Alaska Drought Webinar Series: Climate Review

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Agenda for Today

• What is Drought?
• Monitoring Precipitation in Alaska
• Review of Alaska Precipitation Climate
• Assessing Drought in Alaska
• Dry Alaska in the Past
What is Drought?

• “Drought is a shortage of water over an extended period of time.” —NWS

• “A drought means that a place has less precipitation (rain or snow) than normal over a few months or even longer.” —NDMC

• “A drought is an event of prolonged shortages in the water supply, whether atmospheric (below-average precipitation), surface water or ground water.” —Wiki
Kinds of Drought

- **Meteorological** drought occurs when there is a prolonged time with less than average precipitation.
- **Agricultural** droughts affect crop production or the ecology of a range.
- **Hydrological** drought: water reserves (including mountain snowpack) available in sources fall below a locally significant threshold.
- **Ecological** drought: a prolonged and widespread deficit in naturally available water supplies...that create multiple stresses across ecosystems

Lots of ambiguity: Prolonged? Widespread?
Drought: Low (Stored) Precipitation Plus Impacts

- Precipitation Deficit
  - Pre-existing supply
  - Rain vs. Evaporation
  - Snow level
  - Snow pack
  - Snow on/off dates

- Impacts
  - Human Society
    - Power generation
    - Water Supply
    - Food security
    - Business disruptions
  - Ecosystem
    - Vegetation
    - Wildfire
    - Stream temps
    - Streamflow
    - Health

Drought
Time Line of Precipitation Extremes

- High Precipitation
  - Flash Flood
  - Flood
  - High Water

- Low Precipitation
  - Flash Drought
  - Short Term Drought
  - Long Term Drought

- Climate Variability/Change
  - 1-hour
  - 1-day
  - 1-week
  - 1-month
  - 1-season
  - 1-year
  - Multi-year
Precipitation Monitoring in Alaska

- Point based precipitation observations
  - Very limited in much of rural Alaska
  - Quality issues (especially winter, worst in tundra environments)
- Water content of snowpack
  - Cold season precipitation: regions that don’t melt out in winter
  - Limited info off of the road system
- Streamflow
  - Mountain snow/glacier melt a confound
- Vegetation Growth or Damage
  - Many regions in Alaska plant productivity influenced by temperature not precipitation.
Measuring Precipitation

Traditional Weather Station

Water in Snowpack

Alaska Snow Survey Report

February 1, 2020

Water in Lakes
Gridded Precipitation

- NCEI: Point based with climatology background
  - Available monthly or longer timescales
- Model based, e.g. PRISM, ECMWF’s ERA5
- Remote Sensing
  - Radar: Most of Alaska has no radar coverage
    - Best at event scale
  - Satellite estimates: not yet useful at high latitudes
    - Best at event scale
NOAA Gridded Precipitation
Model-Based Precipitation

January 2021
Remote Sensing Precipitation
Alaska Precipitation Climate Review

- Precipitation varies greatly
  - Short distances due to terrain influence
  - Long distances due to shear size of Alaska
- Precipitation is not evenly distributed through the year
  - Moderate to extreme “seasonality”
- Snow is important part of the annual cycle
Alaska Precipitation Varies a LOT

Normal Annual Precipitation: 1981-2010 Climatology

Source: PRISM Group
800m 1981-2010 normals.
Twitter: @Climatologist69
© Brian Brettschneider
Large Difference in Normal Monthly Precipitation

Ratio of Wettest Month to Driest Month (1981-2010)
Wettest/Driest Month of the Year

Wettest Month of the Year: 1981-2010 PRISM

Driest Month of the Year: 1981-2010 PRISM
Seasonality of Normals and Extremes

Anchorage Airport
Monthly Precipitation 1981-2020

Data source: NOAA/NCEI & NWS
Alaska Issues for Assessing Drought

- Limited station precipitation observations
  - Very little reliable data western Alaska, worst in winter
- Snowpack data (automated or manual) limited in both time and space
- Timescale of drought: weeks to seasons but vary seasonally
- What does drought mean in ecosystems with 5 to 8 months/year with snow cover?
  - Dealing with snowmelt timing and precipitation
Warm Season Precipitation Stations
Cold Season Precipitation Stations
End of Winter 2019-20
Snowpack Measurements

March 2020
SNOTel
&
Snow Course
Tools for Assessing Drought

- Departures from Long Term Average
- Percent of Normal Precipitation/Snowpack
- Indices Designed to Measure Precipitation Deficit (Excess)
  - Standardized Precipitation (Evapotranspiration) Index
  - Palmer Drought Index (not useful in Alaska)
- Soil Moisture
- Streamflow
- YOU: Your personal observations!!

