EAS372 Open Book Final Exam 22 April, 2014

Professor: J.D. Wilson Time available: 2 hours Value: 30%

A. Multi-choice (16 x 1/2% $\rightarrow$ 8 %)

1. Contemporary operational NWP models have of the order of ____ vertical levels, and a finest horizontal resolution of the order of order ____ km
   (a) 100; 10 ✓✓
   (b) 1000; 10
   (c) 100; 100
   (d) 100; 1000
   (e) 1000; 1

2. Let (u, v) be the Cartesian components of the horizontal wind, let ρ_v be the absolute humidity, and let $\nabla = \hat{i}\,\partial/\partial x + \hat{j}\,\partial/\partial y$ be the (horizontal) gradient operator. Which expression for the convergence of the horizontal moisture flux is **false**?
   (a) $\nabla \cdot (\mathbf{u}\,\rho_v)$
   (b) $\partial(u\rho_v)/\partial x + \partial(v\rho_v)/\partial y$
   (c) $\rho_v\ (\partial u/\partial x + \partial v/\partial y)$ **xx**
   (d) $\mathbf{u} \cdot \nabla\rho_v\ +\ \rho_v\,\nabla \cdot \mathbf{u}$

3. If the precipitation rate were given as 1.44 $[\mathrm{mm\,hr^{-1}}]$, what would be the equivalent value in the SI mass flux density unit $[\mathrm{kg\,s^{-1}\,m^{-2}}]$?
   (a) 4×10^{-4} ✓✓
   (b) 1×10^{-2}
   (c) 0.04
   (d) 0.4
   (e) 1.0

4. Which statement regarding CMC's GEM-global NWP model is **false**?
   (a) formulated in the velocity components
   (b) terrain-following vertical coordinate η
   (c) non-hydrostatic **xx**
   (d) time step about 10 minutes
   (e) operational runs twice daily

5. Suppose $f(x)$ is the probability density function for a continuous random variable x defined on the range $a \le x \le b$. Which defines the median m of x?

   (a) $0.5 = \int_a^m f(x)\,dx$ ✓✓

   (b) $m = \int_a^b f(x)\,dx$

   (c) $m = \int_a^b x\,f(x)\,dx$

   (d) $1 = \int_a^b m\,f(x)\,dx$

   (e) $1 = \int_m^b x\,f(x)\,dx$

6. Suppose y is a continuous variable whose probability density function is

$$g(y) = \begin{cases} 0 & , \ |y| > 1/3 \\ \alpha & , -1/3 \le y \le 1/3 \ . \end{cases}$$

   What choice for α ensures that $g(y)$ is correctly normalized?

   (a) 1/3
   (b) 2/3
   (c) 1
   (d) 4/3
   (e) 3/2 ✓✓

7. Referring to the variable of Q6, if one wished to define (equiprobable) classes (below normal, normal, above normal) then what value defines the upper threshold of the "below normal" class?

   (a) - 2/6
   (b) -2/9
   (c) -1/6
   (d) -1/9 ✓✓
   (e) 1/9

Over the next few hours the temperature gradient in the region of **A** (Figure 1) will _____

8. (a) reverse
   (b) strengthen ✓✓
   (c) decay
   (d) remain unchanged

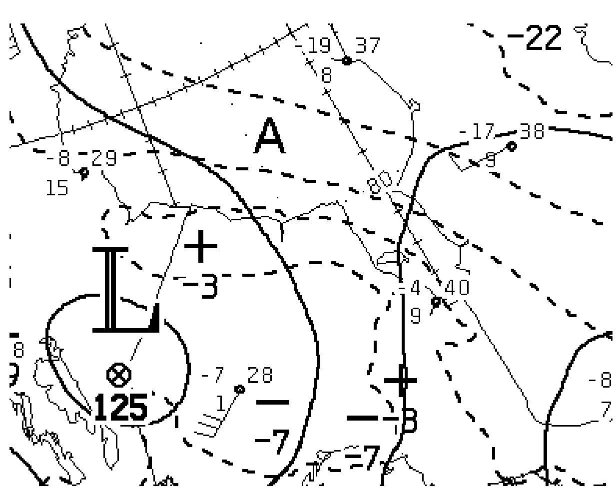


 Figure 1: 12 UTC 26 Jan. 2012 (850 hPa).

9. If (over some region) a particular level p of the atmosphere is a 'level of non-divergence' (LND), then at that level ____
   (a) vertical velocity $\omega = 0$
   (b) magnitude $|\omega|$ of the vertical velocity is a local maximum, i.e. $\partial|\omega|/\partial p = 0$ ✓✓
   (c) the wind is Geostrophic
   (d) atmospheric stratification is unconditionally stable
   (e) relative vorticity $\zeta = 0$

10. The quasi-geostrophic (QG) vorticity equation can be written

$$\frac{\partial \eta}{\partial t} + \mathbf{V}_g \cdot \nabla \eta = -f_0 \, D_p$$

   where η is the absolute vorticity, f_0 is the Coriolis parameter at the central latitude and $\mathbf{V}_g$ is the geostrophic wind. Here D_p is the ____ and it is evaluated using the ____
   (a) horizontal divergence; geostrophic wind
   (b) horizontal divergence; ageostrophic wind ✓✓
   (c) thermal advection; vertical wind
   (d) thermal wind; ageostrophic wind
   (e) lapse rate; moist adiabatic rate

11. According to the QG paradigm, in mid-latitudes the evolution of the synoptic scale height field is primarily determined by ____ advection of ____
   (a) vertical; humidity and temperature
   (b) vertical; horizontal vorticity and temperature
   (c) horizontal; humidity and temperature
   (d) horizontal; vertical vorticity and temperature ✓✓
   (e) geostrophic; earth vorticity

12. A qualitative diagnosis of ongoing or pending lower-tropospheric temperature advection is most reliably made on the basis of the ____ .
   (a) surface analysis
   (b) hodograph
   (c) infra-red satellite loop
   (d) configuration of 850 mb height contours and isotherms ✓✓
   (e) configuration of 500 mb height contours and 1000-500 mb thickness contours

From Figure 2, estimate the potential temperature (referred to $p_0 = 1000$ hPa) of air at the 500 hPa level over The Pas (western Manitoba): $\theta = T(p_0/p)^{R/c_p}$

13. (a) 198 K
    (b) 234 K
    (c) 198 K
    (d) 241 K
    (e) 294 K ✓✓

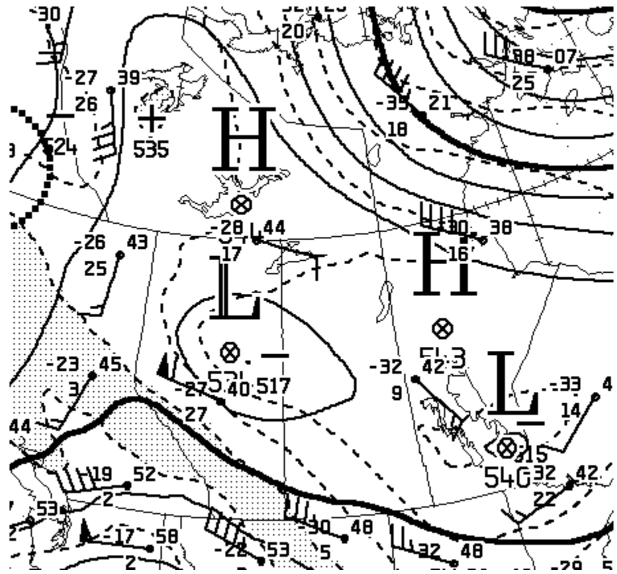


Figure 2: CMC 500 hPa analysis, 12 UTC Thurs. 17 April 2014. Stippling: 534-540 dam thickness band.

14. Through 15-18 April 2014, Edmonton experienced prolonged cool, cloudy conditions with accumulating light snowfall. Based on Fig.2, which conjecture is spurious (or **not** supported)?
    (a) arctic vortex in NE Canada injected cold air over the prairies
    (b) mid-troposphere conditionally unstable over C. Alberta **xx**
    (c) closed upper low over Alberta — likely to be slow moving
    (d) thickness trough extends into Alberta from the central prairies
    (e) based on thickness pattern, precip. (if any) would be snow

15. Suppose $y = \alpha\, x + \beta$ is a best least squares model for the relationship between variables x, y (where x is the "predictor"). Then if x_{oi}, y_{oi} $(i = 1...N)$ is a set of paired observations of the two variables, and if

$$SS = \sum_{1}^{N} \left[(\alpha\, x_{oi} + \beta) - y_{oi} \right]^2 \ ,$$

then the model's "slope" variable α is obtained by ____
    (a) minimizing $\sqrt{SS}$ with respect to α
    (b) minimizing $(SS)^2$ with respect to β
    (c) minimizing SS independently with respect to both α and β ✓✓
    (d) maximizing $\sqrt{SS}$ with respect to α
    (e) maximizing SS independently with respect to both α and β

The vertical distribution of N. hemisphere winds depicted in Figure 3 implies

16. (a) warm advection ✓✓
    (b) cold advection
    (c) isotherms are perpendicular to $\mathbf{V_T}$
    (d) thickness contours are perpendicular to $\mathbf{V_T}$
    (e) horizontal divergence

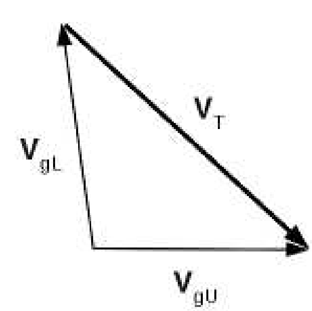


Figure 3: Wind vector at lower (L) and upper (U) levels.

