EAS270, "The Atmosphere" Quiz 2 9 Oct., 2009

Professor: J.D. Wilson Time available: 15 mins Potential Value: 10%

Instructions: For all 10 questions, choose what you consider to be the best (or most logical) option, and use a pencil to mark that choice on the answer form. **Eqns/data and an optional feedback sheet given at back**. You may keep this quiz.

1. In the cloudless atmosphere blue light is scattered ____ efficiently as/than red. Molecular diameter is ____ than/to the wavelength of visible light.

   (a) less; much larger
   (b) more; much larger
   (c) less; much smaller
   (d) more; much smaller ✓✓
   (e) equally; about equal

2. The shortwave reflectivity (or albedo) is defined ____

   (a) $K\uparrow / K\downarrow$ ✓✓
   (b) $K\downarrow / K\uparrow$
   (c) K^*
   (d) L^*/K^*
   (e) $K\uparrow / L\downarrow$

3. Mie scattering of visible light by aerosols is selective with respect to ____ but only weakly selective with respect to ____

   (a) direction; wavelength ✓✓
   (b) temperature; humidity
   (c) humidity; temperature
   (d) wavelength; solar elevation
   (e) wavelength; direction

4. An atmospheric gas that selectively absorbs upwelling radiation in wavelength-band $\lambda_1 - \lambda_2$ will emit radiation ____

   (a) In the shortwave band
   (b) In the longwave band
   (c) At all wavelengths
   (d) Downwards towards ground but in no other direction
   (e) Whose wavelength lies in the same band $\lambda_1 - \lambda_2$ ✓✓

5. The "diurnal" (daily) range in temperature is normally largest ____ . At the same latitude and time of year, diurnal range is generally ____ over land than over ocean.

   (a) at night; larger
   (b) at the base of the atmosphere; smaller
   (c) at the base of the atmosphere; larger ✓✓
   (d) at the top of the atmosphere; smaller
   (e) by day; larger

6. In the stably-stratified atmospheric boundary layer vertical mixing is ____ and the direction of convective sensible heat transfer is ____

   (a) Enhanced; towards ground
   (b) Damped; towards ground ✓✓
   (c) Enhanced; away from ground
   (d) Damped; away from ground
   (e) Nonexistent; undefined

7. Conditions associated with a radiation frost are a strong ____ with a convective flow of heat ____

   (a) wind; from ground to atmosphere
   (b) wind; from atmosphere to ground
   (c) temperature inversion; from ground to atmosphere
   (d) temperature inversion; from atmosphere to ground ✓✓
   (e) downward solar flux density $K\downarrow$; from air to nitrogen molecules

8. Climatologically, the latitudinal temperature gradient is strongest in the ____ hemisphere over ____

   (a) summer; continents
   (b) summer; oceans
   (c) southern; oceans
   (d) winter; continents ✓✓
   (e) winter; oceans

For the remaining questions, please refer to Figures (1, 2), CMC analyses valid 00Z Wed. 7 Oct., 2009.

9. Based on the analyses one expects that over the following few hours south-eastern Alberta will experience ____ , while north-central Alberta will experience ____

   (a) no wind; strong SE wind

   (b) rapid cooling trend; slower cooling trend ✓✓

   (c) rain; strong SE wind

   (d) east wind; strong NW wind

   (e) snow; snow

10. At the surface, winds are blowing anticlockwise around the low centred in Saskatchewan. The cross-isobar component of the wind, very noticeable in central Alberta, can best be attributed to ____

    (a) an imbalance of horizontal forces

    (b) existence of a ridge of high pressure, extending down from the High in northern B.C. and along the lee of the Rockies

    (c) Geostrophic flow (i.e. balance of pressure gradient and Coriolis forces)

    (d) the influence of friction in the atmospheric boundary layer ✓✓

    (e) weight of air causing it to "fall" down the lee side of the Rockies and exert a pressure towards the east

Equations and Data.

- one full barb on the wind vector corresponds to 5 m s^{-1}
- $Q^* = Q_H + Q_E + Q_G$

  Surface energy balance on a reference plane at the base of the atmosphere, all fluxes in [W m^{-2}]. Q^* the net radiation, positive if directed towards the surface; Q_H, Q_E the sensible and the latent heat fluxes, positive if directed from the surface towards the atmosphere; Q_G the 'soil' heat flux, positive if directed from the surface into ground/lake/ocean.

- $Q^* = K^* + L^* = K\downarrow - K\uparrow + L\downarrow - L\uparrow$

  The radiation balance on a horizontal reference plane surface. All fluxes are in $[W\ m^{-2}]$. $K\downarrow, K\uparrow$, the incoming and outgoing solar fluxes (net solar, $K^* = K\downarrow - K\uparrow$); and $L\downarrow, L\uparrow$, the incoming and outgoing longwave fluxes (net longwave, $L^* = L\downarrow - L\uparrow$). Any quantity carrying the arrow ($\downarrow$ or $\uparrow$) is non-negative by definition.

