

16th Lme

Meeting with
Coastal Partners

Paris (FR) 8 - 11 July 2014



Climate Change and Fisheries Biomass Yields

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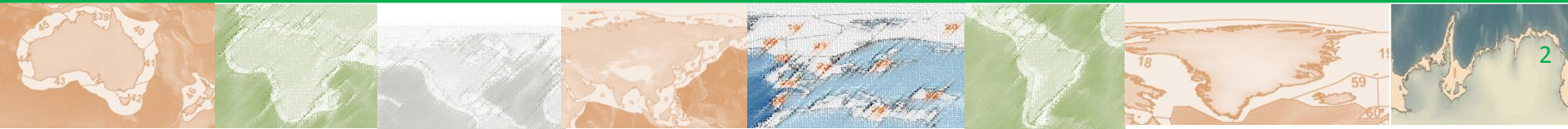
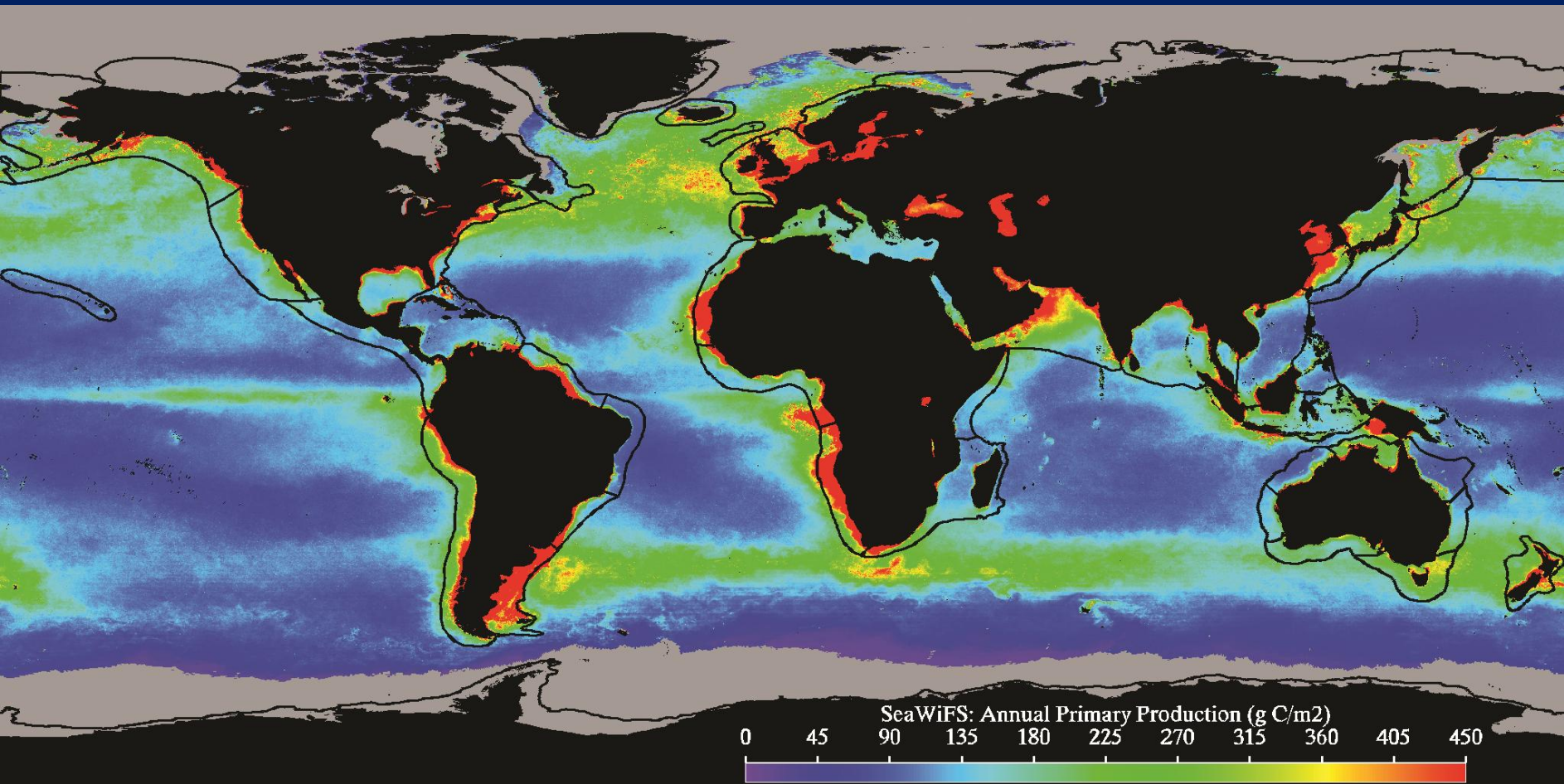
Institution: **NOAA**

