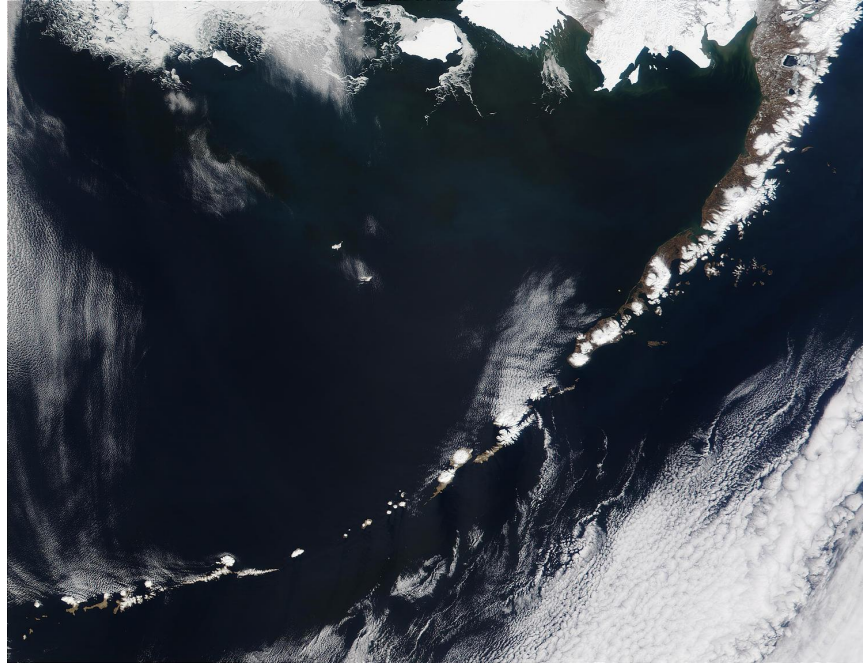


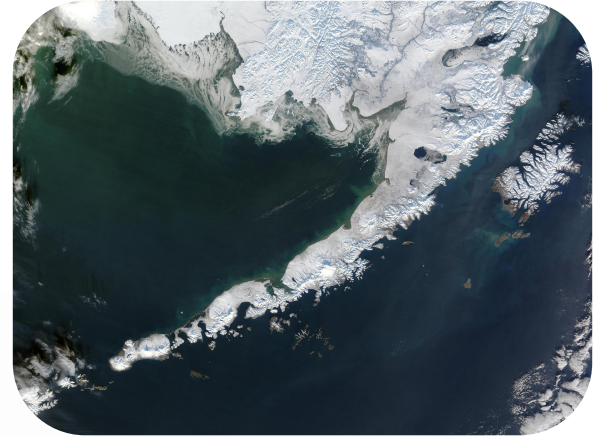
Physical Processes of The Aleutian Islands



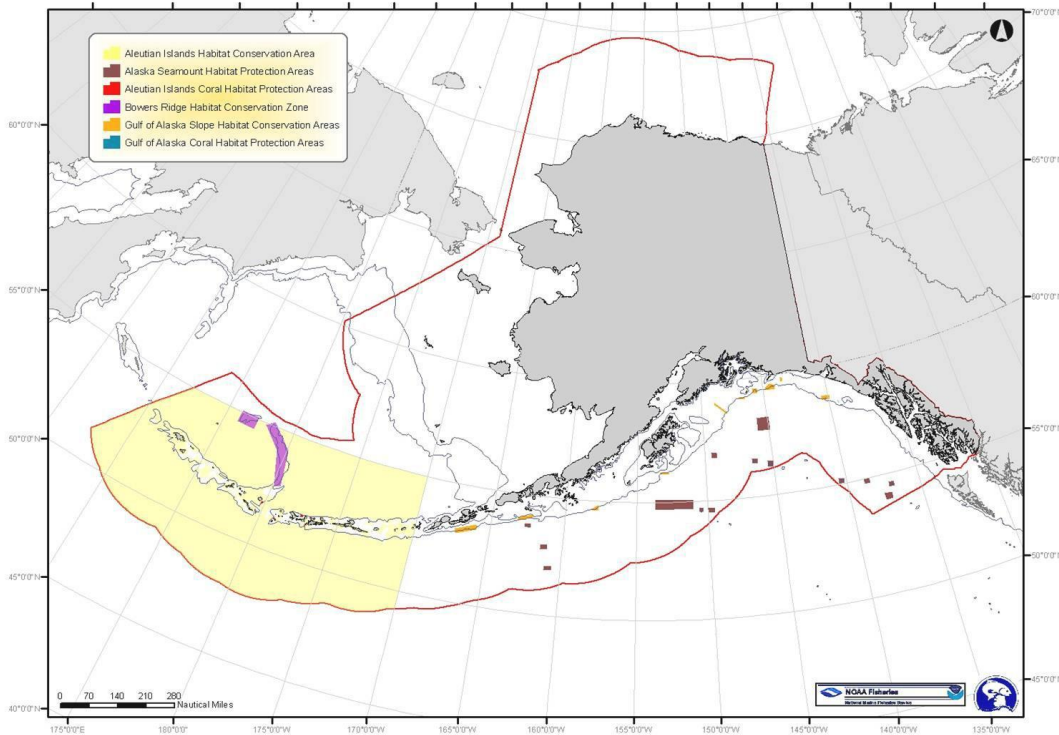
LO: To explore the physical oceanographic characteristics that define the Aleutians

