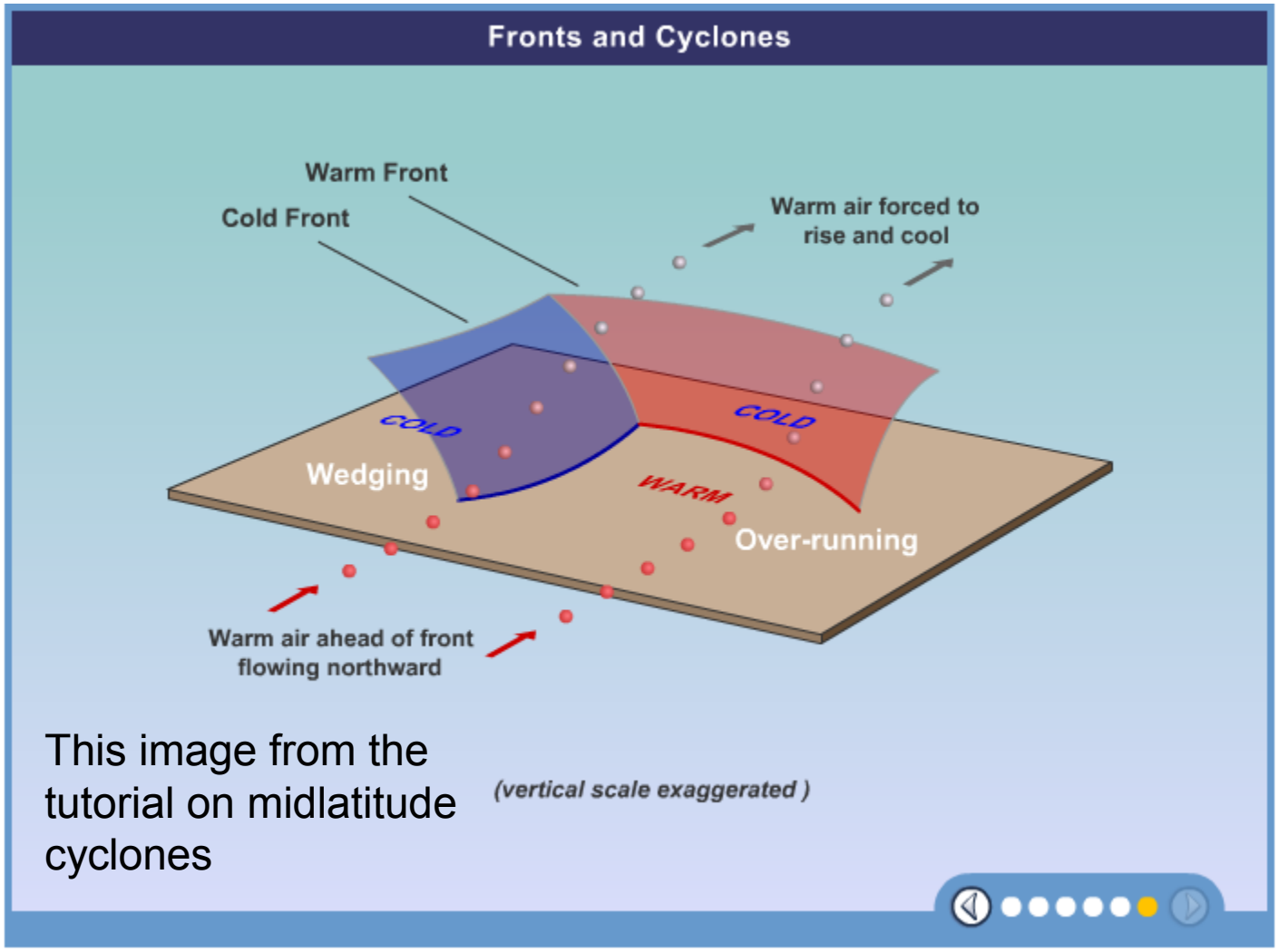
Goal for today:

4 Nov., 2011

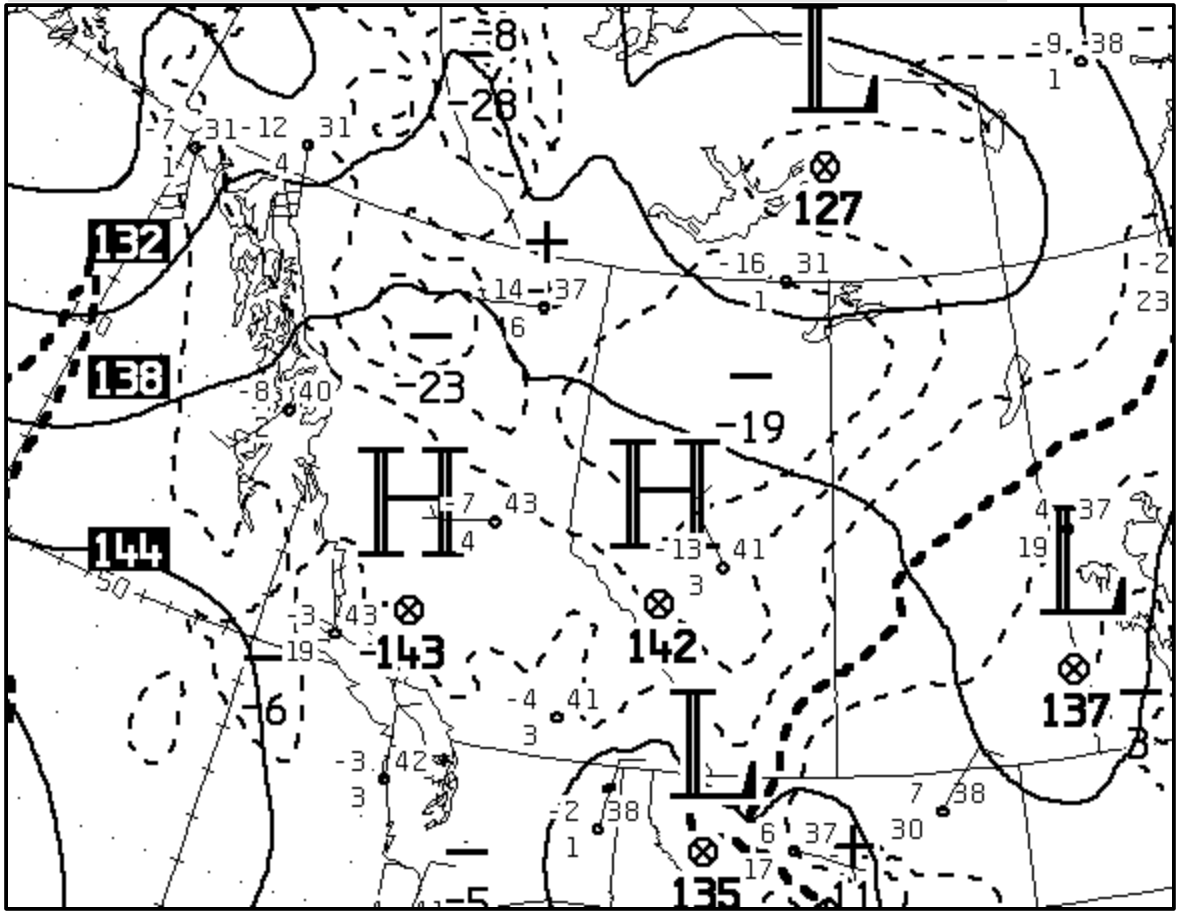
- Complete Ch 9: Airmasses & Fronts



This image from the tutorial on midlatitude cyclones

- steady advective cooling
- there was a frontal passage, albeit not a very dramatic one
- switch in wind direction
- increased speed + gusts
- pressure began to rise
- both T and T_d have dropped

