

Main Results

- 93 years of monthly divisional temperature and precipitation anomalies available for Alaska
- Low-frequency climate signal in divisional temperature that impacts trends
- Long-term warming in most divisions, mixed trends in precipitation

Motivation and Background

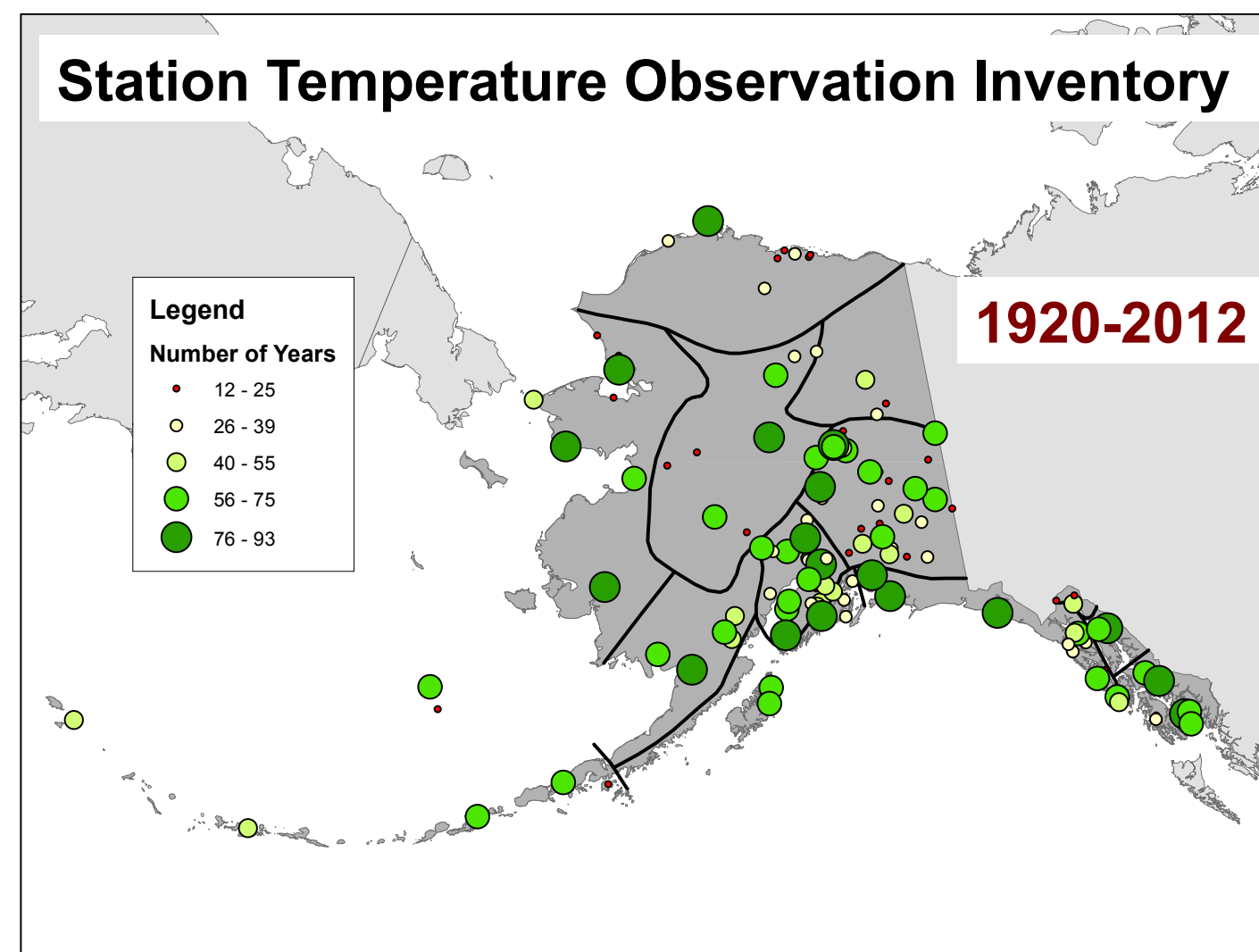
- Complex topography and proximity to coasts results in multiple climate types in Alaska
- Climate variability is regional in Alaska
- Understanding regional climate variability can further evaluation of climate change, seasonal climate prediction, and teleconnection impacts.
- Novel climate divisions for Alaska present new avenues for climate products and services



