

# ALASKA REGION CLIMATE OUTLOOK BRIEFING

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December 22, 2023

Rick Thoman

Alaska Center for Climate Assessment and  
Policy/University of Alaska Fairbanks



# Today's Agenda

- Feature of the month: 2023 Arctic Report Card
- Climate Forecast Basics
- Climate System Review
  - Observations and CPC forecasts for most recent month & season
  - Current Atmosphere and Ice
  - Climate Drivers: SSTs, ENSO
- Climate Forecast Guidance
  - ENSO
  - Statistical tools
  - Dynamic models
- CPC Outlooks
  - January and January-March 2024
  - Look ahead to Spring 2024



# 2023 Arctic Report Card

- 18<sup>th</sup> Annual Report Card
  - 82 authors from 13 countries
- 6<sup>th</sup> warmest year (Oct 22-Sep 23)
  - Warmest summer
- 6<sup>th</sup> wettest year
- North America record low snow cover extent in May
- Record northern Canada wildfire



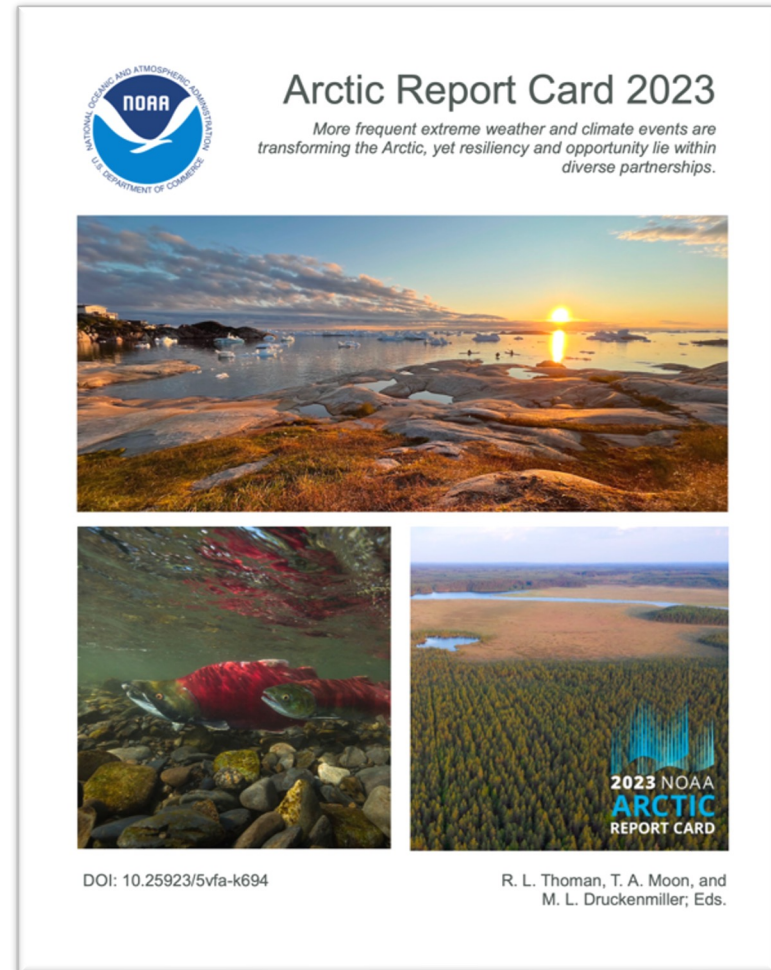
# 2023 Arctic Report Card

## Two Alaska focused essays

- *Nunaaqqit Savaqatigivlugich: Working With Communities to Observe the Arctic*
  - Lead Roberta Glenn-Borade
- *Divergent Responses of Western Alaska Salmon to a Changing Climate*
  - Lead Erik Schoen

**ACCAP's annual**

**Arctic Report Webinar January 17<sup>th</sup>**



# Notable November-December Happenings

- **Southcentral:** Very snowy in some areas (esp. Anchorage)
- **Western Alaska:** Winter weather arrives. Long duration blowing Bering Strait blowing snow Dec 9-11
- **Interior:** Above normal snow
- **Southeast:** Nov 20<sup>th</sup> Wrangell landslide. Continued mild and wet
- **North Slope:** Still milder than normal

No -40s yet in Alaska  
Latest since 2002



Winter Solstice in Interior Alaska

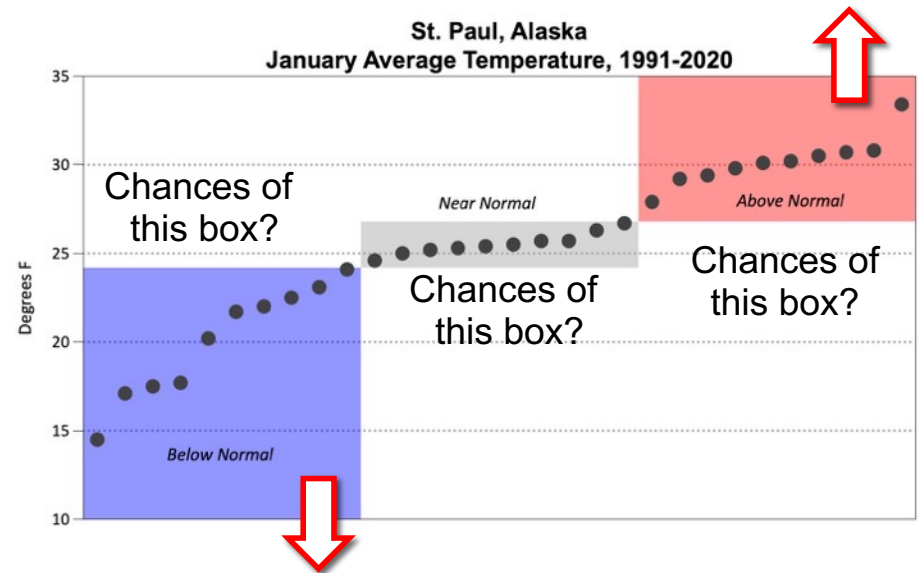
Photo credit: L. Petersen

# Climate Forecast Basics

**Climate Prediction Center:** primary NOAA/NWS forecast responsibility

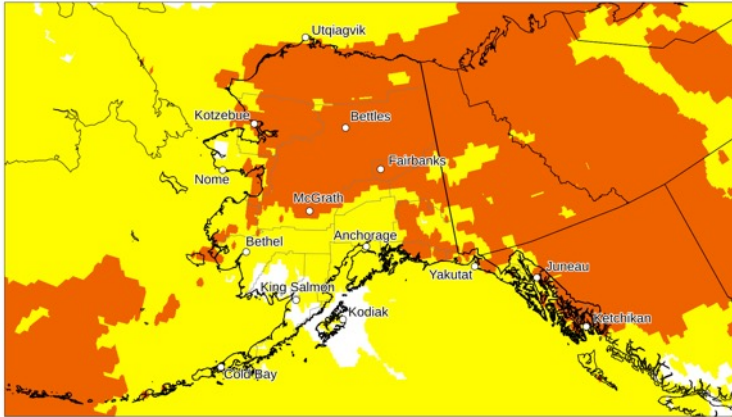
- **Climate Outlooks**

- Relation to some long term normal (e.g. 1991-2020)
- Categorical (often three)
- Probabilistic
- Traditional Elements
  - **Temperature:** centered around average
  - **Precipitation:** centered around median (can significantly differ from the “normal”, which by convention is the mean)

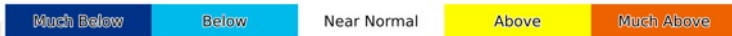


# Model-Based Regional Analysis

Temperature Classification for Nov 2023

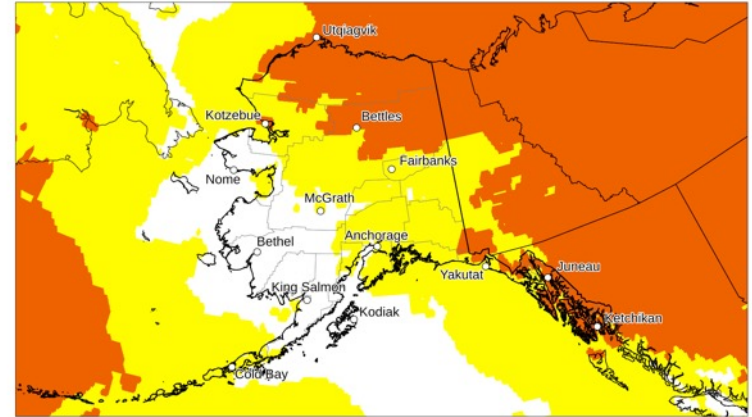


Source: ERA5 Reanalysis Map by: Brian Brettschneider

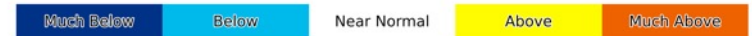


Compared to 1991-2020 Base Period

Temperature Classification for Sep-Nov 2023



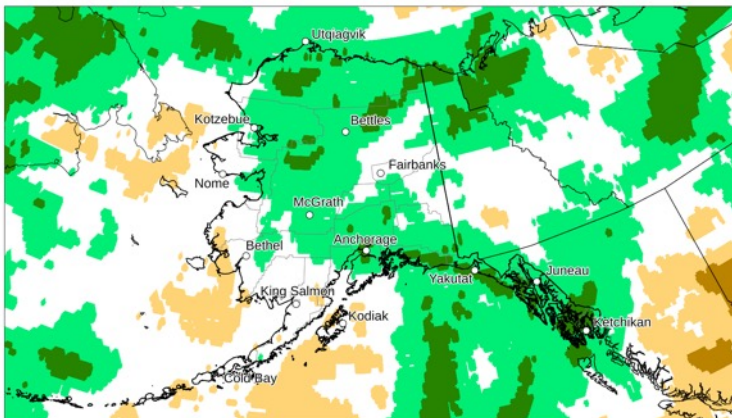
Source: ERA5 Reanalysis Map by: Brian Brettschneider



