EAS270, "The Atmosphere" <u>Quiz 3</u> 26 Nov., 2014

<u>Professor</u>: J.D. Wilson <u>Time available</u>: 20 mins <u>Value</u>: 10%

Instructions: Choose the best (or most logical) option, and use a pencil to mark that choice on the scantron form. **Eqns/data given at back**. You may keep this quiz.

1. Referring to Figure (1), suppose the ELR in the uppermost layer were altered to zero (i.e. an isothermal layer replaced the inversion layer). What other amendment to the diagram would be appropriate?
   (a) lower cloud base height (LCL)
   (b) higher cloud base height
   (c) lower cloud top
   (d) higher cloud top ✓✓[72% correct. Lec Fri 31 Oct., p7]
   (e) shallower surface layer

2. Which cloud type may result in a halo around a brightly visible sun or moon?
   (a) nimbostratus
   (b) altostratus
   (c) altocumulus
   (d) stratocumulus
   (e) cirrostratus ✓✓[97% correct. Lec Fri 31 Oct.]

3. Figure (2a) is an example of which cloud type?
   (a) altostratus
   (b) altocumulus
   (c) stratocumulus ✓✓[86% correct. Lec Fri 31 Oct.]
   (d) cirrus
   (e) cirrostratus

4. Which factor militates **against** (i.e. tends to prevent) formation of a radiation fog over a dry plain?
   (a) very strong wind ✓✓[97% correct. Lec Fri 31 Oct., p12]
   (b) long night
   (c) absence of cloud
   (d) humid layer at ground overlain by drier air
   (e) abundance of Cloud Condensation Nuclei

5. Which is the most reasonable value for the updraft velocity in a stratiform cloud?
   (a) $0.01\,\mathrm{m\,s^{-1}}$
   (b) $0.1\,\mathrm{m\,s^{-1}}$ ✓✓[51% correct. p230, p243]
   (c) $1\,\mathrm{m\,s^{-1}}$
   (d) $10\,\mathrm{m\,s^{-1}}$
   (e) $100\,\mathrm{m\,s^{-1}}$

6. Which is **false**? According to the gradient wind paradigm, a supergeostrophic wind ...
   (a) occurs above the friction layer
   (b) blows parallel to curved height contours
   (c) occurs where the flow rounds a N. hemisphere ridge axis
   (d) implies the magnitude of the Coriolis force exceeds that of the pressure gradient force
   (e) occurs only in an absolutely stable layer of the atmosphere ✓✓[70% correct. Lec. Fri 7 Nov., p9]

7. Consider an atmospheric layer in the N. hemisphere that is bounded by isobaric surfaces P_1, P_2 (heights Z_1, Z_2 with $Z_2 > Z_1$), on which the geostrophic winds are respectively $\vec{V}_{g1}$, $\vec{V}_{g2}$. Which statement correctly gives the orientation of the thermal wind $\vec{V}_{T21} = \vec{V}_{g2} - \vec{V}_{g1}$?
   (a) parallel to height contours, with cold air on its left
   (b) perpendicular to height contours, with warm air on its left
   (c) perpendicular to height contours, with cold air on its left
   (d) parallel to thickness ($h = Z_2 - Z_1$) contours, with cold air on its left ✓✓[55% correct. Lec. Fri 14 Nov., p5]
   (e) perpendicular to thickness ($h = Z_2 - Z_1$) contours, with warm air on its left

8. Assume geostrophic flow along straight height contours in the free atmosphere of the N. hemisphere. Which is the valid inference, if the geostrophic wind vector $\vec{V}_g$ "veers" with increasing height (see Figure 2b)?
   (a) the wind speed is subgeostrophic
   (b) thickness contours are parallel to height contours
   (c) no thermal advection is occurring
   (d) cold advection is occurring
   (e) warm advection is occurring ✓✓[75% correct. Lec. Fri 14 Nov., p5, p10]

9. In order that surface convergence not result in the "filling" of a mid-latitude cyclone, the surface low needs to be located beneath a zone of divergence in the flow aloft. Which is a preferred location for divergence aloft?
   (a) the exit region of an upper ridge
   (b) the entry region of an upper trough
   (c) the exit region of an upper trough ✓✓[81% correct. Lec Fri 7 Nov., p11, p12]
   (d) a region of zonal flow
   (e) an absolutely stable layer

10. Referring to Figure (2c), suppose the upstream mean wind speed at $z = 2$ m were $U_0 = 10\,\mathrm{m\,s^{-1}}$. Which option best estimates the mean speed U (still at height $z = 2$ m) at distance $x = 60$ m downwind from the windbreak?
   (a) $5\,\mathrm{m\,s^{-1}}$
   (b) $3\,\mathrm{m\,s^{-1}}$ ✓✓[61% correct. Lec Mon 17 Nov., p6]
   (c) $2\,\mathrm{m\,s^{-1}}$
   (d) $0.6\,\mathrm{m\,s^{-1}}$
   (e) $0.3\,\mathrm{m\,s^{-1}}$

Equations, Data & Figures.

$$|V_{T21}| = \frac{g}{f_c}\left|\frac{\Delta h}{\Delta x}\right|$$

Gives the magnitude of the thermal wind in a layer whose thickness is h, the thickness gradient being evaluated with x pointing perpendicular to thickness contours ($f_c = 2\Omega\,\sin\phi$ is the Coriolis parameter, Ω being the angular velocity of the earth and ϕ the latitude).

