# LARGE-SCALE CLIMATE OF ALASKA

## The Influence of the Pacific Decadal Oscillation on the Climate of Alaska

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### Alaska and the PDO

- Pacific Decadal Oscillation (PDO): variability of Pacific sea surface temperatures (SST) [8]
- Defined by Manuta et al. (1997) as "the leading orthogonal function of the North Pacific (20°-70°N) monthly averaged sea surface temperatures after removing the global mean" [4]
- Climate in Alaska:
  - Positive PDO phase: warmer SST and air temperatures (see figure 2, bottom) [2,5]
  - Negative PDO phase: colder SST and air temperatures (see figure 2, top) [2,5]

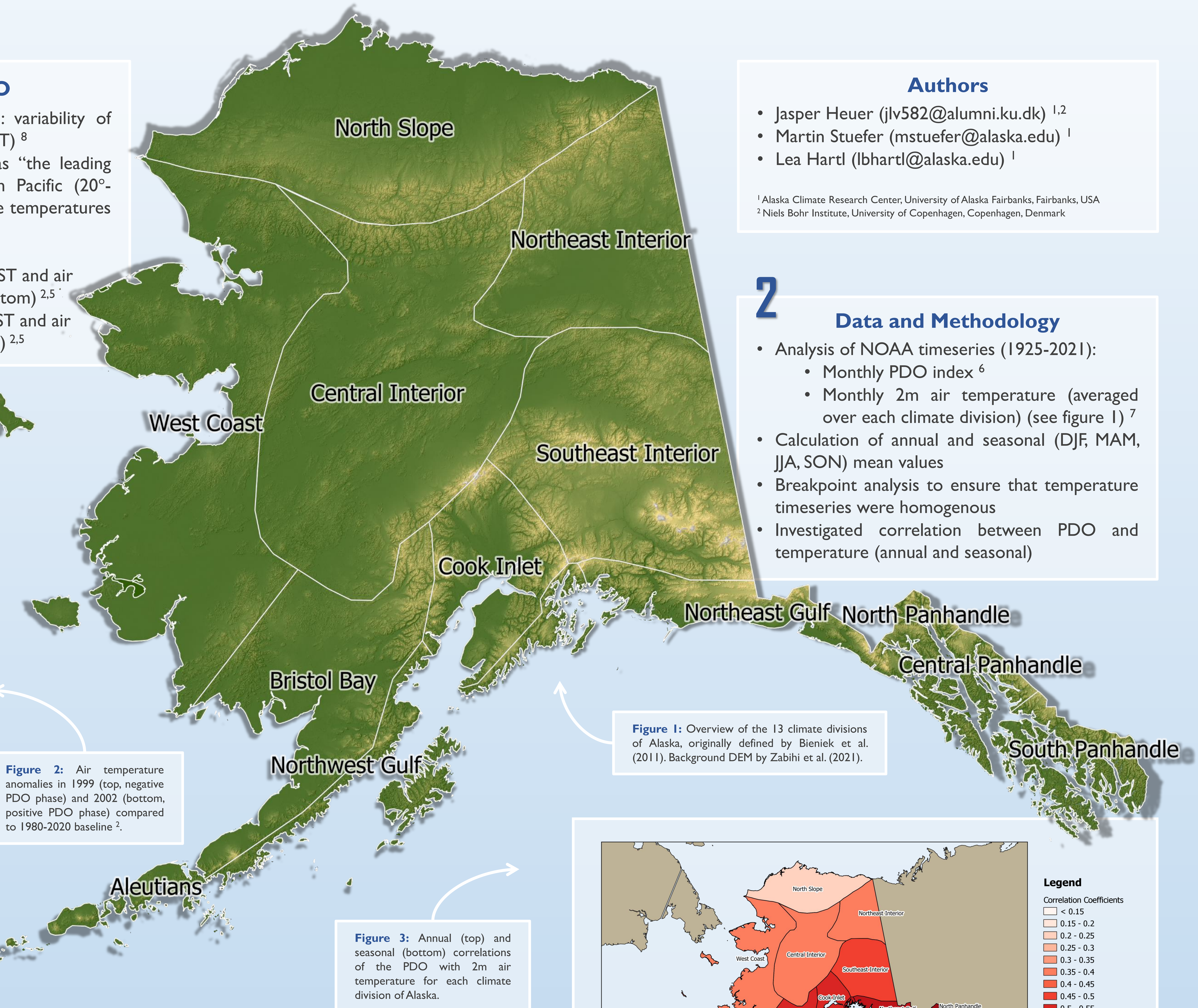


**Figure 1:** Overview of the 13 climate divisions of Alaska, originally defined by Bieniek et al. (2011). Background DEM by Zabihi et al. (2021).

