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Supplement of

A conditional approach for joint estimation of wind speed and direction under future climates

Qiuyi Wu et al.

Correspondence to: Qiuyi Wu (qiuyi_wu@urmc.rochester.edu)

S1 Wind Direction Evaluation

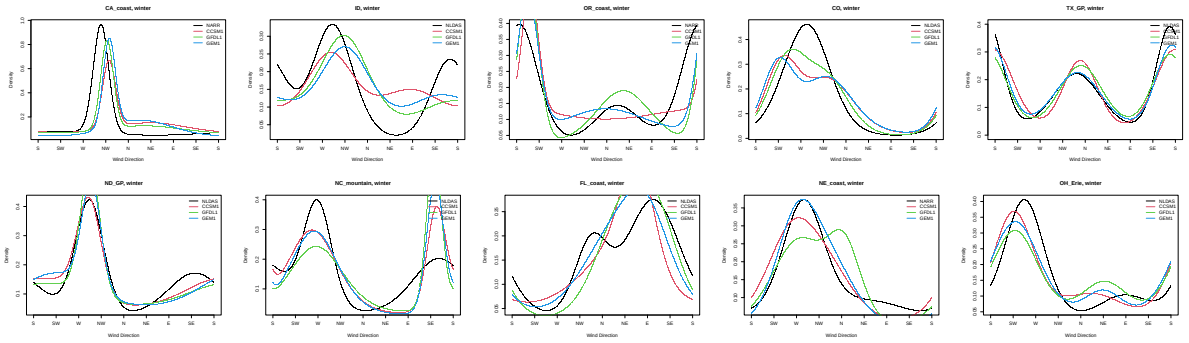

Figure S1: Historical data: fitted von Mises mixtures for data in across 10 locations in **winter**. The black, red, green, blue curves represent benchmark (NARR for offshore and NLDAS for inland), WRF-CCSM, WRF-GFDL, WRF-HadGEM models.

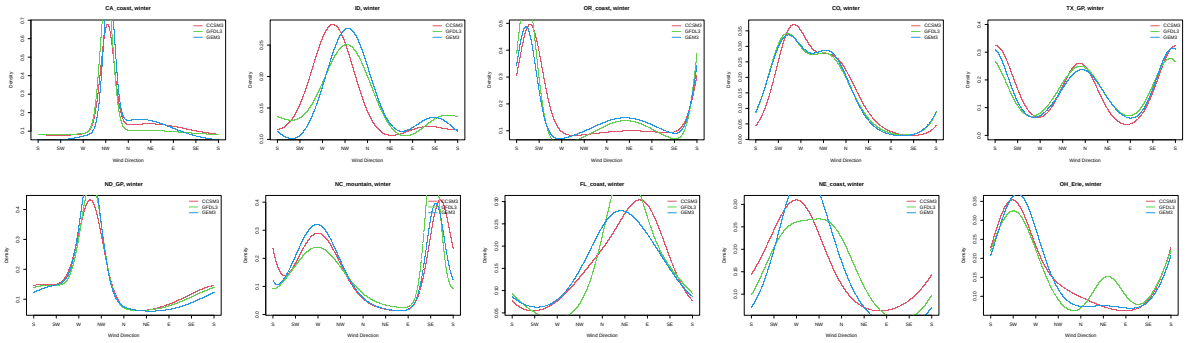

Figure S2: End-of-century projections: fitted von Mises mixtures across 10 locations in **winter**. The black, red, green, blue curves represent benchmark (NARR for offshore and NLDAS for inland), WRF-CCSM, WRF-GFDL, WRF-HadGEM models.

