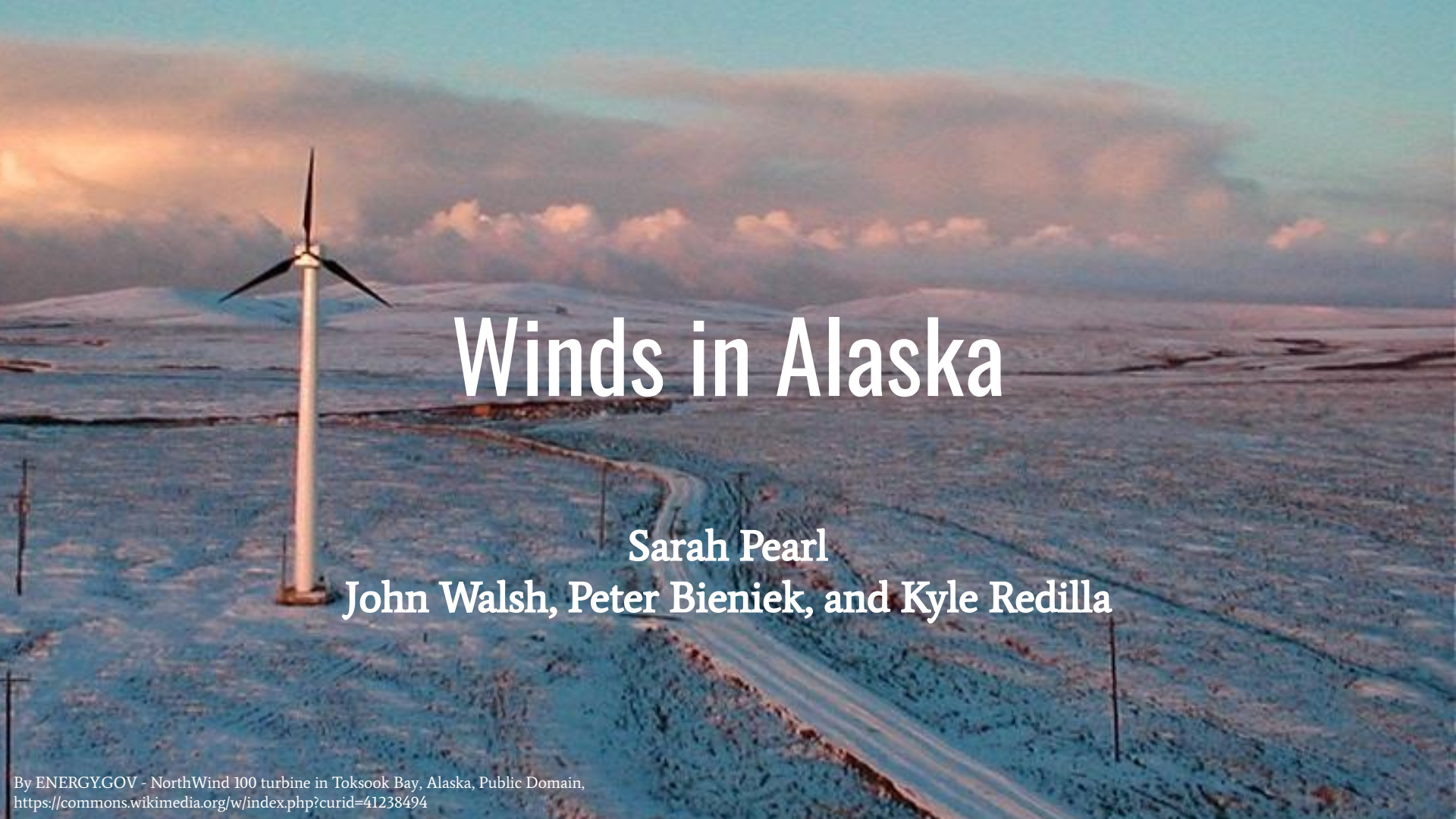


Winds in Alaska

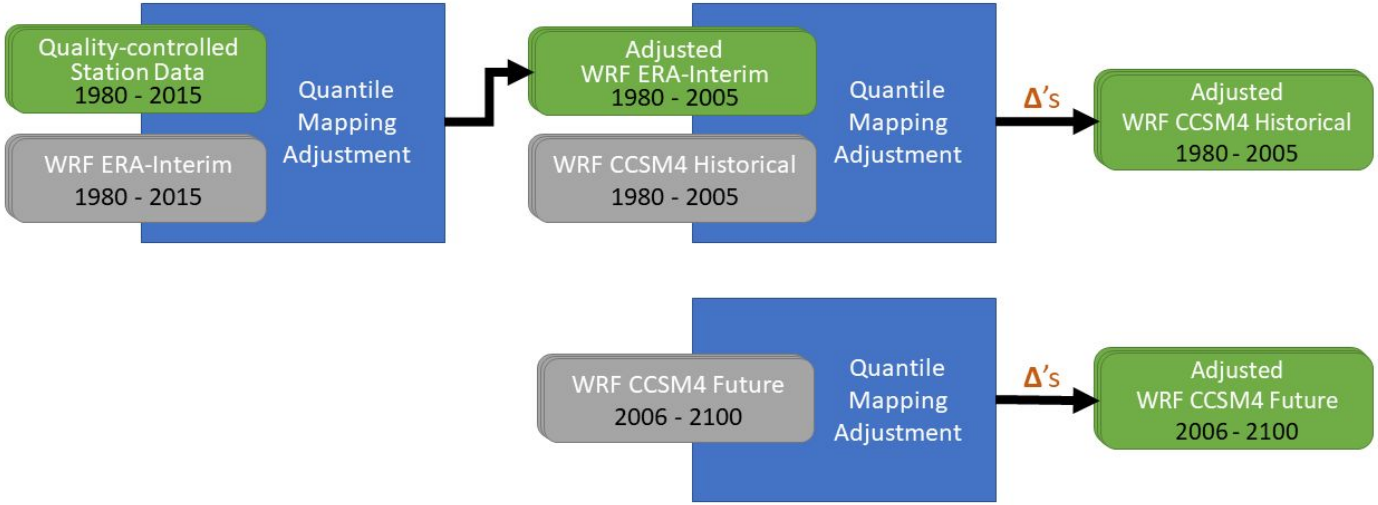
Sarah Pearl
John Walsh, Peter Bieniek, and Kyle Redilla

