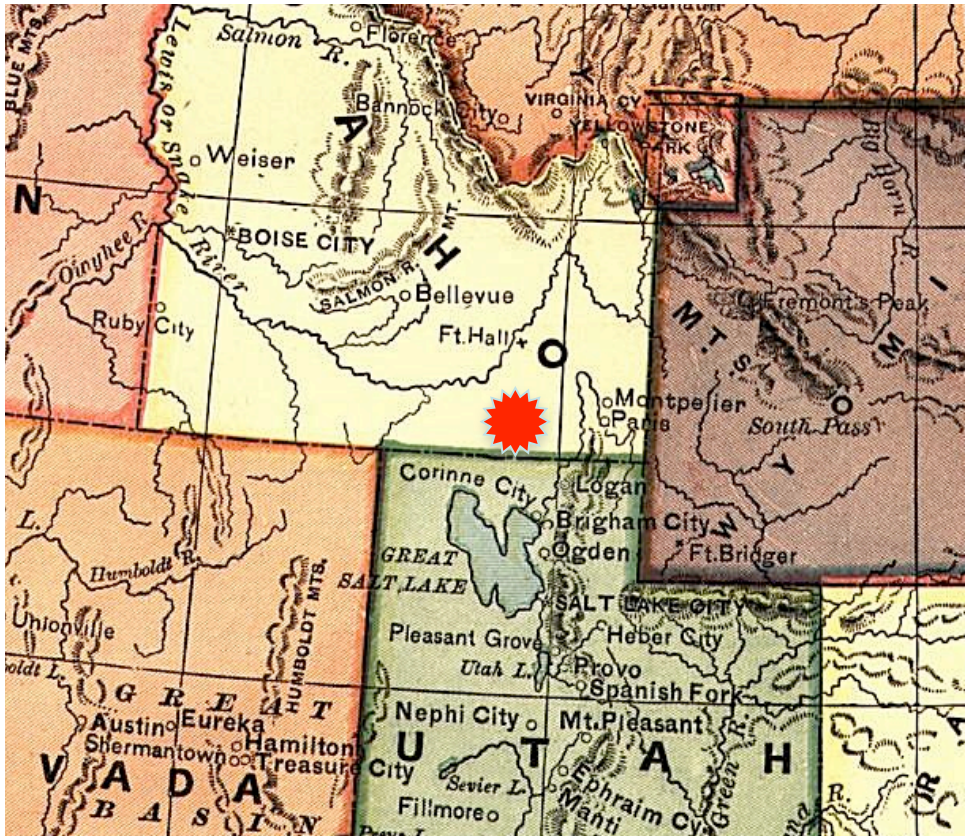
Wind Profiling and Topographical Considerations at Juniper, Idaho for Wind Power Generation



