



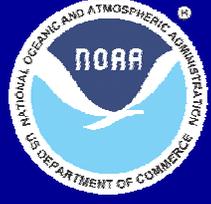
The Contribution of LME Indicators to GEOSS & GOOS

Ned Cyr

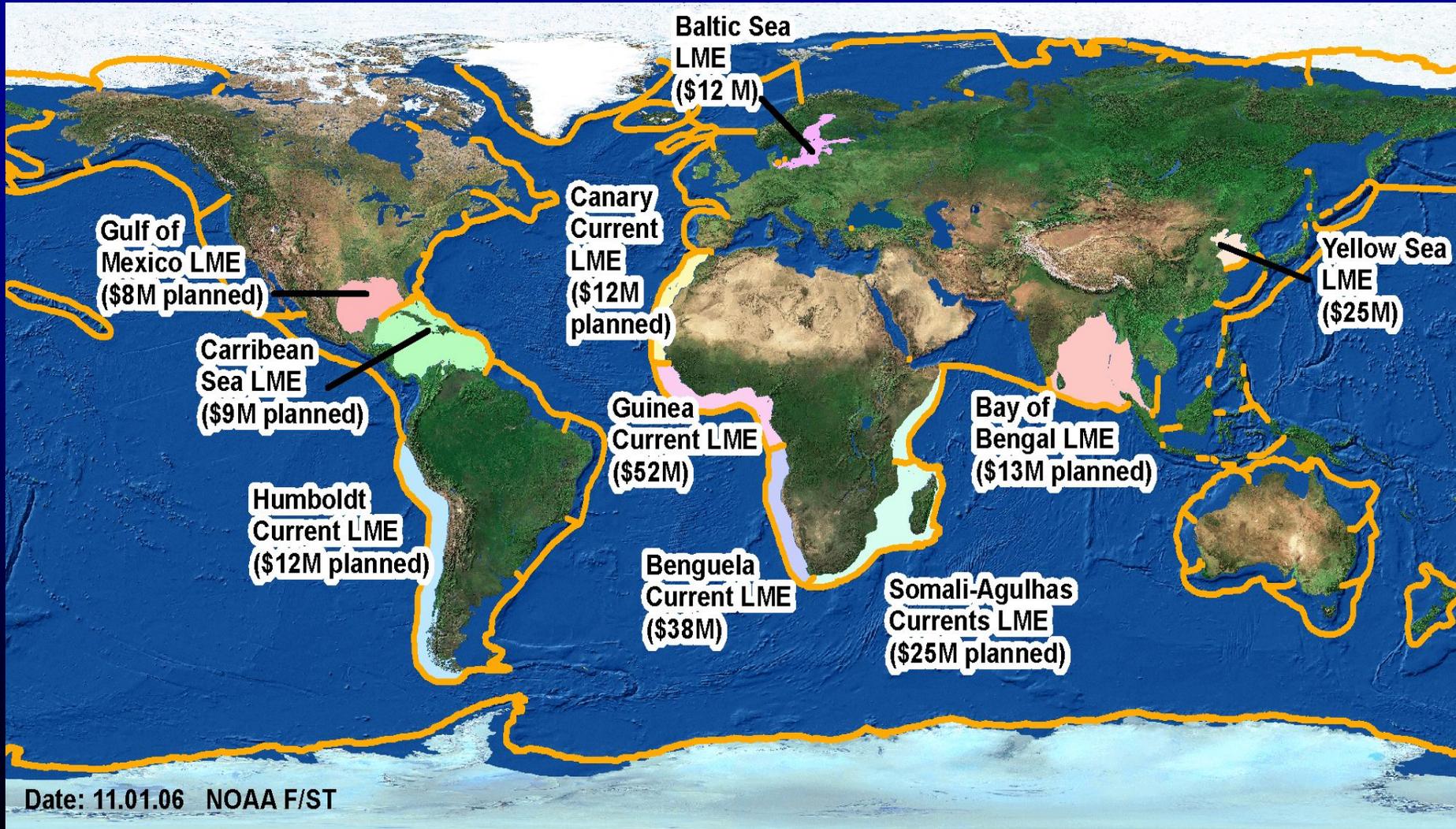
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Global GEF LME Projects





