

ATSC 5014 (Atmospheric Dynamics I)
Homework Assignment 7
December 7, 2015

1. The following u-profiles are found over a relatively smooth lawn and over a rough wheat field located several kilometers downwind of the lawn/wheat border in eastern Wyoming (42°N). Assume that the temperature is 20°C, the pressure is 890 mb and adiabatic conditions prevail.

Height (m)	0	0.5	1	2	3	4	6	8	10
u(m/s) lawn	-	4.02	4.70	5.37	5.75	5.99	6.39	6.67	6.91
u(m/s) wheat	-	-	0.86	1.93	2.56	2.95	3.55	4.00	4.34

- Estimate the friction velocity, u_* , and the roughness length, z_o , for each profile.
 - Calculate the contour numbers at the 2, 4 and 8 m levels for each profile. Is the one-seventh power law a reasonable approximation?
 - Determine values of the geostrophic wind and surface Rossby number that are compatible with each profile.
 - Estimate the wind power density in W/m^2 at 50 m using the i) adiabatic profile and ii) the 10-m wind and 1/7 power law.
2. From the Ekman solution discussed in class, assume that the geostrophic wind is 20 m s^{-1} from 210° . Given that $K = 3 \text{ m}^2 \text{ s}^{-1}$ and $f = 0.0001 \text{ s}^{-1}$, determine the x- and y-components at 10-m increments from the surface to the top of the boundary layer. Estimate the wind power density in W/m^2 at 80 m and compare with values obtained assuming a geostrophic drag coefficient approach with a roughness length of 1 cm.