Important processes

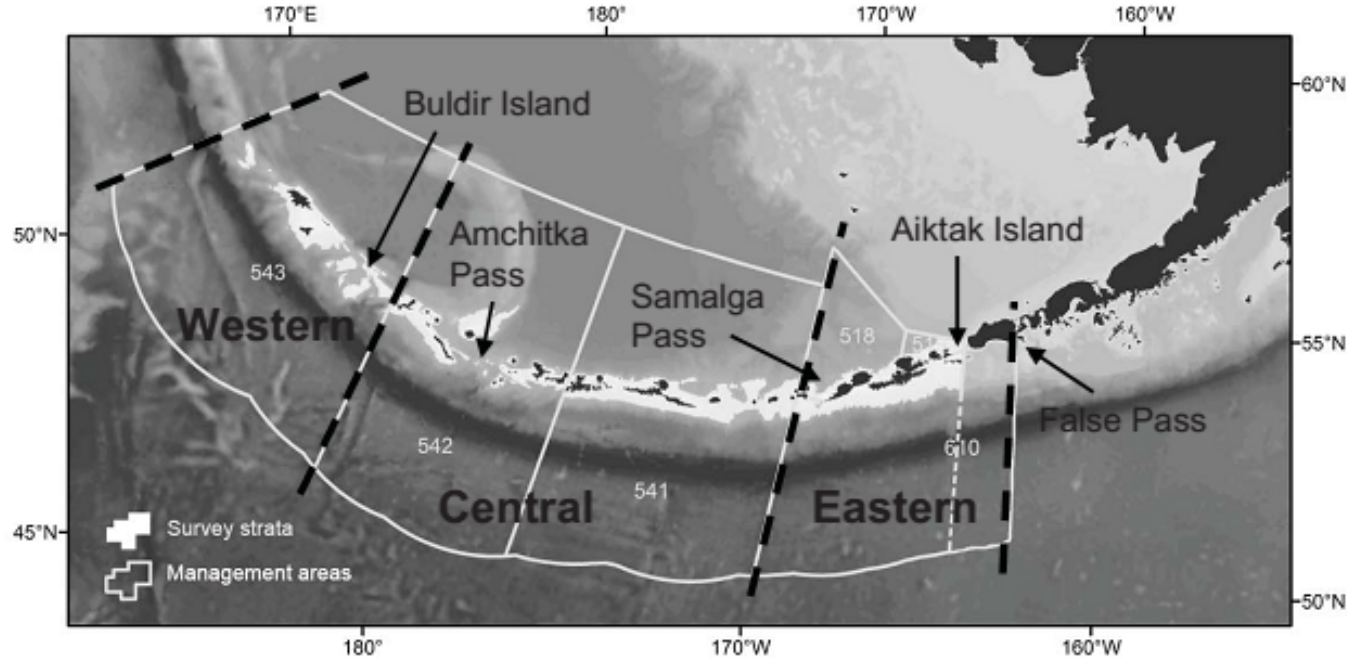
- **Spatial orientation**
- **Current patterns**
- **Bathymetry changes**
- **Salinity variations**
- **Northward transport of water from pacific**
- **Temperature variation over time and spatial scales**
- **Connections between open ocean and shelf habitats**



Location



- Stretches 1900 km from the Alaska Peninsula to the Commander Islands
- 200+ Islands
- 27 Active volcanoes
- ~57% designated wilderness which is overseen by Fish and Wildlife Service.
- Western boundary at 170E(US-Russia border)



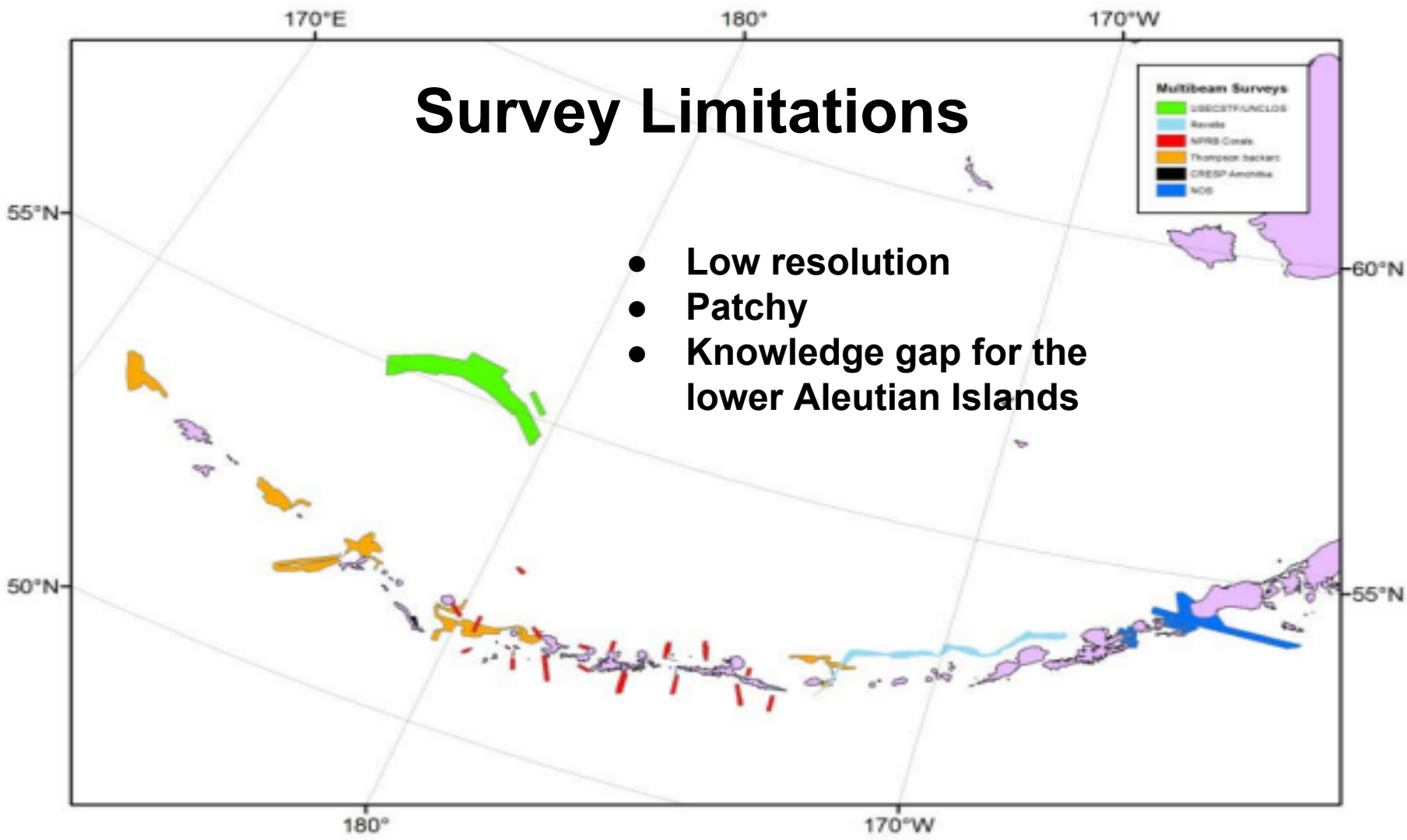
The Aleutian Islands ecosystem assessment breakup composes three ecoregions

Based on:

