Answer Key Final Exam Part I / II 2007 GEOG 300

Part A: Multiple choice questions

Solve all multiple choice questions. All questions have one correct answer. Total marks part A: 24.

1. How is albedo α defined? [2]

   ○ $\alpha = K\downarrow / Q^*$ ○ $\alpha = K\downarrow / K\uparrow$ ○ $\alpha = K\uparrow / Q^*$ ● $\alpha = K\uparrow / K\downarrow$

2. Which one of the following features is typically observed in the nocturnal boundary layer? [2]

   ○ thermal plumes ● inversion ○ entrainment ○ none of those

3. Which of the following equations describes the Reynolds analogy? [2]

   ○ $u(t) = \overline{u} + u'(t)$ ○ $\tau = \rho u_*^2$ ● $K_H = K_E = K_M$ ○ $Re = u\,d/\nu$

4. Which of the following expressions describes the sensible heat flux density Q_H? [2]

   ● $\rho_a\, c_p\, \overline{w'T'}$ ○ $\rho_a\, C_a\, \partial T/\partial z$ ○ $\rho_a\, L_v\, \partial \rho_v/\partial z$ ○ $L_v\, \overline{w'\rho_v'}$

5. Without further information, how would you estimate the roughness length z_0 for a uniform grass canopy of 0.3 m height? [2]

   ○ $z_0 = 0.0003\,\mathrm{m}$ ○ $z_0 = 0.002\,\mathrm{m}$ ● $z_0 = 0.03\,\mathrm{m}$ ○ $z_0 = 0.2\,\mathrm{m}$

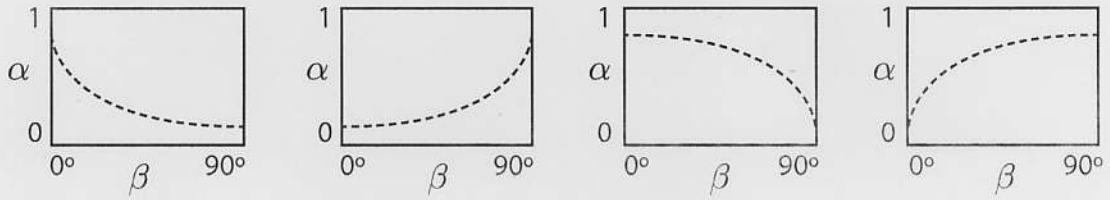
6. When we installed the eddy correlation system at Totem field - what exactly did we measure by calculating the term $\overline{w'\rho_c'}$? (ρ_c = concentration of carbon dioxide) [2]

   ○ Soil respiration ● Net assimilation ○ Potential photosynthesis ○ Photosynthesis

7. What means 'fetch'?
   ○ Roughness change Δz_0 – difference in the roughness length between two different surfaces.
   ○ Thickness δ – of an internal boundary layer.
   ○ Area – field of view of a sensor (e.g. radiometer).
   ● Distance x – measured in the upwind direction.

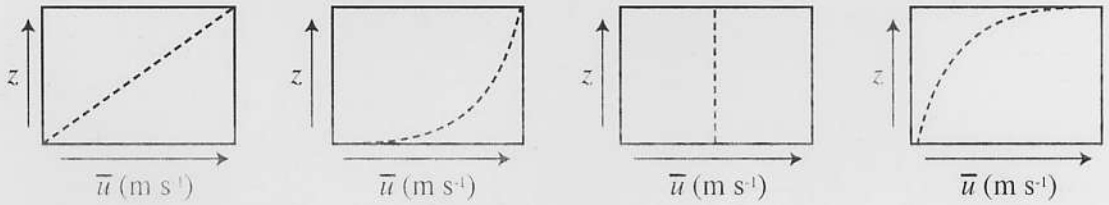
8. Which of the following methods can not be used to determine the complete evapotranspiration of a forest ecosystem? [2]
   ○ Penman-Monteith (Combination approach)
   ○ Bowen-ratio Energy Balance approach.
   ● Porometry.
   ○ Aerodynamic method.

