ADDENDUM A

Meteorological Evaluation of CUP

Evaluation of the Validity of Meteorological Data Presented in NUREG-1580

Hydro Resources, Inc.
Church Rock, Unit 1, and Crownpoint Sites

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Introduction

In 1997 a Final Environmental Impact Statement (FEIS) was issued for three proposed in-situ uranium recovery (ISR) project sites in northwestern New Mexico (NUREG-1508, 1977). These sites include the Church Rock Site, the Unit 1 Site (near Crownpoint) and the Crownpoint site. The three sites are located east-northeast of Gallup, New Mexico at approximate distances of 10, 30, and 35 miles respectively. The FEIS recognized historical weather data from Gallup (1976-1980) as being representative of meteorological conditions at the proposed project locations.

For purposes of NRC licensing, the most critical meteorological parameters are wind speed, wind direction, and atmospheric stability (which can be derived from wind speed and variability in wind direction). These parameters are used in the MILDOS-Area dispersion model. NUREG-1508 states, "Weather data used in the MILDOS-Area simulations were obtained from U.S. Department of Commerce records maintained for Gallup, New Mexico. Gallup is located about 16 km (10 mi) southwest of the Church Rock site, and 56 km (35 mi) from Crownpoint. Gallup is the nearest active weather station maintaining the complete weather information necessary to run the MILDOS program."

NUREG-1569 requires NRC to review data "collected onsite or at nearby meteorological stations. The data to be reviewed include (1) National Weather Service station data, including locations of all National Weather Service stations within . . . [a 50-mile] radius; . . . [or] (2) On-site meteorological data . . . if National Weather Service data representative of the site are not available."

In the absence of on-site meteorological data, the Gallup, New Mexico data meet the proximity requirement of NUREG-1569. The purpose of the following report is to demonstrate that the 1976-1980 wind data from Gallup adequately represent long-term wind characteristics at the project sites. To this end, similar wind patterns are first shown between Gallup and the Crownpoint location over a one-year reference period. Crownpoint wind data were available from a separate project for the period of September 1978 to September 1979 (CDM, 1980). Second, wind data during the 1978-79 period at Gallup are shown to be similar to the 1976-1980 Gallup data cited in the FEIS. Third, wind data from 1976-1980 at Gallup are shown to be representative of current long-term National Weather Service data from Gallup (1996-2010).

Spatial Comparison for Reference Year

Figures 1 and 2 compare wind roses for Crownpoint and Gallup during a one-year period. Both wind roses were taken from the Environmental Report assembled on behalf of Mobil Oil Corporation in connection with the proposed Crownpoint Uranium Mill Project (CDM, 1980). It can be seen that winds from the west-southwest and southwest directions were dominant at both sites during this period. The wind speed distributions from the two locations are also comparable.

Figure 1 Crownpoint Wind Rose for Reference Year

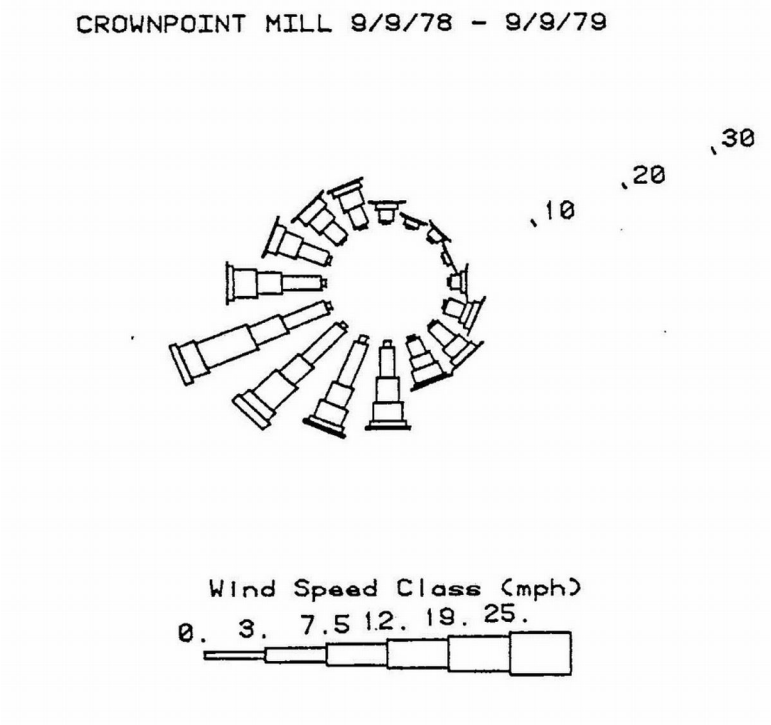
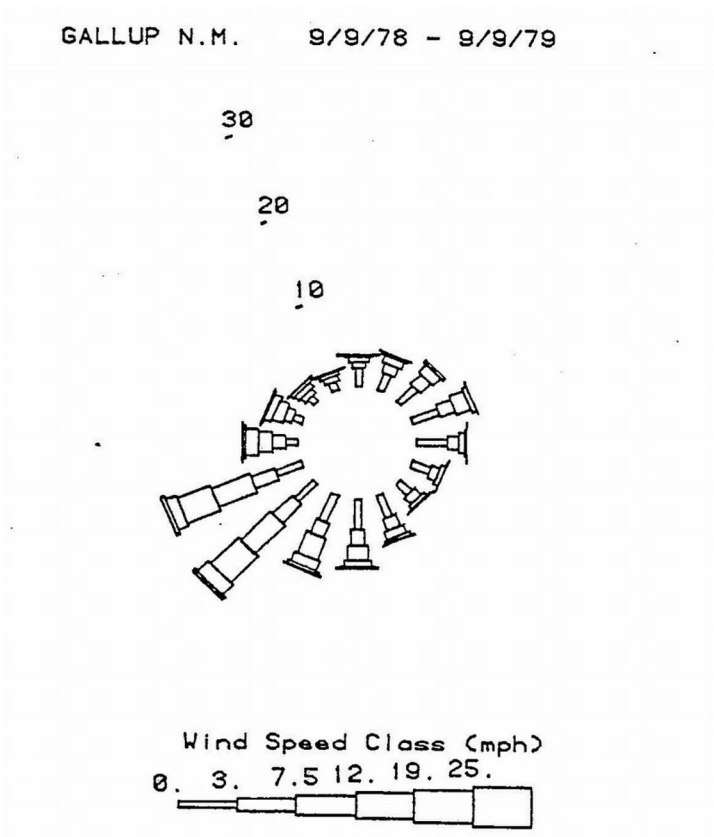