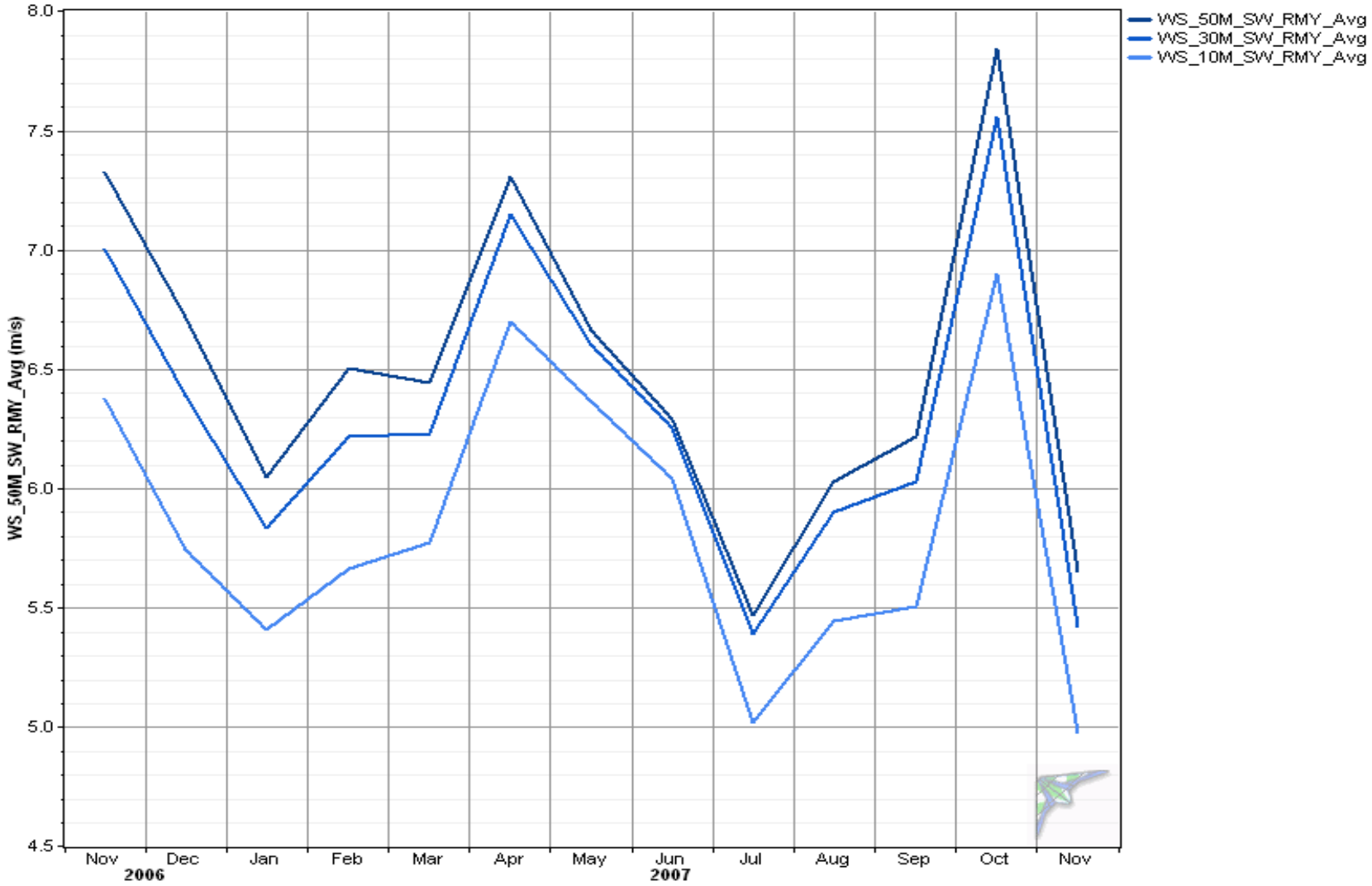
Ryan Campbell

ATMOS 6160, Fall 2009

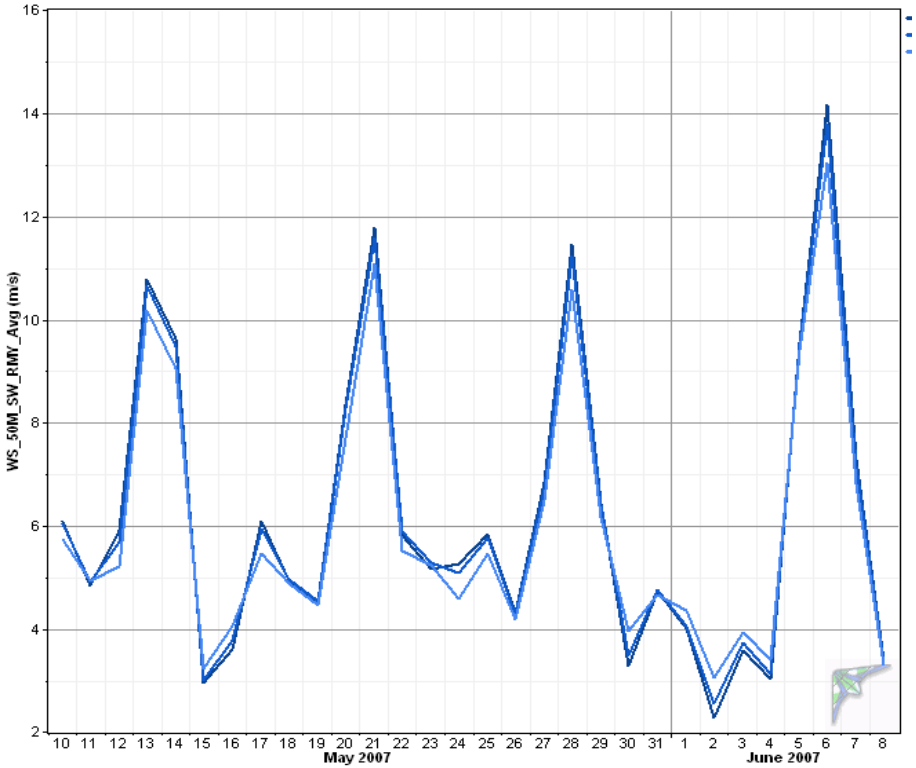
http://www.usgwarchives.org/maps/usa/usmaps/west1897.jpg http://i.treehugger.com/images/2007/5/24/E112_wind_turbine.jpg http://www.wireie.com/blog/wp-content/uploads/2009/04/wind-turbine.jpg