By ENERGY.GOV - NorthWind 100 turbine in Toksook Bay, Alaska, Public Domain,
https://commons.wikimedia.org/w/index.php?curid=41238494

Overview

- **Driving Questions:**
  - How are winds changing, and how will they change into the future?
  - Will reaching high impact wind thresholds become more or less likely in the coming decades?
- **Applications:**
  - coastal flooding/high impact coastal events
  - wind energy potential
  - forest blowdown; wildfire spread; infrastructure damage
- **Data:**
  - high-resolution wind data and climate model output

Methodology



Application 1: high impact coastal events

- Coastal areas are more vulnerable to wind events than interior areas (flooding and erosion from wind-driven waves)
- Retreating sea ice may be influencing storm impacts, tracks, and severity

Nome recovers after super storm

By Diana Haecker

There is nothing like a good-sized storm that gets Nomeites out on Front Street for a walk near the beach. As waves crashed over the seawall armor rock on East Front Street, depositing rocks, driftwood and other debris on the road, people came out in droves to view the spectacle and take video and photos of the angry Bering Sea on a backdrop of a colorful sunset.

The high winds that battered Nome with peak gusts of 66 mph on Tuesday night had subsided by Wednesday afternoon. The Tuesday night blizzard blew six inches of snow on Nome, which accumulated in huge snowdrifts in some areas while other areas were blown clear of any speck of snow.

After the winds died down and visibility returned, the threat of a massive storm surge worried city officials most. Low lying areas like River Street, F Street and Belmont Point flooded. Dry Creek was wet and looked like a lake all the way to Chicken Hill. The storm surge peaked on Wednesday evening with 9.95 feet above the mean low water level. In comparison, a very high tide measures two feet above that level.

However, the anticipated severity of the massive storm did not materialize because the center of the 948-millibar low moved further west over Kamchatka and the wind direction during the main wind storm shifted to the east, blowing across the tundra as opposed to coming from the south as projected, which would have caused the water to surge much higher than it did. Jerry Steiger, meteorologist in charge at the Nome NWS said that the easterly winds pushed the storm-driven waves parallel to the shoreline. "We felt ex-

continued on page 6

Photo by Diana Haecker

IN AWE— Nome Ambulance volunteers Jessica and Charlene Saclamana take a break to witness the storm on Wednesday afternoon at Front Street.

City declares disaster after Bering Sea storm hits Nome

By Sandra L. Medearis

The Nome Common Council is hoping that winds clocked at 66 mph on Nov. 9 along with a sea surge of 10 feet that produced flooding and evacuation of parts of Nome adjacent to the seawall and at Belmont Point will add up to emergency money coming from the state and federal sources to help pay for repairs.

Tuesday a federal and state team was to land in Nome to assess damage here and in the region to coordinate and ascertain the need for relief that could come in three forms: public assistance to repair public facilities, relief to individuals for damages to property and money to establish temporary housing.

Monday night in a special meeting, the Council talked to emergency relief coordination officials via telephone at a special meeting at Nome City Hall and followed up unanimously passing a resolution declaring a disaster delivered by the Bering Sea storm that wham-bammed Nome Nov. 8 and 9. The resolution holds the disaster concept only. City Manager Josie Bahnke said. True costs and complete costs of damage to Port of Nome, utilities and City facilities remain to be gathered. The resolution asks for money for estimates and cost refinement work.

The local declaration is the first step to money for storm cost relief; next, the state will consider a disaster declaration at that level. Even then, there is no guarantee that the Federal Emergency Management Agency—FEMA—will participate. The state Department of Transportation and public facilities will handle damage to the Nome-Council Road. If the damage exceeds $1 million, federal highway programs will be-