Session 2: Knowledge and best governance
practices: Tools, data and information

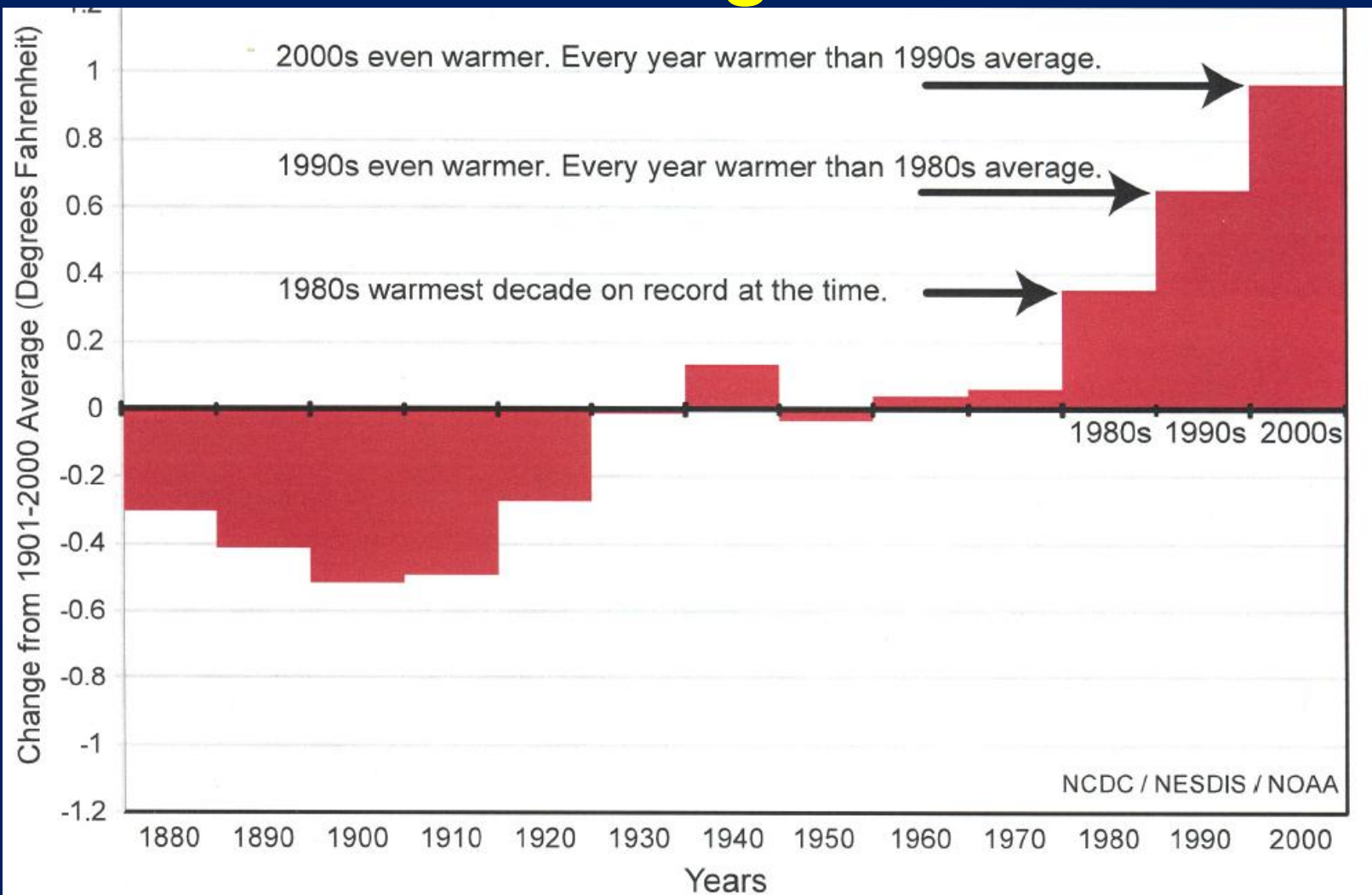
Day of presentation: **Wednesday 9 July 2014**



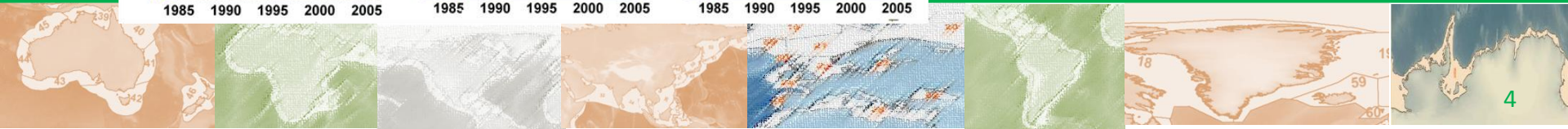
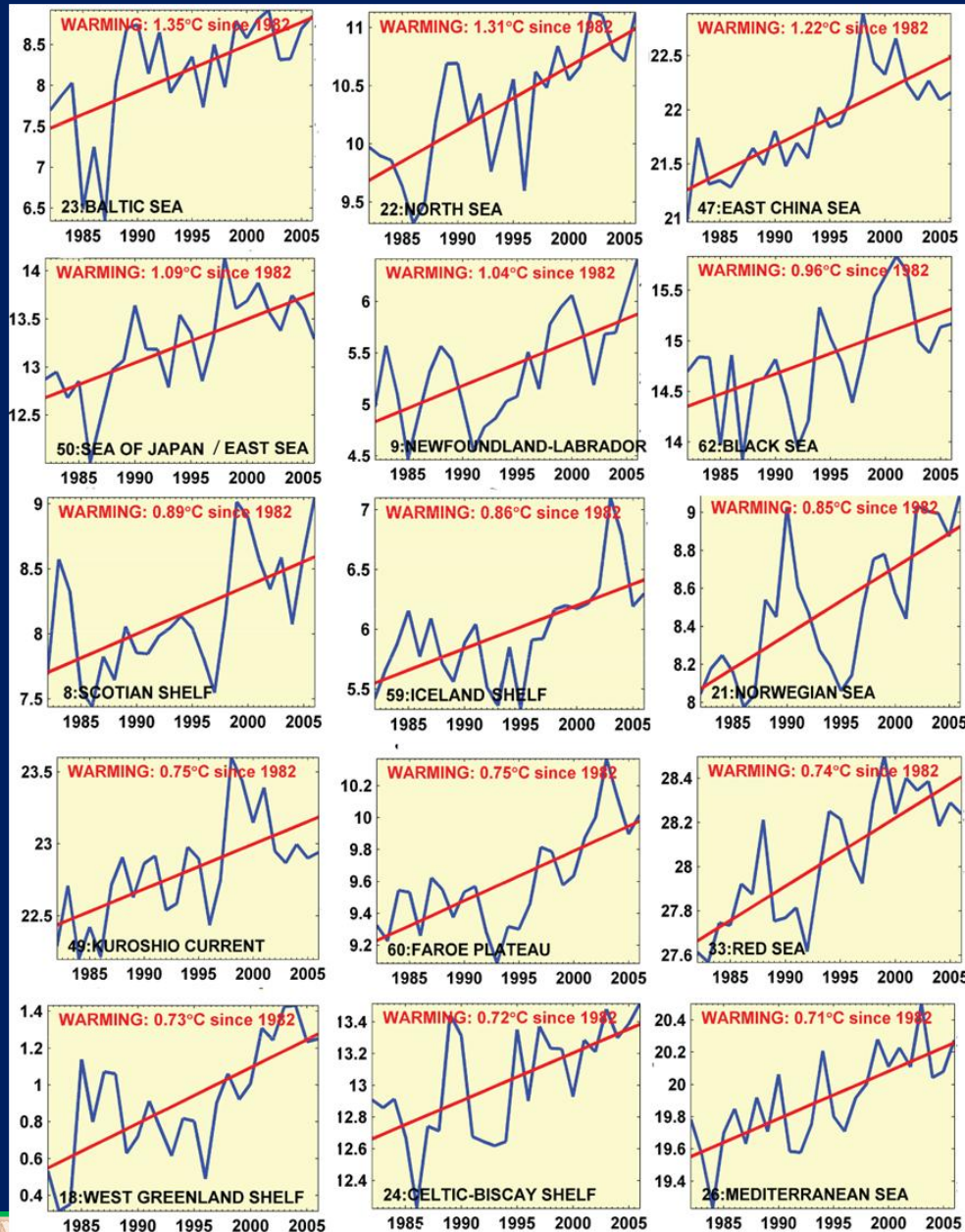
Average Primary Productivity



