EAS270 "The Atmosphere" Final Exam 15 Dec., 2005

Professor: J.D. Wilson Time available: 120 mins Value: 40%

See back pages for equations and data you may need. You may keep the exam.

1 Multi-choice (50 x 1/2 $\rightarrow$ 25 %)

1. Present day CO_2 concentration is about ____
   - (a) 370 kg m^{-3}
   - (b) 1370 kg m^{-3}
   - (c) 0.037 kg m^{-3}
   - (d) 370 ppm (parts per million) ✓
   - (e) 1370 ppm (parts per million)

2. Three very important "greenhouse gases" in the atmosphere are ____
   - (a) O_2, N_2, CO_2
   - (b) Ar, N_2 , methane (CH_4)
   - (c) N_2, CO_2 , methane (CH_4)
   - (d) O_2, N_2, nitrous oxide (N_2O)
   - (e) CO_2, H_2O, methane (CH_4) ✓

3. About ____ of the mass of the atmosphere lies below the 500 mb surface, whose distance above sea-level is about ____
   - (a) 50%; 5 km ✓
   - (b) 50%; 50 km
   - (c) 33%; 1 km
   - (d) 25%; 50 dam
   - (e) 1%; 50 km

4. The "atmospheric window" spans ____
   - (a) the wavelength range of approximately $0.4 - 4\ \mu$m
   - (b) the wavelength range of approximately $8 - 12\ \mu$m ✓
   - (c) the shortwave radiation band
   - (d) the longwave radiation band
   - (e) none of the above

5. Consider three adjacent depth-layers (1,2,3) of the Planetary Boundary Layer. Mean horizontal windspeeds in the three layers are $U_1 < U_2 < U_3$. Layer 3 is therefore the ____ of the three layers. Parcels of air descending from layer 3 to layer 2 exert an influence that could (if not opposed) cause layer 2 to ____

   (a) highest; accelerate ✓
   (b) highest; decelerate
   (c) middle; accelerate
   (d) lowest; accelerate
   (e) lowest; decelerate

6. The term "albedo" means (is a synonym for) ____

   (a) shortwave absorbtivity
   (b) shortwave reflectivity ✓
   (c) longwave absorbtivity
   (d) longwave reflectivity
   (e) none of the above

7. The spatial patterns of lower atmospheric winds and temperature are generally more meaningfully appreciated on the 850 mb map than on a surface map because ____

   (a) except in mountainous regions, this is away from the confounding influence of local terrain
   (b) patterns at 850 mb evolve less rapidly than at ground
   (c) provided the 850 mb is above (or high in) the friction layer, observed winds reflect the synoptic scale pressure gradient
   (d) regions of warm or cold advection are readily identified
   (e) all of the above ✓

8. Noctural longwave radiative cooling of the ground tends to ____ a ground-based layer of the atmosphere, resulting in formation of a/n ____ layer

   (a) destabilize; inversion
   (b) stabilize; inversion ✓
   (c) stabilize; statically neutral
   (d) destabilize; statically neutral
   (e) destabilize; isothermal

9. Polar stratospheric clouds play a role in the mechanism of ____

   (a) the "arctic hurricane"
   (b) the polar low
   (c) the jetstreams
   (d) the ozone hole ✓
   (e) planetary boundary-layer air pollution

10. To determine the location of the jetstream(s) over Canada, one would choose the CMC synoptic analysis for the ____ mb level

   (a) 250 ✓
   (b) 500
   (c) 700
   (d) 850
   (e) surface

11. A dim, "watery" sun visible through a gray sheet-like cloud is often a good indication of ____ clouds.

   (a) stratocumulus
   (b) altostratus ✓
   (c) nimbostratus
   (d) cirrostratus
   (e) cumulonimbus

12. "Cross-isobar flow" occurs in the ____ layer of the atmosphere. That flow is oriented into a center of Low pressure, and results in ____ vertical motion

   (a) geostrophic; descending
   (b) geostrophic; ascending
   (c) friction; descending
   (d) friction; ascending ✓
   (e) tropospheric; ascending

13. The strong winds of a mid-latitude cyclone imply a great amount of storm kinetic energy. Ultimately solar radiant energy drives the storm (and all atmospheric motion). But the "immediate" energy source feeding the storm is ____

   (a) rotational energy of the earth, ie. work done by the Coriolis force
   (b) latent heat of condensation of water vapour, released in the clouds
   (c) gravitational potential energy inherent in the pre-storm state (contact of cold and warm air columns along the polar front) ✓
   (d) terrestrial (longwave) radiant energy
   (e) frictional potential energy

14. In a desert there is often a strong diurnal cycle in surface windspeed. This is unsurprising because ____

    (a) Low humidity implies the air is lighter, so its velocity responds dramatically to daily-varying forces
    (b) Due to strong daytime turbulent mixing, winds aloft drag along the daytime surface winds; but a strong nocturnal inversion under clear, dry skies suppresses that coupling ✓
    (c) Cold air drainage off the dunes at night slows the winds
    (d) A strongly positive daytime sensible heat flux Q_H implies friction is non-existent during the day
    (e) Both (c) and (d) make sense

