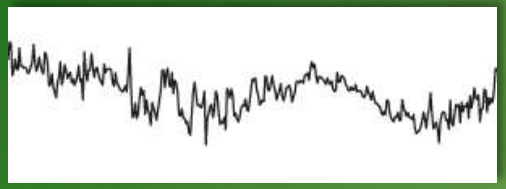
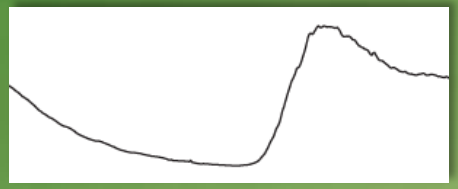




Rain, Snow, and Glacier Ice: Streamflow Drivers in the Susitna River Basin, Alaska

– and –

The Floods of September 2012

Janet Curran

USGS Alaska Science Center

USGS

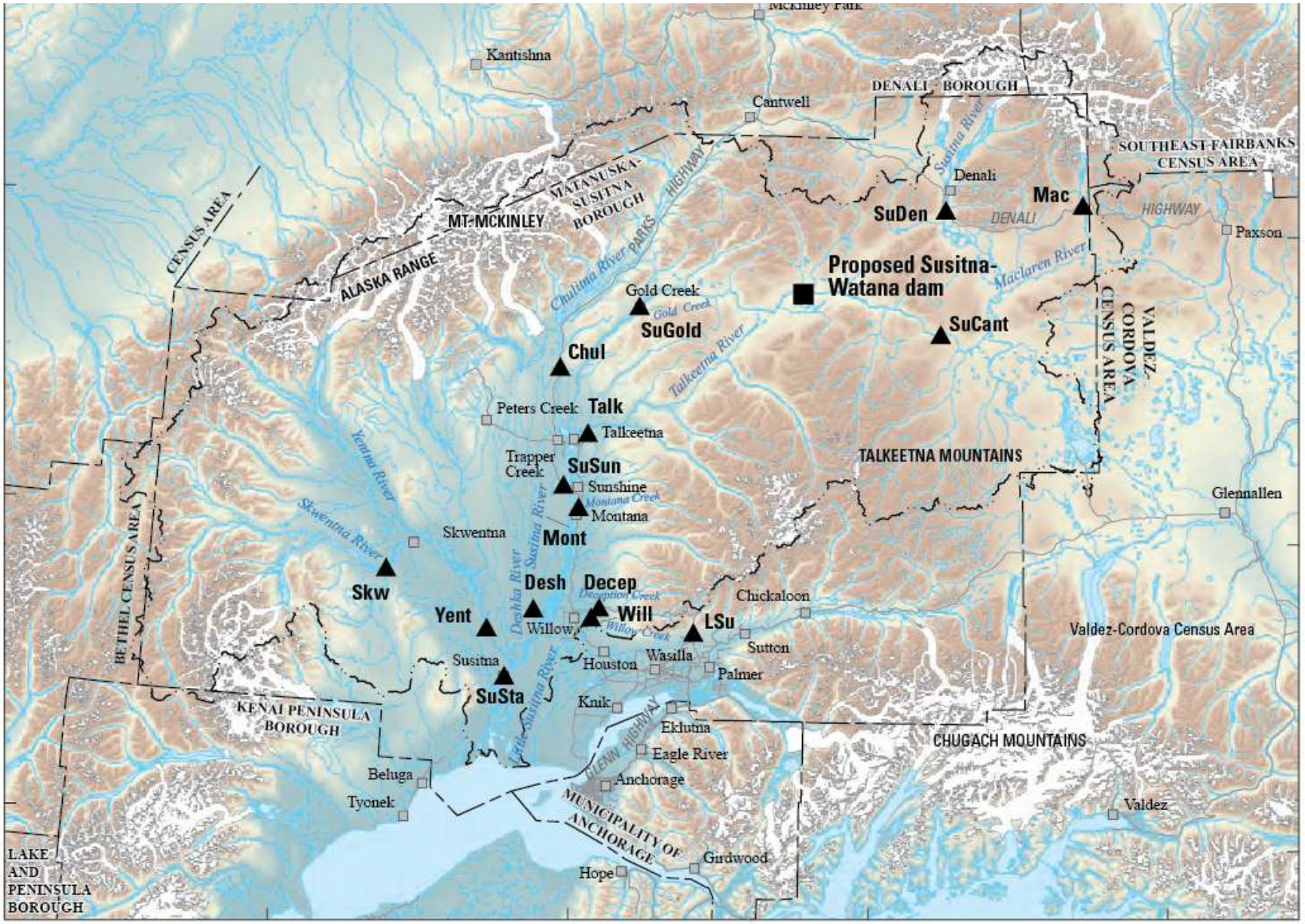
In cooperation with Alaska Department of Transportation and Public Facilities, Alaska Department of Natural Resources, and Alaska Energy Authority

Seasonal streamflow patterns were explored for several projects

- Flood frequency analysis
  - Suitability of statewide data for seasonal analysis was examined for 2003 reports
- Susitna River Basin streamflow extension
  - Planning and assessing the proposed Susitna-Watana hydroelectric project required daily streamflow data
  - Streamflow record extension techniques were used to estimate daily discharge values for missing periods in USGS streamgaging records in the Susitna River Basin for water years 1950-2010

