

Sec 3.6 Influence of temperature on pressure distribution

Thermal pressure system:
shallow area of high or low
pressure created by cooling or
warming

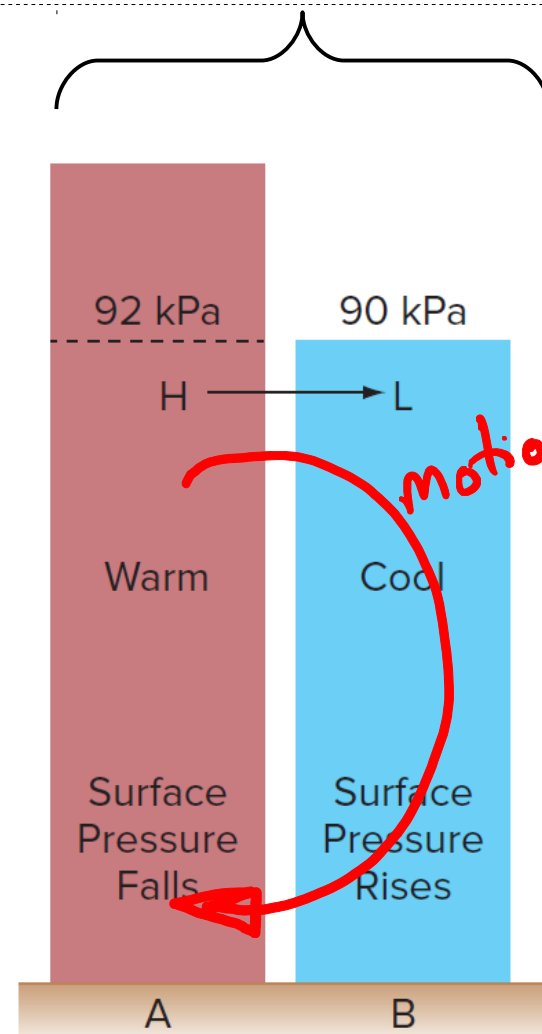
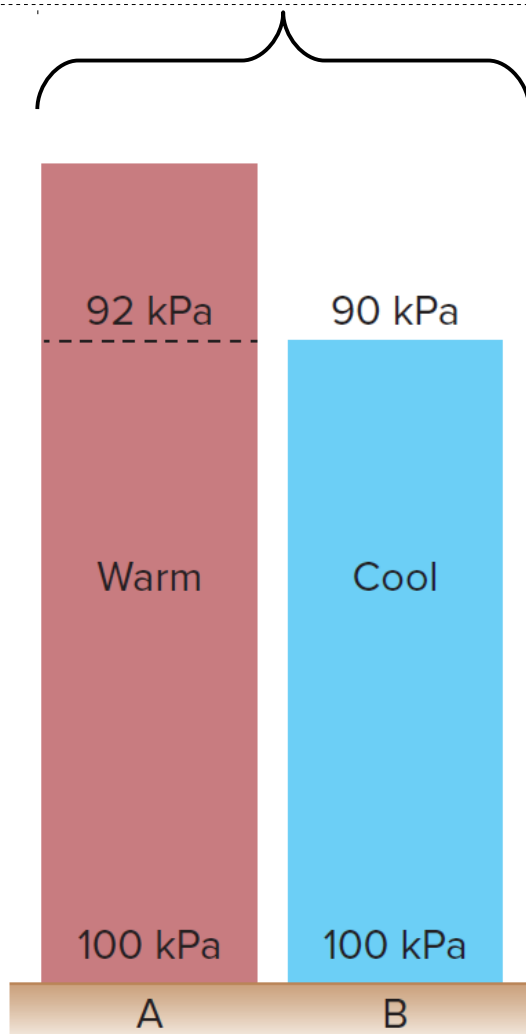
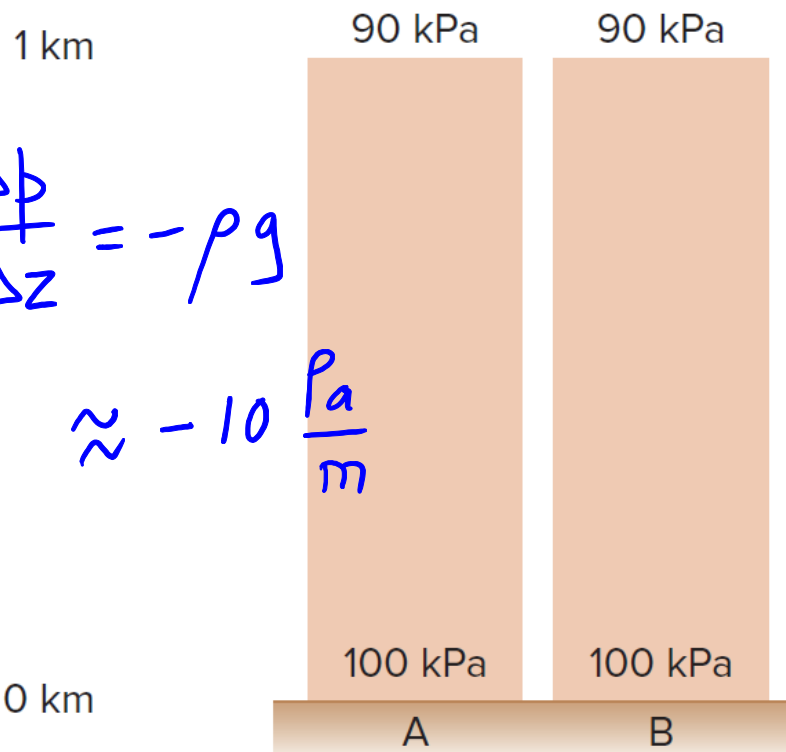
Recall (Eq 3.10):

$$\frac{\Delta P}{\Delta z} = - \frac{P g}{R_d} \frac{1}{\bar{T}_v}$$

THOUGHT EXPT.