Figure 2 Gallup Wind Rose for Reference Year



The wind roses in Figures 1 and 2 also demonstrate some differences. As explained in the Environmental Report (CDM, 1980), local topographic features may account for these differences. For example, a nocturnal pattern is evident at Crownpoint during the summer months that does not exist at Gallup. Downslope convection breezes typically blow from the higher mesas during the nighttime and early morning. The topography rises nearly 1,300 ft. immediately to the south of Crownpoint, whereas the topography surrounding Gallup (and Church Rock) is milder.

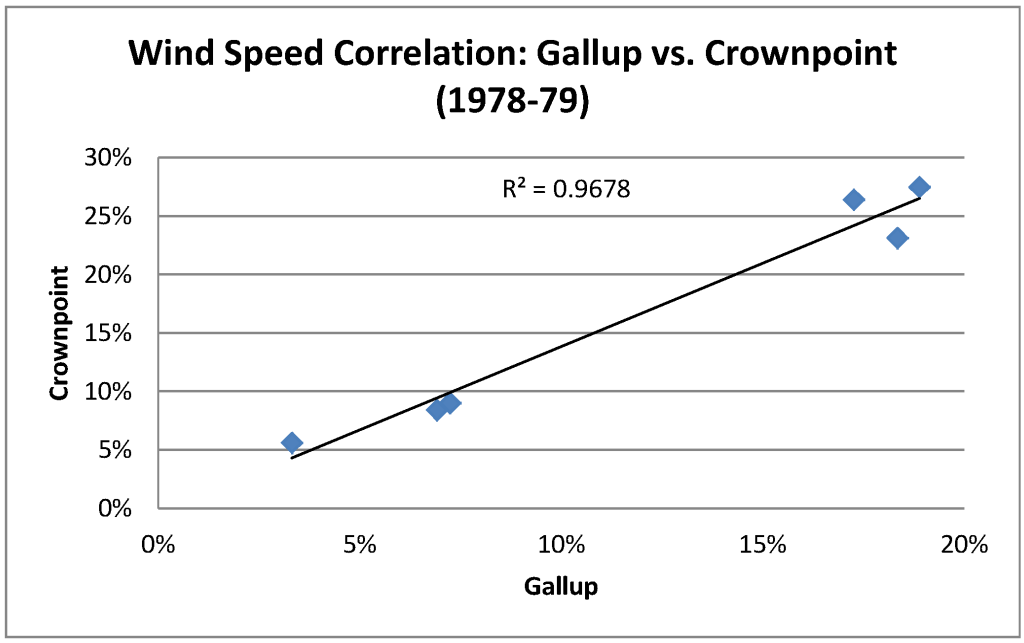
To quantify the similarities between wind patterns at Gallup and Crownpoint, it is useful to perform correlation analyses between wind speed distributions and between wind direction distributions at the two locations. For the joint frequency wind distribution used in the MILDOS-AREA model, wind speeds are divided into six classifications ranging from mild (0 – 3 mph) to strong (> 24 mph). Likewise, wind directions are divided into 16 categories corresponding to the compass directions illustrated in the wind roses.

The percent of the time that winds occur in each of the six wind speed categories can be calculated to produce a wind speed frequency distribution. The percent of the time that winds blow from each of the sixteen directions can be calculated to produce a wind direction frequency distribution. For each parameter, the one-year Crownpoint and Gallup distributions can then be compared. Linear regression analysis provides a useful tool to assess the degree of correlation between the two locations.

Figure 3 presents this correlation for the wind speed distributions. Each point represents one of the six wind speed classes. The x coordinate corresponds to the percent of the one-year period during which the wind speed fell in a given class at Gallup, while the y coordinate corresponds to the percent of the one-year period during which the wind speed fell in that same class at Crownpoint.