15. The standard height for windspeed measurements is 10 m above ground. Standardizing the height for measuring wind is important because ____

    (a) This places the instruments out of reach of animals (provided special provisions are made to discourage giraffes and kangaroos)
    (b) At this height the measurement is above the friction layer
    (c) At this height the wind is Geostrophic
    (d) Windspeed changes rapidly with height, and so conditions at two weather stations could falsely appear to differ only because their winds were cited for differing heights ✓
    (e) Common wind instruments (such as the cup anemometer) cannot function reliably in the lighter winds near ground

16. Three-dimensionality (x, y, z) in space is an essential feature of many types of atmospheric circulation, while others possess symmetry. A numerical model that carried only two space coordinates, radius (r) and height (z), ie. a model that assumed azimuthal symmetry, might suitably represent a ____

    (a) severe thunderstorm
    (b) mid-latitude cyclone
    (c) fair-weather cumulus ✓
    (d) Rossby wave
    (e) cold front

17. The chief advantage of using a global domain in NWP is that ____

    (a) accuracy of 24 hour forecasts is increased
    (b) otherwise planetary waves would not be resolved
    (c) one has no need to specify conditions on side boundaries ✓
    (d) the smallest scales of motion are captured
    (e) latitude-longitude coordinates can be used

18. A “Kuo scheme” in an NWP model would constitute part of the model ____ , and parameterizes ____

(a) dynamics; drag on unresolved hills

(b) dynamics; vertical redistribution by unresolved cumulus convection

(c) physics; sea-air heat and vapour fluxes

(d) physics; vertical redistribution of energy by unresolved cumulus convection ✓

(e) domain; sea-air heat and vapour fluxes

19. Suppose $U(I,J,K,n)$ represents the east-west component of the windspeed and $\rho_v(I,J,K,n)$ the absolute humidity, at gridpoint I,J,K and time n. The product $U(I,J,K,n)\,\rho_v(I,J,K,n)$ is a/n ____ quantity representing ____

(a) resolved; vertical rate of transport of heat

(b) unresolved; eastward rate of transport of heat

(c) resolved; eastward rate of transport of vapour ✓

(d) unresolved; vertical rate of transport of vapour

(e) resolved; baroclinicity

20. Ensemble short- and medium-range forecasting is an approach that is able to ____

(a) rationally account for uncertainty in the initial state of the atmosphere

(b) identify geographical regions where the forecast is uncertain

(c) reduce forecast vulnerability to model bias by combining forecasts from two or more NWP models

(d) outperform persistence and climatology forecasts

(e) all of the above ✓

21. As the basis for issuing public “tornado watch” broadcasts, the Meteorological Service of Canada ____

(a) forecasts each tornado’s path, with a lead time of at least 6 hours and an accuracy of 100 m or better, using a very high resolution numerical model

(b) uses Model Output Statistics (MOS) in conjunction with conventional NWP (lead times out to several days) to predict the point of outbreak and track of each tornado

(c) uses radars to watch existing thunderstorms for signs of rotation

(d) uses all available synoptic tools (eg. thermodynamic charts, surface and upper analyses) to diagnose up to many hours in advance the possibility of severe storms that might brew a tornado

(e) both (c) and (d) ✓

22. Consider the layer of air between ground and 700 mb. Which of the processes listed does NOT act to stabilize the layer?

    (a) Nocturnal radiative cooling of the ground
    (b) Warm advection at 700 mb
    (c) Flow of the identified layer off cold water and onto warm land ✓
    (d) Evaporation of surface water after a rainshower
    (e) Absorption of solar radiation by clouds whose tops are at 700 mb

23. The lapse rate of temperature with height in the troposphere ____

    (a) is always negative
    (b) is always positive
    (c) has units of W m^{-2}
    (d) varies geographically and temporally in sign and magnitude, and controls the gravitational stability/instability of the atmosphere ✓
    (e) is governed by the hydrostatic equation

24. Suppose late on a fine day in early autumn the weather office had predicted an overnight minimum temperature of 0^oC, indications being that the night should be clear and calm. If, counter to those expectations, the wind increased and remained gusty all night, the minimum temperature most likely would be ____

    (a) about the same as predicted, but would occur earlier in the night
    (b) higher than predicted, due to release of advected of latent heat
    (c) much lower than predicted due to longwave radiation
    (d) higher than predicted due to the unexpected vertical mixing ✓
    (e) lower than predicted due to the forced convection

25. Favoured locations for cyclogenesis are ____

    (a) over very warm oceans (surface temperature exceeding 27 Celcius)
    (b) along the polar front and in the lee of mountain barriers ✓
    (c) in the warm sector of a mid latitude cyclone
    (d) in the wake of a mid latitude cyclone
    (e) on the 850 mb surface

26. Pick the incorrect association:

    (a) temperature advection - baroclinicity
    (b) barotropic - isotherms parallel with height contours
    (c) shortwave - barotropic atmosphere ✓
    (d) longwave - vorticity maxima and minima
    (e) temperature advection - isotherms not parallel with height contours