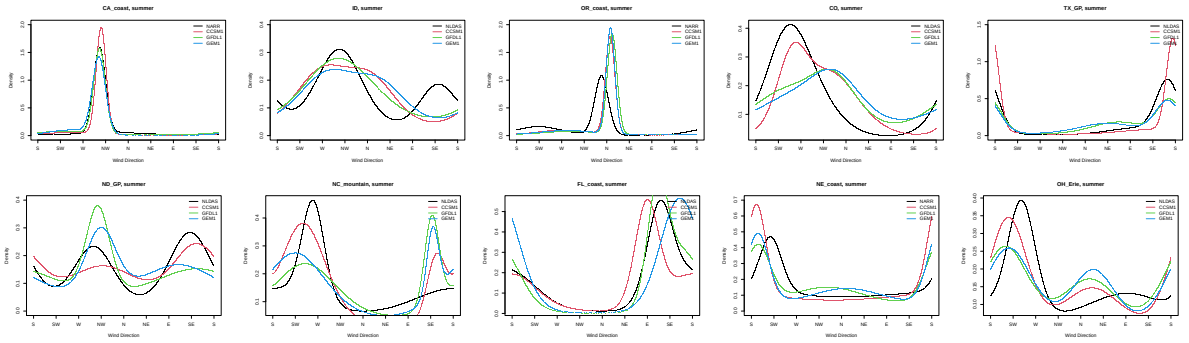

Figure S3: Historical data: fitted von Mises mixtures for data in across 10 locations in **summer**. The black, red, green, blue curves represent benchmark (NARR for offshore and NLDAS for inland), WRF-CCSM, WRF-GFDL, WRF-HadGEM models.

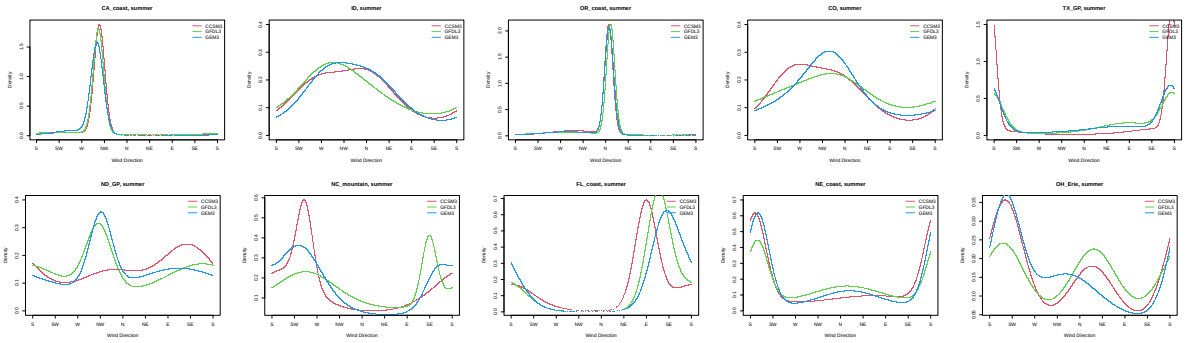

Figure S4: End-of-century projections: fitted von Mises mixtures for data in across 10 locations in **summer**. The black, red, green, blue curves represent benchmark (NARR for offshore and NLDAS for inland), WRF-CCSM, WRF-GFDL, WRF-HadGEM models.

