DROUGHT IN A RAINFOREST…HAS IT HAPPENED IN THE PAST, WHAT IS IMPACTED AND IS THERE RELIEF IN THE NEAR FUTURE?

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TODAY'S AGENDA

- BASICS: DROUGHT, RAIN FORESTS
- CURRENT DROUGHT CONDITIONS ACROSS SOUTHEAST ALASKA
- ARE DROUGHT CONDITIONS PART OF A NORMAL CLIMATE CYCLE IN A TEMPERATE RAINFOREST?
- IMPACTS IN THE RAINFOREST
  - **HYDRO-ELECTRIC POWER GENERATION**
  - **DRINKING WATER SUPPLY**
  - **FISHERIES**
  - **WINTER SPORTS**
  - **RAINFOREST HEALTH**
- WHAT IMPACTS WERE REPORTED IN THE SUMMER OF 2019
- WHAT IS CPC OUTLOOK FOR THE FALL/WINTER

WHAT IS DROUGHT?

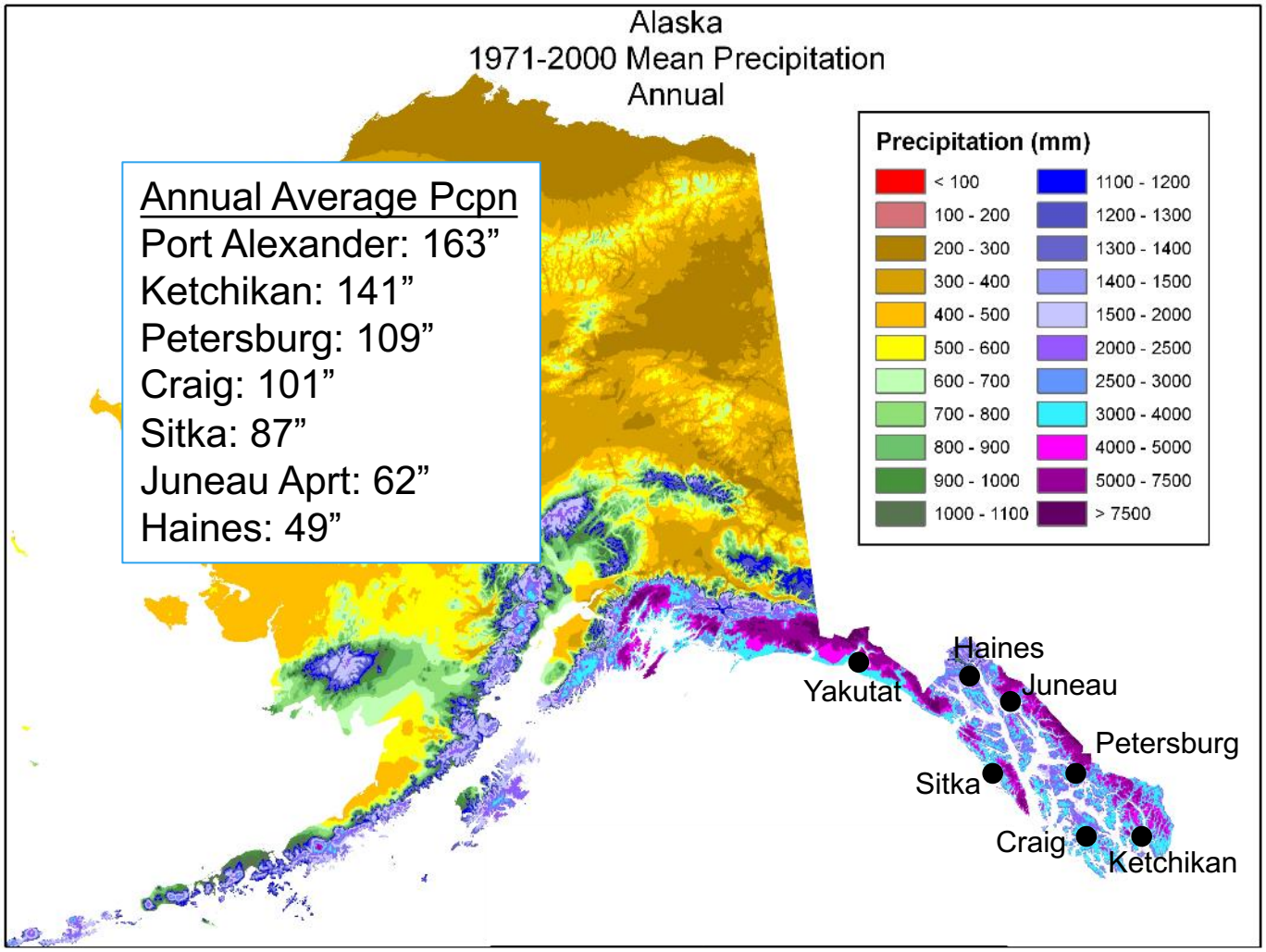
- DROUGHT ORIGINATES FROM A DEFICIENCY OF PRECIPITATION OVER AN EXTENDED PERIOD OF TIME
- IMPACTS RESULT FROM THE INTERPLAY BETWEEN THE NATURAL EVENT AND THE DEMAND PEOPLE PLACE ON WATER SUPPLY
- DROUGHT USUALLY DEFINED BOTH CONCEPTUALLY AND OPERATIONALLY

Source: drought.gov

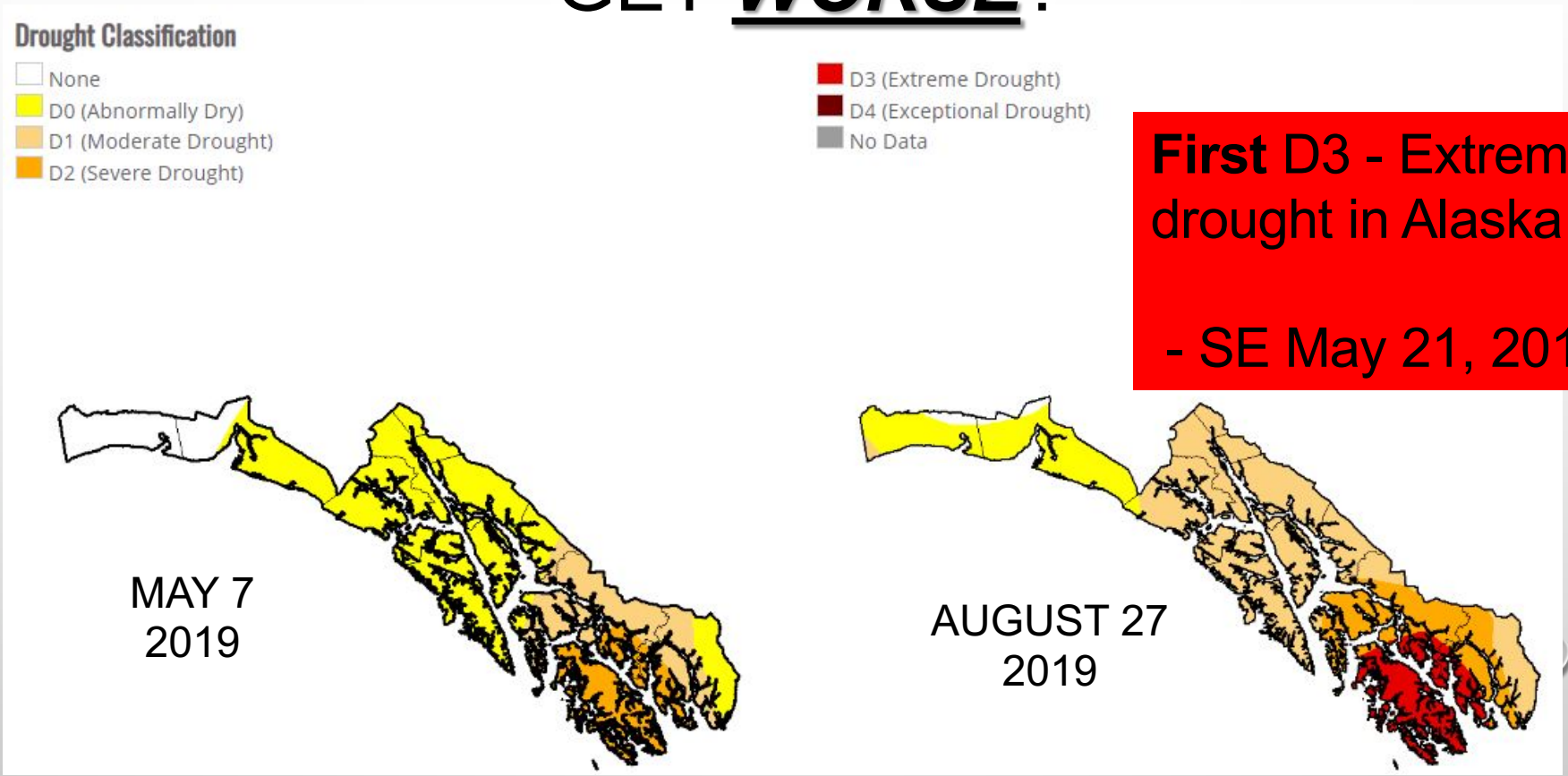
DROUGHT IN NORTHERN CLIMATES?

