

Climate drivers of Alaska summer stream temperatures

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Main Results

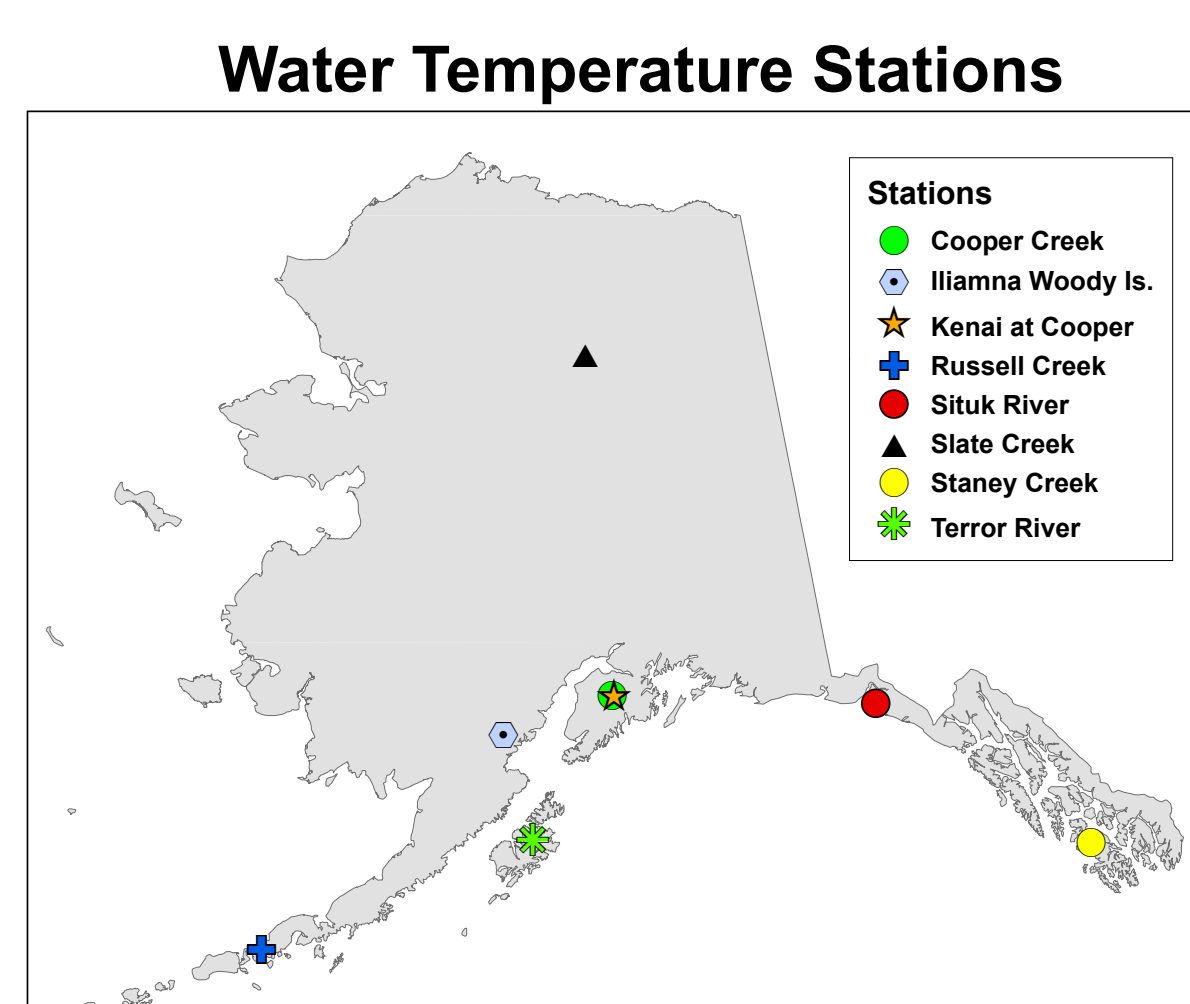
- Jun-Aug stream temperatures enhanced with warmer air temperatures
- Warmer air temperatures occur under 500hPa high pressure
- Teleconnection links with summer 500hPa heights unclear for Alaska

Motivation

- River, stream and lake temperatures impact water quality and fisheries
- In Alaska fish are a critical source of food for subsistence users, an important part of the aquatic ecosystem and the economy
- Under observed and projected Alaska climate change understanding the climate drivers of stream temperature is important
- Warm season (Jun-Aug) focus since the least is known about climate drivers for Alaska in summer. Threshold temperatures critical for the aquatic ecosystem are also prominent in summer.