Compared to 1991-2020 Base Period

Temp

Precipitation Classification for Nov 2023

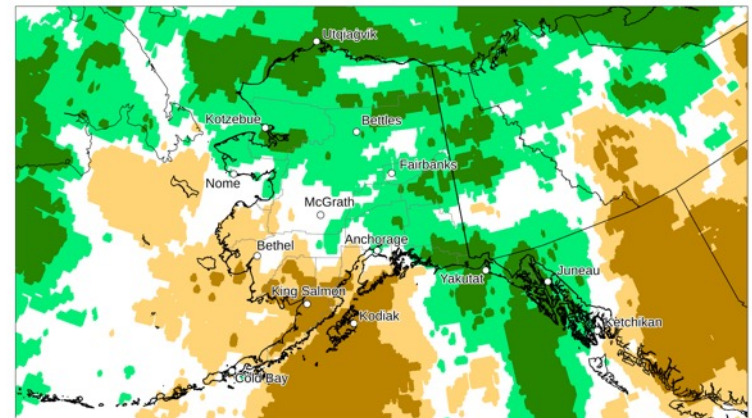


Source: ERA5 Reanalysis Map by: Brian Brettschneider



Compared to 1991-2020 Base Period

Precipitation Classification for Sep-Nov 2023



Source: ERA5 Reanalysis Map by: Brian Brettschneider



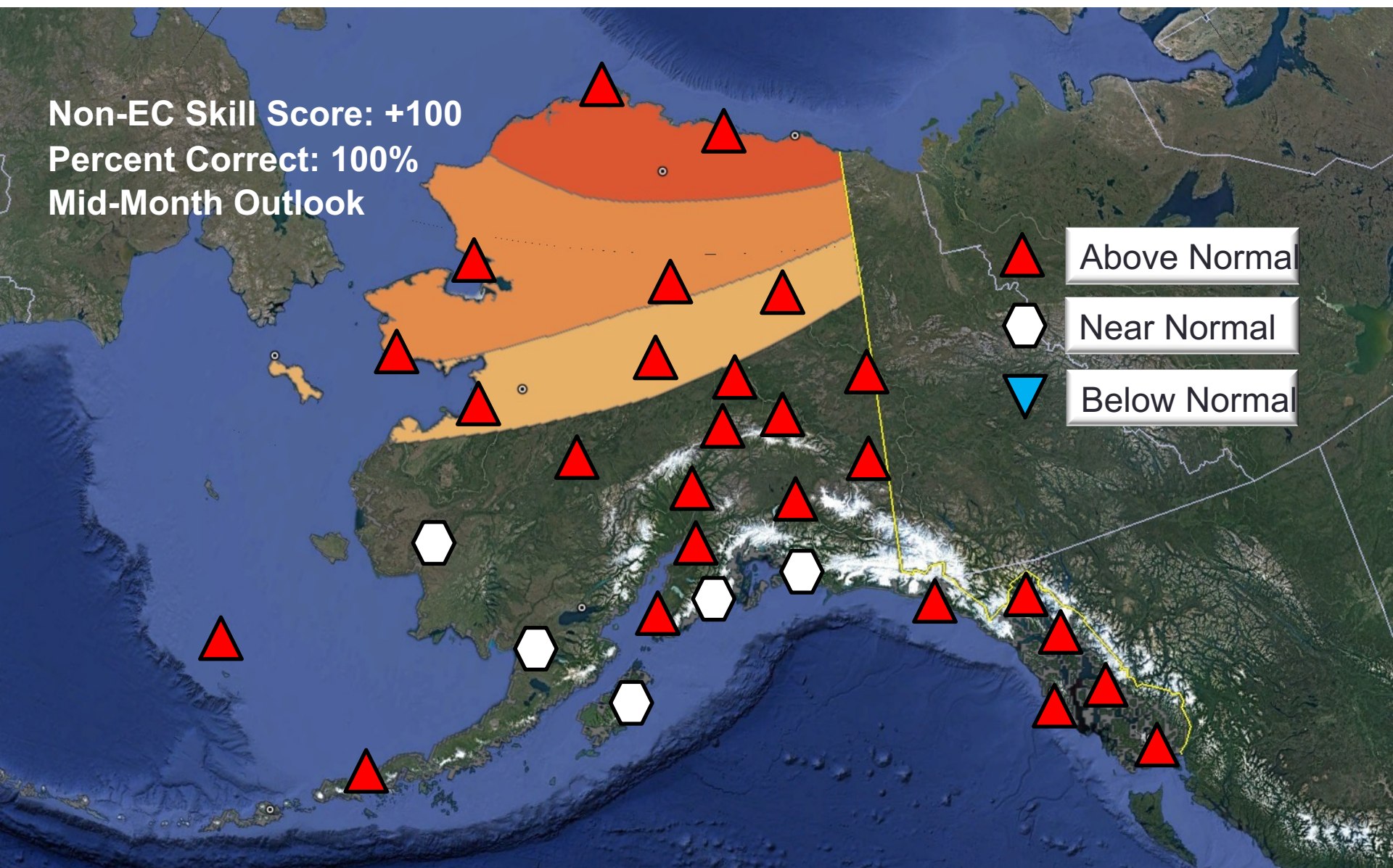
Compared to 1991-2020 Base Period

Precip

# November 2023 Temperature Anomalies

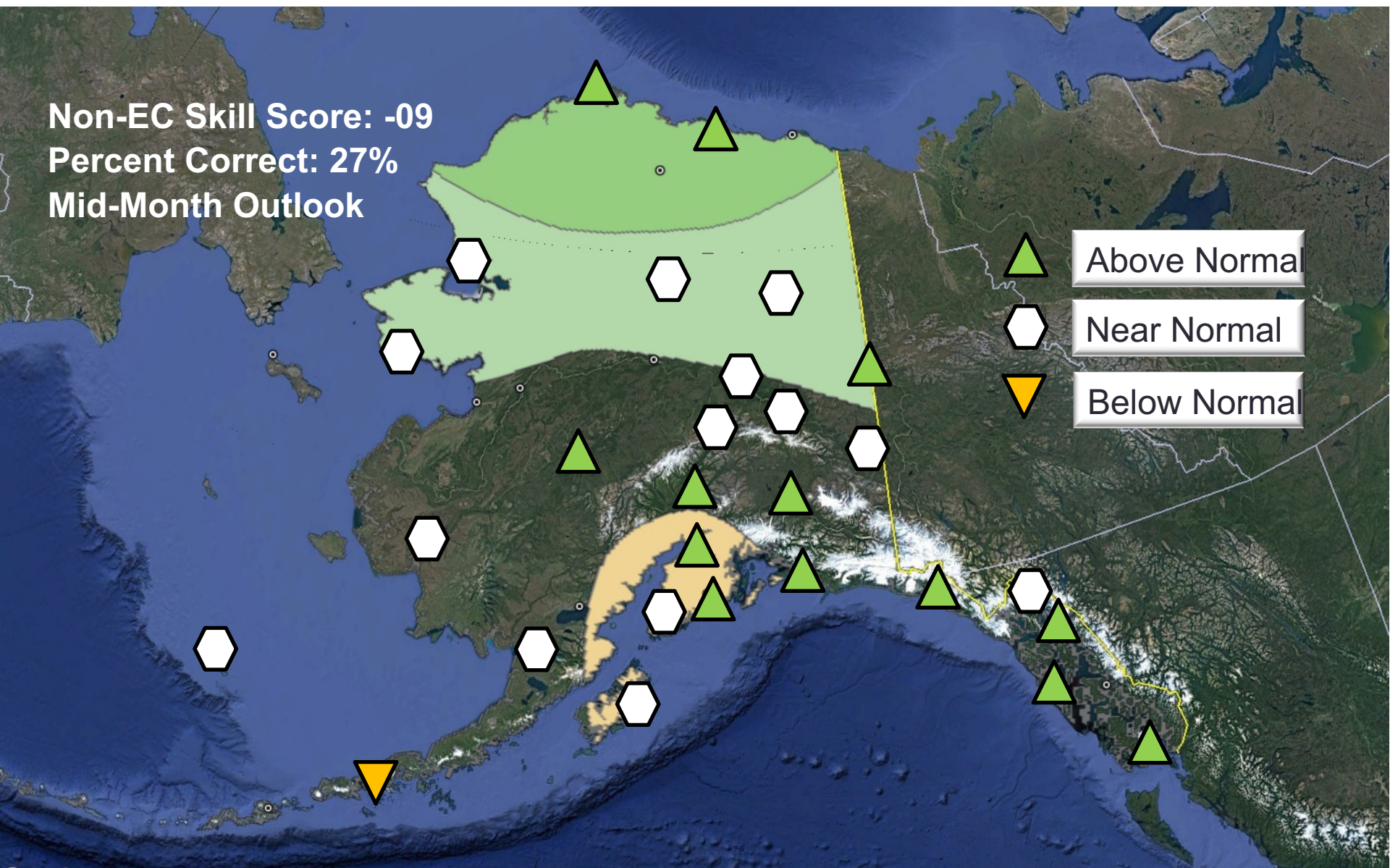
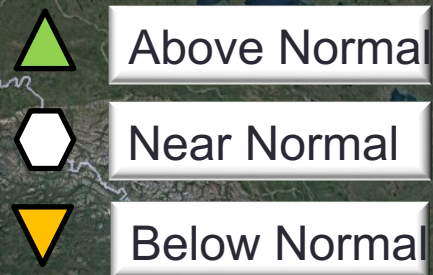
Non-EC Skill Score: +100  
Percent Correct: 100%  
Mid-Month Outlook

Above Normal  
Near Normal  
Below Normal



# November 2023 Precipitation Anomalies

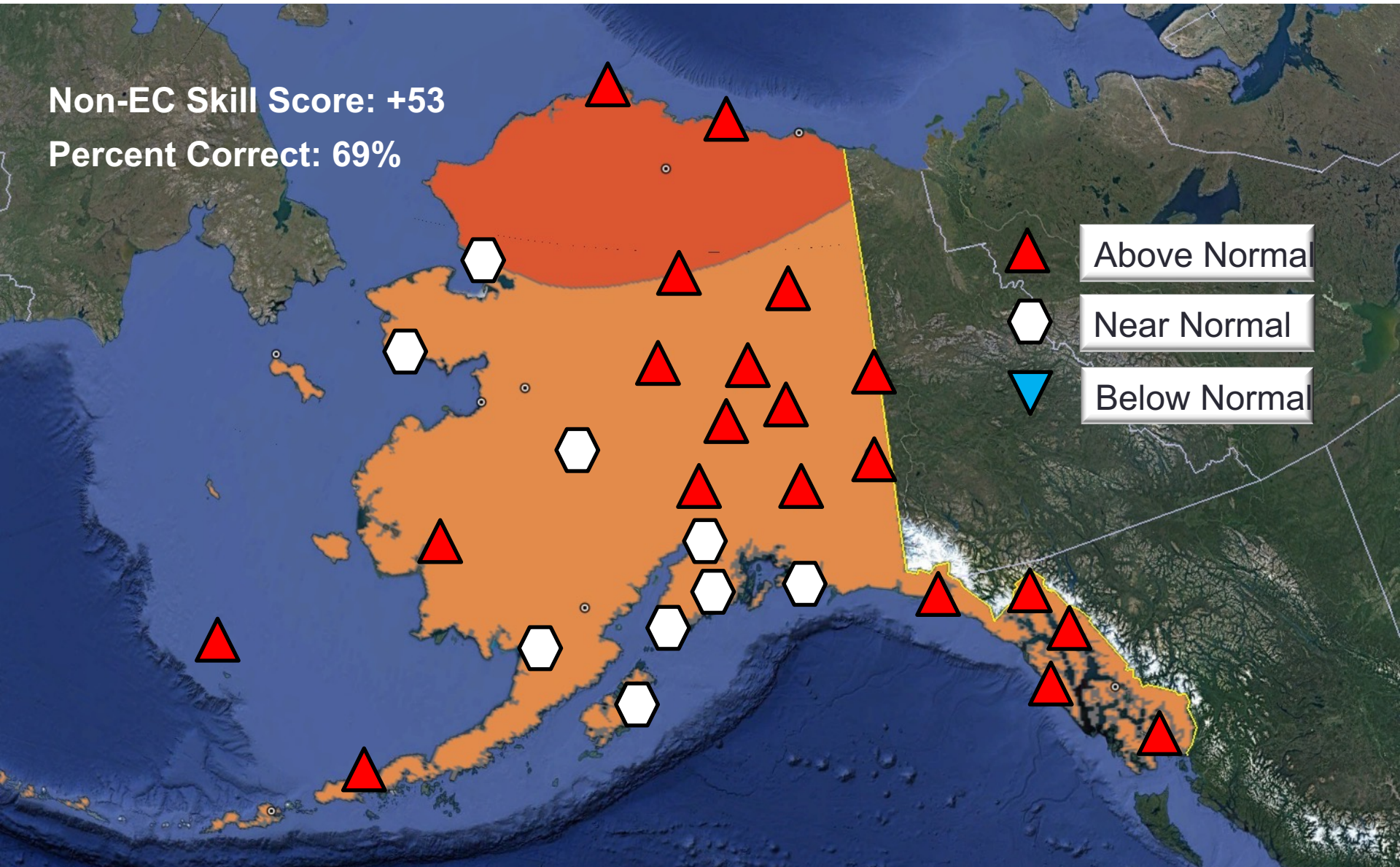
Non-EC Skill Score: -09  
Percent Correct: 27%  
Mid-Month Outlook






# Sep-Oct-Nov 2023 Temperature Anomalies

Non-EC Skill Score: +53

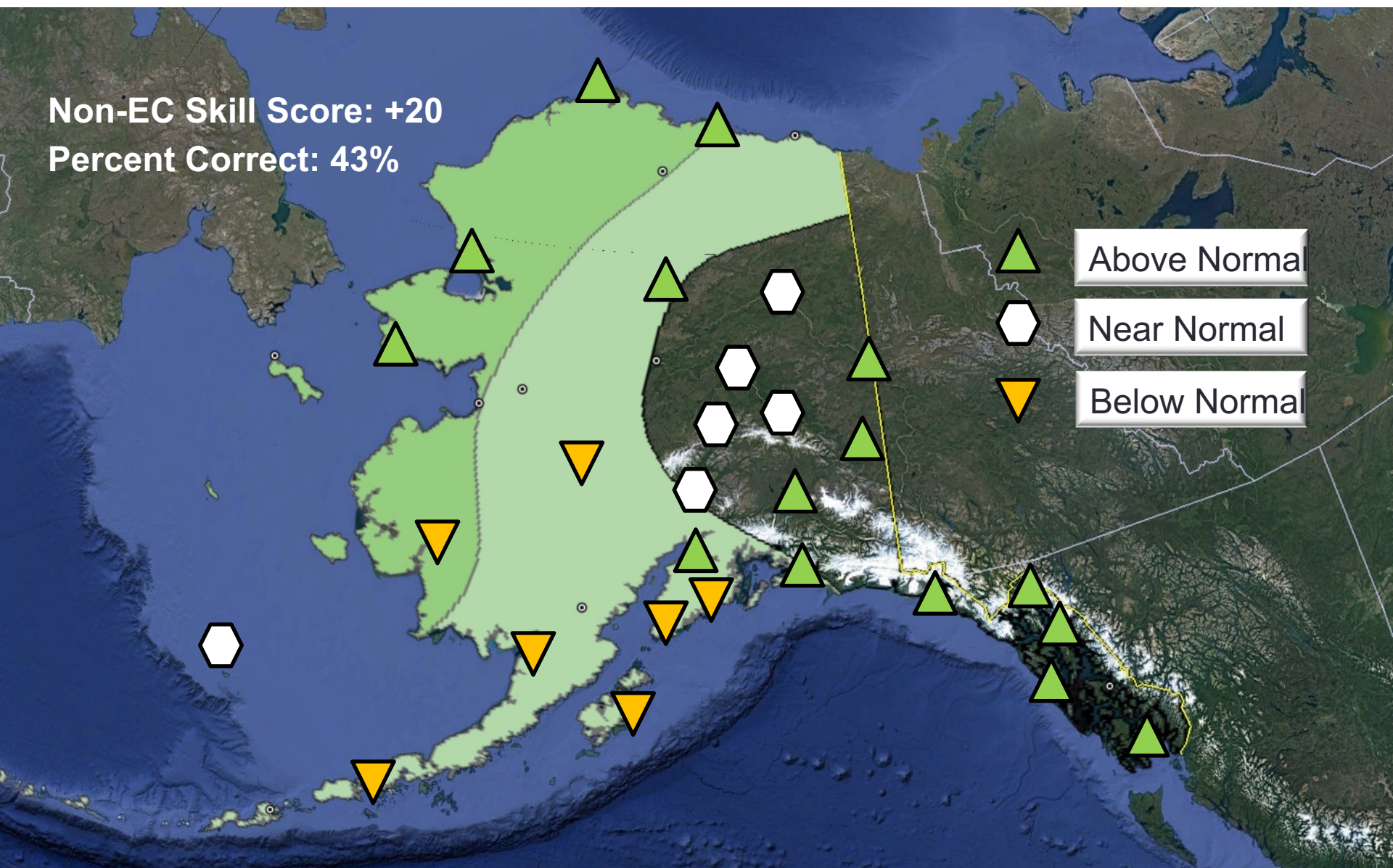
Percent Correct: 69%



-  Above Normal
-  Near Normal
-  Below Normal

# Sep-Oct-Nov 2023 Precipitation Anomalies

Non-EC Skill Score: +20  
Percent Correct: 43%

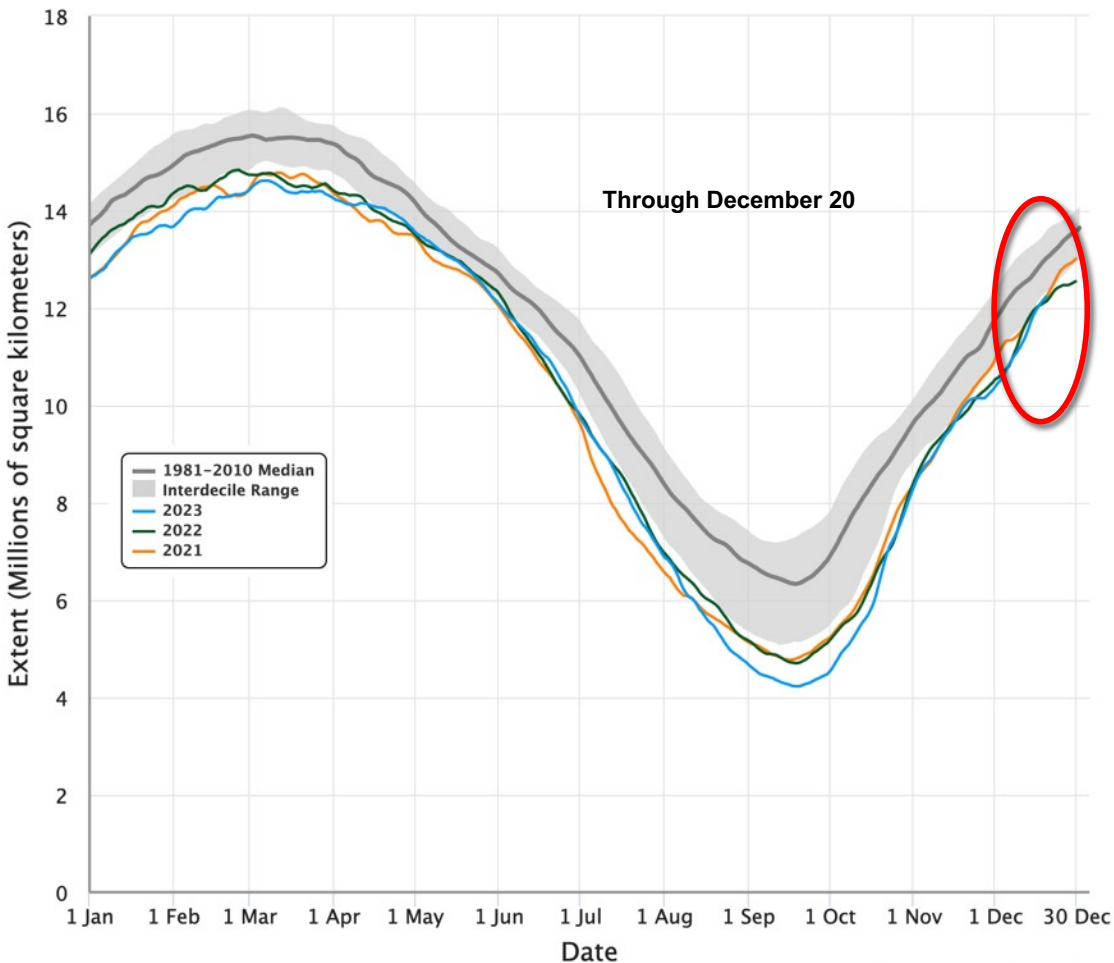


- Above Normal
- Near Normal
- Below Normal

# Arctic Wide Sea Ice

## Arctic Sea Ice Extent

(Area of ocean with at least 15% sea ice)