Varying Time Scales!
Running Precipitation Accumulation
Haywood Plots

In the interactive chart below, the 5 wettest years, 5 driest years, current year, and period of record average are highlighted to stand out. All other years are in light gray.

Alaska, Climate Division 6. Cook Inlet
October—September Cumulative Precipitation

- Oct 1979-Sep 1980
- Oct 1936-Sep 1937
- Oct 1928-Sep 1929
- Oct 1976-Sep 1977
- Oct 1943-Sep 1944
- Average
- Oct 1973-Sep 1974
- Oct 1977-Sep 1978
- Oct 1949-Sep 1950
- Oct 1995-Sep 1996
- Oct 1968-Sep 1969
- Oct 2020-Sep 2021
NCEI County Level Ranks

County Precipitation Rank (of 96 years)  
October 2020 - January 2021
SPI at Climate Division Scale

4-month Standardized Precipitation Index through the end of January 2021

Cook Inlet Division, Alaska
Climate Division (06), Standardized Precipitation Index

Based on Divisional Precipitation Data
Provisional Data provided by
CPC and NWS
Western Regional Climate Center
Desert Research Institute
Las Vegas, Nevada

Provisional Data
from CPC and NODC
Time Scale in Months (As of the end of Jan. 2021)

Graphics courtesy WRCC
Model Based Precipitation
Percent of Normal

Total Precipitation: Percent of Normal
January 2021

1981-2010 baseline
ERA5 courtesy of ECMWF/Copernicus
Snowpack Assessment

Alaska Snowpack as of March 1, 2015
Based on Snow Water Content

Average Snow Water Equivalent Percent of Normal
March 2020

Percent of 1981-2010 Median
130 - 150
110 - 129
90 - 109
70 - 89
50 - 69
< 50
Wildfire and Drought
Fairbanks Long Term Precipitation

Fairbanks North Star Borough, 1930-2020
60-Month Running Precipitation Difference from Average

Data source: NOAA/NCEI
1951-2010 Baseline
Updated through December 2020
Recent Examples of “Drought”

- 2002, 2015 and 2017 Iditarod restart moves
- 2004: Eastern Interior Drought and Wildfire
- 2007: North Slope and Wildfire
- 2013: Interior Drought and Wildfire
- 2017-19 Southeast Alaska Drought
- 2019: Southcentral & Southwest Alaska Drought
Drought Isn’t New in Alaska

**Fairbanks, August 1920**

**REMARKS:**
Grain Crops suffered from drought during the first half of the month and yield was cut 35% below normal. Late hay and potato crops benefited greatly by rain.

**Fairbanks, August 1923**

**REMARKS BY OBSERVERS**

- Allakaket: Smoke disappeared 9th.
- Candle: Very dry all month. Candle Creek dry.
- Fairbanks: Continued dry weather hastened maturity of grain crops. Harvest was well under way by the middle of the month. Wheat, oats, and barley, the principal crops, were harvested and shocked. Heads well filled, straw medium to short. Potato crop injured by drought in quantity only. Quality will be excellent. Forest fires continue to burn in all directions, causing some loss of standing timber. Most of the area had been burned at previous times, and the chief loss was the destruction of new growth. Smoke 1st to 10th and 19th to 25th.
What does drought mean in Alaska?

- Hydropower and drinking water supply
- Wildfire
- Ecosystem Health
  - Forest, Tundra, Rivers
  - Food security
- Business Disruptions
- Transportation (e.g. snow drought in autumn)

What does drought mean to you?