21st Century Oceanography in the Last Frontier

RVTEC 2019
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Alaska region research

• Relevant Scales:
  • Local
  • Regional
  • Global

• Issues relating to:
  • Climate
  • Social Justice
  • Economics
  • Politics & Geopolitics

Shishmaref, 2005
Ongoing changes affecting extreme storm hazard events

- Rising sea level
- Warming temperatures
- Thawing permafrost
- Coastal Erosion
- Reduced sea ice cover
- Ice run-up on shore
- Increased fetch
- Increased wave heights
- Changing storm frequency
- Changes in wind direction
- Altered hydrological cycles

Nome, 2004

Photo: KNOM
Views from Little Diomede Island

7 December 2017

Photo: O. Ahkinga
Views from Little Diomede Island

20 January 2018

Photo: O. Ahkinga
Views
from
Little
Diomede
Island

20 February 2018

Photo: F. Ozenna
Bering Sea Near-Bottom Temperature

Percent Change from 2010

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arctic Cod</td>
<td>-88%</td>
<td>-100%</td>
</tr>
<tr>
<td>Pacific Cod</td>
<td>+900%</td>
<td>+2000%</td>
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[L. Britt & NOAA AFSC RACE Division, 2018]
Alaskan Arctic
Open Water Season
Vessel Activity
Arctic Shipping

Red: PC6 Ice Strengthened
Blue: Open Water

[Smith & Stephenson, 2013]
Arctic Shipping

4 September 2019

5 July 2019

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MarineTraffic.com
Avoiding conflict in marine operating areas
Community & Environmental Compliance Standard Operating Procedures (CECSOP) for R/V *Sikuliaq* Research Operations

For interfacing with the Arctic Waterways Safety Committee:

- Alaska Beluga Whale Committee
- Alaska Eskimo Whaling Commission
- Eskimo Walrus Commission
- Alaska Nanuuq Commission
- Ice Seal Committee
- Oil / Gas / Mining
- Tugs (Barges & Cargo)

- Research
- Tourism
- Fishing
- Alaska Marine Pilots
- Municipality of Nome
- Northwest Arctic Borough
- North Slope Borough
2018: IMO Authorization for new vessel routing in Bering Strait region
High Frequency Radar (HFR) Installations

Real-Time Maps of Ocean Currents

NE Chukchi: Since 2009
Western Beaufort: Since 2014
Bering Strait: Since 2019

www.chukchicurrents.com
www.straitcurrents.com
Remote Power Module (RPM)

- Insulated instrument shelter
- Trussed aluminum foundation
- Adjustable feet!
- Four wind turbines
- Six solar panels
- Battery Bank
- Monitoring and control electronics
- HughesNet satellite
- WiFi Router

Photo: H. Statscewich
Cape Simpson:
Summer 2014

Photo: H. Statscewich
Cape Simpson:
Summer 2018

Photo: H. Statscewich
Cape Simpson: Summer 2018

Photo: H. Statscewich
Operation Swamp Buggy

Photo: H. Statscewich
DIY Boat Lift
Bering Strait HFR: Wales
September 2019

Photos: H. Statscewich
Wales HFR
Radial Velocity Coverage Map
When your ocean is not liquid:
Make your moorings short.
Mooring 1
Physics & Passive Acoustics
- Currents
- Waves
- Temperature
- Salinity
- Pressure
- Underwater Sound
- Water Sampler

Mooring 2
BioGeoChemical & Active Acoustics
- Temperature
- Salinity
- Pressure
- Ice Draft
- Dissolved Oxygen
- PAR
- CDOM
- NO$_3$
- $\delta^{18}$O
- pH
- pCO$_2$
- Chl-a Fluorescence
- Optical Backscatter
- Acoustic Backscatter
- Particle Size Spectra
- Sediment Trap

Mooring 3
Freeze-Up Buoy
Real-time data through freeze-up
- Temperature
- Salinity
- Pressure
- Webcam

45 m water depth
12 m mooring height
Chukchi Ecosystem Observatory
Alaska Region Marine Ecosystem Mooring Network

2014: CEO
2019: GEO
Gulf of Alaska Ecosystem Observatory (GEO)
Mooring Cluster

- McLane Ice-Tethered Profiler
- 2 Surface Buoys w/real-time data
- Active Acoustics
- Passive Acoustics
- Sediment Trap
- Particle Camera
- Chl_a, CDOM, OBS
- NO\textsubscript{3}, DO, pH, pCO\textsubscript{2}
- Currents
- Wind, Sea Level Pressure, Air Temp
GEO Data

Salinity

Chlorophyll

NMWW3 20191008 06z 150h forecast
GFS driven global model
valid 2019/10/15 18z
Taking stock as we enter 2020
Fig. 1: Seward Line Program: GLOBEC, Gulf Watch Alaska, and NGA LTER. Trend of GAK1 temperature anomaly: 200 to 250 m. Monthly anomaly (°C) from 1970 to 2015. The trend is 0.17 ± 0.04 °C per decade. The figure highlights the warming trend in the early 1970s and the cooling trend in the 1980s.

Anderson & Piatt 1997
Spring 2015
Sikuliaq Ice Trials

June 2018
Chukchi Sea
Summer 2019
R/V Nanuq