Evaluation of the Accuracy of MM5/CALMET Generated Wind Fields in Southwestern Wyoming

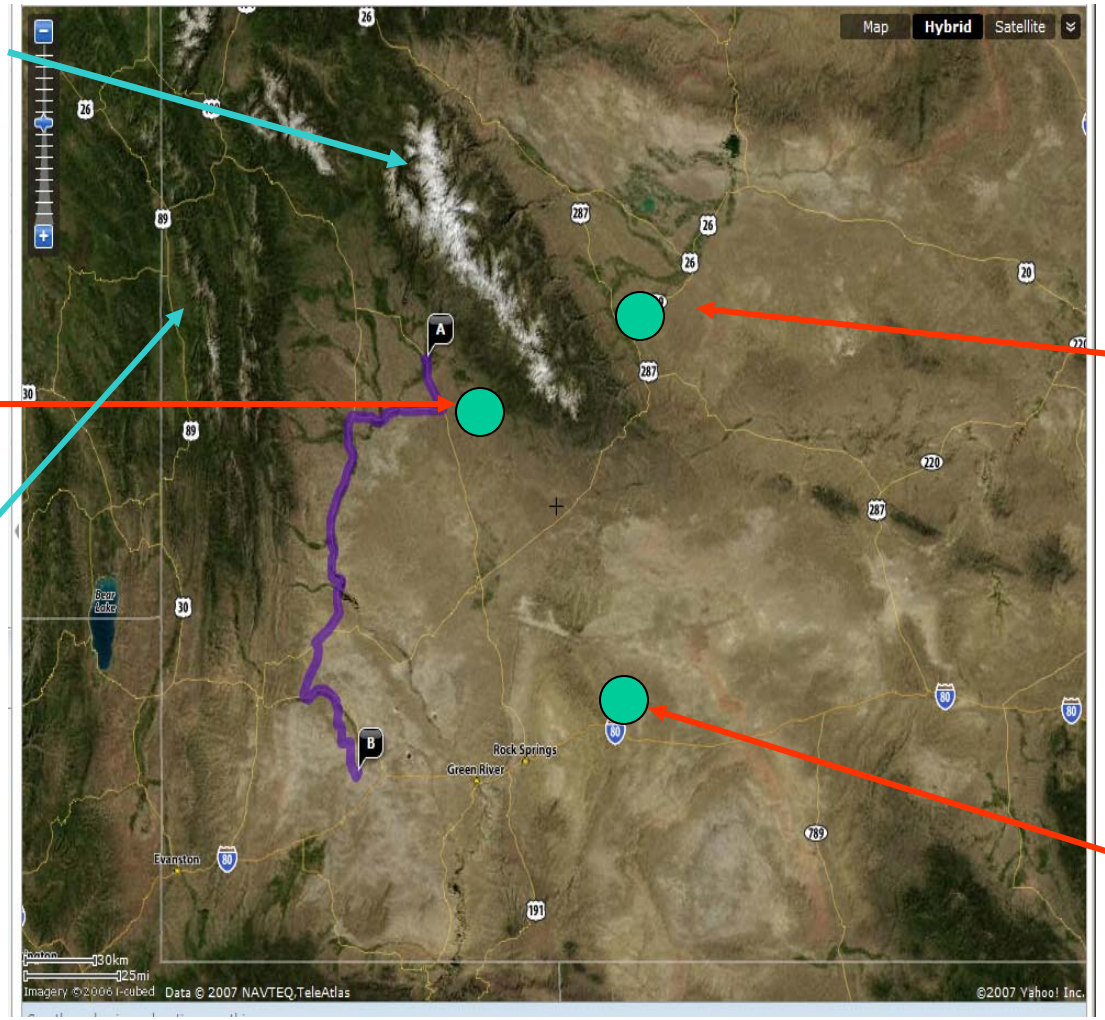
D.N. Blewitt, CCM

Comments on behalf of the
American Petroleum Institute

Importance of Accurate Meteorological Modeling Results

- For conducting regional air quality analyses for AQRVs and ozone, accurate meteorological modeling results are imperative
- Because Class I Areas are a concern, accurate estimates of wind direction are necessary
- Because of the importance of chemical reactions, accurate estimates of wind speed are necessary

Southwest Wyoming Geography



MM5 Results Available for CALMET Input

- MM5 was run as part of the SWWYTAF analysis using a 36 kilometer grid for the year 1995 (EarthTech, 2001The Southwest Wyoming Regional CALPUFF Air Quality Modeling Study)
- MM5 was run for 2002 using a 12 kilometer grid (Bureau of Land Management, 2007, Moxa Arch Area Infill Gas Development Project)
- MM5 was run for for Southwest Wyoming for the year 2006 using a 4 kilometer grid – CALMET was not run (Environ 2008)

36 and 12 Kilometer CALMET Analysis

- MM5 was used as the initial guess field for CALMET
- In addition to MM5, CALMET used 22 surface stations and 5 upper air stations
- The modeling domain was 464 km (east-west) by 400 km (north-south)
- The grid size used in CALMET was 4 kilometers

