Ecoregional analysis of nearshore sea-surface temperature in the North Pacific

Meredith C. Payne &
Deborah A. Reusser

Oregon State University OSU College of Oceanic and Atmospheric Sciences

USGS science for a changing world

Cheryl A. Brown &
Henry Lee II

United States Environmental Protection Agency

Overview

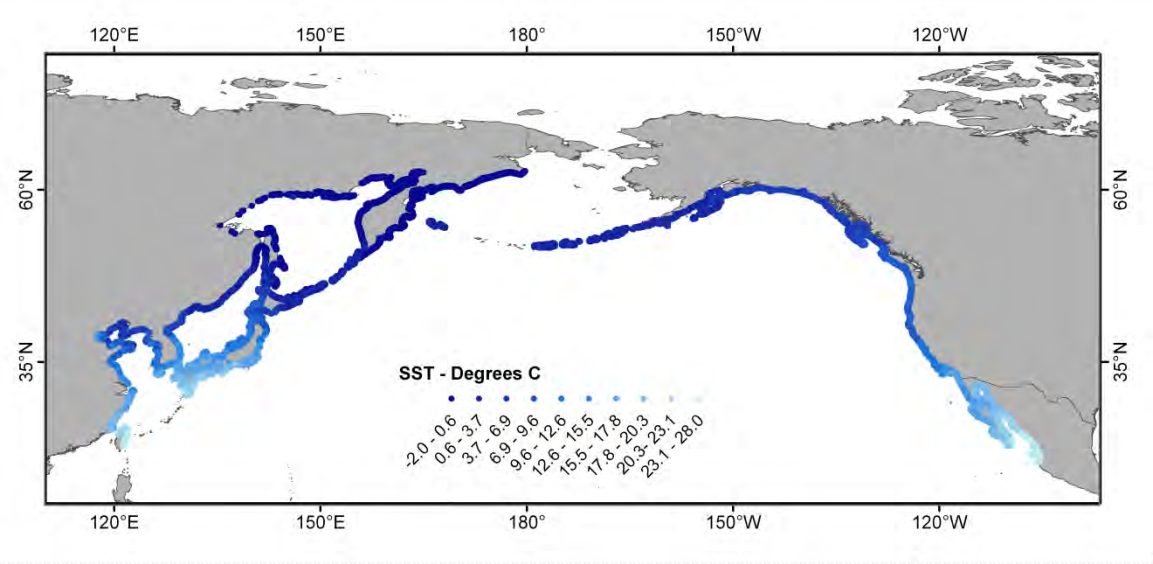
- Generate a sea surface temperature (SST) dataset for nearshore regions of the North Pacific.
- Make data publically available. http://pubs.usgs.gov/of/2010/1251/index.html
- Examine SST patterns in the North Pacific using Marine Ecoregions of the World (MEOW) as a geographic framework.
- Ultimate goal: Relate to biogeography and climate change studies.