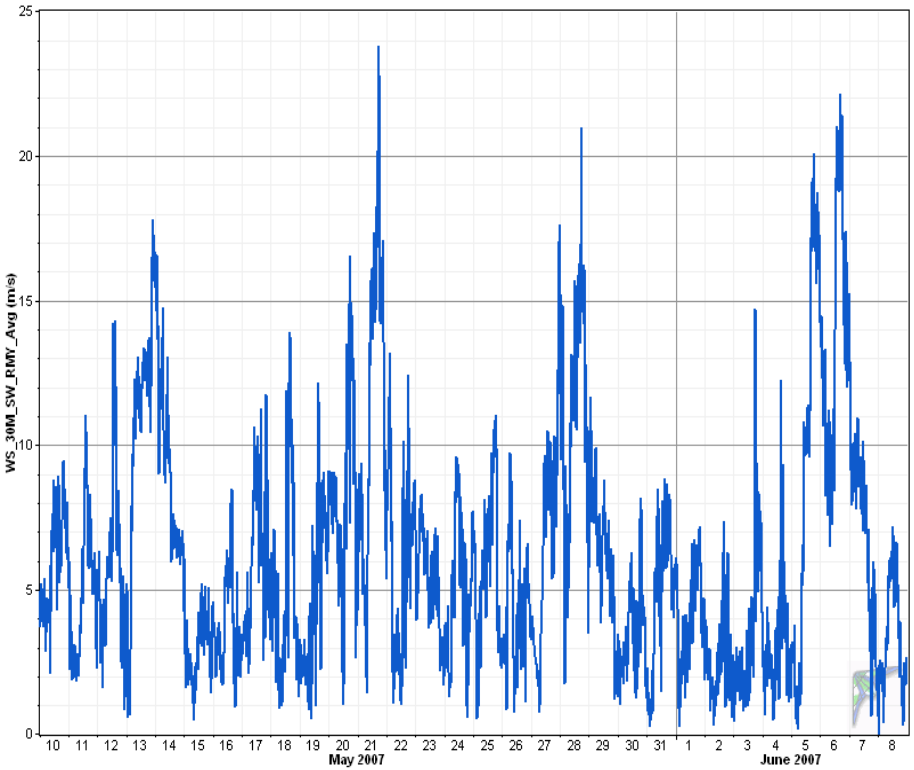

26 10:20 AM

Average Monthly Windspeeds at 10, 30, and 50 m



Daily and 10-min Windspeed



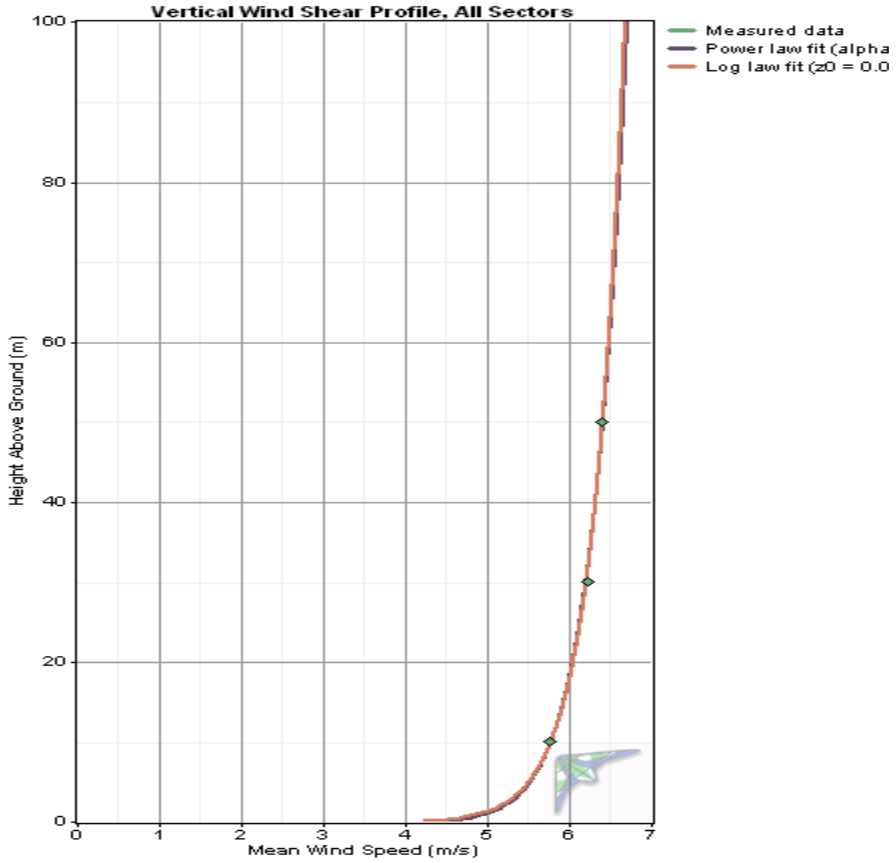


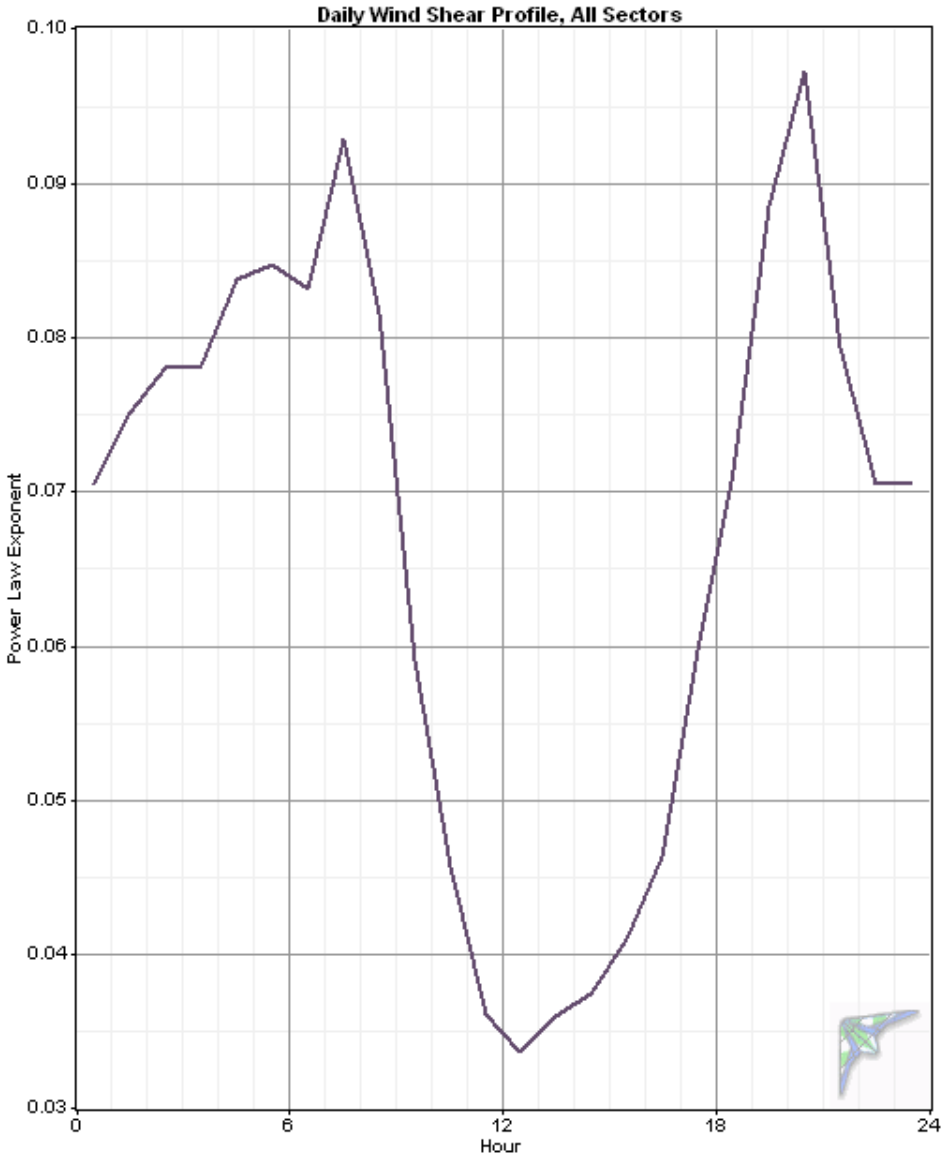
- Notice mesoscale variation and turbulence