Jonah Meteorological Data

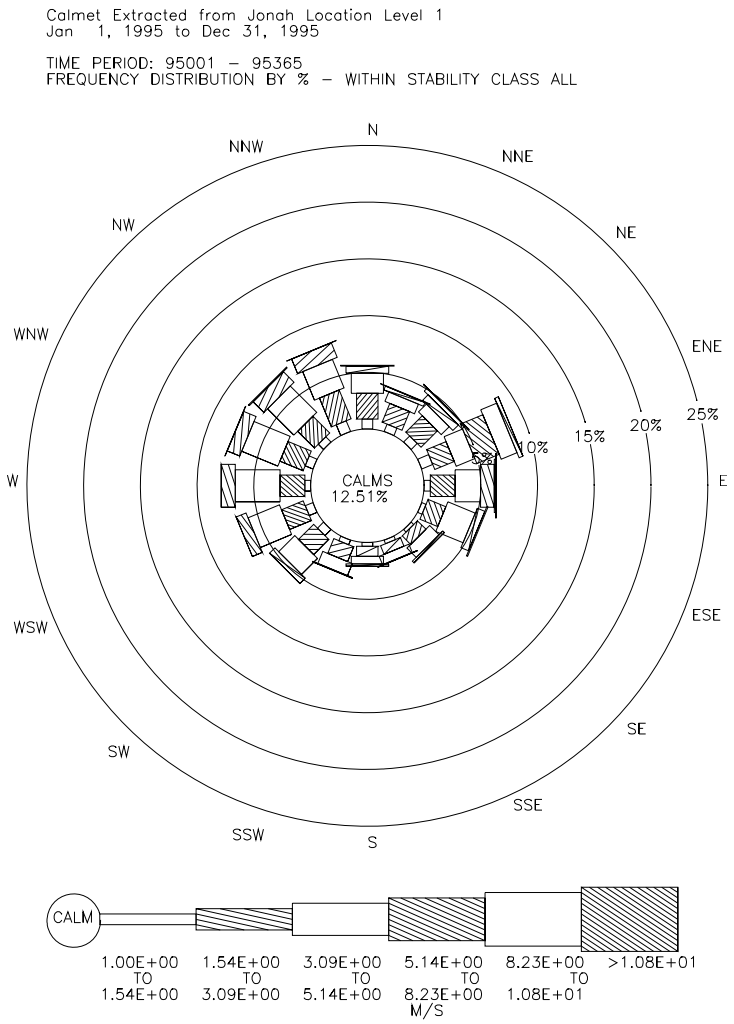
- Data collected 1999 to 2004
- 10-meter tower
  - Wind speed
  - Wind direction
  - Temperature
  - Sigma theta
- Data recovery in excess of 99 percent
- QA/QC calibrations and audits performed according to EPA Guidelines

Analysis Technique

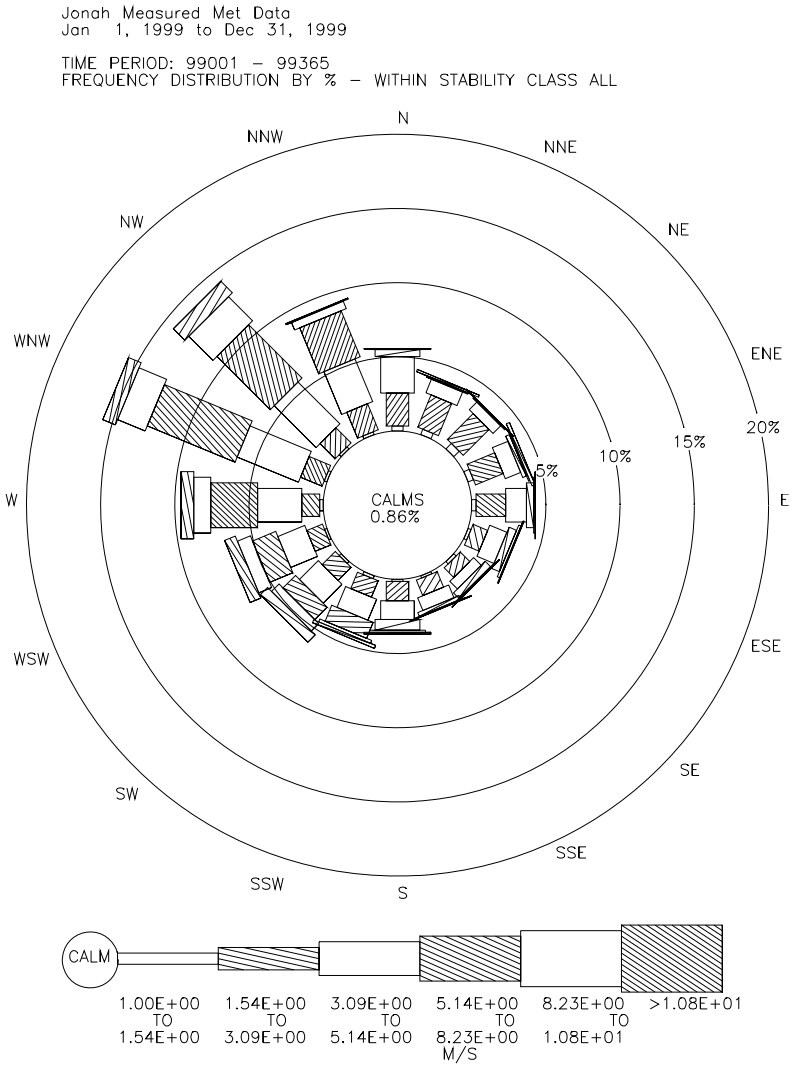
- CALMET was run and ISC met data sets for the Jonah and Lander sites were extracted
- Compared extracted wind rose to measured wind rose
- Comparison between MM5/CALMET is based on pairing in space but not time
- Operational evaluation
- Qualitative comparison of model output to monitored data