continued on page 4

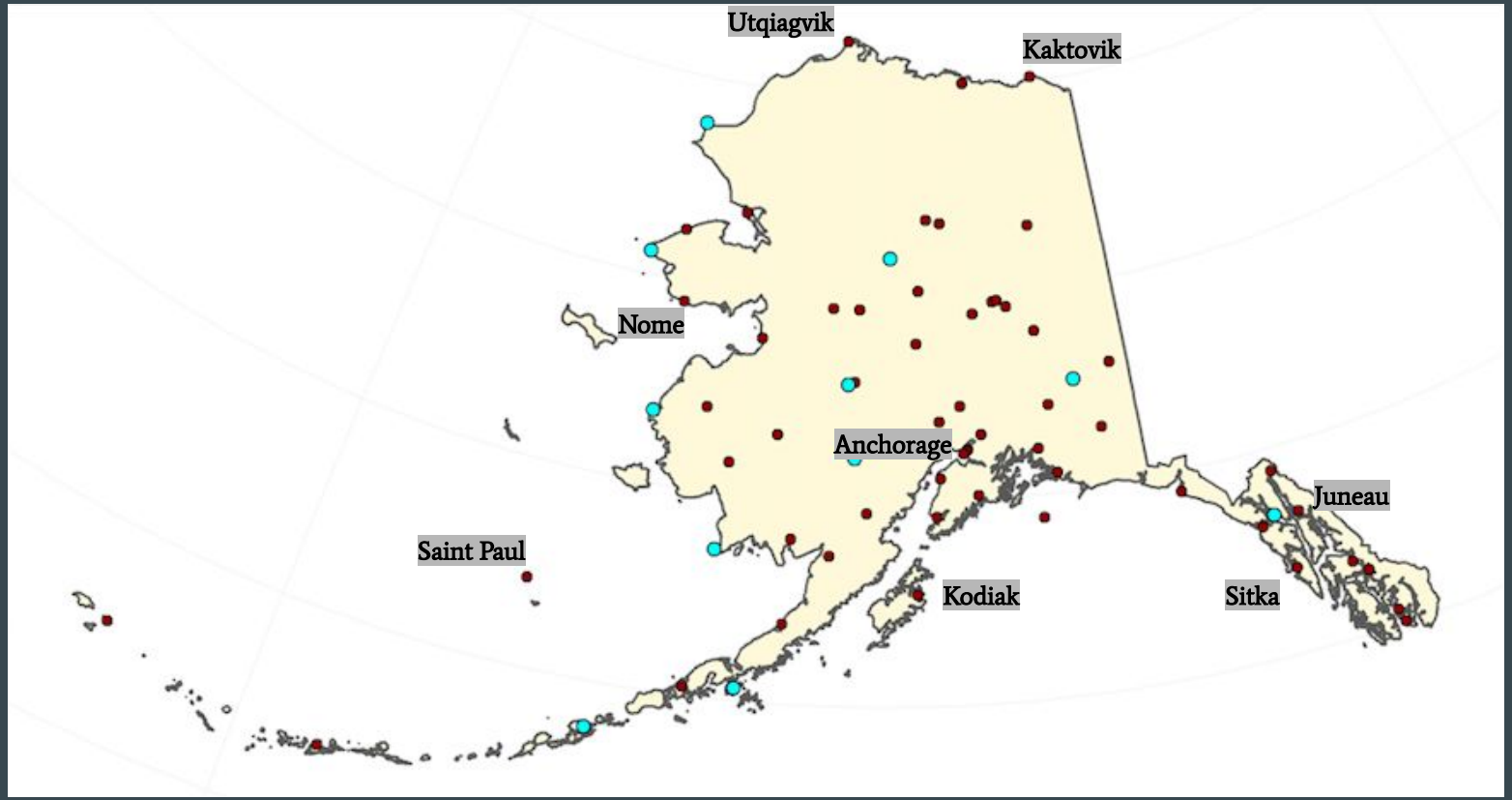
Photo by Air Force

Retrieved by Nathan Kettle and Lindsey Heaney

Approach and Analysis

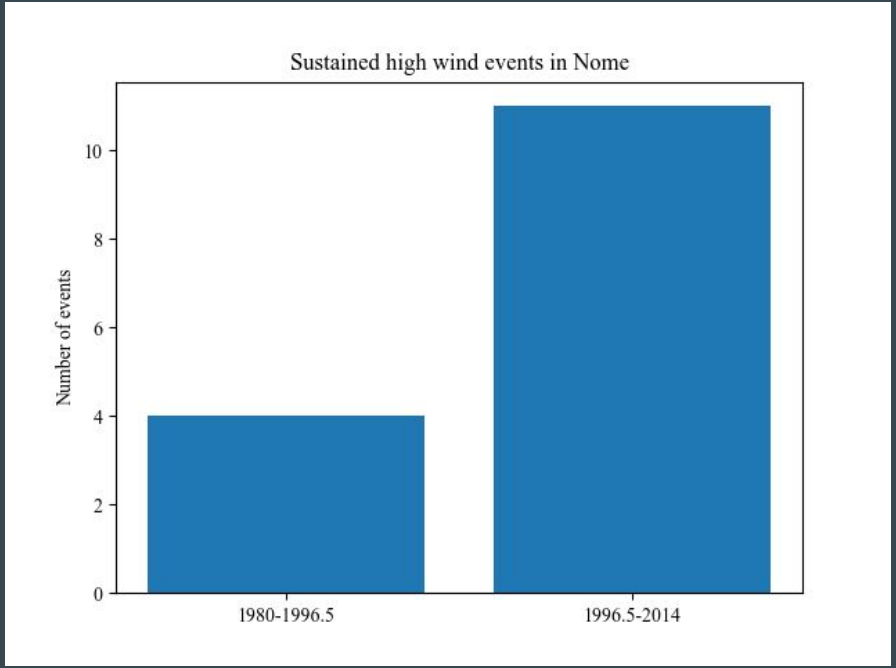
- Approach
  - Identify events where a certain wind speed is sustained for a certain duration
  - Use thresholds that produce a list of ~12-20 events at a station

- Analysis
  - How are events distributed throughout the historical period?
  - Are these events becoming more or less frequent into the future?
  - What weather patterns produce these events?