Stream temperature and climate information

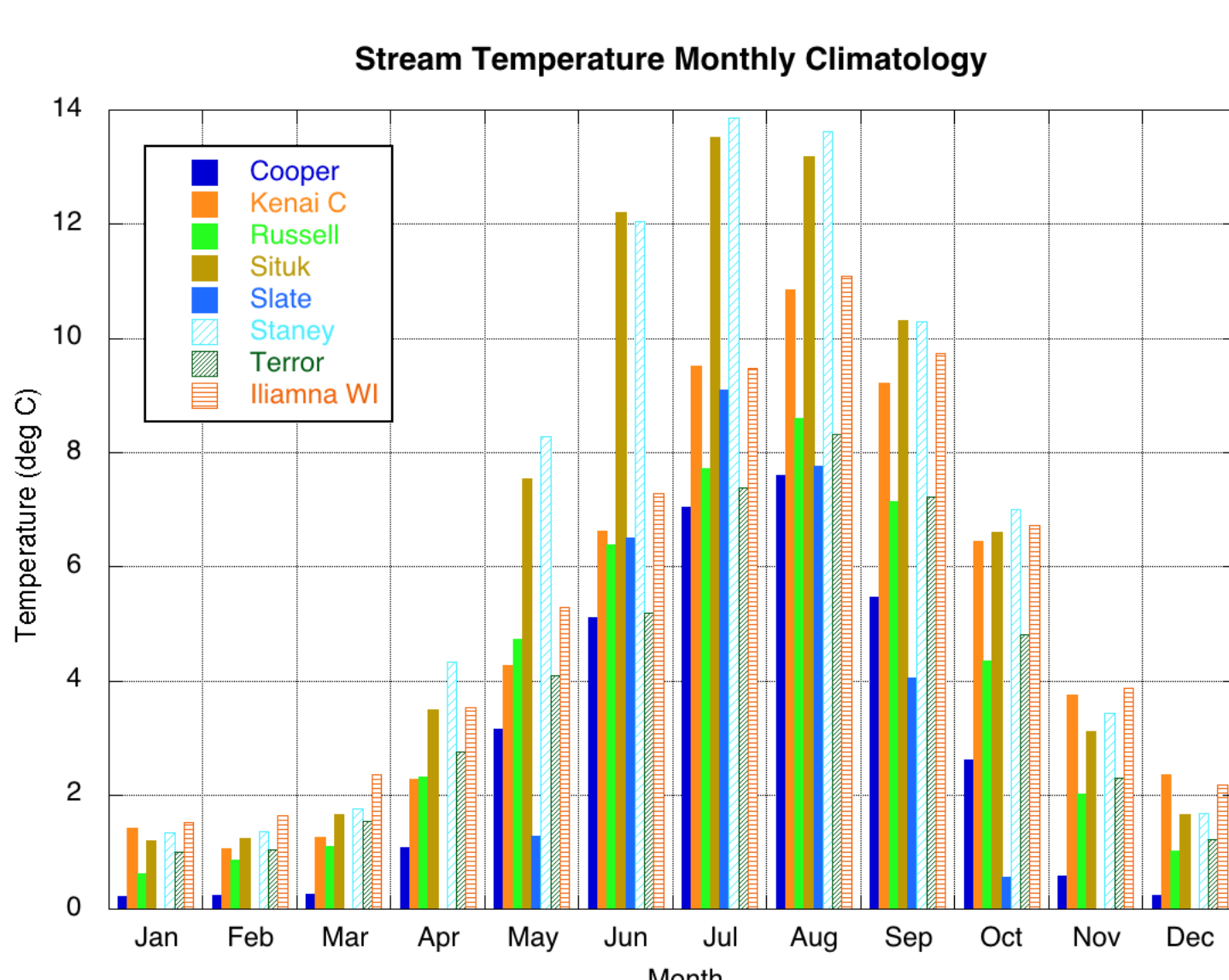
- Alaska WRF downscaled ERA-Interim 1979-2013 (Bieniek et al. 2016)
 - 20km 262x262 grid, daily
- NCEP/NCAR Reanalysis 1
- NOAA extend reconstructed SSTs
- JISAO Pacific Decal Oscillation (PDO) index
- CPC Arctic Oscillation (AO) index, Oceanic Niño Index (ONI)
- UCAR North Pacific Index (NPI)