USGS

USGS streamgages in the Susitna River Basin

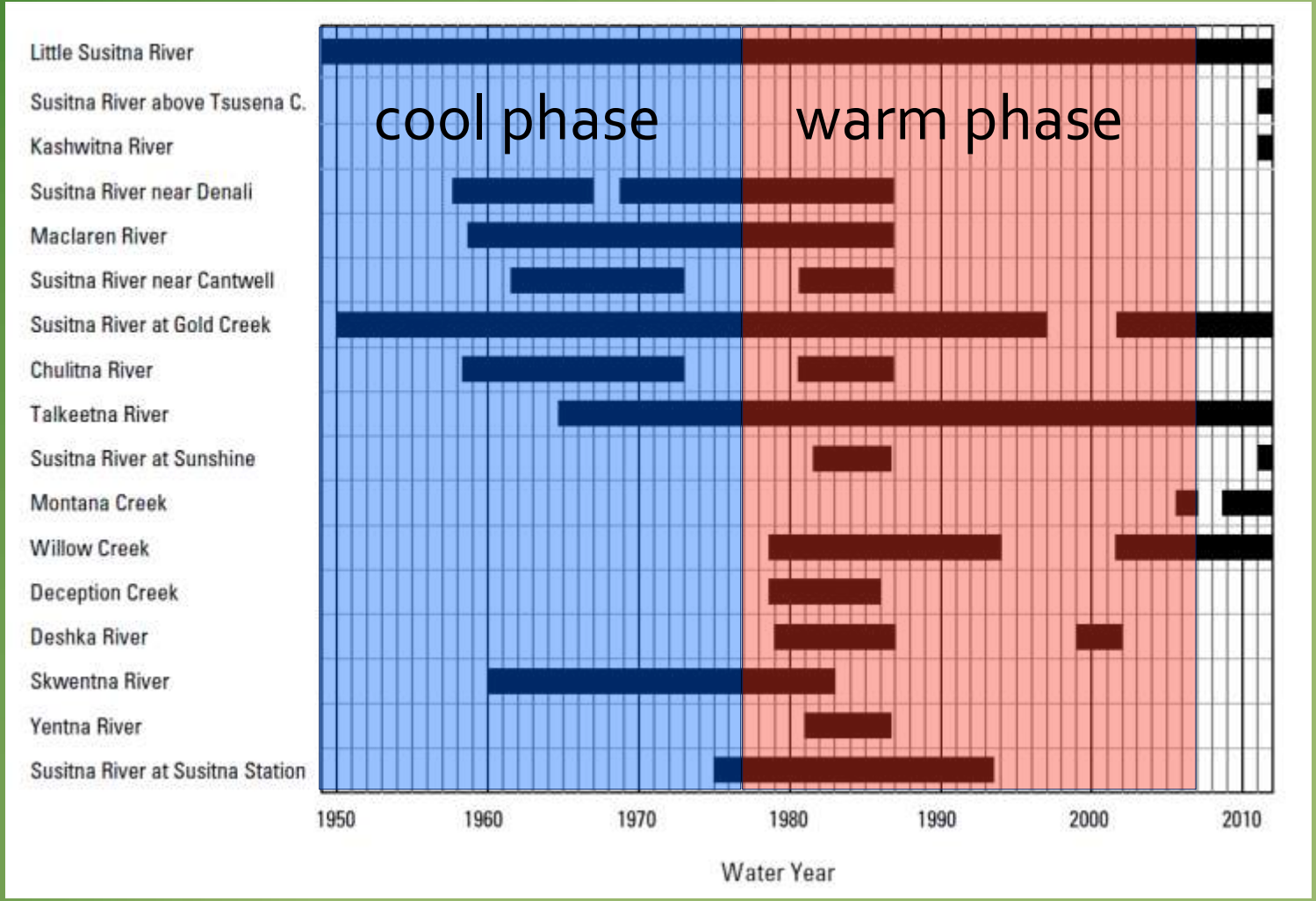


Base map modified from USGS digital datasets, various scales. Projection: NAD83 UTM Zone 6
Roads and towns from Alaska Department of Transportation and Public Facilities digital datasets
Susitna River basin boundary modified from Watershed Boundary Dataset

0 40 60 MILES
0 40 80 KILOMETERS

Streamflow is lower in winter, higher in summer during the cool phase of the Pacific Decadal Oscillation (PDO)

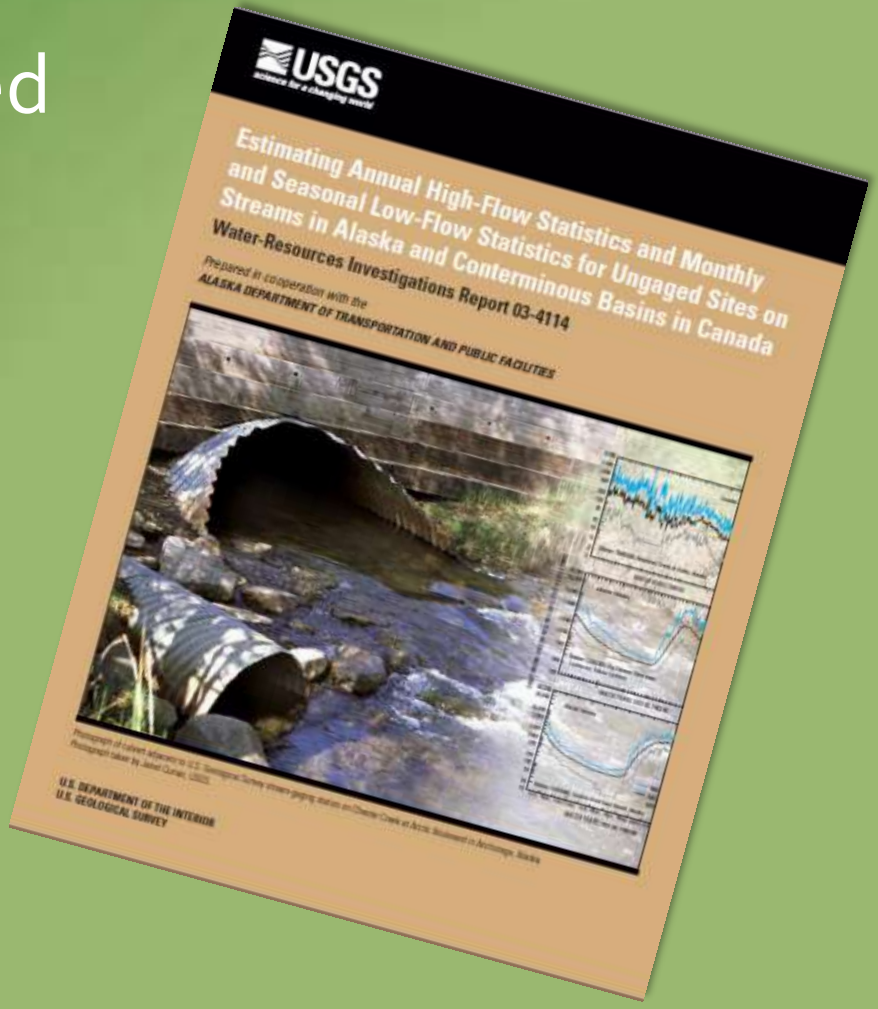
(Hodgkins, 2009, WRR v. 45)