- DROUGHT NOT SO CLEARLY DEFINED IN AREAS WITH LONG SNOW COVER SEASON AND LOW EVAPORATION
- TIMING IS IMPORTANT
- PRECIPITATION DROUGHT VS. SNOW DROUGHT
  - **PRECIP DROUGHT**: LESS STUFF FALLS OUT OF THE SKY (2017-19)
  - **SNOW DROUGHT**: NEAR NORMAL PRECIP BUT BELOW NORMAL SNOW ACCUMULATION CAUSED BY HIGHER THAN USUAL SNOW LEVELS…SO LOW MOUNTAIN SNOW PACK (E.G. 2014-15)

SOUTHEAST ALASKA
LAND OF A LOT OF PRECIPITATION



DID DROUGHT CONDITIONS ACROSS SEAK IMPROVE OR GET ***WORSE***?



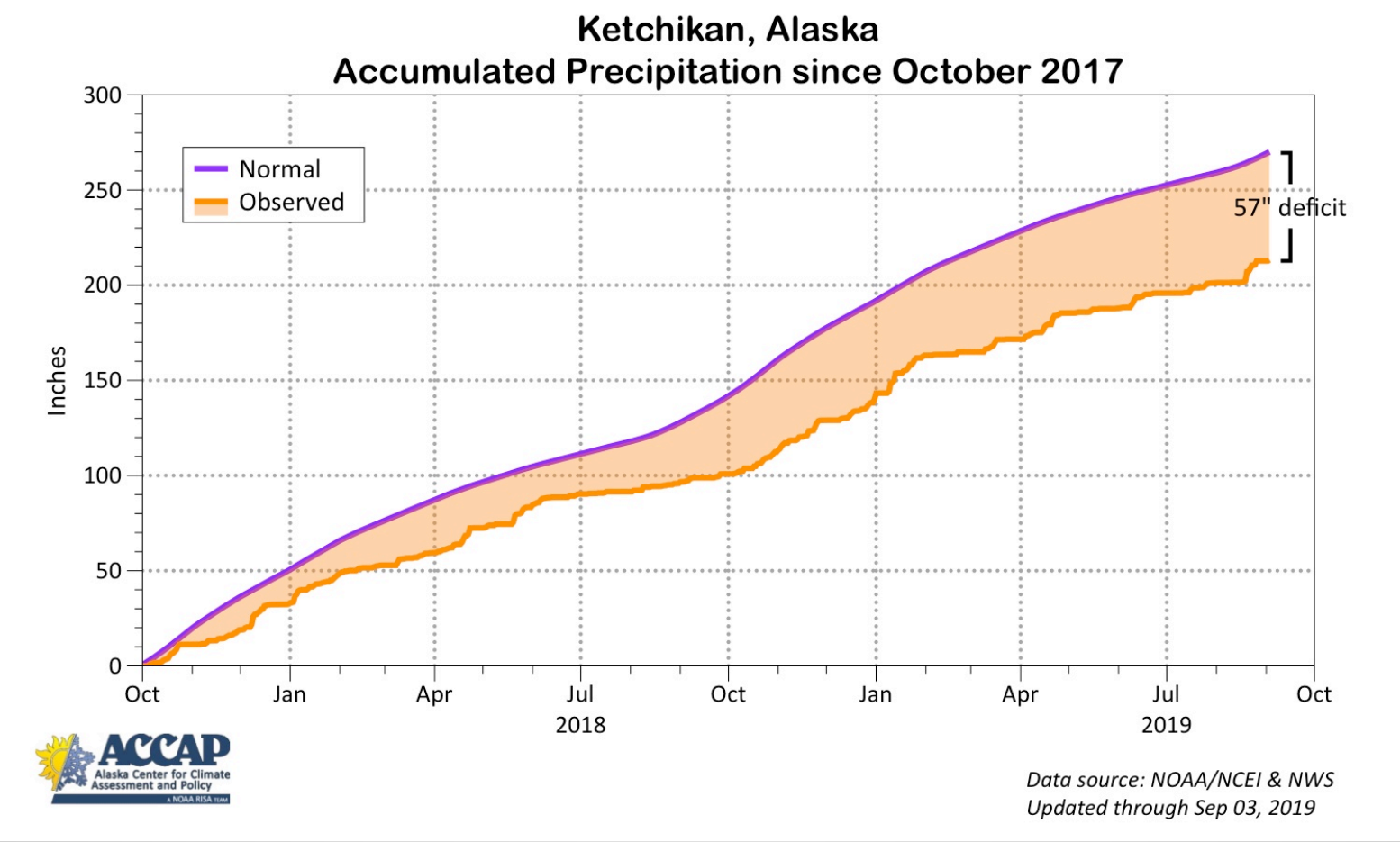
First D3 - Extreme drought in Alaska

- SE May 21, 2019

DID SOUTHEAST ALASKA GET RAIN THIS SUMMER?


Summer 2019
Percent of Normal Rainfall
42
101
94
66
77
68
86
80
60
100
91
97
109
102
136
BRITISH COLUMBIA
TONGASS NATIONAL FOREST
ALEXANDER ARCHIPELAGO
JUNEAU
Whitehorse