Ⓐ No motion

Ⓑ permit motion



$$P_{0A} = \frac{M_A g}{area} \quad c) \quad P_{0B} = \frac{M_B g}{areq}$$

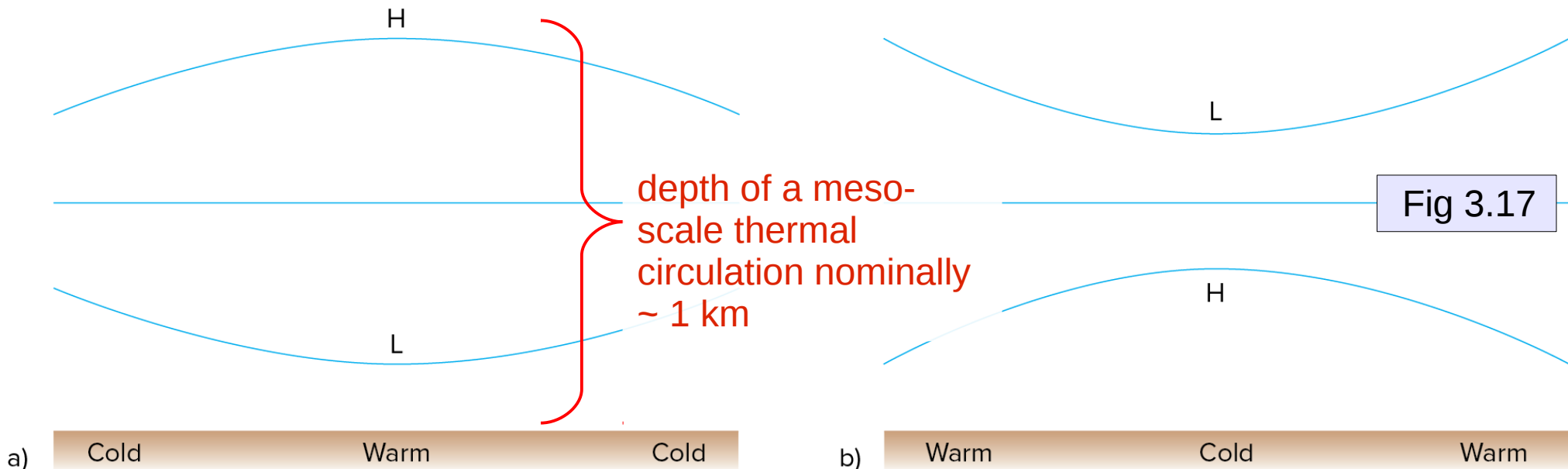
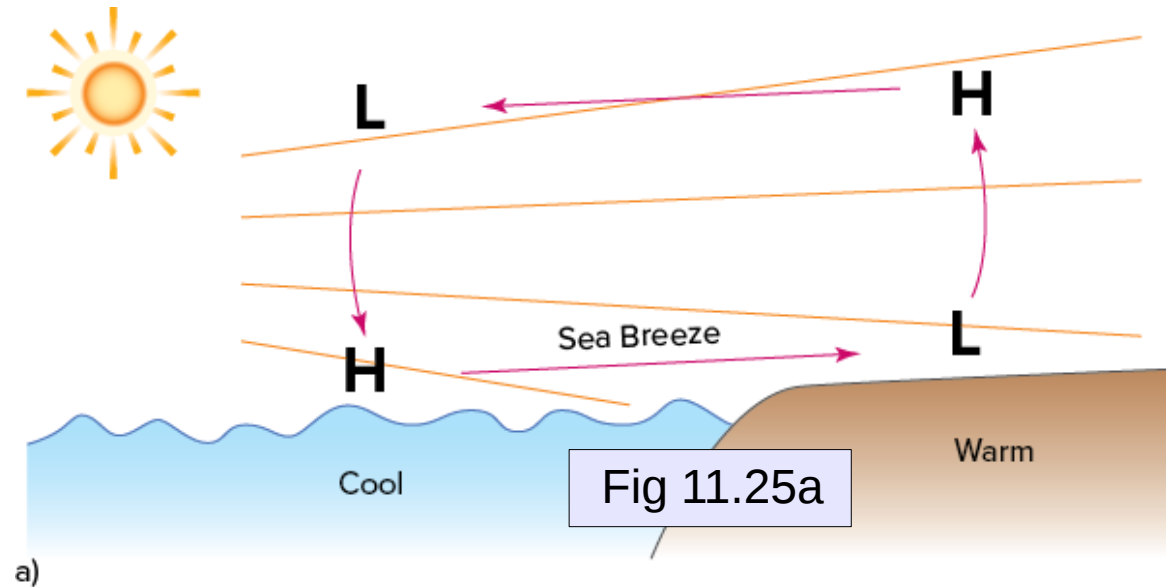
Fig 3.16

a)

b)

c)

- thermal pressure systems are shallow – pressure gradient weakens quickly with increasing height, and reverses aloft
- "core" of a thermal low (high) is warm (cold)
- example of a "meso-scale" thermal circulation: sea breeze (faster daytime warming of land surface than of ocean)

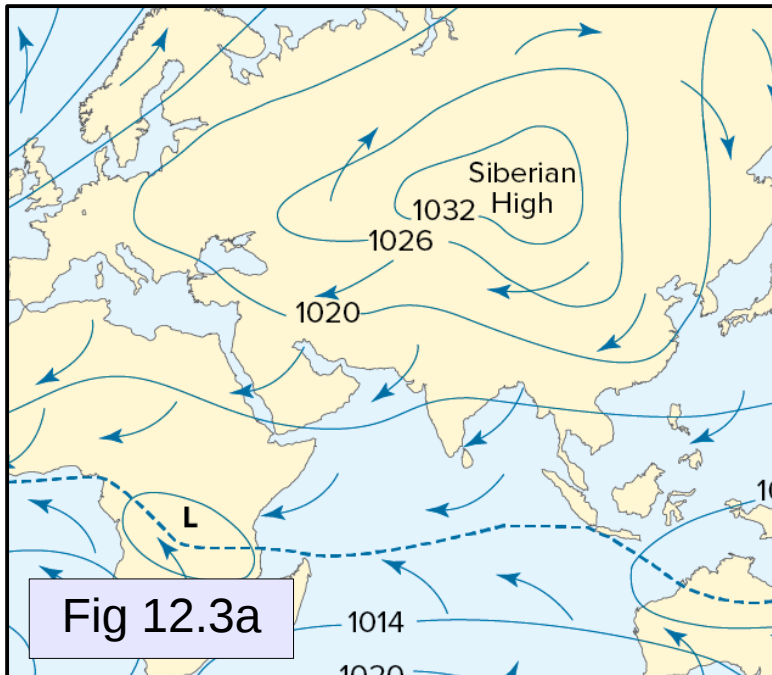


- microscale circulation – horizontal scale up to ~ 1km
- mesoscale ("middle scale") circulation – horizontal scales from ~1km to ~100 km
- synoptic scale circulation – horizontal scale from ~100km to ~1000km
- planetary scale