Wind Profile

$U(z) = u_* \ln(z/z_o)/k$

$U(z) = \beta * z^{\alpha}$



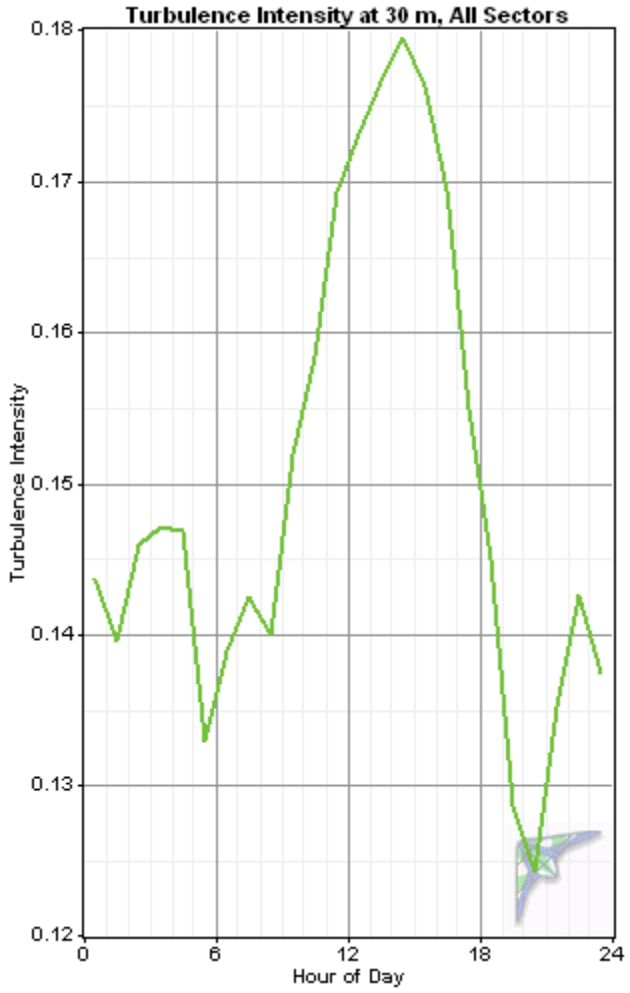


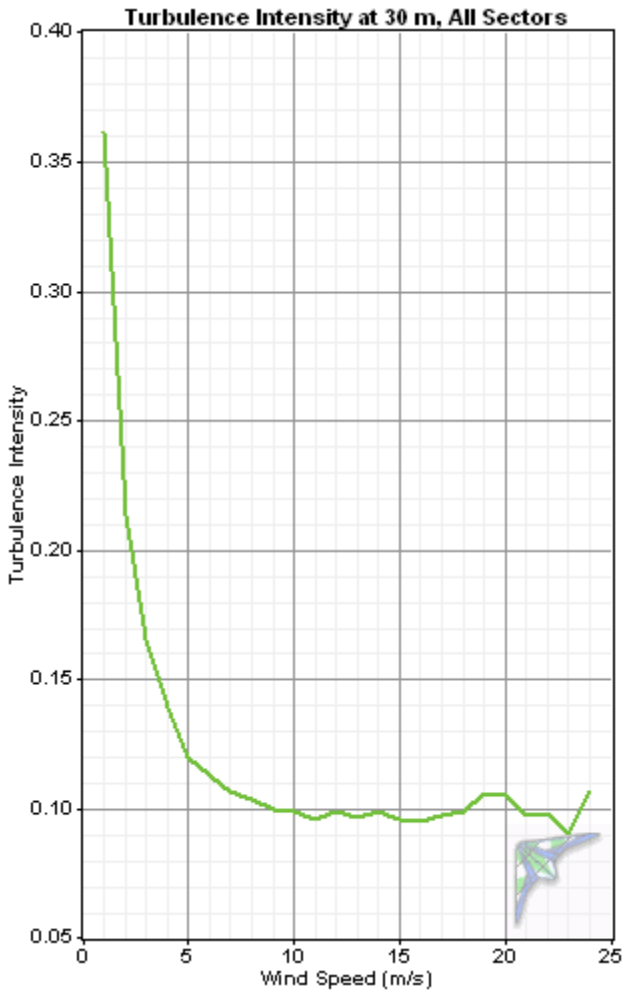
$z_0 = 4.31 \times 10^{-6}$ m $\alpha = 0.0650$