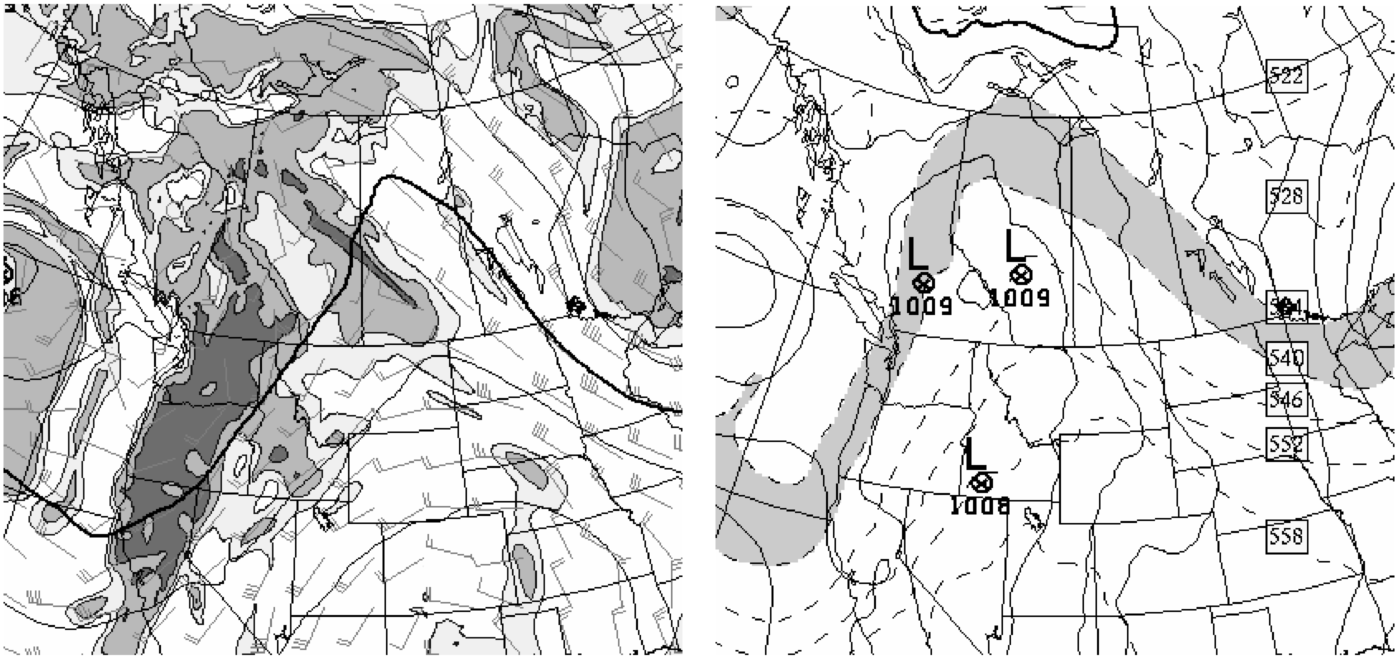
B. "Live" web weather data (4 x 2 $\rightarrow$ 8%)

Additional weather maps students could have accessed during the exam are appended at the back of this exam

1. Briefly summarize the *actual* meteorological regime over Alberta as of 12Z today.

   Points that could be made (emphasized, the most important):

   - **height** and **thickness ridge axes** run though Alberta — mild (see added Figures 10, 12)
   - aloft, a somewhat **weak southerly upper flow**, exiting a **trough on the west coast** (added Figure 11); $T = T_d$ spread at 750 hPa level less than 5°C in northern half of the province
   - at the surface (added Figure 14), a ridge of high pressure runs east of Alberta (almost uninterupted from NWT into central U.S.); a weak, shapeless zone of lower pressure covers Alberta and B.C. Generally easterly (but weak) sfc winds.
   - no high cloud, patchy lower cloud (GOES – added Figure 17)
   - from the sounding (added Figure 15), several degrees of $T - T_s$ **spread** at all levels. Conditionally unstable above a **nocturnal surface inversion**. Surface SE wind beneath a weak southerly (around 700 hPa) and SW above about 500 hPa. Veering wind – warm advection.



(a) 700 hPa, 12Z Tues. 22 Apr. (dark shading: RH$\geq$ 90%)   (b) MSLP & 1000-500 hPa Thickness, 12Z Tues. 22 Apr.

Figure 4: GEM glbl 96h prog, initialized 12Z Friday 18 April, valid 12Z Tuesday 22 April 2014.

2. Briefly comment on the resemblance (or otherwise) between the analysed 700 hPa flow pattern and the GEM global 96h forecast (Fig.4a).

   Very strong qualitative resemblance (see added Figure 19 for side-by-side comparison): ridge axis through Saskatchewan, trough on the west coast, closed low centre west of Vancouver Island, weak S or SW flow over Alberta, patches of higher humidity.

3. What is the 1000-500 hPa thickness over C. Alberta at 12Z today? What value had been forecast by the GEM global 96h prog (Fig.4b)?

   546 dam thickness contour runs through Edmonton (from Stony Plain sounding, $\Delta z = 5530 - 46 = 5484$ m or 548 dam). This is in accord with the GEM global 96h prog (Fig.4b), which (also) showed the 546 dam thickness contour running through C. Alberta.

4. Briefly comment on the resemblance (or otherwise) of the analysed and forecast MSLP patterns

   Very strong qualitative resemblance (see added Figure 20 for side-by-side comparison): thickness ridge over Ab., weak (multi-centred) low over Ab. and B.C. with a weak closed low west of Vancouver Island.

C. Interpretation of weather situation. (1 x 5$\rightarrow$ 5%)

Figures (5-9) depict the meteorology of a short spell of very cold weather in central Alberta at the end of February, 2014. Briefly give your interpretation of this cold snap, based on these figures: what message(s) about the event does each chart convey?

- On Friday Feb.28th we see a strong flow from the far north at the 500 hPa level, due to a high amplitude ridge off the west coast coupled with a strong low in eastern Canada (one could justifiably surmise this is an Omega-block). Alberta is at the western edge of a thickness trough, whose core (coldest zone) is in N. Saskatchewan
- at the 850 hPa level we also see a brisk ($10\,\mathrm{m\,s^{-1}}$), cold northerly flow. The coldest air at this level is (again) in Saskatchewan (-40^{o}C). There is a strong temperature gradient across the Rockies.
- at the surface, the axis of an arctic ridge extends from the far north directly through Alberta and into Montana. Surface winds are light, and variable in direction. Skies are clear.
- days later, on Tues. March 4th, a closed upper low in northern B.C. is driving a strong WSW current across central Alberta, as distinct from the northerly current that initiated the cold spell
- however the Stony Plain sounding indicates that this westerly and (relatively) mild current aloft is running over a deep dome of cold surface air (note the very strong inversion somewhere around the 800 hPa level). The inversion layer is saturated — cloud layer? Veering of the wind suggests warm advection should be occurring.

D. Short answer (3 x 3 % → 9 %)

Please answer any **three** of the following questions.

1. In the isobaric coordinate system, the "horizontal" velocity vector $\mathbf{V}_\mathrm{H} \equiv (U, V)$ obeys

$$\frac{\partial \mathbf{V}_\mathrm{H}}{\partial t} + (\mathbf{V}_\mathrm{H} \cdot \nabla_\mathrm{H})\,\mathbf{V}_\mathrm{H} + \omega\,\frac{\partial \mathbf{V}_\mathrm{H}}{\partial p} = -\,\nabla_\mathrm{H}\Phi \,-\, f\,\hat{k} \times \mathbf{V}_\mathrm{H}$$

where $\Phi\,(= g_0 Z)$ is the geopotential, $\nabla_\mathrm{H} = \hat{\imath}\,\partial/\partial x + \hat{\jmath}\,\partial/\partial y$ and f is the Coriolis parameter. Write down the implied equation for the zonal component (i.e. U). Note: to get the Coriolis term, pick the appropriate part of this determinant:

$$\begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 0 & 0 & 1 \\ fU & fV & 0 \end{vmatrix} .$$

$$\frac{\partial U}{\partial t} + U\,\frac{\partial U}{\partial x} + V\,\frac{\partial U}{\partial y} + \omega\,\frac{\partial U}{\partial p} = -\,\frac{\partial \Phi}{\partial x} + f\,V$$

2. For an unsaturated, horizontally-homogeneous and cloud free atmospheric boundary layer (ABL) of depth δ, the rate of change of potential temperature θ is (very) approximately

$$\frac{\partial \theta}{\partial t} = \frac{Q_{H0}}{\rho\, c_p\, \delta}\,,$$

where Q_{H0} is the surface sensible heat flux density. If the boundary layer is 1000 m deep and the rate of warming is 1.8 $\mathrm{K\,hr^{-1}}$, estimate the implied sensible heat flux density Q_{H0}. (Note: $c_p \approx 10^3\,\mathrm{J\,kg^{-1}\,K^{-1}}$).

Taking $\rho \approx 1\,\mathrm{kg\,m^{-3}}$, substitution gives $Q_{H0} = 1.8{\times}10^6\,\mathrm{J\,m^{-2}\,hr^{-1}} = 500\,\mathrm{W\,m^{-2}}$. (With $\rho = 1.2$, $Q_{H0} = 600\,\mathrm{W\,m^{-2}}$).

3. List at least four processes that are normally classified as belonging to the set of model "parameterizations" (or "grid point computations" or "model physics") in NWP models

4. Referring to Fig.6, the wind at The Pas (Manitoba) is a $10\,\mathrm{m\,s^{-1}}$ northerly. Give an approximate estimate for the rate of thermal advection in Saskatchewan, just west of The Pas.

   Cooling at a rate of order $1\,\mathrm{K\,hr^{-1}}$.

5. If $Z_{\mathbf{P}}$ is the height of an isobaric surface at point **P** and $\overline{Z}_{\mathrm{nbrs}}$ the average height of the same isobaric surface in the neighbourhood of **P**, a qualitative statement of the QG height tendency equation is:

$$\frac{\partial}{\partial t}\left[\overline{Z}_{\mathrm{nbrs}} - Z_{\mathbf{P}}\right] \propto \left[-\mathcal{U}_g \frac{\partial \eta}{\partial s}\right] + \beta \frac{\partial}{\partial z}\left[-\mathcal{U}_g \frac{\partial T}{\partial s}\right]$$

   where η is the absolute vorticity, $\mathcal{U}_g$ is the magnitude of the Geostrophic wind, s is a coordinate parallel to height contours, and β is positive. Explain the implication of this expression.

   The first term on the rhs is the rate of **vorticity advection**: when $-\mathcal{U}_g\,\partial\eta/\partial s$ is positive, we have "PVA" and this (acting alone) would cause the difference $\overline{Z}_{\mathrm{nbrs}} - Z_{\mathbf{P}}$ to increase, meaning height **fall** at **P** relative to its surroundings (**PVA is associated with falling heights**).