27. It is conceivable that an ability to skillfully forecast El Nino/La Nina with a long lead time (eg. 6 months) could result from refinement of ____

    (a) coupled deterministic ocean-atmosphere-land-biosphere-cryosphere models ✓
    (b) satellite sea-surface temperature observations
    (c) the radiosonde network
    (d) ocean basin models
    (e) global atmosphere models

28. Occurrence over a particular region of an "Omega-block" in the mid-tropospheric flow is considered to flag the possibility of ____

    (a) an unstable (rapidly changing) weather pattern
    (b) a stable (slowly changing) weather pattern ✓
    (c) warm weather
    (d) cold weather
    (e) zonal flow

29. Surprisingly, in Edmonton the mean diurnal range in temperature is not greatly different in winter than in summer, despite greatly reduced mean diurnal range in net radiation Q^*. A plausible explanation is that ____

    (a) solar reflection off snow accentuates daytime temperature rise
    (b) longwave reflection off snow accentuates nighttime temperature fall
    (c) both of the above
    (d) depth of mixing is greater in winter
    (e) depth of mixing is greater in summer ✓

30. The aspect of a hurricane that usually is the most devastating (in terms of the size of the area affected) is ____

    (a) lightning associated with the pinwheel spiral of thunderstorms
    (b) high windspeeds
    (c) tornadoes
    (d) elevated sea level and swell ✓
    (e) high rainfall rate in the eyewall

31. From a perspective covering the 20th century Atlantic hurricanes, an extremely strong hurricane would be one whose central pressure is lower than ____ mb

    (a) 975
    (b) 925
    (c) 900 ✓
    (d) 800
    (e) 750

32. Which of the following phrases refers to a concept or theory or idealization relative to the atmosphere?

    (a) air density
    (b) vapour pressure
    (c) Geostrophic wind speed ✓
    (d) wind speed
    (e) air pressure

33. Hurricanes do not cross the equator because ____

    (a) conditions in the ITCZ do not favour deep convection
    (b) surface ocean temperatures along the equator are low
    (c) strong synoptic wind shear occurs in the ITCZ, disturbing a hurricane's organized winds
    (d) the Coriolis force is weak or non-existent near the equator ✓
    (e) all of the above

34. Which statement is false?

   (a) surface rotation in hurricanes is always cyclonic
   (b) tornados never occur within hurricanes ✓
   (c) most dust devils occur when the base of the friction layer is unconditionally unstable
   (d) a sea breeze circulation is usually much shallower than the depth of the troposphere
   (e) orographic clouds are by definition absent from the oceanic atmosphere, except in proximity to coastlines

35. 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

The remaining questions relate to weather conditions as inferred from the attached analyses and sounding for 12Z on Tues 6 Dec 2005 (except for Fig. 2, which is the sounding for 12Z Wed 7 Dec).

36. The 500 mb flow pattern indicates ____

   (a) strong zonal flow over the Canadian prairies
   (b) weak flow aloft over the western Canadian prairies ✓
   (c) Edmonton under the influence of maritime Polar (mP) air
   (d) longwave ridge axis running north-south through central North America
   (e) all of the above

37. Height of the 500 mb surface over Edmonton was ____

   (a) 1036 mb
   (b) 936 mb
   (c) 536 mb
   (d) 536 dam ✓
   (e) 360 dam

38. This is a western-Canadian flow regime that ____

   (a) couples central Alberta to maritime Pacific air
   (b) couples central Alberta to continental Tropical (cT) air off the west-central United States
   (c) ensures central Alberta is dominated by a continental Polar or Arctic (cP or CA) air ✓
   (d) is associated with mild winter weather in central Alberta
   (e) it is surprising to observe at any time of year

39. From the spacing of the 500 mb height contours, over the Pacific at (latitude,longitude) = (40^o, 150^o) the windspeed, assuming the Geostrophic law applies, would be about ____

   (a) 1.4 $\mathrm{m\,s^{-1}}$
   (b) 14 $\mathrm{m\,s^{-1}}$ ✓
   (c) 140 $\mathrm{m\,s^{-1}}$
   (d) 14 kph
   (e) 140 kph

40. The Edmonton (ie. Stony Plain) 1000-500 mb thickness is difficult to determine from the 500 mb analysis, but the sounding data (attached) indicate it was ____ (note: $1\,\mathrm{hPa} \equiv 1\,\mathrm{mb}$)

   (a) 5360 dam
   (b) (5360-301) m, ie. about 506 dam ✓
   (c) 536 dam
   (d) 500 dam
   (e) between 521 and 535.4 dam

41. 72 hours later (12Z Friday 9 Dec) the thickness over Edmonton was 540 dam. Therefore since 12Z Tuesday 6 Dec, the mean temperature of the lower atmosphere over Edmonton had ____

   (a) remained unchanged
   (b) cooled by 17^oC
   (c) warmed by 4 ^{o}C
   (d) warmed by 17^oC ✓
   (e) warmed by 34^oC