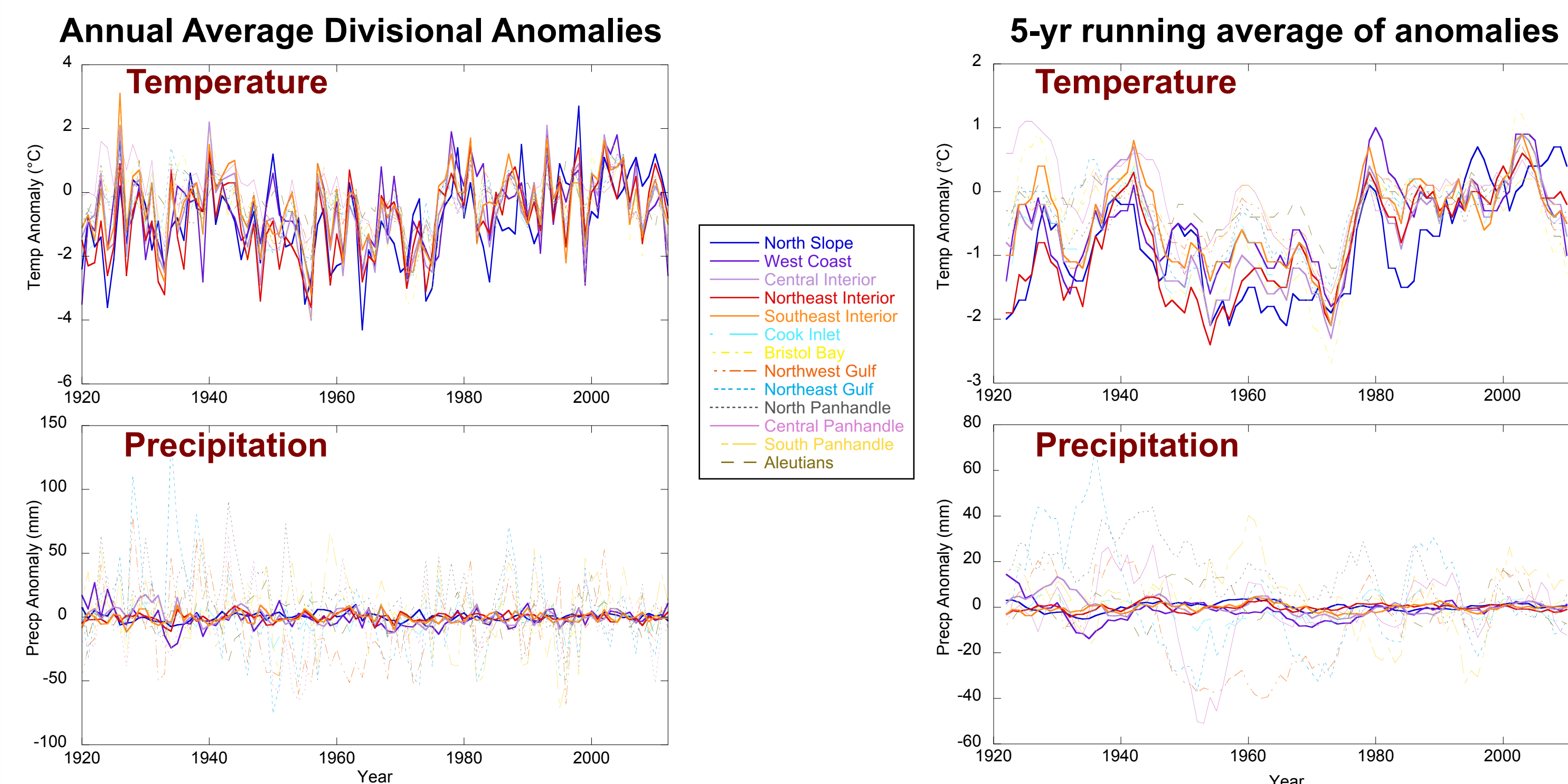
Figure: Bieniek et al. (2012)