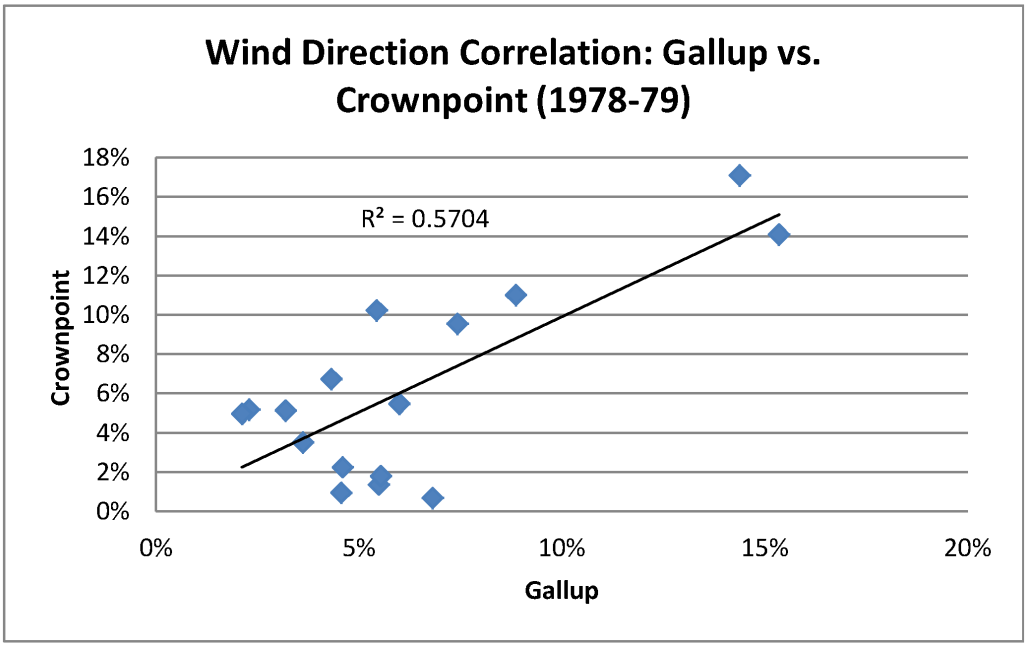
The regression line in Figure 3 represents the least-squares fit to the six data points. The corresponding R^2 value (coefficient of determination) of 96.8% implies very strong linear correlation (correlation coefficient R is 0.98).

Figure 3 Spatial Correlation of Wind Speed Distribution



A similar analysis can be performed for wind direction frequencies. Figure 4 presents this correlation between Gallup and Crownpoint. Each point represents one of the sixteen wind direction categories. The x coordinate corresponds to the percent of the one-year period during which the wind blew from a given direction at Gallup, while the y coordinate corresponds to the percent of the one-year period during which the wind blew from that same direction at Crownpoint.

Figure 4 Spatial Correlation of Wind Direction Distribution



The regression line in Figure 4 represents the least-squares fit to the sixteen data points. The corresponding R^2 value of 57.0% implies moderate linear correlation (correlation coefficient R is 0.76). As explained above, the correlation is likely weakened by differences in local topography.

Figures 3 and 4 demonstrate rough similarity between Gallup and Crownpoint during the reference year 1978-79. Based on separation distance and topography, wind patterns at Crownpoint are probably more different from Gallup than those at Church Rock. Stated differently, the similarities in wind patterns shown between Crownpoint and Gallup are apt to be stronger for Church Rock.

Short-Term Temporal Comparison for Gallup

Temporal representativeness between the Crownpoint monitoring year of 1978-79 and the historical period (1976-1980) referenced in the FEIS can be demonstrated in similar fashion. Figure 5 shows the linear correlation between wind speed distributions at Gallup for these two periods. The R^2 value of 95.6% indicates very strong correlation.