LONG TERM DRYNESS



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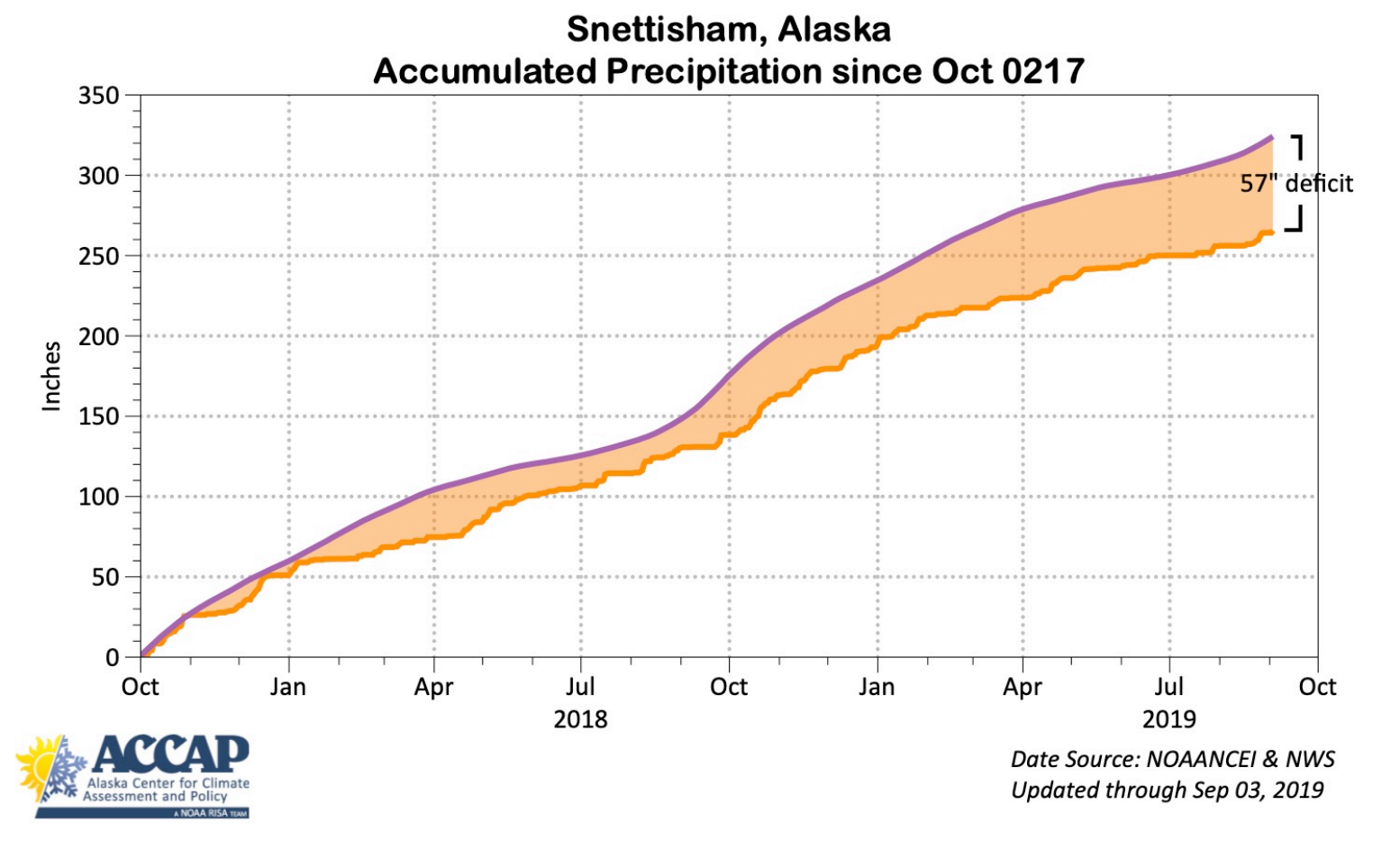
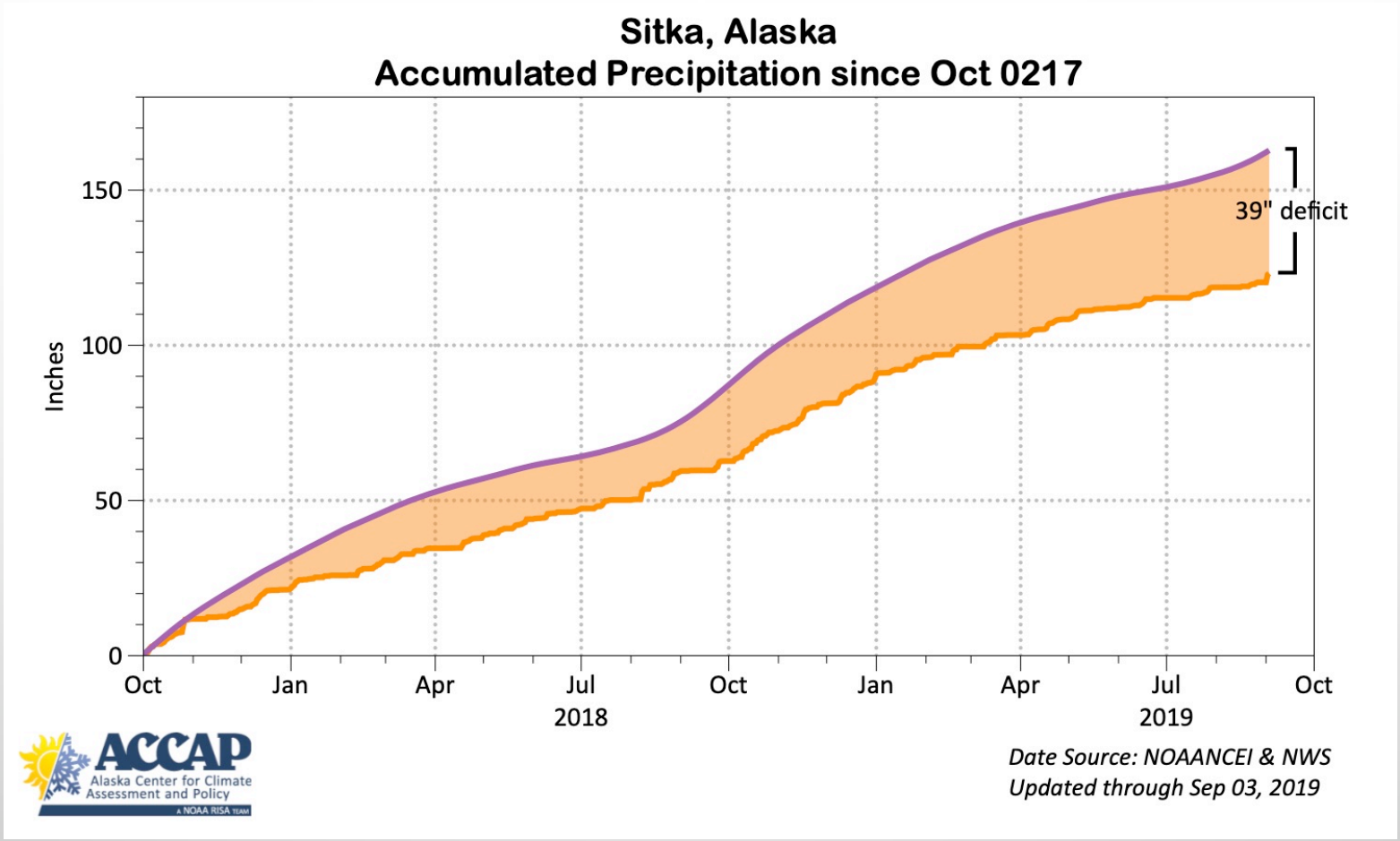
NATIONAL WEATHER SERVICE

LONG TERM DRYNESS



LONG TERM DRYNESS



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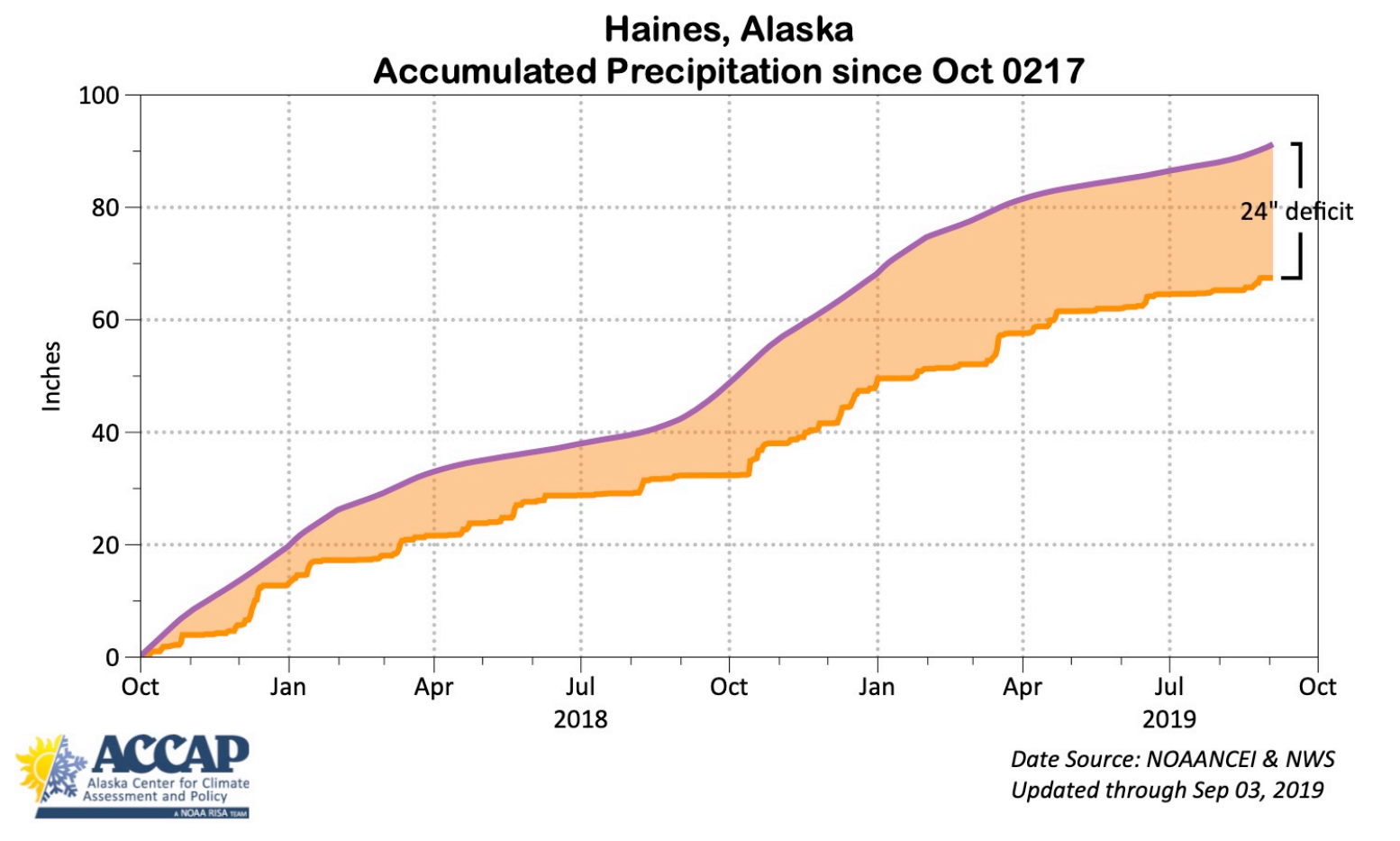
LONG TERM DRYNESS