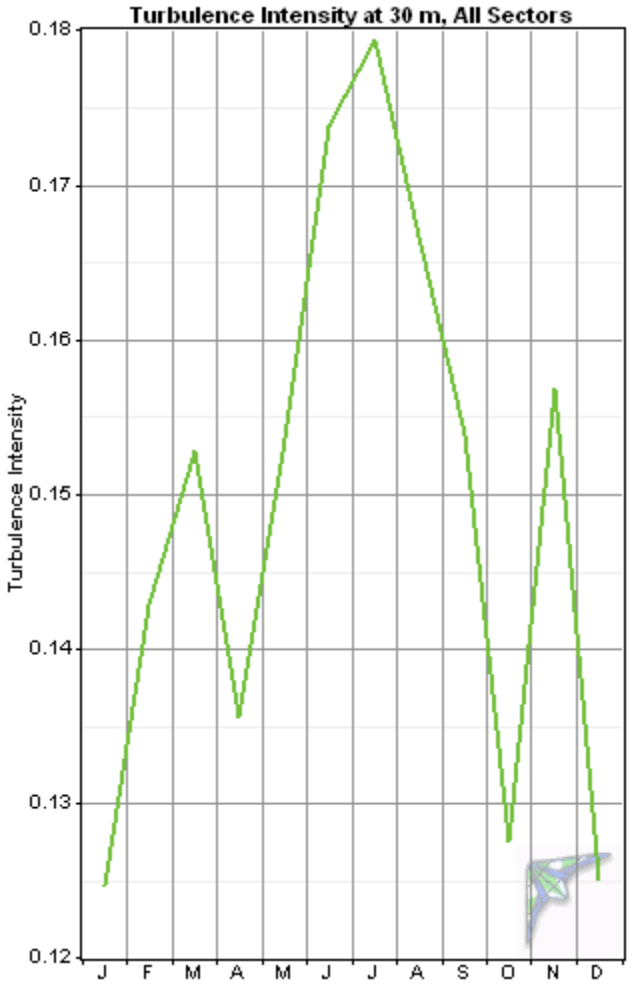
$u_* = 0.158$ m/s $\beta = 4.979$

Turbulence Intensity

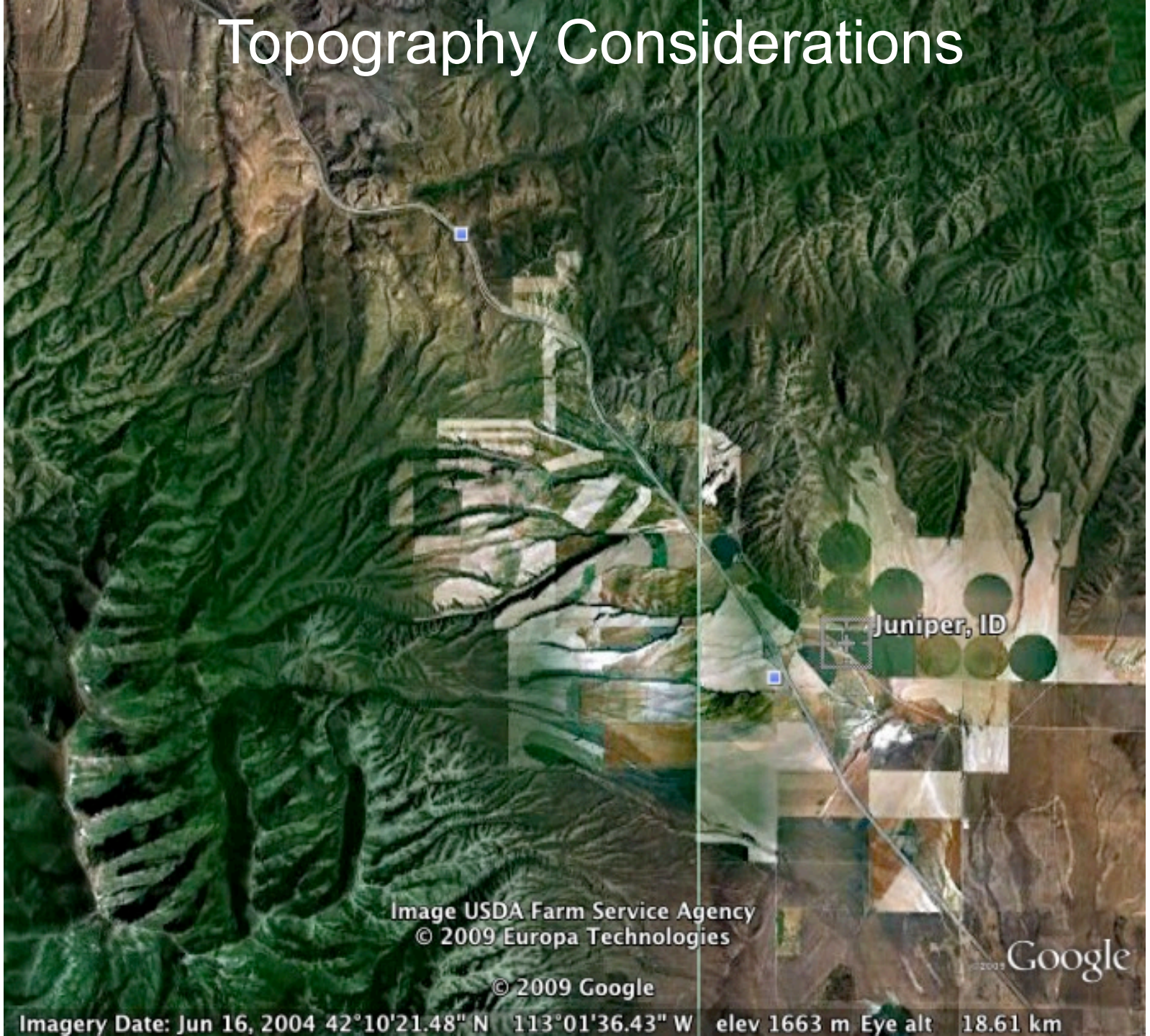
$$I = \sigma / U$$



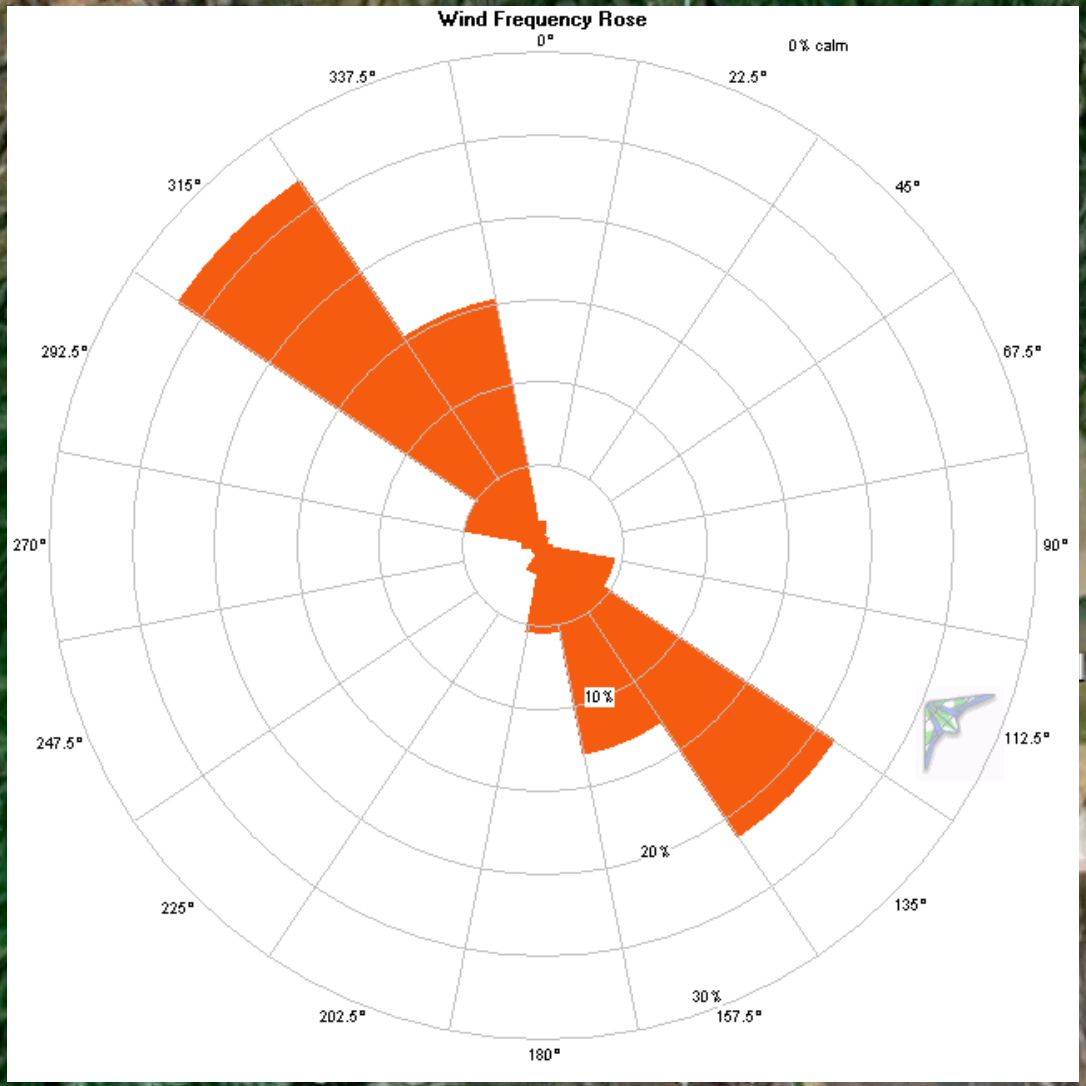




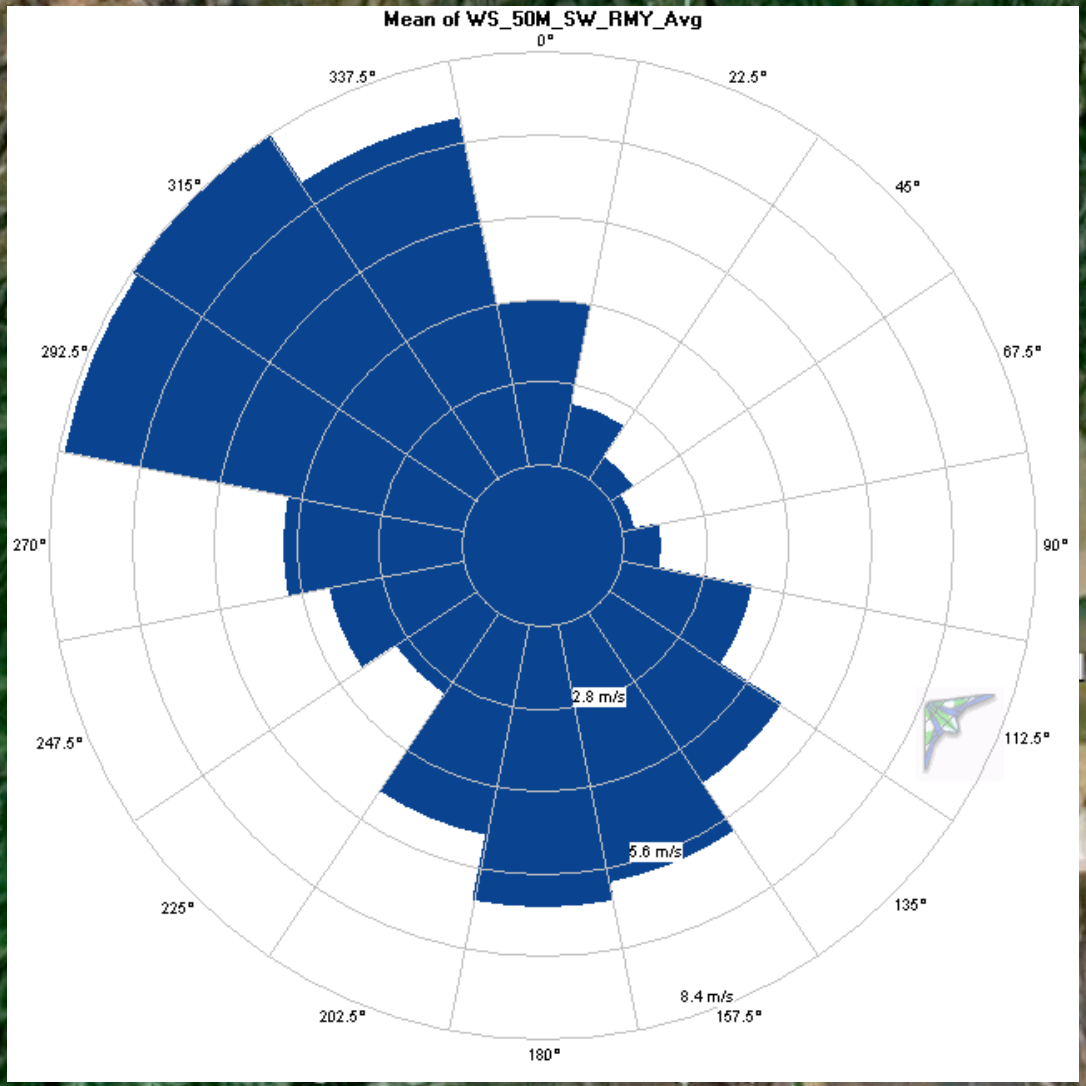
Topography Considerations



