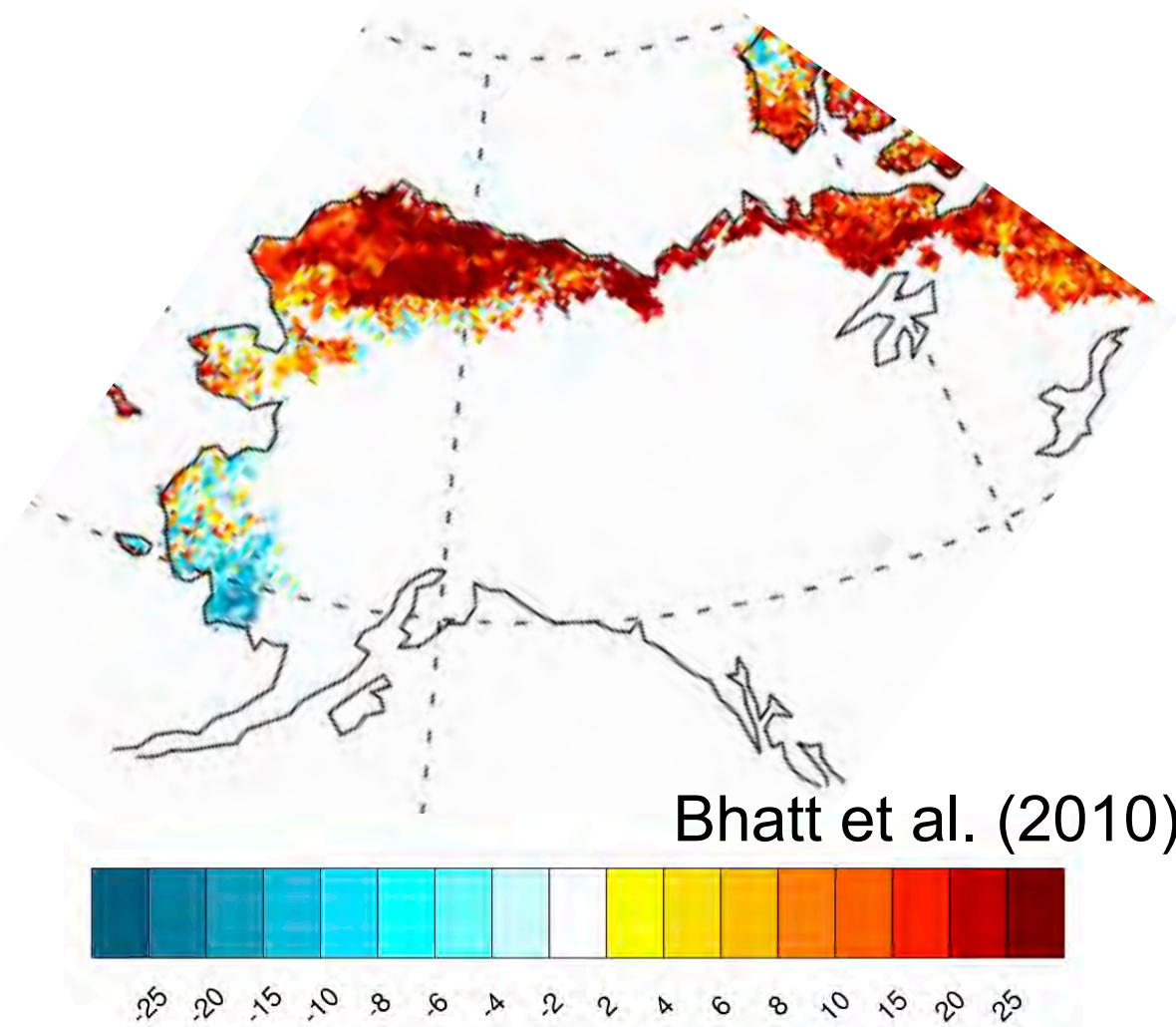
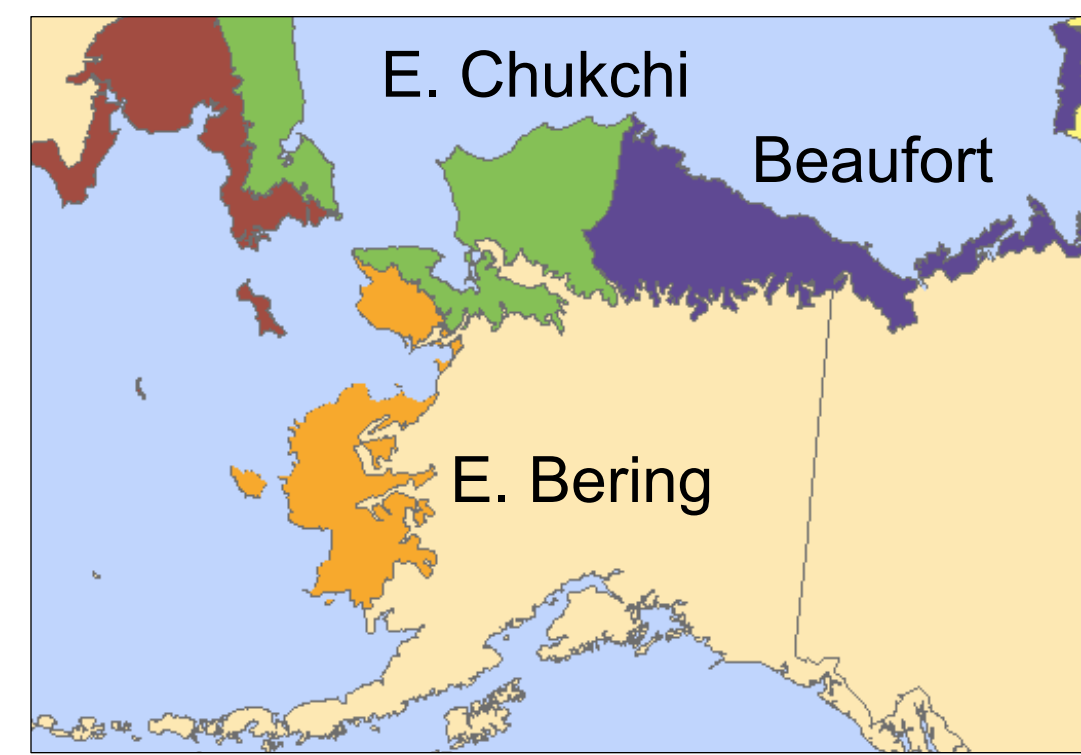