- **Geometry of island pass differences**
- **Currents**

Survey Limitations

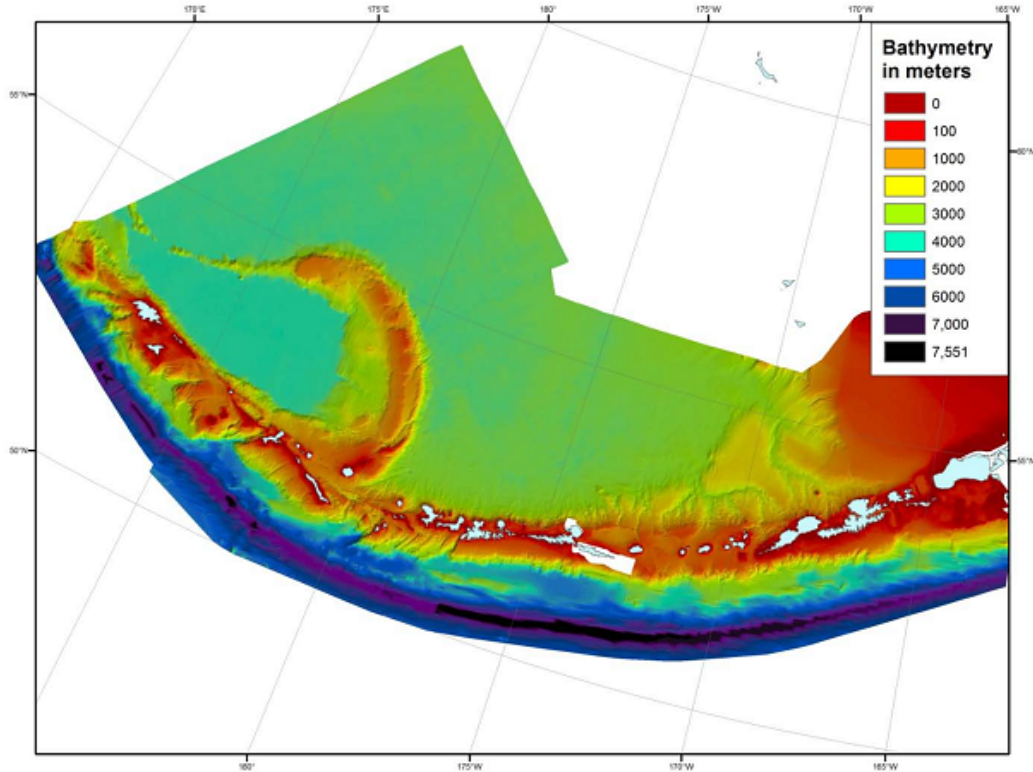
- Low resolution
- Patchy
- Knowledge gap for the lower Aleutian Islands





**Shelf and Open
Ocean of the
Aleutians**

Bathymetry of the Aleutians



- **Characterized by rapid changes in bathymetry at very small spatial scales (NOAA)**

Bathymetry Cont.

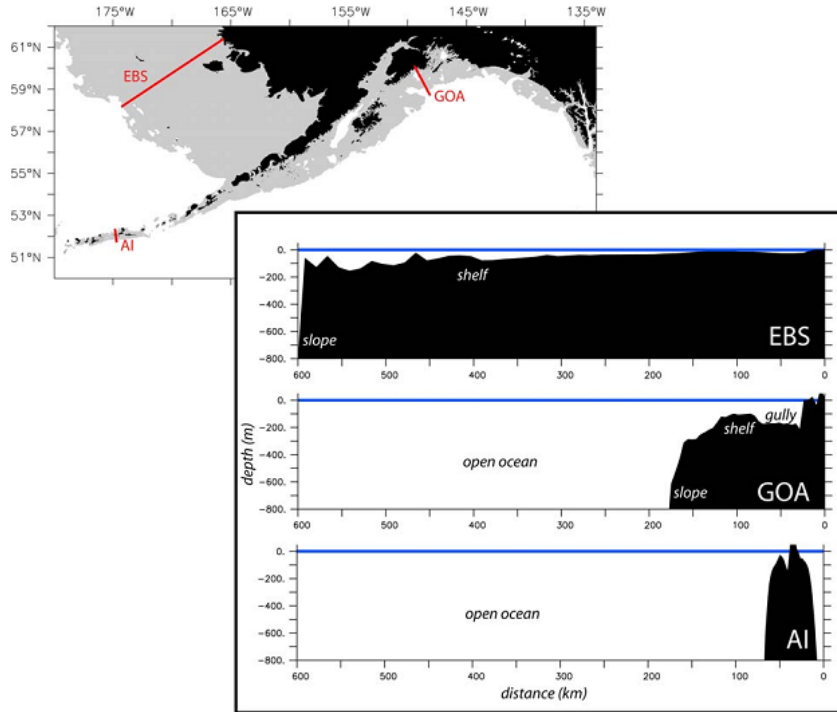


Figure 3-10 Aleutian Islands (AI) bathymetric profile and resulting oceanic-shelf-nearshore habitat proximity compared with other Alaskan ecosystems, to the Eastern Bering Sea (EBS) and the Gulf of Alaska (GOA).

- The Aleutian Islands form a boundary between the Bering Sea and the North Pacific
- Warmer to the south and colder to the north
- East to west orientation

Table 1. Depth and area of major passes in the Aleutian-Commander island arc (after Favorite, 1974; Ladd *et al.*, 2005a). Flow from Arsen'ev (1967) in Favorite (1974), and Stabeno *et al.* (2004).