USGS

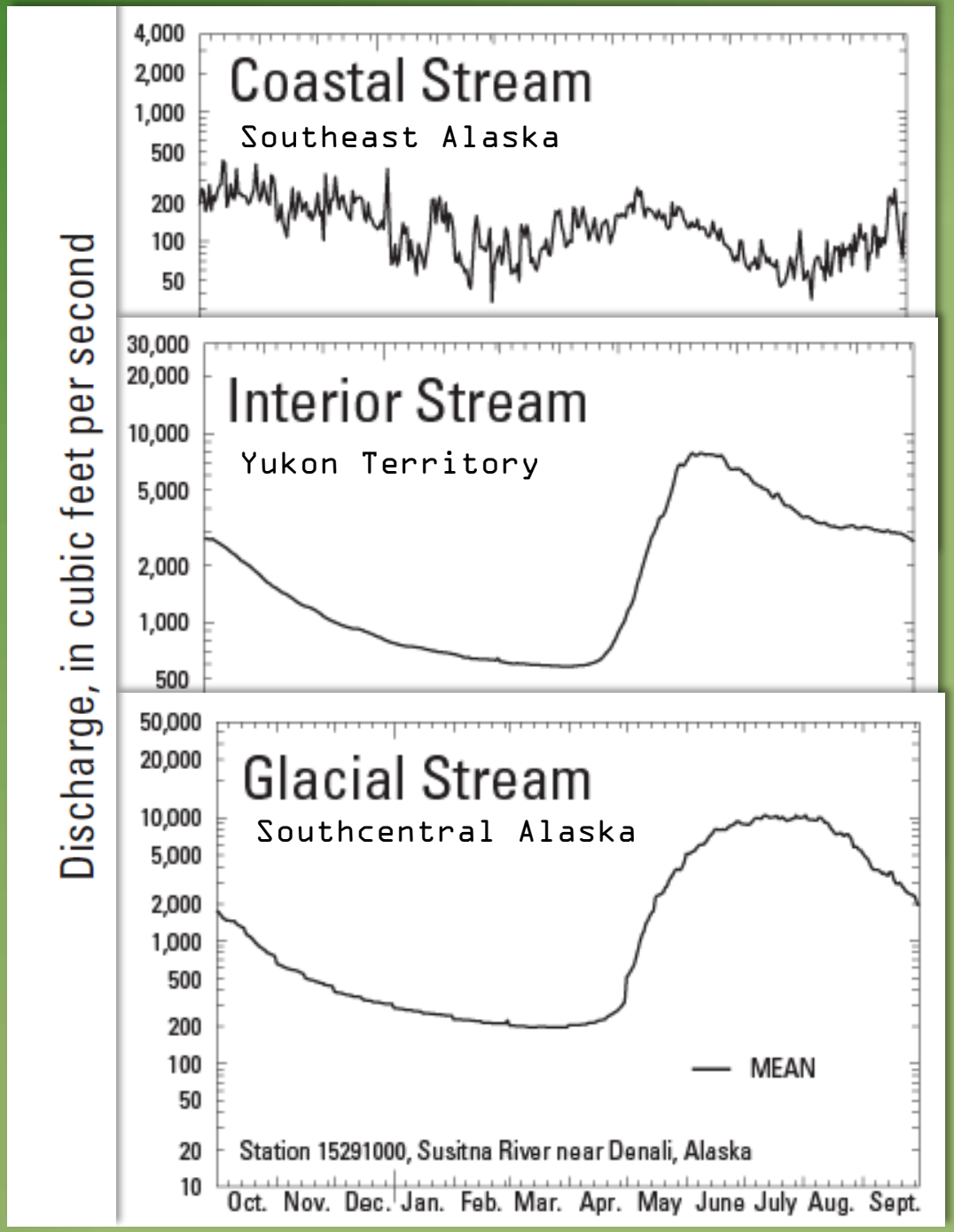
Analysis of seasonal streamflow patterns

- General patterns noted for flood frequency analysis in 2003



USGS

Seasonal streamflow patterns in and near Alaska



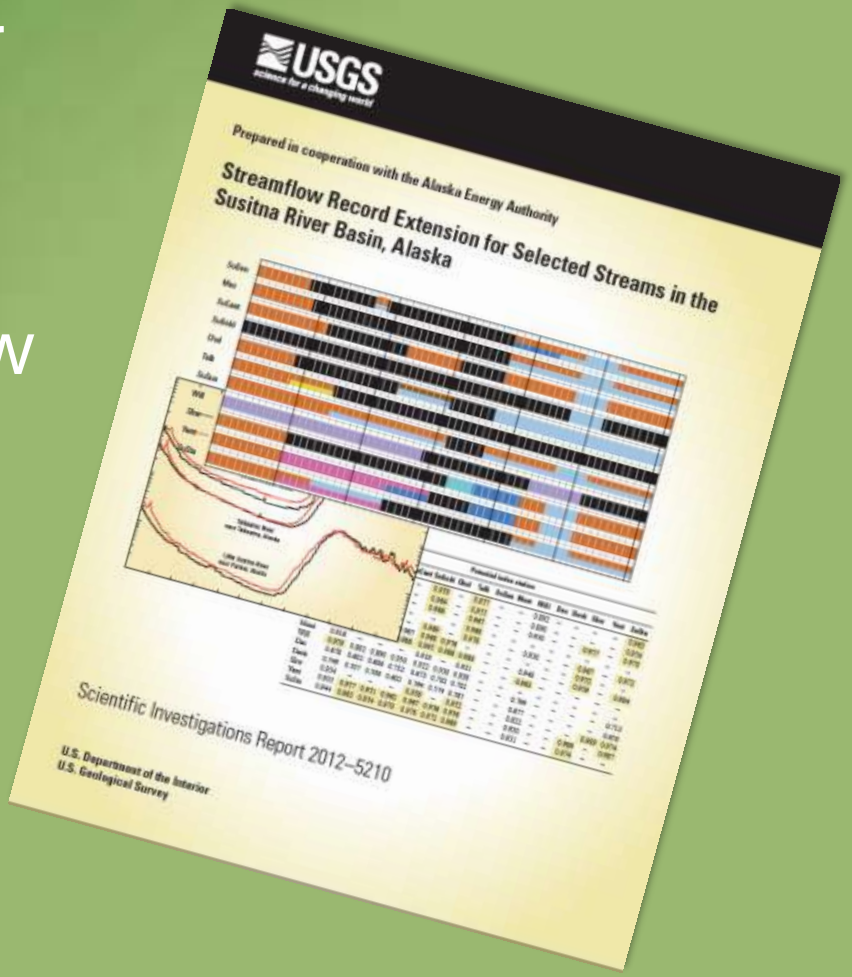
Mean daily discharge, compiled from 14-38 years of record.

