Alaska Precipitation Extremes

LEO Monthly Webinar
February 23, 2021

Rick Thoman
Alaska Center for Climate Assessment and Policy
International Arctic Research Center
University of Alaska Fairbanks
rthoman@Alaska.edu

Agenda for Today

- Review of Alaska Precipitation Climate
- Monitoring Precipitation in Alaska
- Precipitation Extremes in Alaska

Salmon Creek Reservoir near Juneau
Courtesy NWS Juneau

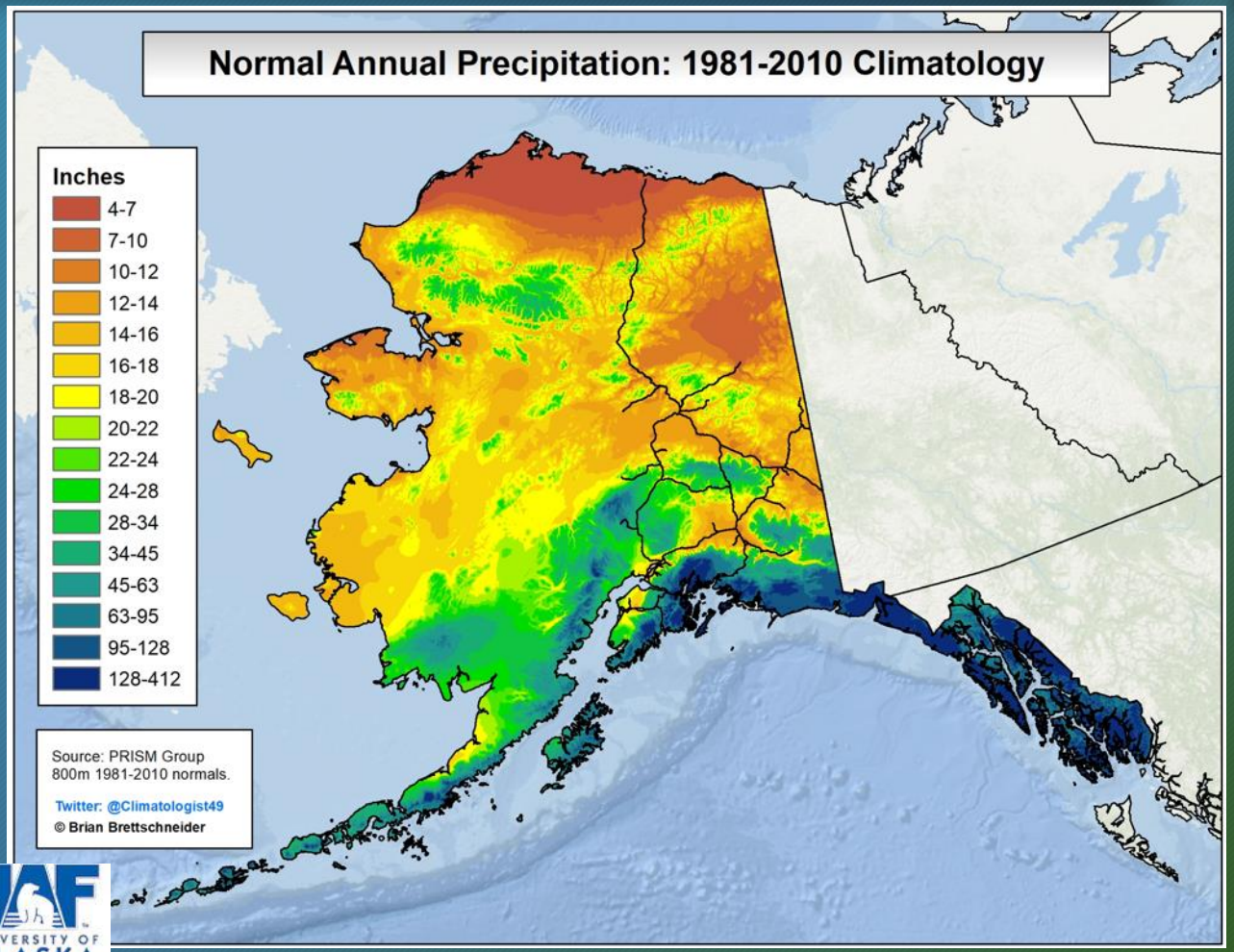
ACCAP Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM
UAF UNIVERSITY OF ALASKA FAIRBANKS

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

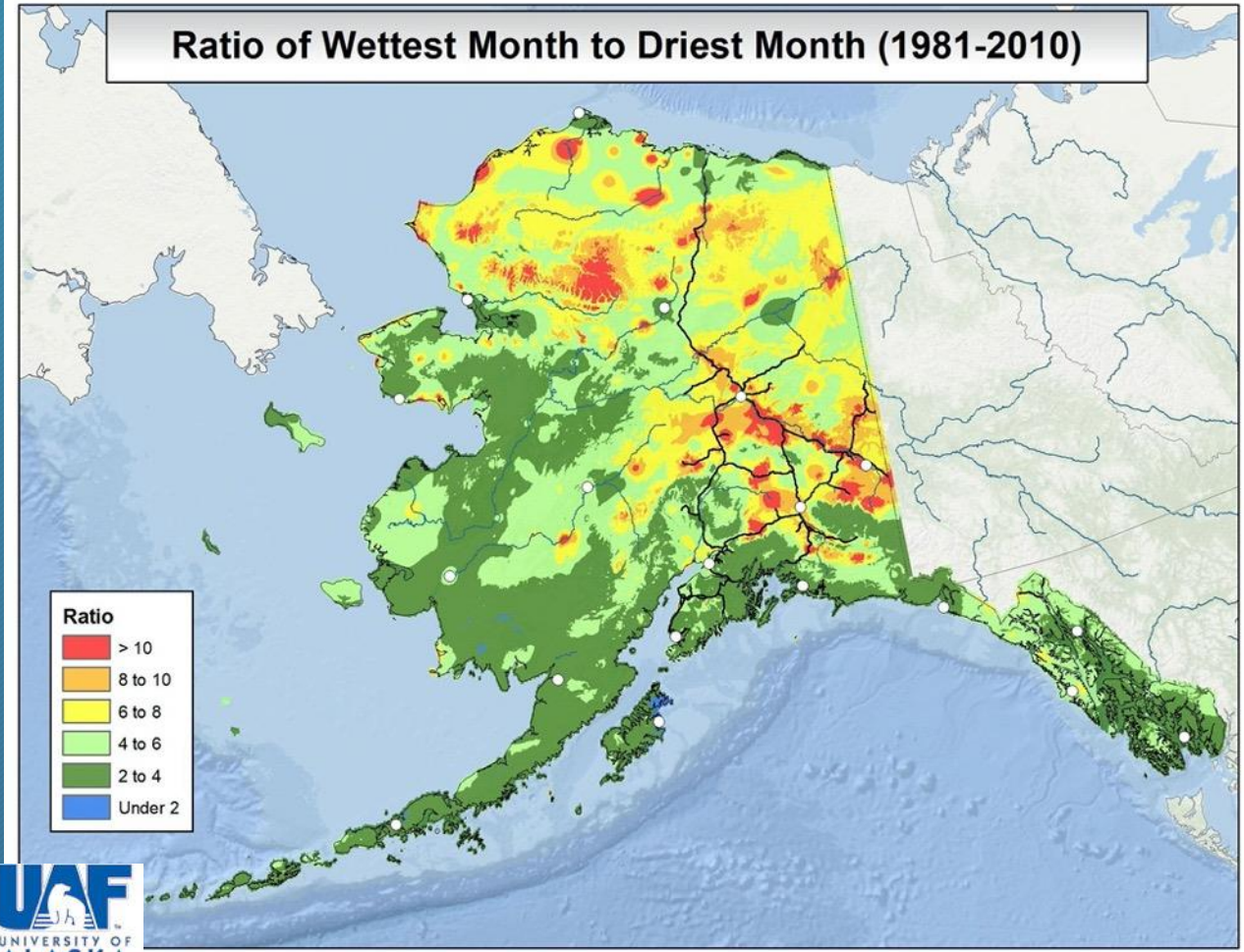
ACCAP Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM
UAF UNIVERSITY OF ALASKA FAIRBANKS

Alaska Precipitation Varies a LOT



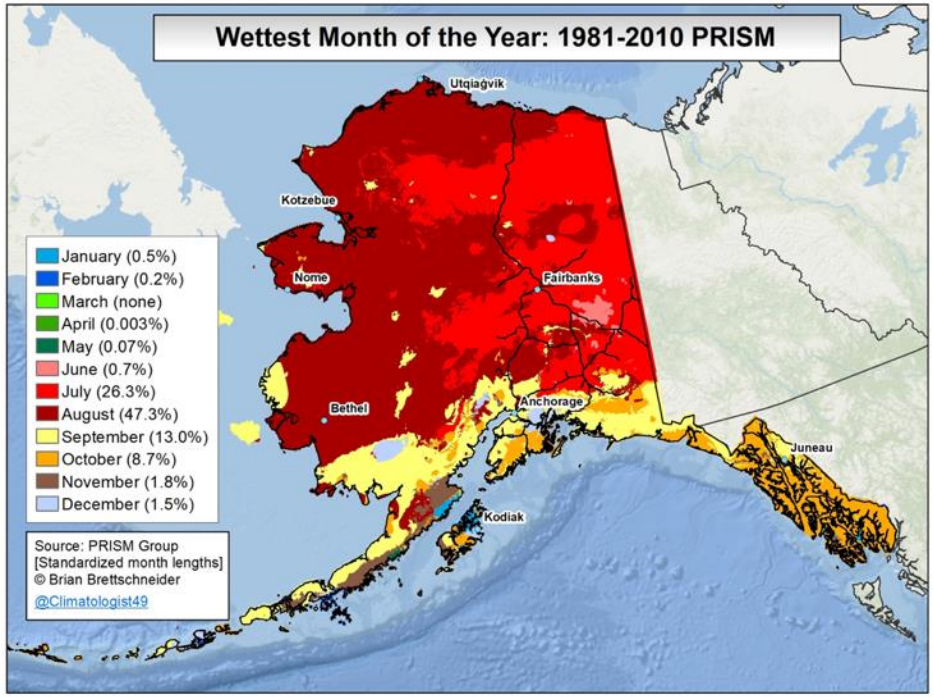
ACCAP Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM
UAF UNIVERSITY OF ALASKA FAIRBANKS