42. At 850 mb over the Canadian prairies ____

   (a) dewpoints were above freezing
   (b) winds were southerlies
   (c) a front can be identified
   (d) temperature was rather uniform (and cold) ✓
   (e) all of the above

43. A NE 850 mb wind was reported at Churchill (on the Hudson's Bay coast in northern Manitoba), which ____

   (a) demonstrates Hudson's Bay must be ice-covered
   (b) might explain the warmer 850 mb temperature at that station than at Saskatchewan and Alberta stations ✓
   (c) is inconsistent with the 850 mb height contour
   (d) signifies warm advection
   (e) signifies cold advection

44. Still judging from the 850 mb chart, strong onshore warm heat advection ____ occurring along the southwest coast of B.C. because of ____ (it may help to focus on the 49^o latitude line)

   (a) is; the strong temperature gradient
   (b) is not; the absence of a strong temperature gradient
   (c) is; the strong wind perpendicular to packed isotherms
   (d) is not; the weakness of the 850 winds along the coastline ✓
   (e) is not; flow impeded by the mountains on Vancouver Island

45. From the 850 mb chart it is evident that ____

   (a) the Rocky Mountains represent something of a barrier protecting coastal southern B.C. from invasion by cold continental-interior air masses
   (b) freezing conditions extend over most of the North American continent
   (c) temperature is much more variable across B.C. than across the prairie provinces
   (d) a broad and irregular 'axis' or 'system' of low pressure extending from the north pole down across most of eastern North America is associated with the far southward penetration of very cold air
   (e) all of the above ✓

46. Looking at the surface chart, we can say Alberta is under the influence of ____

(a) a trough of cold air
(b) a winter storm
(c) an arctic ridge
(d) an anticyclone
(e) both (c) and (d) apply ✓

47. Three stations at and to the north of the northern border of Alberta report overcast with ____ as present weather. Over this region the 500 mb chart shows a ____

(a) steady snow; shortwave trough ✓
(b) steady rain; shortwave ridge
(c) drizzle; shortwave trough
(d) fog; shortwave ridge
(e) intermittent rain; longwave trough

48. At Red Deer, surface pressure (sea-level corrected) was ____ mb and ____

(a) 10382; rising
(b) 9382; falling
(c) 1038.2; falling ✓
(d) 1038.2; rising
(e) 938.2; falling

49. From the evidence of the three analyses, over the forthcoming 12-24 hours central Saskatchewan can expect ____

(a) strong winds, heavy precipitation
(b) rapid warming
(c) rapid cooling
(d) light winds, continued cold, little or no precip ✓
(e) rapidly deteriorating weather associated with retrograding (westerly) motion of the closed 500 mb high over Manitoba at analysis time

50. Fig. (2) is the Stony Plain sounding for 12Z Wed Dec 7, ie. 24 hours after the previous charts. The air overhead is very mild, but these two factors cause doubt about forecasting immediate surface warming: ____

(a) very large T-T_d spread from about 900-700 mb; light low-level winds
(b) extremely stable stratification; light low-level winds ✓
(c) surface saturation at ground; rotation of wind direction with increasing height
(d) high tropopause (about 200 mb); strongly stable stratification in the stratosphere
(e) strong northerly winds above about 650 mb; unconditionally-unstable below 700 mb

2 Short answer (7.5%)

Instruction: Answer question tidily on this side (only) of this page. Tear off, and hand in at end of exam.

The dewpoint lapse rate for an unsaturated parcel ($\Delta T_d / \Delta z$) is about 0.2^{o}C per 100 m, whereas the dry adiabatic lapse rate (DALR) of temperature is 1^{o}C per 100 m (both temperatures falling as one progresses aloft). Therefore as an unsaturated parcel moves along the vertical, its temperature and dewpoint $T(z), T_d(z)$ converge towards each other (on ascent) or separate (on descent) at the rate of about 0.8^{o}C per 100 m.

Noting any assumptions you make, estimate the pressure at the Lifting Condensation Level (LCL) and the distance Δz from ground to the LCL, if parcels at ground have properties $p = 940$ mb, $T = 20^o$C, $T_d = 17^o$C.

Name: ID#:

Schematic Answer

We need to solve

$$T_d = 17.0 - (0.2/100)\,\Delta z = \; T = \; 20.0 - (1.0/100)\,\Delta z \tag{1}$$

or rearranging,

$$0.01\,(1.0 - 0.2)\,\Delta z = \; 20.0 - 17.0 \tag{2}$$

which gives $\Delta z = 375$ m. Now, to find what is the pressure this high above ground, we need to substitute this value of Δz into the hydrostatic law $\Delta p = -\rho g \Delta z$. We can approximate ρ for the calculation as $\rho = 94000/(287 * (273 + 20))$.

3 Short answer (7.5%)

Instruction: Plan/organize your response before starting to write! Answer question tidily on this side (only) of this page. Tear off, and hand in at end of exam.

In essay or point format, give your ideas on the linkages between the historical (and likely future) development of weather forecasting, and the evolution of *technology*.