Water temperature data were obtained from the AKOATS database (<http://accs.uaa.alaska.edu/aquatic-ecology/akoats/>):

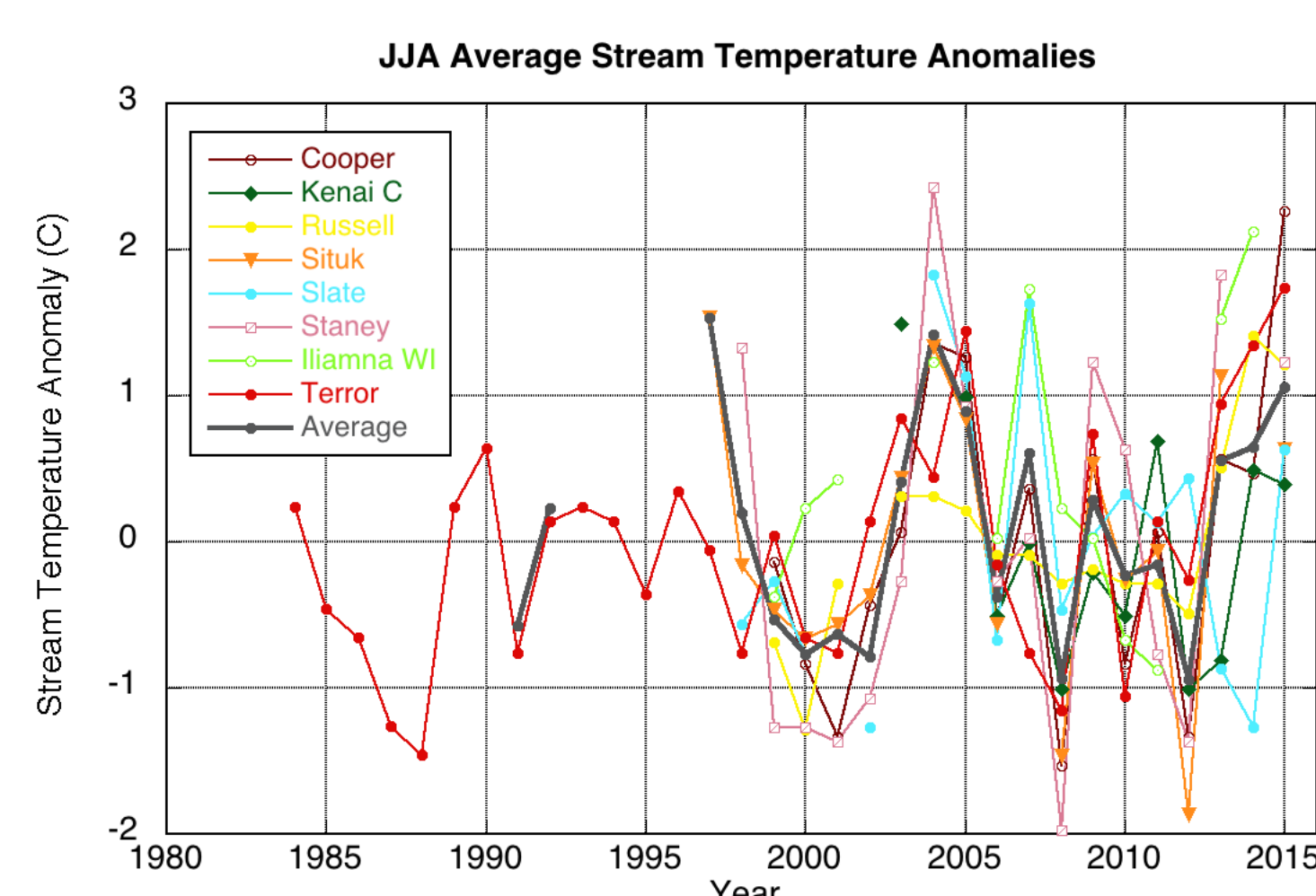
- USGS, University of Washington data sources
- Stations with >10 years data included
- Longest record analyzed began in 1984 (Terror River)