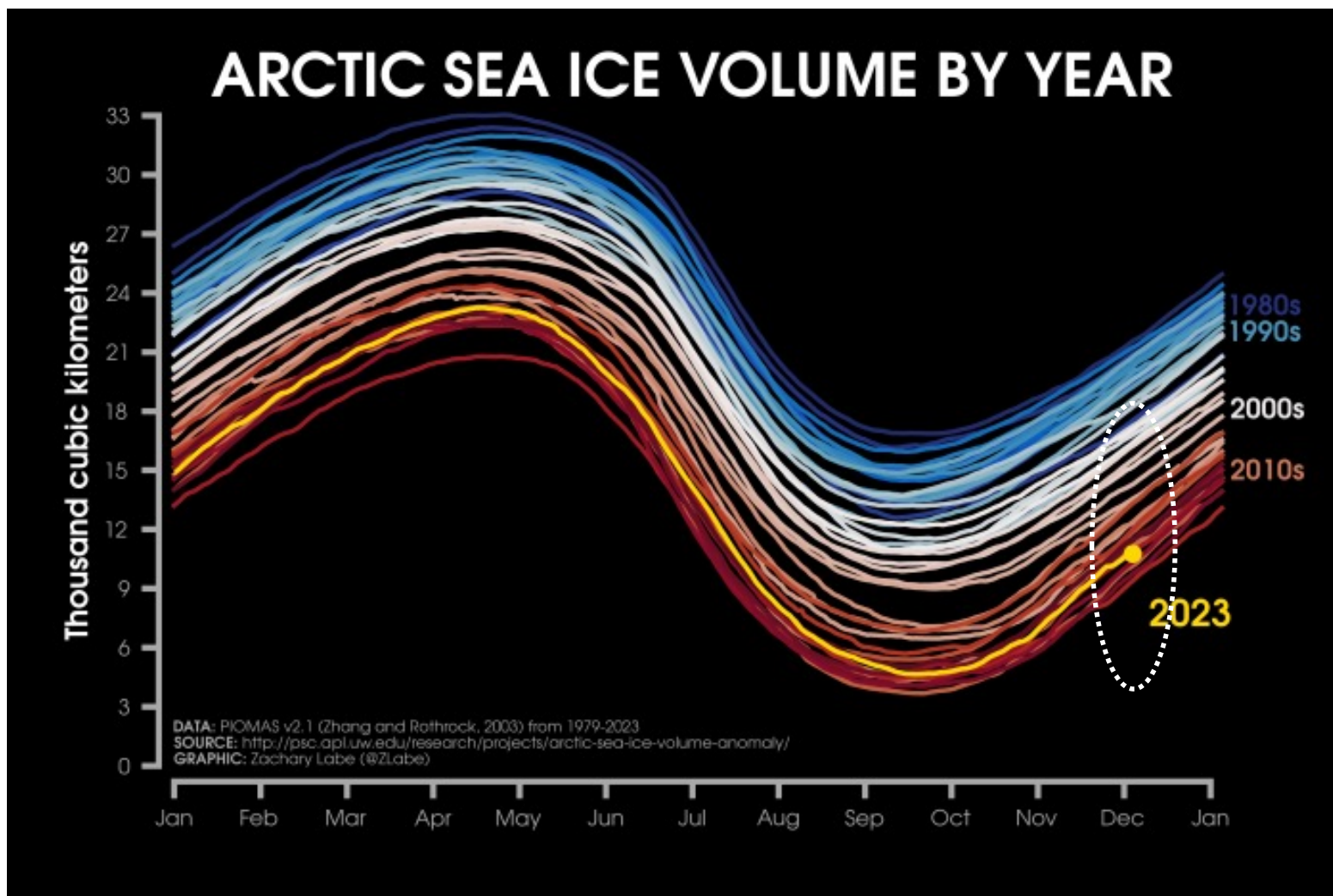
## Sea Ice Extent, 20 Dec 2023



National Snow and Ice Data Center, University of Colorado Boulder

National Snow and Ice Data Center, Boulder, CO

# Arctic Sea Ice Volume

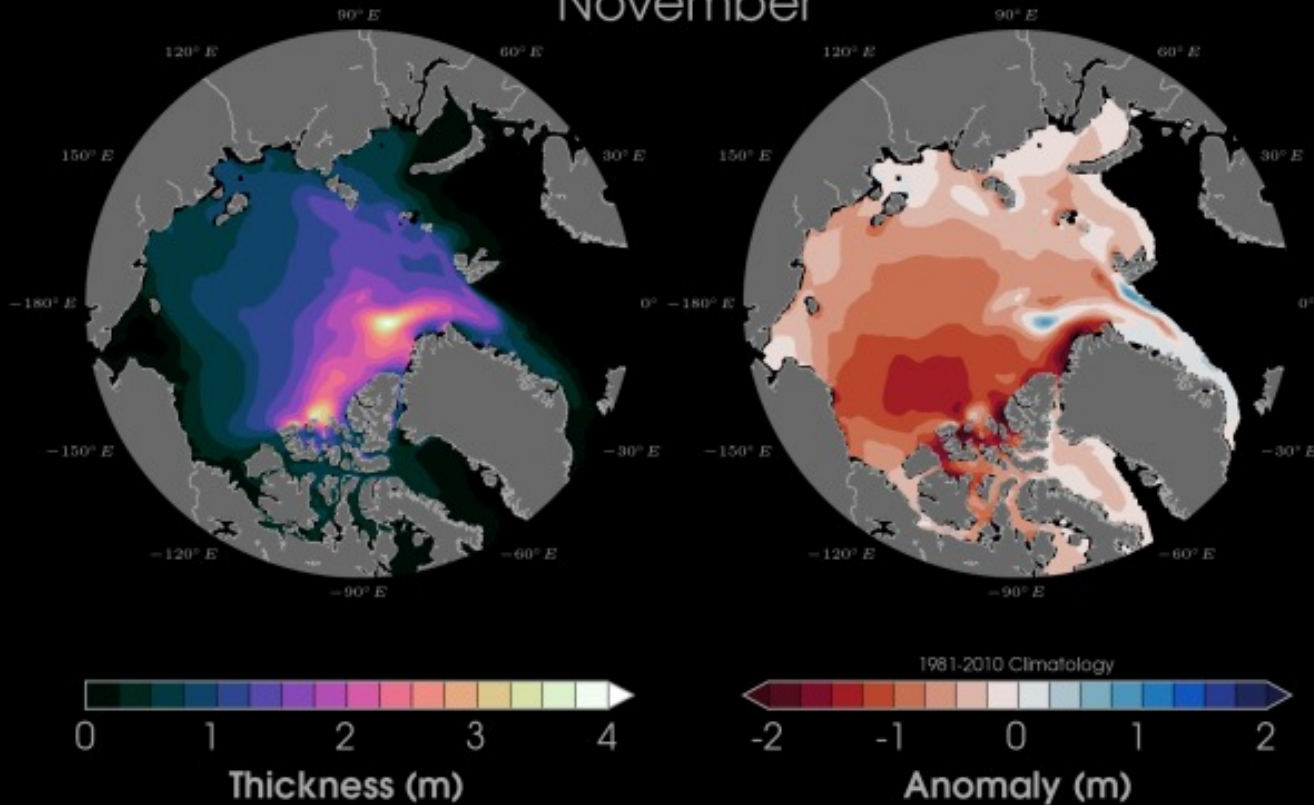


Sources:  
Data from U. Wa./PIOMAS data  
Graphics by Z. Labe, Princeton U.

# Arctic Sea Ice Thickness

## PIOMAS – SEA ICE THICKNESS – 2023

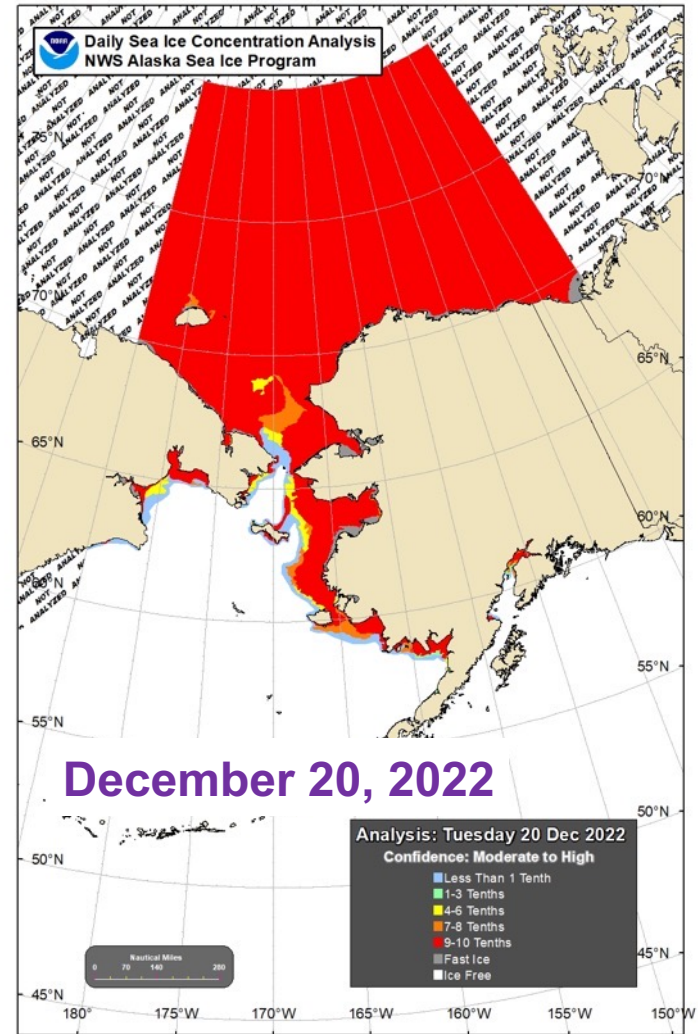
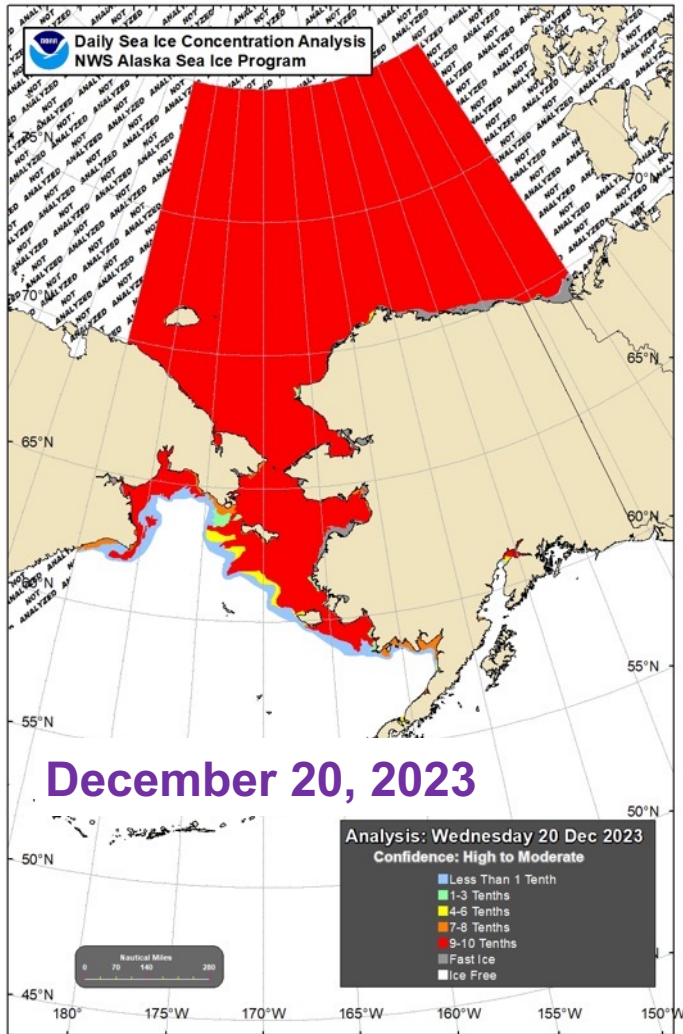
November



SOURCE: <http://psc.apl.uw.edu/research/projects/arctic-sea-ice-volume-anomaly/>  
DATA: PIOMAS v2.1 (Zhang and Rothrock, 2003)  
GRAPHIC: Zachary Labe (@ZLabe)

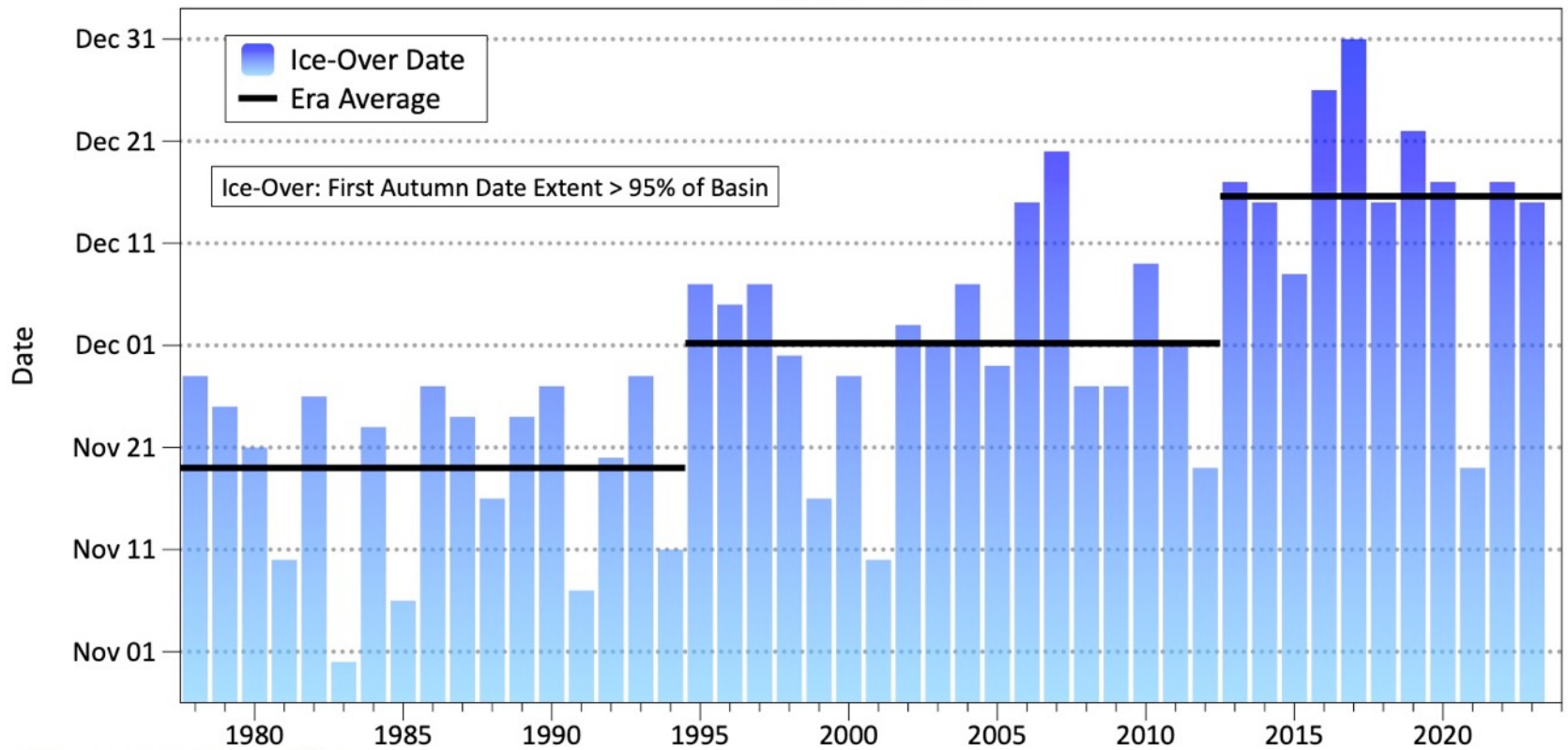
Sources:  
Data from U. Wa./PIOMAS data  
Graphics by Z. Labe, Princeton U.

