High-Resolution Seasonal Forecasts of Northeast Pacific Physics and Biogeochemistry

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NOAA Physical Sciences Laboratory

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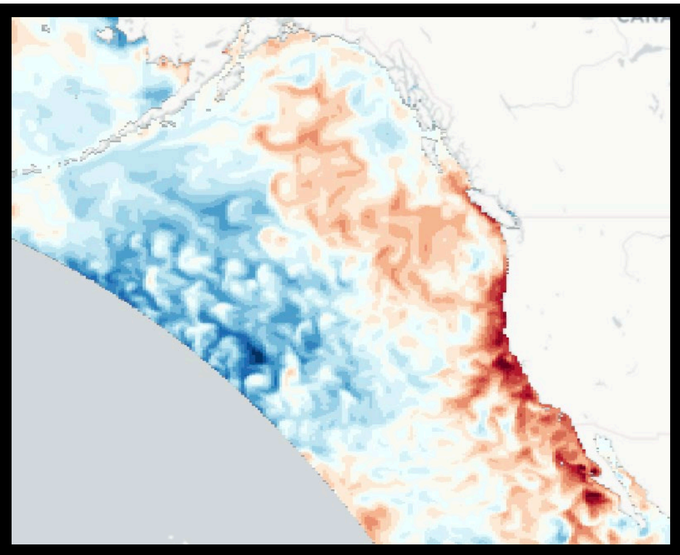
NOAA's Changing Ecosystems and Fisheries Initiative (CEFI)

Provide ocean forecasts and decision support tools that enable resource managers and stakeholders to adapt to changing ocean conditions and related impacts on marine ecosystems and fisheries






CEFI is developing regional ocean modeling capabilities for all U.S. coastlines

Regional ocean - sea ice - biogeochemistry model

MOM6 ocean model

COBALT biogeochemistry

~10 km resolution

Products (frequency)

Historical (annual update)

Seasonal forecast (4x per year)

Decadal forecast (1x per year)

Long-term projection (every ~5 years)

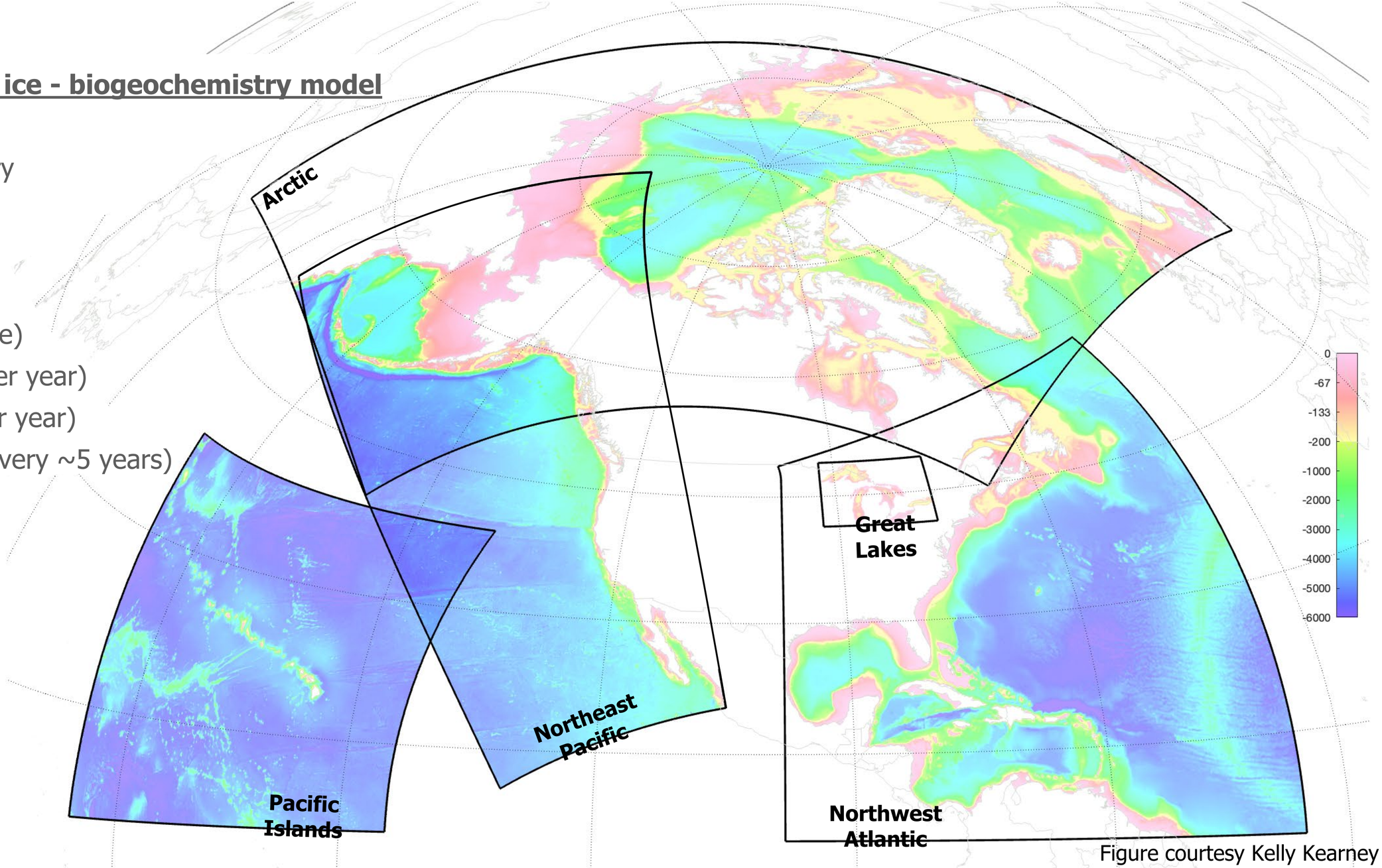


Figure courtesy Kelly Kearney

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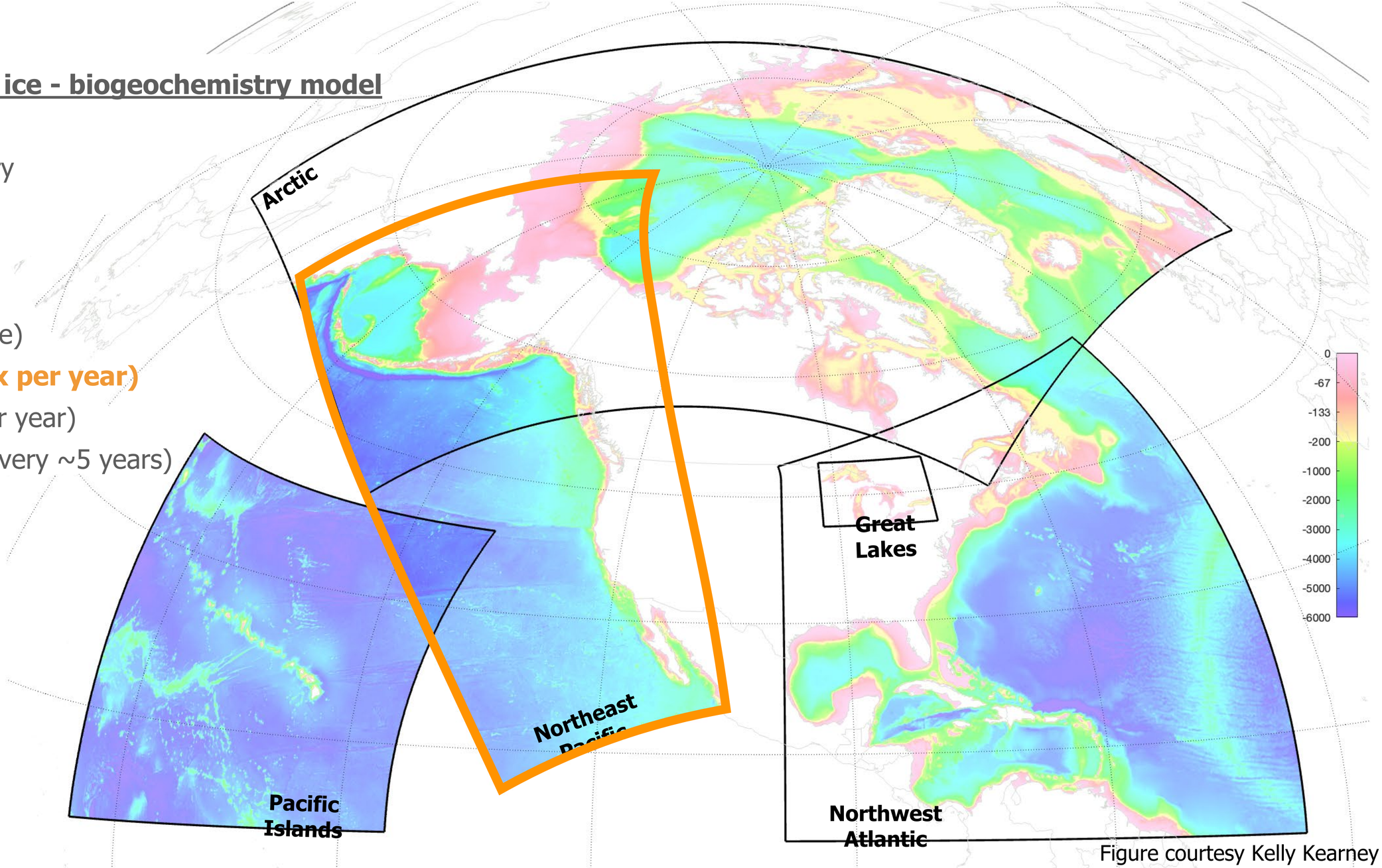


Figure courtesy Kelly Kearney

Seasonal Forecasts for the Northeast Pacific

Forcing from GFDL-SPEAR global forecasts

Physics + biogeochemistry

~10 km resolution

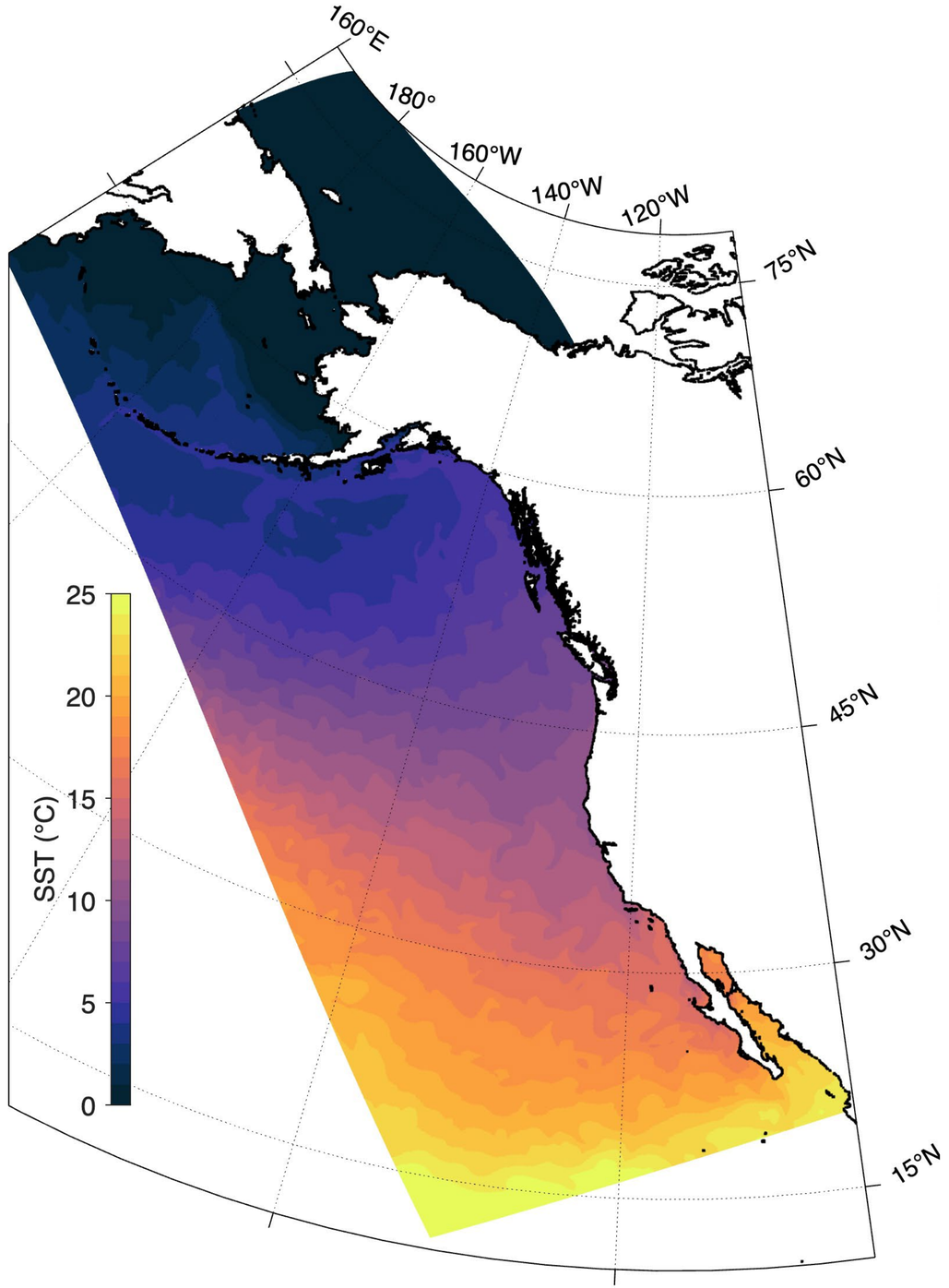
Initialized 4x per year (Jan, Apr, Jul, Oct)

