Shell's Alaska Venture Program Update – Open Water Meeting

March 7, 2012

Agenda

- Presentation Materials
  - Proposed operations for 2012
  - Proposed monitoring program overview
  - Details of select aspects of monitoring program
    - MMO programs
    - Acoustics
      - Sound Source Characterization – vessel strategy
      - Real time Sound Source Characterization
      - Optimal placement of arrays
    - Aerial
      - Beaufort
      - Chukchi
      - Power analyses Beaufort / Chukchi
  - Peer review questions
- Q&A
- Discussion of Comprehensive Report

Chukchi and Beaufort Seas

Burger to Barrow	140 miles	Burger to Point Hope	206 miles	Kaktovik to Topedo	55 miles
Burger to Wainwright	78 miles			Nuiqsut to Sivulliq	118 miles
Burger to Point Lay	92 miles			Barrow to Sivulliq	256 miles

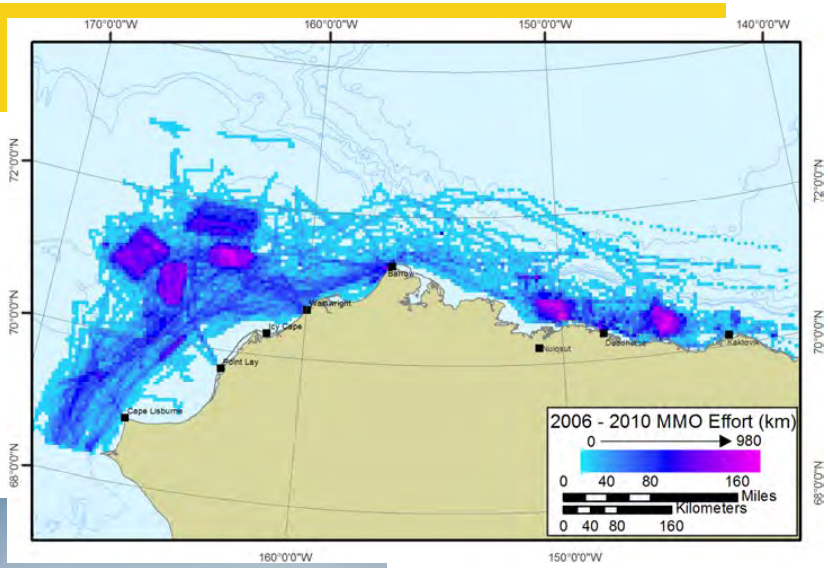
2012-13 Proposed Operations

- Chukchi Sea: Drill up to three wells per year during open water drilling season (July-October)

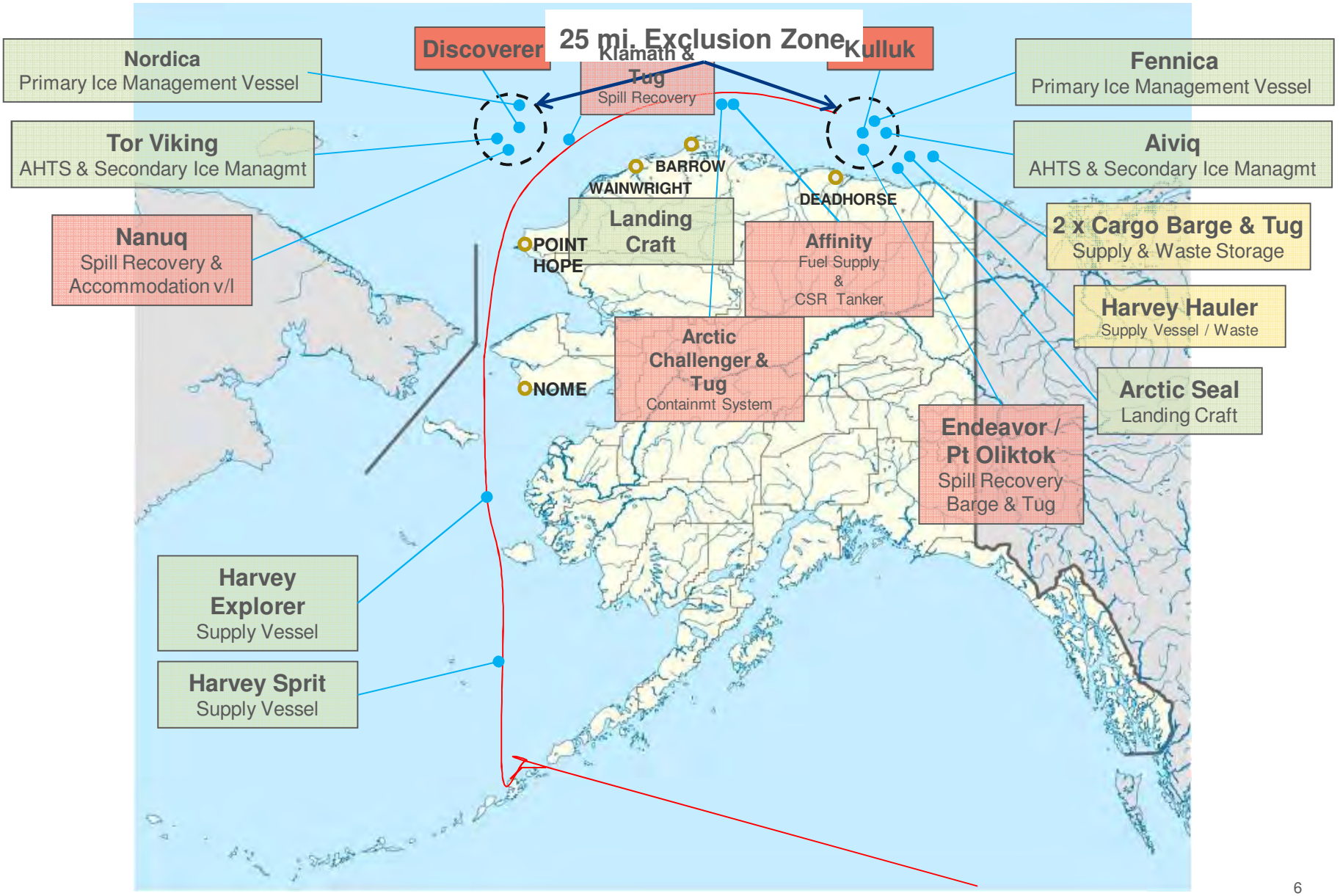
- Beaufort Sea: Drill up to two wells per year during open water drilling season (July-October)

2012-13 Science Program

- **Joint Industry Program**
  - Offshore ecological studies
- **Mammal Monitoring Program**
- **Ice & Metocean Buoys**
- **On-shore and Near shore ecological studies (continued from 2010 and 2011)**
- **Drilling Monitoring**



Fleet Overview



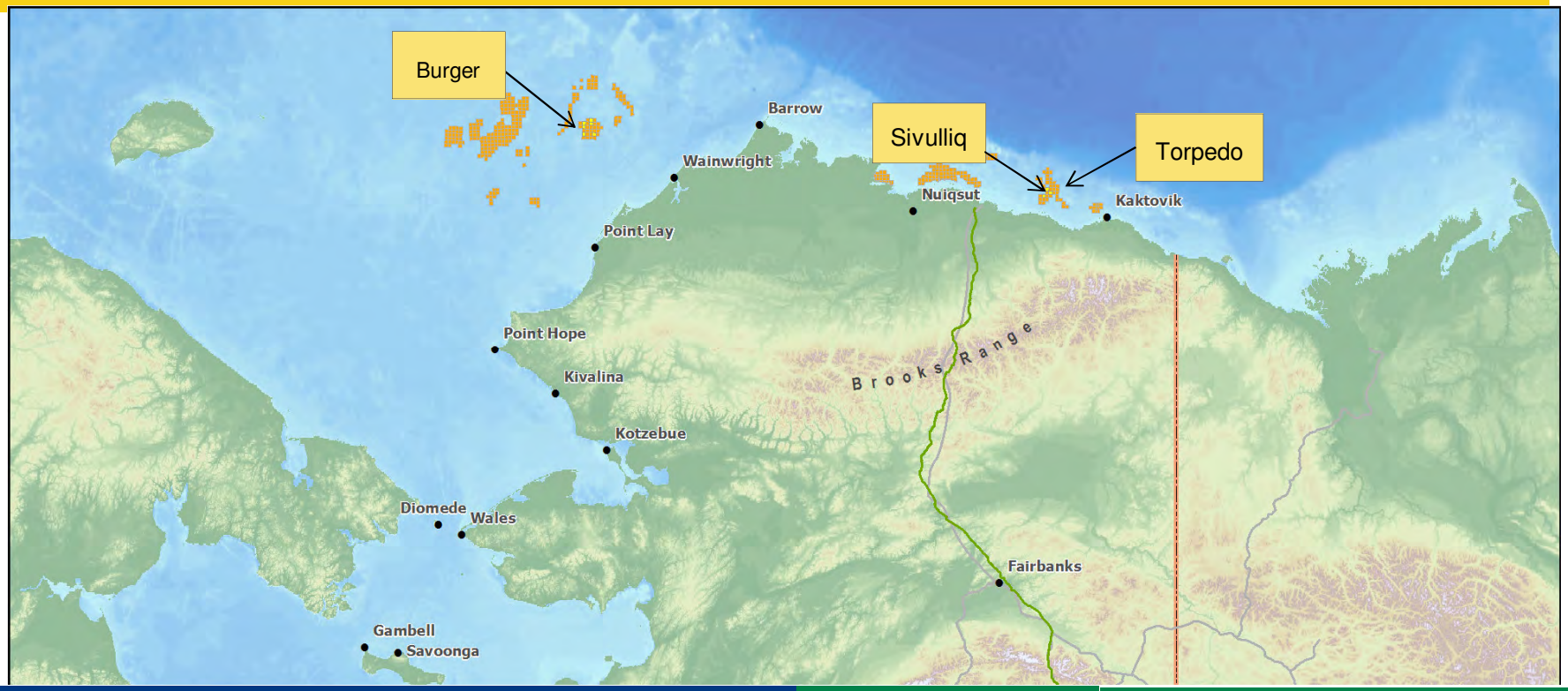
Mitigation Commitments

- Plan of Cooperation
- Beaufort Sea shutdown and remove drilling rig assets by midnight August 25
- Beaufort Sea Captured Discharge:
  - Drilling fluids
  - Cuttings after 20” casing
  - Treated sanitary and gray water
  - Ballast and bilge water
- Communication Plan for avoiding conflicts with subsistence users
- Collaboration and Communication with Whaling Associations, AEWC, Walrus, Nanuq, Beluga, and Seal Commissions
- No transiting without communicating
- Commitment to hire Subsistence Advisors
- Marine Mammal Observers on all vessels
- Robust Marine Mammal Monitoring Protocol

Mitigation Commitments

- Capping stack and Arctic Containment System
- Real time Ice and Weather Forecasting
- Crew change by helicopter and collaboration on routes to and from operations
- Barrow, Deadhorse, and Wainwright shore bases
- Full OSR capabilities for each sea
- Second rig relief well capability

Shell's 2012 Drilling Program



Community	Mitigation Measures
Barrow	Com Center, SA (Subsistence Advisor), CLO (Community Liaison Officer), transit offshore
Kaktovik	Com Center, SA, CLO, cease program 8/25 until after bowhead whale hunt, crew change by helicopter sensitive to subsistence hunting
Nuiqsut	Com Center, SA, CLO, cease program 8/25 until after bowhead whale hunt, zero discharge at Camden Bay well-sites
Wainwright	Com Center, SA, CLO

Community	Mitigation Measures
Point Hope	Com Center, SA, CLO
Point Lay	Com Center, SA, CLO, sensitivity to beluga hunt
Kivalina & Kotzebue	Com Center, CLO, SA, sensitivity to beluga hunt
St. Lawrence Island	Com Center, SA
Wales	Com Center, SA
Diomede	SA

Plan of Cooperation Meetings

2011 Village meetings:

- Kaktovik
- Nuiqsut
- Barrow
- Wainwright
- Point Lay
- Point Hope
- Kivalina
- Kotzebue
- Kiana
- Shishmaref
- Gambell
- Savoonga

2012 Village meeting plans:

- Kaktovik
- Nuiqsut
- Barrow
- Wainwright
- Point Lay
- Point Hope
- Atqasuk
- Anaktuvuk Pass
- Kivalina
- Kotzebue
- Wales
- Gambell
- Savoonga

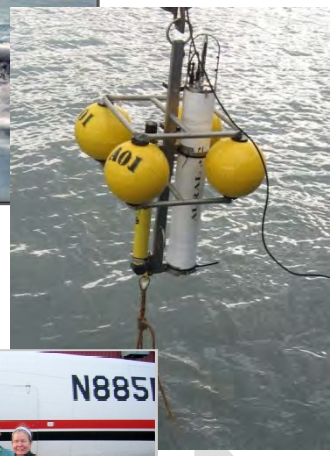
Questions
&
Discussion

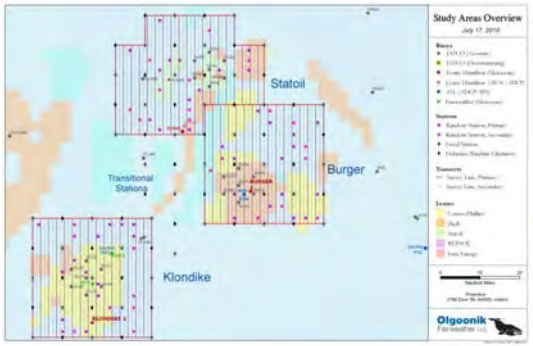
Science and Monitoring Program Overview

Alaska Venture Science Studies Program

Monitoring

- Permit driven (compliance)
- Marine Mammal MP
- Threatened & Endangered
- Air



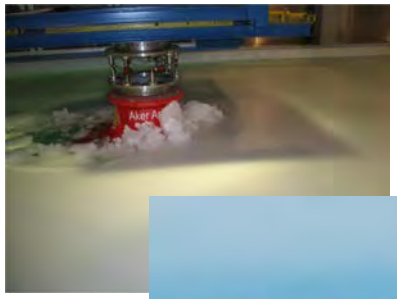


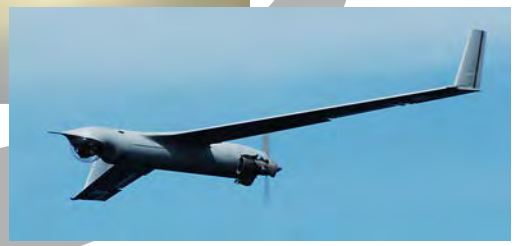
Baseline studies

- Provides basis for project design
- Identifies issues
- Fills data gaps
- Provides basis for NEPA documents (EIS)
- Ecological
- Ice/weather
- Ice gouge / streudel scour / soil testing
- Traditional knowledge

Engineering & Technology

- Enabling both E & P
- Unmanned aerial
- Autonomous underwater
- On-ice seismic
- Sound mitigation
- Ice forces



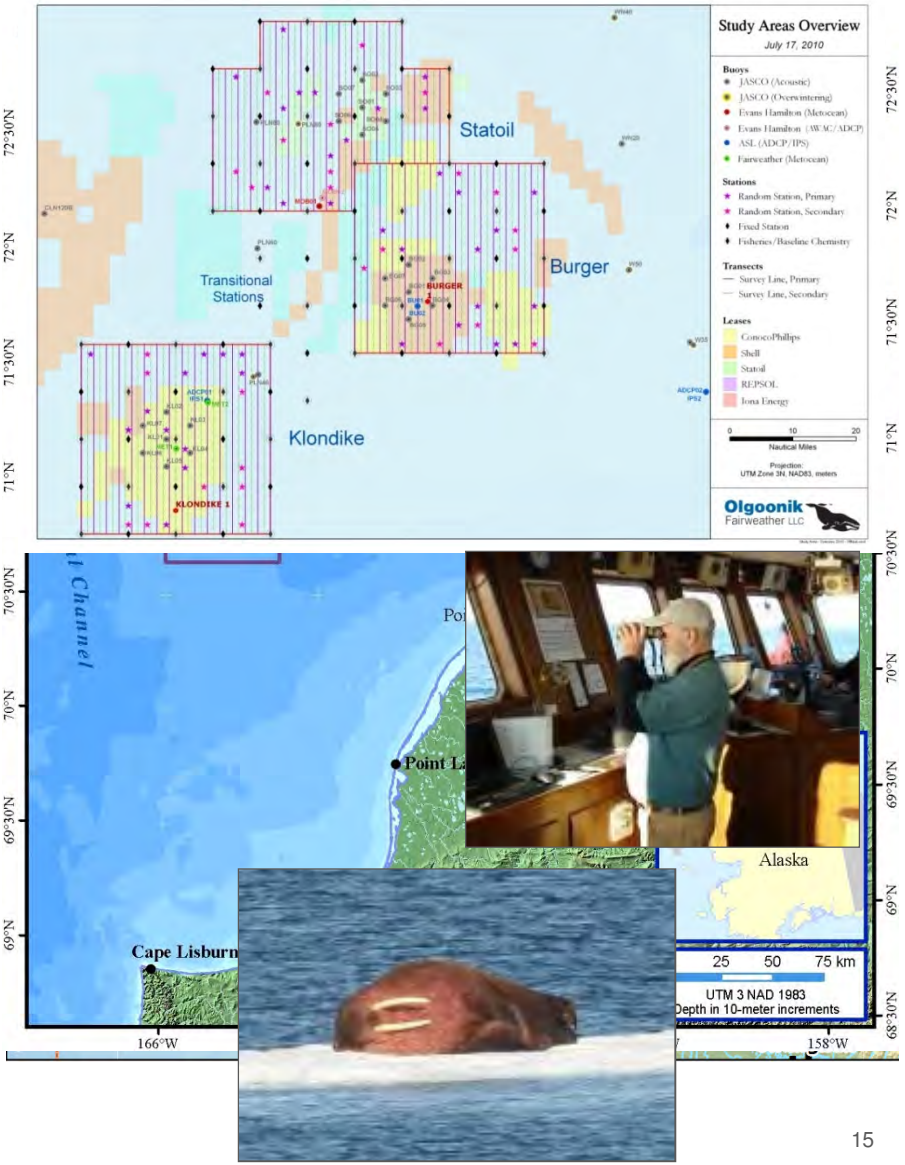


Alaska OCS Science Collaboration

- Majority of Shell science is through collaboration
  - ConocoPhillips key along with Statoil, GXT, Pioneer, & ENI
  - Universities (UAF, UT, UMD) and Government including USGS, BOEM, NOAA
  - Research entities including NFWF, Northern Forum, SINTEF
- 60 % of Shell Alaska science is leveraged
- Shell - North Slope Borough Science Agreement to fund local community directed priorities w/ $5 million/5 years
- Shell/ConocoPhillips/Statoil – NOAA agreement on sharing scientific studies data and ice and weather monitoring/forecasting

Chukchi Sea Lease Areas and Baseline Studies

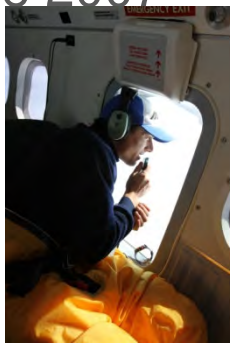
- Jointly funded by ConocoPhillips & Statoil
- Operated by native corporation
- Three areas of top priority
- Subject to intensive interdisciplinary study each year since 2008
  - Physical oceanography
  - Benthos
  - Plankton
  - Acoustics
  - Fishes
  - Marine Mammals
  - Marine Birds