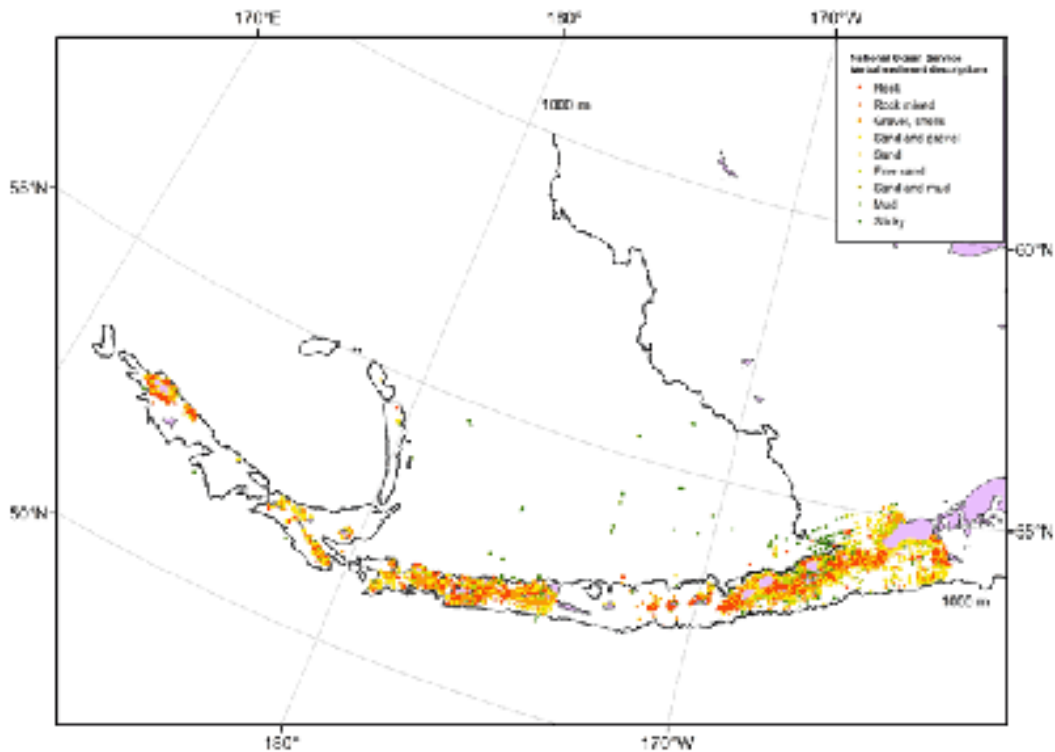
Region	Pass/strait	Depth (m)	Cross-sectional area (km ²)	Flow into Bering Sea (10 ⁶ m ³ s ⁻¹)
Eastern Aleutians	Unimak	52	1.0	0.1
	Akutan	30	0.1	0.1
	Umnak	7	1.6	??
	Regional total		3.9	~0.2
Central Aleutians	Samalga	200	3.9	??
	Chuginadak	210	1.0	??
	Herbert	275	4.8	??
	Yunaska	457	6.6	??
	Amukta	430	19.3	4.0
	Seguam	165	2.1	0.4
	Tanaga*	235	3.6	
	Amchitka*	1155	45.7	
	Regional total		87.0	>8.8
Western Aleutians	Kiska	110	6.8	
	Buldir	640	28.0	
	Semichi	105	1.7	
	Regional total		36.5	0.7
Commander-Near Straits	Near	2000	239	
	Commander	105	3.5	
	Regional total		242.5	14.4
Kamchatka Strait [†]		4420	335.3	2.6

Table listing average depth, estimated area, and estimated flow of the major passes between Aleutian islands

*Favorite gives the combined flow for Tanaga Pass and Amchitka Pass as 4.4 Sv.

[†]Below 3000 m.

Sediment types



- Green: Sand or Mud
- Red: Rock
- Orange: Gravel

Current Patterns

Hunt and Stabeno, 2005

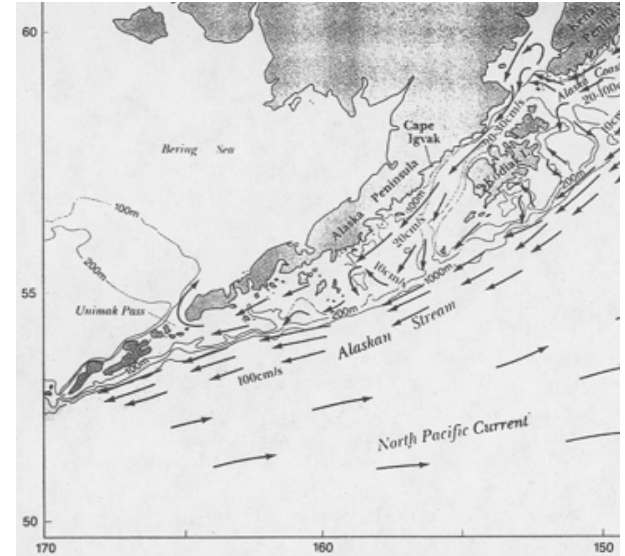
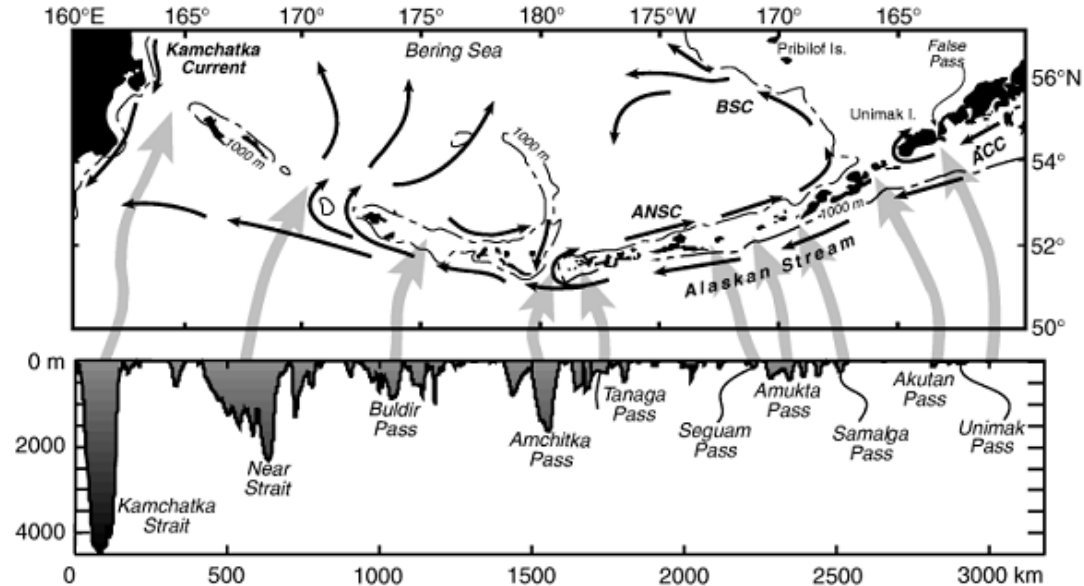
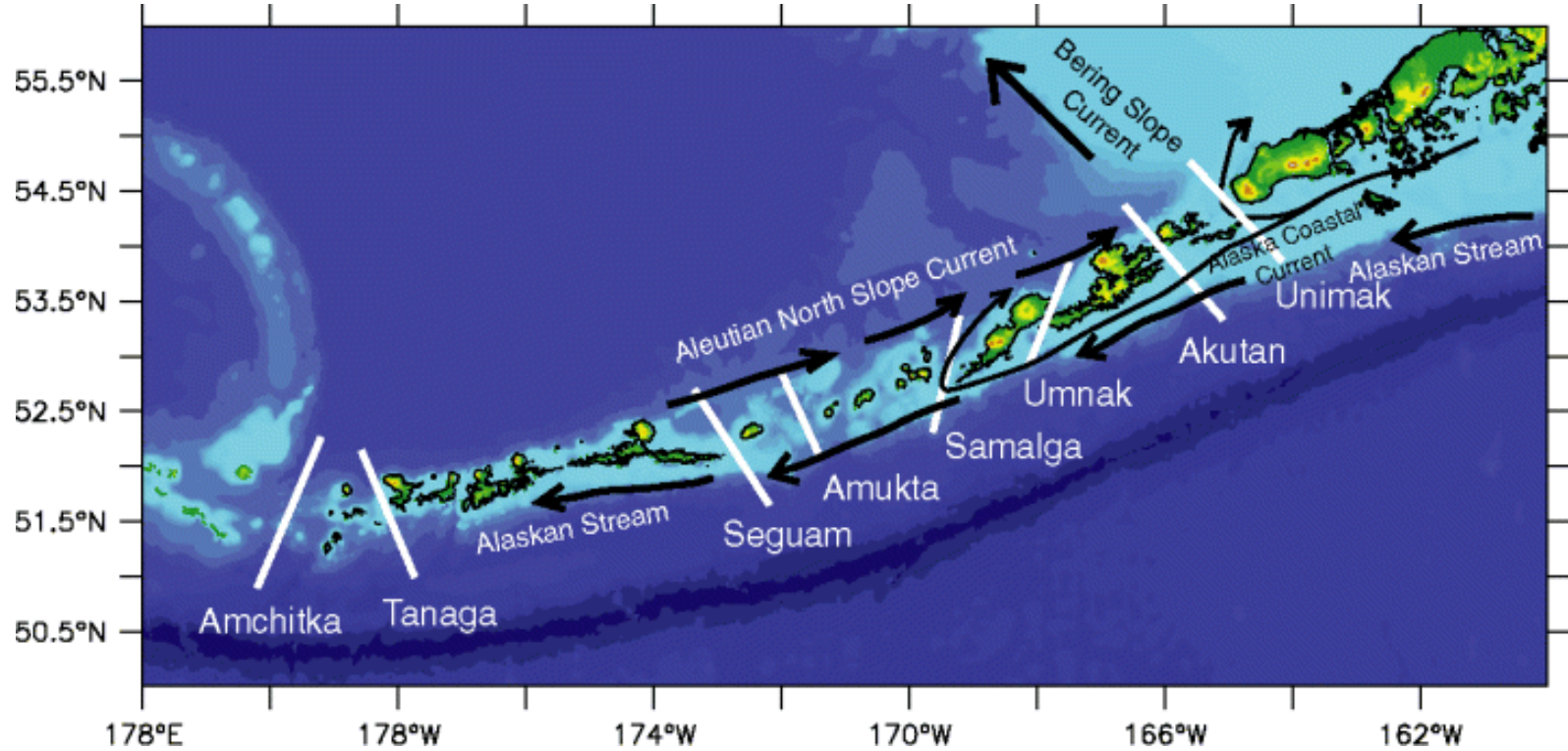


