EAS270, "The Atmosphere" Quiz 2 8 Oct, 2004

Professor: J.D. Wilson Time available: 20 mins Value: 7%

Instructions: For all 14 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 given at back**.

1. The numerical value of the "solar constant" is about 1.37 x ____ [W m^{-2}]
   - (a) 10^{-3}
   - (b) 10^{-1}
   - (c) 10^{0}
   - (d) 10^{2}
   - (e) 10^{3} ✓✓

2. The shortwave radiation band spans approximately ____ [μm]
   - (a) 0.4 – 40
   - (b) 0.4 – 4 ✓✓
   - (c) 4 – 100
   - (d) 40 – 100
   - (e) 0.4 – 100

3. In the 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

4. The spectrum of radiation from a certain black body has a spectral peak at wavelength $\lambda_{max} = 14\mu m$. The temperature of the body must be about ____ (two correct answers - my mistake - marked accordingly)
   - (a) 207^oC
   - (b) -67^oC ✓✓
   - (c) 207^oK ✓✓
   - (d) -67^oK
   - (e) 480^oK

5. A gas that selectively absorbs 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 $\lambda_1 - \lambda_2$ ✓✓

6. The local, half-hour average net radiation Q^* on the ground surface is ____

   (a) of smaller magnitude than the solar constant ✓✓
   (b) equal to the solar constant
   (c) greater than the solar constant
   (d) always positive
   (e) always negative

7. A thick, unbroken layer of low cloud overnight should have the consequence that at the surface beneath ____

   (a) Net longwave radiation $L^* \approx 0$
   (b) Net radiation $Q^* \approx 0$
   (c) Net shortwave radiation $K^* > 100$ W m^{-2}
   (d) Net radiation $Q^* < -100$ W m^{-2}
   (e) both (a) and (b) make sense ✓✓

8. The depth of the turbulent friction layer is largest over ____ ground during ____ winds and ____ surface heat flux (Q_H).

   (a) rough; light; strong upward
   (b) rough; strong; strong upward ✓✓
   (c) smooth; light; strong downward
   (d) smooth; strong; strong upward
   (e) frozen; light; strong downward

9. On a fair summer day, maximum temperature usually occurs well after noon because

   (a) By then morning dew has evaporated
   (b) Live plant tissue respires while sunlit, producing heat
   (c) Maximum temperature occurs precisely 9 hours after sunrise
   (d) Net radiation $Q^* = K^* + L^*$ remains positive until late afternoon ✓✓
   (e) Net solar radiation K^* is maximum in late afternoon

10. The shortwave reflectivity (or albedo) r is defined to be ____

   (a) $\frac{K\uparrow}{K\downarrow}$ ✓✓
   (b) $\frac{K\downarrow}{K\uparrow}$
   (c) K^*
   (d) $K^* + L^*$
   (e) $\frac{K\uparrow}{L\downarrow}$

For the remaining questions, please refer to the attached meteorological charts

11. In your estimation, the given 'skew T-log P' diagram was probably observed

   (a) around dawn after a heavily cloudy night
   (b) around dawn after a calm, cloudless night ✓✓
   (c) mid-afternoon on a sunny, cloudless day
   (d) mid-afternoon on a cloudy day
   (e) impossible to judge from the given information

12. According to the 'skew T-log P' diagram, temperature at 850 mb was about

   (a) -4 C
   (b) 2 C
   (c) 6 C
   (d) 10 C ✓✓
   (e) 15 C

13. On the 48 hour prog, the solid isolines are ____ and the dashed isolines are ____

   (a) 500 mb height; 850 mb temperature
   (b) 500 mb height; 500 mb temperature
   (c) 700 mb height; 700 mb humidity (eg. 522 meaning 52.2 %)
   (d) sea-level pressure [mb]; 1000-500 mb thickness [dam] ✓✓
   (e) sea-level pressure [mb]; 850 mb temperature (eg. 522 meaning 5.22 C)

14. According to the prog, at 12Z on 1 Oct/04 S. Manitoba should have experienced

   (a) strong winds winds, rapid warming
   (b) strong winds, rapid cooling ✓✓
   (c) light winds, rapid warming
   (d) light winds, rapid cooling
   (e) calm, with temperature steady

Equations and Data.