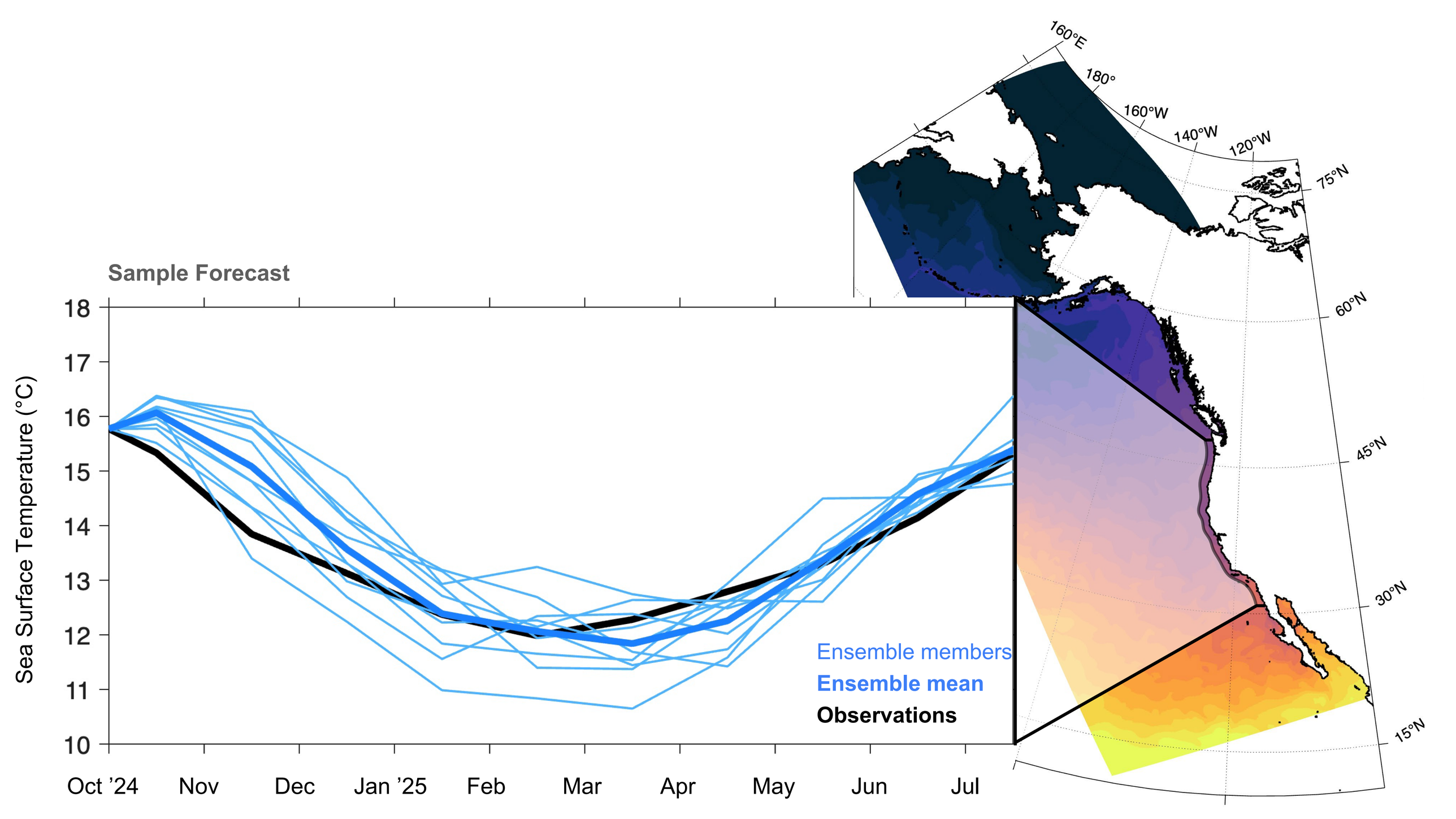
10 ensemble members

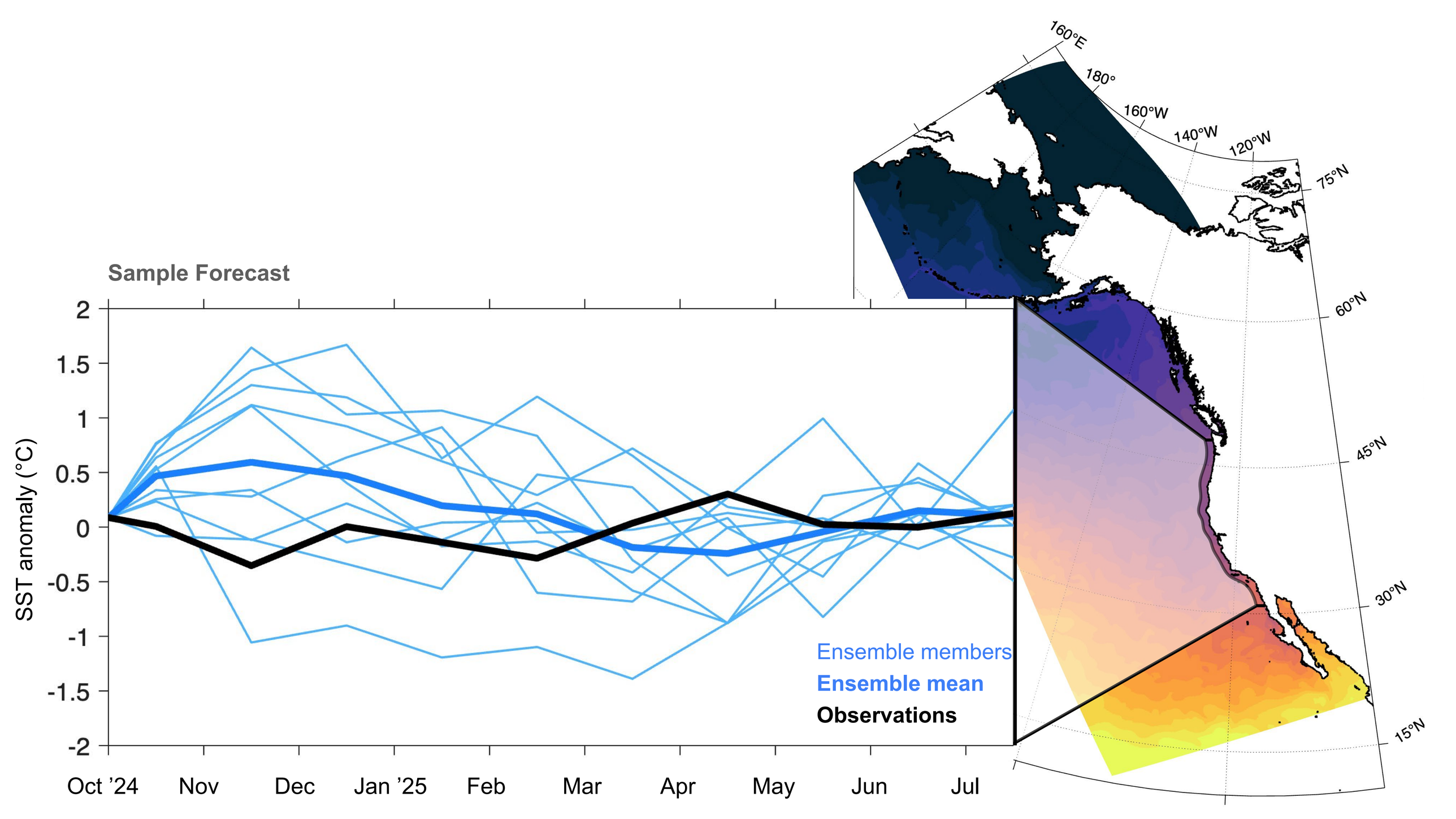
12-month forecasts

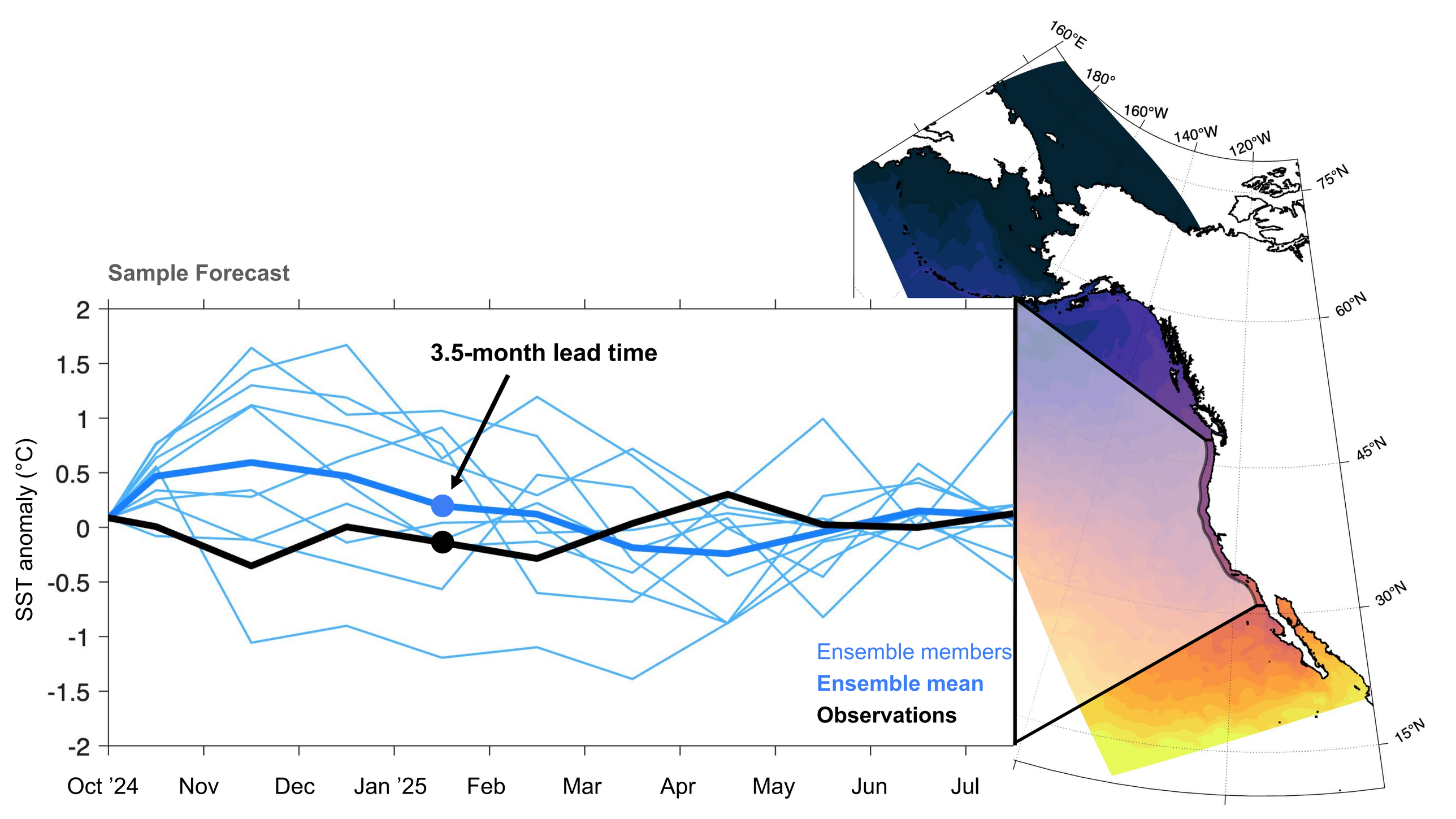
Retrospective forecasts for 1993 – 2025

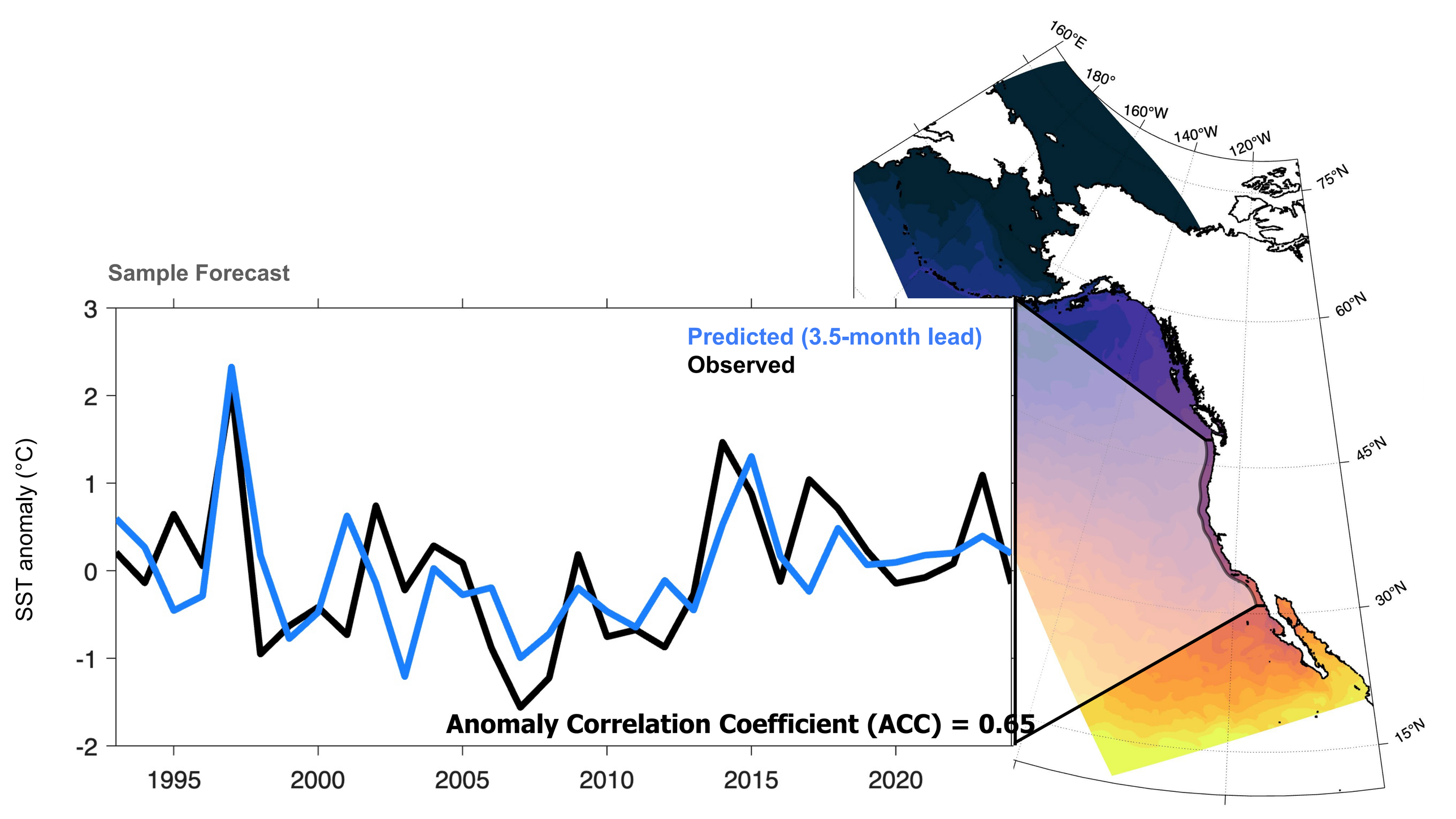
Real-time forecasts started Oct 2026

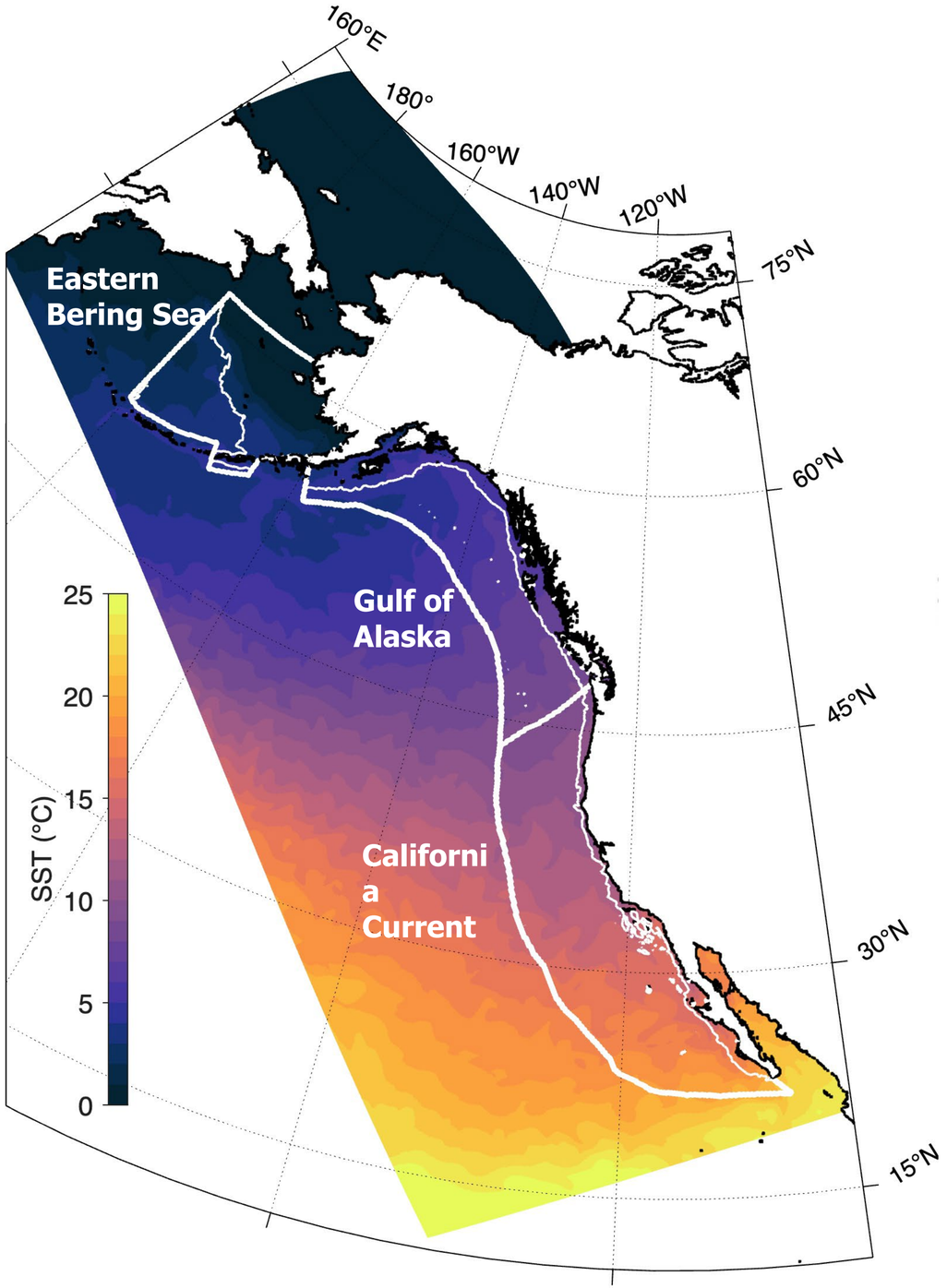


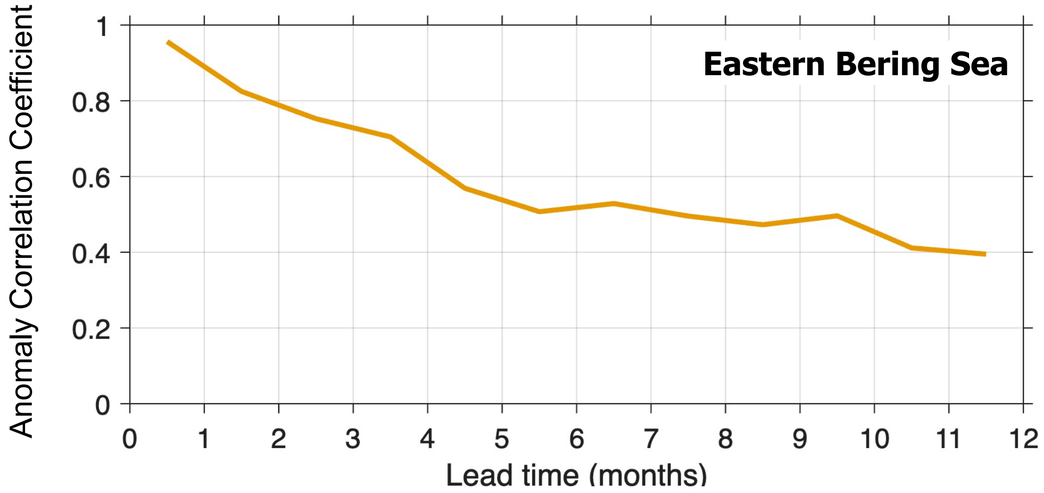

Sample Forecast
Sea Surface Temperature (°C)
18
17
16
15
14
13
12
11
10
Oct '24
Nov
Dec
Jan '25
Feb
Mar
Apr
May
Jun
Jul
Ensemble members
Ensemble mean
Observations
160°E
180°
160°W
140°W
120°W
75°N
60°N
45°N
30°N
15°N

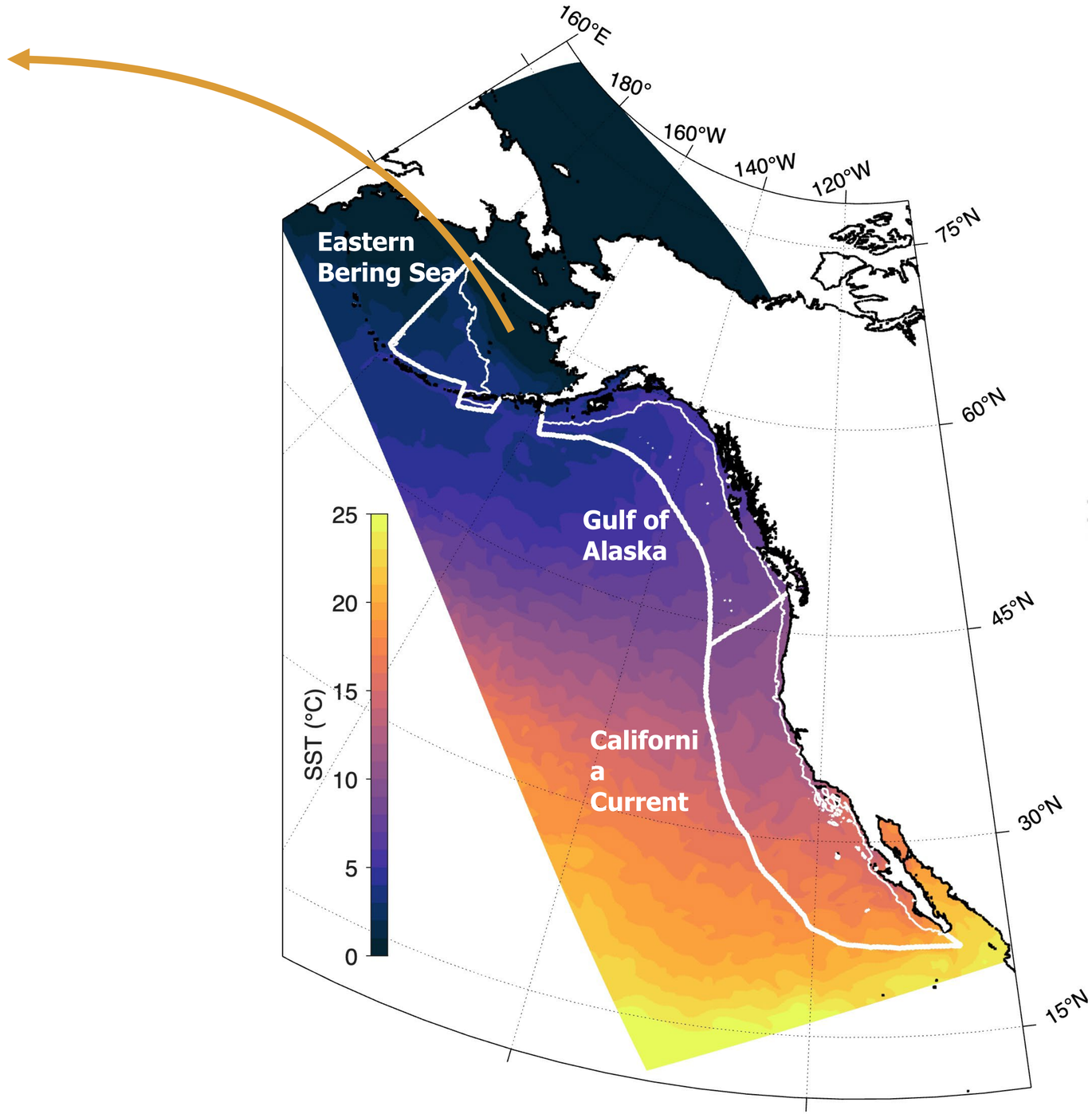

Sample Forecast
SST anomaly (°C)
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
Oct '24
Nov
Dec
Jan '25
Feb
Mar
Apr
May
Jun
Jul
Ensemble members
Ensemble mean
Observations
160°E
180°
160°W
140°W
120°W
75°N
60°N
45°N
30°N
15°N

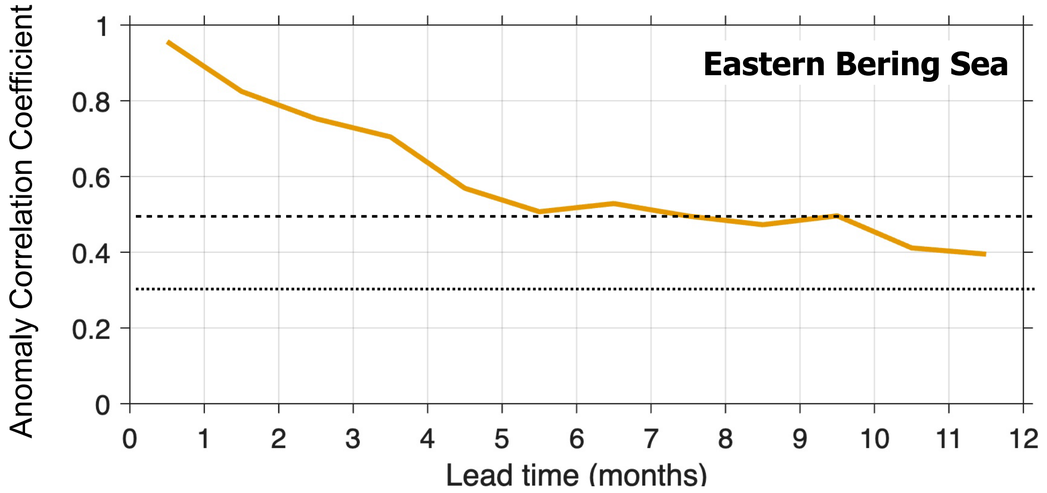

Sample Forecast
SST anomaly (°C)
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
Oct '24
Nov
Dec
Jan '25
Feb
Mar
Apr
May
Jun
Jul
3.5-month lead time
Ensemble members
Ensemble mean
Observations
160°E
180°
160°W
140°W
120°W
75°N
60°N
45°N
30°N
15°N


Sample Forecast
Predicted (3.5-month lead)
Observed
Anomaly Correlation Coefficient (ACC) = 0.65
SST anomaly (°C)
3
2
1
0
-1
-2
1995
2000
2005
2010
2015
2020
160°E
180°
160°W
140°W
120°W
75°N
60°N
45°N
30°N
15°N


160°E
180°
160°W
140°W
120°W
75°N
60°N
45°N
30°N
15°N
Eastern
Bering Sea
Gulf of
Alaska
Californi
a
Current
SST (°C)
25
20
15
10
5
0


Eastern Bering Sea
Anomaly Correlation Coefficient
Lead time (months)
0
0.2
0.4
0.6
0.8
1
0
1
2
3
4
5
6
7
8
9
10
11
12