Figure 5 Correlation of 1-Yr and Historical Wind Speed Distributions

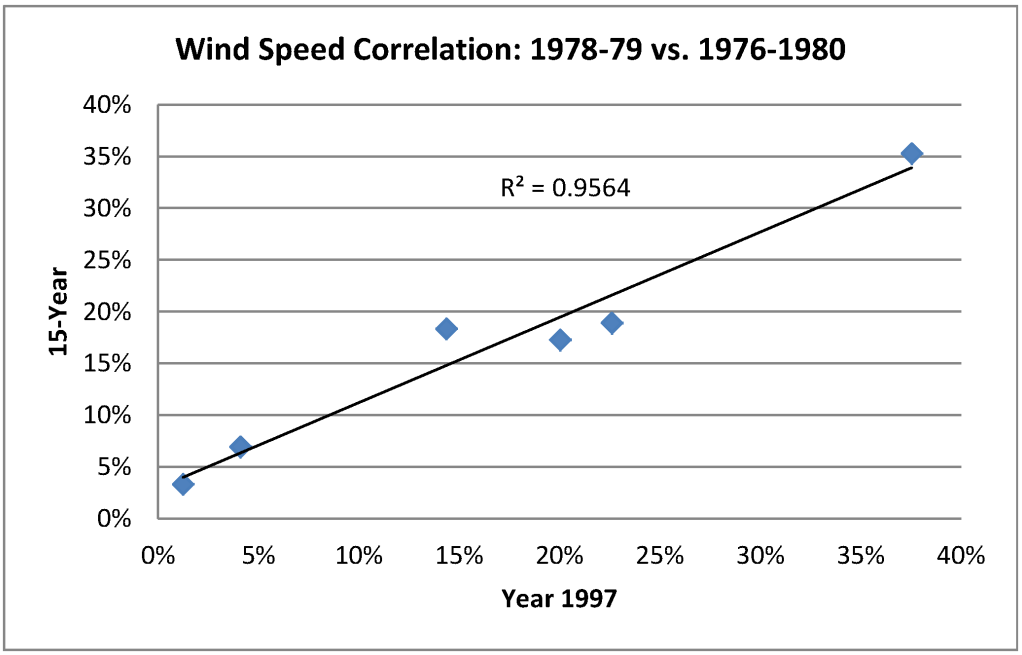
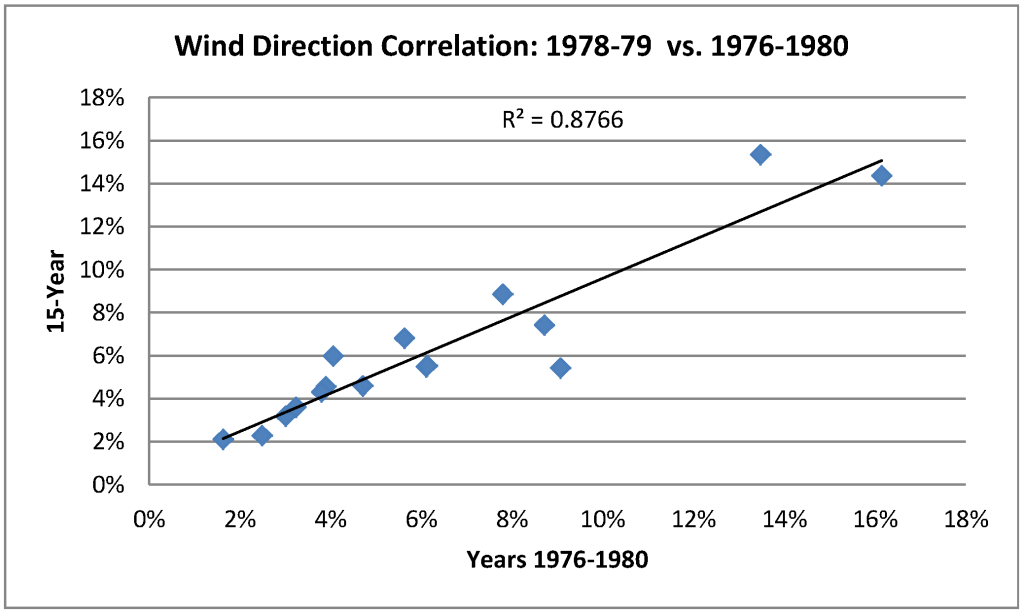


Figure 6 shows the linear correlation between wind direction distributions at Gallup for these two periods. Again, the R^2 value of 87.7% indicates a strong correlation.

Figure 6 Correlation of 1-Yr and Historical Wind Direction Distributions



Figures 5 and 6 demonstrate that winds at Gallup during the Crownpoint monitoring year were quite similar to winds at Gallup during the historical period used in the FEIS.

Long-Term Temporal Comparison for Gallup

If wind data from 1978-79 are representative of the 1976-80 period, it remains to be demonstrated that 1976-80 is representative of the long term at Gallup. Hourly wind data at Gallup are available from the National Climate Data Center for 1996 to 2011 (NCDC 2011). These data were downloaded, processed and analyzed for this purpose.

Figure 7 shows the Gallup wind rose for 1976-80 as presented in the FEIS. Figure 8 shows the Gallup wind rose for the 15-year period ending 12/10/2011. Figure 9 compares wind direction frequencies between the two periods side by side. Qualitatively, the wind roses and frequency plot suggest strong similarities between the two periods.

It should be noted that the NCDC wind speeds were generated based on an anemometer threshold of 3 mph and the average wind directions had a resolution of 10° - both of which represent very rough specifications for hourly wind data. These same quality control parameters are not known for the FEIS wind data, but dissimilar thresholds and resolutions might explain some of the differences between Figures 7 and 8 and between the wind direction frequencies in Figure 9.