MSC 850 hPa analysis, 12Z Fri 4 Nov. 2011

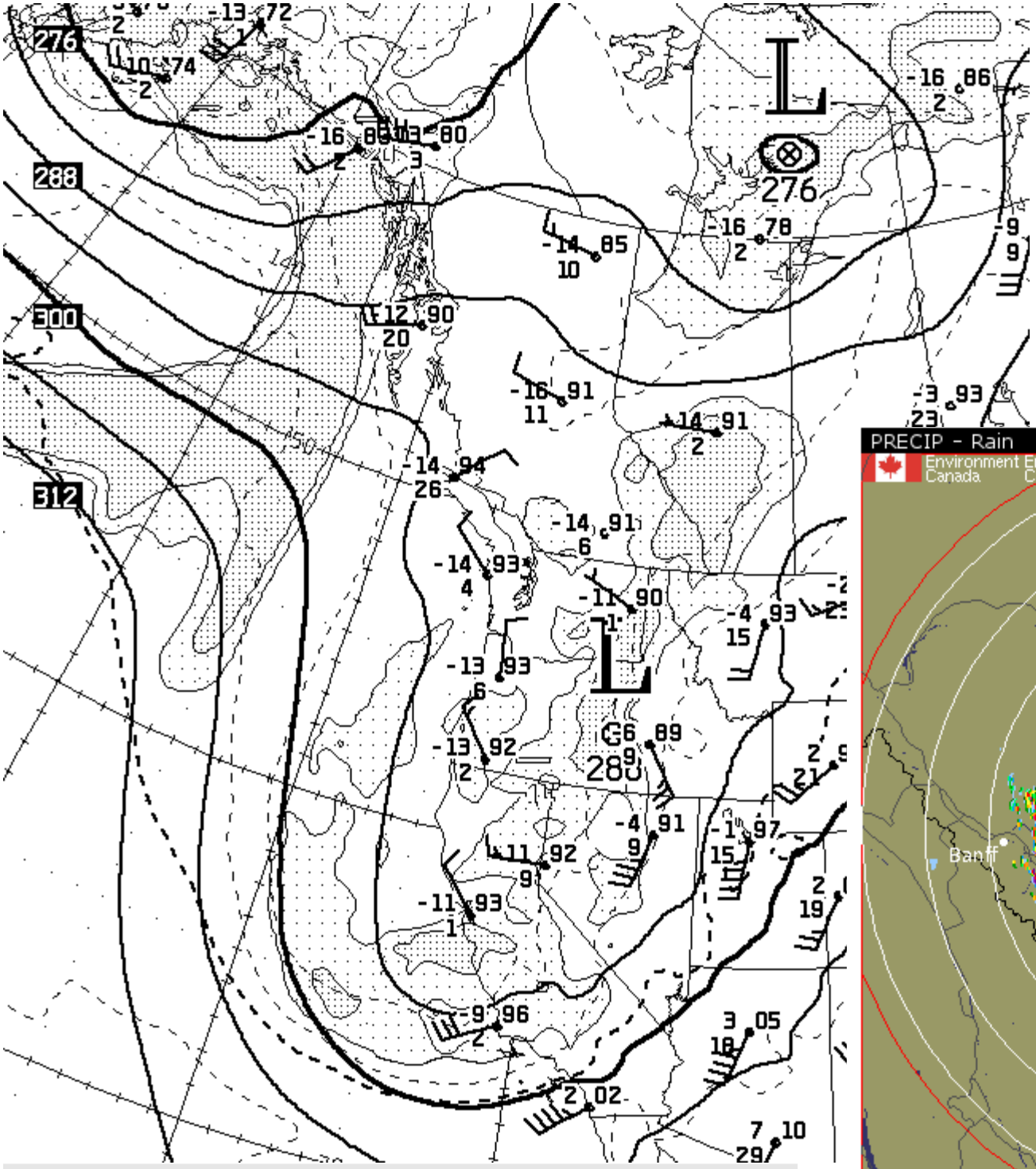


Edmonton City Centre Airport
Past 24 Hour Conditions

Imperial Units

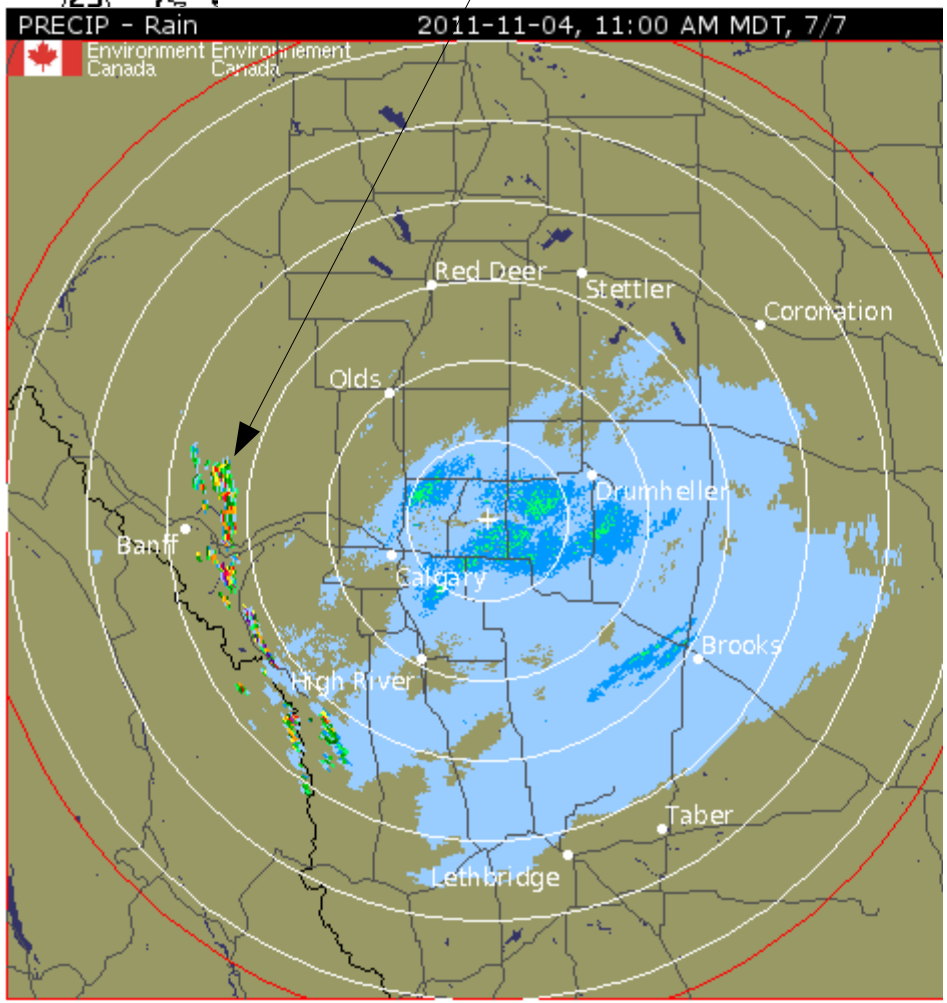
Date / Time (MDT)	Conditions	Temp (°C)	Humidity (%)	Dew Point (°C)	Wind (km/h)	Pressure (kPa)
4 November 2011						
10:00	Partly Cloudy	-10	66	-15	NW 11	101.7
9:00	Cloudy	-10	68	-15	WNW 15	101.7
8:00	Cloudy	-9	65	-15	WNW 13	101.7
7:00	Cloudy	-8	62	-14	NW 21	101.7
6:00	Cloudy	-8	62	-14	NW 18	101.7
5:00	Cloudy	-8	60	-14	NNW 18	101.7
4:00	Cloudy	-7	59	-14	NNW 18	101.7
3:00	Cloudy	-7	57	-14	NNW 21	101.7
	Cloudy	-6	57	-14	NNW 21 gust 32	101.7
	Cloudy	-6	58	-13	N 18	101.6
	Cloudy	-5	56	-12	NNW 24 gust 33	101.6
	Cloudy	-4	64	-10	N 17	101.5
	Mostly Cloudy	-3	65	-9	N 22	101.5
	Cloudy	-2	66	-7	N 17 gust 30	101.4
	Cloudy	0	65	-6	NNW 21 gust 32	101.2
	Cloudy	1	66	-4	NNW 26	101.1
	Light Snow	3	62	-3	NNW 24 gust 33	101.0
	Light Drizzle	5	53	-4	NNW 21 gust 39	100.9
	Sunny	7	44	-5	NW 26	100.8
	Sunny	8	38	-5	NW 24	100.7
	Sunny	8	36	-6	NW 26	100.7
	Sunny	9	34	-6	NNW 15 gust 28	100.6
	Sunny	7	33	-8	NW 22	100.6
	Sunny	5	37	-8	WSW 5	100.6
	Sunny	3	41	-9	SW 8	100.6

- precip near Calgary
- “ground clutter” (false radar scatter) off Rockies
- upper trough advecting moisture over W. edge of continent

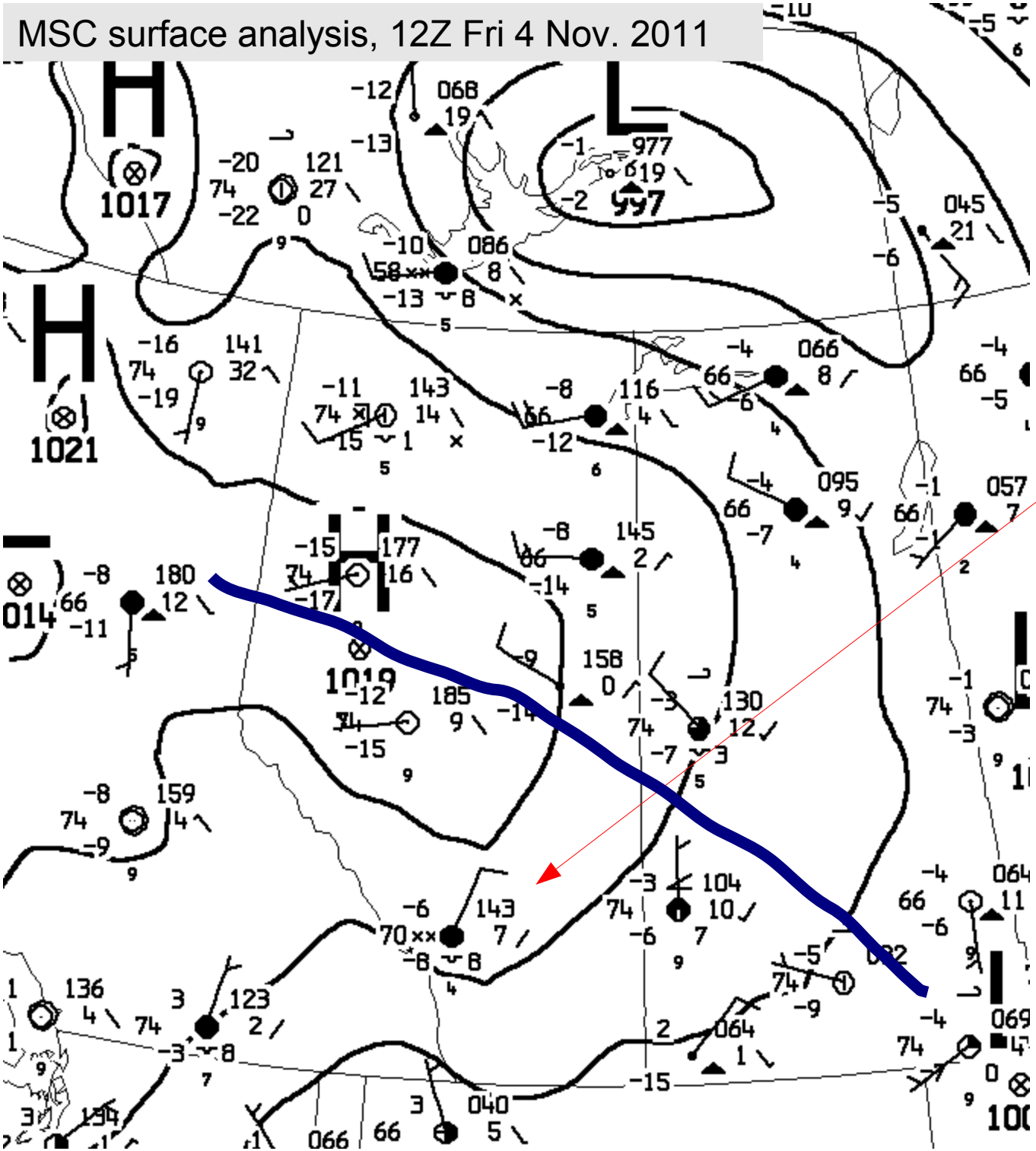


MSC 700 hPa analysis, 12Z Fri 4 Nov. 2011

ground clutter



MSC surface analysis, 12Z Fri 4 Nov. 2011



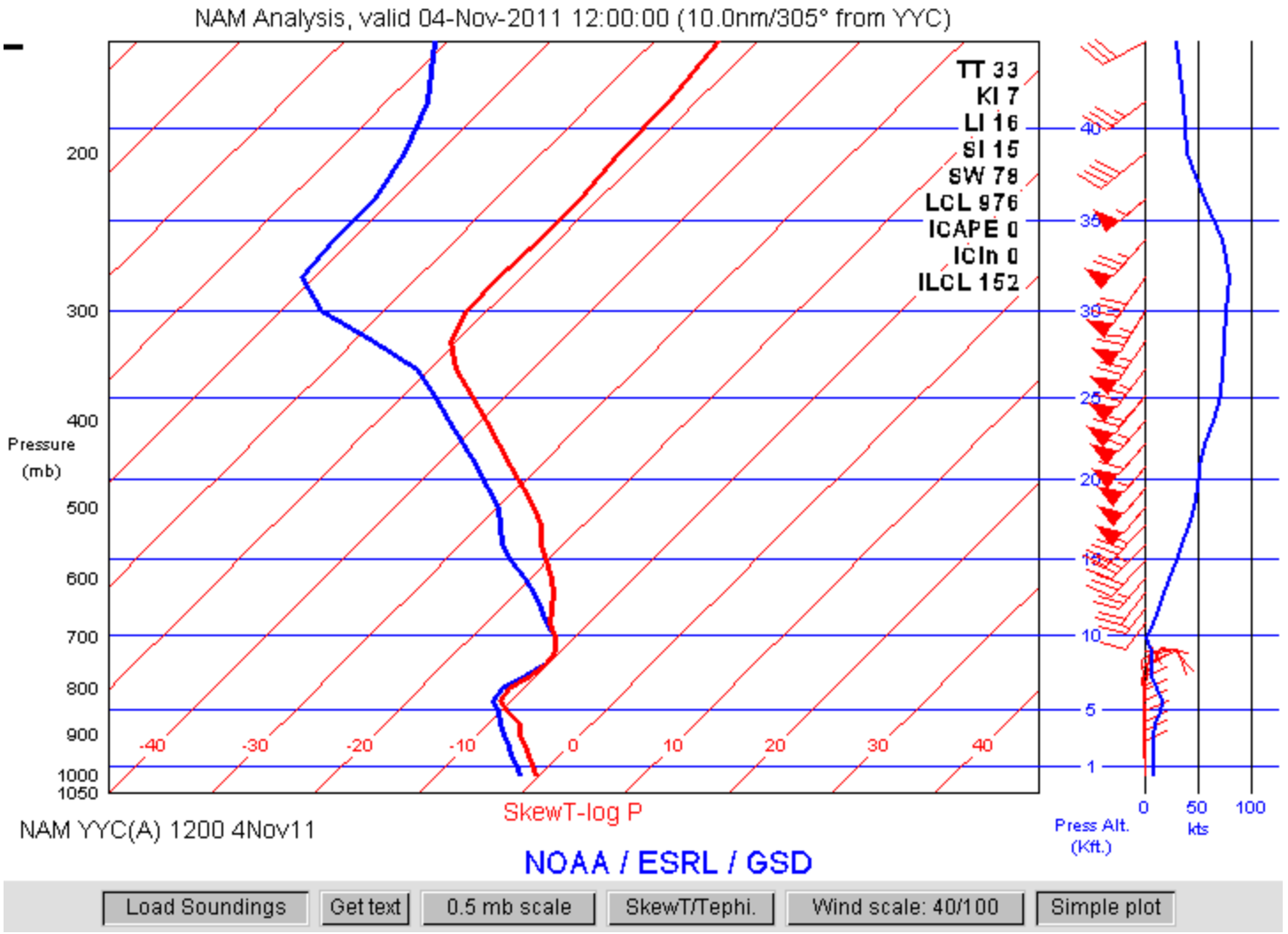
ENVIRONMENT CANADA 7:00 AM CDT FRIDAY NOV. 4 2011. .. ALBERTA... **ARCTIC RIDGE** AT SURFACE HAS BUILT DOWN INTO S. ALBERTA. DEEP UPPER TROUGH MOVING IN FROM BC. STARTING TO SEE ACCUMULATIONS IN S. ALBERTA AS SW FLOW FROM UPPER TROUGH OVERRIDES ARCTIC RIDGE. … UPSLOPE COMPONENT INTO MOUNTAIN PARKS.. SNOWFALL WARNINGS FOR KANANASKIS AND PINCHER CREEK REGIONS AND WEATHER WARNINGS FOR CARDSTON AND OKOTOKS SINCE THIS WILL BE THE FIRST SIGNIFICANT SNOWFALL OF THE YEAR

• there is no sounding (radiosonde) at Calgary

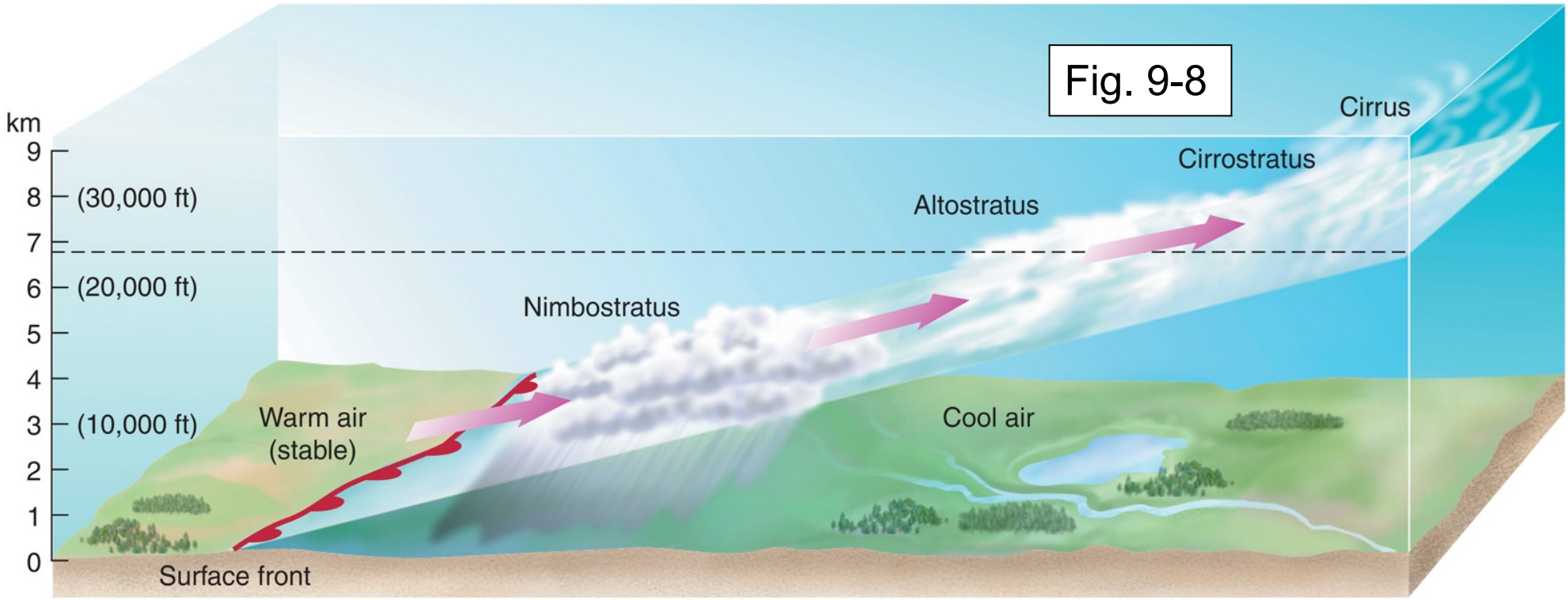
• but soundings can be “created” from output of the operational analyses/forecasts