   The second term is trickier, in that it involves the **height variation** of **thermal advection**. Since advection usually gets weaker with increasing height, suppose we have positive temperature advection (i.e. $-\mathcal{U}_g\,\partial T/\partial s > 0$) at low level, but decreasing with increasing height: then the second term is negative meaning $Z_{\mathbf{P}}$ is **rising** relative to its surroundings (height rise).

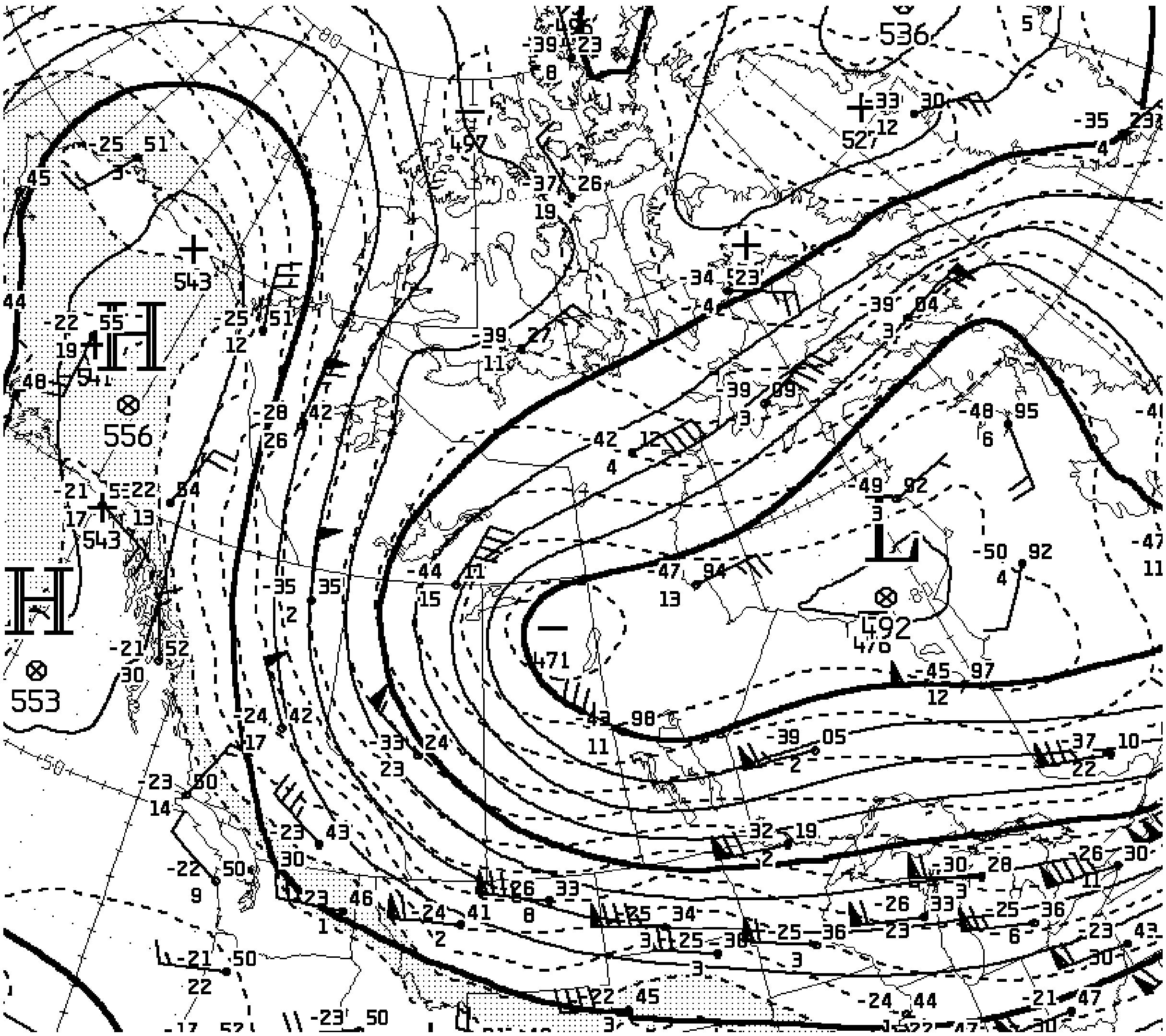


Figure 5: CMC 500 hPa analysis 12 UTC **Friday** February 28, 2014.

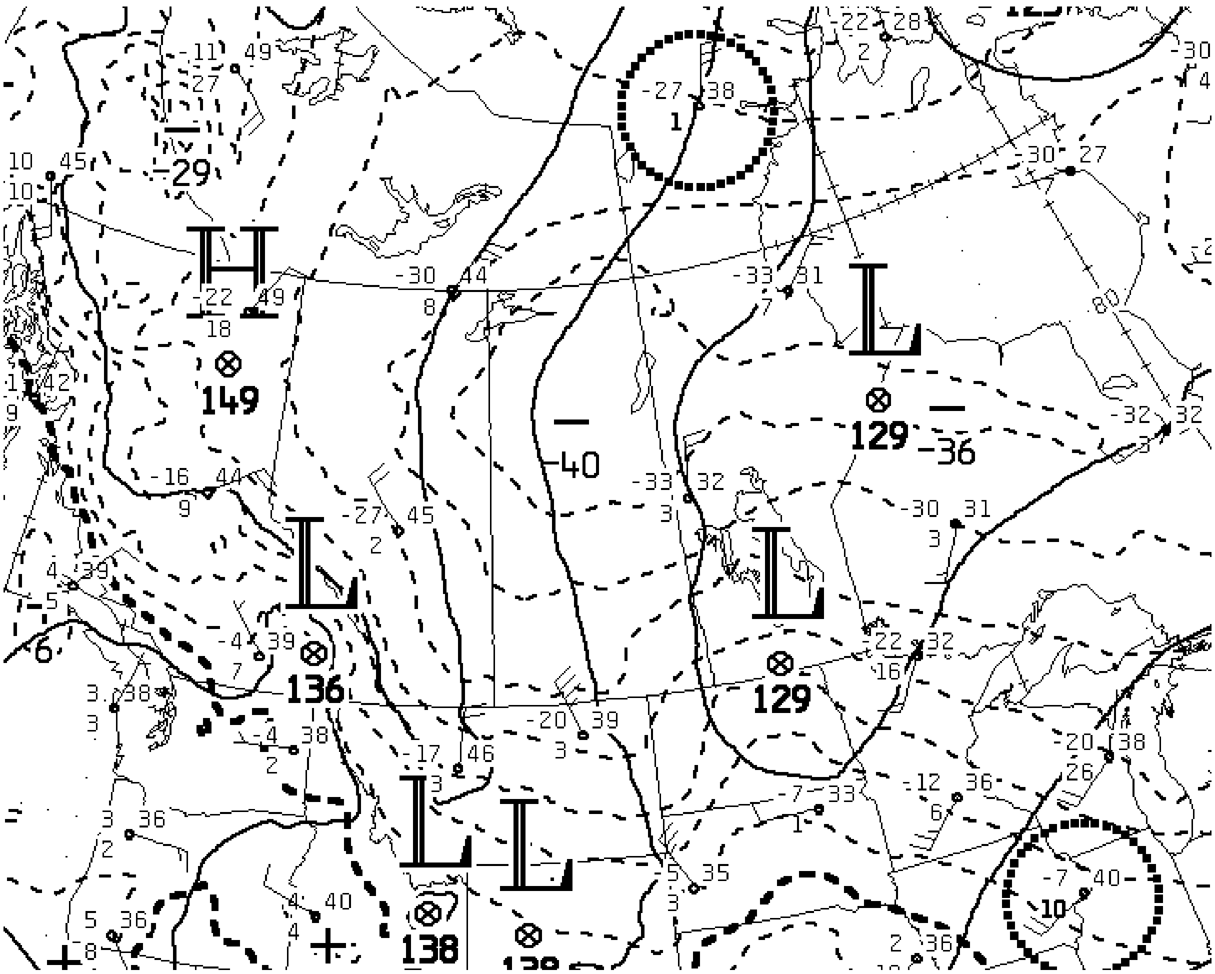


Figure 6: CMC 850 hPa analysis 12 UTC **Friday** February 28, 2014.