36 Kilometer Comparison

Jonah MM5/CALMET Predicted



Jonah Observed



Comparison of MM5 Wind Direction to CALMET Wind Direction
36 Kilometer MM5 Run

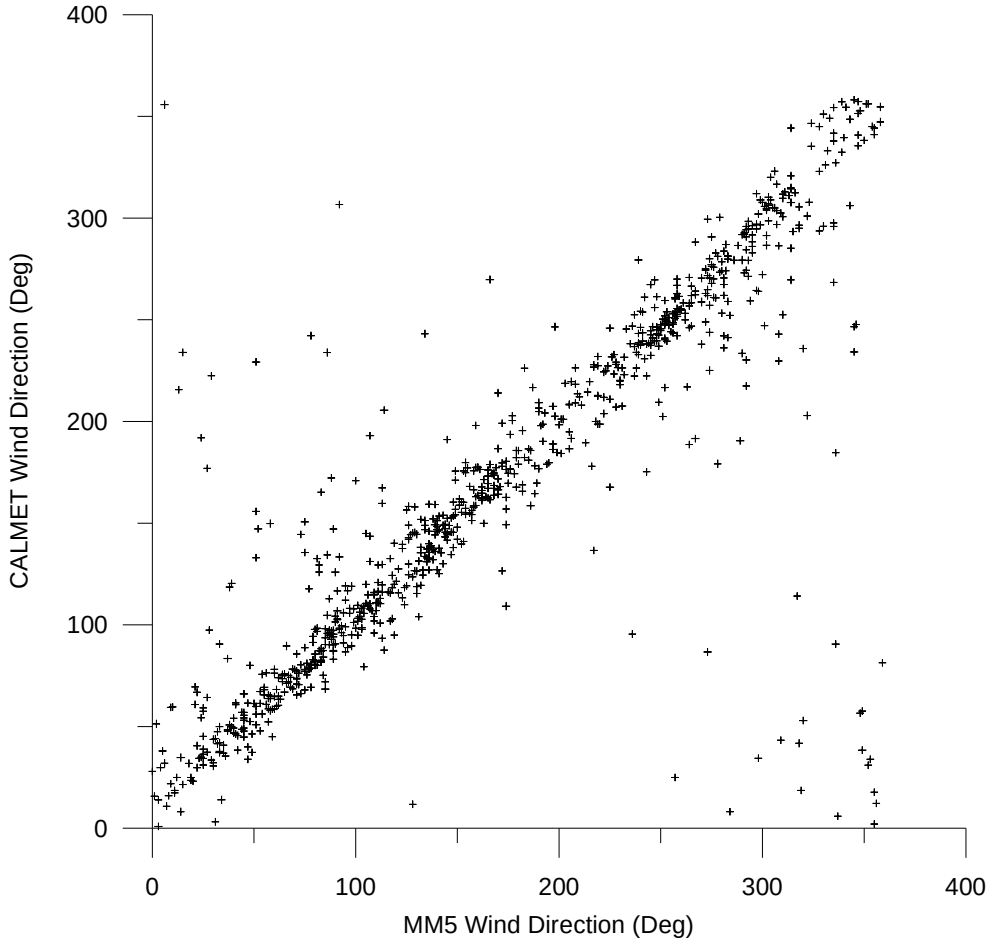
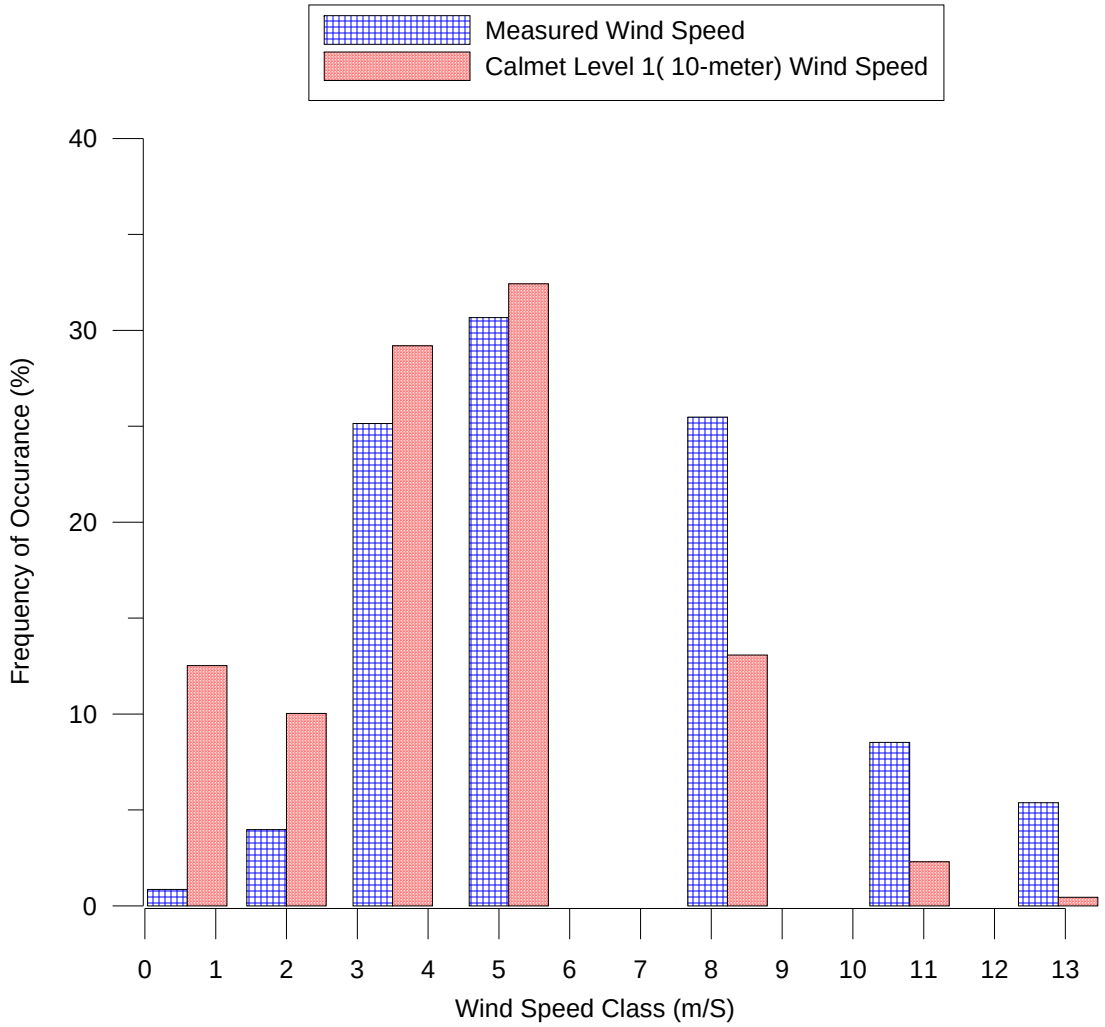