Name: ID#:

Schematic Answer

A good start would be to note that, reduce to its essentials, modern weather forecasting entails: (1) data collection, (2) data communications and (3) computations. Here are some relevant points that could form the core of your response (for coherency, best to put them in roughly chronological sequence)... although some of the following points may seem unrelated to weather forecasting, from the above breakdown it is clear that ability to *measure* the weather is a key aspect of weather forecasting (until you can measure weather, it is meaningless to forecast it). Thus, technology that relates to ability to measure and to communicate weather data fittingly belongs with technological steps in weather forecasting...

- invention of thermometer and barometer
- telegraphy/communications - enabled communication of weather data over long distances (allows to draw state of atmosphere at a given instant)
- hot air balloon (later, radiosondes) - enabled measurements aloft
- internal combustion engine - leads to aviation and specialized measurements aloft, eg. mapping earth's terrain needed for NWP
- discovery of laws of physics (eg. Newton's laws, other conservations laws) - basis for NWP (actually, this isn't really technology so strictly it doesn't belong)
- invention of numerical algebra (finite differences etc.) - solution of equations on the computer (again, hardly technology - but these methods developed along with control systems for machinery)
- transistor and microelectronics - leads to the computer
- radar - ability to detect weather and to track rawindsondes
- automatic weather stations
- rocketry, leading to satellites - remote sensing of the atmosphere from space (and facilitates communication with remote ground-based weather stations)
- space-based spectral radiometers - remote sensing
- internet - dissemination of information to the public

- transportation - enhanced the need for aviation and public weather forecasts, leading to increased funding for research and development
- buoy network for measurements over the oceans

Equations and Data.

- $\frac{\Delta P}{\Delta z} = -\rho\, g$

  The hydrostatic law. ΔP [Pascals], the change in pressure as one ascends a distance Δz [m]; ρ [kg m^{-3}] the density; $g \sim 10$ [m s^{-2}] acceleration due to gravity.

- $P = \rho\, R\, T$

  The ideal gas law. P [Pascals], pressure; ρ, [kg m^{-3}] the density; T [Kelvin], the temperature; and $R = 287$ [J kg^{-1} K^{-1}], the specific gas constant for air).

- $V = \frac{g}{f}\,\frac{\Delta h}{\Delta x}$

  The Geostrophic wind equation. Δh [m], the change in height of a constant pressure surface over distance Δx [m] normal to the height contours; $f = 2\Omega\ \sin\phi$ [s^{-1}] the Coriolis parameter (where $\Omega = 2\pi/(24\text{x}60\text{x}60) = 7.27\text{x}10^{-5}$ s^{-1} is the angular velocity of the earth, and ϕ is latitude); $g \sim 10$ [m s^{-2}] acceleration due to gravity.

- 1^o latitude corresponds to a distance of 111 km

- Each full slash on the wind barb counts 5 m s^{-1}

Table 1: Saturation vapour pressure $e_s(T)$ [mb] versus temperature T [C].

T	$e_s(T)$	T	$e_s(T)$	T	$e_s(T)$	T	$e_s(T)$	T	$e_s(T)$	T	$e_s(T)$
0	6.11	5	8.72	10	12.27	15	17.04	20	23.37	25	31.67
1	6.57	6	9.35	11	13.12	16	18.17	21	24.86	26	33.61
2	7.05	7	10.01	12	14.02	17	19.37	22	26.43	27	35.65
3	7.58	8	10.72	13	14.97	18	20.63	23	28.09	28	37.80
4	8.13	9	11.47	14	15.98	19	21.96	24	29.83	29	40.06