Figure 3-8 The mean circulation along the Aleutian Arc is shown together with geographic place names. The lower panel shows the depth of the passes in the Aleutian Arc.

Reprinted from Stabeno et al. 2005.

Note: ANSC = Aleutian North Slope Current, ACC = Alaska Coastal Current, BSC = Bering Sea Current.

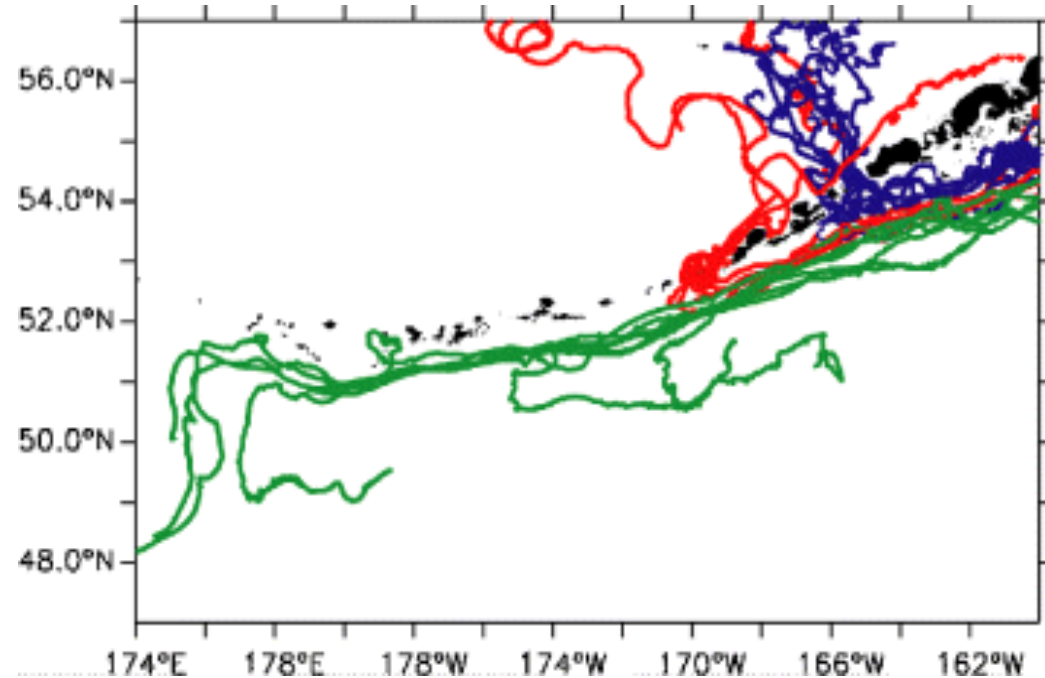
Major currents affecting the Aleutian Islands



(Ladd et al 2005)

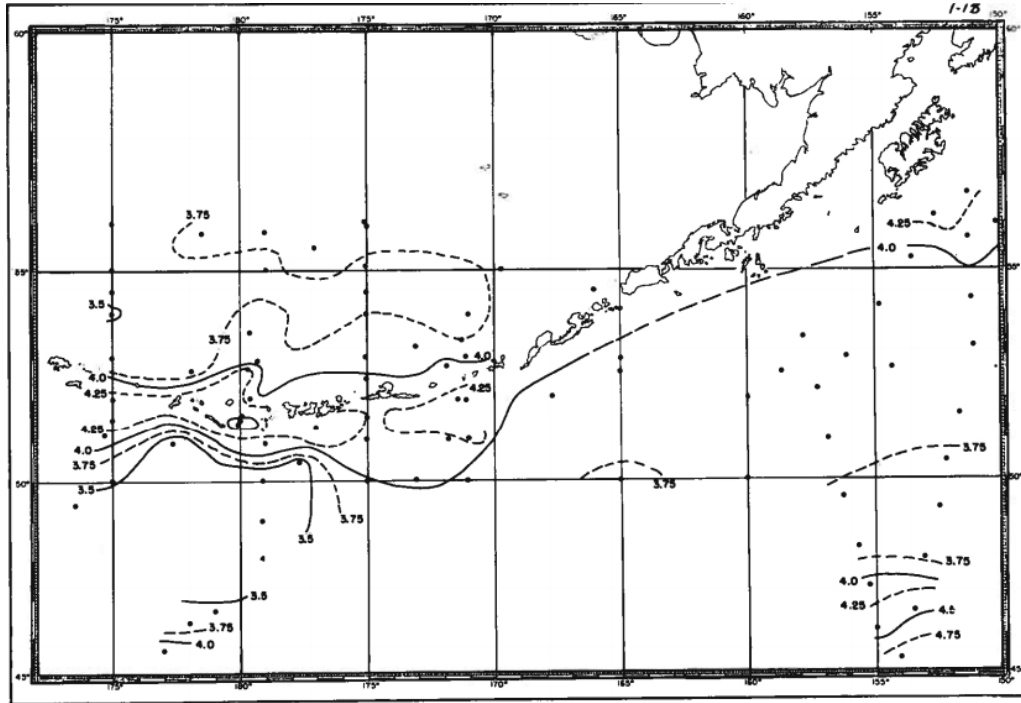
Currents Cont.