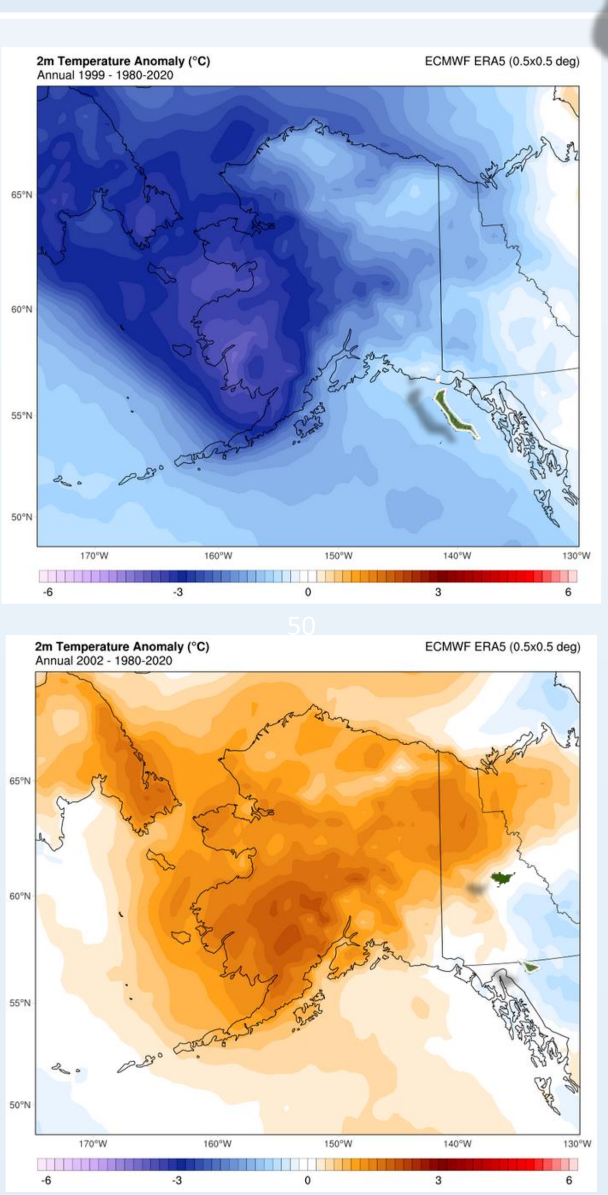


**Figure 2:** Air temperature anomalies in 1999 (top, negative PDO phase) and 2002 (bottom, positive PDO phase) compared to 1980-2020 baseline [2].


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### Data and Methodology

- Analysis of NOAA timeseries (1925-2021):
  - Monthly PDO index [6]
  - Monthly 2m air temperature (averaged over each climate division) (see figure 1) [7]
- Calculation of annual and seasonal (DJF, MAM, JJA, SON) mean values
- Breakpoint analysis to ensure that temperature timeseries were homogenous
- Investigated correlation between PDO and temperature (annual and seasonal)