- NDVI trends different on North Slope and Southwest Alaska
- Seasonality of trends in coastal sea ice vary in Alaska
- Need improved Pan-Arctic snow data for climate studies

## Motivation and Background



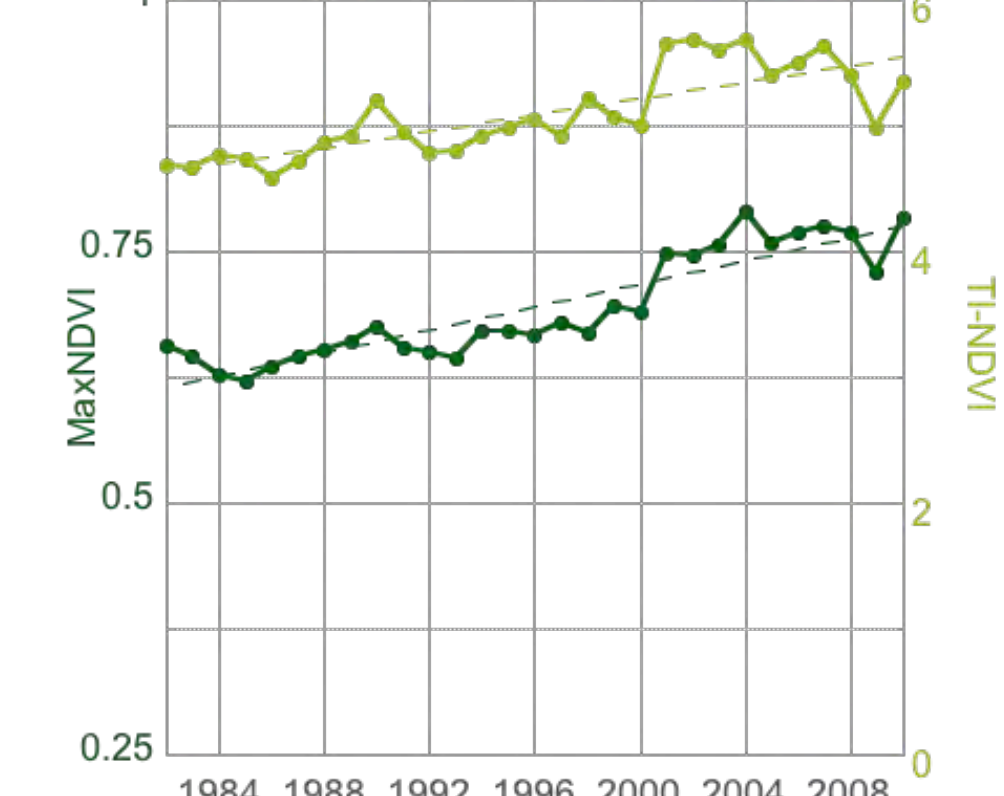
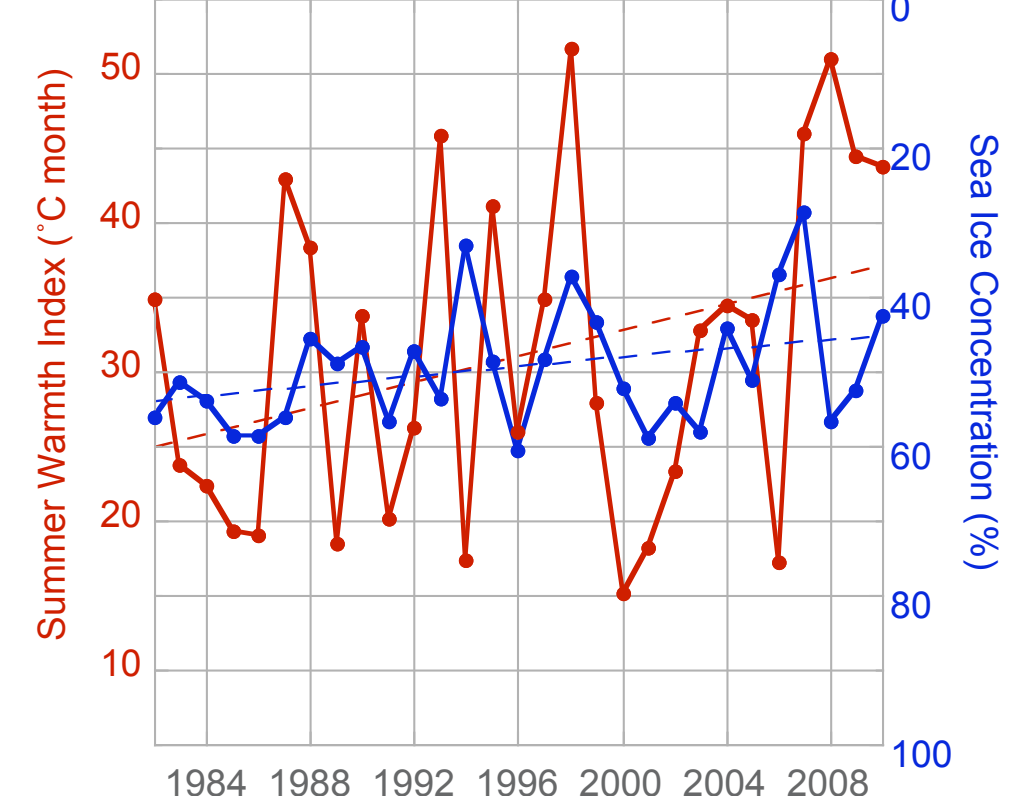
- Increasing (greening) NDVI trends in the East Chukchi and Beaufort Sea terrestrial regions tundras
- Decreasing (browning) NDVI trends in the East Bering Sea region tundra

• Are the Alaska NDVI trends consistent with climate trends?

