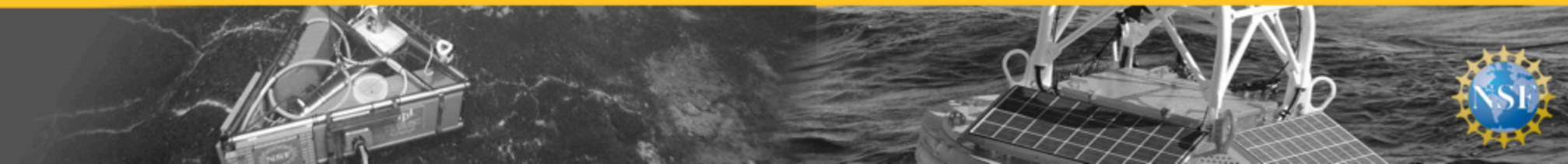


# Coastal & Global Scale Nodes (CGSN) Operational Status

November 12, 2019

Al Plueddemann, Derek Buffitt



# CGSN Operations Team

- **Refurb/Mechanical:** Kris Newhall
- **Electrical:** John Reine
- **Software:** Stephanie Petillo
- **Instruments:** Jennifer Batryn
- **System Engineering & Data Team Lead:** Sheri White
- **Data QA/QC:** Andrew Reed (science); TBD (operations)
- **Documentation/Config. Management:** Rebecca Travis
- **Platform Operations:** Peter Brickley
- **Logistics:** Dee Emrich

# CGSN Status: Pioneer

## Operations

- CP03ISSM: One FBB w/ intermittent faults, all other systems operational
- CP04OSSM: One FBB w/ intermittent faults, one damaged wind turbine following storm event, all other systems operational
- CP01CNSM: PSC unable to power MFN, where possible MFN instruments on battery and collecting, all other systems operational
- CP02PMXX, CP04OSPM, CP02ISPM, CNPM: all profiler moorings functional.
- Up to date on ingestion of available telemetered data, recovered data from Pioneer 12 in progress

Platform	Infrastructure %	Instruments %	Delivered XMIT %	Data Collected %
CP01CNSM	87%	92%	64%	92%
CP03ISSM	96%	100%	100%	100%
CP04OSSM	96%	100%	100%	100%
CP02PMCI	100%	100%	100%	100%
CP02PMCO	100%	100%	100%	100%
CP02PMUI	100%	100%	100%	100%
CP02PMUO	100%	100%	100%	100%
CP04OSPM	100%	100%	100%	100%
CP01ISPM	100%	100%	100%	100%
CP01CNPM	100%	100%	100%	100%

## Mobile Assets

- 1 of 5 planned gliders in the field
- Glider 340 recovered 11/5 after GPS failure
- Glider 379 healthy and on track
- AUV cruise scheduled for December, an additional 3 gliders planned for deployment

## Refurbishment

- All moorings completed refurbishment on time for Fall cruise.
- Recovered Pioneer 12 material refurbishment underway.
- Integration: February 2020
- Burn-in: March 2020

## Cruise

- RV Neil Armstrong completed Pioneer 13 cruise successfully in Oct 2019
- Pioneer 14 cruise will take place from April 17, 2020 to May 7, 2020
- Mob/Demob Port: WHOI
- Currently identifying cruise personnel

# CGSN Status: Southern Ocean

## Operations

- GSM is currently functional; GPS is non-functional, currently operating on internal clocks. GPS was shipping bad data causing NSIF to shutdown.
- Deterioration of instrumentation on IMM, a portion of inductively-coupled instruments are on batteries
- PCO2W sensor troubleshooting success, data continues to be delivered
- NOC CUSTARD sensors continue to function normally
- Up to date on ingestion of available telemetered and recovered data

Platform	Infrastructure %	Instruments %	Delivered XMIT %	Data Collected %
GS01SUMO	86%	40%	42%	42%



## Refurbishment

- Southern Ocean 6 January 2020 cruise is recovery only.
- Select items from Southern Ocean 5 cruise refurbished as needed for other GSMs or placed into storage.

## Cruise

- Global Surface Mooring turned in December 2018 on Southern Ocean 5
- Recovery gear shipping to Chile Nov. 8, 2019
- RRS Discovery Southern Ocean 6 cruise will take place from Jan. 16 – Jan. 26, 2020 for GSM recovery only
- Mob/Demob Port: Punta Arenas
- Commenced IPTs, IRR scheduled for Jan. 8, 2020