Modified from Figure 2, Wiley and Curran, 2003, USGS WRIR 03-4114

USGS

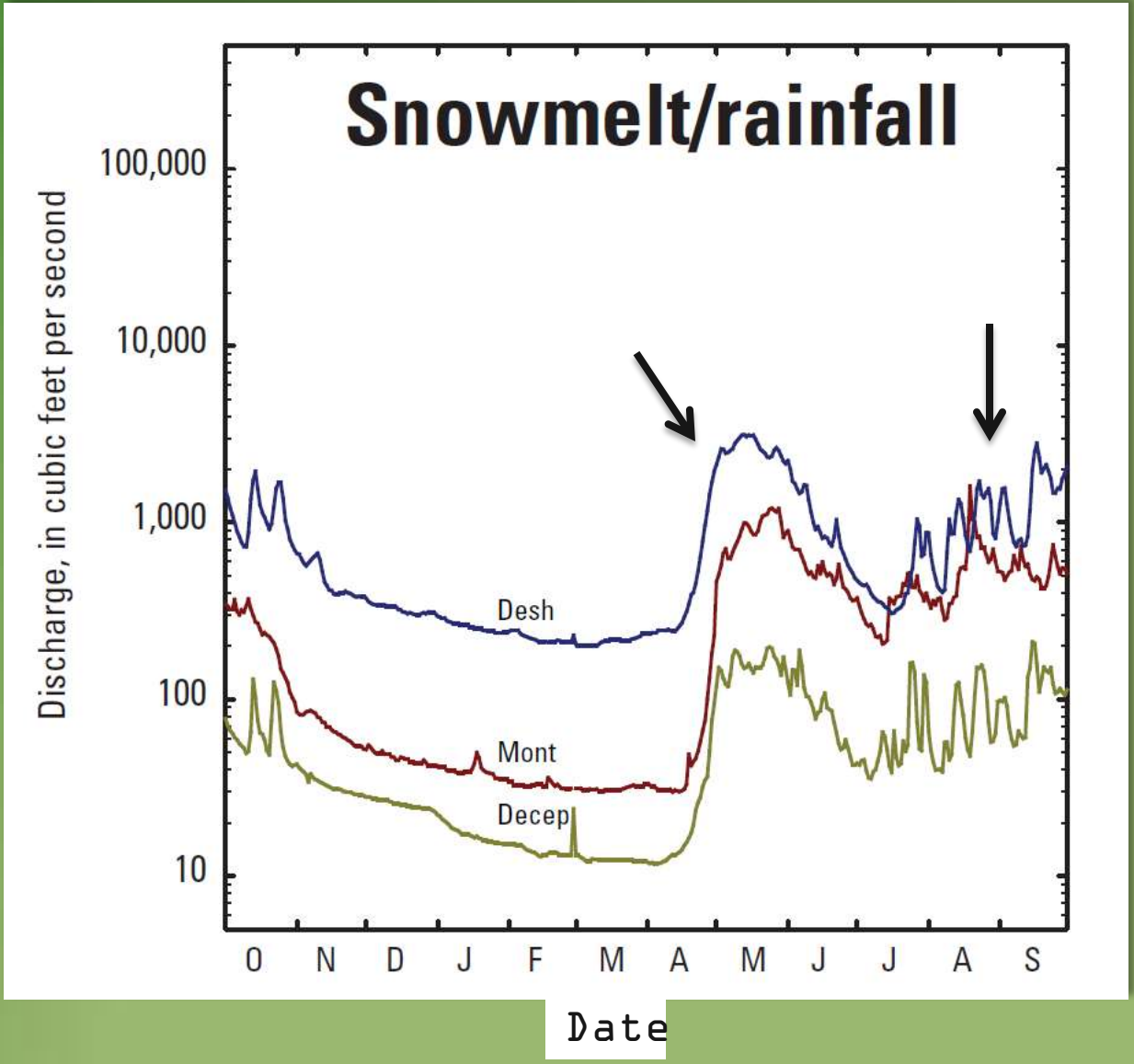
Analysis of seasonal streamflow patterns

- Became important for selection of index stations for Susitna River Basin streamflow extension