Data and Methodology

- Alaska station data obtained from the Global Historical Climatology Network-Daily (GHCND)
- Temperature and precipitation 1920-2012
- Division membership of each station identified
- Monthly anomalies based on 1981-2010 mean
- Station must have more than 10 years in 1981-2010 to be included
- Divisional average anomalies



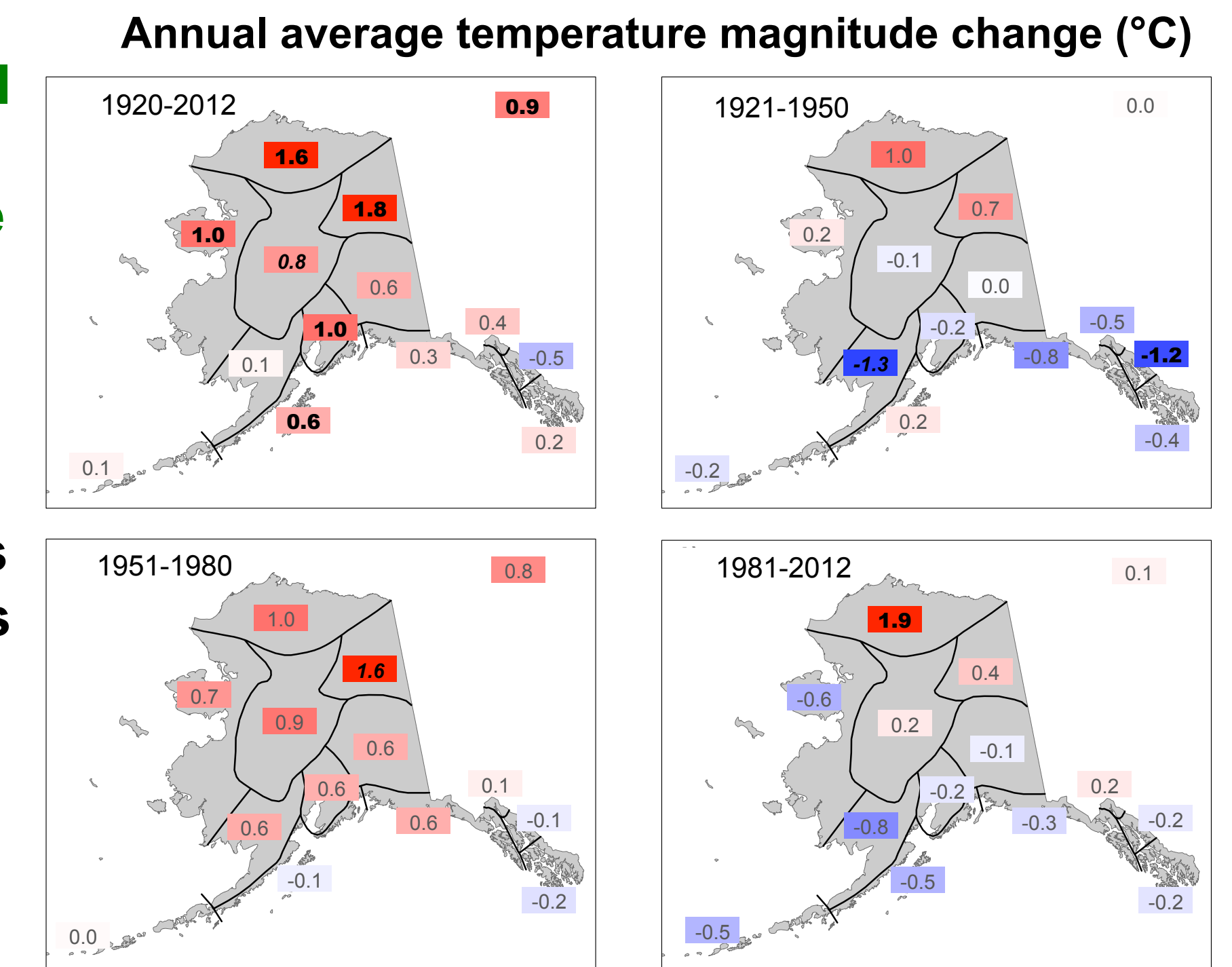
Annual time series