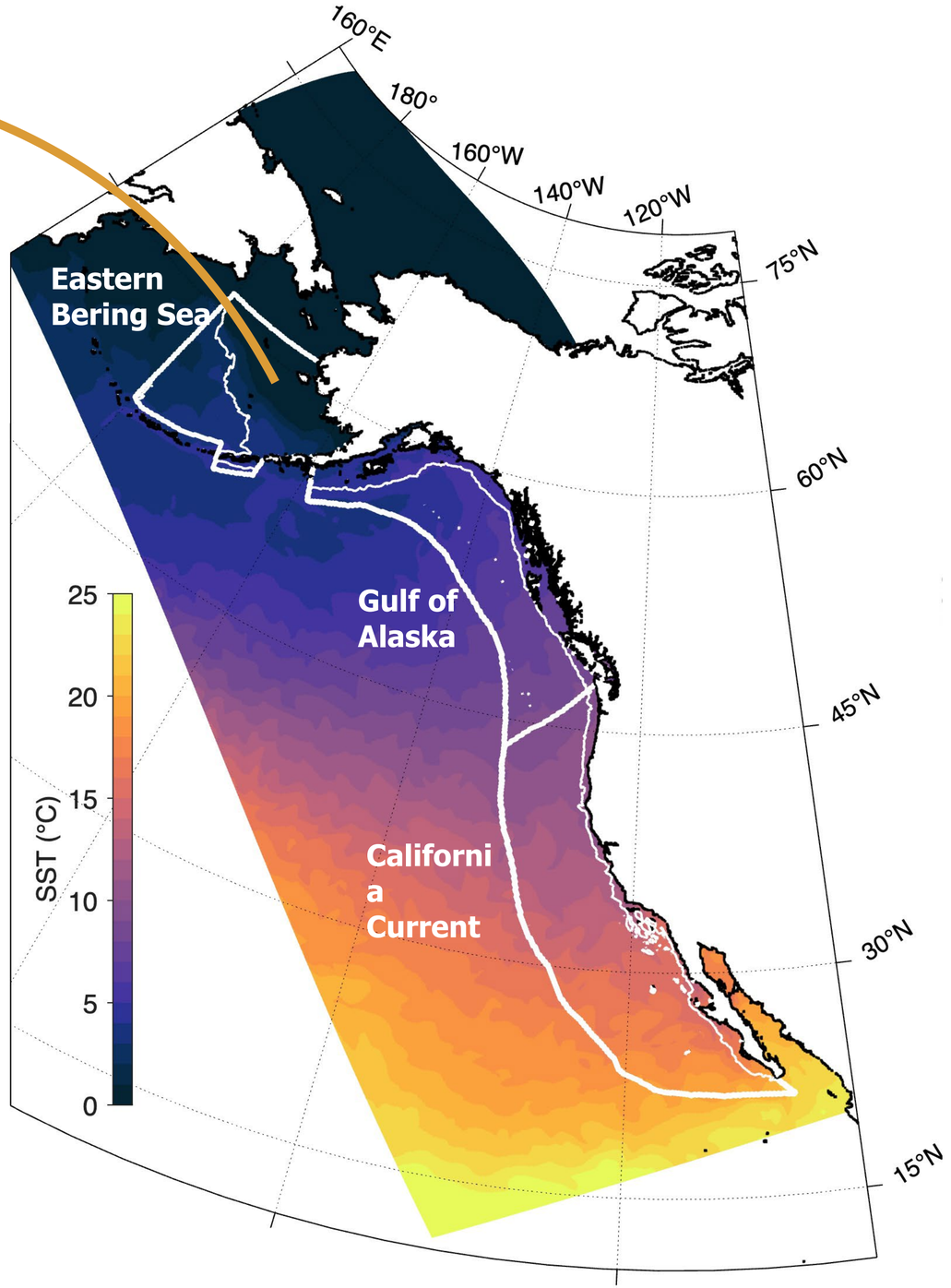

160°E
180°
160°W
140°W
120°W
75°N
60°N
45°N
30°N
15°N
Eastern Bering Sea
Gulf of Alaska
California Current
SST (°C)
0
5
10
15
20
25