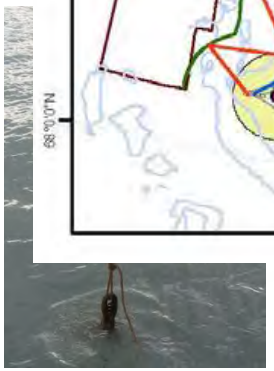


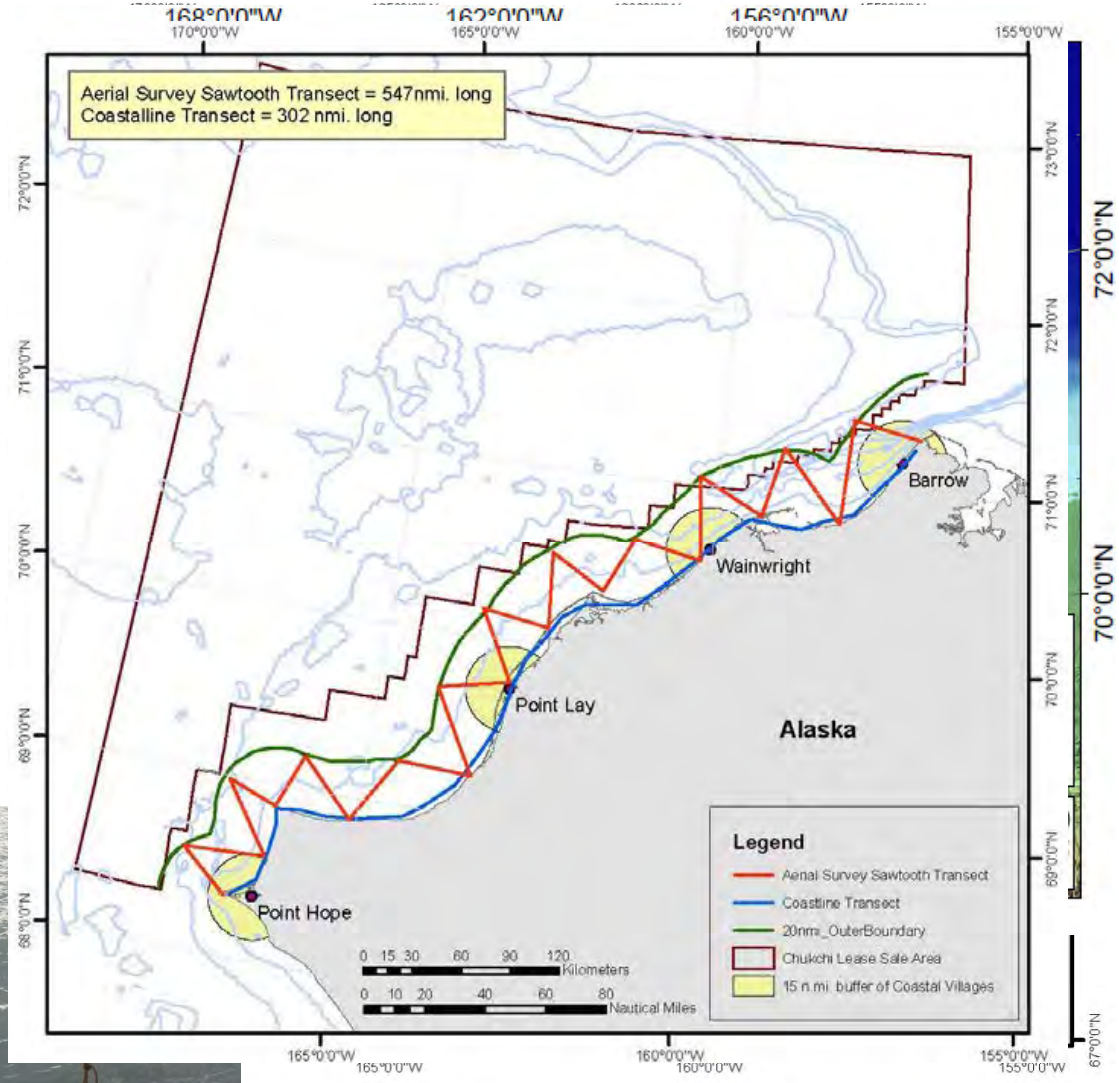
Marine Mammal Observations

Triad of Information

- Vessel based observations
  - MMOs on every vessel
  - Integrated biologist/local knowledge staff
- Aerial observations
- Acoustics
  - Open water since 2006
  - Year around since 2007

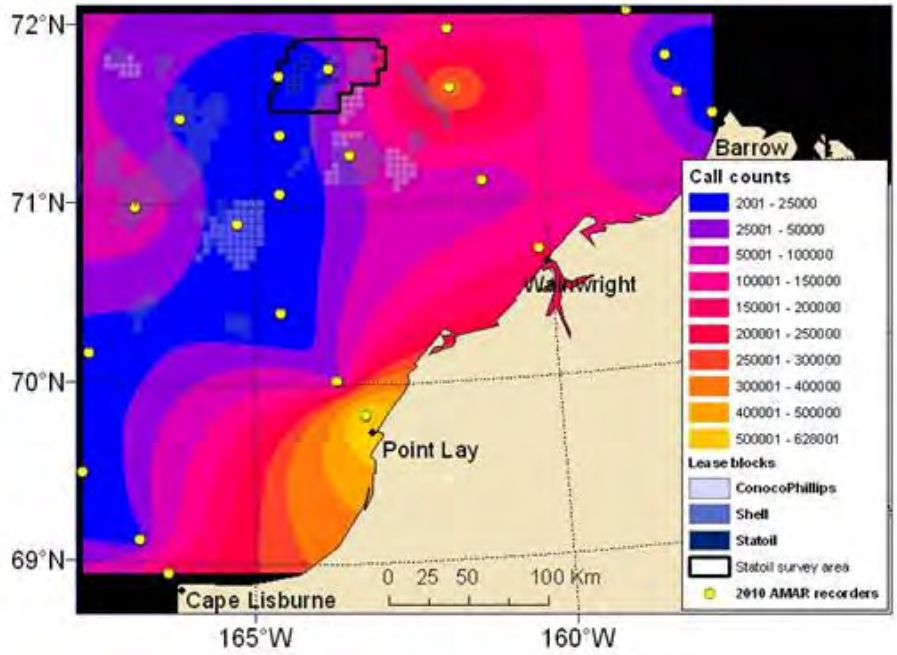


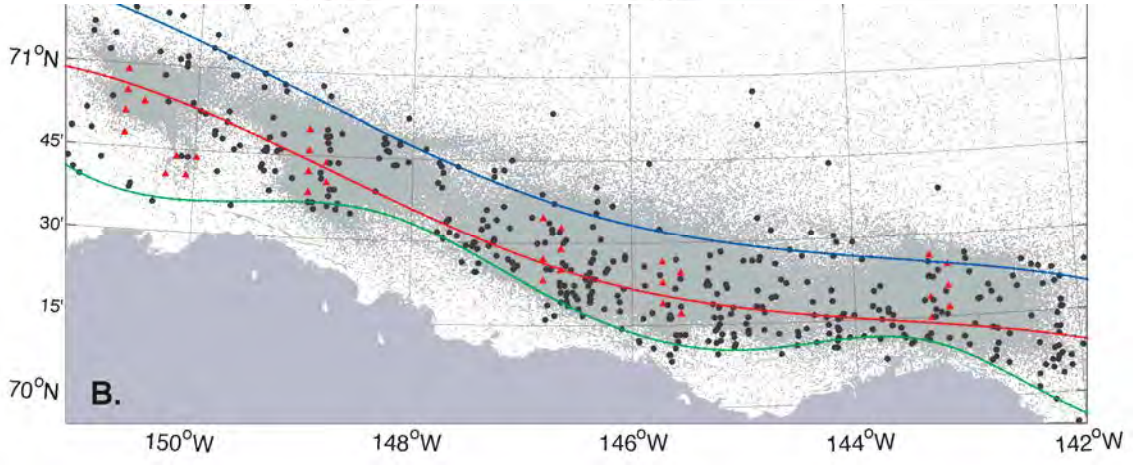




Acoustics – Regional arrays

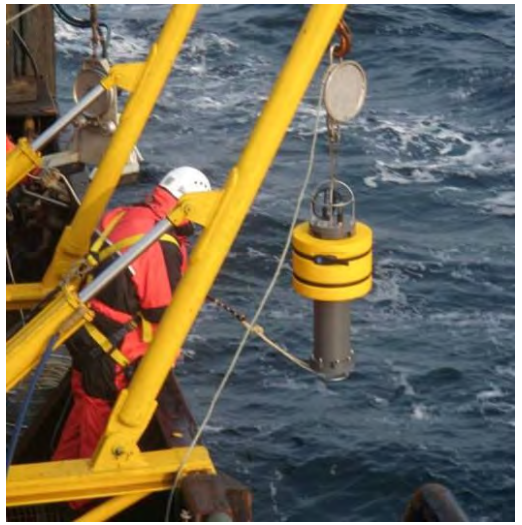
- Acoustic recorders deployed in the Chukchi & Beaufort
- Localization capability in Beaufort
- Goals
  - Understand effects of industry sound on the distribution and behavior of marine mammals.
  - Understand patterns of distribution and movement

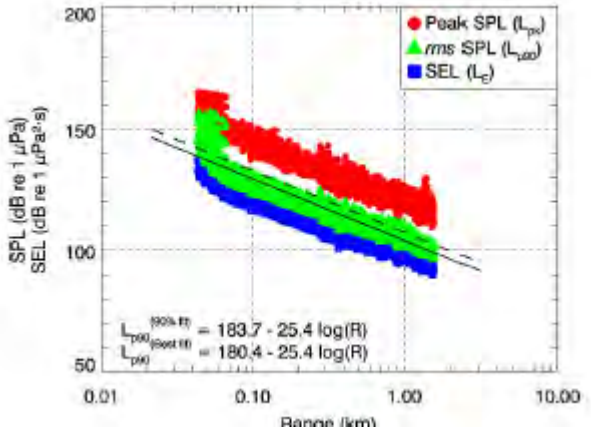




Acoustics – Sound Source Characterization

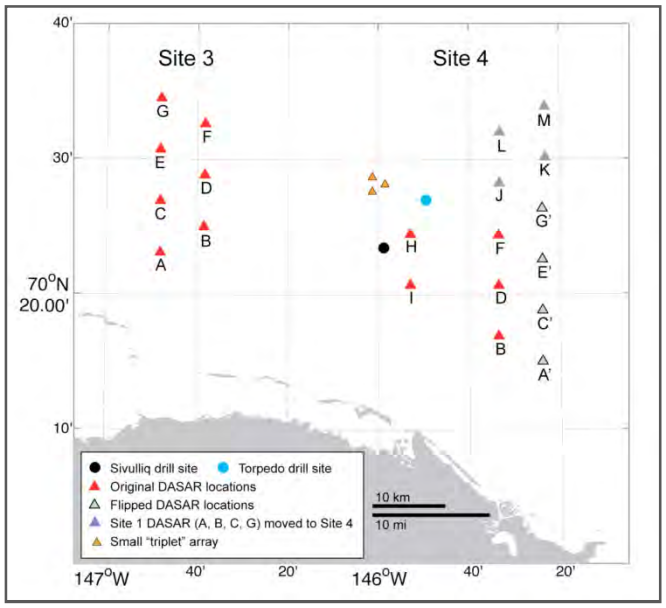
- SSC conducted on all vessels unless previously assessed at location
- Vessel SSCs at initiation of activities
- Rolling SSC for drilling
  - Real time evaluation
  - Weekly reporting

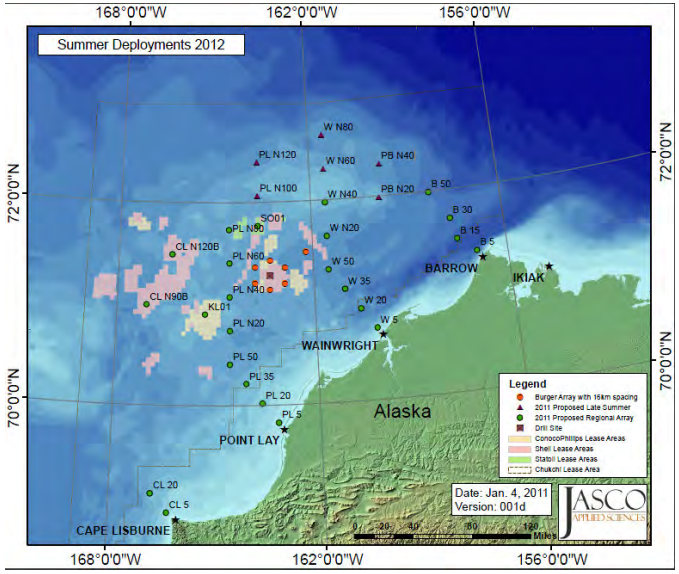




Acoustics – Site specific arrays

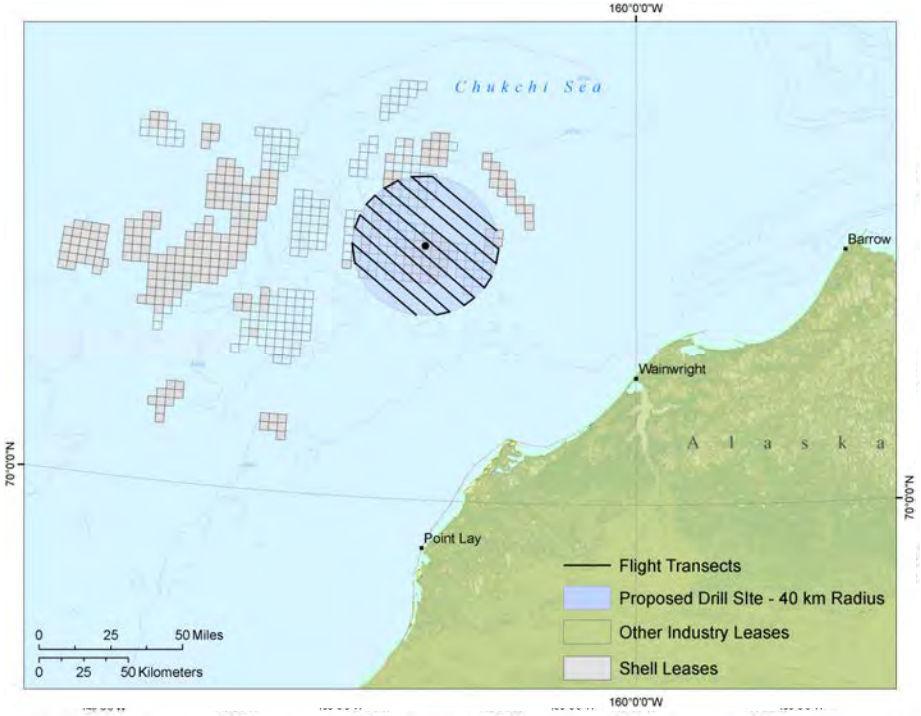
- Monitor and evaluate drilling related sound levels
- Collect distribution and movement information through call data
- Based upon learnings since 2006
  - Masking
  - Localization
  - Calling behavior
- Need input on final plan

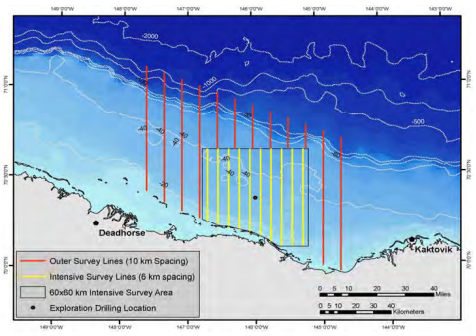


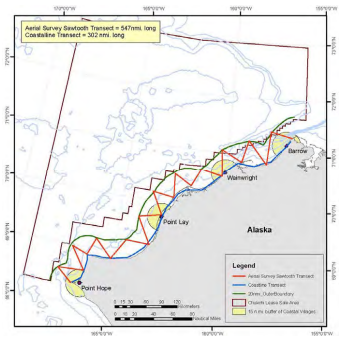


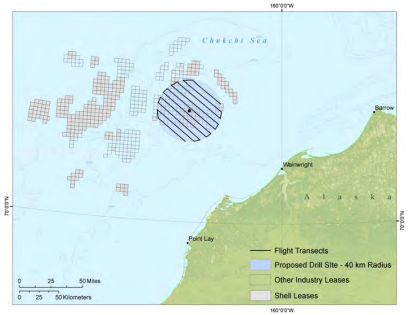
Aerial Program

- Offshore overflights in the Beaufort
  - Manned flights w/ photography
  - Stratified sampling strategy
- Chukchi nearshore
  - Sawtooth pattern
  - Manned flights w/ photography
- Chukchi Burger prospect
  - Photographic survey
  - Manned aircraft
  - No MMOs







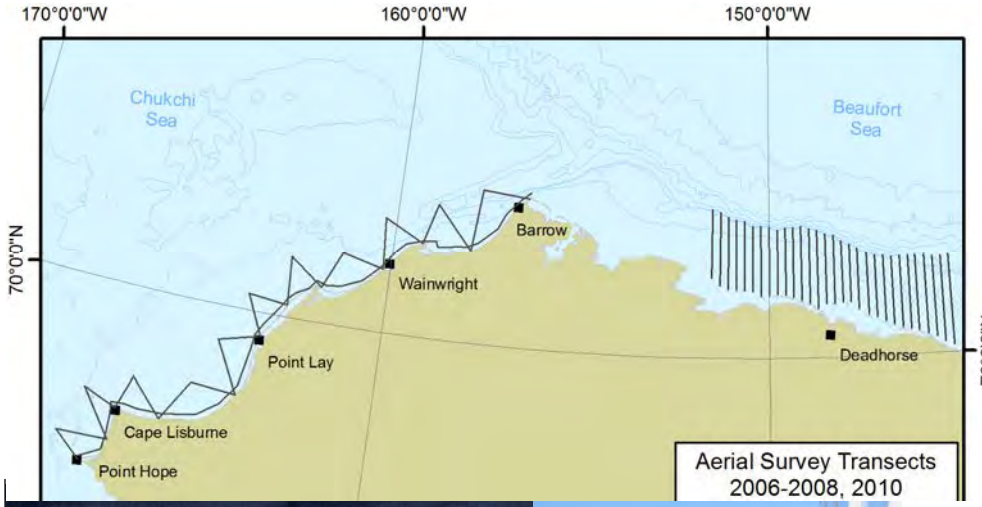


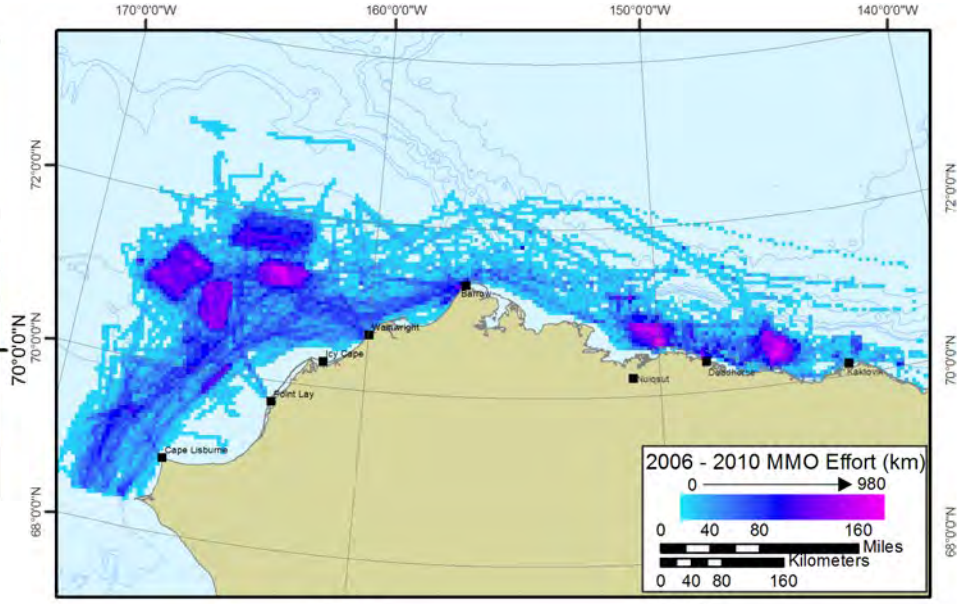
Drilling Monitoring

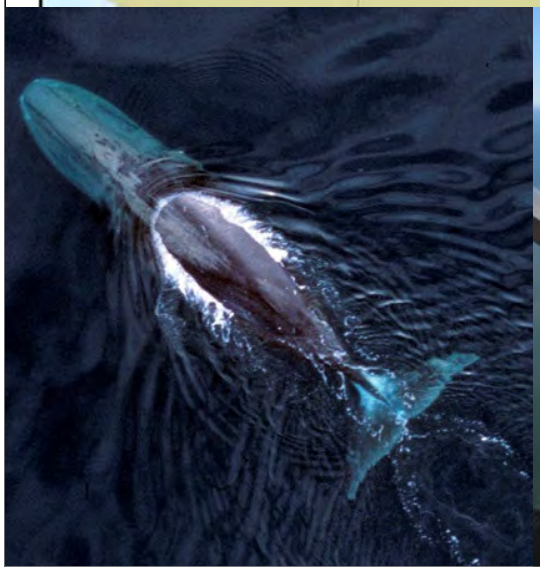
- Before
  - Sediment/water chemistry
  - Biota community assessment
  - Repetition of Joint studies evaluations localized at drill site(s)
- During
  - Plume monitoring – turbidity, chemistry
  - Deposition
  - Water chemistry
- After
  - Sediment/water chemistry
  - Biota Community assessment
  - Bioaccumulation

Questions
&
Discussion

Shell 2012 MMO Program: Capturing Past Recommendations from NMFS and Local Stakeholders