Figure 11. MM5 wind Direction vs Calmet for Wind Speeds > 1.0 m/s

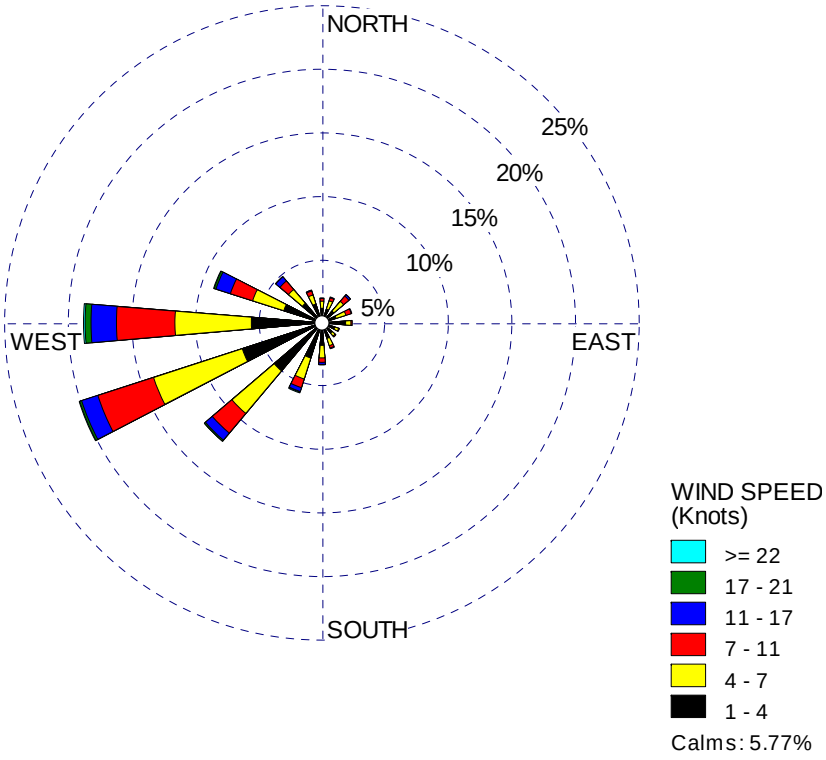
Note: Every 10th point is plotted



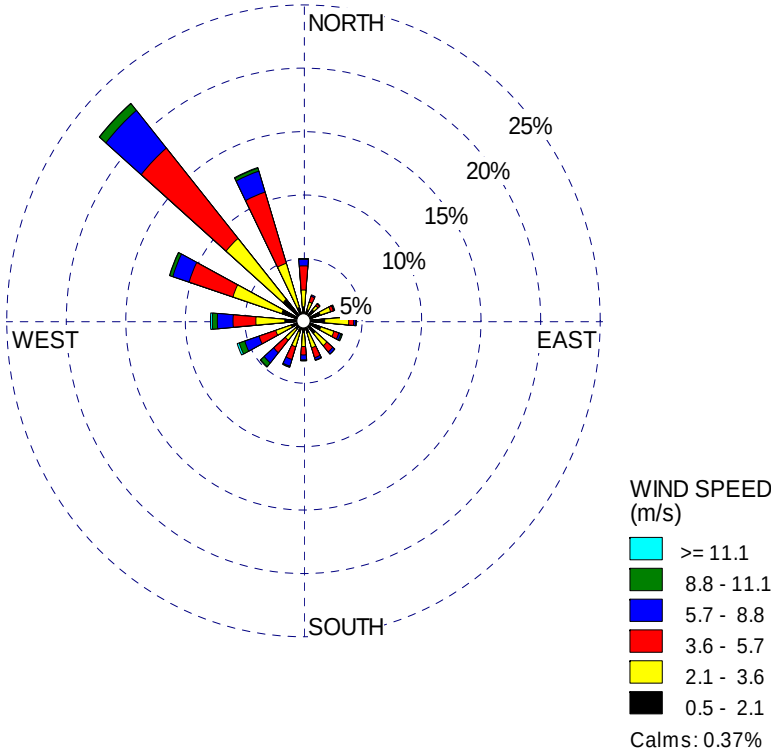
Comparison of Frequency of Occurance of Measured Wind Speed and Calmet Extracted Wind Speed for the Same Location and All Stabilities