Utqiagvik
Kaktovik
Nome
Anchorage
Juneau
Saint Paul
Kodiak
Sitka

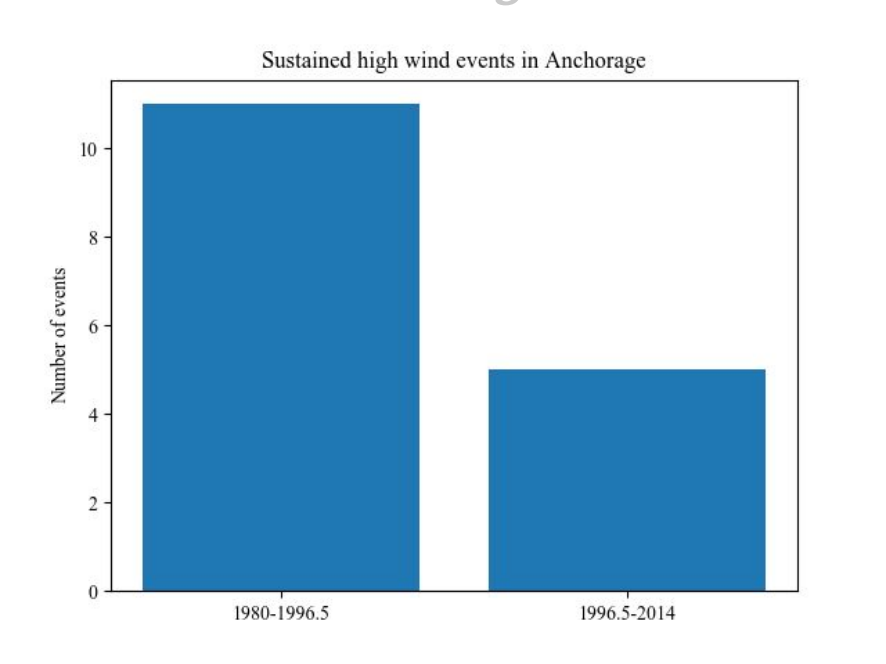
Historical Trends

Nome



30 mph, 10 hours

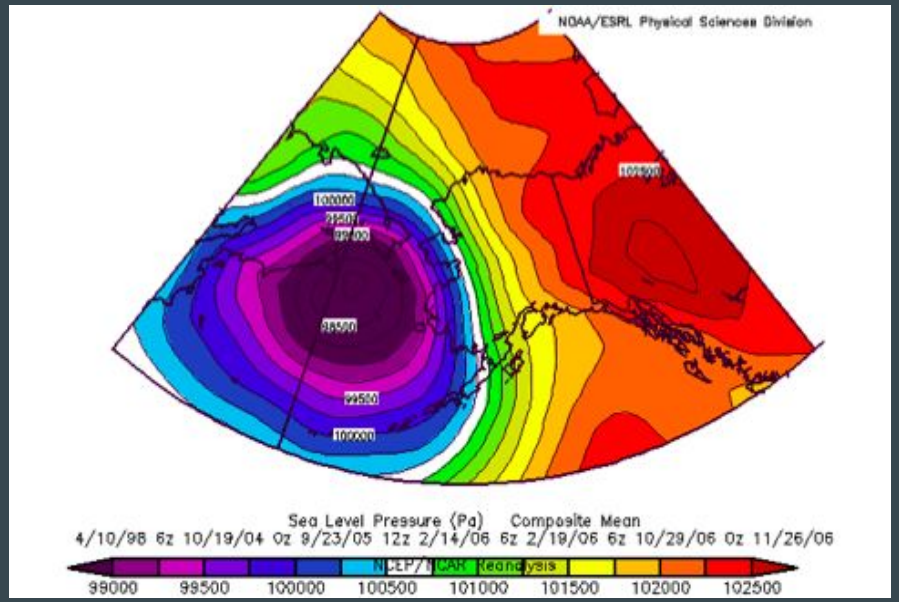
Anchorage



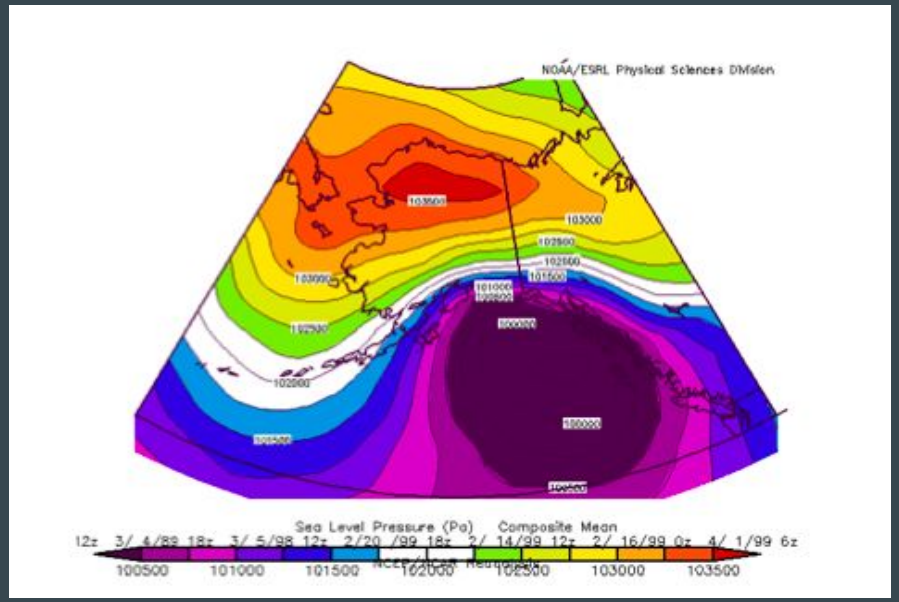
25 mph, 10 hours

Weather patterns

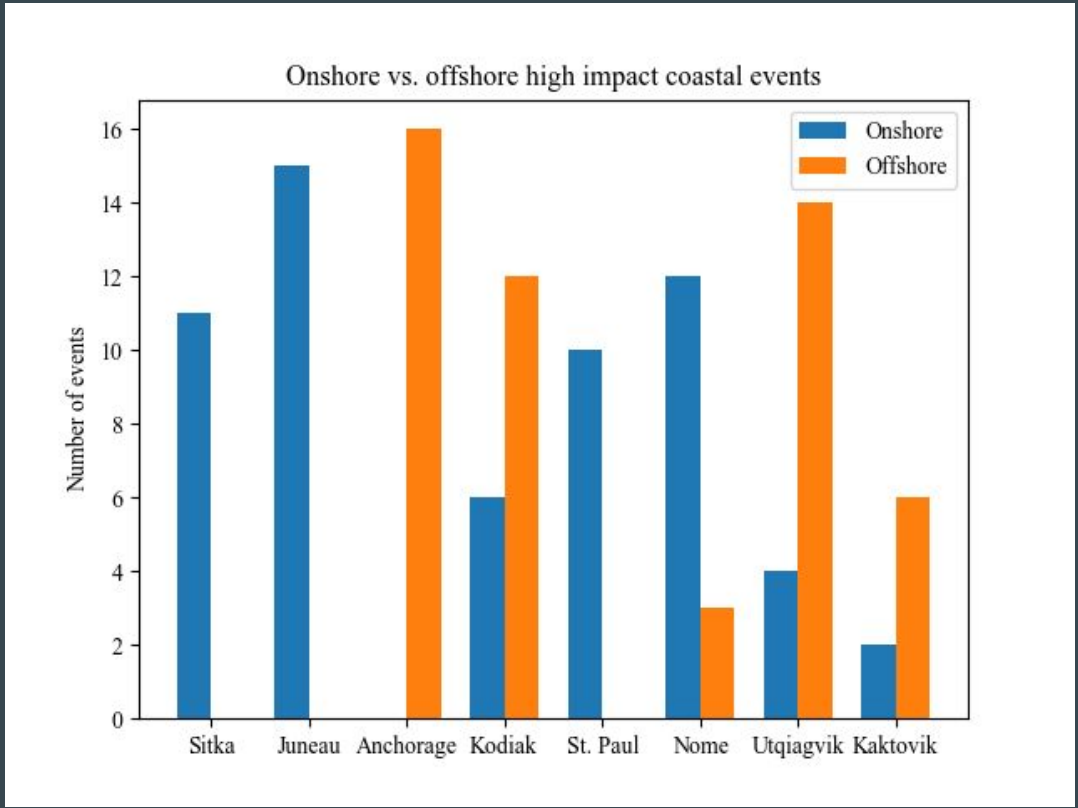
Nome, 15-case composite sea level pressure