Jun-Aug stream temperatures highly inter-correlated



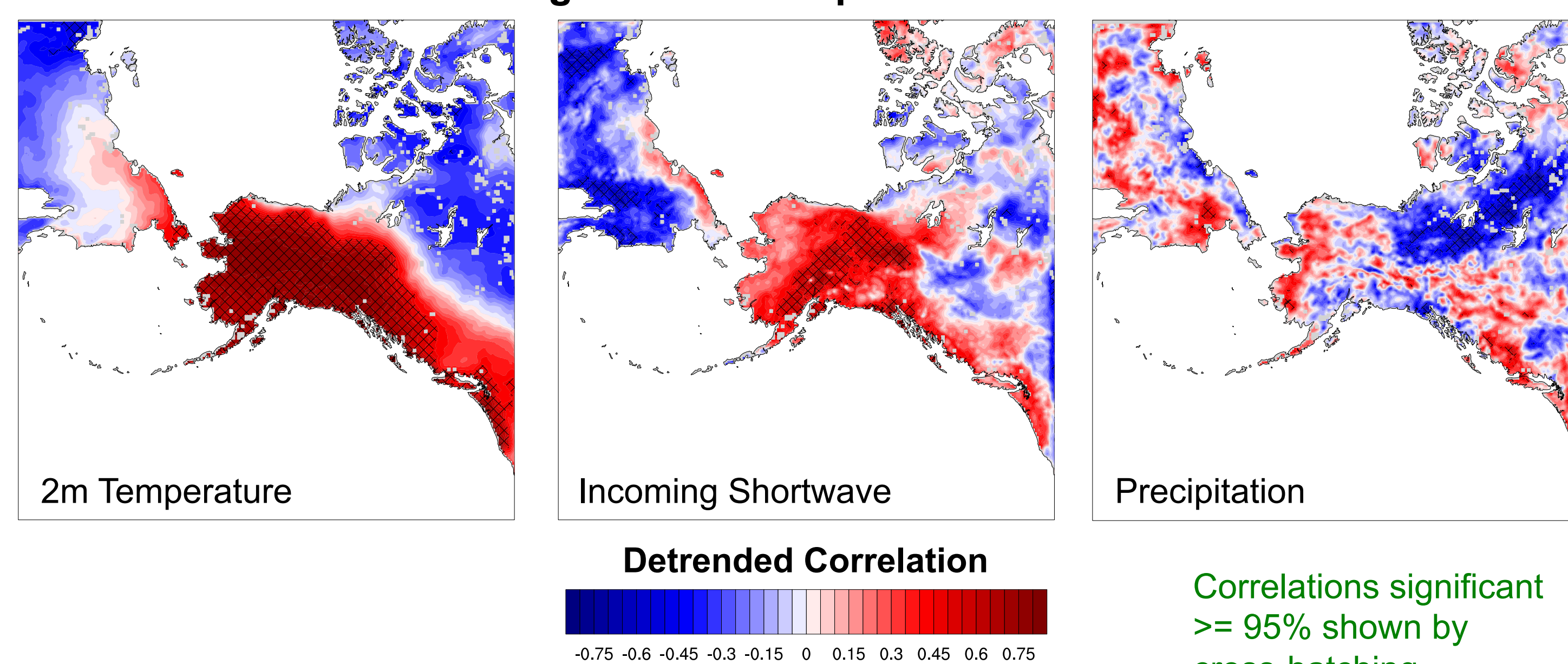
- Stream temperatures display a seasonal cycle ranging from near 0°C in Dec-Mar to greater than 12°C in Jun-Aug for the warmest rivers
- Climatologically the coldest water body is Slate Creek and the warmest is Situk River

- Stream temperature anomalies computed for period of record
- Mean anomalies computed for short record rivers to produce more coherent record suitable for climate analysis
- Correlations amongst rivers generally greater than 0.6