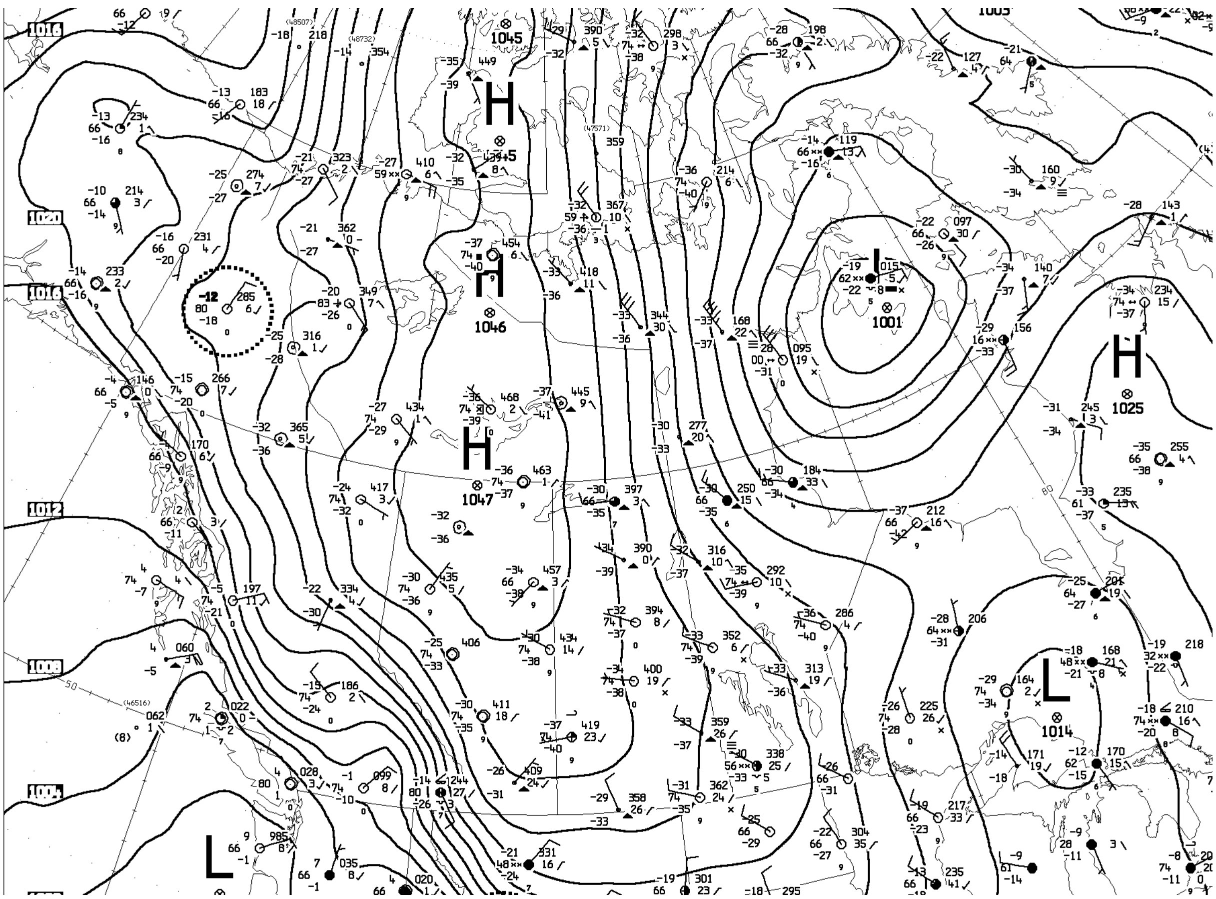


Figure 7: CMC surface analysis 06 UTC **Saturday** March 1, 2014.

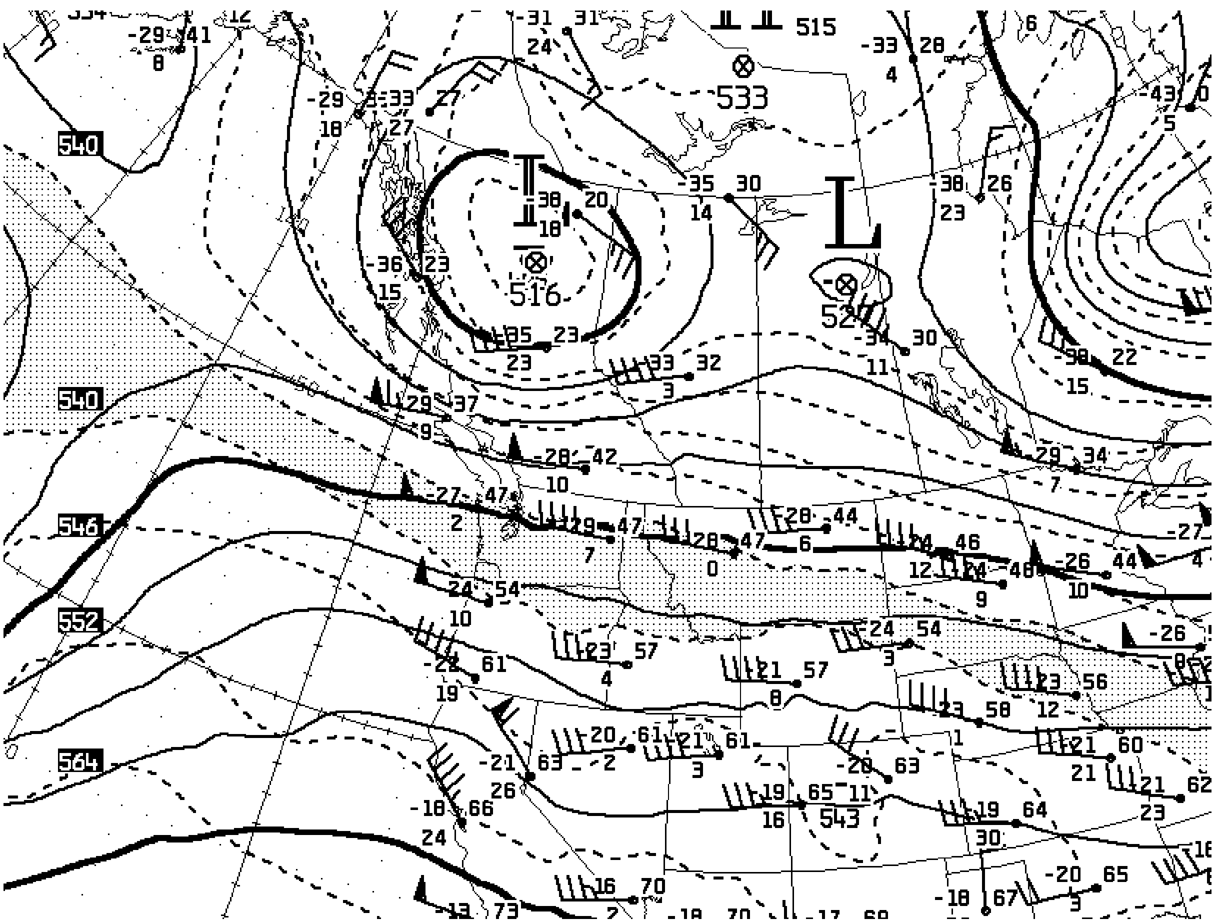


Figure 8: CMC 500 hPa analysis 12 UTC **Tuesday** March 4, 2014.

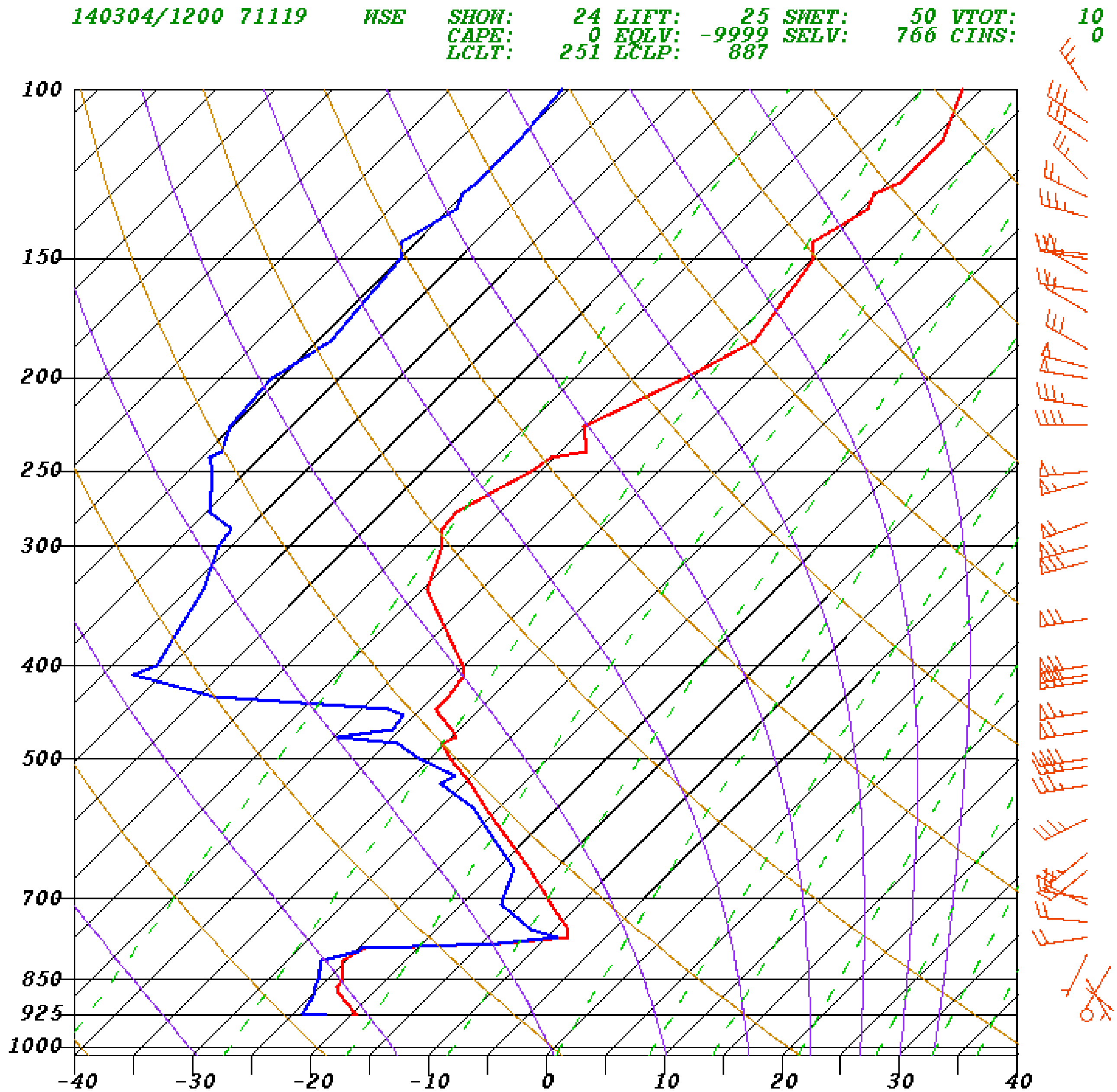


Figure 9: Stony Plain (CWSE) sounding, 12 UTC **Tuesday** March 4, 2014.

THE FOLLOWING CHARTS WERE ADDED ON 22 APRIL 2014, AFTER THE EXAM...