These are qualitative designations – boundary between categories subjective

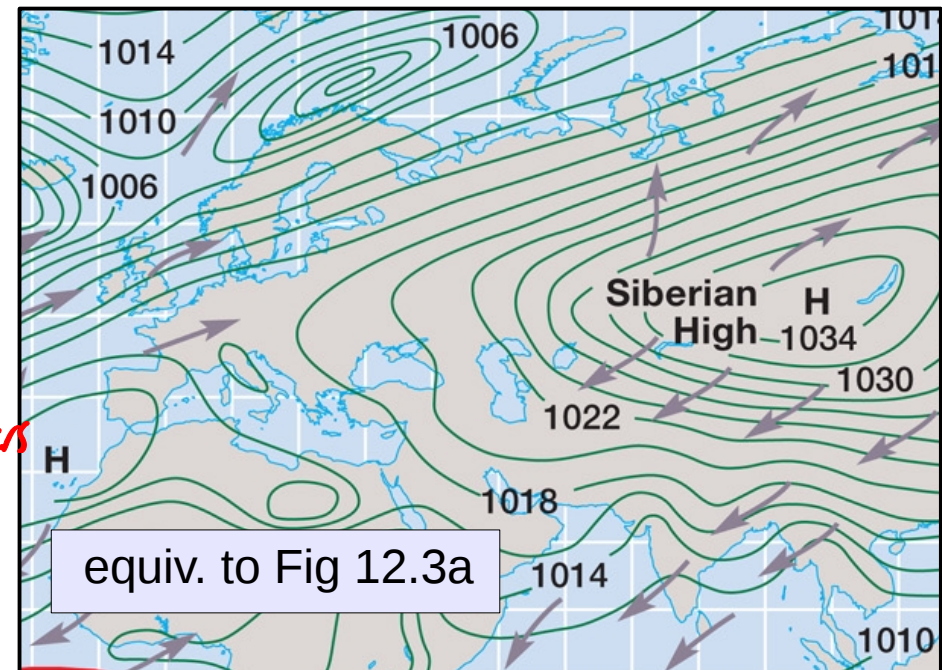
On the synoptic scale, the temperature contrast between the oceanic surface and wintertime continental land surface may induce what is effectively a "thermal high" whose horizontal scale is vast.

These features are so common that they show up when we draw isobars of climatological January surface pressure



Isobars of climatological January sea level press. & surface wind

Why does W. Europe have milder winters than Cdⁿ prairies?



- when meteorologists speak of there being "no weather," they mean that the situation is quiescent – no precip, nothing radical going on, perhaps no change at all (other than that due to the rising and falling of the sun – the diurnal cycle). "No weather" does not necessarily mean it is warm, or not cold
- "dynamic" pressure systems, particularly affecting middle latitudes, **are** associated with "weather", that is, they are responsible for changeable weather... that (in the case of dynamic lows, i.e. "storms") may entail clouds & precipitation, and perhaps even violently windy conditions
- dynamical lows entail a pattern of disturbance spanning the whole troposphere – unlike thermal lows, dynamic lows are "deep"
- dynamic lows (at least sometimes) can be considered to have a "cold core" – whereas thermal lows are warm-cored



Edmonton Int'l Airport, Alberta

Latitude 53.31° N | Longitude 113.58° W

Past 24 Hour Conditions

Date / Time (MDT)	Conditions	Temperature (°C)
20 September 2016		
9:00	Mostly Cloudy	5 (4.9)
8:00	Mist	0 (-0.4) ↓
7:00	Mist	0 (-0.3)
6:00	Mist	1 (1.4)
5:00	Mostly Cloudy	2 (1.9)
4:00	Mostly Cloudy	3 (2.7)
3:00	Mostly Cloudy	1 (0.8)
2:00	Mostly Cloudy	1 (1.3)
1:00	Mostly Cloudy	2 (2.2)
00:00	Mostly Cloudy	0 (0.4)

But for
the cloud,
we'd
have
had
a
frost

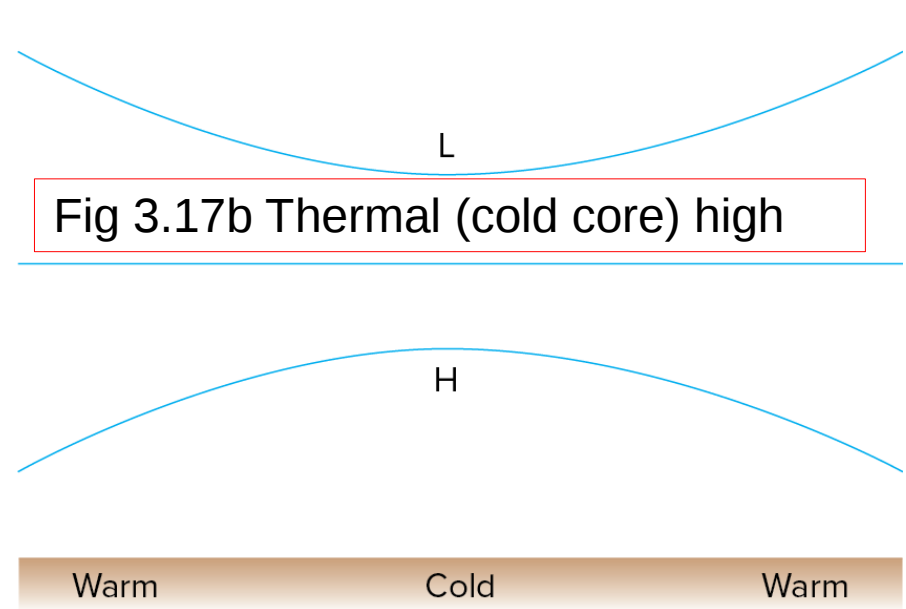
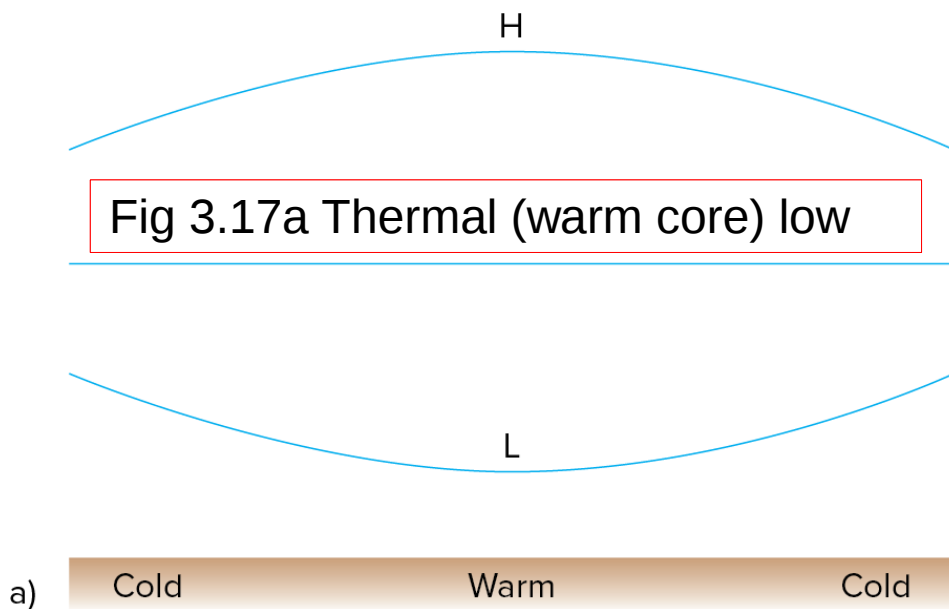
What do the blue lines represent?
isobaric surfaces