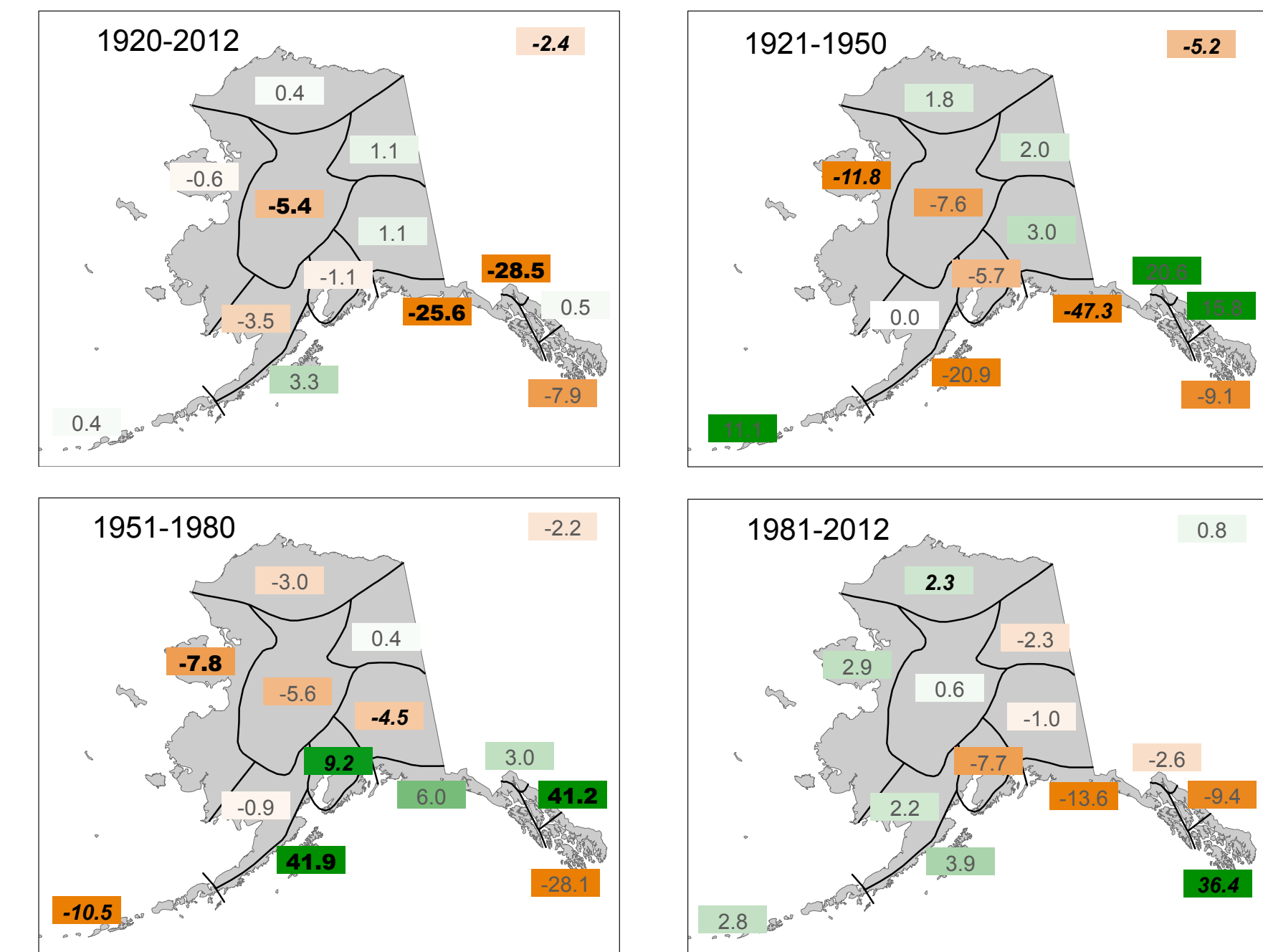
- 93 years of annual/monthly divisional anomalies available for Alaska
- 5-year running average temperature anomalies consistently display jumps in 1940's and 1970's
- Pacific Decadal Oscillation (PDO)-like decadal signal in temperature. Known to be responsible for 1970's upward shift in Alaska temperatures (e.g. Hartman and Wendler 2005)
- Smoothed precipitation displays more mixed variability