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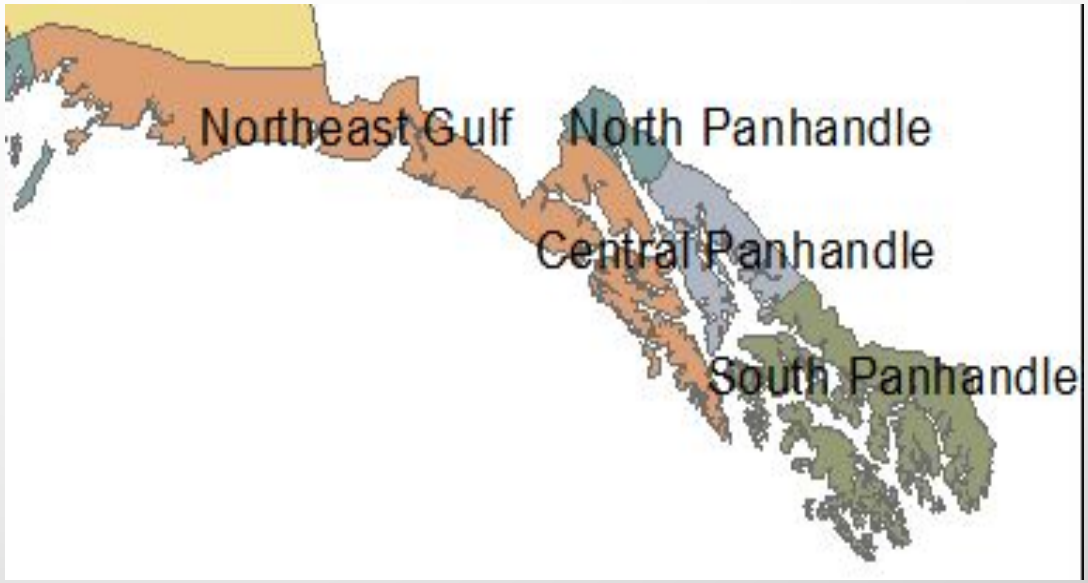
STANDARDIZED PRECIPITATION INDEX

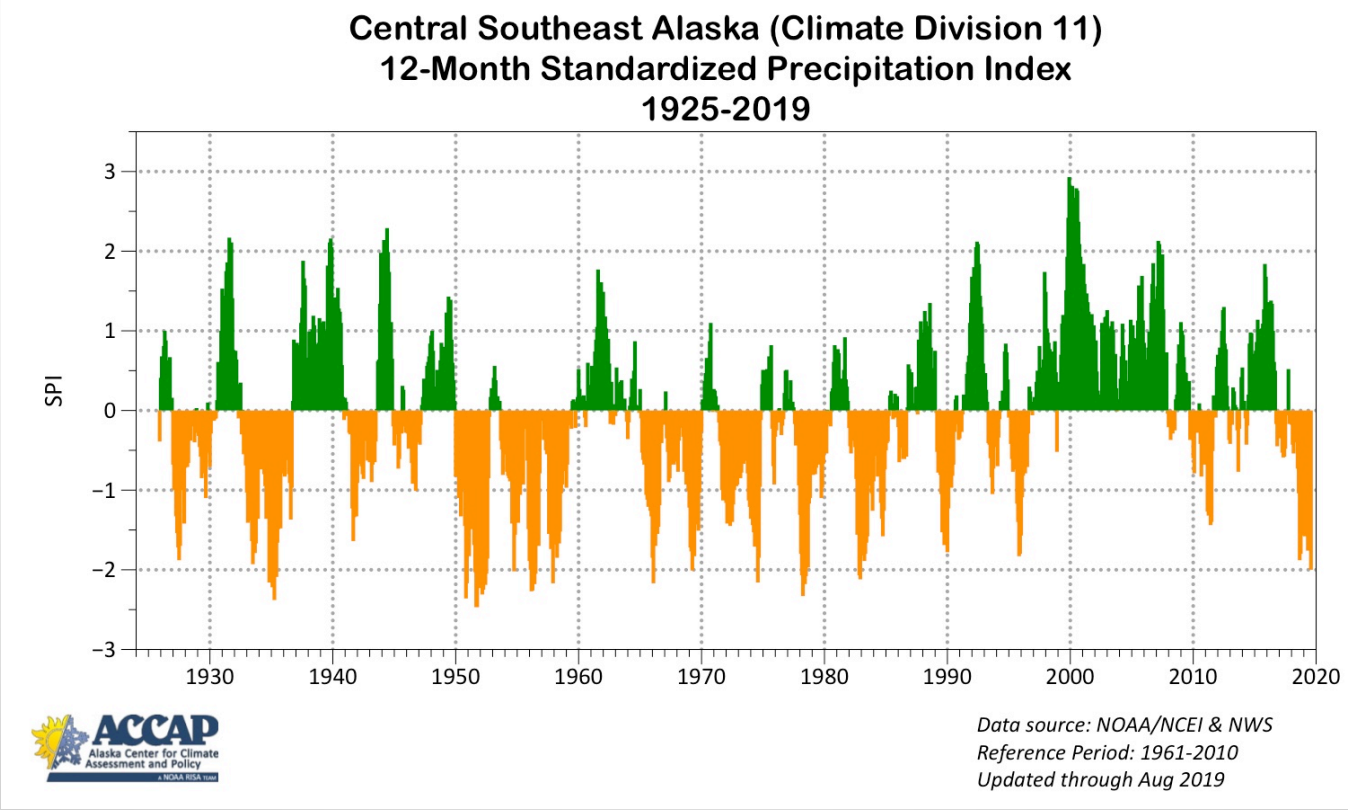
- PUTS “DEPARTURES FROM NORMAL” INTO CONTEXT
  - REQUIRES ONLY PRECIPITATION DATA
- TAKES INTO ACCOUNT SEASONAL CLIMATOLOGY OF PLACE/REGION AND USEFUL FOR MULTIPLE DROUGHT “FLAVORS”
- COMPUTED FOR TIME SCALES OF WEEKS TO YEARS
- WIDELY USED TO MONITOR DROUGHT
  - RECOMMEND BY WORLD METEOROLOGICAL ORGANIZATION(WMO) IN 2009

CLIMATE DIVISIONS WHAT ARE THEY AND WHY USE THEM?