# CGSN Status: Irminger Sea

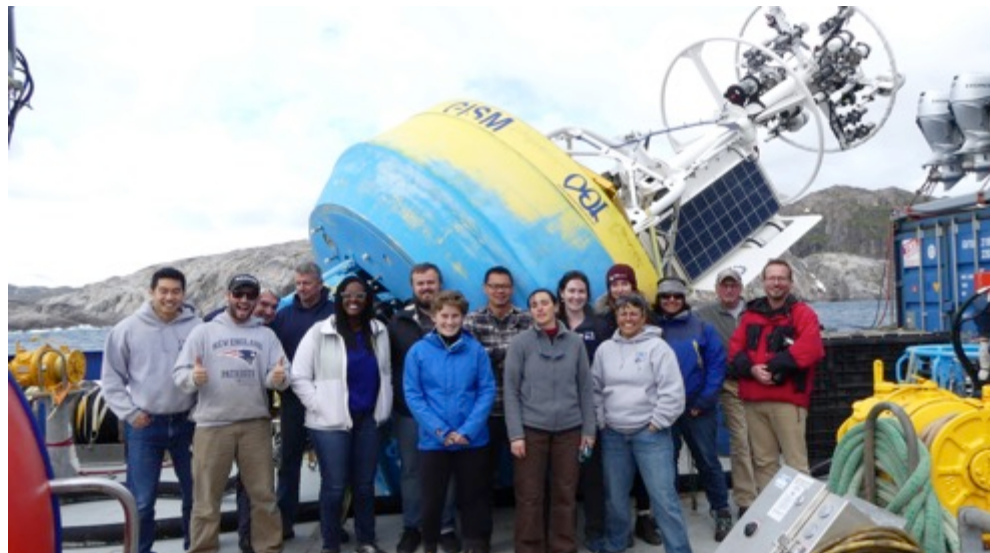
## Operations

- Actively monitoring forecasts for storm events. Ops team can manually control turbines and while monitoring battery charging. Wind turbines shutdown during storm events successfully saving units for use.
- GSM FBB1 and FBB2 failed, potentially a cable/connector issue. Xmit modified to send subsets of all DCL logs to view port/instrument function and maintain status monitoring.
- VELPT, along with IMM PHSENs and PCO2s have failed.
- HYPM, FLMA, FLMB fully operational.
- Up to date on ingestion of available telemetered and recovered data

Platform	Infrastructure %	Instruments %	Delivered XMIT %	Data Collected %
GI01SUMO	95%	80%	10%	86%

## Mobile Assets

- 2 of 3 planned gliders in the field, includes Biological Carbon Pump (BCP) glider
- Glider 525 (BCP: Nicholzen/Pavelsky) healthy and on track
- Glider 560 healthy and on track for FLMA



## Refurbishment

- All moorings completed refurbishment on time for Irminger 6 cruise.
- All materials received at WHOI and currently undergoing inspection & refurbishment.
- Integration: April 2020
- Burn-in: May 2020

## Cruise

- RV Neil Armstrong completed successful Irminger 6 turn in August 2019
- Irminger 7 cruise will take place from May 22, 2020 to June 21, 2020
- Mob Port: WHOI
- Demob Port: Galway
- Currently identifying cruise personnel

# CGSN Status: Station Papa

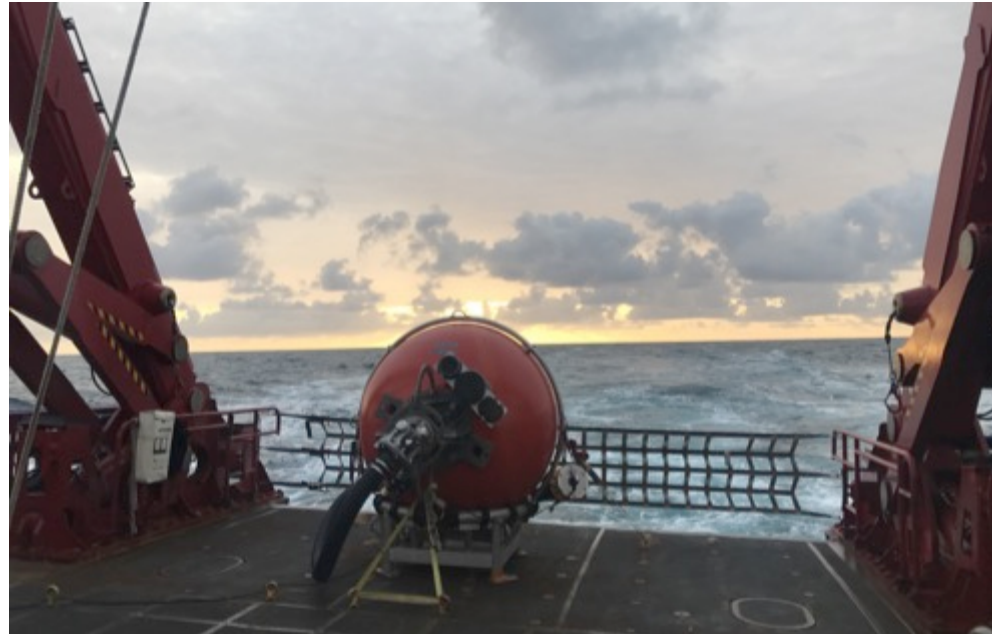
## Operations

- All subsurface moorings in operation
- Upper WFP on HYPM failed to communicate inductively and will not be logging any mule data. Data will be recovered next turn.
- Up to date on ingestion of available telemetered and recovered data



## Mobile Assets

- 2 of 3 planned gliders in the field
- Glider 537 healthy and on track for FLMA
- Glider 575 healthy and on track for HYPM