**Pollution &
Ecosystem Health**

Productivity

Fish & Fisheries

Socioeconomics

Governance



LME Observations and Indicators



Productivity Module

- Primary productivity
- Chlorophyll *a*
- Surface and water column temperature
- Photosynthetically active radiation
- Nitrogen
- Zooplankton biomass
- Zooplankton biodiversity

Fish and Fisheries Module

- Demersal species surveys
- Pelagic species surveys
- Ichthyoplankton surveys
- Invertebrate surveys (clams, scallops, shrimp, lobster, squid)
- Essential fish habitat
- Marine protected areas

Pollution and Ecosystem Health Module

- Water Clarity
- Dissolved Oxygen
- Coastal Wetland Loss
- Eutrophic Condition
- Sediment Contamination
- Benthic Index
- Fish Tissue Contaminants
- Multiple Marine Ecological Disturbances



Ocean Observing Systems



Global Earth Observing System of Systems (GEOSS)

Global Ocean Observing System (GOOS)

GOOS Regional Alliances (e.g., U.S. IOOS)





Observing Systems – Ecological Objectives



- GEOSS
 - Improve the management and protection of terrestrial, coastal, and marine ecosystems.
- GOOS
 - Protect and restore healthy ecosystems more effectively
 - Restore and sustain living marine resources more effectively
- GRAs (e.g., IOOS)
 - More effectively protect and restore healthy coastal ecosystems
 - Enable the sustained use of ocean and coastal resources



Coastal GOOS - Global Common Variables



Attenuation of solar radiation

Salinity

Sea level

Changes in bathymetry

pH

Biological oxygen demand

Biomarkers (oil, pesticides, metals)

Currents

Dissolved inorg. nutrients

(N, P, Si)

Dissolved oxygen

Eh in sediment

Incident solar radiation

Particulate organic C and N

Changes in shoreline position

Surface waves, direction, spectrum

Total organic C and N

Total suspended solids

Water temperature

Benthic biomass and spp diversity

Primary production

Fisheries: landings and effort

Nekton biomass

Nekton species diversity

Phytoplankton biomass (chlorophyll)

Sediment grain size, organic content

Zooplankton biomass, diversity

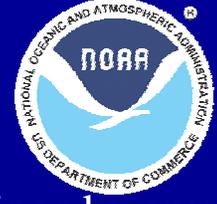
Colored dissolved organic matter

Seabird abundance and diversity

Fecal indicators



Coastal GOOS - Variables for Regional and National Systems



Artificial radionuclides
Metal toxins in sea food
Bio-assays of contaminant effects
Metals/organometals
Biogenic toxins in sea food
Nekton species
Coastline geomorphology
Optical properties of surface waters
Extent of biologically structured habitat
PAHs
Suspended plastics and plastics/liter on seashore
Human pathogens
Tar balls on the seashore
Macrobenthic species
Toxins in humans
POPs
Sediment chemical composition
Petroleum hydrocarbons
Pharmaceuticals
Sediment chemical composition

Fisheries: Fishing effort and landings by spp.
Sea ice
Fisheries: Location/frequency of habitat disturbance
Fisheries: Size spectrum of exploitable populations
Fisheries: Recruitment rates for exploitable species
Fisheries: By-catch
Fisheries: Diet of exploitable fish species
Phytoplankton species
Strandings and mass mortalities
Fisheries: Spawning stock biomass of exploitable populations
Marine mammals/birds species
Meiobenthic species
Zooplankton biomass