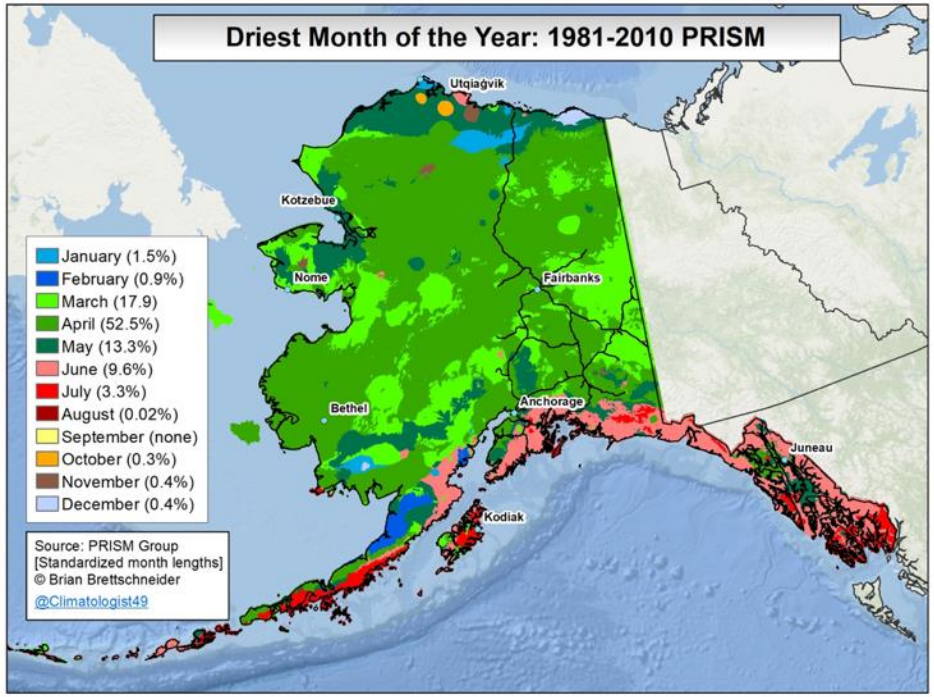
Large Difference in Normal Monthly Precipitation