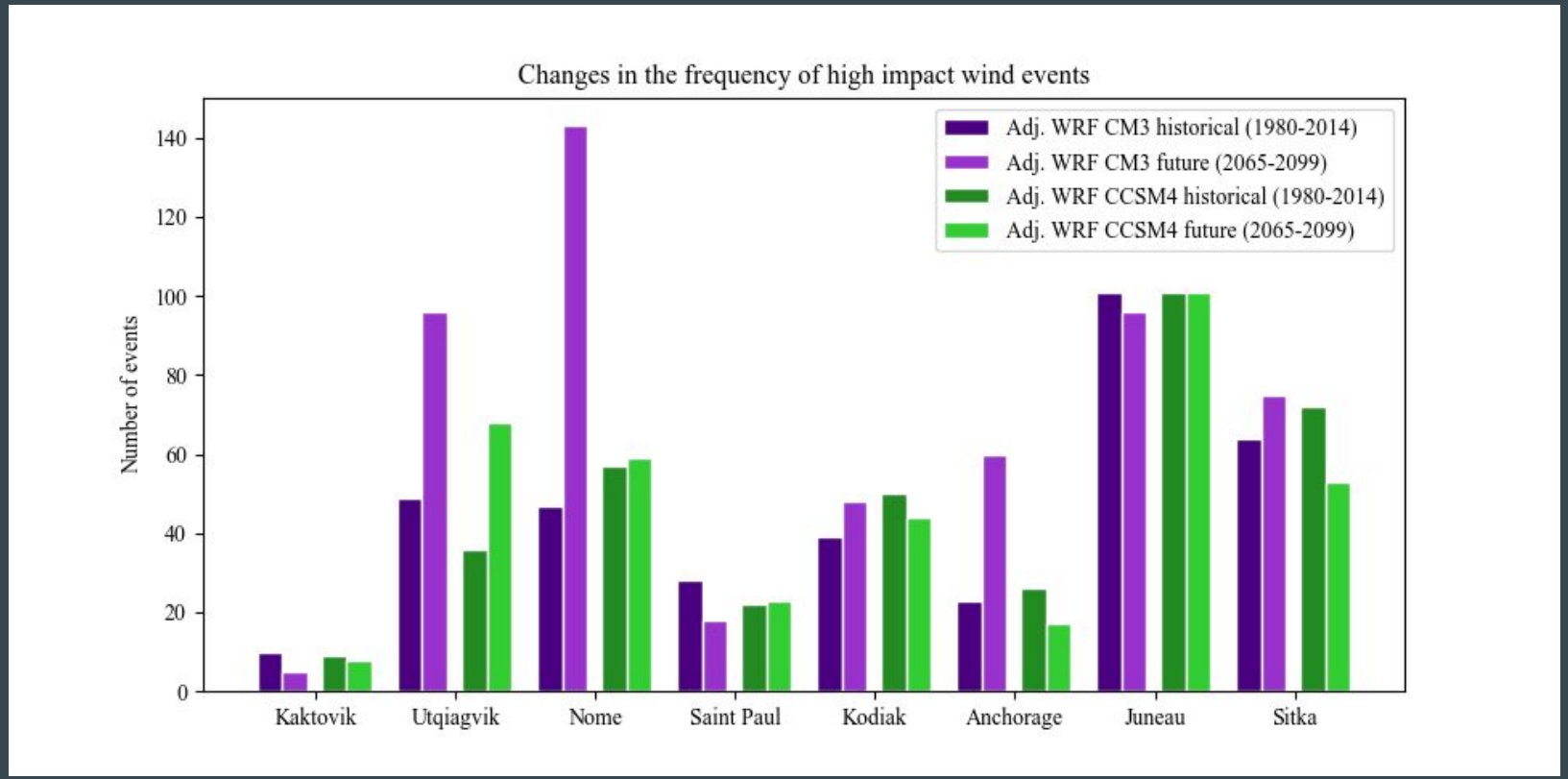
Anchorage, 16-case composite sea level pressure



Characteristics of coastal high wind events



Future trends



Highlights of high impact coastal events

- Historical: the number of events increased at 5 stations and decreased at 3 from the first to second half of the 35 year period

- Future:
  - Models agree that Utqiagvik and Nome will see increases in the frequency of high wind events