- AREAS WITH BROADLY SIMILAR CLIMATE RESPONSE
- MAXIMIZES AVAILABLE INFORMATION
- REDUCES IMPACT OF MISSING DATA
- BUT…MAY NOT REFLECT LOCAL CONDITIONS



CENTRAL SE: 12-MONTH SPI LOWEST SINCE 1980S



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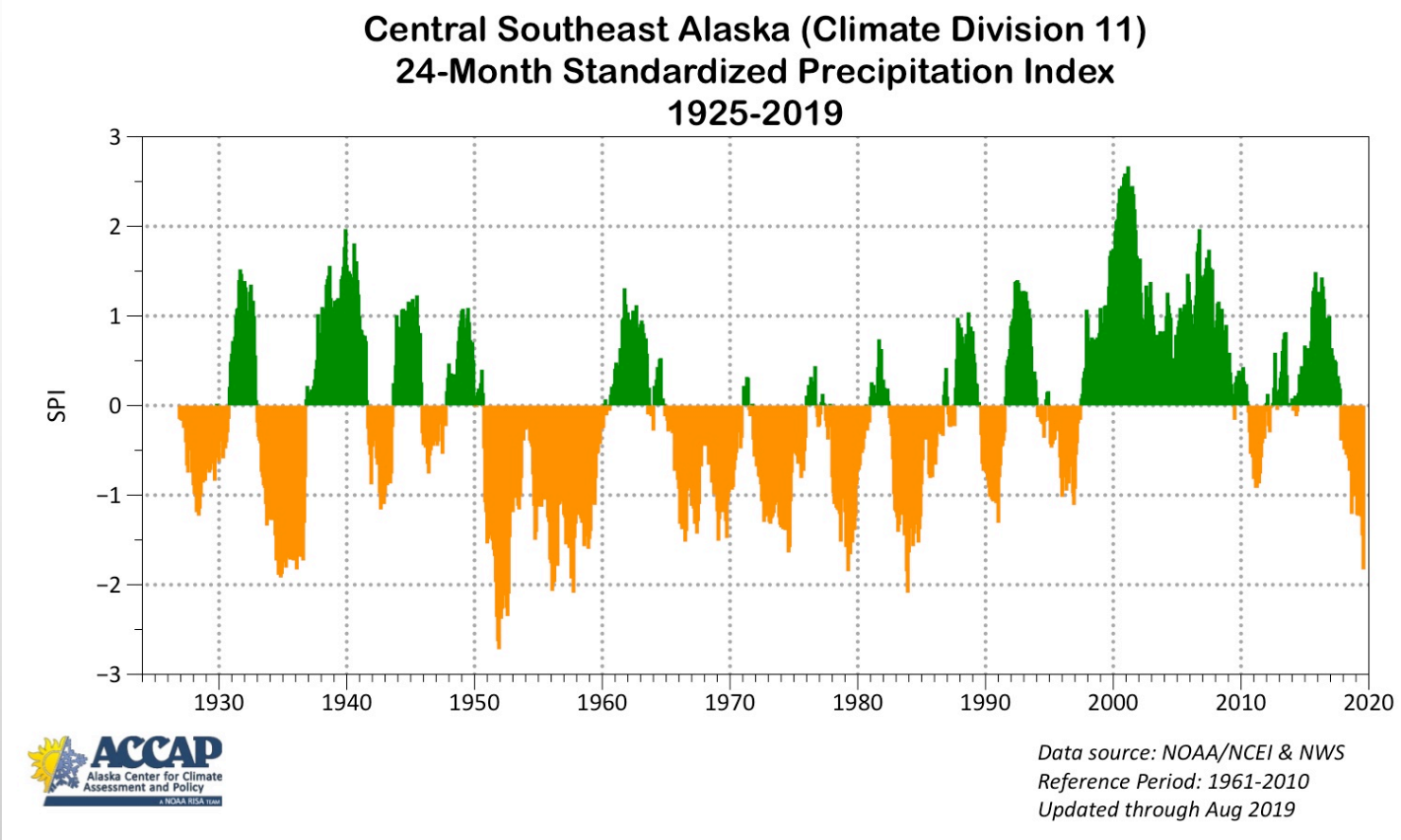
CENTRAL SE: 24-MONTH SPI LOWEST SINCE 1980S



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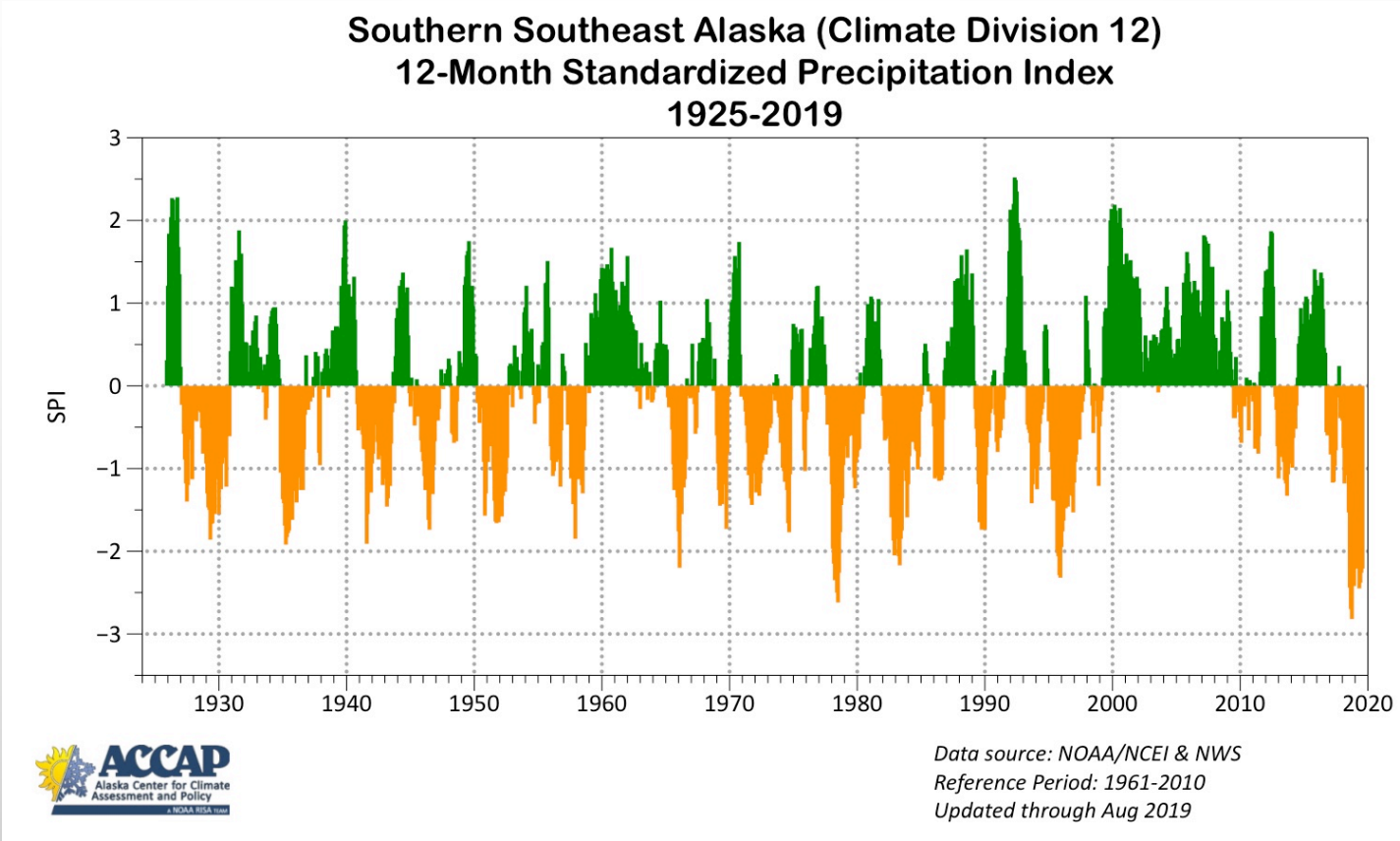
SOUTHERN SE: 12-MONTH SPI LOWEST OF RECORD