• here a “sounding” for Calgary at 12Z today

• clearly shows the layering – cold low level northerly wind under mild, saturated upper south-westerly



Idealized configuration of a warm front

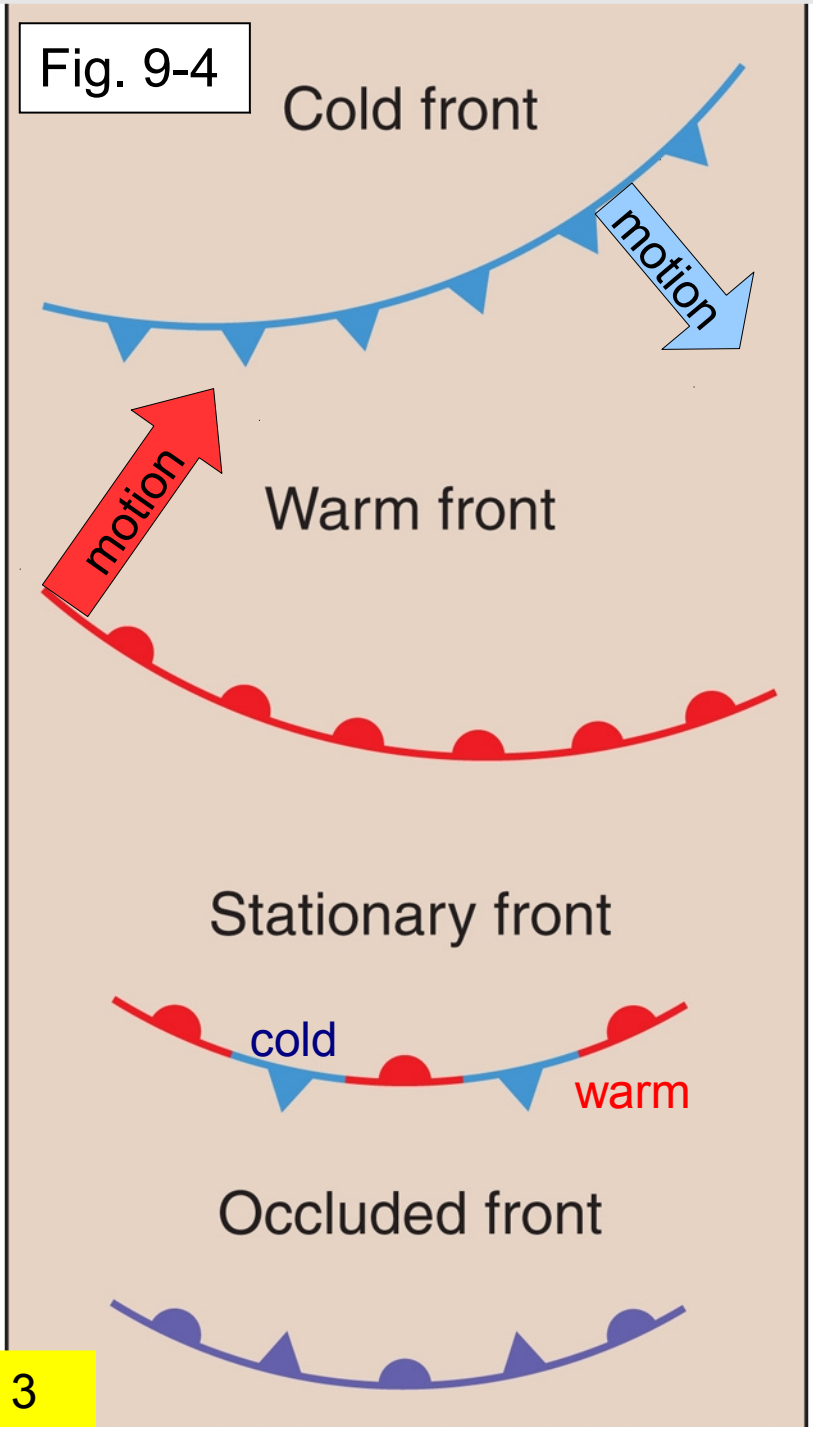


- gentler slope (nominally 1:200) than cold front, and slower movement (20 kph vs. up to 50 kph for cold front)

- cold air lies beneath the overrunning & ascending warm air – tends to produce stratiform cloud types

- precip rates low, but in winter precip falling into colder air may lead to freezing rain

Fronts & their symbols



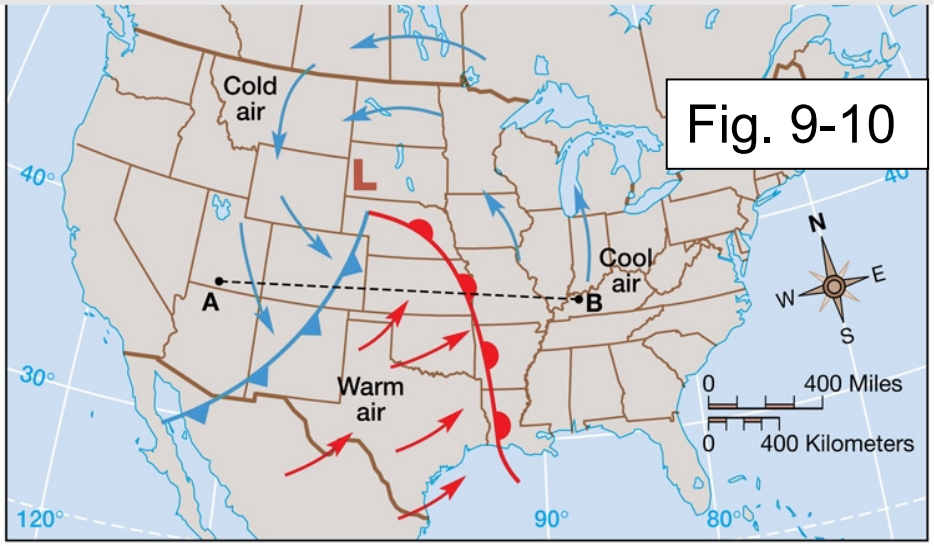
cold air pushing under warm air, lifting it and forcing it to retreat

warm air riding over cold air, and forcing it to retreat

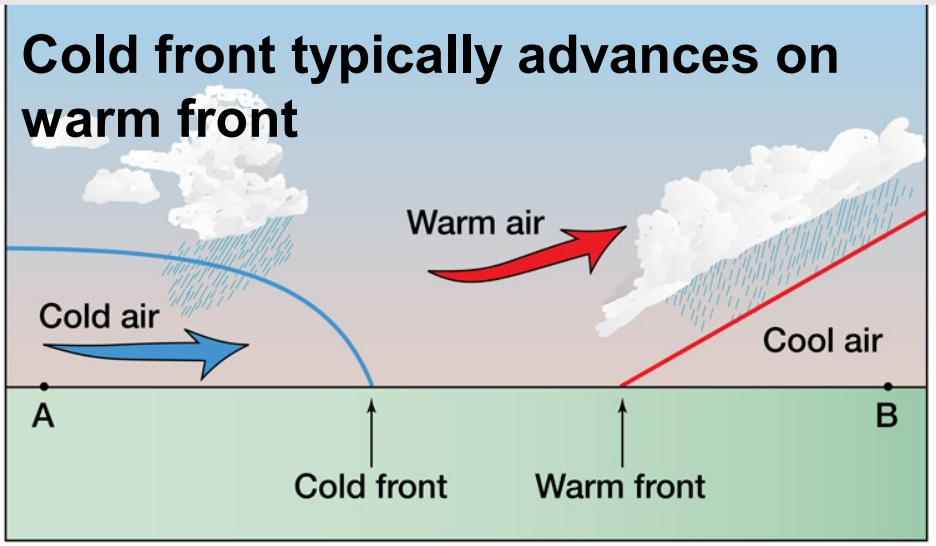
sloping boundary of cold and warm air, not moving

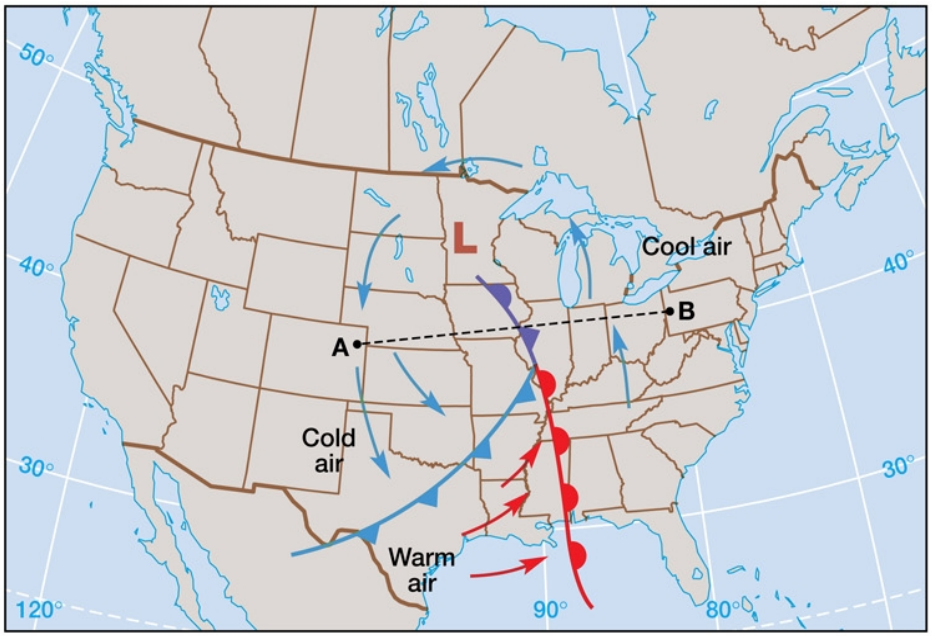
warm air cut off from the surface as the advancing cold front catches up with the warm front – separates two cold airmasses