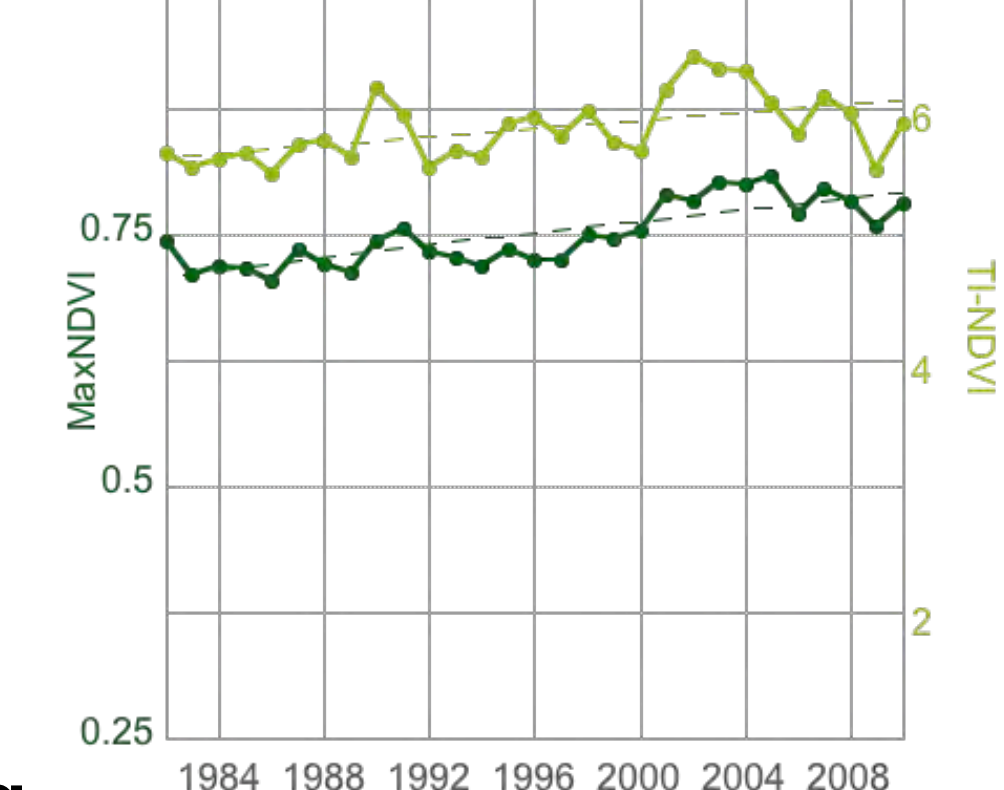
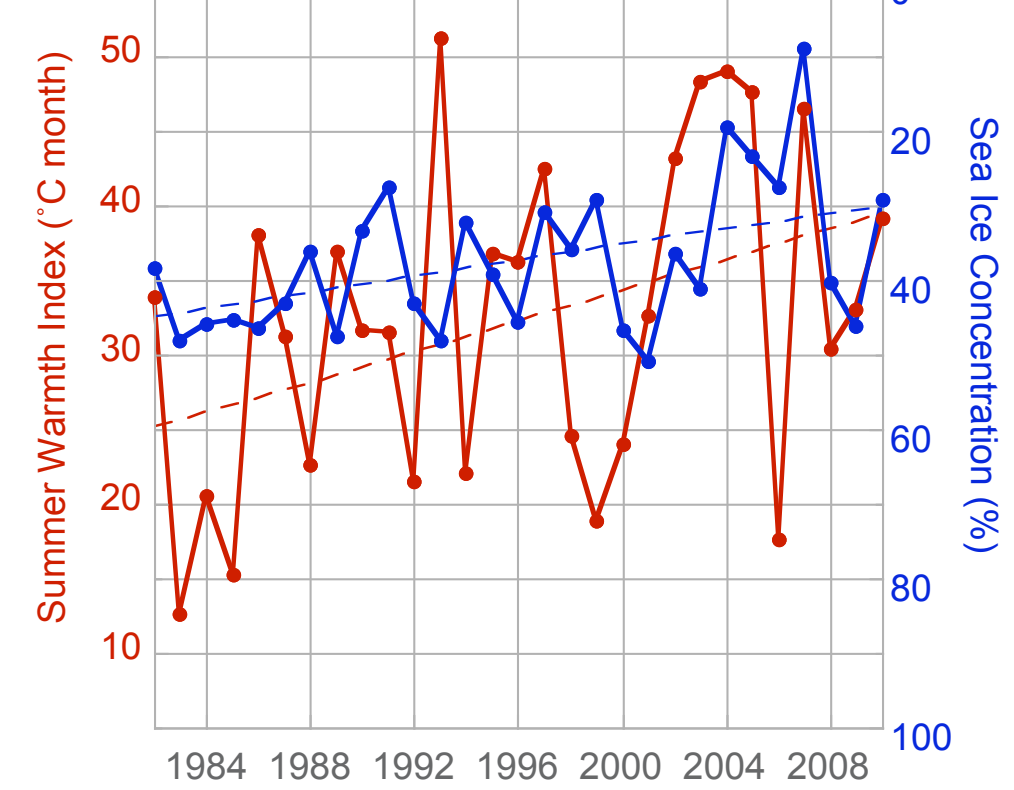
Data:  
Sea ice concentration, surface temperature: Comiso  
Normalized Difference Vegetation Index (NDVI) GIMMS3g: Pinzon et al. (2010)