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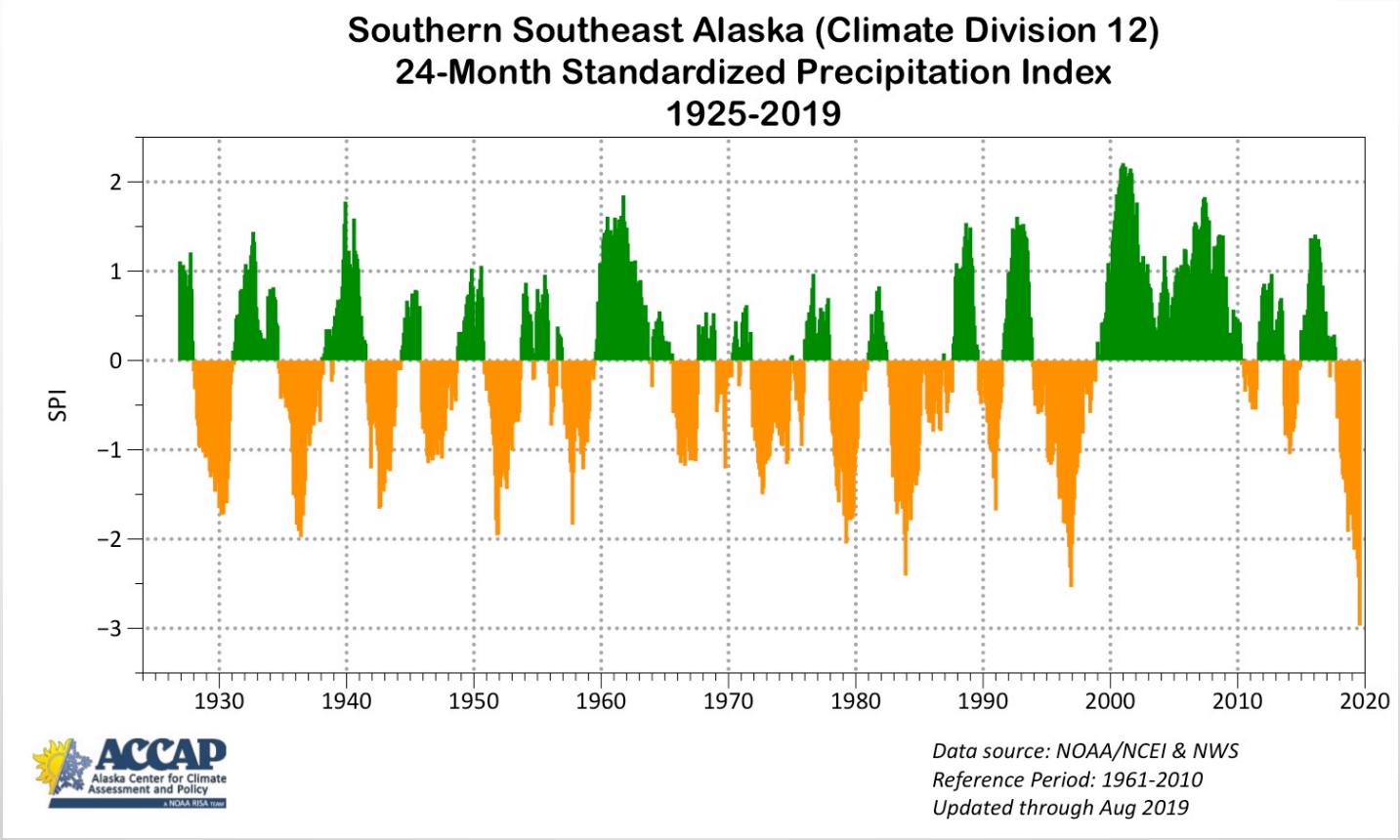


IMPACTS IN THE RAINFOREST

- **HYDRO-ELECTRIC POWER GENERATION**
- **DRINKING WATER SUPPLY**
- **FISHERIES**
- **WINTER SPORTS**
- **RAINFOREST HEALTH**

IMPACTS IN THE RAINFOREST

HYDRO-ELECTRIC POWER GENERATION

TYPES OF DAMS/RESERVOIRS

- ALPINE LAKE (LAKE TAPPED FROM BELOW)
- RUN-OF-RIVER
- STORAGE DAMS
  - EARTHEN
  - DAMMED LAKES

Impacts:

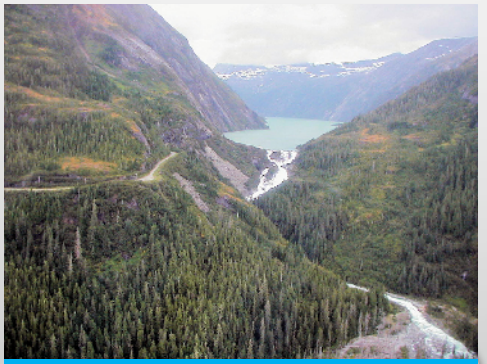
NO hydro-electric generation

- Pass-on cost of expensive diesel to general public (higher electric bills)

REASONS OF IMPACTS:

- LACK OF PRECIPITATION IN THE WET SEASON TO REFILL DAMS/RESERVOIRS
- NOT ENOUGH SNOWMELT(SNOW DROUGHT)
- NOT A PART OF THE USA/CANADA CONTINENTAL POWER GRID

Blue Lake Dam near Sitka (Dammed Lake)



Long Lake, lake tapped (Snettisham Hydroelectric near Juneau)

Falls Creek near Gustavus (Run-of-River)

IMPACTS IN THE RAINFOREST
DRINKING WATER SUPPLY

Community drinking water sources:

- Ground Water aquifer
- Surface water (pulls from streams)
- Reservoirs

Salmon Creek Reservoir near Juneau

Impacts:

Water Restrictions

- On the public (reduce water usage)
- Seafood processors (limited plant usage)

Reasons of impacts:

- Small communities
- Small reservoir storage
- Susceptible to low water levels from lack of rainfall in the wet season to fill reservoirs
- Low snow pack(snow drought), less water to fill reservoirs in spring/early summer
- Low stream flows-delay/lack of snowmelt(snow drought) due to changing weather patterns.

IMPACTS IN THE RAINFOREST
FISHERIES

Fishery activities across Southeast Alaska:

- Commercial fishing
- Recreation(sport) fishing
- Traditional(subsistence/personal use) fishing
- Fish hatcheries (aquaculture)
- Fish processing

Dip netters for Sockeye Salmon
source:
”Changing Water Dynamics USDA FS Dec 2017”

Impacts:

- Fish kills
- Economic loss
- Loss of food resources
- Potential job loss

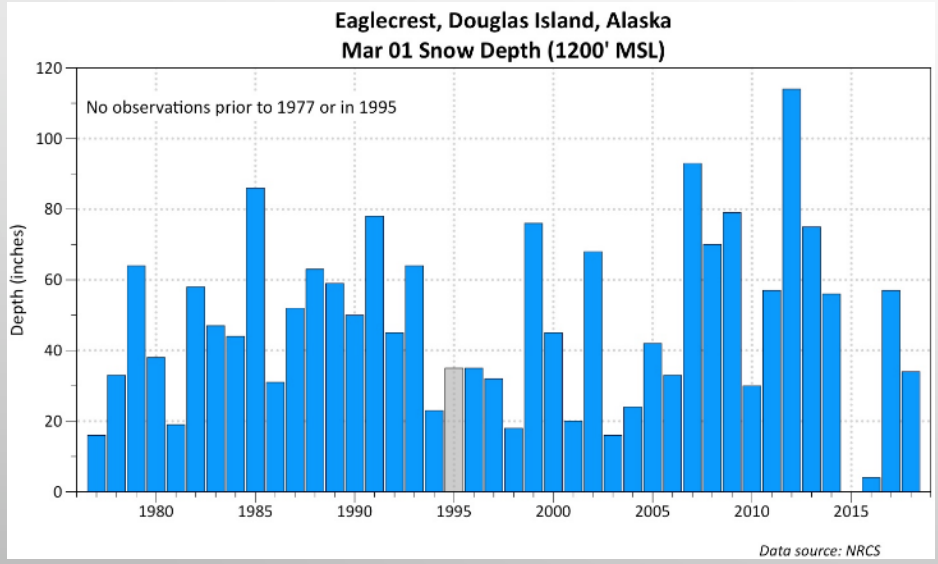
Reasons of impacts:

- Low stream flows: lack of rainfall and snowmelt(snow drought) during spawning periods
- Above normal water temperature
- Low dissolved oxygen

IMPACTS IN THE RAINFOREST
WINTER SPORTS

Winter Sport activities across Southeast Alaska:

- Community owned Ski resorts (Eaglecrest in Juneau)
- Heli-skiing (Haines & Juneau)
- Snow machining
- Backcountry ski touring



Impacts:

- Economic loss to small communities
- Potential job layoffs

Reason for impacts:

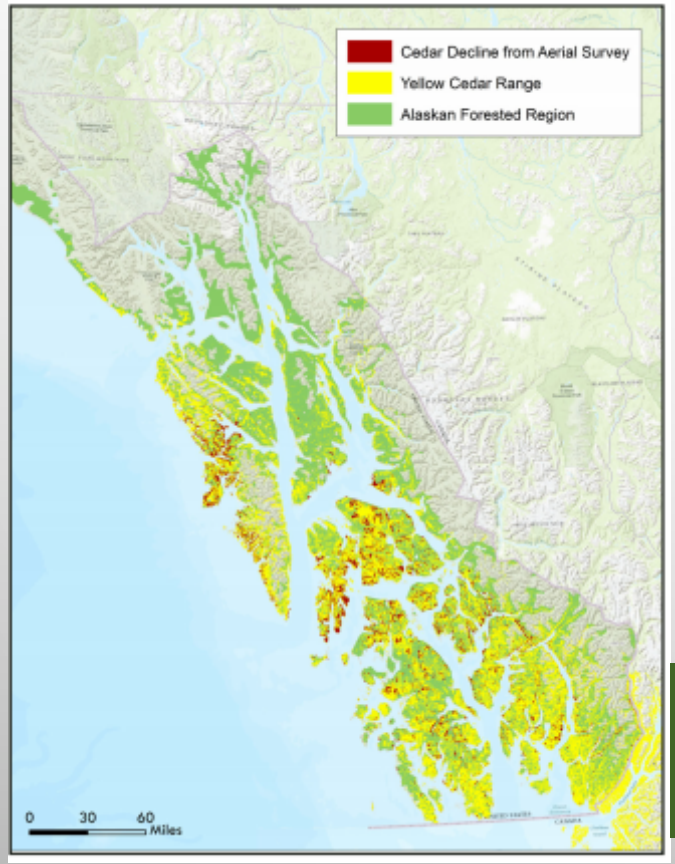
- Snow drought

IMPACTS IN THE RAINFOREST

RAINFOREST HEALTH

Forest activities:

- Timber harvest industry
- Cultural values to Alaska Natives



Impacts:

- Yellow-cedar mortality increase
- Poor conditions for Western Hemlocks with increase of Sawfly outbreaks
- Economic loss to small communities
- Potential job layoffs
- Increased threats to trees from insect and pathogens from changing water dynamics as a result higher temperatures and longer growing season (Hollingsworth et al. 2017)

Reason for impacts:

- Snow drought
- Lack of precipitation to decrease fungal growth to limit sawfly outbreaks

source:
”Changing Water Dynamics USDA FS Dec 2017”

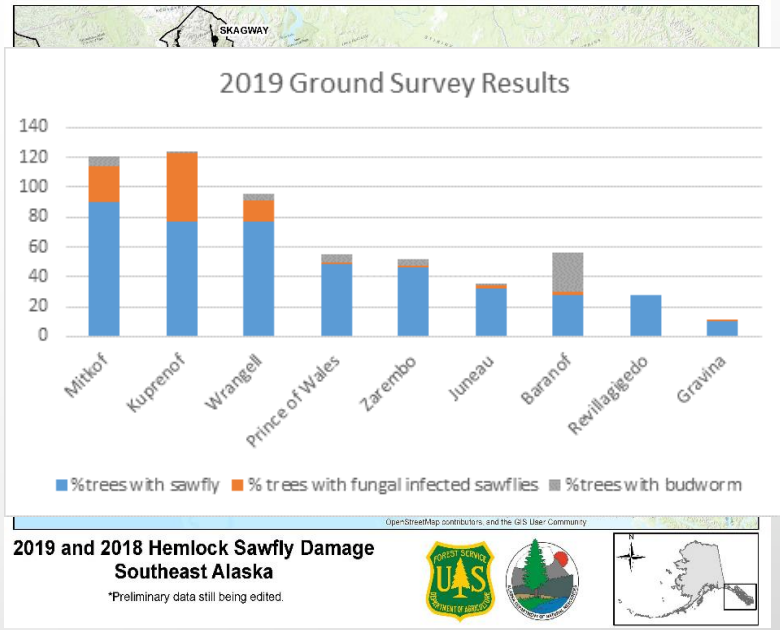
WHAT IMPACTS WERE REPORTED IN THE SUMMER OF 2019

REGION-WIDE IMPACTS

- FIREWORKS BANNED
- FIRE BANNED AT TIMES THROUGHOUT THE SUMMER
- INCREASED FIRE RISK/POTENTIAL(WELL ADVERTISED TO PUBLIC)
  - NOT ABOVE NORMAL FIRE ACTIVITY
  - FOREST SERVICE CREW STARTED FIRE FROM SPARK DOING ROAD WORK IN HOONAH
  - EXTENDED FIRE WEATHER FORECAST DUE TO DROUGHT CONDITIONS
- BELOW NORMAL STREAM-FLOWS (SOME RECORD LOW STREAM-FLOWS)
  - AFFECTED UPSTREAM FISH MIGRATION TIMING
- LARGE AREA OF HEMLOCK SAWFLY OUTBREAK

REGION-WIDE HEMLOCK SAWFLY OUTBREAK

- OUTBREAK BEGAN IN 2018 WITH ~48,000 ACRES RECORDED
- FEEDS ON OLDER FOLIAGE
- OCCASIONALLY RESULTS IN TOP-KILL AND RARELY MORTALITY UNLESS OUTBREAK COINCIDES WITH WESTERN BLACKHEADED BUDWORM
- DAMAGE SKYROCKETED IN 2019, STILL CRUNCHING NUMBERS BUT EXPECT IT TO BE ~400,000 ACRES



Information courtesy of Liz Graham USFS

HEMLOCK SAWFLY OUTLOOK

- OUTBREAKS TYPICALLY LAST 2 OR 3 YEARS AND THEN CRASH. WE EXPECT THIS OUTBREAK TO BE AT ITS CLIMAX.
- STARVATION CAN OFTEN BE THE LEADING CAUSE OF POPULATION CRASH ONCE THE OLDER FOLIAGE IS STRIPPED AWAY.
- AREAS IMPACTED IN 2018 HAD INCREASED INCIDENCE OF FUNGAL INFECTIONS THAN AREAS NEWLY INFESTED.
- COLD FALL CAN LIMIT MATING PERIOD OF ADULTS.
- WET SUMMER IN 2020 COULD HELP BUILD FUNGAL POPULATION AND LIMIT SAWFLY DEVELOPMENT.
- BIGGEST CONCERN NOW IS AN INCREASE IN WESTERN BLACKHEADED BUDWORM POPULATIONS.

IMPACT ON THE FOREST

NEGATIVE

- Decrease in radial growth
- Top-kill
- Mortality

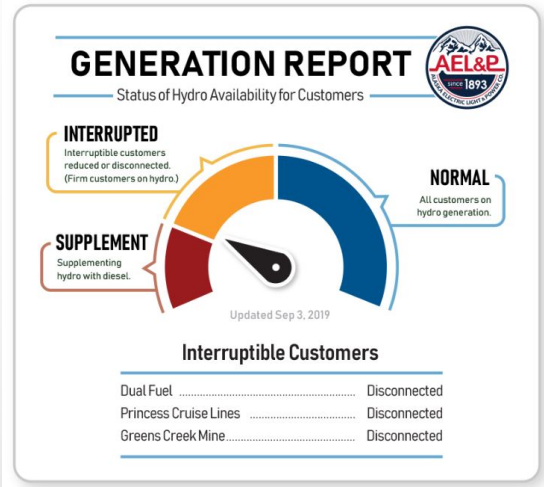
POSITIVE

- Abundant food source available
- Nutrient pulse
- Open up canopy for understory plants

Information courtesy of Liz Graham USFS

REGIONAL IMPACTS NORTHERN HALF (NORTH OF PETERSBURG)

- MANDATORY WATER RESTRICTIONS IN HAINES
- VOLUNTARY WATER RESTRICTIONS IN JUNEAU
- INTERRUPTIBLE CUSTOMERS IN JUNEAU DISCONNECTED FROM AEL&P HYDRO POWER
  (HIGHER PRICE FOR ELECTRICITY TO CUSTOMERS)
- RELEASE OF HATCHERY FISH TO SALT WATER MUCH EARLIER THAN NORMAL



REGIONAL IMPACTS SOUTHERN HALF (SOUTH OF PETERSBURG)

- VOLUNTARY WATER RESTRICTIONS/CONSERVATION
- NO HYDRO POWER GENERATION FROM TYEE/SWAN LAKE SINCE MARCH (HIGHER PRICE FOR ELECTRICITY TO CUSTOMERS)
- KETCHIKAN PUBLIC UTILITY LAKE LEVEL STATUS(RED) MOST OF SUMMER
  - SUPPLEMENTAL DIESEL GENERATION NECESSARY
- NATIVE PLANT HARVEST AFFECTED
- METLAKATLA INDIAN COMMUNITY STILL UNDER EMERGENCY DECLARATION FROM DROUGHT CONDITIONS
- REPORTED PRE-SPAWN KING SALMON FISH KILLS IN THE PETERSBURG (BLIND SLOUGH) AND PINK SALMON NEAR KETCHIKAN