ACCAP Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM
UAF UNIVERSITY OF ALASKA FAIRBANKS

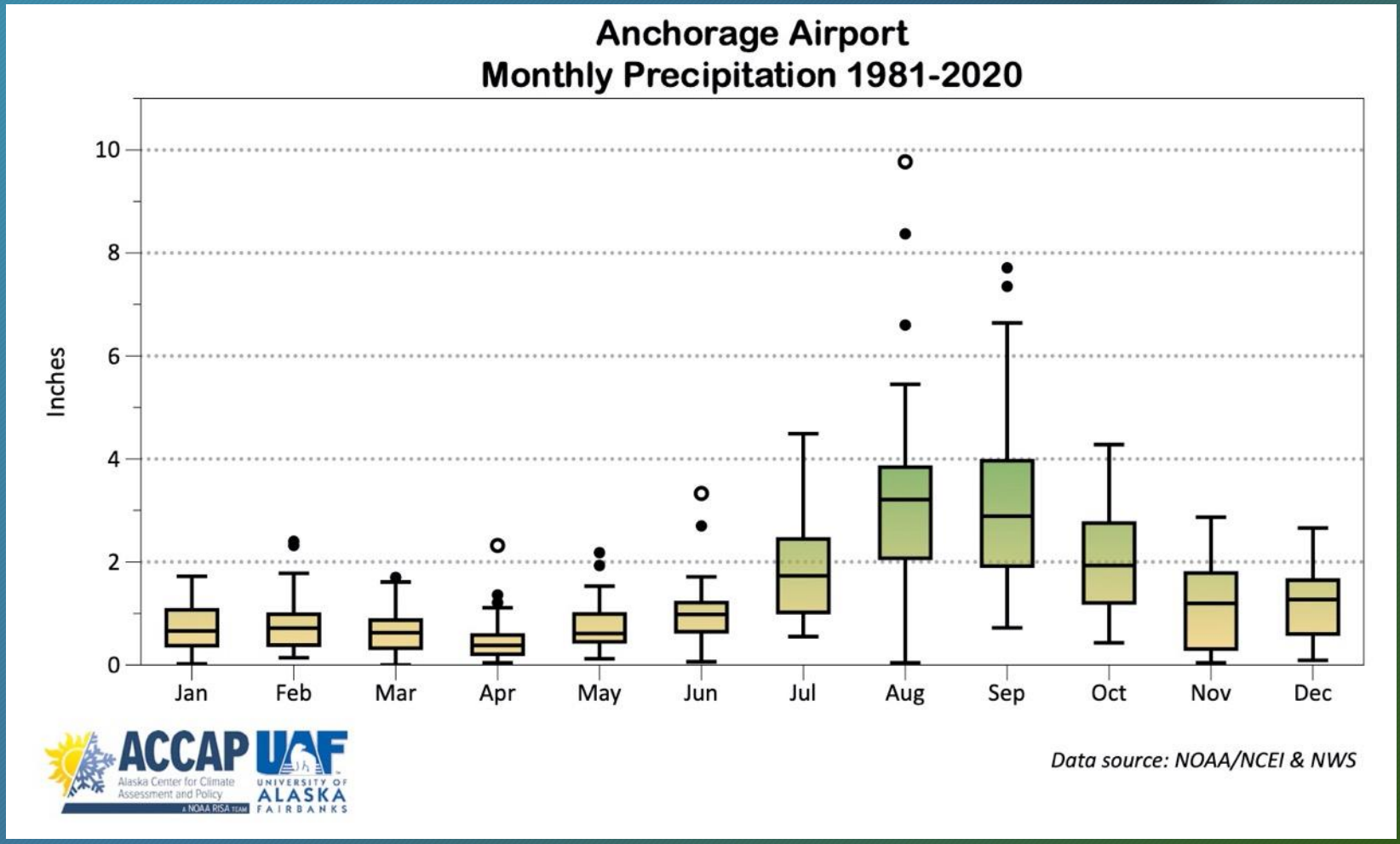
Wettest/Driest Month of the Year



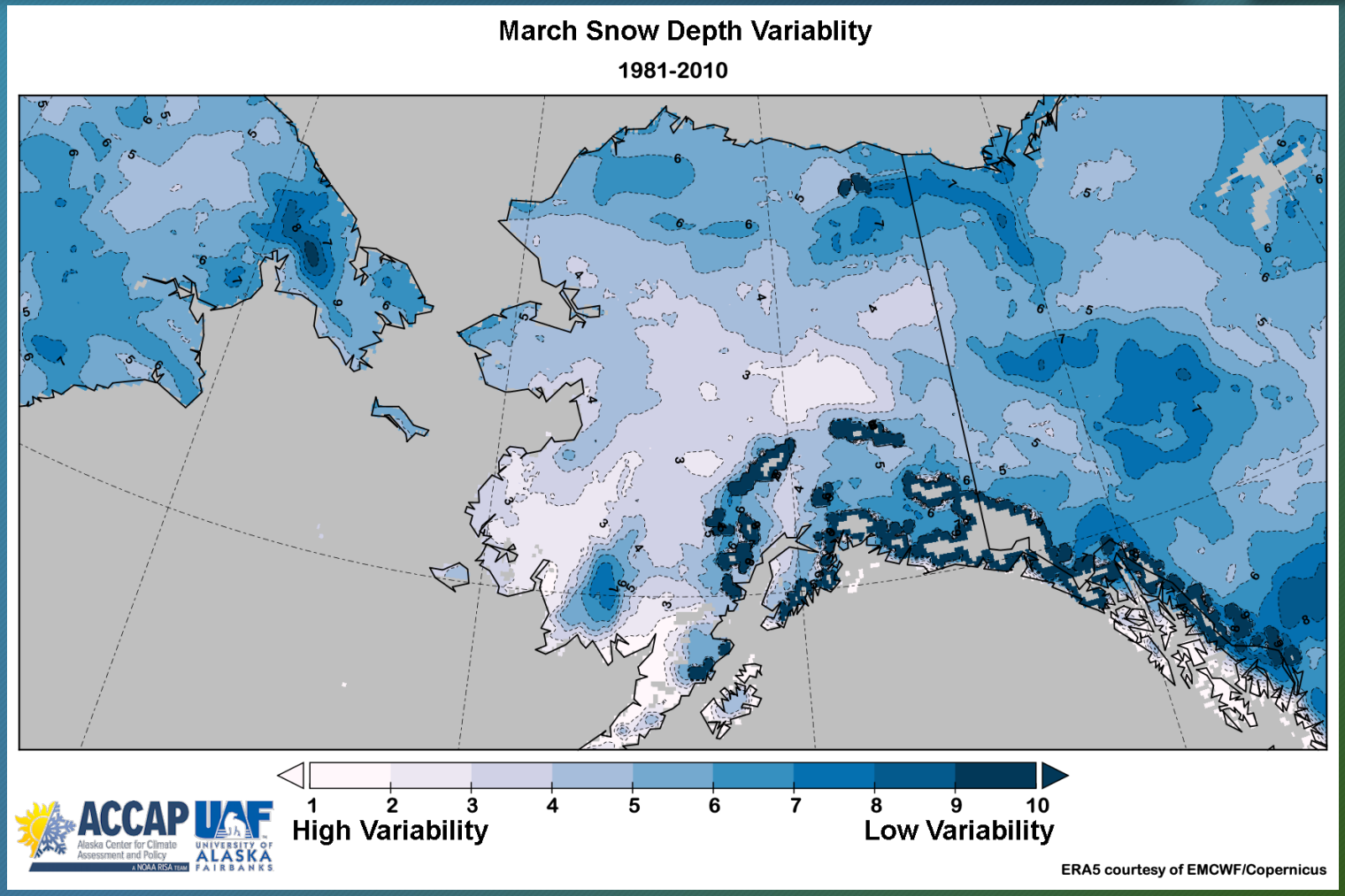


ACCAP Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM
UAF UNIVERSITY OF ALASKA FAIRBANKS

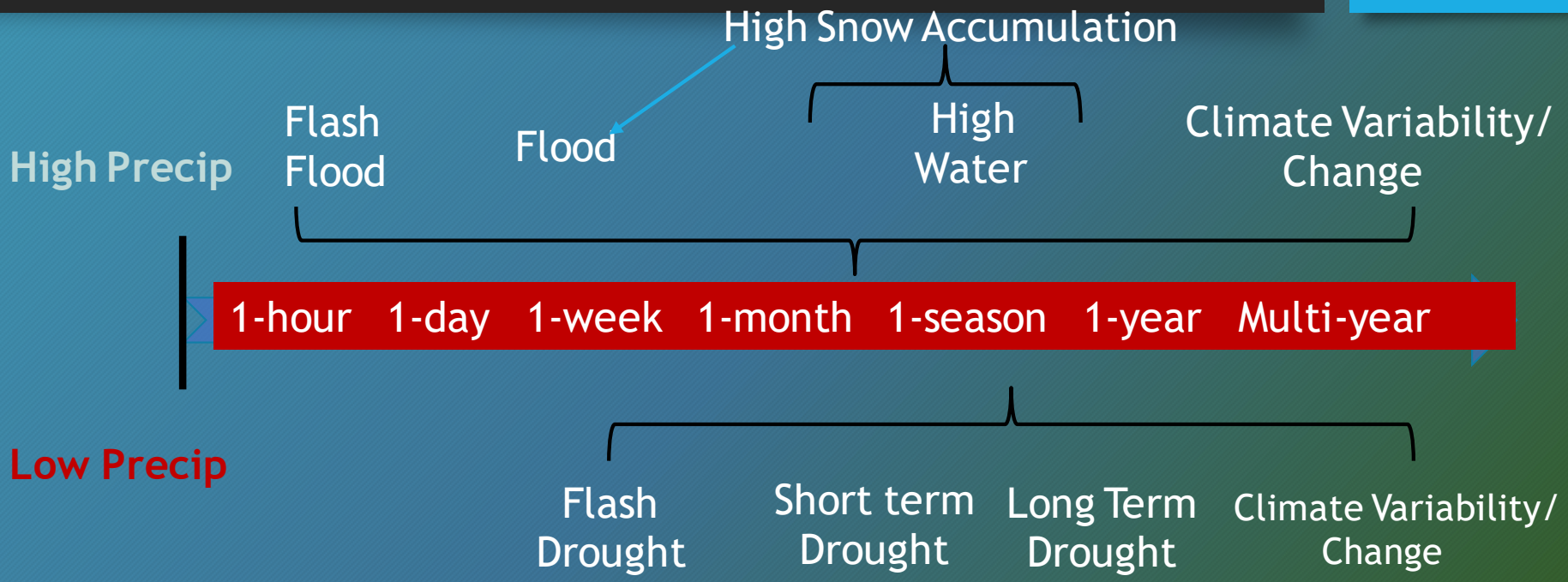
Seasonality of Normals and Extremes



Late Winter Snow Variability



Time Line of Precipitation Extremes



Too Much Precipitation

What happens when too much precipitation in:

- Hours to days
  - Immediate impacts to daily life
- Weeks
  - Impacts may differ based on other factors
- Months to Seasons
  - Impacts may differ based on other factors
- Years
  - Changes in large scale water supply

Pre-existing conditions matter a lot

ACCAP Alaska Center for Climate Assessment and Policy A NOAA RISA TEAM
UAF UNIVERSITY OF ALASKA FAIRBANKS

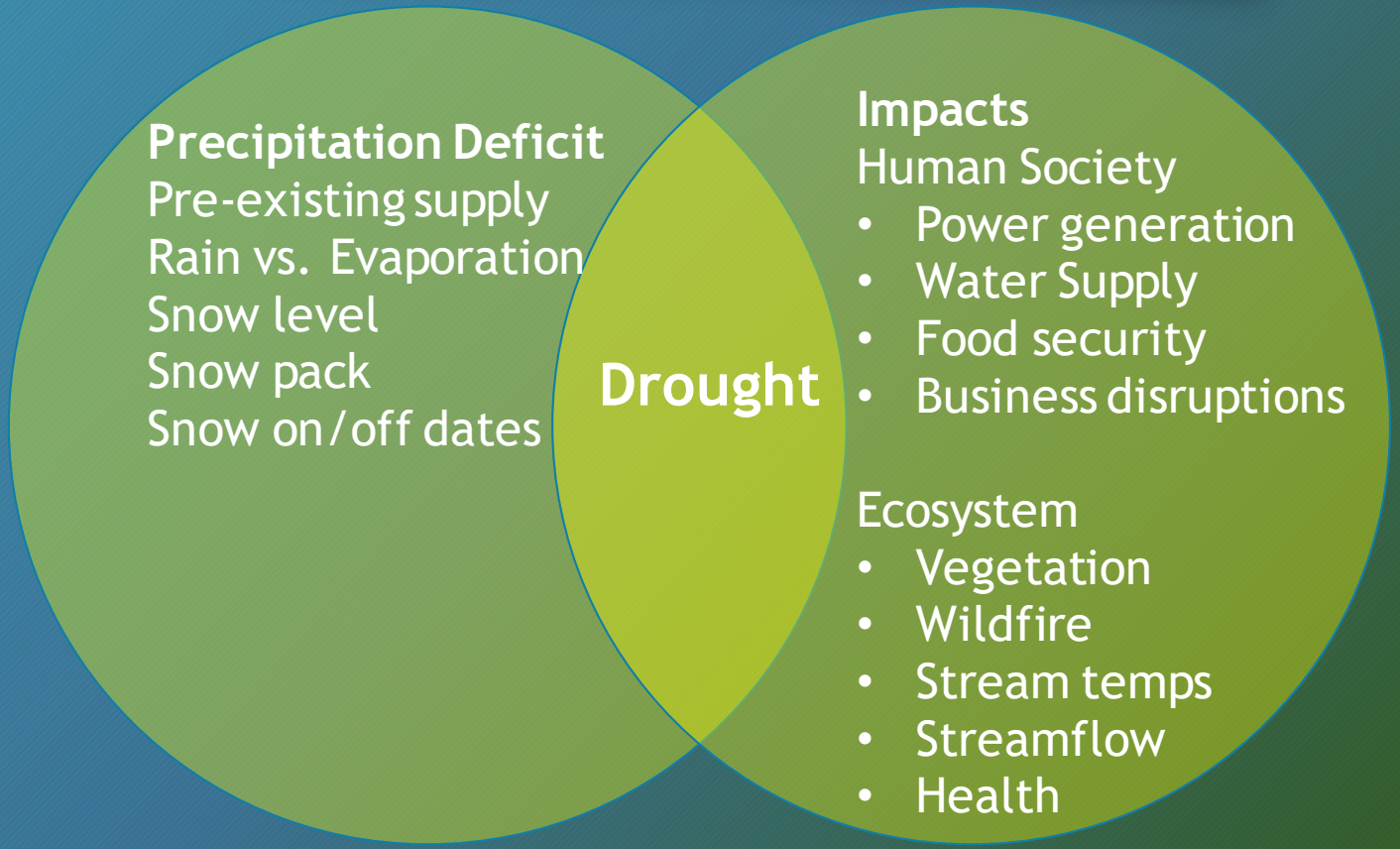
Kinds of Drought

- **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?

ACCAP Alaska Center for Climate Assessment and Policy A NOAA RISA TEAM
UAF University of Alaska Fairbanks

Drought: Low (Stored) Precipitation Plus Impacts



ACCAP Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM
UAF UNIVERSITY OF ALASKA FAIRBANKS

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.