Methods

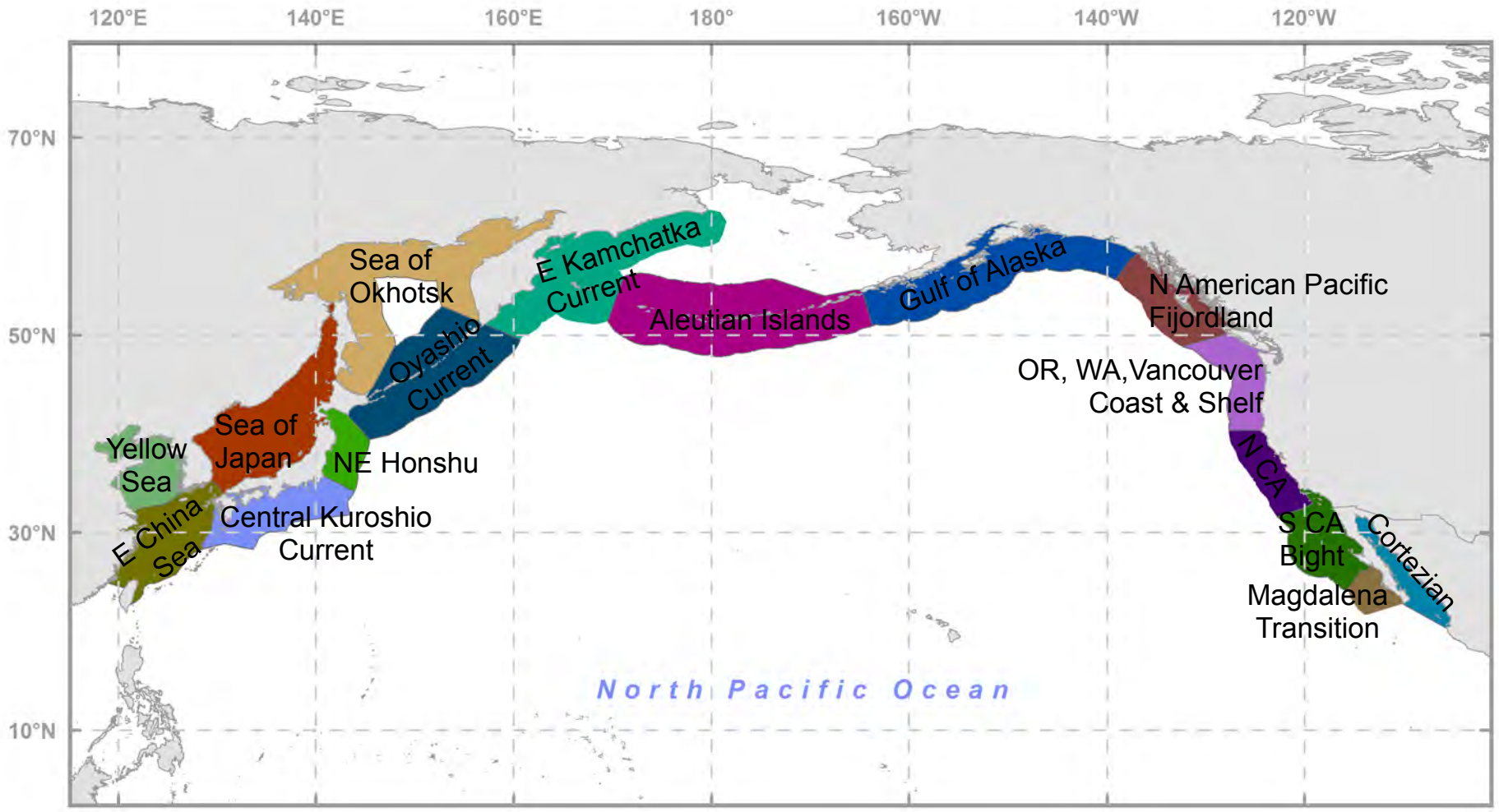
- Obtained data online from NASA and NOAA.
- Processed the data with geospatial and analytical tools.
  - ArcGIS (ESRI) – produce geospatial data layers and files.
  - Marine Geospatial Ecology Tools (MGET – Duke, Univ.) – work with HDF-SDS file reading and conversion for use in ArcGIS.
  - Python – batch geoprocessing to obtain shapefiles and ESRI grid files.
  - R – creation of text data files and databases.
  - PRIMER – clustering, nMDS analysis.
- In addition to geospatial files, the data were stored in Access databases for statistical, plotting, and clustering analyses.

Nearshore SST Data

- Pathfinder V. 5.x
- Monthly-mean SST
- 4 km equal-angle grid cells
- Global coverage
- 09/1981 - 12/2009
- Calibrated with *in situ* data including match-up buoy data
- Within 16 km of coastline.