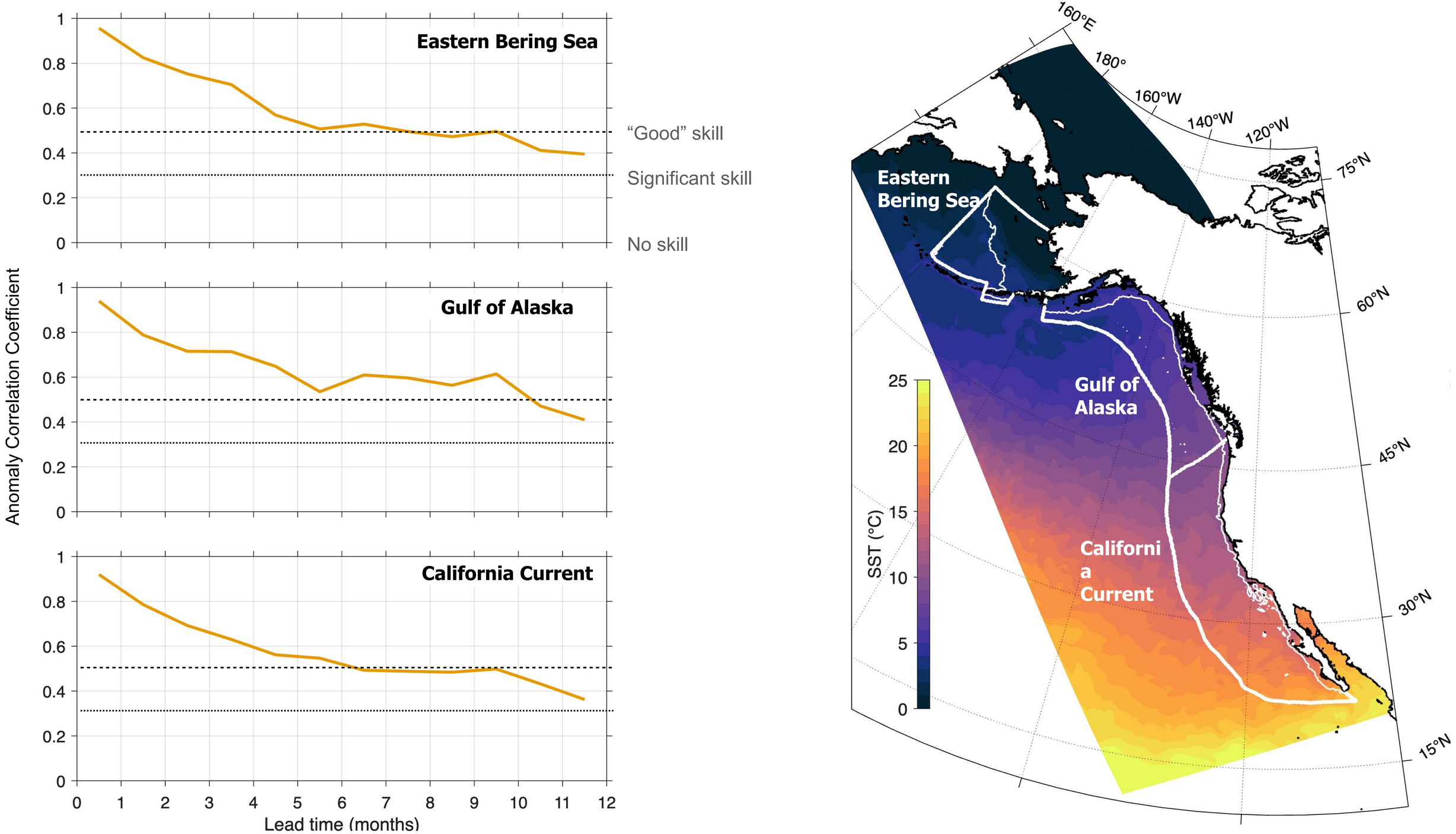


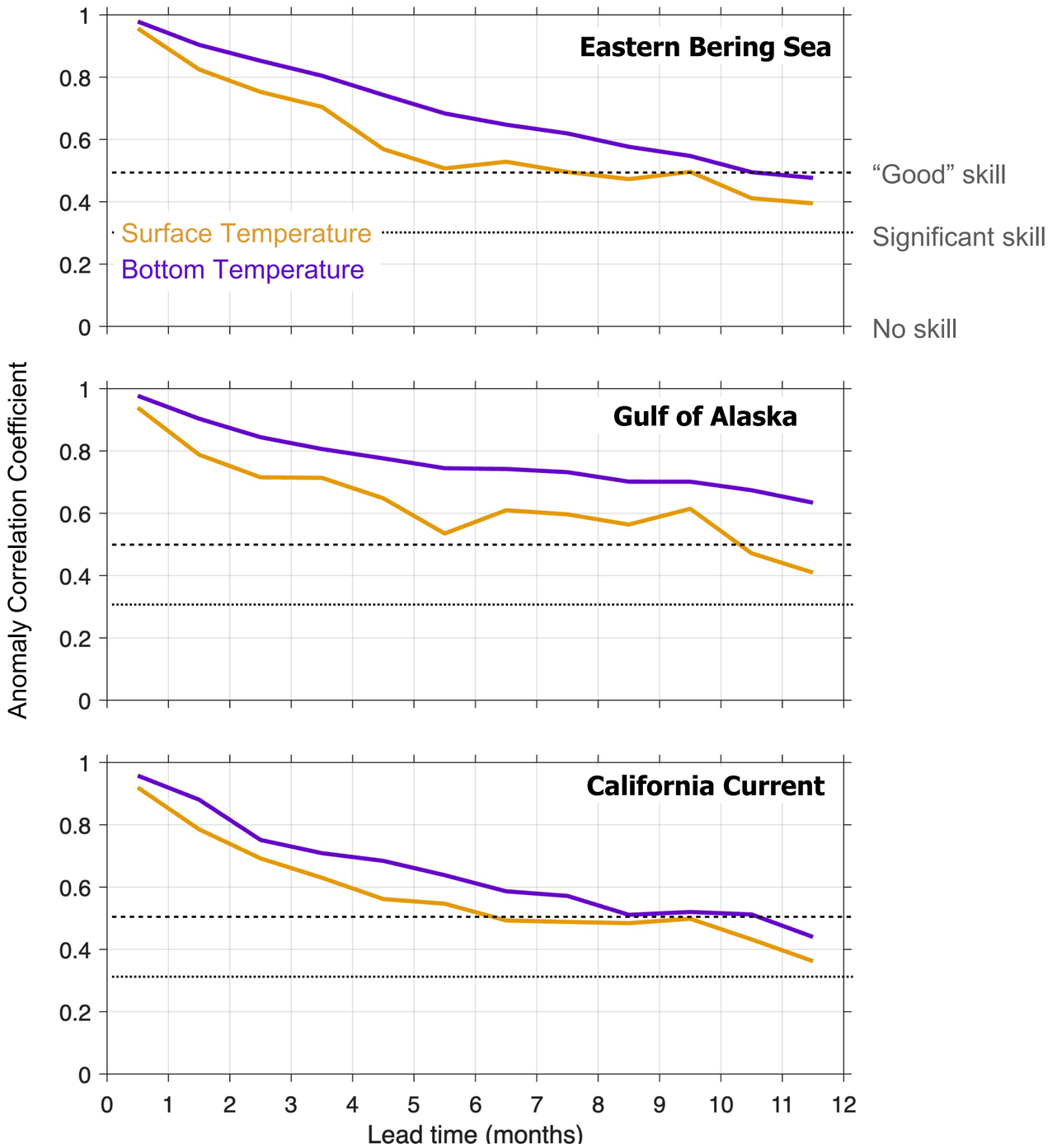
“Good” skill

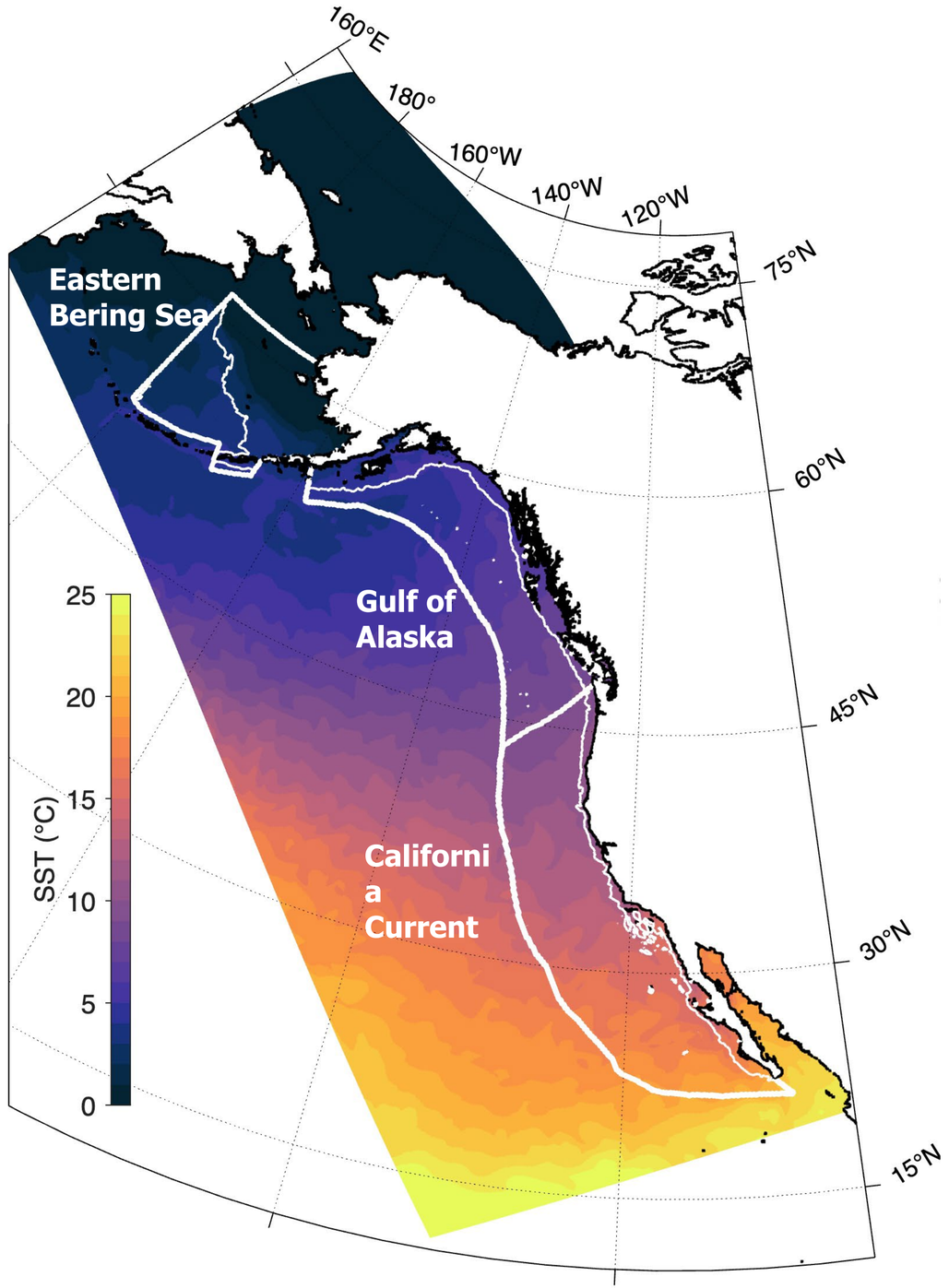
Significant skill

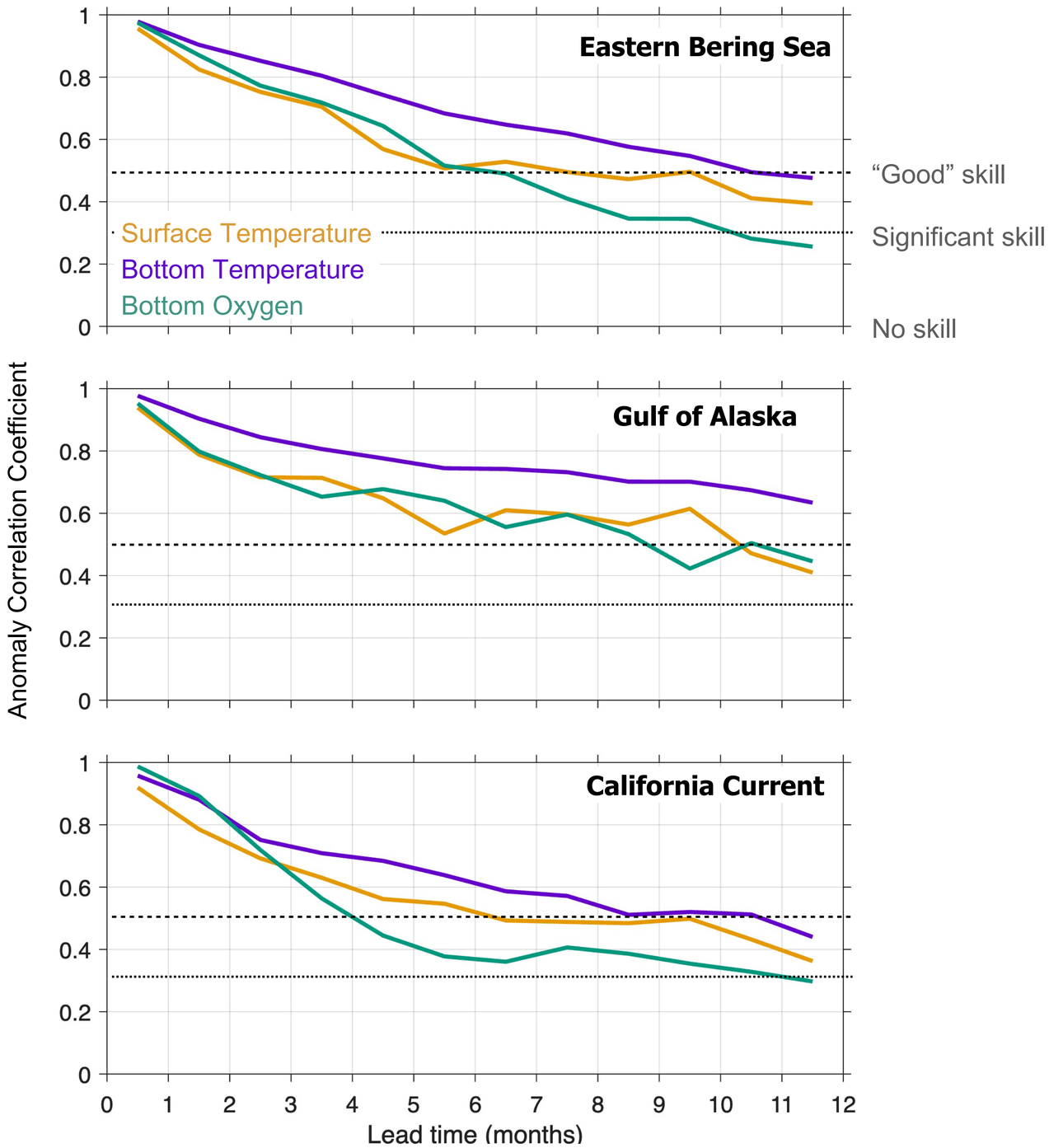
No skill

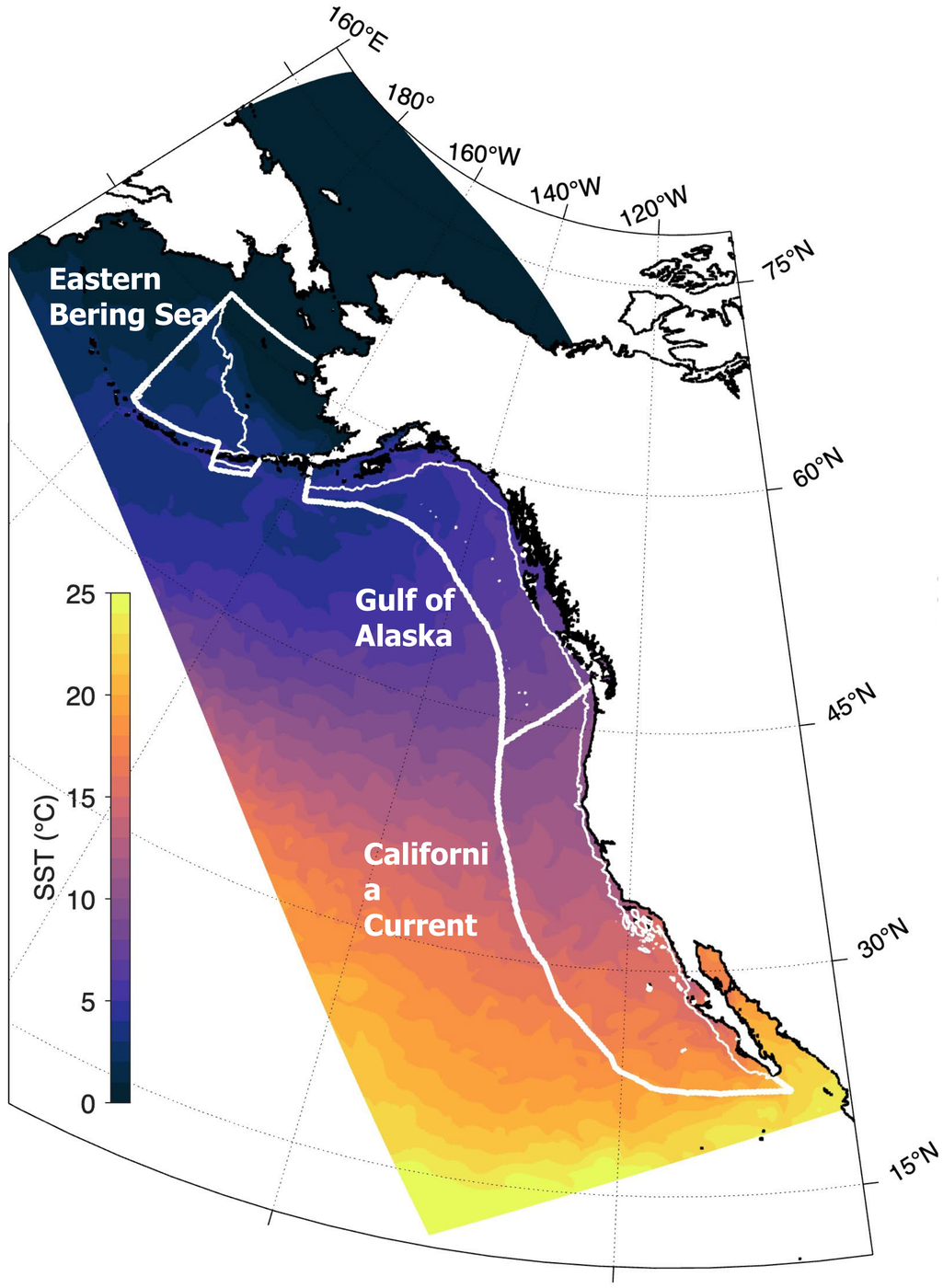



Eastern Bering Sea
Gulf of Alaska
California Current
Anomaly Correlation Coefficient
Lead time (months)
"Good" skill
Significant skill
No skill
Eastern Bering Sea
Gulf of Alaska
Californi a Current
SST (°C)
160°E
180°
160°W
140°W
120°W
75°N
60°N
45°N
30°N
15°N


Eastern Bering Sea
Gulf of Alaska
California Current
Surface Temperature
Bottom Temperature
"Good" skill
Significant skill
No skill
Anomaly Correlation Coefficient
Lead time (months)
0
0.2
0.4
0.6
0.8
1
0