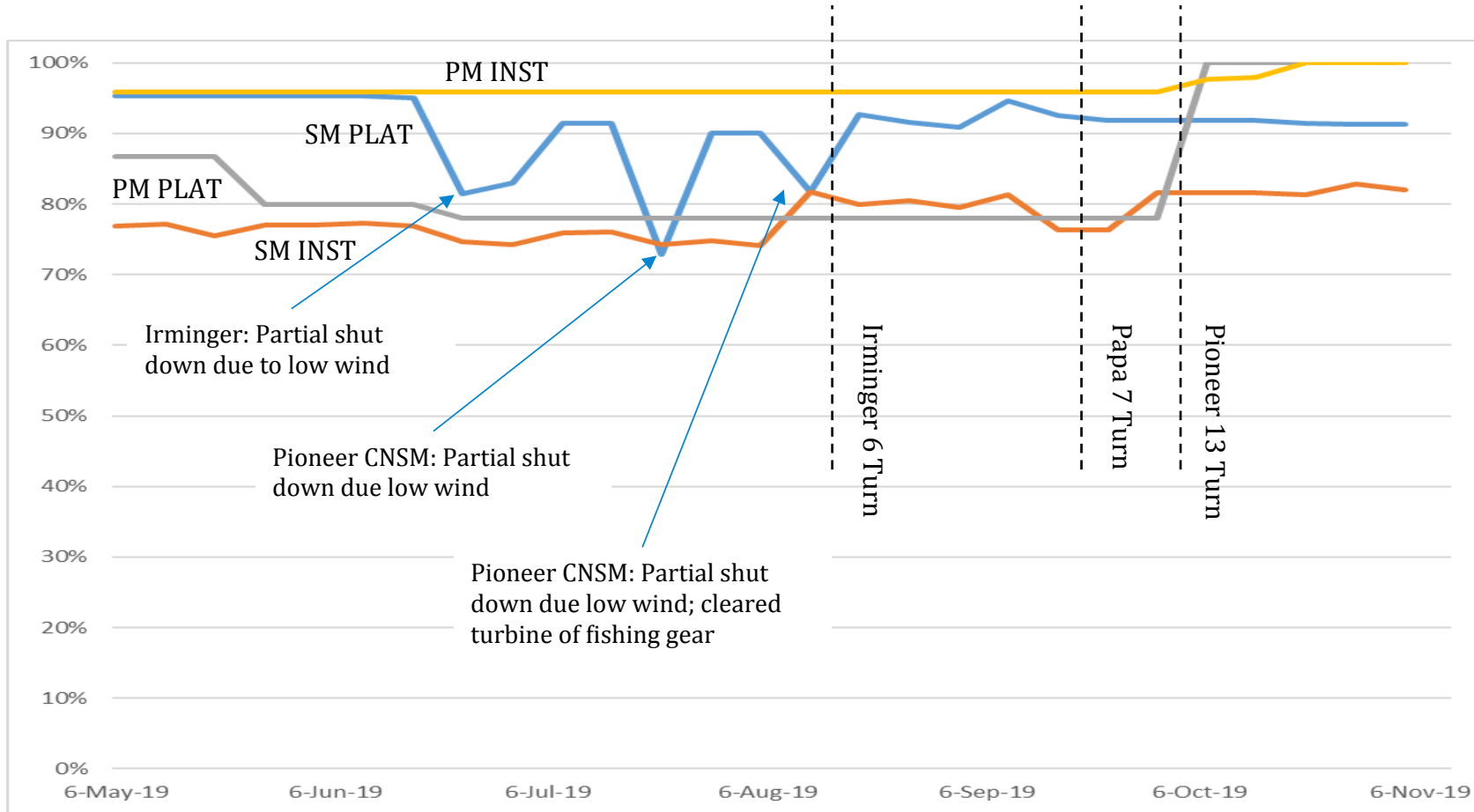
## Refurbishment

- All moorings completed refurbishment on time for August 2019 Papa 7 cruise.
- All recovered materials received and commenced inspection & refurbishment
- Integration: March 2020
- Burn-in: April 2020

## Cruise

- RV Sikuliaq completed Papa 7 cruise successfully in August 2019
- Papa 8 cruise scheduled for May 21, 2020 to June 6, 2020
- Mob/Demob Port: Seattle
- Currently identifying cruise personnel

# Platforms & Instruments: Last 6 months



- Weekly platform status checks and data review
- Includes:
  - Infrastructure health
  - Instrument assessment
  - Risks to infrastructure such as storm events
  - Actions and potential interventions
- Active management:
  - Power systems
  - Instruments

# Technical Developments

- **Surface Mooring Stretch Hoses:** Re-designed, with re-wiring of terminations
  - Increased reliability for power & comms (e.g. increased MFN up-time)
- **EM Cable & End Cap Re-design:**
  - Increased strength and robustness; reduced need for expensive replacements
- **Power generation review in PY2:**
  - Continue testing of higher efficiency solar panels on Pioneer and EA.
  - Evaluate increase of battery capacity on surface moorings
  - Assess benefit of rechargeable batteries for profiler moorings



# Challenges

- **Ship schedule and cost:**
  - Schedule and port changes, impacts to shipping and labor, increased day rates
- **Technical refresh:** Aging instruments and vehicle components
  - Options being reviewed, approach to be coordinated across IOs
- **Glider delivery:** TWR has difficulty delivering refurbished vehicles on time
  - New agreement, weekly meetings, combined CGSN+EA planning, evaluation of wet-testing