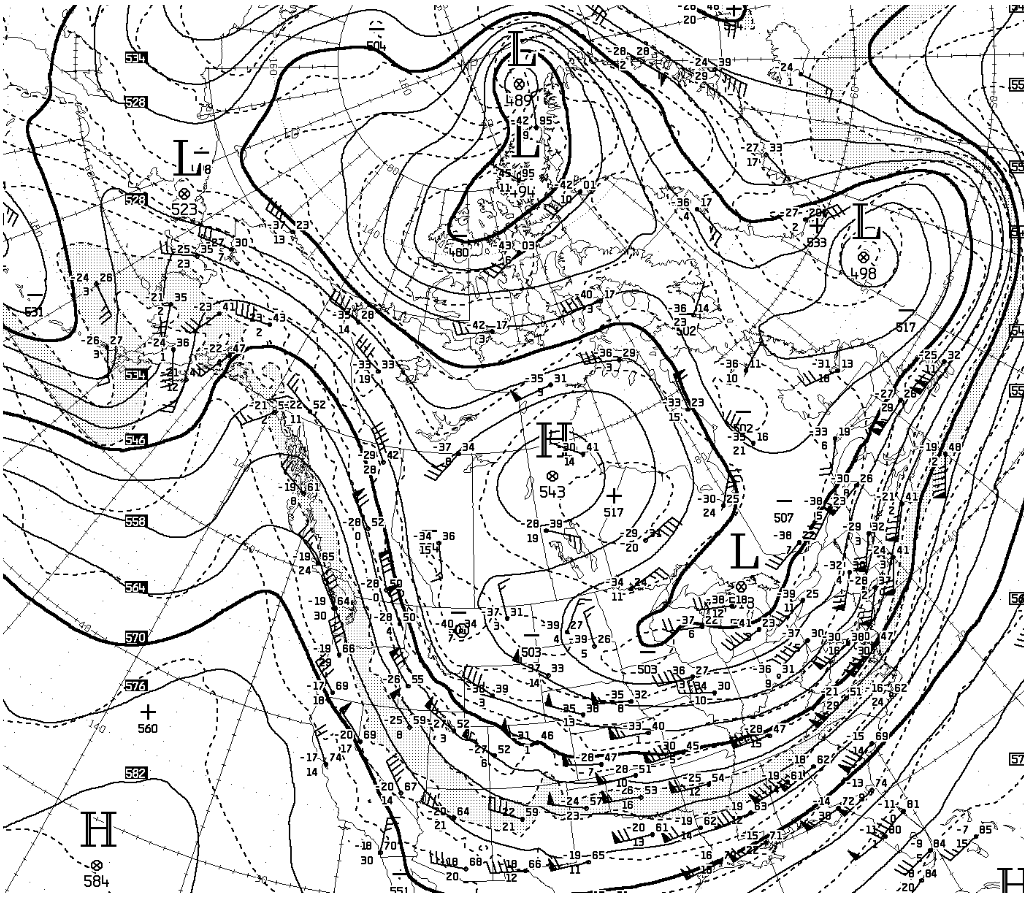
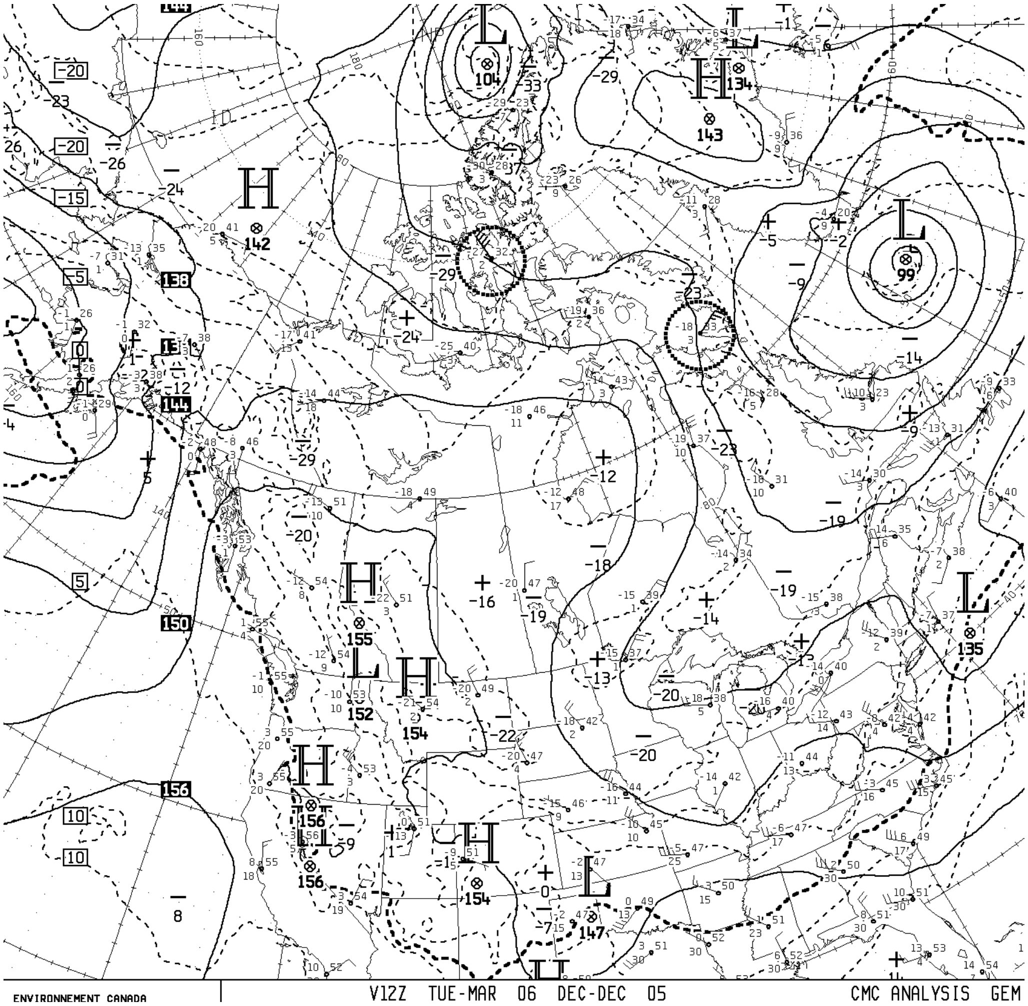