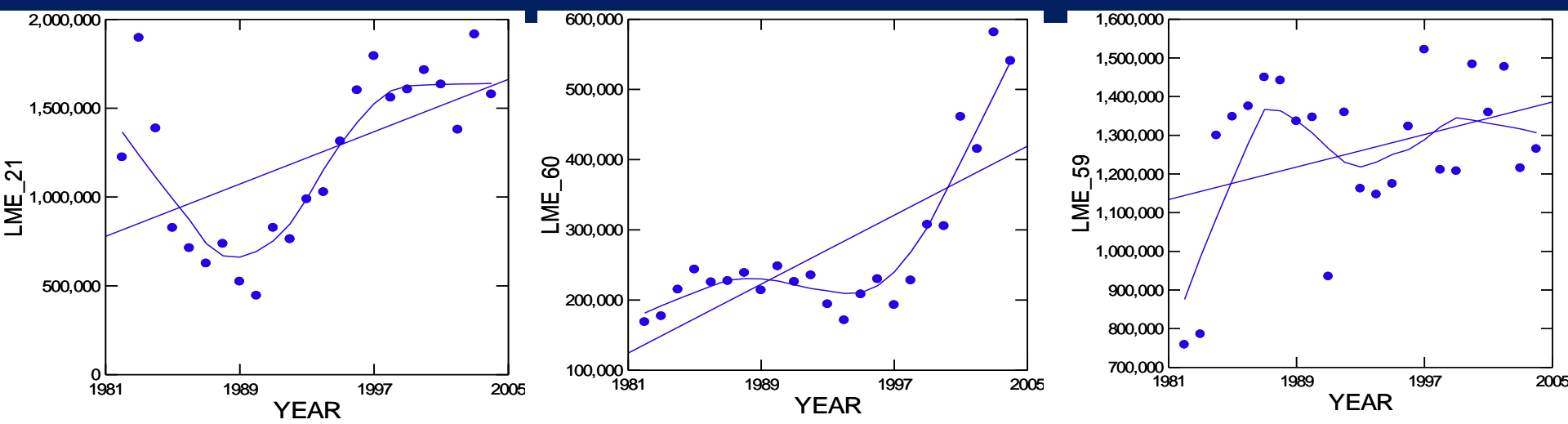
Global Temperature Change Decade Averages



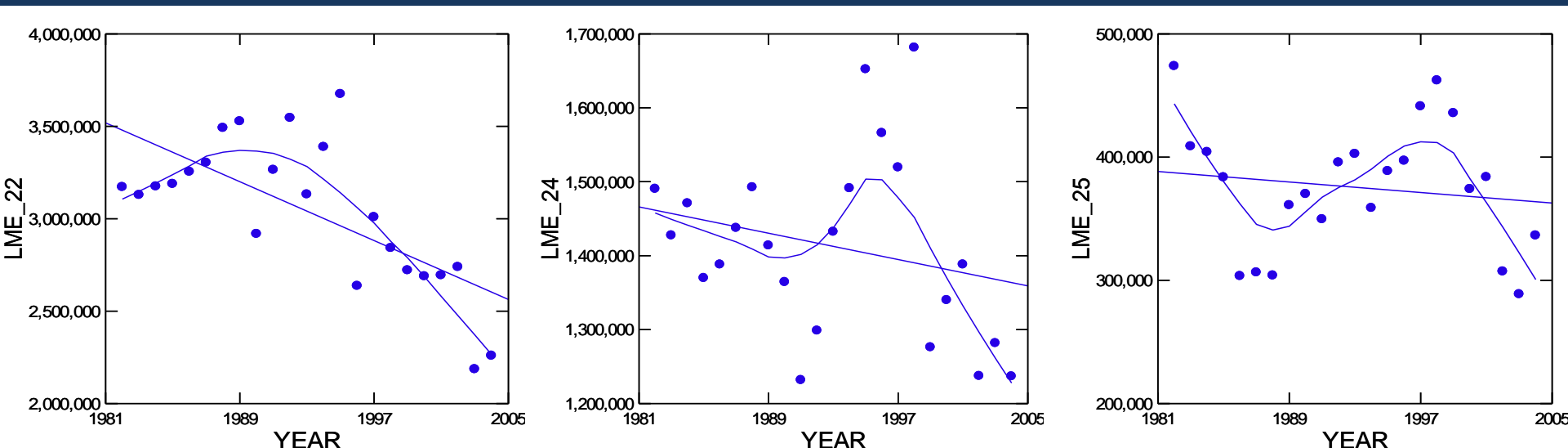
The 15 Fastest Warming LMEs (1982 to 2006)