Warmer streams with enhanced air temps, solar insolation

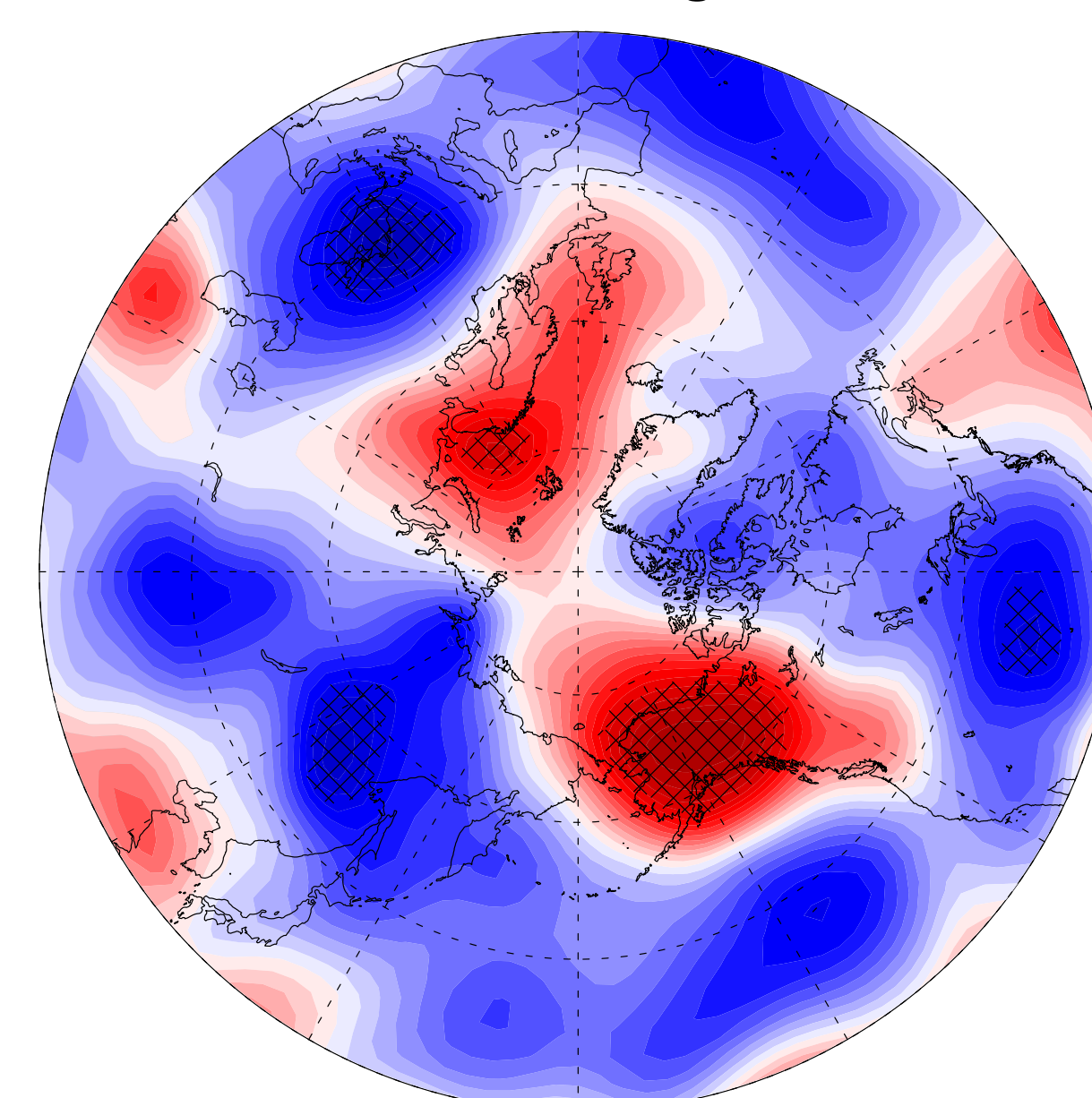
JJA Average Stream Temperature Correlation