Figure 7 Gallup Wind Rose 1976-1980

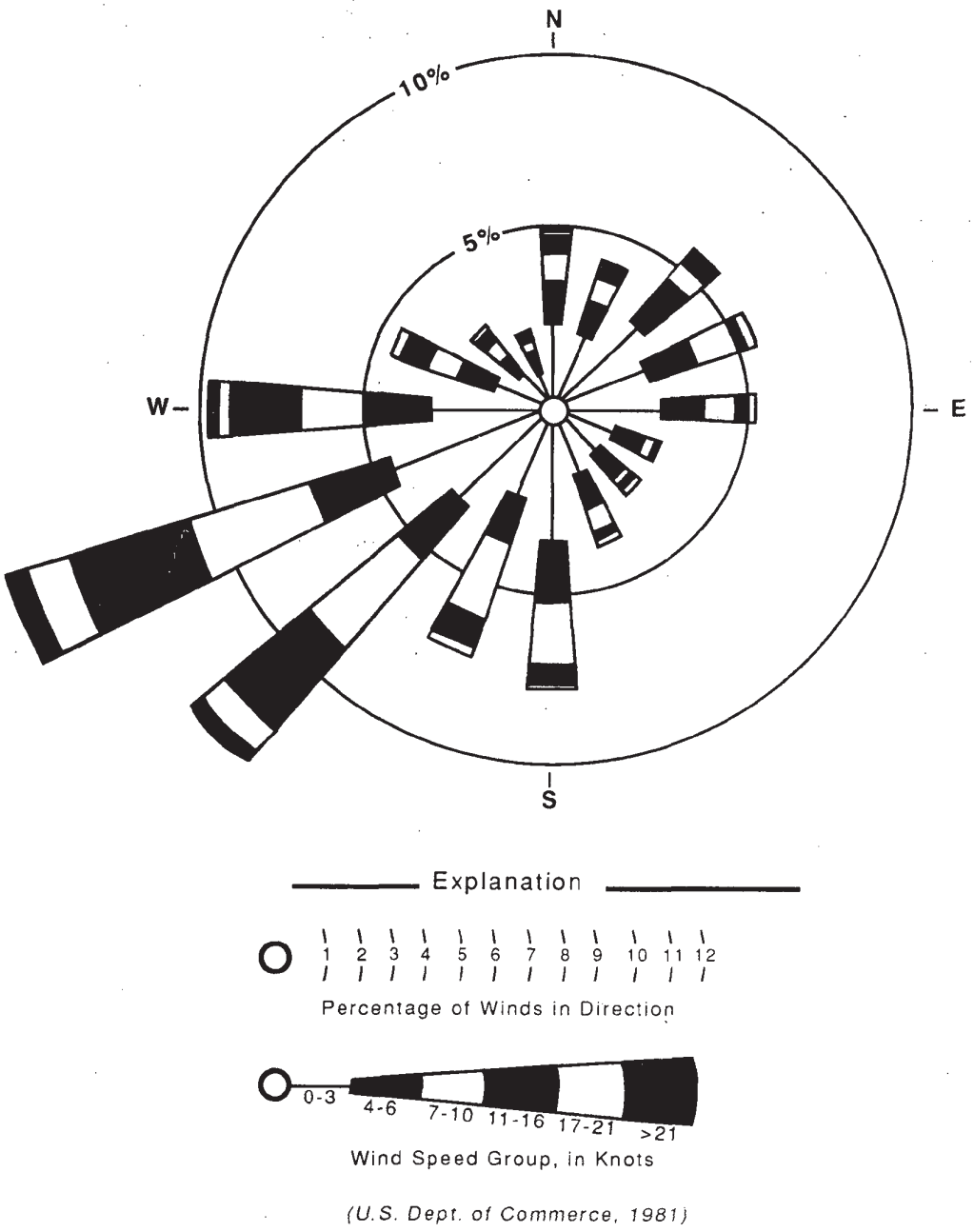


Figure 3.1. Wind rose for Gallup, New Mexico—average annual conditions, 1976–1980. *Source:* U.S. Department of Commerce 1981.