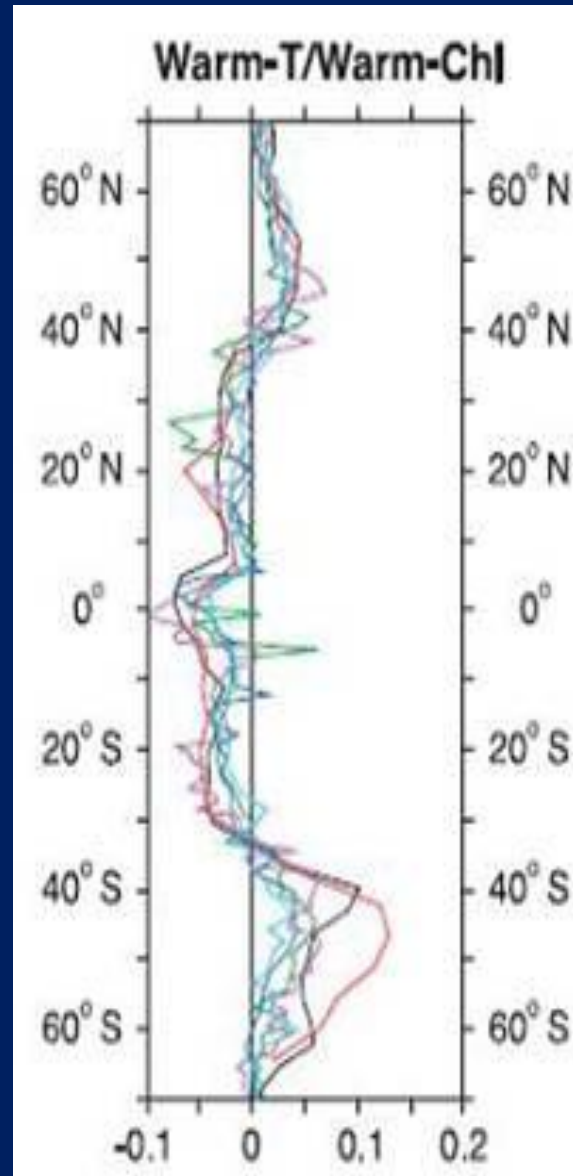
Fisheries biomass yield trends (metric tons) in fast warming cluster 1: Norwegian Sea (LME 21), Faroe Plateau (LME 60), and Iceland Shelf (LME 59).



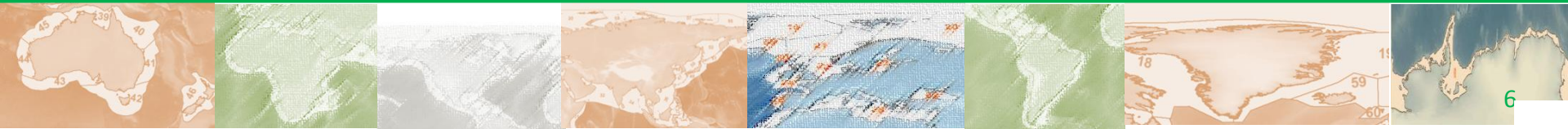
Fisheries biomass yield trends (metric tons) in fast warming cluster 2: North Sea (LME 22), Celtic Biscay (LME 24) and Iberian Coastal (LME 25)



**Estimate of
2040 – 2060
primary
production
change (Pg-C
deg⁻¹ yr⁻¹)**



**The global
effects of
climate warming
on primary
productivity are
projected by
latitude for the
years 240-2060.
The primary
productivity
change (Pg C
deg⁻¹ year⁻¹) and
temperature
increase, is
shown above for
six Atlantic
Ocean
Circulation
models.
Modified from
Sarmiento et al.
2004.**



LMEs Bordering GEF- Eligible Countries	LME Name	5-yr mean fisheries biomass in tonnes	Fisheries biomass yield status - % fully exploited	Fisheries biomass yield status - % overexploited
	Insular Pacific Hawaiian	6,121.00	1	54
	California Current	634,669.00	N/A	N/A
x	Gulf of California	134,297.00	45	48
x	Pacific Central American	788,191.00	42	18
x	Gulf of Mexico	987,865.00	36	60
x	Caribbean Sea	370,231.00	40	58
	Southeast US Continental Shelf	89,216.00	54	26
x	Humboldt Current	10,617,103.00	N/A*	N/A*
x	South Brazil Shelf	130,669.00	20	40
x	East Brazil Shelf	127,969.00	40	48
x	Canary Current	2,229,215.00	72	6
x	Guinea Current	1,010,453.00	71	24
x	Benguela Current	1,307,649.00	50	8
x	Agulhas Current	295,364.00	30	32
x	Somali Coastal Current	58,961.00	45	50
x	Arabian Sea	2,486,227.00	84	11
x	Red Sea	129,206.00	88	10
x	Bay of Bengal	3,062,147.00	83	15
x	Gulf of Thailand	676,304.00	37	50
x	South China Sea	6,454,043.00	83	13
x	Sulu-Celebes Sea	1,207,946.00	82	17
x	Indonesian Sea	2,392,818.00	88	12
	North Australian Shelf	159,572.00	78	18
	Northeast Australian Shelf	36,310.00	46	30
	East Central Australian Shelf	29,095.00	18	64
	West Central Australian Shelf	19,079.00	75	10
	Northwest Australian Shelf	62,842.00	59	18
x	East China Sea	4,339,890.00	77	21
	Kuroshio Current	823,035.00	48	42
SUM		40,666,487.00		

30° North to 30° South

Circumglobal Belt of 29 LMEs at Risk from Projected Primary Productivity Declines

29 LMEs annually produce 40.6mmt or 50.7% average annual biomass yields

20 LMEs border GEF eligible countries

16 LMEs are subjects of present or completed GEF-LME EBM projects

FAO Precautionary Principle implementation Serves as a Mitigation Option

*Annual limits on total allowable catches for dominant pelagic species are presently in place for the Humboldt Current.



New LME Based Global Estimates of Potential Fisheries Yields

Analysis of LME energy flow network models of LMEs indicate potential annual yields of :

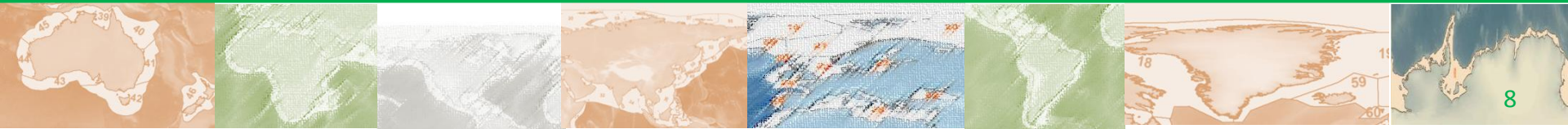
Up to 180 mmt annually of fish

Up to 50 mmt annually of benthic production

REFERENCE

2014 Developing new approaches to global stock status assessment & fishery production potential of the seas.

FAO Fisheries & Aquaculture Circular No. 1086180



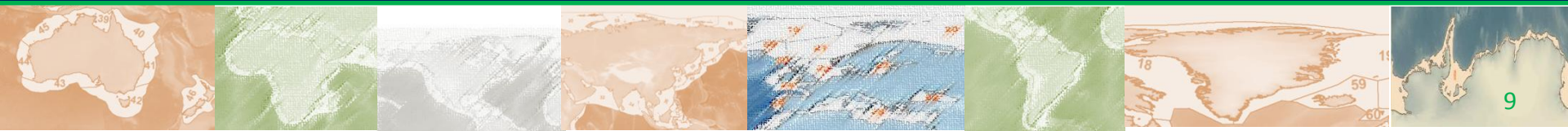
Ecosystem Exploitation Rates

Should not exceed 20 – 25% of available primary production

Present levels of benthivorous and piscivorous species are exceeded in higher-latitude LMEs (subarctic and temperate)