## NDVI Trends in Alaska

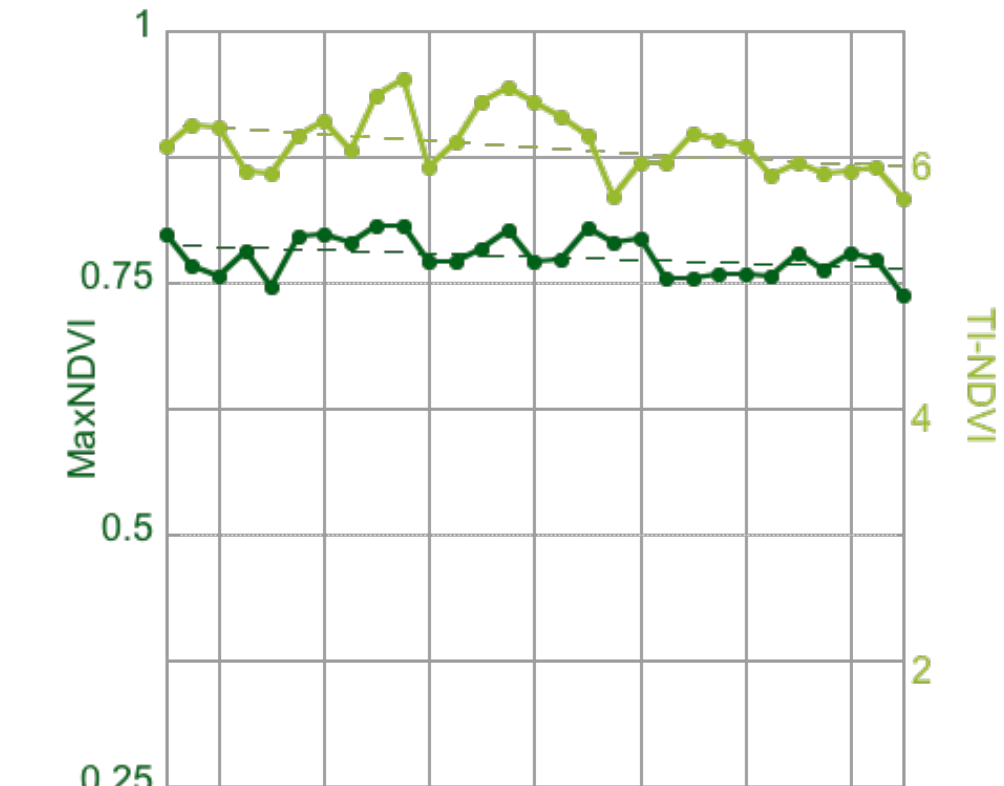
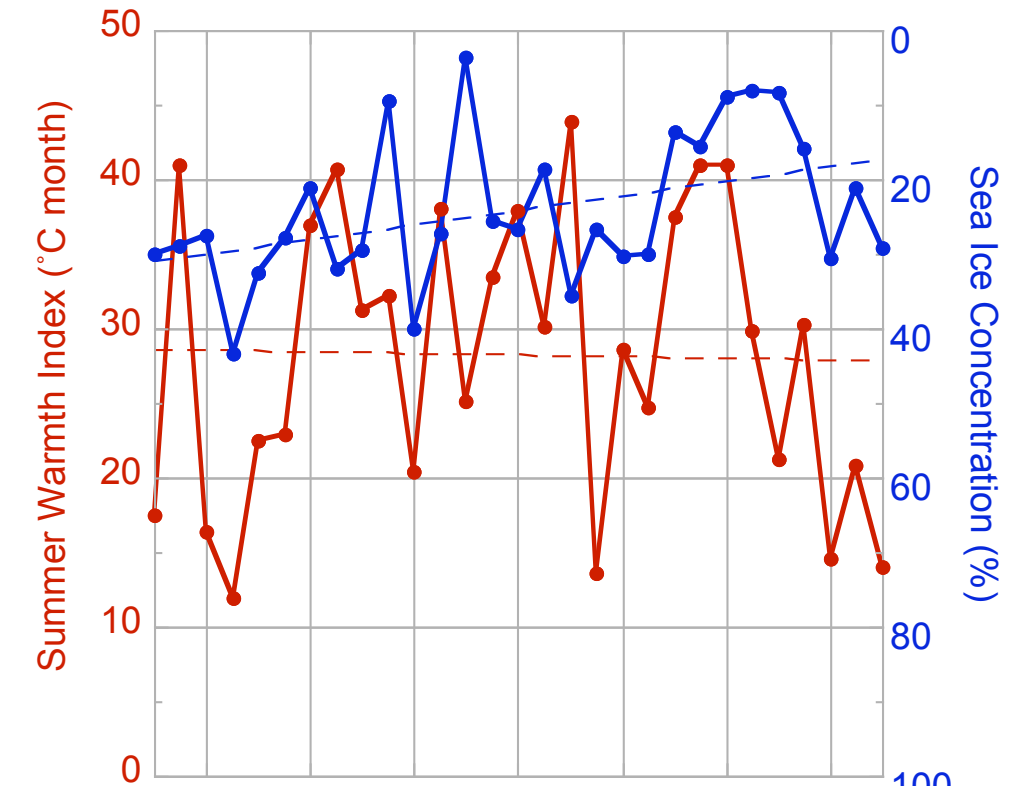
### Beaufort