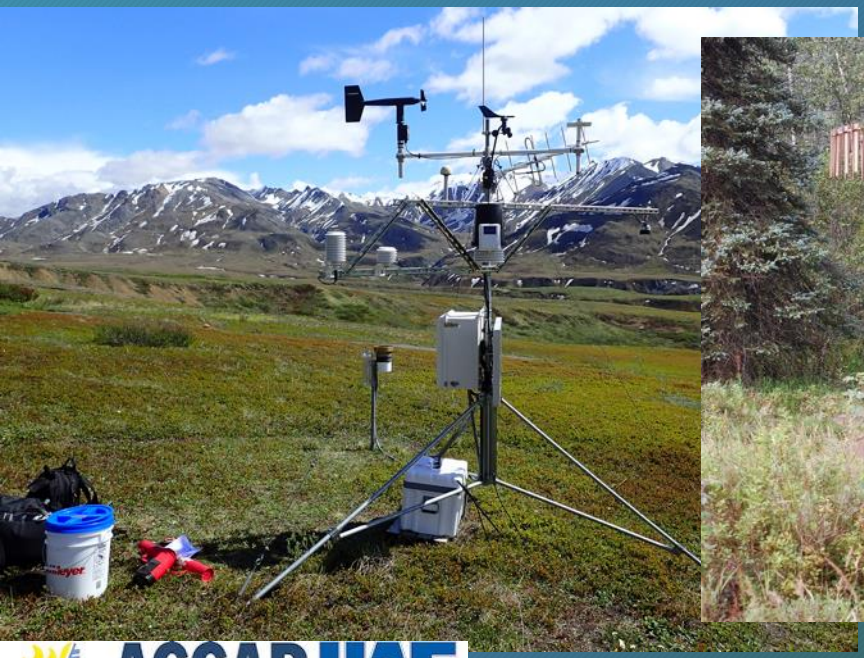
Measuring Precipitation

Traditional Weather Station

Water in Snowpack

Water in Lakes

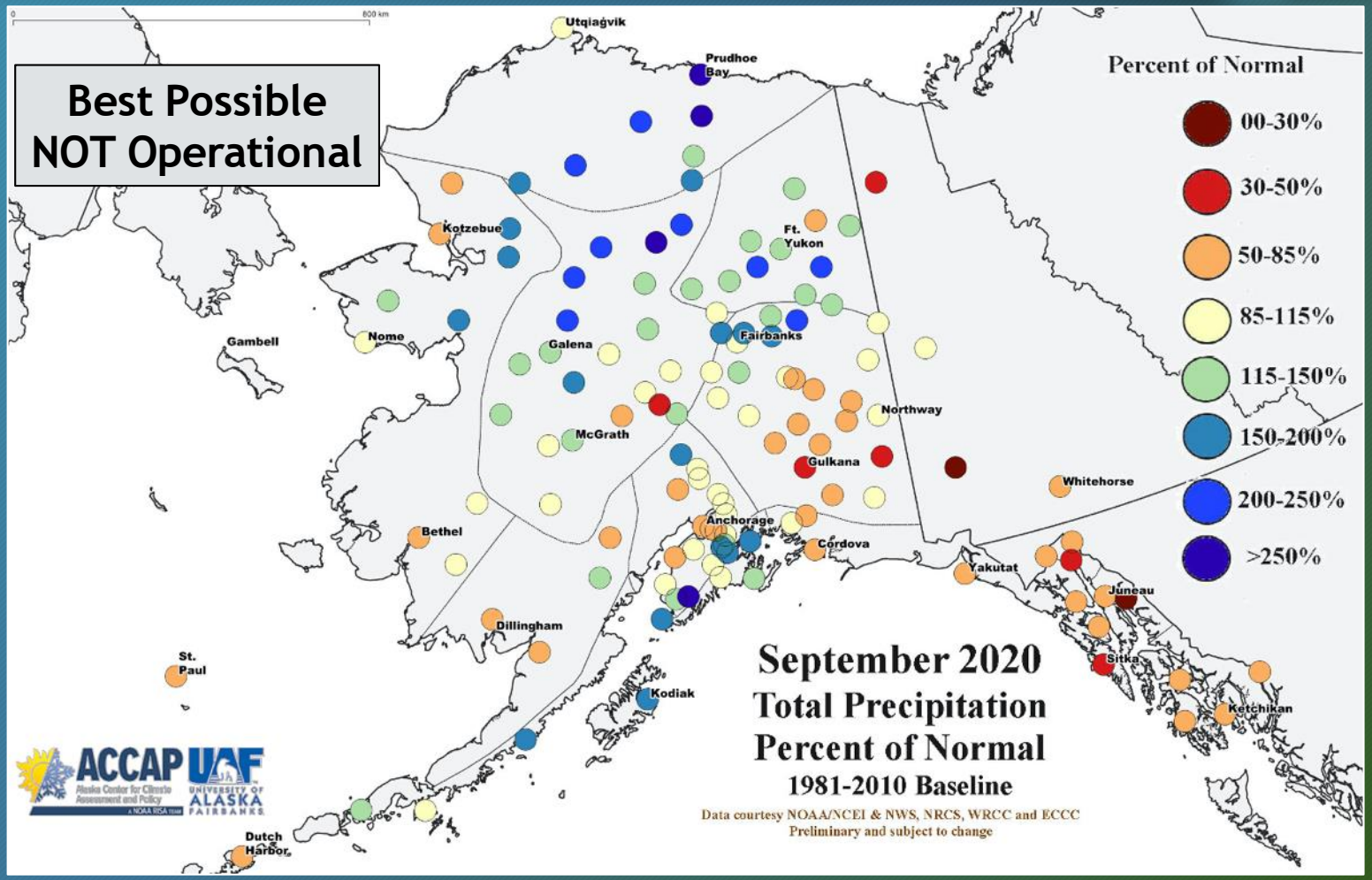
ACCAP Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM
UAF University of Alaska Fairbanks



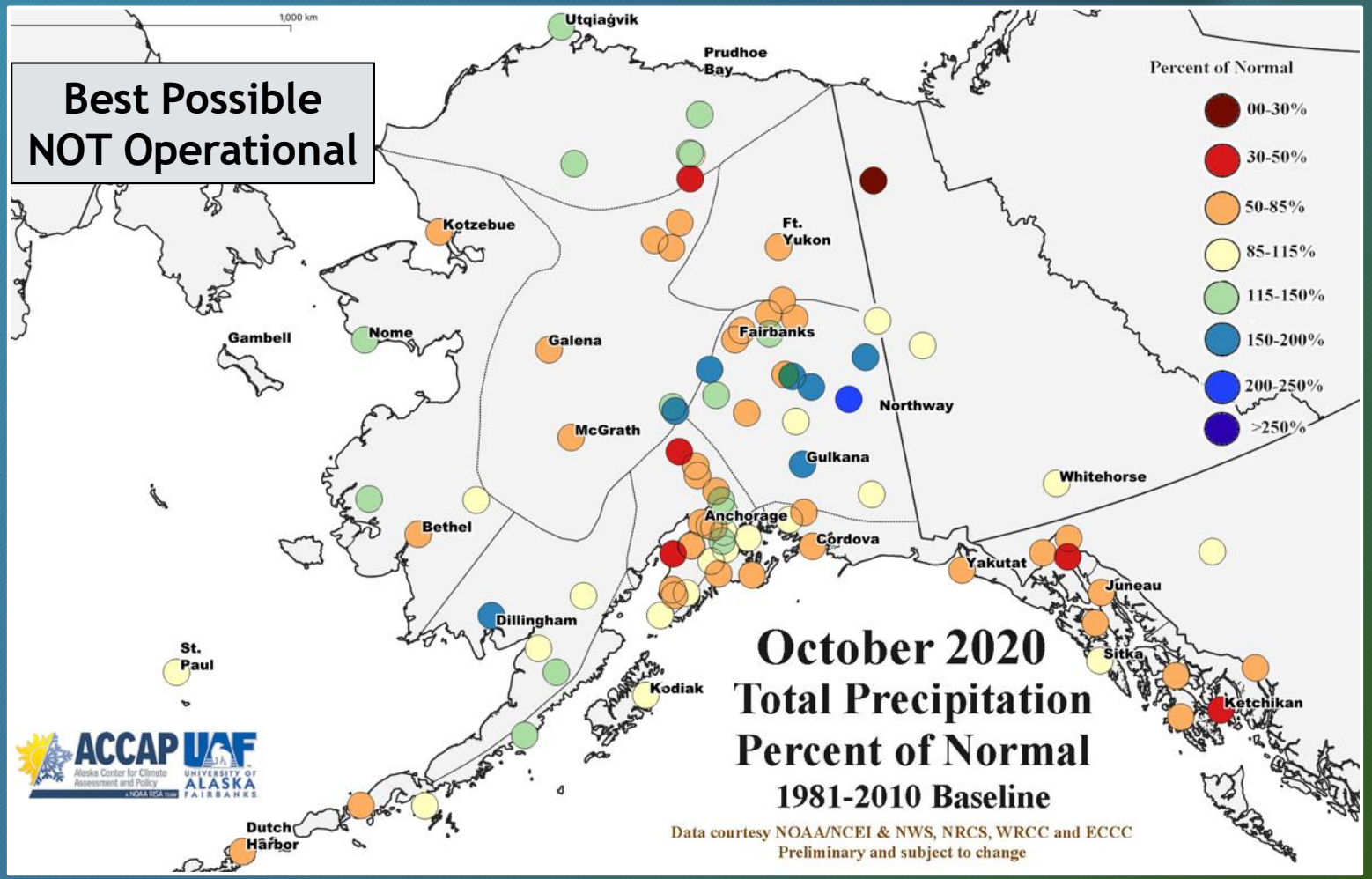
ACCAP
Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM

UAF
UNIVERSITY OF ALASKA FAIRBANKS

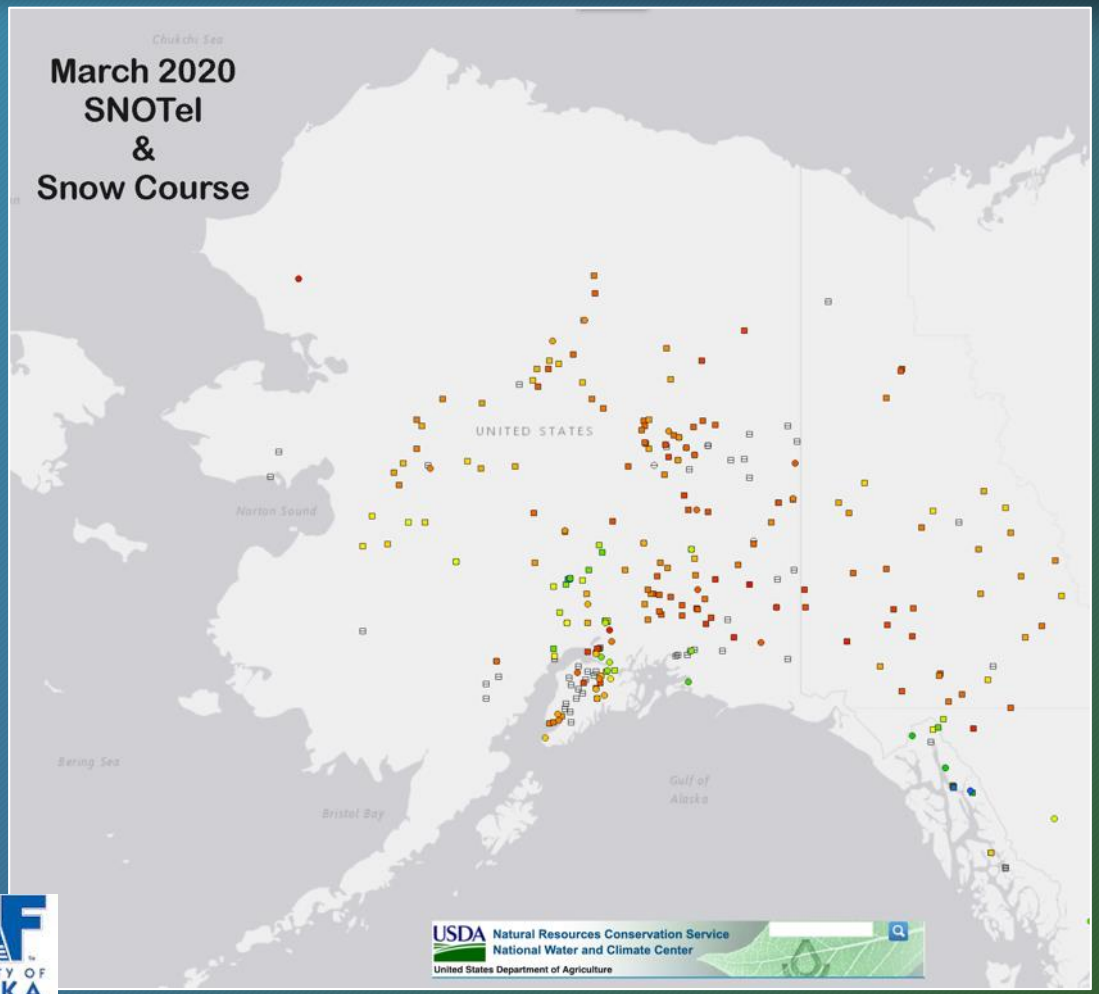
Warm Season Precipitation Stations



Cold Season Precipitation Stations



End of Winter 2019-20 Snowpack Measurements

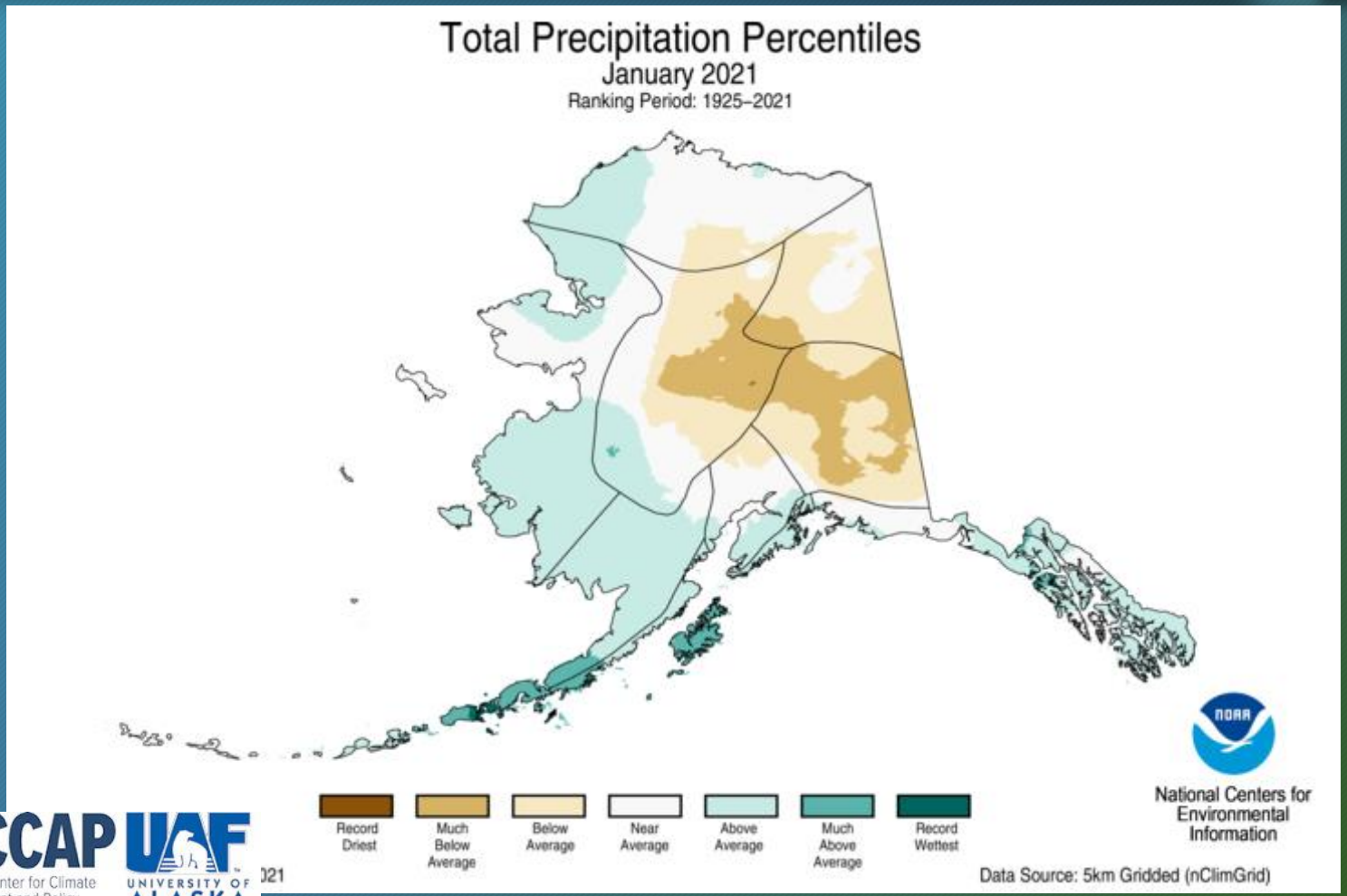


ACCAP Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM
UAF UNIVERSITY OF ALASKA FAIRBANKS

Gridded Precipitation

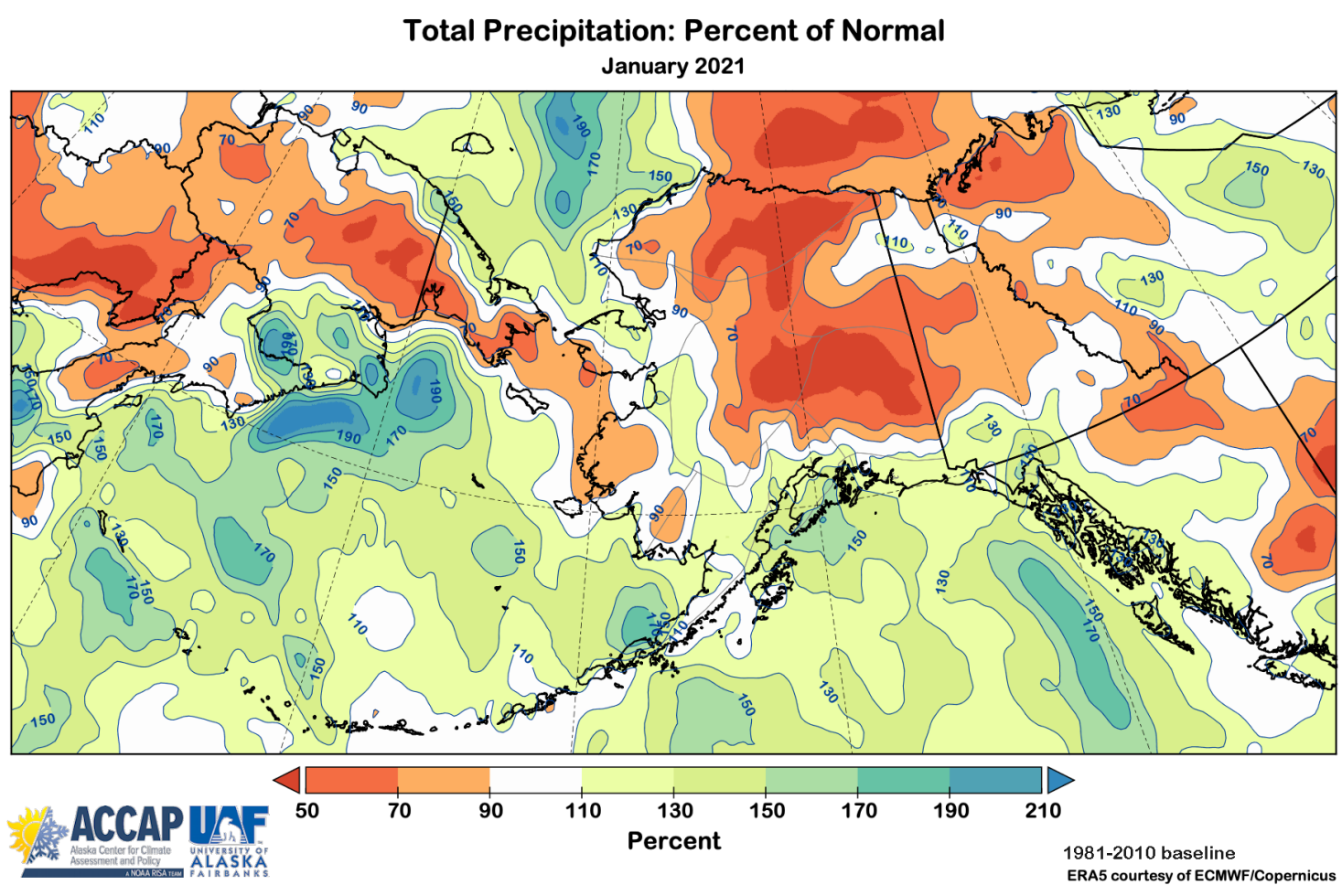
- NCEI: Point based with climatology background
  - Available monthly or longer timescales
- Model based, e.g. PRISM, ECMWF's ERA5
- Remote Sensing
  - Radar: Most of Alaska has no radar coverage
    - Best at event scale
  - Satellite estimates: not yet useful at high latitudes
    - Best at event scale