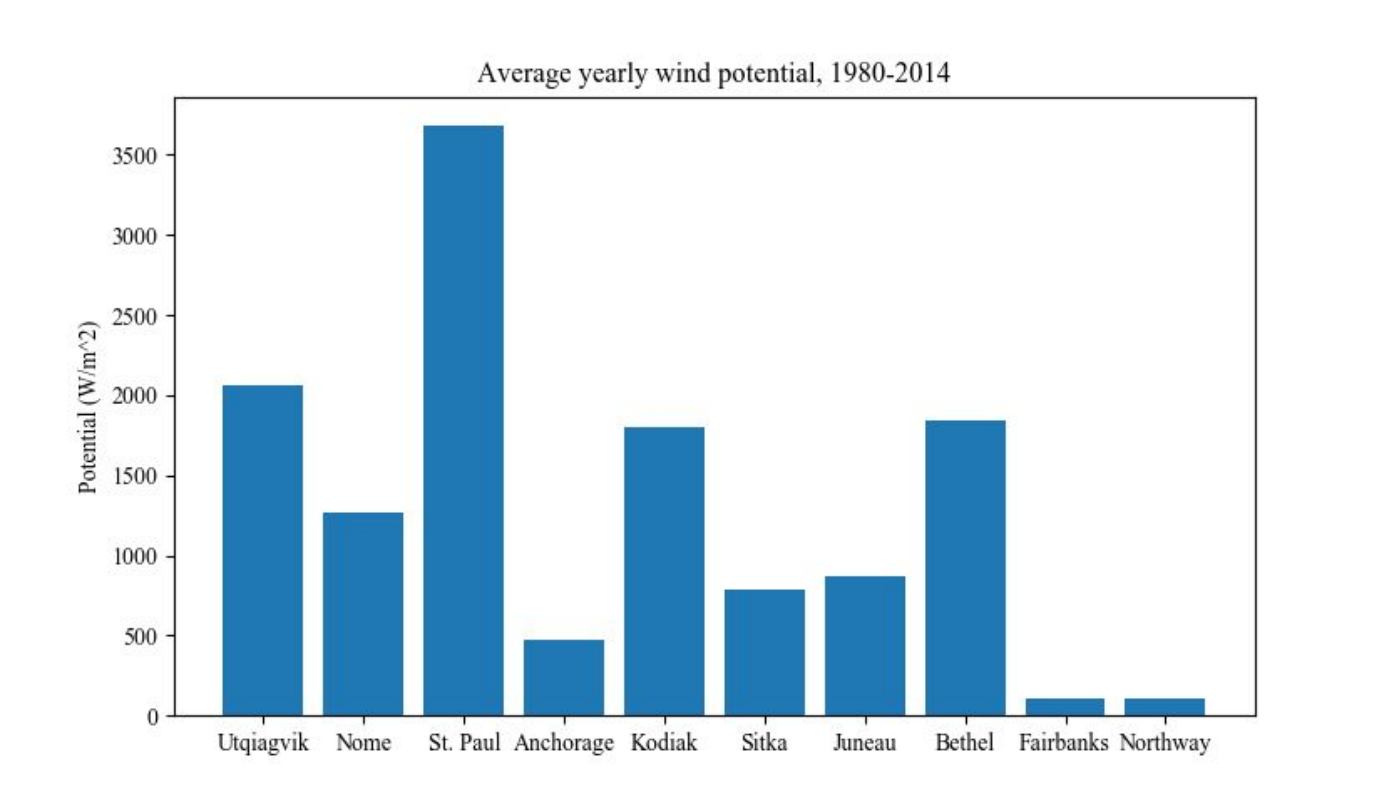
Application 2: wind energy potential

- Underutilized wind resources across the state
- Alaska-specific challenges:
  - Permafrost
  - Remote locations
  - Transmission capabilities

Approach & Calculations

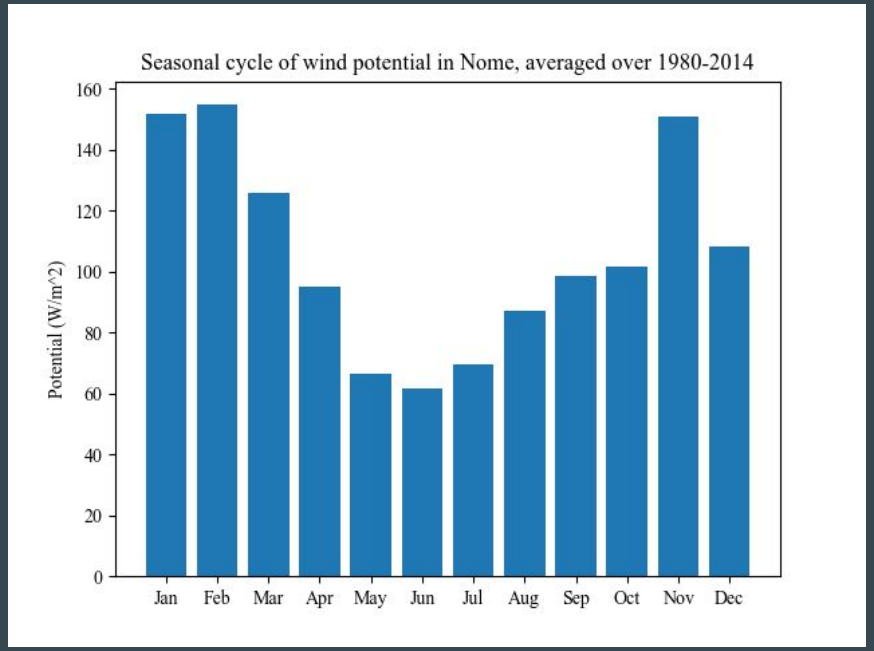
- Approach
  - Used cubed hourly wind speeds, then converted to W/m^2
  - Applied power law to translate speed at anemometer height to speed at turbine height:
    - $u_2 = u_1 (z_2/z_1)^{\alpha}$
    - z_1 = height 1; z_2 = height 2; u_1 = wind speed at height 1; u_2 = wind speed at height 2; α = wind shear coefficient, 1/7 (Kubik et al. 2011; Spera and Richards 1979)
  - Accounted for turbine functional range
- Calculations
  - Annual potential
  - Seasonal variability
  - Projected changes