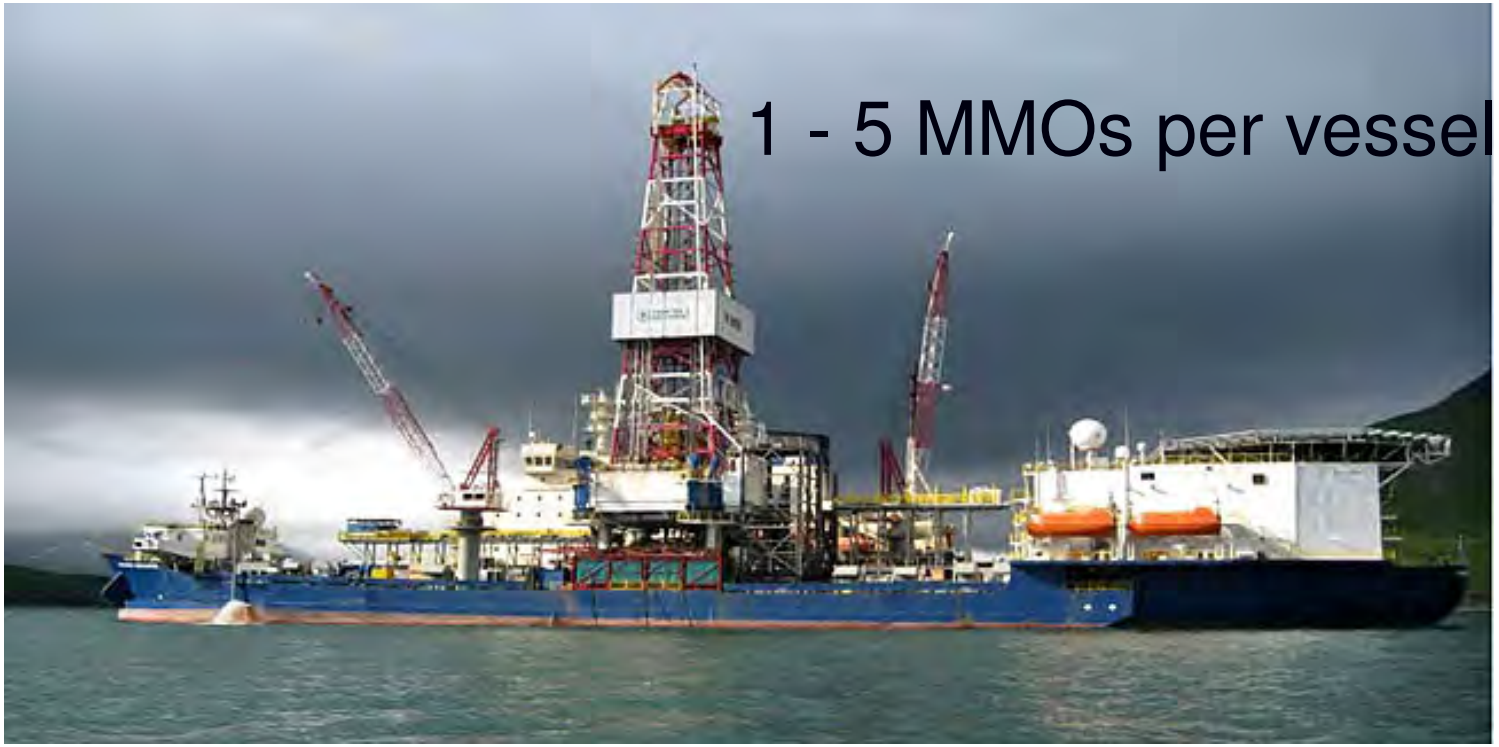




MMO Platforms:

- Aerial ($n = 2$)
- Vessel ($n = 18$)

~58 MMOs in the field

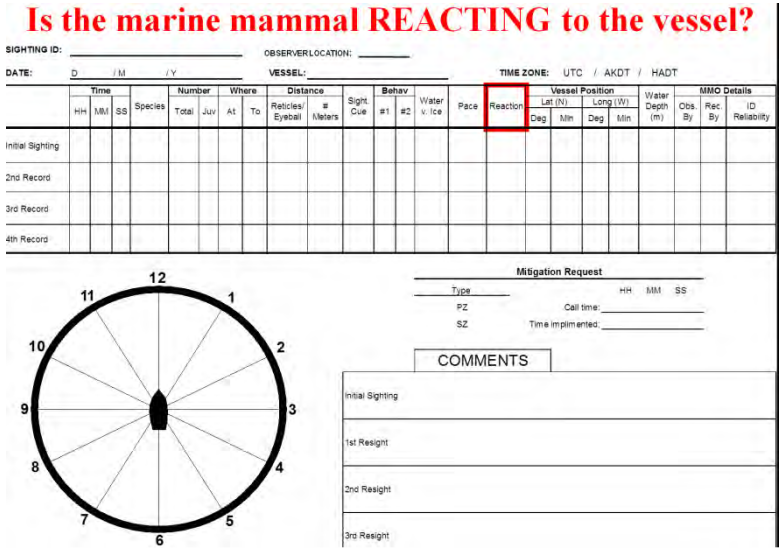


"Qualified MMOs are key elements of successful monitoring and mitigation efforts…" NMFS Expert Panel, 2010

- MMOs on ALL Project Vessels plus 2 Aircraft
- Qualified Alaska Natives and Professional Biologists trained together through extensive use of visual aids over course of 3 days:
  - Emphasis on ID, Regulatory Context, Sighting/Mitigation Scenarios
  - Performance-based assessments/exams
  - Recruiting from N. Slope and NANA region
- Maximize eyes on water in areas relevant to mitigation
- Appropriate use of Big Eyes + low-powered optics and naked-eye search patterns

Additional NMFS Expert Panel Recommendations within Shell's 2012 MMO Program

- MMOs stationed in areas that maximize viewing (e.g., bridge)
- Importance of 'unidentified' ID stressed, focus on what was/was not observed and record in detail in comments
- Improved real-time data recording into computer, including ability to geo-reference sightings for operational context
- Daily correspondence with shore-based support, data reports
- Debriefs following shift/season


Is the marine mammal REACTING to the vessel?

SIGHTING ID: _____ OBSERVER LOCATION: _____

DATE: D / M / Y VESSEL: _____ TIME ZONE: UTC / AKDT / HADT

	Time			Species	Number		Where	Distance		Sight. Cue	Behav		Water v. Ice	Pace	Reaction	Vessel Position				Water Depth (m)	MMO Details		
	HH	MM	SS		Total	Juv	At To	Reticles/ Eyeball	# Meters		#1	#2				Lat (N) Deg	Lat (N) Min	Long (W) Deg	Long (W) Min		Obs. By	Rec. By	ID Reliability
Initial Sighting																							
2nd Record																							
3rd Record																							
4th Record																							

Mitigation Request

Type HH MM SS

PZ Call time: _____

SZ Time implimented: _____

COMMENTS

Initial Sighting

1st Resight

2nd Resight

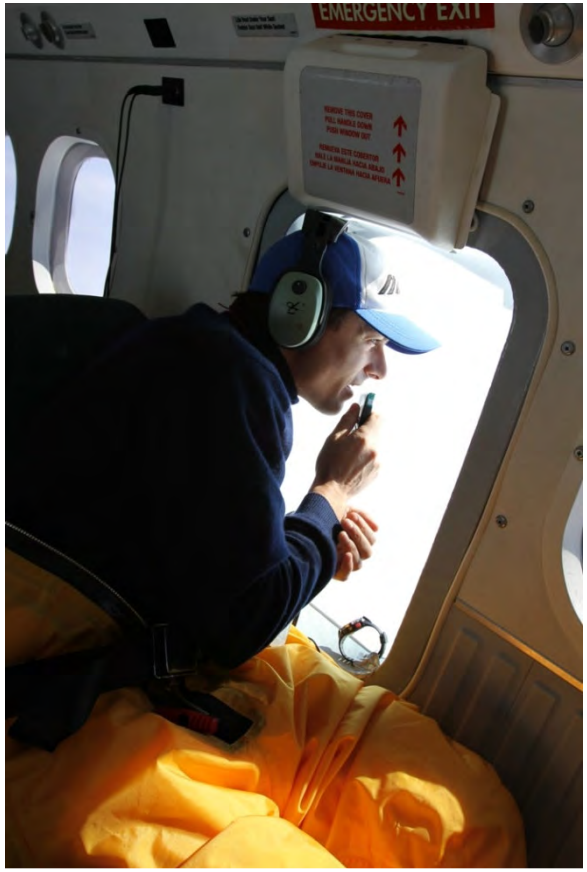
3rd Resight

Additional NMFS Expert Panel Recommendations within Shell's 2012 MMO Program

- Relevant environmental data collected every 30 minutes or when conditions change. Data-analysis criteria to account for detection bias at increasing distance from platform and during periods of poor visibility:
  - Data from periods of favorable conditions used for density / abundance estimates
  - Compare data from periods of drilling vs. non-drilling
- Continued use of night-vision devices (NVDs): drilling and ice-scouting/management activities

Additional NMFS Expert Panel Recommendations within Shell's 2012 MMO Program

- Use of aerial surveys to visually monitor animals at distances greater than can be detected from vessels
  - Aerial MMOs communicate sightings to MMOs on vessels



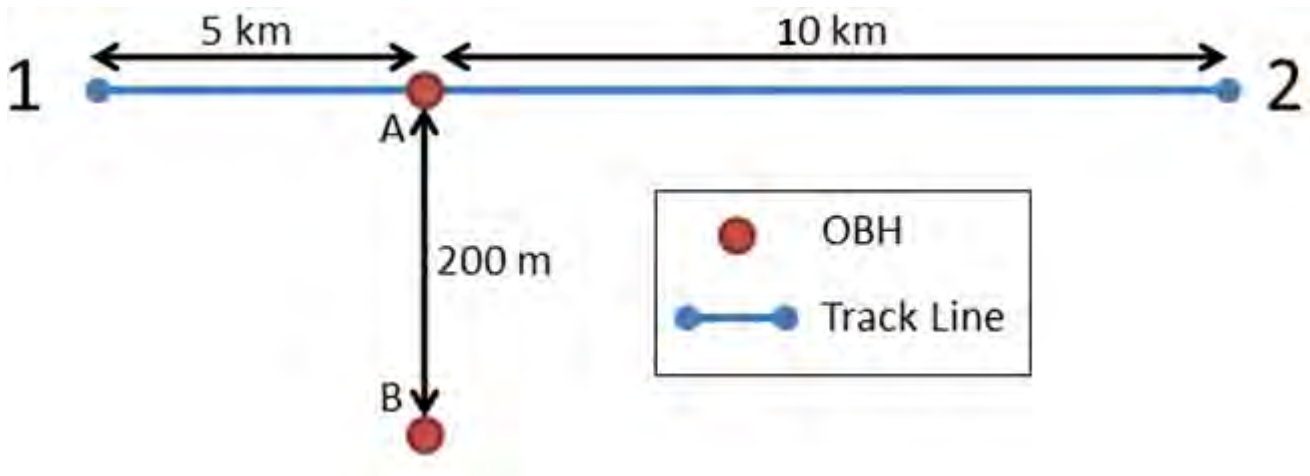
Questions
&
Discussion

Sound Source Characterization Plan

Objectives for Sound Characterization and SSV Measurements

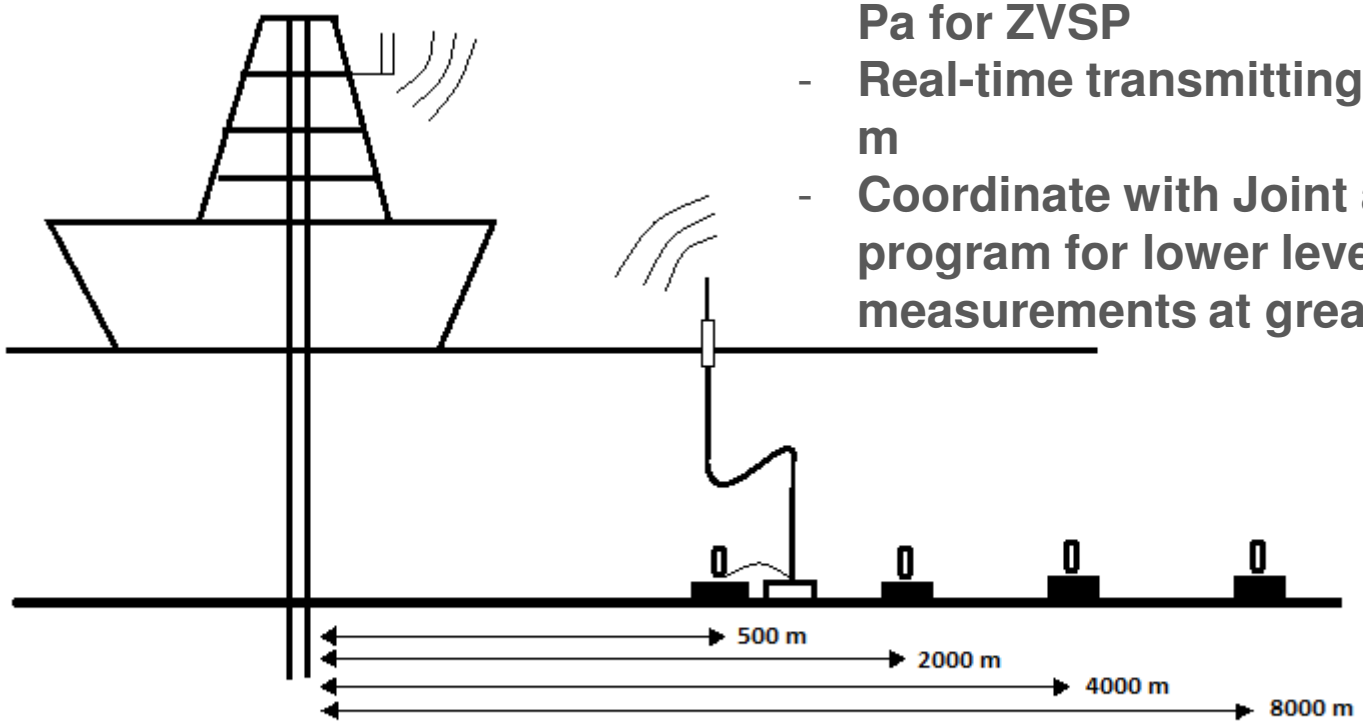
- Quantify industrial underwater sound levels and sound spectra as functions of distance from the drilling program sources
- Determine 1/3-octave band source levels of each industrial noise source
- The purpose of these measurements is to gauge potential impacts on marine fauna (including takes under MMPA), and to provide relevant information for predicting sound levels during similar future operations

Vessel sound characterization approach



- SSC measurements will be made on all vessels that have not previously had sound characterizations
- Most SSC measurements will be performed outside the 25 mi exclusion zone for air permits
- Will make all measurements with a single deployment of recorders as shown above

Drill Rig Acoustic Monitoring and SSV



SSV for drilling and ZVSP

- Monitor at distances corresponding to >120 dB for drilling and for 190 to 160 dB re 1 μ Pa for ZVSP
- Real-time transmitting buoy at 500 m
- Coordinate with Joint acoustics program for lower level ZVSP measurements at greater distances

Objectives for Chukchi Regional Acoustics Monitoring by the Joint Science Program

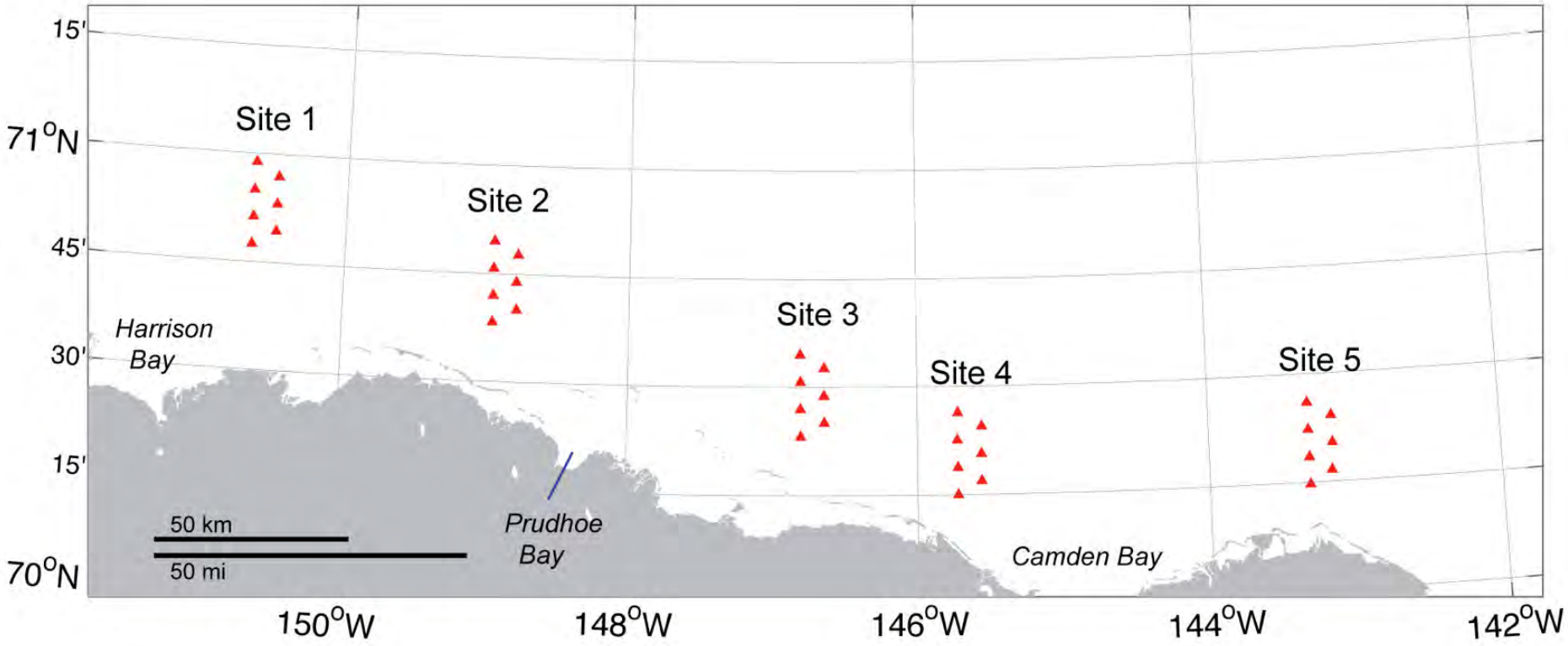
- Measure ambient noise levels over a large area of the northeastern Chukchi Sea
- Measure long-range industrial sound levels from Shell drilling operations, including vessel activities
- Detect marine mammal calls to define spatial and temporal distributions
- Investigate possible changes to vocal behavior due to the presence of industrial noise