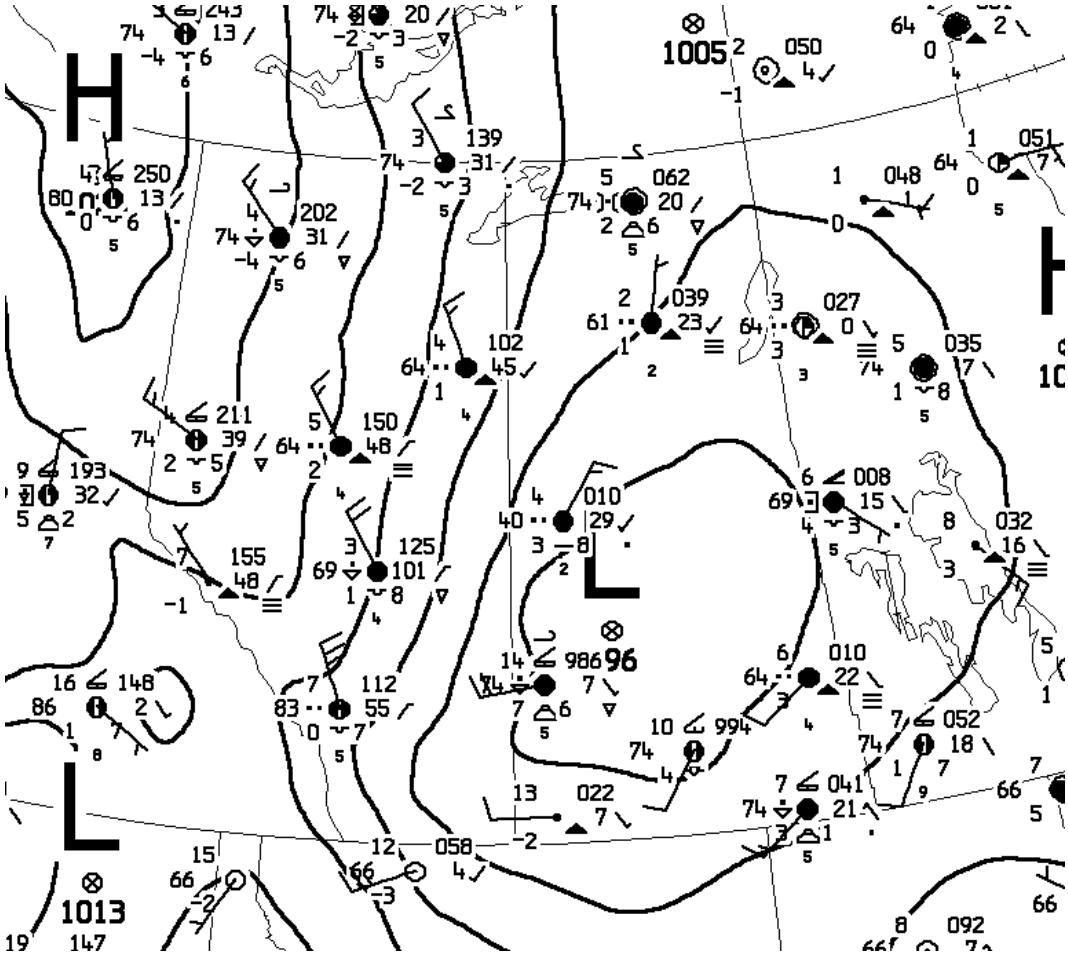

Figure 1: CMC surface analysis, 00Z Oct. 7, 2009

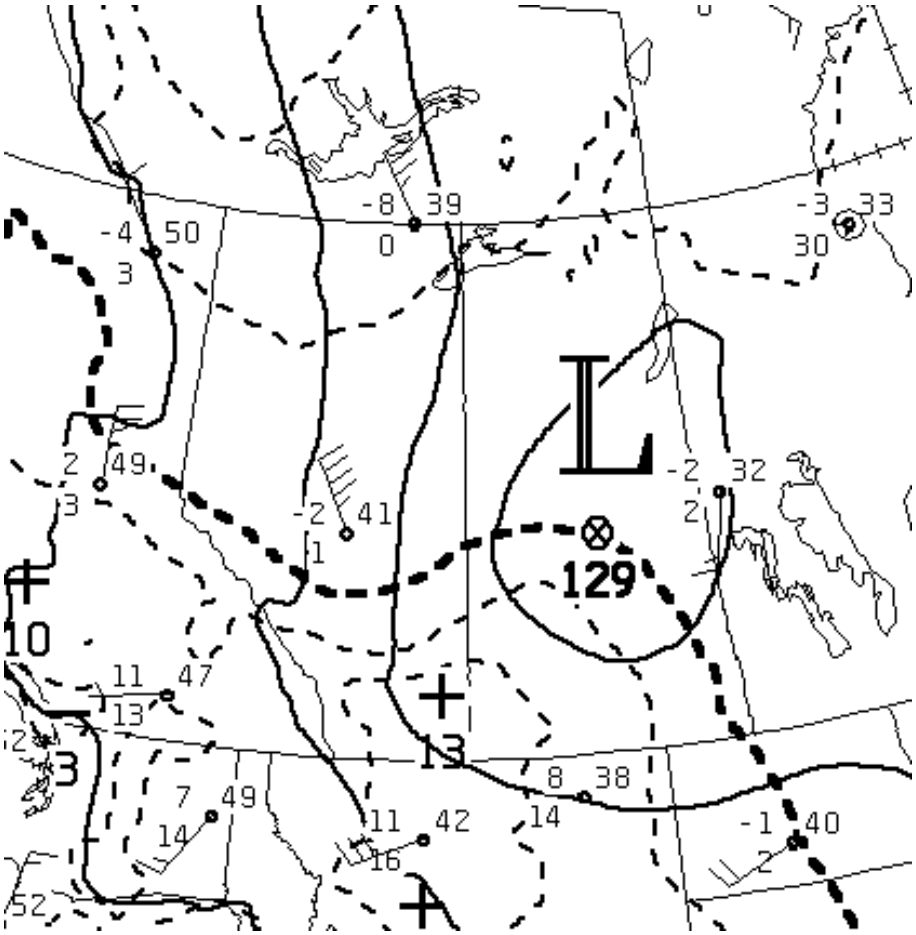

Figure 2: CMC 850 hPa analysis, 00Z Oct. 7, 2009