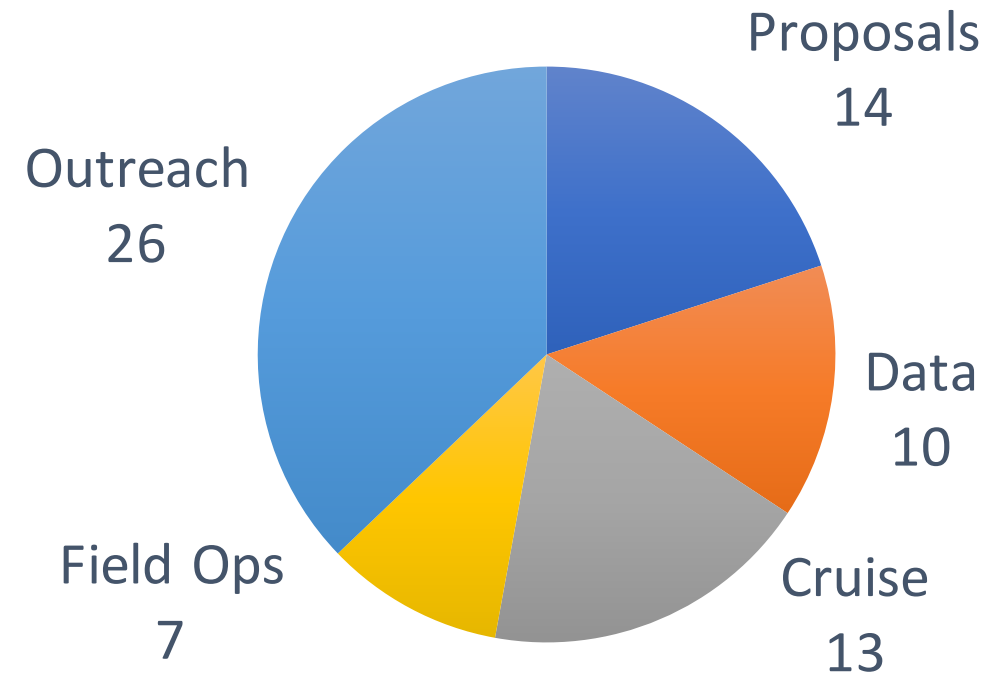
# Community Engagement Activities

- Outreach
- Engagement with researchers
  - Proposal and project support
  - Externally-funded science
- Cruise-related activities
- Conferences and workshops

# Outreach and Engagement PY1

- 70 reportable activities by PI
- Outreach
  - Talks, tours, advice, opportunities
- Proposal-related inquiries
  - Data use, sampling changes, add sensors, add platforms
- Data-related inquires
  - Access, availability, quality
- Cruise-related inquires
  - Participation, operations
- Field operations