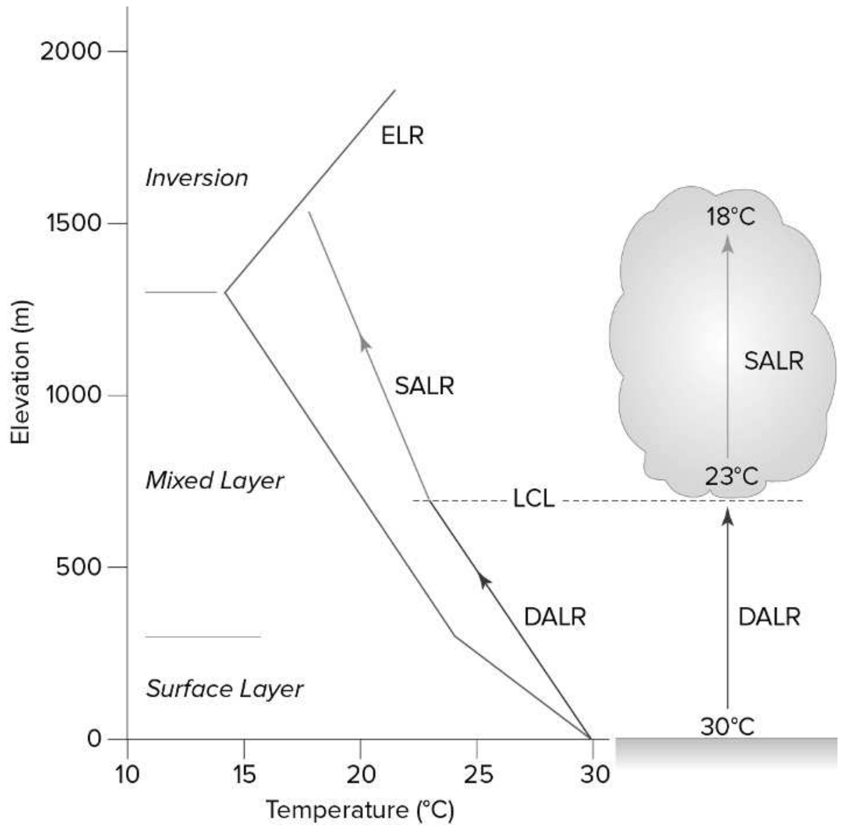
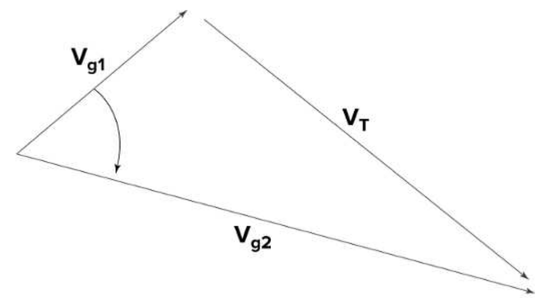
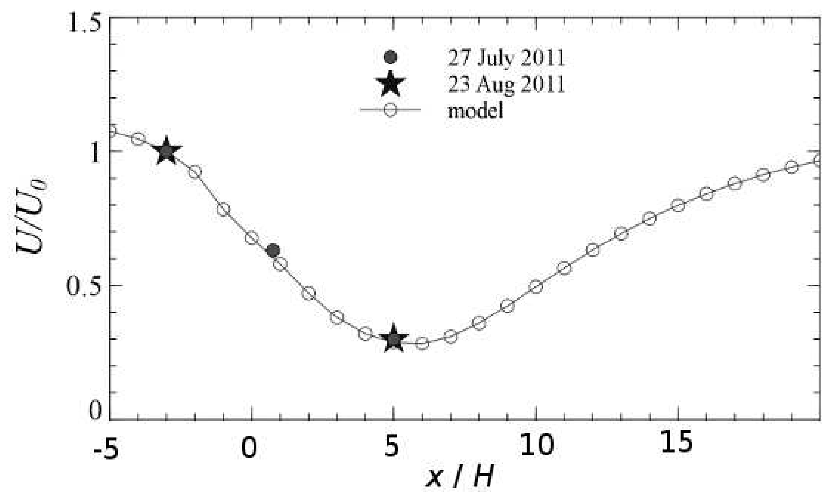


Figure 1: Simplified three-layer scenario for the temperature profile in the ABL (ELR constant within each layer). (Ross's Figure 9.13).

(a) A non-precipitating layer cloud with a base height below 2 km (Ross's Figure 9.16).



(b) A "veering" wind (Ross's Figure 11.24a). Level 2 is higher than level 1.



(c) Relative mean wind speed curve at height $z = 2$ m for winds about a long shelterbelt (windbreak) of height $H = 10$ m situated at $x = 0$: measurements in a neutrally stratified atmospheric surface layer, when the mean wind approached the shelterbelt at perpendicular-incidence. U_0 is the mean wind speed at $z = 2$ m far upwind of the shelterbelt. (Experiment at Indian Head, Saskatchewan.)

Figure 2