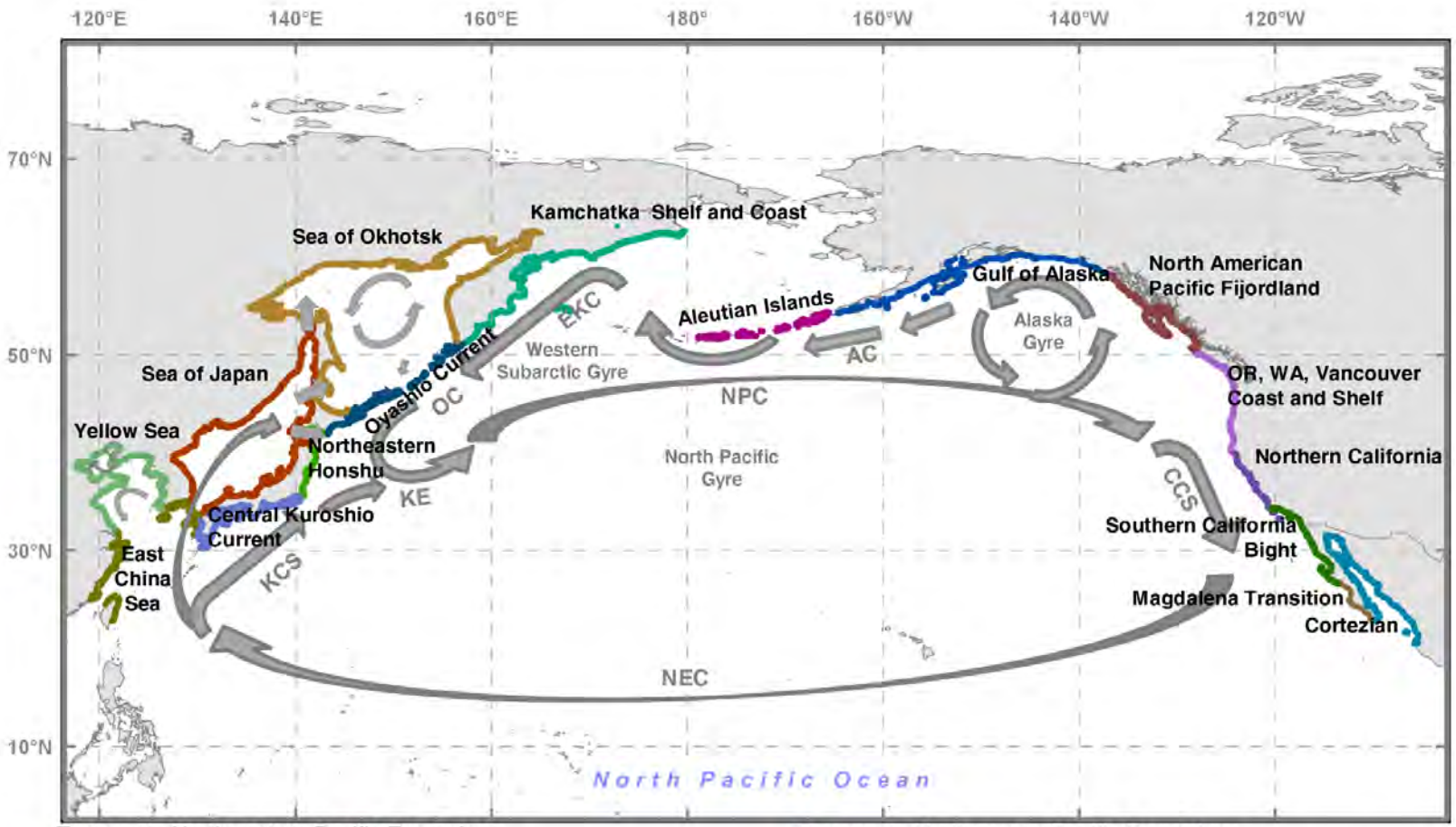


MEOW: Temperate Northern Pacific Ecoregions

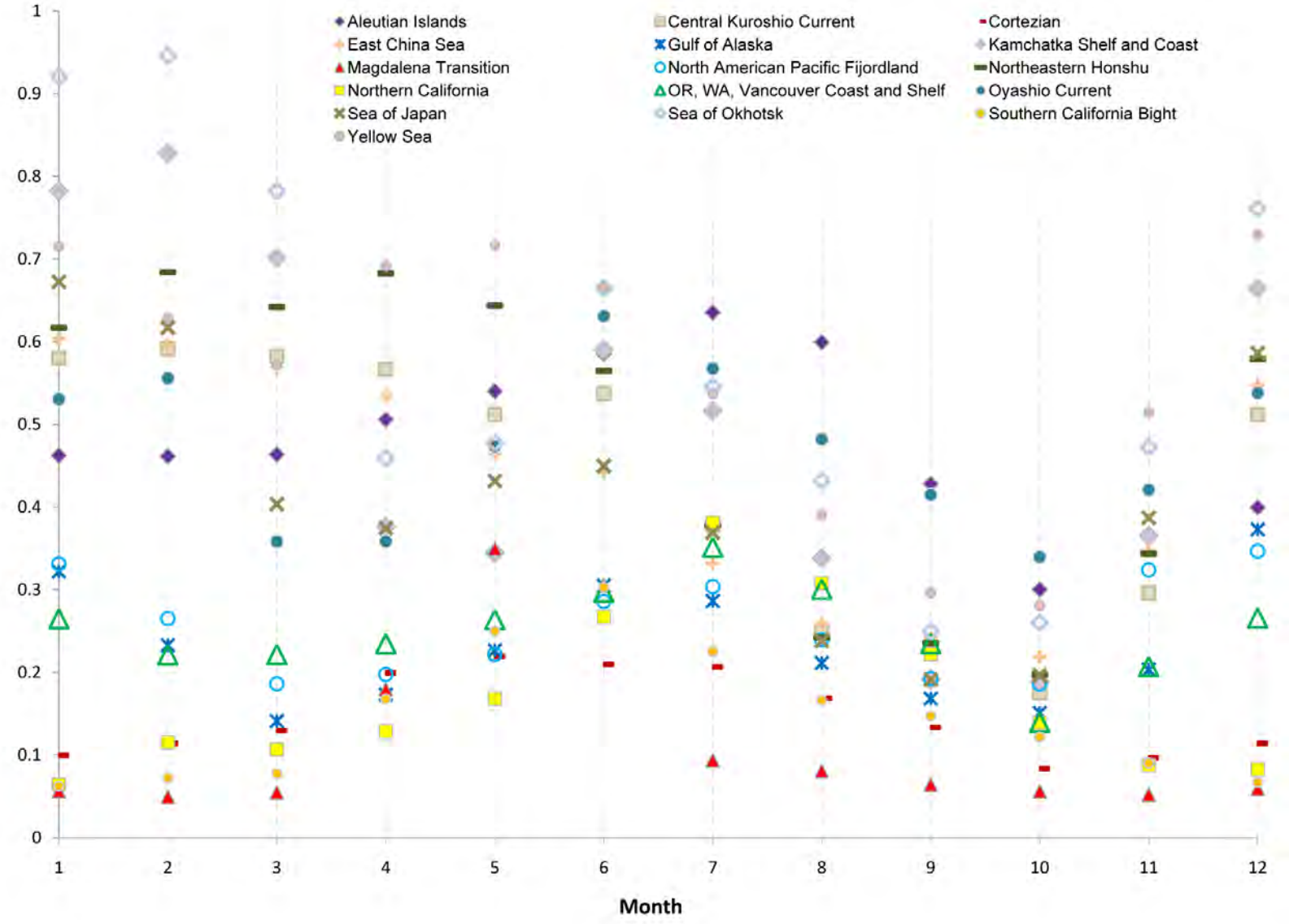