### East Chukchi

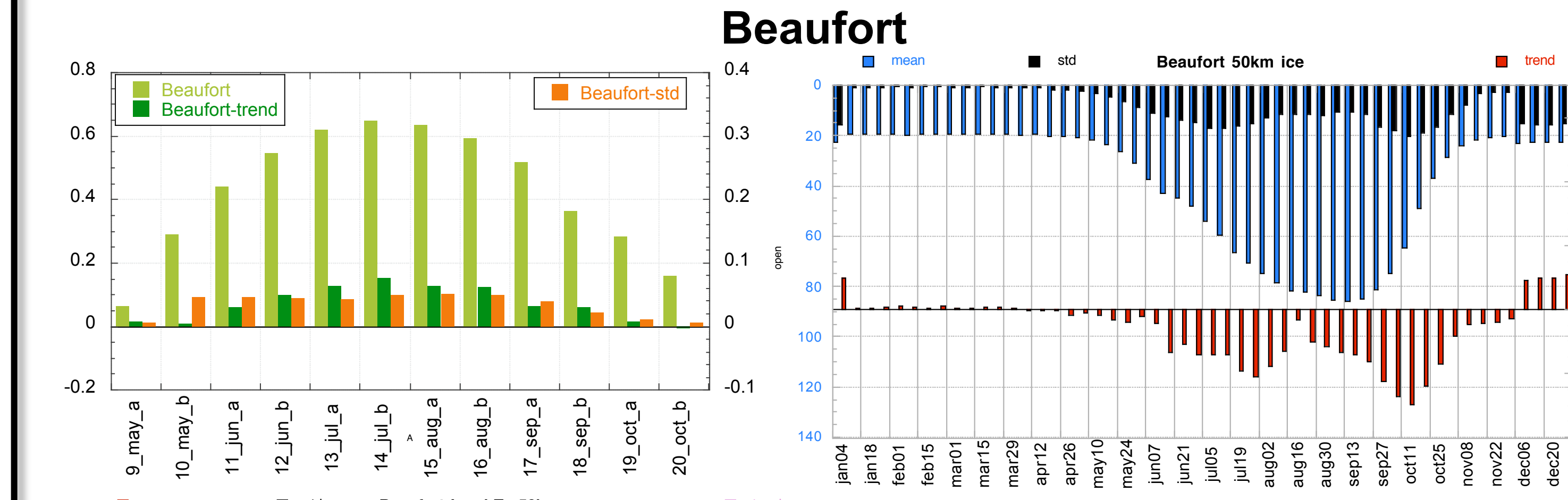


### East Bering

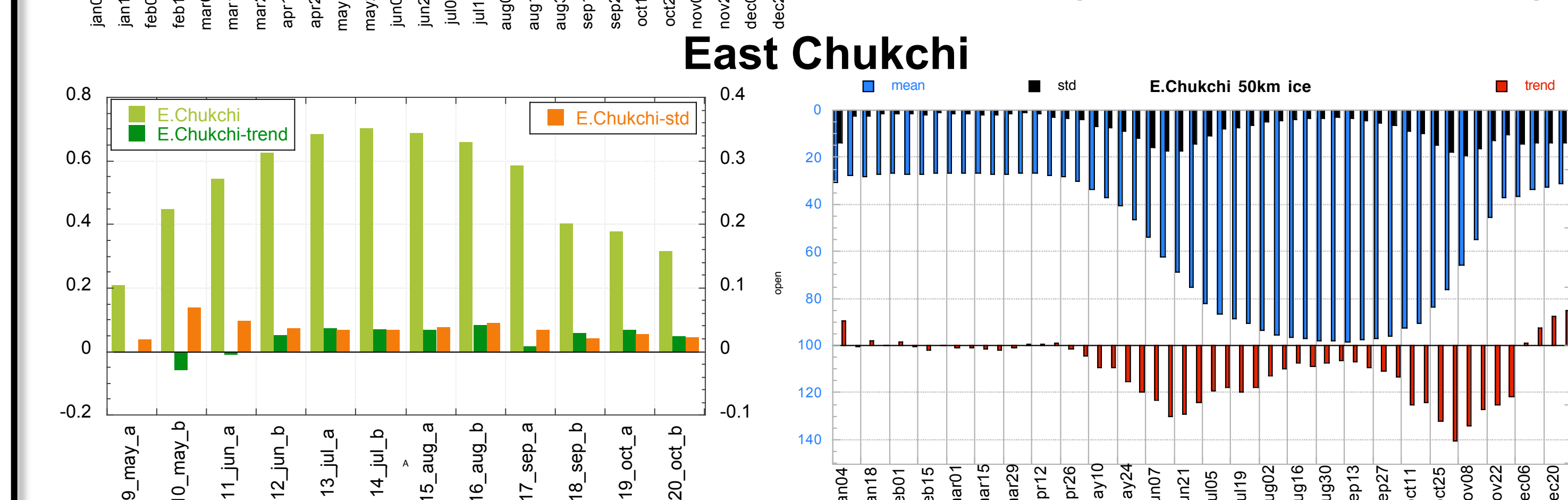


- Max-NDVI and seasonal time integrated NDVI increasing in East Chukchi and Beaufort terrestrial regions, slightly decreasing (browning) in East Bering region
- Summer Warm Index (SWI) increasing in East Chukchi and Beaufort, slightly decreasing in East Bering region
- Coastal sea ice decreasing in all three regions
- What is responsible for these trends?

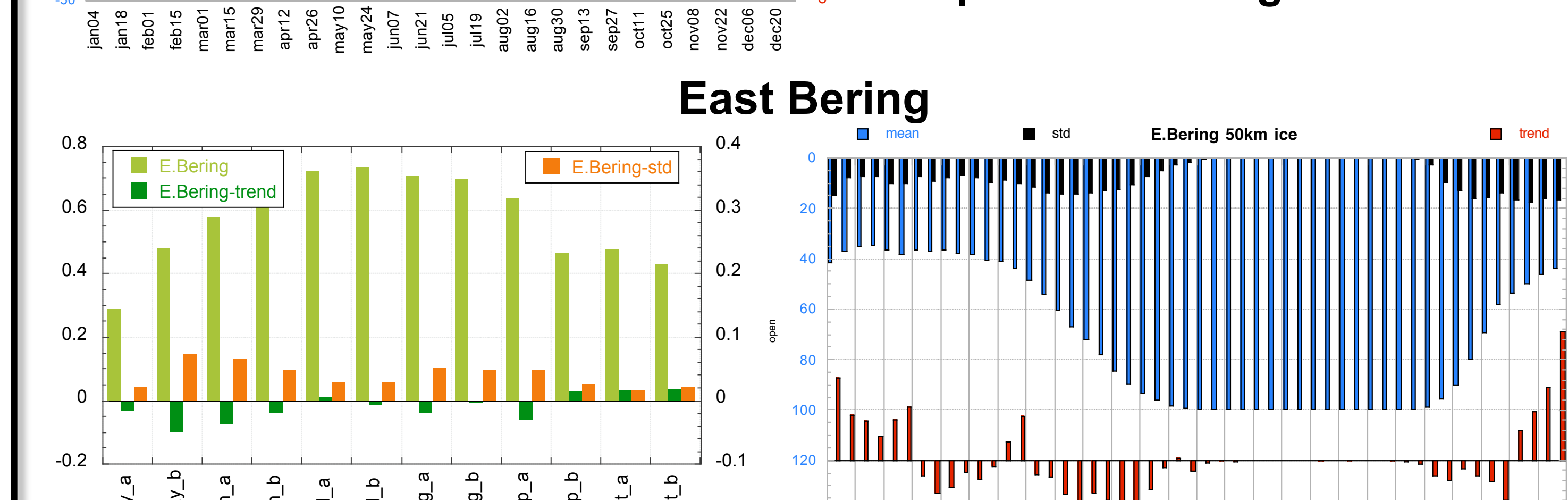
## Seasonal Cycle and Seasonality of Change



- Peak NDVI in July, NDVI increasing July-August
- Earlier breakup and later freeze up of sea ice in Beaufort
- Trends in surface temperature mainly increasing during summer, increasing most in winter/spring