Fig 3.18a Dynamic (cold core) low

Fig 3.18b Dynamic (warm core) high

a)

b)



Think of the 500 hPa isobaric surface as an imaginary sheet in the sky – at every point on the sheet, $P=500$ hPa. The sheet *may* be horizontal, but in general it is not – nor, unlike in this image, is it necessarily *evenly* sloped. It is a complex "topographic" surface featuring ridges and valleys, just like the ground surface

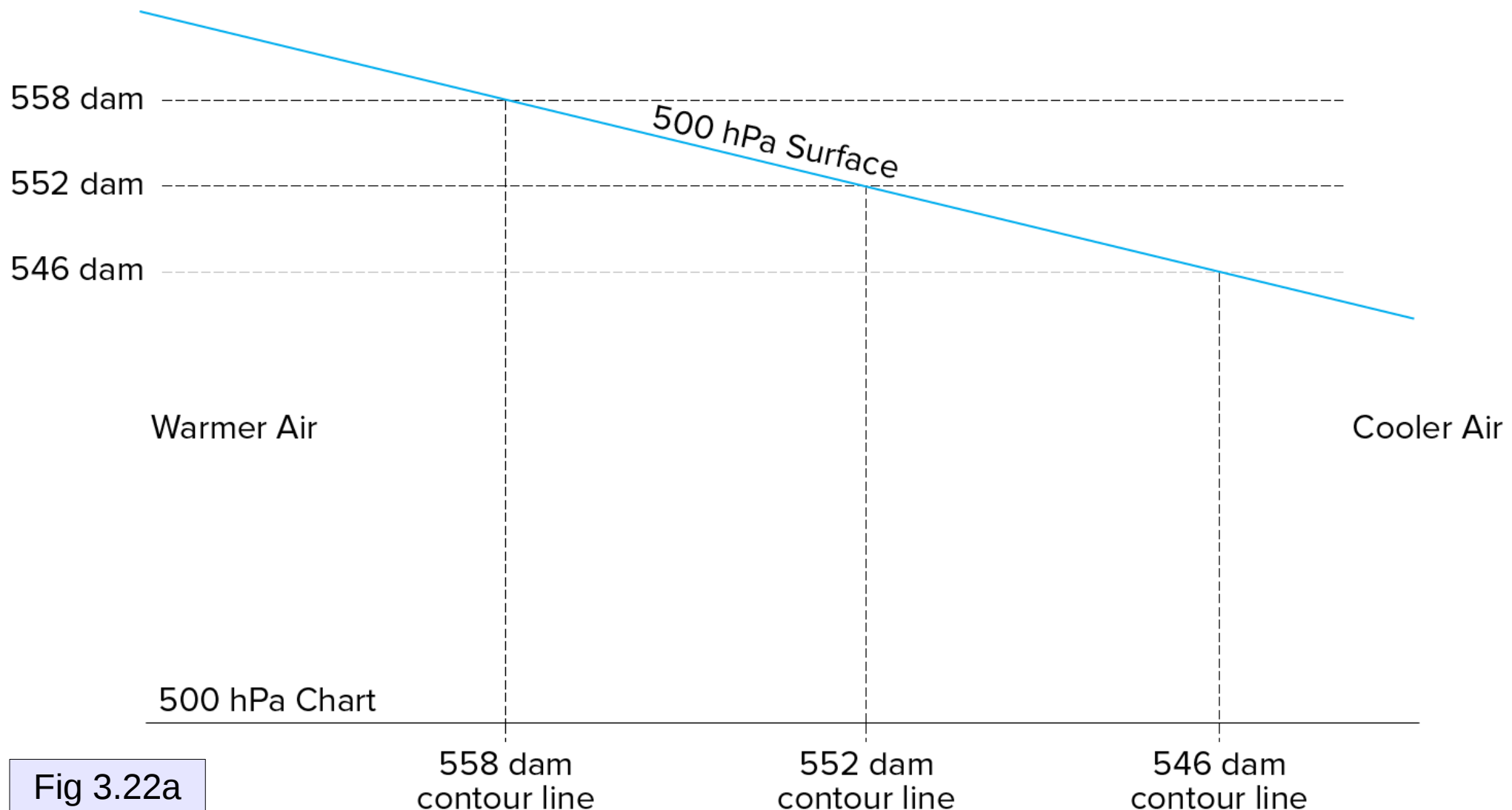
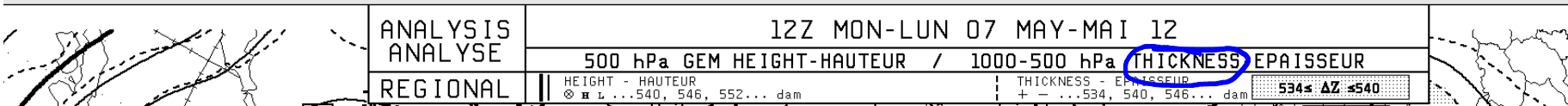