Figure 8 Gallup Wind Rose 1996-2011

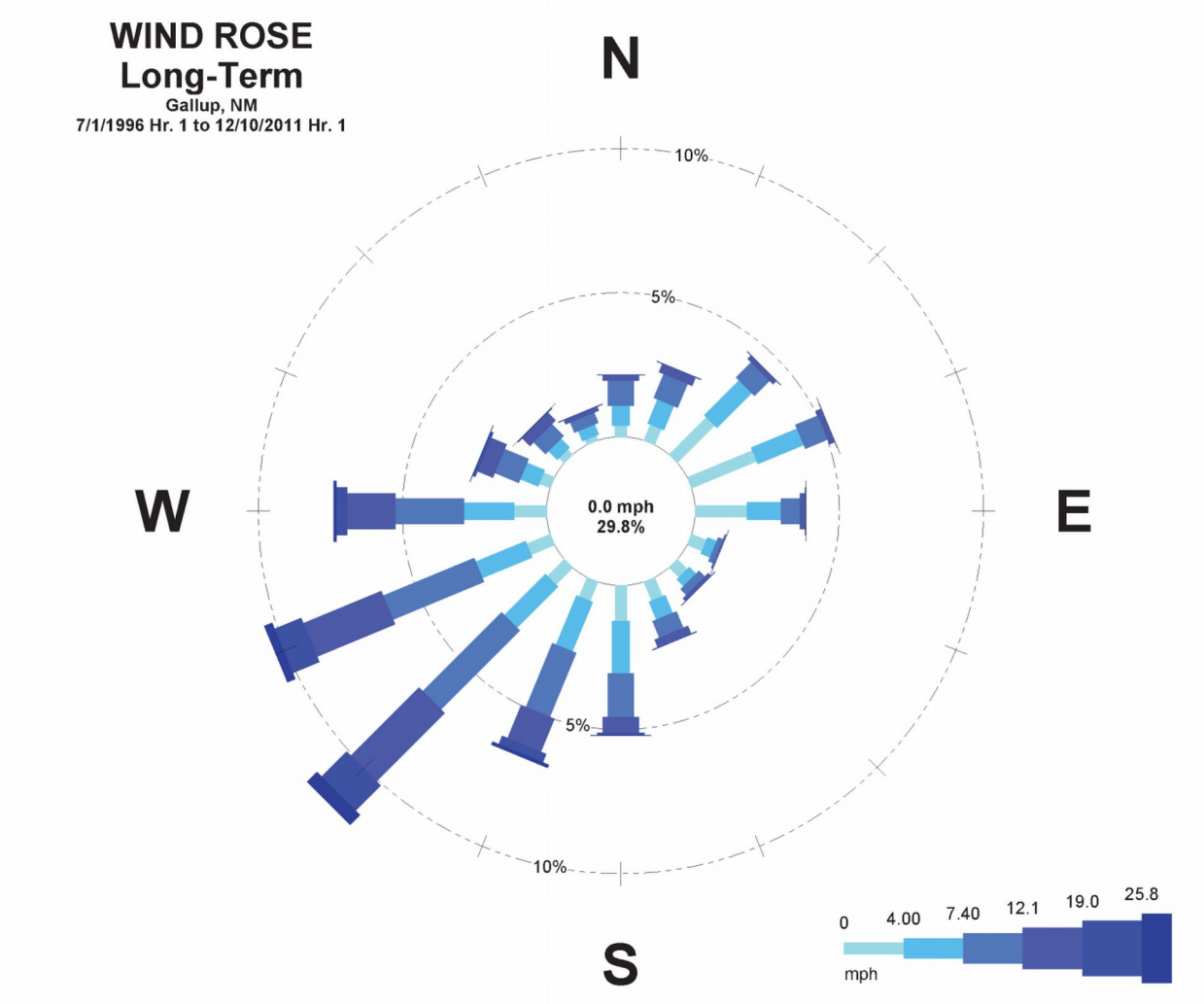
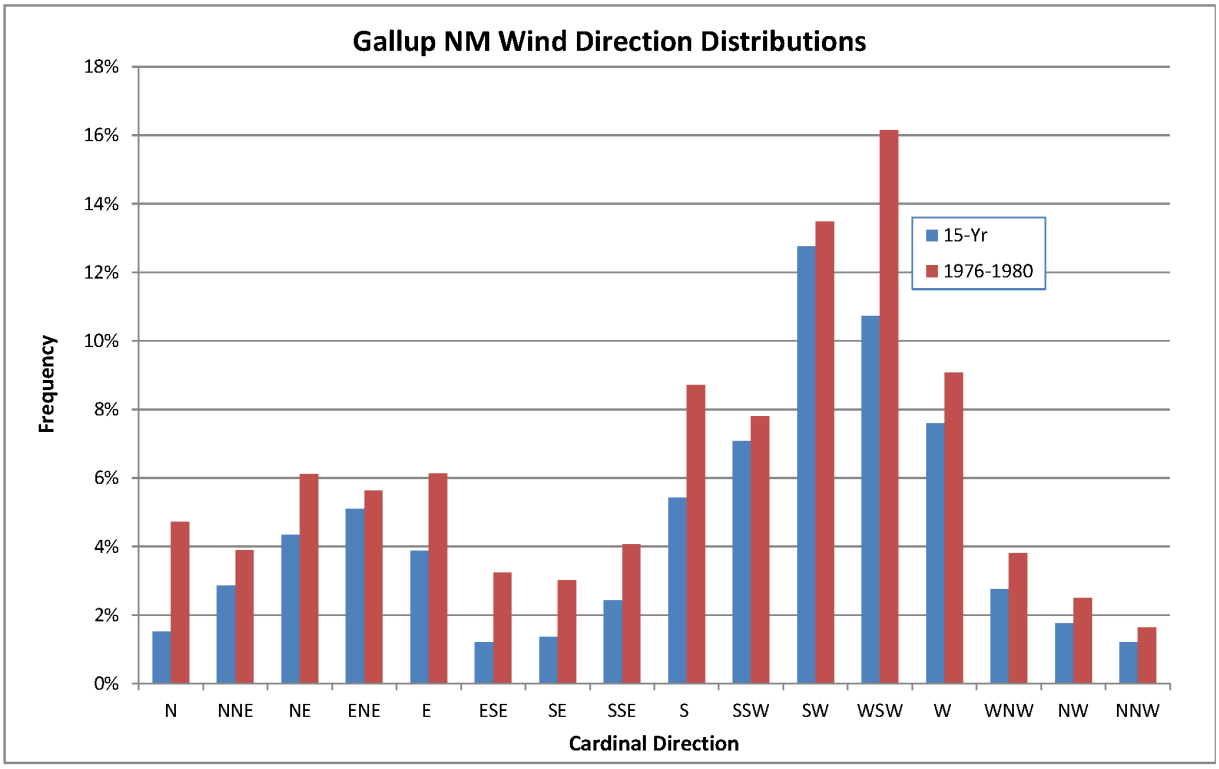


Figure 9 Long-Term (15-Yr) vs. Historical (5-Yr) Wind Direction Distributions



Despite these limitations, a quantitative analysis similar to those presented above shows strong correlation between the 1976-1980 period and the 15-year period ending 12/10/2011. Figure 10 correlates wind speed distributions for the two periods, showing an R^2 of 97.9%. Figure 11 correlates wind direction distributions for the two periods, showing an R^2 of 97.0%.