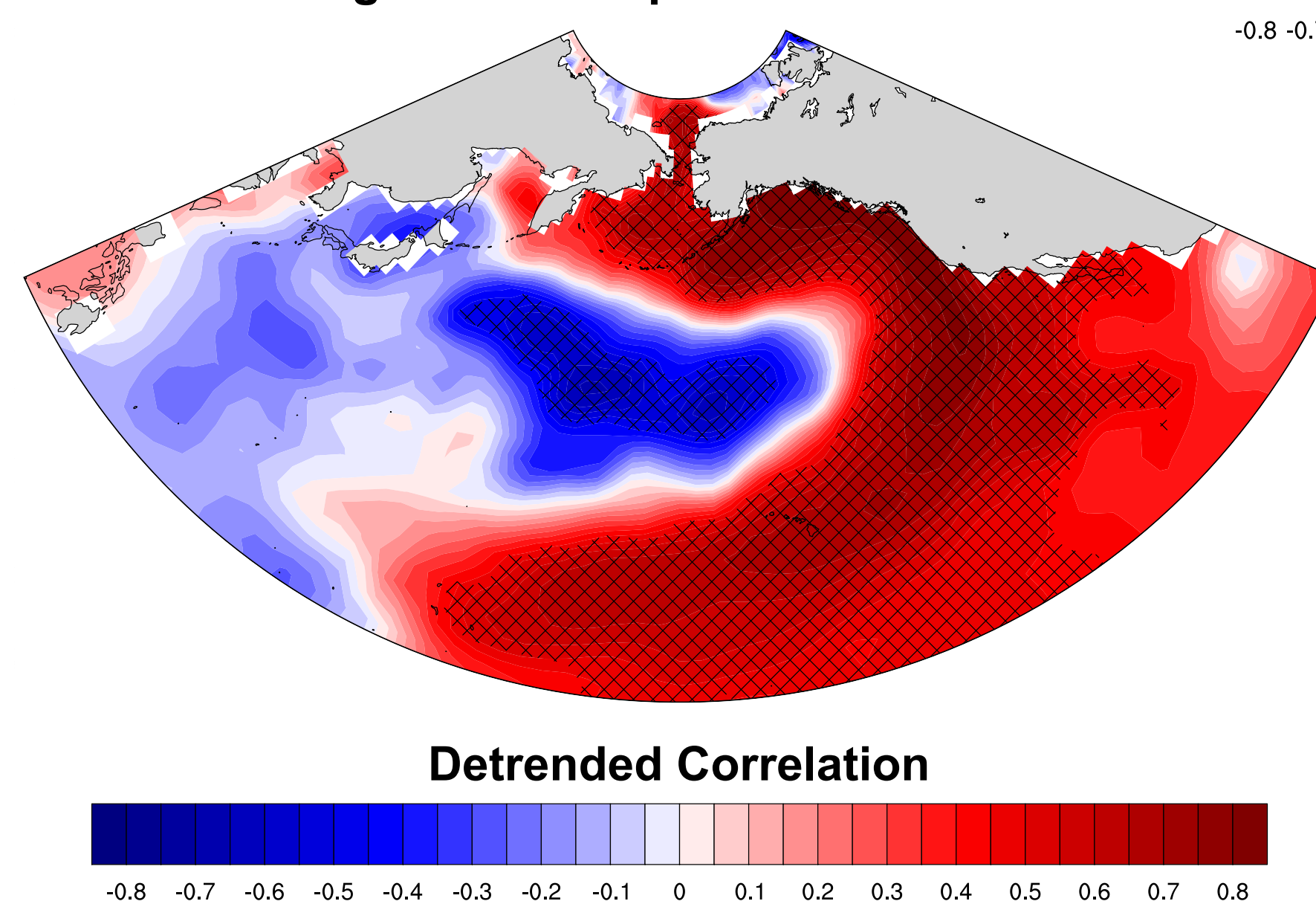
- Higher local near-surface air temperatures when stream temperatures are warmer
- Enhanced downward solar radiation when stream temperatures are warmer
- Mixed correlations with precipitation

