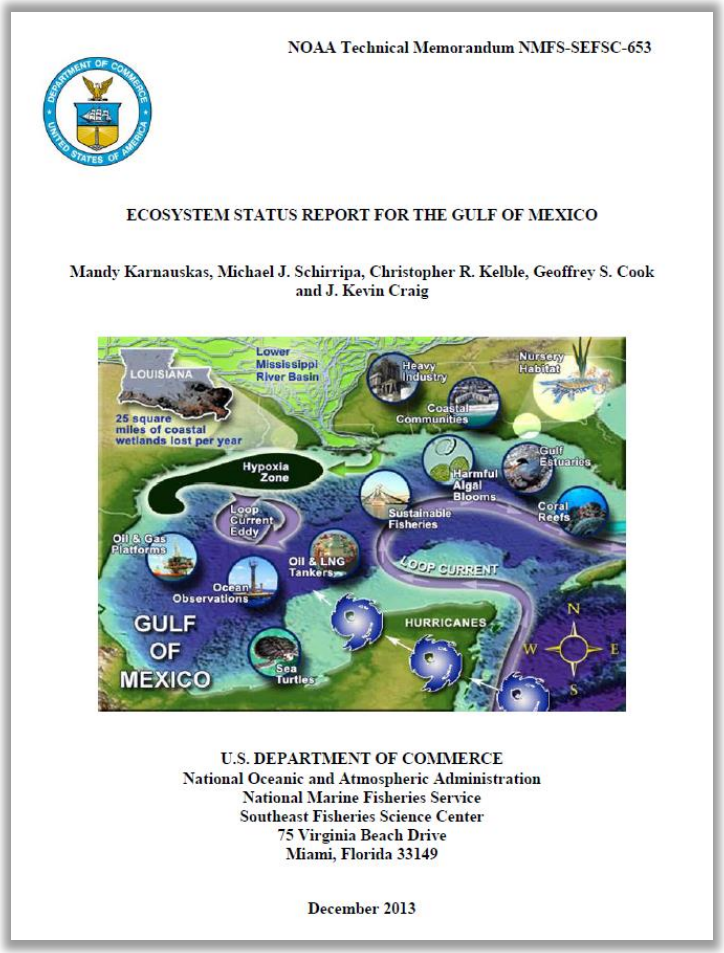
NOAA Technical Memorandum NMFS-SEFSC-653

ECOSYSTEM STATUS REPORT FOR THE GULF OF MEXICO

Mandy Karnauskas, Michael J. Schirripa, Christopher R. Kelble, Geoffrey S. Cook and J. Kevin Craig

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
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Indicator selection process

Responsive – Does the indicator respond to or drive changes in the ecosystem?

Integrative – Does the indicator describe overall ecosystem status?

Understandable – Is the indicator understood by a non-scientific audience?

1. Please indicate your area of expertise.

Economics
Fisheries - Management
Marine Resource Management

2. What is your affiliation?

NOAA Sea Grant

3. Please rate the following indicators according to the criteria listed, with respect to the potential utility of the indicator for the management of the Gulf of Mexico Large Marine Ecosystem. 'Ecosystem' in this context refers to the entire extent of the Gulf of Mexico, and includes coastal human communities dependent on the Gulf.

	Does the indicator respond to changes in the state of the ecosystem?	Does the indicator status reflect OVERALL ecosystem health? (i.e., is the indicator integrative?)	Is the indicator understood by managers and the public?
average trophic level in the catch	Definitely yes	Definitely yes	Maybe
average trophic level in fishery-independent survey	Definitely yes	Definitely yes	Maybe
mean length in the catch (by species)	Probably yes	Probably yes	Probably yes
mean length in the catch (of all species pooled)	Probably yes	Maybe	Maybe
condition factor of individual species in the catch	Probably yes	Probably yes	Maybe
size at maturity in the catch (by species)	Probably yes	Maybe	Probably yes
pelagic: demersal fish ratio in catch	Don't know	Don't know	Don't know
pelagic: demersal fish ratio in fishery -independent survey	Don't know	Don't know	Don't know
proportion of predatory fishes in catch	Definitely yes	Maybe	Maybe
proportion of predatory fishes in fishery-independent survey	Definitely yes	Maybe	Maybe
proportion of moderately exploited species in catch	Probably yes	Maybe	Maybe