Fronts & their symbols

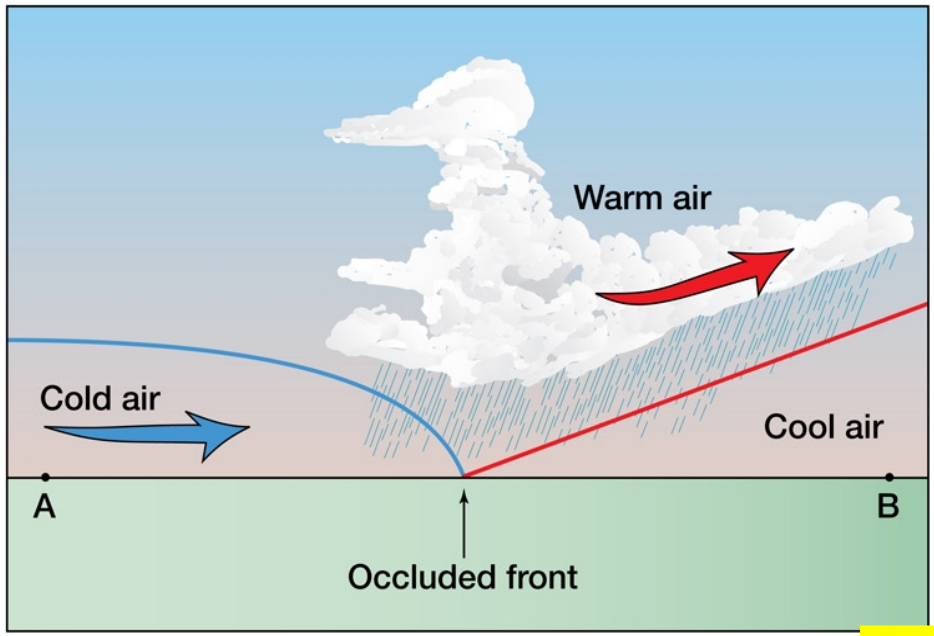


(a) Mature midlatitude cyclone



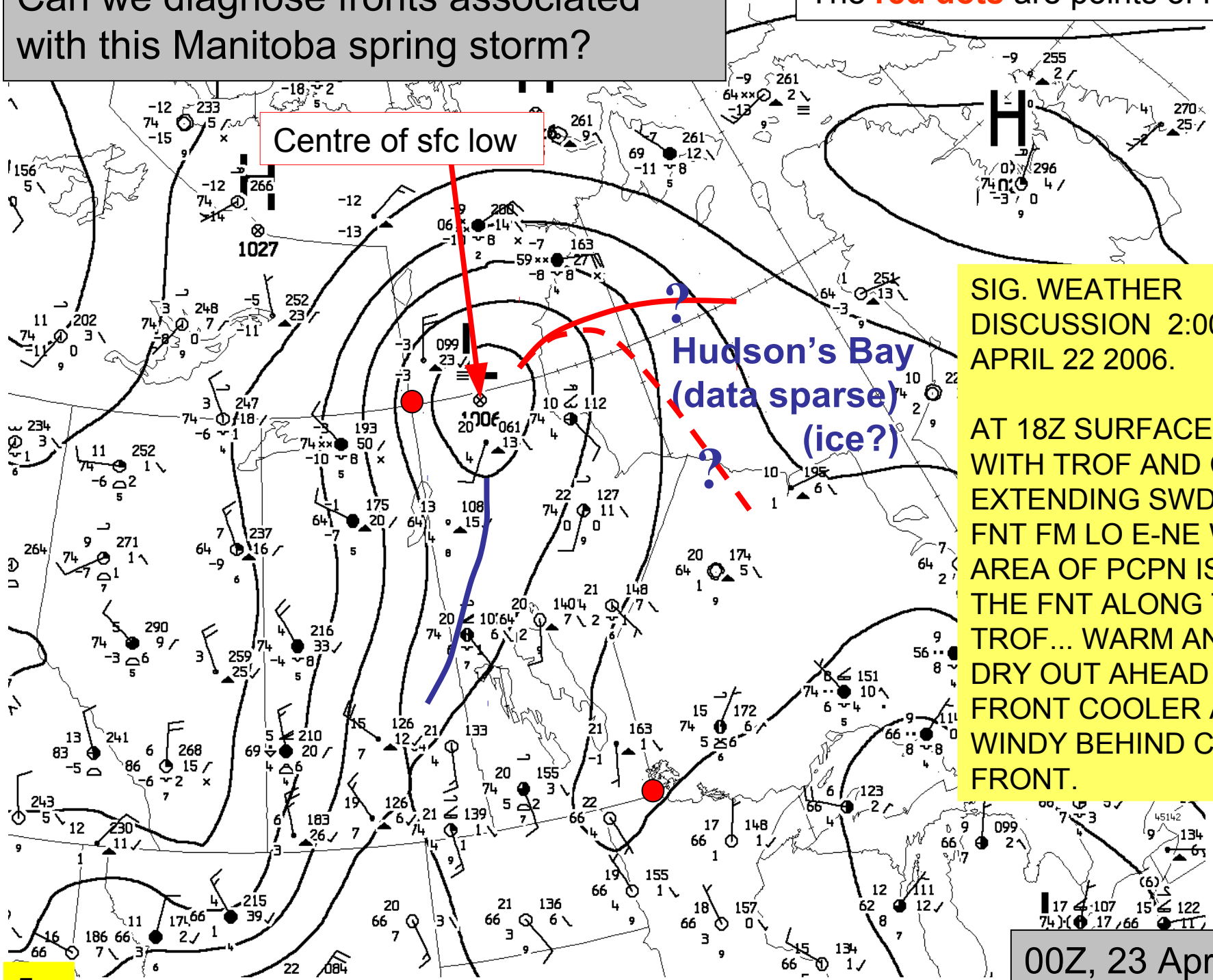


(b) Partially occluded midlatitude cyclone



Can we diagnose fronts associated with this Manitoba spring storm?

The **red dots** are points of reference



SIG. WEATHER DISCUSSION 2:00 PM CDT APRIL 22 2006.

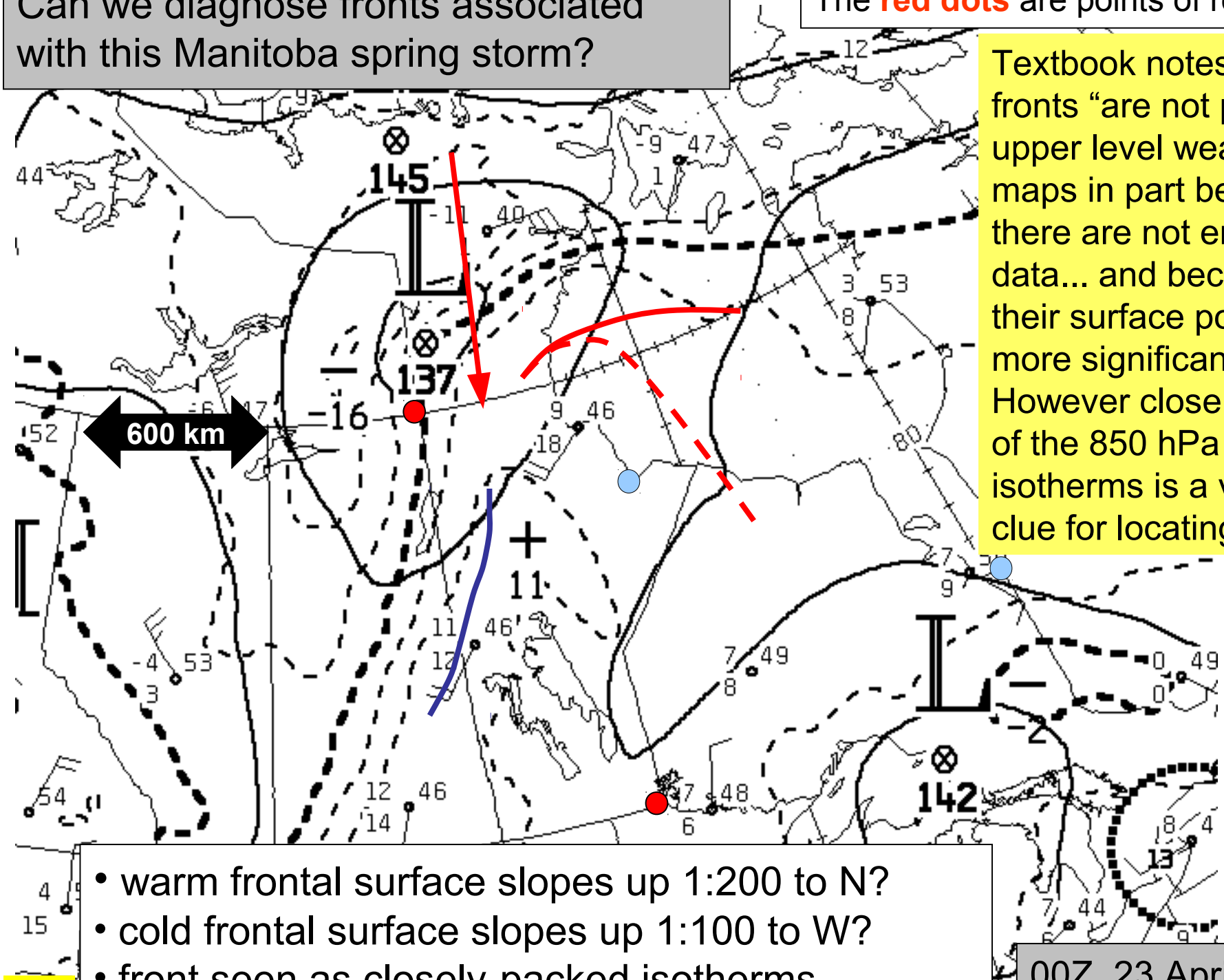
AT 18Z SURFACE LOW... WITH TROF AND COLD FTN EXTENDING SWD... WRM FNT FM LO E-NE WD. MN AREA OF PCPN IS BEHIND THE FNT ALONG THE UPR TROF... WARM AND VERY DRY OUT AHEAD OF COLD FRONT COOLER AND WINDY BEHIND COLD FRONT.

00Z, 23 April 2006

Can we diagnose fronts associated with this Manitoba spring storm?

The **red dots** are points of reference

Textbook notes (p284) fronts "are not plotted on upper level weather maps in part because there are not enough data... and because their surface position is more significant." However close packing of the 850 hPa isotherms is a valuable clue for locating fronts

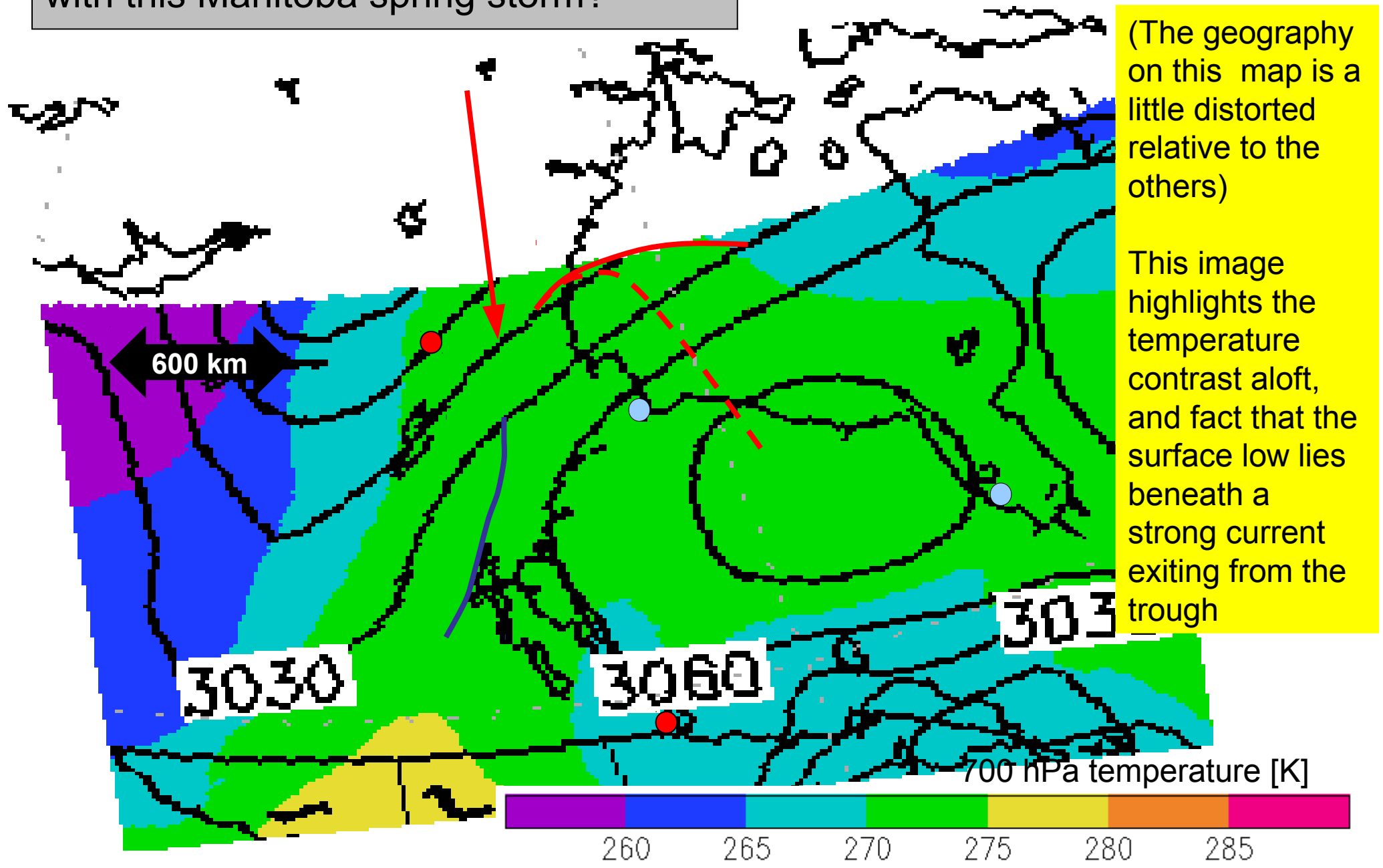


- warm frontal surface slopes up 1:200 to N?
- cold frontal surface slopes up 1:100 to W?
- front seen as closely-packed isotherms

00Z, 23 April 2006

Can we diagnose fronts associated with this Manitoba spring storm?