1
2
3
4
5
6
7
8
9
10
11
12


160°E
180°
160°W
140°W
120°W
75°N
60°N
45°N
30°N
15°N
Eastern Bering Sea
Gulf of Alaska
Californi a Current
SST (°C)
0
5
10
15
20
25


Eastern Bering Sea
Gulf of Alaska
California Current
Surface Temperature
Bottom Temperature
Bottom Oxygen
"Good" skill
Significant skill
No skill
Anomaly Correlation Coefficient
Lead time (months)
0
0.2
0.4
0.6
0.8
1
0
1
2
3
4
5
6
7
8
9
10
11
12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180°
160°W
140°W
120°W
75°N
60°N
45°N
30°N
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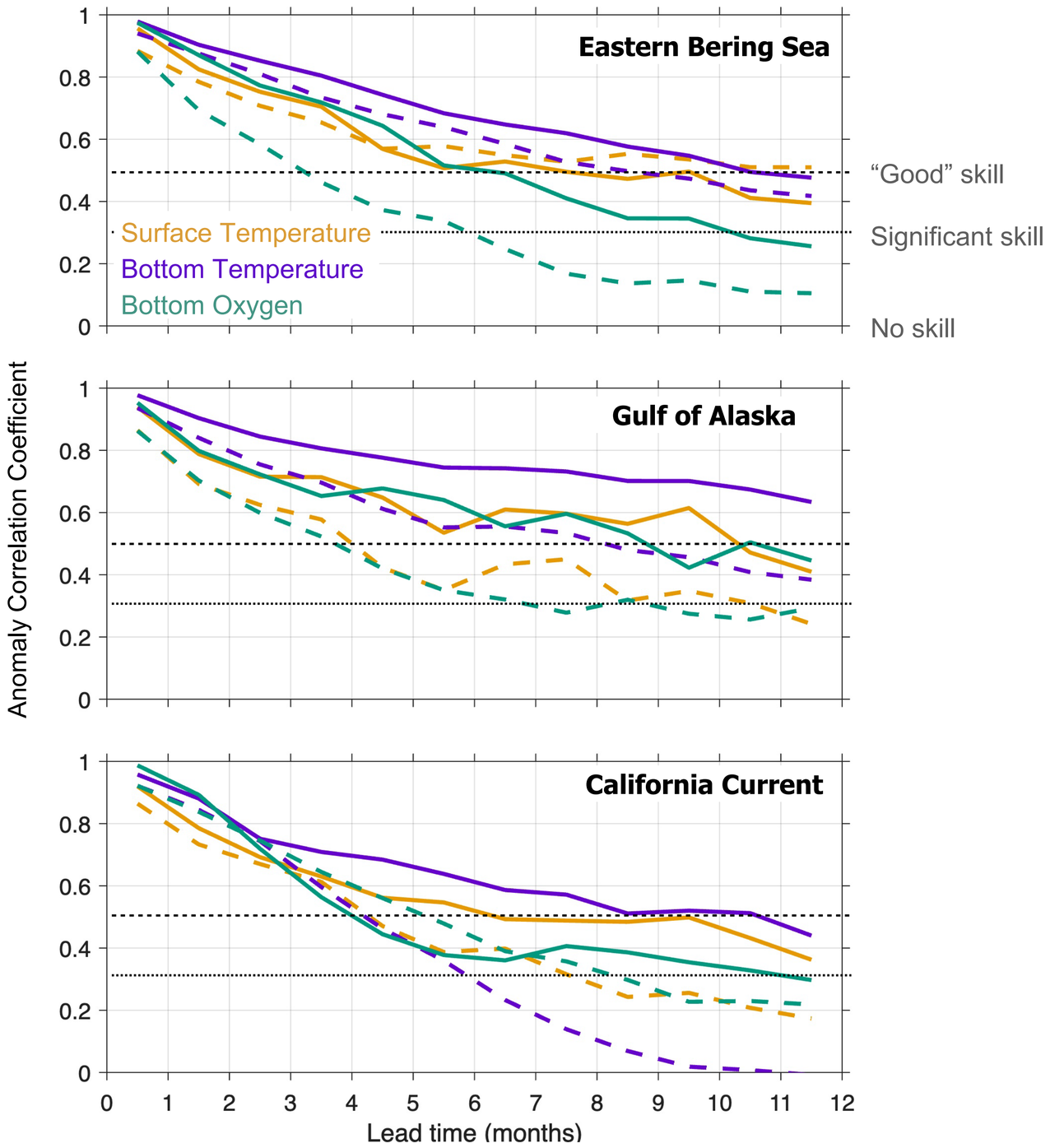
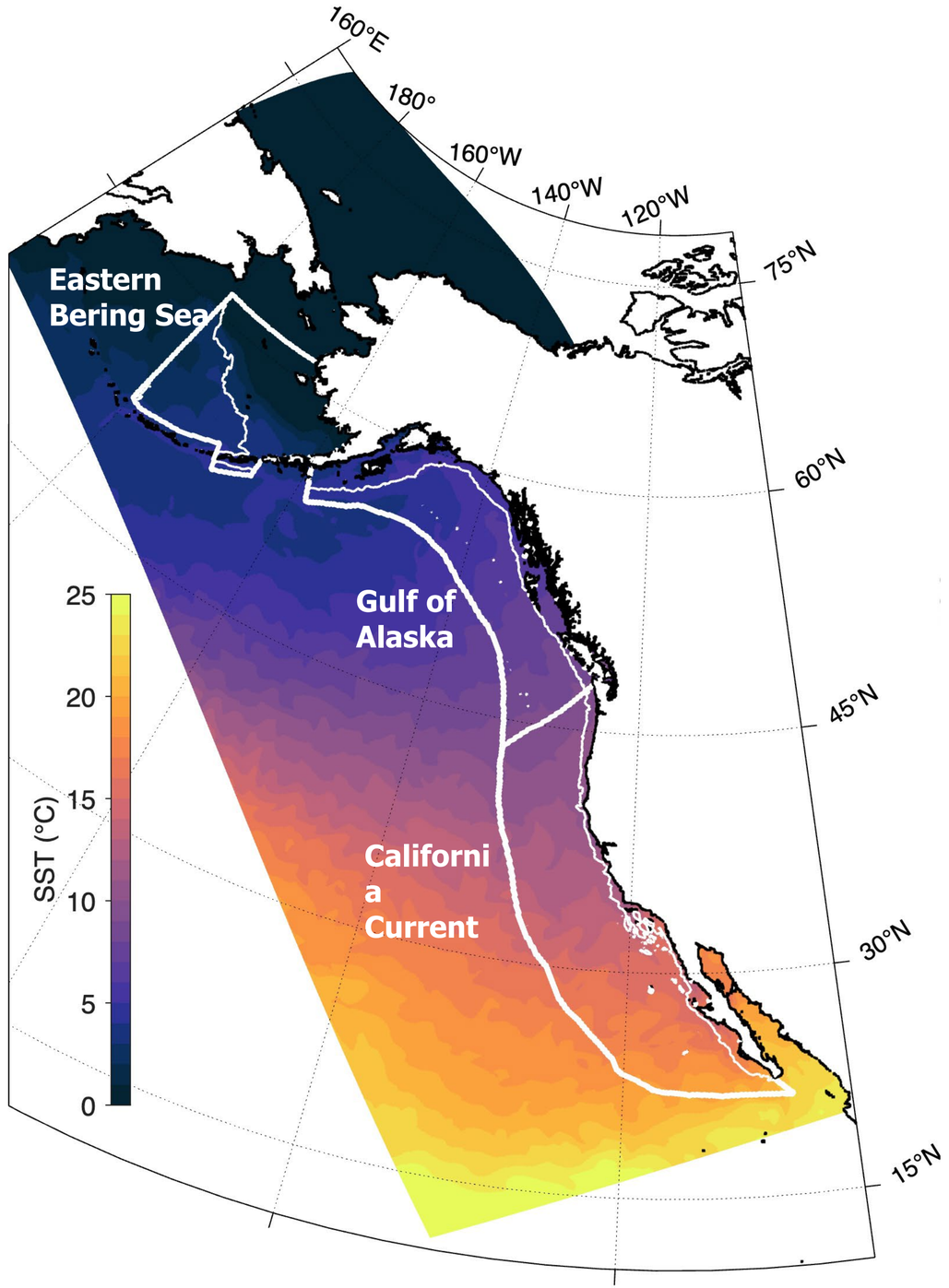
Eastern Bering Sea
Gulf of Alaska
Californi a Current
SST (°C)
0
5
10
15
20
25