Increasing temperature on long time scale

- Magnitude change annual average divisional anomalies of temperature and precipitation
- Strongest, most significant increasing trends in temperature for total period, mixed trends in shorter 30-year periods
- Recent significant warming in arctic
- Some cooling trends



Annual average precipitation magnitude change (mm)

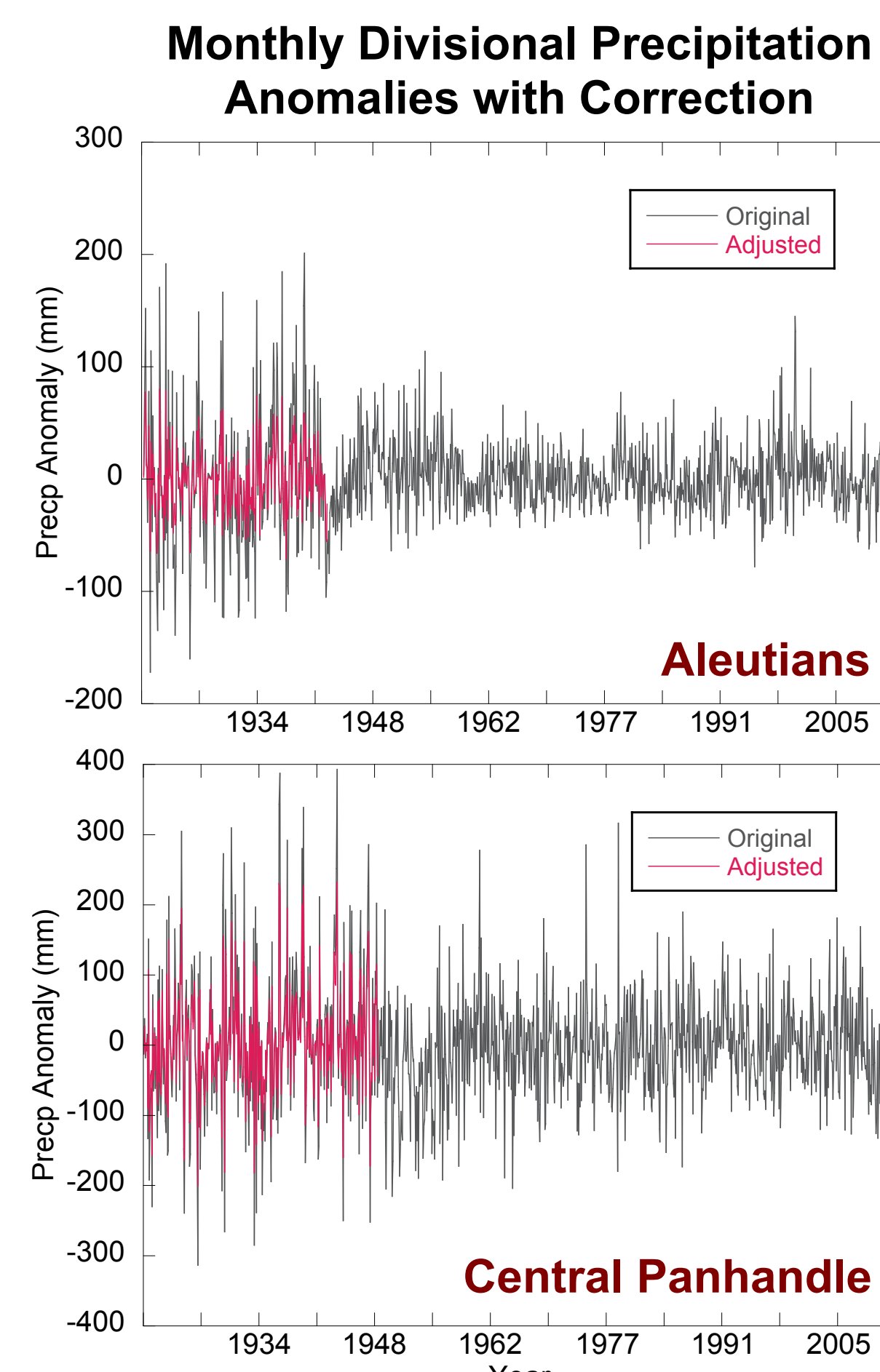


- Mixed trends in precipitation, however there is some spatial coherence
- Few significant long-term trends
- Recent significant increase in precipitation in the arctic

Trend Significance:
90%
95%

Variance fix and missing data replacement

- Due to Alaska's sparse station network, filling of missing data and corrections for stations coming and going was necessary
- Missing data issues were greatest in the Northeast Interior and North Panhandle climate divisions
- Fort Yukon (Northeast Interior) station temperature and precipitation missing data filled using multiple linear regression based on neighboring stations
- North Panhandle divisional anomalies filled using multiple linear regression of all divisional anomalies
- Variance corrected by standard deviation ratio for Aleutians and Central Panhandle precipitation anomalies