The **red dots** are points of reference



(The geography on this map is a little distorted relative to the others)

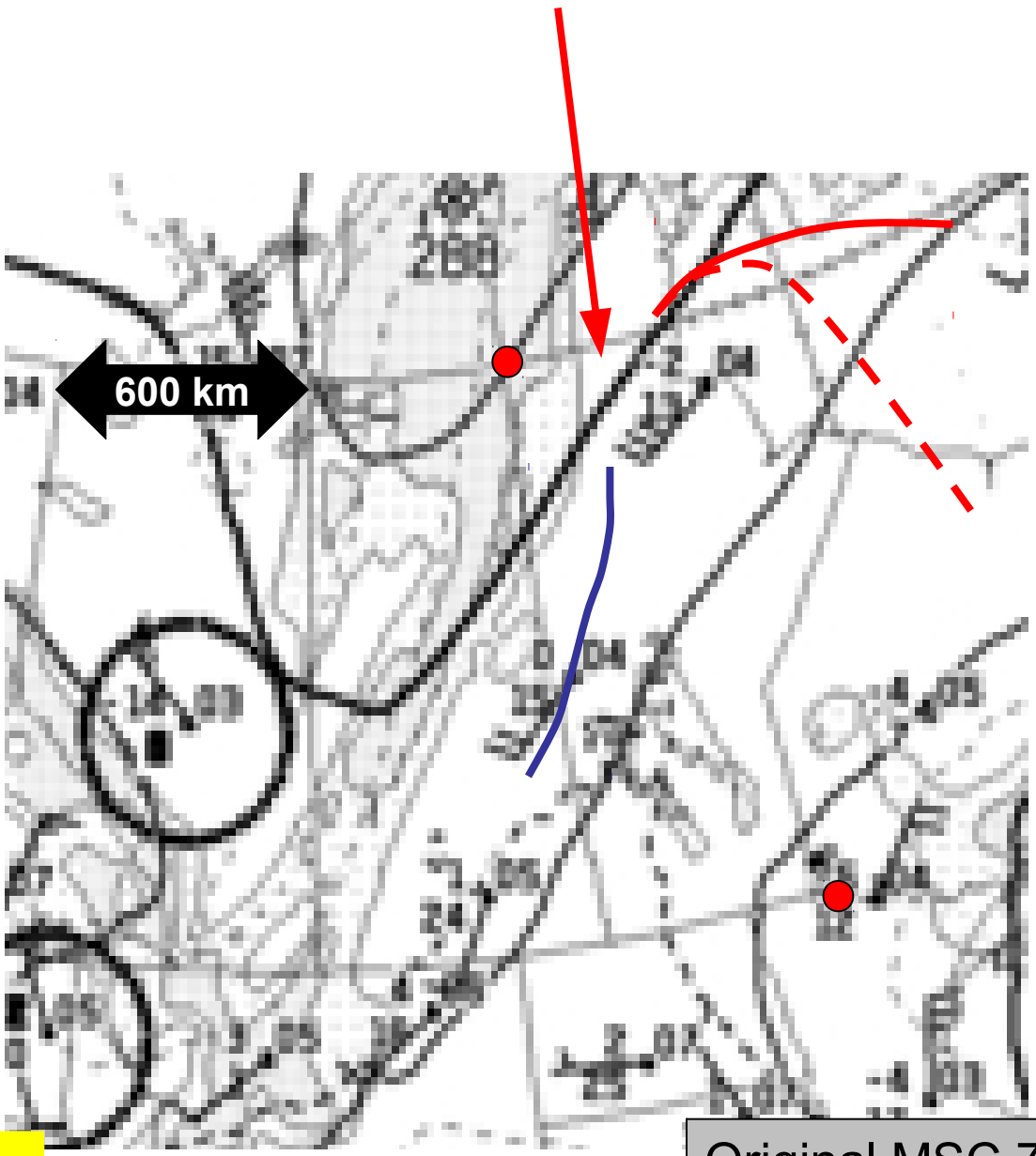
This image highlights the temperature contrast aloft, and fact that the surface low lies beneath a strong current exiting from the trough

7

700 hPa height & temp., NOMADS reanalysis, valid 00Z, 23 April 2006

Can we diagnose fronts associated with this Manitoba spring storm?

The **red dots** are points of reference

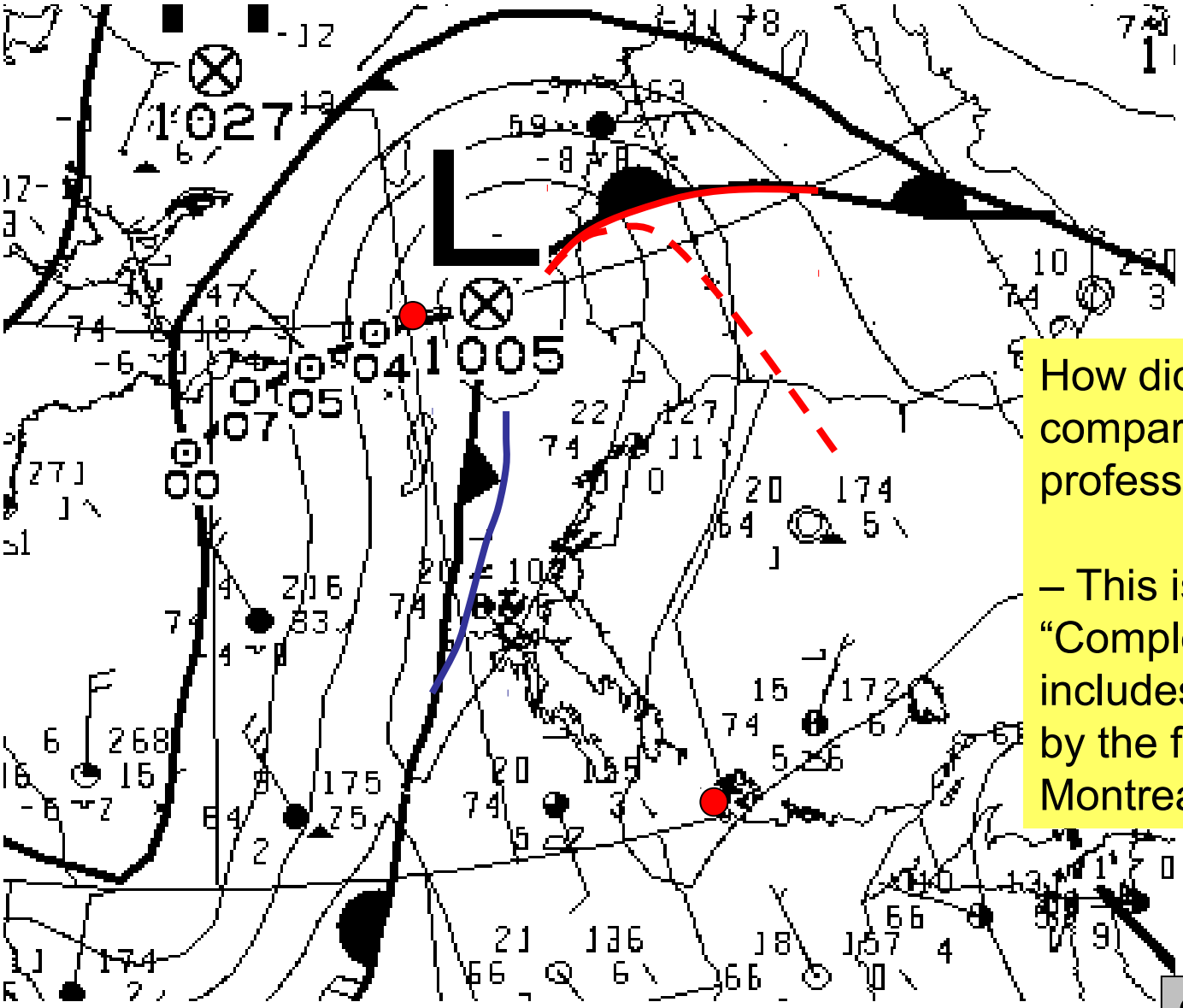


The surface low center (indicated by the head of the red arrow) lies beneath the trough outflow region

Original MSC 700 hPa analysis 00Z, 23 April 2006

Can we diagnose fronts associated with this Manitoba spring storm?

The **red dots** are points of reference

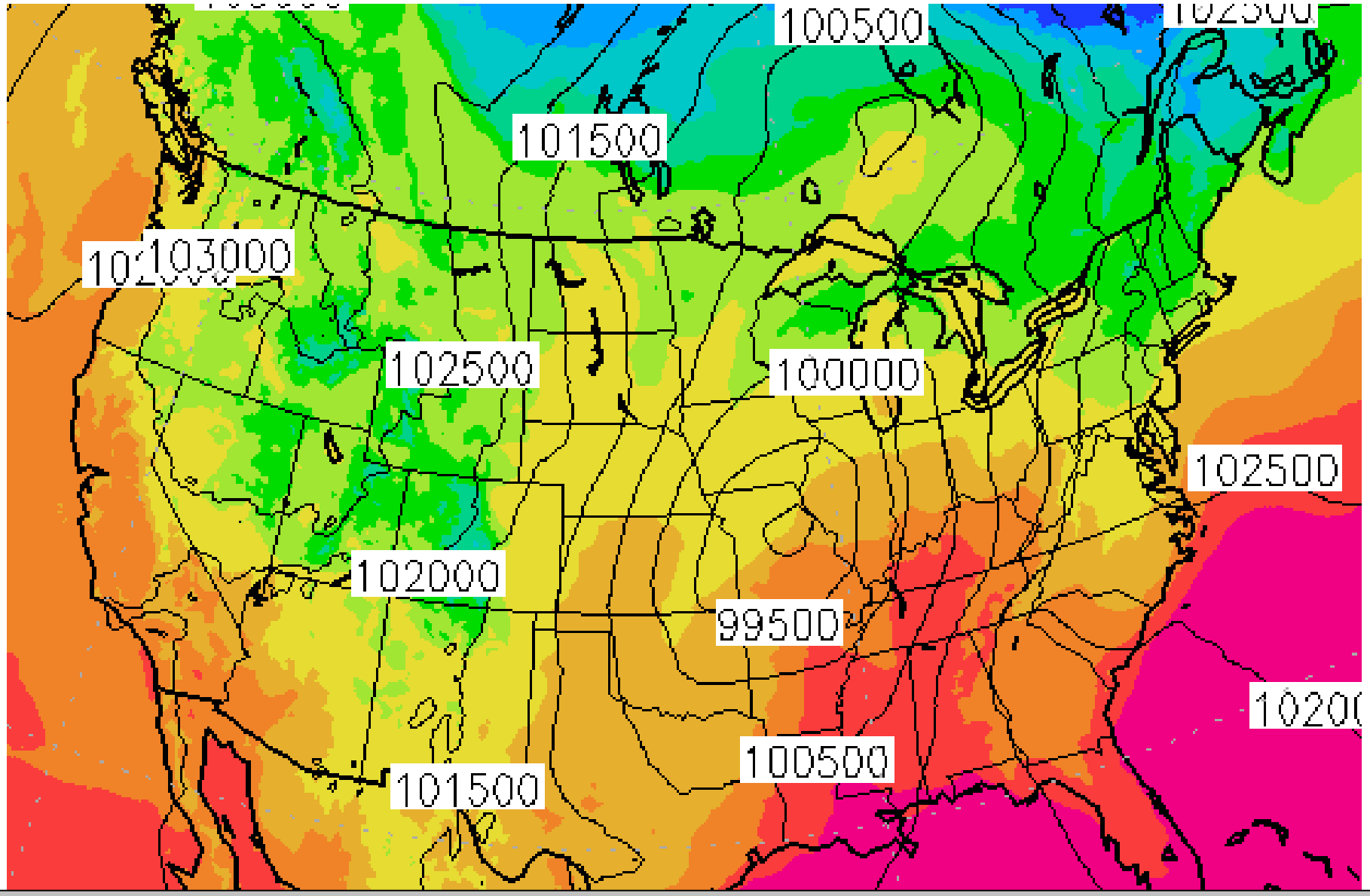


How did we do in comparison with the professionals?

– This is the CMC "Complete" analysis, which includes fronts as analyzed by the forecasters at CMC Montreal

00Z, 23 April 2006

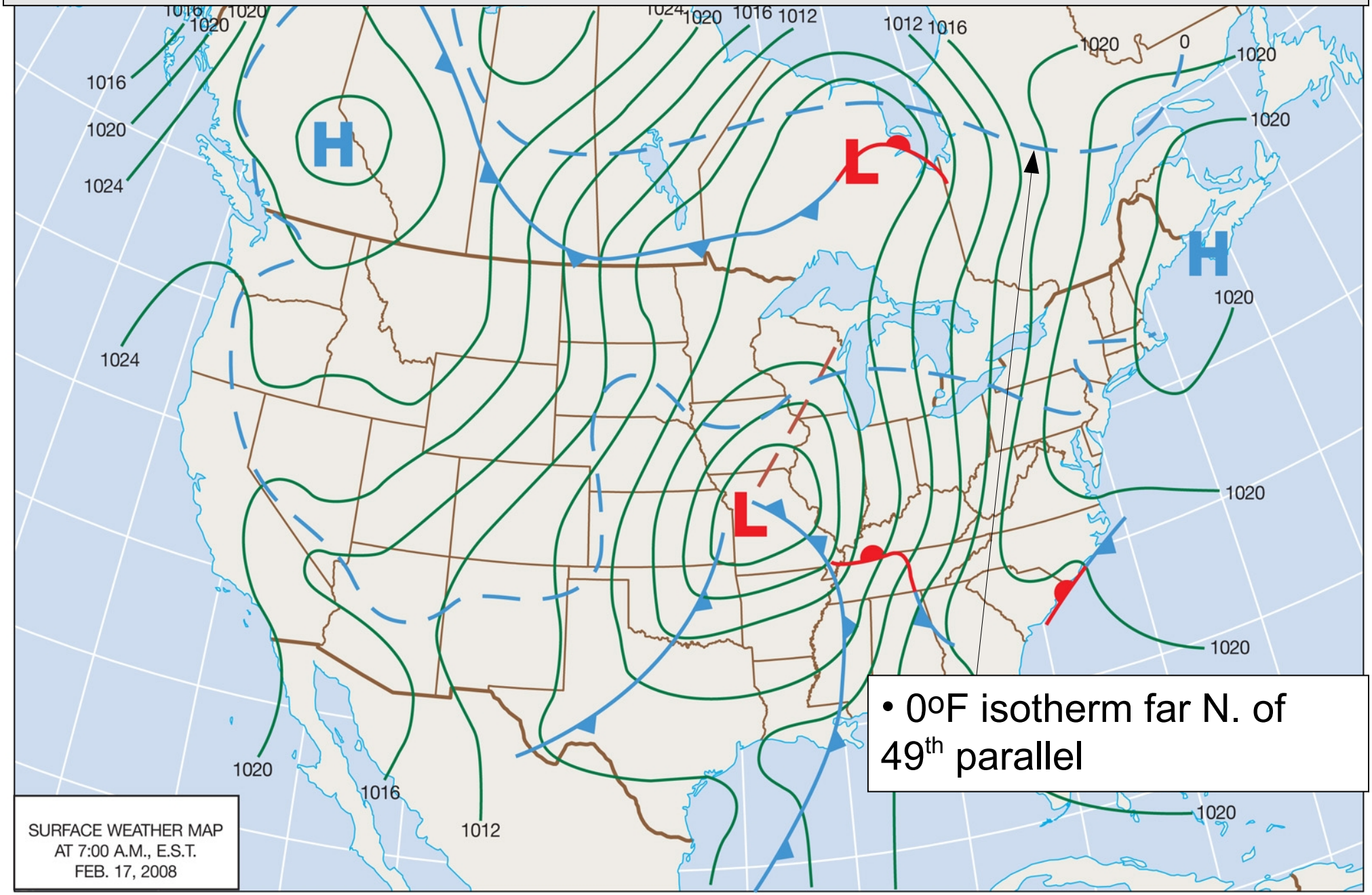
Compare with P286 Fig 1 – textbook's example of a “surge of continental polar air”