# Mid-December Sea Ice Comparison



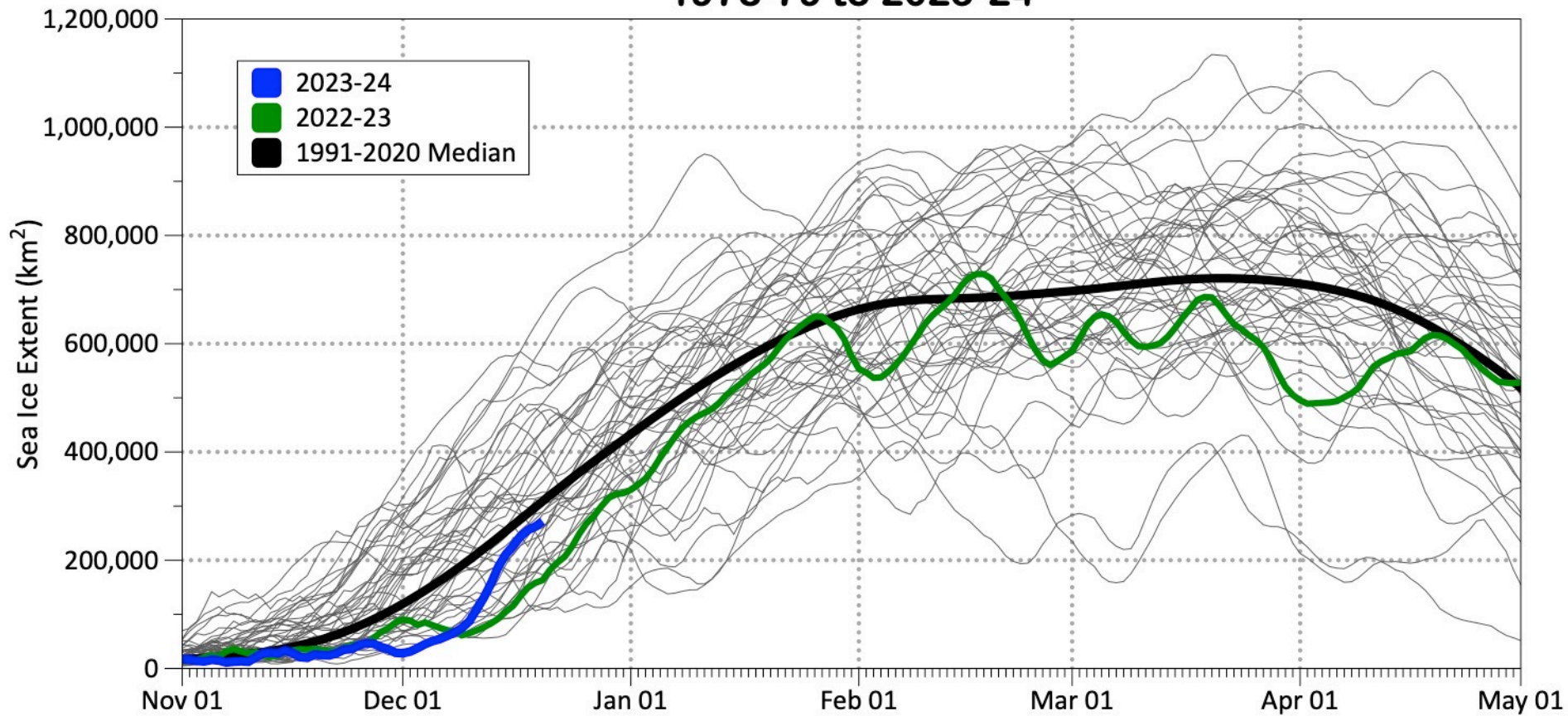
# Ice Season 2023-24

## Chukchi Sea Autumn Ice-Over Date 1978-2023



# Sea Ice Extent Through the Season

## Bering Sea Daily Ice Extent 1978-79 to 2023-24



# Global SST Departure from Average

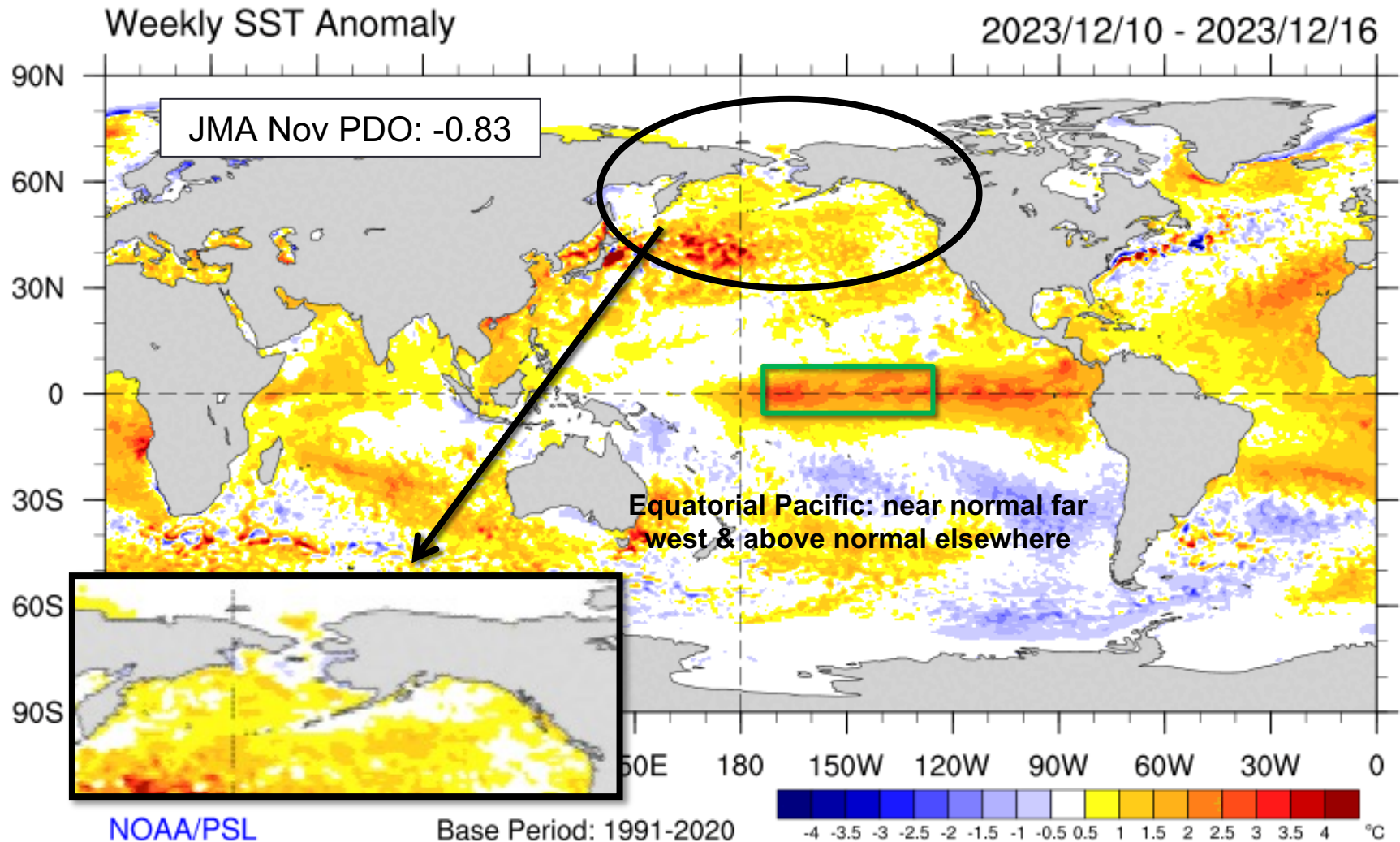
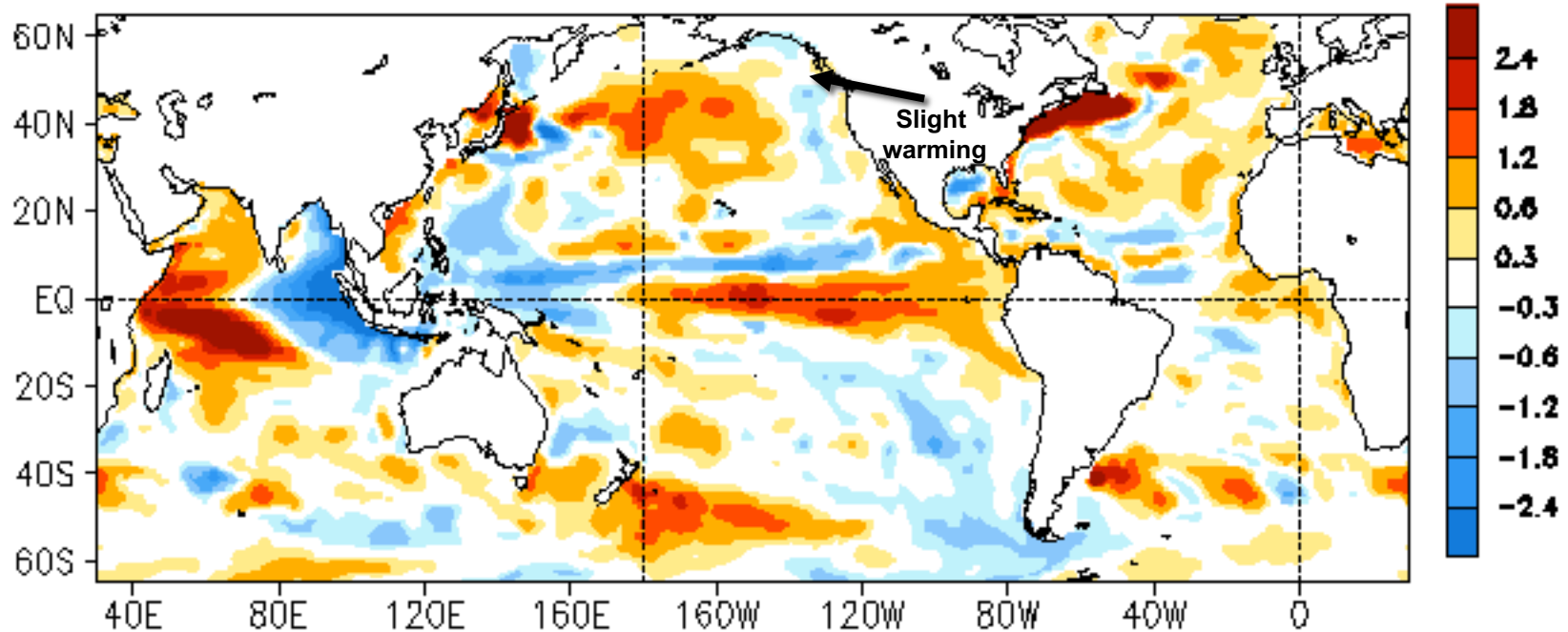


Image courtesy ESRL/PSL

# Upper Ocean Heat Content Anomaly

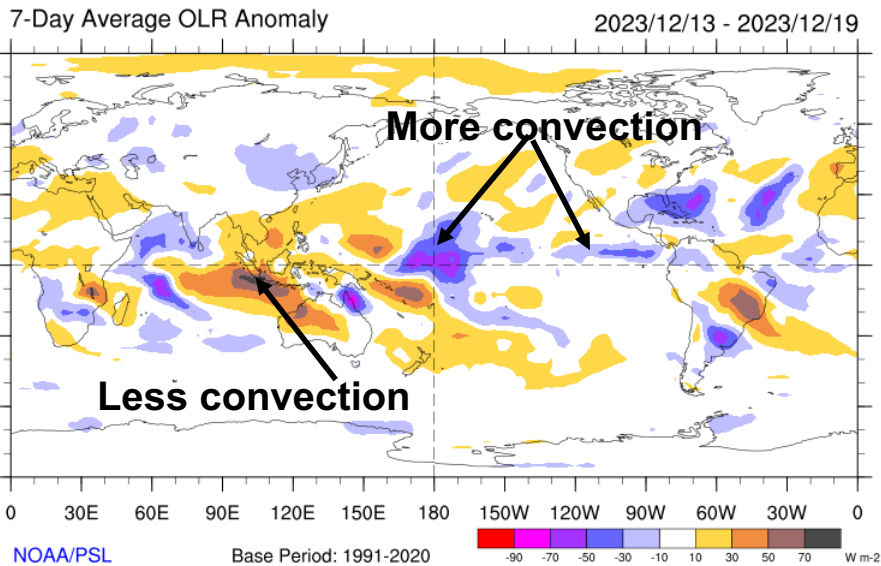
NOV 2023 Heat Content Anomaly (°C)  
(GODAS, Clima. 91-20)



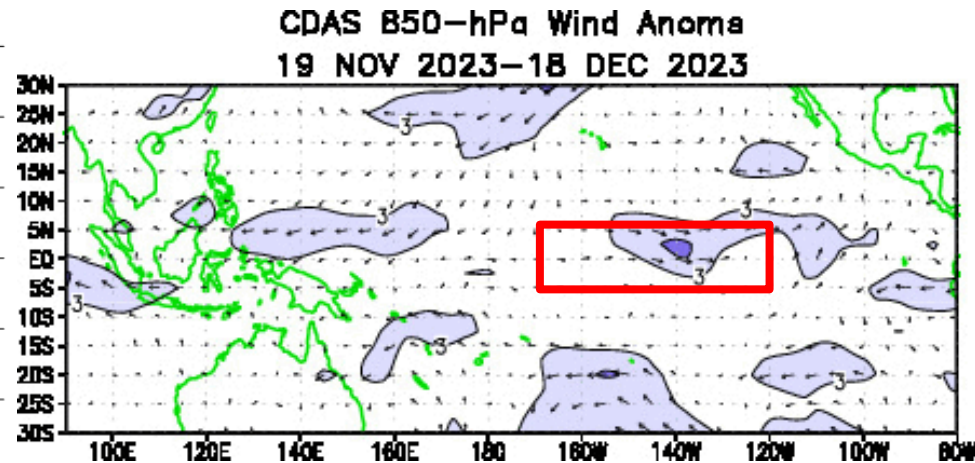
Heat Content Anomaly (°C)  
in the upper 300m

Source: CPC

# Tropical Pacific Atmosphere



OLR="Outgoing Longwave Radiation"  
Proxy for deep tropical convection



Trade winds weaker than average  
Niño Region 3.4

**September-November 2023 Oceanic Niño Index: +1.8**

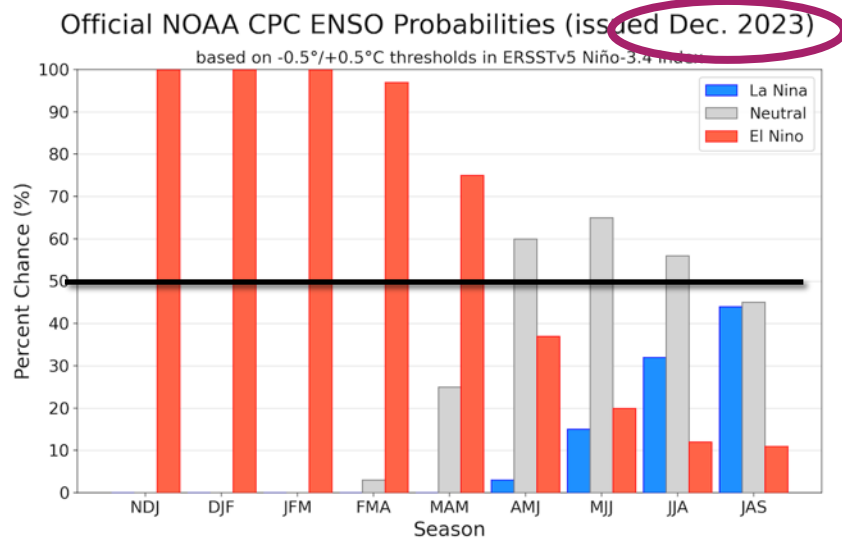
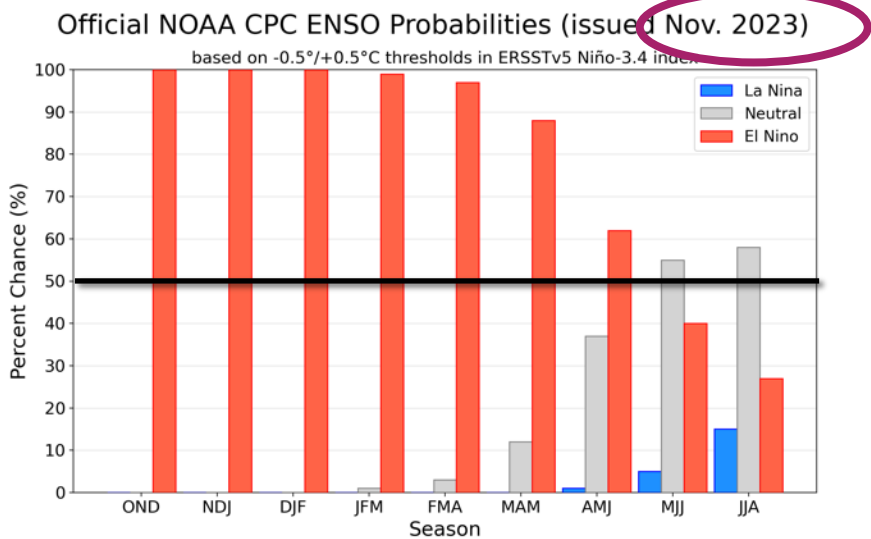
# Guidance

- ENSO (El Niño/La Niña)
  - Expert Evaluation
- Statistical (Using the past)
- Dynamic Models (All physics, all the time)
  - Sea surface temperatures
  - Temp and precipitation
  - Sea ice