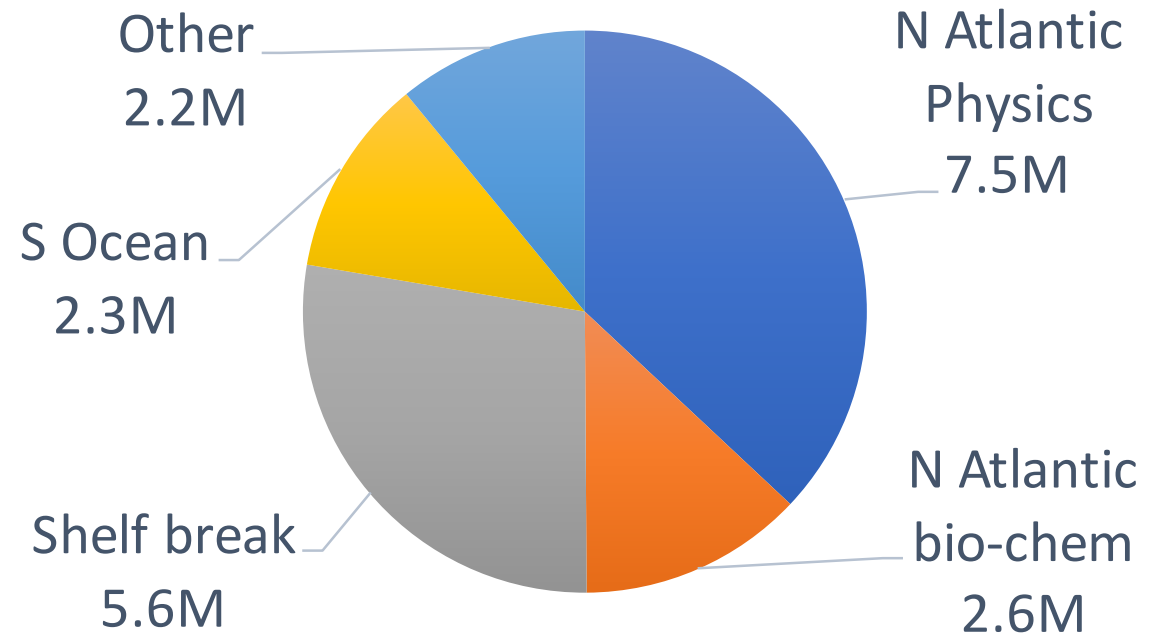
## Engagement Activities



# CGSN-Related External Awards (inception to date)

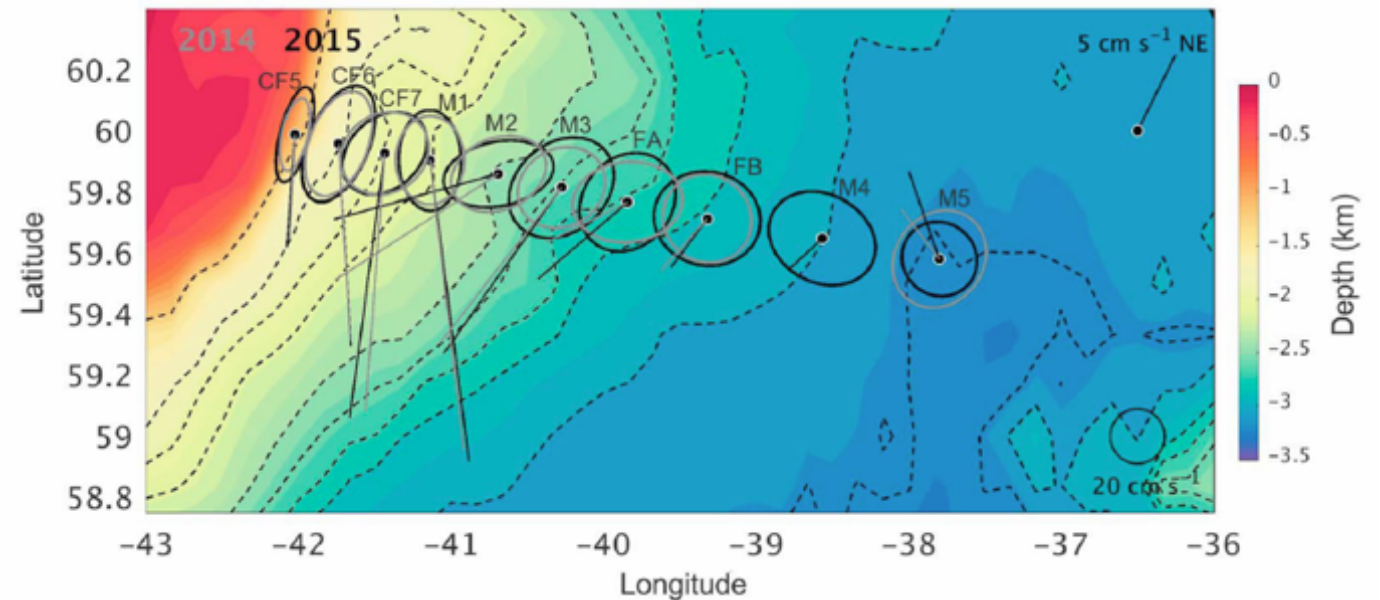
- Identified \$29M in NSF funded projects
  - 31 Awards
  - 23 PIs from 16 institutions
- Additional projects
  - ONR, NASA, LTER, other (not quantified)
- Includes process studies motivated by CGSN Arrays

## NSF Project Funding



# Externally-Funded Science - Irminger

- Irminger Array design modified based on input from OSNAP
  - Discussions began at 2011 EGU meeting
  - Mooring locations adjusted to align with OSNAP line
  - Instruments (CTD, currents) added to flanking moorings
- Enabled transport estimates
  - Hopkins et al., 2019
  - 22 month record
  - Mean and variability



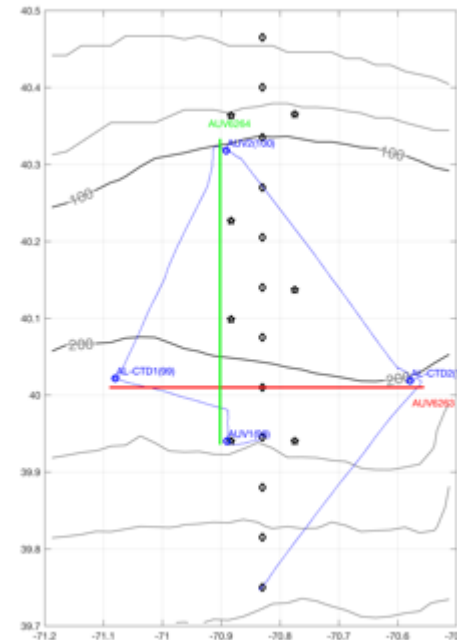
# Externally-Funded Science – Southern Ocean

- Collaboration with Nat. Ocean. Centre, UK
  - Proposal led by NOC PI Adrian Martin
  - Project focus on carbon uptake and seasonal variability (CUSTARD)
  - Funding to add instruments to Southern Ocean surface mooring
    - Nitrate & silicate sensors on NSIF (“lab on a chip”)
    - Second pCO<sub>2</sub> system on buoy
- Additional benefits
  - NERC support for OOI mooring turn

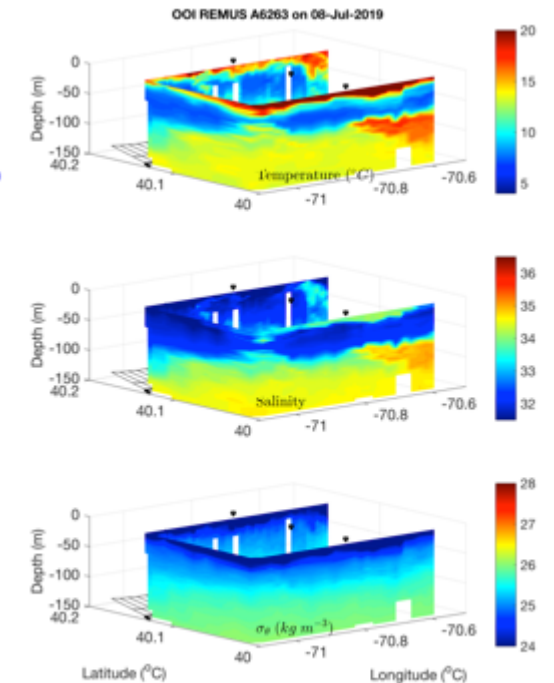


# Externally-Funded Science – Pioneer

- Shelfbreak Productivity project
  - Upwelling, nutrient flux, primary production, grazing
  - Process study cruises in the Pioneer Array region
  - Modified OOI AUV missions
- Enhanced process study
  - Joint field operations
  - Real-time sampling adjustments
- Additional benefits
  - Independent field validation for AUV
  - Outreach video