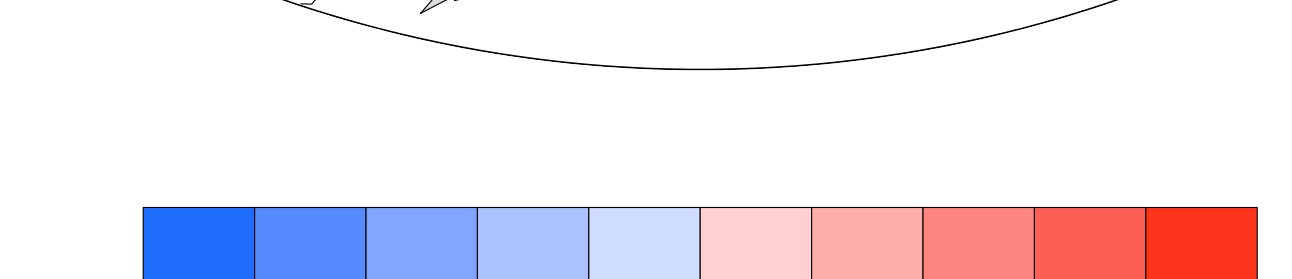
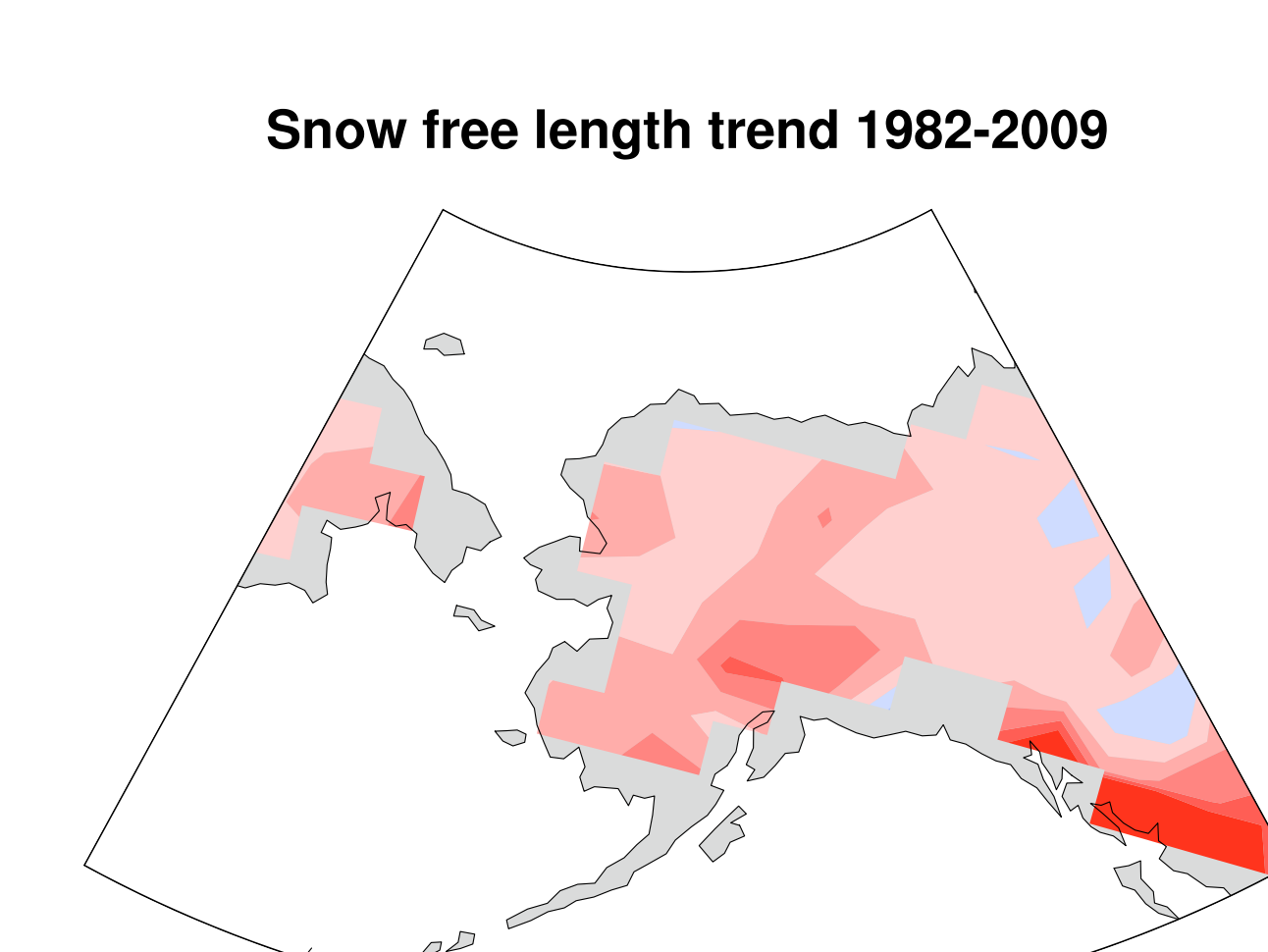