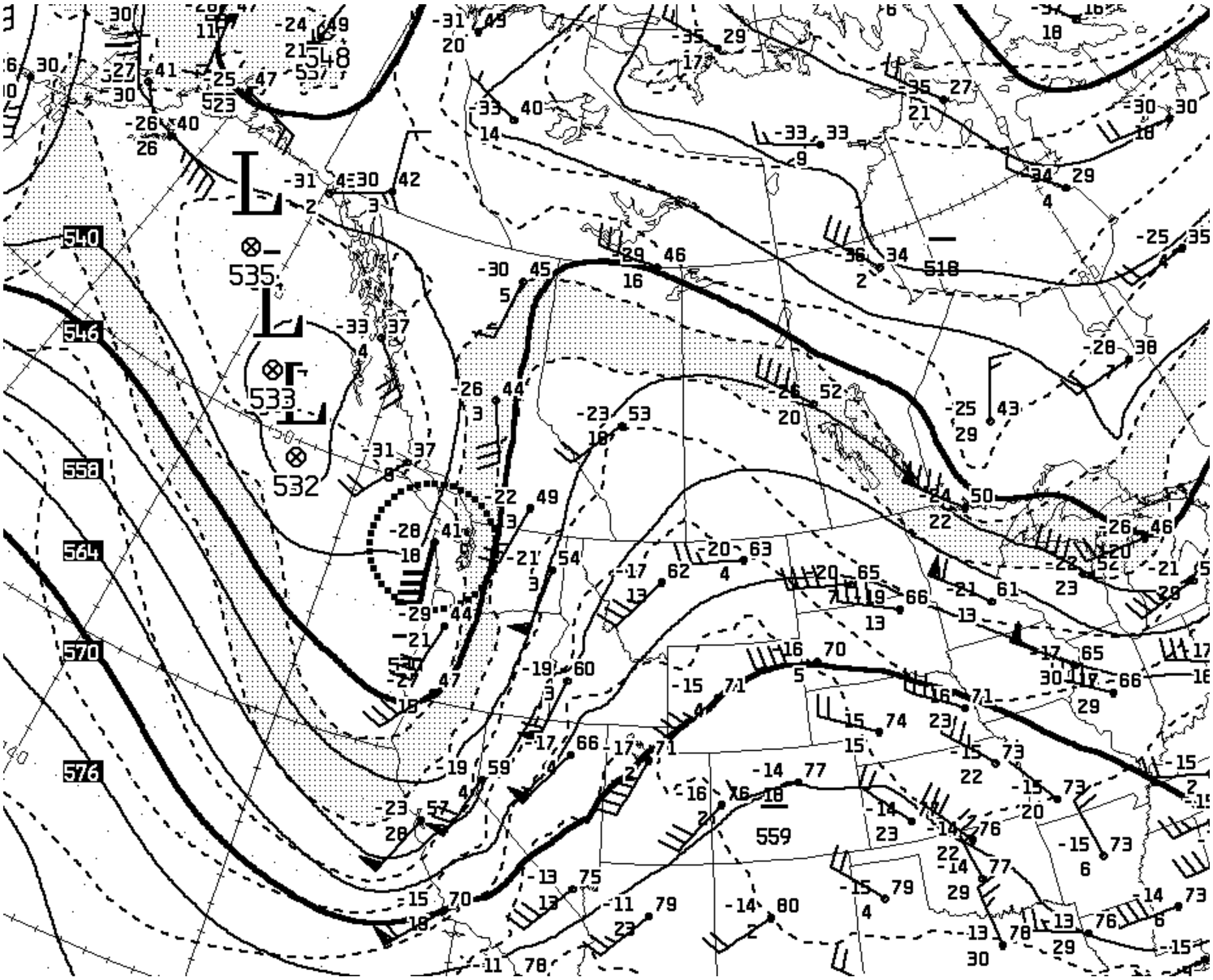


Figure 10: CMC 500 hPa analysis, 12Z Tuesday 22 April 2014. Height & thickness ridges over Alberta; upper trough on the west coast. 546 dam thickness contour runs through Edmonton.

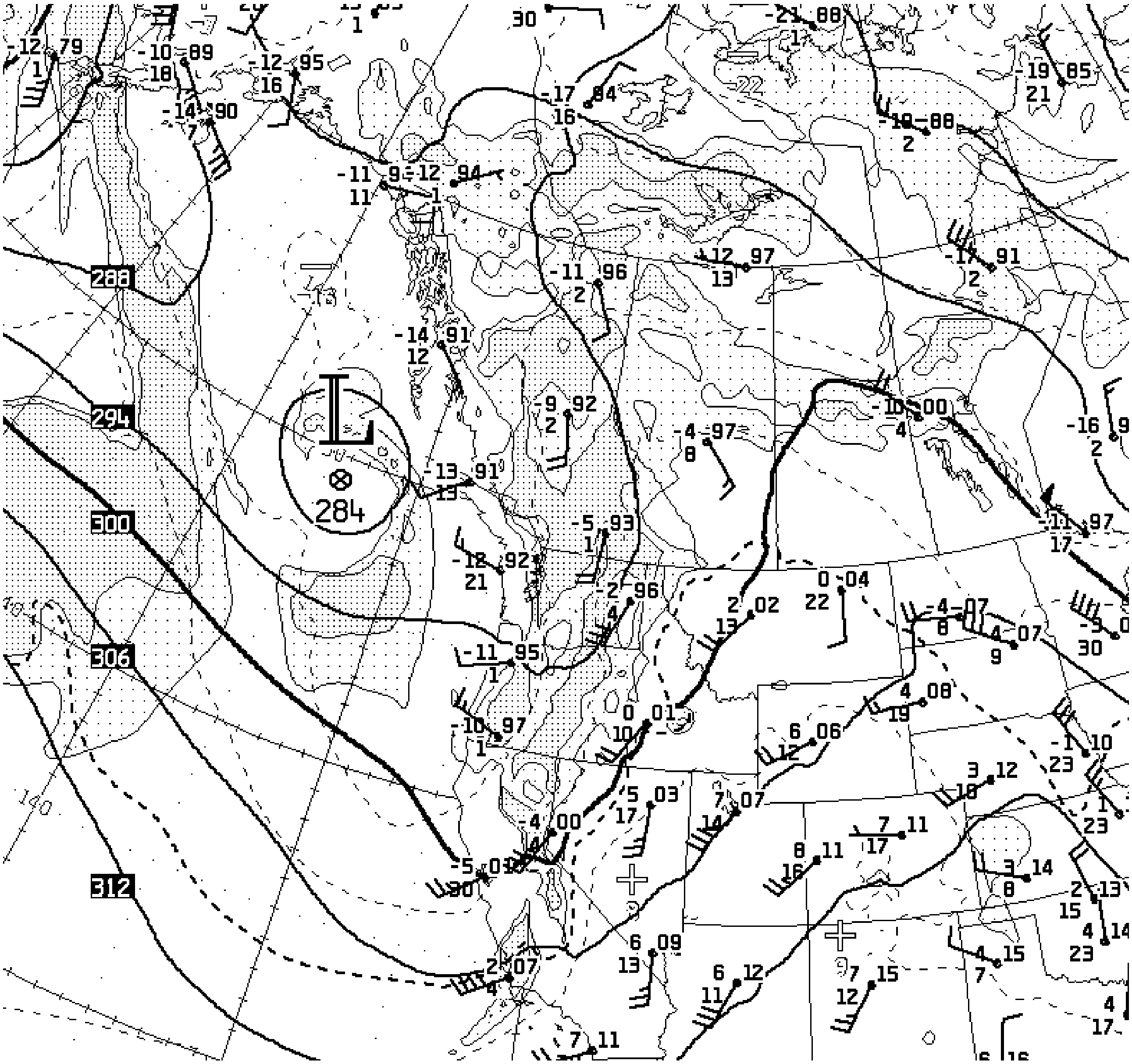


Figure 11: CMC 700 hPa analysis, 12Z Tuesday 22 April 2014. Relatively weak southerly flow over Alberta. Moderately high humidity over the northern half of the province.

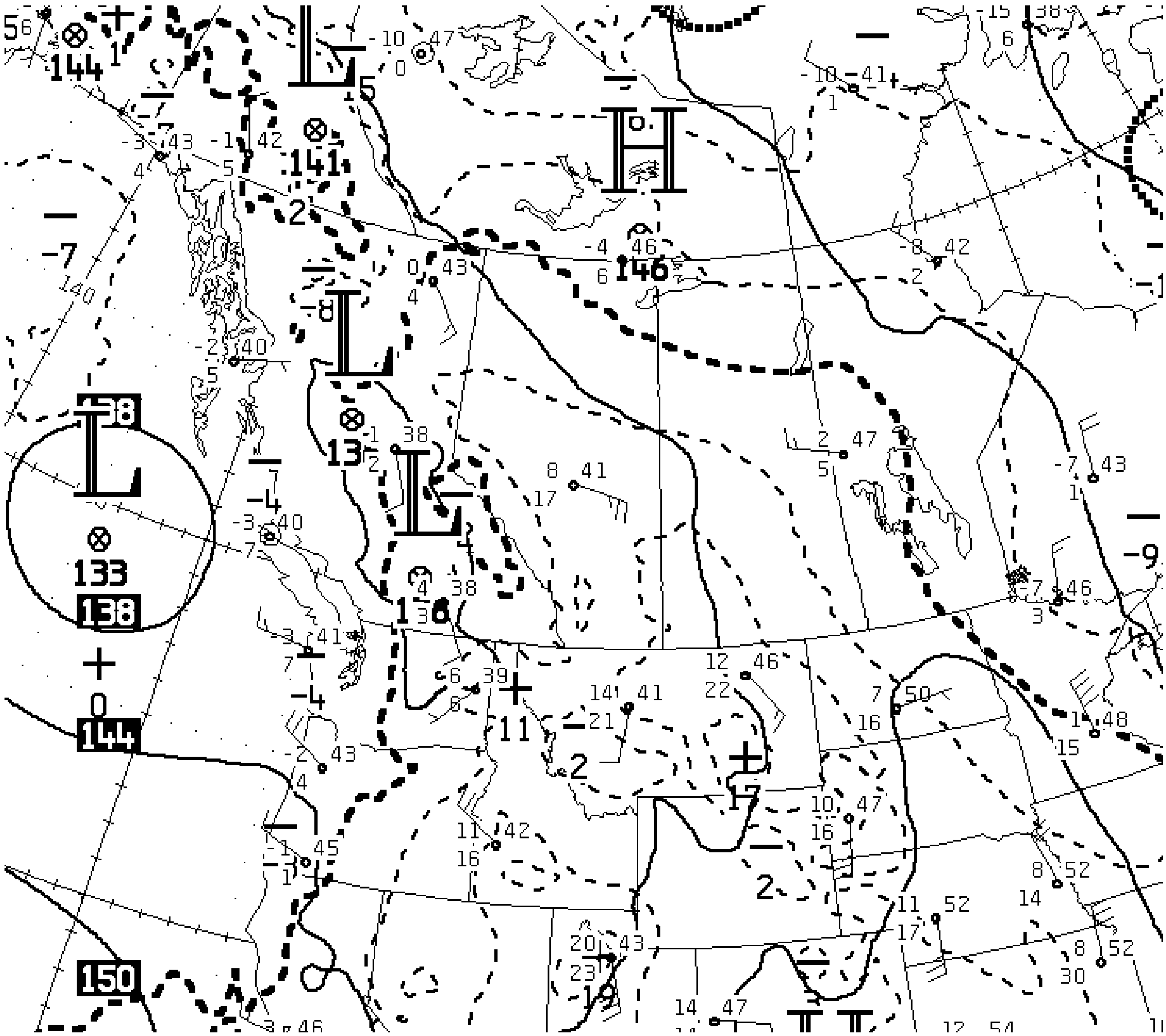


Figure 12: CMC 850 hPa analysis, 12Z Tuesday 22 April 2014. Dry, mild, moderate SE wind aloft over C. Alberta. Thermal pattern echoes the thickness ridge.