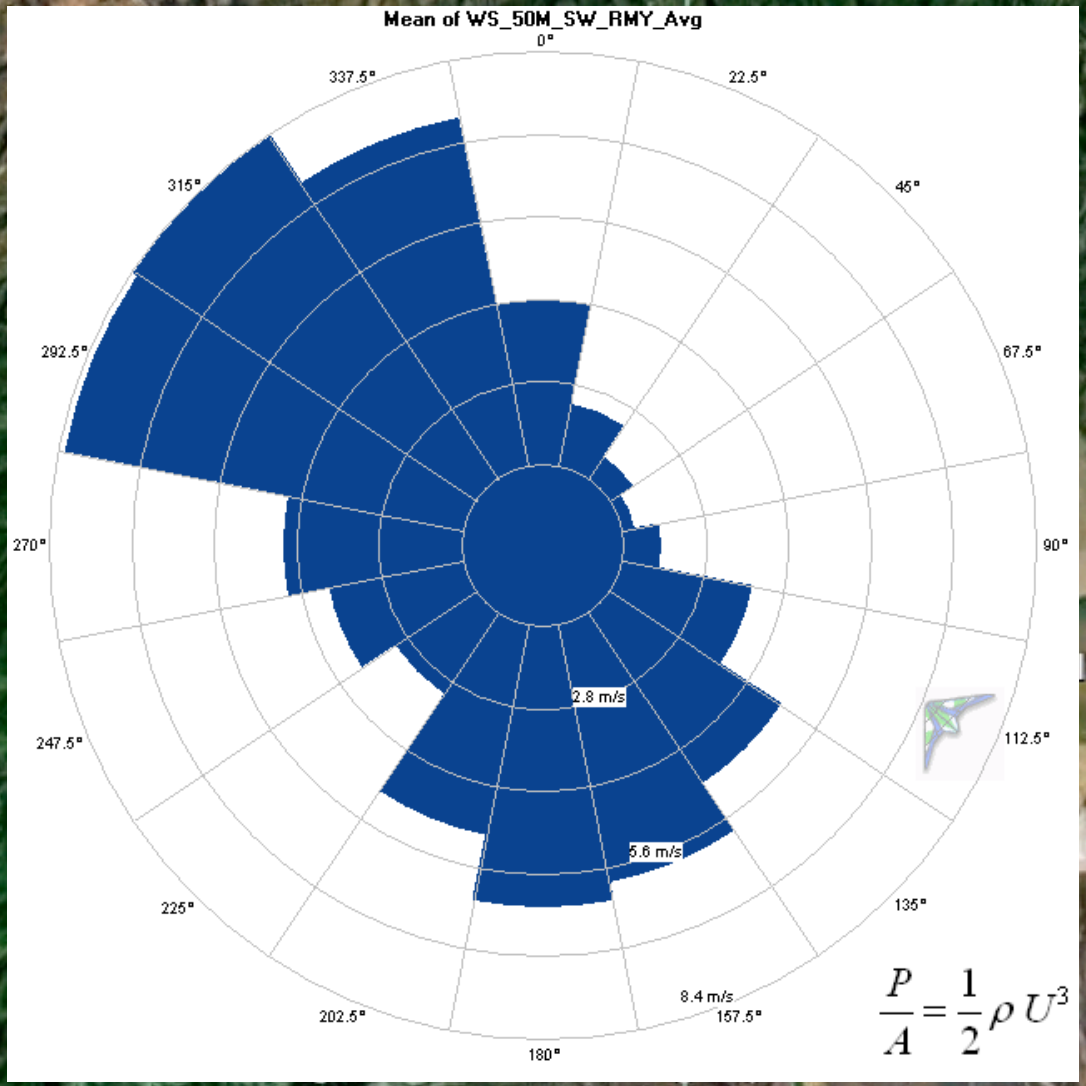
Topography Considerations



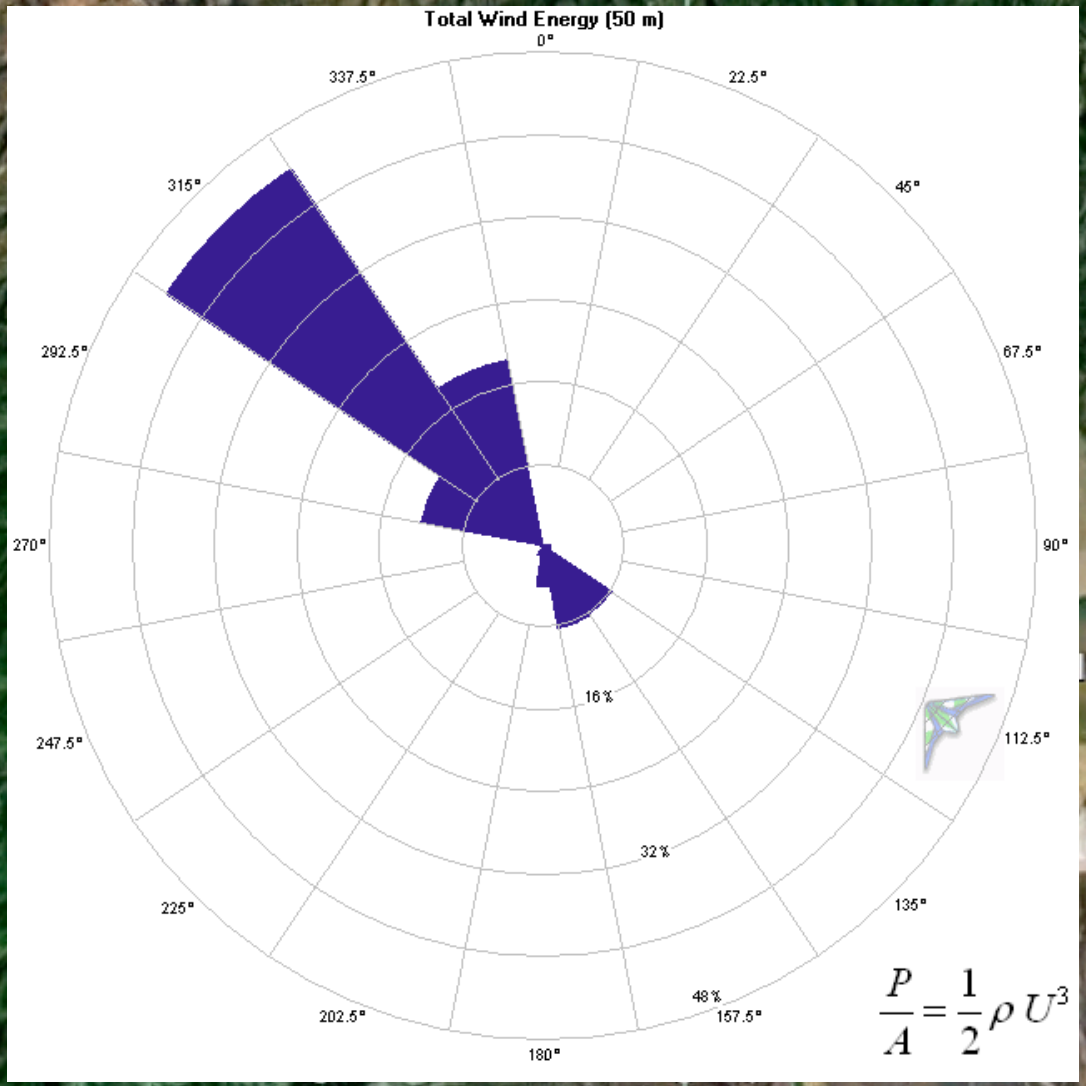
Topography Considerations



Topography Considerations

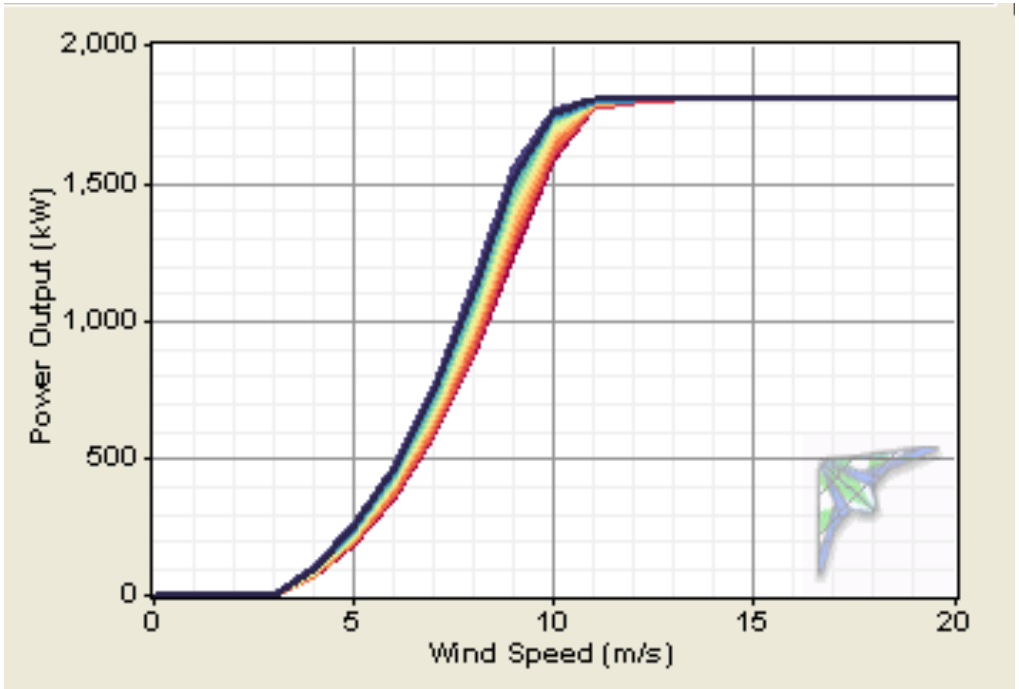


Topography Considerations



Wind Turbine Output

- Vestas 1.8 kW
  - 100 m rotor diameter at 80 m Hub Height