Fig 3.22a



Dashed lines are the
500 - 1000 hPa
thickness (ΔZ_{500}^{1000})

$$\Delta z [\text{dam}] = 2.0 \frac{T_v}{K}$$

Stippled region:

$$534 \leq \Delta z \leq 540$$

- thickness lies between 534 and 540 dam
- considered that in such areas precip, **IF occurring**, could be in form of freezing rain
- NOT a statement that freezing rain is probable

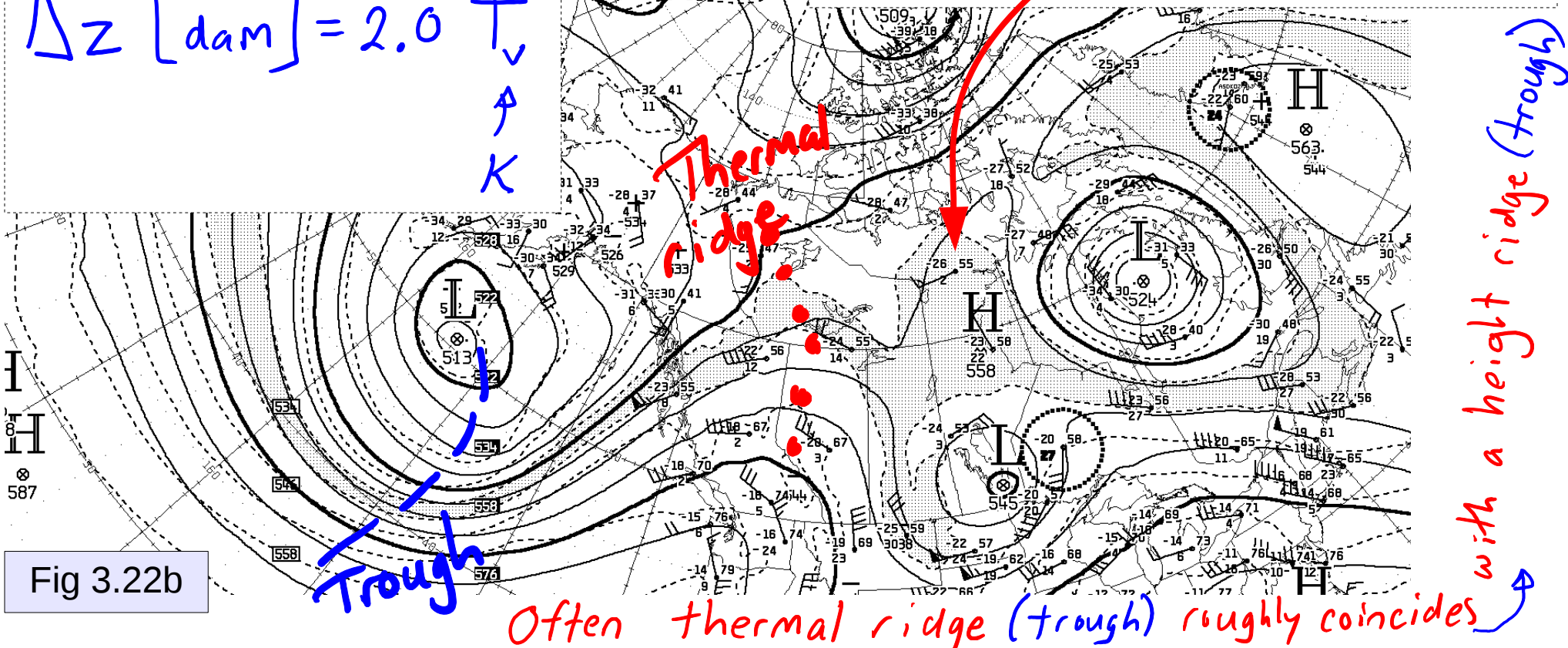


Fig 3.22b

$$1 \text{ knot} = 0.51 \text{ m s}^{-1}$$