Near and slightly below levels in lower latitudes and upwelling LMEs

Greatest production potential estimated for planktivorous species





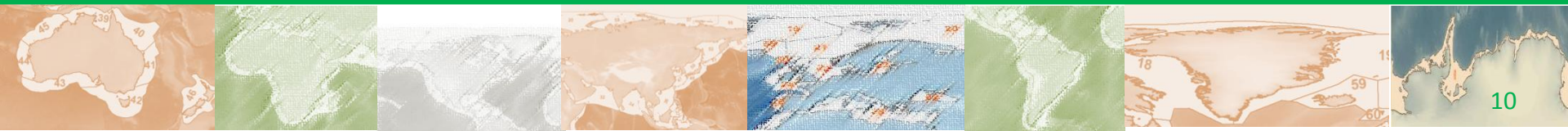
NOAA
FISHERIES

Marine Ecosystem Production: Meeting the Challenges of Food Security in the 21st Century

Michael J. Fogarty

Northeast Fisheries Science Center

Woods Hole, MA



Co-Conspirators



NOAA
FISHERIES



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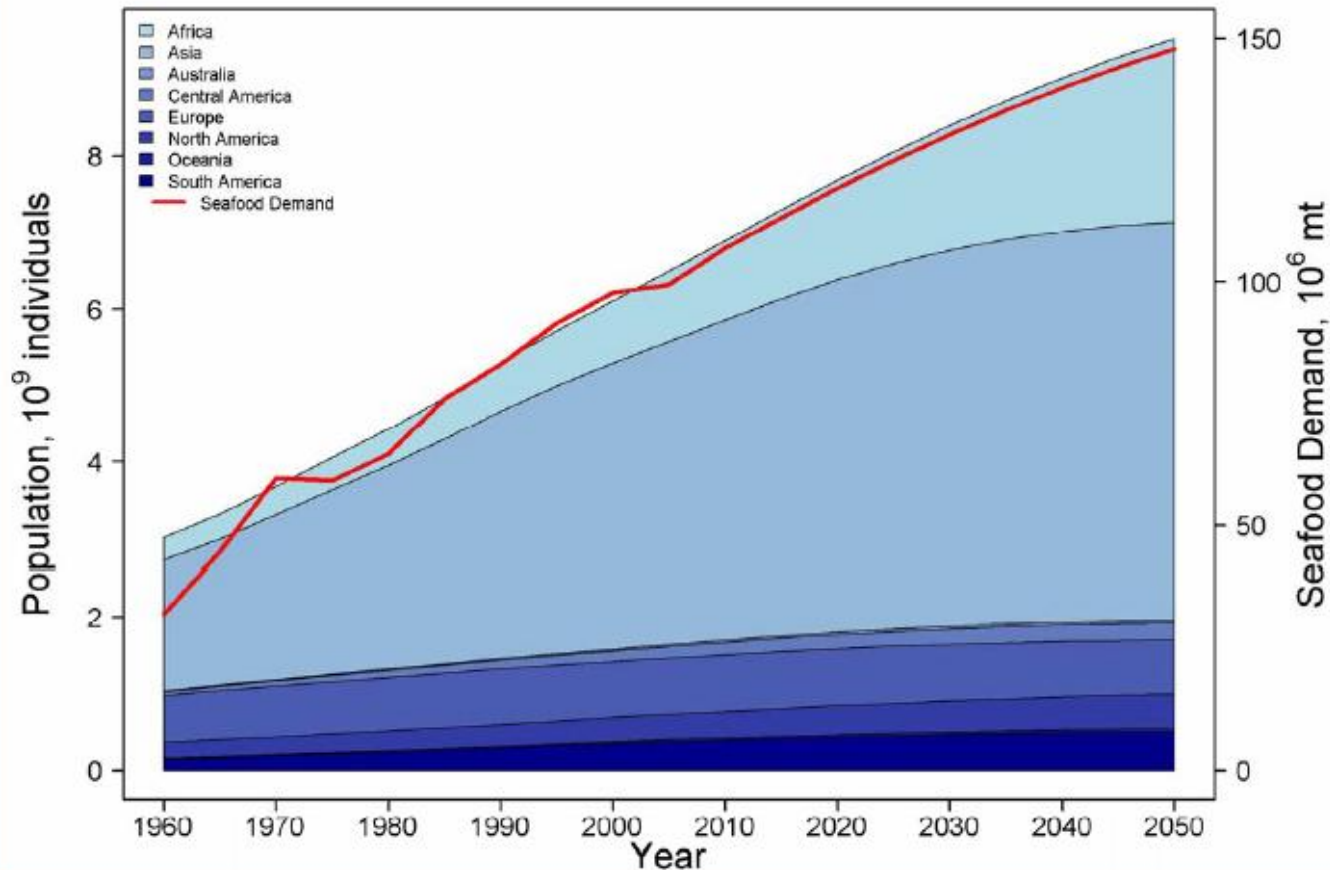
Mark Dickey-Collas