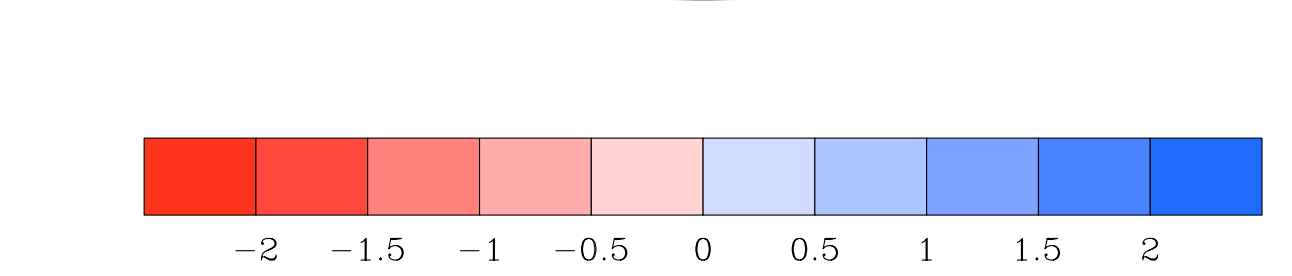
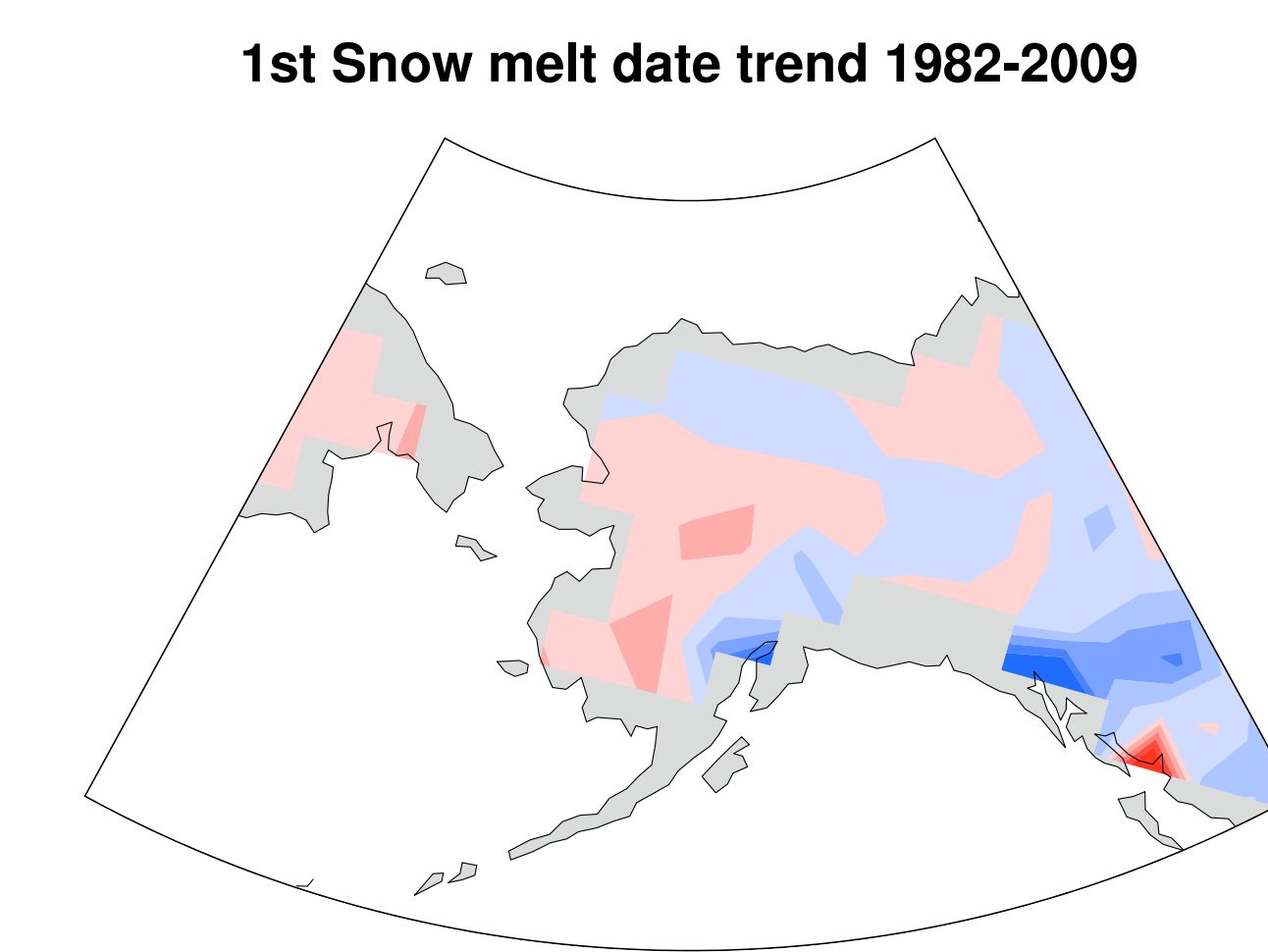