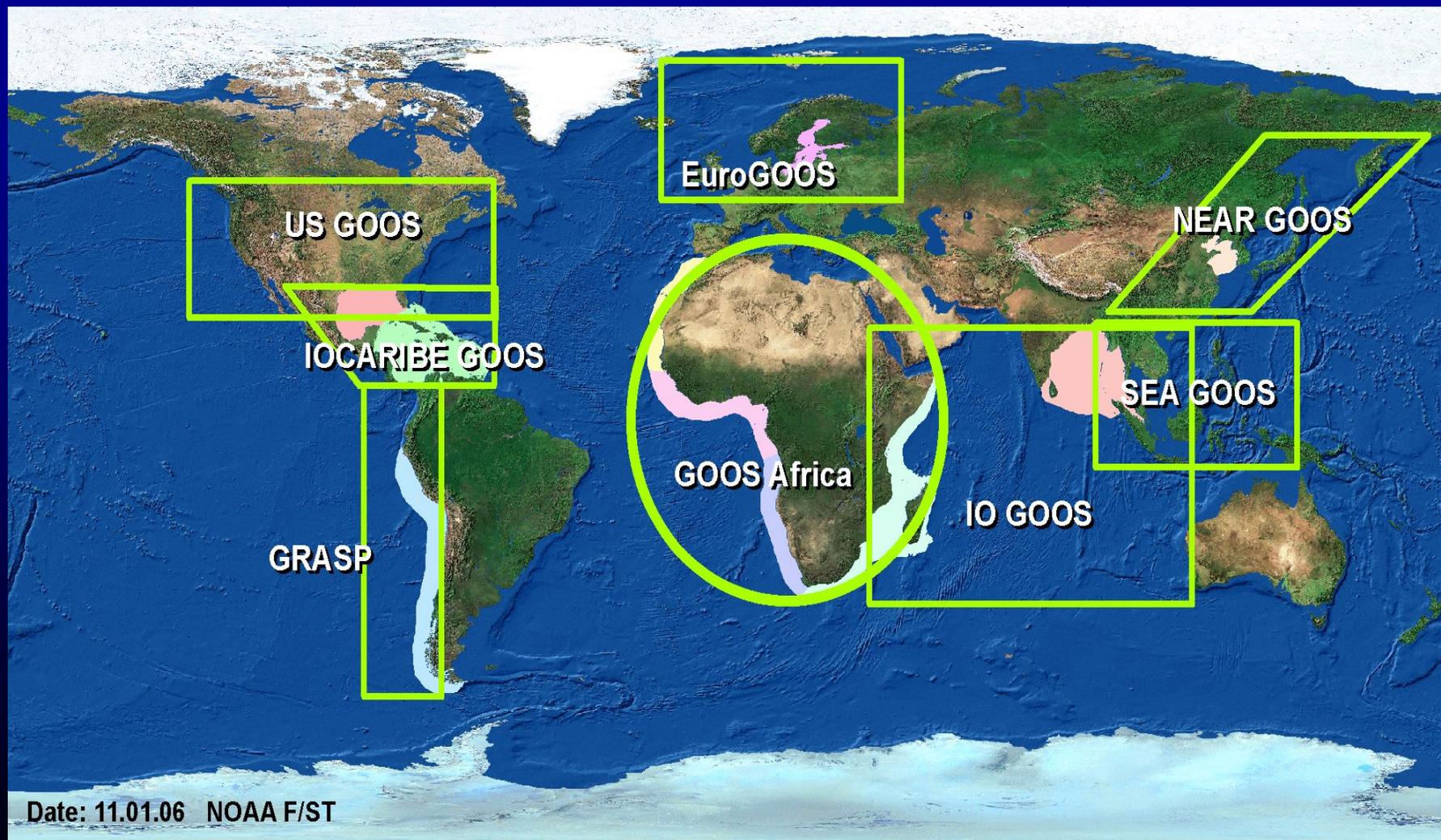
LMEs and GOOS: Overlapping Observing Requirements



Coastal GOOS Observations	Benguela Current LME Observations
Currents	Analysis of upwelling and current variability
Phytoplankton biomass and diversity	Ocean color/chlorophyll (from CPR)
Ocean Chemistry (e.g., dissolved inorg. nutrients (N, P, Si), dissolved oxygen)	Nutrients (from CPR)
Pollution (radionuclides, metals, PAHs, contaminants in seafood)	Coastal zone contaminants in water, sediment, biota
Zooplankton species and biomass (using CPRs and undulators)	Zooplankton species and biomass (using CPRs and undulators)
Commercial finfish species, abundance and distribution	Joint surveys and assessments of shared stocks of commercial species
Non-exploited species abundance and distribution	Joint surveys and assessments of shared stocks of non-exploited species
Top predators (sharks, marine mammals, birds) abundance and distribution	Joint surveys and assessments of shared stocks of key species
Extent of biologically structured habitat	Regional assessment of vulnerable habitats



LME Projects in GRA Regions





Why Should LMEs and GEOSS/GOOS Collaborate?