Data from Spalding *et al.*, 2007

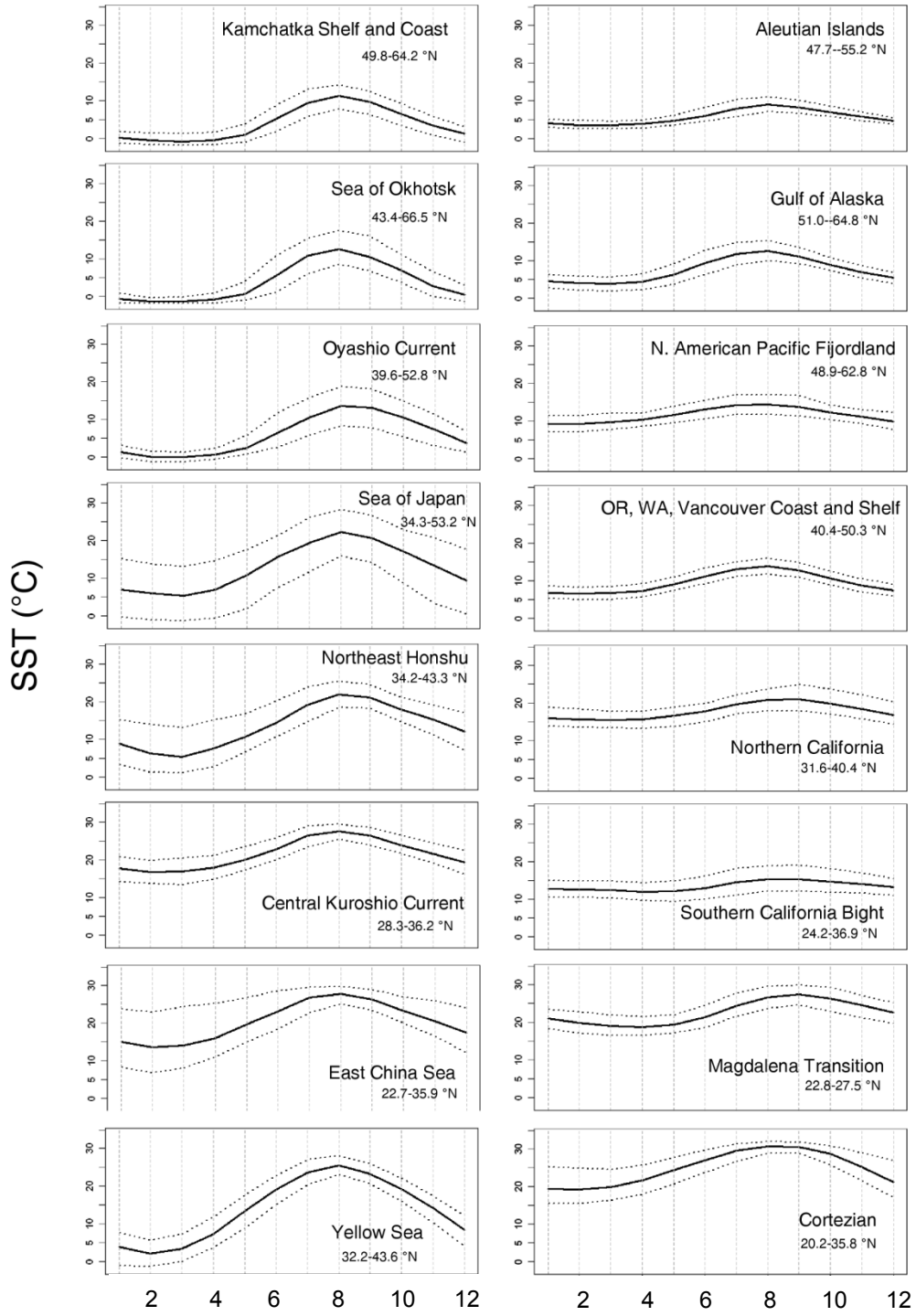
North Pacific Ecoregions and Ocean Circulation

