Coastal and Global Scale Nodes: The Pioneer Array

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Preliminary Design Review
Dec 4-7, 2007

OOI Coastal Science Themes

- Ocean-Atmosphere Exchange
- Climate Variability and Ecosystems
- Mixing and Biophysical Interactions
- Coastal Ocean Dynamics and Ecosystems

OOI Coastal Science Themes

- Ocean-Atmosphere Exchange
  - Focus: Role of extreme forcing events
- Climate Variability and Ecosystems
  - Focus: Role of coastal ocean in CO2 cycle
- Mixing and Biophysical Interactions
  - Focus: Relationship to primary productivity
- Coastal Ocean Dynamics and Ecosystems
  - Focus: Coupled physical-biochemical processes

MAB Pioneer Science Goals

How do shelf/slope exchange processes structure the physics, chemistry, and biology of continental shelves?

What are the processes leading to the large heat, salt, nutrient, and carbon fluxes across the mid-Atlantic Bight shelf-break front?

What is the relationship between the variability in the shelf-break frontal jet and along-front structure in phytoplankton distributions?

What aspects of interannual variability (e.g., stratification, offshore circulation patterns, jet velocities, wind forcing) are most important for modulating shelf/slope exchange of dissolved and particulate materials?

Pioneer Core Sensors

- Air-Sea Interface

Measurement	Example Sensor	Platform	Comments
surface fluxes (bulk)	ASIMET	central, inshore and offshore EOM buoys	Nearby NDBC buoys will supplement Pioneer Array meteorology
surface fluxes (direct covariance)	LP-DCFS	central, inshore and offshore EOM buoys	direct measurement of momentum and buoyancy fluxes
air-sea CO2 flux	PMEL/Sabine	central EOM buoy	simultaneous measurement of air-side and water-side pCO2
surface wave spectra	PSI/Neptune	central EOM buoy	motion sensors in buoy hull

Pioneer Core Sensors

- Ocean Surface Boundary Layer

Measurement	Example Sensor	Platform	Comments
temperature and conductivity	Seabird	central, inshore and offshore EOMs	5 m below surface
mean currents	Nortek	central, inshore and offshore EOMs	5 m below surface
dissolved oxygen	Seabird,	central, inshore and offshore EOMs	5 m below surface
pH	Seabird	central, inshore and offshore EOMs	5 m below surface
optical attenuation and absorption	Wetlabs AC-9	central, inshore and offshore EOMs	5 m below surface
spectral irradiance	Satlantic OCR-507	central, inshore and offshore EOMs	5 m below surface
nitrate	Satlantic ISUS	central, inshore and offshore EOMs	5 m below surface

Pioneer Core Sensors

- Water Column - Profilers

Measurement	Example Sensor	Platform	Comments
temp, conductivity	Seabird	winched profilers	2 m above bottom to surface
	Seabird	moored profilers	near bottom to 15 m below surface
mean currents	ADCP	winched profiler base	near bottom to near surface
	ADCP	moored profiler base	near bottom to near surface
turbulent velocities	3D ACM	winched profilers	2 m above bottom to surface
	3D ACM	moored profilers	near bottom to 15 m below surface
dissolved oxygen	Seabird,	winched profilers	2 m above bottom to surface
	Seabird	moored profilers	near bottom to 15 m below surface
pH	Seabird	winched profilers	2 m above bottom to surface
	Seabird	moored profilers	near bottom to 15 m below surface
optical atten , absorp	AC-9	winched profilers	2 m above bottom to surface
Chl & CDOM fluoresc, optical backscatter	Wetlabs Eco-Puck	winched profilers	2 m above bottom to surface
	Wetlabs	moored profilers	near bottom to 15 m below surface
spectral irradiance	Satlantic	winched profilers	2 m above bottom to surface
nitrate	ISUS	winched profilers	2 m above bottom to surface

Pioneer Core Sensors

- Water Column – Mobile Platforms

Measurement	Example Sensor	Platform	Comments
temp, cond, press	Seabird	gliders	saw-tooth transects to 1500 m
	Seabird	AUVs	saw-tooth transects to 500 m
mean currents	Nortek	gliders	saw-tooth transects to 1500 m
	ADCP	AUVs	saw-tooth transects to 500 m
dissolved oxygen	Seabird,	gliders	saw-tooth transects to 1500 m
	Aanderaa	AUVs	saw-tooth transects to 500 m
Chl, CDOM fluoresc., optical backscatter	Wetlabs Eco-Puck	gliders	saw-tooth transects to 1500 m
	Wetlabs	AUVs	saw-tooth transects to 500 m
nutrients (NO2,NO3,PO4,SiO4)	SubChem	AUVs	saw-tooth transects to 1500 m