USGS

Seasonal streamflow patterns in the Susitna River Basin, Alaska

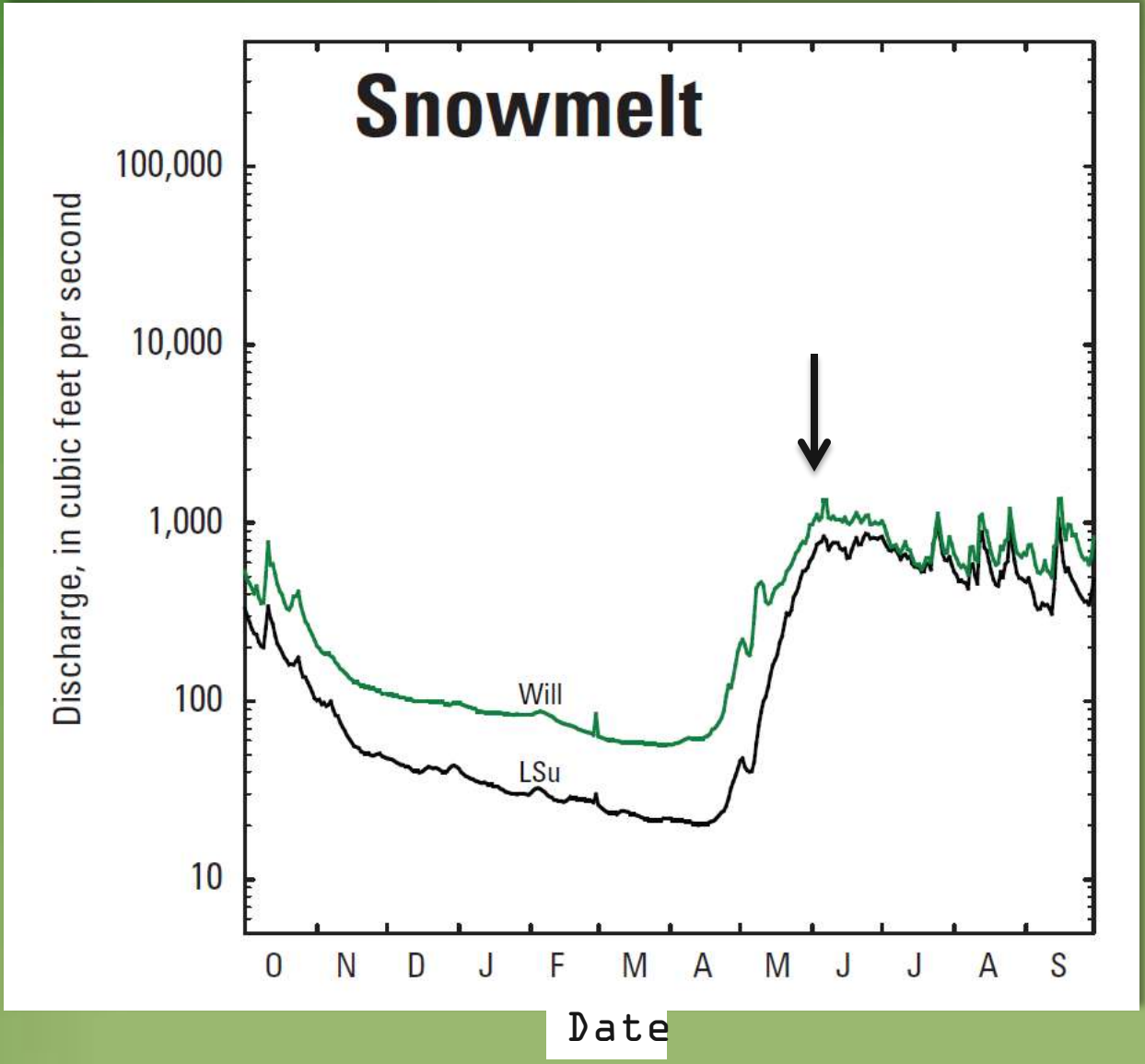


Mean daily discharge, compiled from 4 years of record.

Modified from Figure 3 in Curran, 2012, USGS SIR 2012-5210

USGS

Seasonal streamflow patterns in the Susitna River Basin, Alaska



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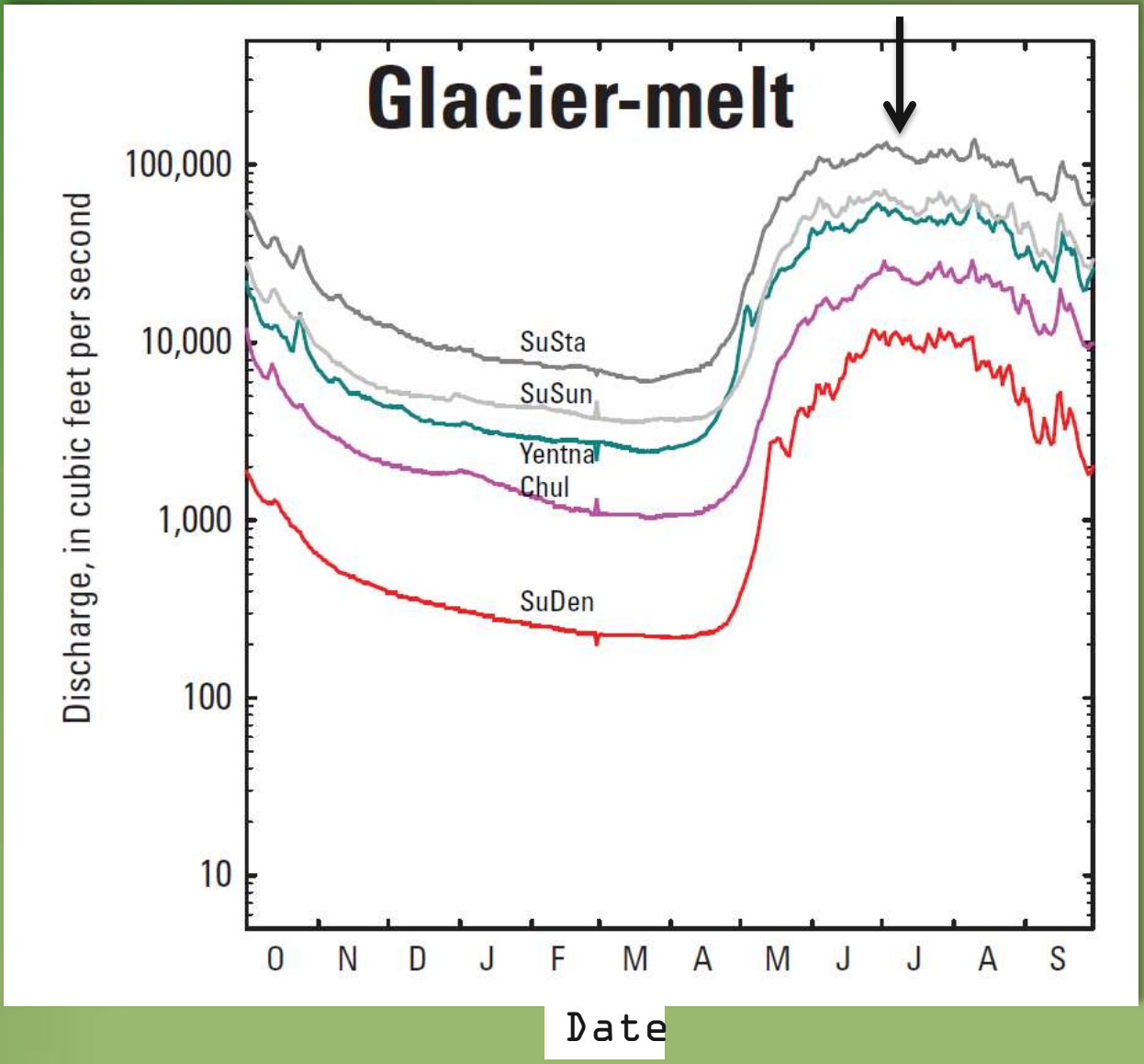
USGS