Eastern Bering Sea
Gulf of Alaska
California Current
Surface Temperature
Bottom Temperature
Bottom Oxygen
"Good" skill
Significant skill
No skill
Anomaly Correlation Coefficient
Lead time (months)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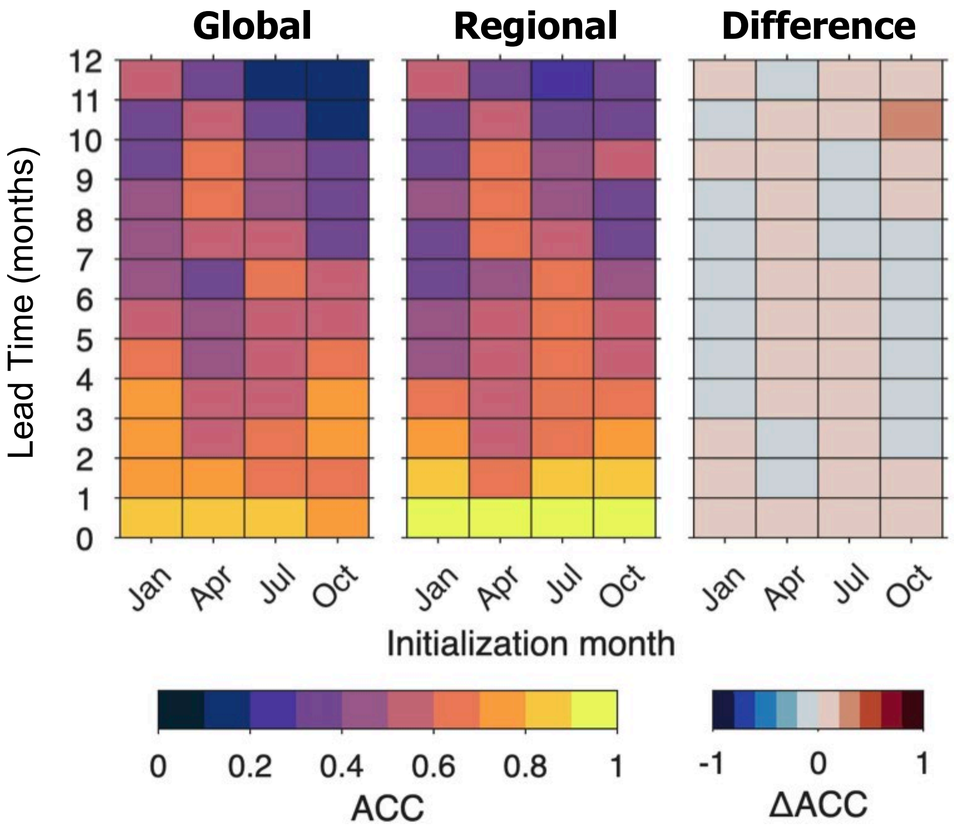
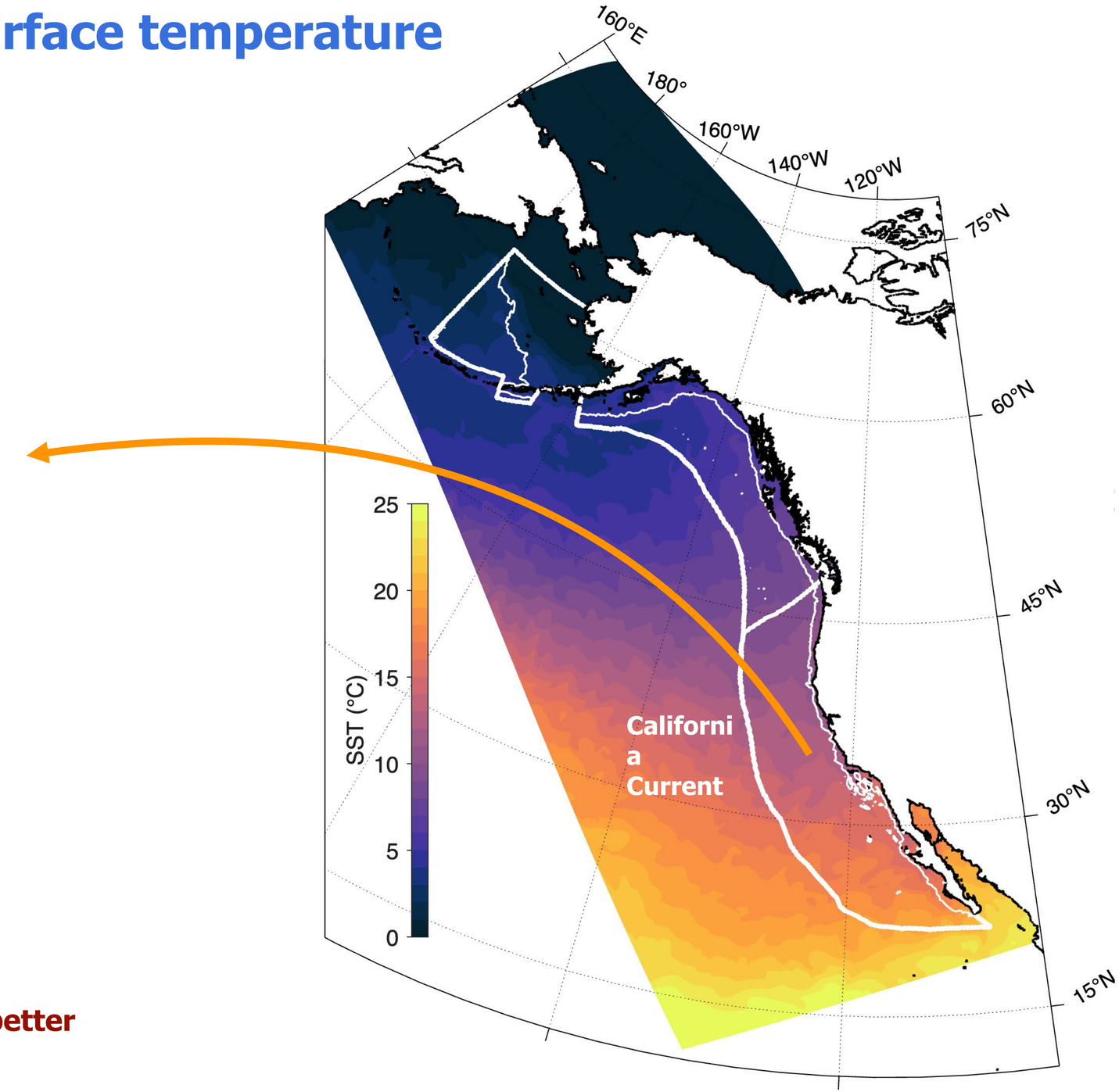
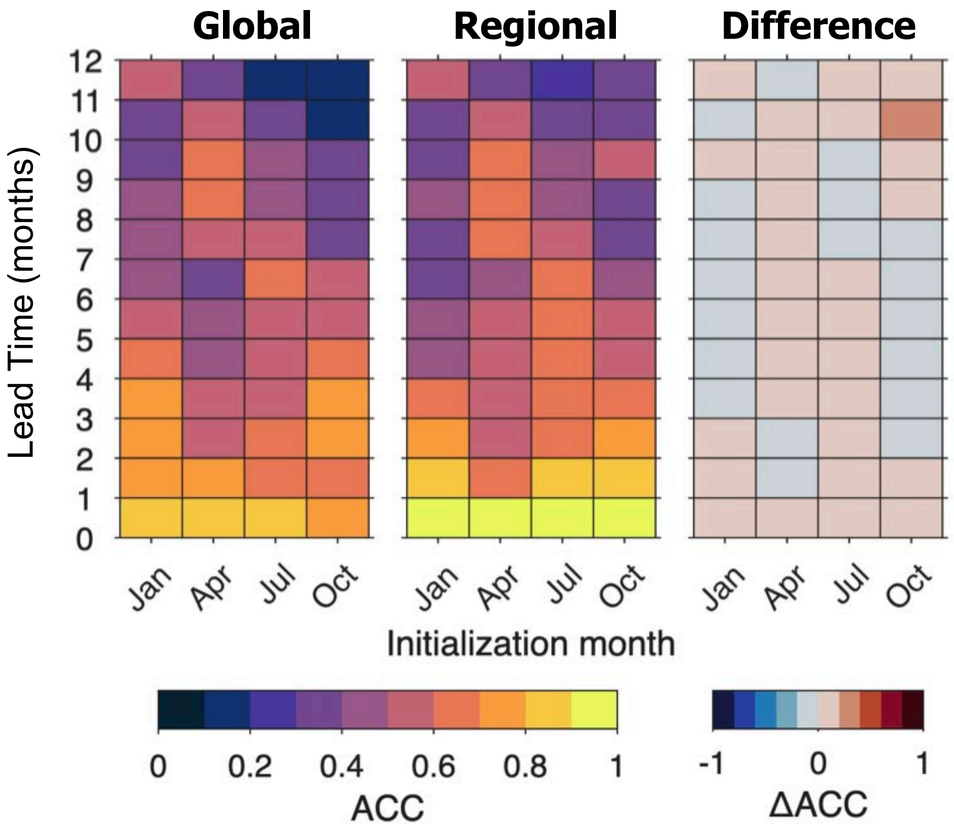
Global vs. regional forecasts of **sea surface temperature**