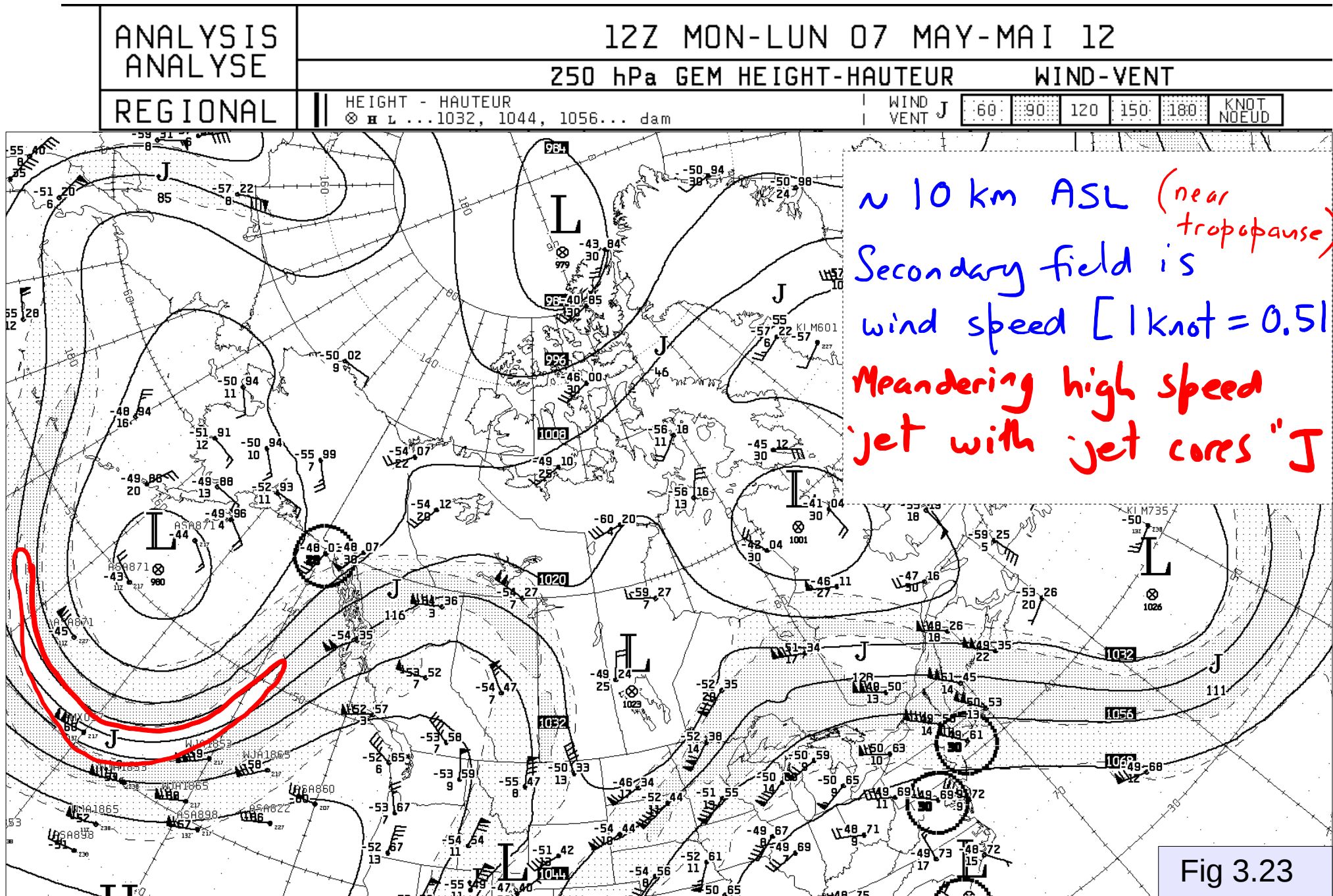
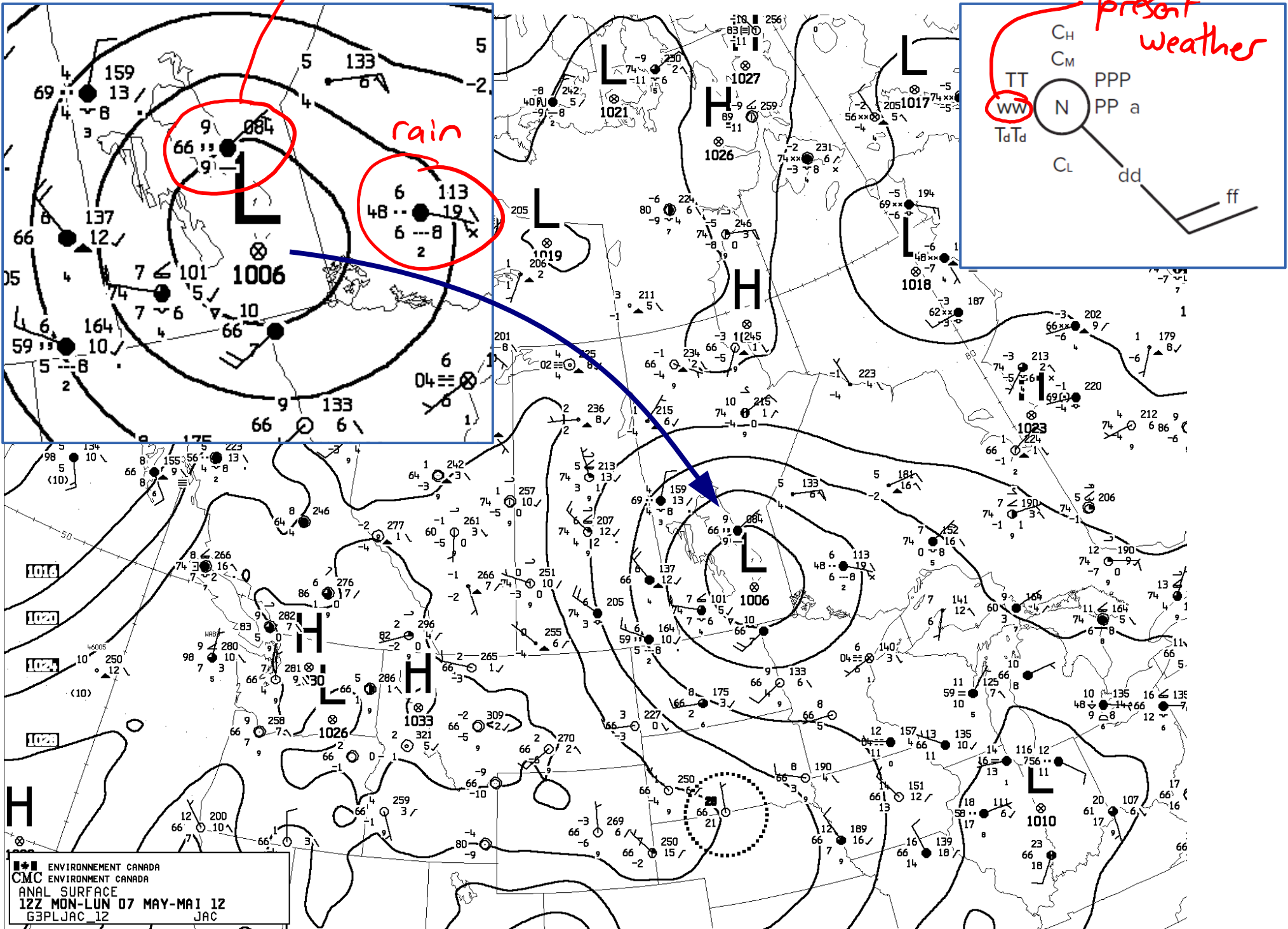
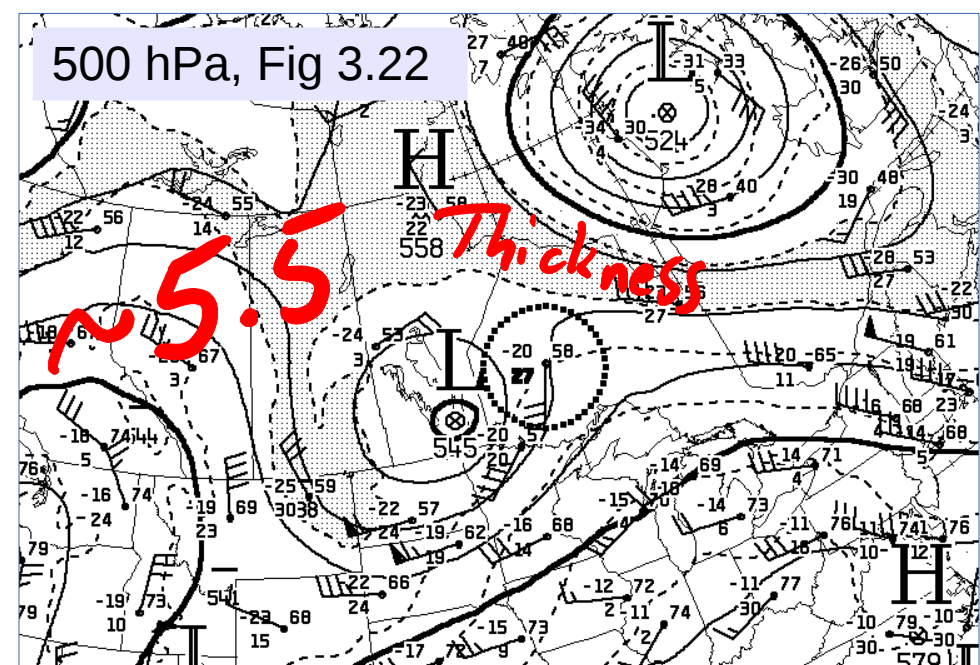
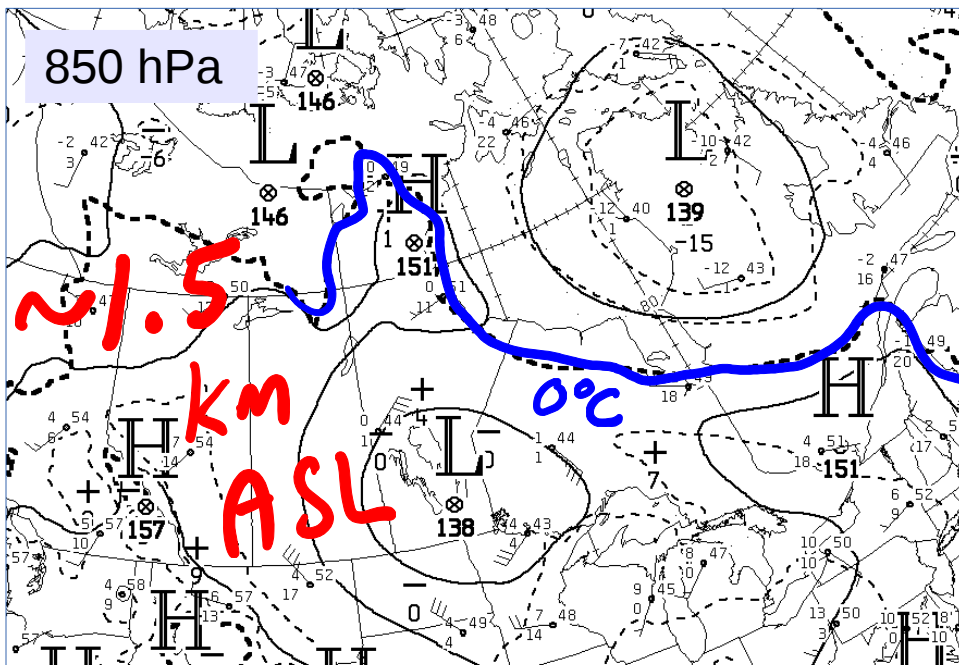
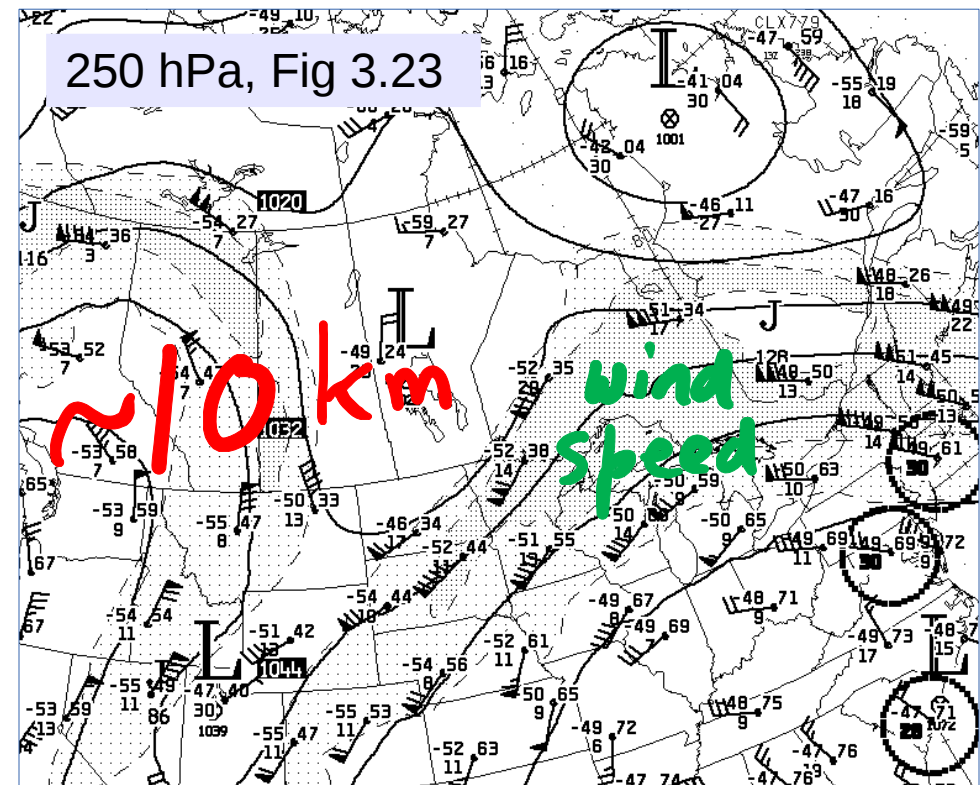
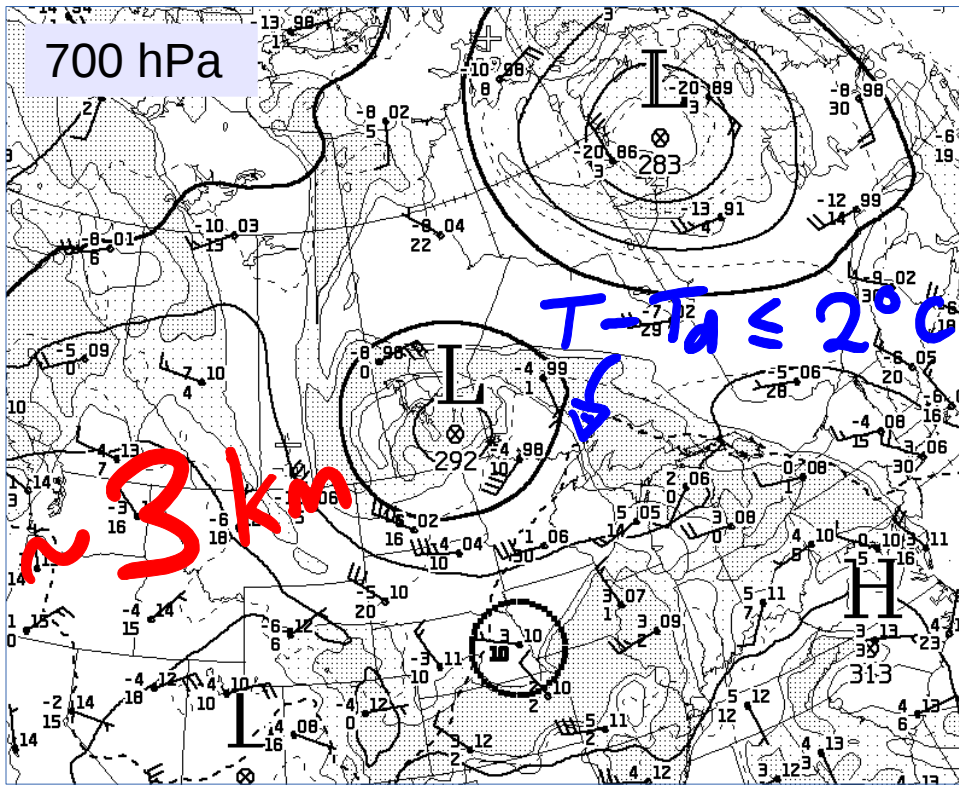