Questions
&
Discussion

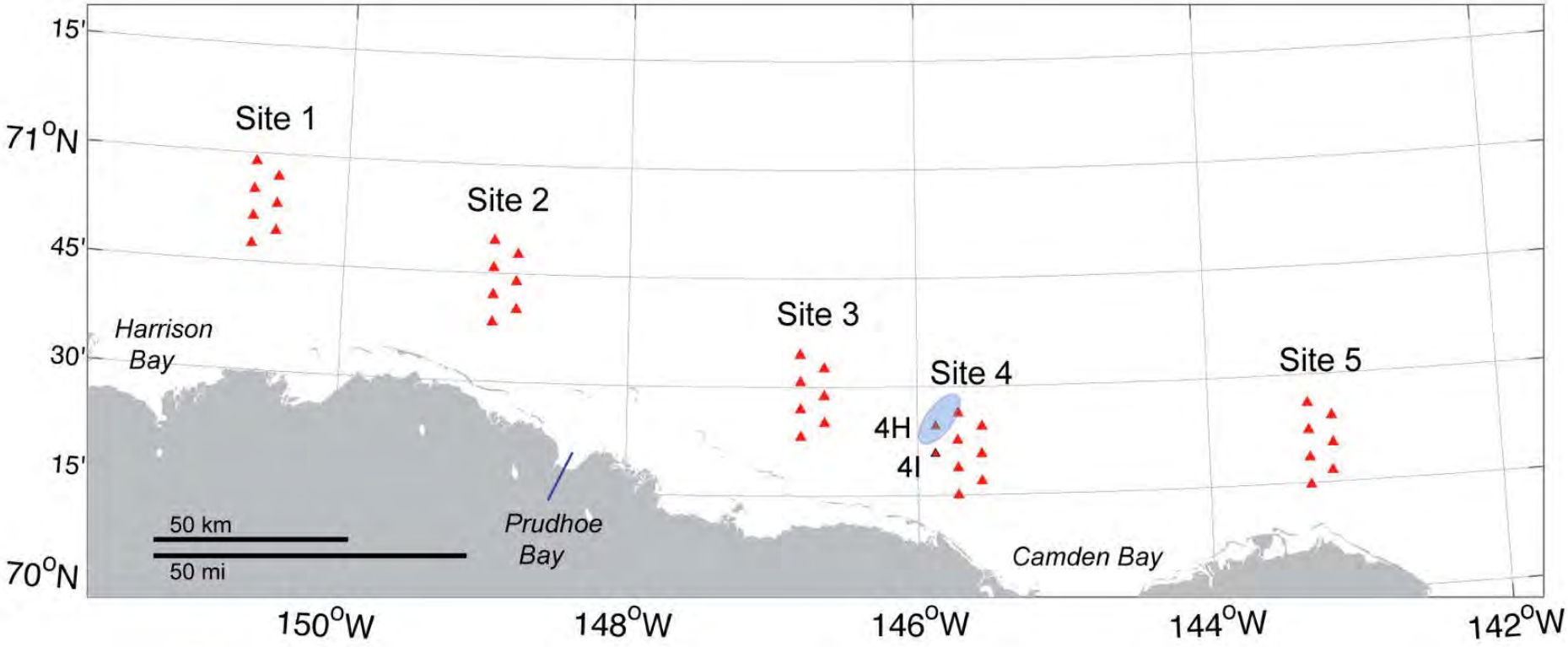
Beaufort Regional Acoustics Program

Beaufort Sea Acoustic Monitoring

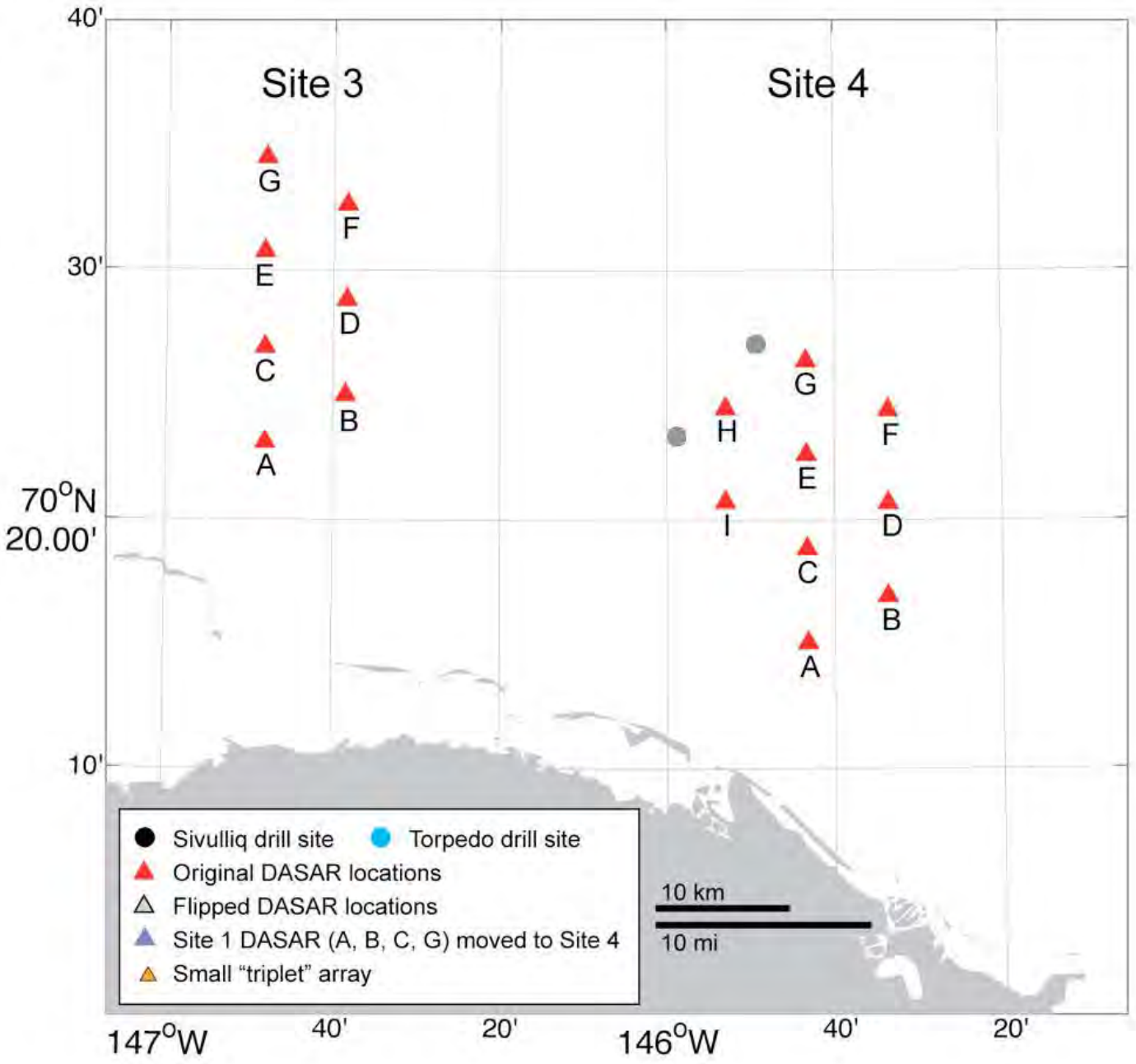
Deployment locations since 2007:



Two DASARs added in 2010 and 2011 to gather background levels near the future drilling locations:



Suggested 2012 deployments near sites 3 and 4:



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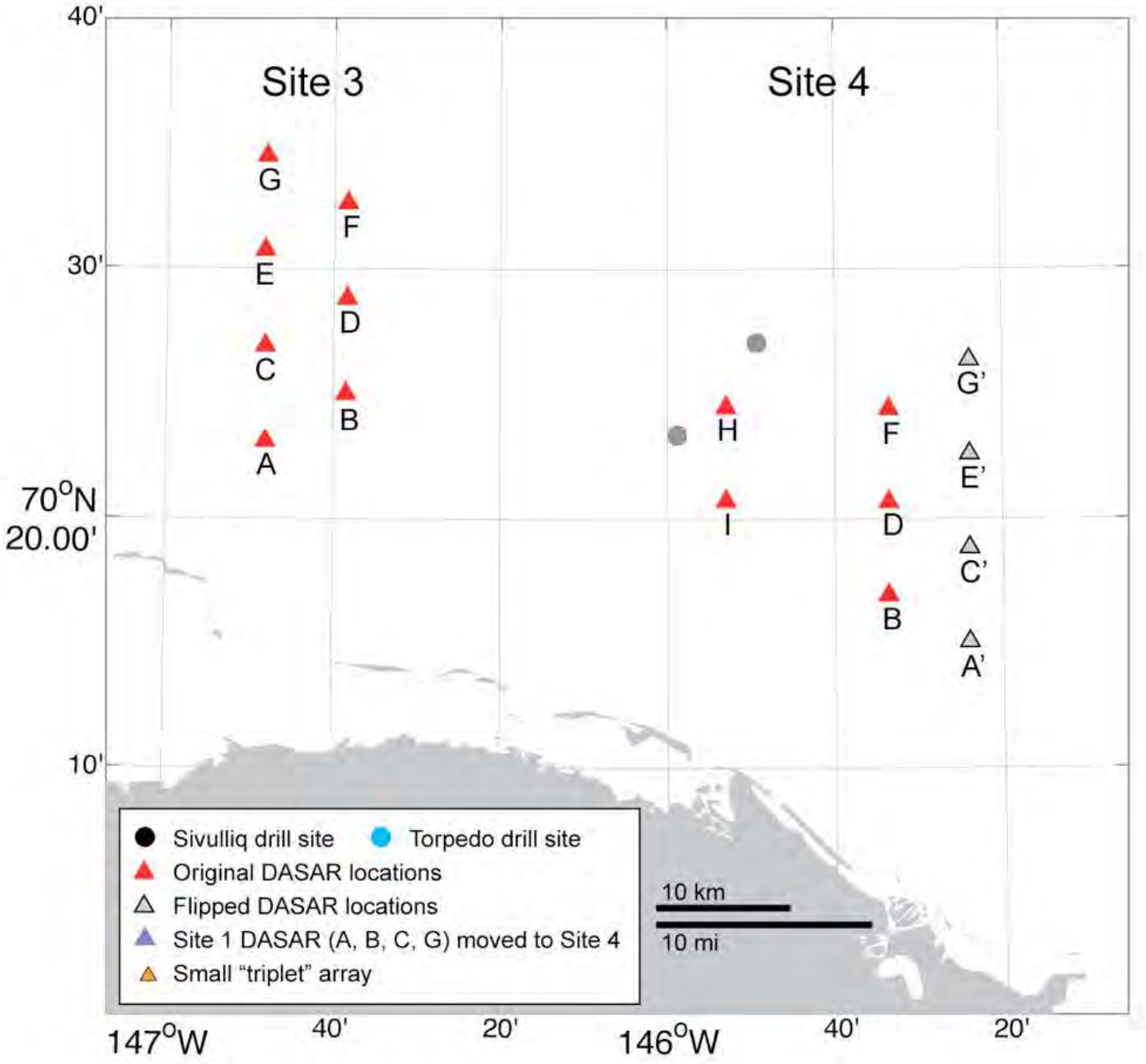

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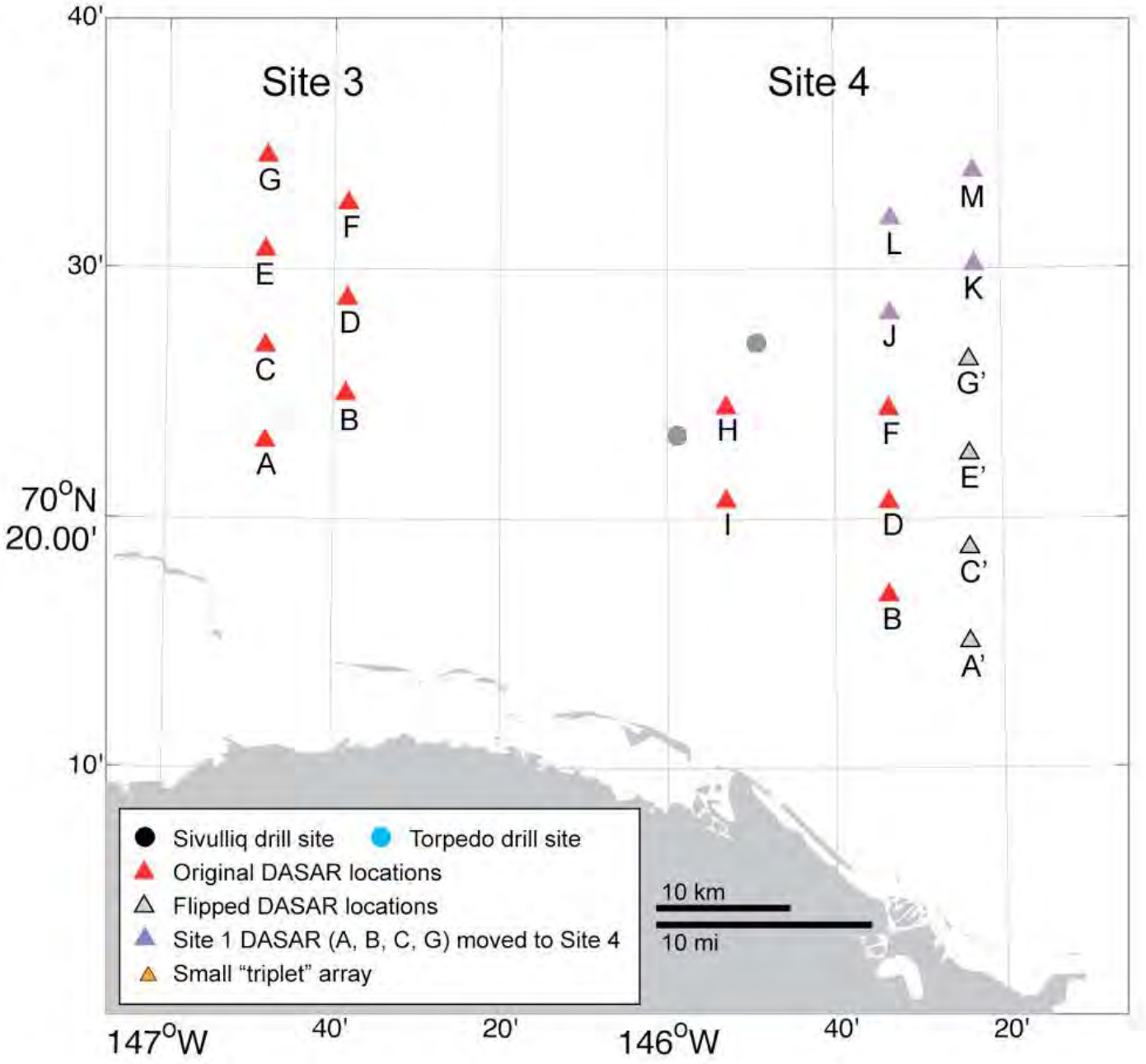

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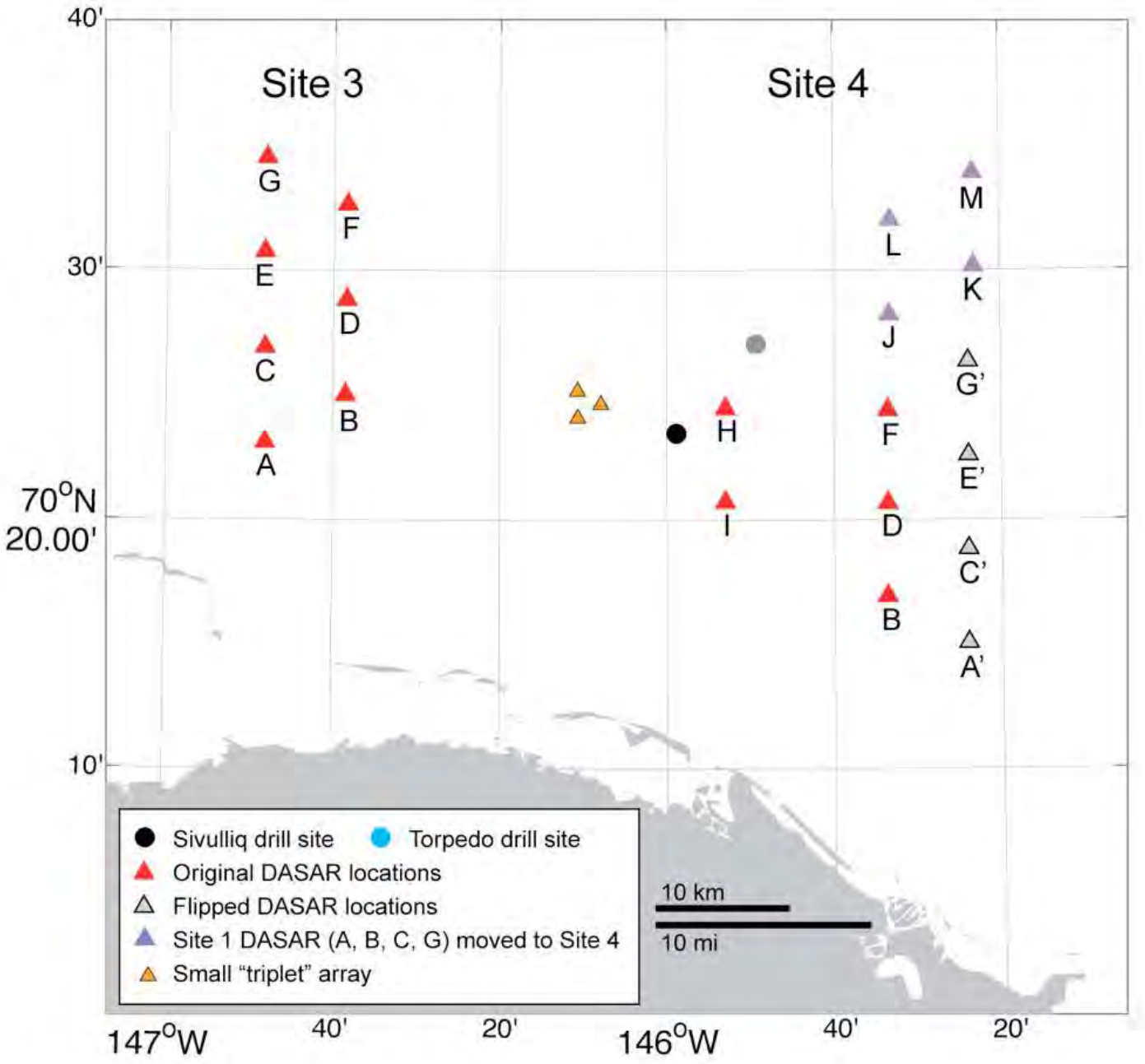

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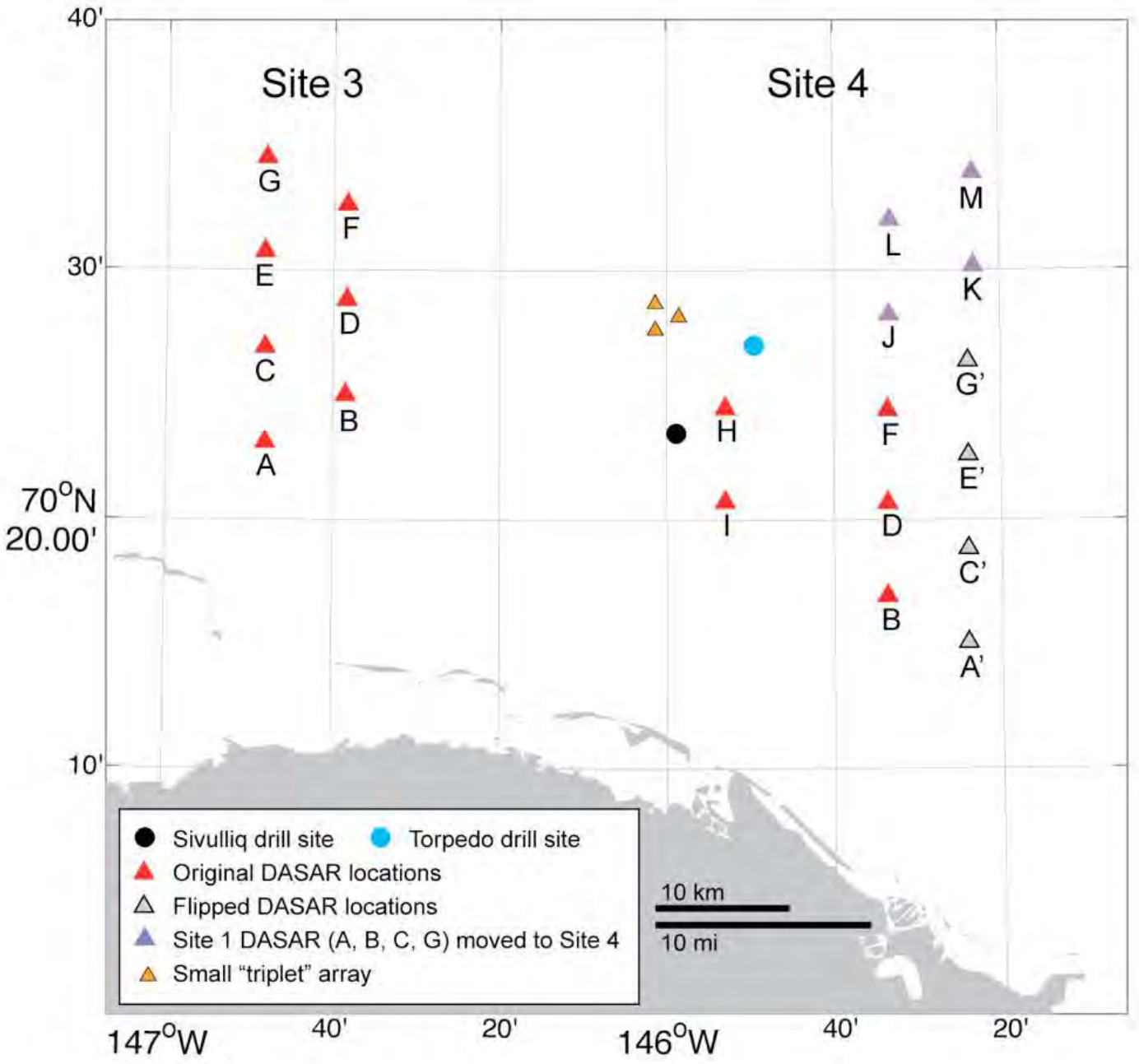
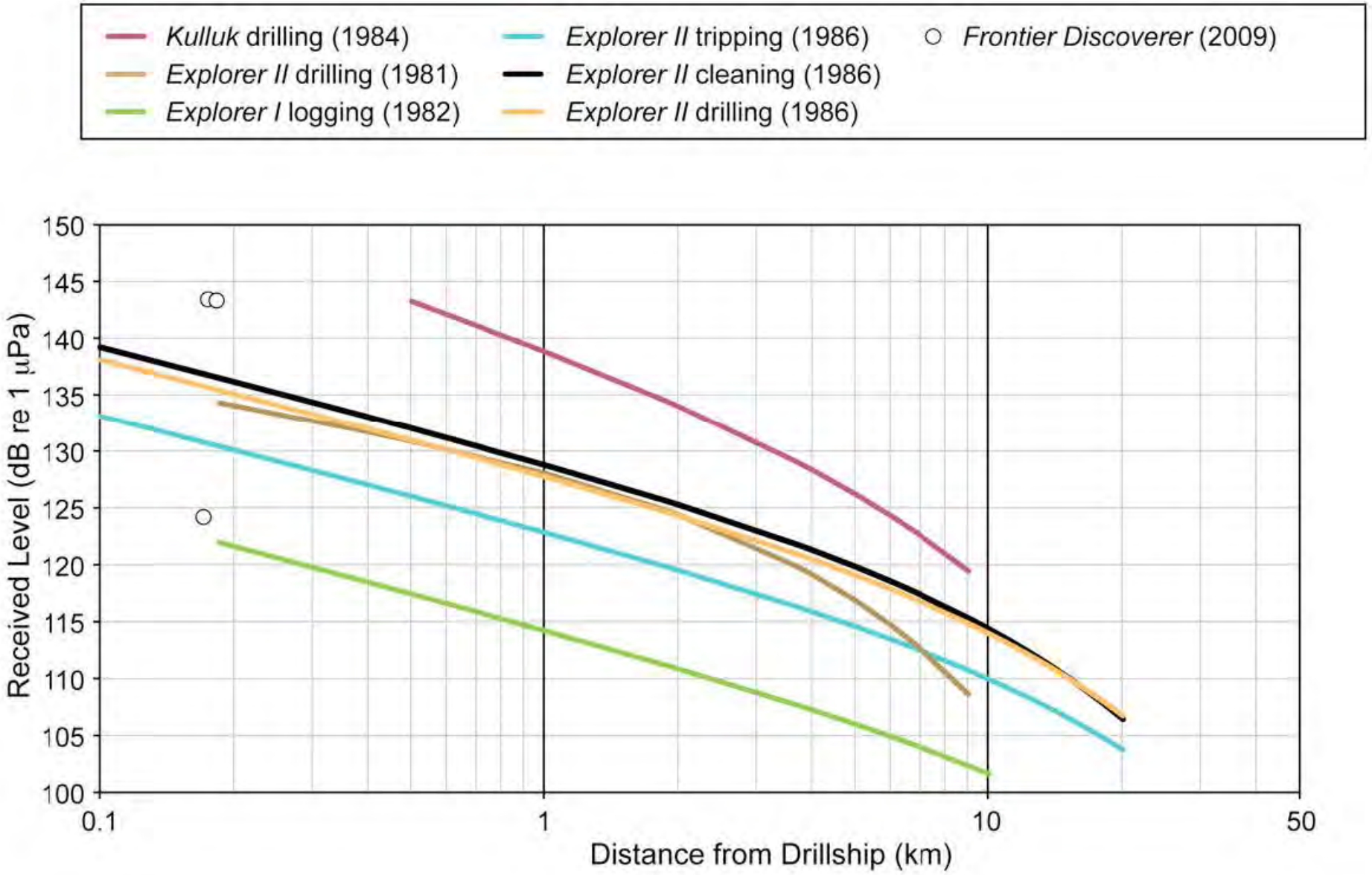
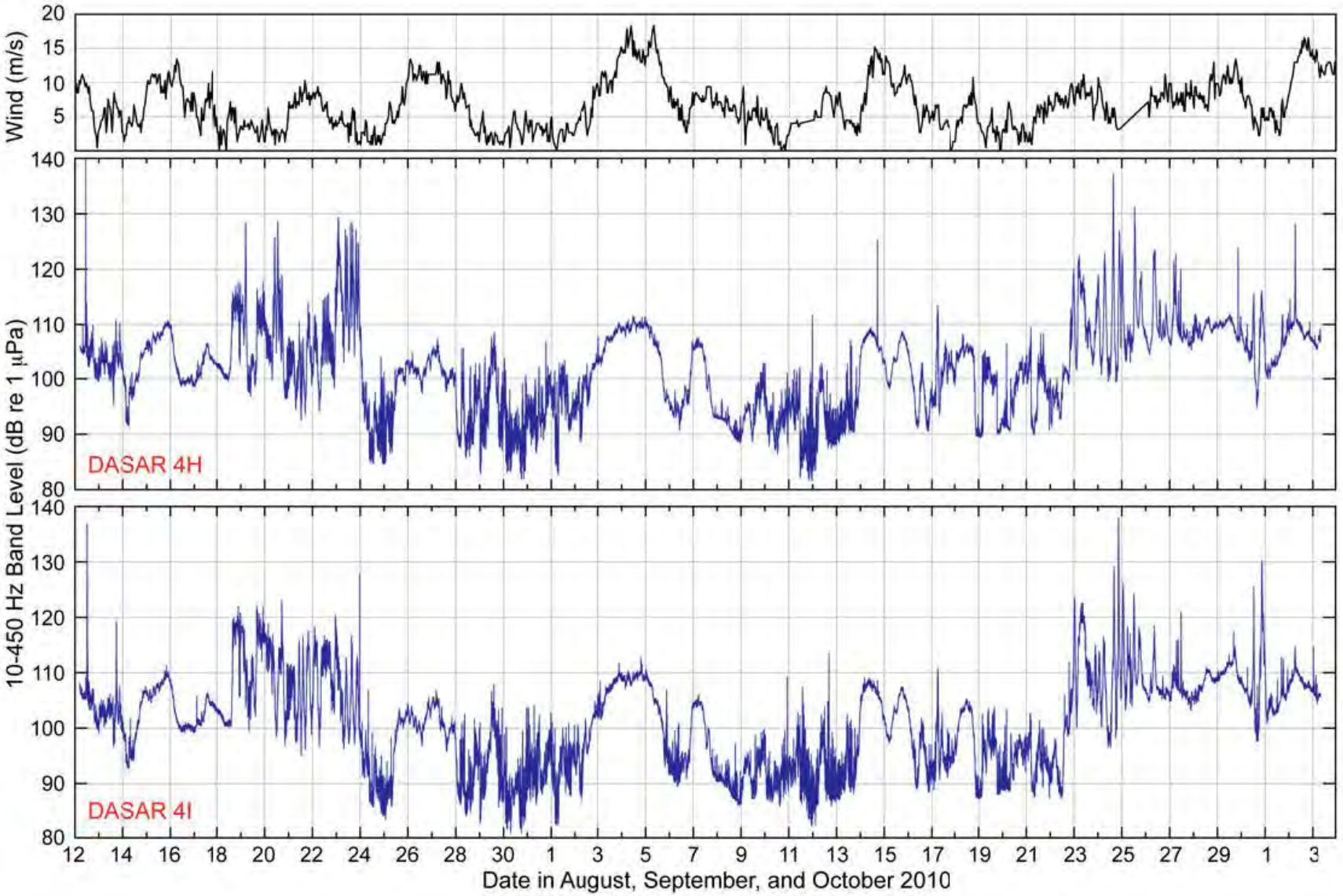


