The performance of GCMs that participated in the Coupled Model Intercomparison Phase 5 (CMIP5) is evaluated by comparing model outputs with radiosonde observation and reanalysis dataset over North America. CMIP5 models are evaluated for their skill to simulate wind climatology, seasonal cycle, interannual variability and trends at surface (10m), and at pressure levels ranging from 850 hPa to 30 hPa. Analysis of surface wind speed show that internal variability and initial condition have little influence on the surface wind speed. Difference in the surface wind speed between reanalysis and models may be associated with the uncertainty in the land surface characterization. The results also show that CMIP5 models and reanalysis successfully reproduce the observed climatological annual mean zonal wind and wind speed vertical distribution. They capture the observed seasonal zonal, meridional and wind speed vertical distribution with stronger (weaker) wind during the winter (summer) season. However, there is disagreement in the shape and magnitude of meridional vertical wind profiles among CMIP5 models, reanalysis and radiosonde observation. Although CMIP5 models and reanalysis agree with the radiosonde observation in terms of vertical profile of interannual variability, none of the models show statistically significant wind trends throughout the vertical profile. This indicates that detection of trends on local scale is challenging because of small signal to noise ratio problems and quality of the radiosonde systems used for wind speed measurements. Associated with trends, the number of years required to detect a statistically significant wind trends using a radiosonde wind measurements is addressed. Overall, it is found that the zonal wind trend mirrors the wind speed trend while the number of years needed to obtain statistically significant trend decreases with increasing pressure level except for the upper troposphere. In the upper troposphere (~200 hPa), a relatively higher number of years is needed to detect a trend for both zonal and wind speed compared to meridional wind.