NOAA Gridded Precipitation



ACCAP Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM
UAF UNIVERSITY OF ALASKA FAIRBANKS

Model Based Precipitation Percent of Normal



Tools for Precipitation

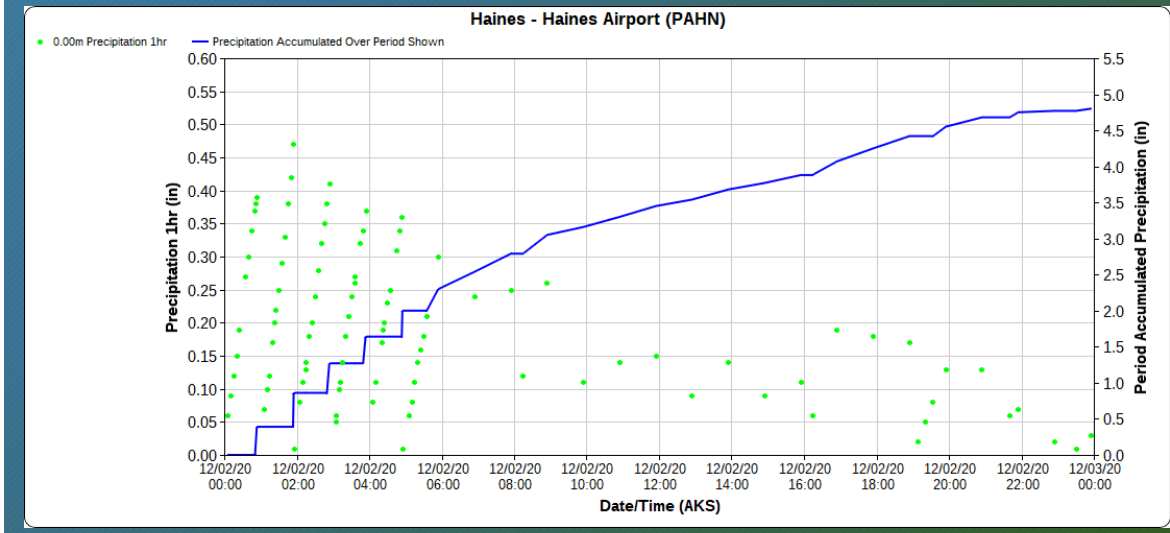
- Departures from Long Term Average
- Percent of Normal Precipitation/Snowpack
- Indices Designed to Measure Precipitation Deficit (Excess)
  - Standardized Precipitation (Evapotranspiration) Index
- Soil Moisture
- Streamflow
- YOU: Your personal observations!!

Varying Time Scales!

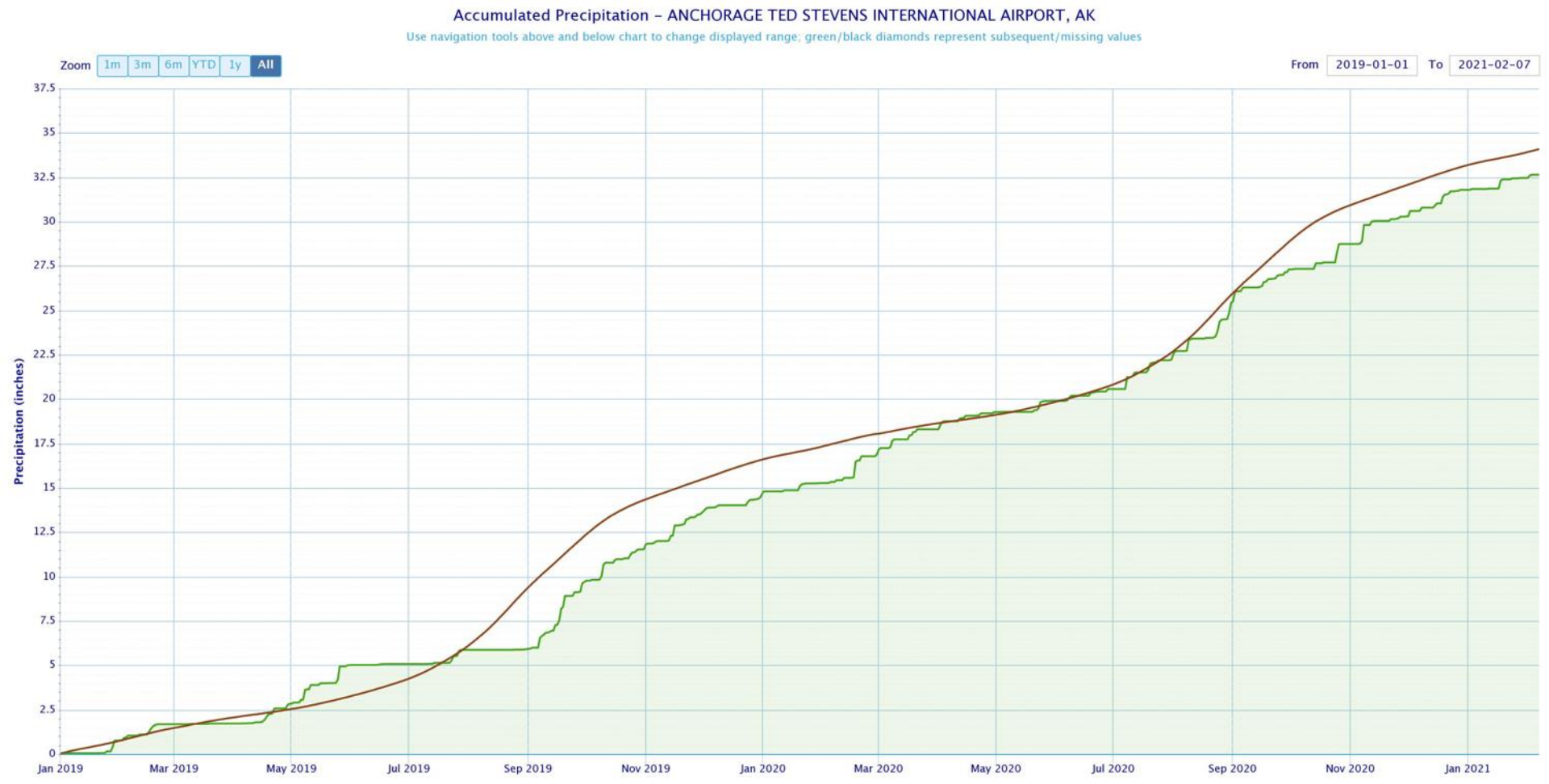
ACCAP Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM
UAF UNIVERSITY OF ALASKA FAIRBANKS