Stream and air temps linked to SSTs and 500hPa heights

JJA avg stream temps correlated with 500hPa height

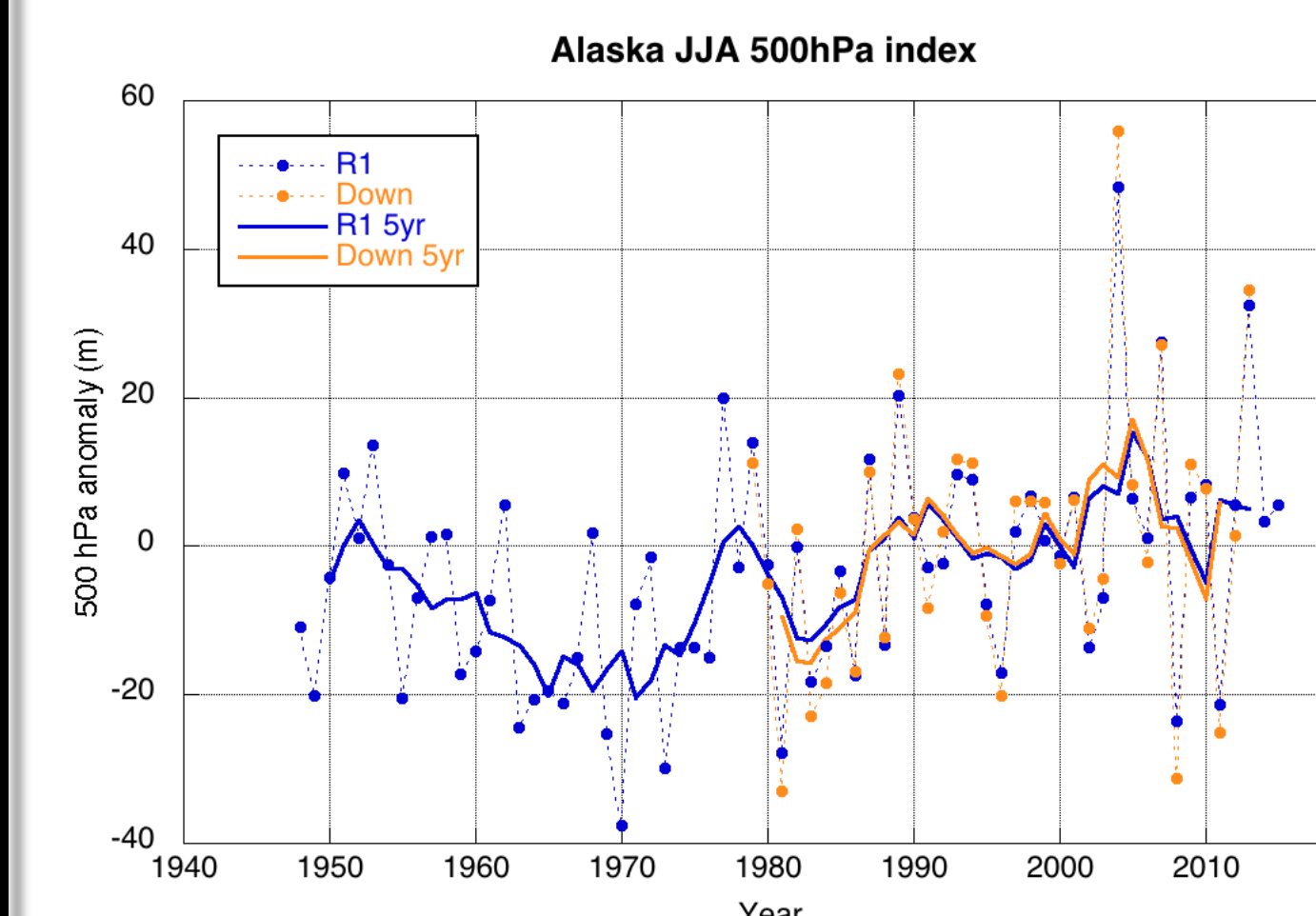


JJA avg stream temps correlated with SST



- Positive correlation with 500hPa heights over Alaska
- Warmer stream and air temperatures occur under anomalous high-pressure centered over Alaska in Jun-Aug
- Subsidence from high pressure suppresses cloudiness and allows for increased downward solar radiation and surface heating in summer
- Strong correlations between 2m air and stream temperatures with sea surface temperatures (SSTs)
- SST correlation pattern resembles a Pacific Decadal Oscillation (PDO)-like signal
- How is summer high pressure and temperature over Alaska linked with the PDO?

