

Lobster landings forecasts

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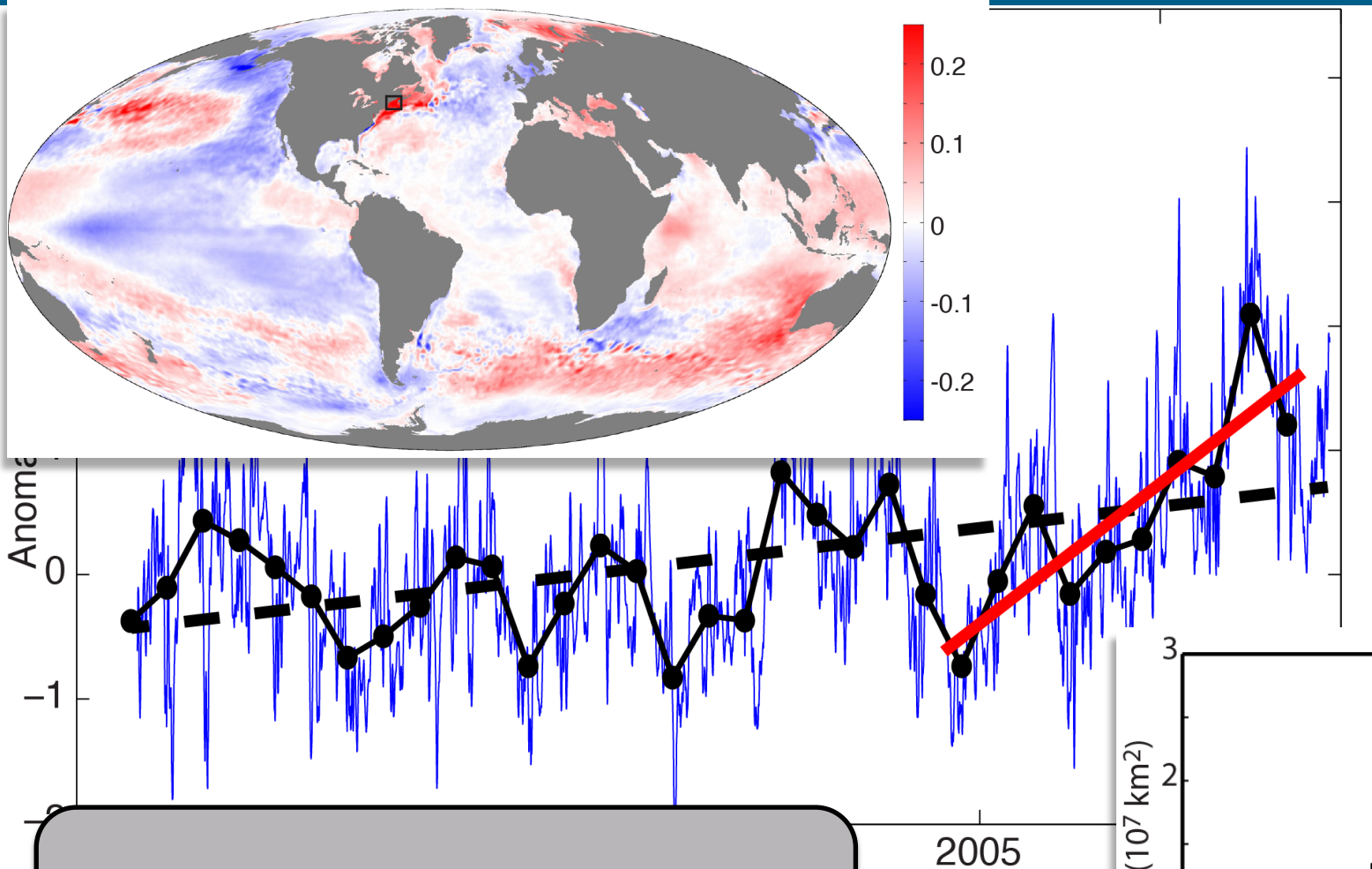


Outline

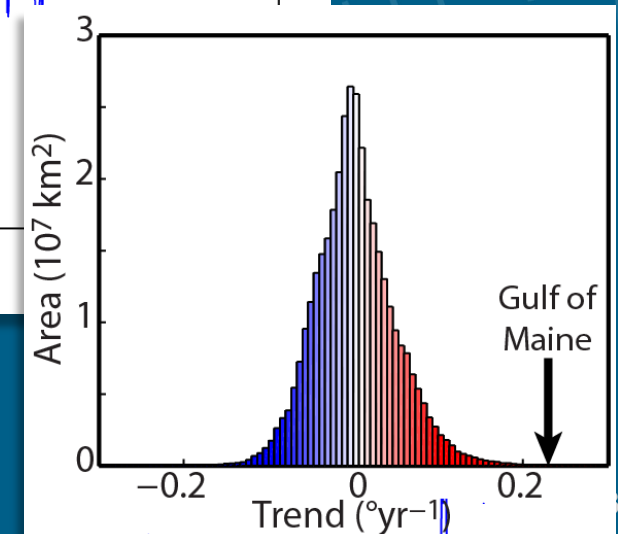
- Gulf of Maine temperature
- 2012: when good lobsters go bad
- Is the phenology of landings tied to temperature?
- Can we predict landings phenology?
- Forecasts