12 Kilometer Comparison

Jonah CALMET/MM5 Predicted

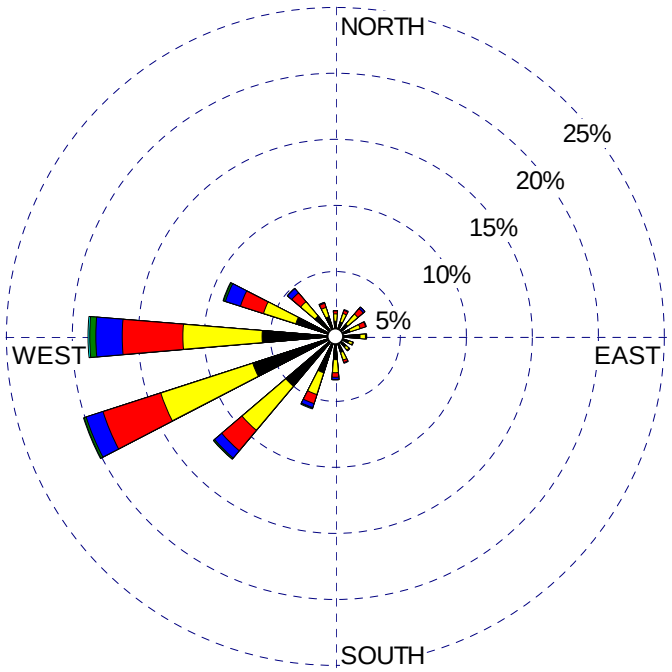


Jonah Measured



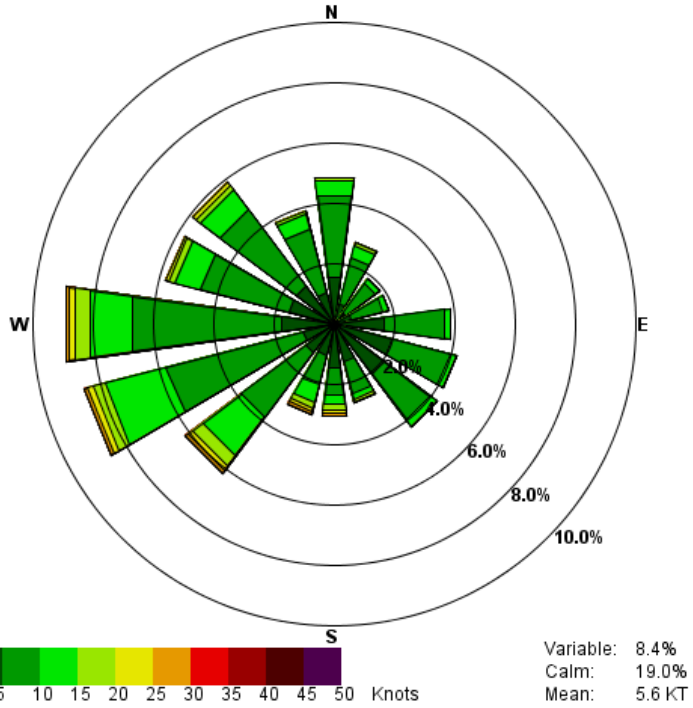
12 Kilometer Comparison

Jonah CALMET/MM5 Predicted