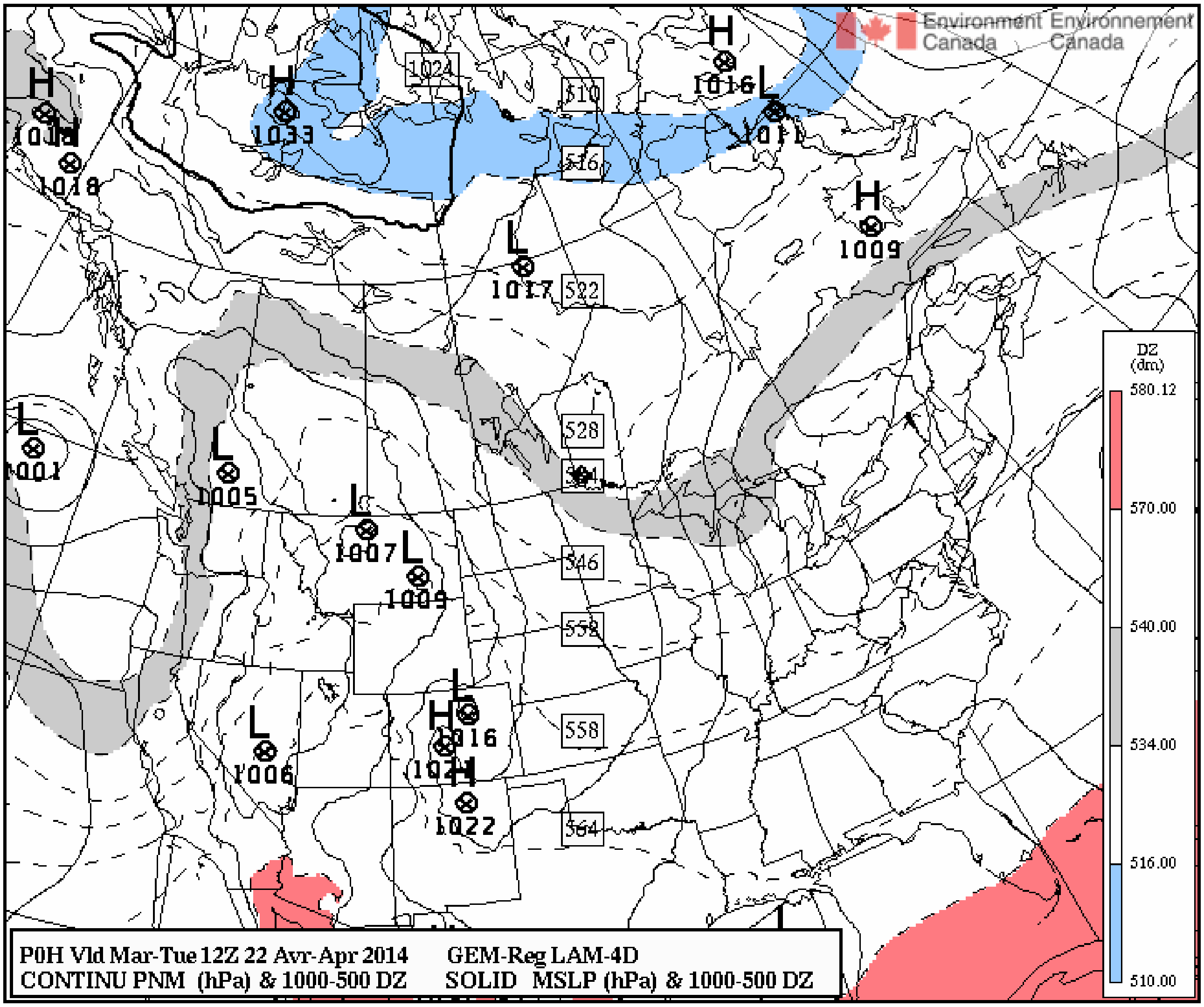


Figure 13: GEM regional 0h prog, MSLP and thickness, 12Z Tuesday 22 April 2014. Thickness ridge in Alberta; weak low pressure systems in Ab (weak grad P in C. Alberta), higher pressure to the east.

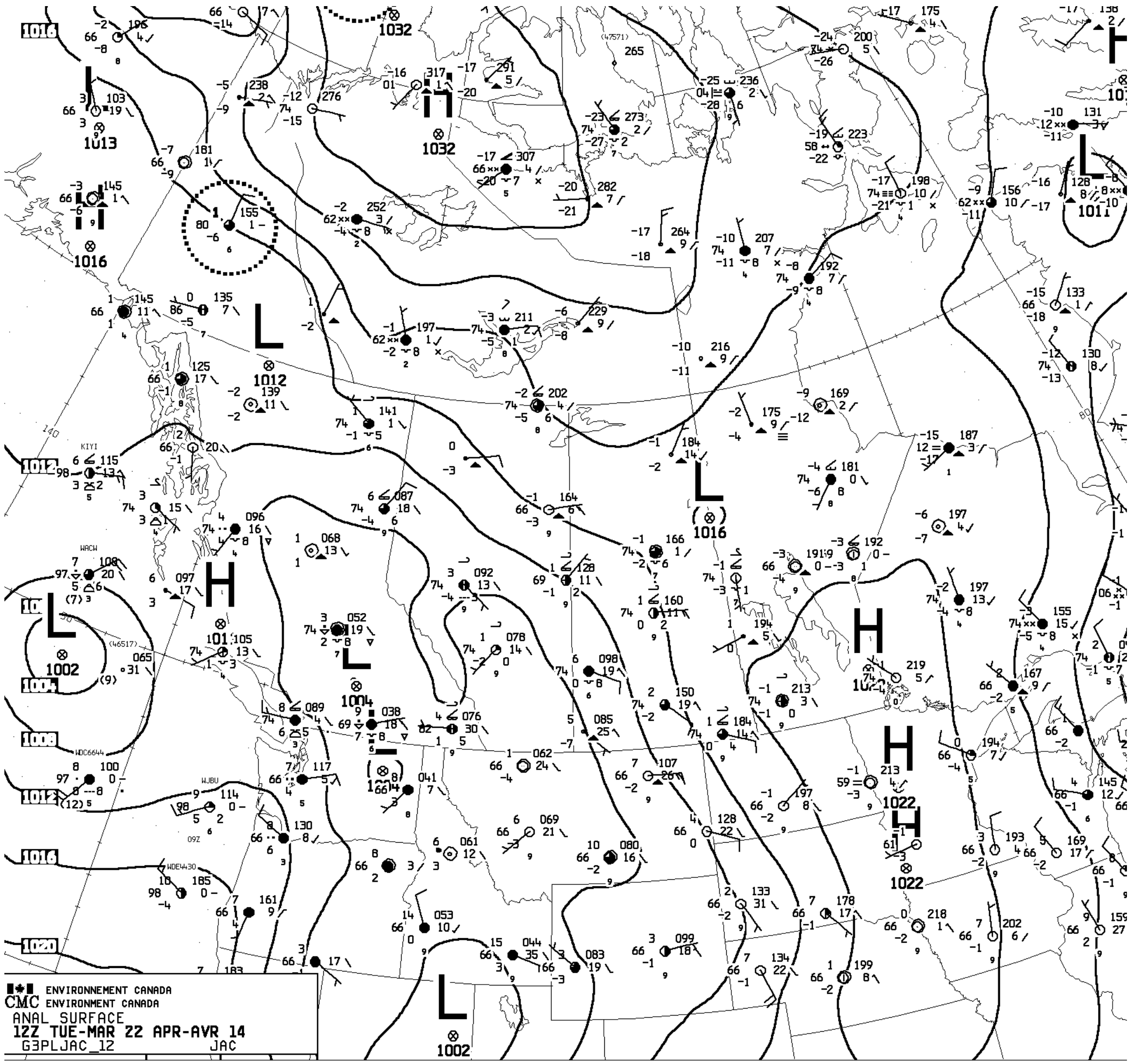


Figure 14: CMC surface analysis, 12Z Tuesday 22 April 2014. Ridge of high pressure east of Alberta (running almost uninterupted from NWT into central U.S.) with a weak, shapeless zone of lower pressure over Alberta and B.C. Generally easterly (but weak) sfc winds.