Seasonal streamflow patterns in the Susitna River Basin, Alaska

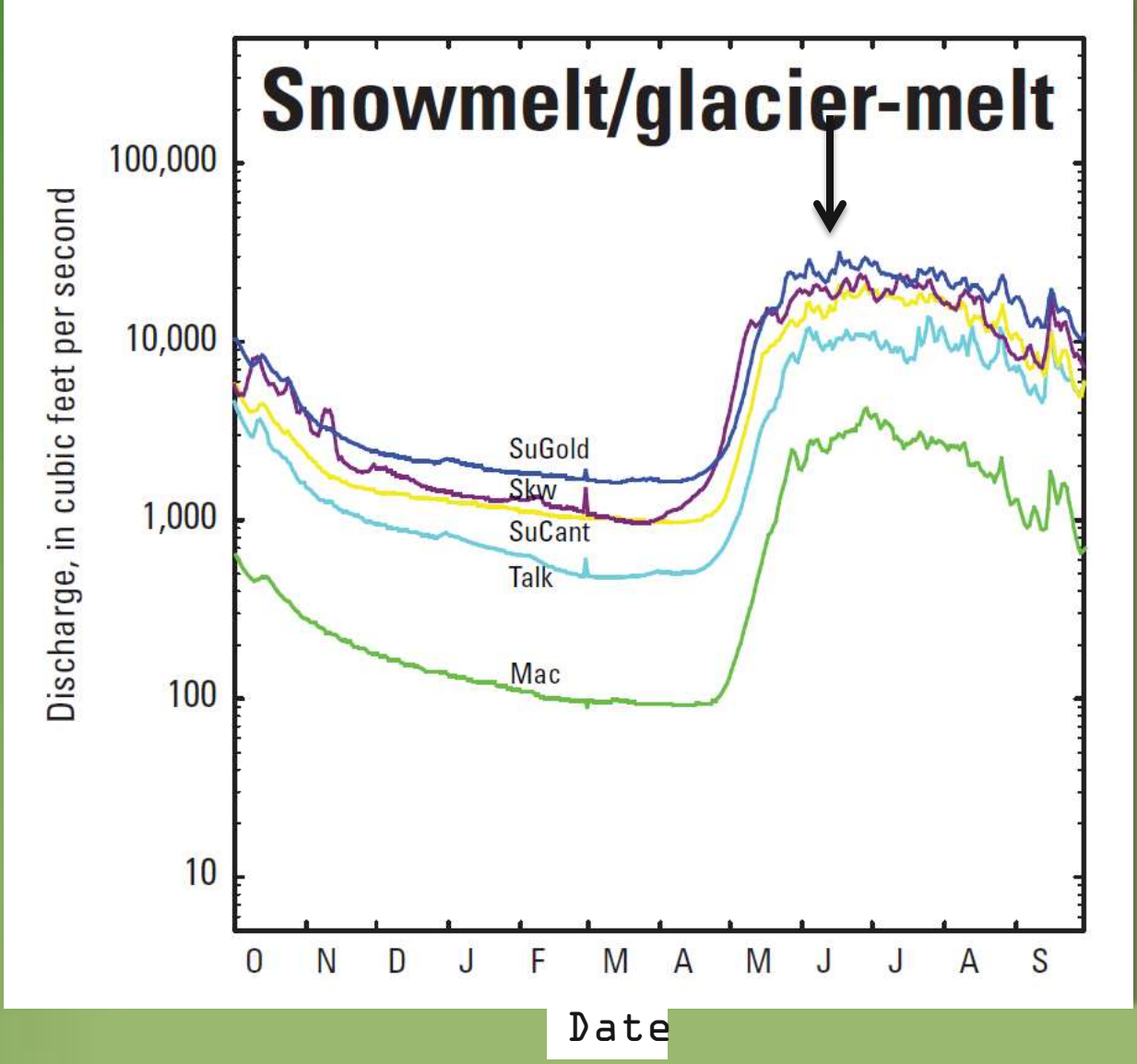


Mean daily discharge, compiled from 4 years of record.

Modified from Figure 3 in Curran, 2012, USGS SIR 2012-5210

USGS

Seasonal streamflow patterns in the Susitna River Basin, Alaska



Mean daily discharge, compiled from 4 years of record.