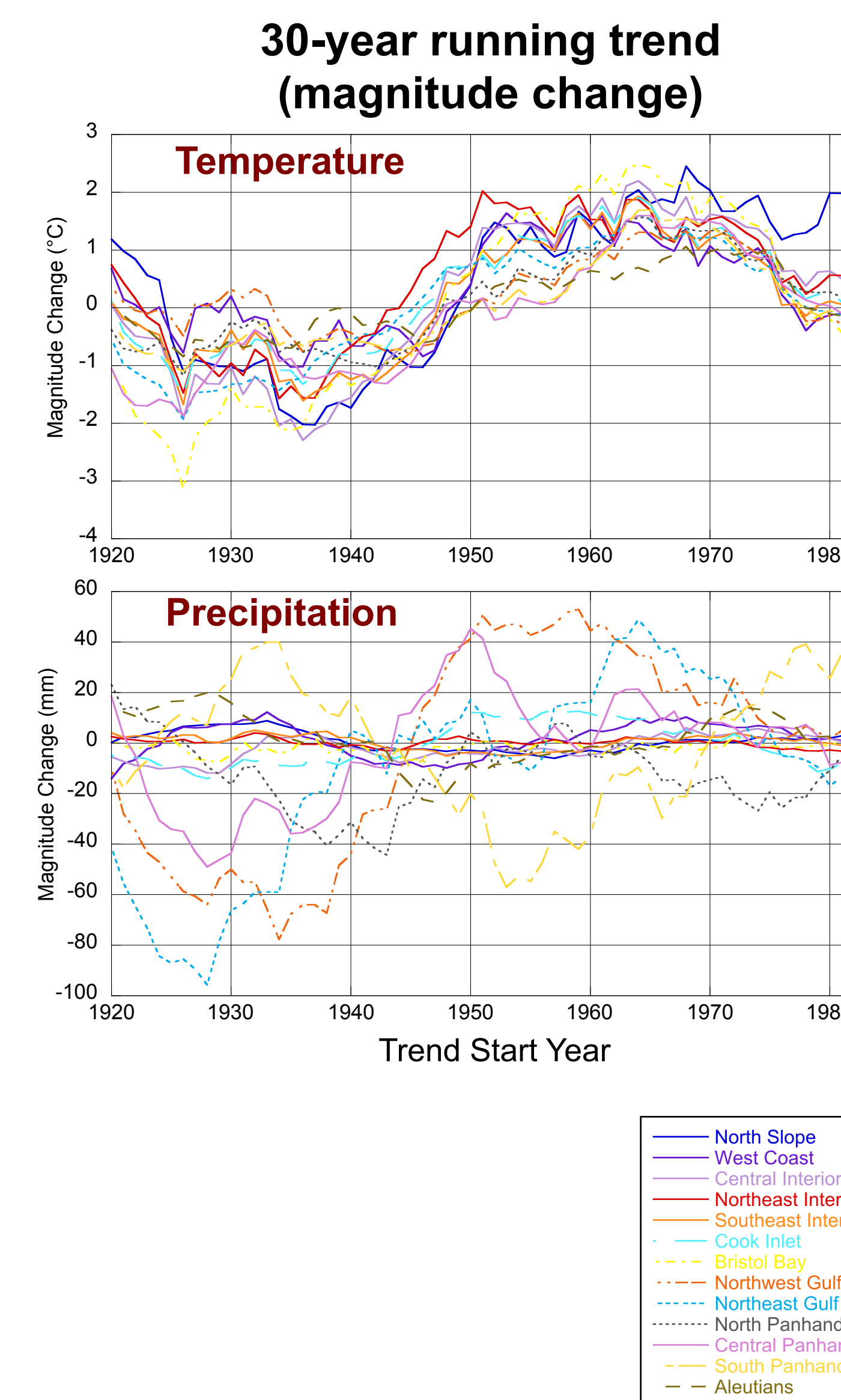


Inflated variance reduced by:

$$\text{ratio} = \frac{\sigma_{\text{good}}}{\sigma_{\text{bad}}}$$

30-year trends impacted by decadal variability

- 30-year running trend of annual average temperature and precipitation divisional anomalies
- Temperature increasing since 1950's, recent and early period decline
- Mixed trends in precipitation:
 - Regions north of the Alaska range with smallest anomalies also have smallest magnitudes of change
 - Coastal regions with largest trends, declines before 1950's increasing after, but trends are mixed
- Decadal variability in temperature appears to be a key factor driving 30-year trends in Alaska
- Precipitation has more complex relationships with climate resulting in variable trends



Summary and Conclusions

- Long-term time series (1920-2012) of divisional temperature and precipitation anomalies are now available
- Low-frequency variability in temperature influences 30-year trends
- Long-term increasing trend in temperature for most Alaska climate divisions
- Recent warming/wetting of the arctic climate division
- Precipitation has relatively mixed trends

References

- Bieniek, P. A., and Coauthors, 2012: Climate divisions for Alaska based on objective methods. *J Appl Meteor Climatol*, 51, 1276-1289.
- Hartmann, B., and G. Wendler, 2005: The significance of the 1976 Pacific climate shift in the climatology of Alaska. *J Climate*, 18, 4824-4839.

Acknowledgements

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