Figure 10 Gallup Wind Speed Correlation

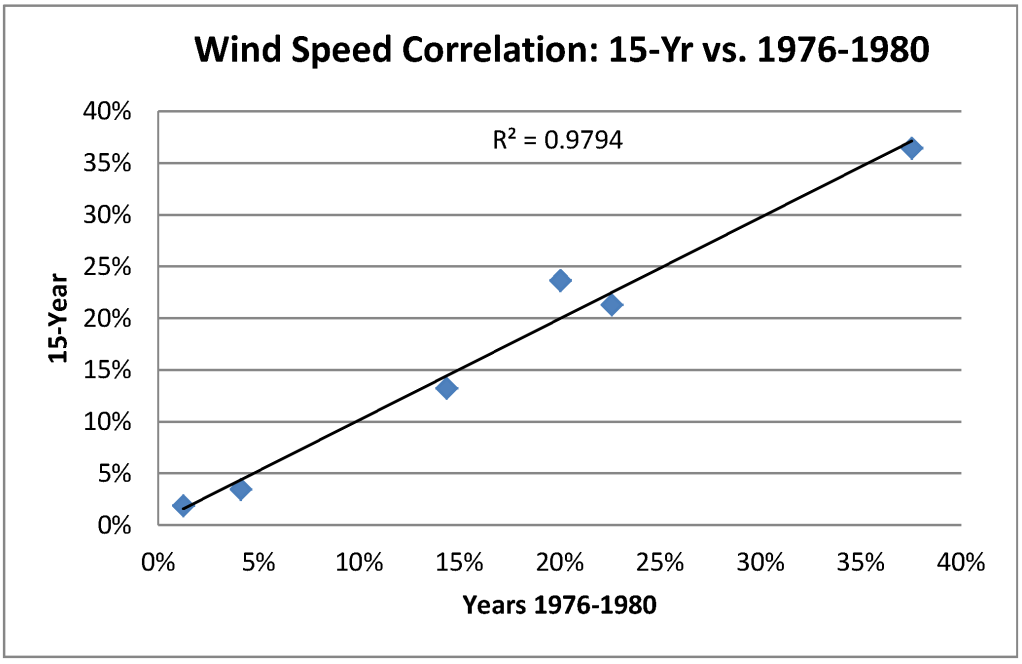
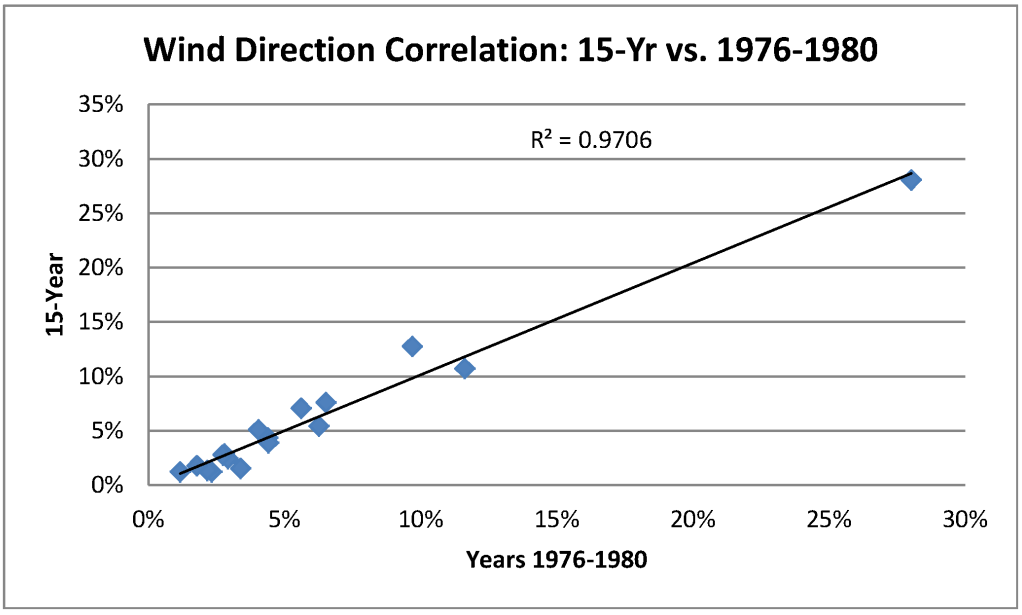


Figure 11 Gallup Wind Direction Correlation



To some degree the high coefficients of determination in Figures 10 and 11 may reflect the averaging effect of the 5-year and the 15-year periods (even though these periods are separated by two or three decades). It is useful to note, however, that any single year also provides a reliable representation of the long term.

This fact was discovered by performing linear correlations between individual years from 1997 to 2010, and the 15-year period from 1996 through 2011. Figure 12 shows

that yearly wind speed distributions correlated strongly with the15-year distribution, with R^2 values ranging from 85% to 98%.