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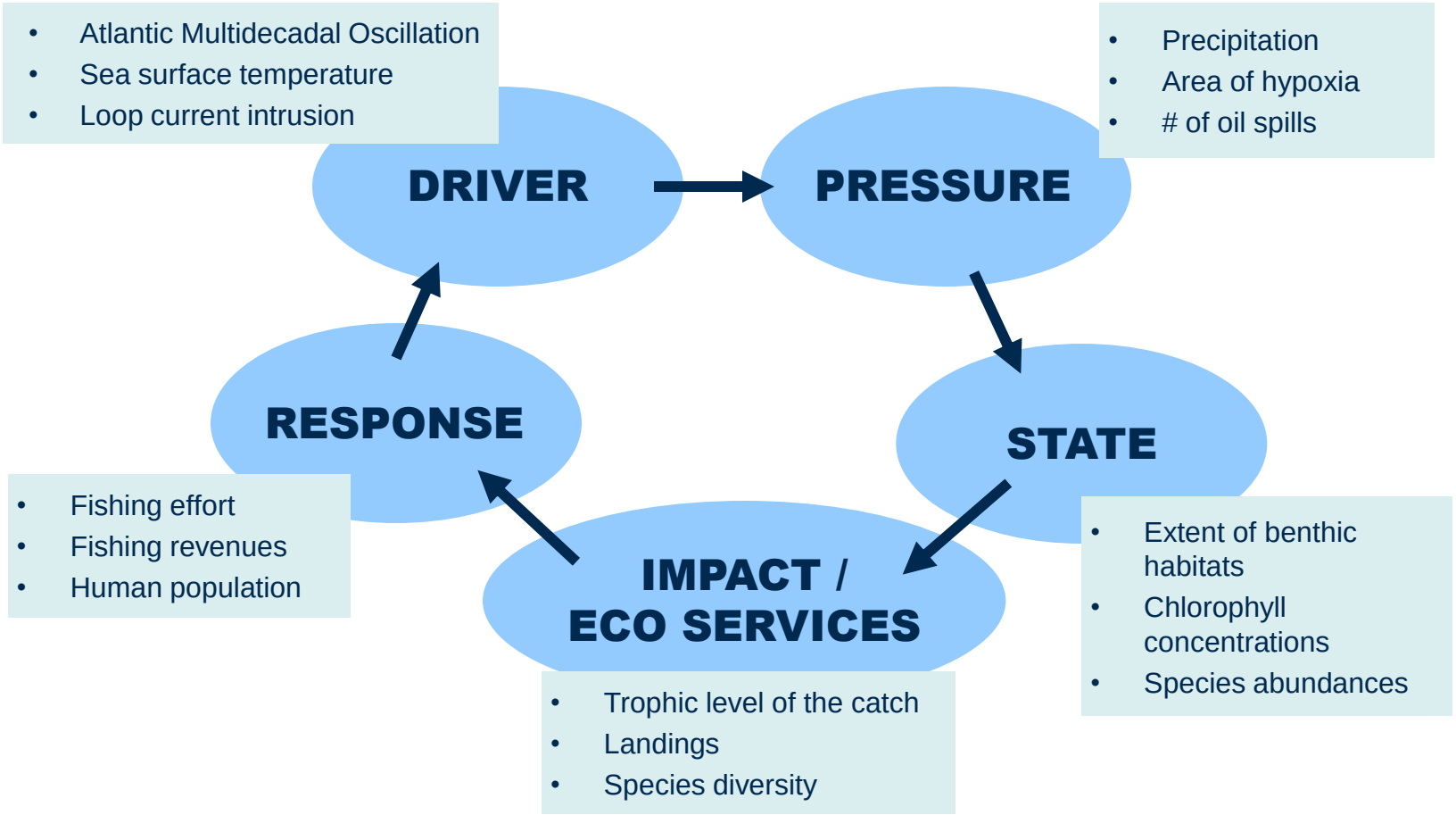
DPSIR Indicator Framework



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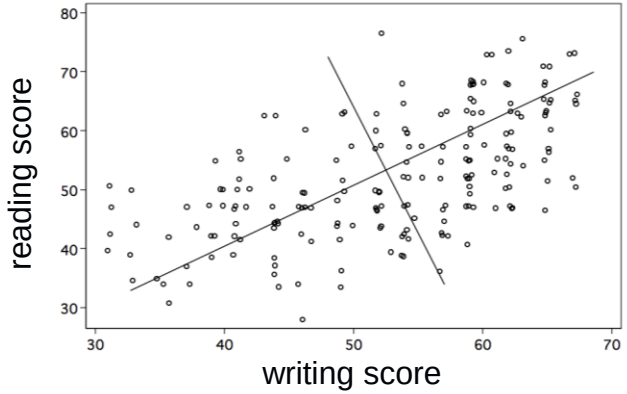
Ordination techniques

data matrix:

	Indicator 1	Indicator 2	Indicator 3
time			

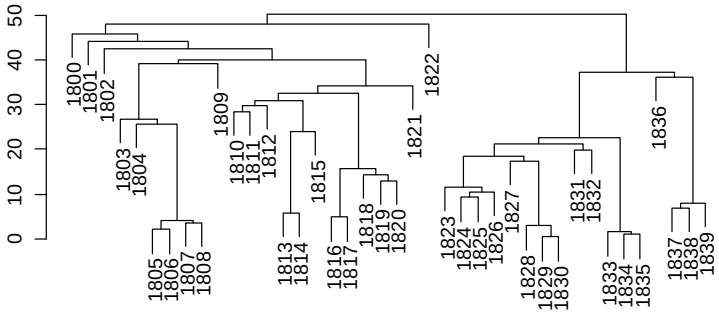
Principal components analysis

Represents complex data sets with a smaller number of axes which represent covariance structure