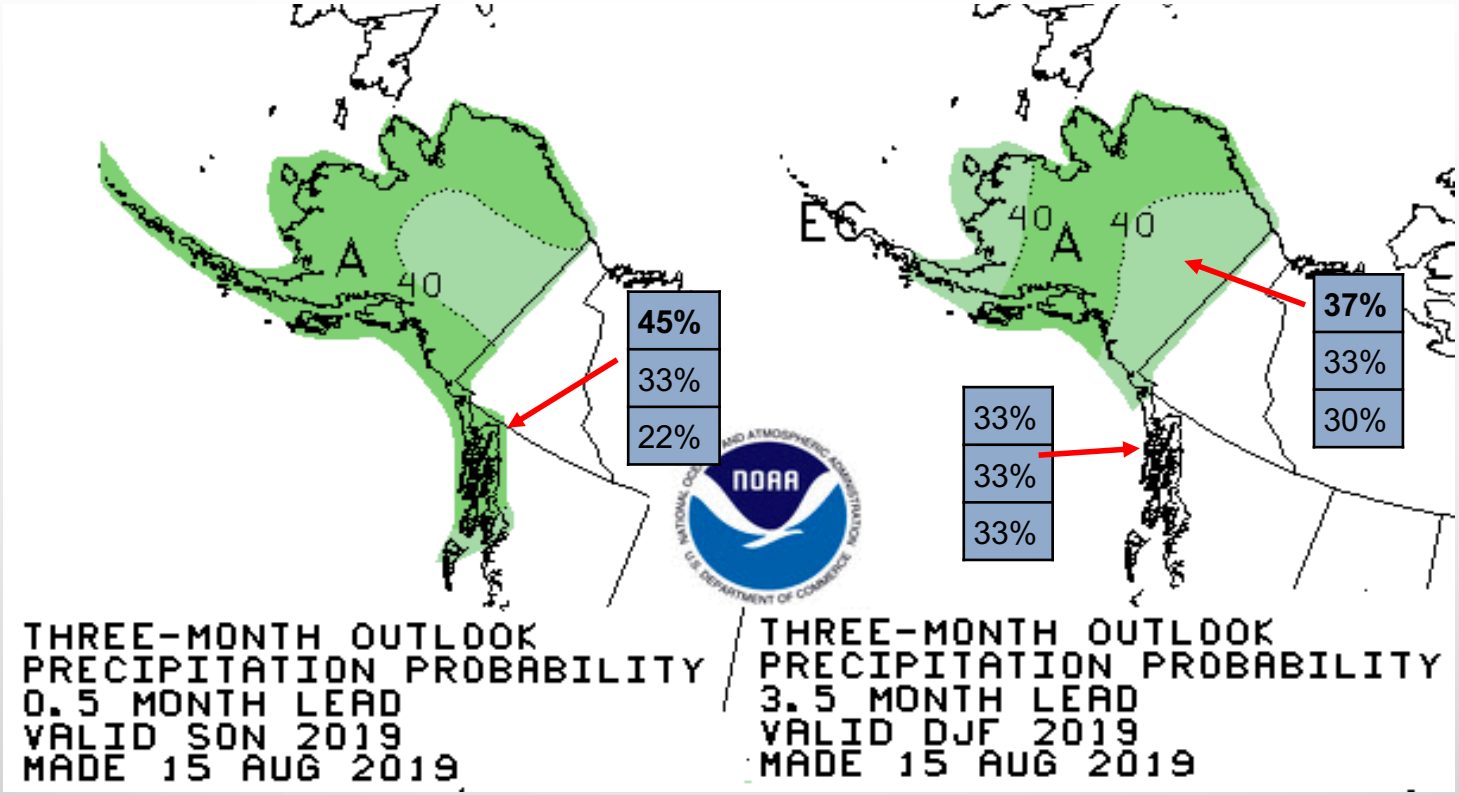
Lake Level Status

- GREEN
- YELLOW
- **RED**

CURRENT RENEWABLE ENERGY SUPPLY STATUS:	**Green** - Reservoir levels are high or rising steadily - Diesel supplementation is unlikely. **Yellow** - Reservoir levels are dropping or inflows are anticipated to be less than normal - Diesel supplementation may be necessary at a later date. **Red** - Reservoir levels are low – Supplemental diesel generation may be necessary. *Reservoir levels and weather patterns change quickly; KPU continually monitors these conditions to respond accordingly.

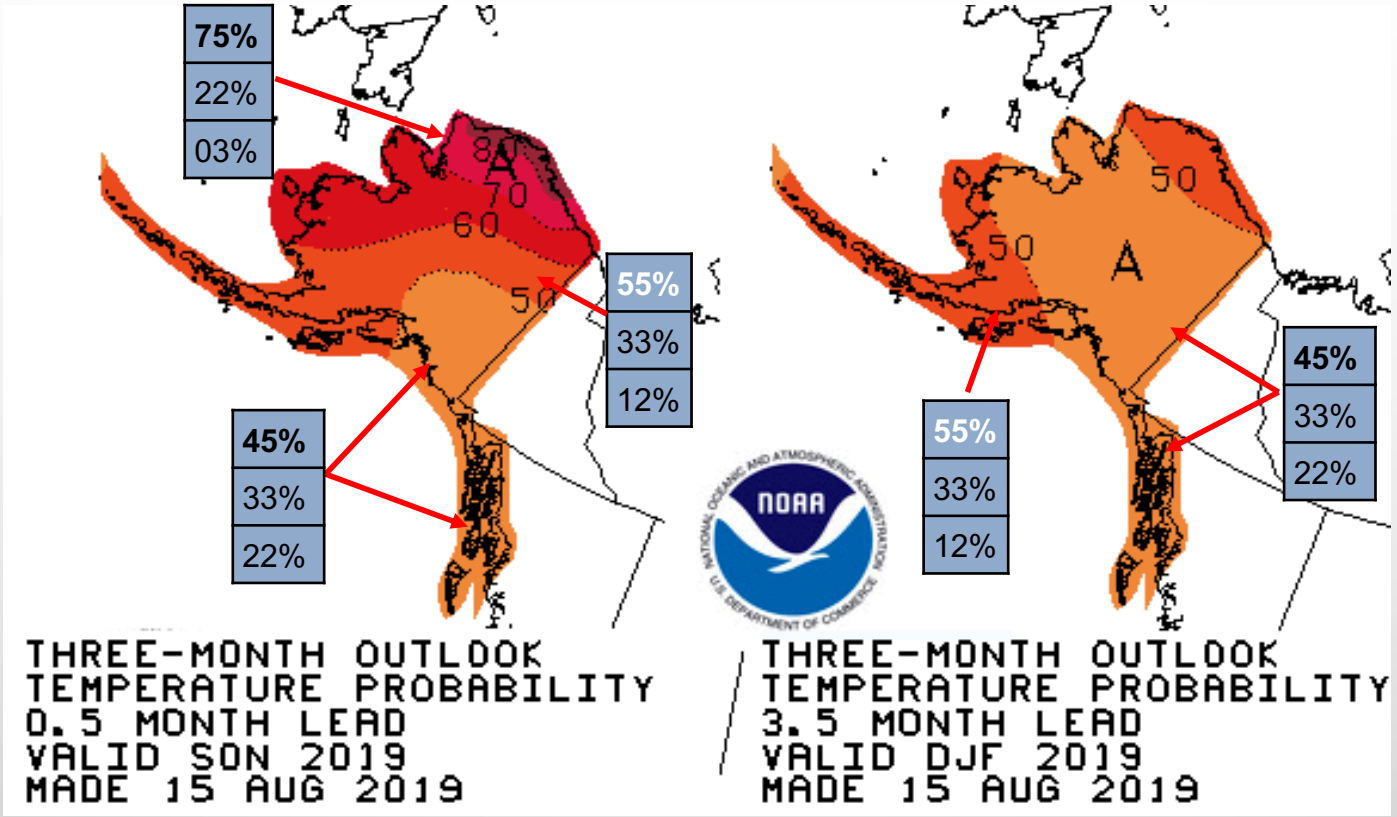
WHAT DOES THE FALL/WINTER PRECIPITATION/TEMPERATURE OUTLOOKS CALL FOR?

CLIMATE PREDICTION CENTER OUTLOOKS



Autumn 2019 **Winter 2019-20**

CLIMATE PREDICTION CENTER OUTLOOKS



Autumn 2019 **Winter 2019-20**

THANK YOU

QUESTIONS?

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