- $L\uparrow = \epsilon\, \sigma\, T^4$

  Stefan-Boltzmann law. $L\uparrow$ [W m^{-2}], the emitted longwave energy flux density; ϵ, the emissivity of the surface (dimensionless); $\sigma = 5.67 \text{ x } 10^{-8}$ [W m^{-2} K^{-4}], the Stefan-Boltzmann constant; T [K], the surface temperature.

- $\lambda_{max} = \frac{2900}{T}$

  Wien's displacement law. λ_{max} [μm], the wavelength at which the peak in the emission spectrum occurs; T [K], the temperature of the emitting surface.

- $\theta = 90 - \Phi_{lat} + \phi_{sol.dec}$

  The solar elevation θ at solar noon, at a location with latitude Φ_{lat}, at the time of year when solar declination is $\phi_{sol.dec}$. Latitude is negative in the southern hemisphere; and solar declination is negative during northern hemisphere winter.

- $Q^* = Q_H + Q_E + Q_G + Q_S$

  The surface energy balance. All fluxes are in [W m^{-2}]. Q^* the net radiation, positive if directed towards the ground surface; Q_H, Q_E the sensible heat flux and the latent heat flux, positive if directed away from the ground surface; Q_G the soil heat flux, positive if directed away from the ground surface; Q_S, the storage term.

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

  The surface radiation balance. 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, $L^* = L\downarrow - L\uparrow$).

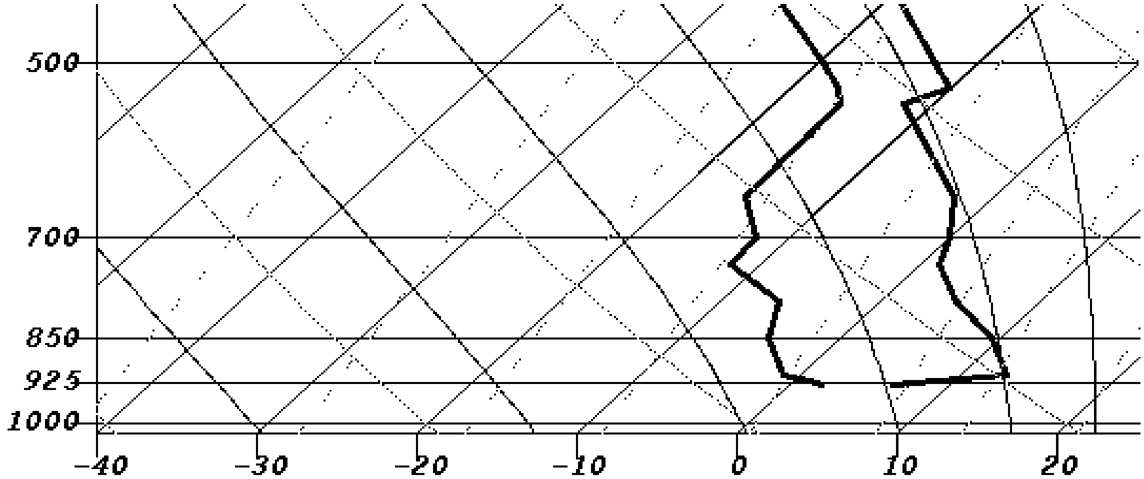
Request for your anonymous feedback... please respond (if you wish) then tear off and leave at the back of the room at the end of class... thanks

I would like to know if there is anything in the way the course is organized or the lectures are delivered that I may be able to improve to everyone's benefit. Please indicate (✓) your satisfaction (or otherwise), and comment if you wish:

- technicalities of lecture delivery are ok (audibility, visibility, etc.)
- material covered can easily be located in the textbook or in the supplementary figures placed on the web
- pace of lectures is ok
- I have a sense of the connections between, and the relevance of, the topics covered
- map discussions are interesting
- I feel I am progressing in my understanding of the atmosphere and weather
- the lecturer is accessible to help me when I have difficulty