Modified from Figure 3 in Curran, 2012, USGS SIR 2012-5210

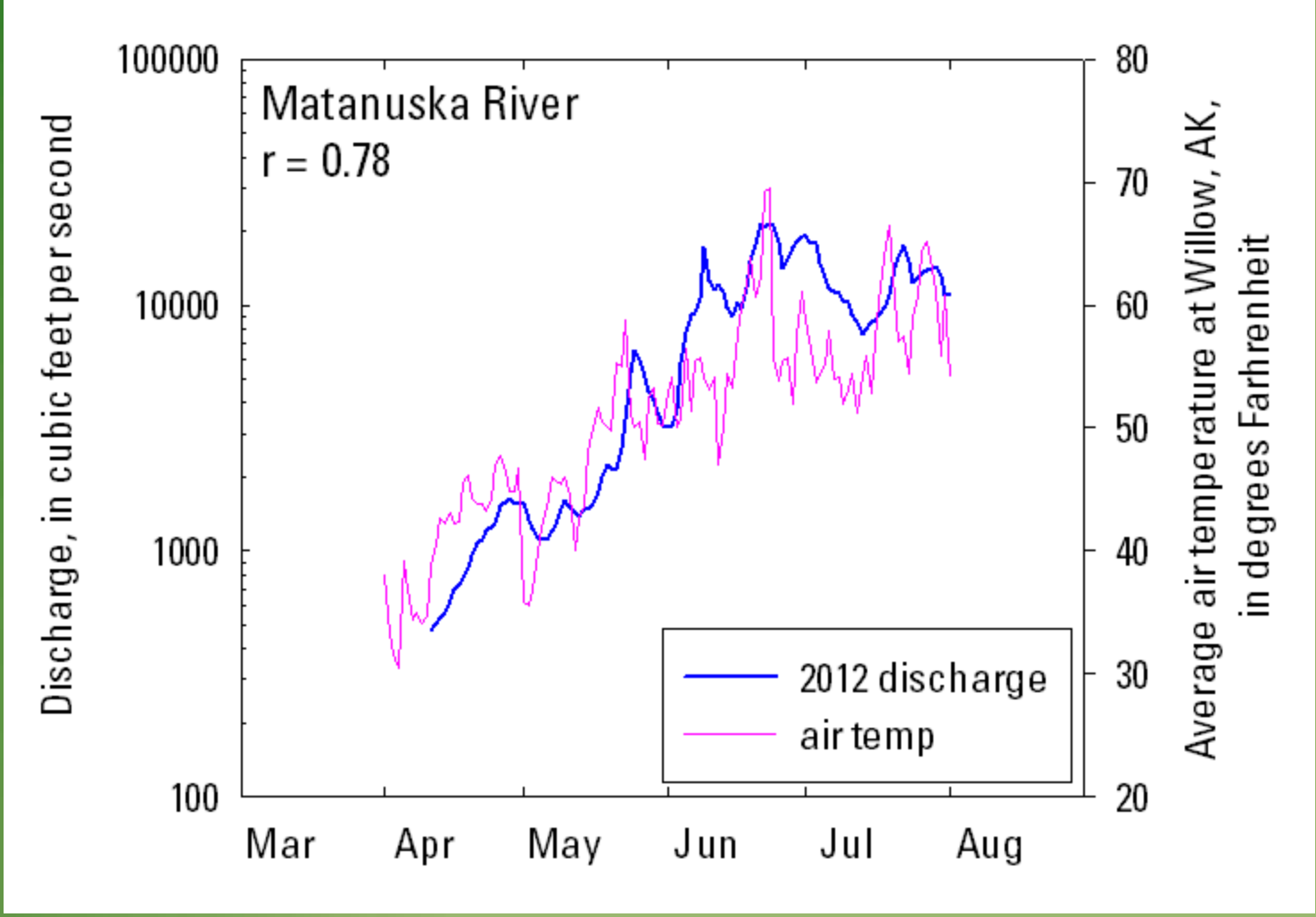
USGS

Glaciers and seasonal streamflow patterns

- Glacier cover could not fully explain the differences in seasonal streamflow pattern in the Susitna River Basin
  - Glacier-melt driven streams had a basin cover of at least 10 percent glaciers
  - Two streams with basin cover of more than 15 percent glaciers had higher snowmelt-period streamflows than glacier-melt-period streamflows