Annual potential

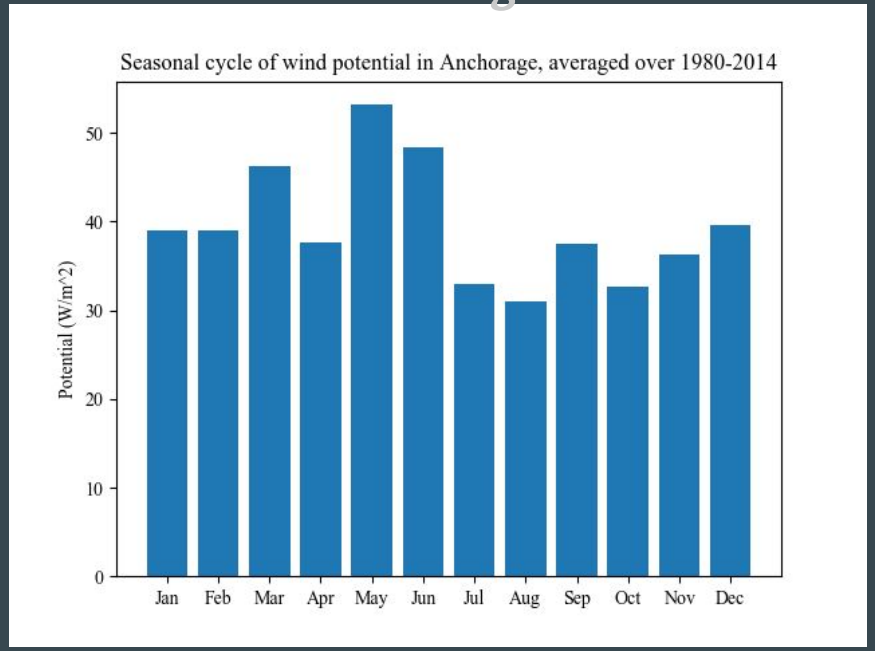


Seasonal variability

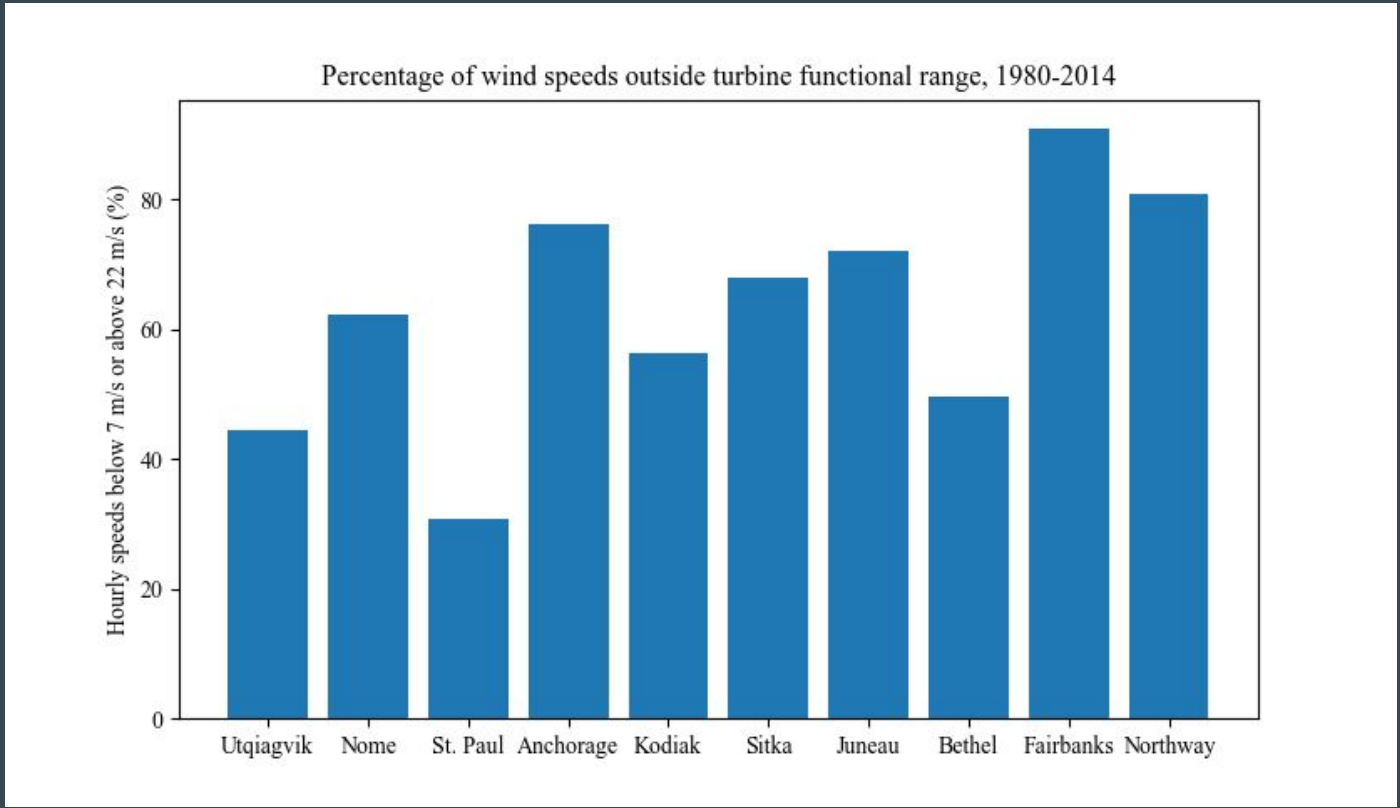
Nome



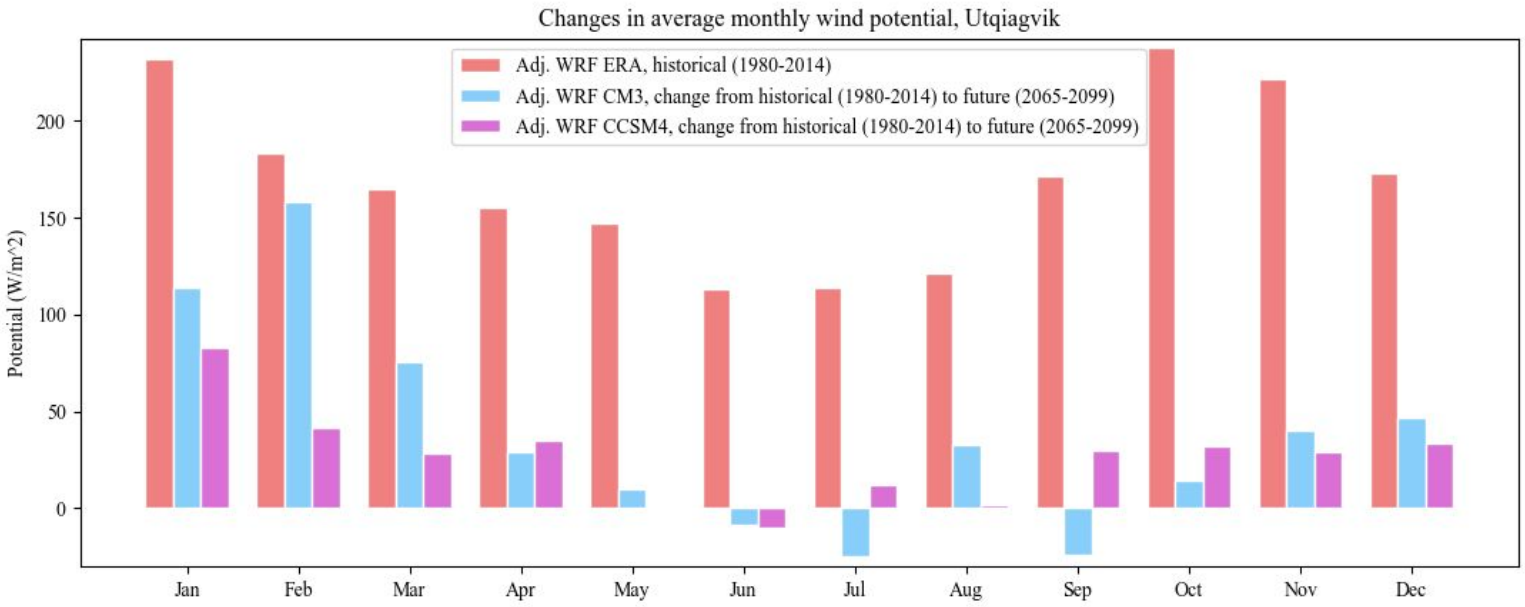
Anchorage



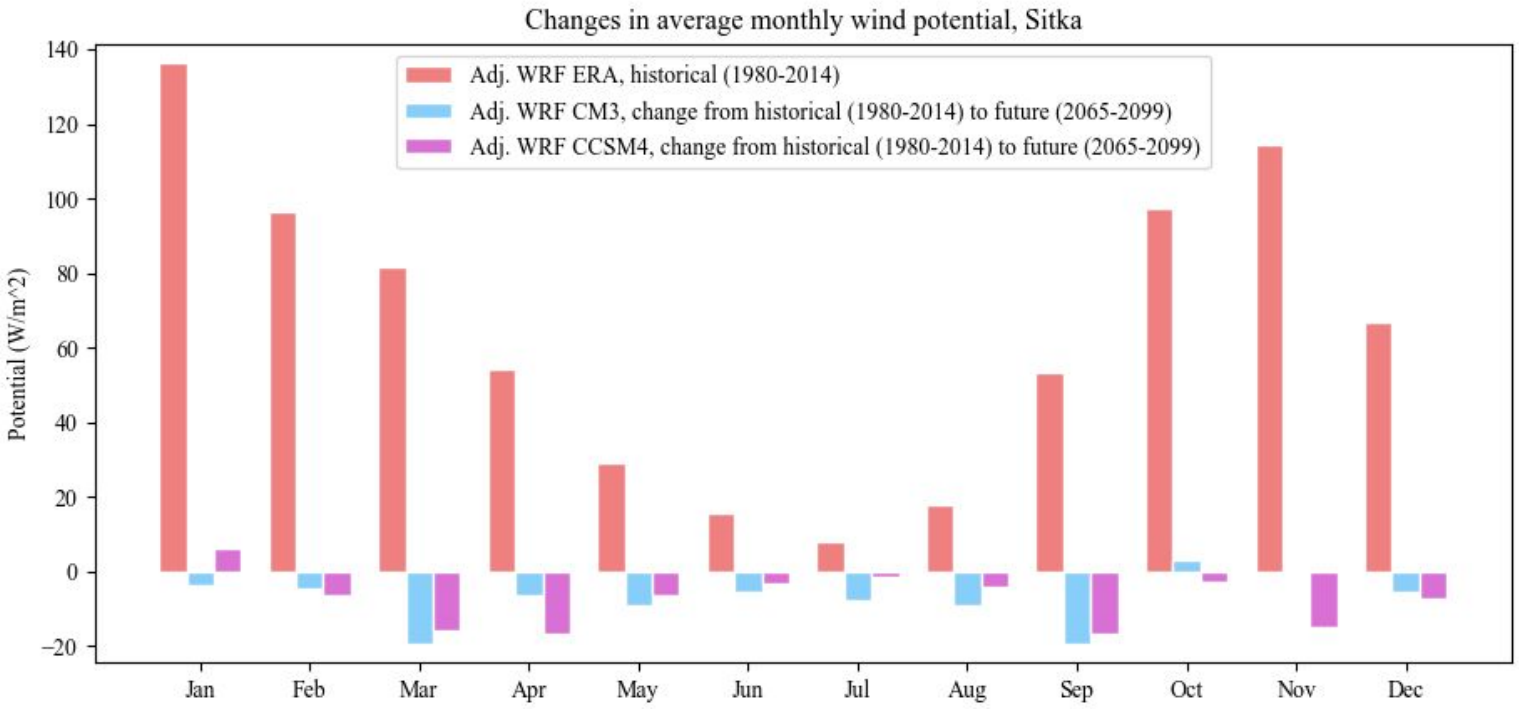
Turbine operation



Future changes: Utqiagvik



Future changes: Sitka



Highlights of wind energy potential

- Interior sites' winds are likely too calm to provide sufficient potential
- Most changes in potential will occur in the winter months, with relatively minimal changes in the summer
- Overall, northern sites' potential is projected to increase, while southern sites' is projected to remain constant or decrease

Applications 3-5: threshold exceedances

1. **Wildfire spread: 20 mph (May-August)**
   - Good model agreement that reaching fire threshold in Fairbanks and Northway will become more frequent

2. **Forest blowdown: 34 mph**
   - No clear trend or signal at any of the stations considered

3. **Infrastructure damage: 47 mph**
   - Good model agreement that Kaktovik will reach threshold less frequently

(Photo by Sherman Hogue/Fort Wainwright PAO)

Overarching Conclusions

- Changes in winds are, in some cases, substantial fractions of present-day levels
- Present-day winds and future changes have strong seasonality
- Northwestern Alaska is projected to see the largest changes in high wind events and storm activity

Acknowledgements

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IARC