And if you are a class-skipper: I sometimes skip EAS 270 class because ____

- the class is boring
- my time is better spent focusing on other courses
- because I can keep up with EAS 270 by following the web log and working independently
- none of the above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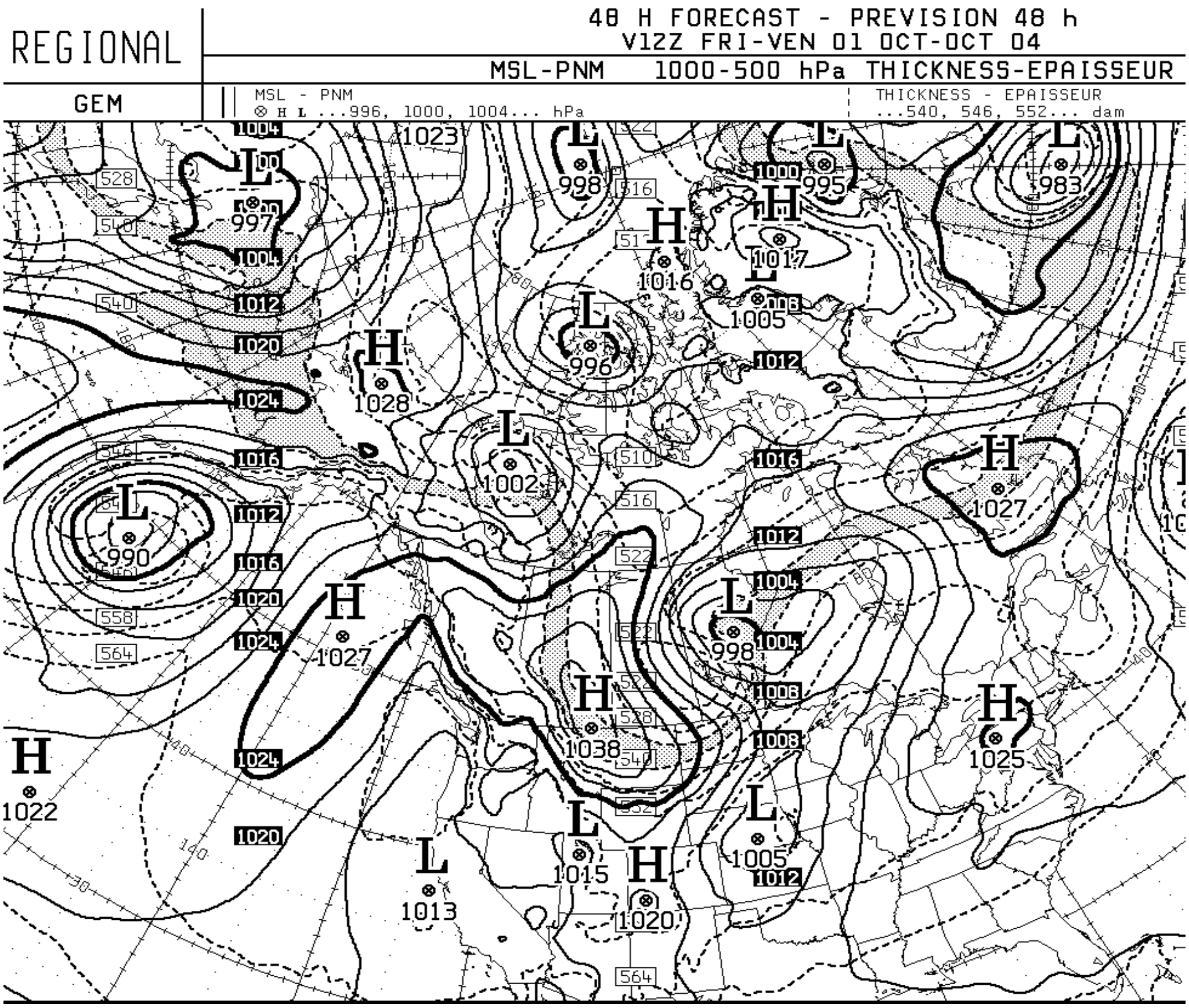
REGIONAL
GEM
48 H FORECAST - PREVISION 48 h
V12Z FRI-VEN 01 OCT-OCT 04
MSL-PNM 1000-500 hPa THICKNESS-EPAISSEUR
MSL - PNM
⊗ H L ...996, 1000, 1004... hPa
THICKNESS - EPAISSEUR
...540, 546, 552... dam