

## Exercises; Boundary Layer Physics, 14 May 2007

Be air density  $\rho_0 = 1.2 \text{ kg/m}^3$ .

1) The aim is to calculate wind profiles over different surfaces.

a) The ground is covered with long grass. Measurements give an average wind speed of 4.2 m/s at a height of 10 m. How large are friction velocity  $u_*$  and momentum transport  $\tau$  (the displacement height is assumed to be zero)?

b) How large is the average wind speed at a height of 100 m?

c) Assuming the same turbulent wind fluctuations (i.e. same friction velocity). How large is the average wind speed at a height of 10 m if the ground was covered with dense forest with an average height of 10 m?

d) And at a height of 100 m?

2) The aim is to determine sensible heat fluxes following different methods.

a) The following values are measured:

t [s]	0	1	2	3	4	5	6	7	8	9
w [m/s]	1	2	2	-2	0	-1	0	-1	-2	1
$\theta$ [°C]	20	21	22	19	18	19	21	20	18	22

How large is the sensible heat flux  $Q_H$  following the eddy correlation method?

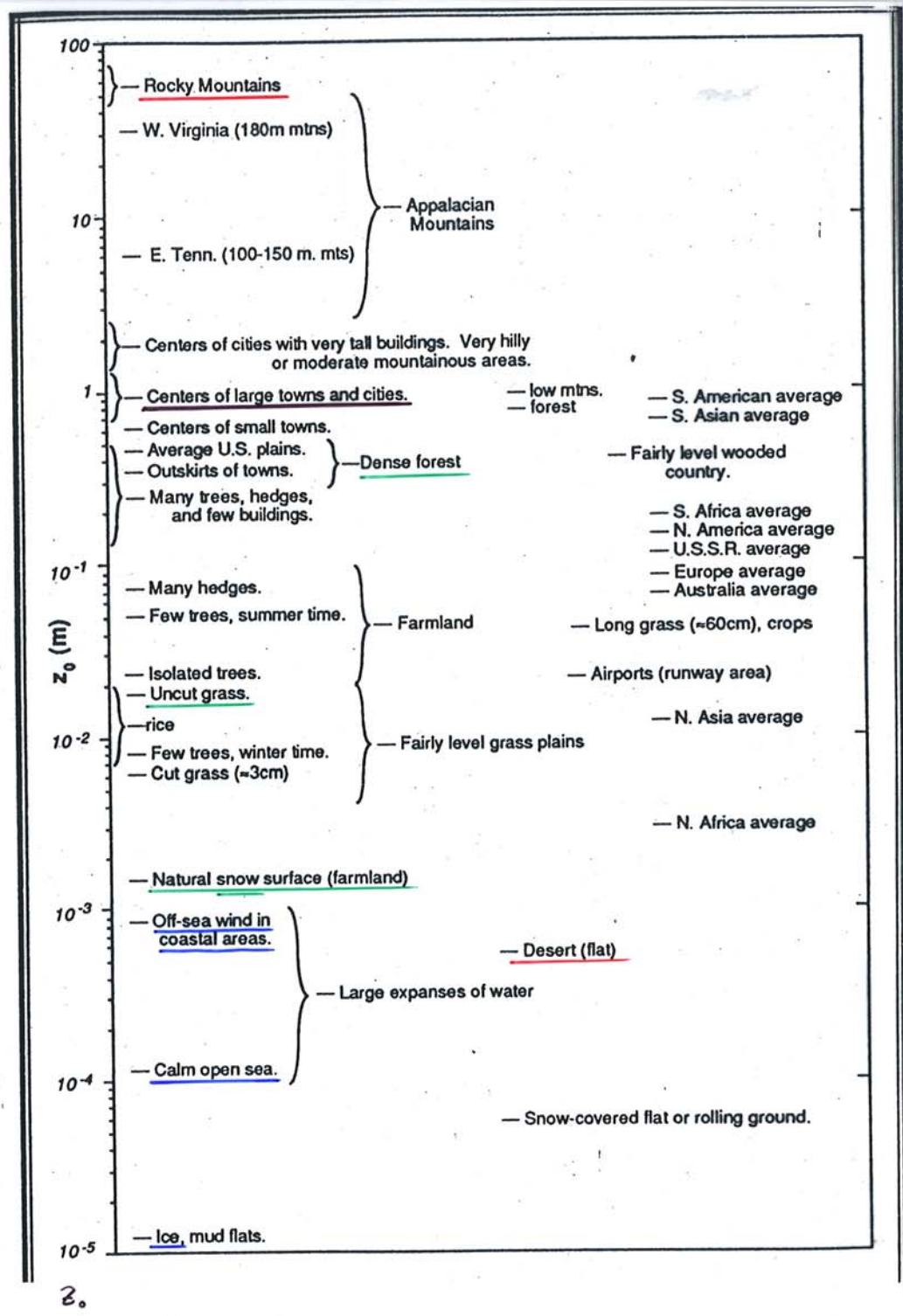
b) Given the eddy diffusivity for heat  $K_H = 5 \text{ m}^2/\text{s}$  for turbulence within a background stable environment, for which a local lapse rate of 0.01 K/m is determined. How large is the sensible heat flux  $Q_H$  following the gradient transport theory?

10m

1m

1cm

1mm



Typical roughness lengths (Stull, 1988)