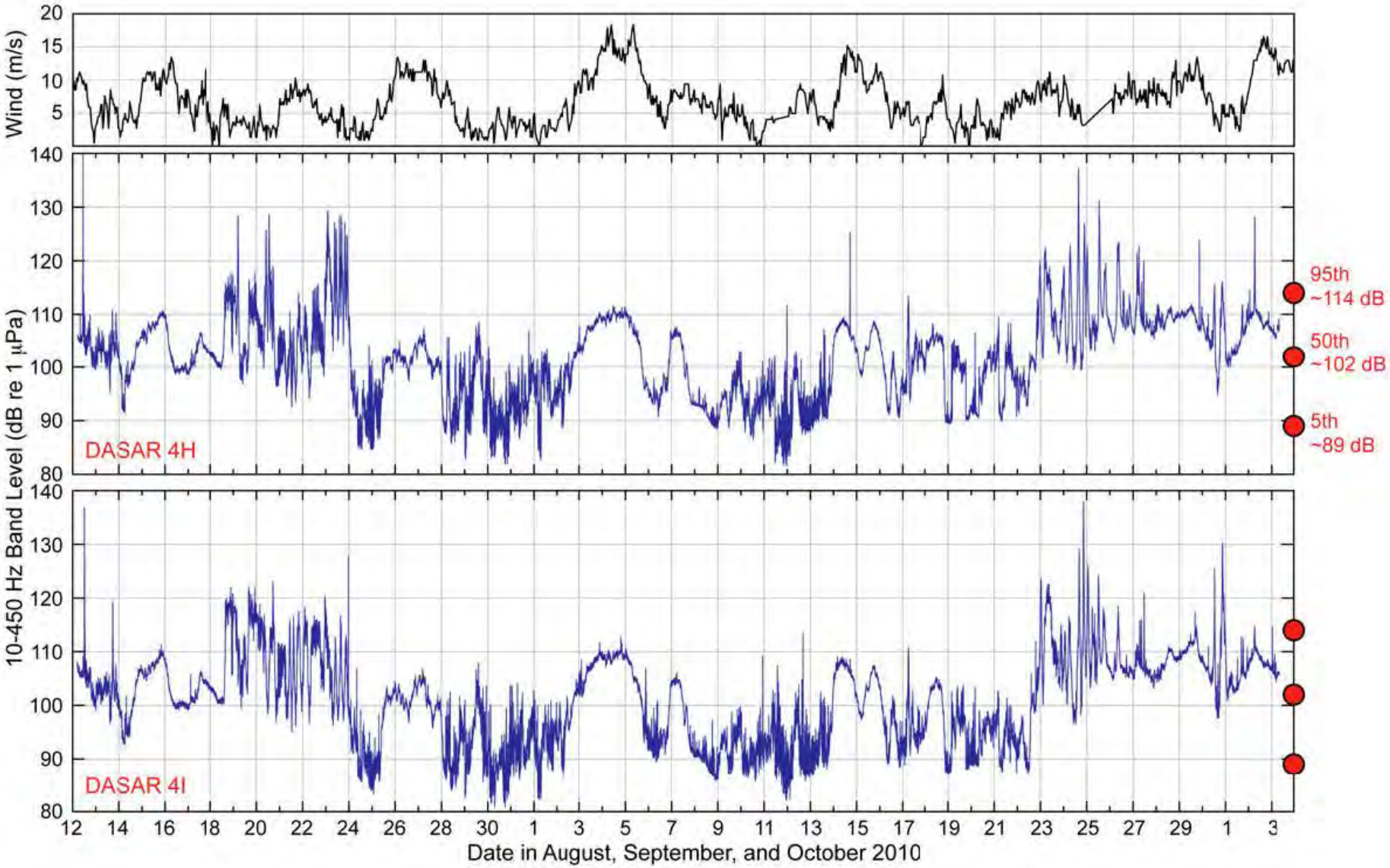
Drillship sounds from previous measurements:



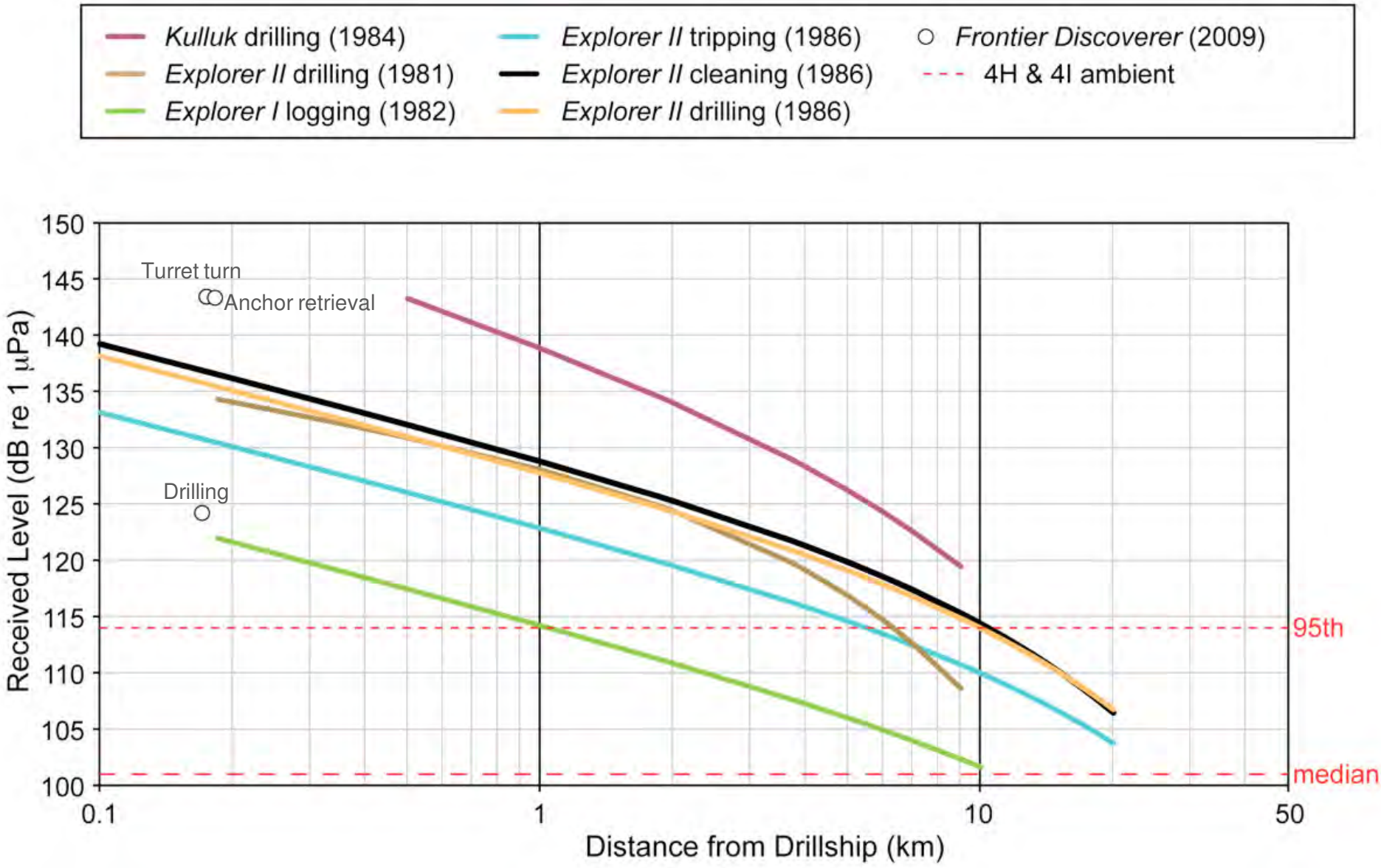
Broadband (10-450 Hz) levels at DASARs 4H and 4I in 2010:



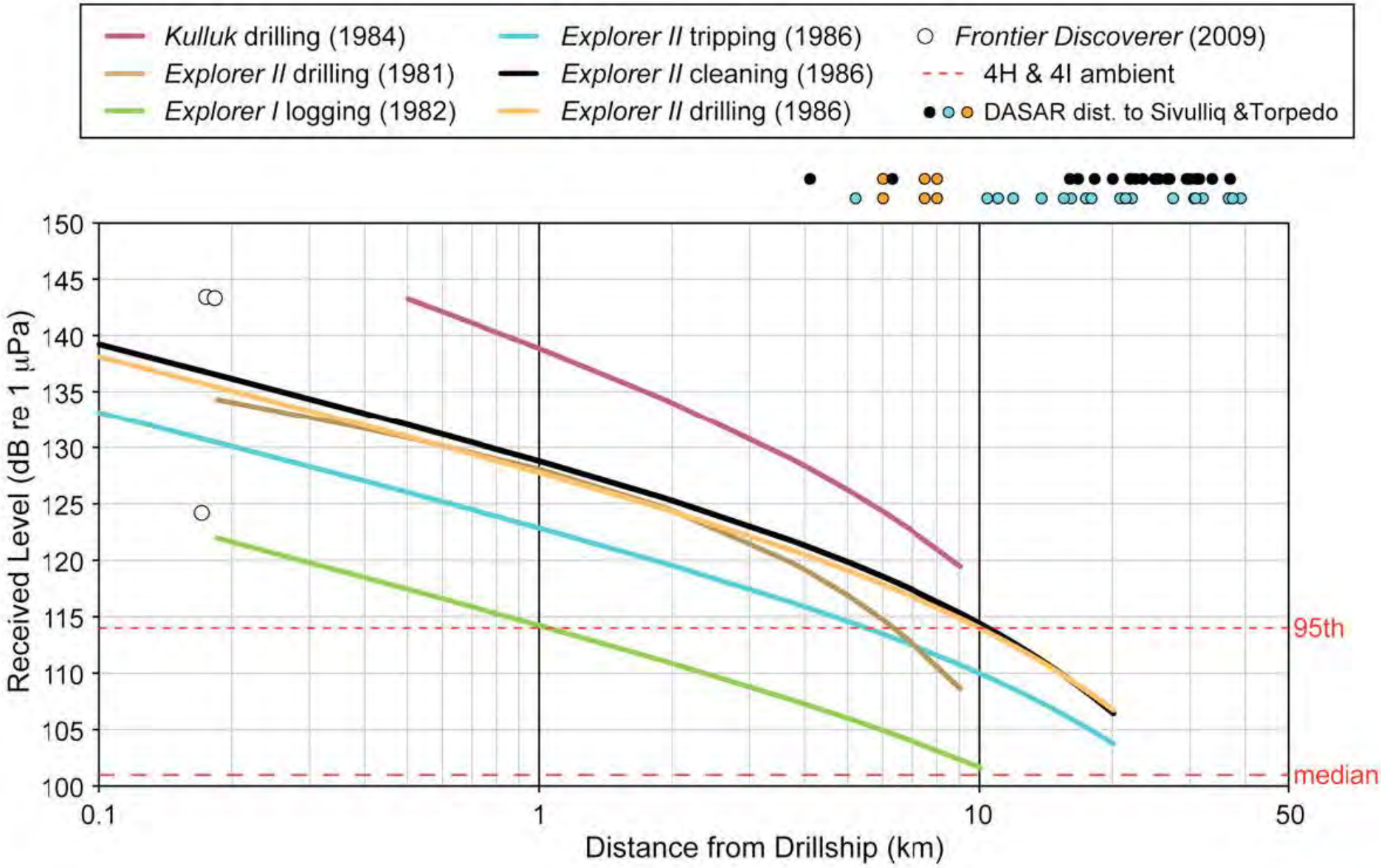
Broadband (10-450 Hz) levels at DASARs 4H and 4I in 2010:



Adding in ambient sound levels as recorded at 4H and 4I in 2010:



Adding in distances from drillships to S3 & S4 DASARs:

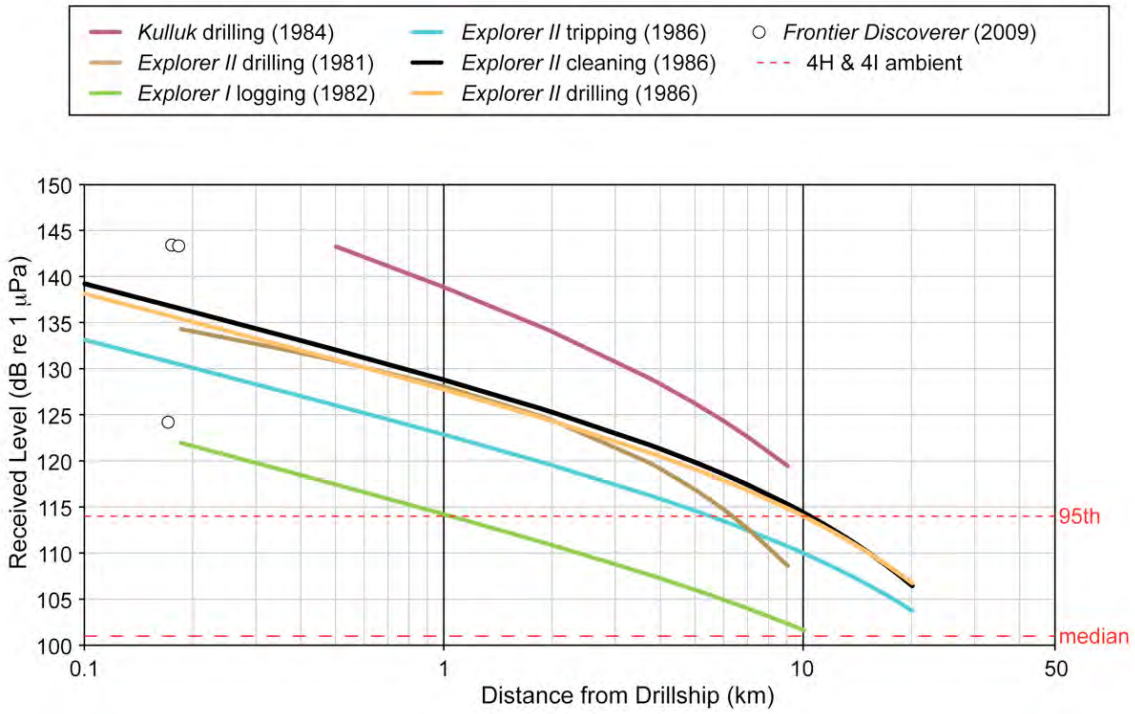


Audibility of average bowhead call at different DASARs:

Question: what is the range of distances at which the RL of an average bowhead call would be above the sound produced by the drillship?

Assumptions:

- Used bowhead call SL of 150 dB re 1 uPa ("average", SLs in the range 130-170 dB)
- Used drillship regression for Explorer II cleaning



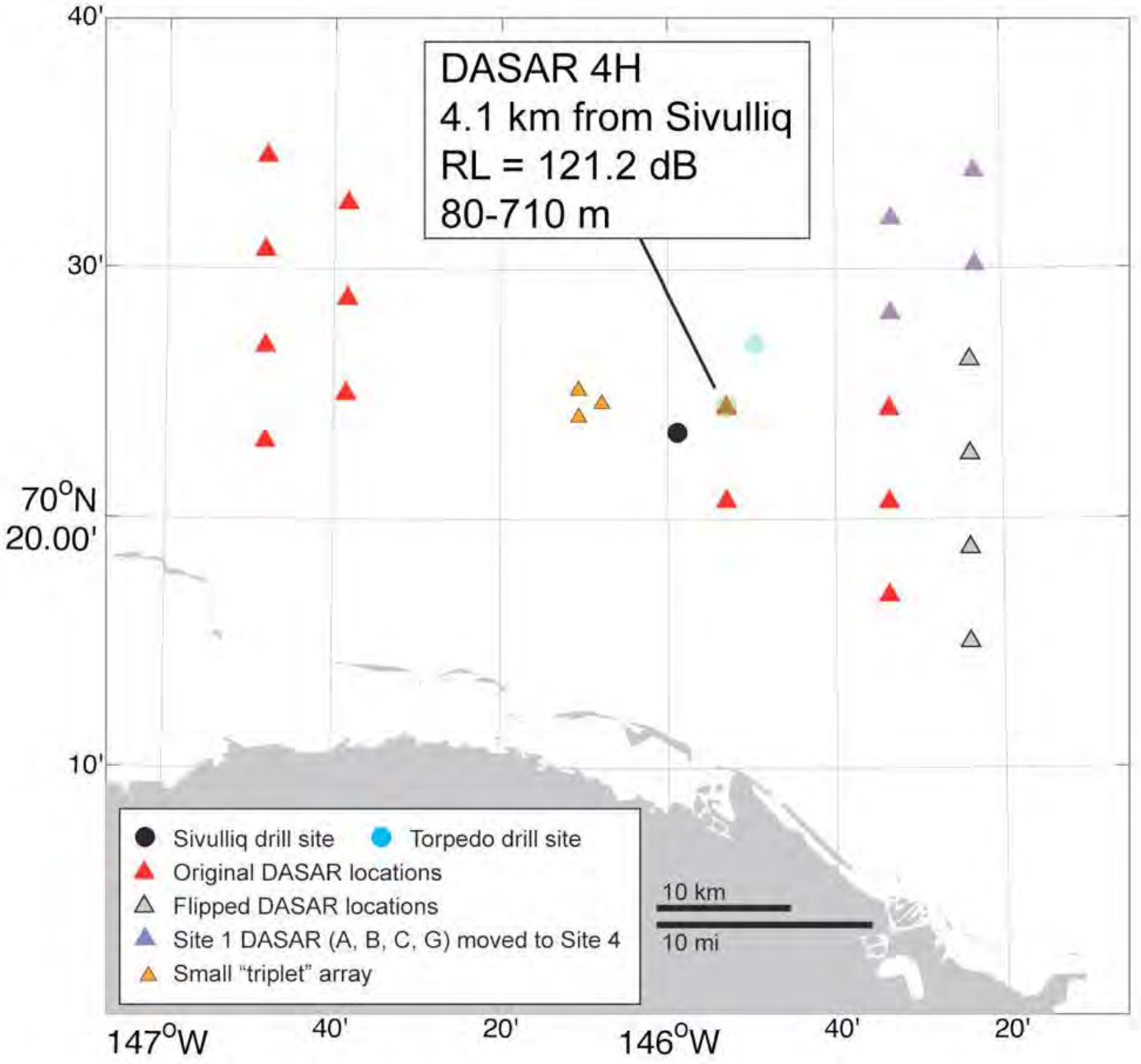
Audibility of average bowhead call at different DASARs:

Question: what is the range of distances at which the RL of an average bowhead call would be above the sound produced by the drillship?