- Peak NDVI in July-August, NDVI increasing most mid-summer
- Earlier breakup and later freeze up of sea ice in East Chukchi
- Trends to increasing surface temperature throughout summer

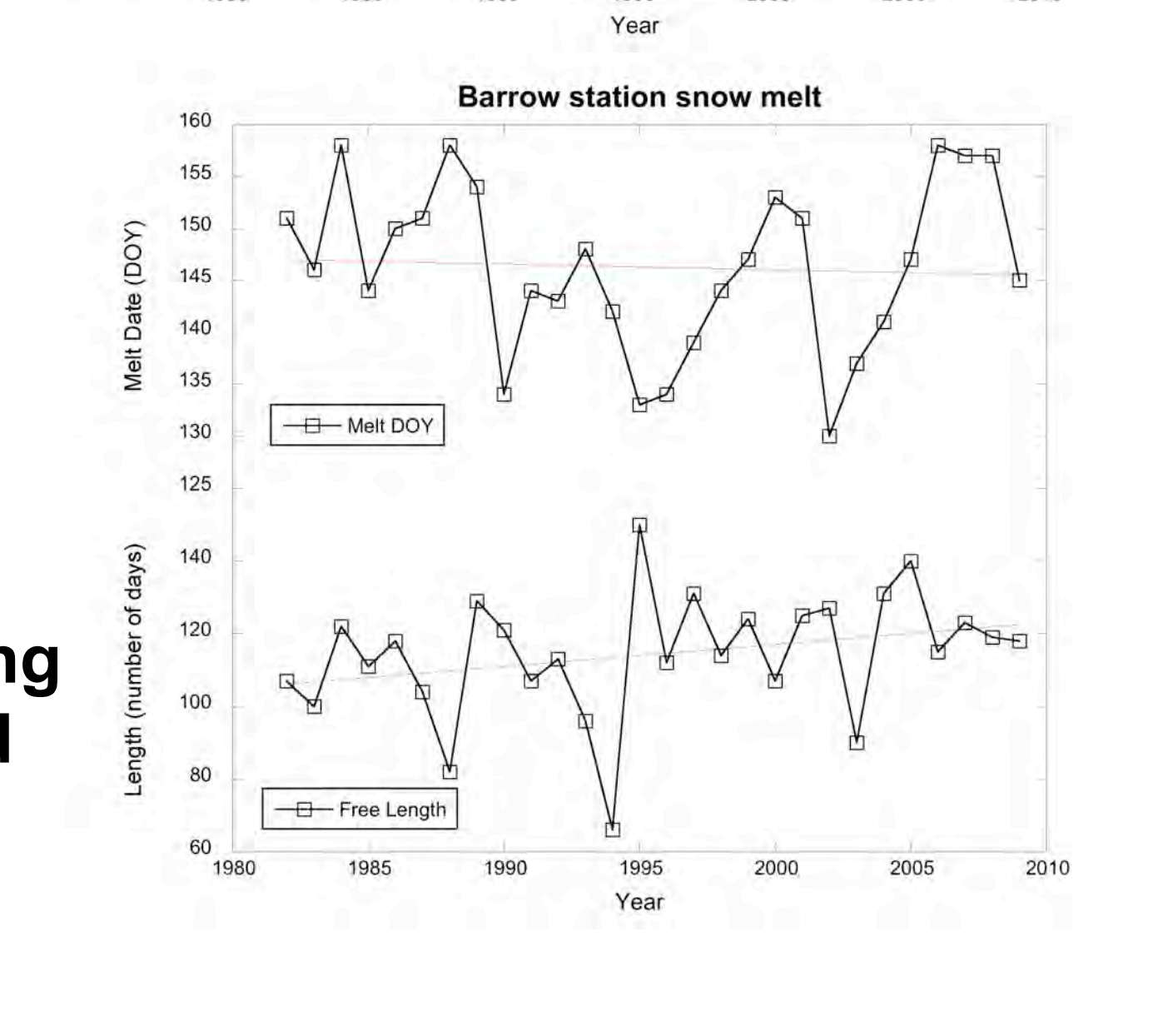
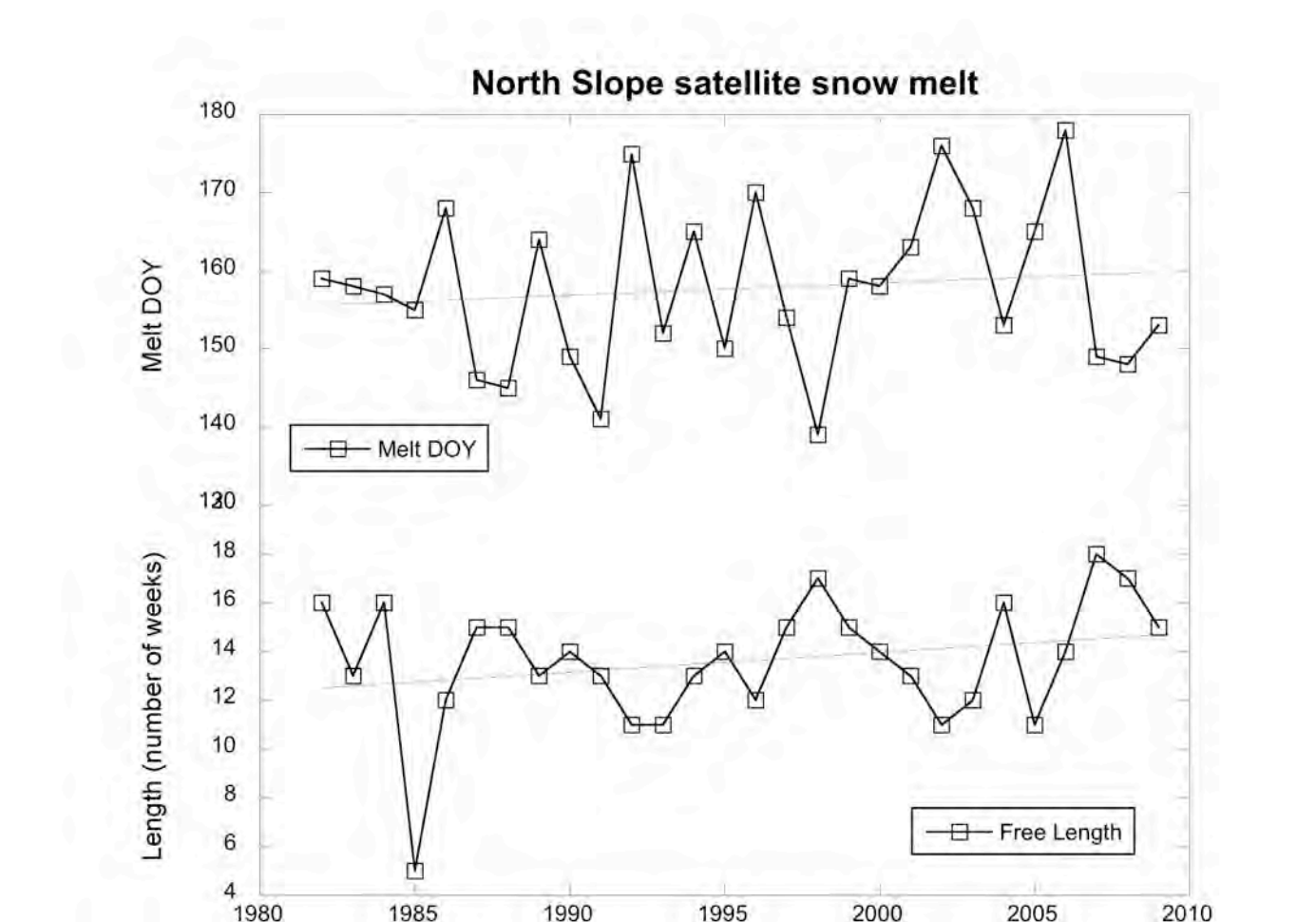


- Peak NDVI in early July, NDVI declining in spring
- East Bering ice free in summer, earlier breakup and later freeze up
- Increasing trends in surface temperature throughout summer
- Summer precipitation influence?

## Snow free season lengthening



- Rutgers weekly gridded snow data, Robinson (2000)
  - Available online: <http://climate.rutgers.edu/snowcover>
  - Digitized NOAA snow maps
  - AVHRR albedo, IMS after 1999
- Mixed trends in snow melt date
  - Later snow melt in Arctic
  - Earlier snow melt in Interior and southwest
- Increasing snow free season length in all of Alaska



- Barrow snow melt is tending to occur earlier, conflicting with gridded data
- Snow free season length increasing at Barrow, consistent with gridded data set
- Need better snow data!

## Thoughts/Next Steps

- Link to large-scale climate?
- Regional modeling experiment?
- Need an improve Pan-Arctic snow data set

## References

Bhatt, U. S., and Coauthors, 2010: Circumpolar Arctic Tundra Vegetation Change Is Linked to Sea Ice Decline. *Earth Interactions*, 14, doi:10.1175/2010EI315.1.  
 Pinzon J. E., C. J. Tucker, M. K. Reynolds, U. S. Bhatt, D. A. Walker, 2010 (in progress), Revised, continuously updated GIMMS3g (AVHRR NDVI) data from 1982 onward  
 Robinson, D.A. & A. Frei (2000) Seasonal variability of northern hemisphere snow extent using visible satellite data. *Professional Geographer*, 51, 307-314.

## Acknowledgements

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