Red = good
Variability is predicted better



Global vs. regional forecasts of **sea surface temperature**



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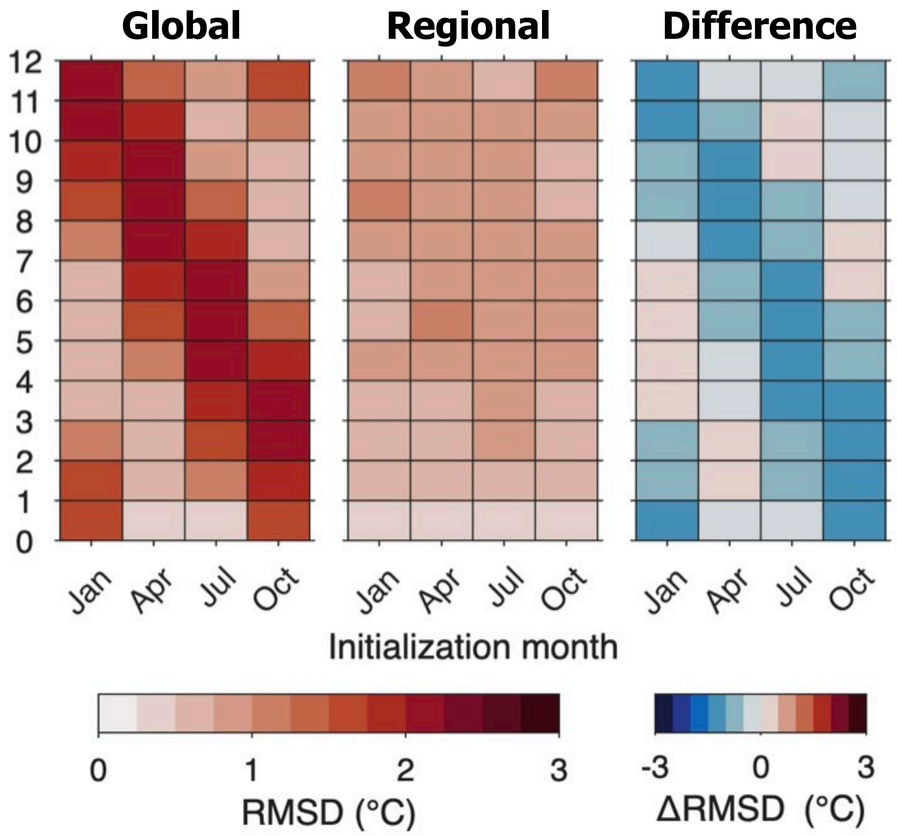
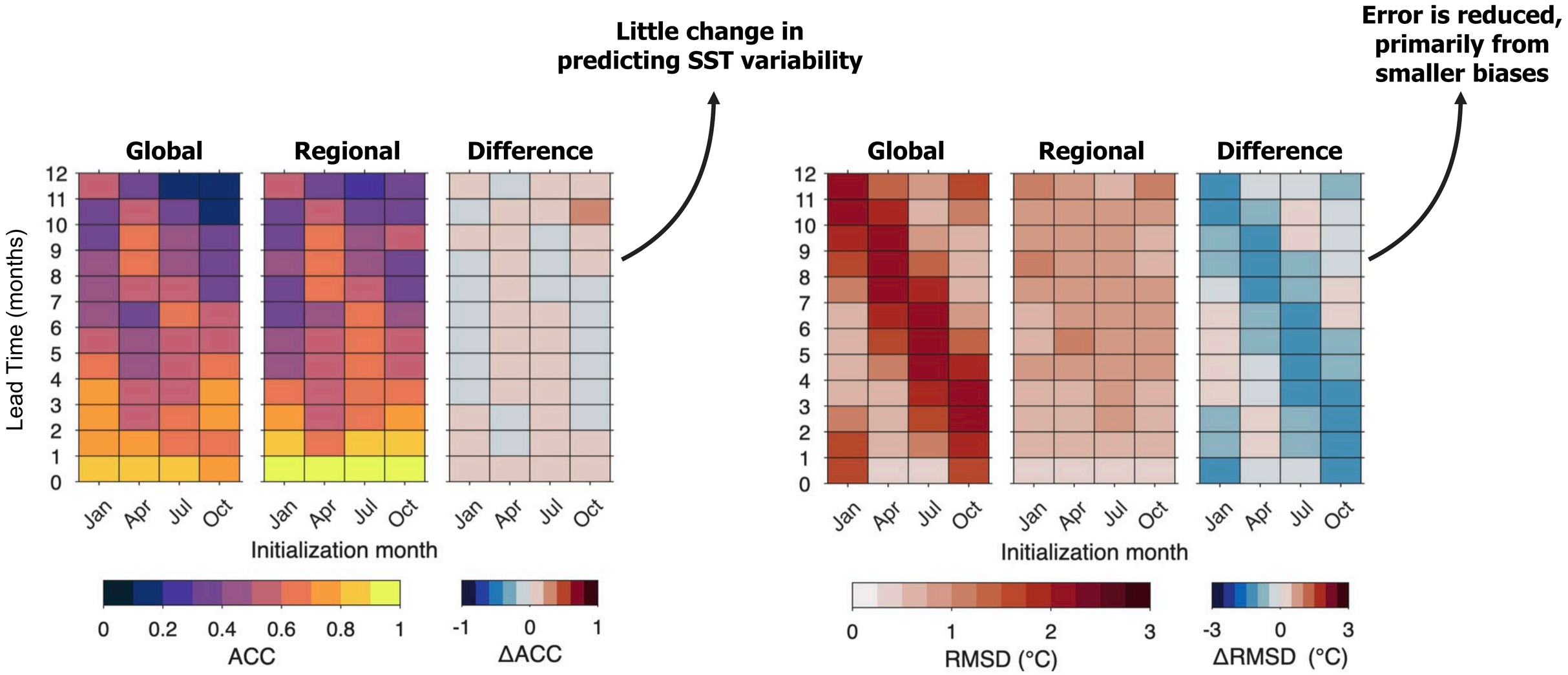


Blue = good
Forecast error is reduced

Jacox et al. (submitted)

Global vs. regional forecasts of **sea surface temperature**



Red = good
Variability is predicted better

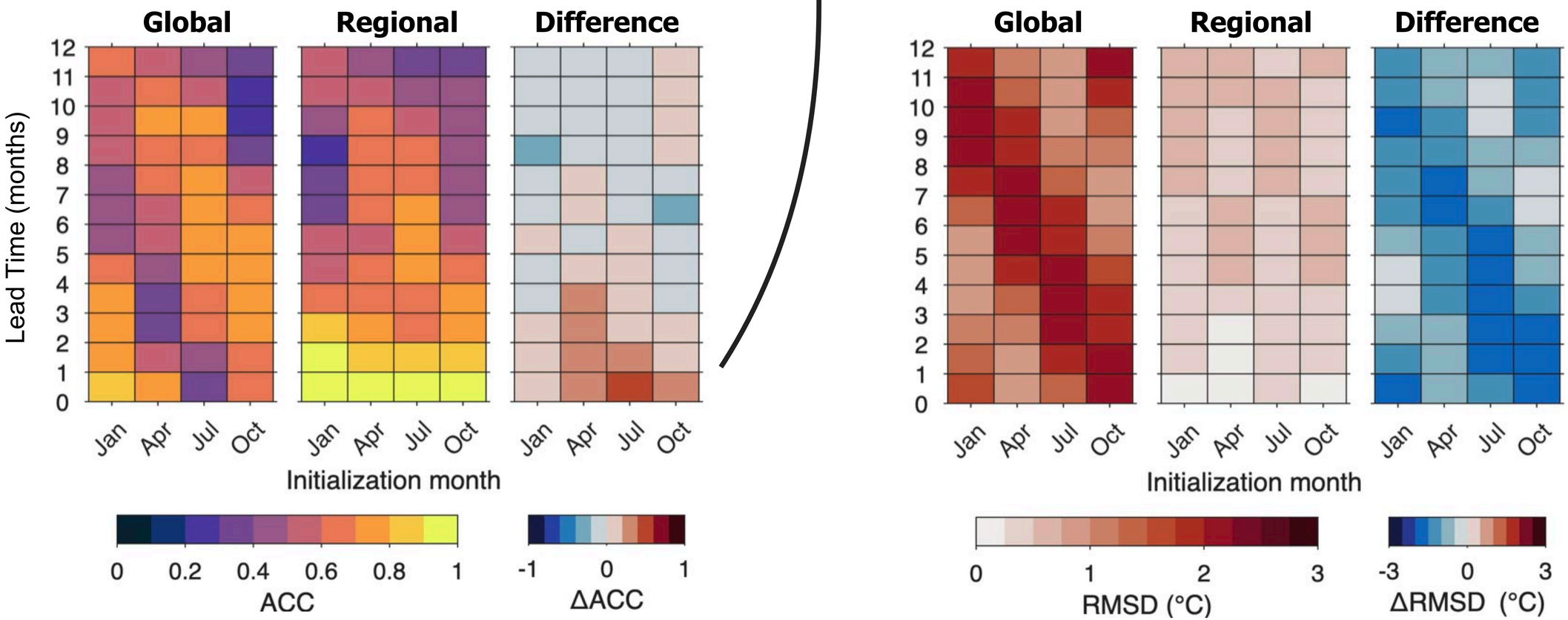
Blue = good
Forecast error is reduced

Jacox et al. (submitted)