S2 Quantile Regression and Weibull WDR

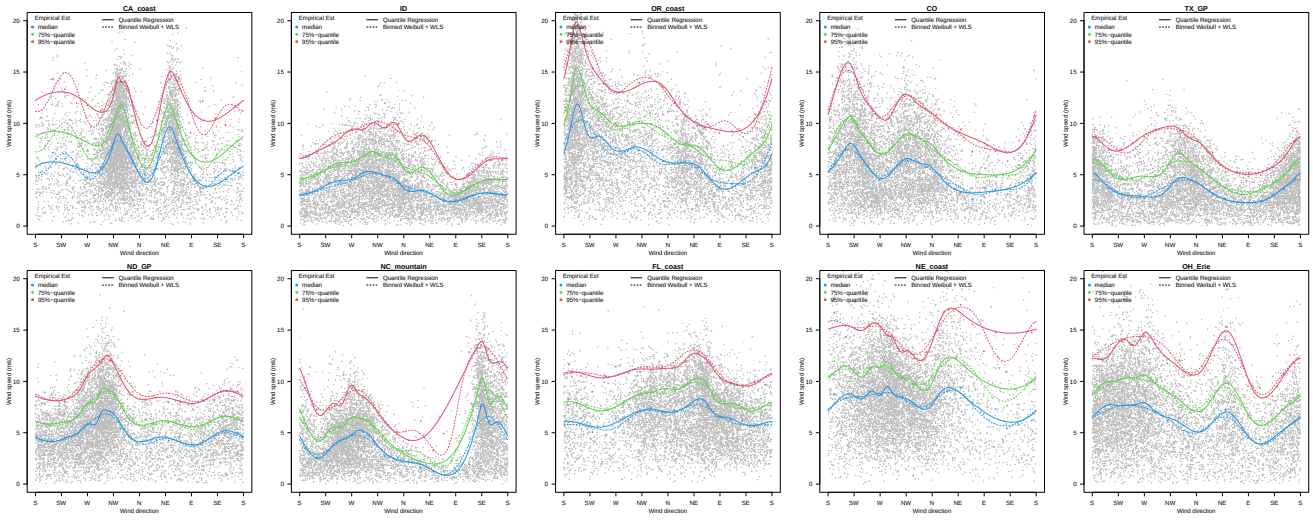

Figure S5: Historical data: estimated 50%, 75% and 95% quantiles (blue, green, red color) by quantile regression (solid lines) and binned Weibull WDR (dotted lines) for WRF-HadGEM data at 10 locations in winter.

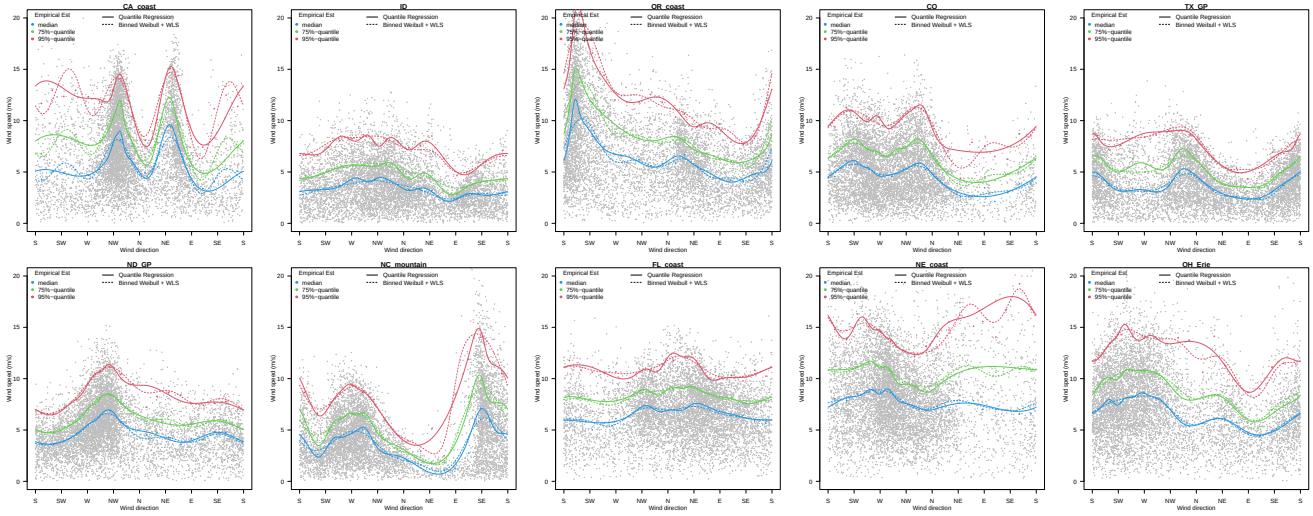

Figure S6: End-of-century projections: estimated 50%, 75% and 95% quantiles (blue, green, red color) by quantile regression (solid lines) and binned Weibull WDR (dotted lines) for WRF-HadGEM data at 10 locations in winter.