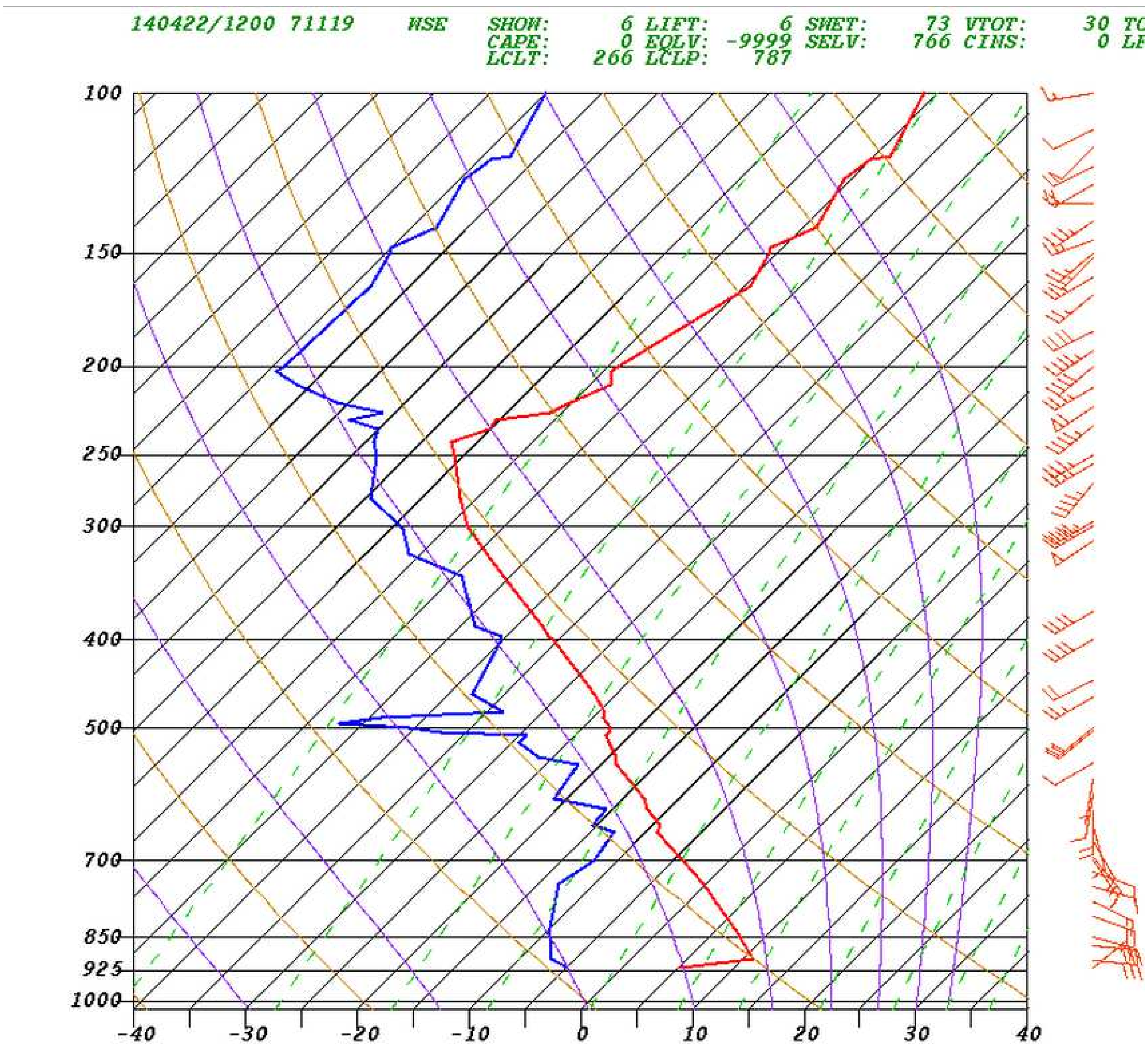


Figure 15: Stony Plain (WSE) sounding, 12Z Tuesday 22 April 2014. Decent $T - T_s$ spread at all levels. Conditionally unstable above a nocturnal surface inversion. Surface SE wind beneath a weak southerly (around 700 hPa) and SW above about 500 hPa.

71119 WSE Edmonton Stony Plain Observations at 12Z 22 Apr 2014

PRES hPa	HGHT m	TEMP C	DWPT C	RELH %	MIXR g/kg	DRCT deg	SKNT knot	THTA K	THTE K	THTV K
1000.0	46									
925.0	708									
919.0	766	5.2	-4.8	48	2.93	50	7	285.1	293.8	285.6
902.6	914	10.2	-6.7	30	2.58	95	30	291.8	299.6	292.2
900.0	937	11.0	-7.0	28	2.52	95	30	292.8	300.6	293.3
869.7	1219	9.1	-8.3	28	2.36	95	28	293.7	301.0	294.1
850.0	1408	7.8	-9.2	29	2.25	105	26	294.3	301.3	294.7
842.0	1486	7.4	-9.6	29	2.20	106	25	294.7	301.5	295.1
807.1	1829	4.8	-10.8	31	2.09	110	18	295.5	302.1	295.9
777.4	2134	2.6	-11.9	34	1.99	115	17	296.3	302.6	296.6
748.8	2438	0.3	-12.9	36	1.90	105	11	297.0	303.0	297.3
744.0	2490	-0.1	-13.1	37	1.88	106	11	297.1	303.1	297.5
720.6	2743	-2.2	-12.6	45	2.03	110	10	297.5	303.9	297.9
700.0	2974	-4.1	-12.1	54	2.17	145	14	297.9	304.8	298.3
693.4	3048	-4.7	-12.2	56	2.17	140	14	298.0	304.9	298.4
666.9	3353	-7.4	-12.6	66	2.19	150	14	298.4	305.3	298.8
652.0	3529	-8.9	-12.8	73	2.20	159	13	298.6	305.6	299.0
651.0	3541	-8.9	-12.8	73	2.21	159	13	298.7	305.7	299.1
641.3	3658	-9.2	-15.0	63	1.87	165	12	299.6	305.6	300.0
640.0	3673	-9.3	-15.3	62	1.83	166	13	299.7	305.6	300.1
616.4	3962	-11.7	-15.6	73	1.86	180	22	300.3	306.2	300.6
614.0	3993	-11.9	-15.6	74	1.86	181	21	300.3	306.3	300.7
599.0	4182	-13.1	-21.1	51	1.19	187	13	301.1	305.0	301.3
592.2	4267	-13.8	-21.2	54	1.19	190	10	301.2	305.1	301.4
568.8	4572	-16.4	-21.7	64	1.19	190	6	301.6	305.6	301.9
549.0	4839	-18.7	-22.1	75	1.19	234	10	302.0	305.9	302.2
546.2	4877	-18.9	-23.3	68	1.08	240	10	302.2	305.9	302.4
539.0	4976	-19.3	-26.3	54	0.83	238	12	302.9	305.7	303.0
519.0	5256	-21.3	-29.3	49	0.66	234	17	303.8	306.0	303.9
509.0	5399	-22.3	-29.3	53	0.67	231	19	304.2	306.6	304.4
505.0	5457	-22.3	-37.3	24	0.31	230	20	304.9	306.0	305.0
503.0	5486	-22.4	-38.6	21	0.27	230	21	305.2	306.2	305.2
500.0	5530	-22.5	-40.5	18	0.22	230	21	305.6	306.4	305.6
495.0	5604	-23.1	-47.1	9	0.11	231	21	305.7	306.1	305.7
486.0	5738	-24.1	-44.1	14	0.16	234	22	306.1	306.7	306.1
480.0	5829	-24.5	-33.5	43	0.47	235	22	306.7	308.4	306.8
462.6	6096	-26.5	-37.1	36	0.34	240	23	307.4	308.7	307.5
459.0	6154	-26.9	-37.9	35	0.32	241	23	307.6	308.8	307.7
443.3	6401	-29.1	-38.5	40	0.31	245	22	307.9	309.1	308.0
400.0	7130	-35.5	-40.1	63	0.29	240	38	308.8	309.9	308.8
397.0	7182	-36.1	-40.4	64	0.29	240	38	308.6	309.7	308.7
386.0	7377	-37.7	-43.7	53	0.21	240	39	309.0	309.8	309.1
372.4	7620	-40.0	-45.3	57	0.18	240	40	309.2	309.9	309.3
340.0	8239	-45.7	-49.4	66	0.12	238	44	309.6	310.1	309.6
322.0	8599	-49.1	-56.1	44	0.06	236	46	309.7	309.9	309.7
310.4	8839	-51.3	-57.7	46	0.05	235	48	309.9	310.1	309.9
302.0	9017	-52.9	-58.9	48	0.04	239	46	310.1	310.3	310.1
300.0	9060	-53.3	-59.3	48	0.04	240	46	310.1	310.3	310.1
296.1	9144	-53.9	-60.2	45	0.04	240	45	310.5	310.6	310.5
279.0	9523	-56.5	-64.5	36	0.02	228	46	312.0	312.1	312.0
268.9	9754	-58.0	-65.6	37	0.02	220	47	313.2	313.2	313.2

Figure 16: Stony Plain (WSE) sounding DATA, 12Z Tuesday 22 April 2014.

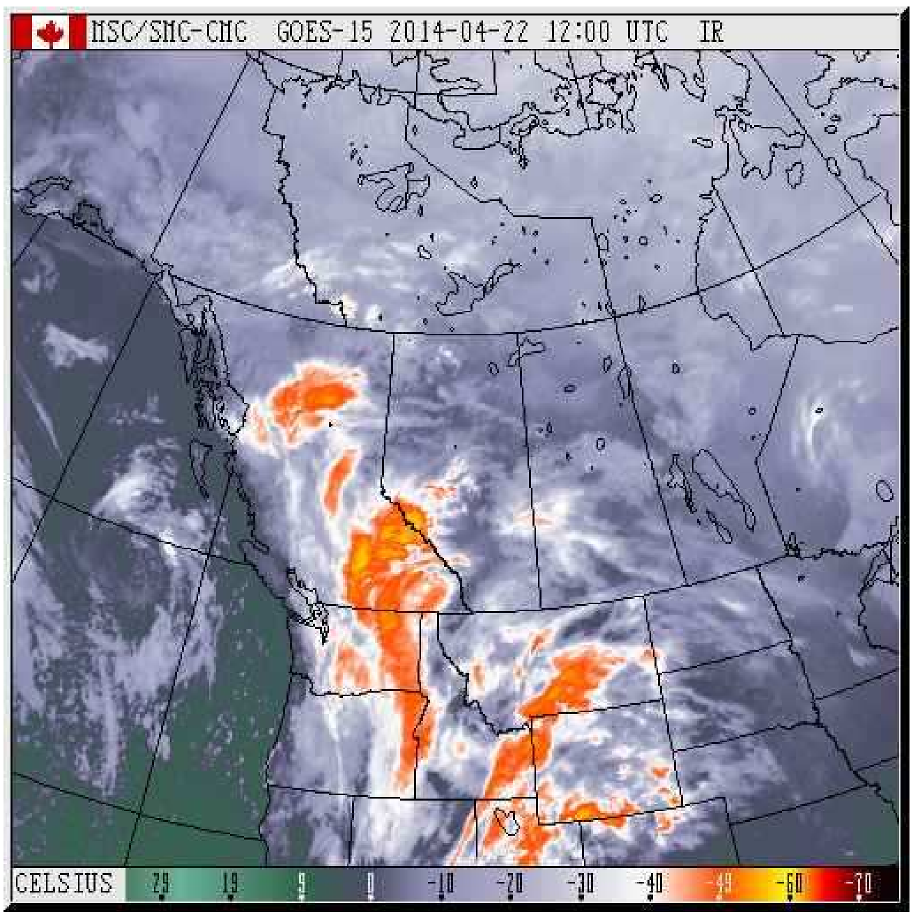


Figure 17: GOES west infrared image, 12Z Tuesday 22 April 2014. Almost no high cloud over Alberta, patches of lower cloud.