# CPC Niño 3.4 Forecasts: Experts

ENSO Alert System Status: **El Niño Advisory**



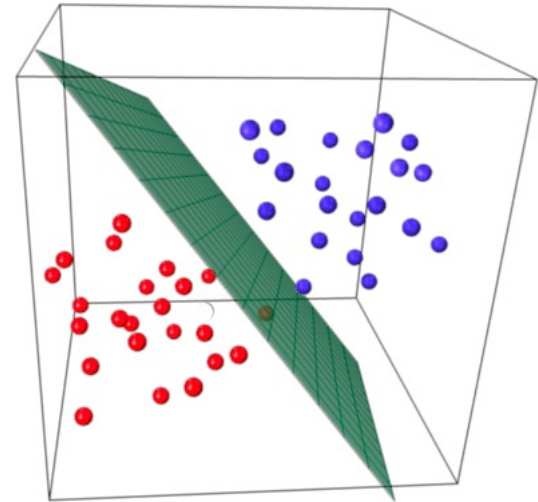
**Strong El Niño reached early autumn (ASO)**

**El Niño expected to weaken rapidly but continue into spring 2024**

# Statistical Guidance

## Using the past to predict the future

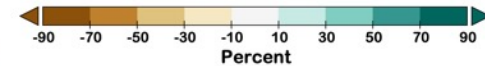
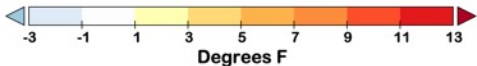
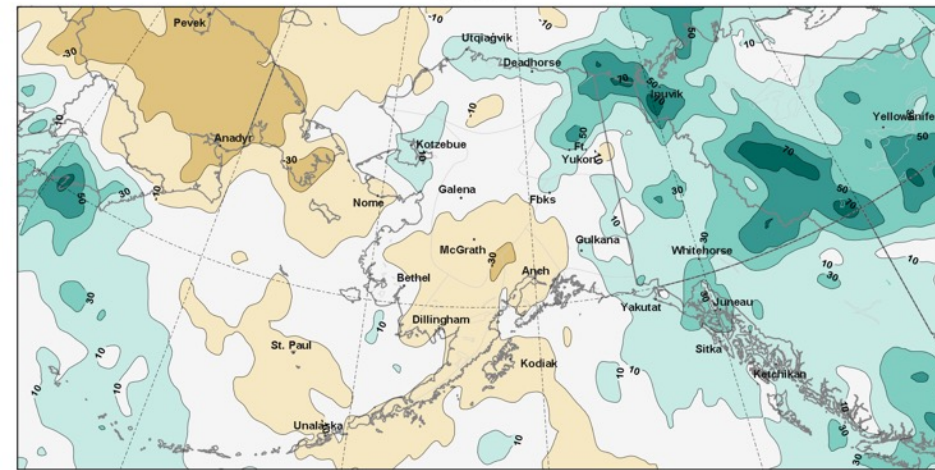
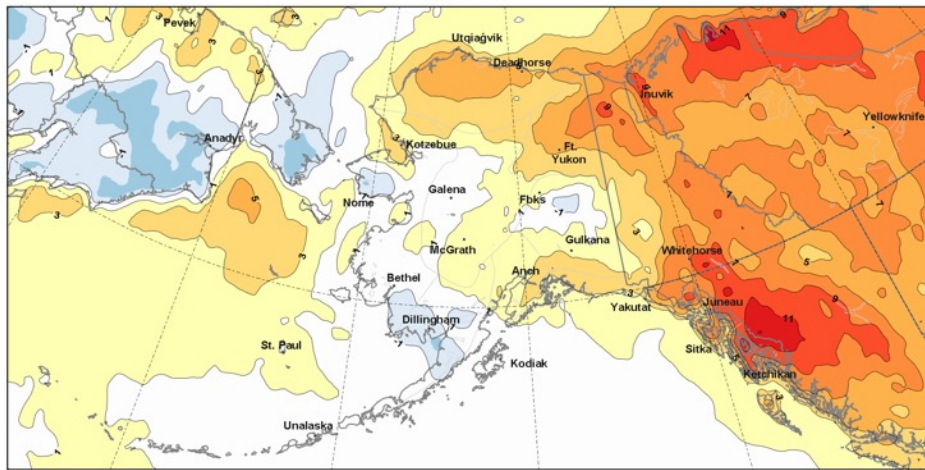
- Long Term Trend
- Optimum Climate Normals: Alaska trends the past 15 years
  - Update to new normals means OCN less informative next few years
- Past Autumn El Niño events



# January Half Century Trends

Total Change in January Average Temperature  
1974-2023

Percent Change in January Precipitation  
1974-2023



ERA5 courtesy of ECMWF/Copernicus

ERA5 courtesy of ECMWF/Copernicus

Temperature Change  
Trend over 50 years

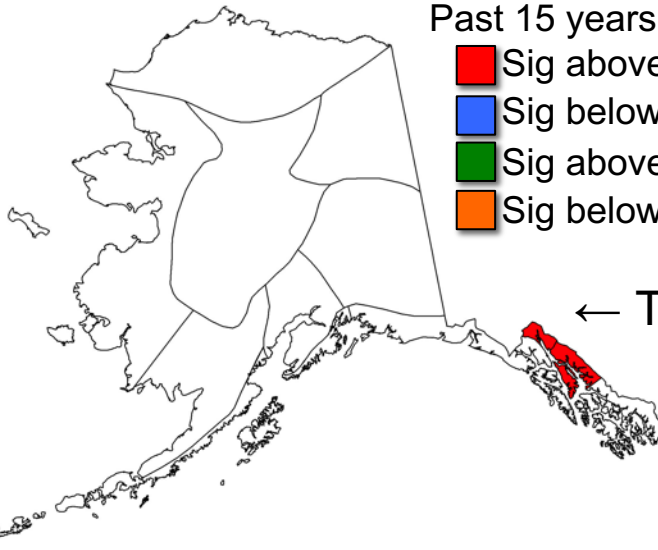
Precipitation Change  
Trend over 50 years

# 2009-2023 Trends

Past 15 years compared to 1991-2020

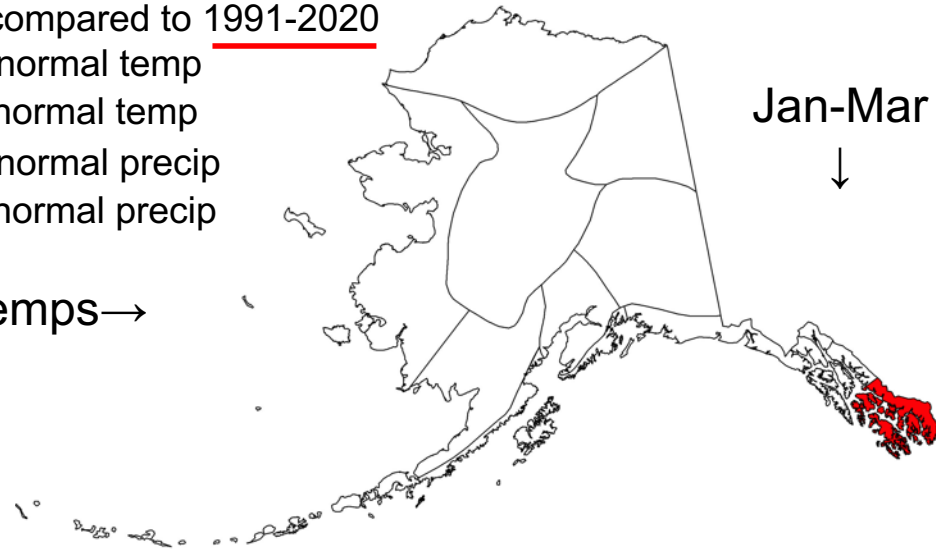
- Sig above normal temp
- Sig below normal temp
- Sig above normal precip
- Sig below normal precip

January

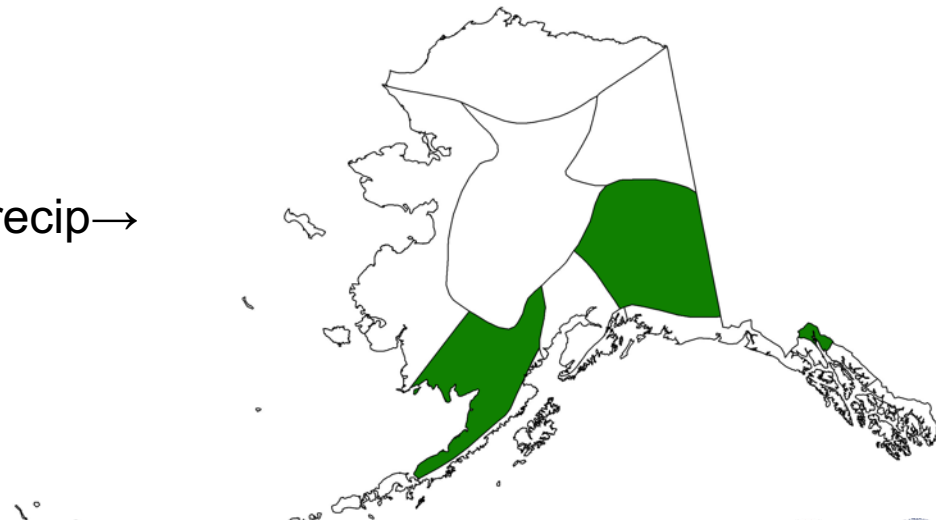
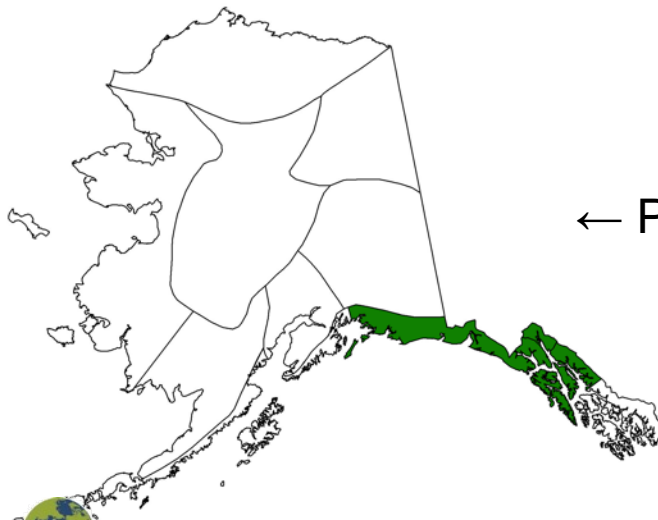


← Temps →

Jan-Mar



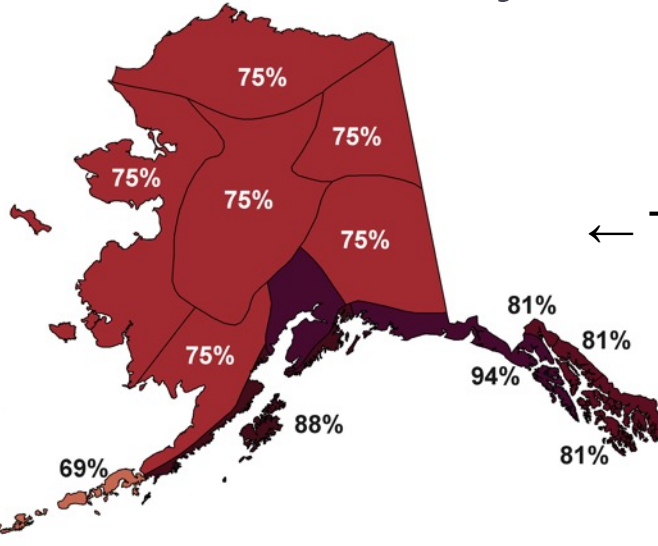
← Precip →



# 16 El Niño since 1976-77

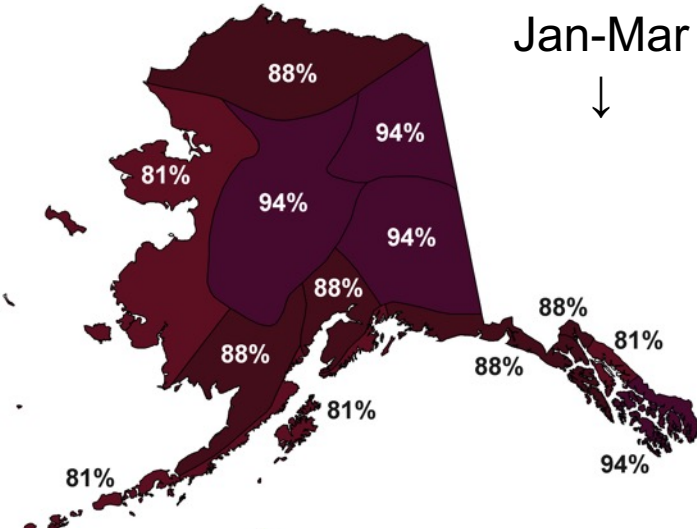
## Percent years above average

January

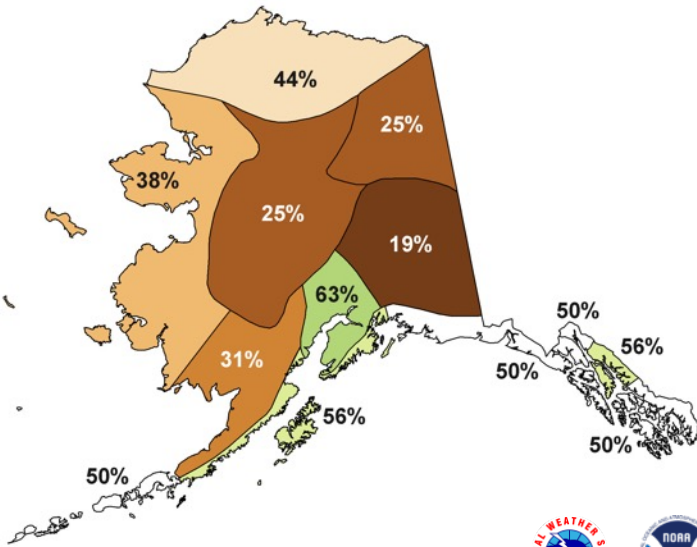
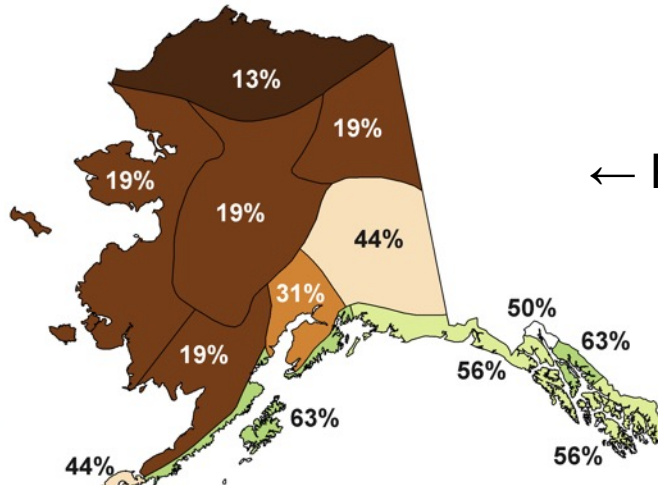


← Temps →

Jan-Mar



← Precip →



# Dynamic Model Forecasts

- Sea Surface Temperatures
- Sea ice forecast
- Temperature and precip anomalies

## Current suite of Dynamic Climate Models

- CPC Experimental Sea Ice Ensemble
- World Climate Service Multi-Model Ensemble
- **NMME**: North American Multi-Model Ensemble