Short Term Extreme Precipitation

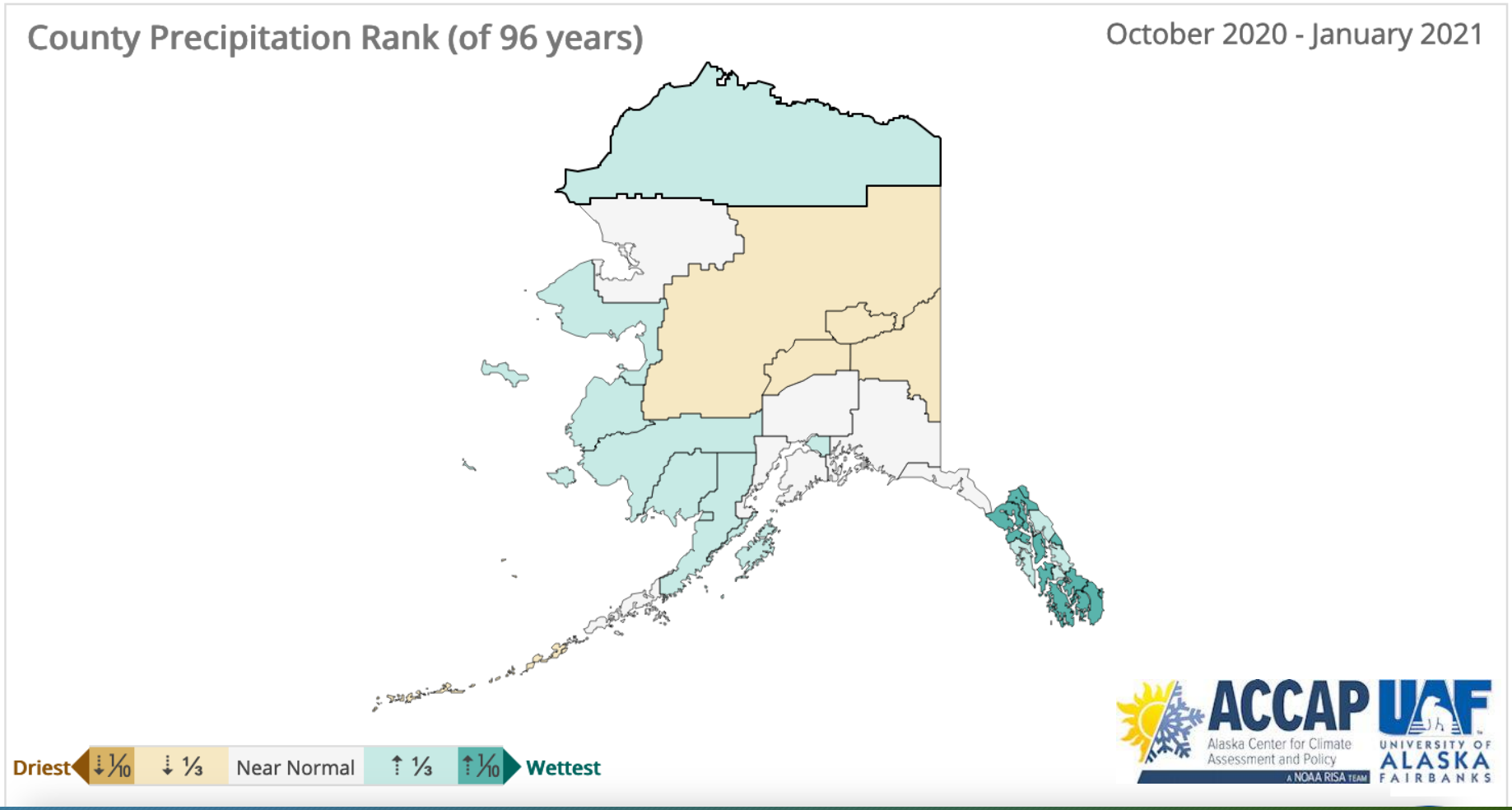
```
463
ASAK67 PAJK 030329
RTPAJK
Regional temperature and precipitation roundup
National Weather Service Juneau Ak
629 PM akst Wed Dec 2 2020

High and low temperatures are from the past 18 hours.
24-hour precipitation and snow depth ending at 3 pm Alaska standard
time today. Snowfall since midnight Alaska standard time.
Snowfall and snow depth data are available only at augmented sites.
M=missing T=trace
.
.B PAJK 1203 Z DH00/TAIRZS/TAIRZI/PPDRZZ/DVH15/SFVRZZ/SDIRZZ
:
:ID            STATION      Hi    Lo    24HR    Snow  Snow
:                           Temp  Temp  Precip  Fall  Depth
PAYA  : Yakutat Airport    :  47 /  46 /  1.70 /    M /    M
PAJN  : Juneau Airport     :  52 /  46 /  4.50 /  0.0 /    0
PAHN  : Haines Airport     :  47 /  42 /  6.78 /    M /    M
PAKT  : Ketchikan Airport  :  51 /  44 /  1.22 /    M /    M
PAKW  : Klawock Airport    :  52 /  42 /     M /    M /    M
PASI  : Sitka Airport      :  57 /  47 /  2.00 /    M /    M
PAGY  : Skagway Airport    :  48 /  38 /  2.95 /    M /    M
.END

:
Cooperative Observations
Max temperature...min temperature...precipitation...and
Snowfall are for 24 hours ending at indicated times.
Note: These locations report data once every 24 hours.
In some weather situations reported low/high temperatures
may reflect conditions from the previous day.
M=missing T=trace

.B PAJK 1202 L DH17/TAIRZX/TAIRZN/PPDRZZ/SFDRZZ/SDIRZZ
:
:ID        Station                Obs       Max  Min   24HR    Snow  Snow
:                                 Time      Temp Temp  Precip  Fall  Depth
KTAA2 : Ketchikan 13N           : DH1500 /  50 /  40 /  0.62 /  0.0/    0
ELVA2 : Elfin Cove              : DH1500 /  52 /  41 /  4.02 /  0.0/    0
HYDA2 : Hyder                   : DH0700 /  33 /  32 /     M /  0.5/   33
MPUA2 : Metlakatla Power        : DH1023 /  53 /  43 /  0.46 /  0.0/    0
KWPA2 : Klawock Water Treatmen  : DH0900 /  48 /  39 /  0.81 /  0.0/    0
JNAA2 : Juneau Downtown         : DH0900 /  52 /  42 /  2.28 /  0.0/    0
THBA2 : Thorne Bay Water        : DH0800 /  48 /  44 /  0.82 /  0.0/    0
JDWA2 : Juneau Douglas WWTP     : DH0800 /   M /   M /  2.37 /  0.0/    0
SITA2 : Little Port Walter      : DH0900 /  52 /  44 /  7.29 /  0.0/    0
AUKA2 : Auke Bay                : DH0915 /  47 /  40 /  2.90 /  0.0/    0
CFSA2 : Craig Forest Service    : DH0845 /  49 /  44 /  1.30 /  0.0/    0
PECA2 : Pelican                 : DH0800 /  52 /  45 /  9.75 /  0.0/    0
HOOA2 : Hoonah                  : DH0600 /  51 /  42 /  4.70 /    T/    0
ECTA2 : Eaglecrest Top          : DH0600 /  38 /  28 /  2.20 /    M/   54
ECBA2 : Eaglecrest Base         : DH0710 /  44 /  36 /  1.59 /  0.0/   22
SPPA2 : Snettisham Power Plant  : DH0700 /  51 /  31 /  3.87 /  0.0/   11
SKGA2 : Skagway Power           : DH0700 /  43 /  32 /  5.37 /  2.0/    7
HCSA2 : Haines Customs          : DH0700 /  34 /  31 /  5.23 /  6.5/    M
AHNA2 : Haines #2               : DH0800 /  43 /  34 /  6.62 /  0.0/   11
GUSA2 : Gustavus                : DH0500 /  47 /  38 /  3.73 /  0.0/    2
AJKA2 : Juneau Forecast Office  : DH2358 /  49 /  36 /  4.09 /  0.0/    2
JLPA2 : Juneau Lena Point       : DH2358 /  45 /  35 /  3.93 /  0.0/    0
APGA2 : Petersburg COOP         : DH2200 /  49 /  37 /  4.38 /  0.0/    0
.END
```