Alaska 500hPa heights and teleconnection link is unclear

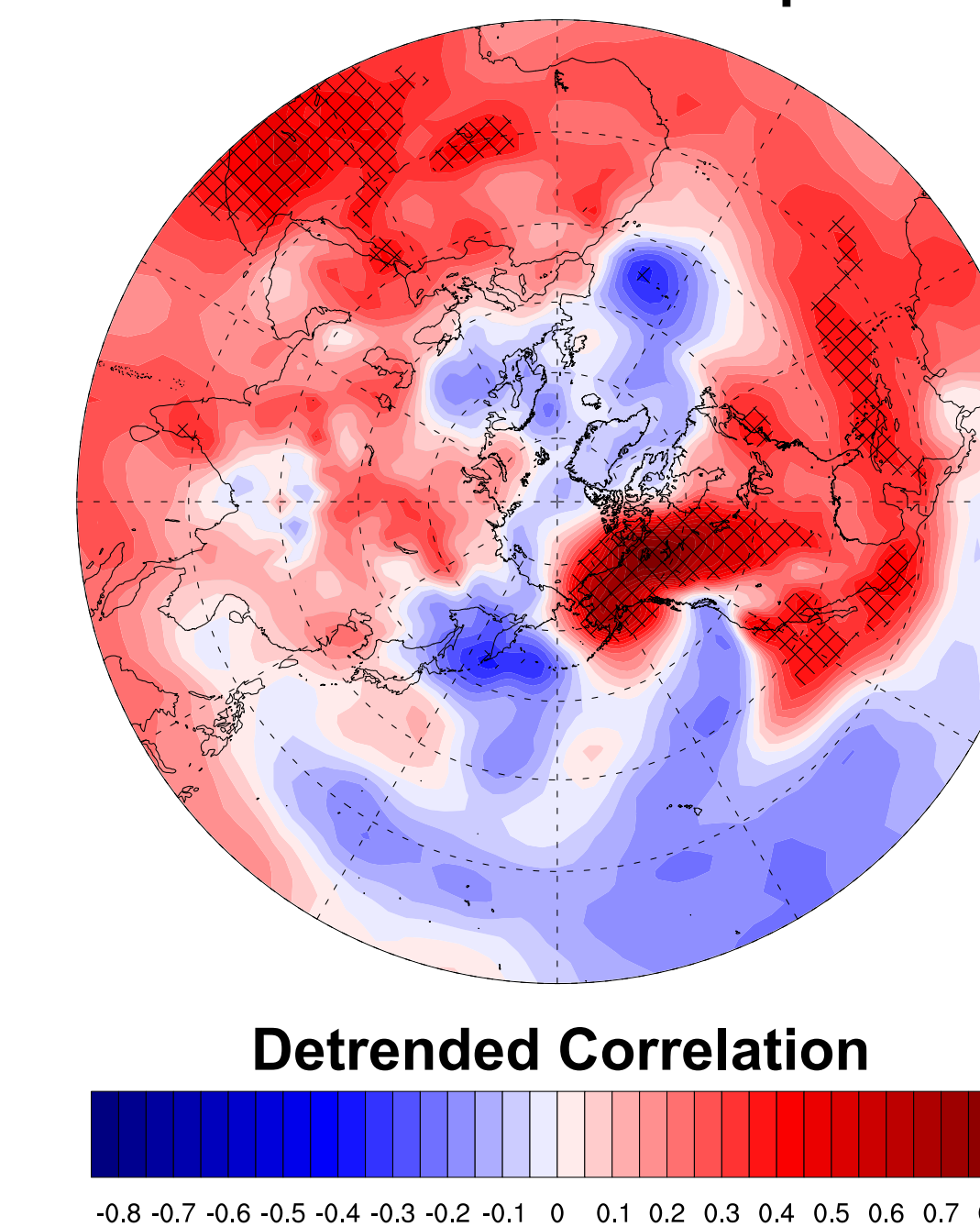


- PDO, ENSO, AO and NPI all have weak correlations with Jun-Aug area averaged 500hPa height over Alaska

Correlation with Alaska 500hPa

Index	Correlation
PDO	0.01
ONI	0.23
NPI	0.08
AO	0.15

JJA Alaska area average 500hPa heights correlated with sea level pressure



- Correlation of Alaska 500hPa with sea level pressure reveals broad correlation pattern:
 - Higher 500hPa in Alaska occurs under generally higher pressure over land
 - Lower pressure over Pacific Ocean
- SLP correlations with teleconnection indices show similar results
- Question remains: how is summer 500hPa height over Alaska related to the global climate?

Conclusions

- Summer stream temperatures enhanced with warmer 2m temperatures and increased solar radiation
- Increased solar radiation and heating occurs under anomalous high pressure at 500hPa
- Link to SSTs and PDO-like pattern found but no clear teleconnection with 500hPa ridging over Alaska is readily apparent
- Is there possibly an inter-hemispheric mode of climate variability in summer? A seasonal transfer of mass between the Eastern and Western Hemisphere is known to occur across the Arctic (e.g. Cullather and Lynch 2003) that could help facilitate such a pattern.

References

- Bieniek, P. A., U. S. Bhatt, J. E. Walsh, T. S. Rupp, J. Zhang, J. R. Krieger, and R. Lader, 2016: Dynamical downscaling of ERA-Interim temperature and precipitation for Alaska. *J Appl Meteor Climatol*, 55:635-654.
- Cullather, R. I., and A. H. Lynch, 2003: The annual cycle and interannual variability of atmospheric pressure in the vicinity of the North Pole. *Int J Climatol*, 23:1161-1183.

Acknowledgements

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