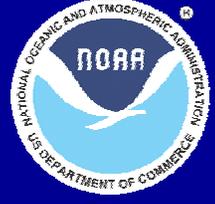


- Similar observations
- Limited resources
- Regional scale
- Mutual emphasis on capacity building
- LME projects and GOOS are both intended to be permanent structures with sustainable funding by national institutions.
- LME projects operate in many countries most in need of assistance/capacity building to initiate observing programs like GOOS.



The 3rd GOOS Regional Forum

Nov. 2006, Cape Town



Recommendations on LMEs and GOOS:

- GOOS Regional Alliances should partner with LMEs to achieve common goals in those regions where both are active.
- To stimulate this process and demonstrate the power of such a collaboration, GOOS Africa and the Benguela LME Program should implement an end-to-end (observations-data management-modeling) pilot project that contributes to the development of both efforts.



Thank you.



NOAA and Integrated Ecosystem Assessments (IEAs)



What are Integrated Ecosystem Assessments?



Single Sector Assessment



- Assesses individual species.
- Narrow perspective and spatial scale.
- Short-term perspective.
- Humans are independent of ecosystem.
- Conservative resource management.
- Single use observations.

Integrated Ecosystem Assessment (IEA)



- Provides a “big picture” of an ecosystem.
- Broad perspective and scale.
- Long-term perspective.
- Human impacts considered in models.
- Adaptive and integrated management.
- Shared and standardized observations.



What are Integrated Ecosystem Assessments?



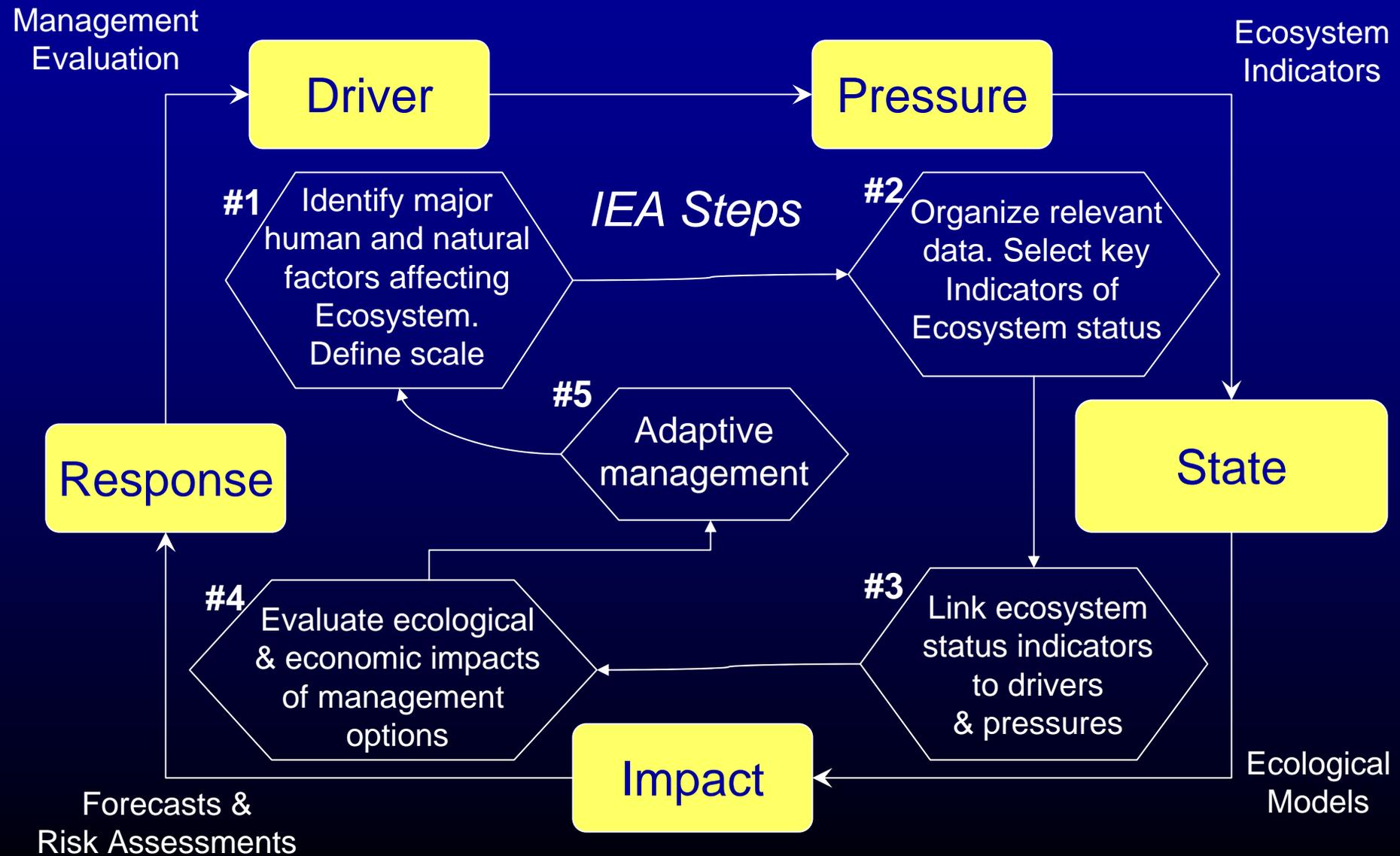
Integrated Ecosystem Assessment (IEA):