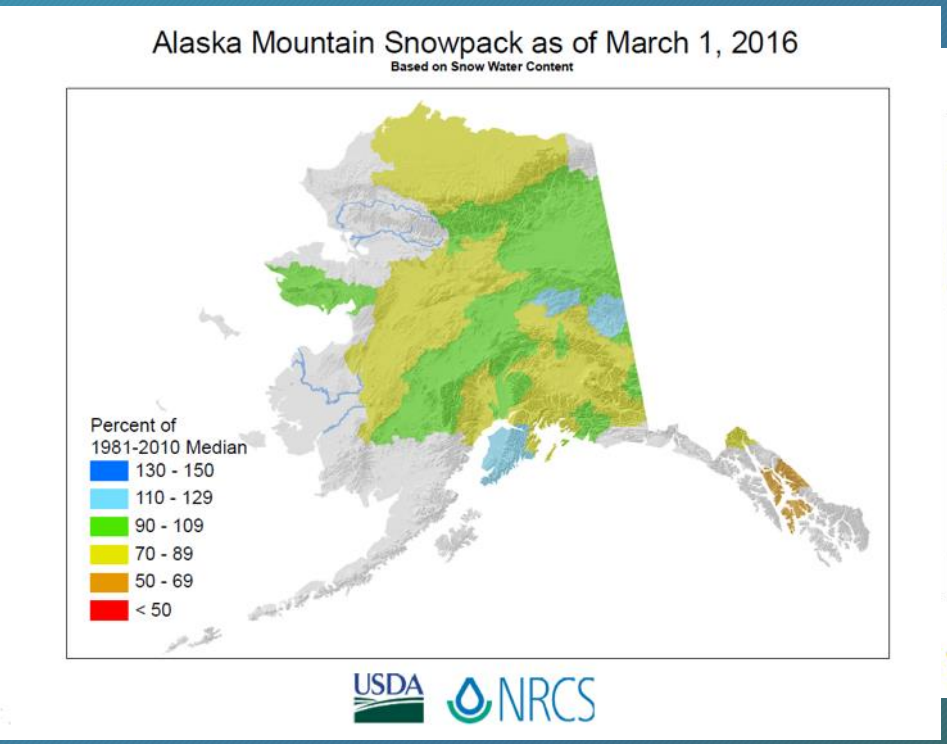
Running Precipitation Accumulation

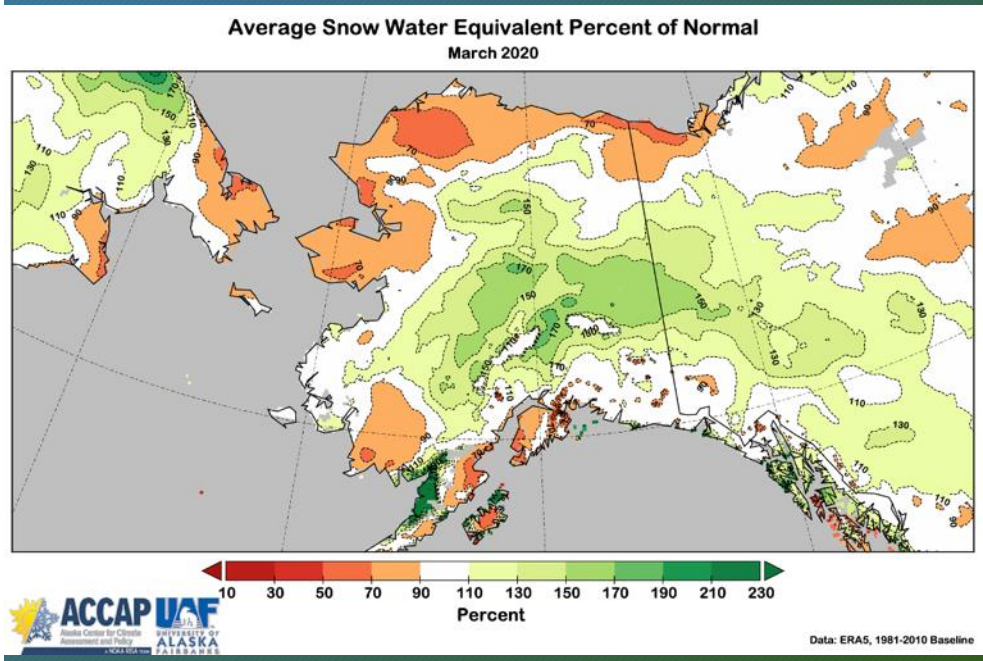


NCEI County Level Ranks



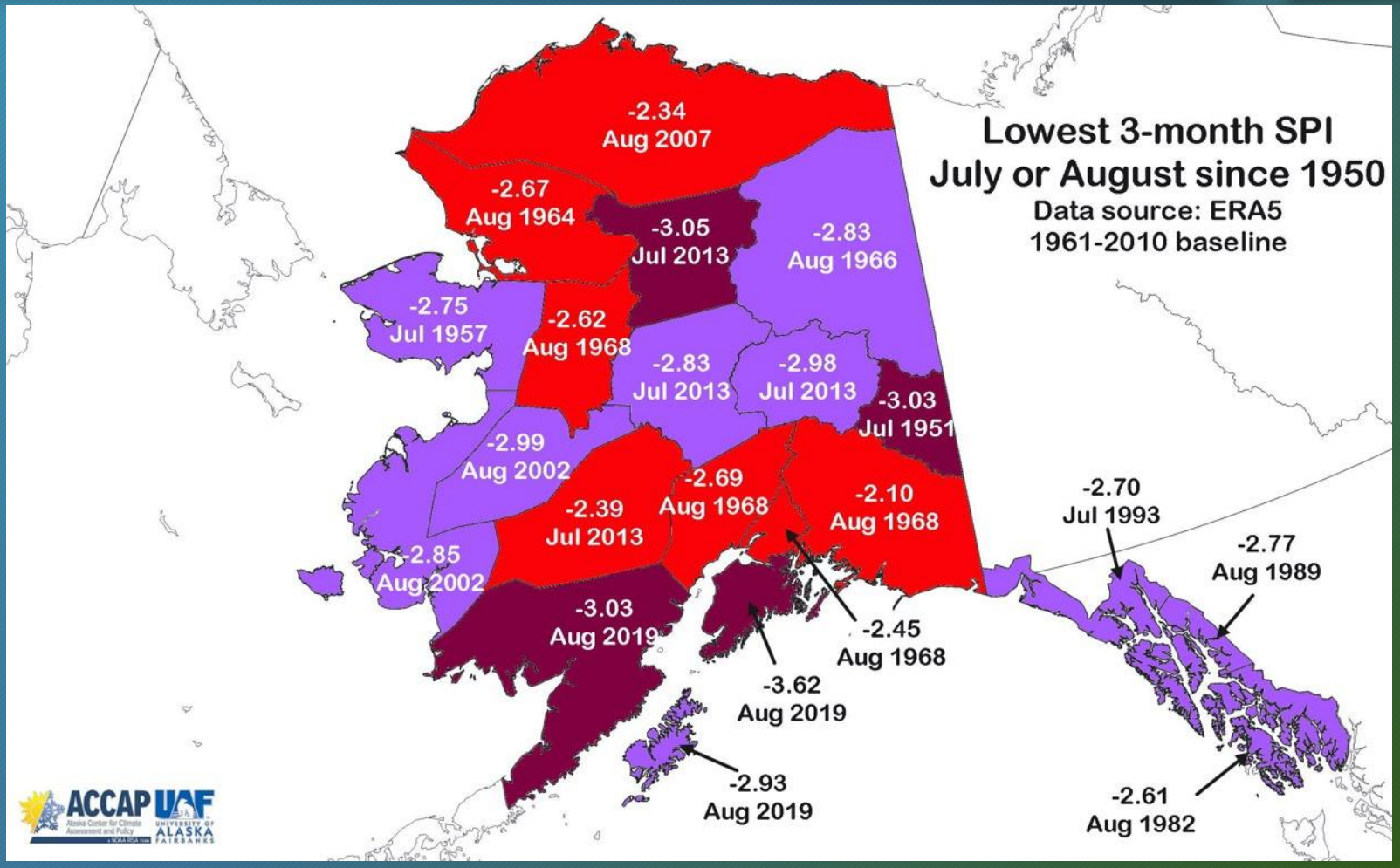
Snowpack Assessment



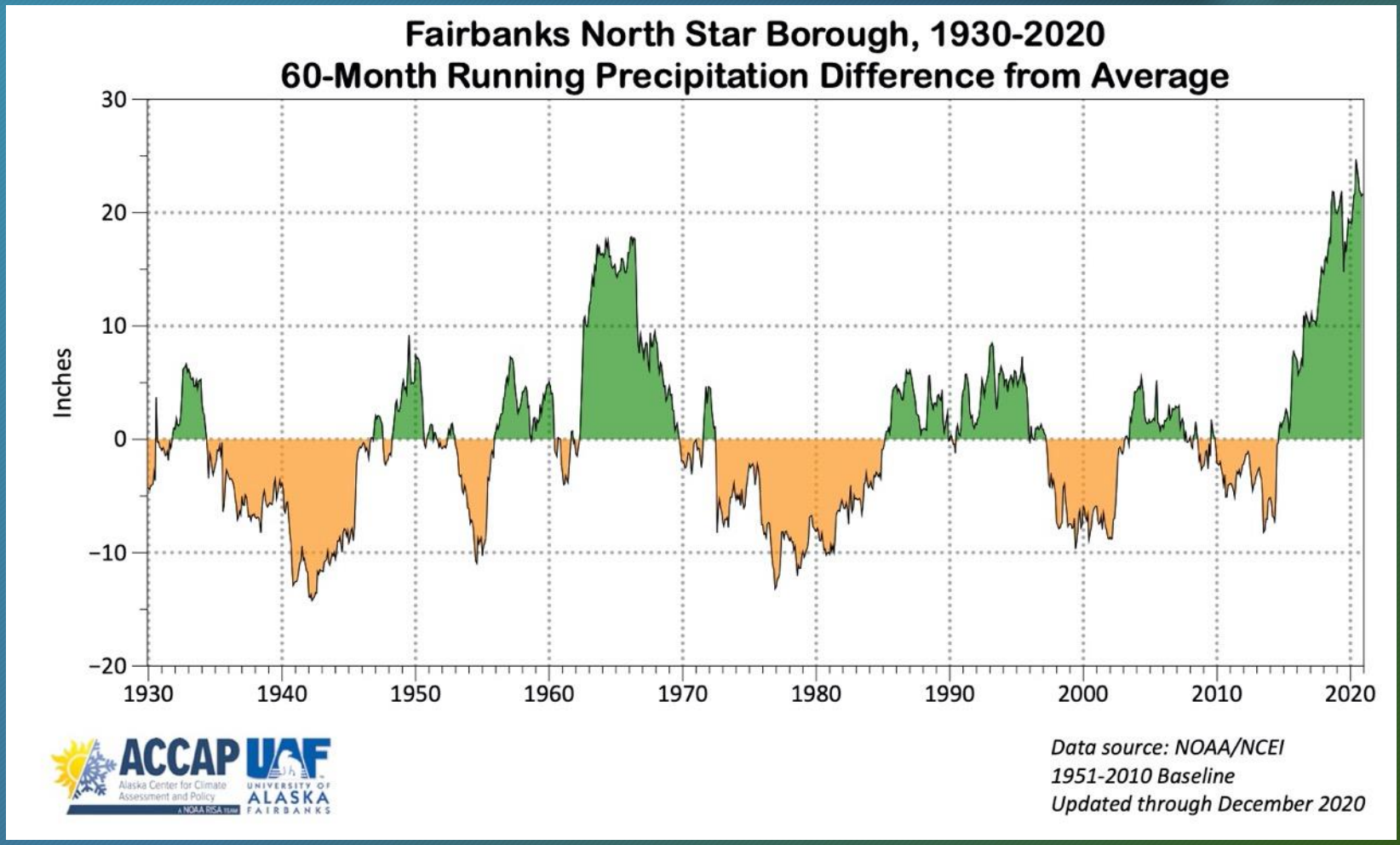


ACCAP Alaska Center for Climate Assessment and Policy A NOAA RISA TEAM
UAF University of Alaska Fairbanks

Wildfire and Drought



Fairbanks Long Term Precipitation



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

ACCAP Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM
UAF UNIVERSITY OF ALASKA FAIRBANKS

Recent Examples of High Precipitation

- 1989: NW Alaska Frequent Rains July/August
- 2012: September Flooding Kenai Peninsula
- 2014: Summer Landslides Taylor Highway
- 2019-20: Heavy snow upper Kuskokwim
- 2020-21: Winter Haines landslides, Ketchikan high reservoirs
- 2014-now High Precipitation Fairbanks

ACCAP Alaska Center for Climate Assessment and Policy A NOAA RISA TEAM
UAF University of Alaska Fairbanks

Precipitation Measurements are Critical

- Precipitation varies greatly over short distances
- Established ways for you to contribute precipitation observations and impacts of extremes
  - CoCoRaHS
  - NWS Forecast Offices
  - Drought Reporter