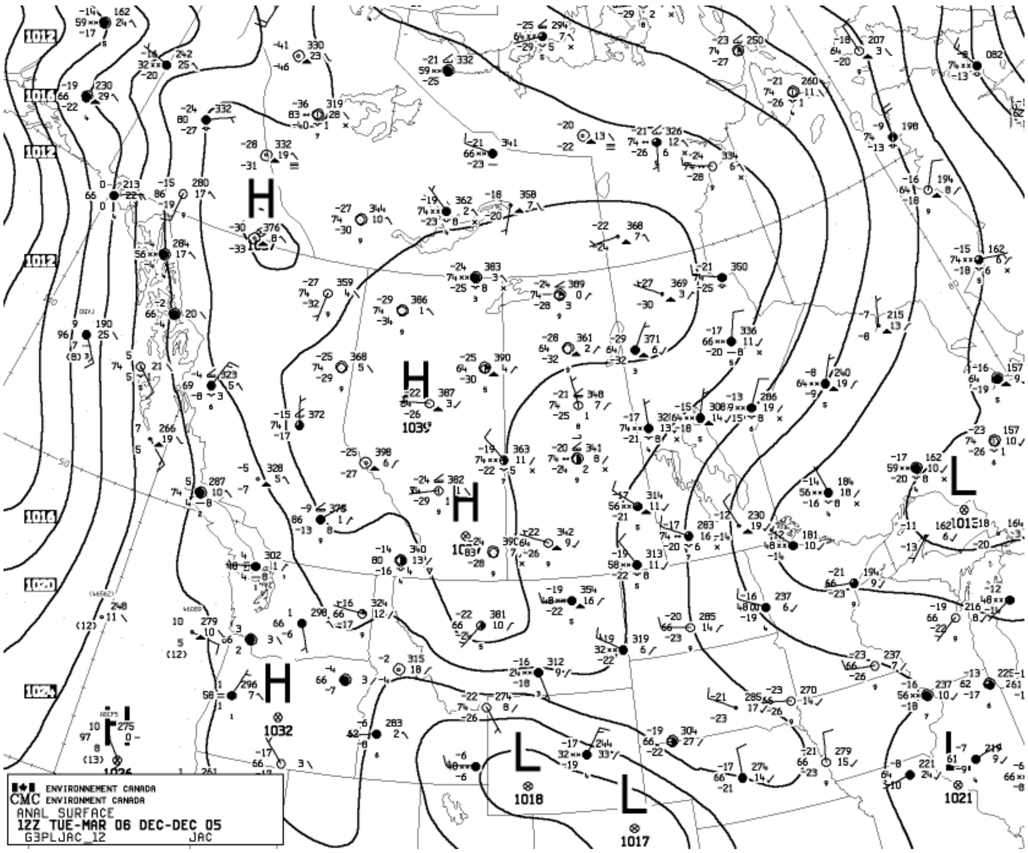