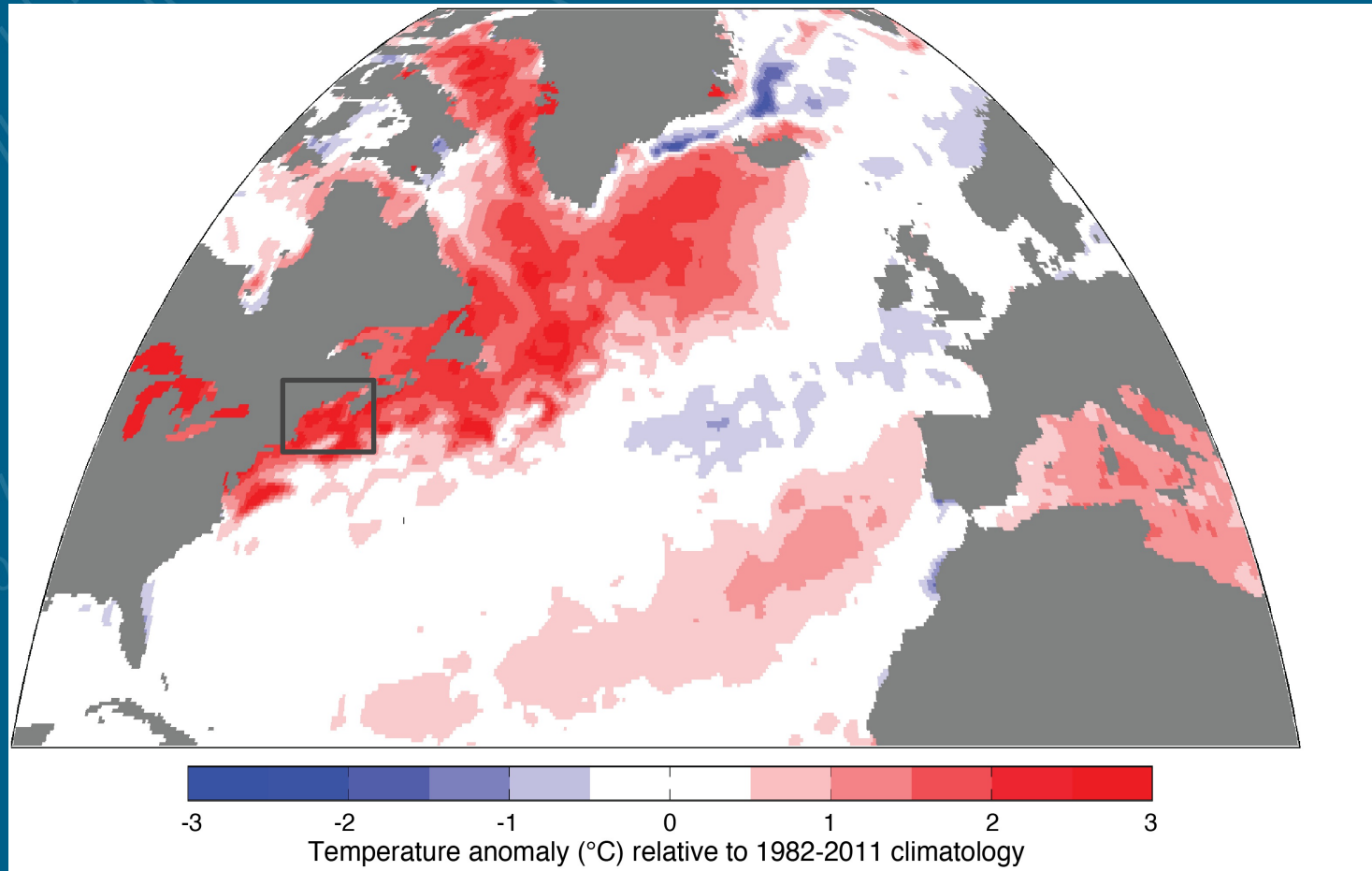
SST Trends: 2004-2013



- Collapse of northern shrimp and Atlantic cod
- Increase in southerly species

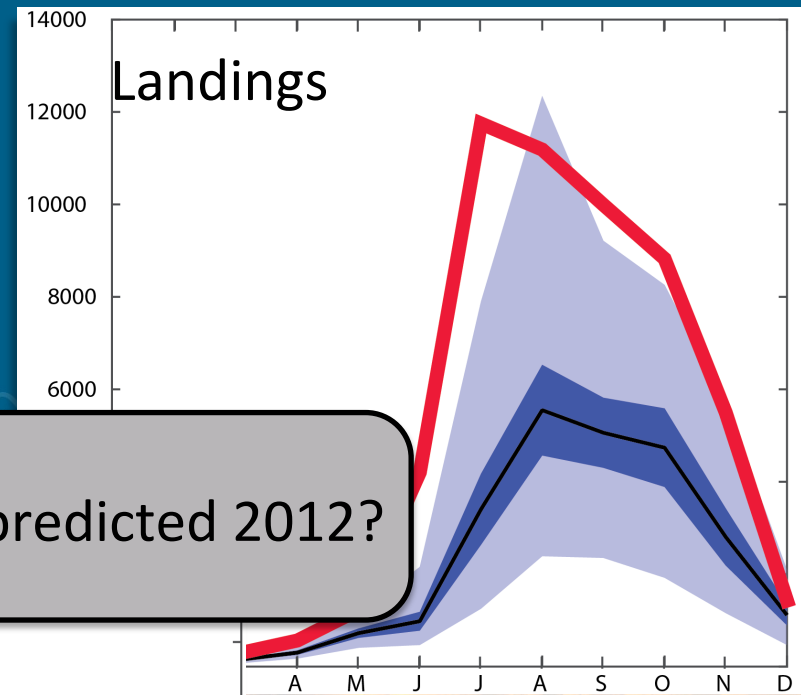
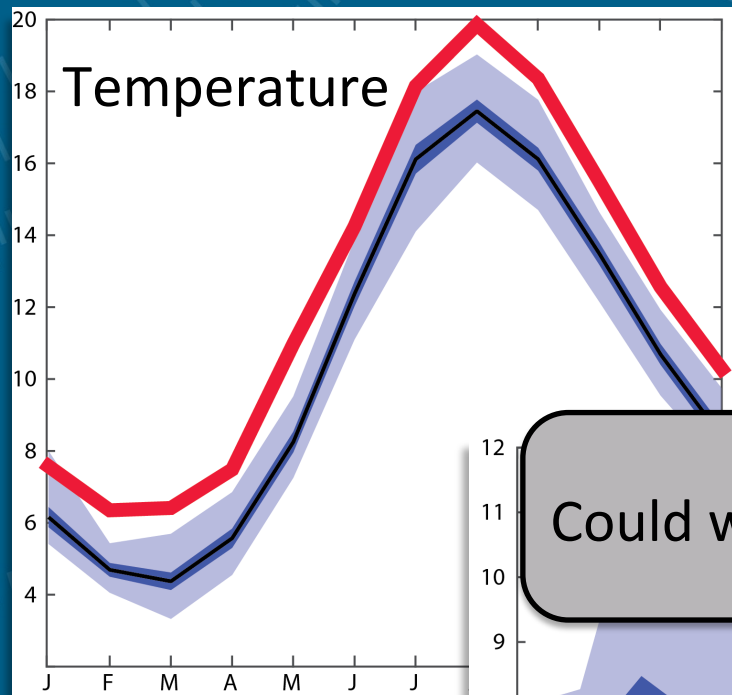