Chronological clustering

Similarities between ordered times steps calculated based on distance matrix



http://www.philender.com

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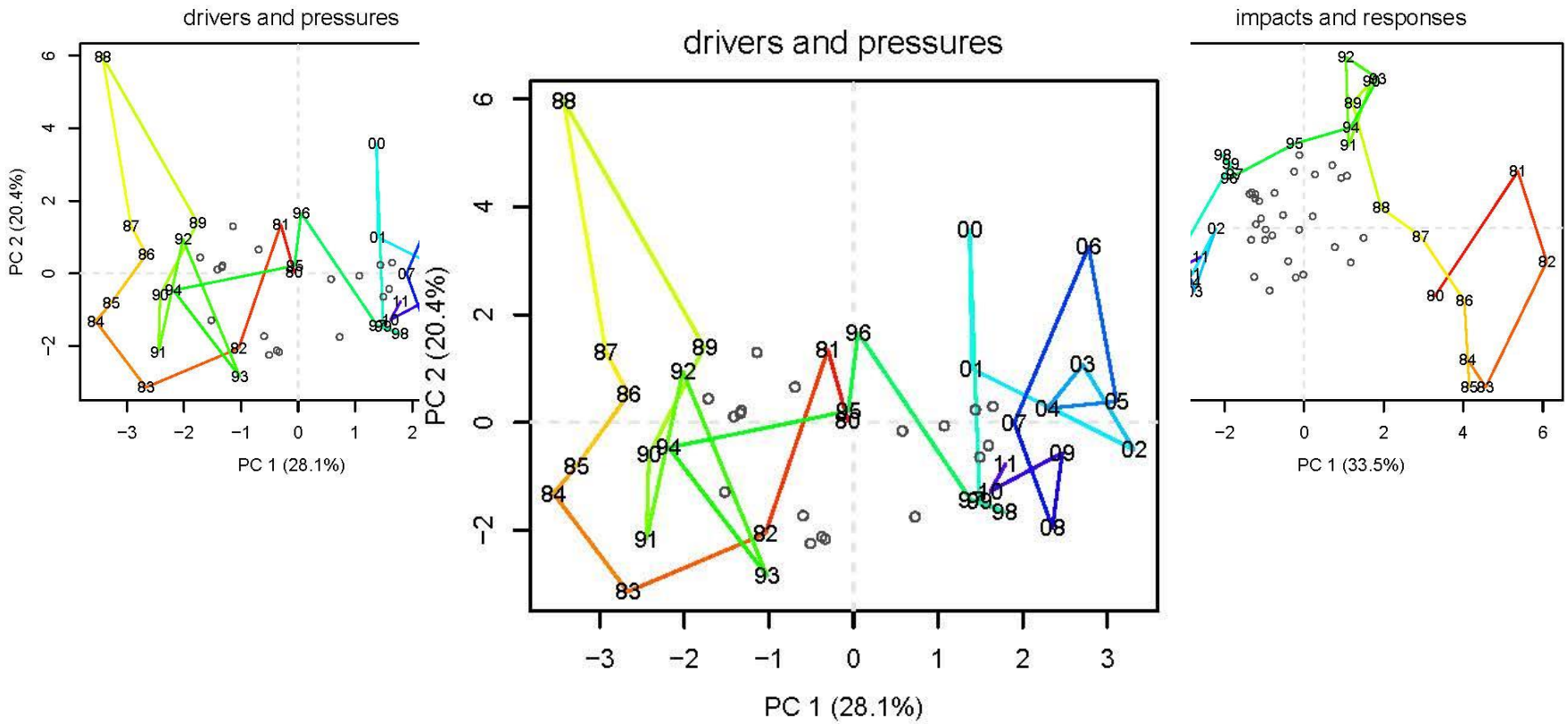
Ordination by indicator group



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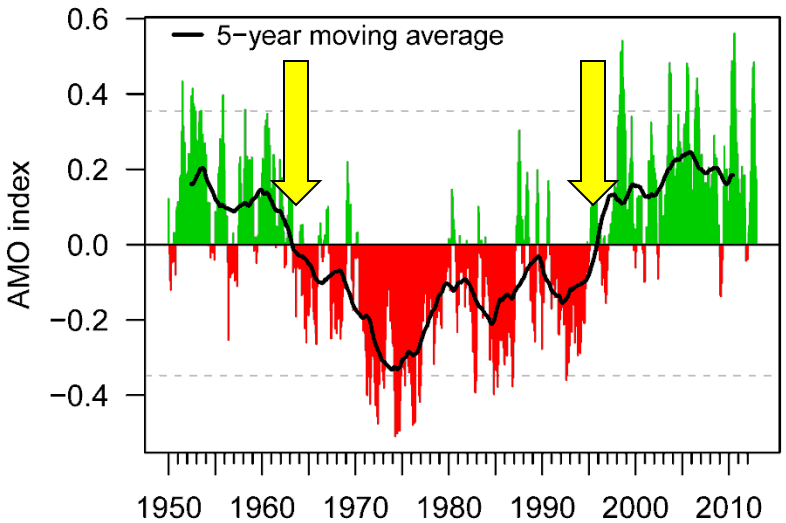
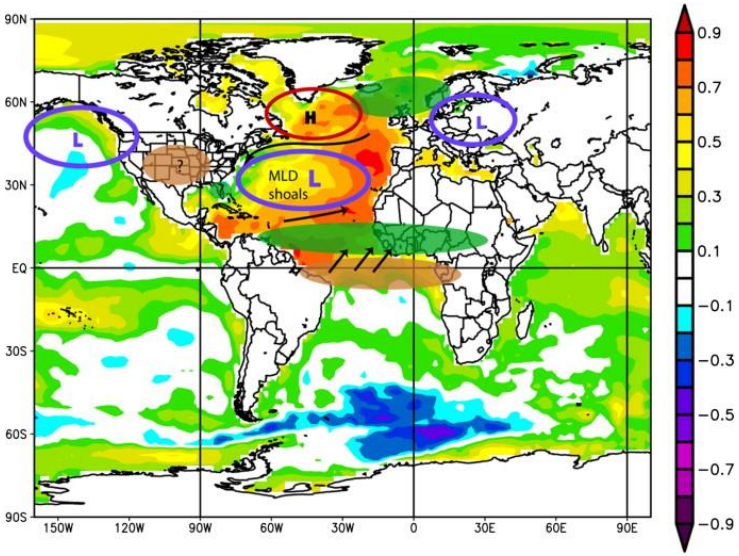
Atlantic Multidecadal Oscillation?