Ladd et al., 2005



- Drifters in the shallowest water (Blue) go through Unimak Pass.
- Drifters placed in deeper water by the shelf-break (Red) go through Samalga Pass.
- Offshore drifters beyond the shelf (Green) become part of the Alaskan Stream and continue westerly along the south side of the Islands.
- Drifters on the shelf follow along the Alaska Coastal Current.
- Mixed water of the eastern passes (Unimak Pass) show evidence of lateral mixing between the North Pacific and the Bering Sea (74% Pacific water 26% Bering Sea water).

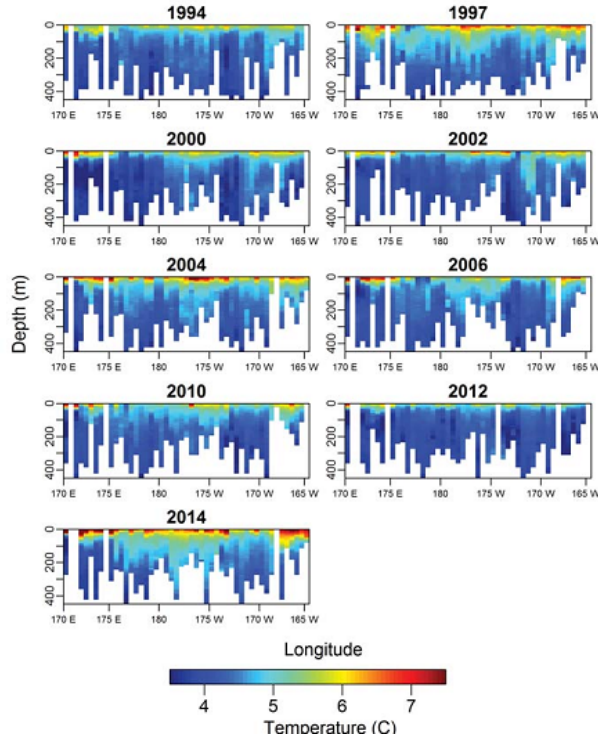
Temperature



Intense vertical mixing in the upper layers shows colder waters at the surface around the Aleutian Islands compared to the Bering Sea and North Pacific.

FIGURE 18. Temperature (°C.) at 300 meters, July—August, 1957. Dots indicate station positions.

Temperature Cont.



- Higher temperature at depth around the Aleutian Islands compared to the Bering Sea and North Pacific.
- This is thought to be a result of advection.

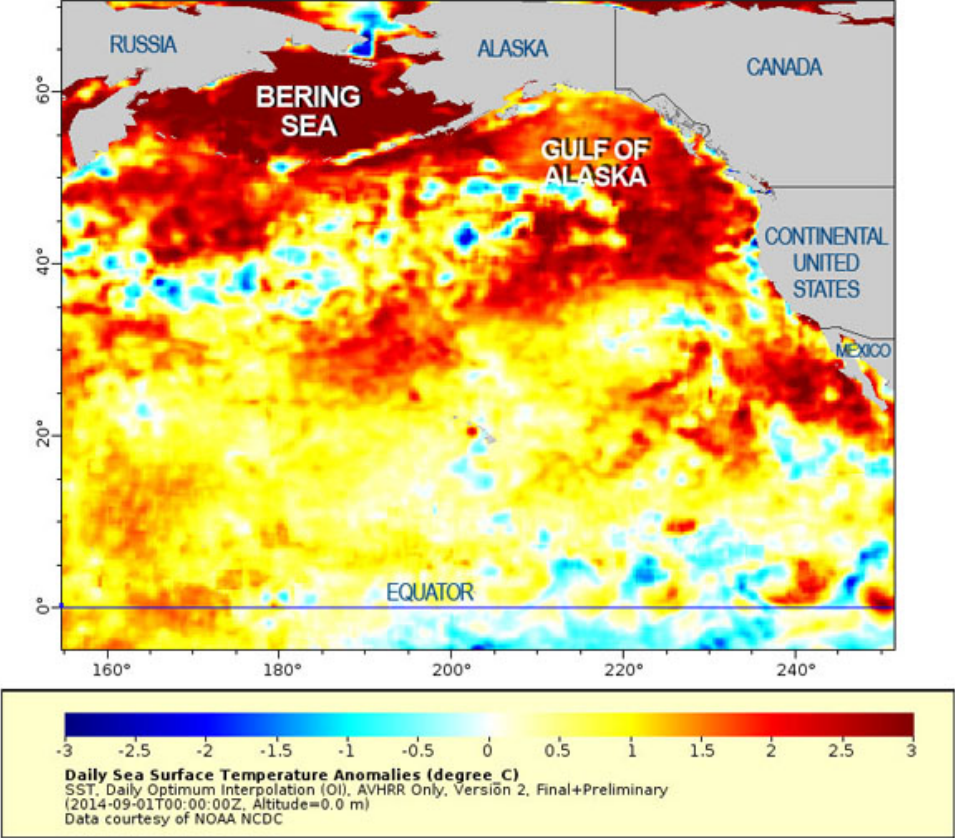
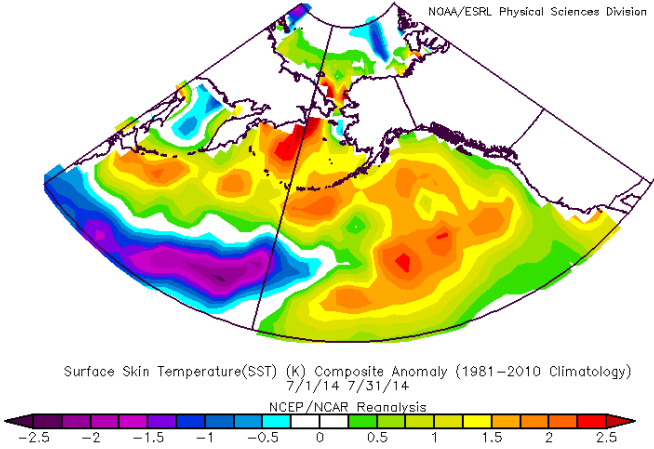
Average temperatures