2012 Ocean Heatwave

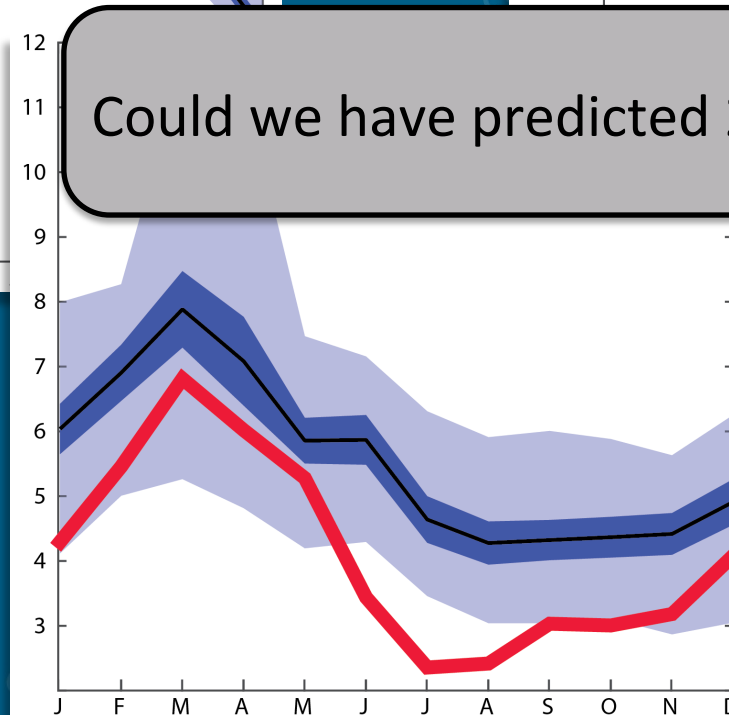


Mills et al. (2013) Fisheries management in a changing climate: lessons from the 2012 ocean heat wave. *O*

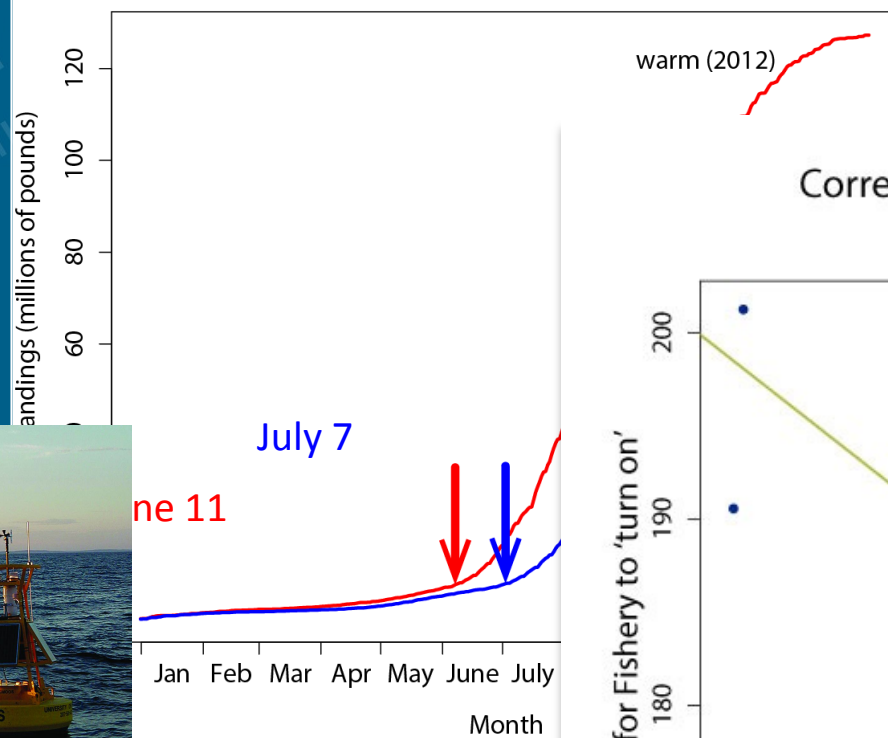
2012 Ocean Heatwave



Could we have predicted 2012?