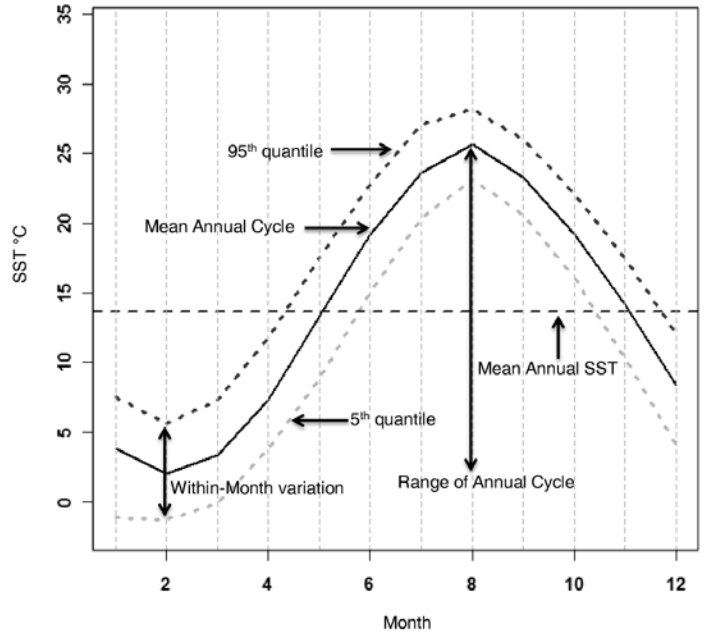


Challenges: missing data by ecoregion



Seasonal SST Curves

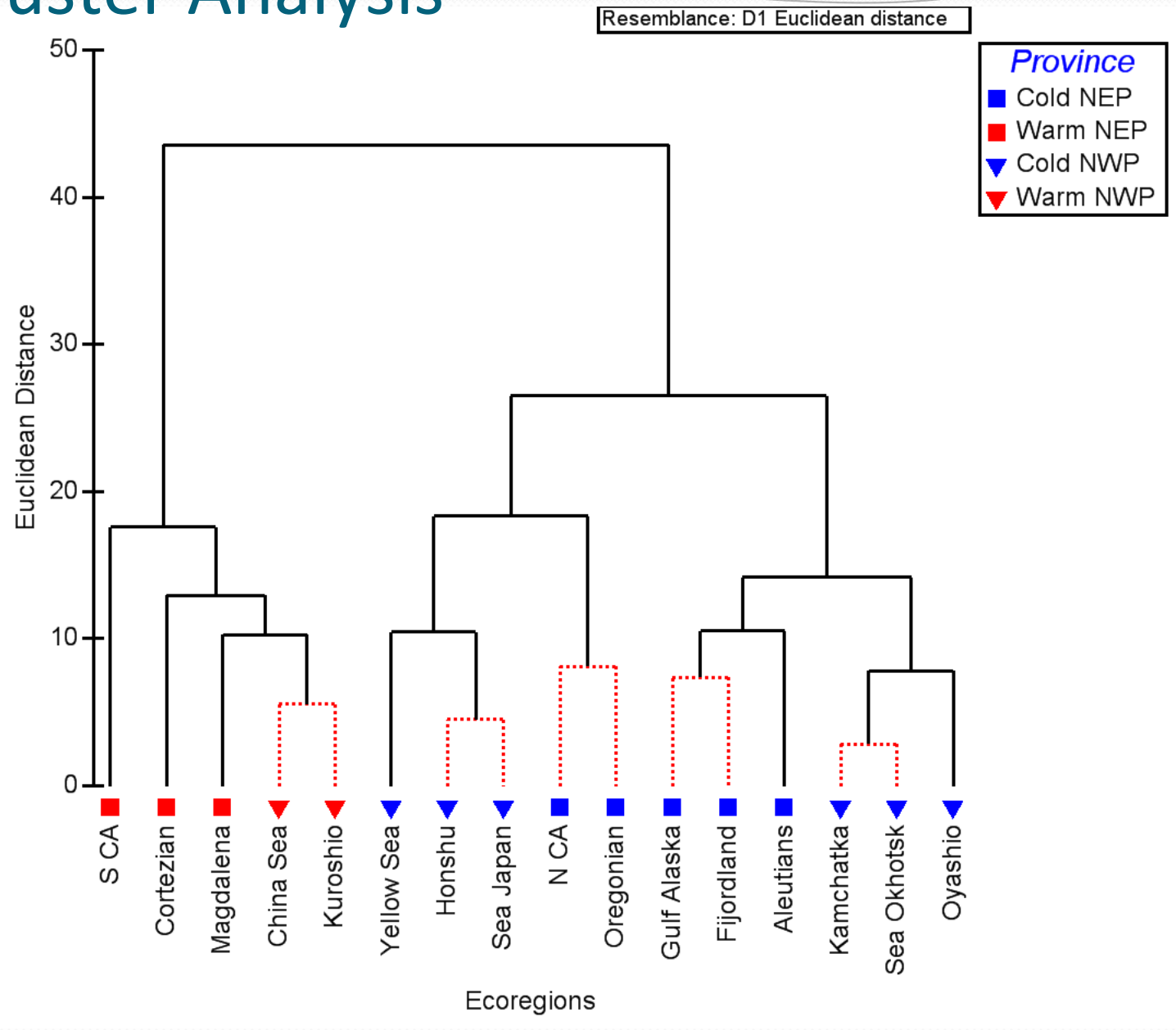