- “A synthesis and quantitative analysis of information on relevant physical, chemical, ecological and human processes *in relation to specified ecosystem management objectives*”.

An IEA:

- Incorporates multiple indicators of the environment and ecosystem, including human factors
- Is geographically specified
- Establishes target levels and thresholds for important ecosystem components
- Evaluates the impacts of management options and risks of not attaining target ecosystem states

How are IEA's developed (steps & content)?



Types of Indicators and Issues considered in IEAs

Drivers &
Pressures



States &
Impacts

Physical
air temperature
sea temperature
weather patterns
waves
salinity
pH
circulation
sea level
decadal indices
upwelling
wind stress
sediment
transport
freshwater input
sea ice cover
extreme events

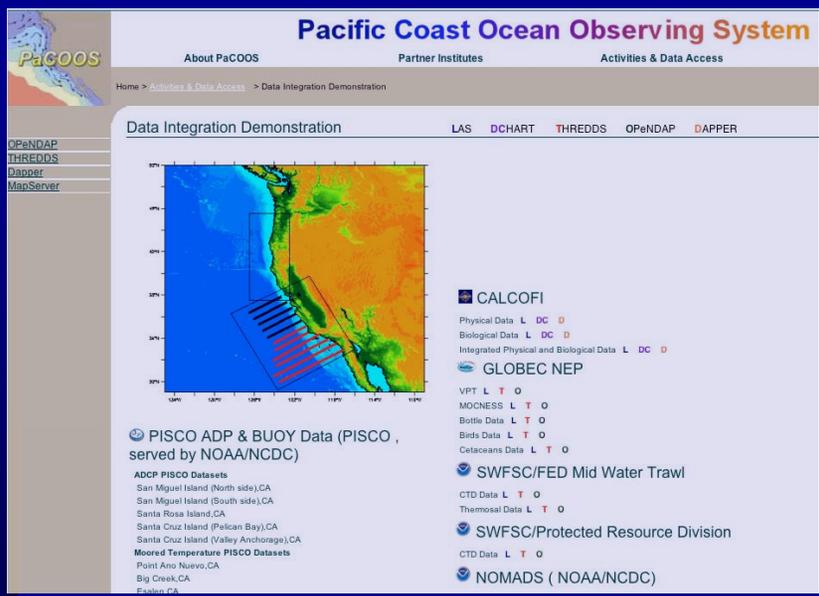
Human-Related
nutrient input
contaminants
microbiological
inputs
radioactive input
hydrocarbons
atmos. deposition
wetlands change
fishing effort
vessel traffic
bycatch
non-native species
introductions
marine debris
coastal & seabed
modifications
marine sound