Temperature and Landings

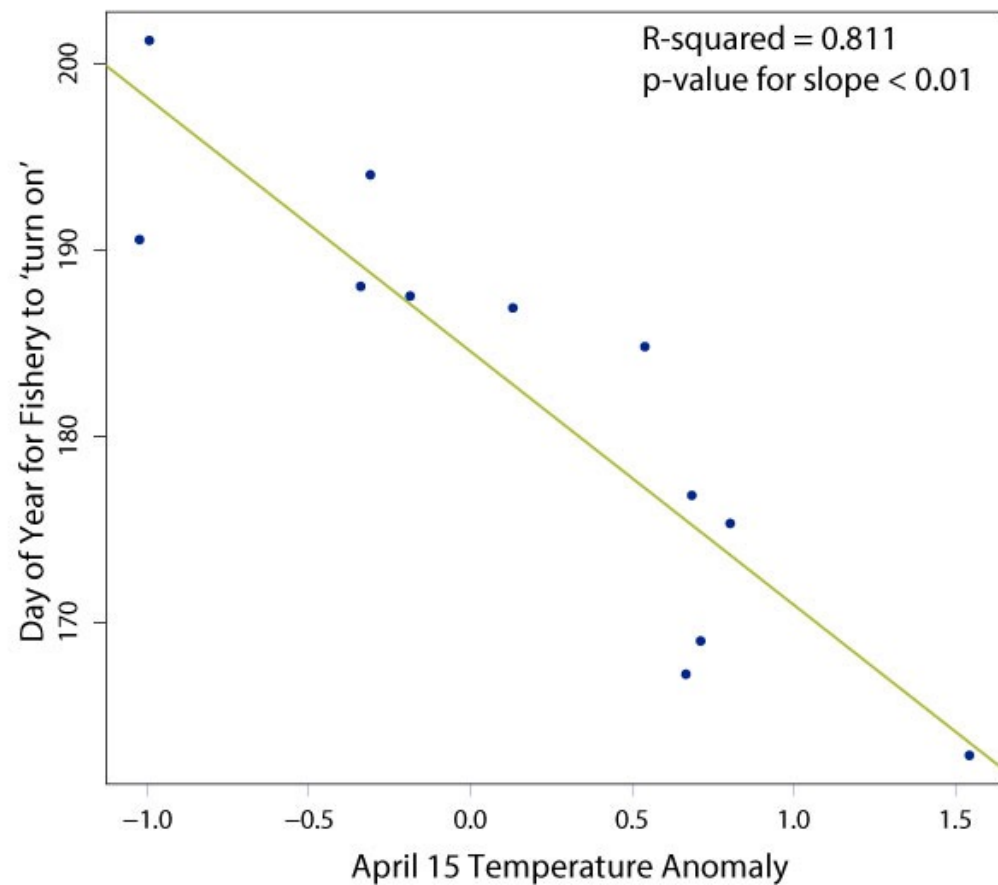


1m

20m

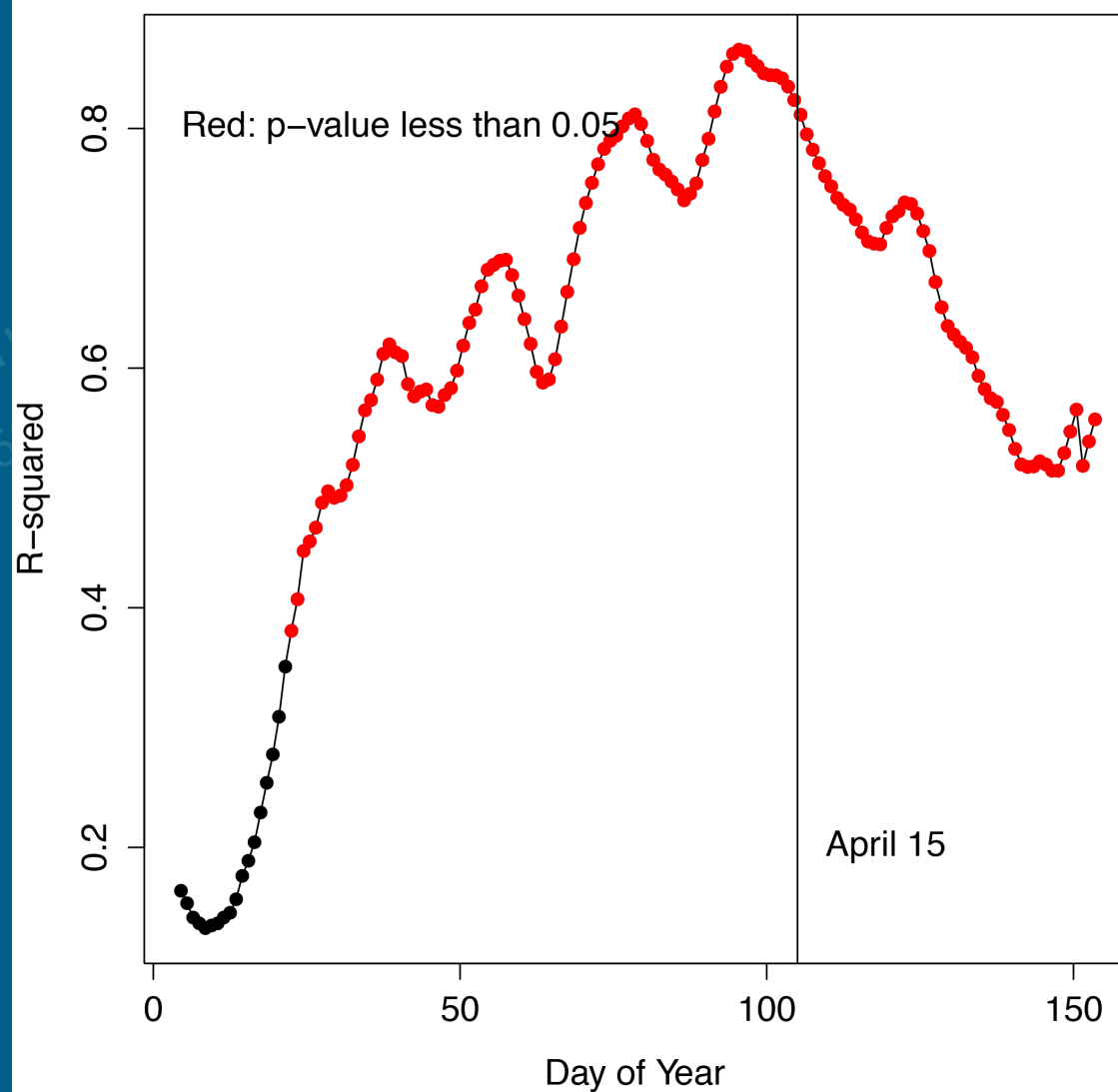
50m

Correlation of Start Day and Temperature
2001-2013

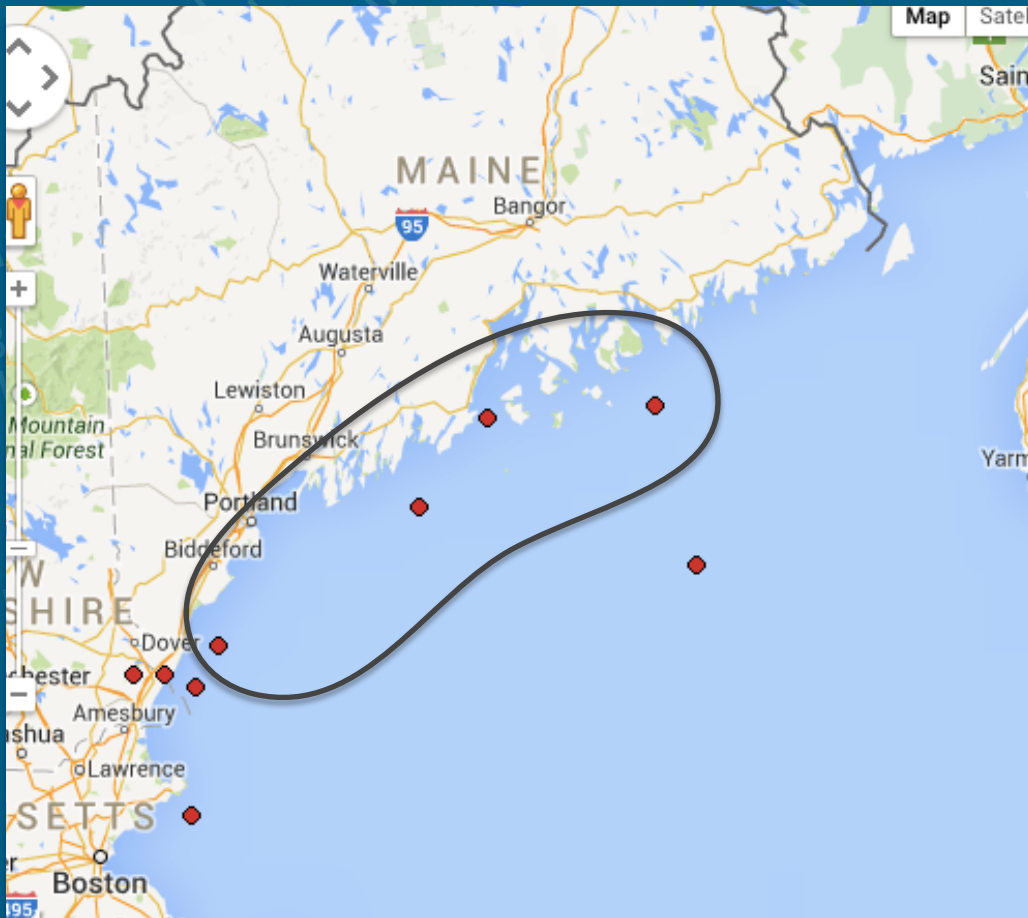


Predictability

Average 50m Temperature Linear Regression R-squared



Operational Forecasts



- linear models for 4 buoys + average
- randomly draw model coefficients and apply
- <http://neracoos.org/> yields probability of start date in a time window

Hindcasts

Early Season 2009 Late Season

	Extremely Early	Very Early	Early	Normal	Late	Very Late	Extremely Late	
March 1	0%	0%	0.97%	93.21%	5.67%	0.07%	0%	
March 15	0%	0%	1.69%	83.61%	14.62%	0%	0%	
April 1	0%	0%	2.45%	42.21%	54.87%	0.45%	0%	
April 15	0%	0%	1.77%	76.41%	21.56%	0.18%	0%	
May 1	0%	0%	13.35%	82.21%	4.4%	0%	0%	
May 15	0%	0%	19.05%	77.11%	3.35%	0%	0%	
	6/12	6/19	6/26	7/3	7/10	7/17	7/24	7/31

First
Forecast