Figure 1: The 150^o longitude line lies westward of the 140^o line off the west coast.


ENVIRONNEMENT CANADA
V12Z TUE-MAR 06 DEC-DEC 05
CMC ANALYSIS GEM


ENVIRONNEMENT CANADA
CMC ENVIRONMENT CANADA
ANAL SURFACE
12Z TUE-MAR 06 DEC-DEC 05
G3PLJAC_12 JAC

71119 WSE Edmonton Stony Plain Observations at 12Z 06 Dec 2005

PRES hPa	HGHT m	TEMP C	DWPT C	RELH %	MIXR g/kg	DRCT deg	SKNT knot	THTA K	THTE K	THTV K
1000.0	301									
940.0	766	-22.5	-25.9	74	0.50	320	6	255.1	256.5	255.2
925.0	885	-20.7	-23.8	76	0.61	305	6	258.1	259.9	258.2
921.4	914	-20.5	-23.8	75	0.61	300	7	258.6	260.4	258.7
921.0	917	-20.5	-23.8	75	0.61	300	7	258.7	260.4	258.8
884.1	1219	-22.0	-25.2	76	0.56	310	9	260.1	261.7	260.2
878.0	1270	-22.3	-25.4	76	0.56	313	10	260.4	262.0	260.4
850.0	1508	-22.1	-24.9	78	0.60	325	13	263.0	264.7	263.1
846.0	1543	-21.9	-24.7	78	0.61	326	14	263.6	265.3	263.6
834.0	1648	-20.3	-23.4	76	0.70	327	16	266.3	268.4	266.4
813.8	1829	-20.9	-23.5	79	0.71	330	21	267.5	269.6	267.7
780.9	2134	-21.9	-23.8	85	0.72	325	24	269.6	271.8	269.8
775.0	2190	-22.1	-23.8	86	0.73	326	24	270.0	272.2	270.1
749.4	2438	-21.6	-22.9	89	0.81	330	23	273.2	275.6	273.3
744.0	2491	-21.5	-22.7	90	0.83	330	22	273.8	276.4	274.0
733.0	2601	-20.3	-23.9	73	0.76	330	20	276.3	278.6	276.4
719.0	2743	-21.1	-26.1	64	0.64	330	17	277.0	279.0	277.1
700.0	2941	-22.1	-29.1	53	0.50	325	14	278.0	279.6	278.1
691.0	3036	-22.5	-30.5	48	0.44	326	12	278.6	280.0	278.6
680.0	3154	-22.9	-28.9	58	0.52	328	9	279.4	281.1	279.5
661.7	3353	-24.1	-31.0	53	0.44	330	5	280.2	281.6	280.3
641.0	3584	-25.5	-33.5	47	0.36	353	3	281.2	282.4	281.3
634.5	3658	-25.5	-39.1	27	0.20	0	3	282.0	282.7	282.1
633.0	3676	-25.5	-40.5	23	0.18	5	3	282.2	282.8	282.2
595.0	4124	-26.1	-52.1	7	0.05	122	8	286.6	286.8	286.6
583.2	4267	-27.2	-51.6	8	0.06	160	10	287.0	287.2	287.0
535.4	4877	-31.7	-49.7	15	0.08	160	14	288.7	289.0	288.7
521.0	5071	-33.1	-49.1	19	0.08	160	15	289.2	289.5	289.2
512.8	5182	-33.4	-49.0	19	0.09	160	15	290.1	290.5	290.2
500.0	5360	-33.9	-48.9	21	0.09	170	14	291.6	292.0	291.7
479.0	5659	-35.9	-48.9	25	0.09	162	11	292.8	293.1	292.8
461.0	5926	-35.1	-47.1	28	0.12	155	9	297.0	297.4	297.0
449.7	6096	-36.4	-47.9	30	0.11	150	7	297.4	297.9	297.5
411.5	6706	-41.2	-50.8	35	0.09	160	6	299.0	299.3	299.0
400.0	6900	-42.7	-51.7	37	0.08	145	8	299.4	299.7	299.4
393.0	7019	-43.5	-52.5	36	0.08	145	9	299.9	300.2	299.9
376.0	7315	-44.4	-58.2	20	0.04	145	10	302.6	302.7	302.6
362.0	7570	-45.1	-63.1	11	0.02	153	8	304.9	305.0	304.9
359.3	7620	-45.3	-63.4	11	0.02	155	8	305.2	305.3	305.2
312.9	8534	-49.5	-69.4	8	0.01	35	4	311.7	311.7	311.7
309.0	8616	-49.9	-69.9	8	0.01	29	5	312.3	312.3	312.3
300.0	8810	-49.5	-69.5	8	0.01	15	6	315.5	315.5	315.5

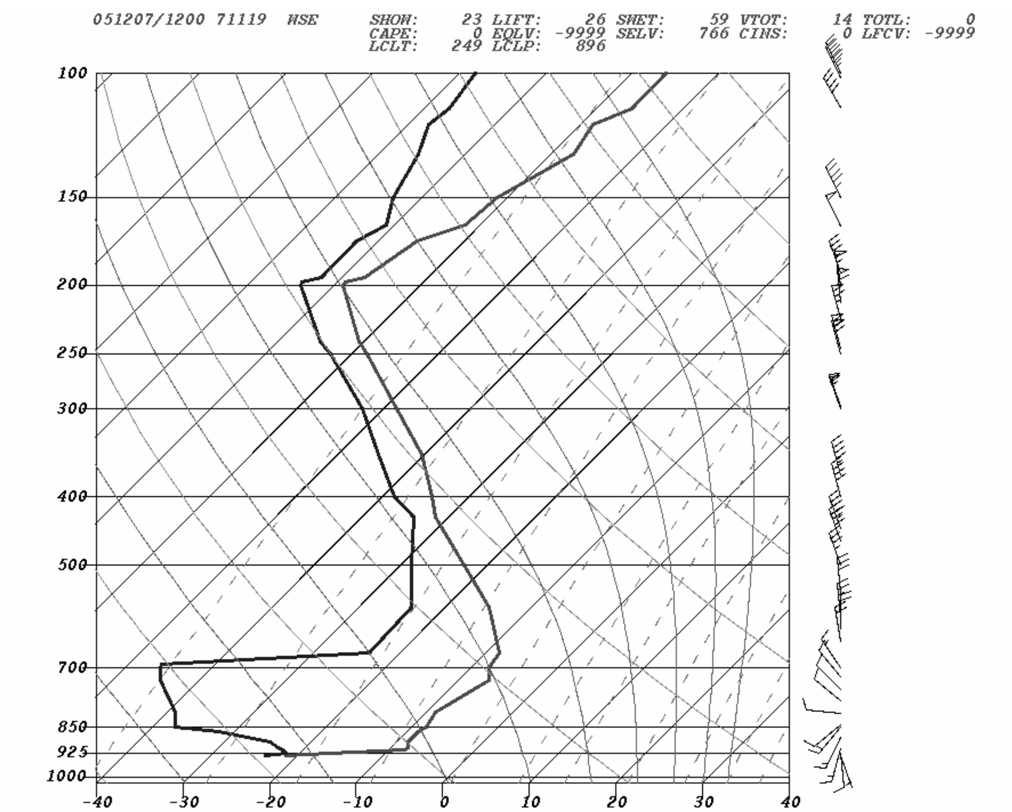


Figure 2: Edmonton (Stony Plain) sounding 24 hours after the previous analyses and sounding.