Sea-level pressure and 2 m temp., NOMADS reanalysis, valid 12Z, 17 Feb. 2008

10 235 240 245 250 255 260 265 270 275 280 285 290

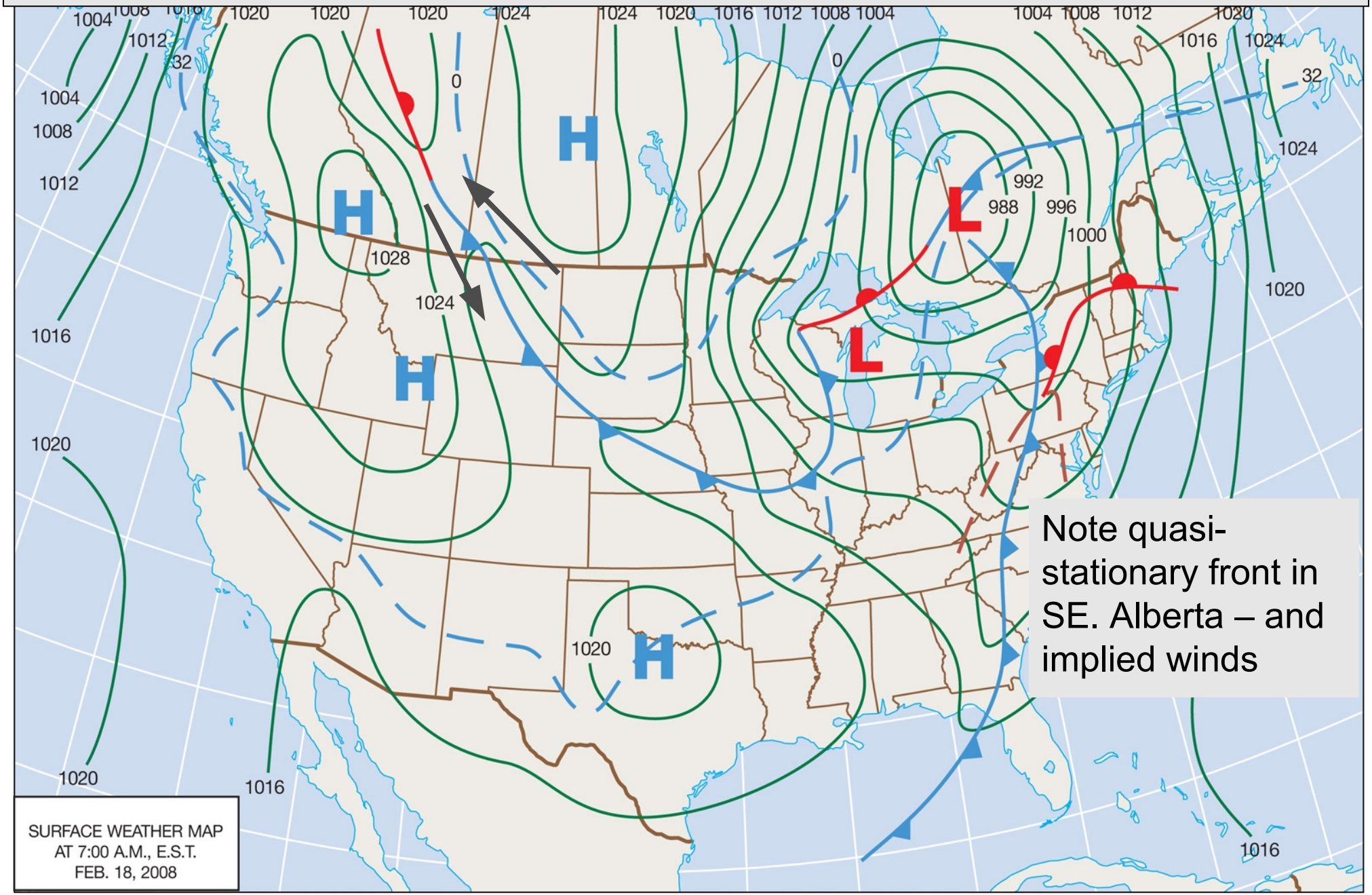
Sec 9-3 An Example of a Cold Front



- 0°F isotherm far N. of 49th parallel

P286 Fig 1. 0700 EST (=12Z) 17 Feb. 2008

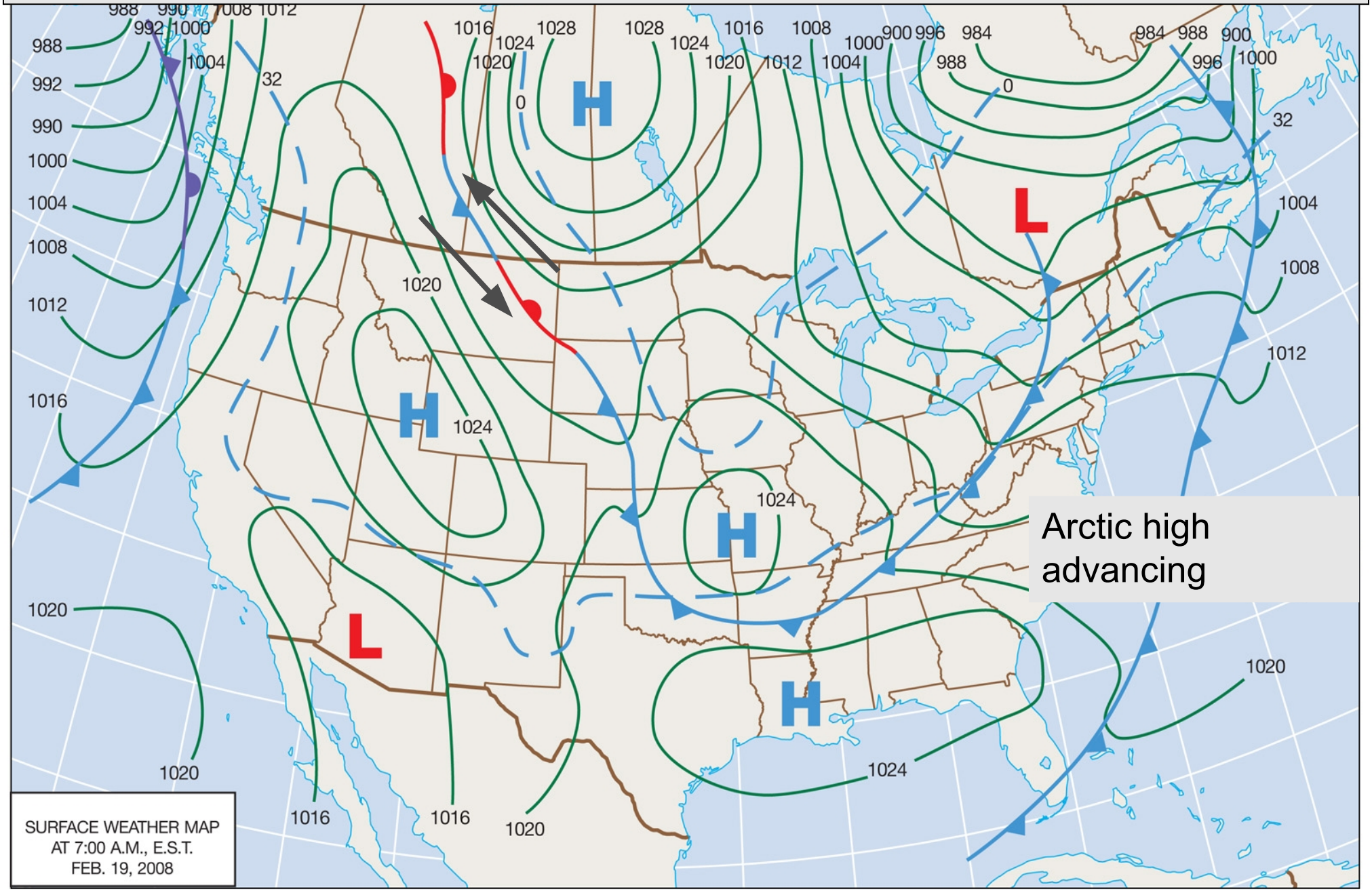
Sec 9-3 An Example of a Cold Front



Note quasi-stationary front in SE. Alberta – and implied winds

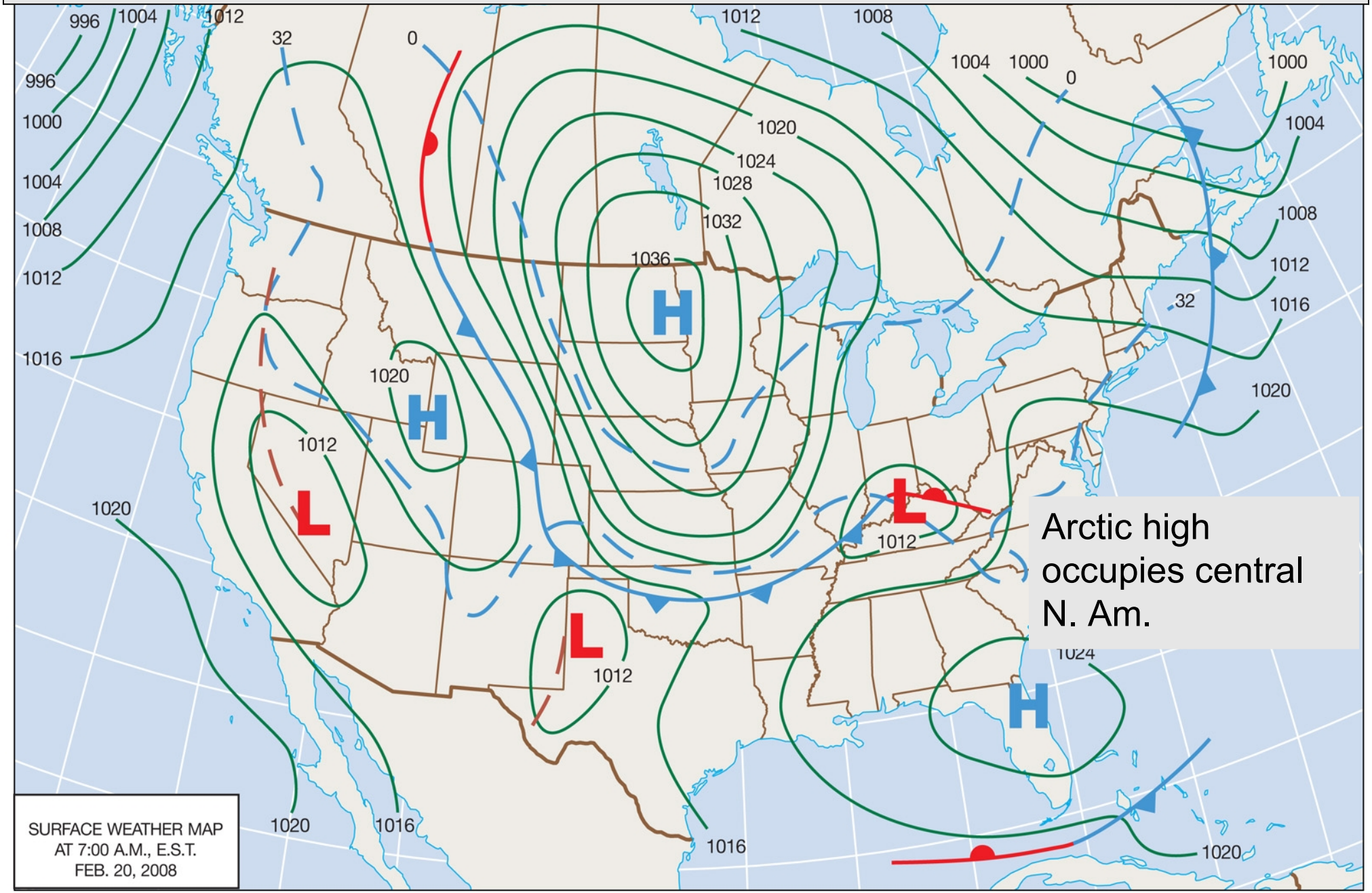
P287 Fig 3. 0700 EST (=12Z) 18 Feb. 2008