Last
Forecast

Hindcasts

Early Season 2012 Late Season

	Extremely Early	Very Early	Early	Normal	Late	Very Late	Extremely Late	
March 1	47.74%	51.4%	0.85%	0%	0%	0%	0%	
March 15	81.74%	17.92%	0.34%	0%	0%	0%	0%	
April 1	73.61%	26.27%	0.13%	0%	0%	0%	0%	
April 15	88.34%	11.45%	0.21%	0%	0%	0%	0%	
May 1	77.3%	21.57%	1.13%	0%	0%	0%	0%	
May 15	19.72%	70.65%	9.63%	0%	0%	0%	0%	
	6/12	6/19	6/26	7/3	7/10	7/17	7/24	7/31

First
Forecast

Last
Forecast

Hindcasts

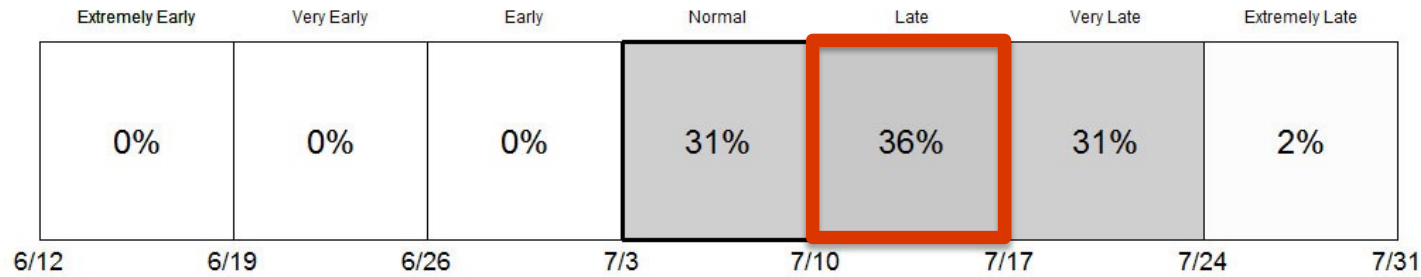
Early Season **2003** Late Season

	Extremely Early	Very Early	Early	Normal	Late	Very Late	Extremely Late
March 1	0%	0%	20%	39.3%	36.97%	3.8%	0%
March 15	0%	0%	0%	20%	52.15%	23.92%	3.93%
April 1	0%	0%	17.86%	9.15%	52.43%	18.41%	2.15%
April 15	0%	0%	0%	19.64%	42.71%	26.97%	11.37%
May 1	0%	0%	0%	33.48%	39.95%	24.7%	1.87%
May 15	0%	0%	0.13%	57.79%	25.45%	14.15%	2.39%
	6/12	6/19	6/26	7/3	7/10	7/17	7/24