Nye et al. 2013

AMO warm phase:

- Increased SST in GoM
- Decreased precipitation in U.S.
- Shallower mixed layer in GoM

Expect to see an ecosystem shift in ~1965?

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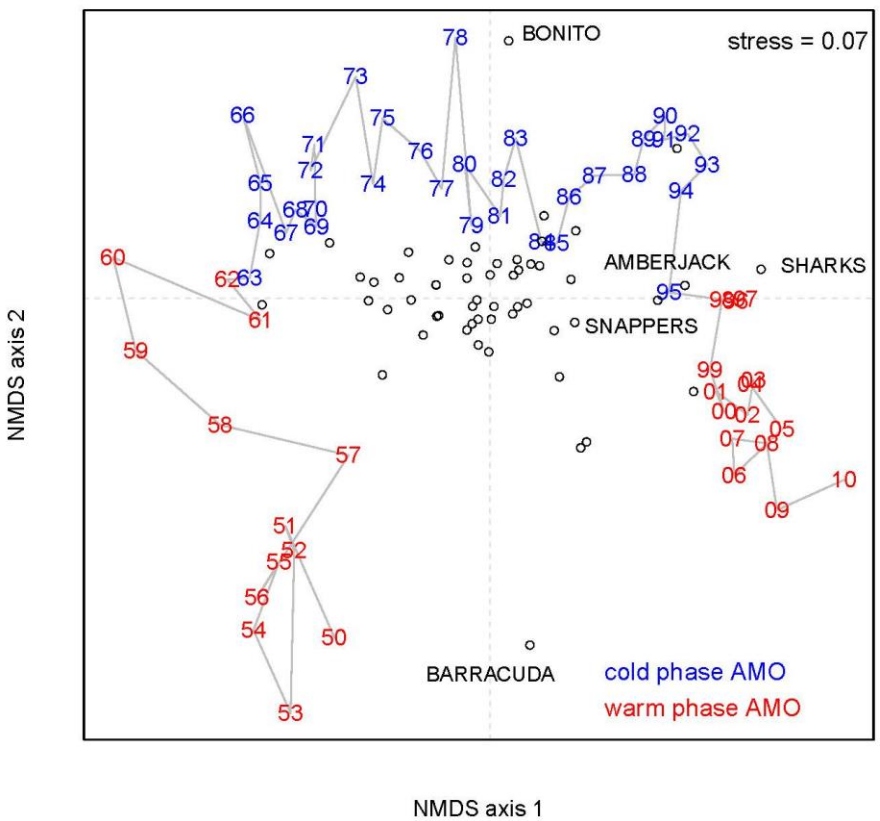
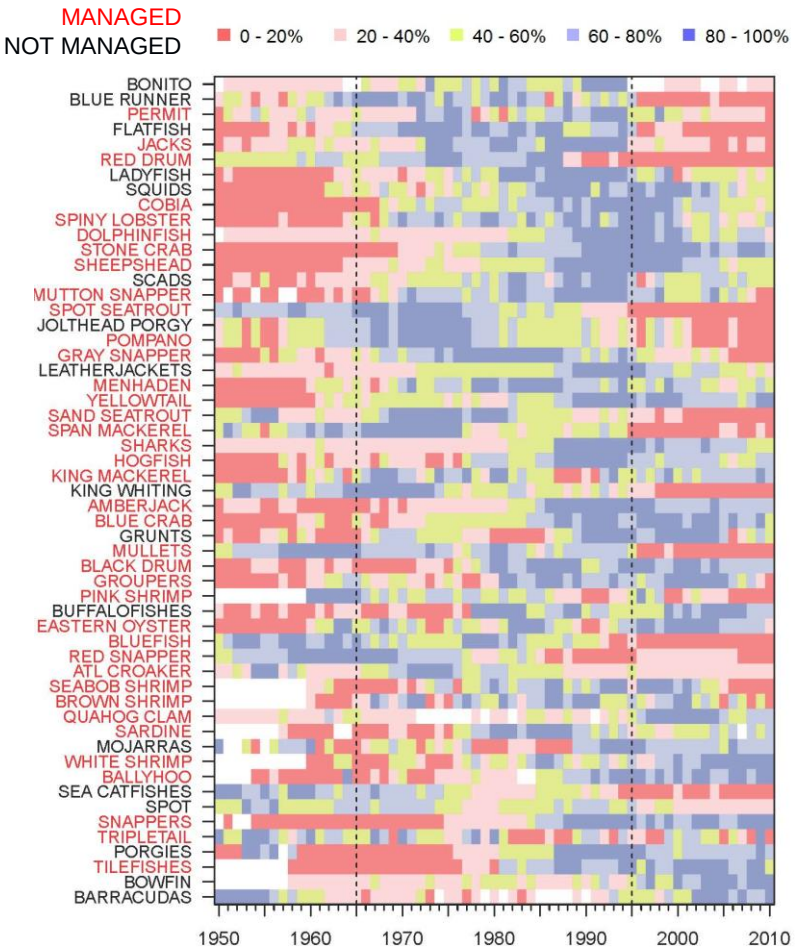
NMDS of landings data to 1950