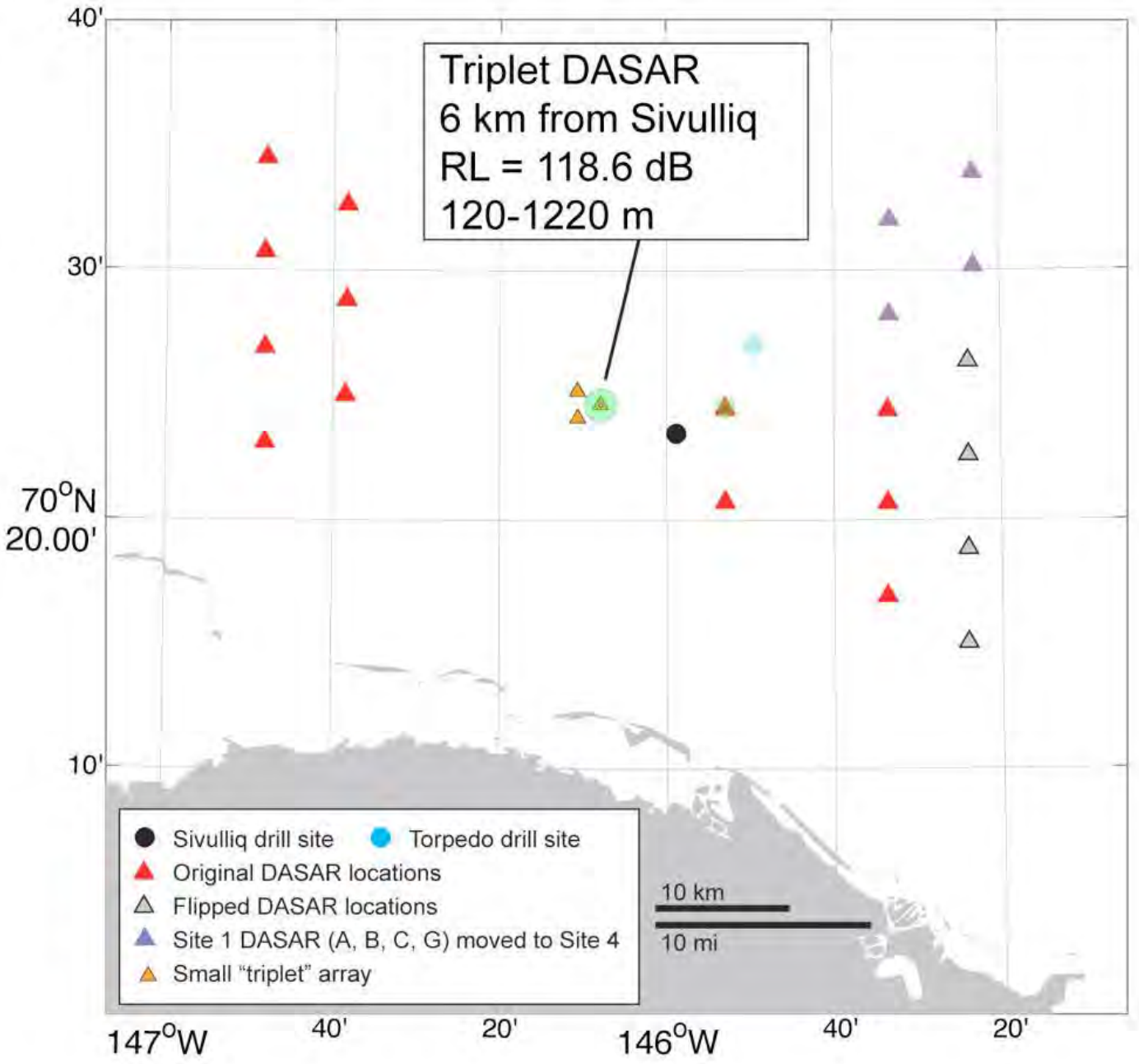
Assumptions:

- Used bowhead call SL of 150 dB re 1 uPa ("average", SLs in the range 130-170 dB)
- Used drillship regression for Explorer II cleaning
- Ambient sound levels are low (below drillship sounds)
- Used spreading loss of 15log(distance) and 10log(distance)

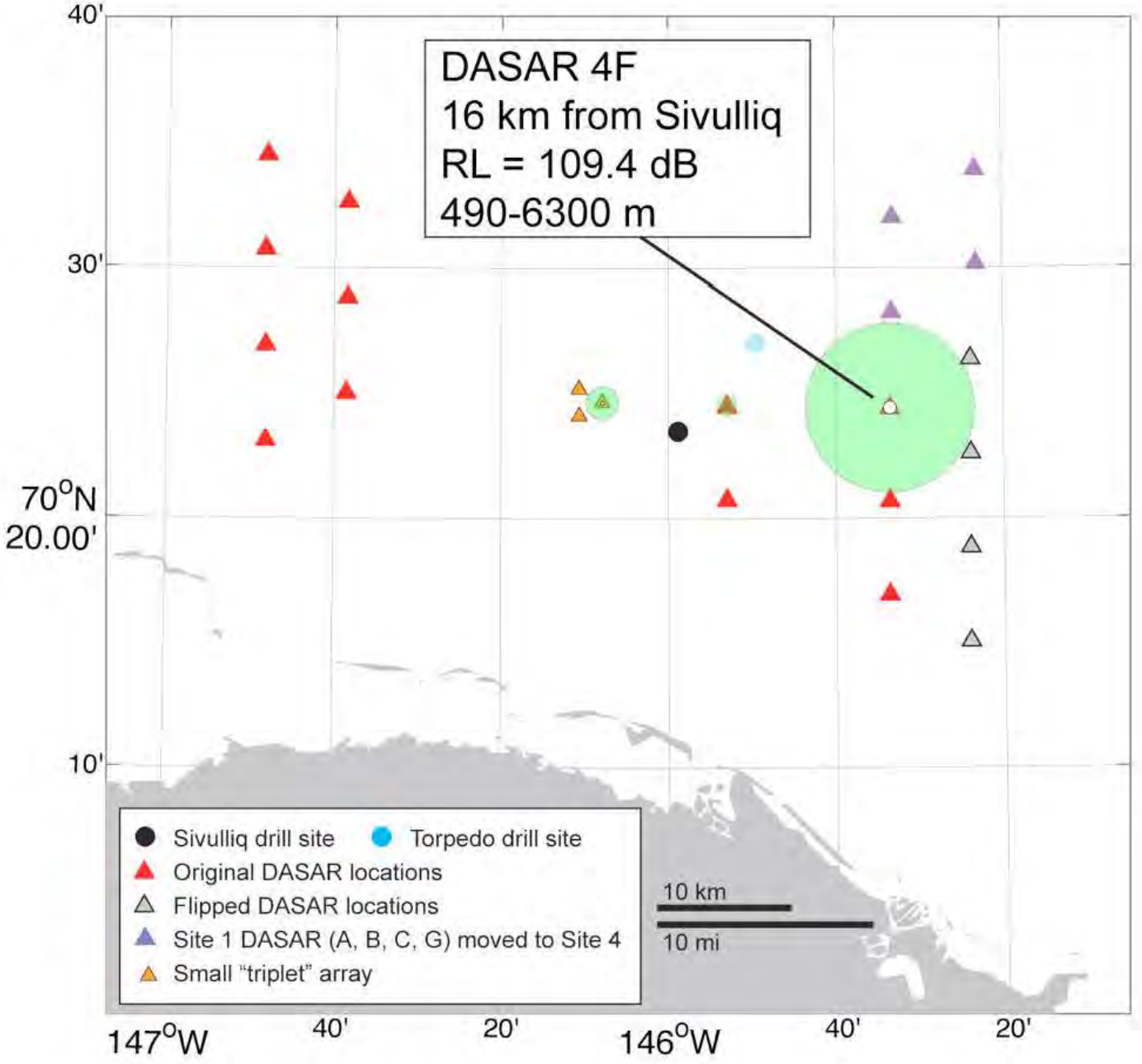
Audibility of average bowhead call at different DASARs:



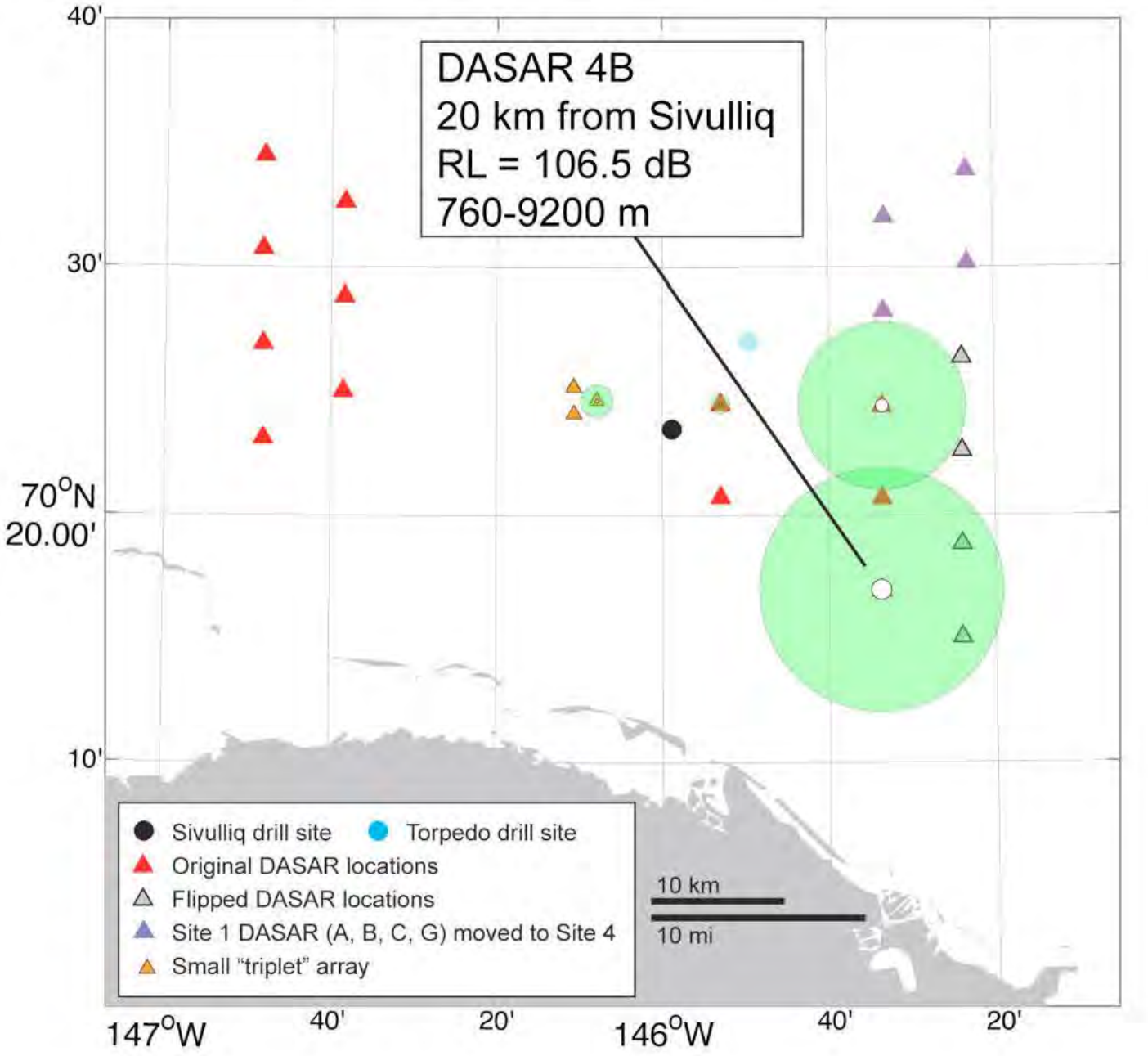
Audibility of average bowhead call at different DASARs:



Audibility of average bowhead call at different DASARs:



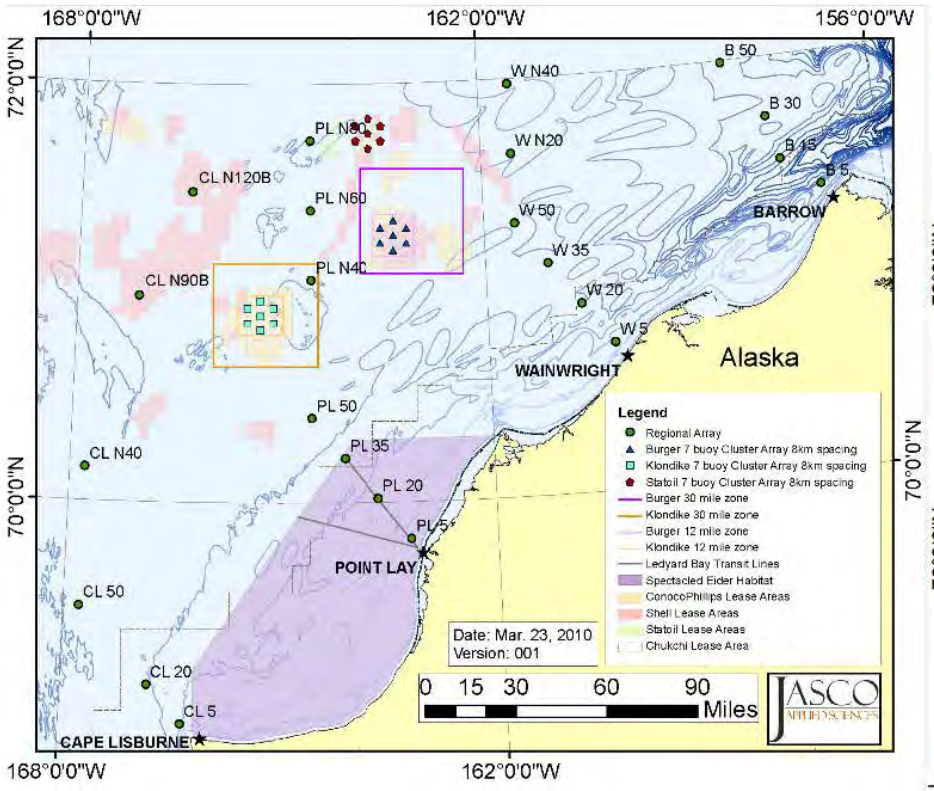
Audibility of average bowhead call at different DASARs:

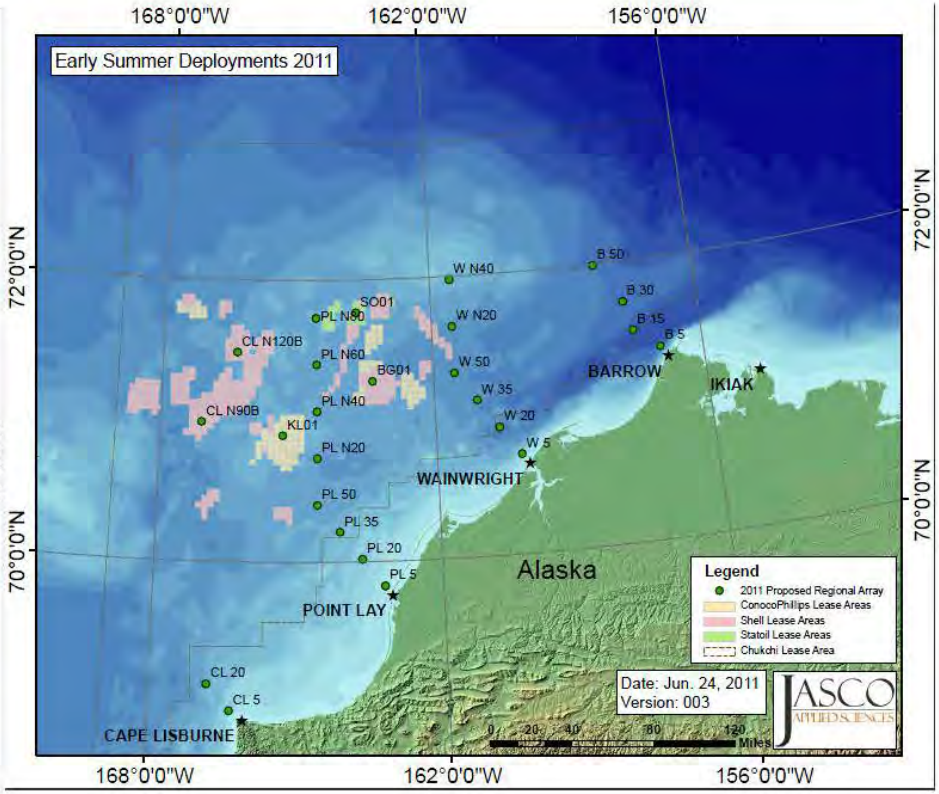


Questions
&
Discussion

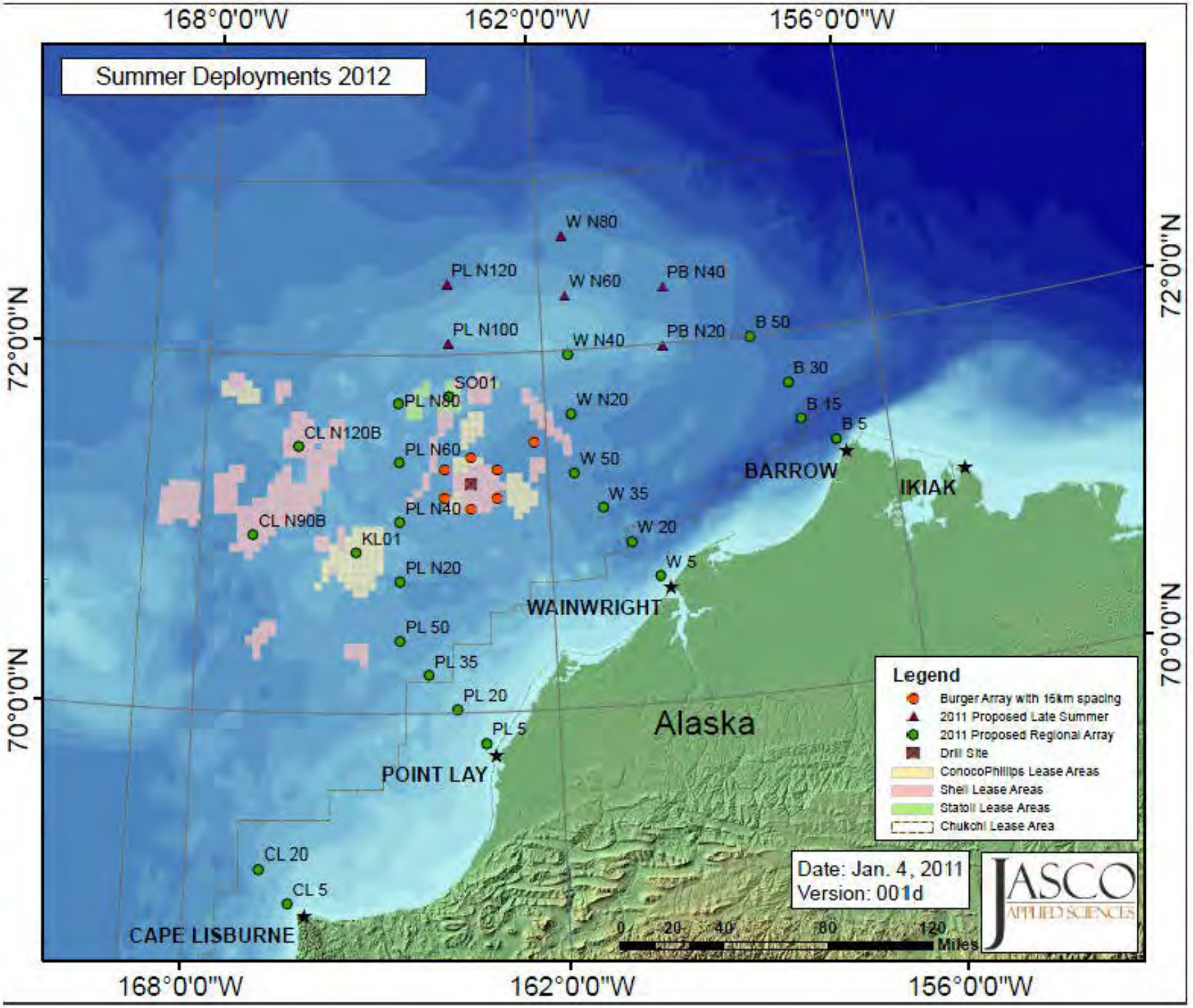
Chukchi Regional Acoustics Program

2010 and 2011 Regional Program Acoustic Buoy Layouts

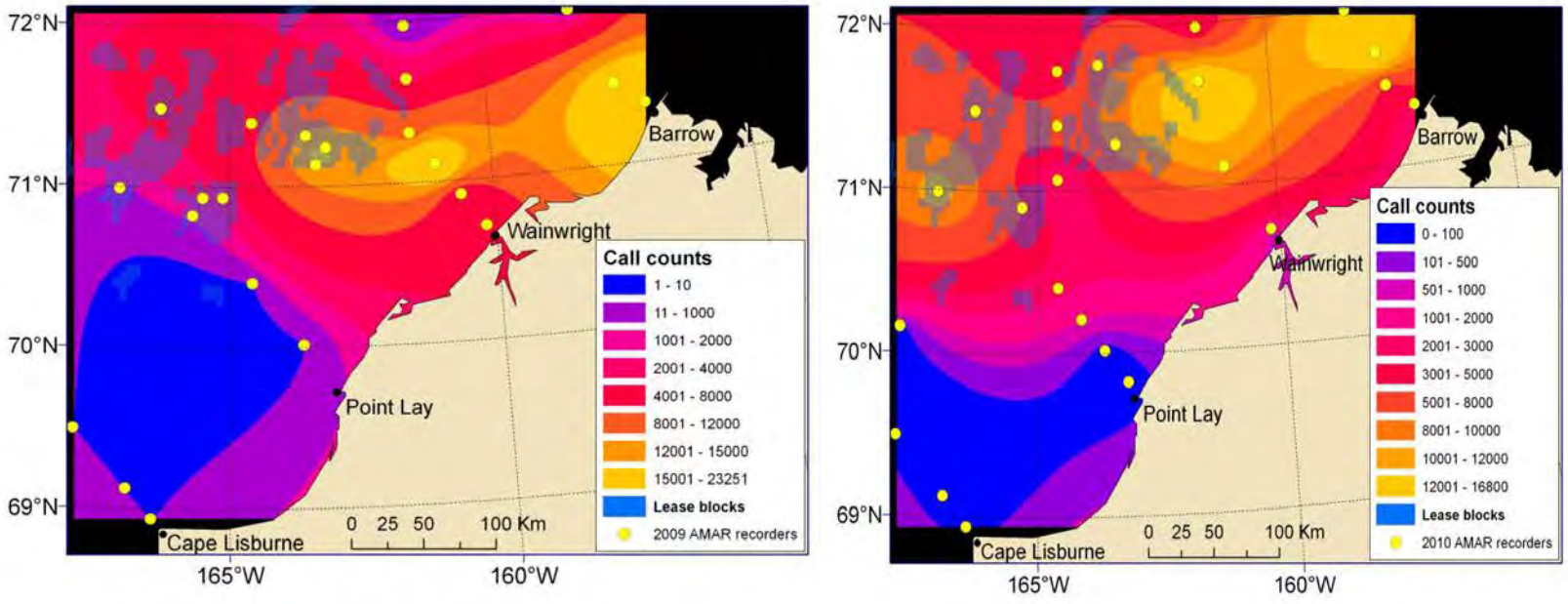




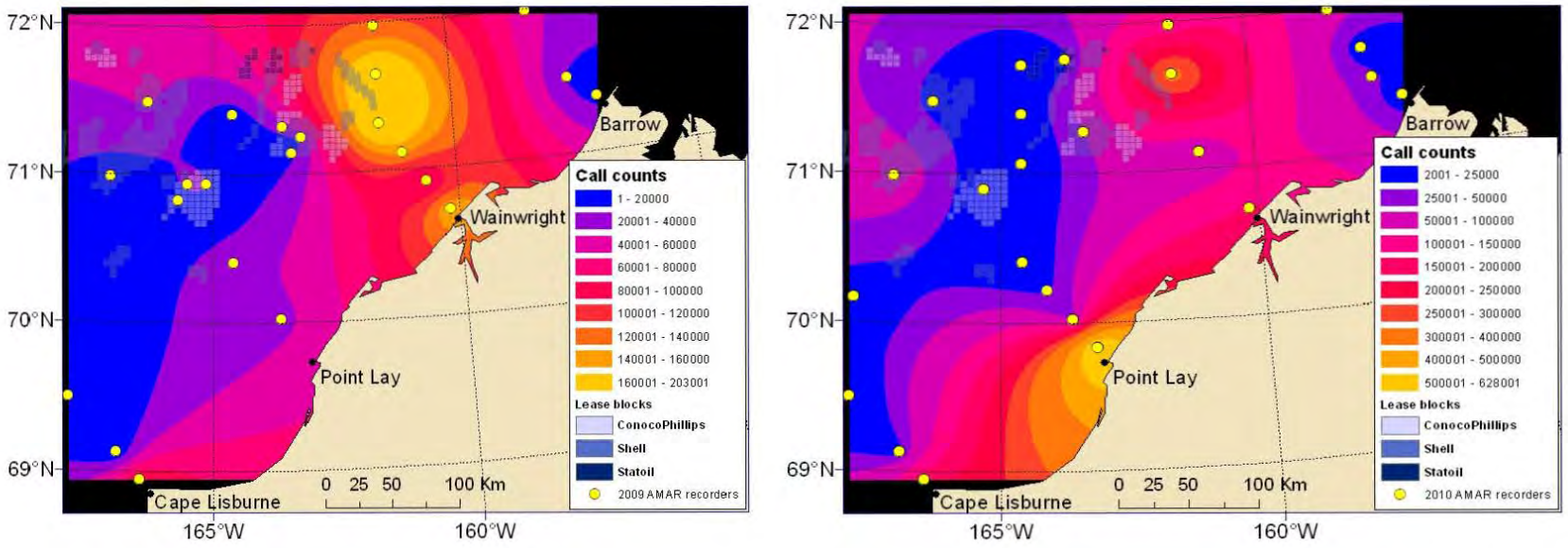
2011 Program also deployed 6 buoys in late August around Hanna Shoal that will record through August 2012


Summer Deployments 2012
168°0'0"W
162°0'0"W
156°0'0"W
72°0'0"N
70°0'0"N
W N80
PL N120
W N60
PB N40
PL N100
W N40
PB N20
B 50
B 30
SO01
PL N80
W N20
B 15
B 5
CL N120B
PL N60
W 50
BARROW
IKIAK
W 35
PL N40
CL N90B
W 20
KL01
W 5
PL N20
WAINWRIGHT
PL 50
PL 35
PL 20
PL 5
POINT LAY
Alaska
CL 20
CL 5
CAPE LISBURNE
Legend
Burger Array with 16km spacing
2011 Proposed Late Summer
2011 Proposed Regional Array
Drill Site
ConocoPhillips Lease Areas
Shell Lease Areas
Statoil Lease Areas
Chukchi Lease Area
Date: Jan. 4, 2011
Version: 001d
JASCO
APPLIED SCIENCES
0 20 40 80 120
Miles

Bowhead distribution (acoustic)



Walrus Distribution (acoustic)



Questions
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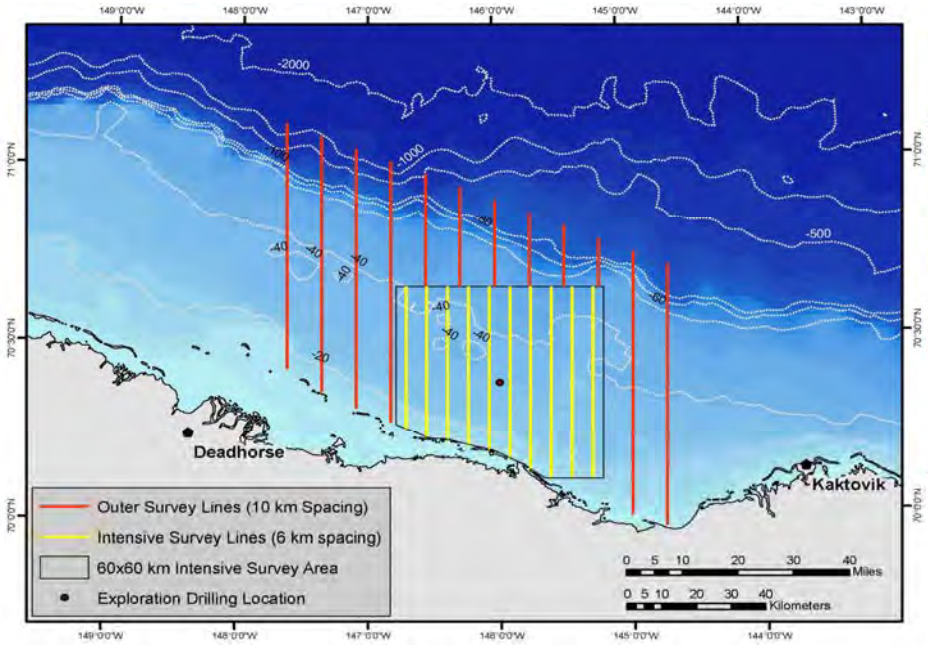
Discussion

Beaufort Aerial Program

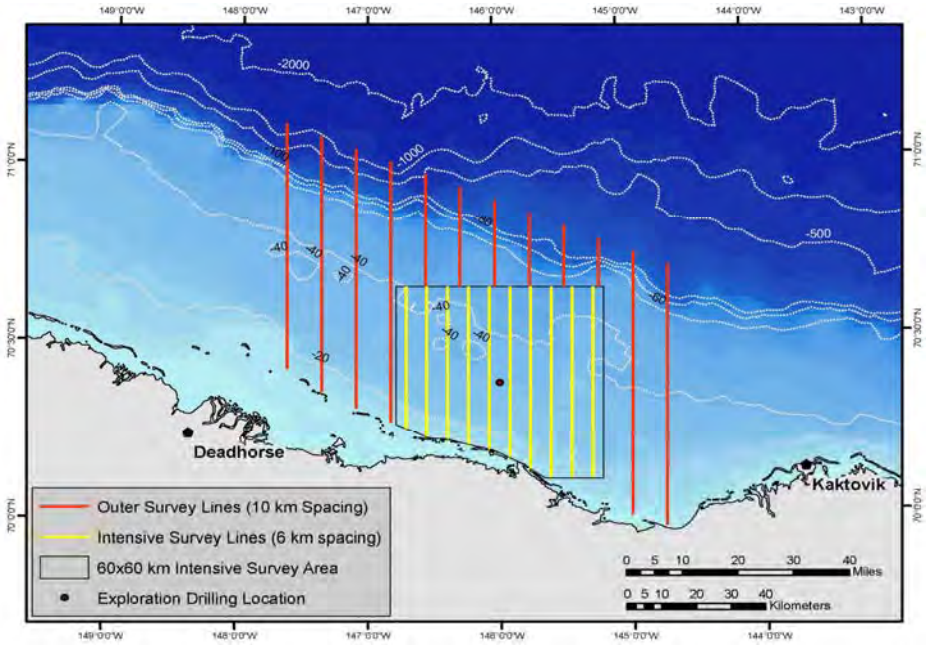
Beaufort Prospect Aerial Survey

- Initiated in 2006 as part of an integrated monitoring program
- Manned flights in 06,07,08,10
- Will fly in 2012 with MMOs aboard to evaluate impacts of drilling activities on migrating bowheads and other species
- Flight pattern will be modified per findings of peer review recommended power analysis
- Aircraft will have both MMOs and photographic equipment



Beaufort Prospect Aerial Survey

- Long term goal to utilize Unmanned Aerial Systems (2013?)
- 2 still frame cameras + HD video
- Dual observation will allow direct comparison of results & derivation of correction factors
- Photography will provide lasting record
- Photo analyses will be done when not flying
- Evaluating multi-spectral scanner



Sensors

2 Still Cameras

- Cannon 5D Mk II digital SLR camera – one with 20 mm lens and other with 20 (Beaufort) or 100 mm (Chukchi?) lens
- 5D is a 21.1 megapixel camera that stores imagery in a 5616 × 3744 pixel array

One HD Video

- Canon XF305
- 1920 × 1080 resolution
- NTSC video is 640 × 480

Survey Area

Still Camera

- Single DSLR camera with 20 mm lens covers 720 m swath, 100 mm lens covers 144 m swath
- One pixel is 12 cm with 20 mm lens and 2.4 cm with 100 mm lens
- Effective Strip Width for manned survey of bowheads has varied from 500 to 700 m and for belugas was ~300 m
- Can detect (20 mm) and identify and count (100 mm) animals that cannot be reliably detected during visual surveys (seals)

Video Camera

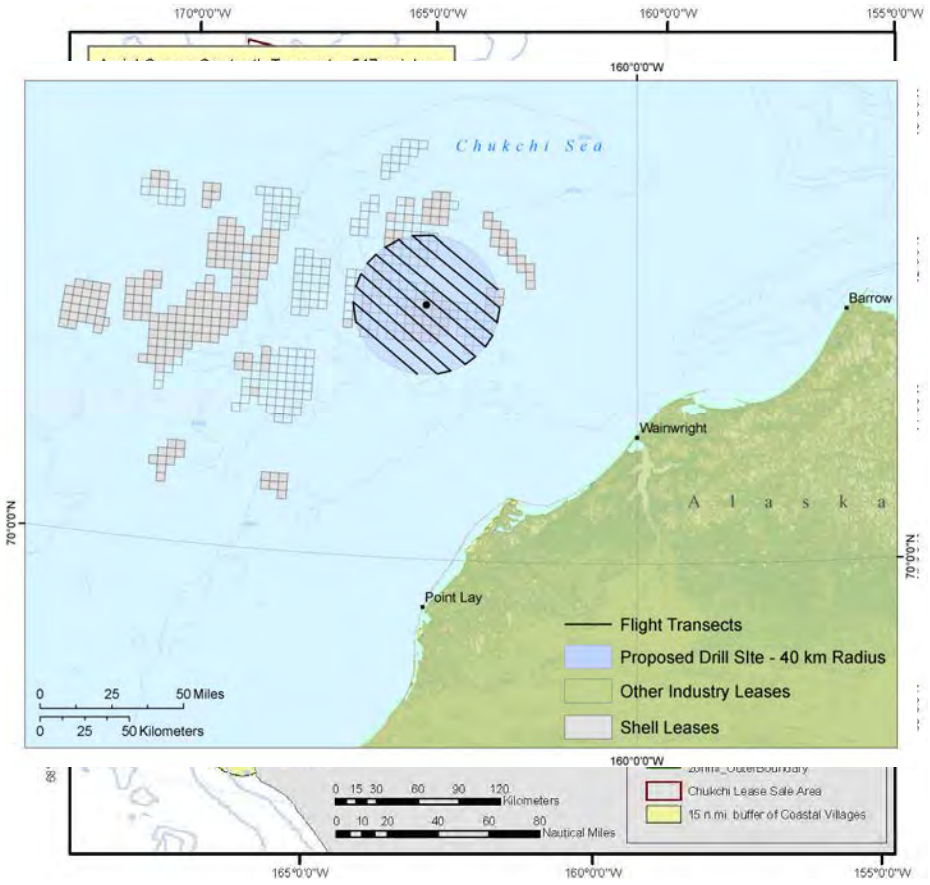
- Camera fixed to cover a 600 m swath
- One pixel on water is 25 cm (same as Koski et al. 2009)
- Provides constant coverage rather than soda-straw coverage making detection easier

Questions
&
Discussion

Chukchi Aerial Program

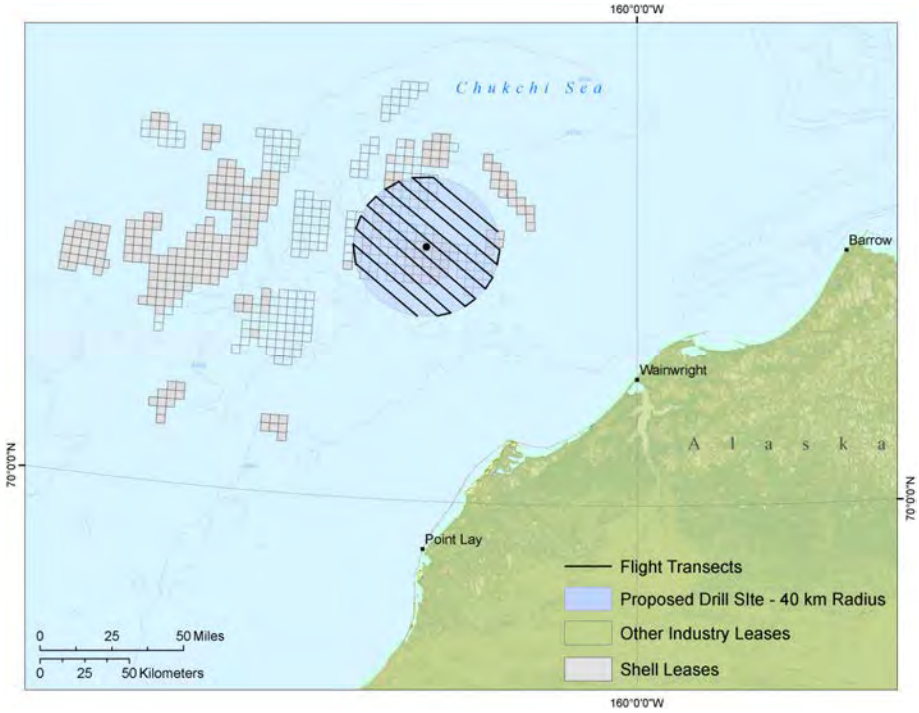
Chukchi Burger Prospect Aerial Survey

- Since 2006 conducted nearshore surveys
- Surveys in 06,07,08, 10
- Benefits have been initial observation of walrus haulouts
- Desire to collect data in the offshore despite risks
- 2012 will add photographic offshore surveys
- Pilot & co-pilot but no MMOs



Chukchi Burger Prospect Aerial Survey

- Offshore unmanned will be flown preferentially
- Nearshore will be flown with MMOs and photography when Burger is not available or needed
- Comparisons to Beaufort and nearshore will enable calibration
- Based out of Barrow, MMOs will analyze data when not flying
- Photographic results will be available
- Eventually computer assisted detection is a goal.



Questions
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Aerial Survey Power Analysis

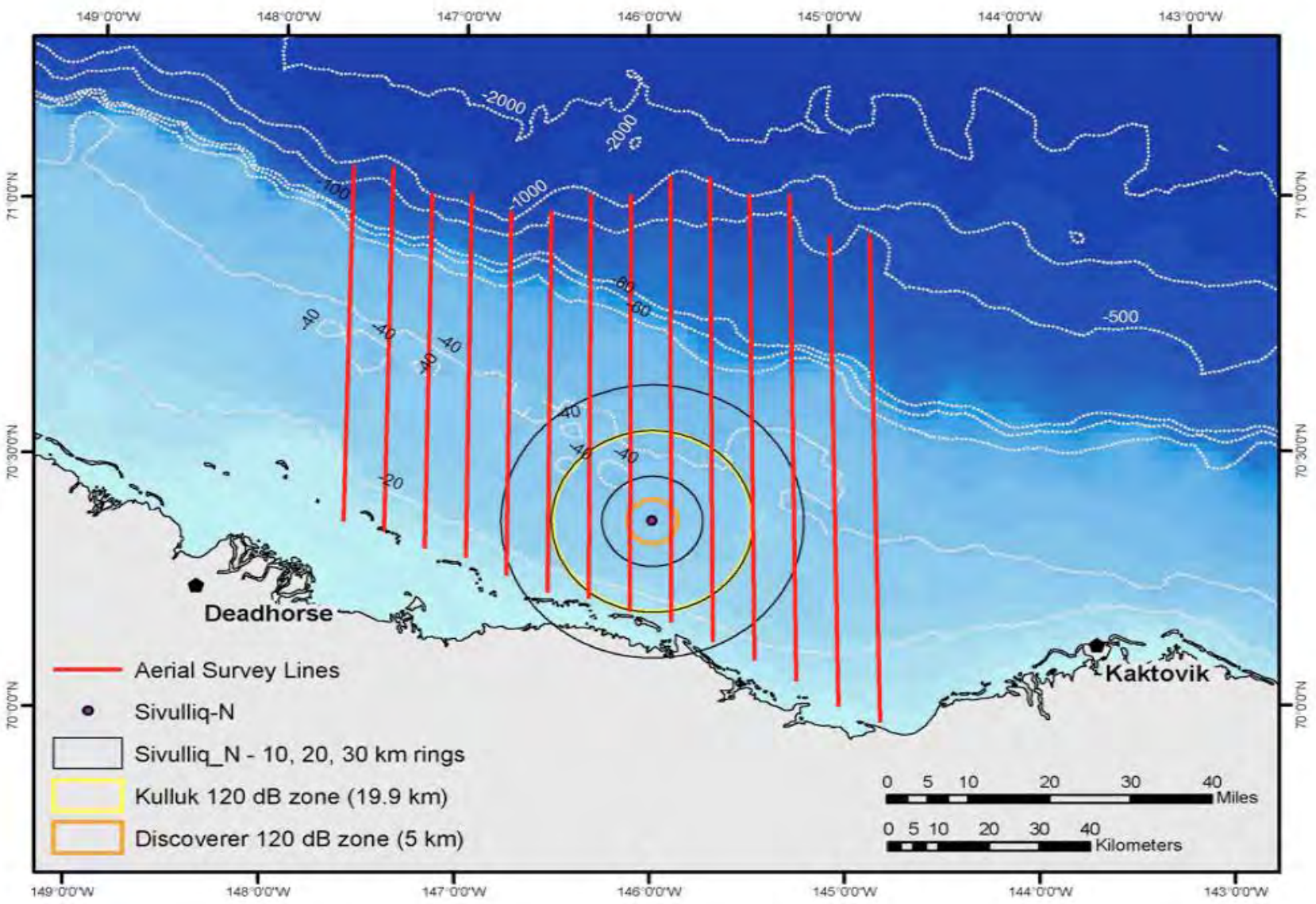
Background

One aspect of aerial monitoring is to investigate potential differences in marine mammal densities around industrial activity.