Figure 12 Gallup Annual Wind Speed Correlations

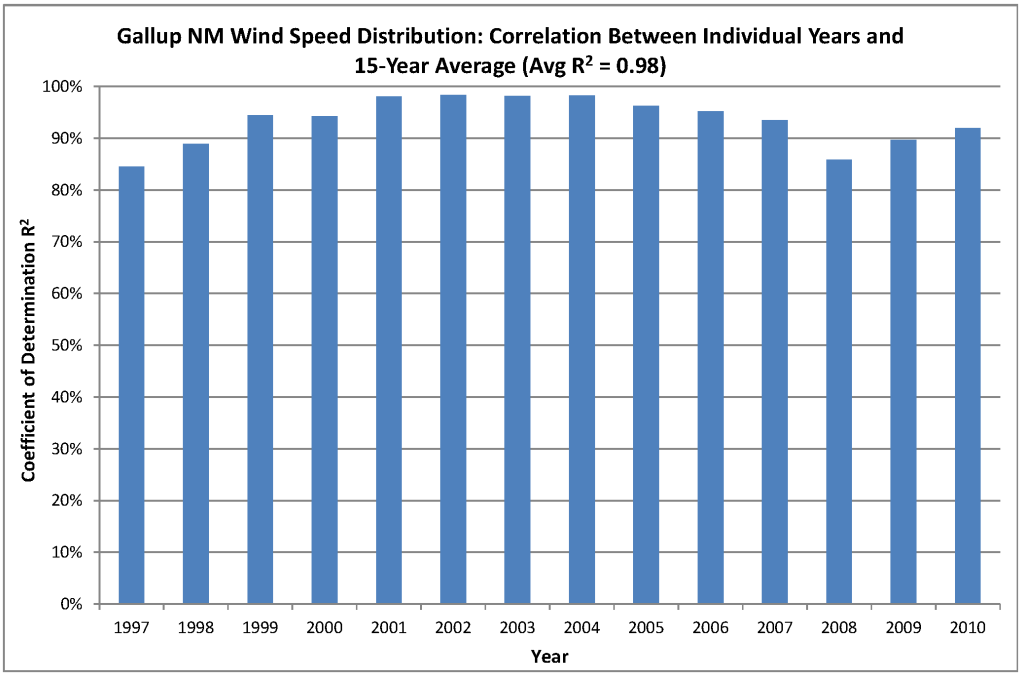
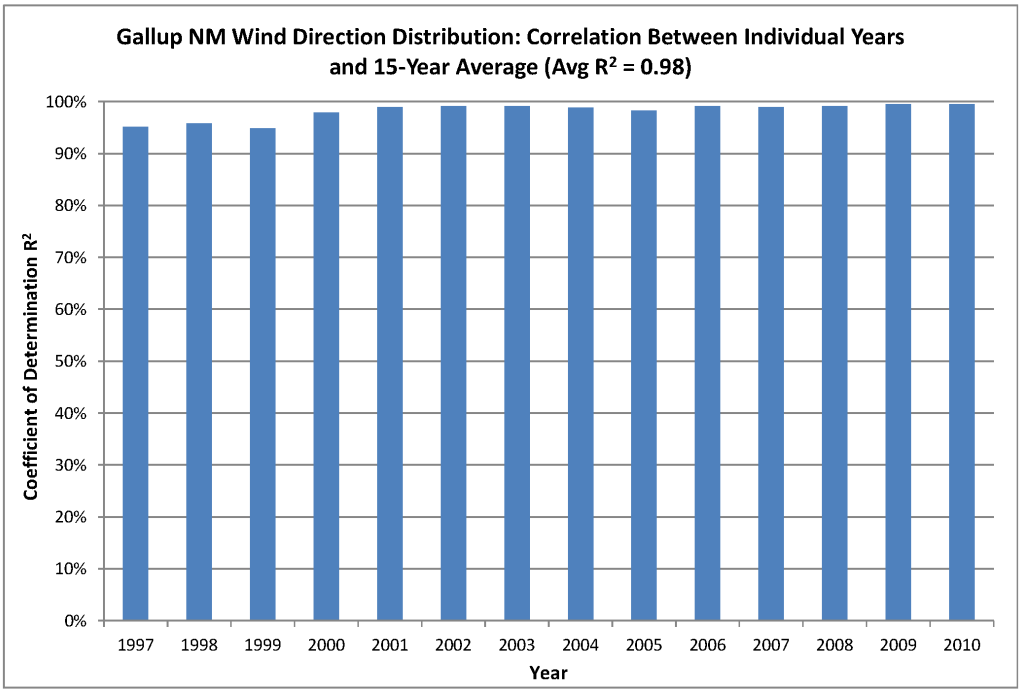


Figure 13 shows even stronger correlations between wind direction distributions, with R^2 values ranging from 95% to 99%.

Figure 13 Gallup Annual Wind Direction Correlations



Conclusions

Temporal correlations of hourly wind data from Gallup, New Mexico demonstrate that wind data from any year or combination of years represent long-term wind conditions quite reliably. This is true of both wind speeds and wind directions.

A more moderate spatial correlation has been demonstrated between the Crownpoint site and the Gallup site for the same, one-year period of record. Spatial correlations of wind data in general tend to be less reliable than temporal correlations due to the effects of local topography. Notwithstanding this tendency, the evidence presented in this analysis supports the similarity between wind patterns at the two locations. Moreover, since Crownpoint lies farther from Gallup than Church Rock and exhibits a greater departure from Gallup's surrounding surface topography the similarities between the Church Rock site and Gallup are expected to be even more pronounced.

Hourly wind speed, wind direction, and direction variability form the meteorological bases for dispersion modeling using MILDOS-Area. Given the need to model the entire project area, which spans a distance of some 25 miles, there is little reason to believe that on-site data from any one of the three project sites would be more representative of this area than Gallup wind data.

References

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2. NUREG-1569, “Standard Review Plan for In Situ Leach Uranium Extraction License Applications.” Washington, DC: U.S. Nuclear Regulatory Commission. June 2003.
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4. NCDC, “Quality Controlled Local Climatological Data,” National Climate Data Center. December, 2011. http://cdo.ncdc.noaa.gov