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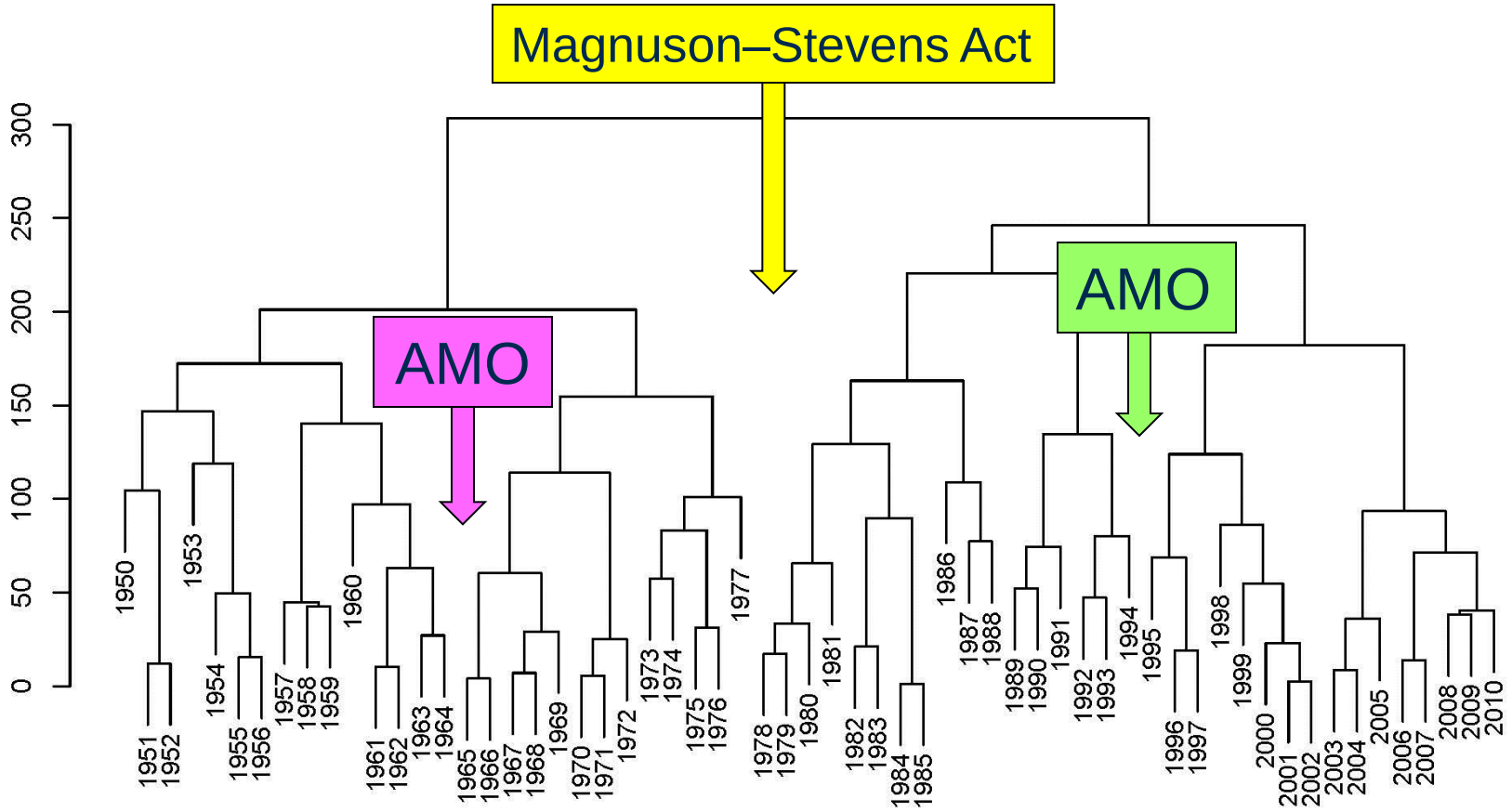
Chronological clustering of landings