S3 Uncertainty Quantification

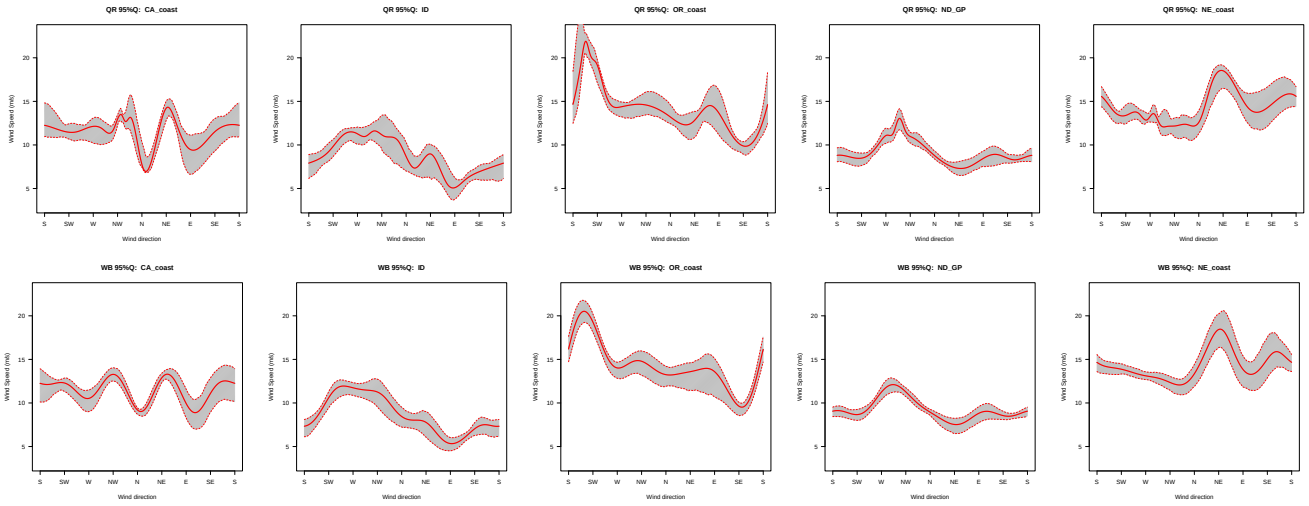

Figure S7: Historical data: Boostraping in 95% quantile with confidence Interval for empirical points at 5 selected locations from WRF-CCSM winter data. Top: Quantile regression; bottom: Weibull WDR