Fig 3.23

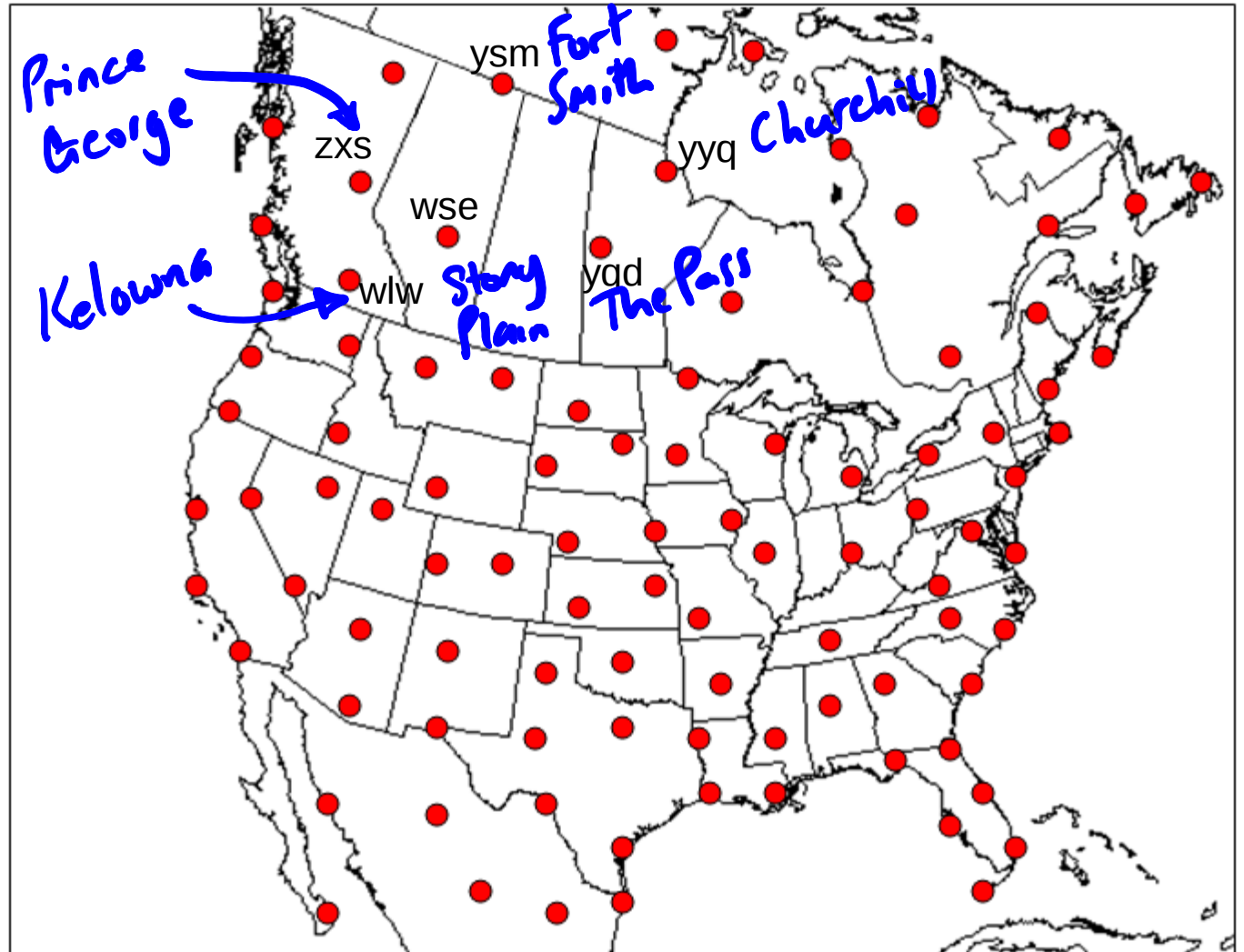
commas = drizzle, $P_0 = 1008.4 \text{ hPa}$

present weather





- radiosondes provide T , T_d and (if tracked by radar) wind speed and direction
- satellites, geostationary and polar orbiting – provide (i) images and (ii) "soundings" (that return information indirectly related to temperature and humidity throughout the atmosphere)
- weather radar – precip. and (if dopplerized) storm winds
- instrument packages on commercial aircraft



Lecture of 21 Sept.

- thermal vs. dynamic pressure systems
- terminology for the "scale" of "circulation systems"
- more familiarization with upper charts – what they give us
- significance of the stippled 534-540 hPa thickness band on CMC charts
- jetstream

A "zero-hour prog" (P0H) is effectively the same as an analysis.

RDPS=Regional Deterministic Prediction System

This low over Hudson Bay has wrapped cooler air (easily identified by the gray 534-540 dam thickness band) into N. Alberta & Saskatchewan

MSLP – surface pressure corrected to sea-level