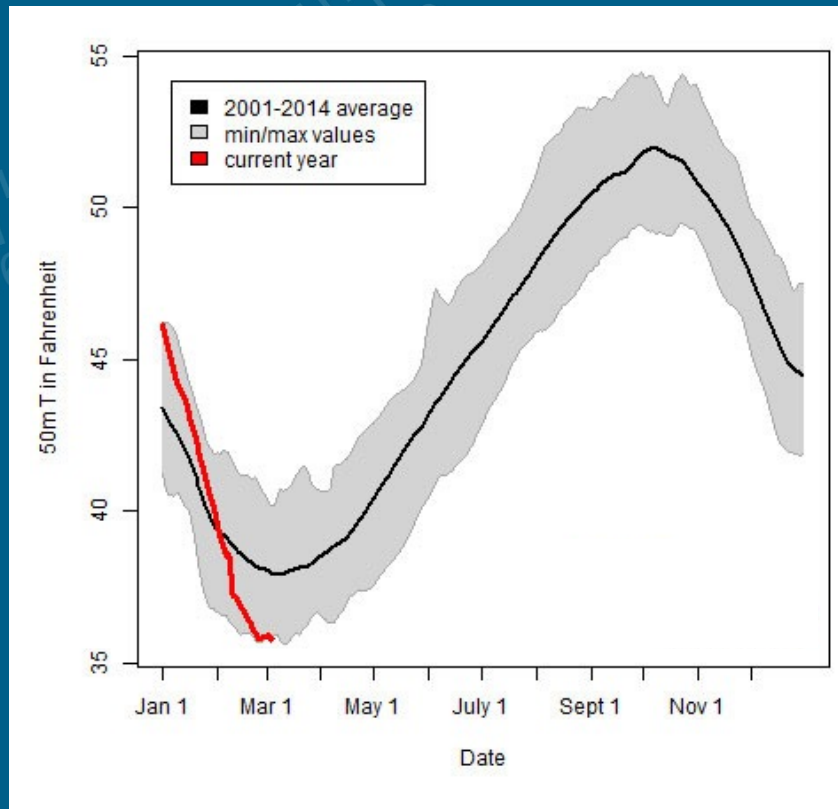
First
Forecast

Last
Forecast

March 4 Forecast

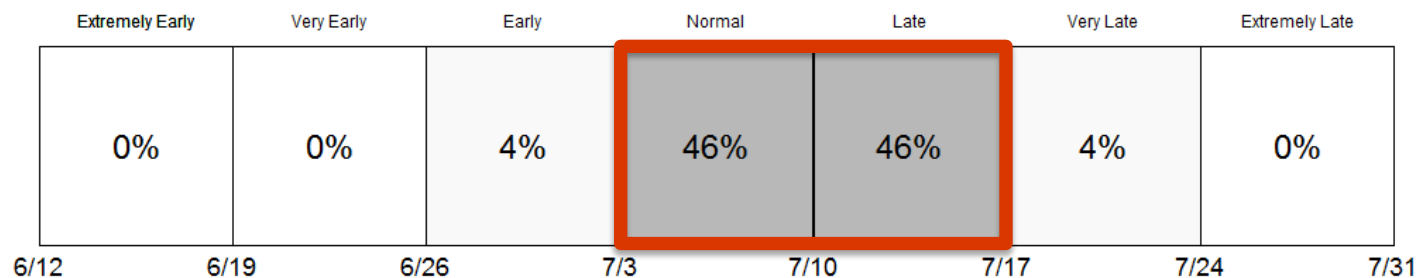


- www.gmri.org/lobster-forecast

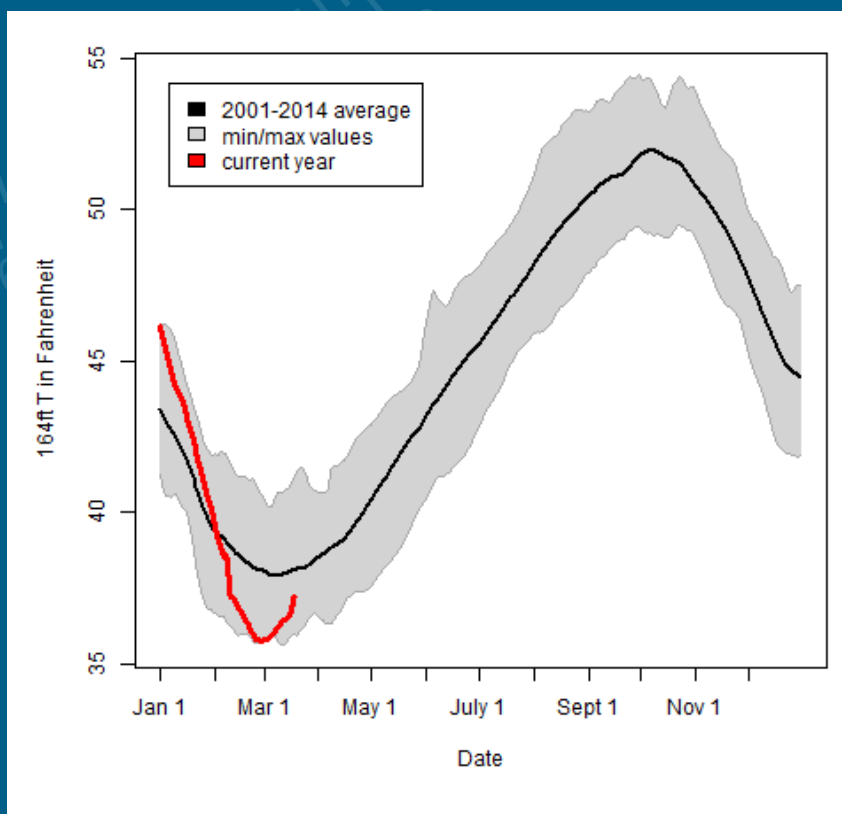


- 3/4—cold water
- predicting late season

March 18 Forecast

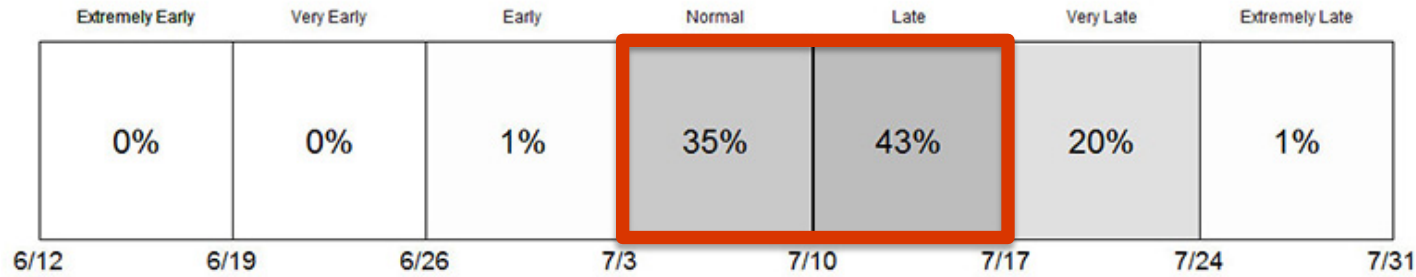


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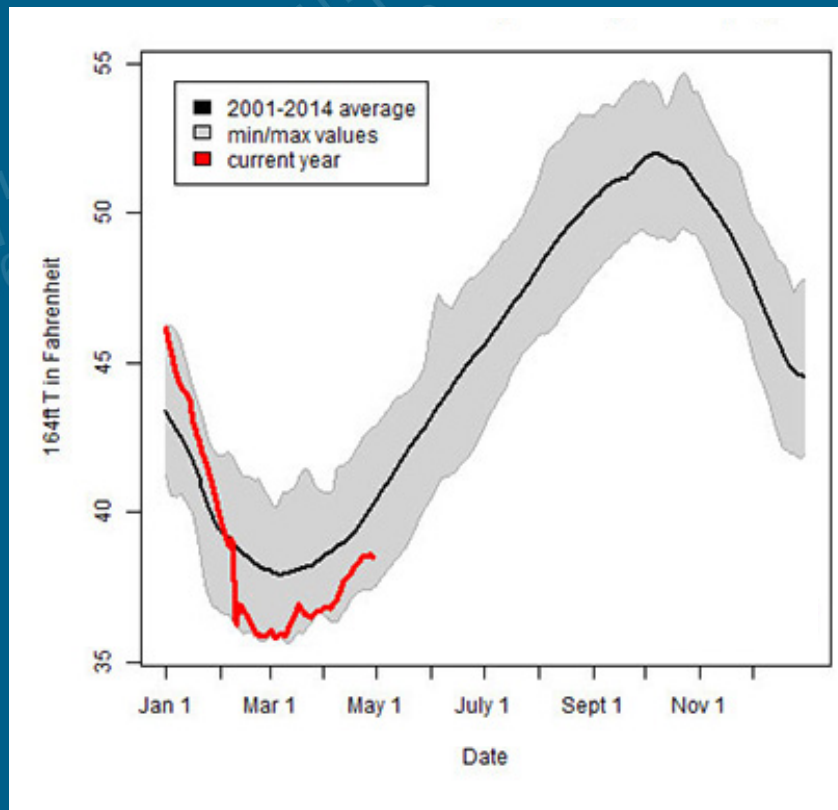