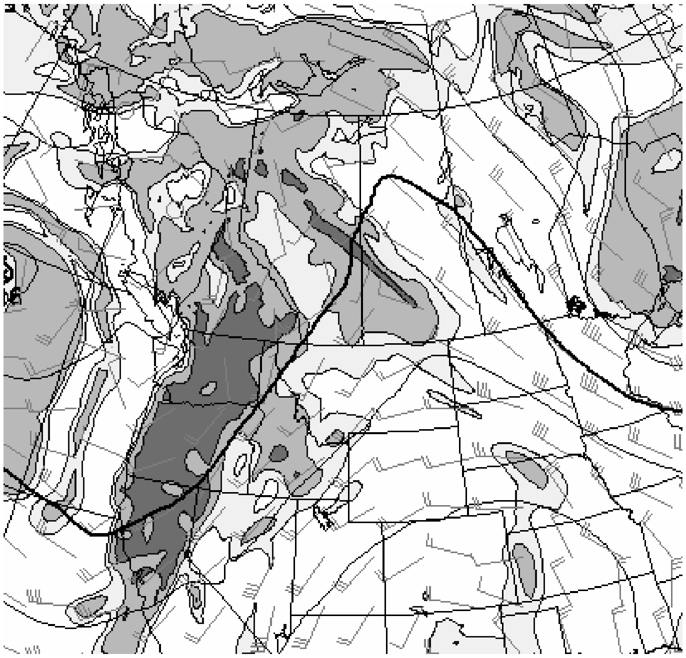
501
FOCN45 CWWG 221200
SIGNIFICANT WEATHER DISCUSSION ISSUED BY THE PRAIRIE AND ARCTIC STORM
PREDICTION CENTRE OF ENVIRONMENT CANADA AT 7:00 AM CDT TUESDAY APRIL
22 2014.

WATCHES, WARNINGS, OR STATEMENTS...NO WARNINGS NOW, BUT
SOON....SPECIAL WEATHER STATEMENT FOR WEST-CENTRAL AB.

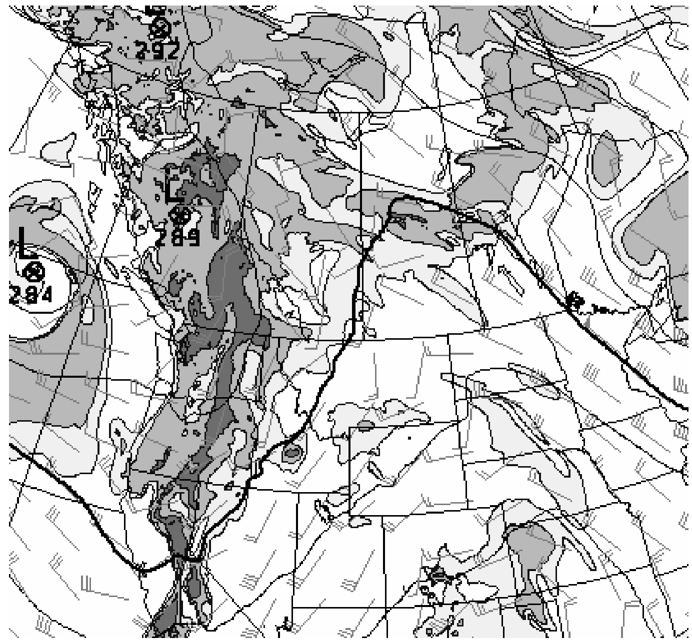
OVERVIEW...ZONAL FLOW AND BAROCLINIC ZONE ACROSS THE SOUTHERN ARCTIC
TODAY. UPPER RIDGE OVER THE WESTERN PRAIRIES. WATER VAPOUR IMAGERY
SHOWS CUT OFF LOW EMBEDDED IN LONG WAVE TROF OFF OF VANCOUVER
ISLAND. THE UPPER LOW WILL INTRUDE INTO SOUTHERN BC TONIGHT AND
EXTREME NORTHERN MONTANA WEDNESDAY. BAROCLINIC WAVE NOW OVER IDAHO IS
FORECAST TO INTENSIFY AS IT TRACKS ACROSS THE NORTHERN PLAIN STATES
OVER THE NEXT COUPLE OF DAYS.

ALBERTA... WARM TEMPERATURES WILL CONTINUE TODAY WITH HIGHS PUSHING
INTO THE TEENS AND EVEN THE LOW 20S OVER SOUTHERN AB. A
DOUBLE-BARRELLED LOW WILL DEVELOP OVERNIGHT FROM THE AFOREMENTIONED
IDAHO DISTURBANCE WITH CENTRES BOTH IN NORTHERN MONTANA AND
SOUTH CENTRAL AB. TOTAL RAINFALL ACCUMULATIONS WITH THIS SYSTEM
ARE EXPECTED TO BE IN THE 15-60 MM RANGE. THERE IS GOOD
CONSENSUS AMONG FOREIGN AND CANADIAN MODELS THAT THE HIGHEST
ACCUMULATIONS ARE EXPECTED TO BE WEST OF EDMONTON FROM WHITECOURT
TOWARDS RED DEER. RAIN WILL LIKELY TRANSITION TO SNOW OVERNIGHT FOR
THE MOUNTAIN PARKS AND NORDEGG REGION. AMOUNTS WILL BE TRICKY IN
THESE AREAS. CURRENTLY, THE TOWNSITES ARE NOT EXPECTED TO RECEIVE
SIGNIFICANT SNOWFALL BUT HIGHER ELEVATIONS COULD SEE 5 TO 15 CM
TOTAL. BEHIND THE LOW, STRONG WESTERLY WINDS WILL DEVELOP FROM
PINCHER CREEK TO LETHBRIDGE, BUT IS EXPECTED TO STAY JUST
SUB-WARNING.

Figure 18: SIGNIFICANT WEATHER DISCUSSION.

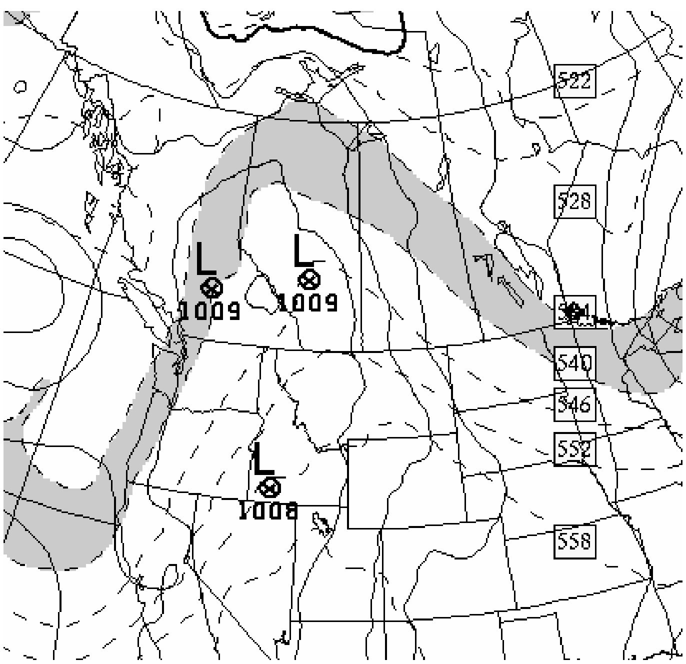


(a) 700 hPa, 96h prog valid 12Z Tues. 22 Apr.

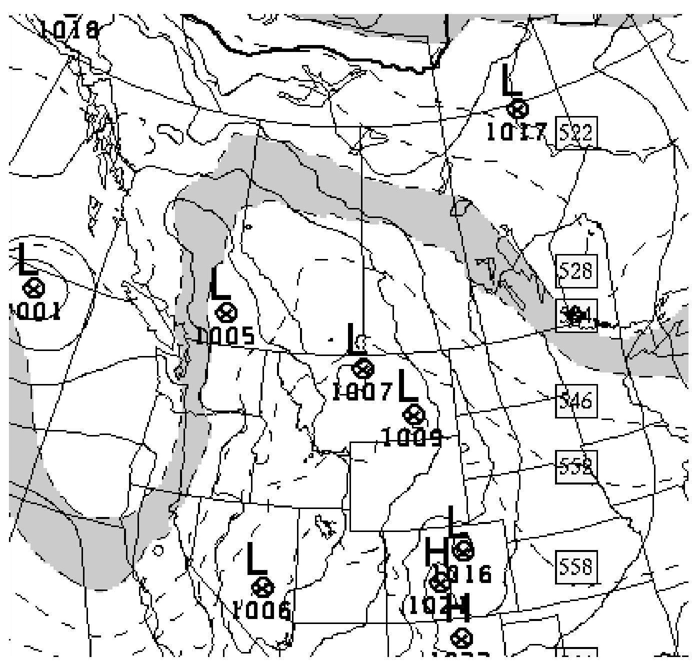


(b) 700 hPa 0h prog (GEM reg), 12Z Tues. 22 Apr.

Figure 19: 700 hPa level: comparing the 96h prog GEM glbl forecast and the analysis: both valid 12Z Tuesday 22 April 2014.



(a) Surface, 96h prog valid 12Z Tues. 22 Apr.



(b) Surface, 0h prog (GEM reg), 12Z Tues. 22 Apr.

Figure 20: Surface level: comparing the 96h prog GEM glbl forecast and the analysis: both valid 12Z Tuesday 22 April 2014.