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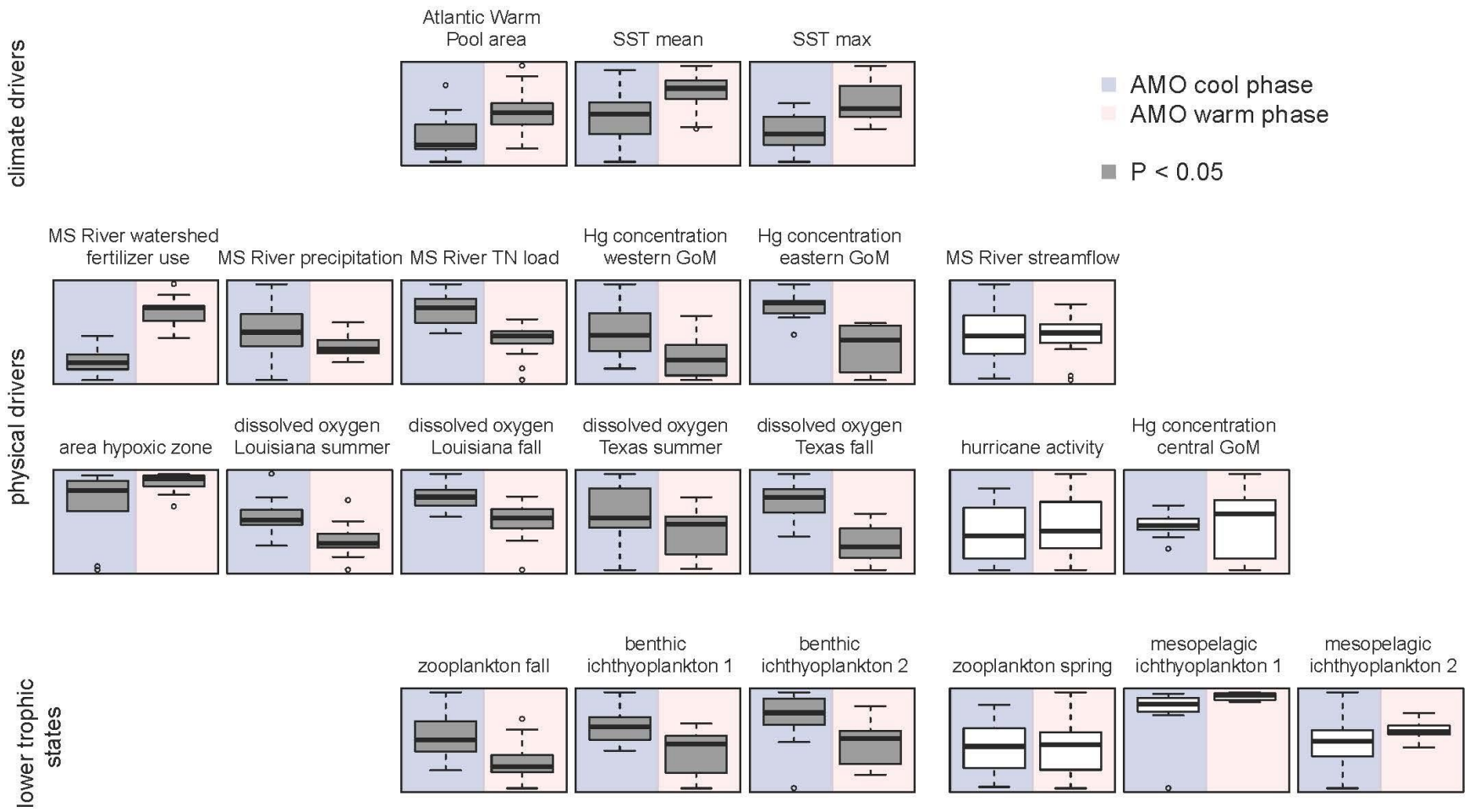
Effects of AMO on GoM



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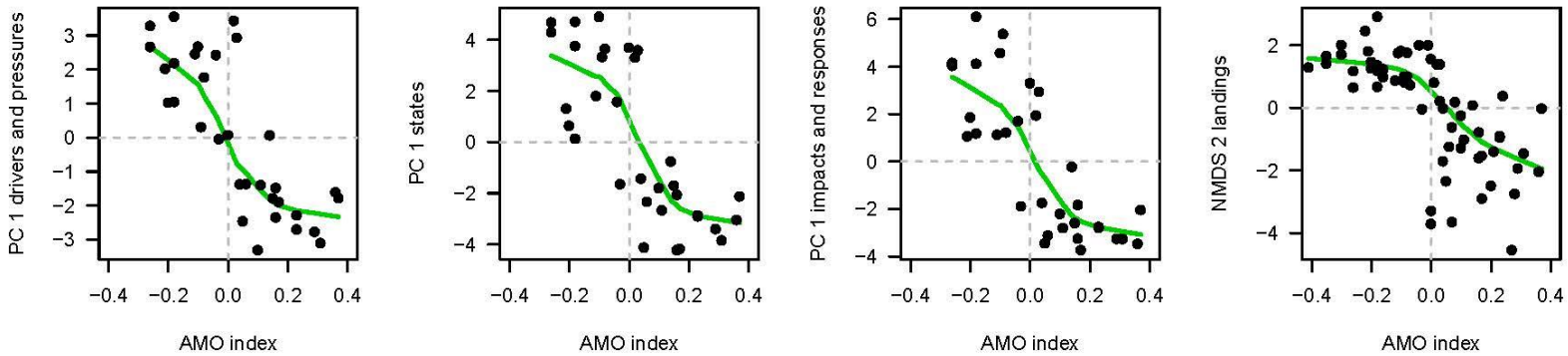
Conclusions



- Different ecosystem states appear to be associated with warm and cool phases of the Atlantic Multidecadal Oscillation
- Changes in GoM likely due to both climatic and anthropogenic forces – and the interactions between the two

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Questions?

