Atmospheric Circulation Patterns Associated with Extreme Events in Alaska

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Motivation and Background

- Extremes in temperature and precipitation impact transportation, the economy, and human health in Alaska
- There has been little documentation of the atmospheric drivers of Alaska extreme events
- It is important to understand changes in frequency of occurrence of extreme events under a changing climate

Data and Methodology

- Alaska station daily maximum and minimum temperature (Tmax, Tmin) and accumulated precipitation obtained from the Global Historical Climatology Network-Daily (GHCND) 1948-2012
- Three-day running average smoothing of precipitation (Pmax)
- Top 10 events in each season identified at all stations
- Events limited to one in a seven day period to diversify events
- Daily Sea Level Pressure from NCEP/NCAR Reanalysis 1
- Anomaly significance determined by two-tailed t-test

Decadal Frequency of Extreme Events at 5 Primary Stations

- Changes in the decadal frequencies of Tmax, Tmin and Pmax are generally consistent across the 5 primary stations
- Increase (decrease) in frequency of Tmax (Tmin) extreme events in recent decades; no systematic changes in Pmax

Composite Anomalies for Summer Extreme Events

- Generally weaker anomalies in summer than in winter for Tmax, Tmin and Pmax extreme events at all 5 primary stations
- Advection from continental North America characteristic of summer Tmax events at Anchorage
- Weak signal indicating possible advection of polar air during summer Tmin extreme events at Barrow
- Advection of maritime air due to Gulf of Alaska storm a driver of summer Pmax extreme events in Juneau

Summary and Conclusions

- Over the 1948-2012 period, Alaska has experienced:
  - Increasingly frequent extreme high temperature events
  - Decreasingly frequent extreme low temperature events
  - Little change in the frequency of extreme high precipitation events
  - During winter, extreme events of all variables are synoptically driven by teleconnections to the North Pacific and, in some cases, the North Atlantic
  - During summer, teleconnections and synoptic controls are much weaker than in winter
  - Advevtive source of extreme maximum temperature events varies seasonally:
    - Marine source region in winter
    - Continental source region in summer
  - Primary moisture source for heavy precipitation events in northern/interior Alaska is the Bering Sea (advection from the southwest)

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