Sec 9-3 An Example of a Cold Front



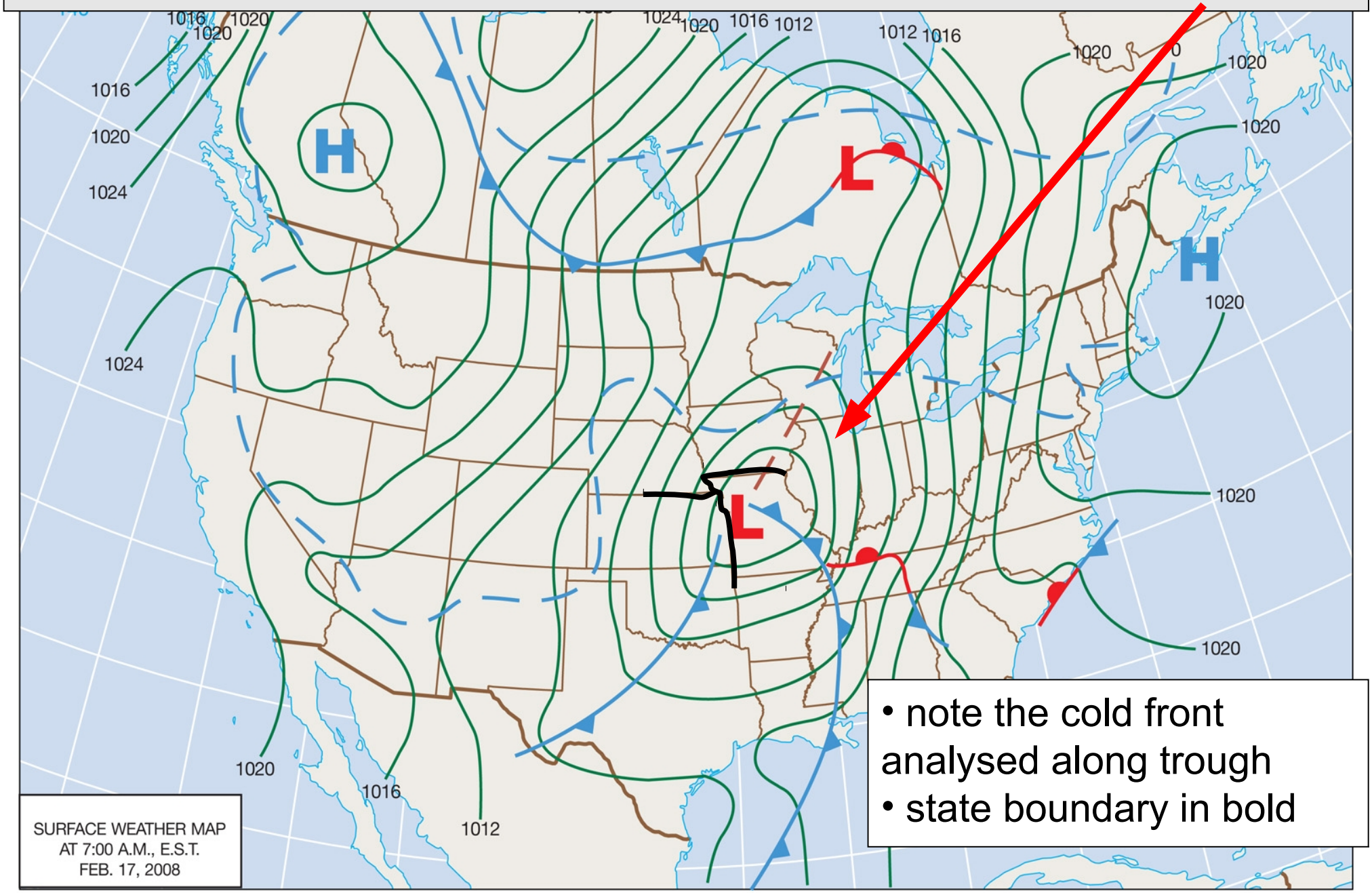
P288 Fig 5. 0700 EST (=12Z) 19 Feb. 2008

Sec 9-3 An Example of a Cold Front



P289 Fig 7. 0700 EST (=12Z) 20 Feb. 2008

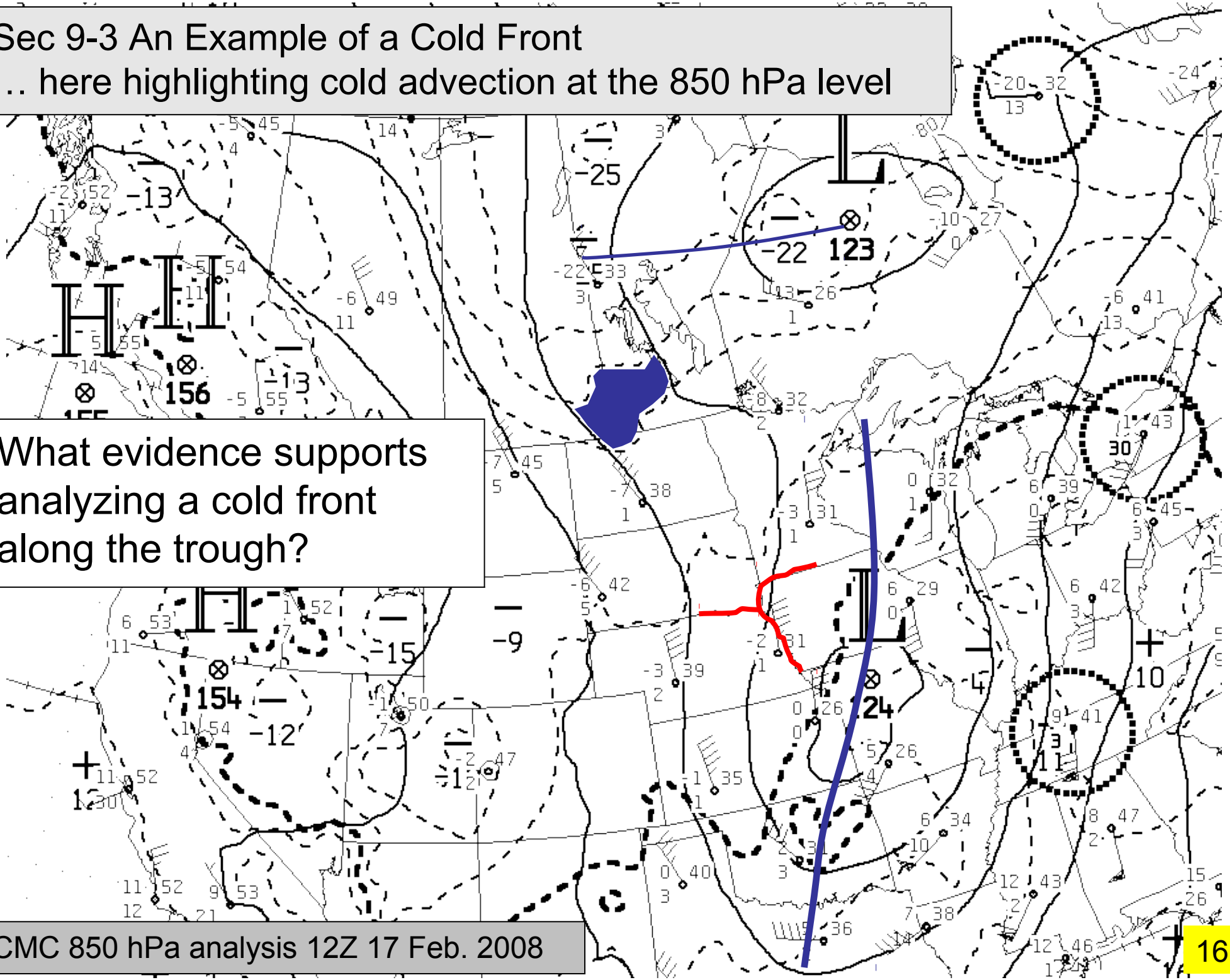
Sec 9-3 An Example of a Cold Front – focus now on the storm



- note the cold front analysed along trough
- state boundary in bold

P286 Fig 1. 0700 EST (=12Z) 17 Feb. 2008

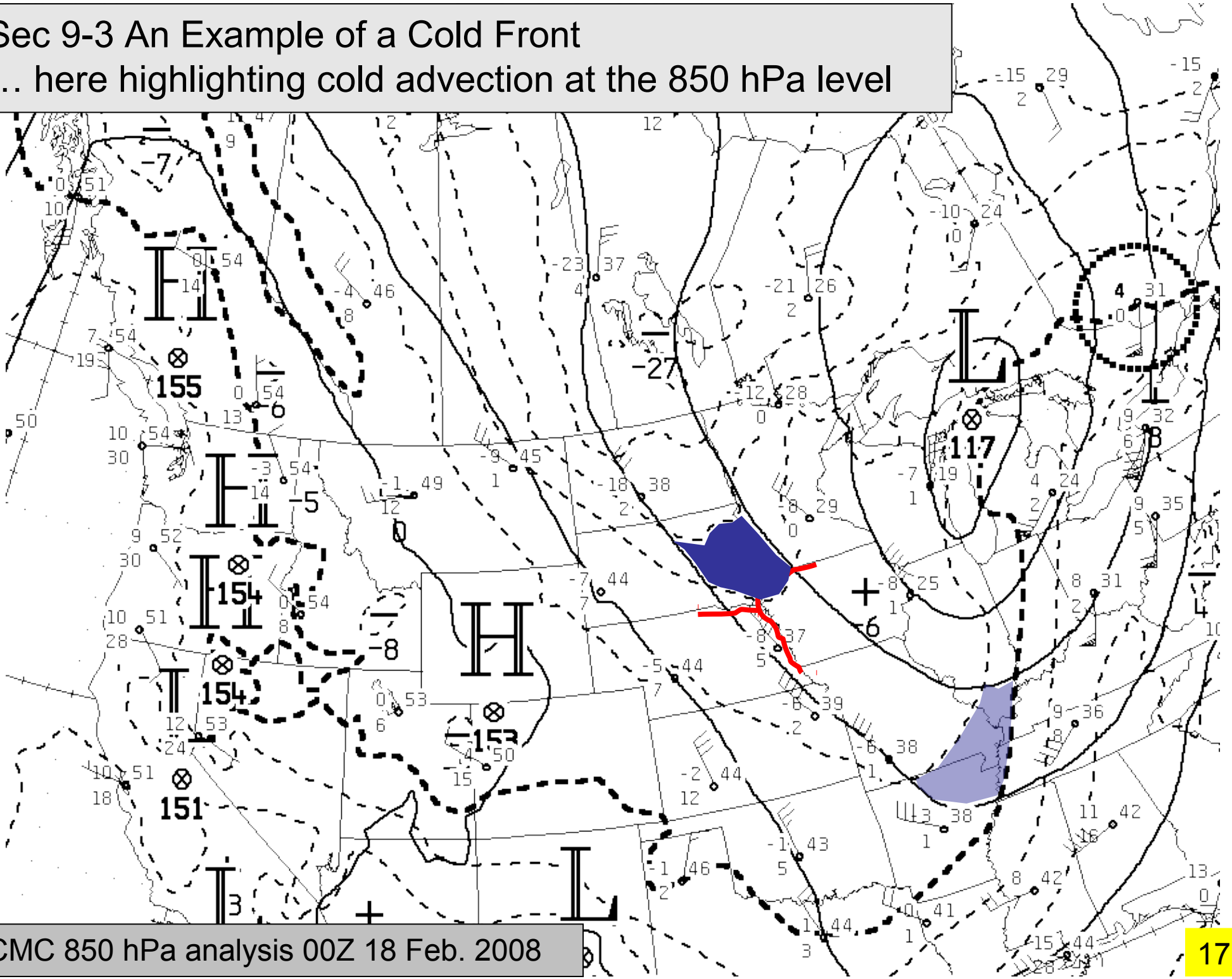
Sec 9-3 An Example of a Cold Front
… here highlighting cold advection at the 850 hPa level



What evidence supports analyzing a cold front along the trough?