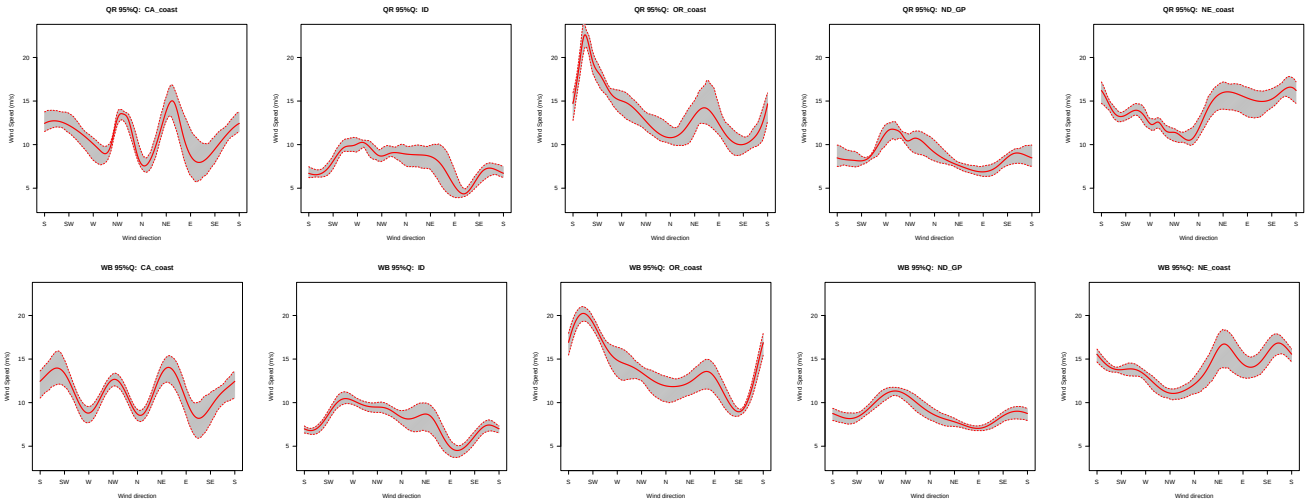

Figure S8: End-of-century projections: Boostraping in 95% quantile with confidence interval for empirical points at 5 selected locations from WRF-CCSM winter data. Top: Quantile regression; bottom: Weibull WDR

S4 Quantile Regression For All WRF Data

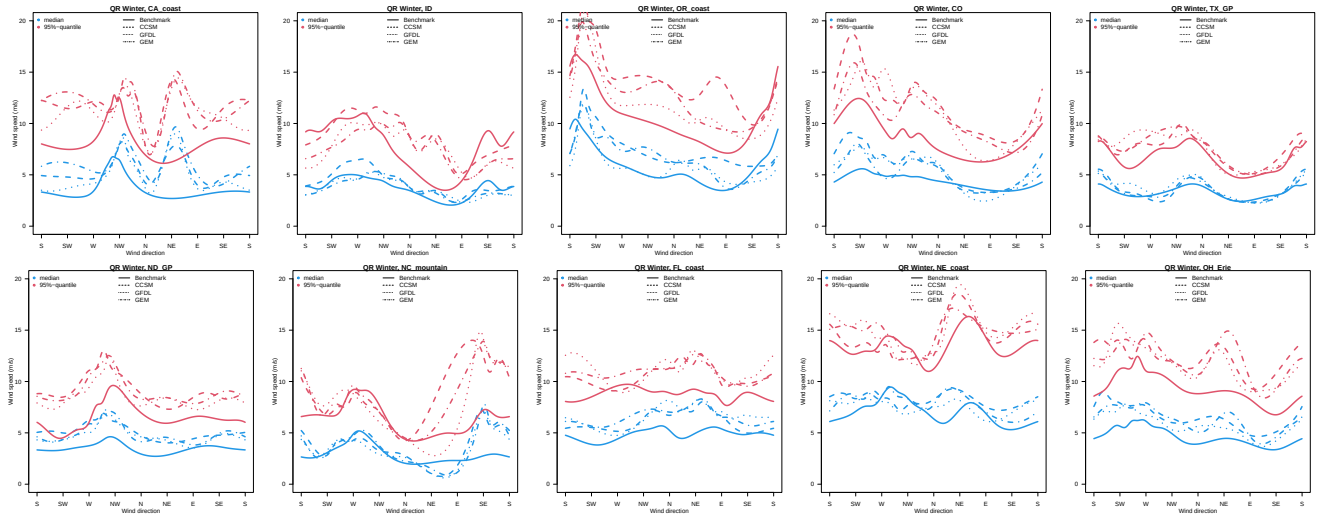

Figure S9: Winter: 50th (blue) and 95th (red) quantiles of wind speed as a function of wind direction for historical period from quantile regression model at 10 locations. The different RCMs are shown with different types of dotted and dashed line, benchmark data are in solid lines (NARR for offshore and NLDAS for inland).