Global vs. regional forecasts of **bottom temperature**

Improved predictions of bottom temp variability for several months

Error is reduced, primarily from smaller biases

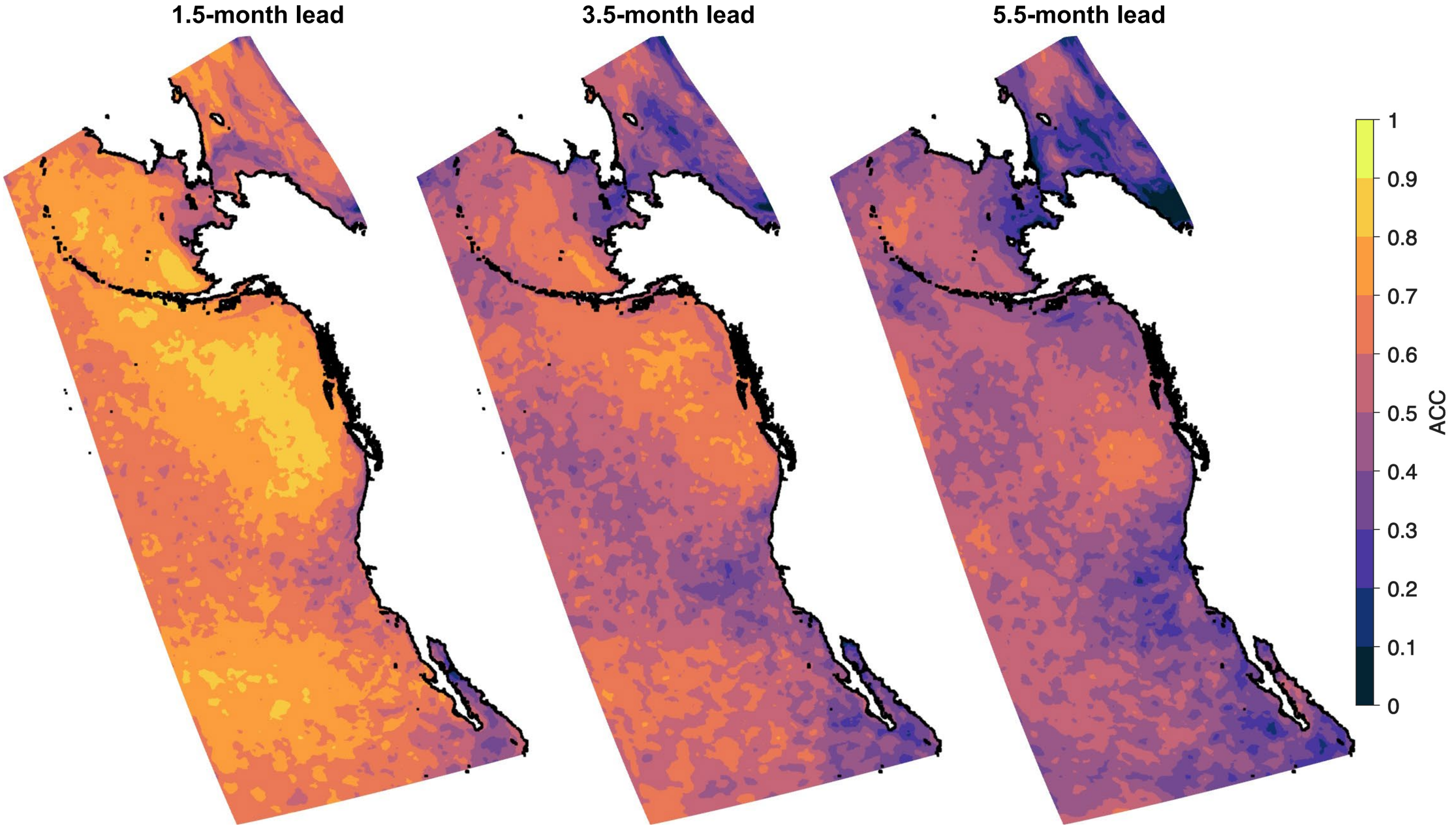


Red = good
Variability is predicted better

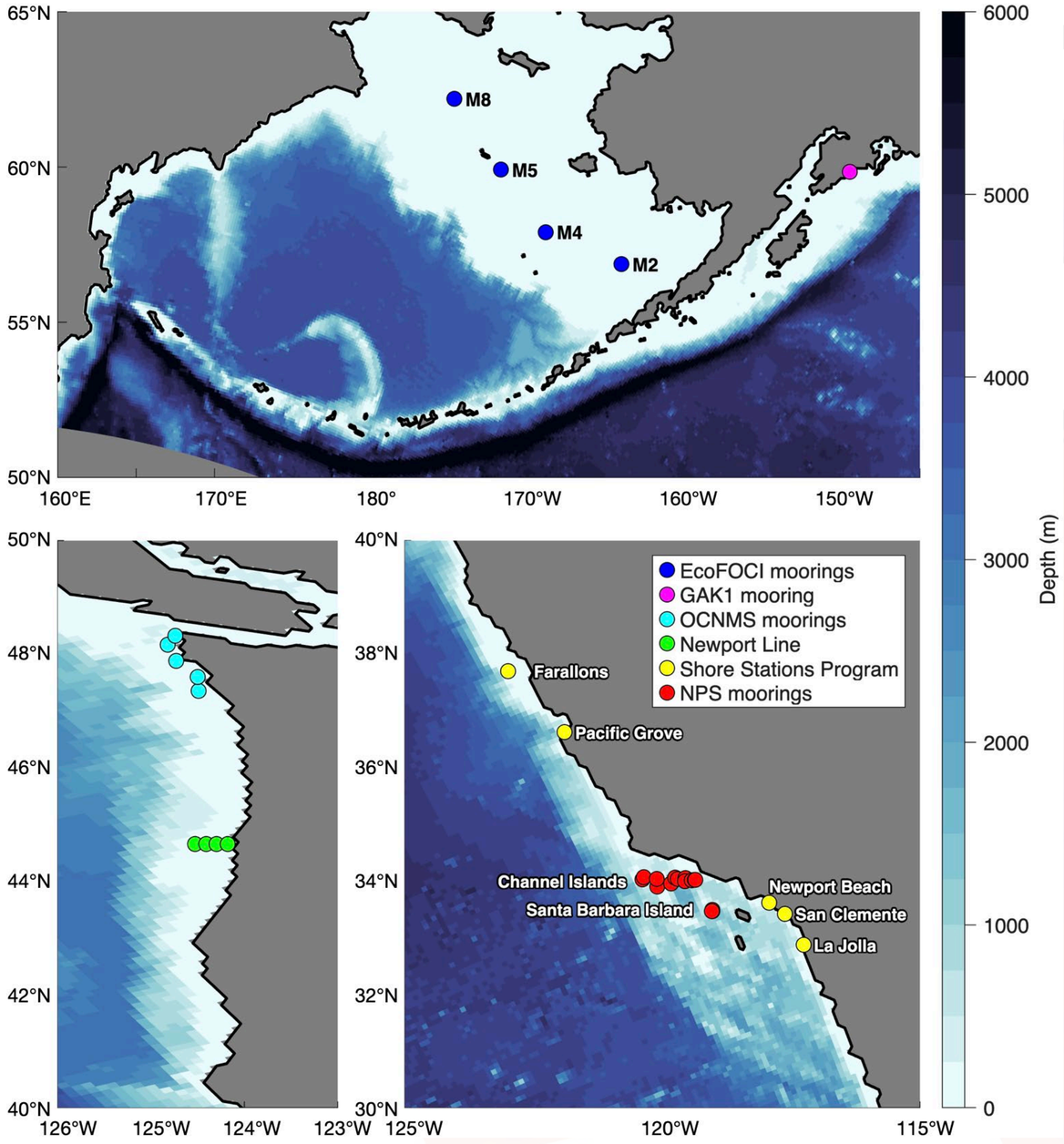
Blue = good
Forecast error is reduced

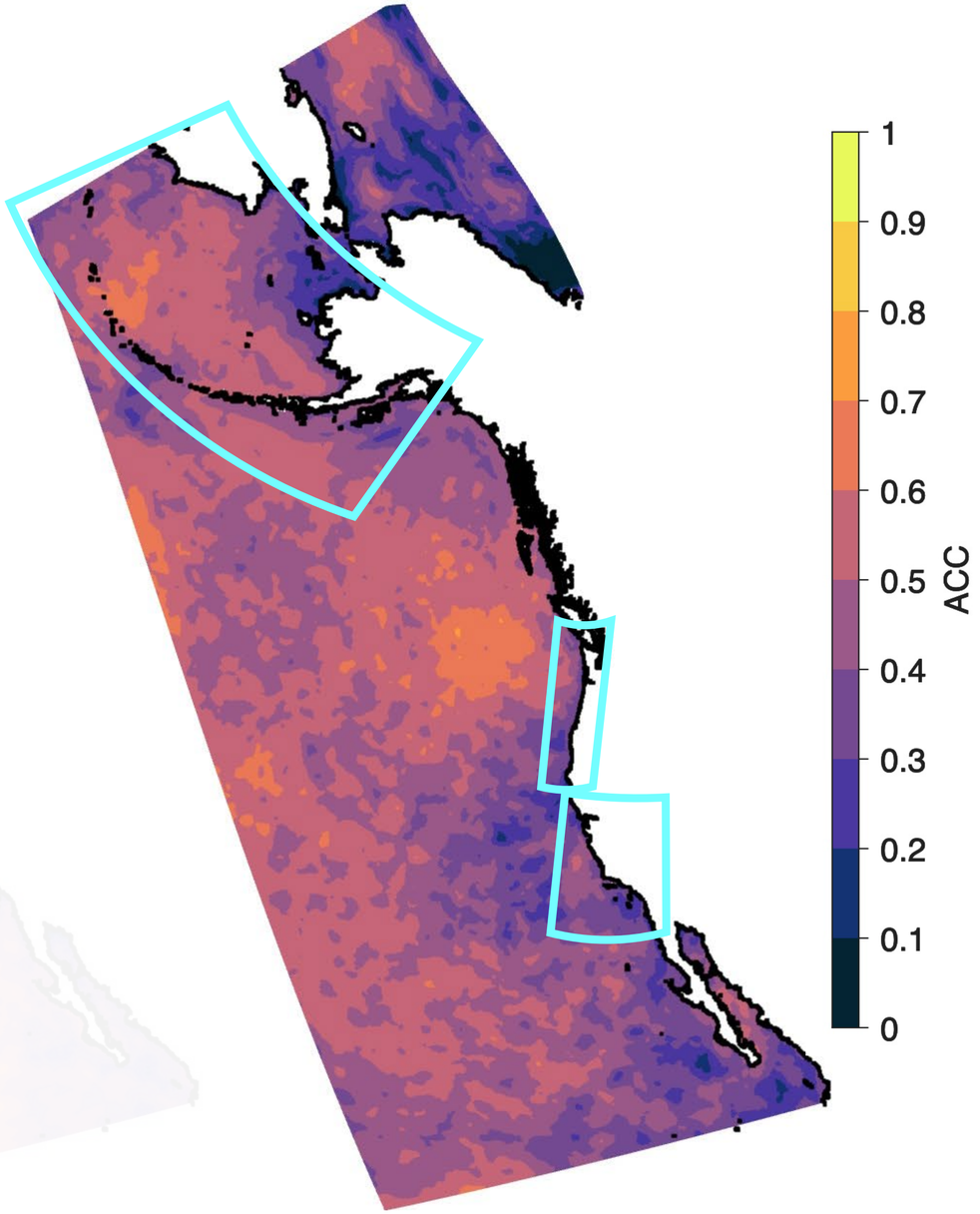
Jacox et al. (submitted)

Regional forecasts of **sea surface temperature**



In situ data for forecast verification





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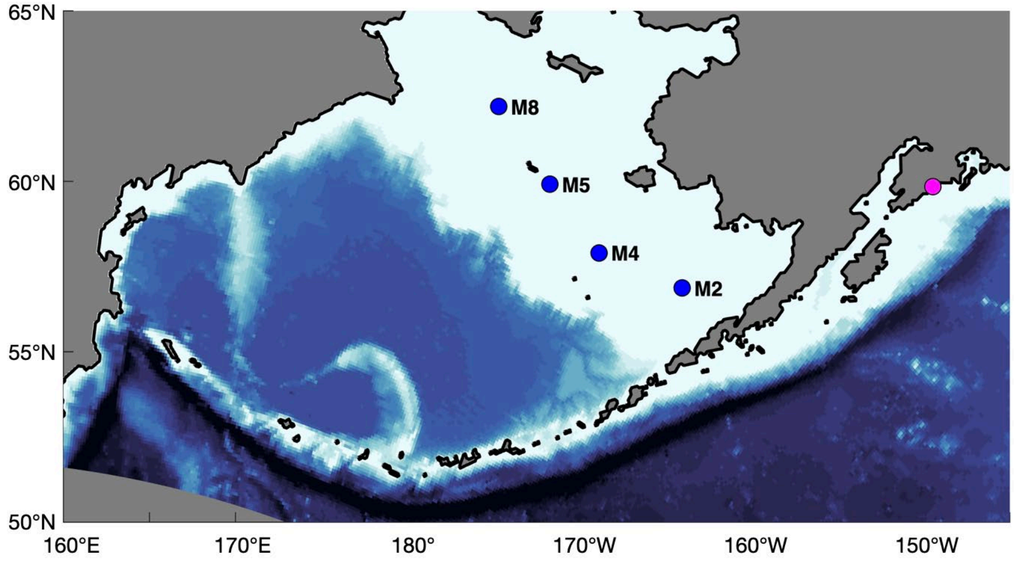
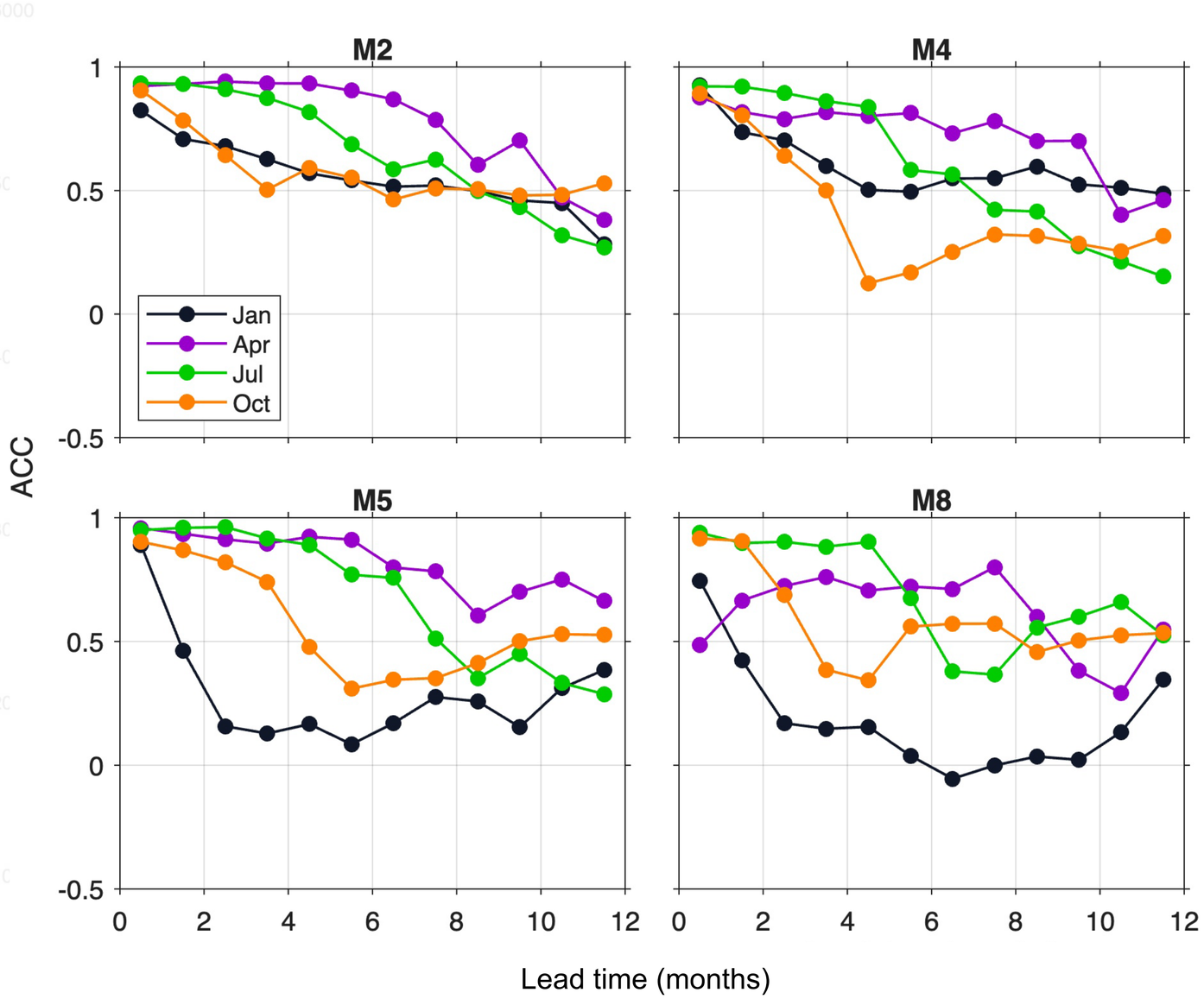


Bottom Temperature from Bering Sea Moorings



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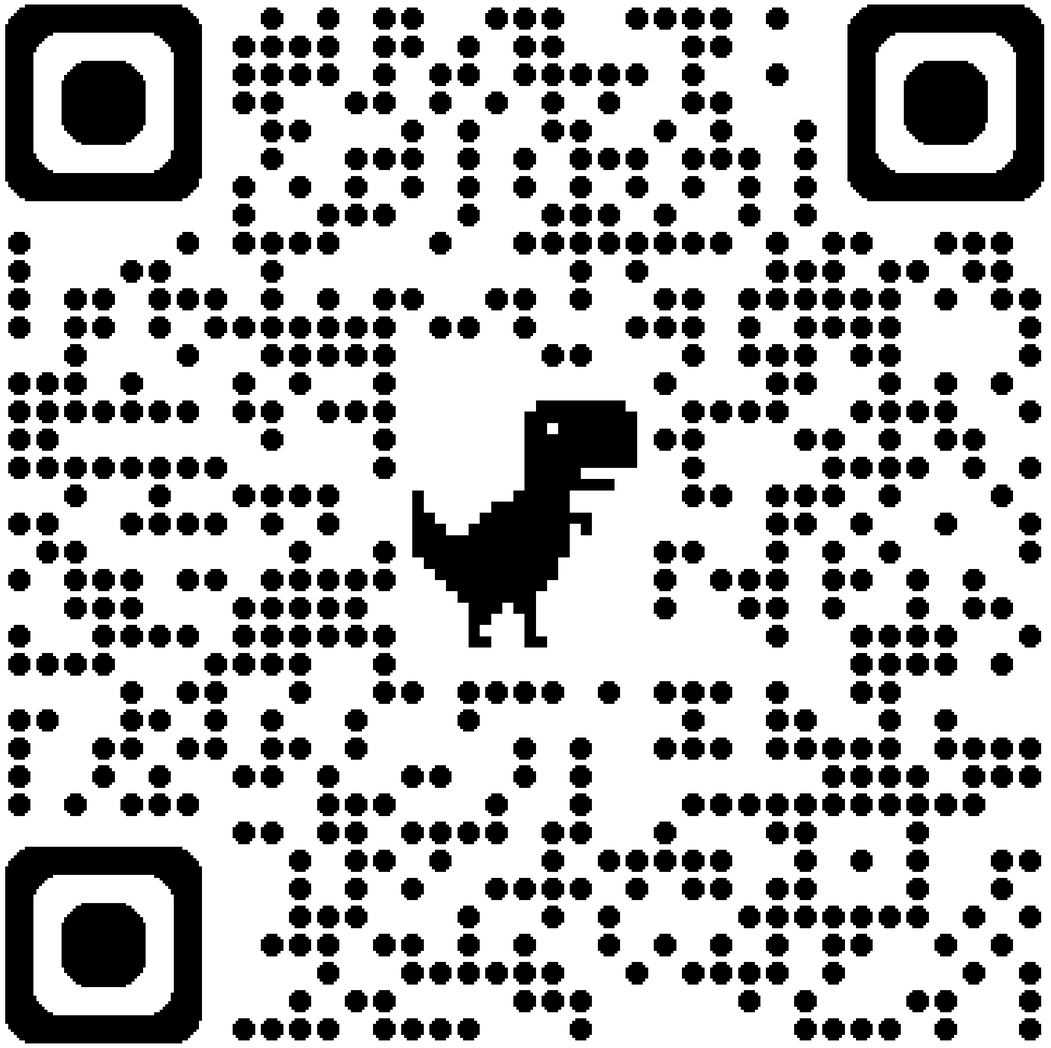

Contact

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mjacox.com/science

Forecast output

psl.noaa.gov/cefi_portal

Forecast Visualizations

mjacox.com/ocean-forecasts

gfdl.noaa.gov/experimental-regional-ocean-forecasts