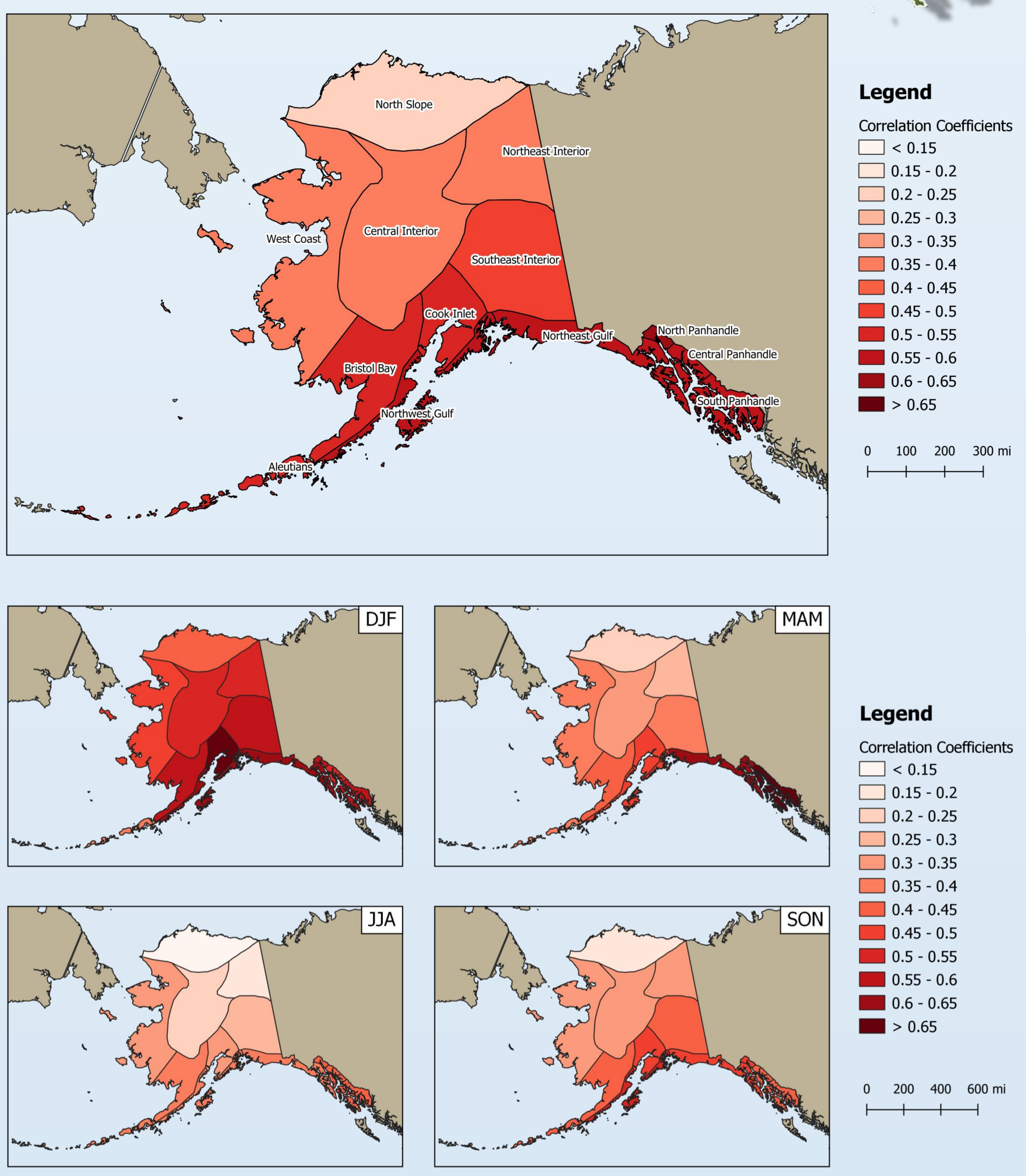


**Figure 3:** Annual (top) and seasonal (bottom) correlations of the PDO with 2m air temperature for each climate division of Alaska.

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### Results

- Annual scale: stronger correlations in the southern regions of Alaska, decrease of correlation strength in the continental interior and weakest correlations in the North Slope (see figure 3, top)
- Overall strongest correlations in the winter months (DJF), weakest in the summer (JJA)
- Apparent west to east migration of strongest correlation from fall to spring (see figure 3, bottom)

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### Discussion

- While not proving causation, the (strong) positive correlations supports the reviewed literature which states that the PDO has the observed influence on the temperature regime of Alaska
- Weakest correlations in the north and strongest in the south:
  - Contradicts the findings of Hartmann and Wendler (2005), who stated that the influence of the PDO is weakest in the northern and southern regions due to the moderating influence of the Arctic and Pacific oceans [3]
  - Strong correlations in the south might be the direct result of the Pacific SST changes occurring in the Gulf of Alaska, while the weak correlations in the North are likely caused by the strong influence of the Arctic Ocean, sea ice cycle, and the natural climatic border formed by the Brooks Range (see southern border of North Slope division in figure 1)
- Seasonal trend: strong correlations in the winter are likely due to the lack of incoming solar radiation in the winter months, while the opposite might be true in the summer [3]

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### Outlook

- According to model runs conducted by Zhang and Delworth (2016), a warming of global mean temperatures could result in a decreased amplitude of PDO fluctuations and a weaker influence on the Alaskan temperature regime [10]
- Future research:
  - Investigate correlations at higher spatiotemporal resolution (station level and monthly measurements, reanalysis climate modelling)
  - How are other climate variables and large-scale weather phenomena correlated with (or affected by) fluctuations of the PDO?

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Mountain graphic at the bottom: https://webstockreview.net/pict/getfirst