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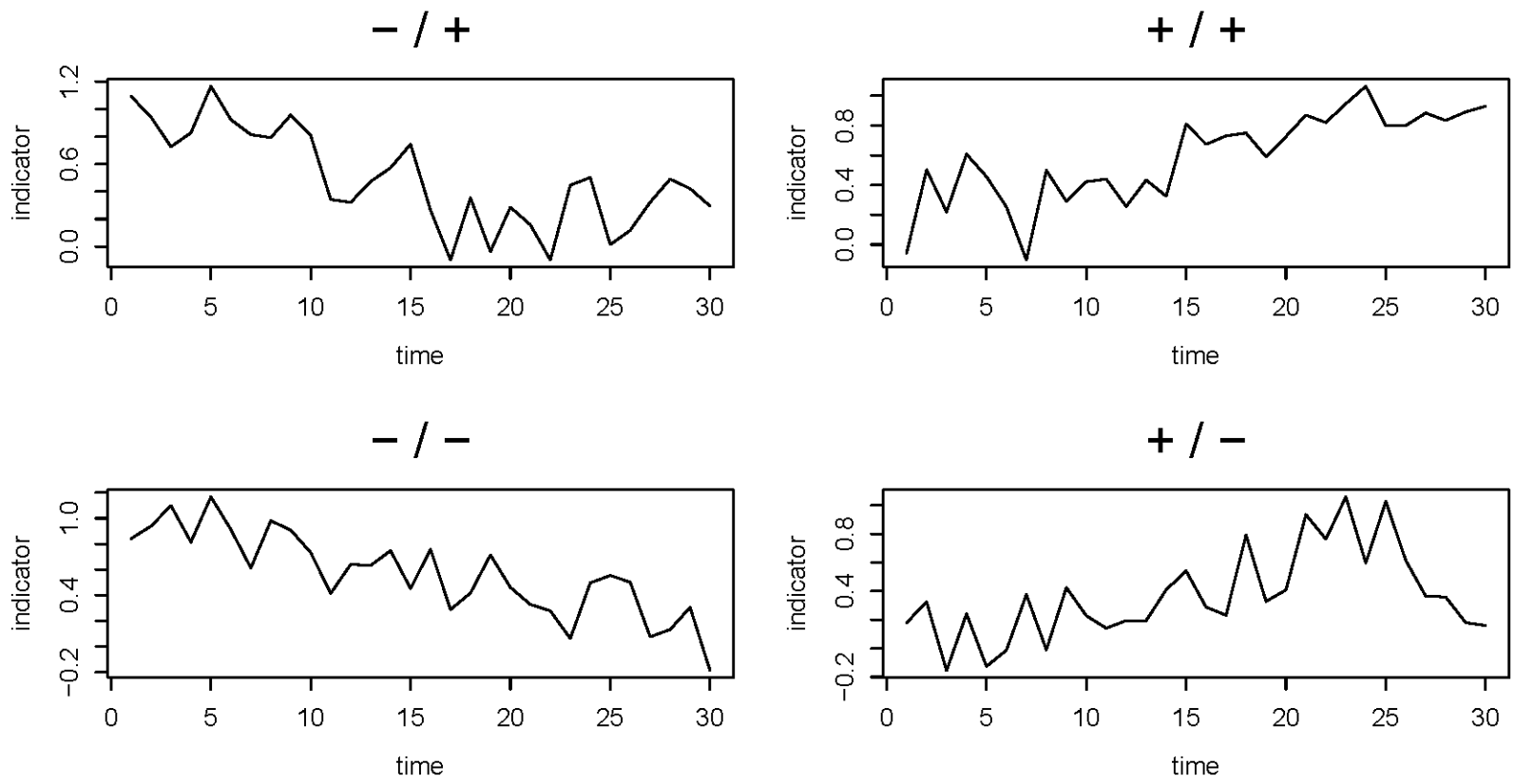
Ecosystem stability – Changes in indicator trends

Short-term vs. long-term



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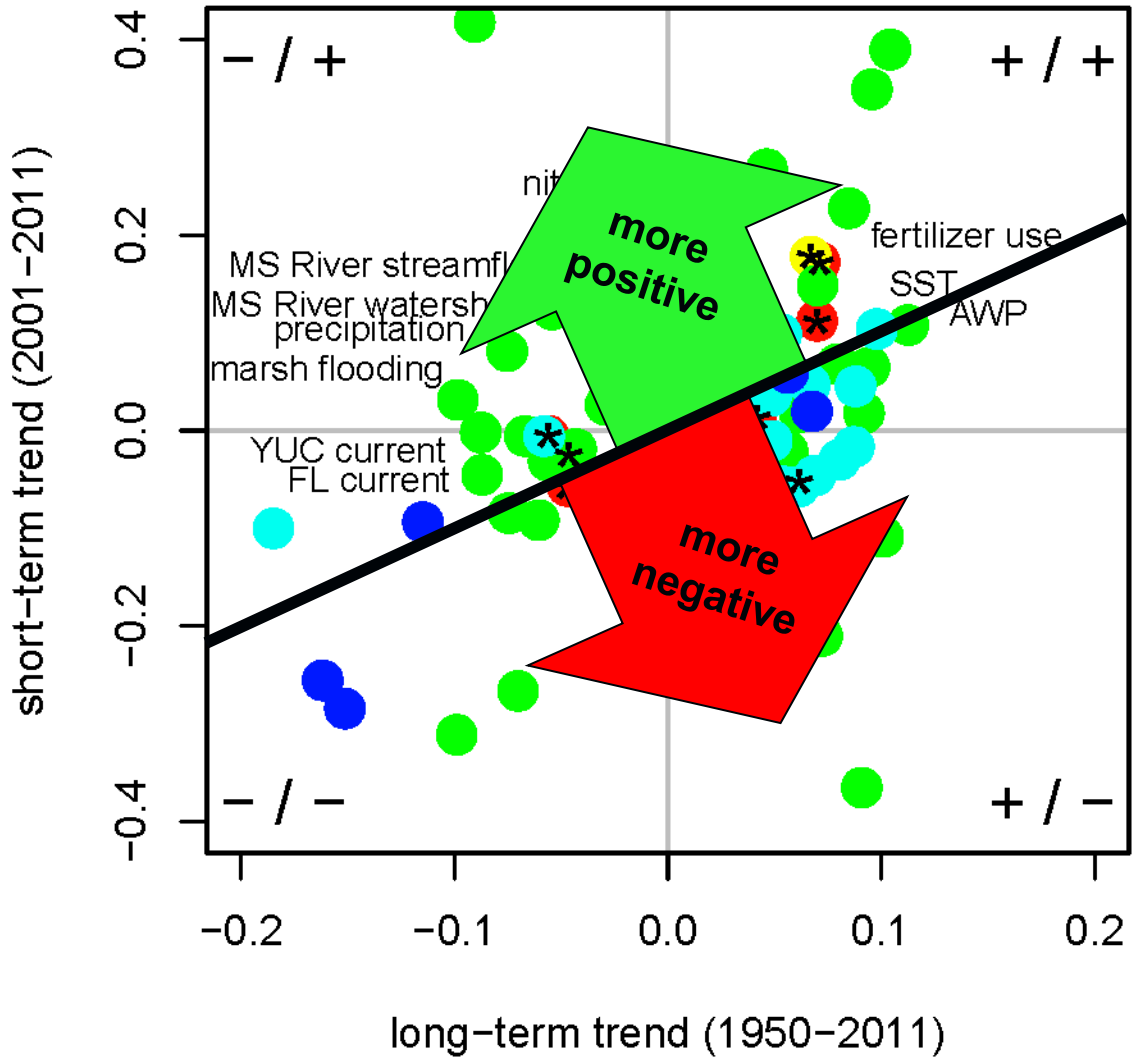
stock recoveries