## SPIROPA



# Cruise-Related Activities – PY1

- Cruise participants
  - Researchers: CTDs, underway sampling, platform deploy/recover
  - Other: UNOLS, grad students, teachers, outreach
- NSF Northeast Shelf LTER
  - Participants on Pioneer mooring turn cruises (ongoing)
  - Coordinated CTD grid and water sampling protocol
  - Additional benefits (e.g. SUNA nitrate sensor evaluation)
- NSF SPIROPA process study (McGillicuddy et al.)
  - ECR to modify AUV track lines and cruise timing
  - Expedited data delivery via raw-data server
  - Coordinated field operations



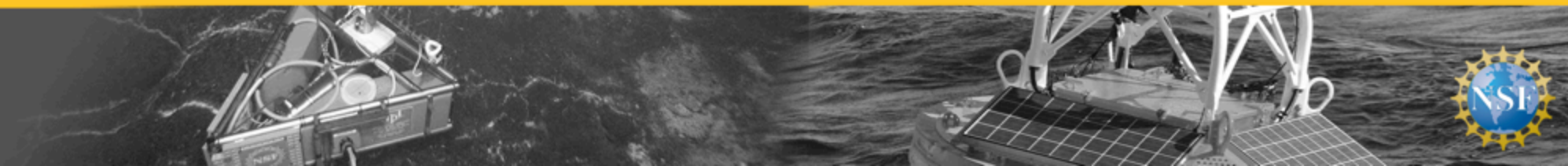
# Meetings and Workshops – PY1

- MABPOM 2018 – presented talk on Pioneer Array
- Fall AGU – Contributed to talks, attended OOIFB Town Hall
- ASLO – Contributed to talk by Dever
- Commercial Fisheries Research Foundation – Pioneer update
- OceanObs'19 – Contributed to OOI whitepapers
- EarthCube Time Series Data meeting - contributed to talk by Ruef
- MABPOM 2019 – contributed to two talks

# Pioneer Array Relocation: Concepts and Questions

November 12, 2019

Al Plueddemann



# Expectations and Recommendations

- **OOI Science Plan 2005:**
  - “... A Pioneer Array is a relocatable asset, deployable over time periods appropriate to the scientific questions at hand, perhaps for 1-7 years.”
- **Trowbridge et al., 2019 Frontiers of Marine Science:**
  - “...the Pioneer Array, a relocatable system with approximately 5 years planned at a series of locations to be selected by the National Science Foundation..”
- **Recommendations:**
  - Pioneer should be relocated co-incident with the OOI 2.0 to 3.0 transition
  - There should be an open competition based on scientific rationale for the location, including the possibility of being maintained at the current location
  - Operation should remain under the OOI 3.0 implementing organization
- **Timing:**
  - Working backwards suggests location known by Fall 2021, planning starts now!

