Evaluation of dynamically downscaled winds over the central Beaufort Sea

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Alaska Marine Science Symposium, 28-31 January 2019, Anchorage, AK.

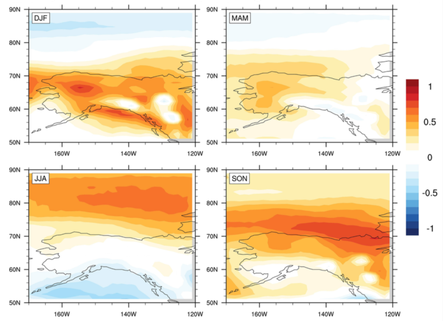
Main Results

- Gridded downscaled reanalysis and projected wind data are needed to support off-shore oil/gas development
- Dynamically downscaled winds compare favorably with local reanalysis and station observations
- Lack of long-term wind observations over the ocean makes a full evaluation challenging

Motivation

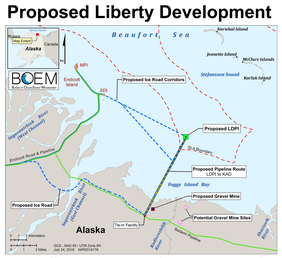
- Changes in wind speed projected over the Beaufort Sea coast
- Significant sea ice declines are also occurring and will likely continue
- Largest increases in wind speed projected in spring and summer
- Off-shore oil and gas development projects need to plan for climate change

Projected (2070-2100) change in wind speed



Seasonal projected wind speed (m/s) difference (2070-2100 minus 1975-2005) from a RCP8.5 multi-model average (Basu and Walsh 2018)

Proposed Liberty Development



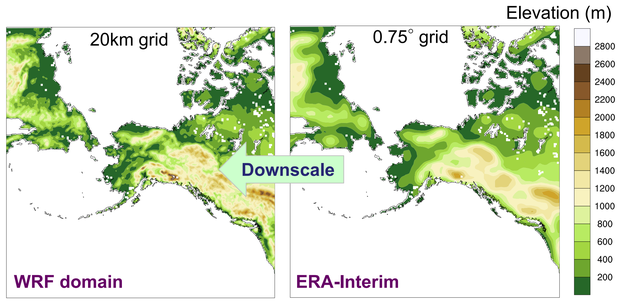
https://www.boem.gov/Hilcorp-Liberty/

- Liberty site is being developed by Hilcorp Alaska LLC in Foggy Island Bay
- Wave models used for planning require gridded wind/sea ice climate forcing data
- Validation of gridded wind data is needed

Proposed facility

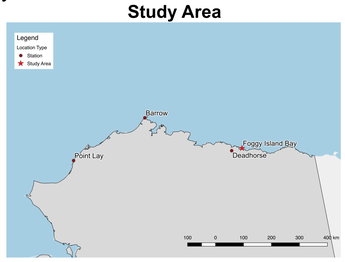
Data and Methods

- Dynamically downscaled ERA-Interim reanalysis (Bieniek et al. 2016)
- Downscaled data have hourly temporal and 20km spatial resolution
- Reanalysis downscaled over 1979-2018 using WRF



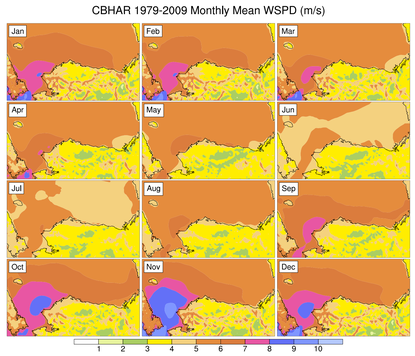
- Chukchi-Beaufort High-Resolution Atmospheric Reanalysis (CBHAR; Liu et al. 2014) used to assess downscaled data over 1979-2009
- Wind speed evaluated at monthly and daily scales
- Hourly wind speed and direction assessed at three long-term stations:
  - Barrow
  - Point Lay
  - Deadhorse
- Stations and CBHAR data were obtained from the Alaska Ocean Observing System (AOOS) data portal: portal.aoos.org