CMC 850 hPa analysis 12Z 17 Feb. 2008

Sec 9-3 An Example of a Cold Front
… here highlighting cold advection at the 850 hPa level



CMC 850 hPa analysis 00Z 18 Feb. 2008

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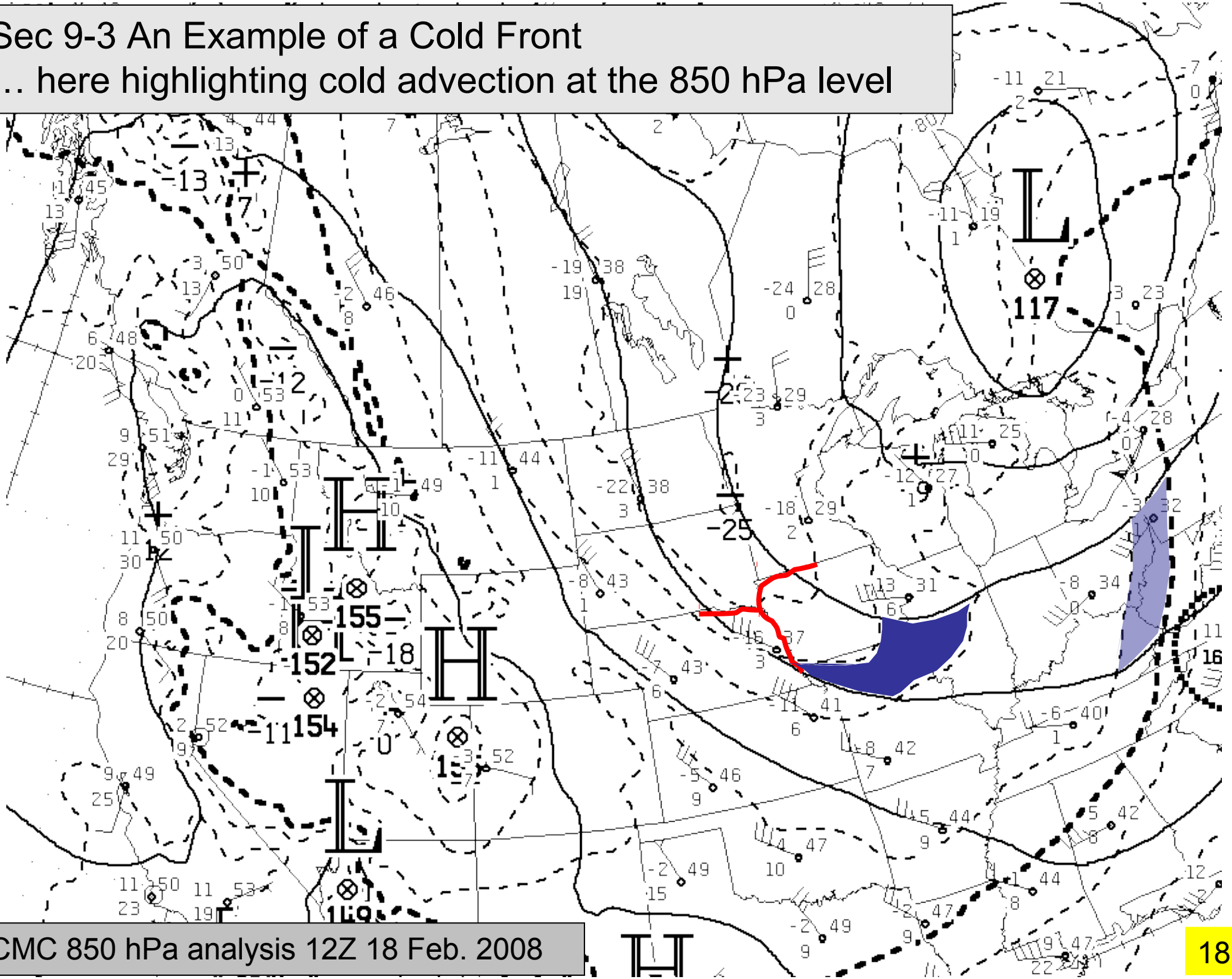

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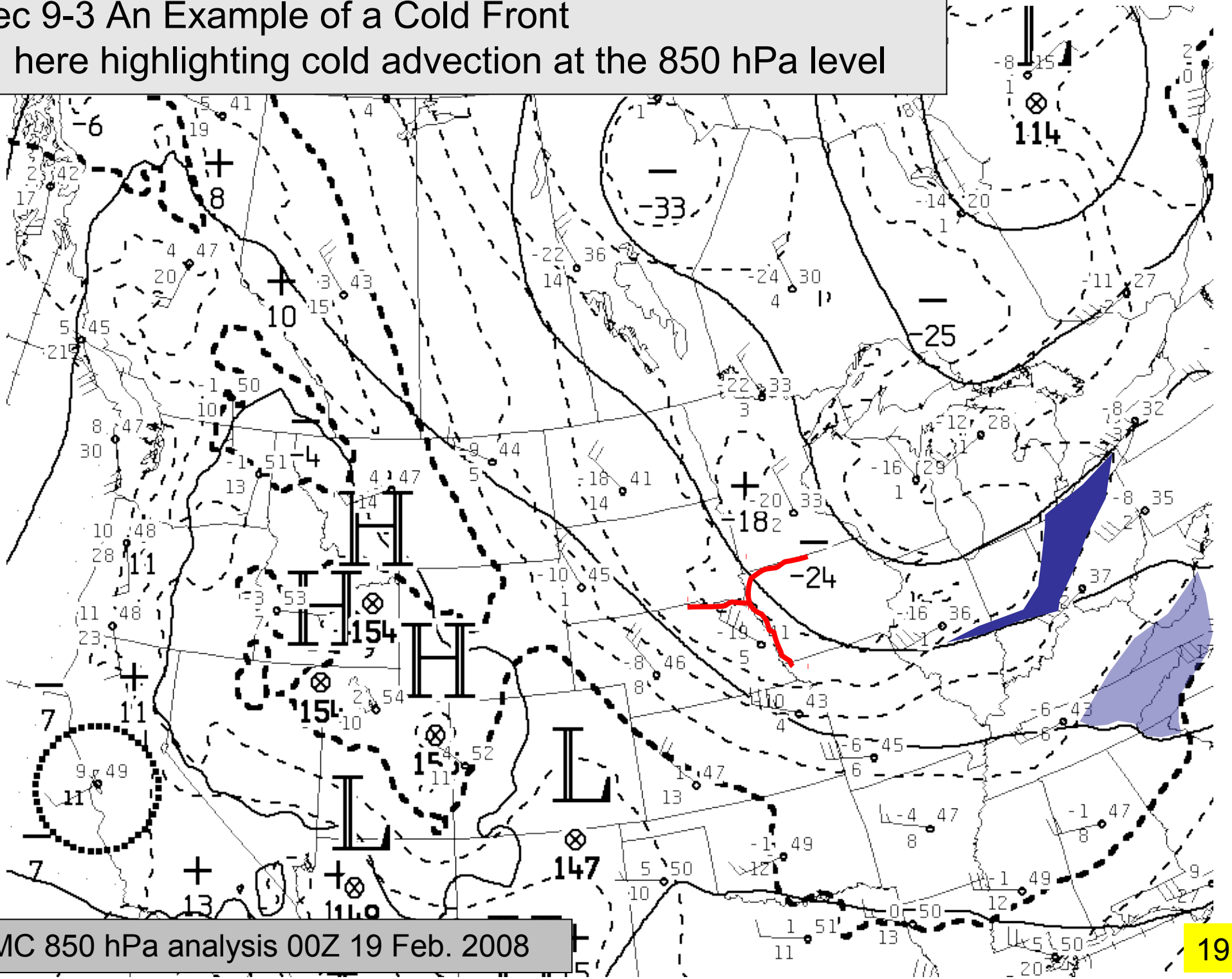


CMC 850 hPa analysis 00Z 19 Feb. 2008

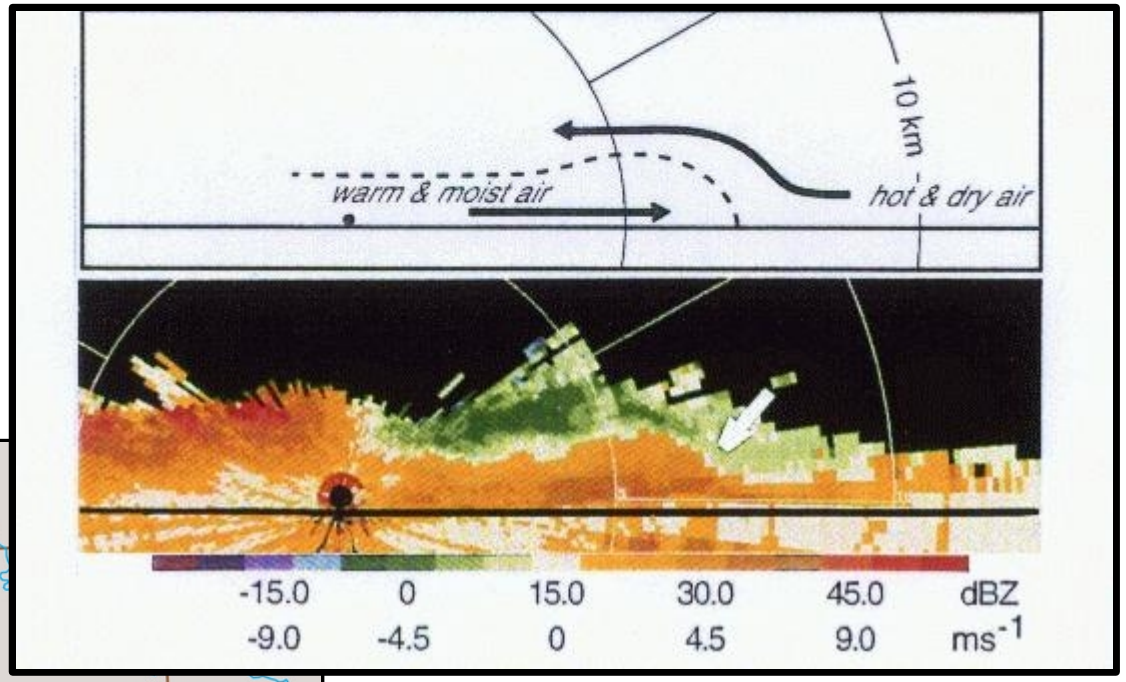
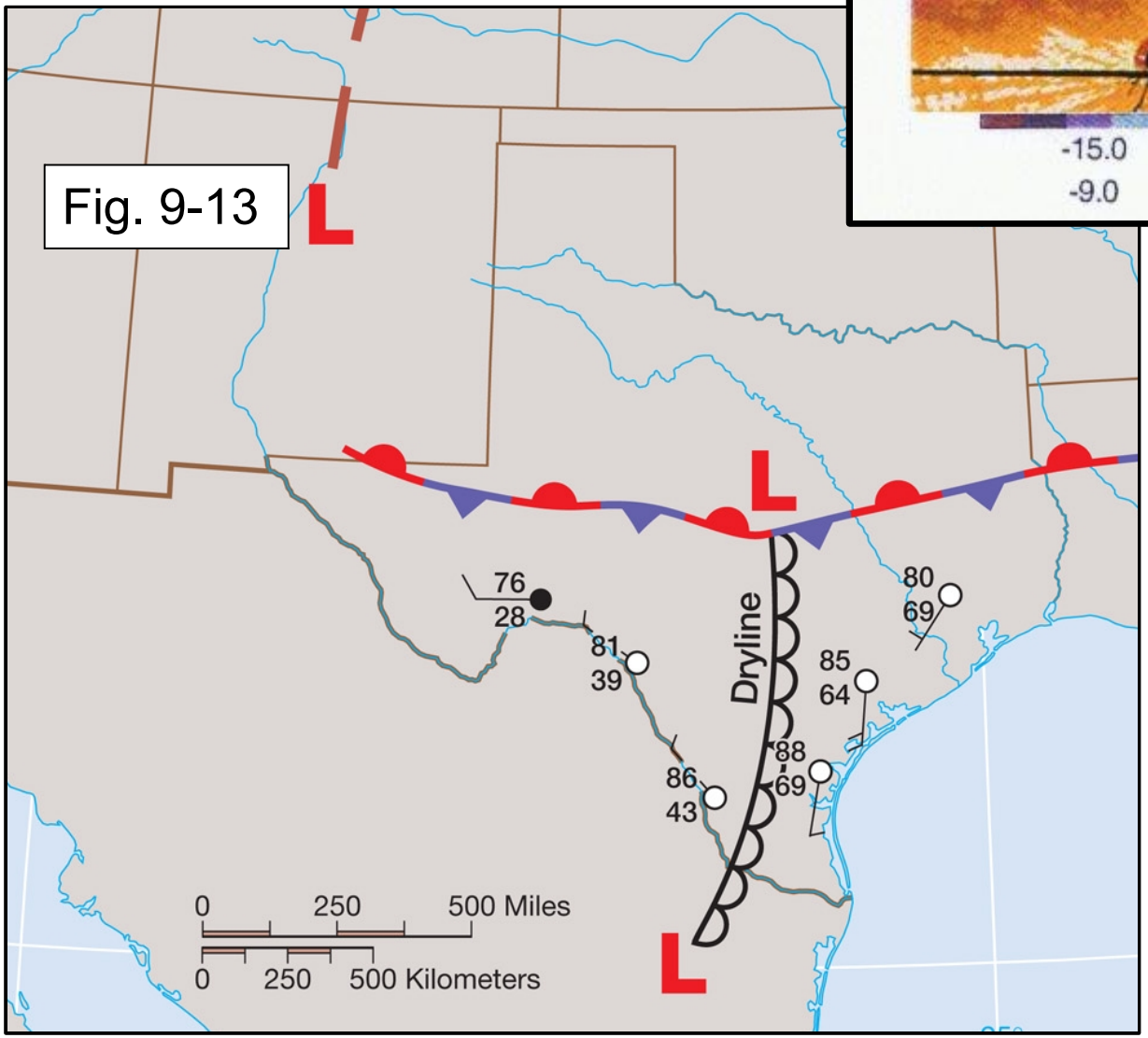


Fig. 9-13



Radar image of a dryline (From Wikipedia; in this case the hot & dry air is to the right of the front, whereas in the sketch at the left the hot dry air is west of the front)