- 3/18—warming
- shift towards normal

April 15 Forecast



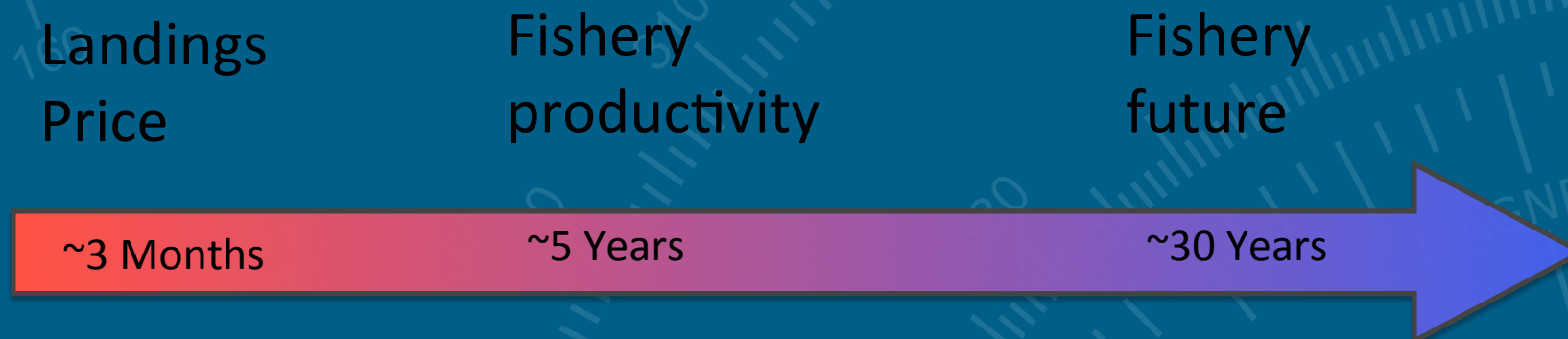
- www.gmri.org/lobster-forecast



- 4/15—warming
- still cold
- late season, with a chance of very late

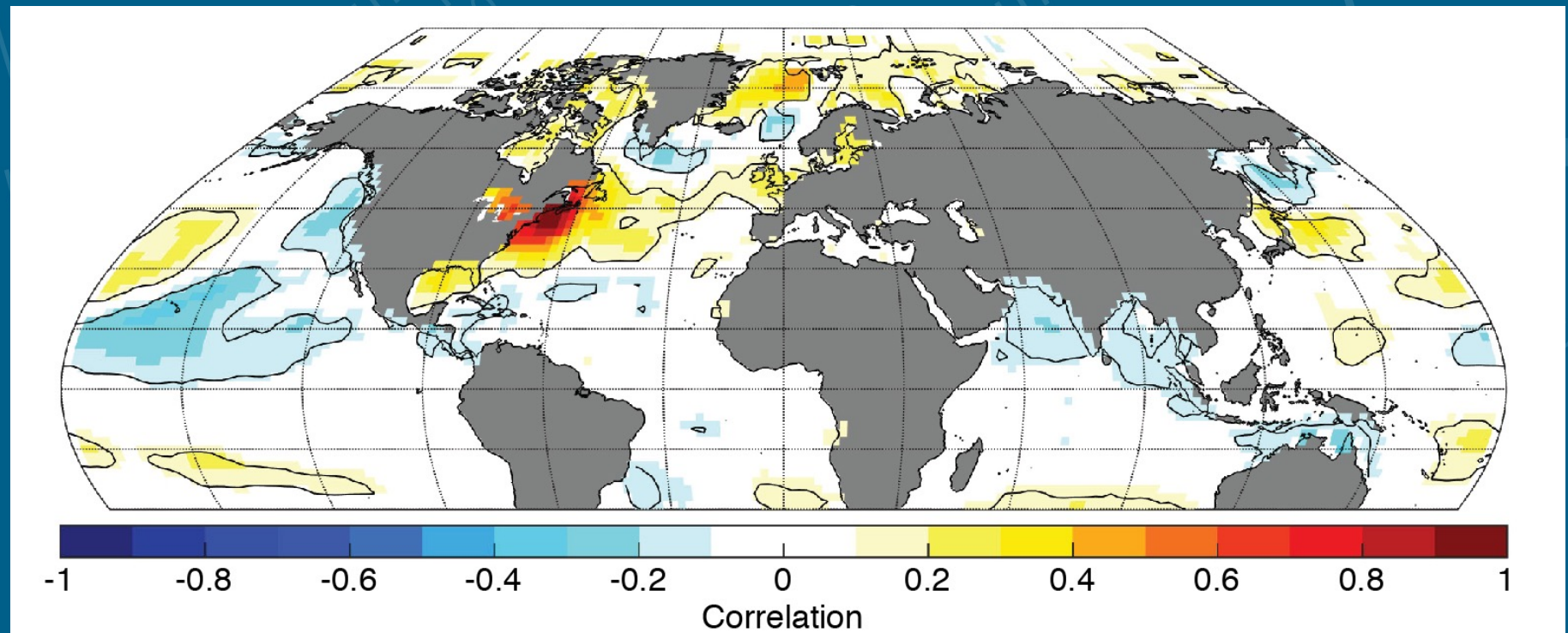
Next Steps

- Outreach with the industry
 - fishermen + dealers
- Improve delivery
 - fishery-climate dashboard
- Continuous forecasting strategy

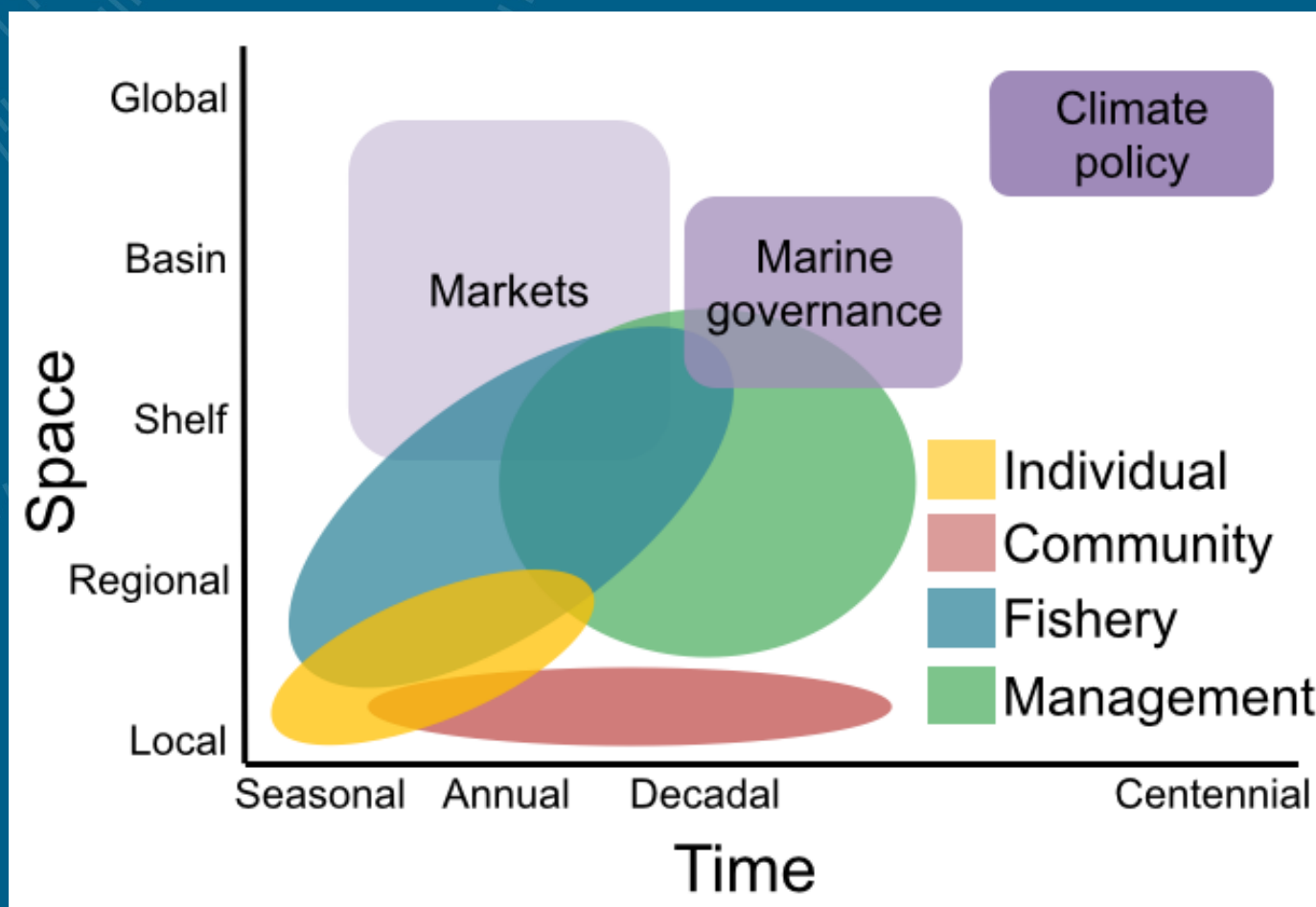


Next Steps

- Can we increase the lead time?
 - NMME—SST, 2m air temperature?
 - Teleconnections?



Bigger Picture



- Climate adaptation is more than assessments
 - individuals, communities, nations
 - industry, management, society

Conclusion

- Phenology matters, at least for lobsters and lobstermen
- Simple model can give 2-3 month forecast
 - better at early years than late
 - max skill in late April
- Questions:
 - can we push the forecasts earlier?
 - how can the industry react?