Pioneer Core Sensors

- Ocean Bottom Boundary Layer

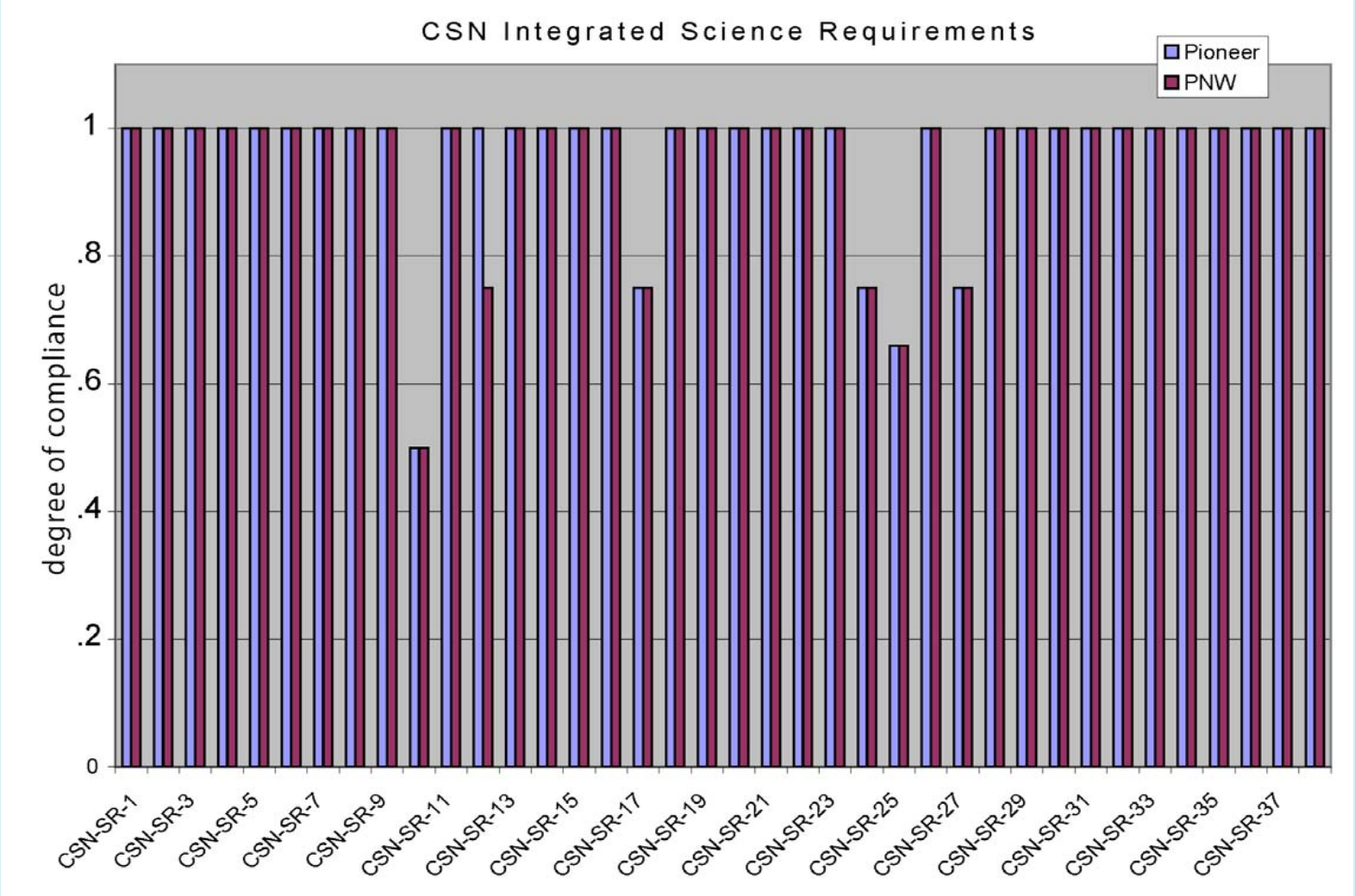
Measurement	Example Sensor	Platform	Comments
temperature and conductivity	Seabird	central, inshore and offshore MFNs	2 m above bottom
high-precision pressure	Seabird	central, inshore and offshore MFNs	2 m above bottom
mean currents	Nortek	central, inshore and offshore MFNs	2 m above bottom
dissolved oxygen	Seabird,	central, inshore and offshore MFNs	2 m above bottom

Pioneer Core Sensor Summary

PIONEER CORE SENSORS	air-sea interface	surface bndry layer	water column profiling	water column mobile	bottom bndry layer
surface flux (bulk)	x	--	--	--	--
surface flux (direct)	x	--	--	--	--
surface waves	x	--	--	--	--
CO2 flux	x	--	--	--	--
temperature	--	x	x	x	x
conductivity	--	x	x	x	x
currents	--	x	x	x	x
dissolved oxygen	--	x	x	x	x
pressure	--		x	x	x
Chl/CDOM/bb	--		x	x	
pH	--	x	x		
optical atten/absorp	--	x	x		
irradiance	--	x	x		
nitrate	--	x	x		
turb velocity	--		x		
N02,N03,P04,SiO4	--			x	