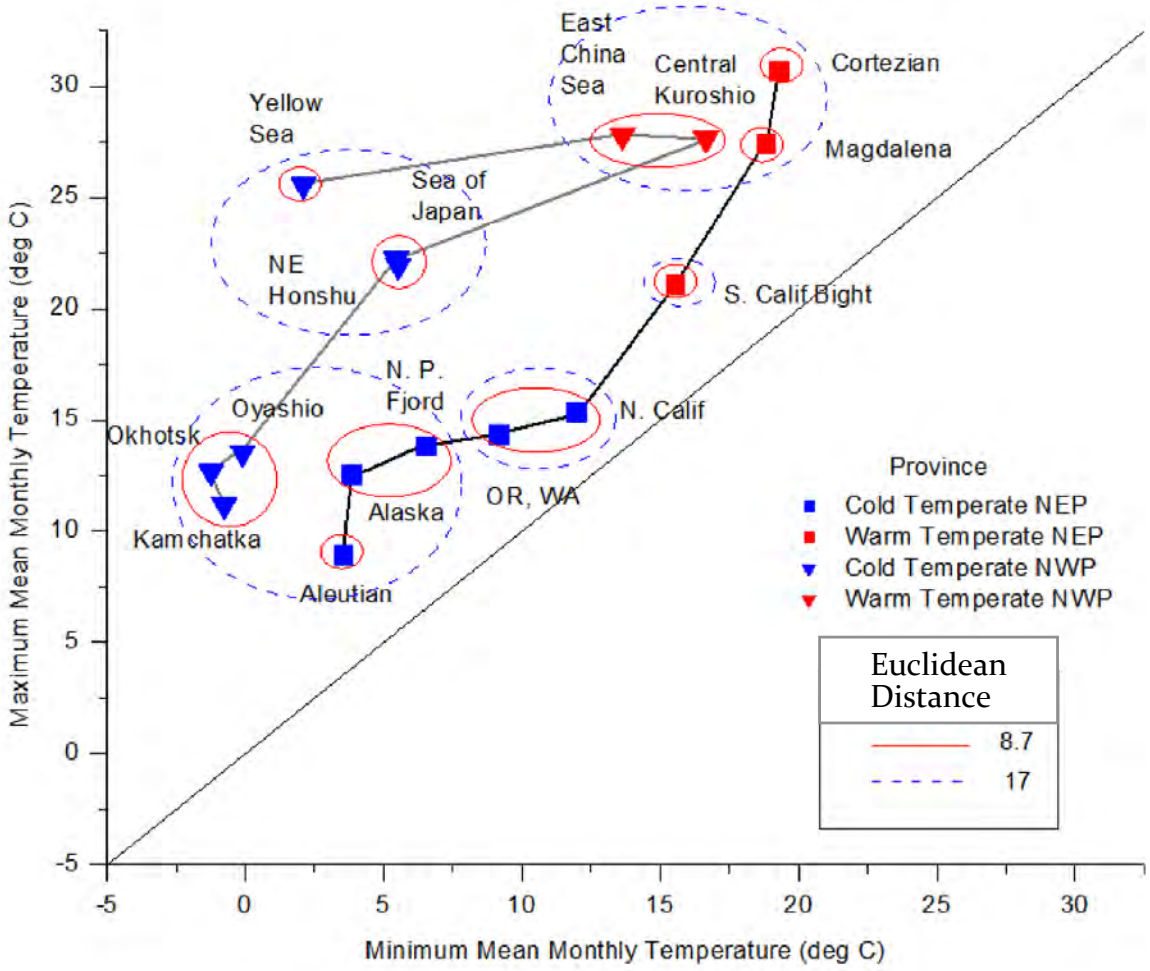
- Annual cycle explains most of variance in SST
- Within-month variation generally larger at lower latitudes and during winter months