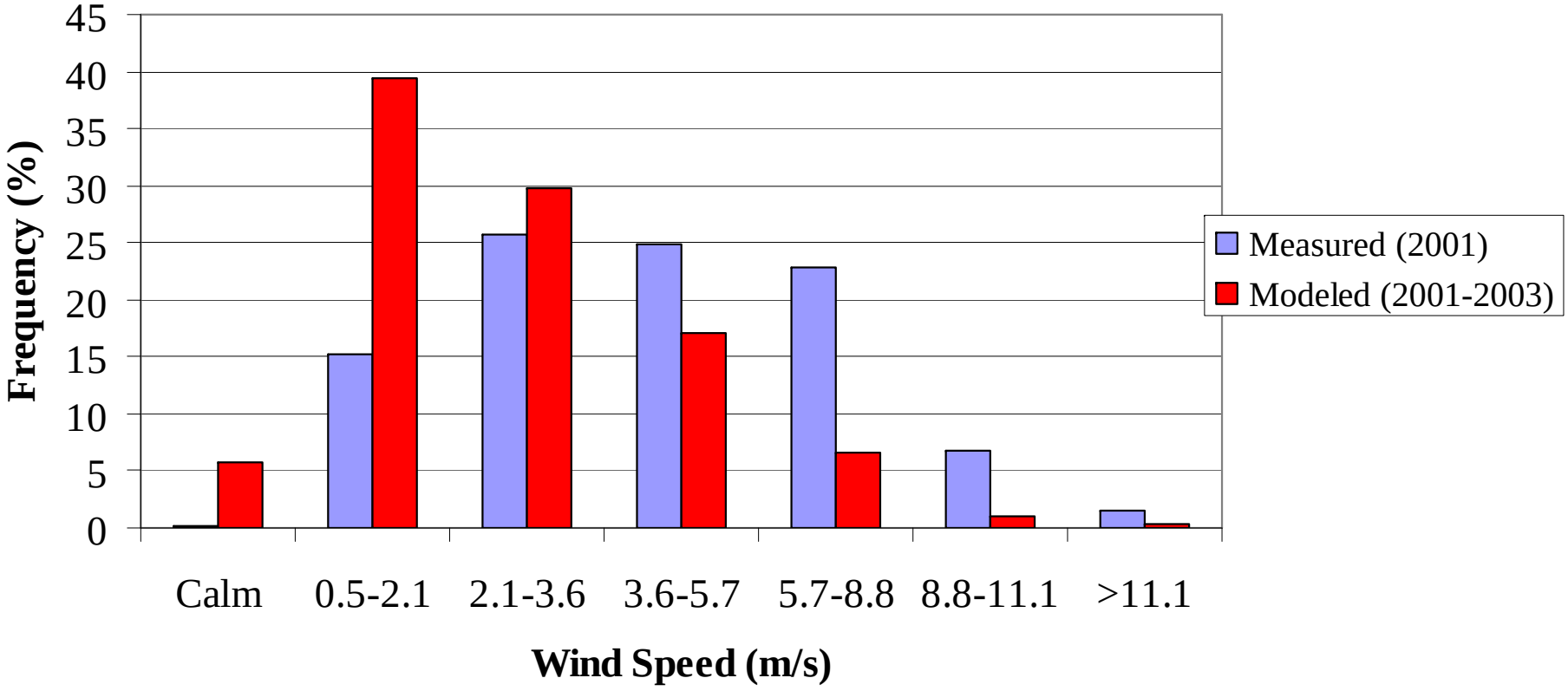


LANDER HUNT FIELD

10-year summary: 1997 - 2006

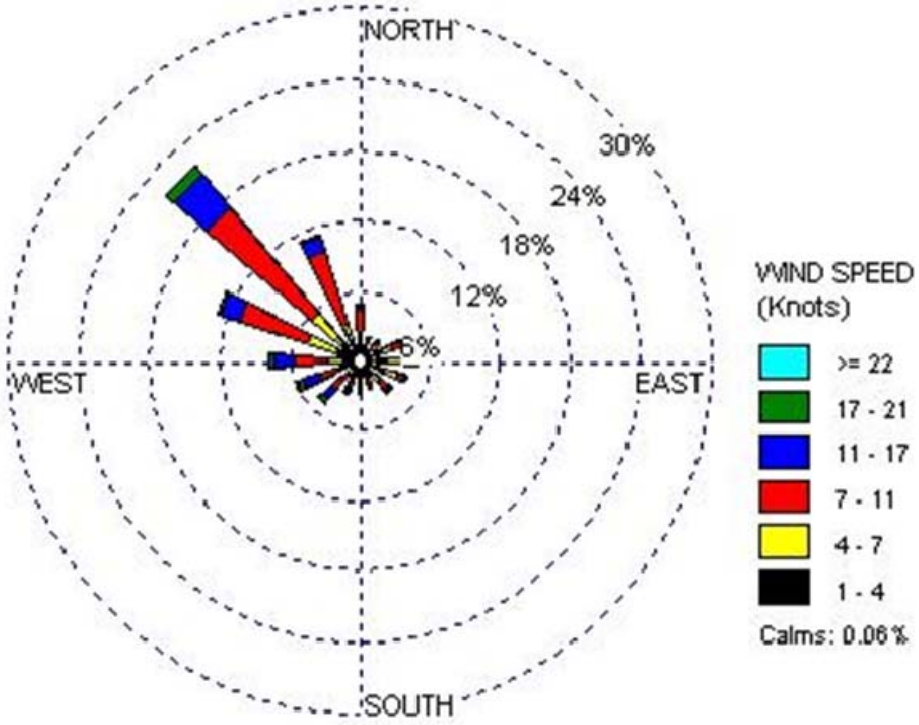


Comparison of Measured and Modeled Wind Speeds (12 Kilometer MM5) at Jonah

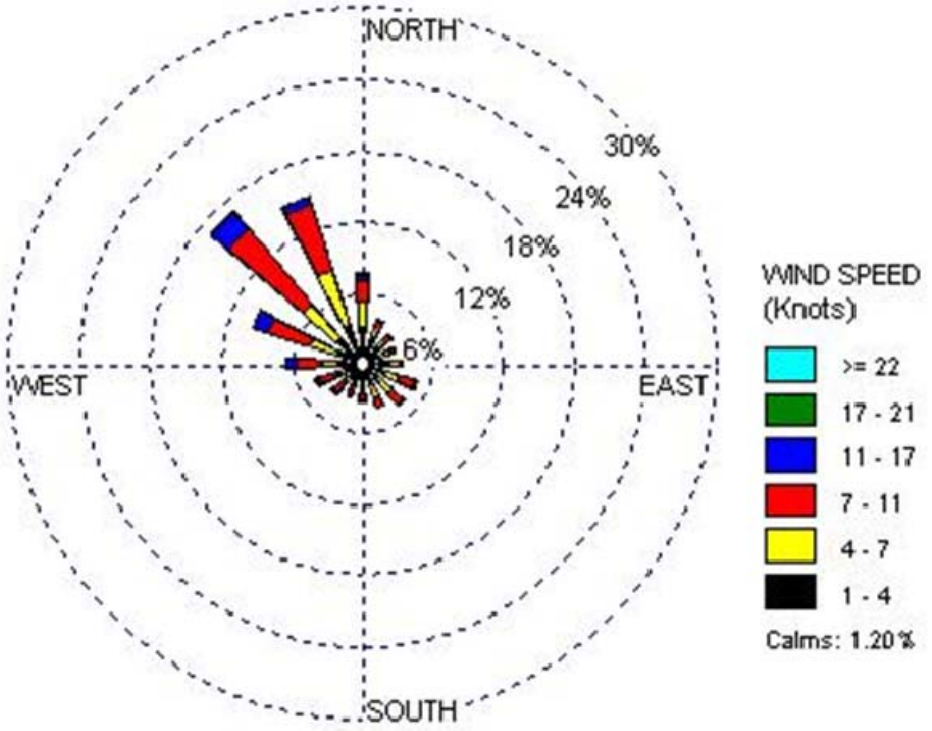


4 Kilometer Comparison

4 Kilometer MM5 Jonah (2006)



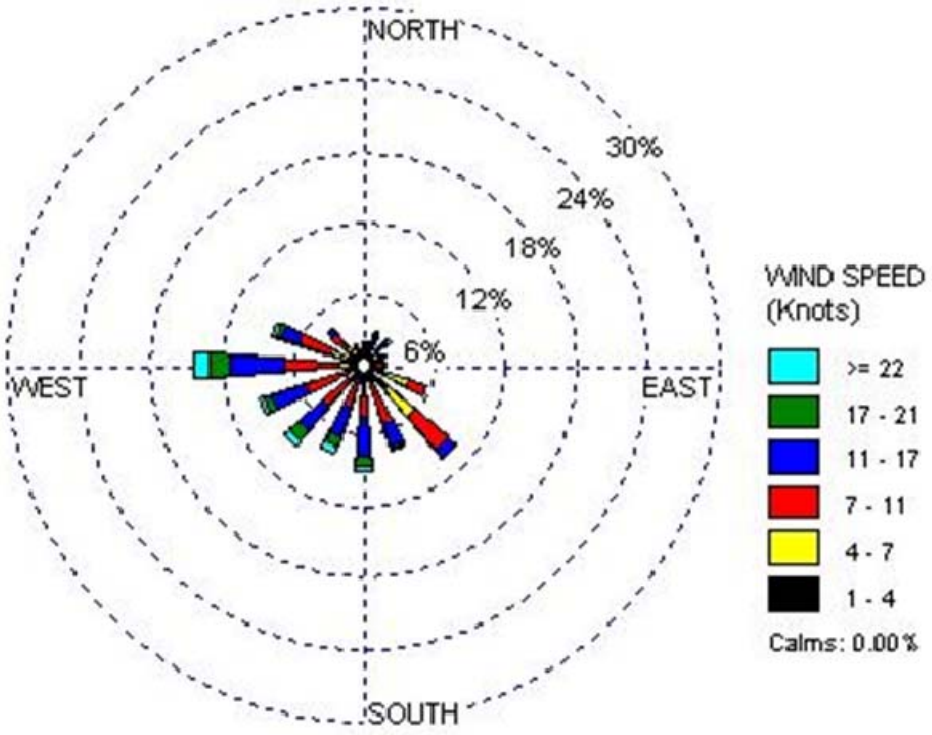
Observed Jonah (2006)