Cóilín Minto

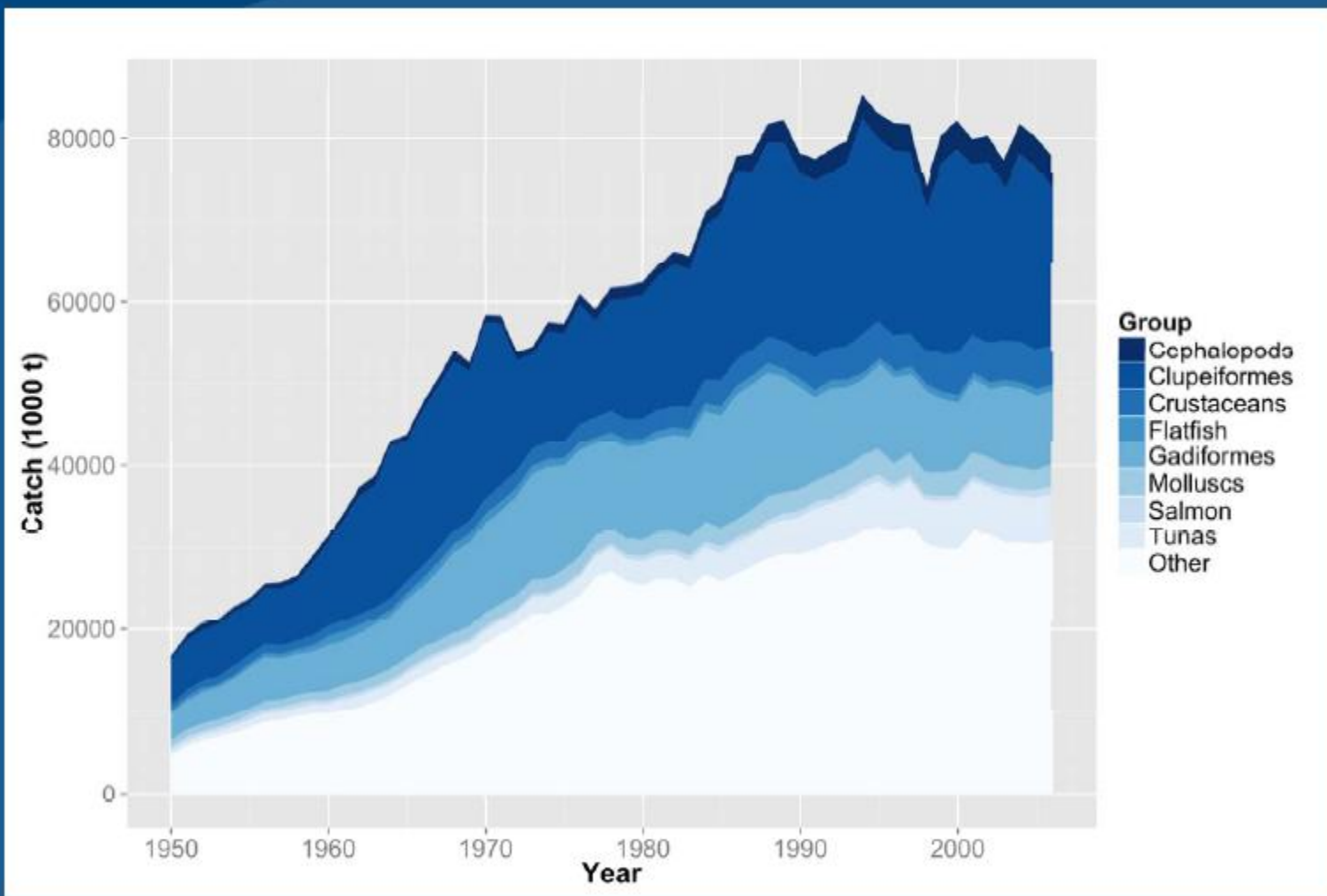
Andy Rosenberg

Jay O'Reilly

Projected Human Population Growth and Seafood Demand

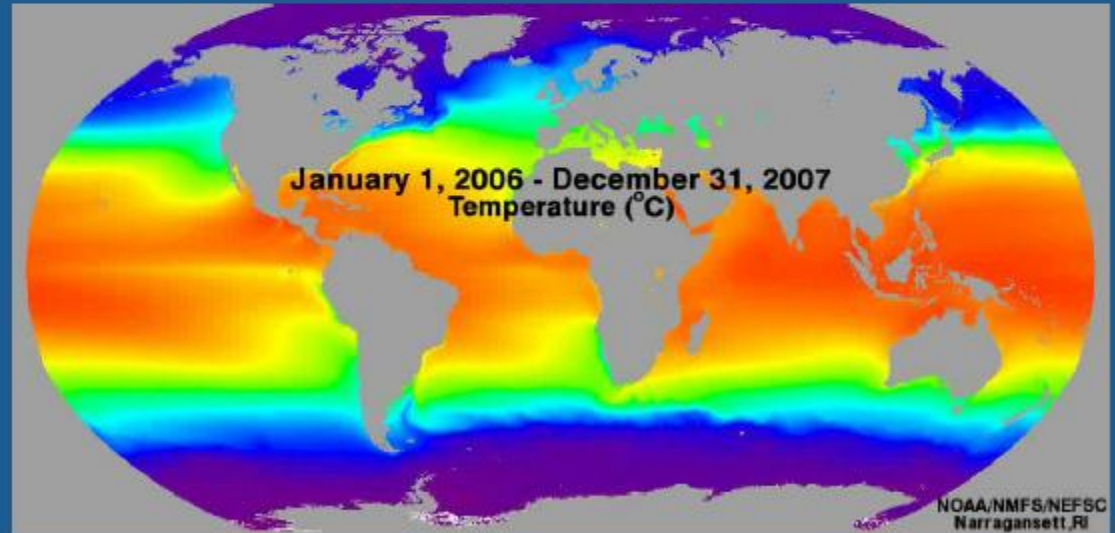


Capture Fisheries Landings

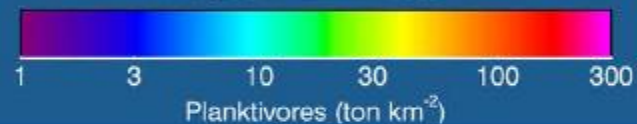
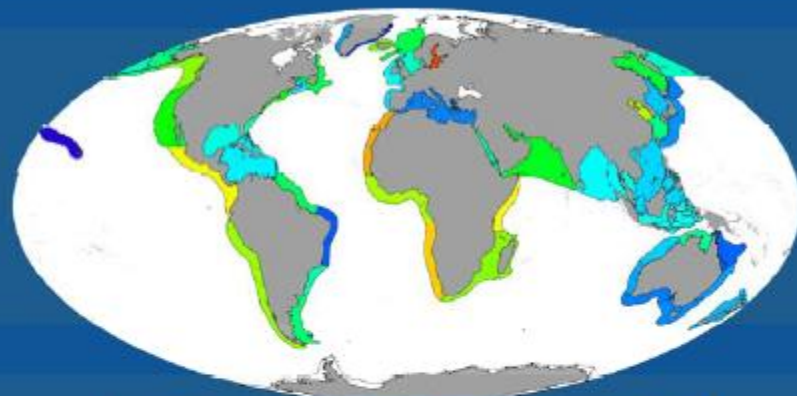