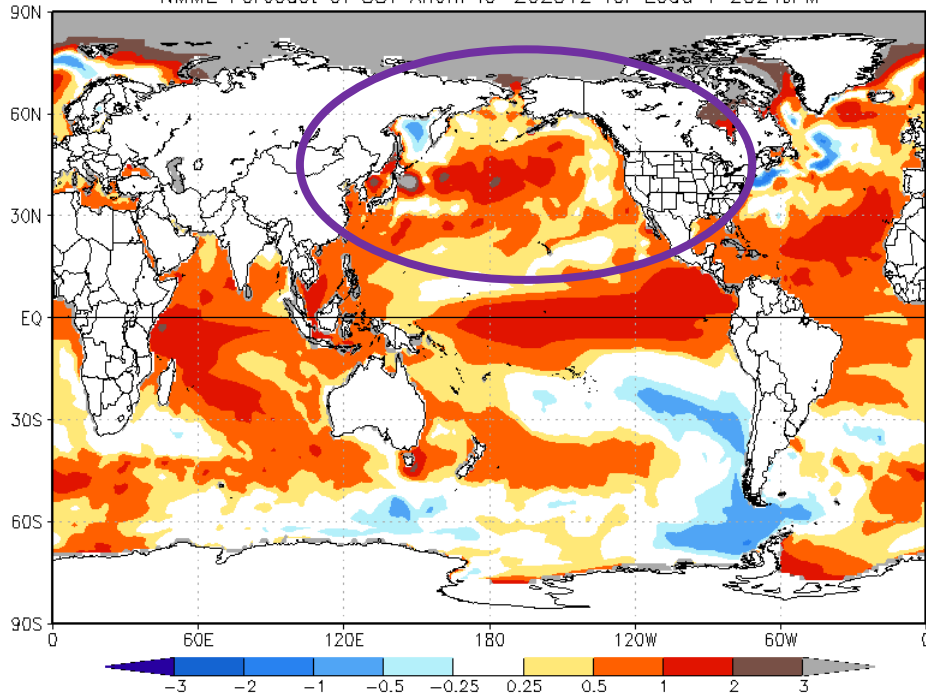


# NMME: January through March 2024 SST Departures from Normal and Forecast Skill

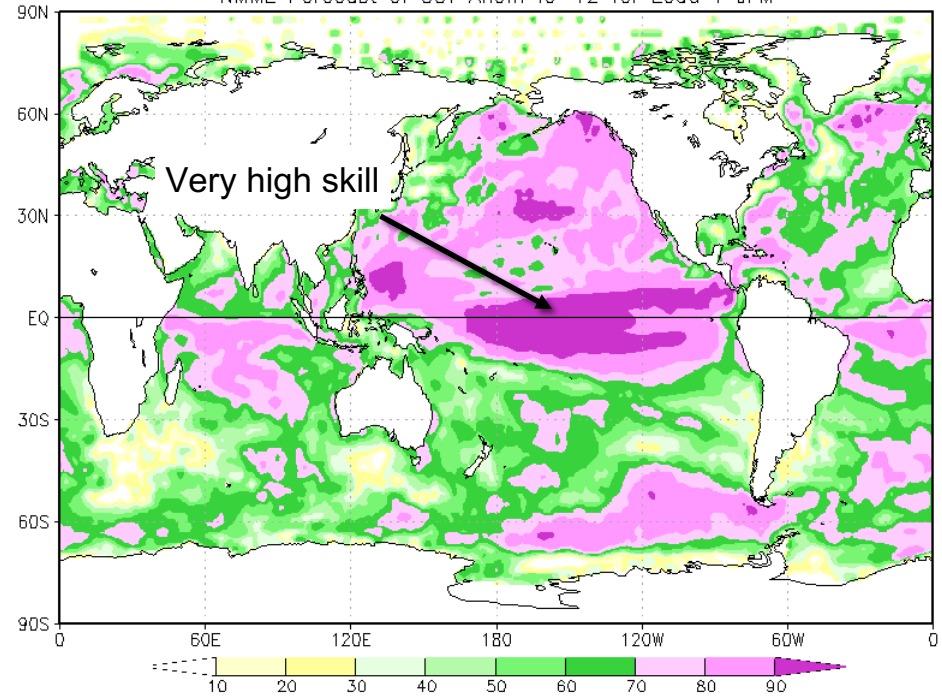
## Forecast

## Skill

NMME Forecast of SST Anom IC=202312 for Lead 1 2024JFM



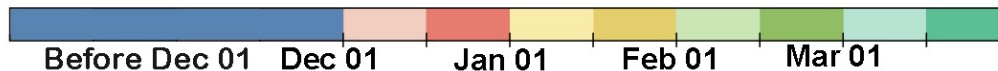
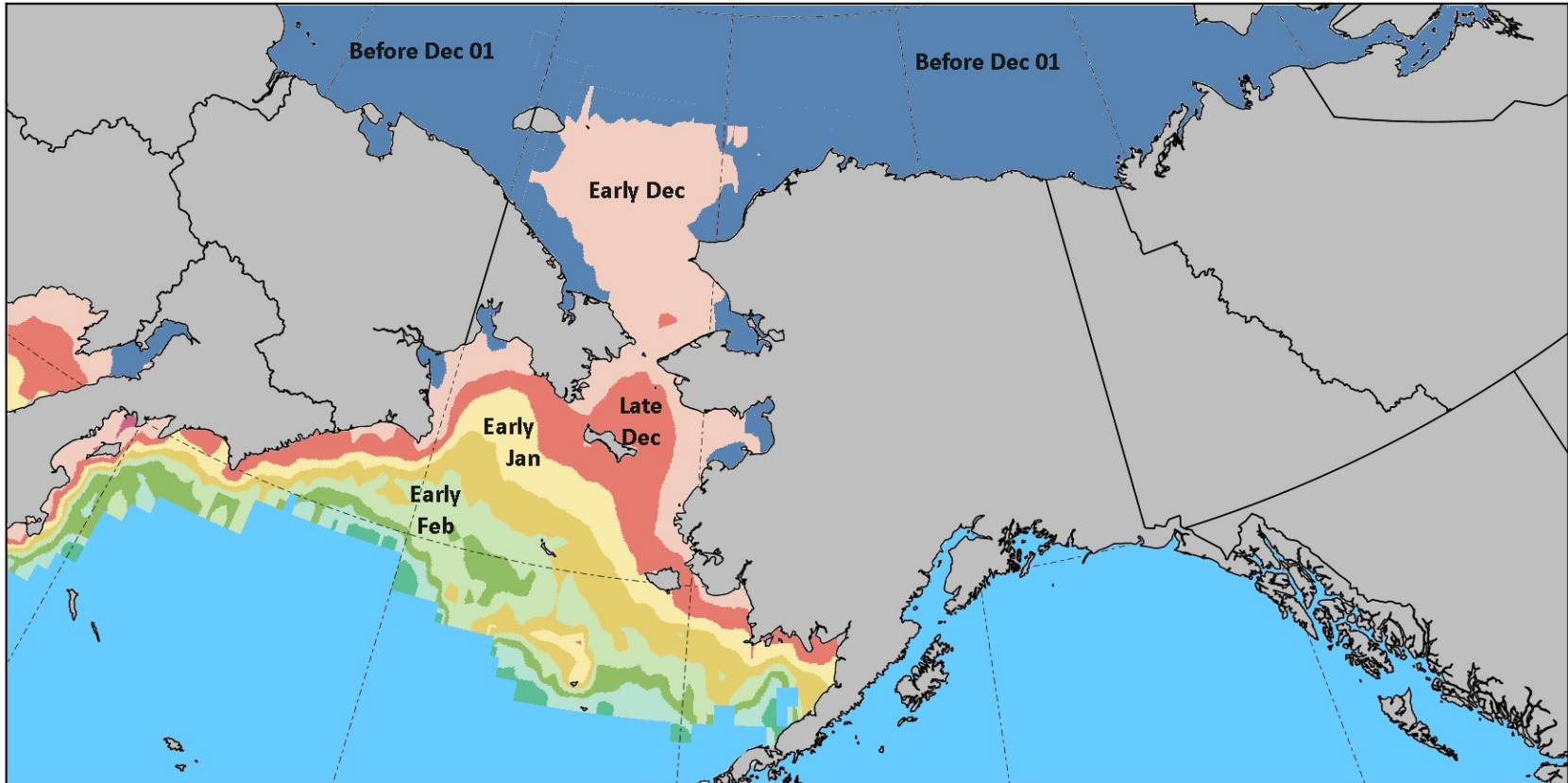
NMME Forecast of SST Anom IC=12 for Lead 1 JFM



Vaguely Negative  
PDO pattern

# CPC Experimental Sea Ice Forecast

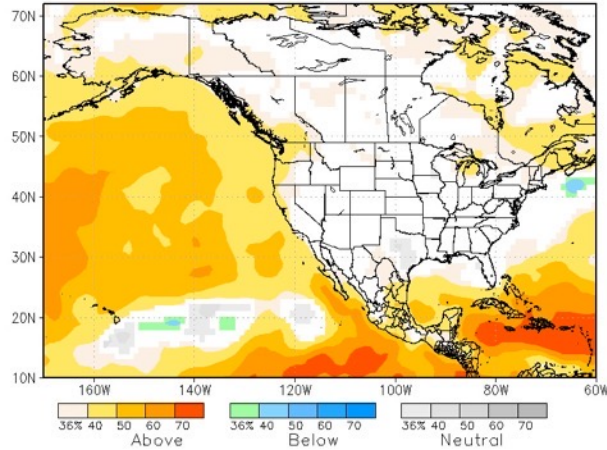
Sea Ice Freeze-up: First Date Concentration  $\geq 15$  Percent  
Autumn/Winter 2023-24



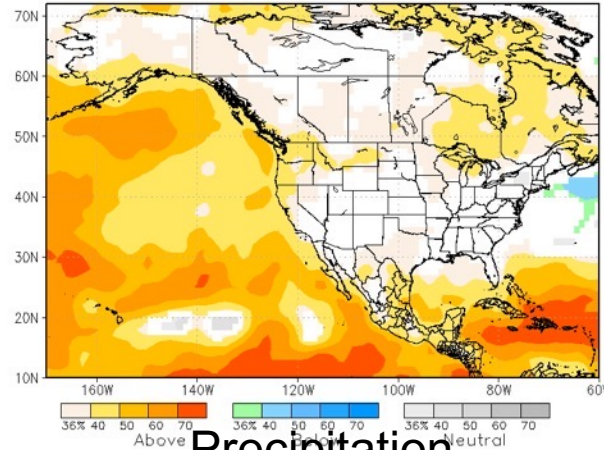
# NMME Calibrated Probability Forecasts for January 2024

## Temperatures

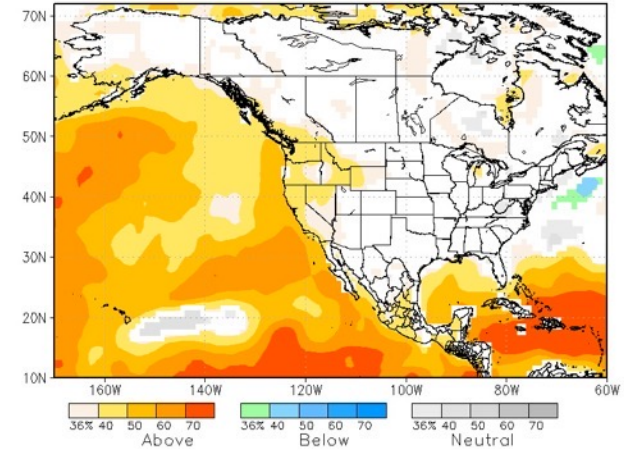
NMME prob fcast TMP2m IC=202310 for lead 3 2024 Jan



NMME prob fcast TMP2m IC=202311 for lead 2 2024 Jan

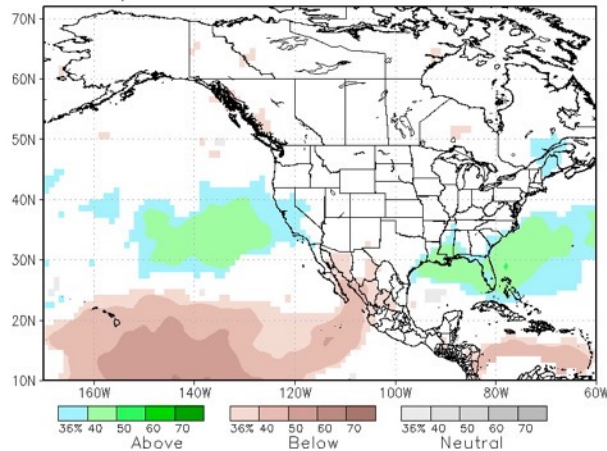


NMME prob fcast TMP2m IC=202312 for lead 1 2024 Jan

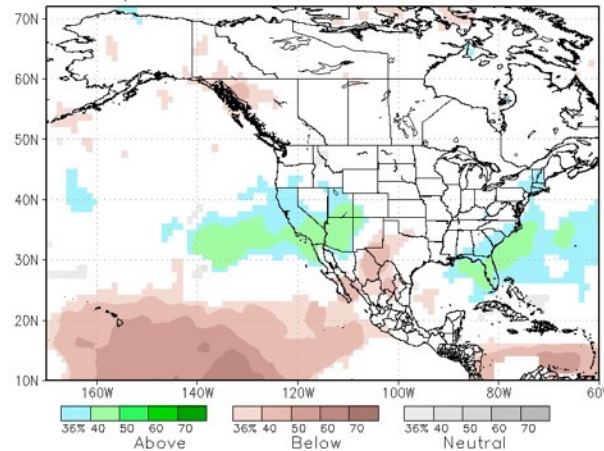


## Precipitation

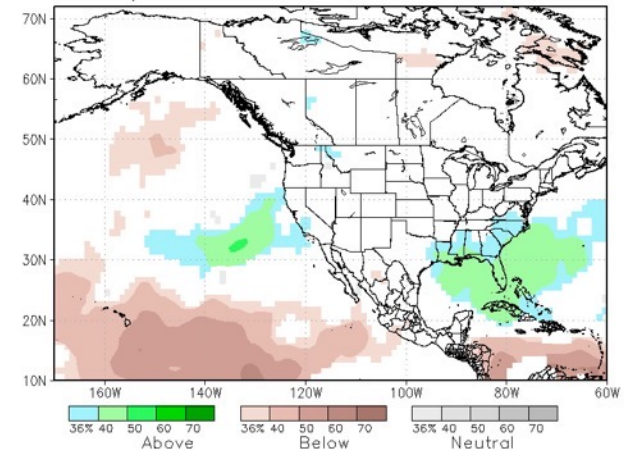
NMME prob fcast Prate IC=202310 for lead 3 2024 Jan



NMME prob fcast Prate IC=202311 for lead 2 2024 Jan



NMME prob fcast Prate IC=202312 for lead 1 2024 Jan



Forecast from: October

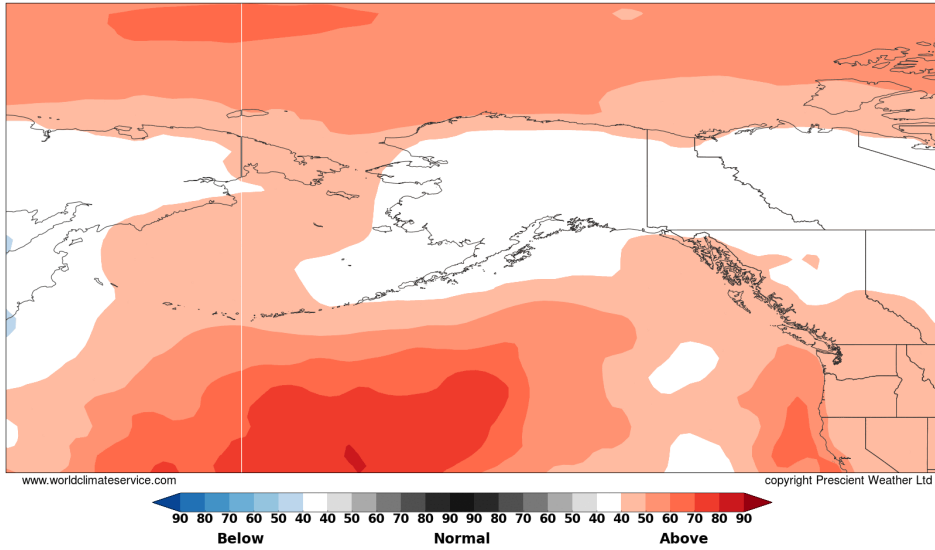
November

December

# January 2024 Outlooks World Climate Service

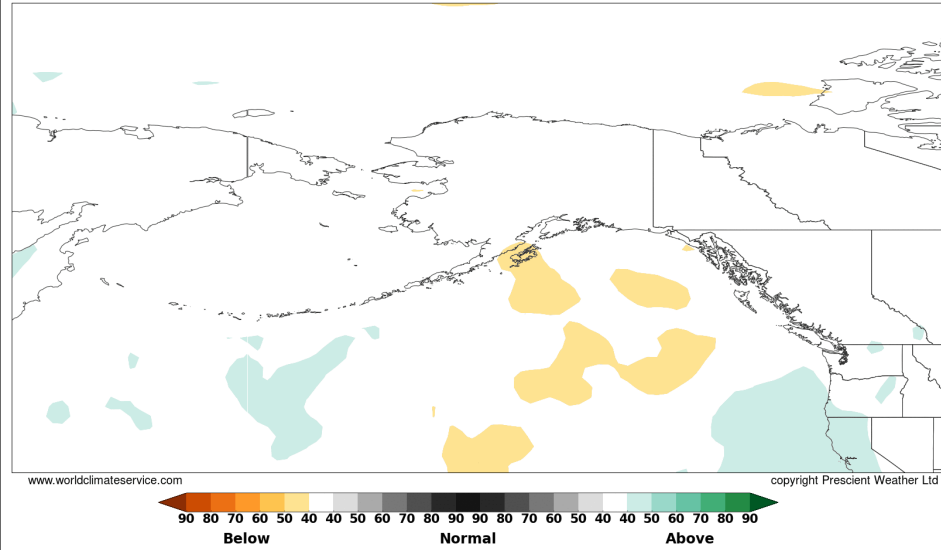
Bias Corrected, Skill Weighted CFS + ECMWF