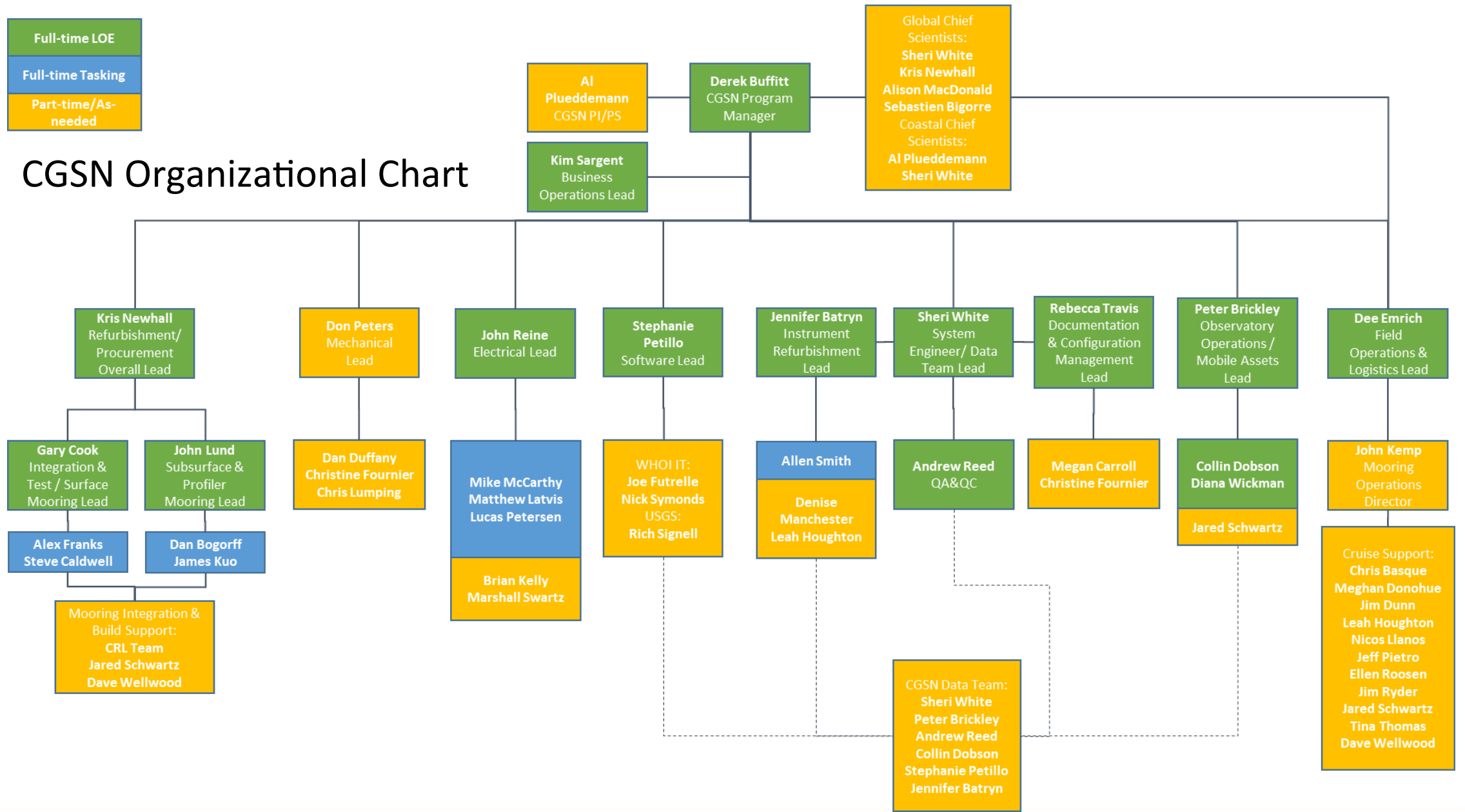
# Timeline and Questions

- **Possible timeline:**
  - 2024 Spring: OOI 3.0 deploys Pioneer Array at new site
  - 2023 Spring: Recover current Pioneer, transition to mooring build for new site
  - 2021 Fall: Competition complete, new location known, begin plan/design/fab
  - 2020 Fall: NSF Call for proposals
- **Questions to be resolved:**
  - How to provide clear separation between MIOs and proposal process?
  - What materials do PMO/MIOs need to provide for the proposal call?
  - Is this best done as an RFA call, or an RFP?
  - What support is provided to the winning PI team?
  - What level of engagement does the winning PI team have with the operator?
  - Should we be announcing the plan at Ocean Sciences in February 2020?

# Questions

Full-time LOE  
 Full-time Tasking  
 Part-time/As-needed

# CGSN Organizational Chart



# Technical Developments & Reviews

- **Surface Mooring Stretch Hoses:** Re-designed, with re-wiring of terminations
  - Provided redundancy for power & comms
  - Decreased risk of shorts causing a system failure
  - Increased operational reliability
- Confirmed following Pioneer 13: increased MFN up time during deployment and 9 of 9 recovered stretch hoses available for re-use
- **EM Cable & End Cap Re-design:**
  - Cable re-design is now an external armor cable, increasing strength and robustness
  - End cap increased electrical reliability
  - Allowed refurbishment of cables and decreased procurements

# Technical Developments & Reviews

- **Power generation under review in PY2:**
  - Continue testing of higher efficiency solar panels on Pioneer and EA.
    - Updated design for obsolete panels
    - Should allow greater power generation from shaded cells
    - Planned expansion on more moorings (currently on single EA and single CGSN mooring)
  - Reviewing increasing battery capacity on surface moorings
    - Increase storage of power during windy/sunny periods
    - Increase available power for additional instrumentation
    - Decrease risk of low power periods during doldrums
  - Assessing benefit of rechargeable batteries for profiler moorings
    - Increased capacity and endurance
    - Decrease battery replacement costs over time
    - Decrease waste from used batteries



# Challenges

- **Ship schedule and cost:**
  - UNOLS schedules differ from AWP: impacts shipping, labor resources, and deployment budgets
  - Increasing vessel costs; operational and port day rates.
  - Will continue mitigations such as decreasing on-site build/burn-in and load days
  - This will be an ongoing risk to the program as rates increase year over year
- **Glider delivery:** TWR has difficulty delivering refurbished vehicles on time
  - New agreement supports TWR planning
  - Weekly management discussions provide greater visibility. Discussions include CGSN & EA allow prioritization of vehicles as a single observatory
  - Planning review of testing options including wet testing of vehicles prior to deployment
- **Technical refresh:** Aging instruments and vehicle components
  - Replacements may impact software, electrical, and mechanical components
  - Options being reviewed include refurbishment of stored instruments, cannibalization of stored vehicles, replacement of G2 glider components with G3, and the need for purchase and replacement. This will be part of PY2 spare plan.