Summer: 7 – 14°C (45 -57°F)

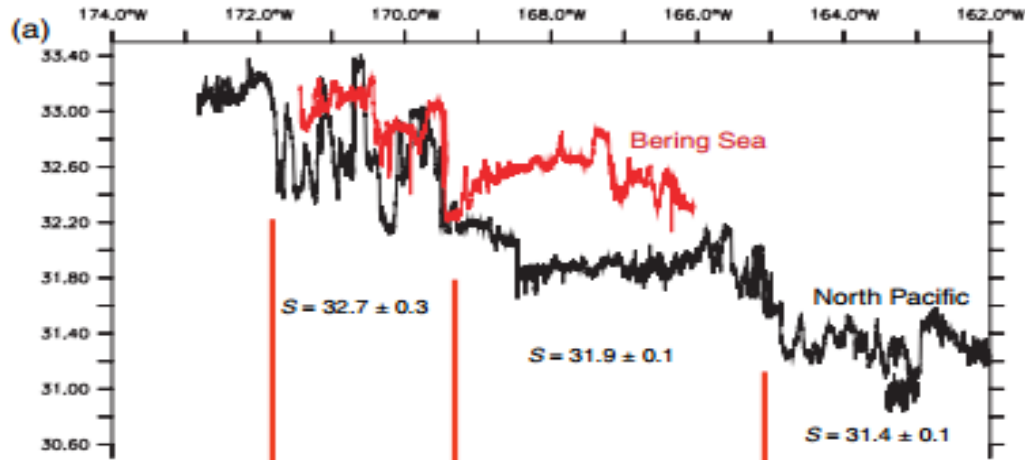
Winter: -3 – 3°C (27 – 37°F)

Warm Pool of September 2014

July 2014 data



Salinity



Ladd et al., 2005

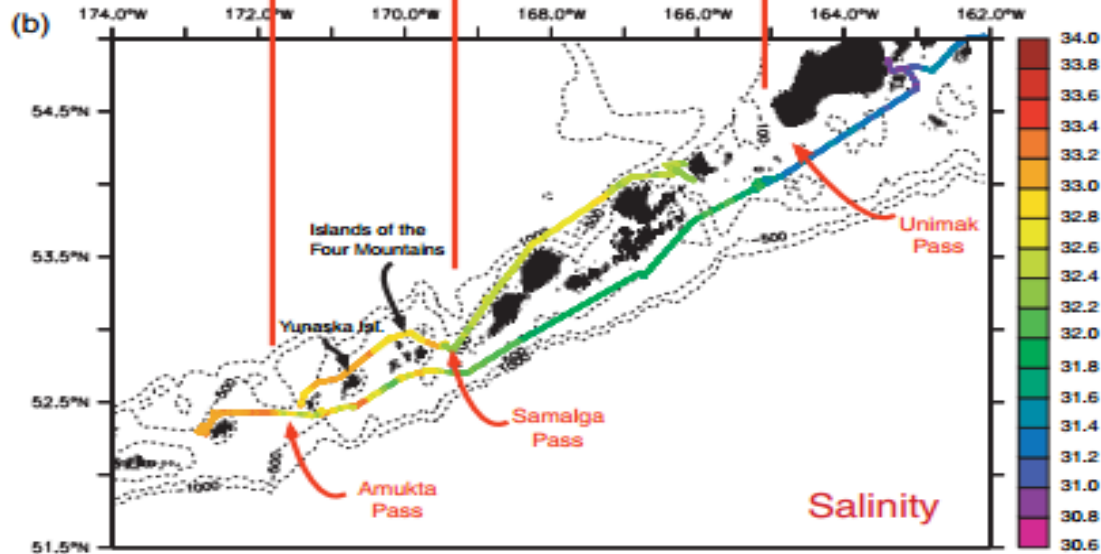
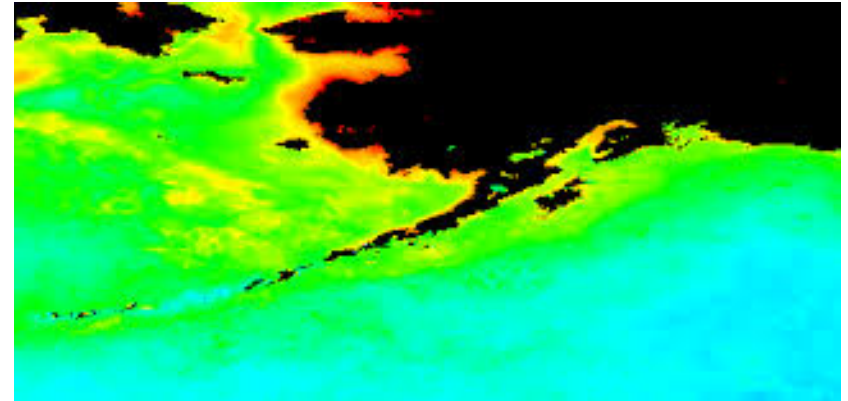
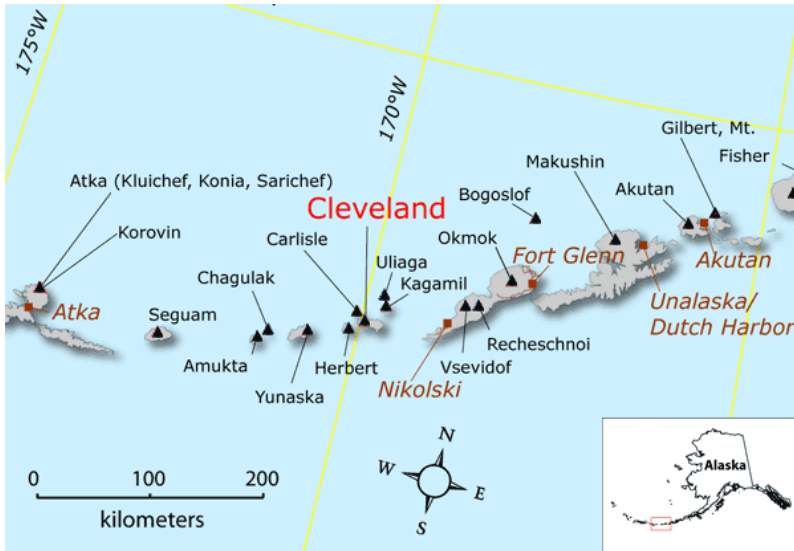


Figure 2. Sea surface salinity (psu) measured underway on the 2001 cruise (from Ladd et al., 2005a). (a) Salinity plotted against longitude south of the Aleutian Islands (black) and north of the islands (red). (b) Average along-track salinity by region, including the region east of Unimak Pass, between Unimak and Samalga Passes, and between Samalga and Amukta Passes.