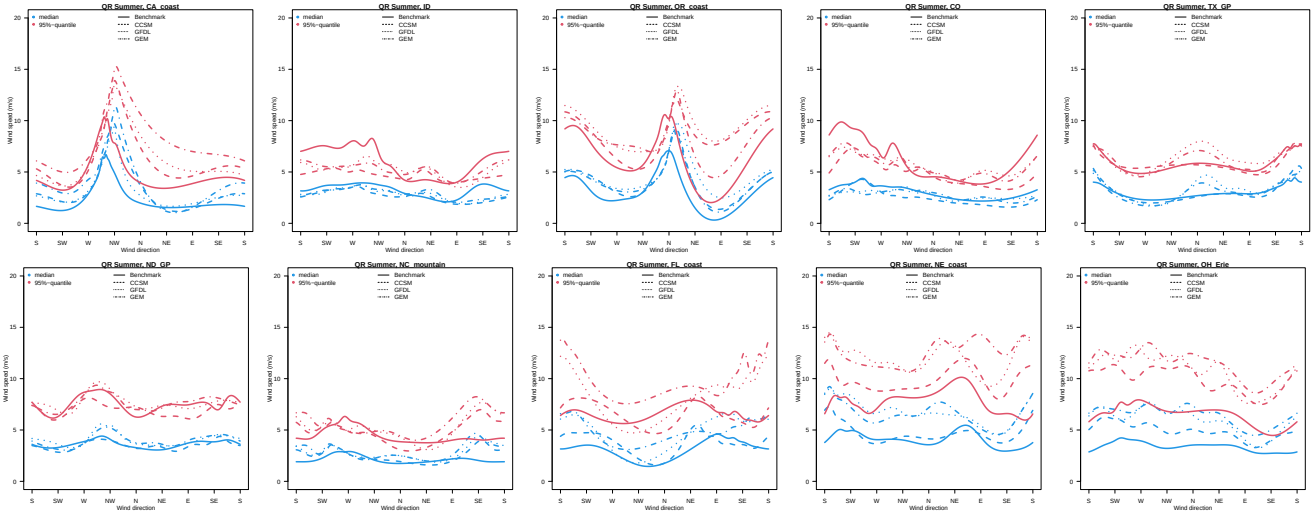

Figure S10: Summer: 50th (blue) and 95th (red) quantiles of wind speed as a function of wind direction for historical period from quantile regression model at 10 locations. The different RCMs are shown with different types of dotted and dashed line, benchmark data are in solid lines (NARR for offshore and NLDAS for inland).