Multi-Model T2m Probability Above/Normal/Below  
Forecast Valid January 2024  
Initialized December 2023 1991-2020 Climatology



Temperature Outlook

Multi-Model Precipitation Probability Above/Normal/Below  
Forecast Valid January 2024  
Initialized December 2023 1991-2020 Climatology

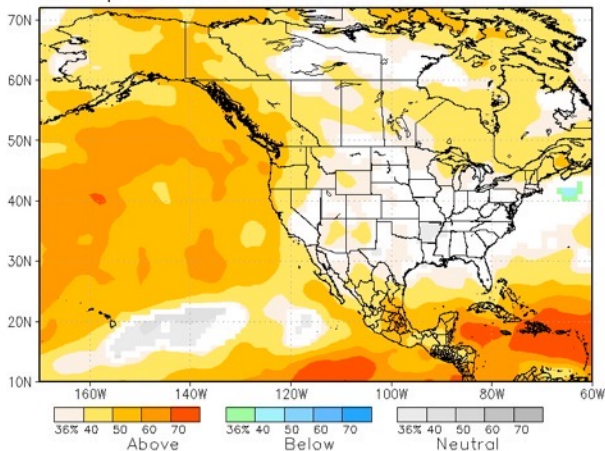


Precipitation Outlook

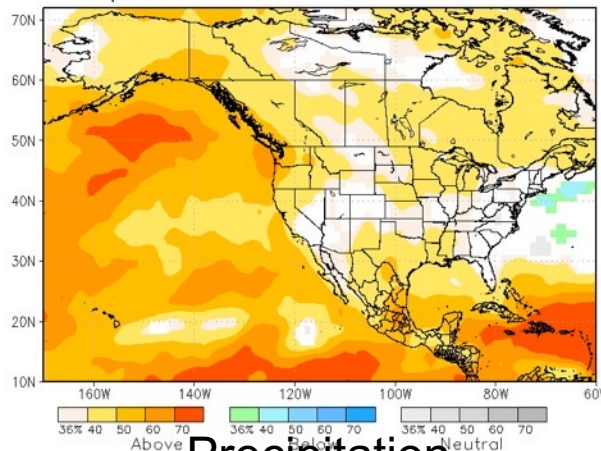
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## Temperatures

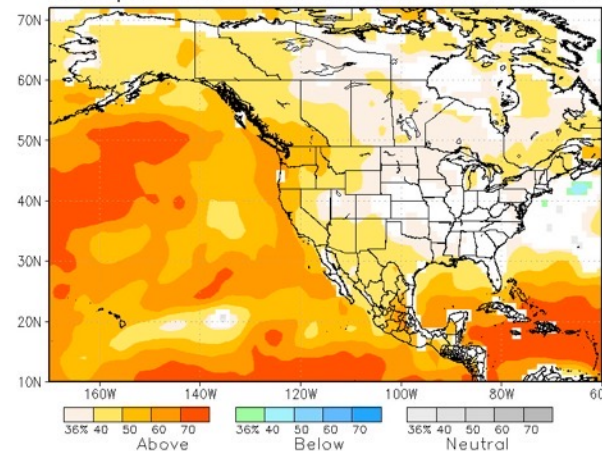
NMME prob fcst TMP2m IC=202310 for lead 3 2024 JFM



NMME prob fcst TMP2m IC=202311 for lead 2 2024 JFM

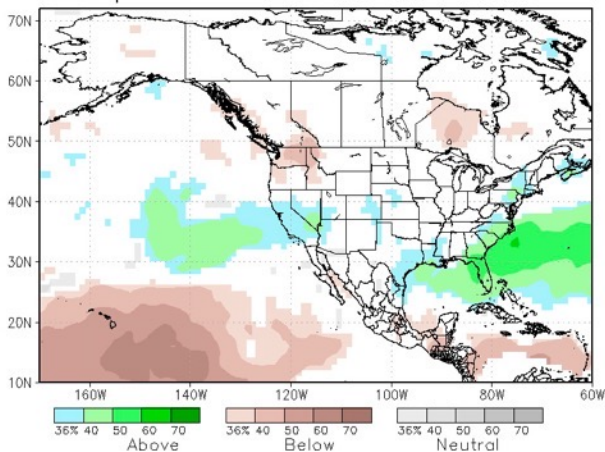


NMME prob fcst TMP2m IC=202312 for lead 1 2024 JFM

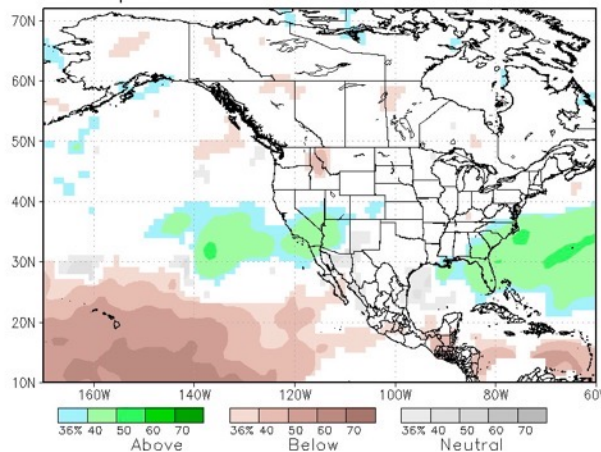


## Precipitation

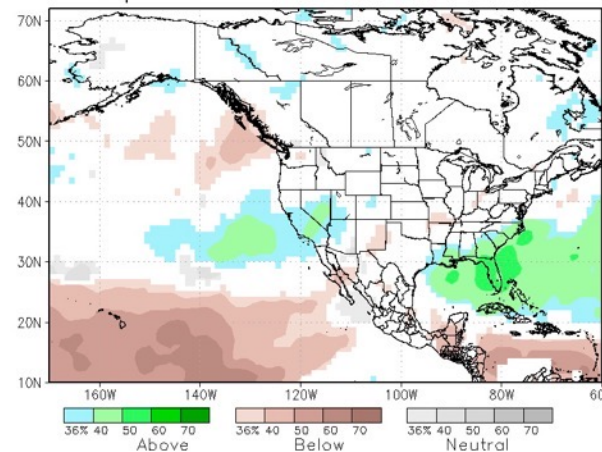
NMME prob fcst Prate IC=202310 for lead 3 2024 JFM



NMME prob fcst Prate IC=202311 for lead 2 2024 JFM



NMME prob fcst Prate IC=202312 for lead 1 2024 JFM



Forecast from: October

November

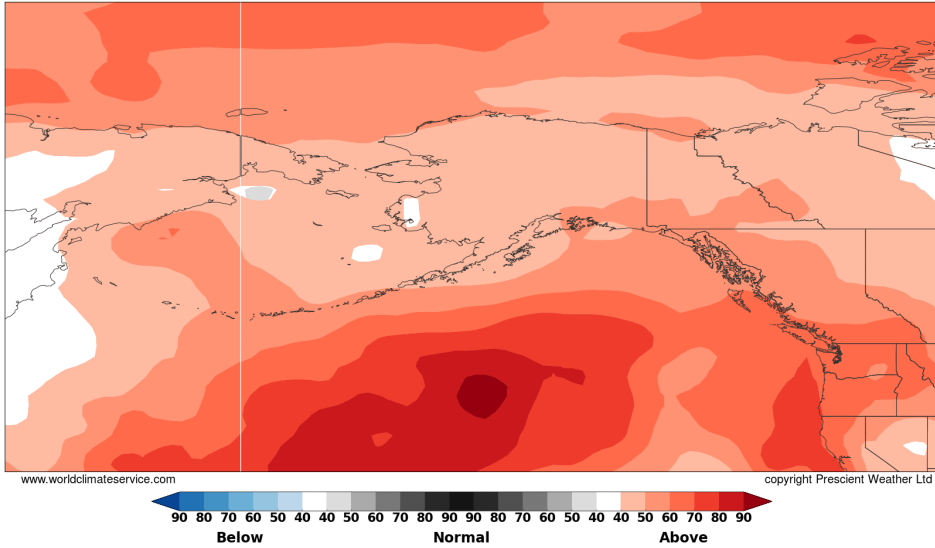
December

# January through March 2024 Outlooks

## World Climate Service

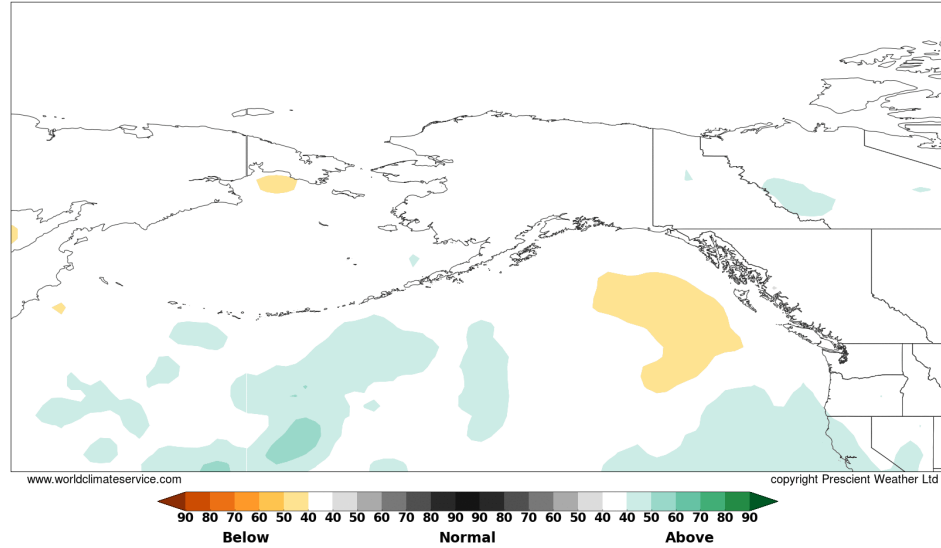
Bias Corrected, Skill Weighted CFS + ECMWF

Multi-Model T2m Probability Above/Normal/Below  
Forecast Valid Jan 2024 - Mar 2024  
Initialized December 2023 1991-2020 Climatology



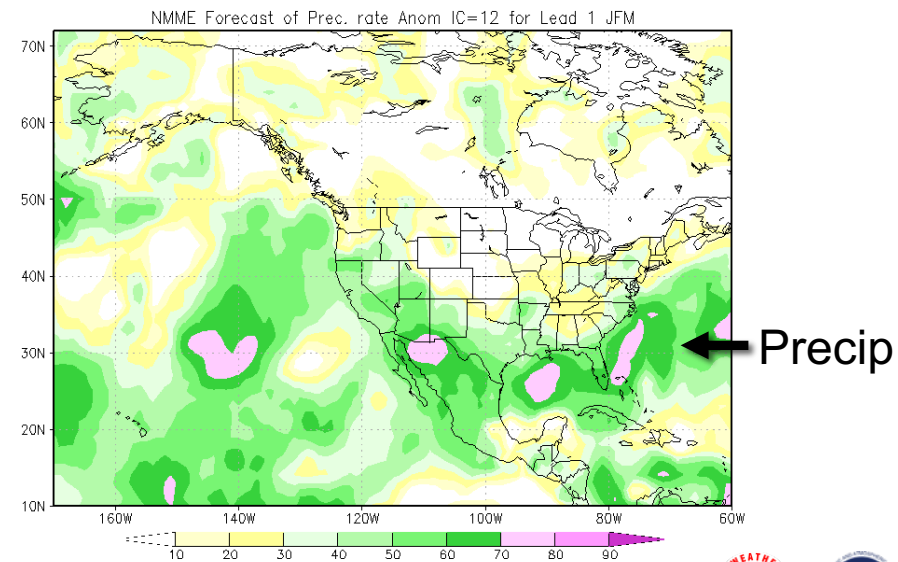
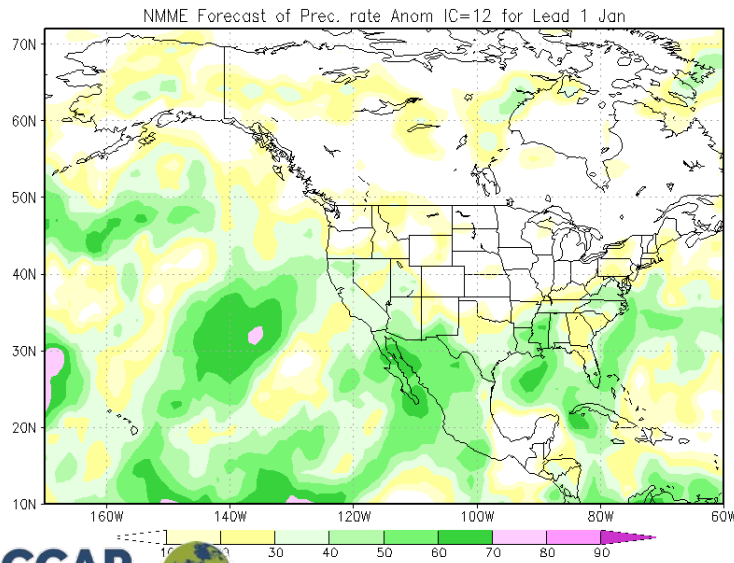
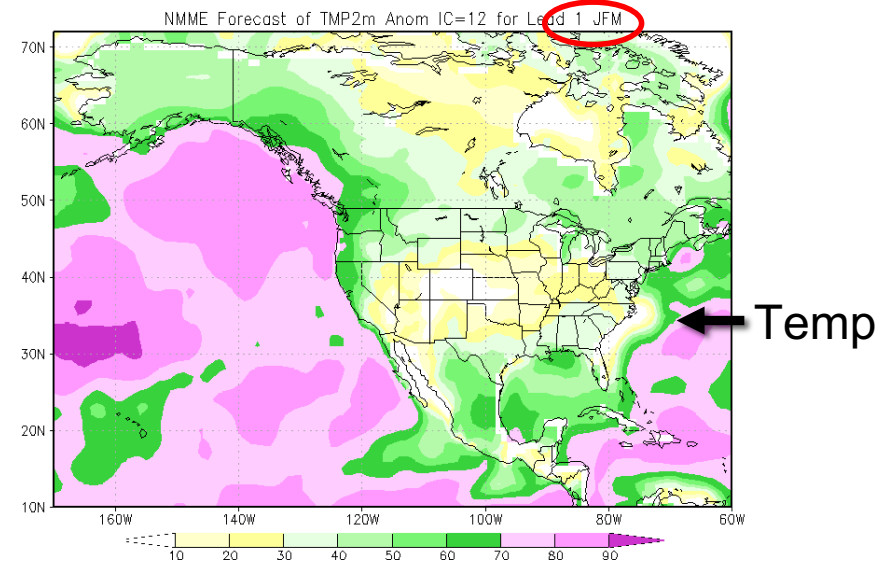
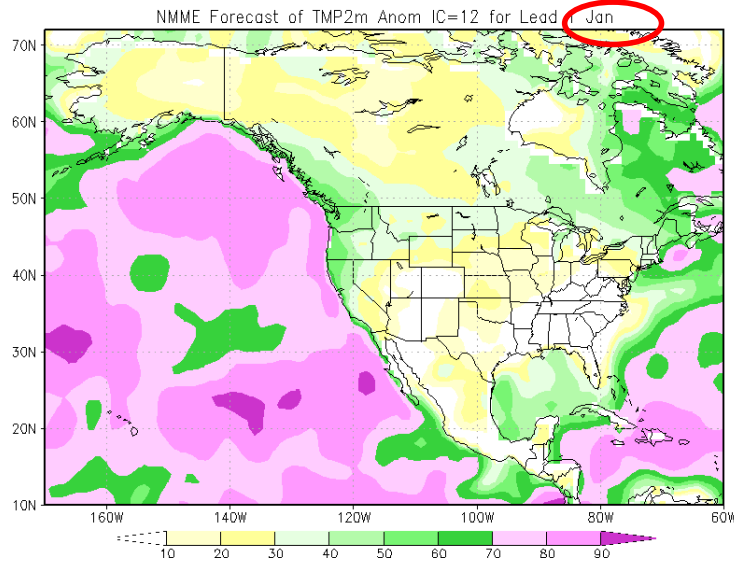
Temperature Outlook