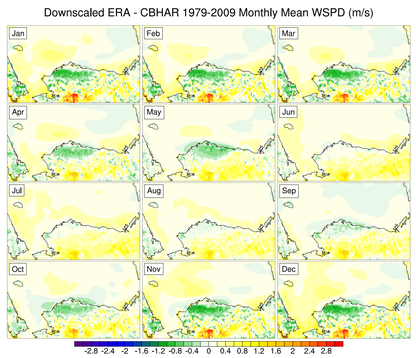
Study Area



Monthly wind speeds similar to observations over oceans

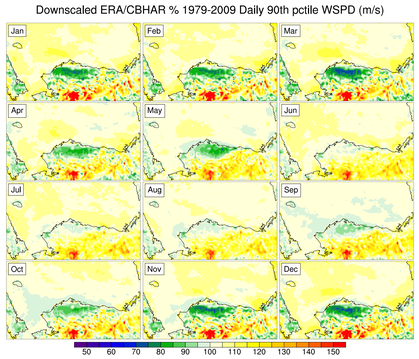
- Monthly climatologies of mean wind speed show that the strongest wind speeds tend to be over the oceans in CBHAR
- The highest wind speeds occur in Oct-Dec in the Chukchi Sea
- The differences between the downscaled ERA and CBHAR are less than 0.5m/s over the ocean areas
- The largest differences are inland with a few isolated areas exceeding 2m/s

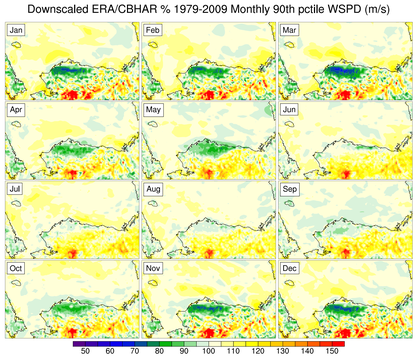




Monthly and daily extremes also similar over the oceans

- Extreme monthly and daily wind speeds identified by the top 90th percentile value
- The monthly 90th percentile winds in the downscaled ERA were generally within 5% of CBHAR over the oceans
- The largest differences (>10%) were over the land

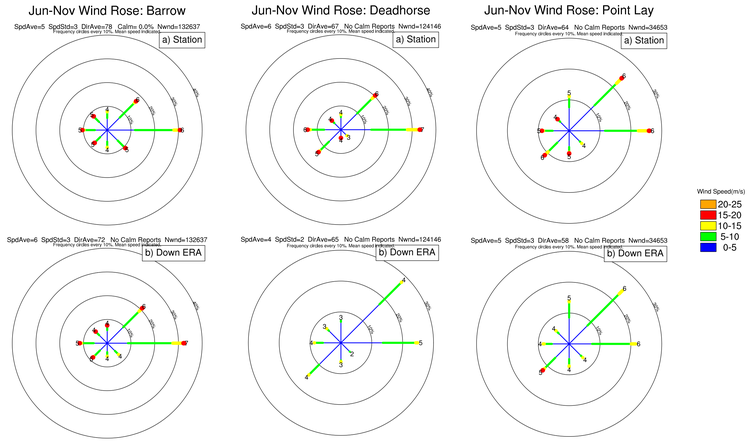




- The lowest differences in daily top 90th percentile wind speeds for each month (<5%) were over the oceans
- Monthly means, extremes and daily extremes all have similar spatial differences CBHAR vs. downscaled ERA

Frequency of hourly winds consistent at stations

- The frequencies of hourly wind speed and direction were compared at three long-term coastal stations with winds from the nearest grid point in the downscaled ERA for Jun-Nov (ice-free season)
- All three locations have a similar preference for east and northeast winds that was also reflected in the downscaled ERA
- Deadhorse has more northeast winds in the downscaled ERA than at the station



Summary

- Downscaled ERA wind speeds were comparable to CBHAR over the oceans for monthly means, and 90th percentile monthly and daily extremes
- The largest differences with CBHAR were inland and may be due to the availability of observations assimilated into CBHAR
- Hourly frequencies of wind speed and direction were generally consistent station vs. downscaled ERA at three long-term stations along the Beaufort and Chukchi Sea coast

Next Steps:

- Evaluate the downscaled ERA against shorter-term wind records at buoys and field sites
- Compare downscaled historical GCM projections against downscaled ERA

References

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- 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.
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Acknowledgements

Funding for this research was provided by the U.S. Bureau of Ocean Energy Management through Cooperative Agreement M17AC00020 (UAF) and CFDA No. 15.423 (USGS).