Approach

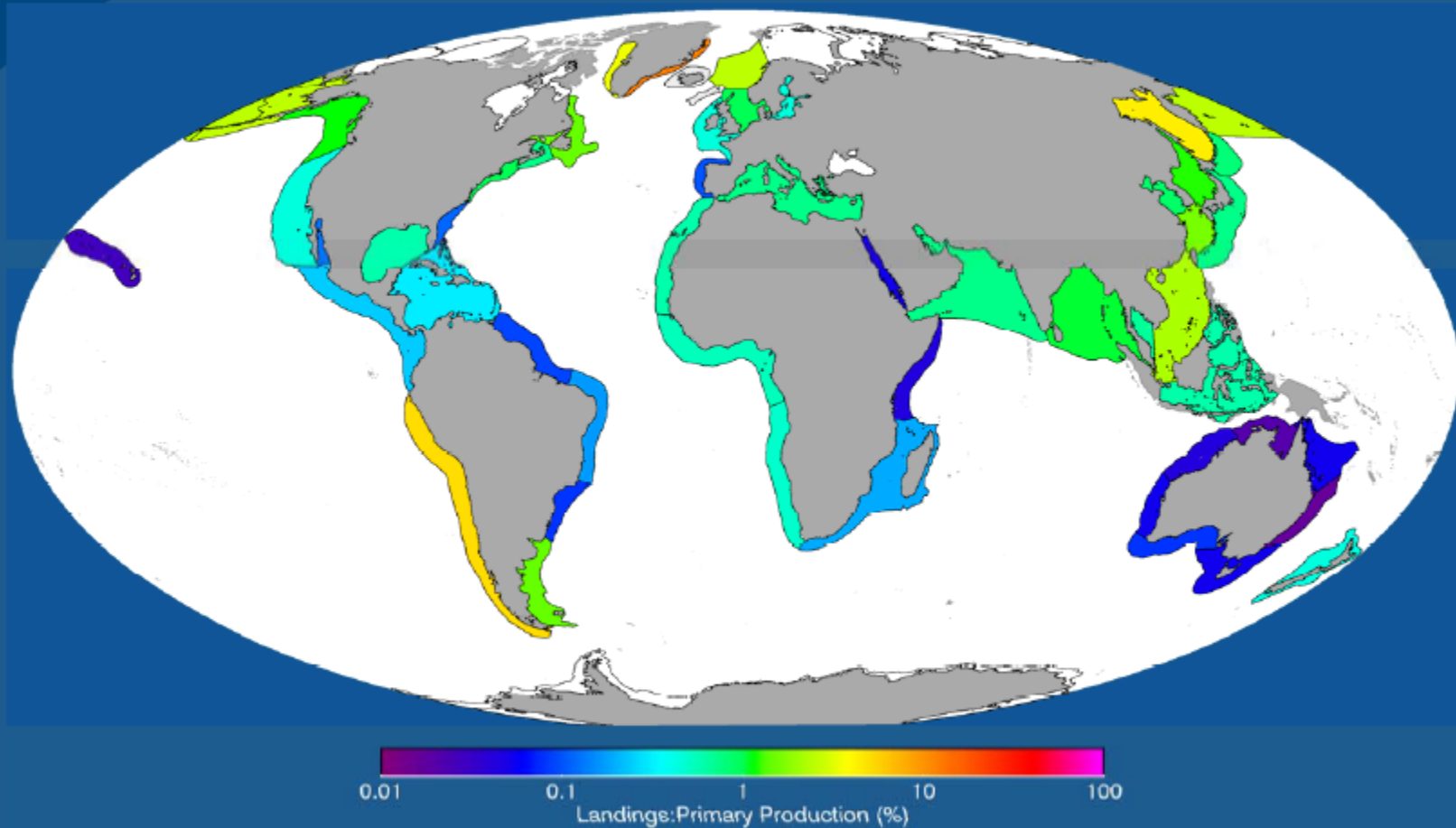
- Satellite Imagery to Determine Chl *a* Concentration & SST
- Empirical Relationships to Determine Primary Production
- Meta-analysis of ~ 240 Network Models to Determine Ecological Transfer Efficiencies
- Specify Probability Distributions for Input Parameters to Account for Uncertainty