Province	Ecoregion	Latitude °N	Longitude °E	Temperature (°C)				29-year variance (°C²)	% of variance explained by annual cycle
				29-year Mean	Min. Monthly Mean	Max. Monthly Mean	Range of Annual Cycle		
Cold Temperate Northeast Pacific	Aleutian Islands	47.7 - 55.2 *(52.6)*	169.6 – -163.8 *(-172.3)*	5.7	3.5	9	5.4	4.1	80.5
	Gulf of Alaska	51.0 - 64.8 *(58.0)*	-164.7 – -136.9 *(-151.9)*	7.4	3.8	12.6	8.7	11.5	83.2
	N. American Pac. Fijordland	48.9 - 62.8 *(53.9)*	-139.1 – -120.9 *(-131.8)*	9.5	6.5	13.9	7.4	8.2	82.6
	OR, WA, Vancouver	40.4 - 50.3 *(45.9)*	-132.3 – -119.4 *(-124.9)*	11.5	9.2	14.4	5.2	5.4	63.0
	Northern CA	31.6 - 40.4 *(36.8)*	-127.7 – -116.9 *(-122.1)*	13.5	12	15.4	3.4	4.2	31.1
Warm Temperate Northeast Pacific	S. CA Bight	24.2 - 36.9 *(30.8)*	-122.7 – -113.7 *(-116.6)*	17.8	15.5	21.1	5.6	7.0	58.6
	Cortezian	20.2 - 35.8 *(26.7)*	-115.8 – -102.0 *(-110.8)*	24.8	19.3	30.7	11.5	23.2	77.8
	Magdalena Transition	22.8 - 27.5 *(24.8)*	-115.7 – -109.8 *(-111.8)*	22.6	18.8	27.4	8.6	12.3	74.1
Cold Temperate Northwest Pacific	Sea of Okhotsk	43.4 - 66.5 *(56.1)*	131.6 – 168.4 *(148.9)*	3.9	-1.3	12.7	13.9	28.9	82.9
	Kamchatka Coast	49.8 - 64.2 *(58.2)*	157.1 – 179.9 *(166.6)*	3.8	-0.8	11.2	11.9	20.5	85.9
	Oyashio Current	39.6 - 52.8 *(46.3)*	142.7 – 160.6 *(149.9)*	5.8	-0.1	13.5	13.6	30.8	81.3
	Northeastern Honshu	34.2 - 43.3 *(40.1)*	139.6 – 145.4 *(141.4)*	13.4	5.5	21.9	16.4	36.2	79.8
	Sea of Japan	34.3 - 53.2 *(42.4)*	125.6 – 142.9 *(136.8)*	12.8	5.5	22.3	16.8	59.1	58.2
	Yellow Sea	32.2 - 43.6 *(37.5)*	113.1 – 128.0 *(122.2)*	13.6	2.1	25.6	23.5	71.2	93.5
Warm Temperate Northwest Pacific	Central Kuroshio Current	28.3 - 36.2 *(33.4)*	128.5 – 143.7 *(134.0)*	21.5	16.7	27.7	11.0	17.7	80.6
	East China Sea	22.7 - 35.9 *(30.3)*	113.5 – 130.7 *(124.3)*	20.3	13.6	27.8	14.2	31.8	70.7