Conditions
extent of hypoxia
HAB events
invasive species
interactions
primary production
secondary production
benthic production
species richness
species diversity
protected species
status & mortality
overfishing status
trophic balance
body burden of
contaminants
distributions of
biota
human factors

Goods & Services
species
-abundance
-biomass
-recruitment
fishery catch
fishery revenue
recreational use
aquaculture
production
non-consumptive
uses
social use and
Importance
transportation
commerce
energy



What are IEA Products? Paper or Plastic?

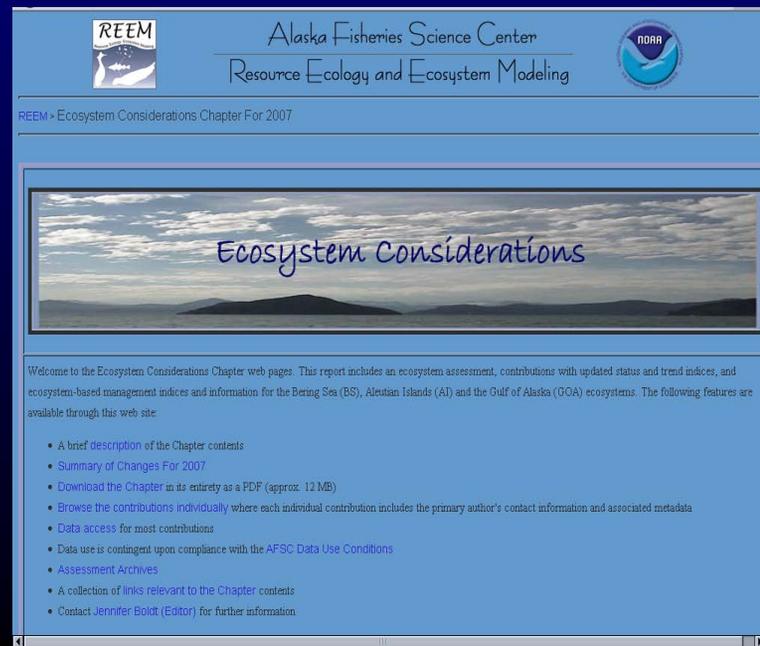


‘Plastic’ = Dynamic, web-based IEAs

- IEA products created on demand on-line
- Local or ‘place based’ scales
- ‘If-then’ scenarios and other assessment tools to inform specific management questions

Pacific Ocean Observing System (PaCOOS Website)

← “Google ocean”