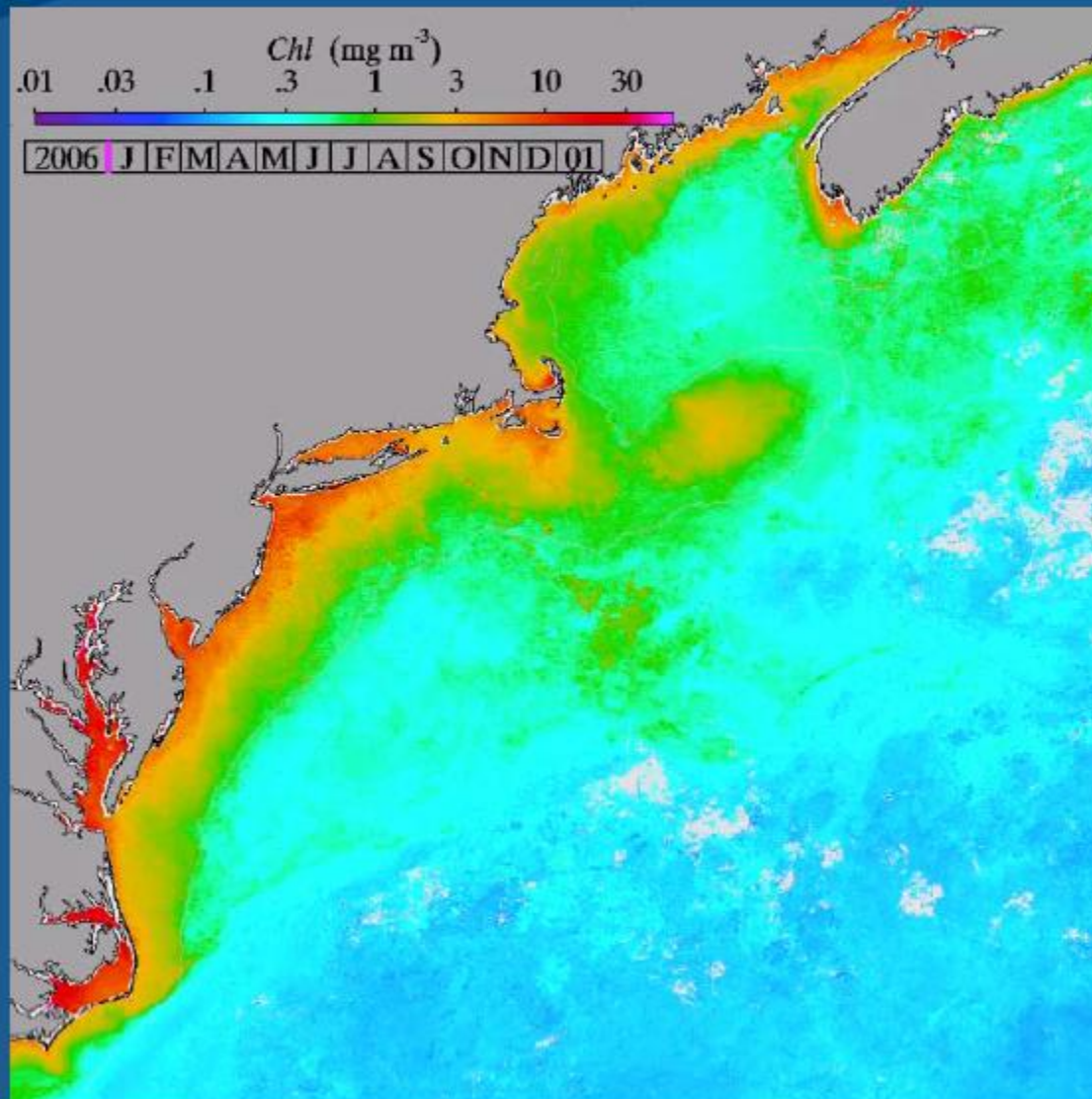
Model Outputs - Production



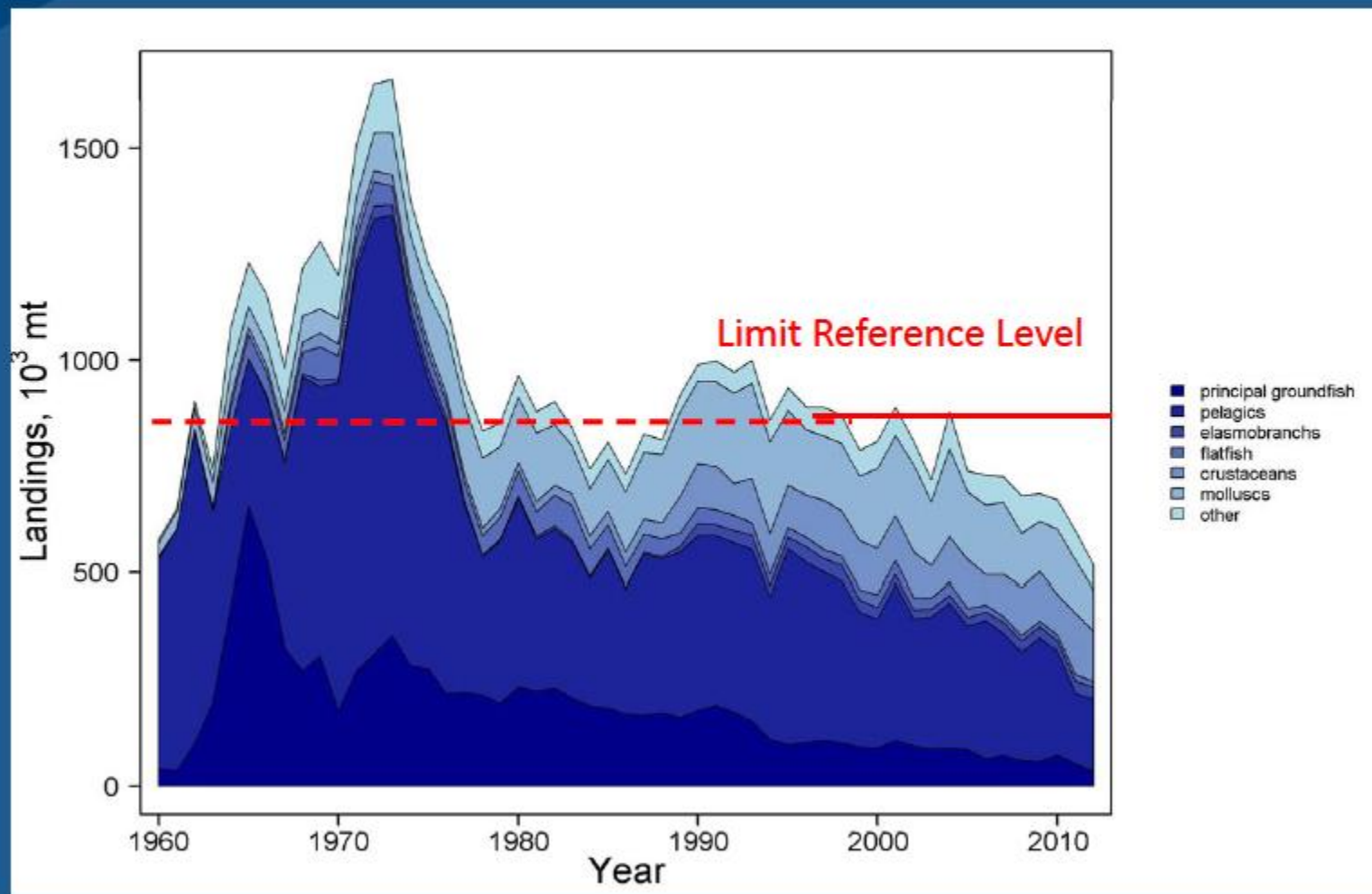
Ratio of Landings to Total Phytoplankton Production



A Closer Look: the Northeast U.S. Continental Shelf



Northeast U.S. Continental Shelf Landings



Options for Increased Yield

- Improved Management of 'Traditional Species'
- Diversification of Landings (Balanced Harvesting) at Lower Overall Exploitation Rates
- Consideration of Options for Increased Harvest of:
 - Krill
 - Mesopelagic Fish
 - Cephalopods
- Mariculture
 - Fed Species (Crustacean & Fish Culture/Ranching)
 - Natural Production (Bivalves and some Fish – e.g. milkfish_

Future Risks: Climate Change

- Changes in Phytoplankton Composition and Primary Production
- Shifts in Species Distribution
- Ocean Acidification
- Sea Level Rise