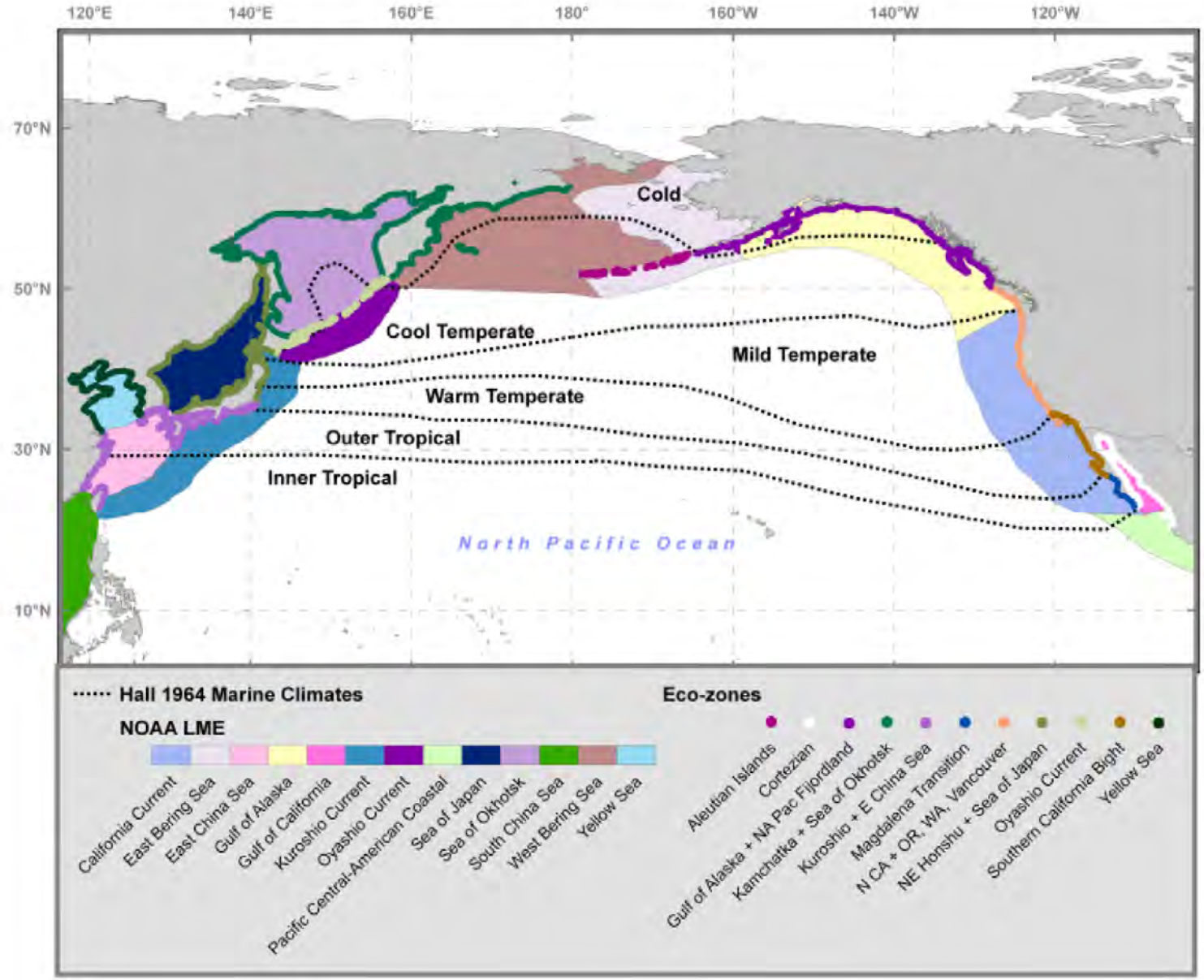
Cluster Analysis



Seasonal Similarity Analysis



Biogeographic Schema



Conclusions

- 4-km SST dataset for N. Pacific coast available at http://pubs.usgs.gov/of/2010/1251/index.html
- Broad-scale ocean surface circulation dictates mesoscale SST patterns.
- Challenges associated with cloud cover do not eliminate the value of using AVHRR SST in nearshore regions.
- Clustering/MDS provide new methods for investigating ecoregion-scale SST trends.
- Nearshore SST patterns alone provide a useful paradigm for classifying biogeographic zones at multiple scales.

Acknowledgements:

- EPA & USGS
- Oregon State University & CIOSS

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