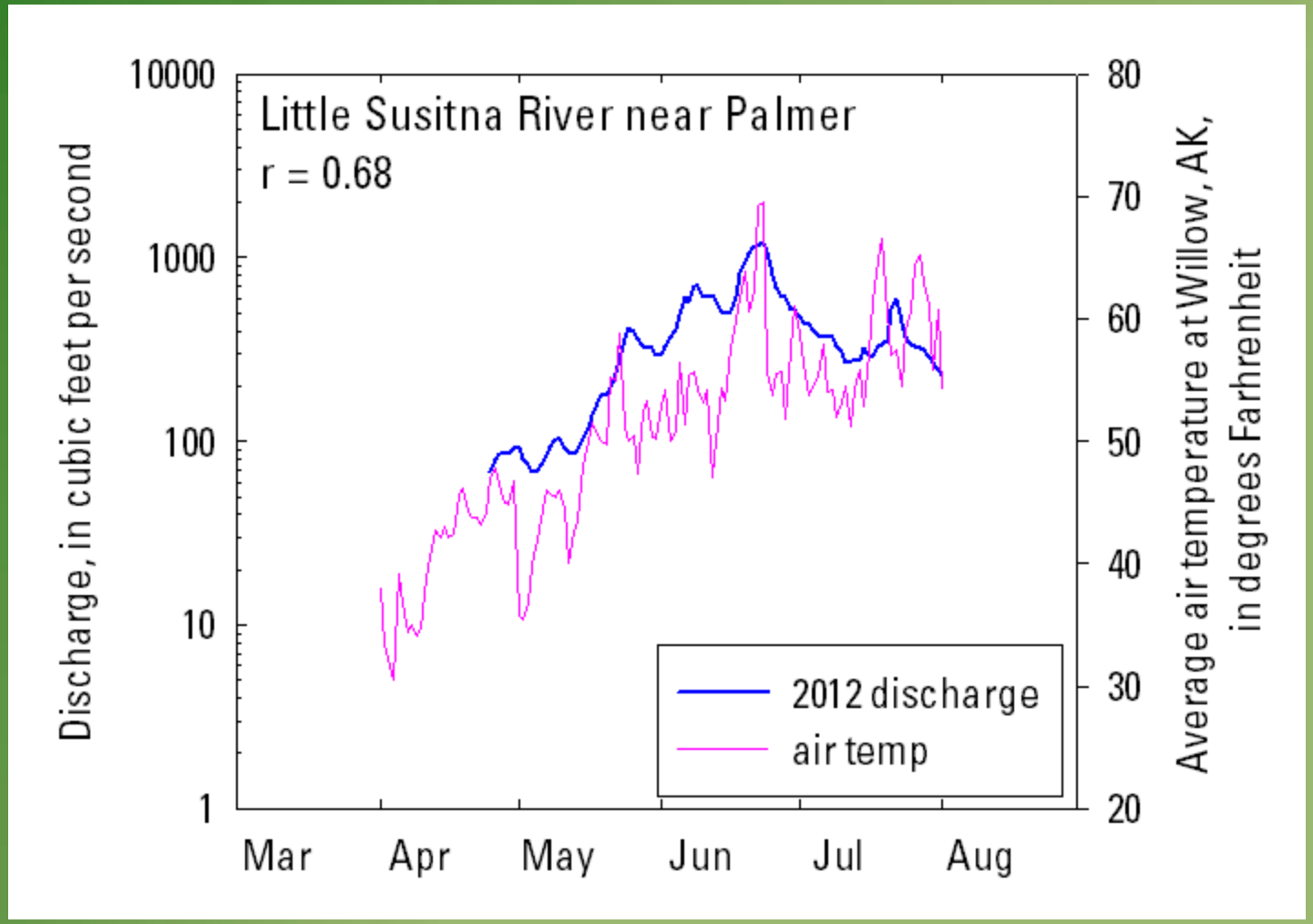
USGS

Correlation of discharge to air temperature – glacier melt



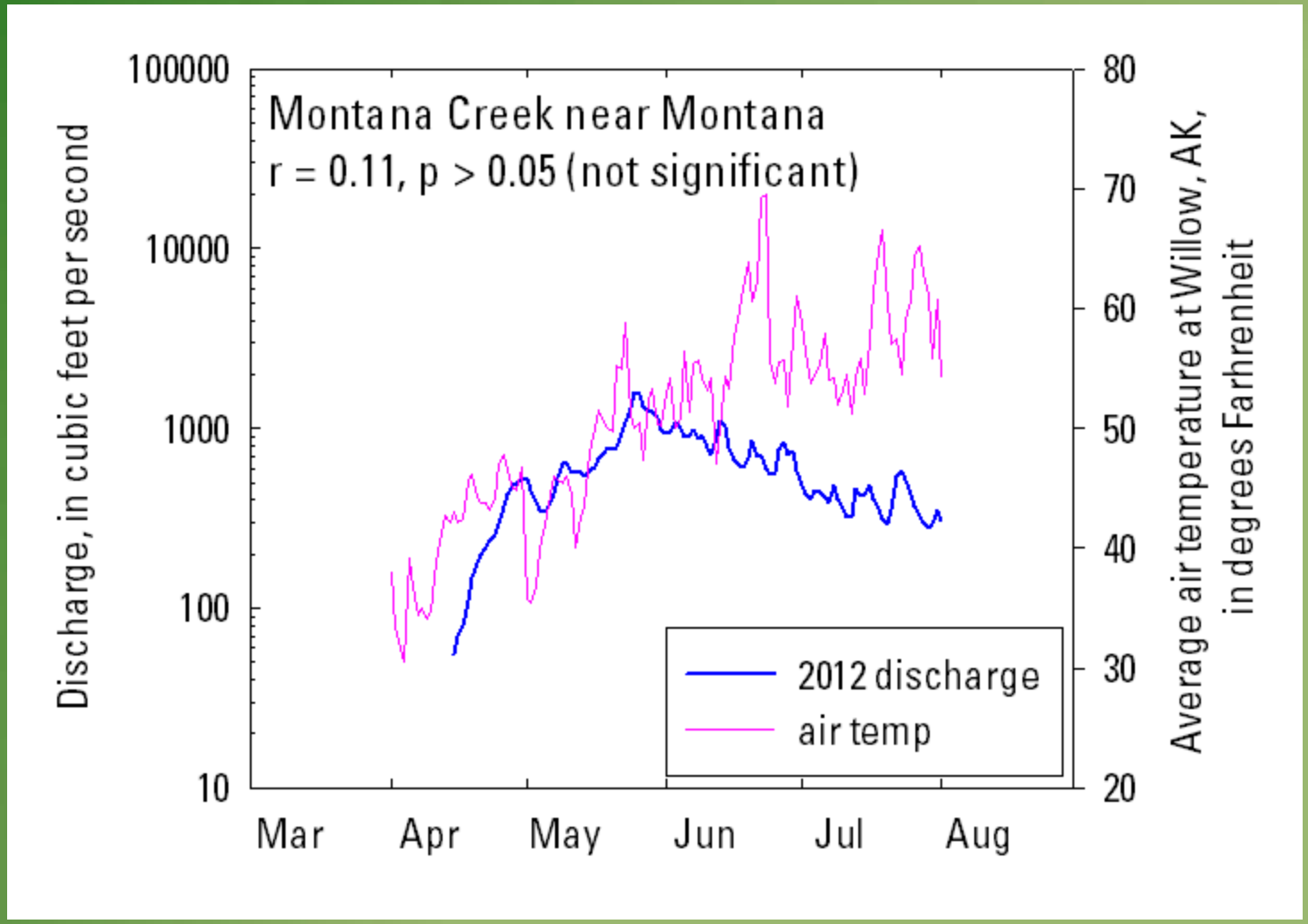
USGS

Correlation of discharge to air temperature - snowmelt



USGS

Correlation of discharge to air temperature – snowmelt/rainfall



USGS

Future Directions

- Understanding seasonal patterns can help predict changes in response to the PDO or changes in glacier cover
- Hydrograph metrics might help quantify differences between streams or between climate conditions
  - Length of snowmelt period (compare to air temperature)
  - Decline after snowmelt period (compare to snowpack data)
  - Magnitude of summer highest daily means (compare snow vs. glacier melt)
  - Timing of summer highest daily means (compare snow vs. glacial melt)

USGS

Flooding in Southcentral Alaska, September 2012

- A series of rainstorms in September 2012 caused flooding in streams along a 250 mile-long path from Seward to Healy
- 2012 flood magnitudes exceeded 2006 flood magnitudes in many streams but were generally not the highest on record

USGS

Flooding in Southcentral Alaska, September 2012

- The Sept. 2012 flood was in the top 3 discharges on record at the following active USGS streamgages:

Kenai Peninsula

- Grouse Creek
- Snow River (excluding outbursts)
- Kenai River at Cooper Landing
- Kenai River at Soldotna

Anchorage

- Ship Creek
- Campbell Creek
- Chester Creek

Mat-Su

- Knik River
- Moose Creek near Palmer
- Matanuska River
- Wasilla Creek
- Little Susitna River
- Chulitna River
- Talkeetna River
- Montana Creek near Montana
- Willow Creek

USGS

Flooding in Southcentral Alaska, September 2012

- The Sept. 2012 flood was larger than the 0.5% chance flood (200-yr flood) at:
  - Ship Creek (largest discharge in 66 years)
  - Matanuska River (largest non-outburst discharge in 53 years)
  - Little Susitna River (2nd largest discharge in 64 years)
- At all other streams noted in the previous slide, the Sept. 2012 flood was smaller than the 1% chance (100-yr) flood

USGS

Flooding and flood frequency

- The Sept. 2012 floods could have been notably large at discontinued streamgages, (such as Eagle River) or ungaged rivers
- New flood frequency estimates are expected for Southcentral and Interior areas by 2014 and will include 2012 data.

USGS

Data for flood frequency analysis

- Flood elevation, areal extent, and damage depend on many variables, so flood frequency analysis uses discharge as a stable metric.
- The basis of flood frequency analysis is an annual series of systematic gaging data.
- Systematic data can be supplemented by documenting all large floods in the discontinued period.
  - The USGS gaging program documents large floods at the cooperator's request, usually for damage assessment

USGS