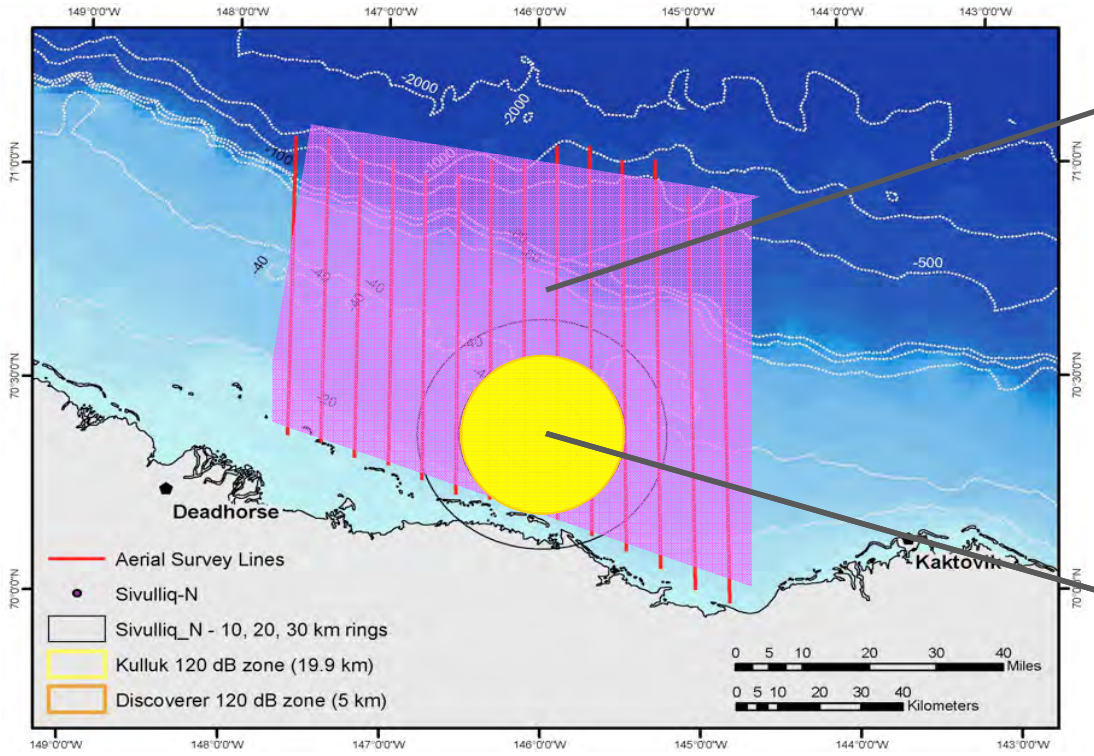
At present, comparisons are made between sighting rates for different received sound pressure level categories.

This analysis addresses a request by NMFS for a power analysis to investigate the probability of the proposed survey design to detect such effects

Original Proposed Beaufort Survey Design



Survey Sub-areas and Effect Sizes



Outer Zone

0.02 bowheads / km^2

Potential Impact Zone

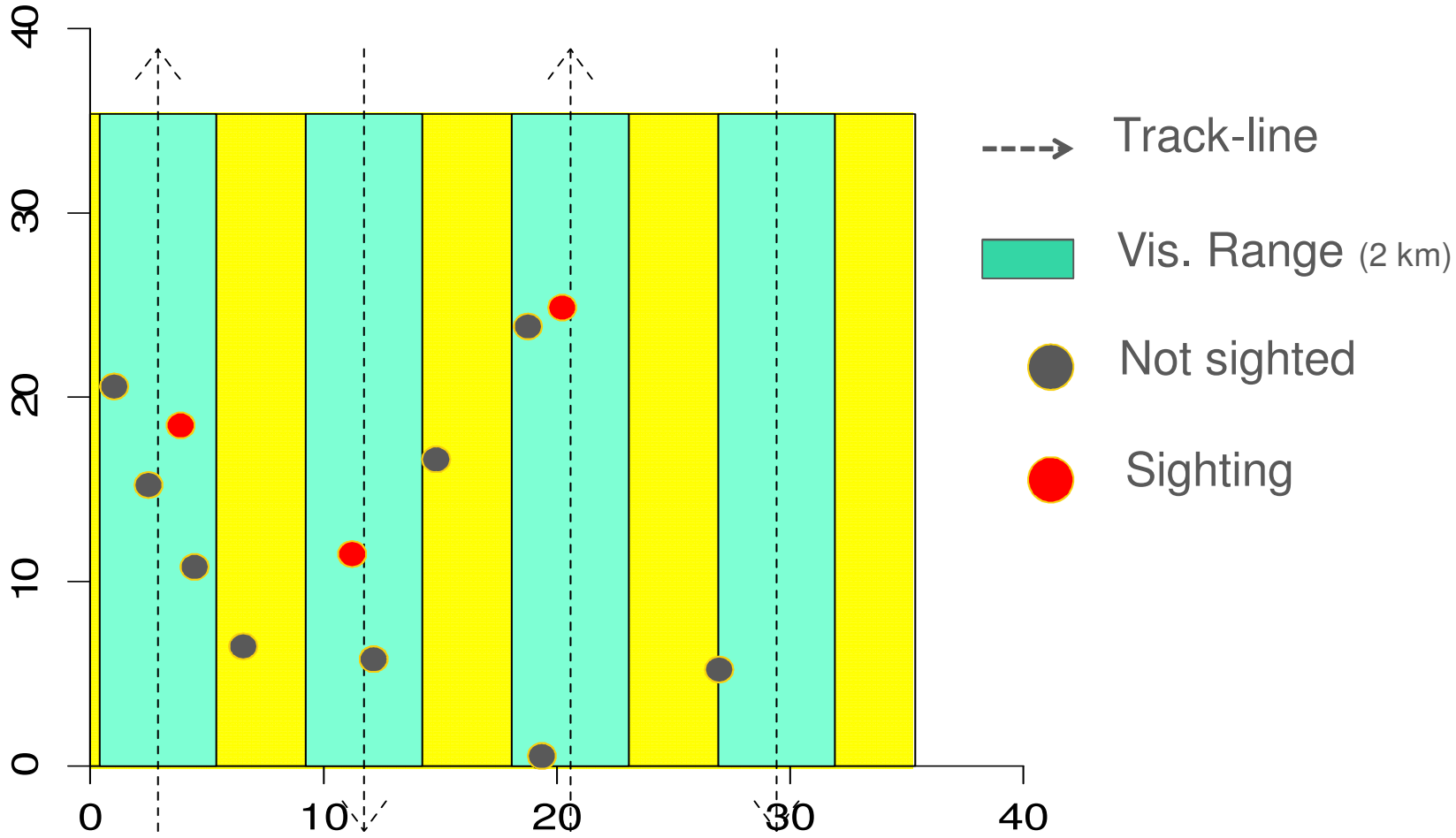
Area = 20 or 30 km radius

Potential Impact Zone bowhead density assumed to be 25% (Big effect), 50% (Medium effect) or 75% (Small effect) of underlying density in Outer Zone.

Estimating Power of Aerial Survey Design through Simulation

- Underlying bowhead density, detection function, g(0) etc. based on existing data.
- Expected effort in 2012 equal to average effort achieved during recent survey seasons.
- Effort in each zone proportional to zone's area divided by total survey area.
- Also ran exploratory power analysis for Chukchi, accounting for additional transit length to offshore survey area

Example Simulated Survey (Impact Zone)



Power:
Original Proposed Survey Design (i.e. Uniform Transect-Line Spacing)

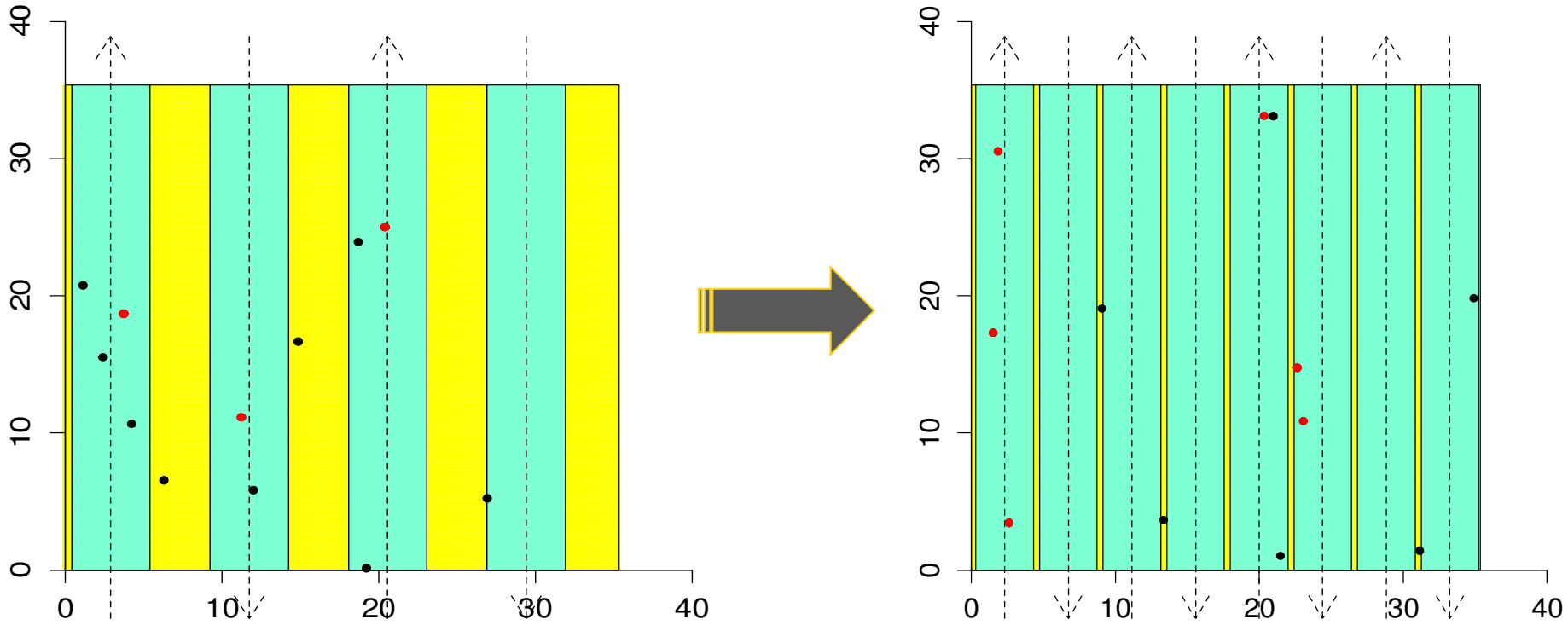
1) Beaufort

	Impact zone density as % of outer zone density		
Radius of impact zone (km)	Big effect (25%)	Medium effect (50%)	Small effect (75%)
20	1	0.49	0
30	1	1	0.38

2) Chukchi

	Impact zone density as % of outer zone density		
Radius of impact zone (km)	Big effect (25%)	Medium effect (50%)	Small effect (75%)
20	0.993	0.113	0
30	1	0.999	0.142

Concentrated Effort in Impact Zone



Power:
Concentrated Effort in Impact Zone

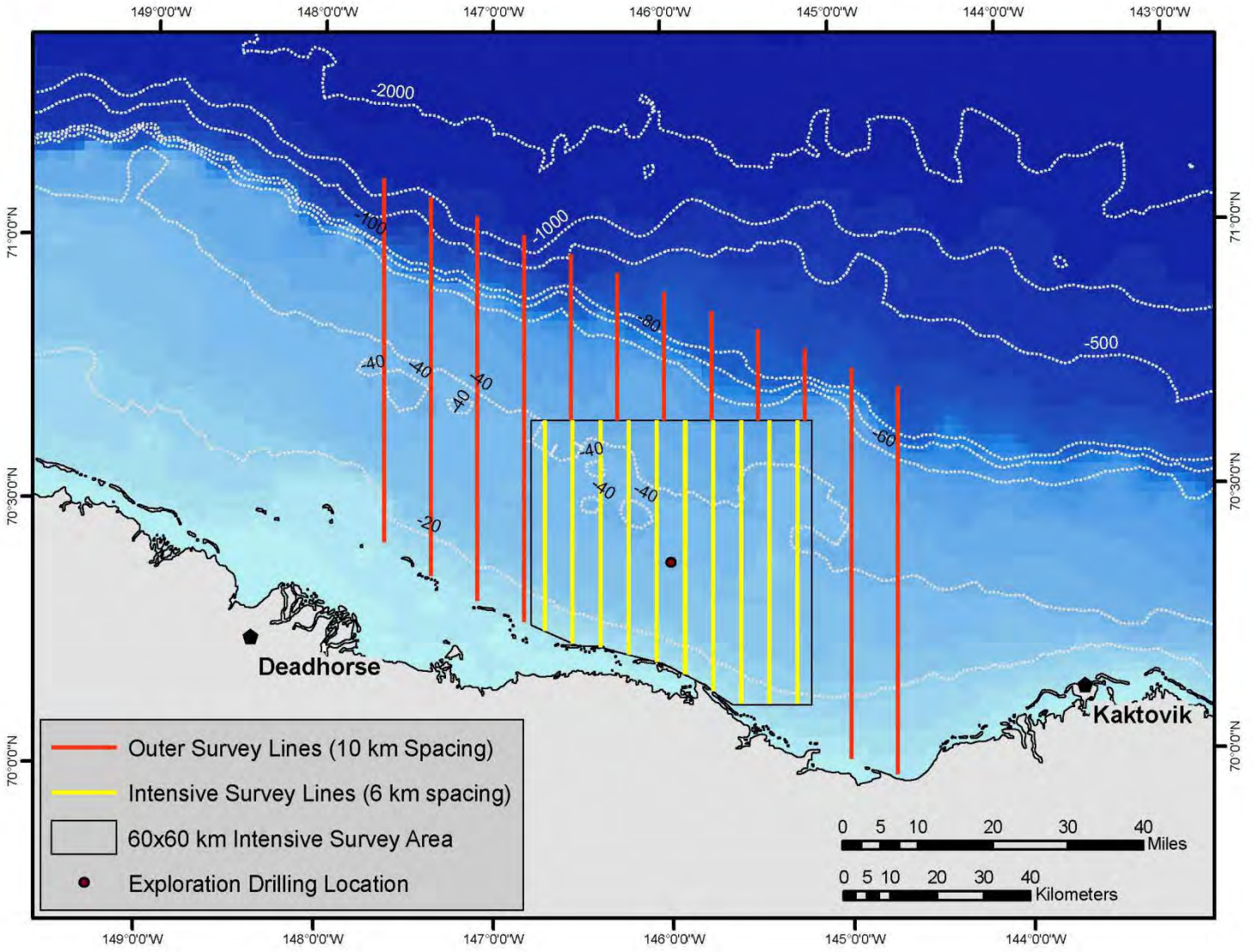
1) Beaufort

	Impact zone density as % of outer zone density		
Impact zone effort multiplier	Big effect (25%)	Medium effect (50%)	Small effect (75%)
Base case	1	0.49	0.00
1.2 x	1	0.88	0.01
1.4 x	1	0.99	0.01
1.6 x	1	0.99	0.06

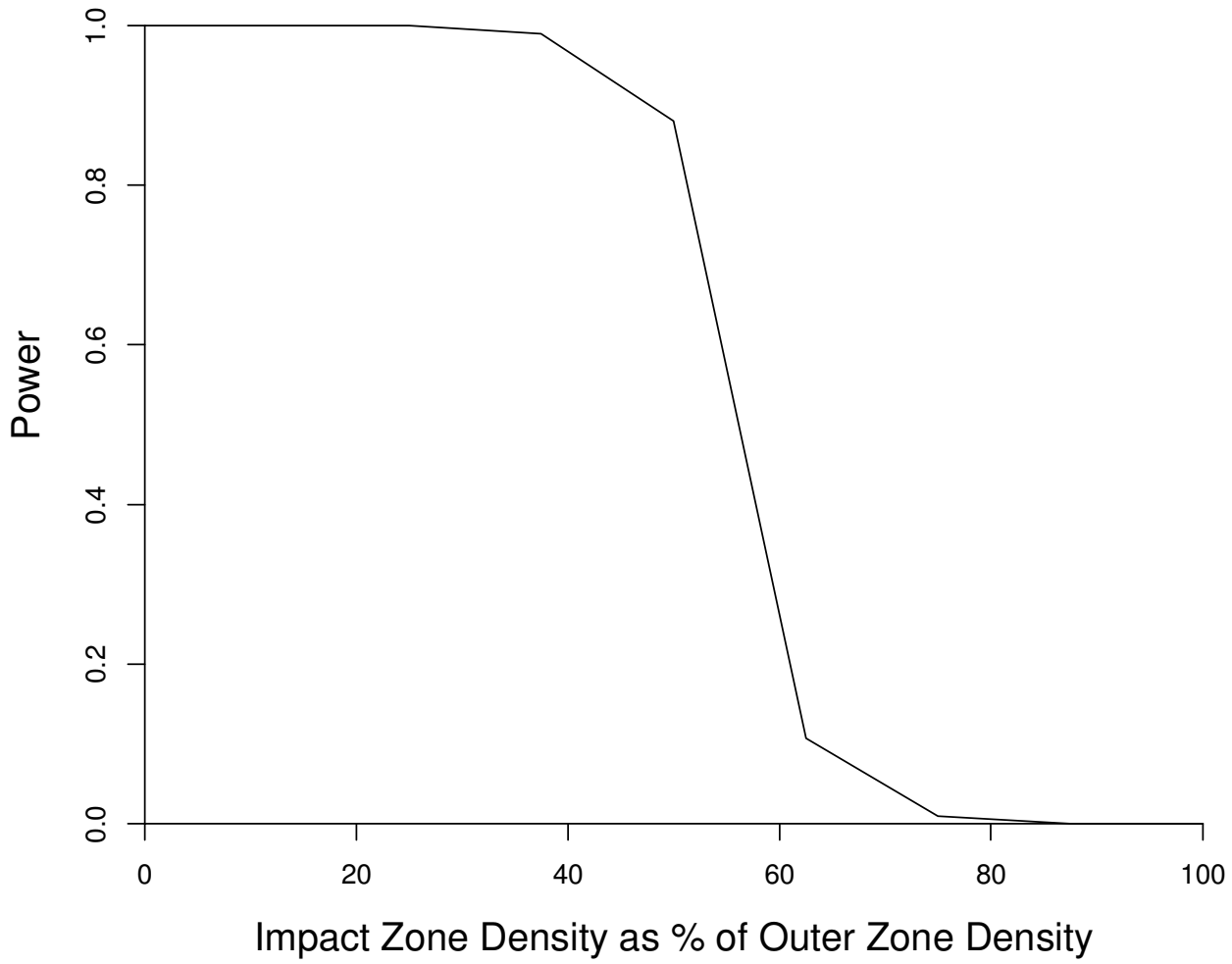
2) Chukchi

	Impact zone density as % of outer zone density		
Impact zone effort multiplier	Big effect (25%)	Medium effect (50%)	Small effect (75%)
Base case	1	0.11	0.00
1.2 x	1	0.33	0.00
1.4 x	1	0.69	0.00
1.6 x	1	0.87	0.00

Revised Proposed Aerial Survey Design



Power Function (20km Impact Radius)



Big change in Density ----------→ Small change

Summary

- If impact radius is 30km, power to detect differences in densities is generally high.

- If impact radius is 20km, power is high for larger changes in density but drops off rapidly for smaller changes.

- In general, maximizing effort around industrial activity maximizes the power to detect differences in underlying densities.
-
- There is a limit to the amount of effort achievable around industrial activity however, as dictated by a minimum desirable spacing of transect lines (else risk double counting).

- The revised aerial survey design has improved power to detect differences in densities over the original design.