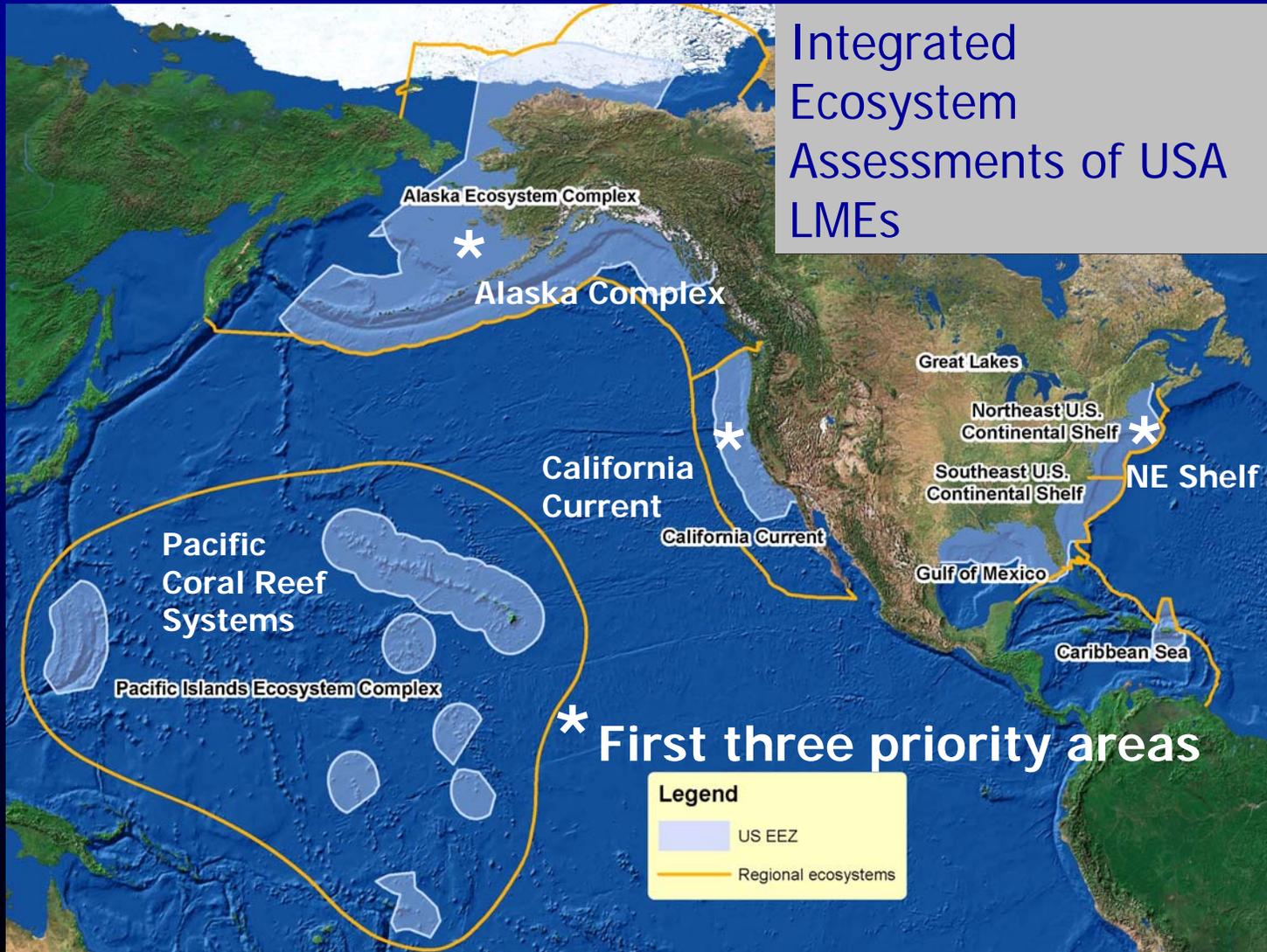
‘Paper’ = Regional Ecosystem IEA Reports

- Produced routinely (~4 years)
- Peer-reviewed
- 8 Regional Ecosystem-scale IEAs + 1 National Synthesis Report

E.g. Alaska Ecosystem Considerations Report used by the North Pacific Fisheries Management Council



Where is NOAA proposing to develop IEAs?





Components of an IEA



- An IEA typically consists of the following components
 - Assessment of ecosystem baseline conditions (**States**)
 - Assessment of stressors on the ecosystem (**Drivers, Pressures**)
 - Prediction of the ecosystem status with no change in management actions (**status quo response**)
 - Prediction of the ecosystem status under different management strategies to meet target states (**optional responses**)
 - Evaluation of the success of management actions (**update states relative to targets and thresholds**)

N.B. Ecosystem status reports ARE NOT integrated ecosystem assessments (DPSIRs)



Have IEAs Been Done Elsewhere?