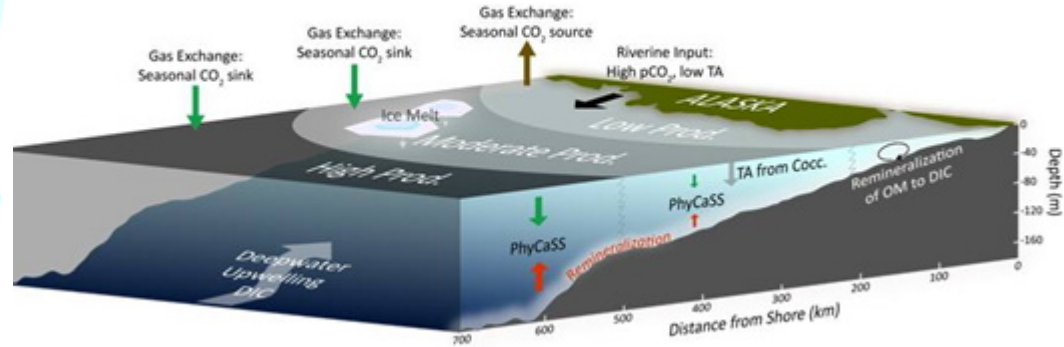
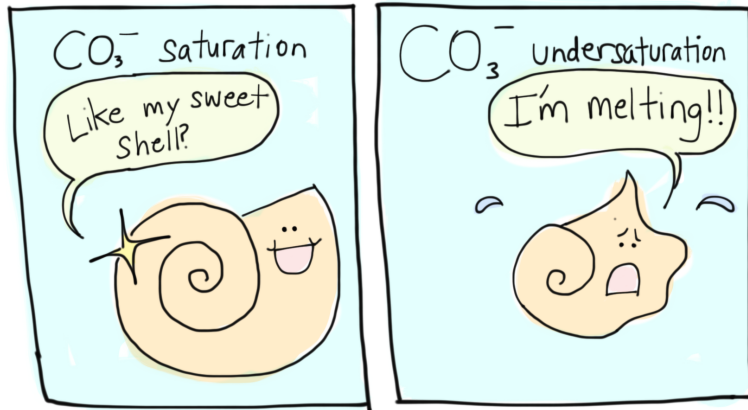
Chemistry of the Aleutians

- Aleutian Volcanic Arc is unique
- Nutrient Variation (nitrate, phosphate, silicic acid):
 - Alaska Coastal Current (ACC) and Alaskan Stream (AS)
- The passes mix the nutrients through the water column

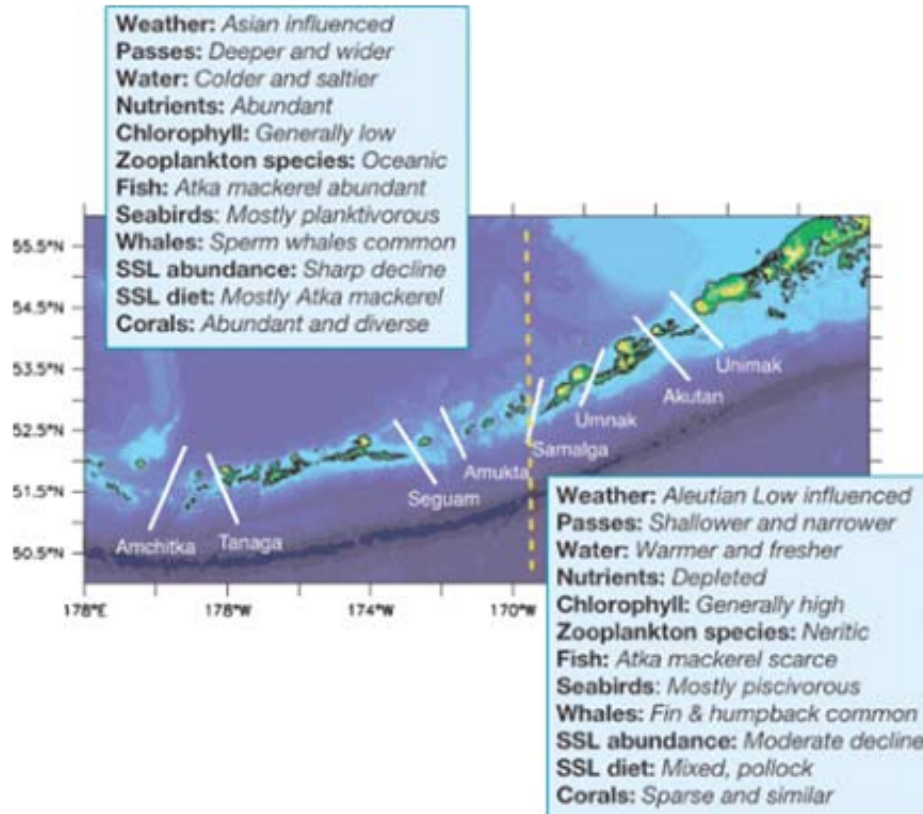


The fragility of the ecosystem and the terror of climate change

- pH is smaller than lower latitudes
- Acidification from:
 - Less sea ice (bio, T-alk, SA), anthropogenic CO₂
- In Bering Sea: omega of 1.5-2, GOA is a little higher



Aleutian Island Dichotomy



Hunt and Stabeno,
2005

[Figure BS-9] Many Aleutian marine environmental attributes change in the vicinity of Samalga Pass, suggesting that the marine ecosystem of the archipelago may be differentiated into multiple, ecologically distinct regions. Future examination of status and trends in the Aleutians may require separate examination of these marine eco-regions. (From Hunt and Stabeno 2005).

The Aleutian Low



A low pressure center that may be located east of 180°W or be split in two:

- One center located east of the Kamchatka peninsula
- One in the Gulf of Alaska.
- Dominant storm crossing Aleutians between 170°W and 150°W
- Variable precipitation of 75 -160cm/year