  - For this site, 36.9% power capacity

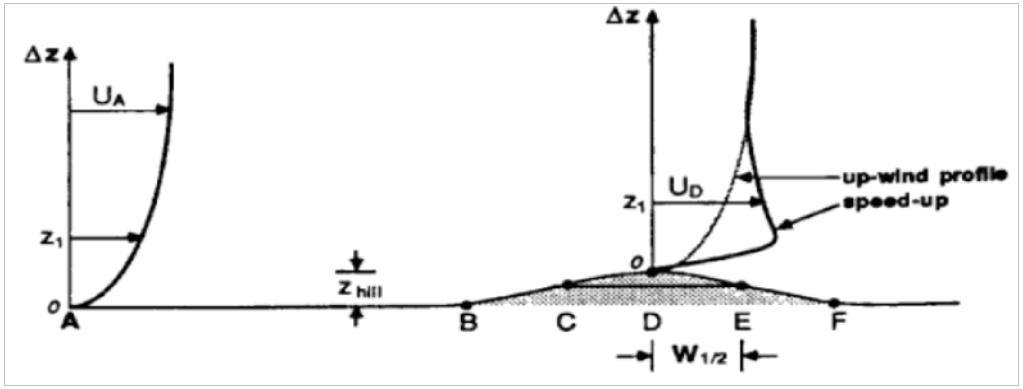


Topography Considerations for an Alternative Site

Topography Considerations

- Jones Ridge 10m mean wind: 5.78 m/s
- Rocky Ridge 10m mean wind: 6.04 m/s

- Estimated wind speeds at 80m assuming same wind profile for both locations:
  - Jones Ridge: 6.61 m/s
  - Rocky Ridge: 6.925 m/s
  - Wind power density will have a ~15% increase
  - This is enough of a difference to warrant more measurements!



Stull 1988


01/15/2008


01/15/2008


01/15/2008

Measurements Preceding Tower Failure