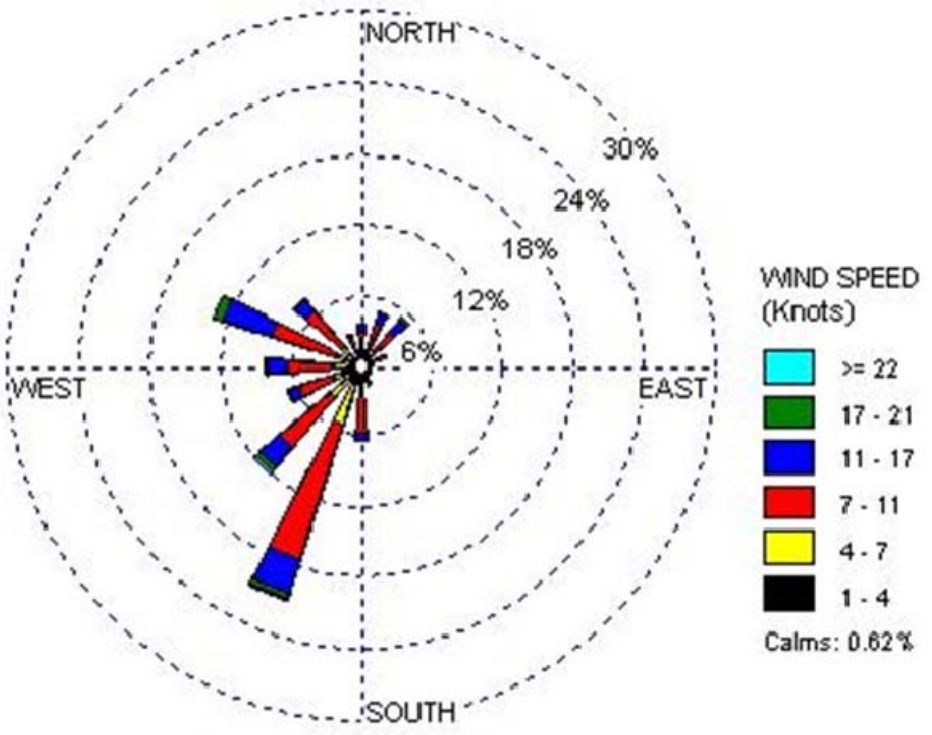
Source: Environ

4 Kilometer Comparison

4 Kilometer MM5 4 Wamsutter (2006)

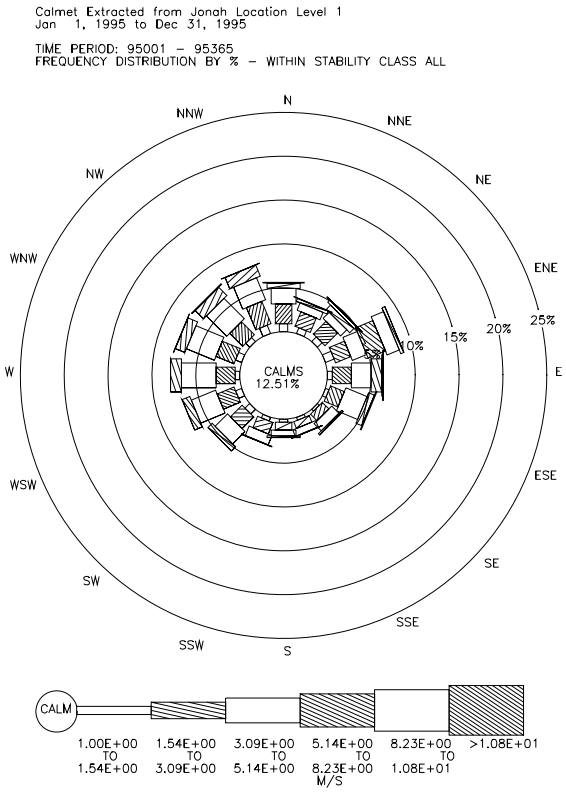


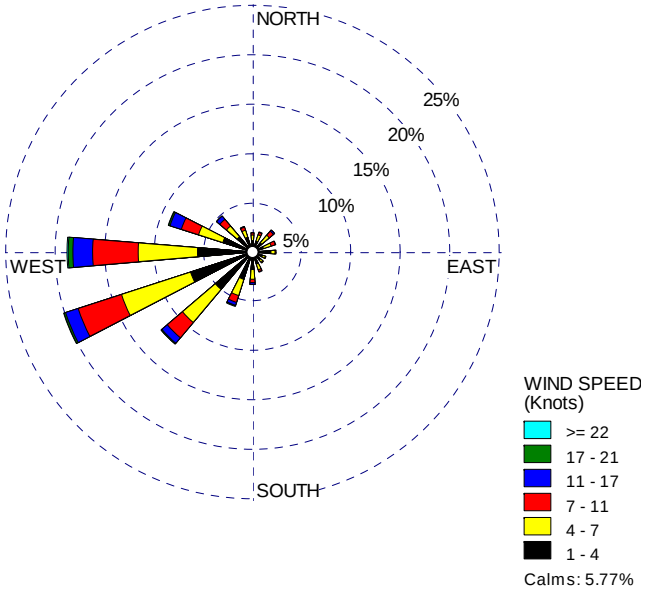
Observed Wamsutter Monitor (2006)

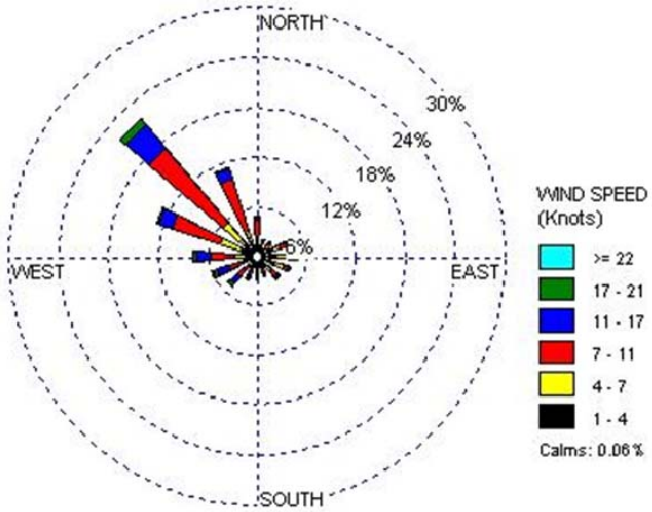


Source: Environ

Comparison of 4 kilometer MM5,
12 and 36 Kilometer MM5/CALMET Windroses for Jonah







Conclusions and Recommendations

The widespread use of meteorological model output in air quality modeling requires:

- The accuracy of MM5/CALMET model output must be tested for each dispersion model application
- EPA needs to coordinate a stakeholder group to develop guidelines for the use of meteorological models in air quality analyses
- Meteorological model accuracy is more important than the number of years of model results used in an air quality analysis

Conclusions and Recommendations (continued)

Topics that the modeling community need to address:

- Which meteorological model should be used?
- Grid size?
- How should meteorological monitoring sites be included in modeling?
- Model performance criteria?