YES!



www.defra.gov.uk

Charting Progress

An Integrated Assessment of the State of UK Seas

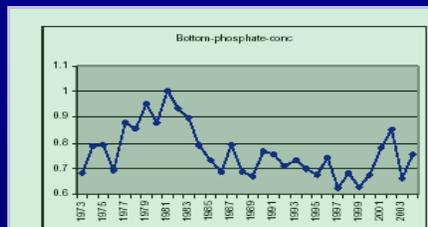
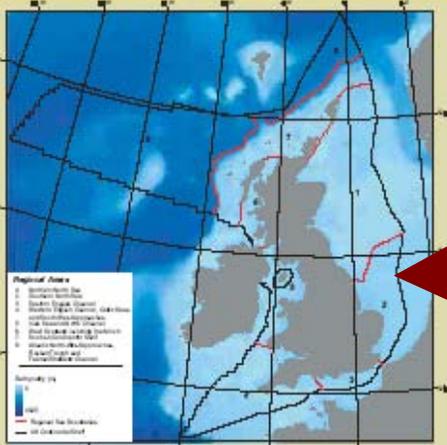


Figure 18: Annual mean values of bottom phosphate for the North Sea between 1973 and 2004

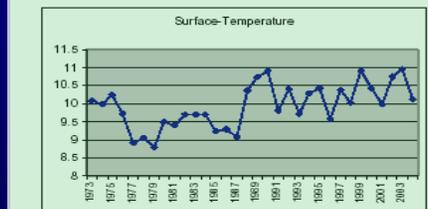
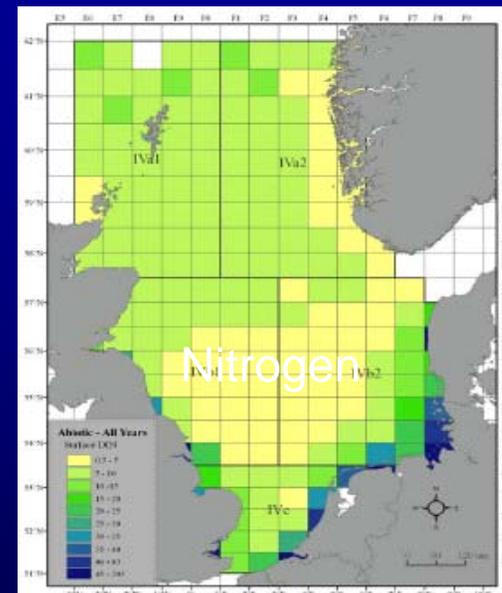


Figure 19: Annual mean values of surface temperature for the North Sea between 1973 and 2004



issues & challenges differ by sub-region

Table 5.1: Main Issues for each region*

Region	1. North Sea	2. Southern North Sea	3. Eastern English Channel	4. Channel and Approaches	5. Irish Sea	6. Western Scotland	7. Scottish Continental	8. Scottish Offshore
Climate Impacts	Red	Red	Red	Red	Red	Red	Red	Red
Fisheries	Red	Red	Red	Red	Red	Red	Red	Red
Nutrients	Red	Red (Coastal)	Red	Red	Red	Red	Red	Red
Microbiological Contaminants	Red	Red	Red	Red	Red	Red	Red	Red
Hazardous Substances	Red	Red	Red	Red	Red	Red	Red	Red
All oil industry	Red	Red	Red	Red	Red	Red	Red	Red
Radioactivity	Red	Red	Red	Red	Red	Red	Red	Red
Construction	Red	Red	Red	Red	Red	Red	Red	Red
Dredging	Red	Red	Red	Red	Red	Red	Red	Red
Sedimentary and Coastal Erosion	Red	Red	Red	Red	Red	Red	Red	Red
Litter	Red	Red	Red	Red	Red	Red	Red	Red

* See also Map (Figure 5.2). ■ Considered important issue per region

How do IEAs impact NOAA's statutory responsibilities?



- Magnuson Stevens Fishery Conservation & Management Reauthorization Act – provides more complete information on factors affecting regulated species & ecosystems
- Marine Mammal Protection Act – allows consideration of the impacts of cumulative human impacts on marine mammals
- Coral Conservation Act – enables coral reef management to consider ocean and land-based threats to corals
- Endangered Species Act – allows comprehensive ecosystem considerations to be included in endangered species recovery
- Marine Sanctuaries Act – allows sanctuary managers to monitor ecosystem status in relation to threats and conditions in broader regional ecosystems
- Coastal Zone Management Act – incorporates watershed, coast, nearshore and offshore ecosystem conditions into comprehensive coastal zone planning