- driver
- pressure
- state
- impact
- response

Indicators of drivers and pressures becoming increasingly positive



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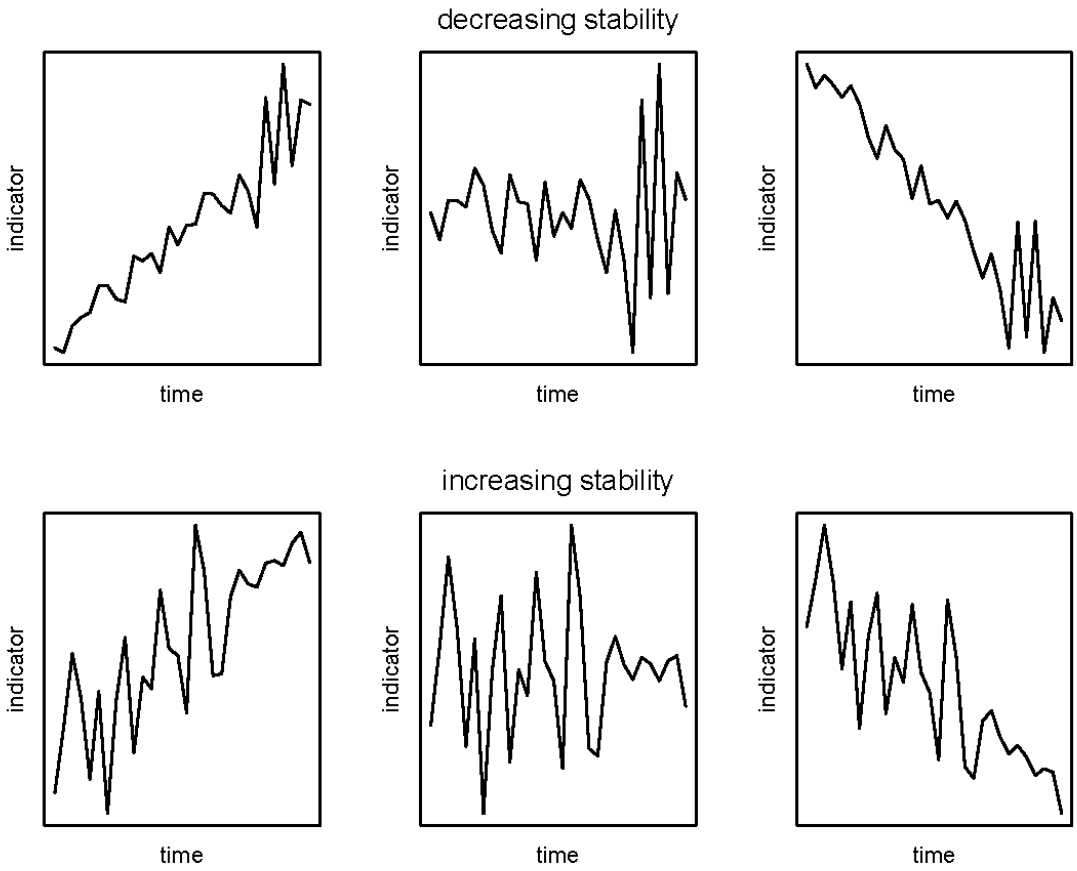
Ecosystem stability – Changes in indicator variance

Populations may show patterns of increasing variance before collapse occurs

(Litzow et al, 2013, Boettiger and Hastings 2013)



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- driver
- pressure
- state
- impact
- response

Major pressures are becoming increasingly variable from year to year