Multi-Model Precipitation Probability Above/Normal/Below  
Forecast Valid Jan 2024 - Mar 2024  
Initialized December 2023 1991-2020 Climatology

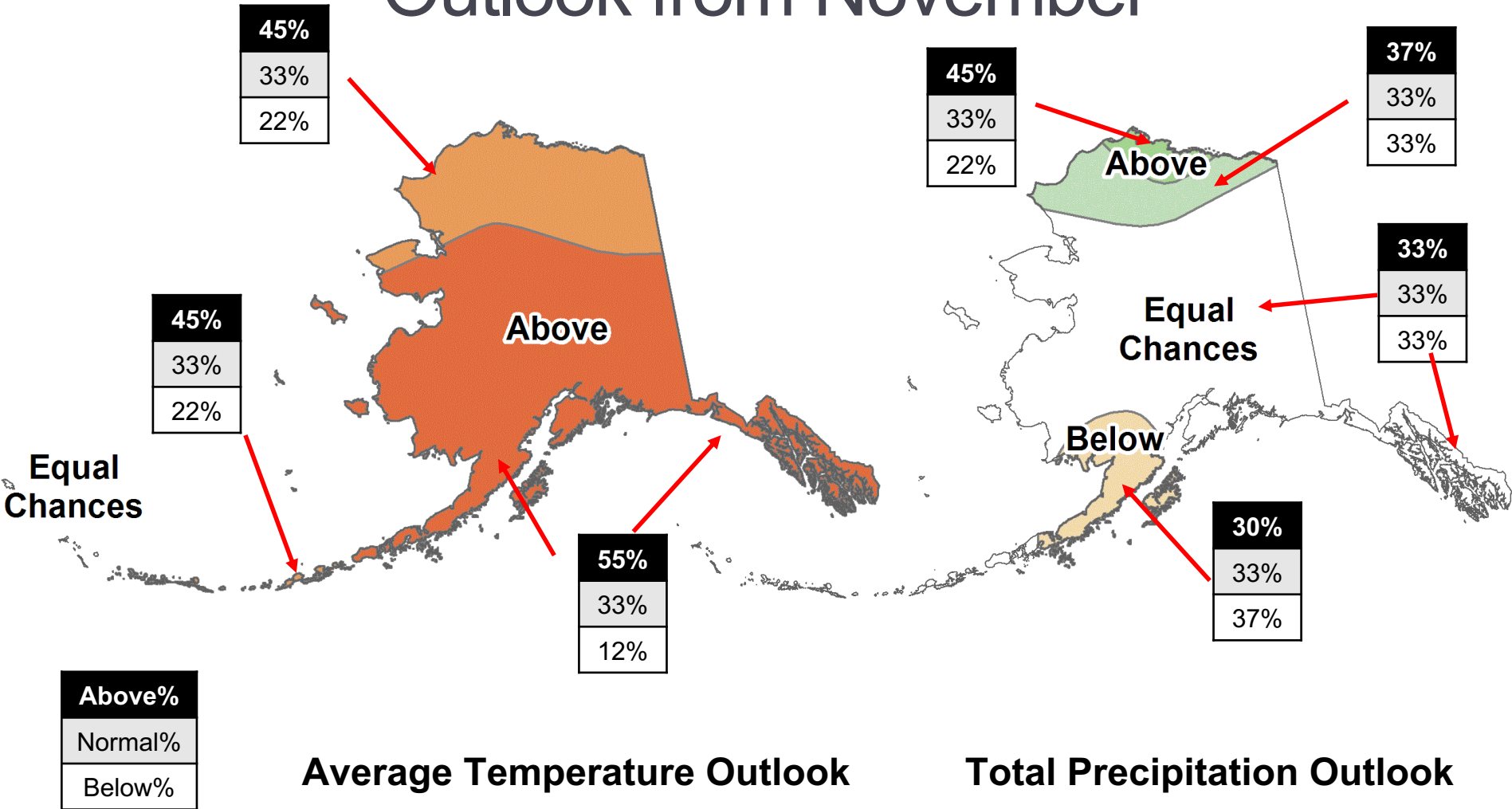


Precipitation Outlook

# NMME Skill for Jan and Jan-Mar

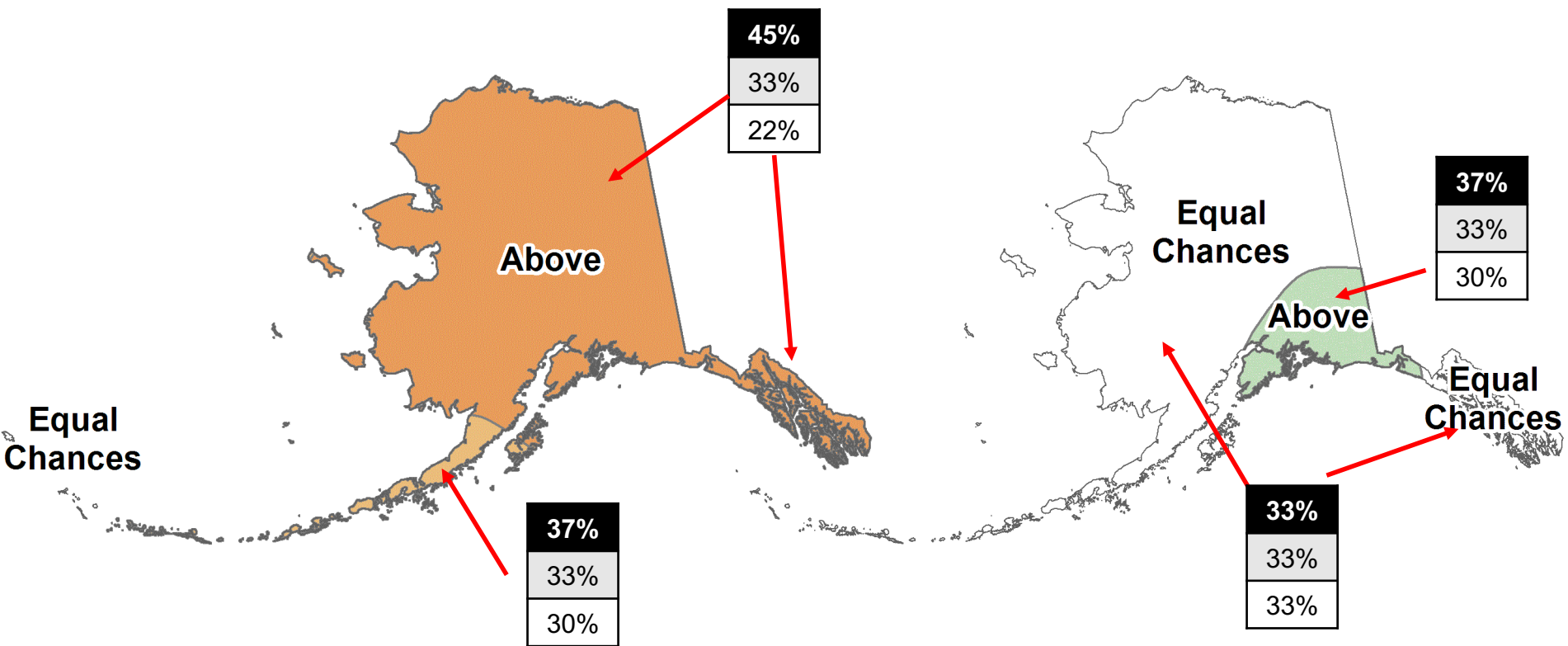


# January through March 2024 Outlook from November





# CPC January 2024 Outlook

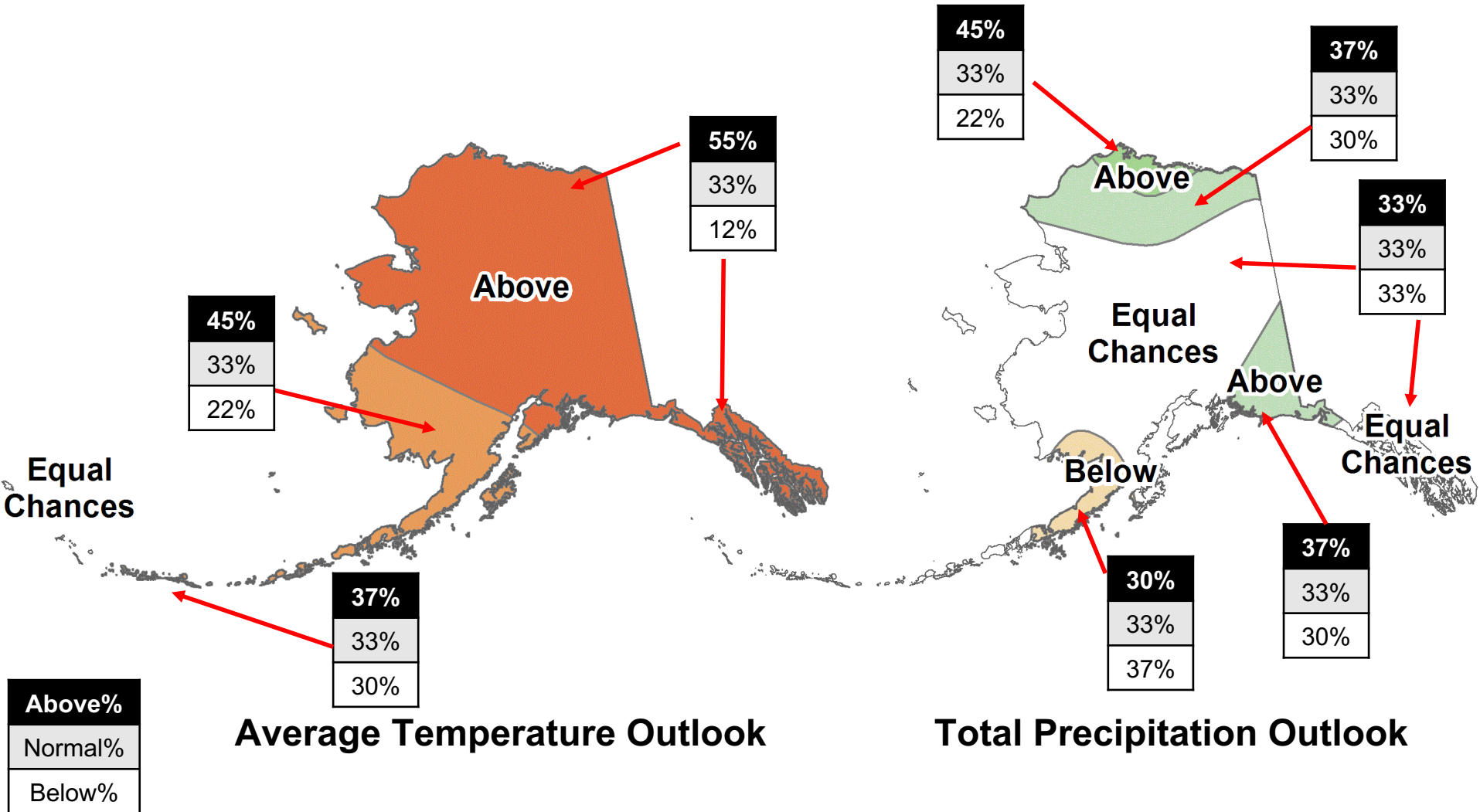


**Average Temperature Outlook**

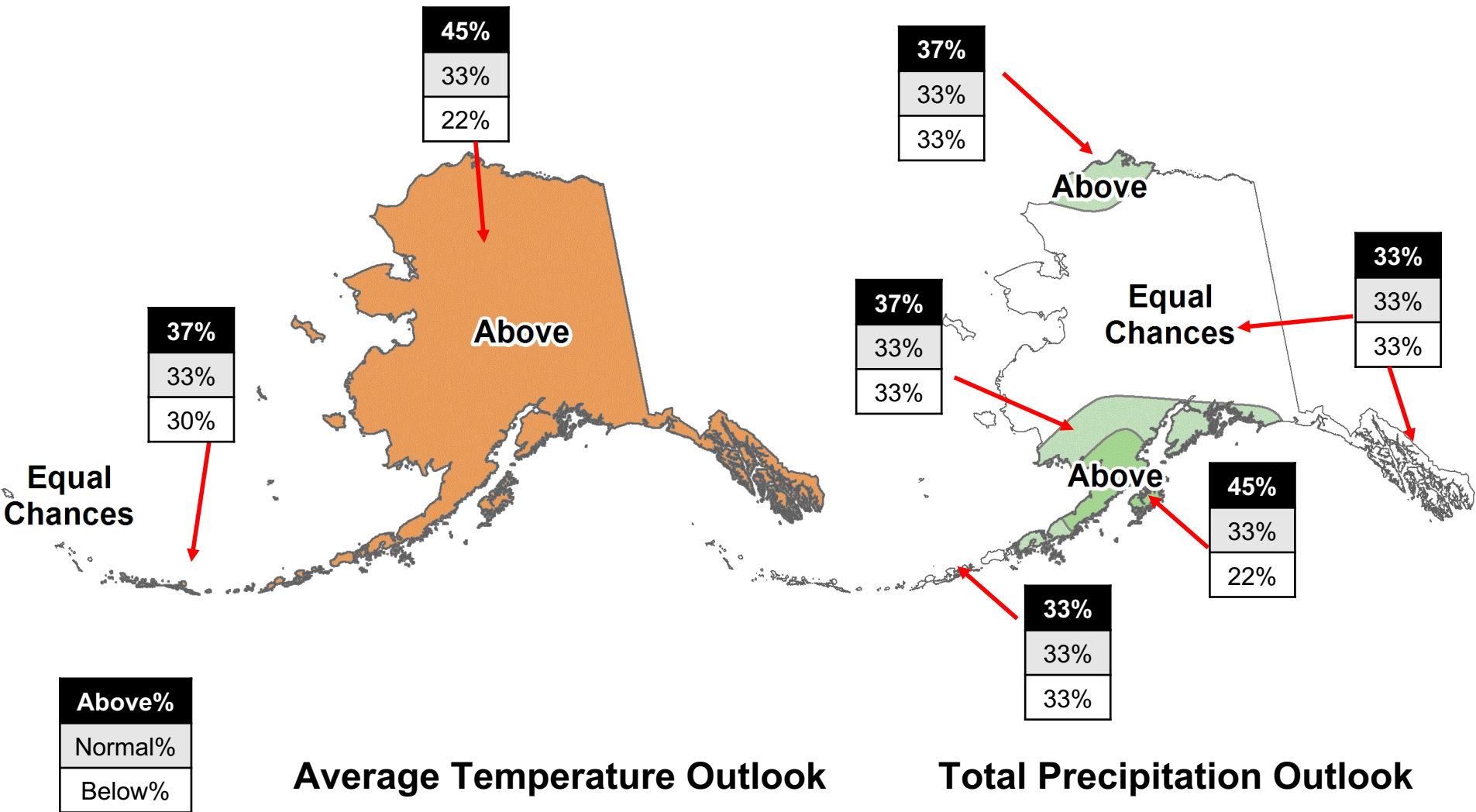
**Total Precipitation Outlook**

<b>Above%</b>
Normal%
Below%

# CPC January to March 2024 Outlook



# Look Ahead: Spring 2024



# The Webinar Future

## Check back for updates

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## Alaska Center for Climate Assessment and Policy

a NOAA CAP/RISA Team

- **January 17:** Arctic Report Card: Background and Key Finding
- **January 24:** Flooding and Environmental History in the Upper Tanana Region near Manh Choh
- **January 26:** NWS Climate Outlook Briefing