# Proposal/Project Support

- Pre-proposal discussions
- Assistance with data availability
- Letters of Collaboration
- Feasibility Assessments
- Subcontract (SOW and Budget)
- Engineering Change Request
- Sampling changes
- Coordinated field operations

**View/Edit ECR**

ECR ID: 1303-01216      ECR Name: 3202-00007 Irminger Sea Site Characterization Paper updates  
ECR Status: Completed      Previous Session: [2014-02-19 - 2/19/2014 1:30:00 PM](#)

[Detail](#) | [Documents](#) | [Comments](#) | [History](#) | [Vote](#) | [Post Session](#)

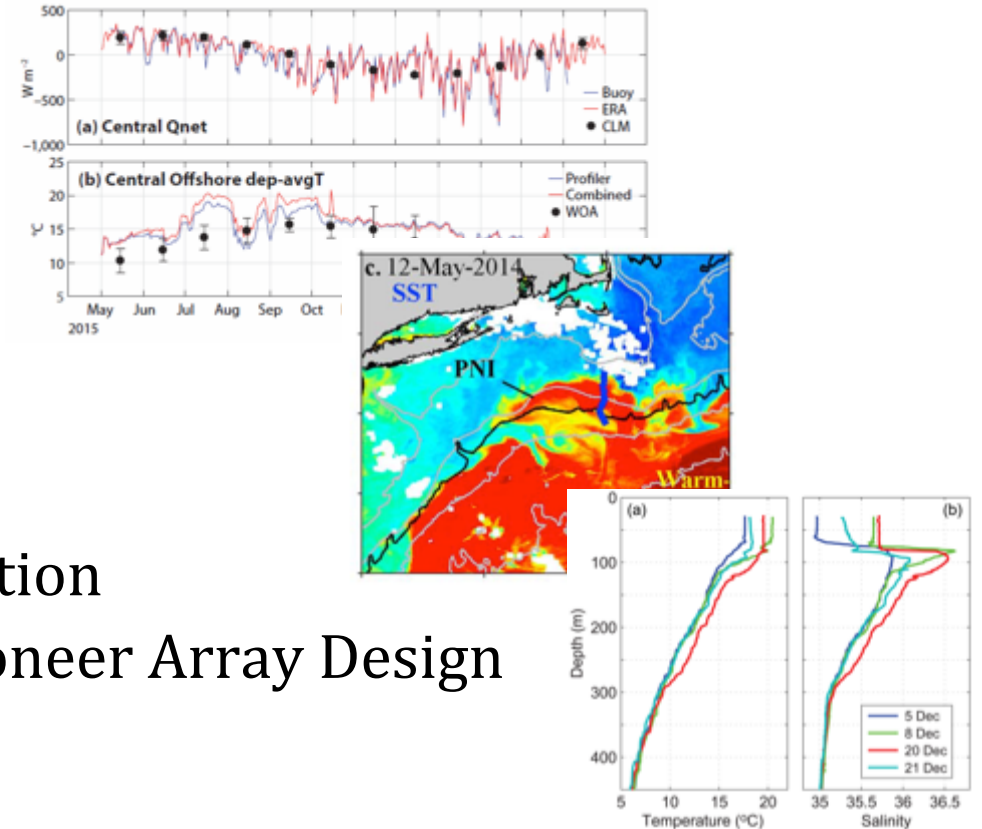
[Print](#)

ECR Name	3202-00007 Irminger Sea Site Characterization Paper -- mooring location updates	Board Requested	Coastal Global
Requestor	Sheri White	Requestor Phone	(508) 289-3740
ECR Class	2	Current Status	Completed
WBS Elements	<a href="#">Add WBS</a> <a href="#">Remove WBS</a>		
File Control Number	3202-00007_CGSN_Site_Characterization_Irmin	Configuration Manager	Wickman, Diana
Control Account Name	None	Control Account Manager	None

[Change Details](#)

# Publications (inception to date)

- 19 Pioneer-related publications
- 28 Global-related publications
- OOI-team efforts
  - Smith et al., 2019, OOI Lessons Learned
  - Trowbridge et al., 2019, OOI 2.0 Description
  - Gawarkiewicz & Plueddemann, 2019, Pioneer Array Design



# PY2 Goals – Following the PY2 AWP

- Support CE efforts undertaken by the PMO
- Continue Engagement with Researchers
- Continue cruise-related activities
- Participate in Conferences and Workshops
  - Fall AGU, Ocean Sciences, MABPOM, MTS Buoy Workshop
- Seminars at regional institutions
- Public Outreach via talks, tours and other contributions

## Instrument Up-Time OOI 2.0, PY-1

### Surface Mooring Instruments

Up-time calculated based on all impacts (instrument failures & infrastructure failures)

Instrument	Avg Up-Time
MOPAK	90%
METBK	87%
HYD	89%
DOSTA	81%
SPIKR	94%
NUTNR	85%
PCO2A	58%
PCO2W	53%
WAVSS	82%
FDCHP	23%
OPTAA	78%
FLORT	88%
VELPT	80%
CTDMO	67%
PHSEN	49%
CTDBP	43%
ADCP	74%
ZPLSC	69%

# Instrument Up-Time OOI 2.0, PY-1

## Profiler Mooring Instruments

Up-time calculated based on all impacts (instrument failures & infrastructure failures)

Instrument	Avg Up-Time
MOPAK	91%
ADCP	89%
VELPT	91%
DOSTA	91%
CTD	91%
FLORT	92%
PAR	91%

# Coastal Glider Up-Time

## OOI 2.0 PY-1

Based on planned mission duration for available vehicles (planned missions vary based on cruise schedule and vendor deliveries)

Year	# of Deployments	Total Deployment Days	Avg Days per Deployment	Avg % of Planned Deployment
2014-2015	13	959	74	78%
2015-2016	17	969	57	55%
2016-2017	25	1157	46	54%
2017-2018	13	820	63	79%
2018-2019	11	788	72	85%