9. How does albedo α of a water surface change with changing solar altitude β under clear sky conditions? [2]



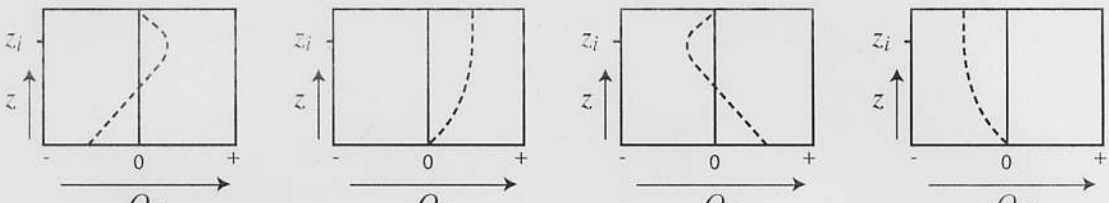
● ○ ○ ○

10. How does mean wind speed $\overline{u}$ change with height z over a smooth surface under neutral conditions? [2]



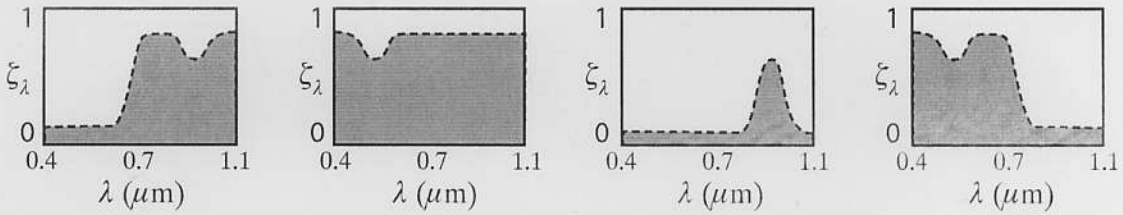
○ ● ○ ○

11. How does the sensible heat flux density Q_H change with height z in the daytime convective boundary layer (CBL)? z_i is the height of the CBL. For Q_H assume the micrometeorological sign convention we typically used in the course i.e an upward transport of sensible heat is positive. [2]



○ ○ ● ○

12. How does the spectral absorptivity ζ_λ of a green leaf change with wavelength in the short-wave part of the spectrum? [2]



○ ○ ○ ●

Part B: Short answer questions

Answer all of the following short answer questions in one or a few words, or provide a formula. Total marks part B: 16.

1. How do we call the whole layer of the atmosphere where a diurnal course of meteorological variables (temperature, humidity, pollutants, ...) is measurable? [2]

   Planetary boundary layer (or PBL)

2. Write down the name of an instrument that measures evapotranspiration from a soil monolith by tracking its weight? [2]

   Lysimeter

3. List a soil thermal property of your choice and provide its unit. [2]

   thermal conductivity - $W\ m^{-1}\ K^{-1}$
   or heat capacity - $J\ m^{-3}\ K^{-1}$
   or thermal diffussivity - $m^2 s^{-1}$ (and more)

4. In a turbulent flow, how do we call an event that transports momentum surplus from a high velocity region into a region with a low velocity? [2]

   Sweep

5. What is the 'Bowen ratio' (provide formula or alternatively words). [2]

   $\beta = \frac{Q_H}{Q_E}$ or the ratio of sensible heat flux density to latent heat flux density

6. List the name of a radiometer that measures short-wave irradiance in the soild angle 2π? [2]

   Pyranometer

7. Provide a formula of a flux-gradient approach of your choice using the K-Theory. [2]

   $Q_H = -C_a K_H \frac{\partial \bar{\theta}}{\partial z}$ or any formula on slide 9, lecture 22

8. Name a dimensionless number of your choice that can be used to describe dynamic stability. [2]

   "Ri" or "Rf" or "z/L"
   Gradient Richardson number
   Flux Richardson number
   Obukhov length