CSN SUR Trace Summary

- 32 of 38 science requirements met with core sensors



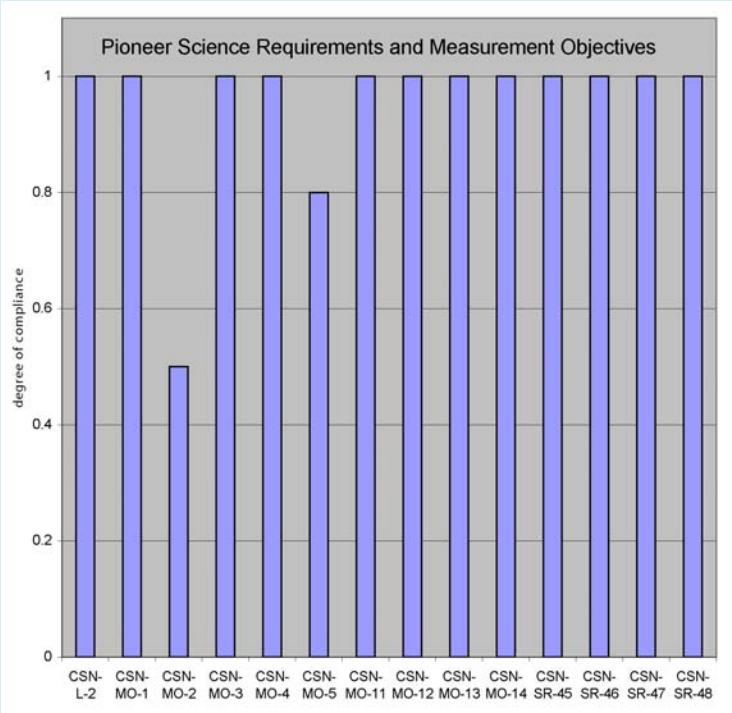
CSN SUR Trace Summary

- SR-10: Quantify acoustic and EM noise
  - Feasible in lab, difficult in-situ
- SR-12: Internal storage capacity of 6 months
  - Problematic for highest data rates on cabled nodes
- SR-17: Maintain sensors for 6 month duration
  - Some sensors will degrade with time
- SR-24: High-resolution observations in upper 150 m
  - Response time of some sensors will limit resolution
- SR-25: Multi-disciplinary observations to seafloor
  - 10 of 15 sensors can be accommodated on deep profilers
- SR-27: Mulit-disciplinary water column sensors
  - 12 of 16 measurements accommodated with core sensors

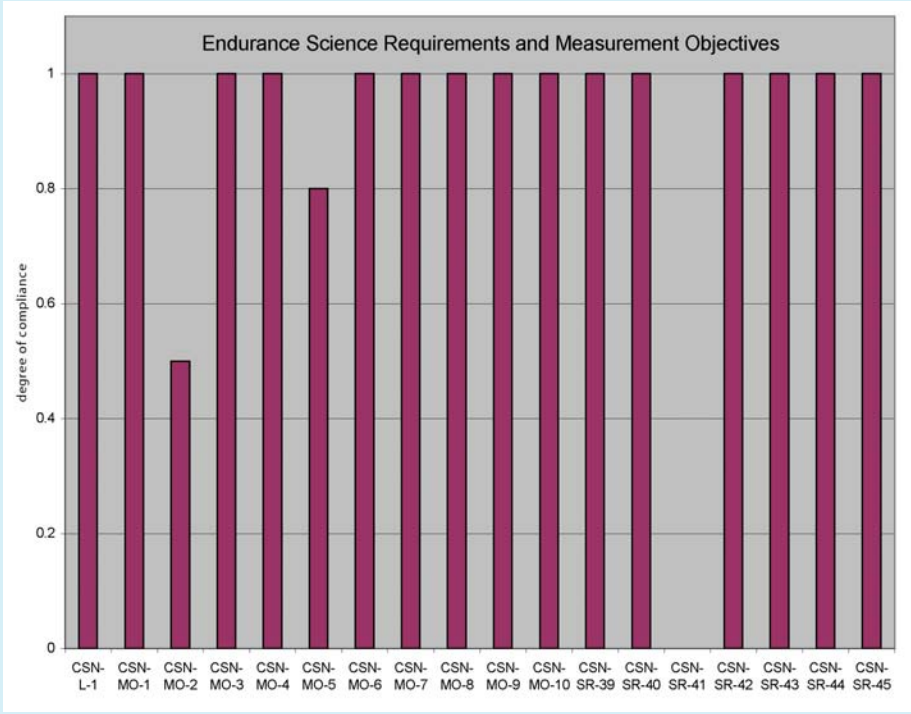
CSN SUR Trace Summary

- 27 of 32 site-specific requirements met with core sensors

Pioneer



Endurance



CGSN Risks and Mitigation

- Sensor degradation
  - Profilers and AUVs will be “parked” below the euphotic zone whenever possible
  - Newly deployed mobile platforms will pass by mooring locations to provide transfer standard
  - Mooring service cruises will be timed so that phenomena of interest (e.g. spring bloom, fall mixing) are observed with fresh sensors
  - Sensors on certain platforms (gliders, AUVs, winched profilers) will be serviceable in-situ
  - All sensors will be post-calibrated upon recovery