S5 Weibull WDR For All WRF Data

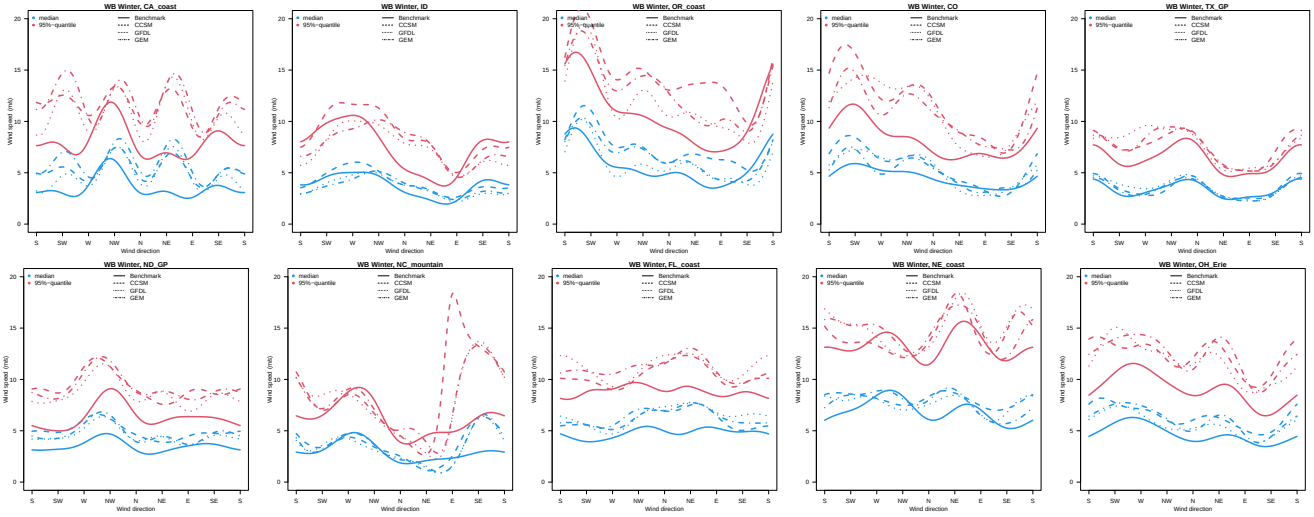

Figure S11: Winter: 50th (blue) and 95th (red) quantiles of wind speed as a function of wind direction for historical period from Weibull WDR model at 10 locations. The different RCMs are shown with different types of dotted and dashed line, benchmark data are in solid lines (NARR for offshore and NLDAS for inland).

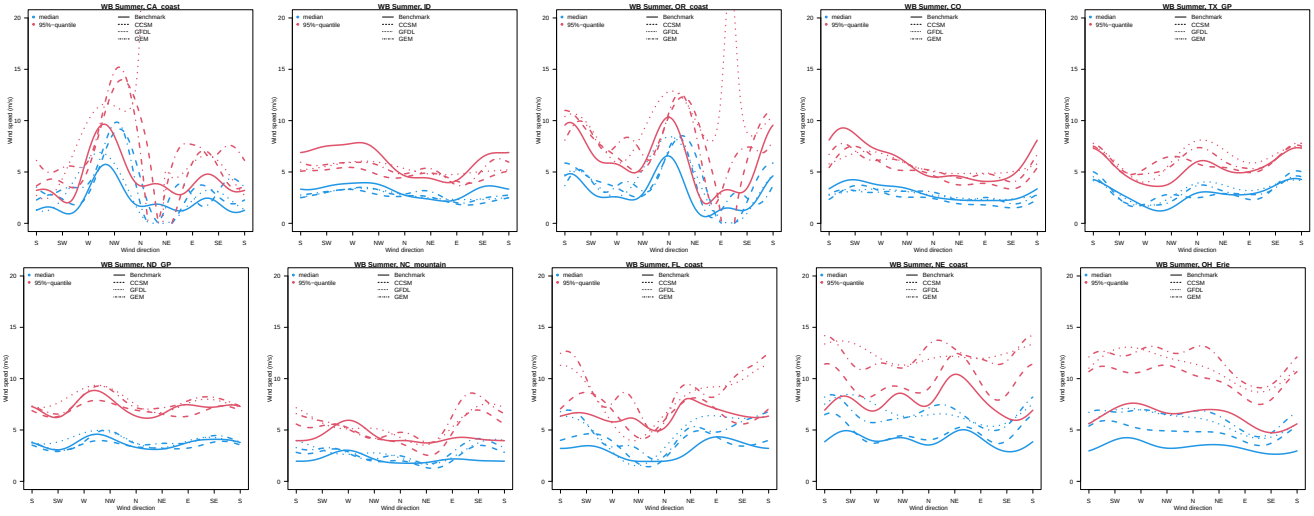

Figure S12: Summer: 50th (blue) and 95th (red) quantiles of wind speed as a function of wind direction for historical period from Weibull WDR model at 10 locations. The different RCMs are shown with different types of dotted and dashed line, benchmark data are in solid lines (NARR for offshore and NLDAS for inland).